Workshop Service Manual for Range Rover 2014

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    - Auxiliary Radiator
    - Coolant Expansion Tank
    - Cooling Module
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    - Specification
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        - Fuel Injection Component Cleaning
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- 303-05C: Accessory Drive - V8 S/C 5.0L Petrol
  - Specification
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    - Accessory Drive
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    - Accessory Drive Belt Tensioner
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    - Supercharger Belt Idler Pulley
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  - Description and Operation
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  - Description and Operation
    - Starting System
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    - Starting System
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  - Specification
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- 303-08B: Engine Emission Control - V6 S/C 3.0L Petrol
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    - Air Cleaner LH
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    - Supercharger
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  - Removal and Installation
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    - Air Cleaner RH
    - Air Cleaner Outlet Pipe LH
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    - Air Cleaner Outlet Pipe T-Connector
    - Charge Air Cooler

        - Supercharger
        - Supercharger Spring Isolator
- 303-12D: Intake Air Distribution and Filtering - TDV8 4.4L Diesel
    - Specification
    - Description and Operation
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- 303-13B: Evaporative Emissions - V8 S/C 5.0L Petrol
    - Specification
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        - Evaporative Emissions
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- 303-14B: Electronic Engine Controls - V6 S/C 3.0L Petrol
    - Specification
    - Description and Operation
        - Electronic Engine Controls
    - Diagnosis and Testing
        - Electronic Engine Controls
    - General Procedures
        - Brake Pedal Position (BPP) Switch Adjustment
    - Removal and Installation
        - Camshaft Position (CMP) Sensor LH

- Camshaft Position (CMP) Sensor RH
- Crankshaft Position (CKP) Sensor (18.30.12)
- Engine Coolant Temperature (ECT) Sensor (18.30.10)
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- Manifold Absolute Pressure (MAP) Sensor (18.30.56)
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- Mass Air Flow (MAF) Sensor (19.22.25)
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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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    - Variable Valve Timing (VVT) Oil Control Solenoid LH
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- 303-14D: Electronic Engine Controls - TDV8 4.4L Diesel
  - Specification
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    - Engine Control Module (ECM) (18.30.03)
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    - Fuel Rail Pressure (FRP) Sensor
    - Heated Oxygen Sensor (HO2S) (19.22.16)
    - Manifold Absolute Pressure and Temperature (MAPT) Sensor
    - Mass Air Flow (MAF) Sensor (19.22.25)
    - Pre Catalytic Converter Temperature Sensor
    - Post Catalytic Converter Temperature Sensor
    - Post DPF Exhaust Gas Temperature Sensor
- 303-14E: Electronic Engine Controls - SDV6 3.0L Diesel - Hybrid Electric Vehicle

- Specification
- Description and Operation
  - Electronic Engine Controls
- General Procedures
  - Brake Pedal Position (BPP) Switch Adjustment
- Removal and Installation
  - Camshaft Position (CMP) Sensor (18.30.24)
  - Crankshaft Position (CKP) Sensor (18.30.12)
  - Crankshaft Position (CKP) Sensor Ring (18.30.14)
  - Diesel Particulate Filter (DPF) Differential Pressure Sensor
  - Engine Coolant Temperature (ECT) Sensor (18.30.10)
  - Engine Control Module (ECM) (18.30.03)
  - Engine Oil Level Sensor (12.60.51)
  - Engine Oil Pressure (EOP) Sensor
  - Exhaust Gas Temperature Sensor RH
  - Heated Oxygen Sensor (HO2S) (19.22.16)
  - Intake Air Temperature (IAT) Sensor (18.30.09)
  - Manifold Absolute Pressure (MAP) Sensor (18.30.56)
  - Mass Air Flow (MAF) Sensor (19.22.25)
  - Oil Temperature Sensor (18.30.41)
  - Post Catalytic Converter Temperature Sensor
  - Post DPF Exhaust Gas Temperature Sensor
  - Pre Catalytic Converter Temperature Sensor

- 307: Automatic Transmission/Transaxle
  - 307-01A: Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD
    - Specification
    - Description and Operation
      - Transmission Description
    - Diagnosis and Testing
      - Diagnostics
    - General Procedures
      - Transmission Fluid Level Check - V8 5.0L Petrol/V8 S/C 5.0L Petrol
      - Transmission Fluid Level Check - TDV6 3.0L Diesel /TDV8 4.4L Diesel
      - Transmission Fluid Drain and Refill - V8 5.0L Petrol/V8 S/C 5.0L Petrol
      - Transmission Fluid Drain and Refill - TDV6 3.0L Diesel /TDV8 4.4L Diesel
    - Removal and Installation
      - Input Shaft Seal
      - Extension Housing Seal
      - Selector Shaft Seal
      - Transmission Control Module (TCM) and Main Control Valve Body
      - Transmission Fluid Pan, Gasket and Filter
      - Transmission Support Insulator
    - Removal
      - Transmission - TDV6 3.0L Diesel
      - Transmission - TDV8 4.4L Diesel
      - Transmission - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol
    - Installation
      - Transmission - TDV6 3.0L Diesel
      - Transmission - TDV8 4.4L Diesel
      - Transmission - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol
  - 307-01B: Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed - Hybrid Electric Vehicle - Automatic Transmission – AWD
    - Specification
    - Description and Operation
      - Transmission Description
    - Diagnosis and Testing
      - Diagnostics - SDV6 3.0L Diesel - Hybrid Electric Vehicle
    - General Procedures
      - Transmission Fluid Level Check
      - Transmission Fluid Drain and Refill
    - Removal and Installation
      - Extension Housing Seal
      - Selector Shaft Seal
      - Transmission Support Insulator
      - Hybrid Drive Assembly
      - Input Shaft Seal
      - Transmission Control Module (TCM) and Main Control Valve Body
      - Transmission Fluid Pan, Gasket and Filter

- Motor Generator
- Removal
  - Transmission
- Installation
  - Transmission
- 307-02A: Transmission/Transaxle Cooling - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD
  - Specification
  - Description and Operation
    - Transmission Cooling
  - Diagnosis and Testing
    - Transmission Cooling
  - Removal and Installation
    - Transmission Fluid Cooler - TDV6 3.0L Diesel
    - Transmission Fluid Cooler - TDV8 4.4L Diesel
    - Transmission Fluid Cooler - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol
    - Transmission Fluid Cooler Tubes - TDV6 3.0L Diesel
    - Transmission Fluid Cooler Tubes - TDV8 4.4L Diesel
    - Transmission Fluid Cooler Tubes - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol
- 307-02B: Transmission/Transaxle Cooling - Vehicles With: 8HP70 8-Speed - Hybrid Electric Vehicle - Automatic Transmission – AWD
  - Specification
  - Description and Operation
    - Transmission Cooling
  - Removal and Installation
    - Transmission Fluid Cooler - TDV6 3.0L Diesel
    - Transmission Fluid Cooler - TDV8 4.4L Diesel
    - Transmission Fluid Cooler - V8 5.0L Petrol/V8 S/C 5.0L Petrol
    - Transmission Fluid Cooler Tubes - TDV6 3.0L Diesel
    - Transmission Fluid Cooler Tubes - TDV8 4.4L Diesel
    - Transmission Fluid Cooler Tubes - V8 5.0L Petrol/V8 S/C 5.0L Petrol
    - Motor Generator Coolant Pump
- 307-05A: Automatic Transmission/Transaxle External Controls - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD
  - Specification
  - Description and Operation
    - External Controls
  - Diagnosis and Testing
    - External Controls
  - Removal and Installation
    - Emergency Park Position Release Lever
    - Transmission Control Switch (TCS)
    - Upshift Paddle Switch
    - Downshift Paddle Switch
- 307-05B: Automatic Transmission/Transaxle External Controls - Vehicles With: 8HP70 8-Speed - Hybrid Electric Vehicle - Automatic Transmission – AWD
  - Description and Operation
    - External Controls

- 308: Manual Transmission/Transaxle, Clutch and Transfer Case
  - 308-07A: Four-Wheel Drive Systems
    - Specification
    - Removal and Installation
      - High/Low Range Sensor
      - Transfer Case Clutch Solenoid
      - Transfer Case Shift Motor
      - Four-Wheel Drive (4WD) Control Module
  - 308-07B: Transfer Case - Vehicles With: Single Speed Transfer Case
    - Specification
    - Description and Operation
      - Transfer Case
    - Diagnosis and Testing
      - Transfer Case
    - General Procedures
      - Transfer Case Draining and Filling
    - Removal and Installation
      - Transfer Case Front Output Seal
      - Transfer Case Front Output Shaft Bearing
      - Transfer Case Rear Output Seal
      - Transfer Case Rear Output Shaft Bearing

- Transfer Case Connecting Sleeve Seals
- Transfer Case Differential
- Removal
  - Transfer Case - TDV6 3.0L Diesel
  - Transfer Case - V6 S/C 3.0L Petrol
- Installation
  - Transfer Case - TDV6 3.0L Diesel
  - Transfer Case - V6 S/C 3.0L Petrol

- 308-07C: Transfer Case - Vehicles With: Twin Speed Transfer Case
  - Specification
  - Description and Operation
    - Transfer Case
  - Diagnosis and Testing
    - Transfer Case
  - General Procedures
    - Transfer Case Draining and Filling
  - Removal and Installation
    - Transfer Case Front Output Seal
    - Transfer Case Front Output Shaft Bearing
    - Transfer Case Rear Output Seal
    - Transfer Case Rear Output Shaft Bearing
    - Transfer Case Connecting Sleeve Seals
    - Transfer Case Chain
  - Removal
    - Transfer Case - TDV6 3.0L Diesel
    - Transfer Case - TDV8 4.4L Diesel
    - Transfer Case - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol
    - Transfer Case - SDV6 3.0L Diesel - Hybrid Electric Vehicle
  - Installation
    - Transfer Case - TDV6 3.0L Diesel
    - Transfer Case - TDV8 4.4L Diesel
    - Transfer Case - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol
    - Transfer Case - SDV6 3.0L Diesel - Hybrid Electric Vehicle

- 309: Exhaust System
  - 309-00A: Exhaust System - TDV6 3.0L Diesel
    - Specification
    - Description and Operation
      - Exhaust System
      - Component Location
      - System Operation and Component Description
    - Diagnosis and Testing
      - Exhaust System
      - Diesel Particulate Filter
    - Removal and Installation
      - Catalytic Converter (17.50.01)
      - Diesel Particulate Filter (DPF)
      - Exhaust System (30.10.01) - Vehicles Without: Diesel Particulate Filter (DPF)
      - Exhaust System (30.10.01) - Vehicles With: Diesel Particulate Filter (DPF)
      - Rear Muffler (30.10.22)
  - 309-00B: Exhaust System - V6 S/C 3.0L Petrol
    - Specification
    - Description and Operation
      - Exhaust System
    - Diagnosis and Testing
      - Exhaust System
    - Removal and Installation
      - Catalytic Converter LH (17.50.03)
      - Catalytic Converter RH (17.50.04)
      - Exhaust System (30.10.01)
      - Front Muffler (30.10.11)
      - Rear Muffler (30.10.22)
  - 309-00C: Exhaust System - V8 S/C 5.0L Petrol
    - Specification
    - Description and Operation
      - Exhaust System
    - Diagnosis and Testing
      - Exhaust System
    - Removal and Installation
      - Catalytic Converter LH (17.50.03)

- Catalytic Converter RH (17.50.04)
- Exhaust System (30.10.01)
- Front Muffler (30.10.11)
- Rear Muffler (30.10.22)

- 309-00D: Exhaust System - TDV8 4.4L Diesel
  - Specification
  - Description and Operation
    - Exhaust System
    - Component Location
    - System Operation and Component Description
  - Diagnosis and Testing
    - Diesel Particulate Filter
    - Exhaust System
  - Removal and Installation
    - Catalytic Converter (17.50.01)
    - Diesel Particulate Filter (DPF)
    - Exhaust System (30.10.01) - Vehicles Without: Diesel Particulate Filter (DPF)
    - Exhaust System (30.10.01) - Vehicles With: Diesel Particulate Filter (DPF)
    - Rear Muffler (30.10.22)

- 310: Fuel System
  - 310-00: Fuel System - General Information
    - Specification
    - General Procedures
      - Diesel Filter Water Drain-Off - TDV6 3.0L Diesel
      - Fuel System Pressure Release (19.50.02) - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol
      - Fuel Tank Draining
      - High-Pressure Fuel System Bleeding
      - Low-Pressure Fuel System Bleeding (19.50.07)
  - 310-01A: Fuel Tank and Lines - TDV6 3.0L Diesel
    - Specification
    - Description and Operation
      - Fuel Tank and Lines
    - Diagnosis and Testing
      - Fuel Tank and Lines
    - Removal and Installation
      - Fuel Cooler
      - Fuel Filter Element (19.55.24)
      - Fuel Level Sender
      - Fuel Pump and Sender Unit
      - Fuel Tank (19.55.01)
      - Fuel Tank Filler Pipe (19.55.07)
  - 310-01B: Fuel Tank and Lines - V6 S/C 3.0L Petrol
    - Specification
    - Description and Operation
      - Fuel Tank and Lines
    - Diagnosis and Testing
      - Fuel Tank and Lines
    - Removal and Installation
      - Fuel Pump and Sender Unit
      - Fuel Level Sender
      - Fuel Filter
      - Fuel Tank Filler Pipe (19.55.07)
      - Fuel Tank (19.55.01)
  - 310-01C: Fuel Tank and Lines - V8 S/C 5.0L Petrol
    - Specification
    - Description and Operation
      - Fuel Tank and Lines
    - Diagnosis and Testing
      - Fuel Tank and Lines
    - Removal and Installation
      - Fuel Pump and Sender Unit
      - Fuel Level Sender
      - Fuel Filter
      - Fuel Tank Filler Pipe (19.55.07)
      - Fuel Tank (19.55.01)
  - 310-01D: Fuel Tank and Lines - TDV8 4.4L Diesel
    - Specification
    - Description and Operation

        - Fuel Tank and Lines
    - Diagnosis and Testing
        - Fuel Tank and Lines
    - Removal and Installation
        - Auxiliary Fuel Cooler
        - Fuel Cooler
        - Fuel Filter Element (19.55.24)
        - Fuel Level Sender
        - Fuel Pump and Sender Unit
        - Fuel Tank Filler Pipe (19.55.07)
        - Fuel Tank (19.55.01)
- 310-01E: Fuel Tank and Lines - SDV6 3.0L Diesel - Hybrid Electric Vehicle
    - Specification
    - Description and Operation
        - Fuel Tank and Lines
    - Removal and Installation
        - Fuel Cooler
        - Fuel Filter Element (19.55.24)
        - Fuel Level Sender
        - Fuel Pump and Sender Unit
        - Fuel Tank (19.55.01)
        - Fuel Tank Filler Pipe (19.55.07)
- 310-02: Acceleration Control
    - Specification
    - Removal and Installation
        - Accelerator Pedal (19.20.01)
- 310-03A: Speed Control - TDV6 3.0L Diesel
    - 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 Sensor
        - Speed Control Switch
- 310-03B: Speed Control - V6 S/C 3.0L 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 Sensor
        - Speed Control Switch
- 310-03C: Speed Control - 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 Sensor
        - Speed Control Switch
- 310-03D: Speed Control - TDV8 4.4L Diesel
    - 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 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: Engine (303-01A Engine - TDV6 3.0L Diesel, 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)

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 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 Engine Cooling - TDV6 3.0L Diesel, 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 Engine Cooling - TDV6 3.0L Diesel, 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 Engine Cooling - TDV6 3.0L Diesel, Diagnosis and Testing).
Engine takes too long to reach operating temperature	• Thermostat stuck open	• For cooling system checks, REFER to: Engine Cooling (303-03A Engine Cooling - TDV6 3.0L Diesel, Diagnosis and Testing).
External oil leaks	• Gaskets • Seals • Oil pipes • Oil filter • Oil cooler • Damaged/cracked casings • Crankcase ventilation system • Piston ring blow-	• 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.

	by	
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 Accessory Drive - TDV6 3.0L Diesel, 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	• For engine management system tests, REFER to: Diagnostic Trouble Code (DTC) Index - TDV6 3.0L Diesel , DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation). For fuel charging and controls systems tests, REFER to: Fuel Charging and Controls (303-04A Fuel Charging and Controls - TDV6 3.0L Diesel, Diagnosis and Testing), Turbocharger (303-04B Fuel Charging and Controls - Turbocharger - SDV6 3.0L Diesel - Hybrid Electric Vehicle/TDV6 3.0L Diesel, Diagnosis and Testing). For EGR system tests, REFER to: Engine Emission Control (303-08A Engine Emission Control - TDV6 3.0L Diesel, Diagnosis and

	• Broken piston rings • Damaged/cracked casings	Testing). Carry out a compression test, GO to Pinpoint Test A. Check for excess wear in engine components

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 - TDV6 3.0L Diesel , DTC: Engine Control Module (ECM) (100-00 General Information, 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.

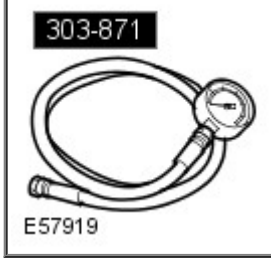
PINPOINT TEST C : CHECK THE ENGINE OIL PRESSURE	
NOTES:  Check and, if necessary, top-up the engine oil level before beginning this test.	
 Where reference is made to 'suitable equipment', this refers to standard workshop equipment. Refer to the operating instructions for your own equipment when performing 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)

	Oil pressure testing adaptor, 303-1451
	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 (303-01C, Description and Operation),
Engine (303-01C Engine - V8 S/C 5.0L Petrol, 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
• 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 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 S/C 5.0L Petrol, DTC: Engine Control Module (ECM) (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.

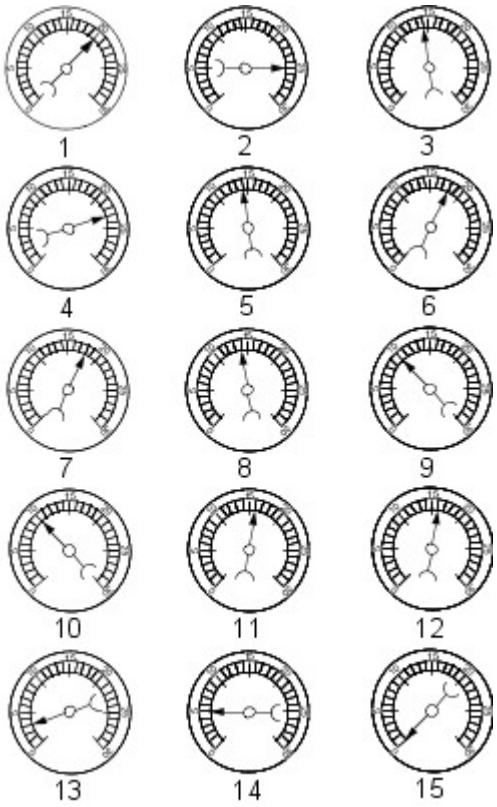
The reading should be steady. As necessary, adjust the gauge damper control (where used) if the needle is fluttering rapidly. Adjust damper until needle moves easily without excessive flutter.

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: Specifications (414-00 Battery and Charging System - General Information, Specifications).
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) /
   Oil Filter Element (303-01C Engine - V8 S/C 5.0L Petrol, 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) /
    Oil Filter Element (303-01C Engine - V8 S/C 5.0L Petrol, 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

Published: 27-Dec-2013

Engine System - General Information - Engine V6 S/C 3.0L Petrol

Diagnosis and Testing

Principle of Operation

For a detailed description of the V6 S/C 3.0L engines, refer to the relevant Description and Operation sections in the workshop manual.
REFER to: Engine (303-01B Engine - V6 S/C 3.0L 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 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
• Coolant leaks • Oil leaks • Leaks in the fuel system • Visibly damaged or worn parts • Loose or missing fixings	• Fuses • Loose or corroded electrical connectors • Harnesses • Sensors

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

Symptom Chart

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 engine control module for diagnostic trouble codes and refer to diagnostic trouble code 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 diagnostic trouble codes and refer to diagnostic trouble code 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 diagnostic trouble codes and refer to diagnostic trouble code 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)

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 to log diagnostic trouble codes. After the measurements have been carried out, diagnostic trouble codes 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 diagnostic trouble codes from the engine control module.

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.

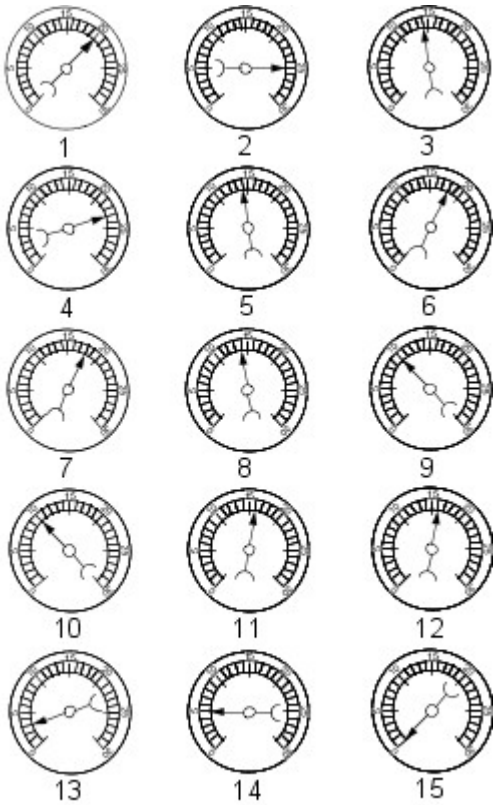
The reading should be steady. As necessary, adjust the gauge damper control (where used) if the needle is fluttering rapidly. Adjust damper until needle moves easily without excessive flutter.

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.

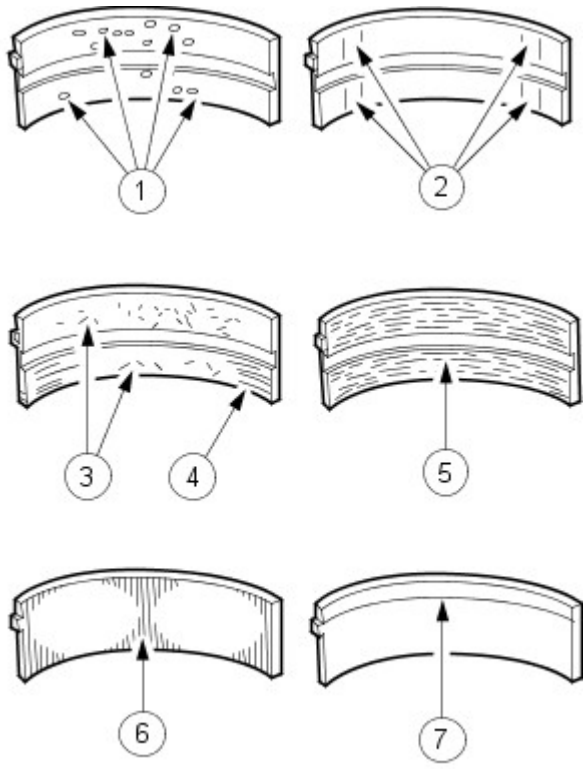
DTC Index

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 - V6 S/C 3.0L Petrol , DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation).

Published: 11-May-2011

Engine System - General Information - Bearing Inspection

General Procedures



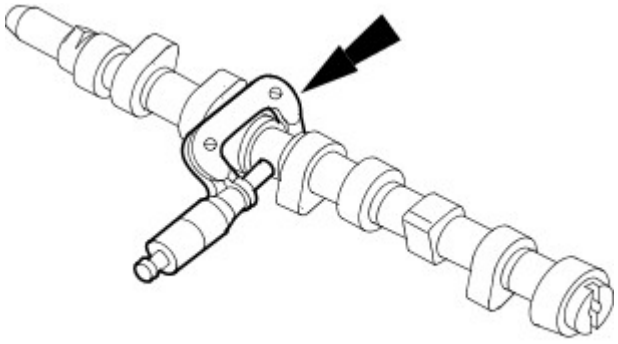
VUJ0002219

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.

Published: 11-May-2011

Engine System - General Information - Camshaft Bearing Journal Diameter

General Procedures



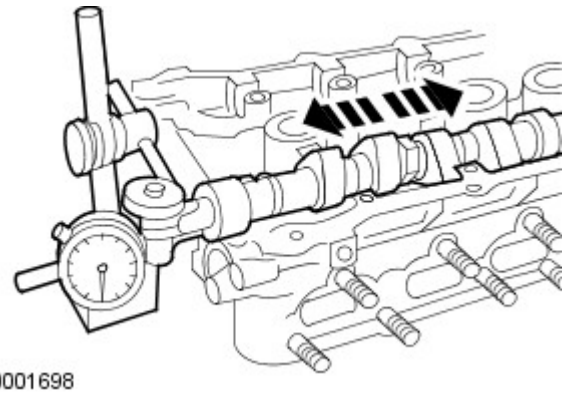
VUJ0001695

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

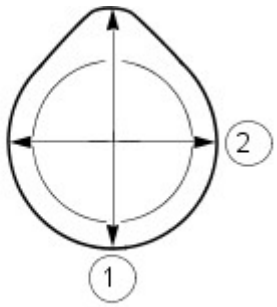
1. NOTE: Make sure that the camshaft is to specification.

   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



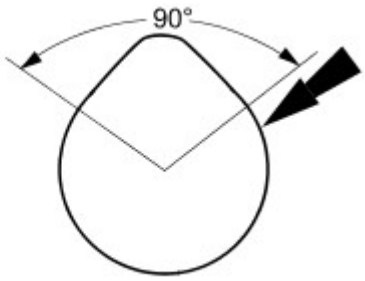
VUJ0001699

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



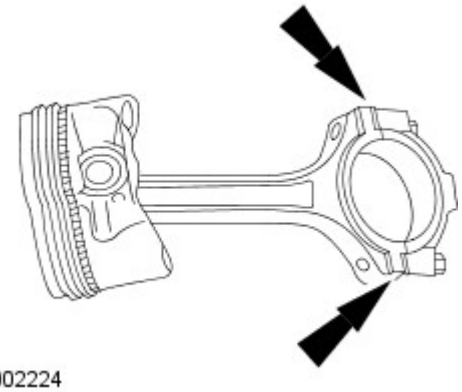
VUJ0001700

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

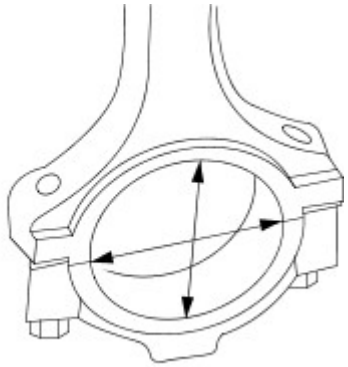
1. CAUTION: Do not use a caustic cleaning solution or damage to connecting rods may occur.

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

Published: 11-May-2011

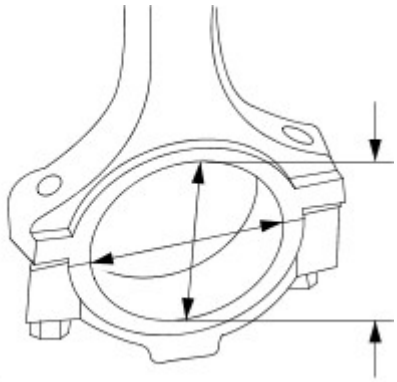
Engine System - General Information - Connecting Rod Large End Bore

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.



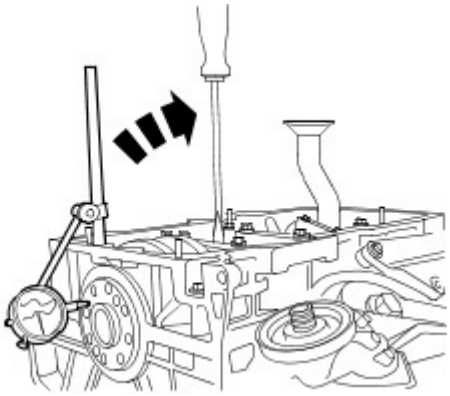
VUJ0002222

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



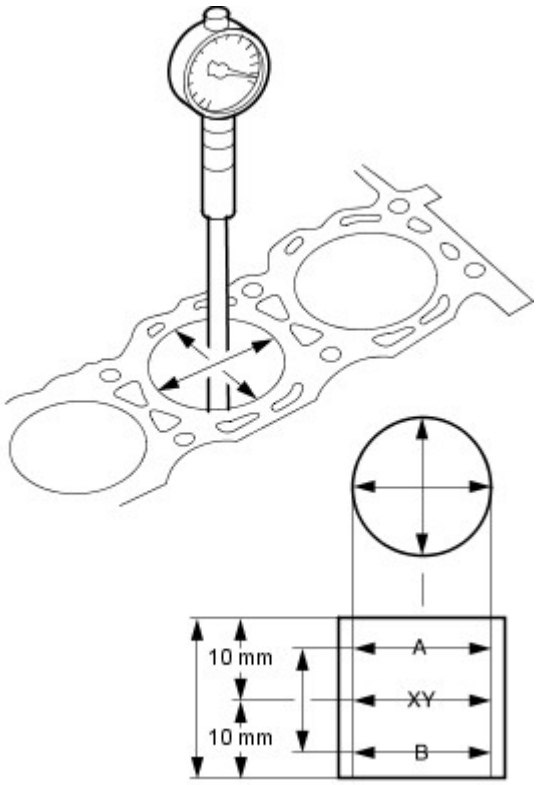
VUJ0002235

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

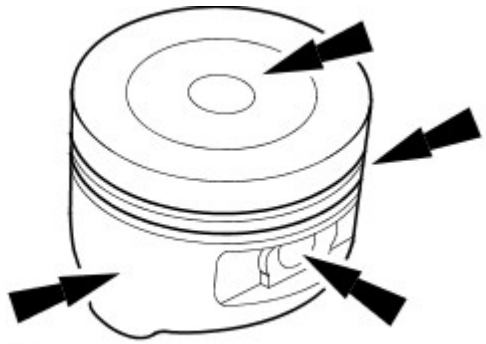
General Procedures

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

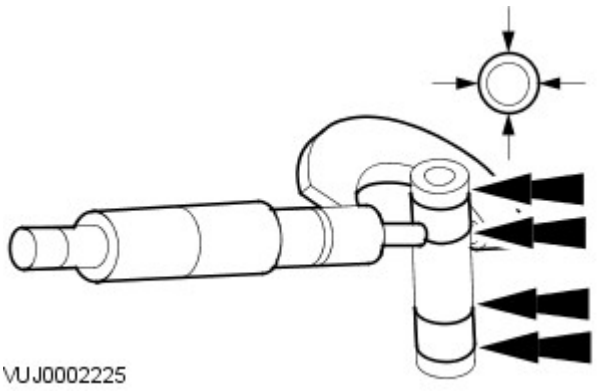
1. CAUTION: Do not use any aggressive cleaning fluid or a wire brush to clean the piston.

   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



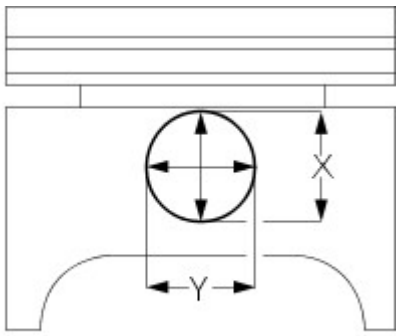
1. NOTE: The piston and piston pin are a matched pair. Do not mix up the components.

   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

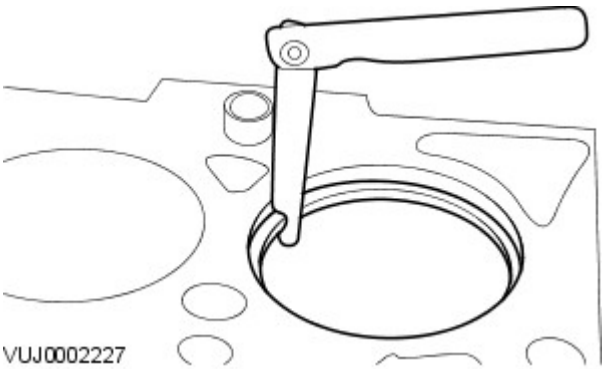
1. NOTE: The piston and piston pin form a matched pair. Do not mix up the components.

   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



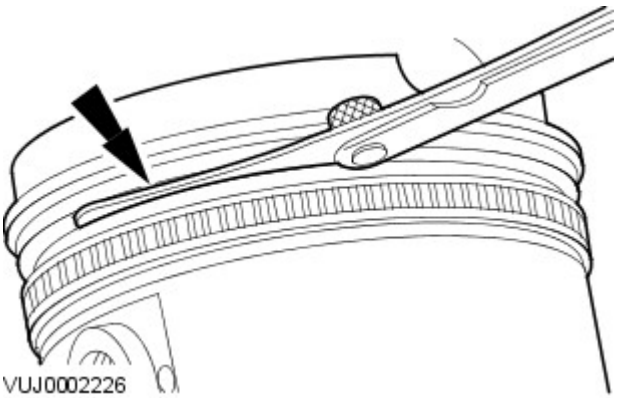
1. CAUTION: Do not mix up the piston rings. Install the piston rings in the same position and location.

   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



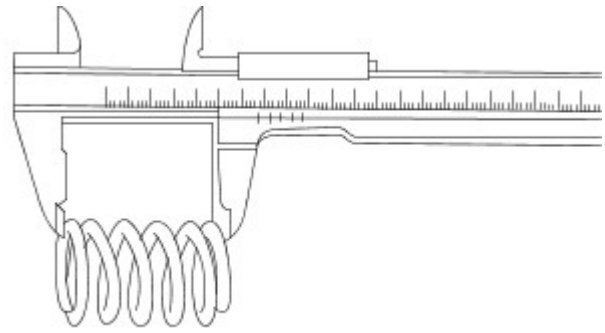
1. NOTE: The piston ring must protrude from the piston groove. To determine the piston ring clearance, insert the Feeler Gauge right to the back of the groove, behind the wear ridge.

   Using the Feeler Gauge, measure the piston ring clearance.

Published: 11-May-2011

Engine System - General Information - Valve Spring Free Length

General Procedures



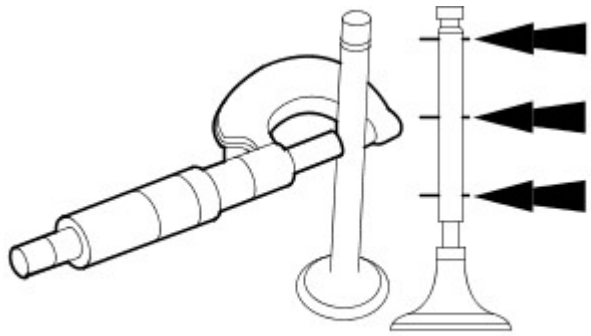
VUJ0002221

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:

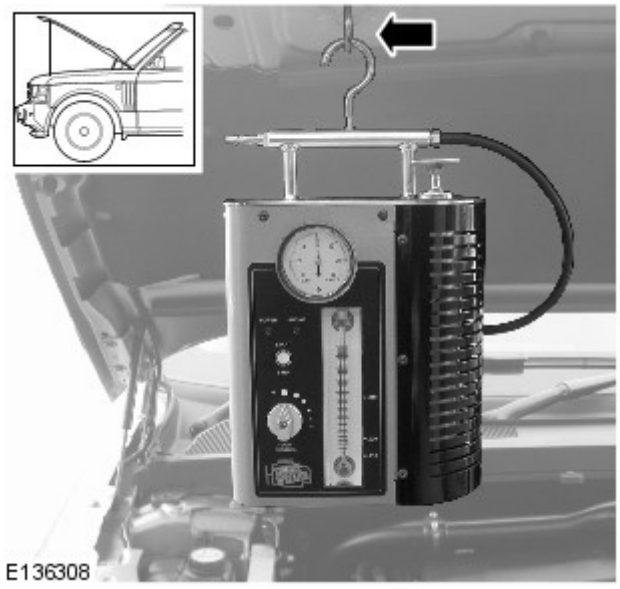
The vehicle battery must be in good condition and fully charged before carrying out this procedure.

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.

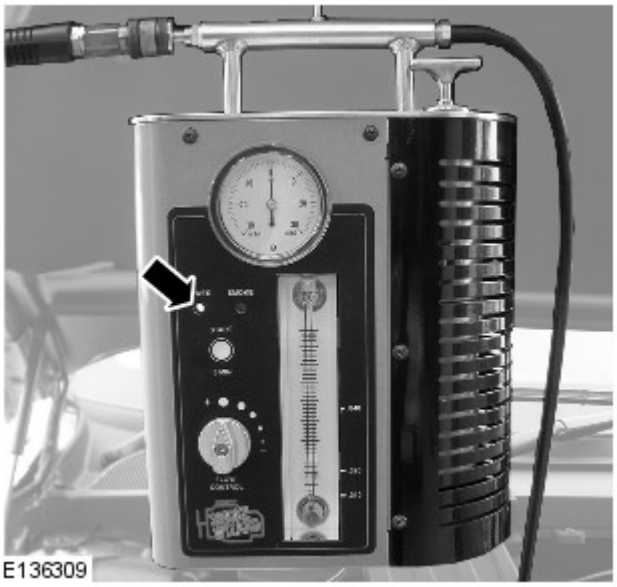
3. Connect the smoke test equipment positive power cable to the battery positive terminal.

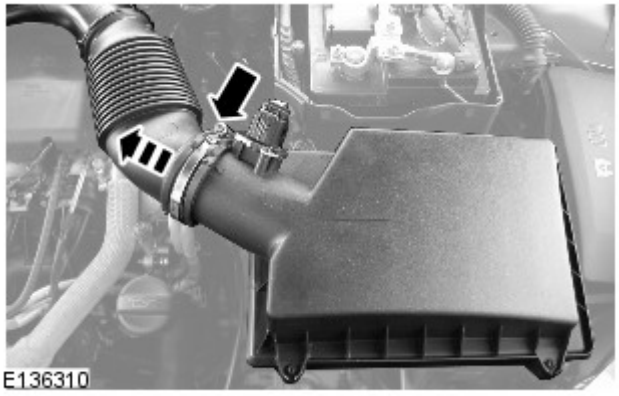
4. WARNING: Do not connect the smoke test equipment negative cable to the battery negative terminal.

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

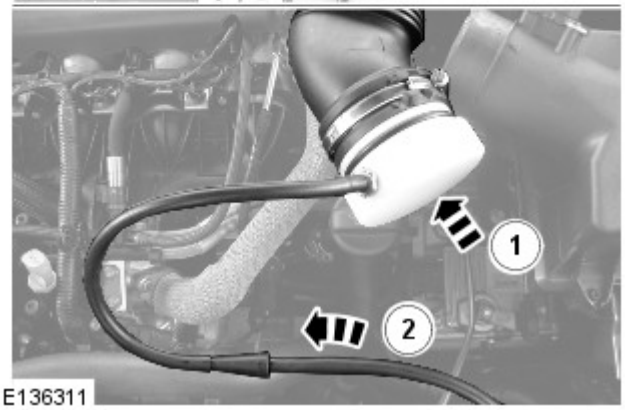
5. NOTE: A flashing green light indicates low battery voltage. In this case, place the battery on charge and make sure that the battery is fully charged before using the smoke test equipment.

   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.

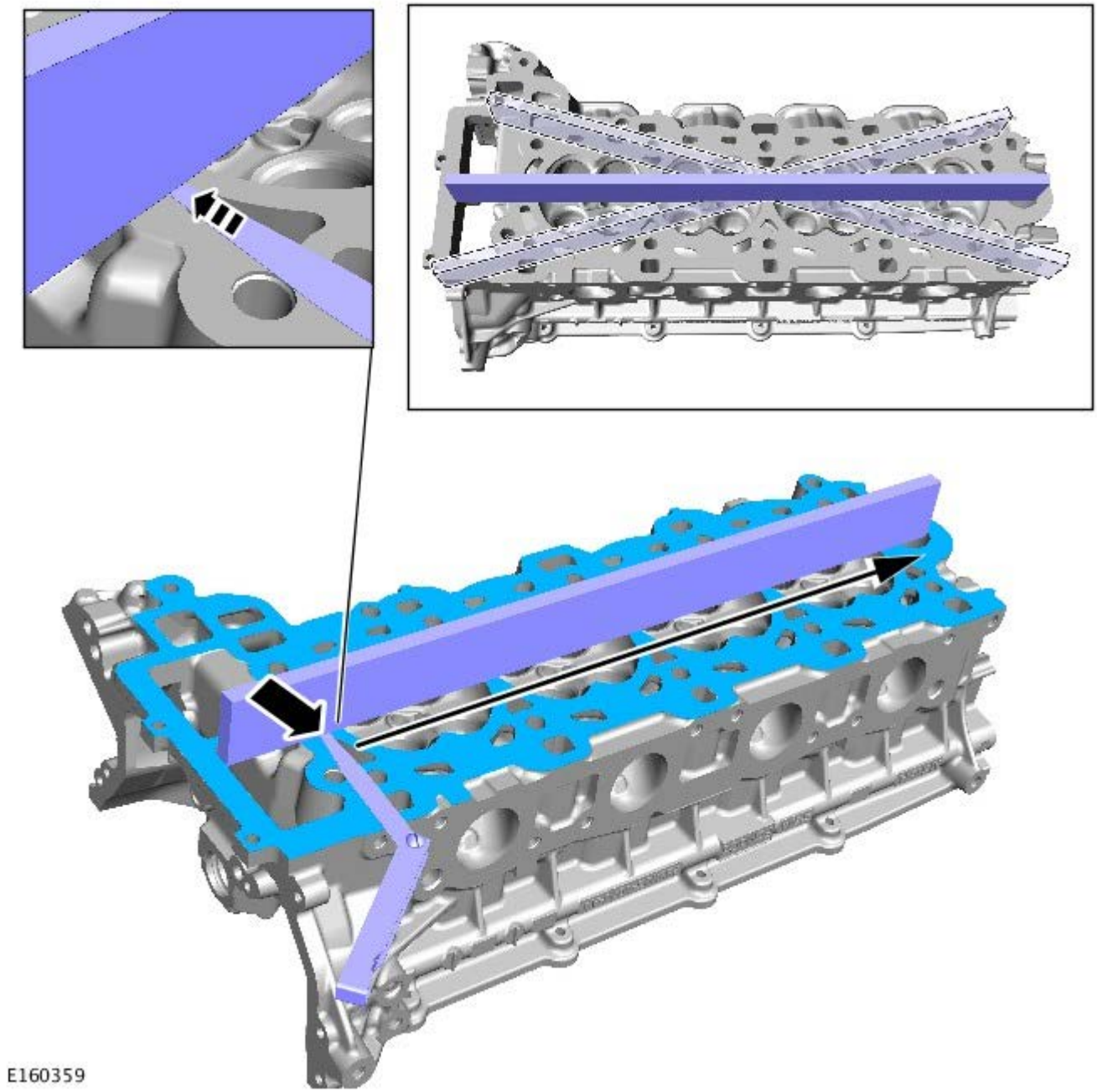
Published: 12-Sep-2013

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

This section contains no data

Published: 16-Dec-2013

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	190 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 vehicles with Diesel Particulate Filter (DPF)	5W/30 – WSS–M2C934–B
Engine oil without (DPF)	5W/30 – WSS–M2C913–C
Sealant	WSE–M4G323–A5
Core plug and stub pipe retainer	WSK-M2G349-A7
Cooling system fluid	Havoline Extended Life Coolant (XLC)

Capacities

Description	Liters
Engine oil initial fill	6.66
Engine oil service fill with oil filter change	6.0

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
Cylinder head maximum permitted warp (mm) flatness specification	0.2mm (0.008 in)

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	-

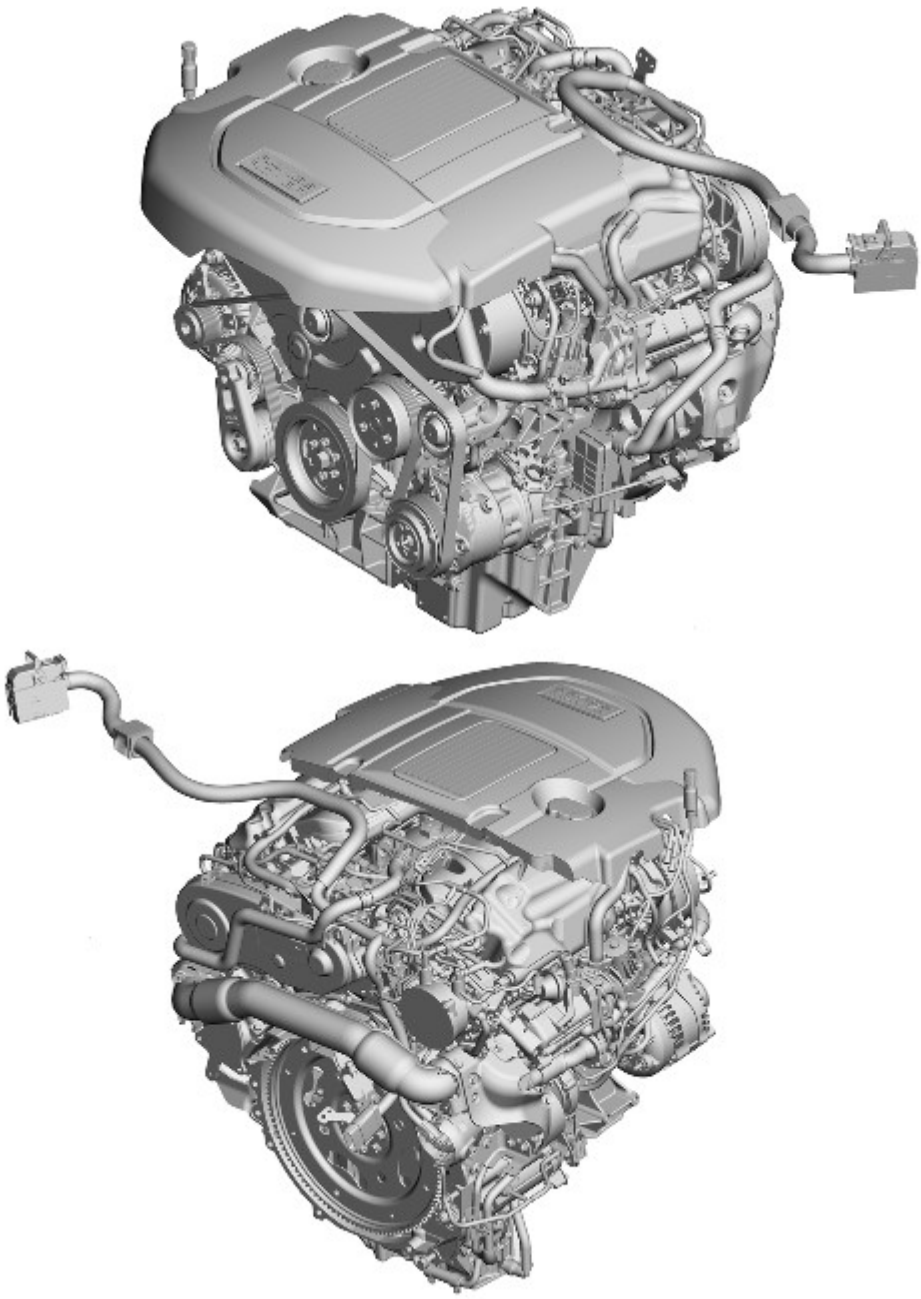
Fuel injection pump bracket to cradle retaining bolts	10	7	-
Fuel injection pump to bracket retaining bolts	10	7	-
Oil pump retaining bolts	10	7	-
Crankshaft rear oil seal housing retaining bolts	10	7	-
Oil pan retaining bolts M6	10	7	-
Oil pan retaining bolts M8	23	17	-
Oil pump pick up pipe retaining bolts	10	7	-
Engine oil level sensor retaining nuts	10	7	-
Crankshaft timing belt pulley retaining bolt	**A**	-	-
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	-
Engine mount bracket to engine mounting	130	96	-
Engine mounting to subframe bolts.	**A**	-	-
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	-
Generator retanining 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: 31-May-2013

Engine - TDV6 3.0L Diesel - Engine

Description and Operation

EXTERNAL VIEWS



E142993

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.

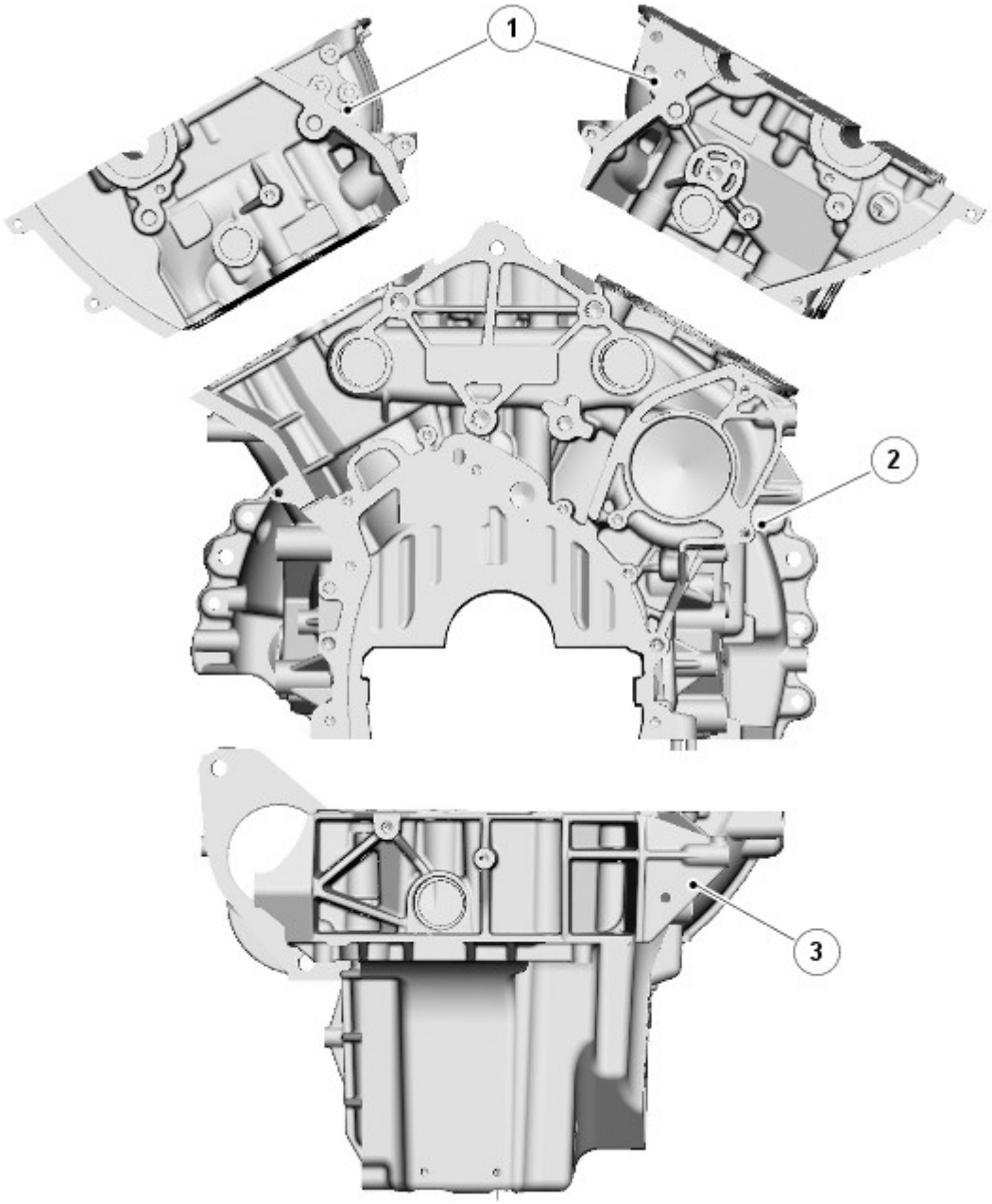
The cylinder block is coupled with a cast oil pan to provide a lightweight, compact and very stiff bottom end. The cylinder heads are fitted with integrated intake manifold and camshaft covers. The exhaust manifolds are unique for each cylinder head. An acoustic cover is fitted over the upper engine 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 (303-12A Intake Air Distribution and Filtering - TDV6 3.0L Diesel, Description and Operation).

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.

DESCRIPTION

Engine Structure



E120983

Item	Part Number	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. This type of construction provides outstanding strength and durability and reduces engine weight and length.

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.

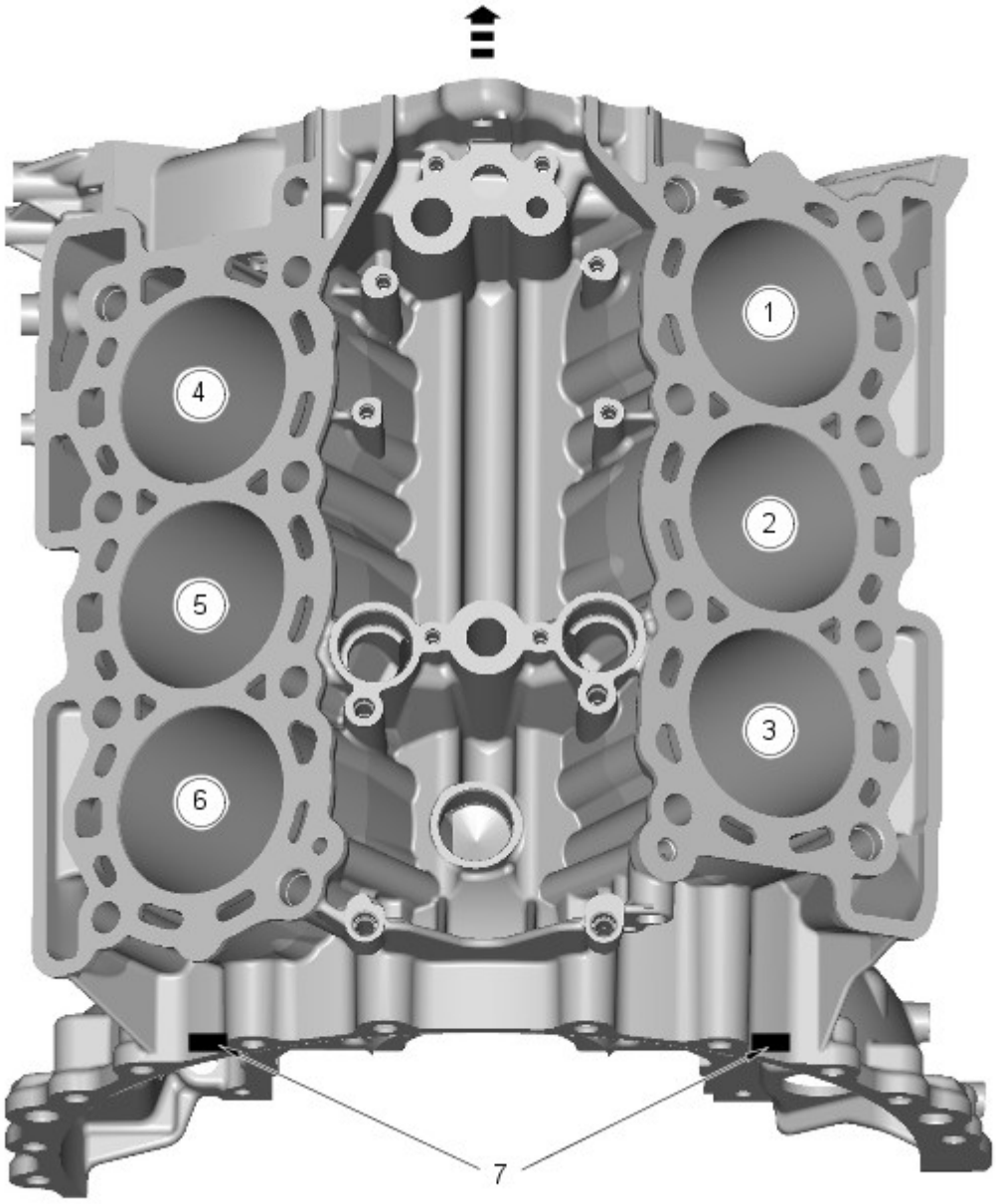
A tapping at the rear of the cylinder block connects a pipe to the turbochargers by means of banjo connections. Oil is supplied, under pressure via this tapping, from the oil pump to provide lubrication for the bearings of the turbochargers.

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

Two hollow dowels are used to locate the cylinder heads to the cylinder block, 2 on each side at the rear and front of the unit.

A port is included at the right and left 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 right side, and the other is fitted in the middle of the cylinder block on the left side.

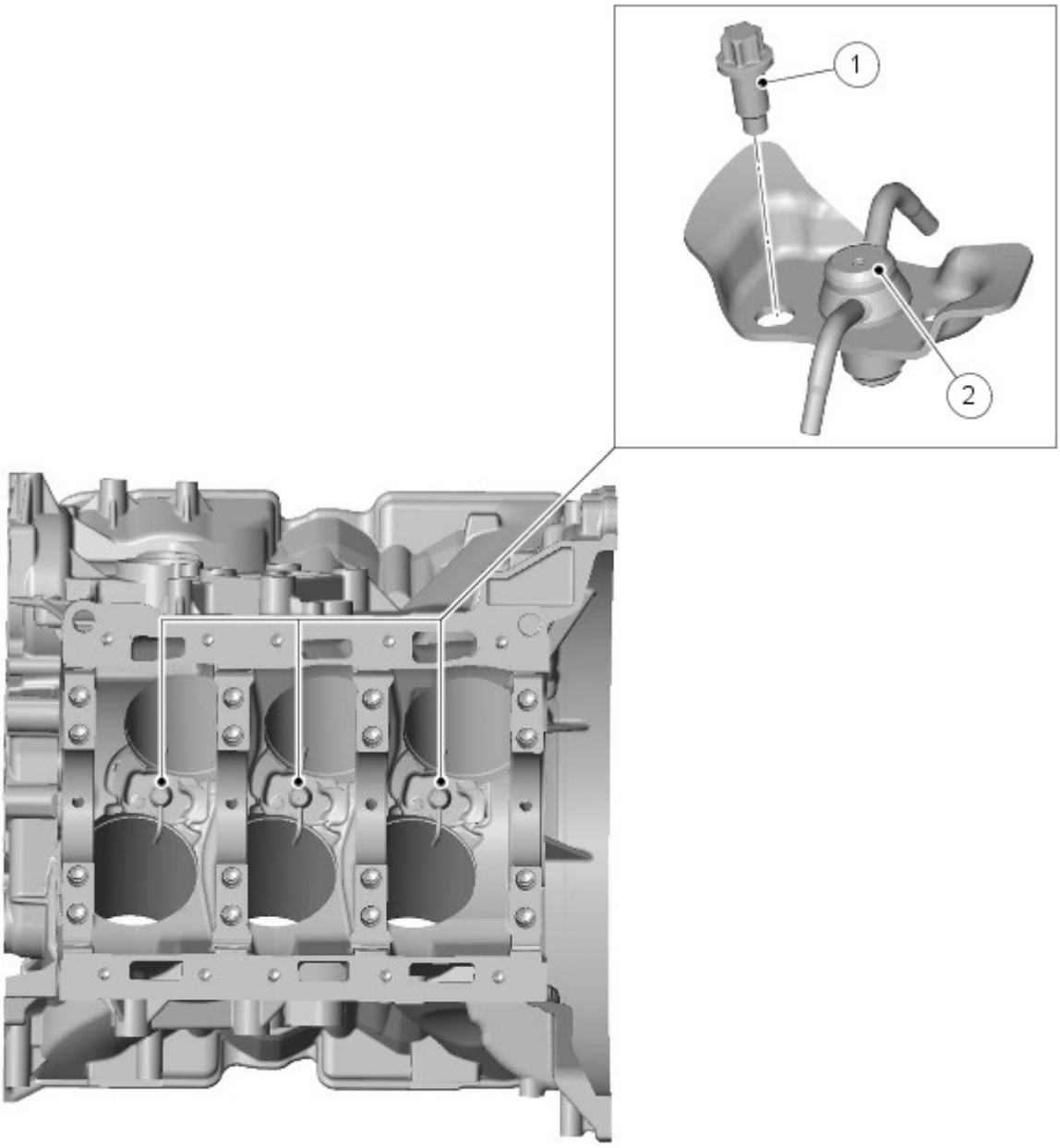


E152116

Item	Part Number	Description
7	-	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. The cylinders are numbered as shown above, with cylinders 1 and 4 being at the front of the engine.

PISTON COOLING JETS

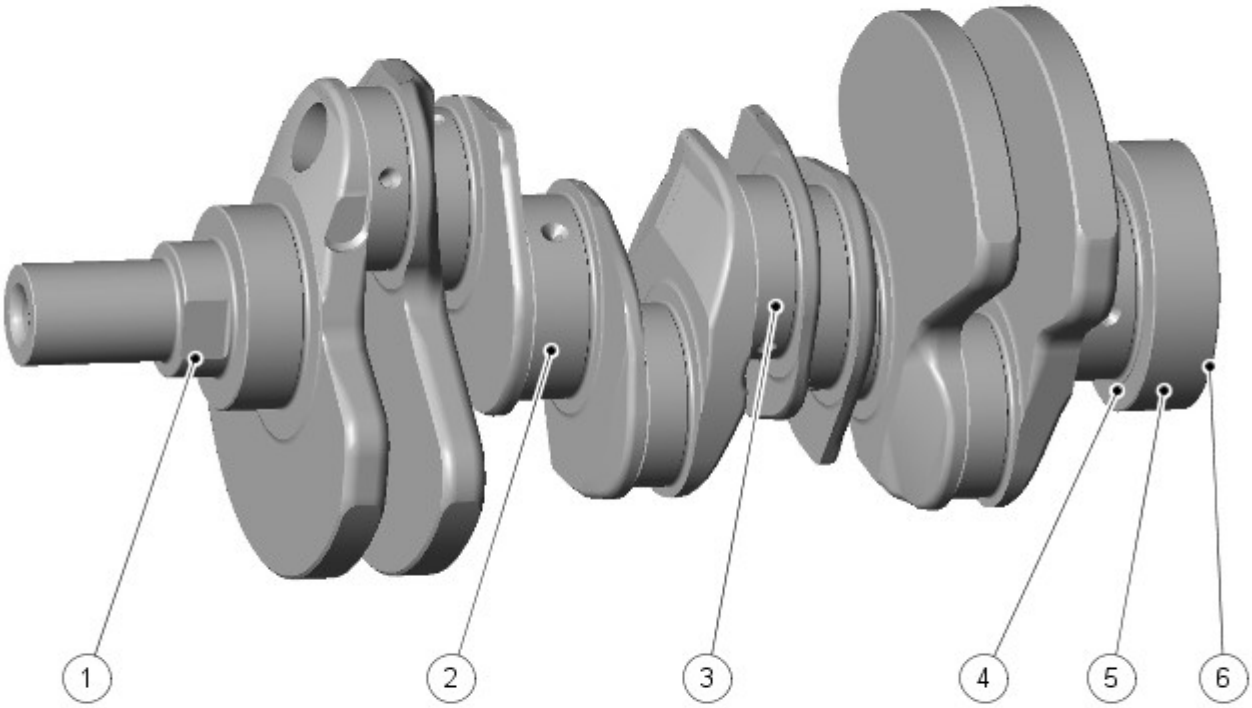


E152112

Item	Part Number	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



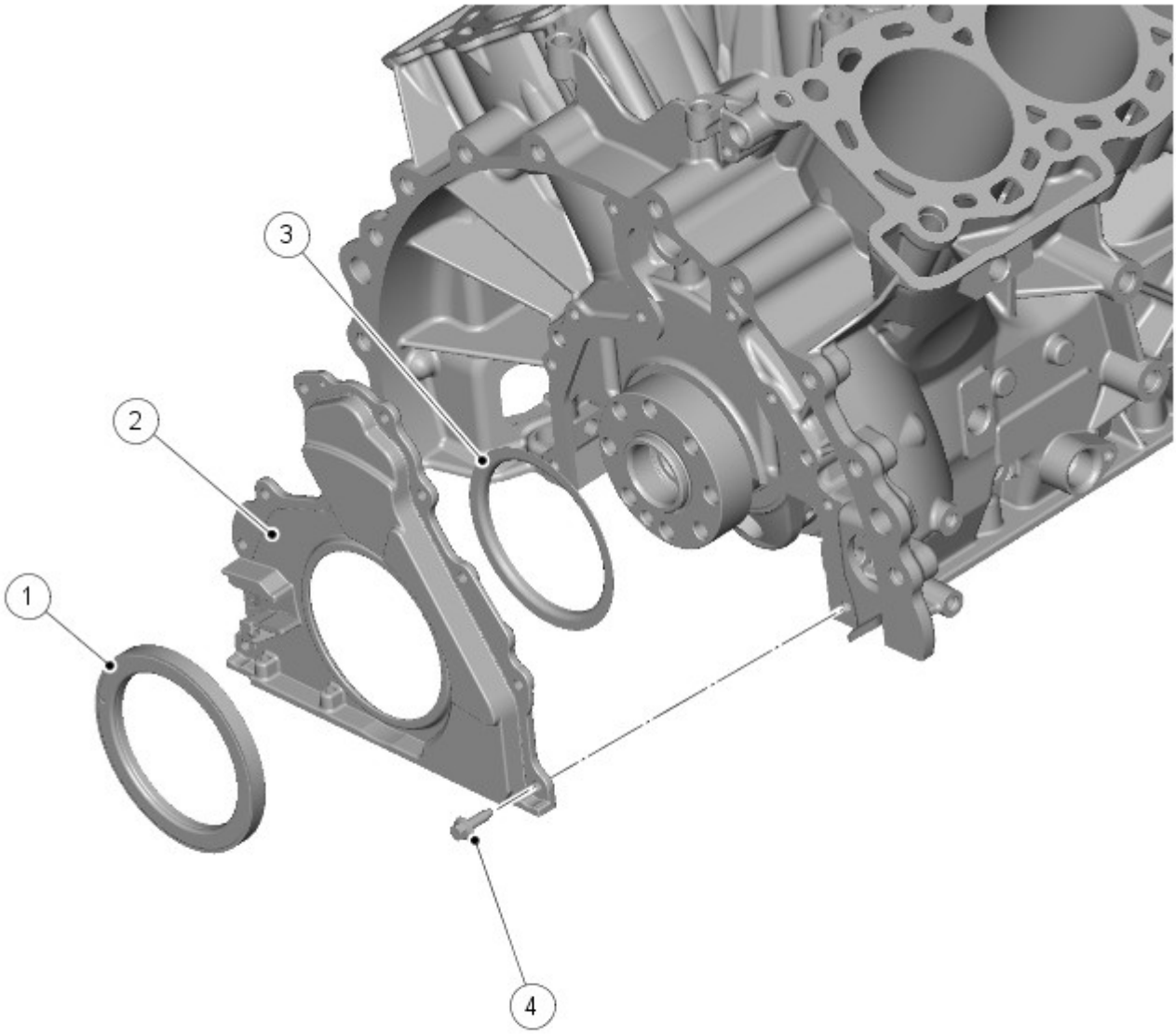
E152113

Item	Part Number	Description
1	-	Oil pump drive
2	-	Main bearing journal
3	-	Connecting rod bearing journal
4	-	Rear drive flange
5	-	Rear oil seal location
6	-	Reluctor ring location

The crankshaft runs 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 selective split plain bearings. An oil groove in the top half of each bearing transfers oil into the crankshaft for lubrication of the connecting rod bearings.

CRANKSHAFT REAR OIL SEAL

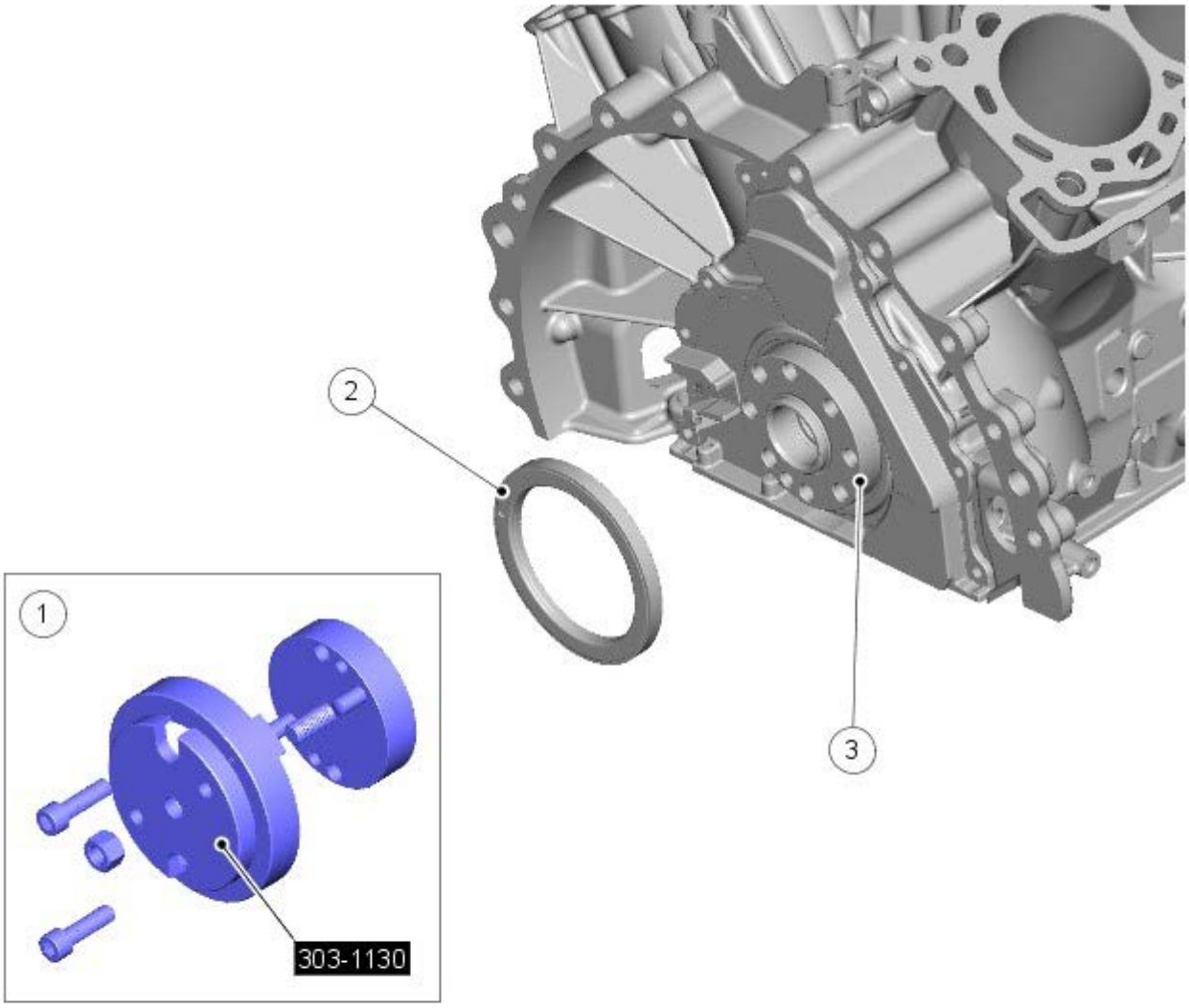


E152122

Item	Part Number	Description
1	-	Reluctor ring
2	-	Rear oil seal retainer
3	-	Seal
4	-	Bolt (10 off)

The rear main oil seal and retainer assembly is a one-piece unit and is supplied with its own fitting sleeve. The seal and retainer have 2 locating dowels, 10 fixing bolts and a seal. In addition, the retainer has a location for the CKP (Crankshaft Position) sensor.
For additional information, refer to: Electronic Engine Controls (303-14A Electronic Engine Controls - TDV6 3.0L Diesel, Description and Operation).

CRANKSHAFT RELUCTOR RING



E152123

Item	Part Number	Description
1	-	Special tool
2	-	Reluctor ring
3	-	Crankshaft

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

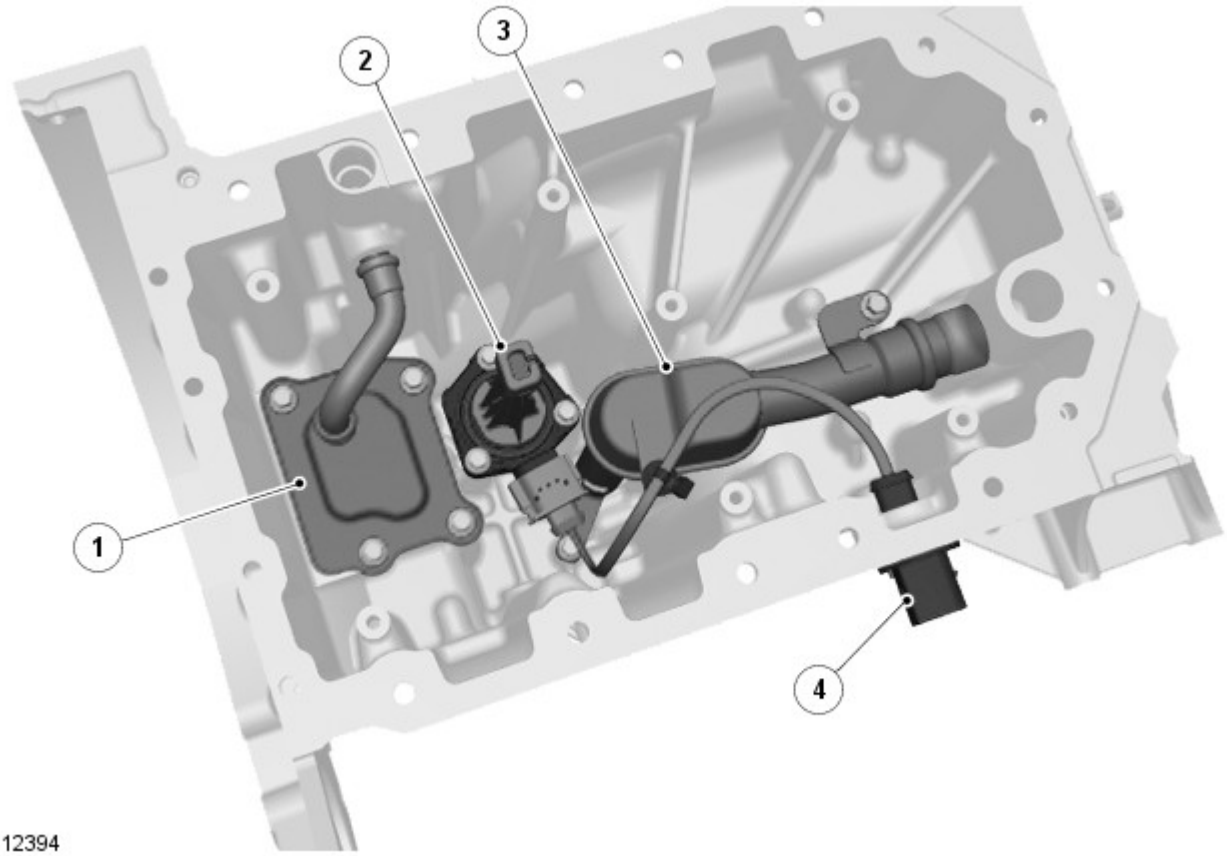
The reluctor ring consists of 60 magnets minus 2 for ECM (Engine Control Module) crankshaft position reference and synchronization. The magnets cannot be seen on the reluctor ring, which therefore can only be positioned using the special tool.

If the reluctor ring is removed for any reason, then a new reluctor ring must be fitted.

CRANKSHAFT DAMPER PULLEY

The crankshaft damper pulley is bolted to the front of the crankshaft to provide the drive for the engine accessory components.
For additional information, refer to: Accessory Drive (303-05A Accessory Drive - TDV6 3.0L Diesel, Description and Operation).

Oil Pan Components



Item	Part Number	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 fitted to the lower cylinder block to stiffen the base structure of the engine, helping to reduce NVH (Noise, Vibration 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:

- M8 x 20 (9 off).
- M8 x 75 (1 off).
- M6 x 105 (8 off).

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.

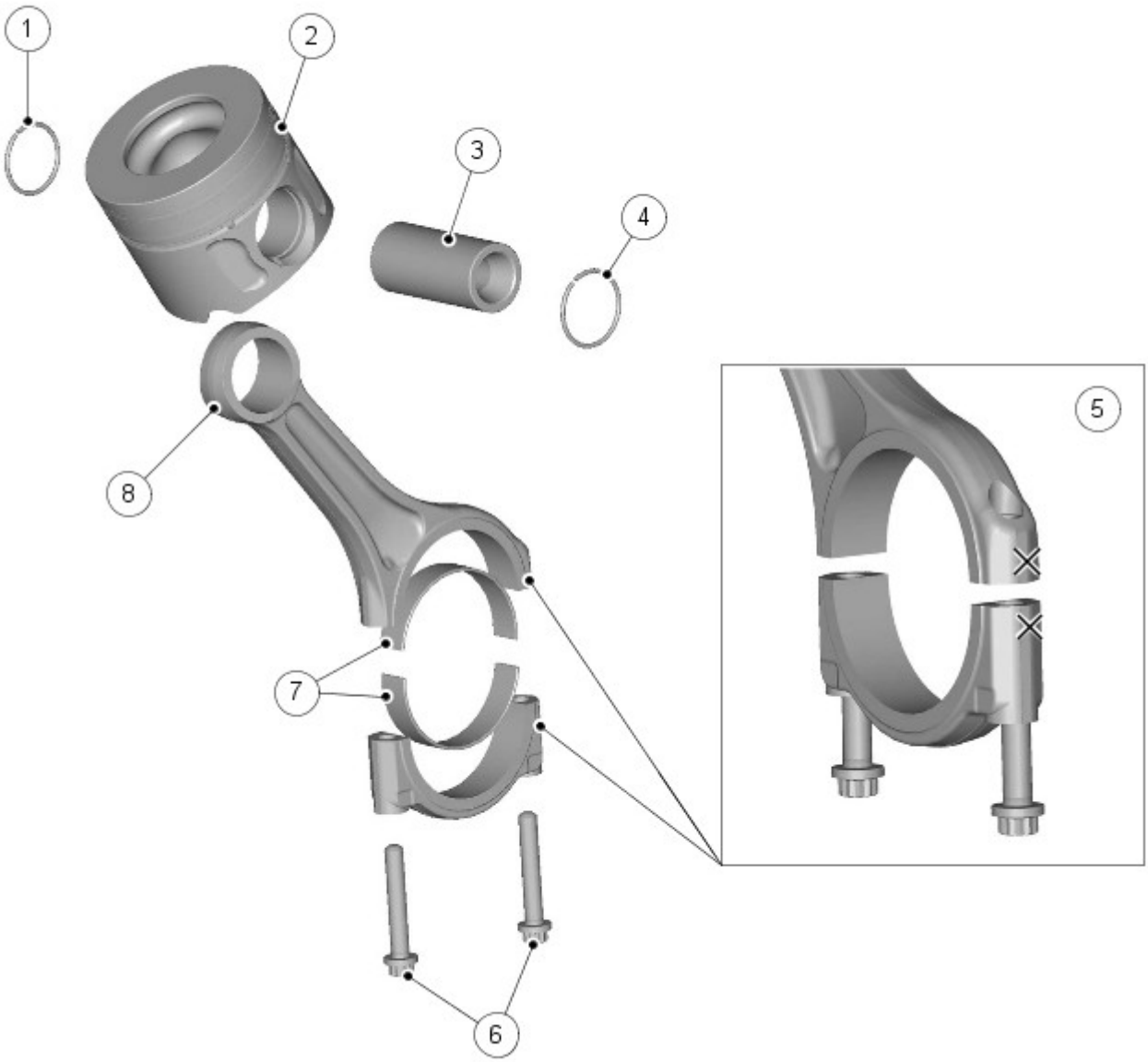
An oil level and temperature sensor provides an electronic indication of the oil level. This removes the requirement for the mechanical dipstick. An advantage in comparison with the static 'dipstick' method is that all marginal influences, for example vehicle being on a slope, lateral and longitudinal 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



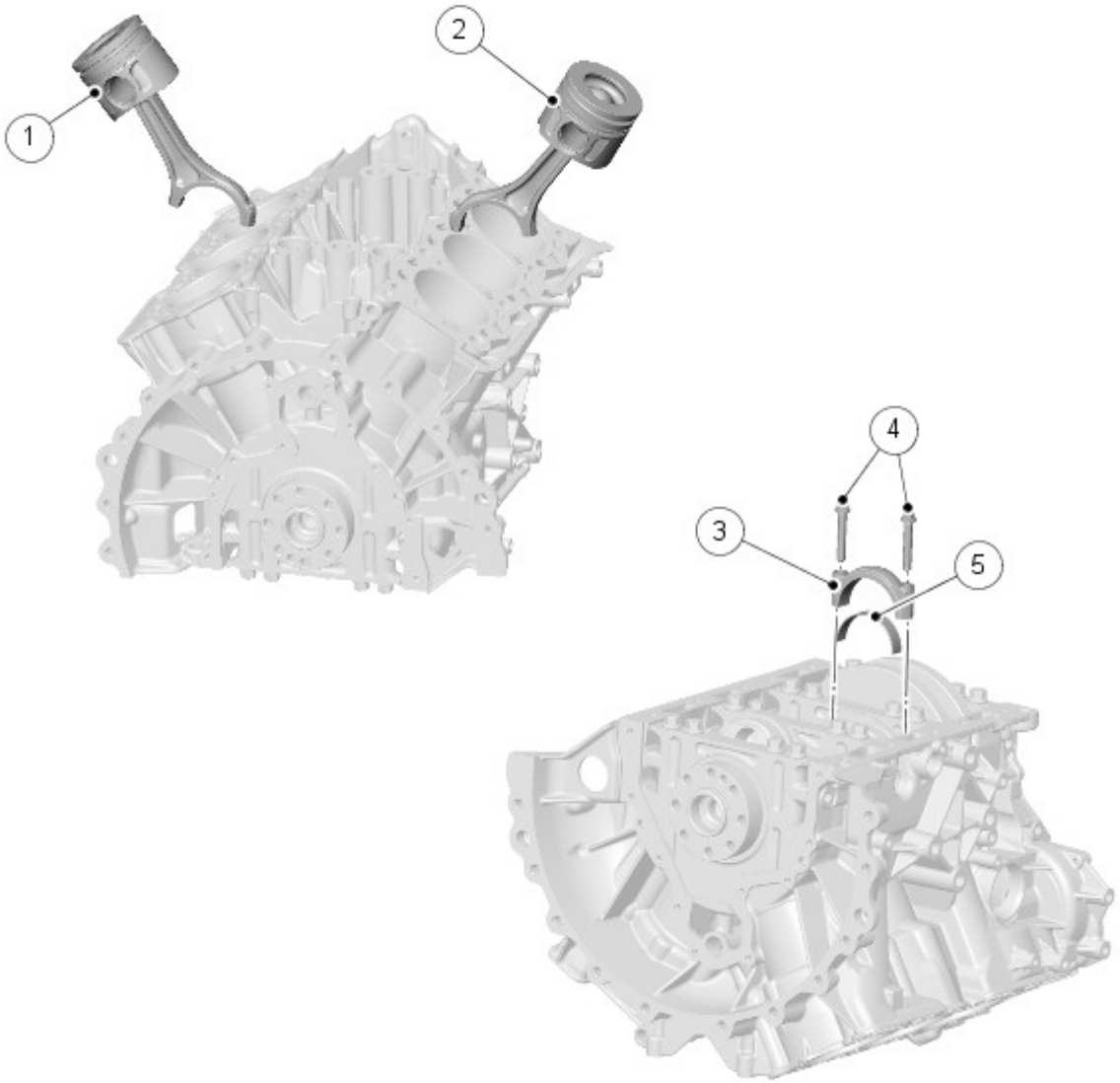
E152118

Item	Part Number	Description
1	-	Circlip
2	-	Piston
3	-	Gudgeon pin
4	-	Circlip
5	-	Connecting rod identification
6	-	Connecting rod bolts
7	-	Connecting rod bearings
8	-	Connecting rod

The connecting rods have fracture-split bearing caps. The bearing caps are produced by fracturing the opposing sides of the connecting rod at the bearing horizontal center-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 connecting rod bearings are selective split plain bearings. The connecting rod lower bearing is 'sputter coated', which is a manufacturing process that layers the bearing material to produce a higher load capacity for improved durability.The upper is a tri-metal bearing with bismuth overlay.

NOTE: The connecting rods are not selective.

PISTON AND CONNECTING ROD ORIENTATION



E152111

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

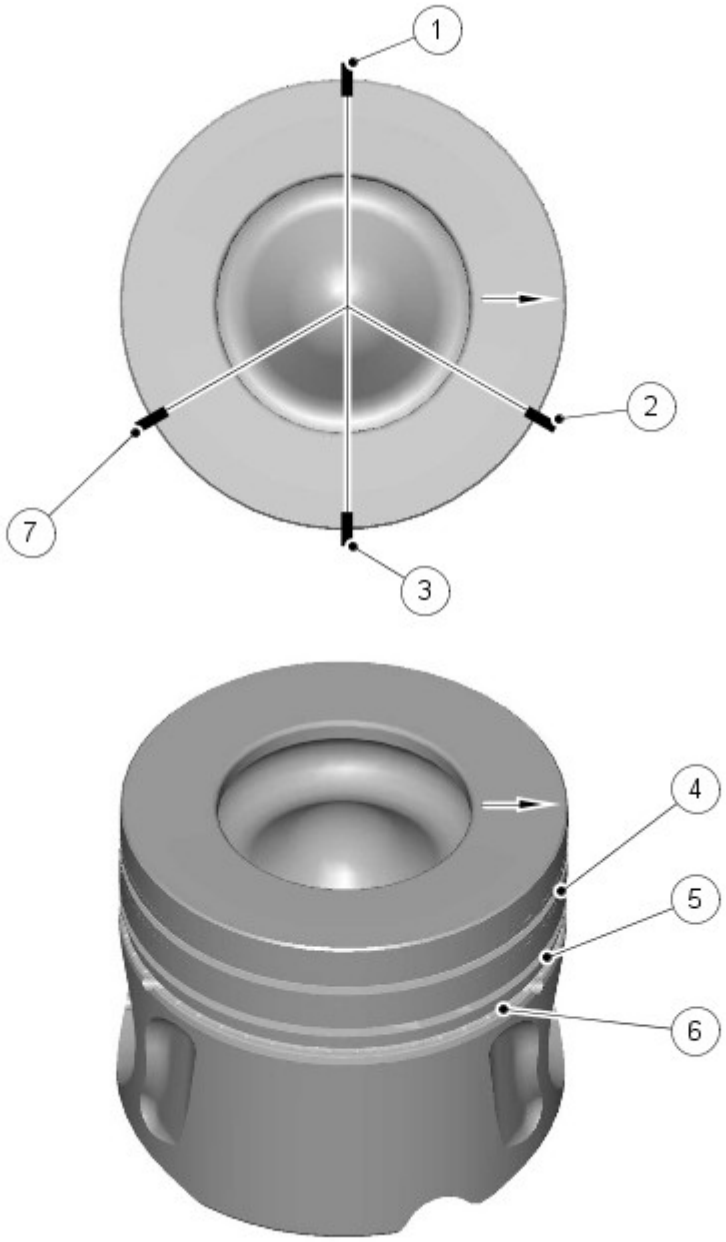
When installing a connecting rod, ensure the back of the connecting rod faces the center of the 'vee'.

The pistons are 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 gudgeon pin located in a bushing in the connecting rod.

PISTON RINGS ORIENTATION



E152119

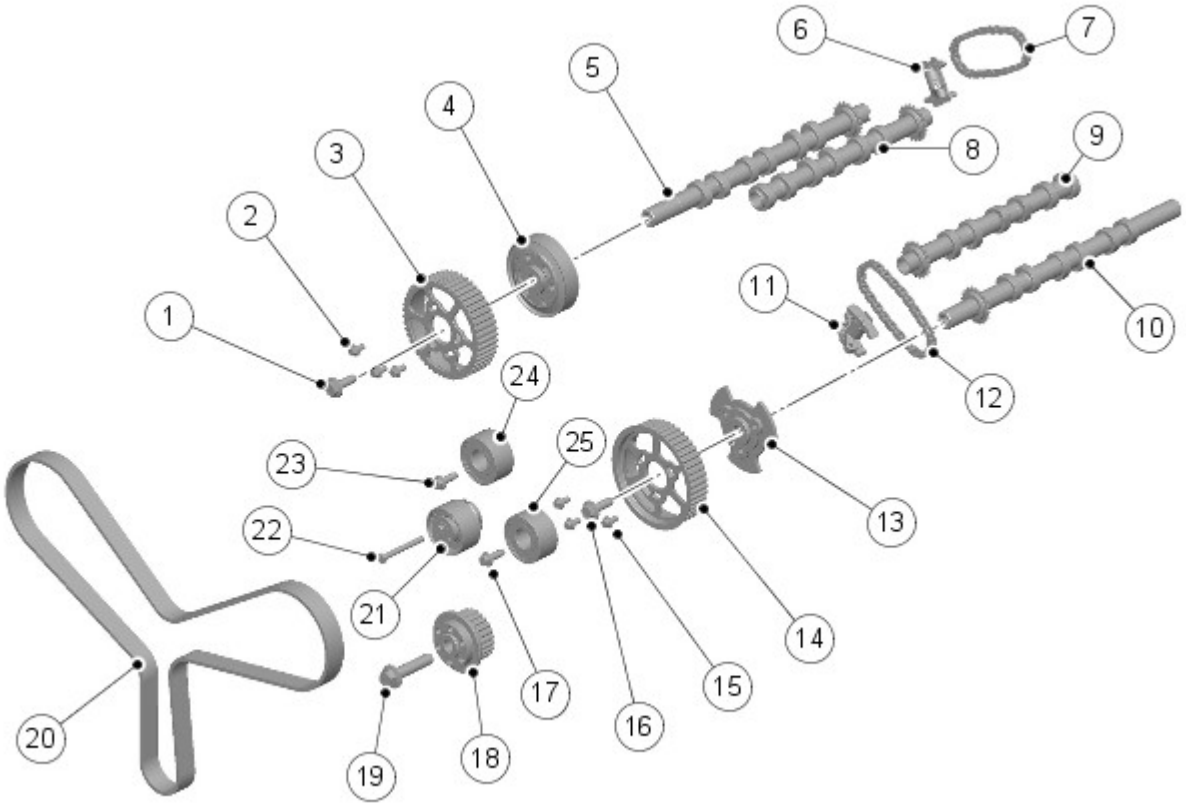
Item	Part Number	Description
1	-	Ring gap oil control
2	-	Ring gap upper compression
3	-	Spiral joint oil control
4	-	Upper compression ring
5	-	Lower compression ring
6	-	Oil control ring
7	-	Ring gap lower compression

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 rectangular ring with a barrel machined face and with a diamond coating and it is fitted to the top of the piston. The lower compression ring is a rectangular taper faced ring, the oil control ring is a coil spring loaded, bevel edged ring. 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 beveled oil control ring must be opposite the spiral control joint.

Camshaft Timing Components

PRIMARY DRIVE



E152121

Item	Part Number	Description
1	-	Bolt
2	-	Bolt (3 off)
3	-	Right camshaft timing pulley
4	-	Camshaft hub
5	-	Right exhaust camshaft
6	-	Right chain tensioner
7	-	Right crossover chain
8	-	Right intake camshaft
9	-	Left intake camshaft
10	-	Left exhaust camshaft
11	-	Left chain tensioner
12	-	Left crossover chain
13	-	Camshaft hub
14	-	Left camshaft timing pulley
15	-	Bolt (3 off)
16	-	Bolt
17	-	Bolt
18	-	Crankshaft sprocket
19	-	Bolt
20	-	Timing belt
21	-	Tensioner
22	-	Bolt
23	-	Bolt
24	-	Idler
25	-	Idler

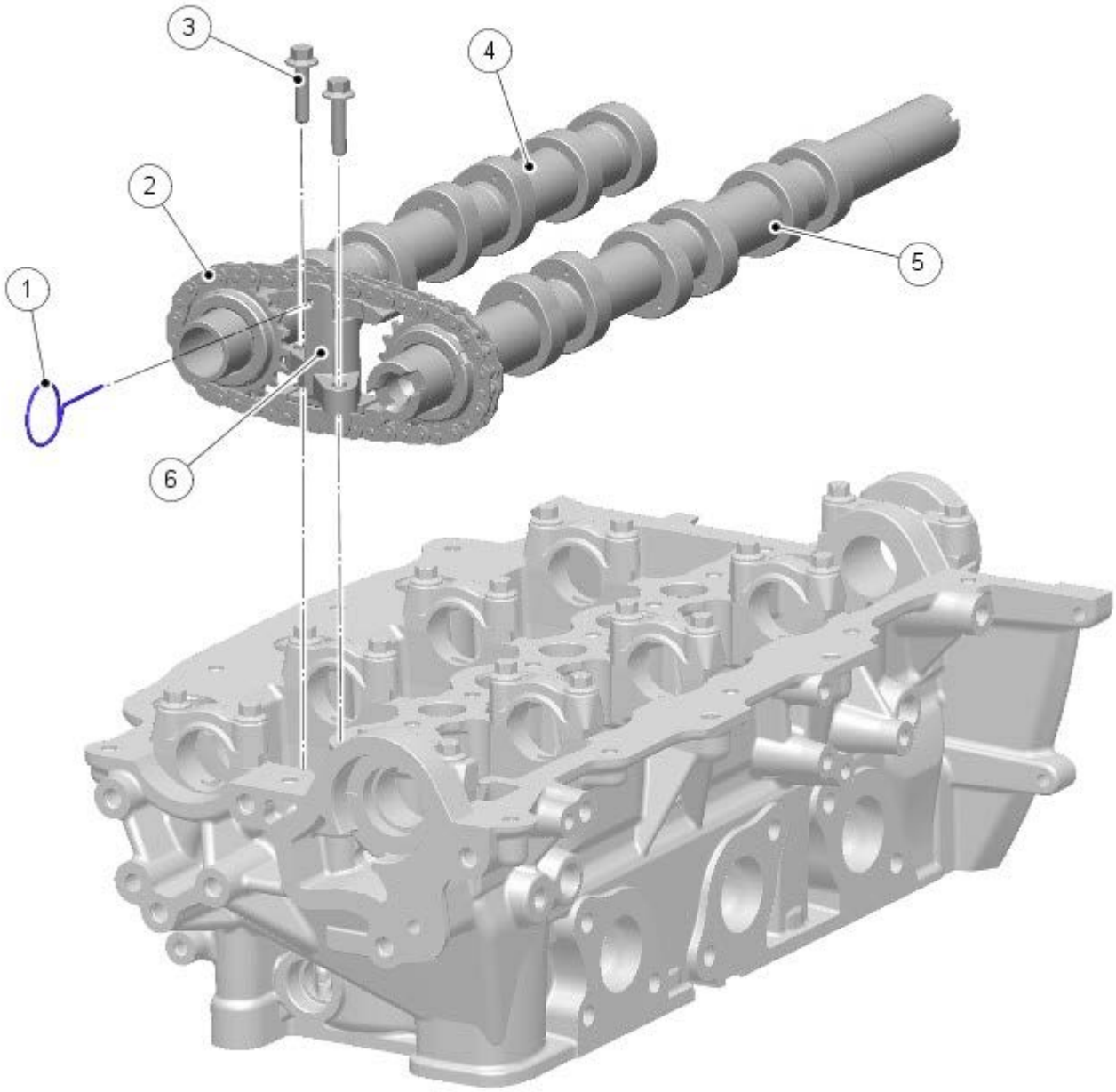
Primary drive is provided by a toothed timing belt from the crankshaft to the exhaust camshaft gears of each cylinder bank via 2 idler pulleys and a tensioner.

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

The primary drive cover is secured to the front of the cylinder block, cylinder heads, intake manifolds and oil pump housing. The cover is sealed with a gasket.

SECONDARY DRIVE

NOTE: Bank 1 cylinder head installation shown, Bank 2 is similar.



E152125

Item	Part Number	Description
1	-	Tensioner firing pin
2	-	Timing chain
3	-	Bolt (2 off)
4	-	Intake camshaft
5	-	Exhaust camshaft
6	-	Chain tensioner

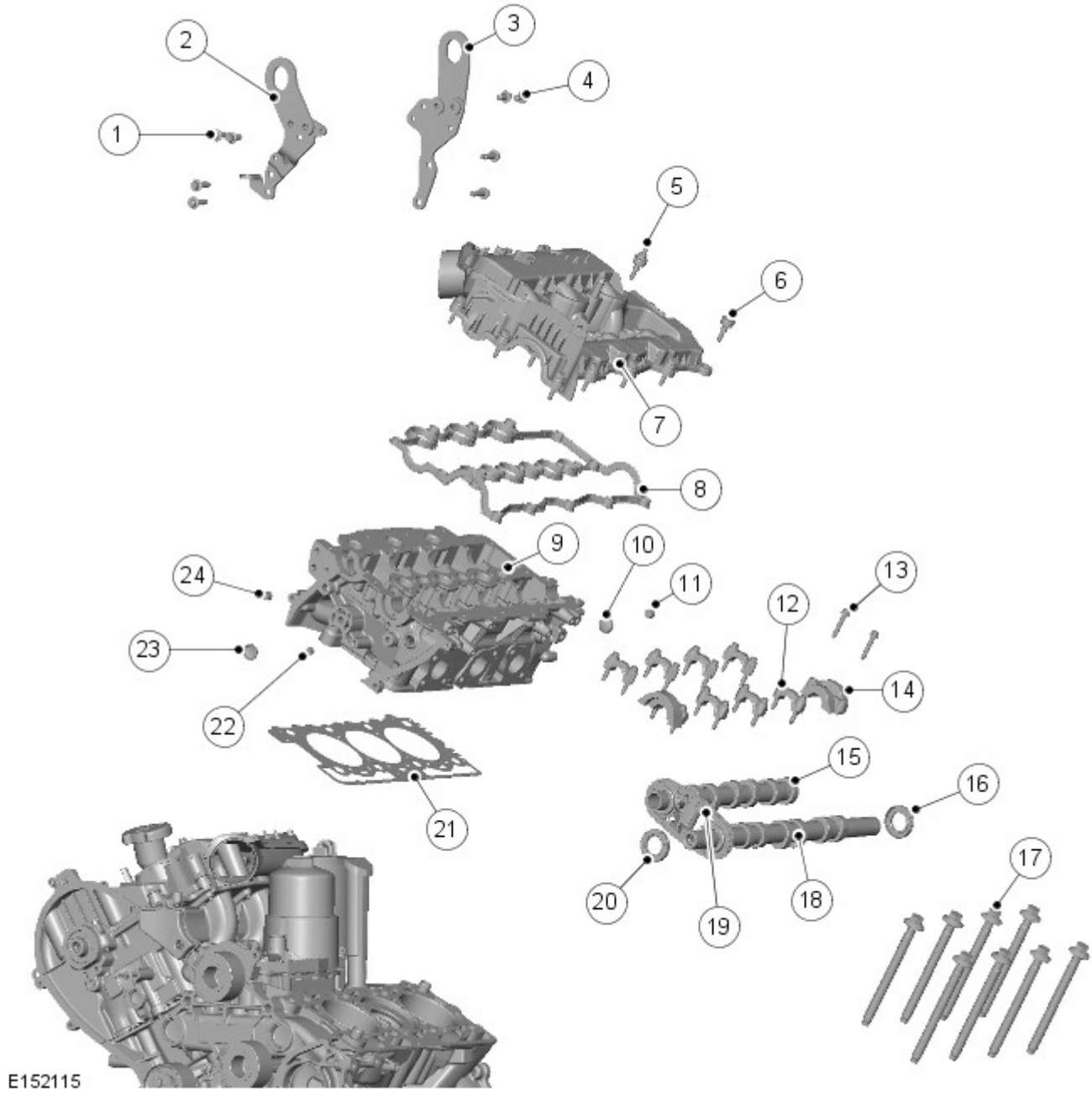
Secondary drive is provided by 2 short crossover chains, which transfer drive from the exhaust camshaft gears to the intake camshaft gears. The crossover drives are located at the rear of the right cylinder bank and the front of the left cylinder bank. This allows for a much shorter and simpler run for 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 fixing pin holds the automatic chain tensioner in a compressed state to aid installation.
For additional information, refer to: Camshaft LH (303-01A Engine - TDV6 3.0L Diesel, Removal and Installation) / Camshaft RH (303-01A Engine - TDV6 3.0L Diesel, Removal and Installation).

Cylinder Head Components

NOTE: Bank 2 cylinder head installation shown, Bank 1 is similar.

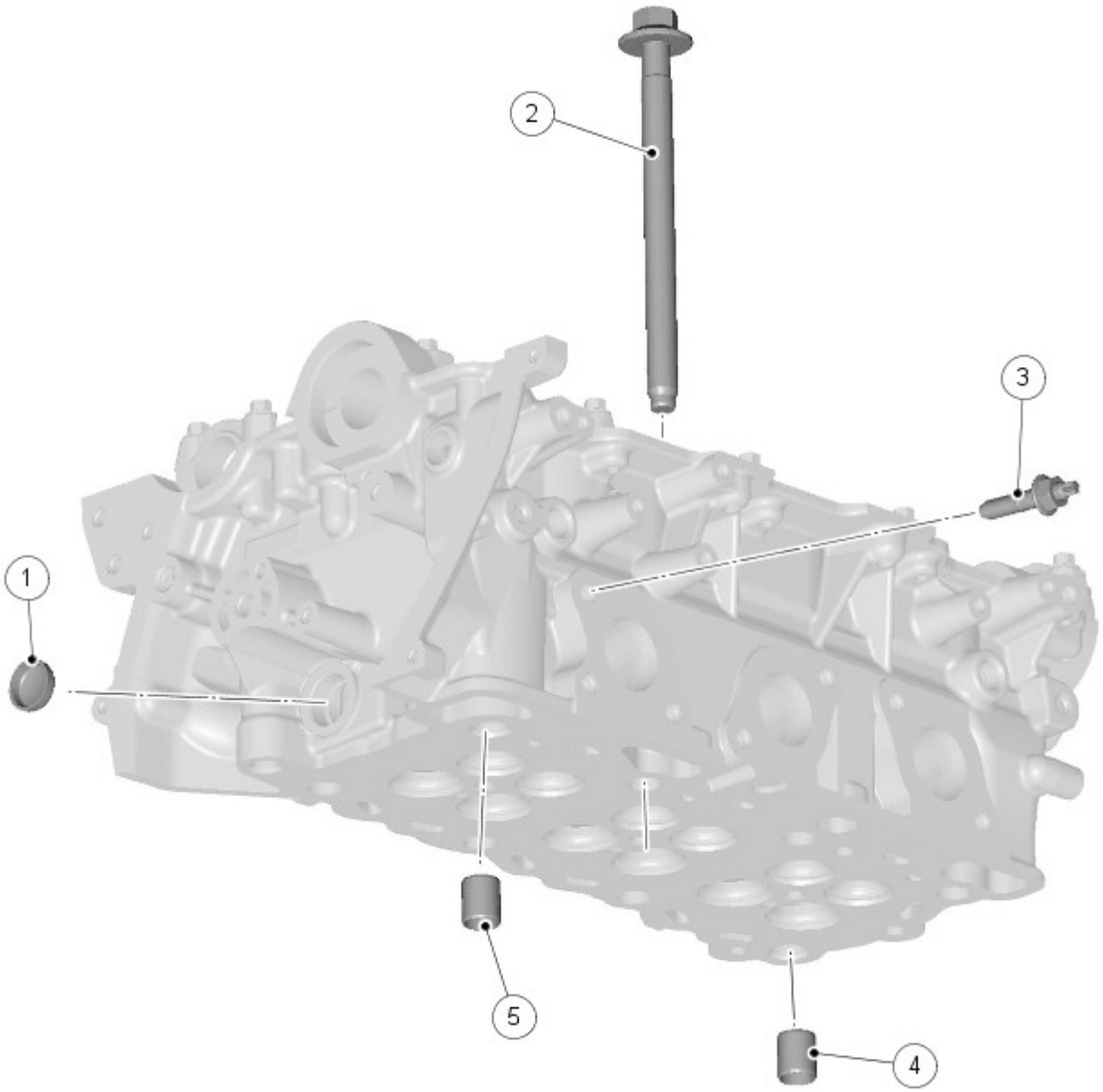


Item	Part Number	Description
1	-	Bolt (4 off)
2	-	Front lifting eye
3	-	Rear lifting eye
4	-	Bolt (4 off)
5	-	Camshaft cover stud (6 off)
6	-	Camshaft cover bolt (7 off)
7	-	Intake manifold camshaft cover assembly
8	-	Gasket
9	-	Cylinder head
10	-	Plug (coolant)
11	-	Plug (oil port)
12	-	Camshaft bearing cap (7 off)
13	-	Bolts (18 off)
14	-	Camshaft bearing cap and seal housing (2 off)
15	-	Intake camshaft
16	-	Seal
17	-	Cylinder head bolts (8 off)
18	-	Exhaust camshaft
19	-	Secondary drive
20	-	Seal

21	-	Cylinder head gasket
22	-	Plug (oil port)
23	-	Plug (coolant)
24	-	Plug (oil port)

CYLINDER HEADS

NOTE: Bank 2 cylinder head installation shown, Bank 1 is similar.



E152114

Item	Part Number	Description
1	-	Plug (coolant 2 off)
2	-	Cylinder head bolt (8 off)
3	-	Exhaust manifold stud (6 off)
4	-	Cylinder head dowel
5	-	Cylinder head dowel

The 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.

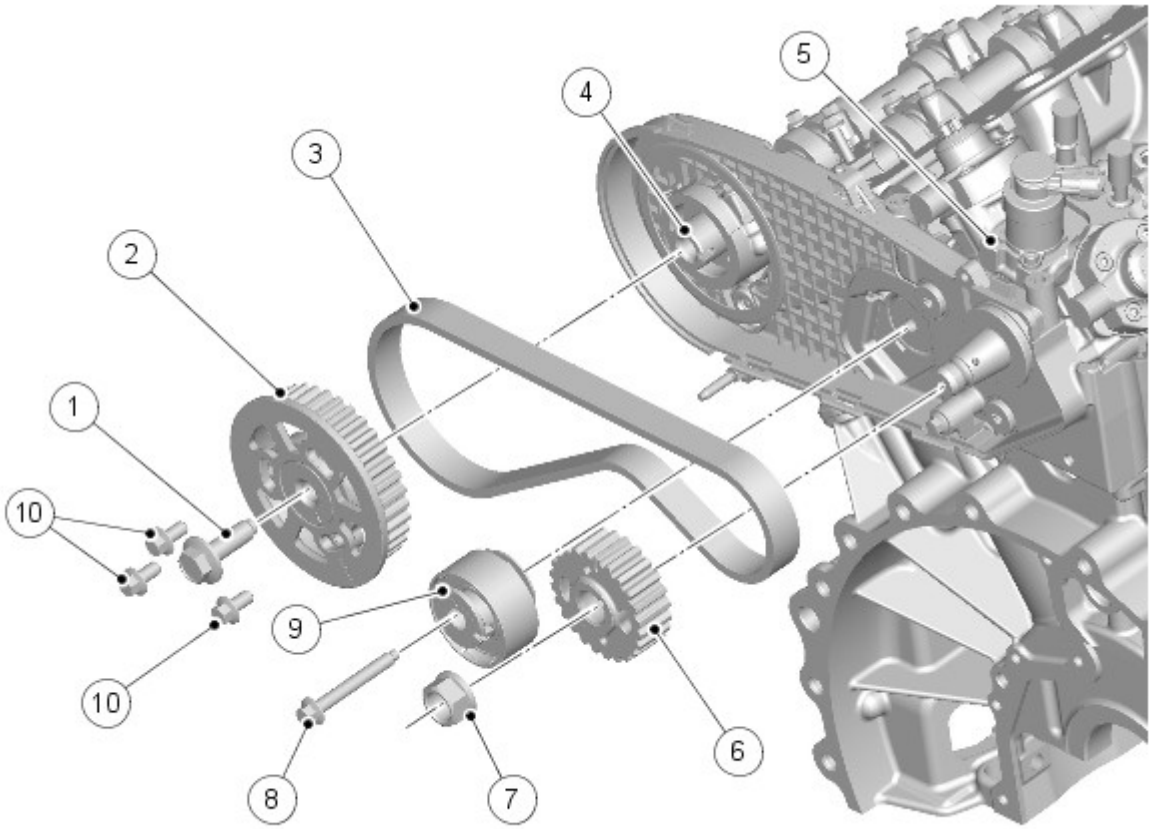
NOTE: The cylinder heads cannot be reworked.

The cylinder head gasket is 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.
For additional information, 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 tube construction, with pressed on lobes. Each camshaft is retained by 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.

HIGH PRESSURE FUEL PUMP DRIVE



E152120

Item	Part Number	Description
1	-	Bolt
2	-	Camshaft gear
3	-	Toothed belt
4	-	Left cylinder head exhaust camshaft
5	-	High pressure (HP) fuel pump
6	-	High pressure (HP) fuel pump gear
7	-	Nut
8	-	Bolt
9	-	Tensioner
10	-	Bolts

The left cylinder bank exhaust camshaft is machined to accept a rear camshaft gear. The rear camshaft gear provides drive for the HP (high pressure) fuel pump.The HP fuel pump drive incorporates the following main components:

- Camshaft gear
- HP fuel pump gear
- Toothed belt
- Tensioner

For additional information, refer to: Fuel Charging and Controls (303-04A Fuel Charging and Controls - TDV6 3.0L Diesel, Description and Operation).

The exhaust camshaft gear of the left cylinder head also incorporates a reluctor ring, which is used in conjunction with the CMP (Camshaft Position) sensor to measure engine position.
For additional information, refer to: Electronic Engine Controls (303-14A Electronic Engine Controls - TDV6 3.0L Diesel, Description and Operation).

The right cylinder head exhaust camshaft is machined at the rear end to provide a drive connection for the vacuum and oil scavenge pump.

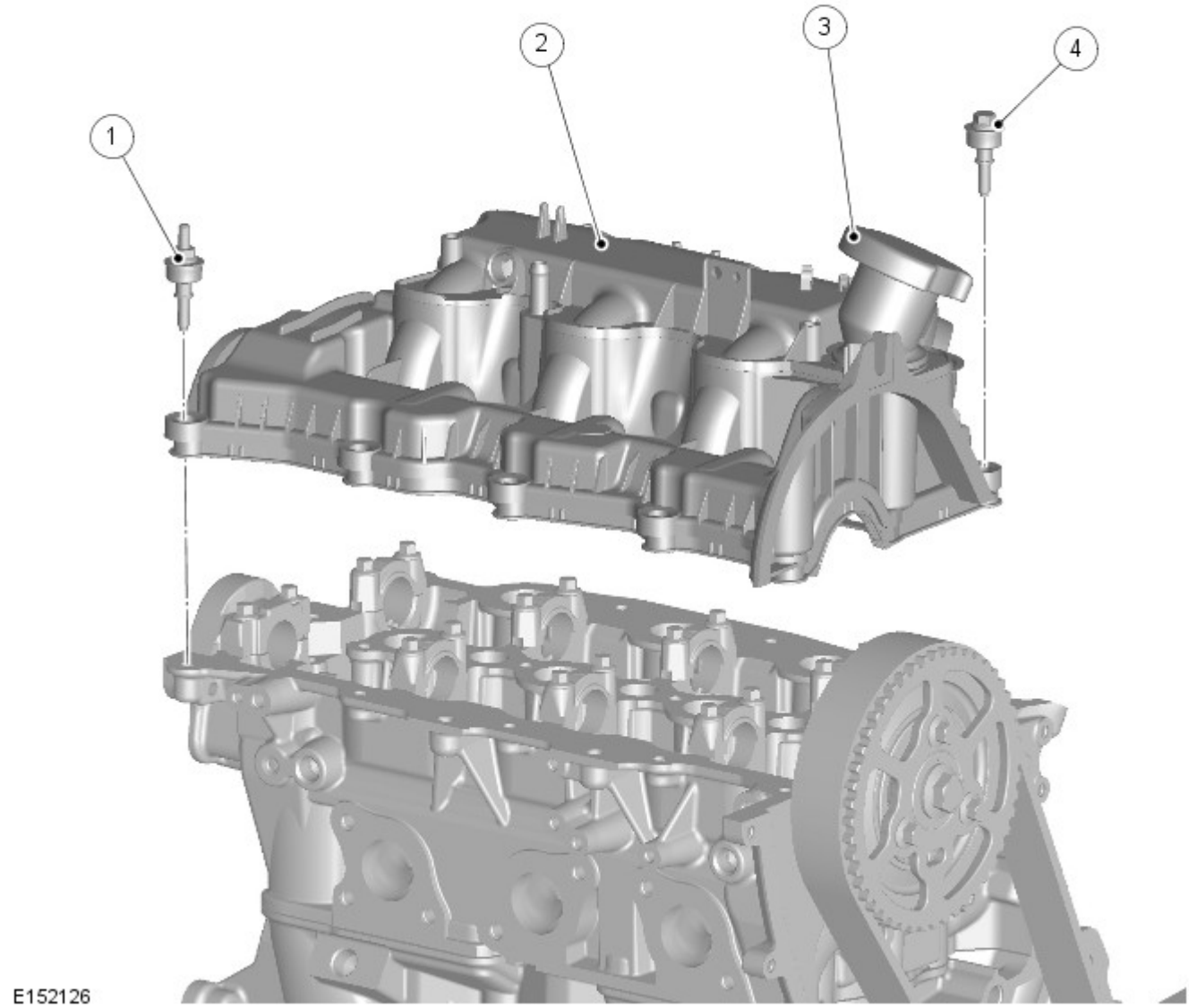
The fuel injection nozzles are centrally mounted above each cylinder.
For additional information, refer to: Fuel Charging and Controls (303-04A Fuel Charging and Controls - TDV6 3.0L Diesel, Description and Operation).

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: Glow Plug System (303-07C Glow Plug System - TDV6 3.0L Diesel, Description and Operation).

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

CAMSHAFT COVERS

NOTE: Bank 1 installation shown, Bank 2 is similar.



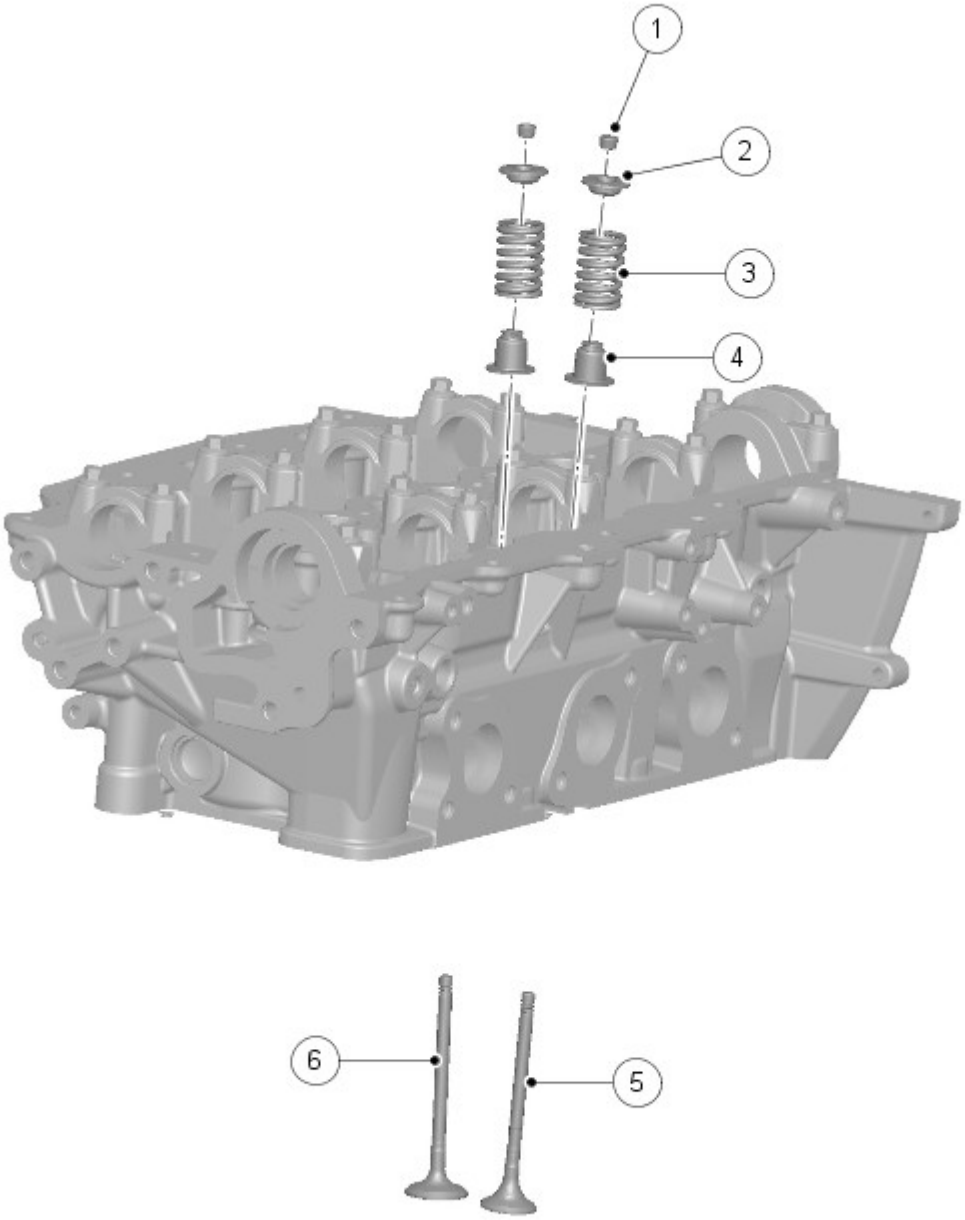
Item	Part Number	Description
1	-	Camshaft cover stud (8 off)
2	-	Camshaft cover - intake manifold assembly
3	-	Oil filler cap
4	-	Camshaft cover bolt (5 off)

The right bank camshaft cover incorporates an outlet for the full load engine breather and the engine oil filler cap. The left bank camshaft cover incorporates an outlet for the part load engine breather.
For additional information, refer to: Engine Emission Control (303-08A Engine Emission Control - TDV6 3.0L Diesel, Description and Operation).

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

NOTE: Bank 1 installation shown, Bank 2 is similar.

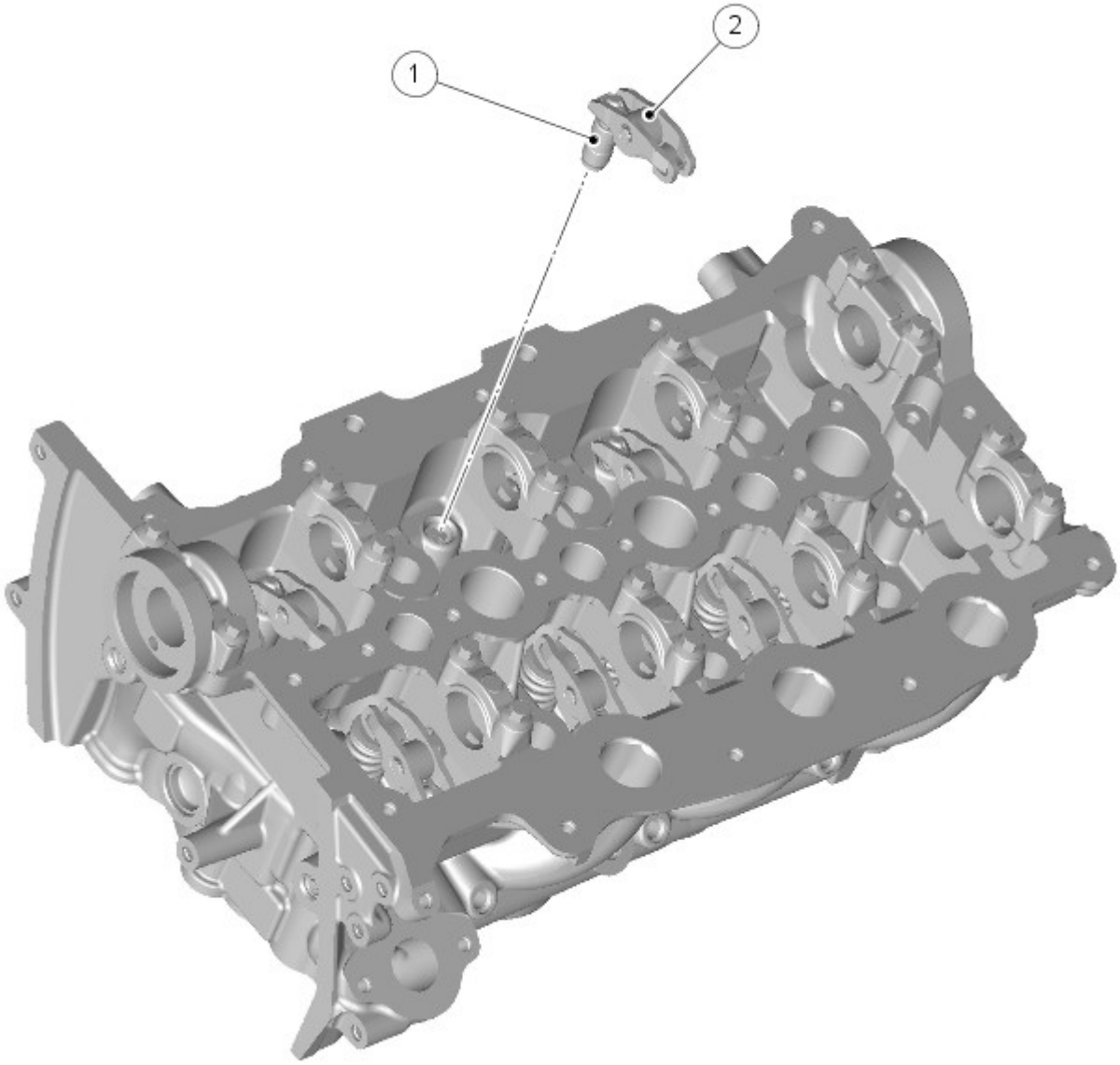


E152155

Item	Part Number	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 steam seal (24 off, 12 per cylinder head)
5	-	Exhaust valve (12 off, 6 per cylinder head)
6	-	Intake valve (12 off, 6 per cylinder head)

Each cylinder head incorporates 2 overhead camshafts operating 4 valves per cylinder via rocker arms with hydraulic lash adjusters.

ROCKER ARMS AND HYDRAULIC LASH ADJUSTERS

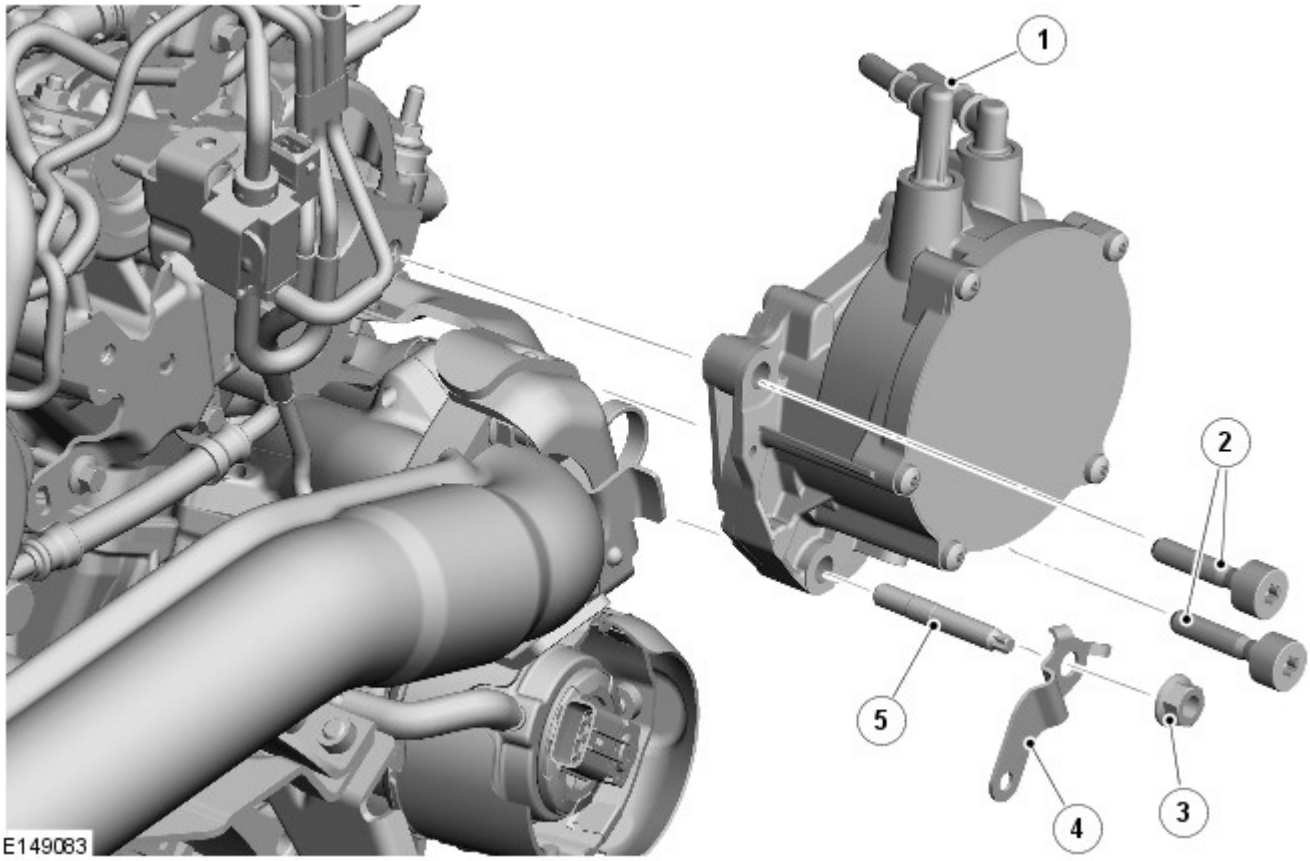


E152124

Item	Part Number	Description
1	-	Hydraulic lash adjuster (24 off, 12 per cylinder head)
2	-	Rocker arm (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 seats and guide inserts. Valve spring collets, collars seats locate single valve springs on both intake and exhaust valves. Valve stem seals are integrated into the valve spring seats.

VACUUM AND OIL SCAVENGE PUMP

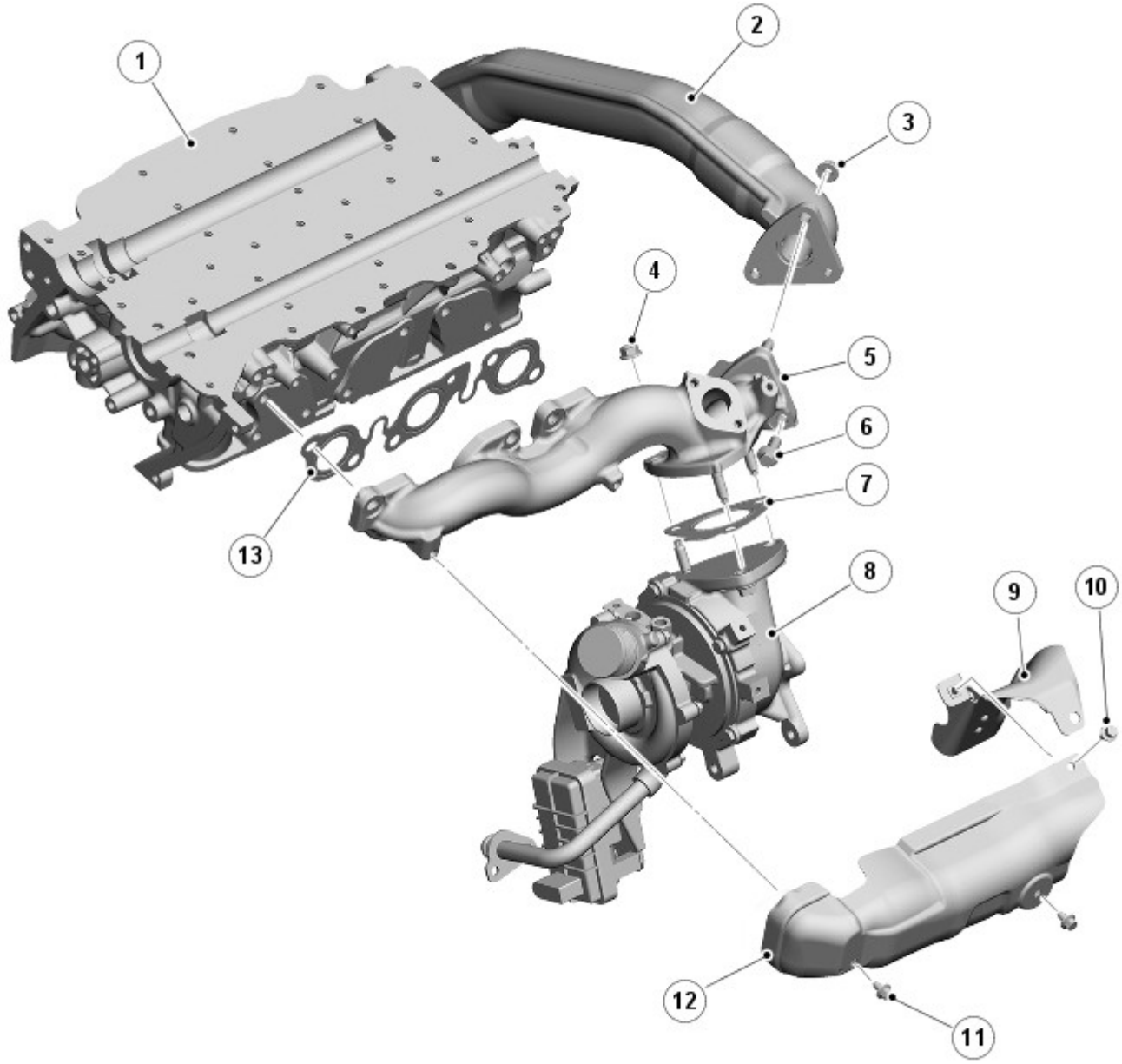


Item	Part Number	Description
1	-	Vacuum pipe connections
2	-	Torx bolt (2 off)
3	-	Nut
4	-	Bracket (emission hose)
5	-	Stud

The vacuum and oil scavenge pump is located at the rear of the right cylinder head and driven from the exhaust camshaft. The pump provides the vacuum used by the EGR (Exhaust Gas Recirculation), turbocharger and brake booster systems, and scavenges oil from the turbochargers.

EXHAUST MANIFOLDS

NOTE: Left exhaust manifold shown, right exhaust manifold similar.



E115531

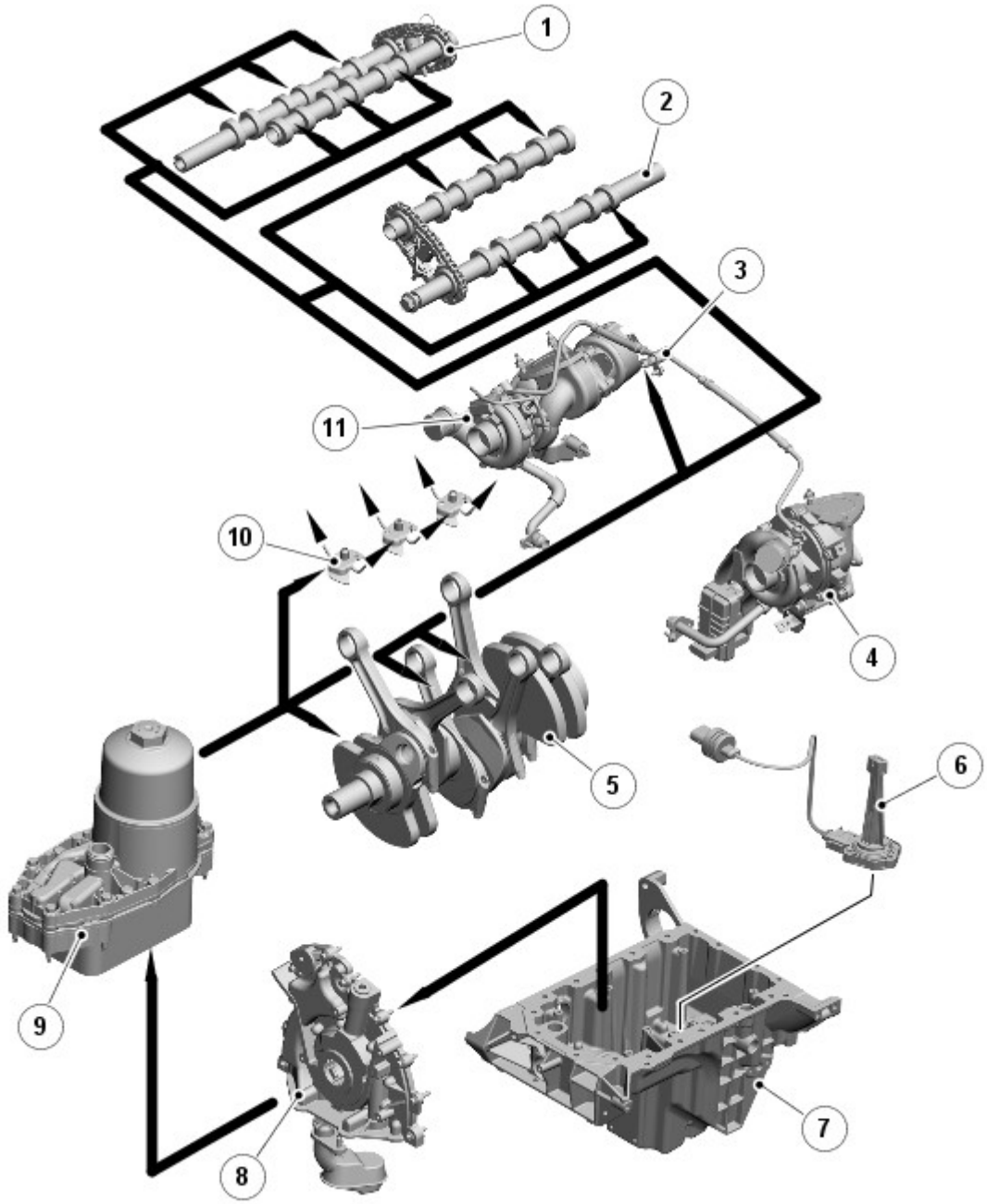
Item	Part Number	Description
1	-	Cylinder head
2	-	Connecting pipe
3	-	Nut (2 off)
4	-	Nut (3 off)
5	-	Exhaust manifold
6	-	Bolt
7	-	Gasket
8	-	Turbocharger (primary turbocharger shown)
9	-	Manifold rear heat shield
10	-	Bolt
11	-	Bolt (2 off)
12	-	Manifold heat shield

The exhaust manifolds are sealed to the cylinder head by means of a gasket. Sacrificial 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 transfer pipe.

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

Lubrication System



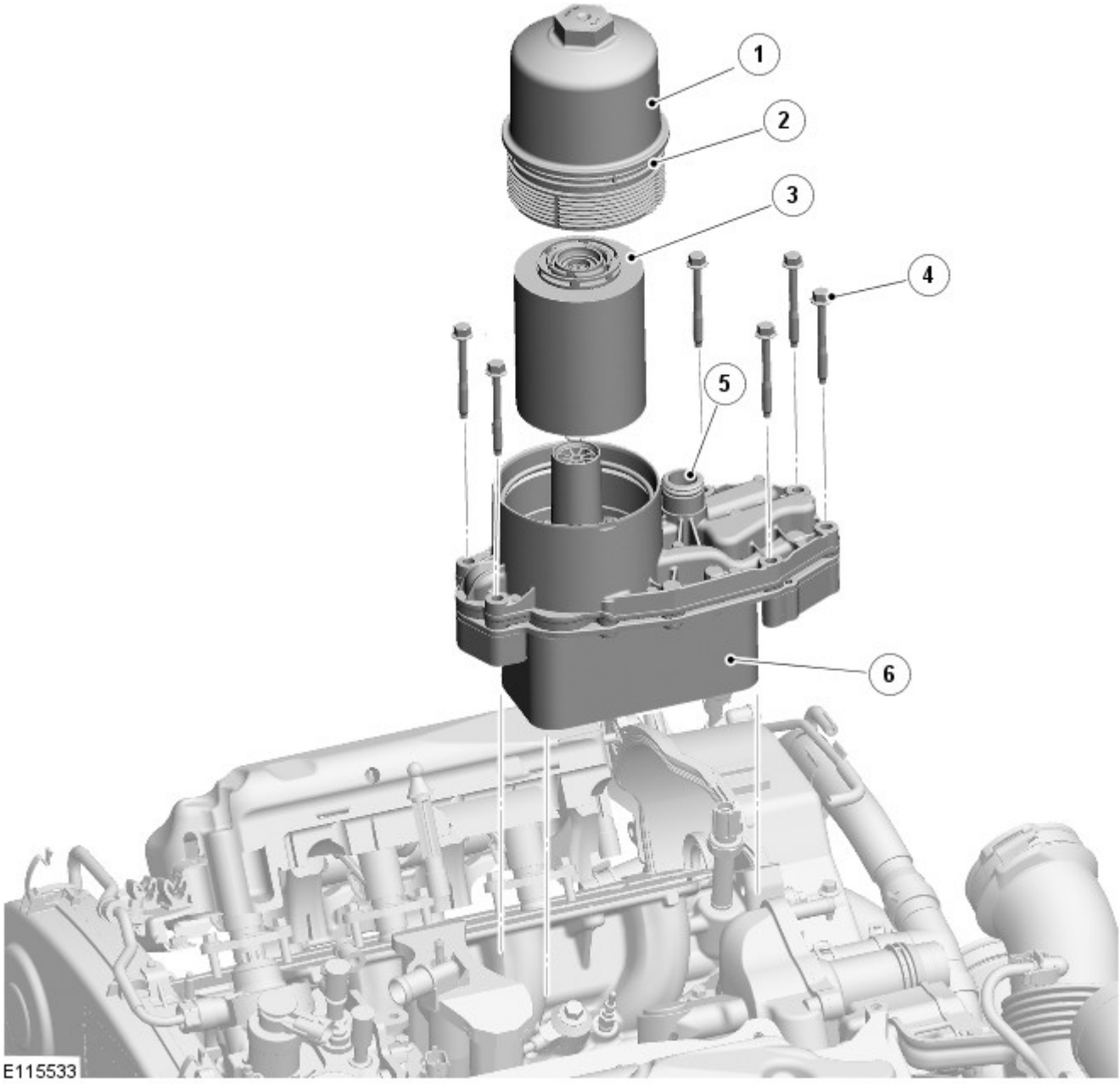
E117573

Item	Part Number	Description
1	-	Intake 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 lash adjusters and the timing gear chain tensioners.

OIL COOLER AND FILTER ASSEMBLY



Item	Part Number	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.

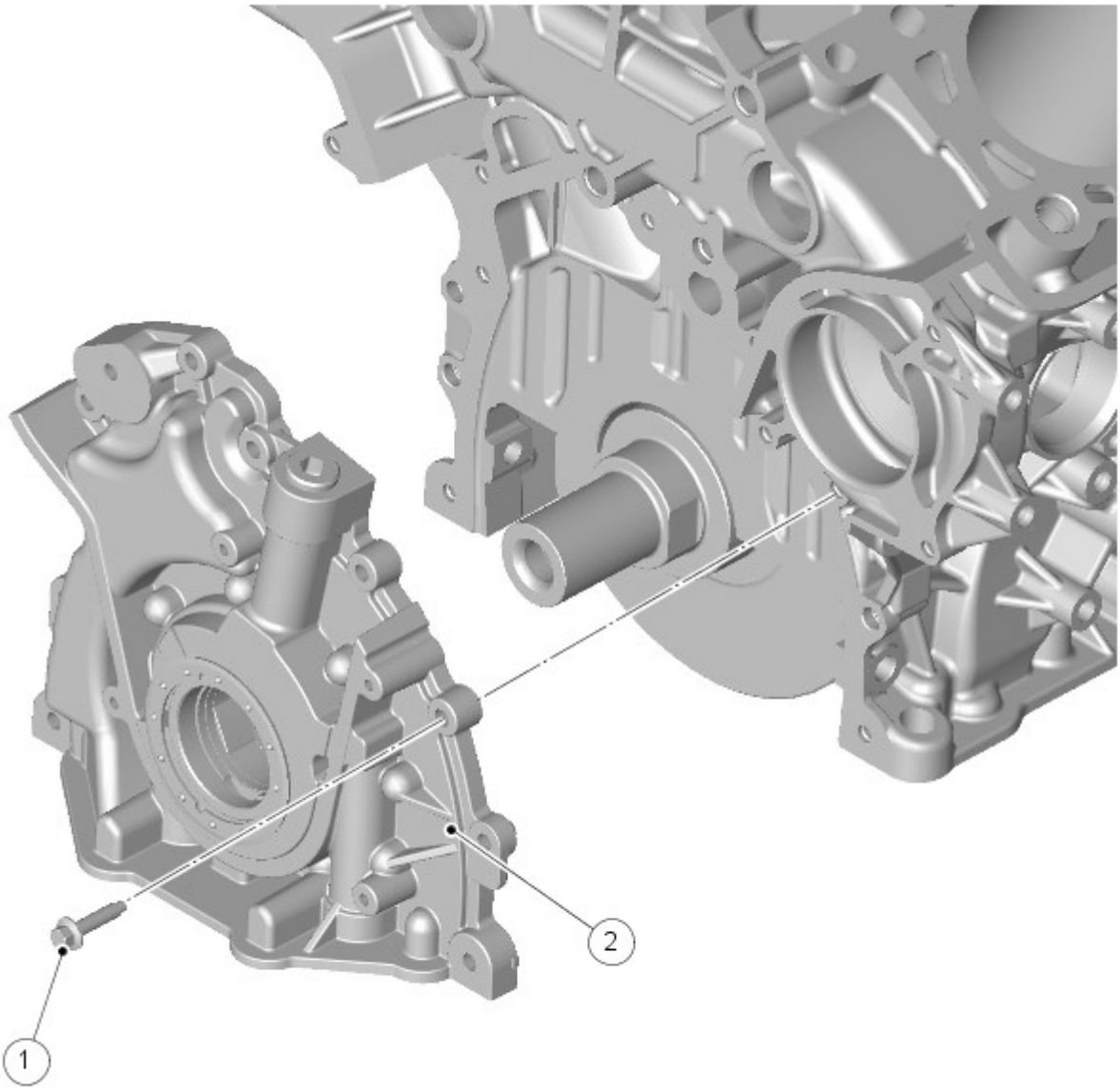
Oil returns to the oil pan under gravity. Large drain holes through the cylinder heads and cylinder block ensure the quick return of the oil, reducing the volume of oil required and enabling an accurate check of the contents soon after the engine stops.

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

The 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 intake prevents debris from entering the oil system.

The oil cooler and filter assembly incorporates an oil cooler bypass valve which improves oil prime time especially at cold ambient temperatures (<0 deg C), as well as benefiting fuel economy by aiding engine warm up.

OIL PUMP



E152117

Item	Part Number	Description
1	-	Bolt (10 off)
2	-	Oil pump

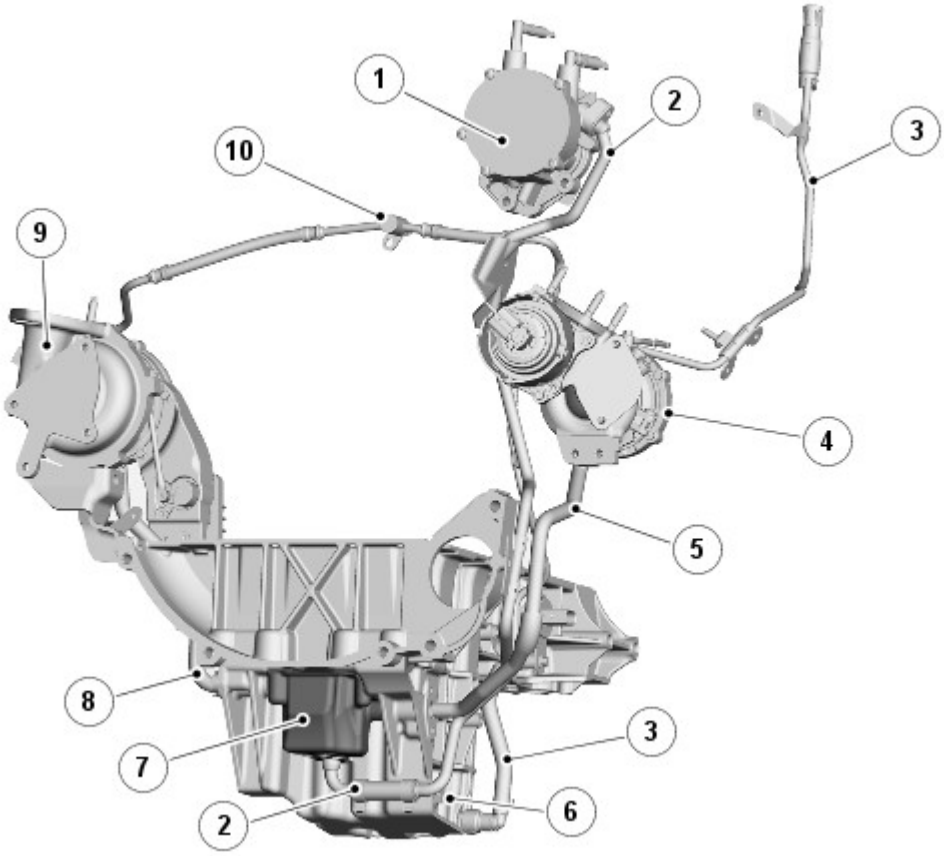
The oil pump is a gear type pump and is bolted and doweled to the front of the cylinder block. It is sealed by means of a gasket, which is recessed into the oil pump housing. The pump intake and outlet ports align with oil passages in the cylinder block.

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/in²).

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.

OIL PAN



E142995

Item	Part Number	Description
1	-	Vacuum and oil scavenge pump
2	-	Oil scavenge pipe
3	-	Oil extraction tube
4	-	Secondary turbocharger
5	-	Secondary turbocharger oil return tube
6	-	Drain plug
7	-	Secondary reservoir
8	-	Primary turbocharger oil return tube
9	-	Primary turbocharger
10	-	Turbocharger oil feed pipes

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. At extreme angles there is a risk the turbochargers may be below the oil level in 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 reservoir of the oil pan.
- A secondary reservoir in the oil pan, sealed off from the main reservoir, to receive oil from the primary turbocharger bearings.
- The secondary turbocharger oil return tube routes to the crankcase directly and allows the oil to drain back into the oil pan.
- The vacuum and oil scavenge pump to assist the oil flow from the turbocharger bearings by scavenging oil from the secondary reservoir into the right camshaft cover.

For service, a drain plug and an oil extraction tube are installed to drain the main body of the oil pan.

OIL LEVEL CHECK

The engine oil level can be displayed in the message center on the instrument cluster.

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.

The method of checking the oil level can be found in the oil draining and filling procedures. For additional information, refer to: (303-01A Engine - TDV6 3.0L Diesel)

Engine Oil Vacuum Draining and Filling (General Procedures),
Engine Oil Draining and Filling (General Procedures).

OPERATION

Operation of the engine is controlled by the ECM.
For additional information, refer to: Electronic Engine Controls (303-14A Electronic Engine Controls - TDV6 3.0L Diesel, Description and Operation).

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 failure(s)	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

	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: 13-Jan-2014

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

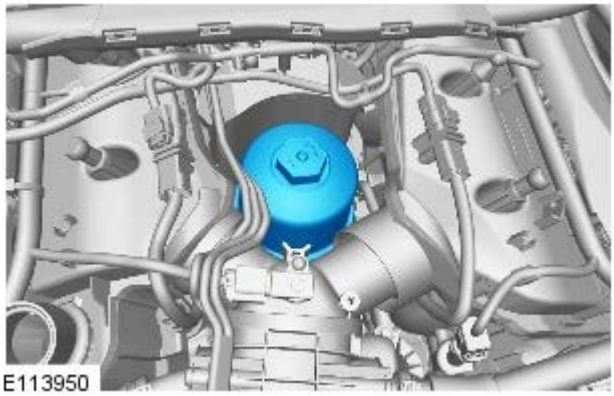
General Procedures

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: Engine Cover - TDV6 3.0L Diesel (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.

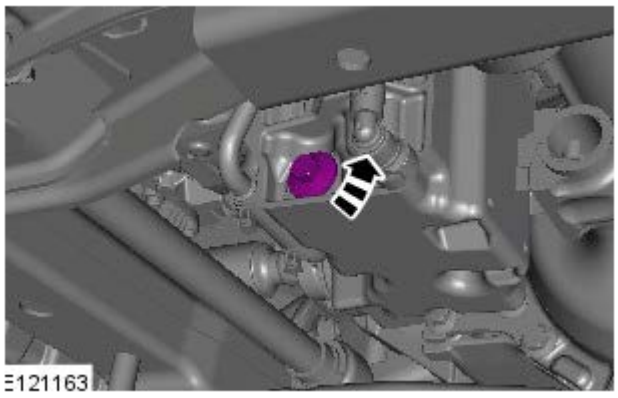

E113951

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

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

   Raise and support the vehicle.

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


E121163

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

   CAUTIONS:

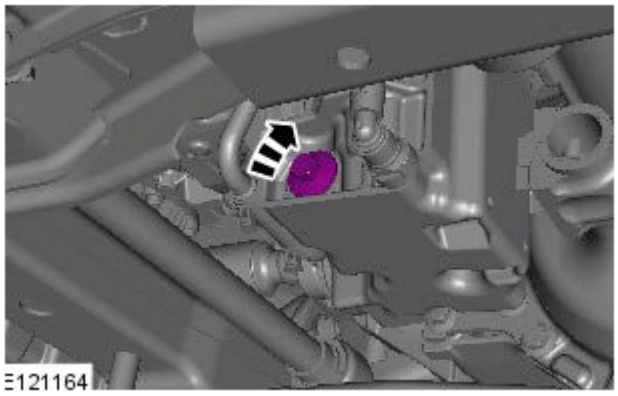
   Be prepared to collect escaping oil.

   Discard the bolt.

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

   Drain the engine oil.

Filling


E121164

1. CAUTIONS:

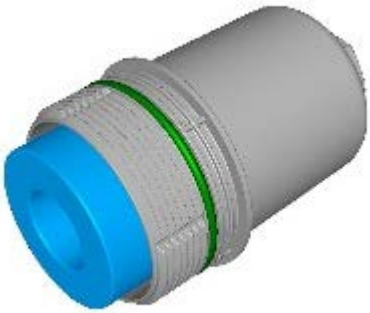
   Make sure that the component is clean, free of foreign material and lubricant.

   Make sure that a new bolt is installed.

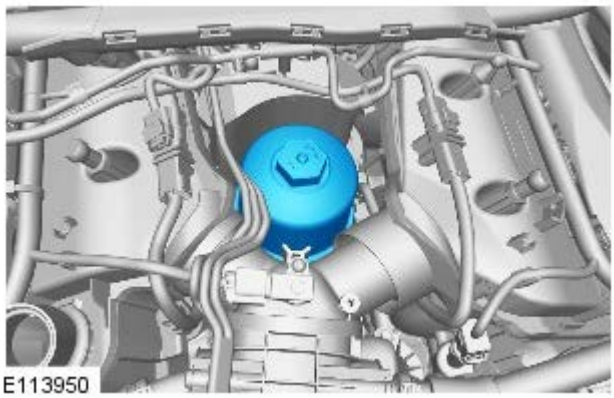
   Torque: 23 Nm

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

3. Lower the vehicle.


E129862

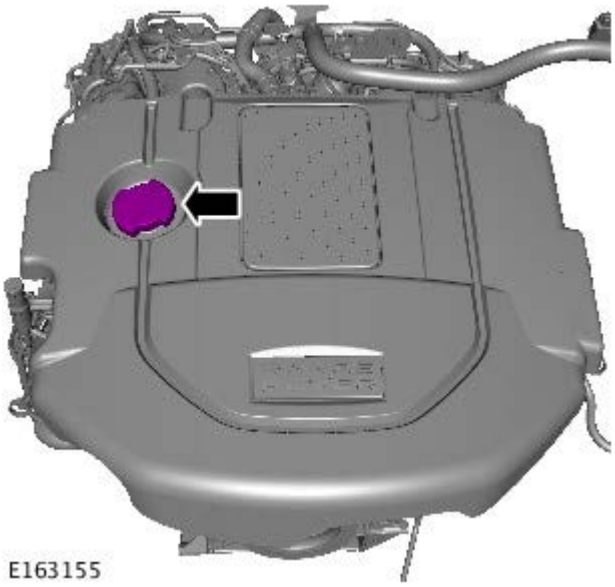
4.
   - Clean the components.
   - Install a new oil filter element to the oil filter cover.
   - Install a new oil filter cover O-ring seal.
   - Lubricate the O-ring seal with clean engine oil.


E113950

5. *Torque:* 28 Nm

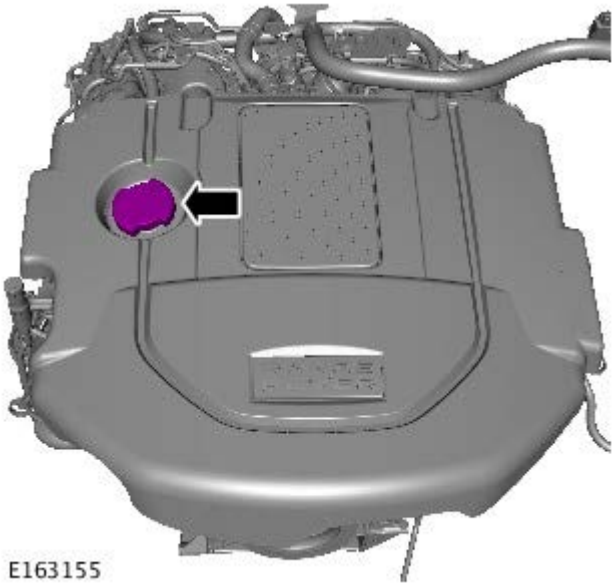
6. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05 Interior Trim and Ornamentation, Removal and Installation).

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



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

9.



10. CAUTION: Make sure that the vehicle has been left for 5 minutes from filling with oil.
    - Start the engine and allow to run for 10 minutes, stop the engine.
    - Check for leaks.

11. CAUTIONS:

    Make sure that the selector lever is in the park (P) position.

    Make sure that the hood is open.
    - Set the ignition to the ON position.

12.
    - Press the left-hand OK buton to access the Instrument Cluster (IC) Main Menu.



13.

- Press the left-hand directional button and select Service Menu.



14.

- Press the left-hand OK button.



E147184

15.

- Press the left-hand directional button and select the Oil Level display.



E147185

16.

- Press the left-hand OK button to access the Oil Level display.




E147181

17. CAUTION: Make sure that the hood is open.

- Press the speed control cancel button twice within 2 seconds while being on the oil level display.

18.

- The message center displays the actual oil level in service mode.
- 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.



19. Set the ignition to the OFF position.
20. Allow 10 minutes for the engine oil level to stabilize if there has been additional oil top up.

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

21. Repeat step 11 to 17 to access the oil level display in service mode.



22. NOTE: The actual volume displayed on the bar graph will be written into the electronic control unit as a new value.
    - Press and hold the speed control cancel button for more than 5 seconds.
    - The message center display the current oil level.

NOTE: Close the hood.

23. Set the ignition to the OFF position.
24. Set the ignition to the ON position.
25. NOTE: The following steps are to check the



current oil level in a customer mode.

- Press the left-hand OK button to access the Instrument Cluster (IC) Main Menu.

26.



- Press the left-hand directional button and select Service Menu.

27.

- Press the left-hand OK button.



E147184

28.

- Press the left-hand directional button and select the Oil Level display.

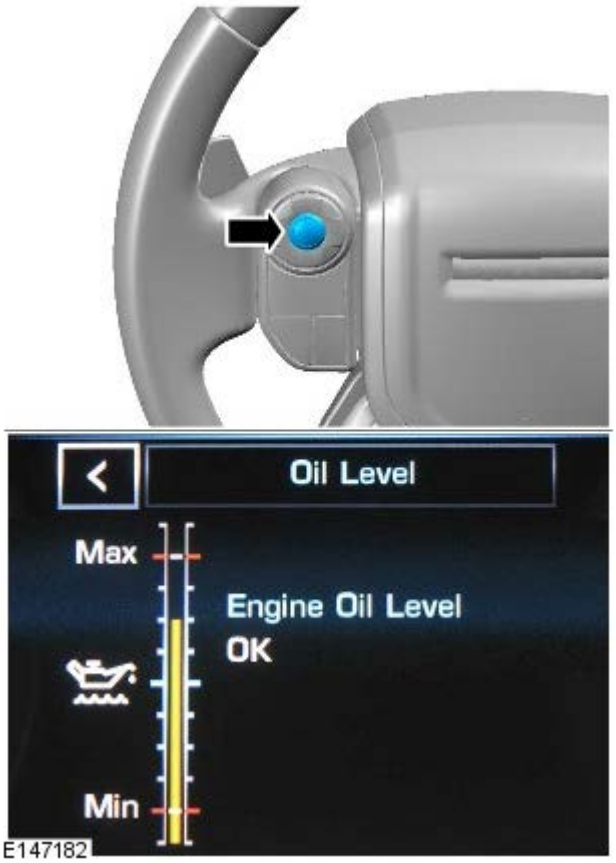


E147185

29.

- Press the left-hand OK button and follow the instructions.
- NOTE: If the message shows "Not available" wait for further 10 mins to allow the oil level to stabilize.

  Make sure that the average oil level value has now been updated.


Oil Level
Max
Engine Oil Level
OK
Min
E147182

Published: 13-Jan-2014

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

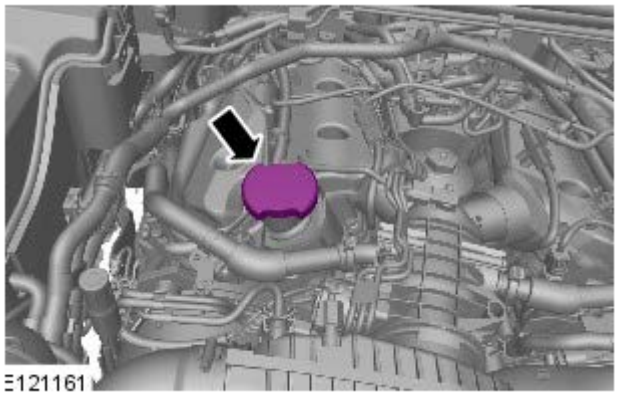
Draining

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

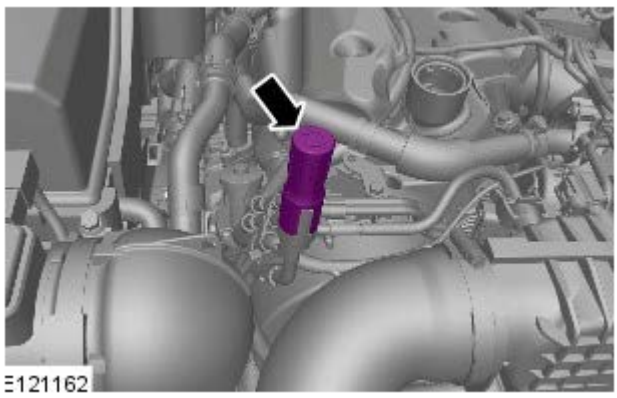
CAUTION: Make sure the engine is warm.

1. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05 Interior Trim and Ornamentation, Removal and Installation).

2.


E121161

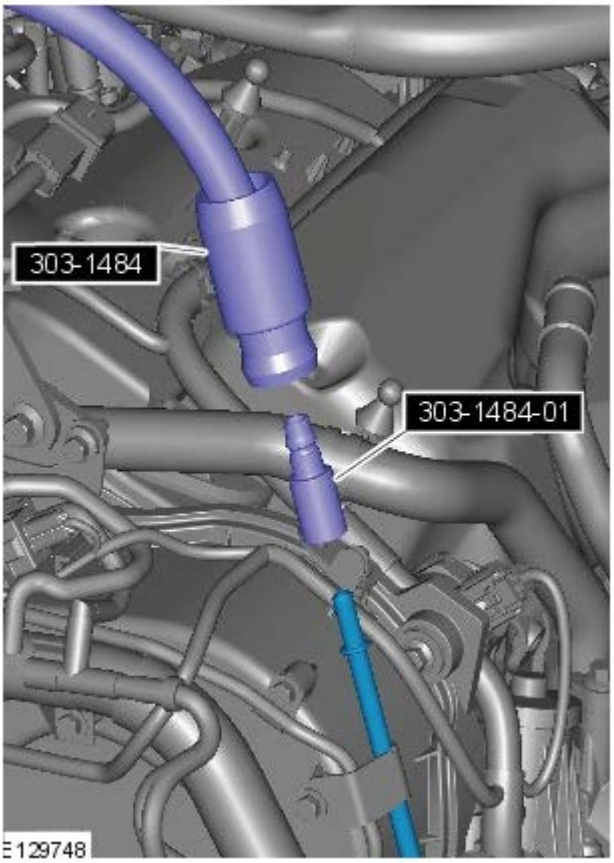
3.


E121162

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

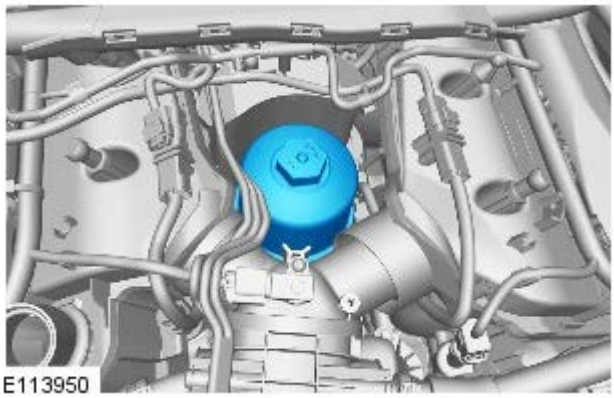
   Using the oil vacuum pump drain the oil out through the oil extraction tube.

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



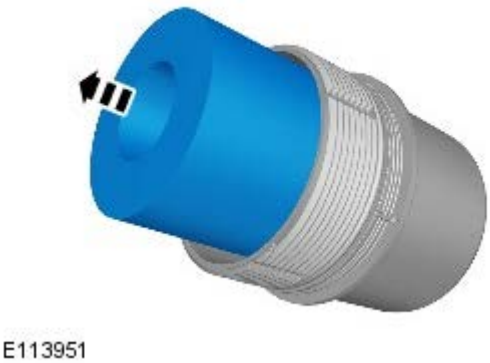
5.

- Remove the oil vacuum pump.



6.

- 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.

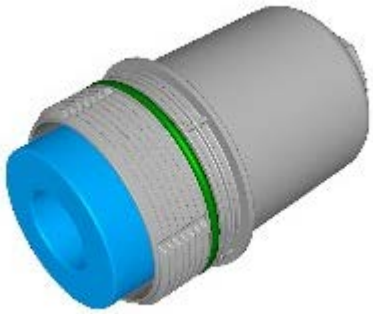


7. NOTE: Remove and discard the O-ring seal.

Filling

1.

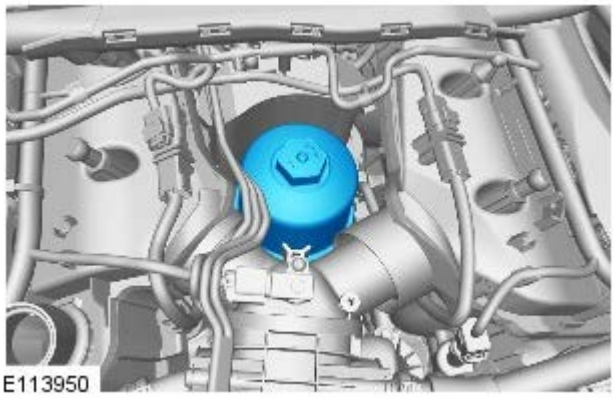
- Clean the components.
- Install a new oil filter element to the oil filter cover.
- Install a new oil filter cover O-ring seal.



E129862

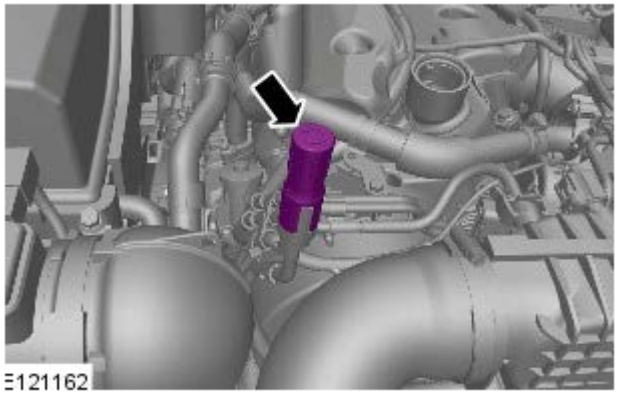
Lubricate the O-ring seal with clean engine oil.

2. *Torque:* 28 Nm



E113950

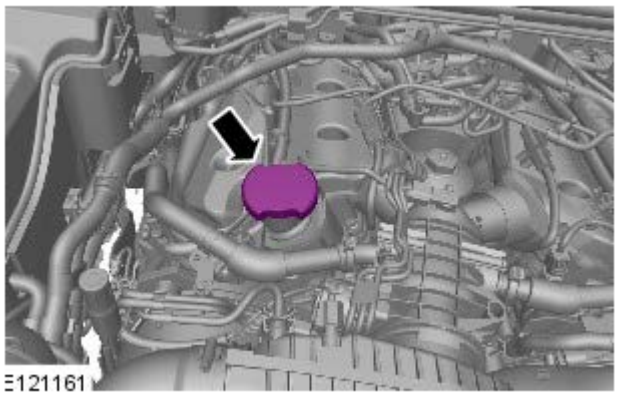
3.



E121162

4.

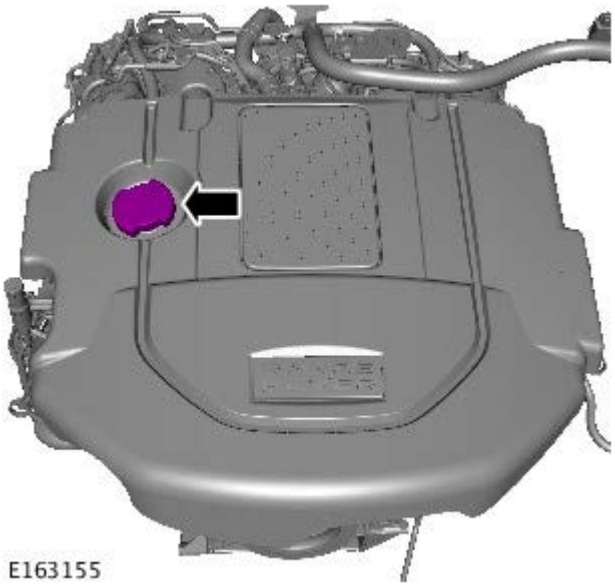
- Fill the engine with the recommended oil to the correct level.
- Clean any residual engine oil from the oil filler cap area.



E121161

5. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05 Interior Trim and Ornamentation, Removal and Installation).

6.



7. CAUTION: Make sure that the vehicle has been left for 5 minutes from filling with oil.
   - Start the engine and allow to run for 10 minutes, stop the engine.
   - Check for leaks.

8. CAUTIONS:

   Make sure that the selector lever is in the park (P) position.

   Make sure that the hood is open.
   - Set the ignition to the ON position.

9.
   - Press the left-hand OK button to access the Instrument Cluster (IC) Main Menu.



10.
   - Press the left-hand directional button and select

Service Menu.



11.

- Press the left-hand OK button.



12.

- Press the left-hand directional button and select the Oil Level display.



13.

- Press the left-hand OK button to access the Oil Level display.



14. CAUTION: Make sure that the hood is open.

- Press the speed control cancel button twice within 2 seconds while being on the oil level display.



E147181

15.

- The message center displays the actual oil level in service mode.
- Only after having started and run the engine for 10 minutes (as indicated in Step 7), 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.



E147272

16. Set the ignition to the OFF position.

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

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

18. Repeat step 8 to 14 to access the oil level display in service mode.

19. NOTE: The actual volume displayed on the bar graph will be written into the electronic control unit as a new value.

- Press and hold the speed control cancel button for more than 5 seconds.
- The message center display the current oil level.



NOTE: Close the hood.

20. Set the ignition to the OFF position.
21. Set the ignition to the ON position.
22. NOTE: The following steps are to check the current oil level in a customer mode.
    - Press the left-hand OK button to access the Instrument Cluster (IC) Main Menu.



23.
    - Press the left-hand directional button and select Service Menu.



24.

- Press the left-hand OK button.



25.

- Press the left-hand directional button and select the Oil Level display.



26.

- Press the left-hand OK button and follow the instructions.
- NOTE: If the message shows "Not available" wait for further 10 mins to allow the oil level to stabilize.

  Make sure that the average oil level value has now been updated.

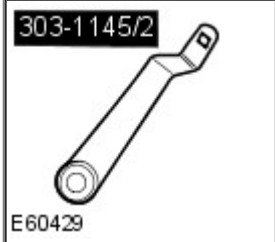
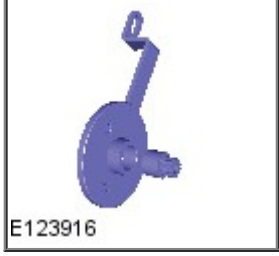


Published: 08-Aug-2012

Engine - TDV6 3.0L Diesel - Camshaft LH

Removal and Installation

Special Tool(s)

	303-1124 Holding Tool, Camshaft Front Pulley
	303-1145/2 Remover, Camshaft Rear Pulley Bolt
	JLR-303-1523 Remover/Installer, Camshaft Rear Pulley

Removal

1. Refer to: Specifications (414-00, Specifications).
2. Refer to: Rear End Accessory Drive (READ) (303-05A Accessory Drive - TDV6 3.0L Diesel, Removal and Installation).
3. Refer to: Timing Belt (303-01A Engine - TDV6 3.0L Diesel, Removal and Installation).
4. Install the special tool.

   Special Tool(s): JLR-303-1523



5. Install the special tool.

   Special Tool(s): JLR-303-1523



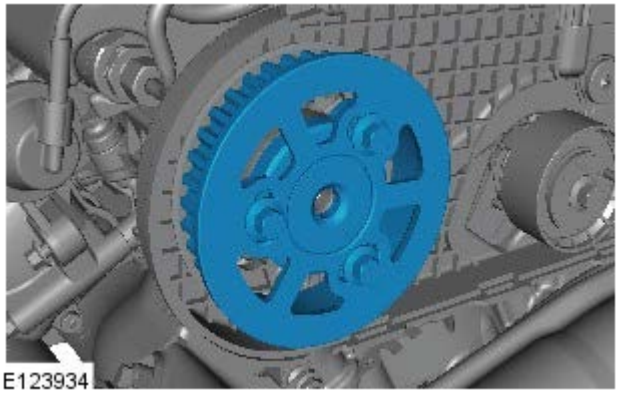
6. Using the special tool, remove the rear camshaft pulley retaining bolt.

   Special Tool(s): 303-1145/2

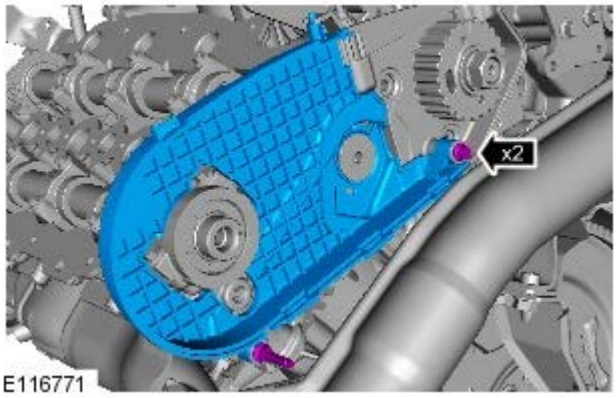


7. Remove the special tools.

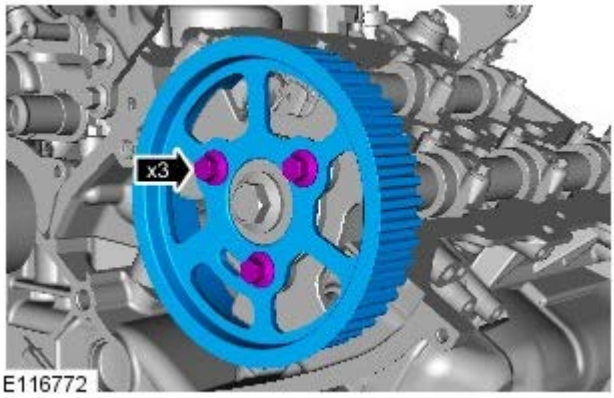
8.



9.

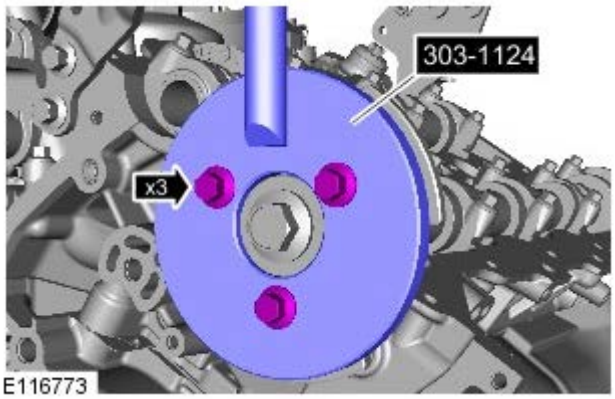


10.

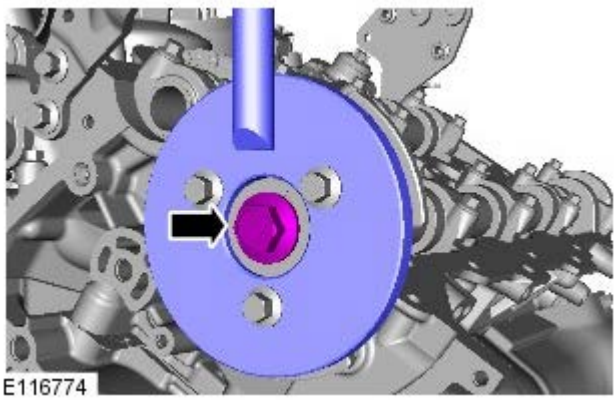


11. Install the special tool.

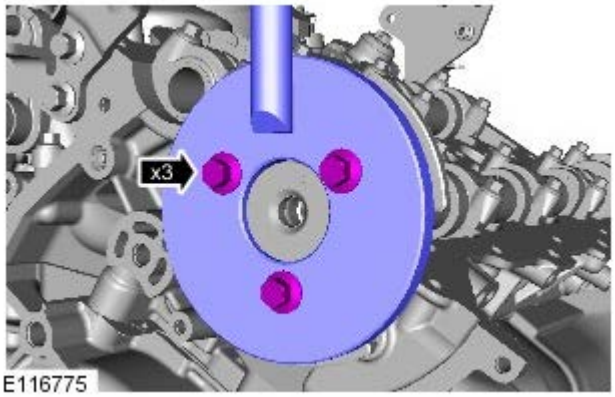
Special Tool(s): 303-1124



12.

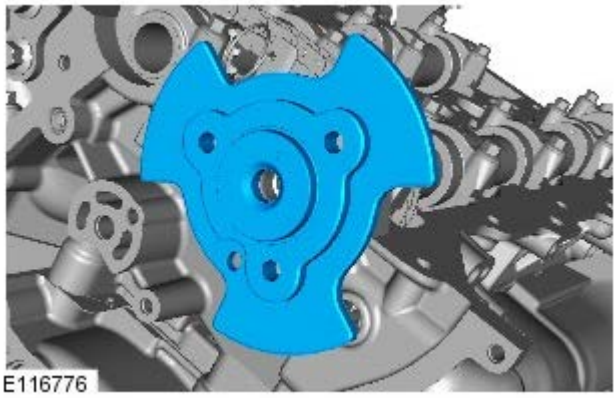


13. Remove the special tool.



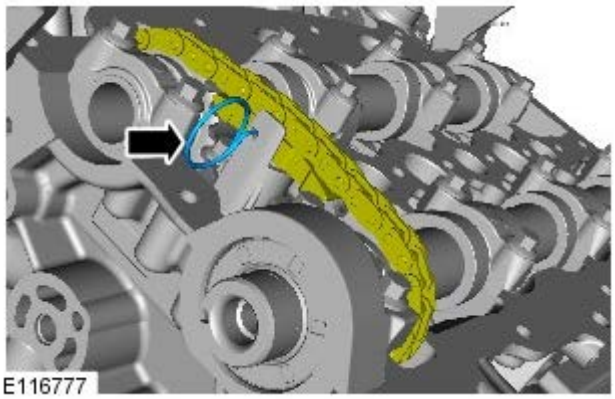
E116775

14.

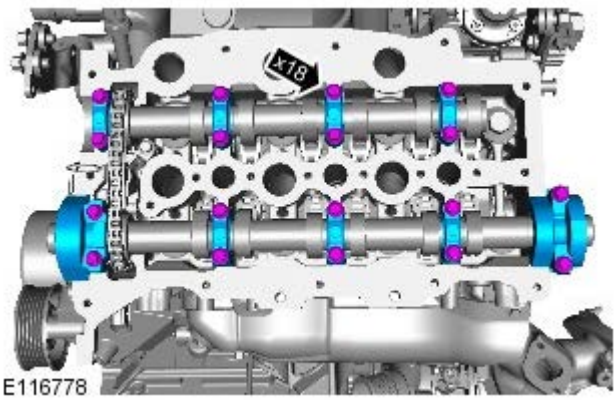

E116776

15.

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

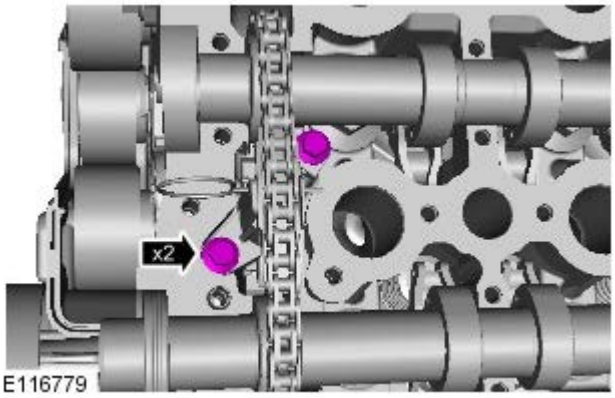

E116777

16. Remove the camshaft bearing caps evenly.

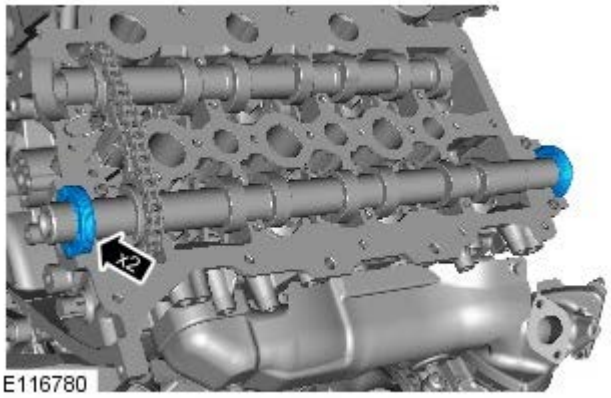


E116778

17.



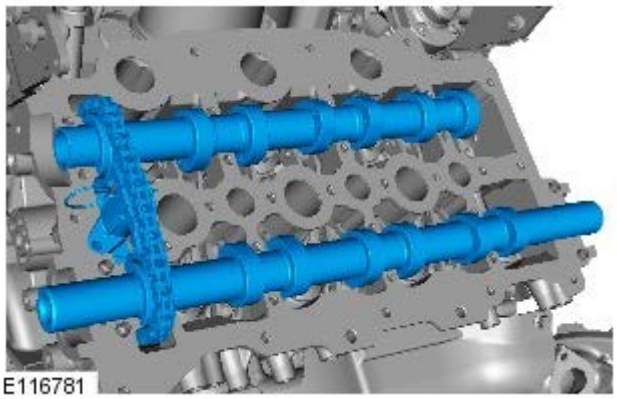
E116779



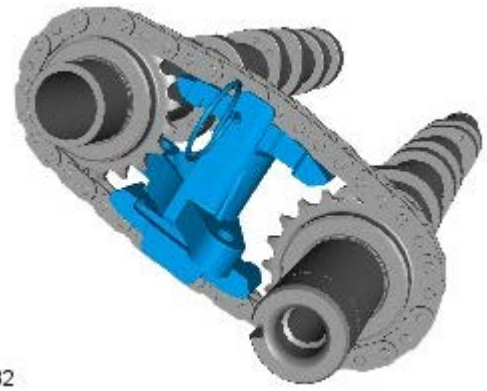
E116780

18. CAUTION: Discard the seals.

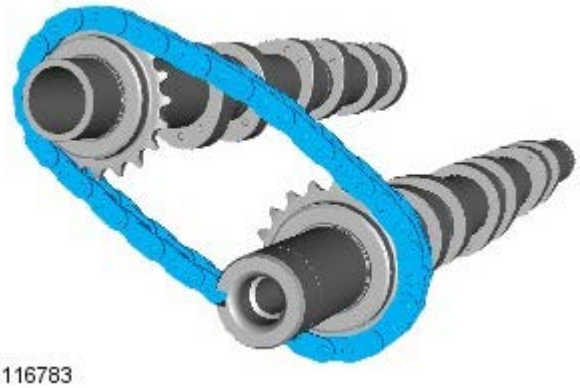
19.


E116781

20.


E116782

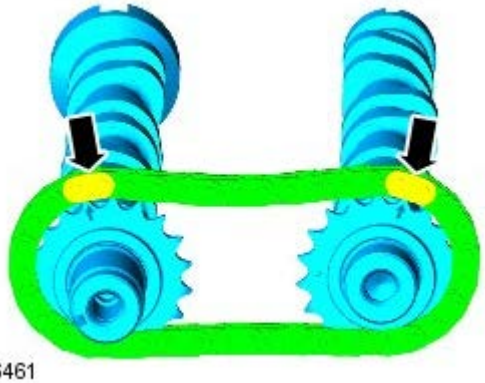
21. Remove the secondary timing chain from the camshafts.



E116783

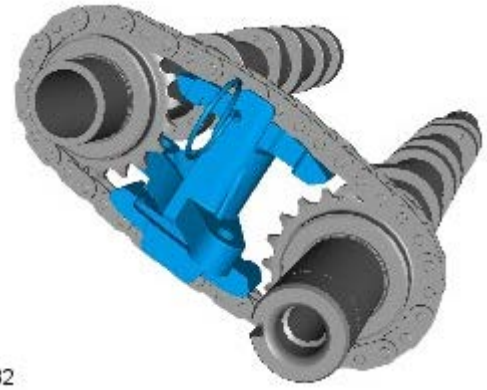
Installation

1. Install the secondary timing chain onto the camshafts.

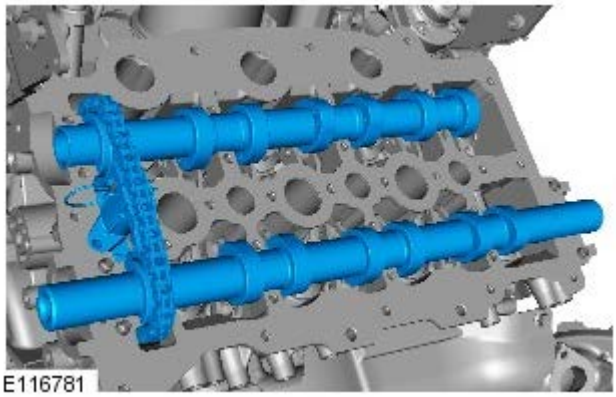


E86461

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.

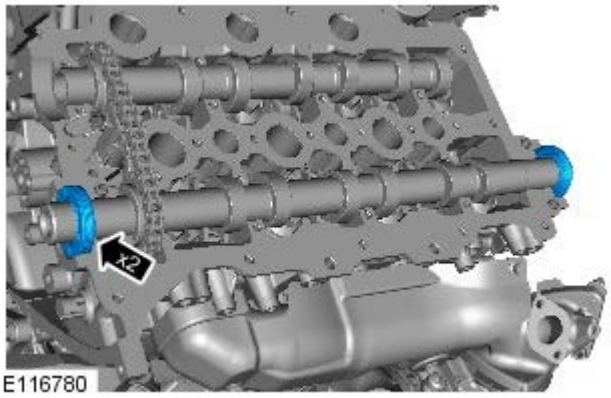
   NOTES:

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

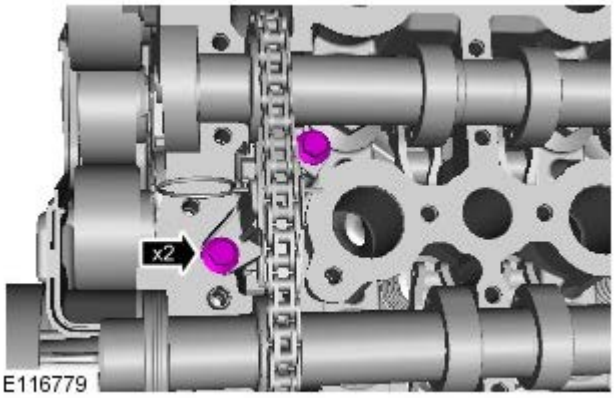
   Use hypoid oil to lubricate the camshafts.

   Install the camshafts.

4. NOTE: Install new seals.

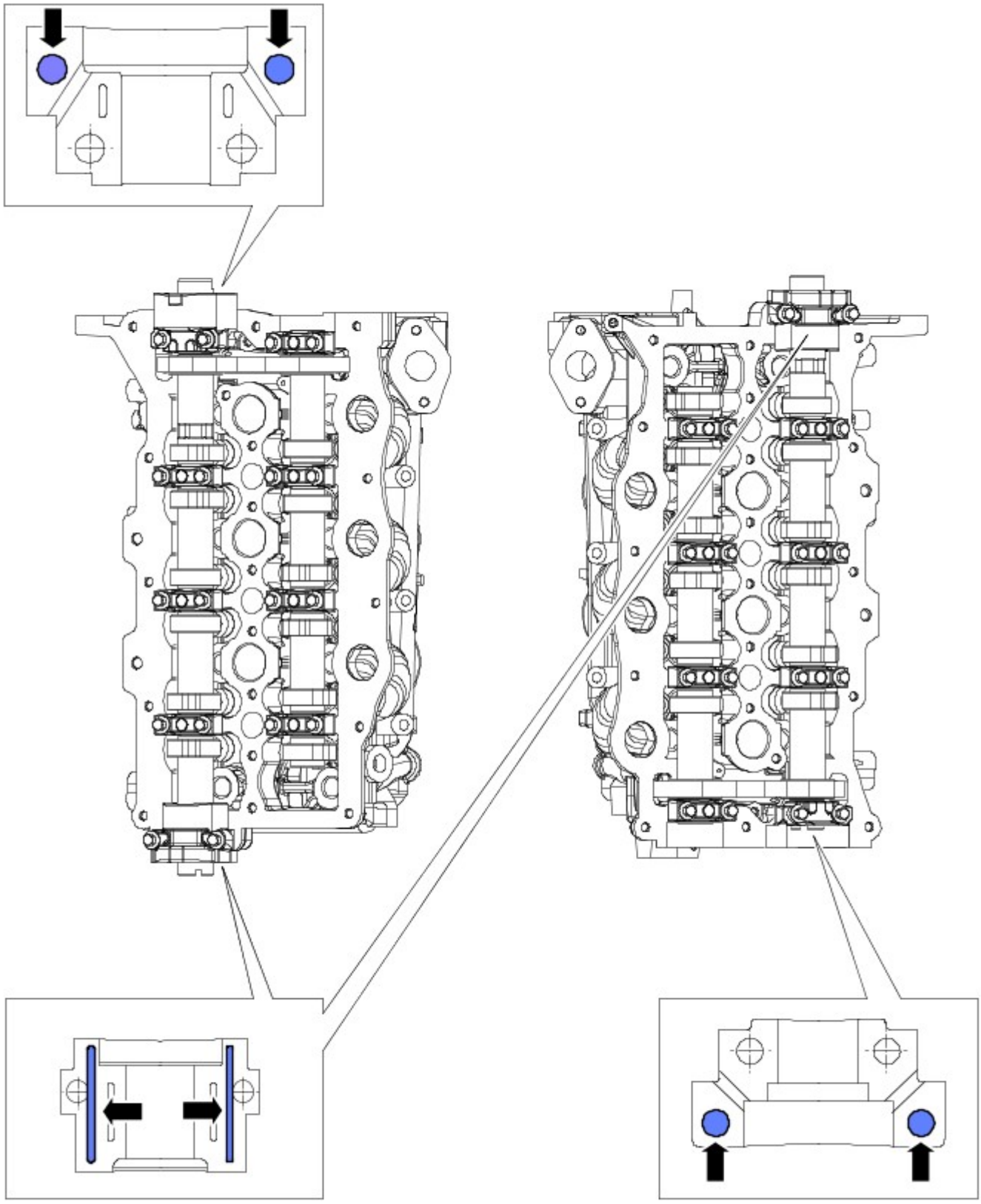


5. *Torque:* 10 Nm



6.

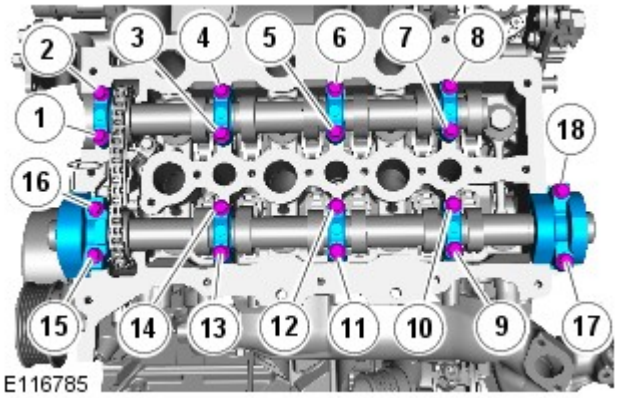
- Apply Loctite 518 sealant to the exhaust camshaft seal bearing caps.
- Apply Loctite 518 sealant, 2 mm wide, to the LH rear and RH front camshaft bearing caps.
- Apply Loctite 518 sealant, 7 mm diameter, to the LH front and RH rear camshaft bearing caps.



E116784

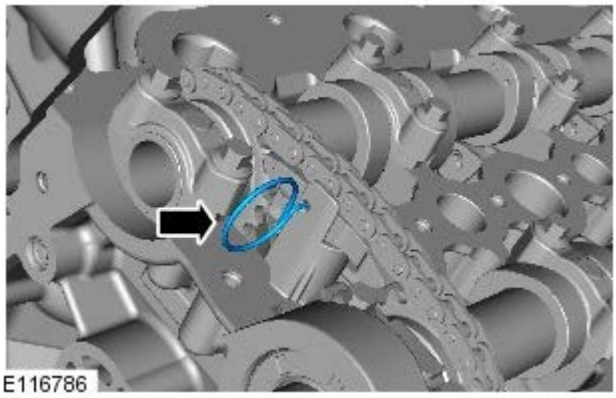
7. NOTE: Tighten the bolts in the indicated sequence.

- 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.

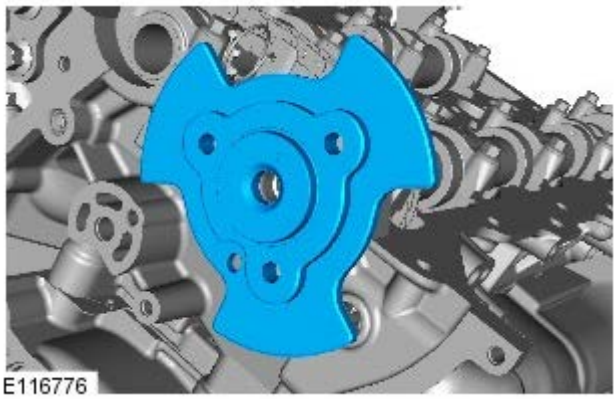


E116785

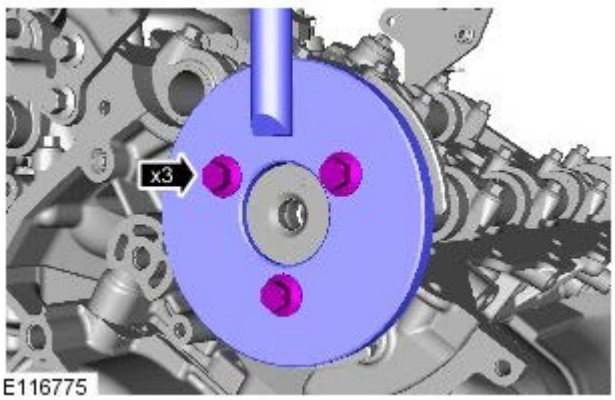
8. Remove the secondary timing chain tensioner retaining pin.


E116786

9.

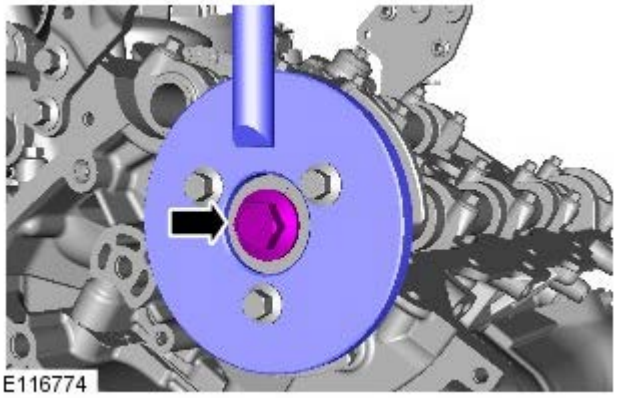

E116776

10. Install the special tool.

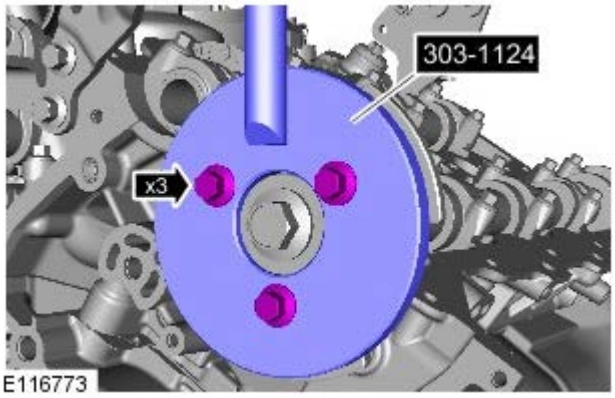


E116775

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

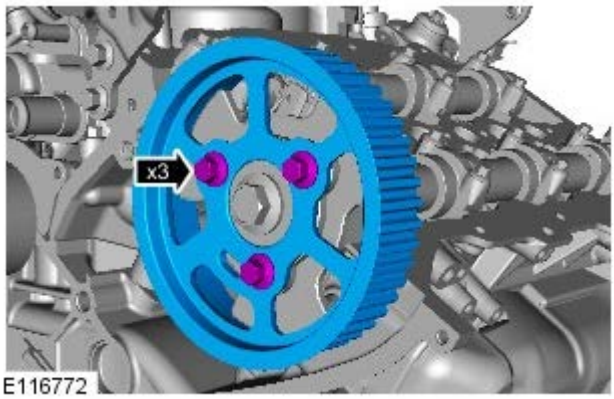

E116774

12. Remove the special tool.



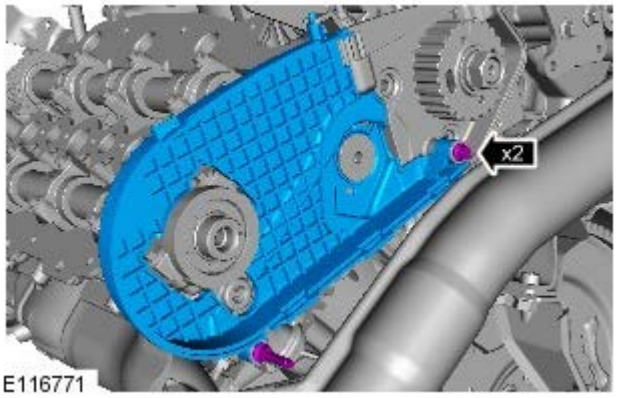
E116773

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



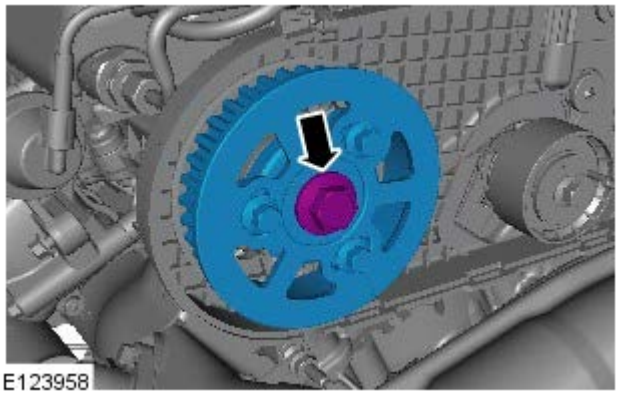
E116772

14. *Torque:* 10 Nm



E116771

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


E123958

16. Install the special tool.

    Special Tool(s): JLR-303-1523



E123893

17. Install the special tool.

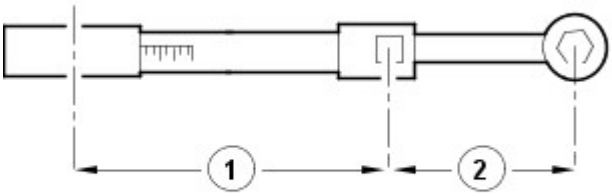
    Special Tool(s): JLR-303-1523



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

20. Remove the special tools.

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

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

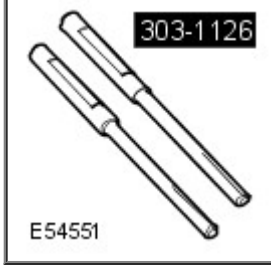
23. Refer to: Specifications (414-00, Specifications).

Published: 13-Dec-2013

Engine - TDV6 3.0L Diesel - Camshaft RH

Removal and Installation

Special Tool(s)

	303-1117 Timing Peg, Automatic Transmission
	303-1124 Holding Tool, Camshaft Front Pulley
	303-1126 Timing Peg, Camshaft Pulley

Removal

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.

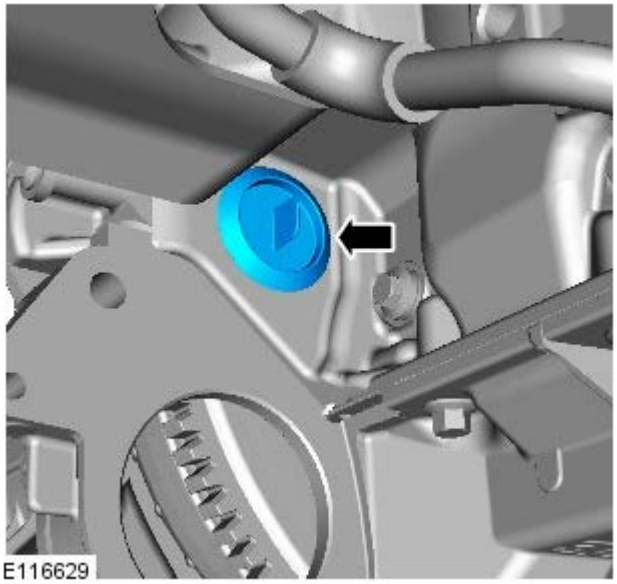
   Raise and support the vehicle.

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

4. Refer to: Brake Vacuum Pump - TDV6 3.0L Diesel (206-07, Removal and Installation).

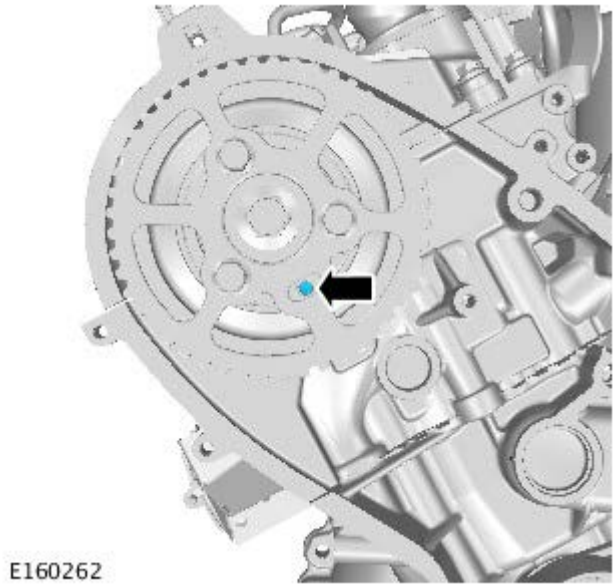
5. Refer to: Valve Cover RH (303-01A Engine - TDV6 3.0L Diesel, Removal and Installation).

6.



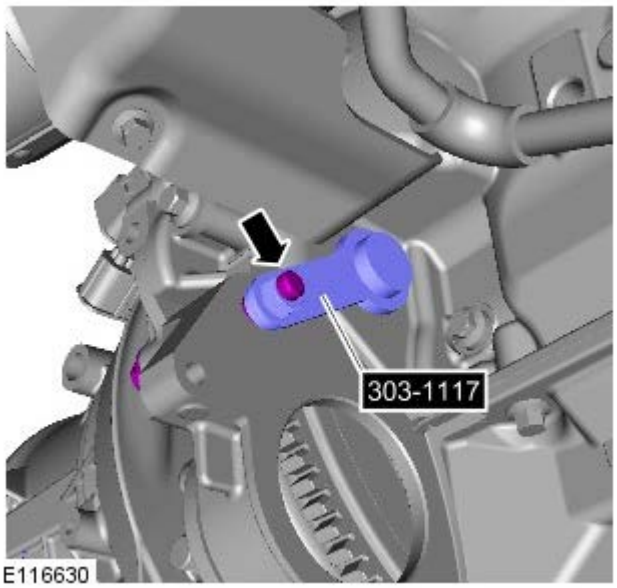
7. Rotate the crankshaft clockwise to align the crankshaft alignment hole in the flywheel or flexplate with the block aperture.

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

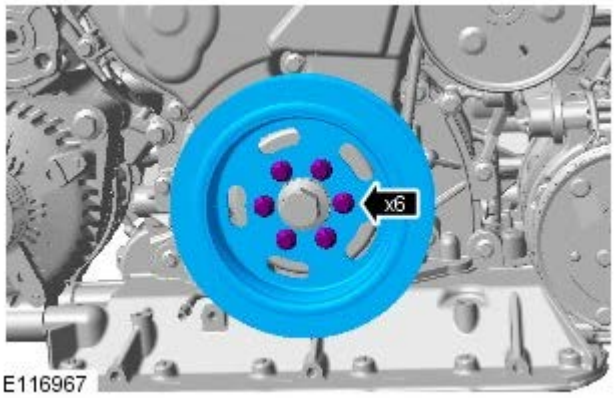


9. Install the special tool.

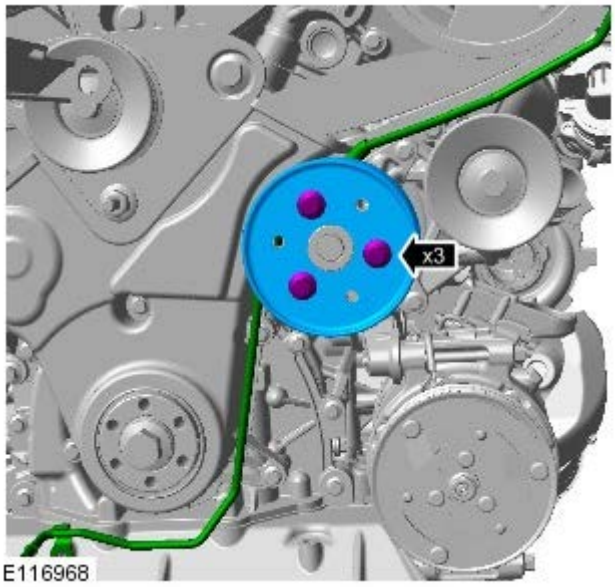
   Special Tool(s): 303-1117



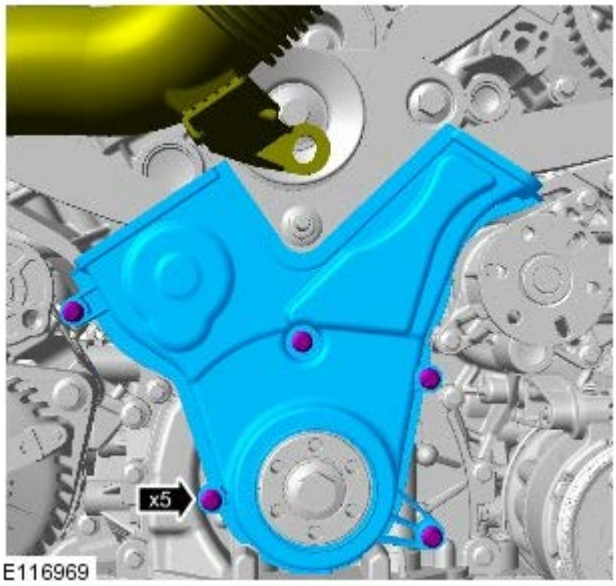
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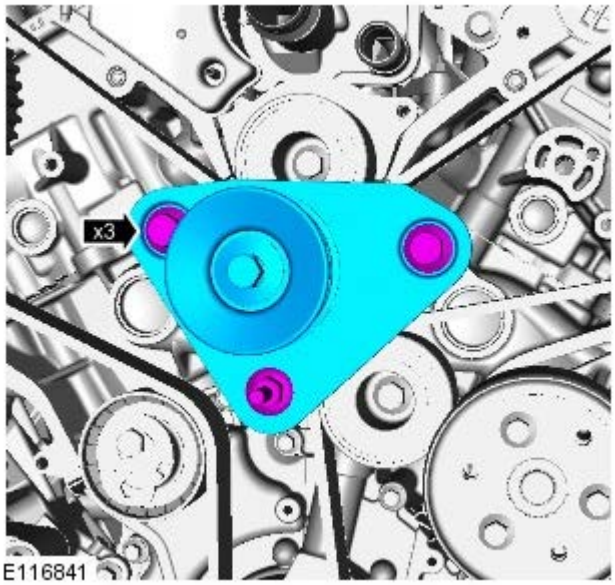
11. CAUTION: Discard the bolts.



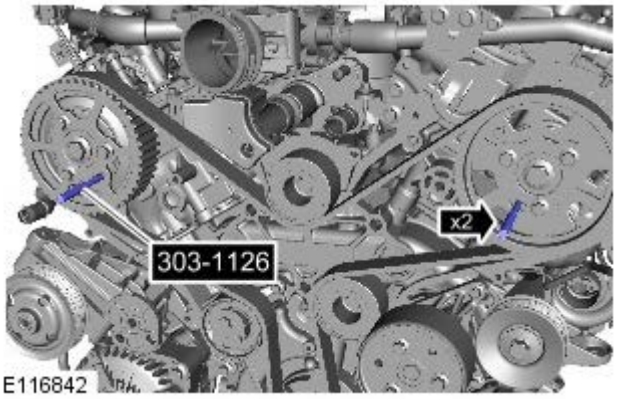
12. NOTE: Discard the gasket.



13.

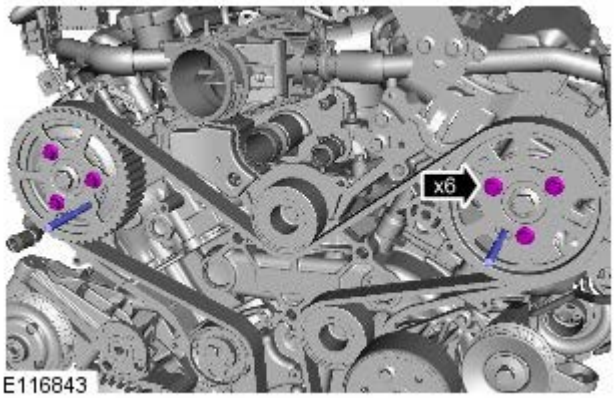


14. *Special Tool(s):* 303-1126



15. 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.

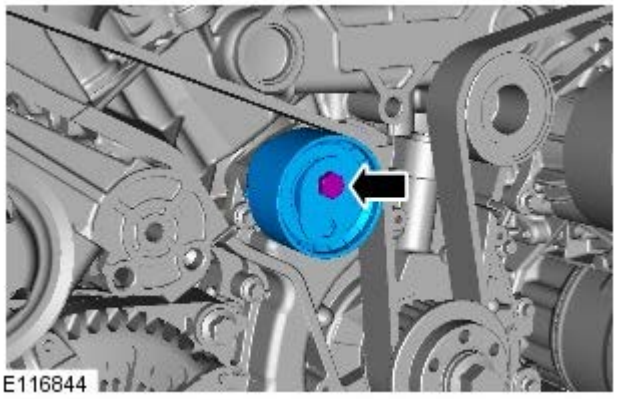
NOTE: Do not loosen the bolts more than 2 turns.



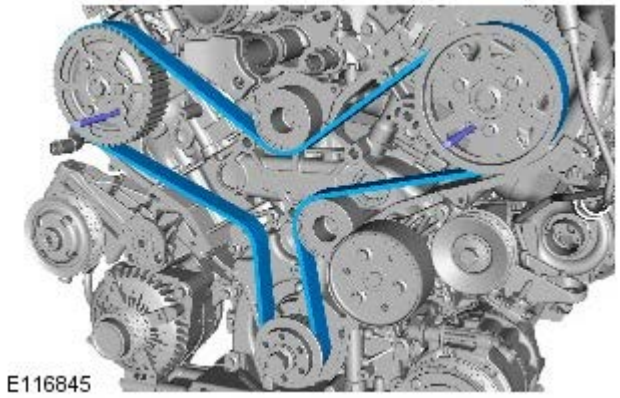
16. CAUTIONS:

Discard the component.

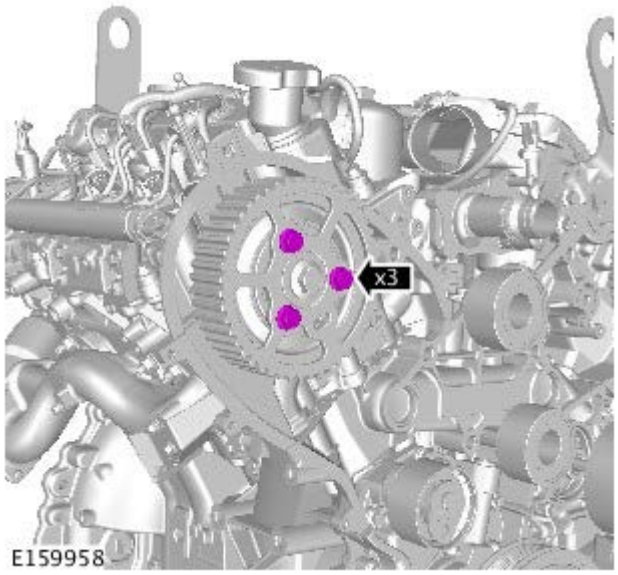
Discard the bolt.



17. CAUTION: Discard the component.

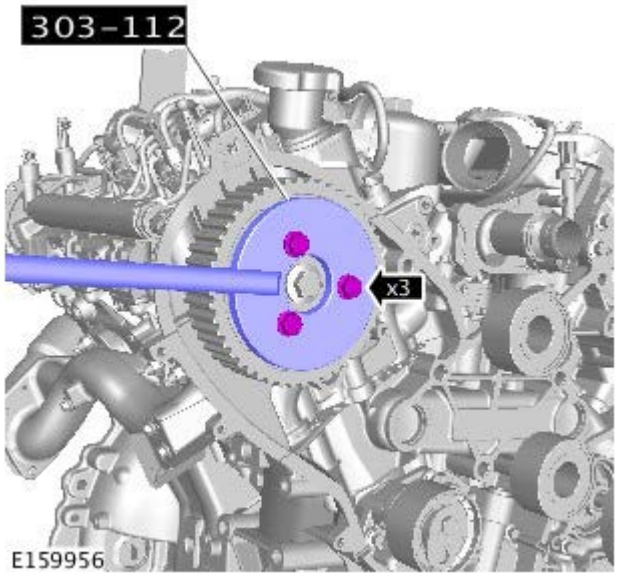


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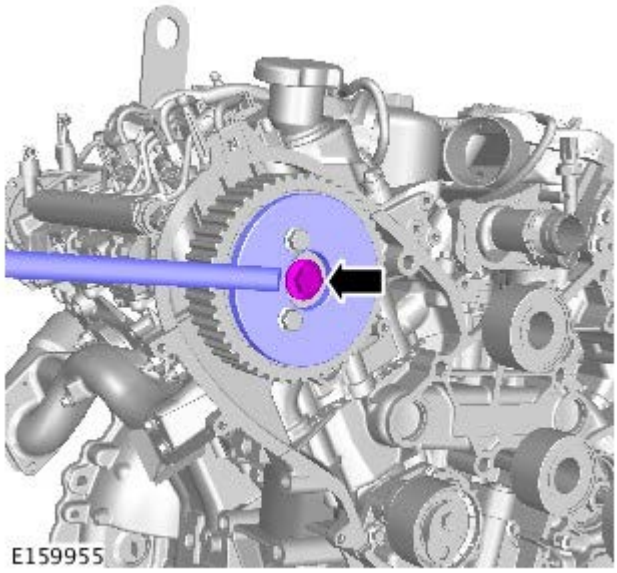


19. Install the special tool.

Special Tool(s): 303-1124

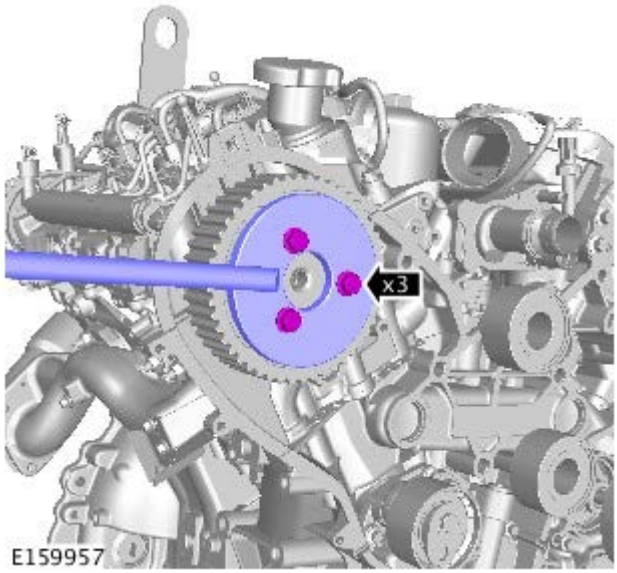


20.

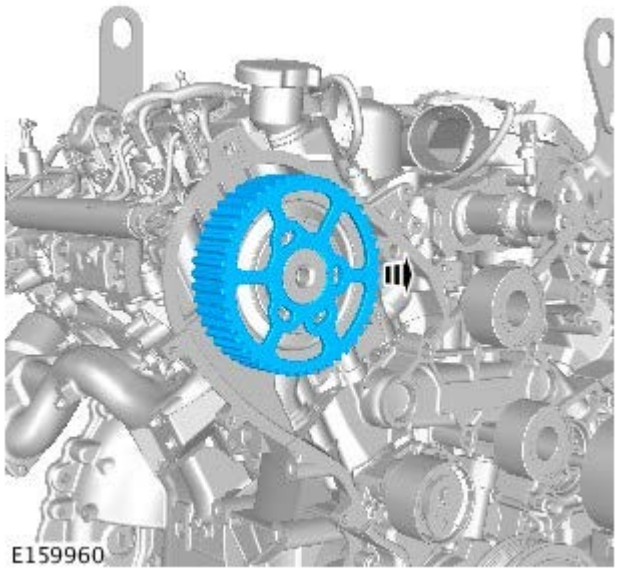


21. Remove the special tool.

    Special Tool(s): 303-1124

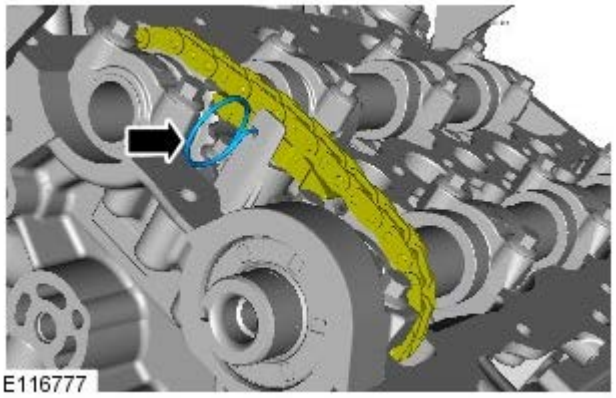


22.

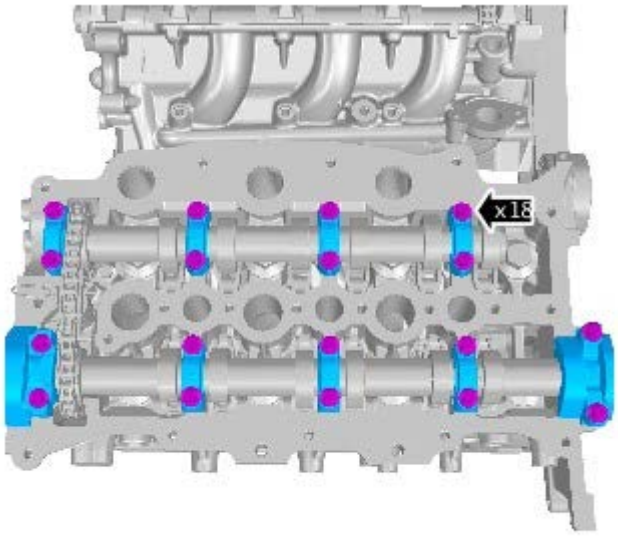


23.

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

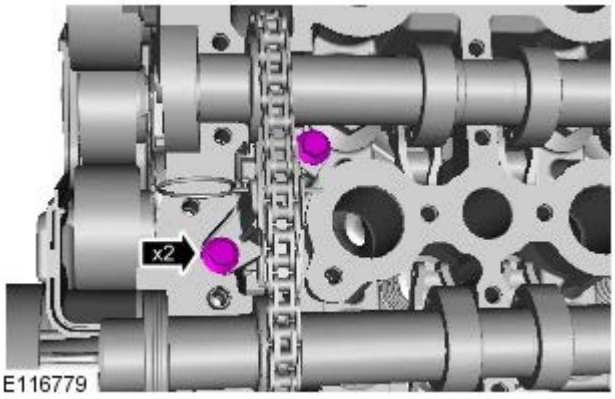

E116777

24. Remove the camshaft bearing caps evenly.



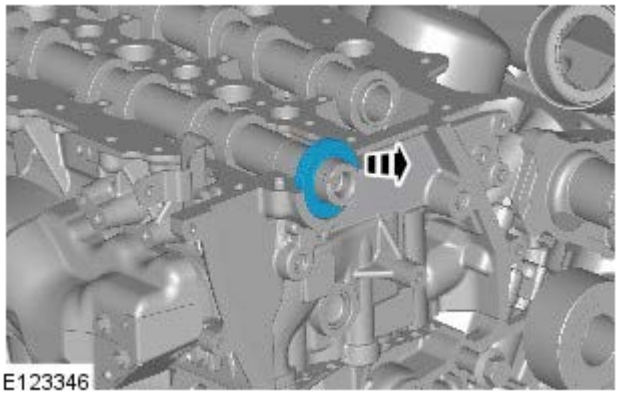
E159959

25.

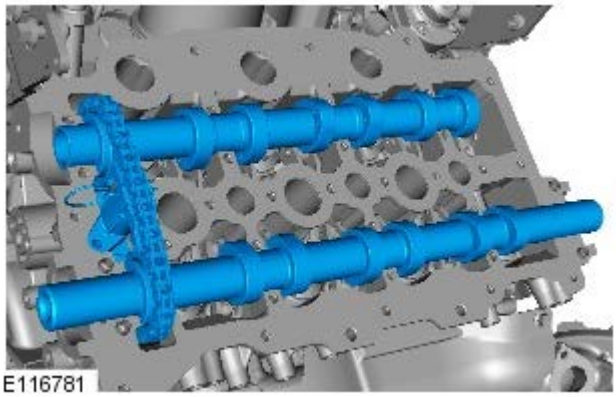


E116779

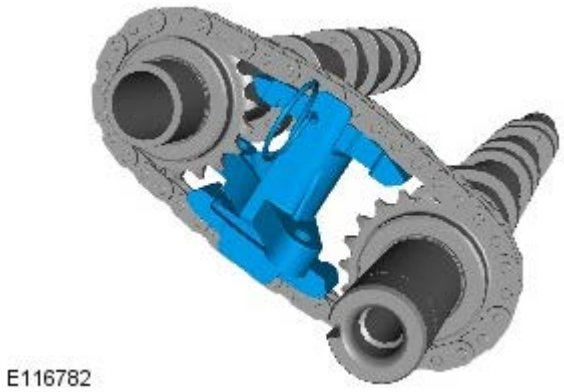
26. CAUTION: Discard the seal.


E123346

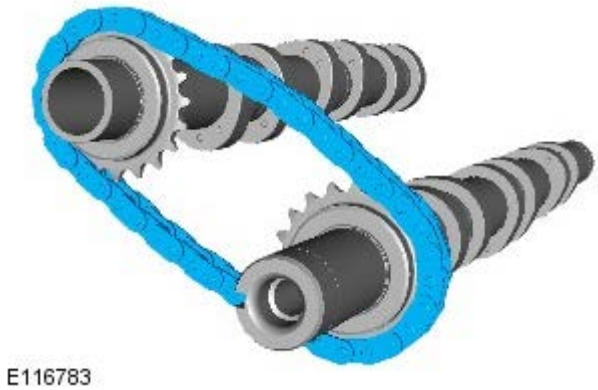
27. Remove the RH bank camshafts and secondary timing chain tensioner assembly.


E116781

28. Remove the secondary timing chain tensioner assembly.

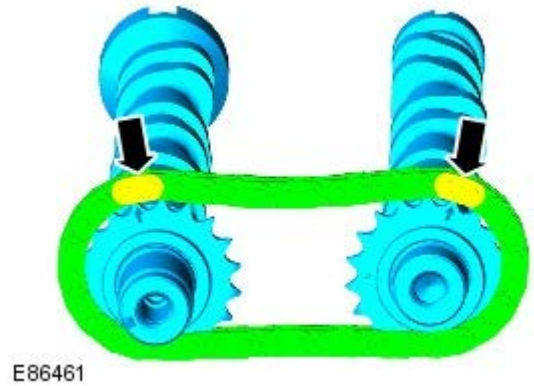

E116782

29. Remove the secondary timing chain from the camshafts.

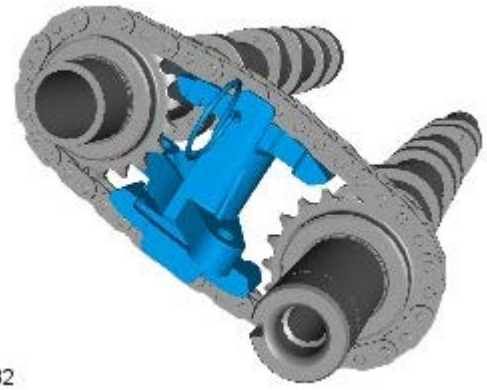

E116783

Installation

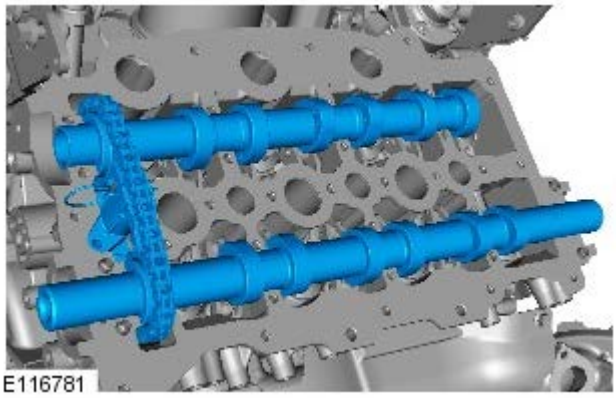
1. Install the secondary timing chain onto the camshafts.


E86461

2. Install the secondary timing chain tensioner assembly.



E116782



E116781

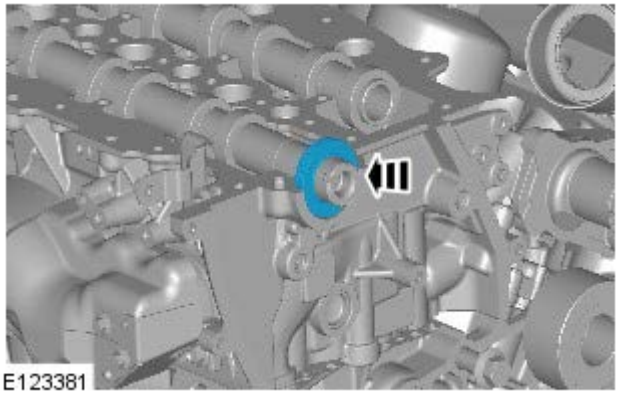
3. CAUTION: Make sure that the dots on the camshafts are aligned at the 12 o'clock position. Failure to follow this instruction may result in damage to the engine.

   NOTES:

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

   Use hypoid oil to lubricate the camshafts.

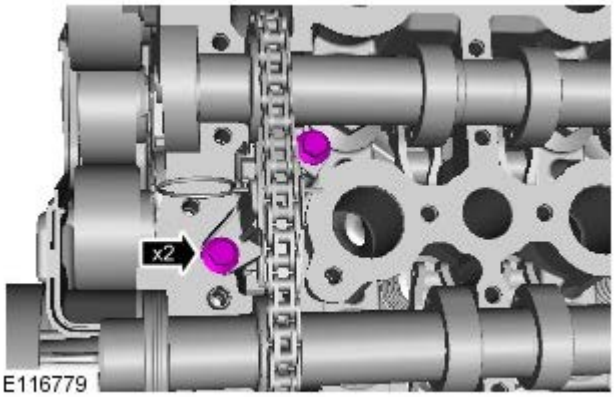
   Install the camshafts.



E123381

4. NOTE: Install a new seal.

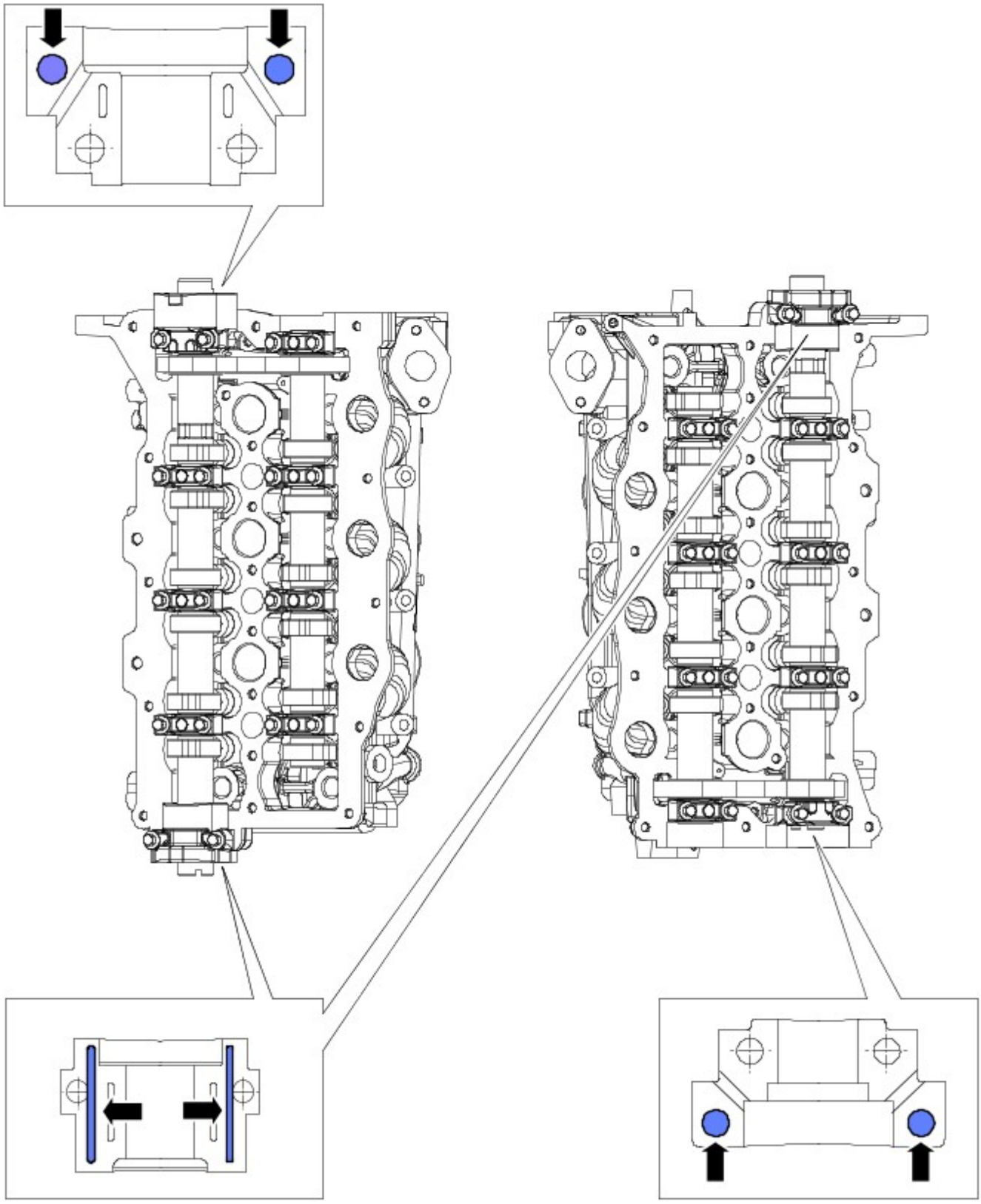
5. *Torque:* 10 Nm



E116779

6.

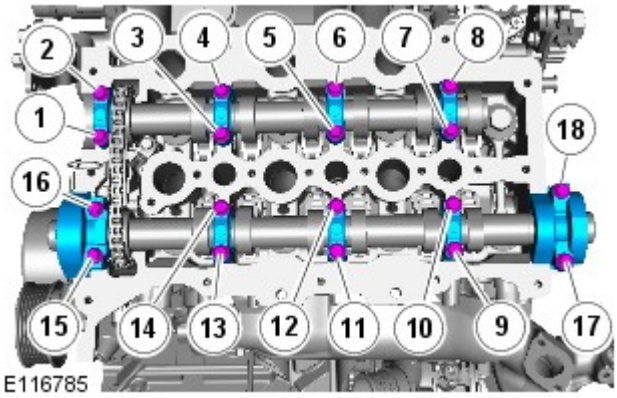
- Apply Loctite 518 sealant to the exhaust camshaft seal bearing caps.
- Apply Loctite 518 sealant, 2 mm wide, to the LH rear and RH front camshaft bearing caps.
- Apply Loctite 518 sealant, 7 mm diameter, to the LH front and RH rear camshaft bearing caps.



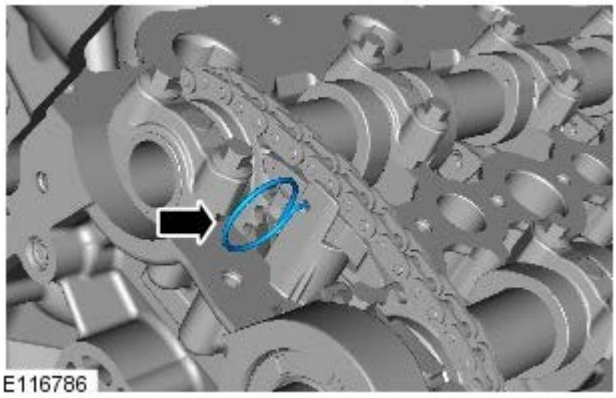
E116784

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

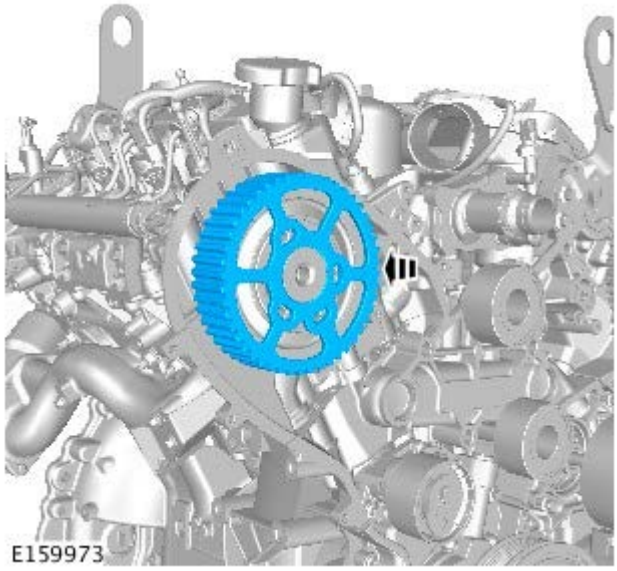
- Install the camshaft bearing caps in their original positions.
- Stage 1: Bolts 1 to 14, 1 Nm.
- Stage 2: Bolts 1 to 14, 5 Nm.
- Stage 3: Bolts 1 to 14, 10 Nm.
- Stage 4: Bolts 15 to 18, 1 Nm.
- Stage 5: Bolts 15 to 18, 5 Nm.
- Stage 6: Bolts 15 to 18, 10 Nm.



8. Remove the secondary timing chain tensioner retaining pin.

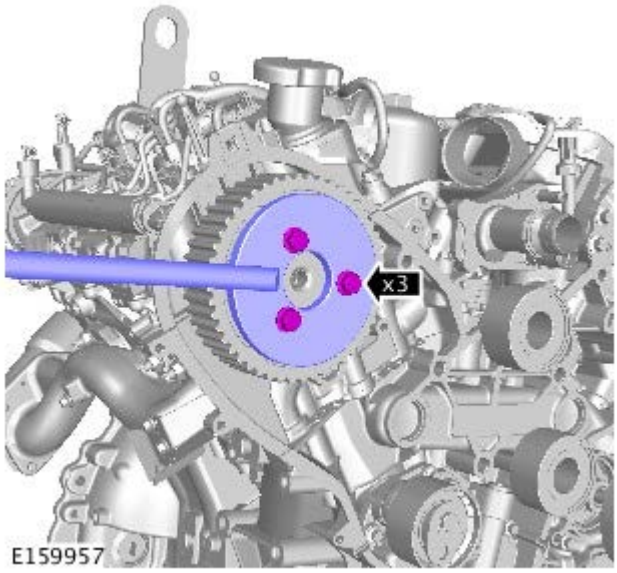


9.

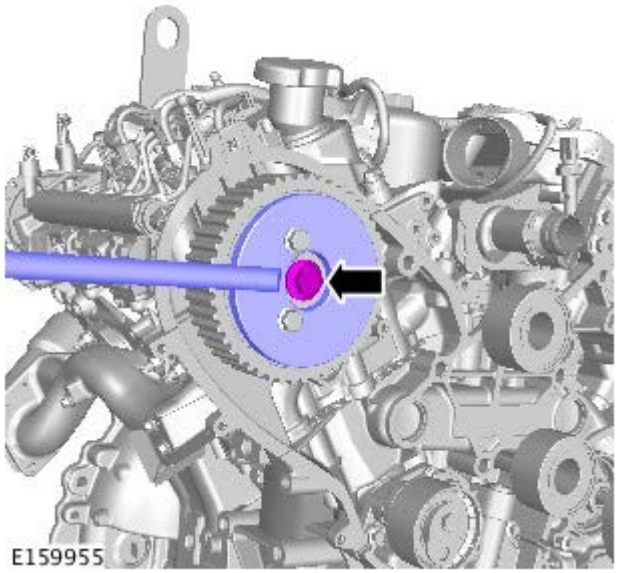


10. Install the special tool.

Special Tool(s): 303-1124

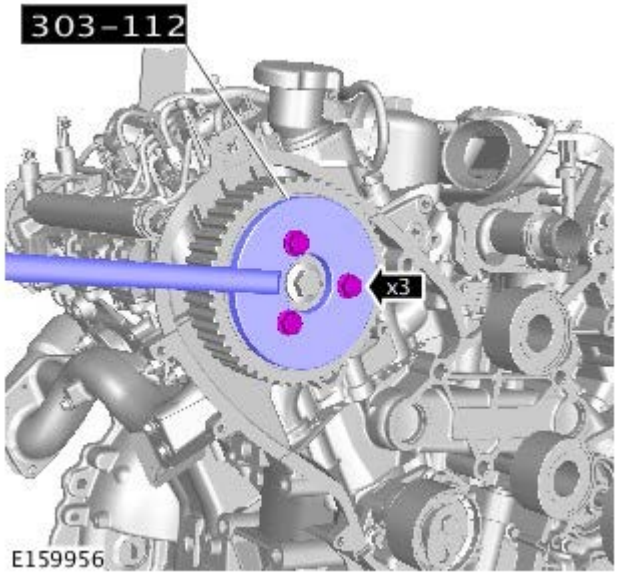


11. *Torque:*
    Stage 1:80 Nm
    Stage 2:80°

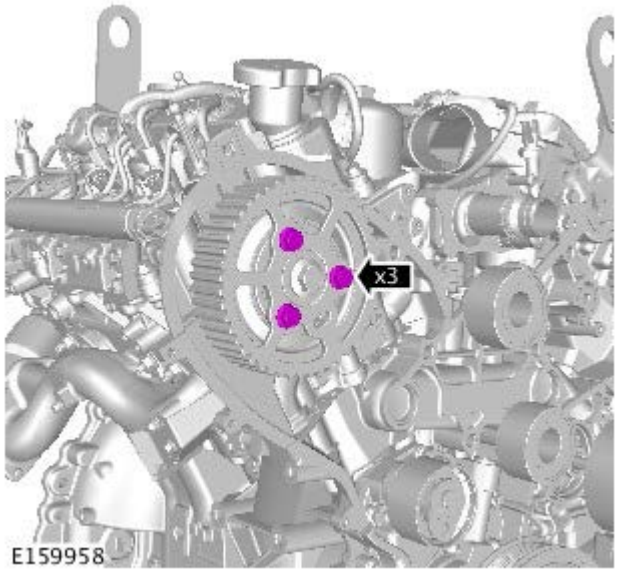


12. Remove the special tool.

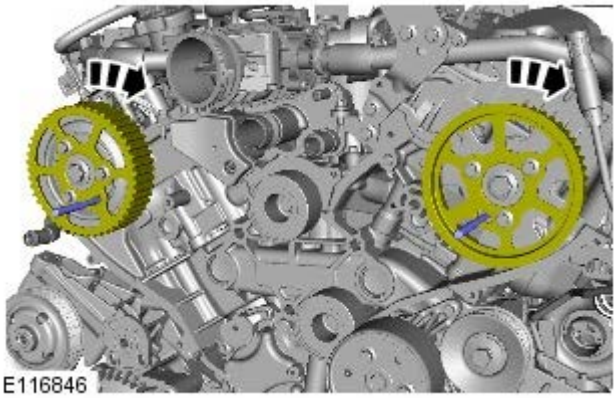
    Special Tool(s): 303-1124



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



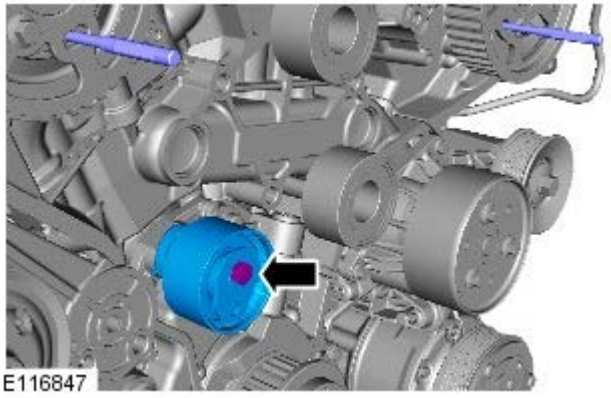
14.



15. CAUTIONS:

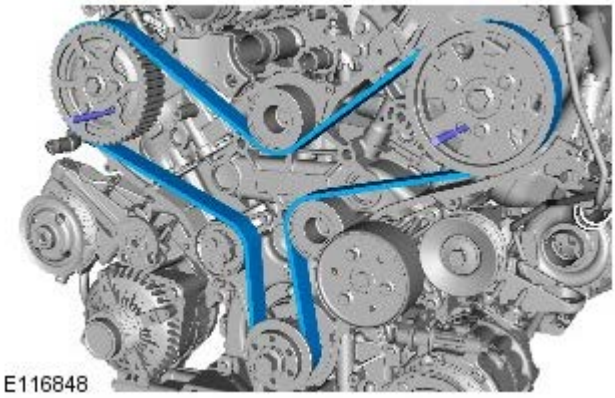
Make sure that a new bolt is installed.

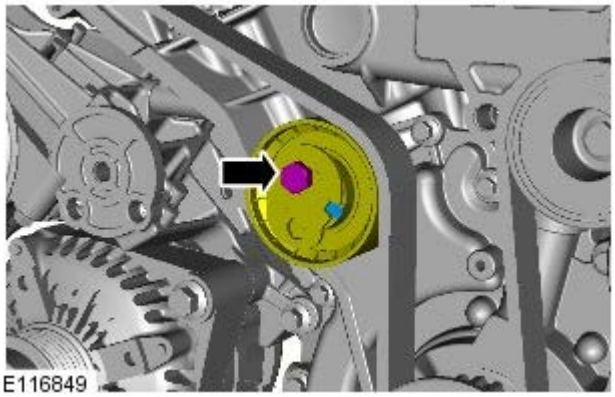
Only tighten the bolts finger-tight at this stage.



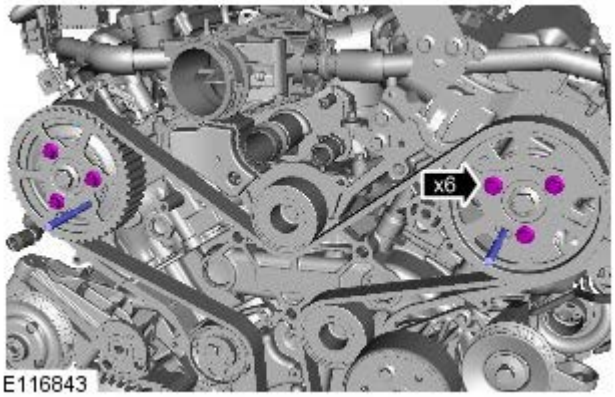
16. CAUTION: Make sure the camshaft pulleys remain in the clockwise position.

- 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.

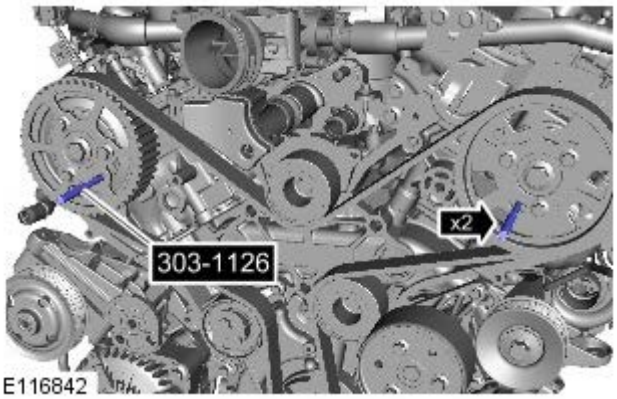




17. CAUTION: Make sure the timing belt tensioner window is aligned with the groove as illustrated.
    - Tension the timing belt.
    - Rotate the tensioner assembly counter-clockwise.
    - *Torque:* 26 Nm

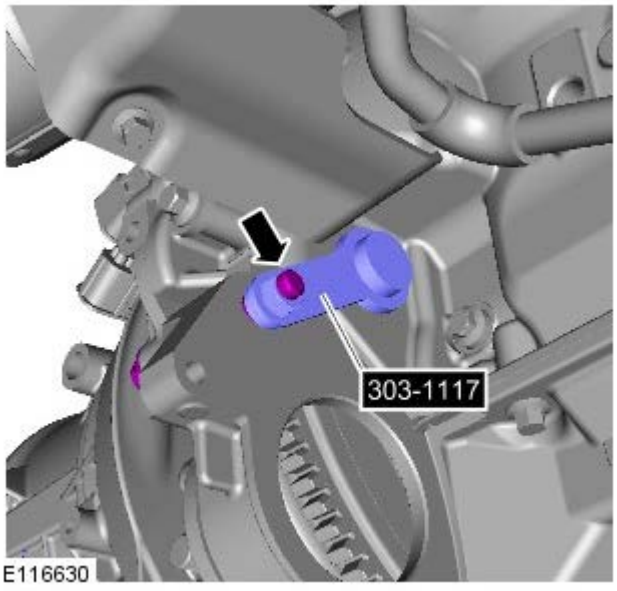


18. CAUTION: Do not use the special tools to lock the camshafts. Failure to follow this instruction may result in damage to the engine or the special tools.
    - Using a suitable tool, counterhold the camshaft pulley center retaining bolts.
    - *Torque:* 23 Nm



19. Remove the special tool.

    Special Tool(s): 303-1126



20. Remove the special tool.

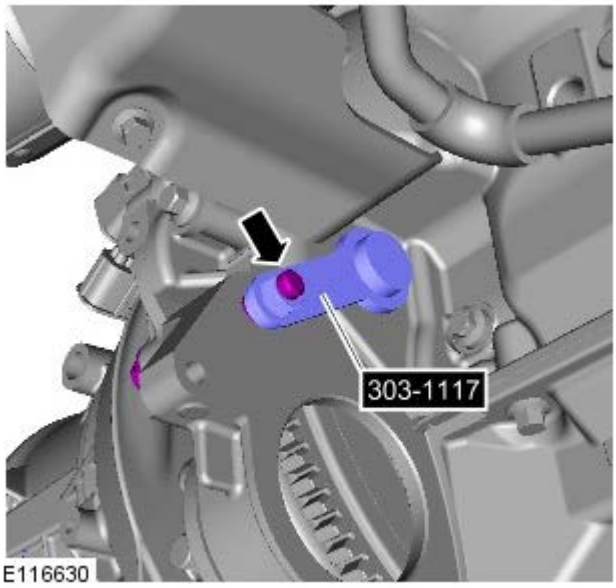
    Special Tool(s): 303-1117

21. CAUTION: Only rotate the crankshaft clockwise.

Rotate the engine two complete turns clockwise.

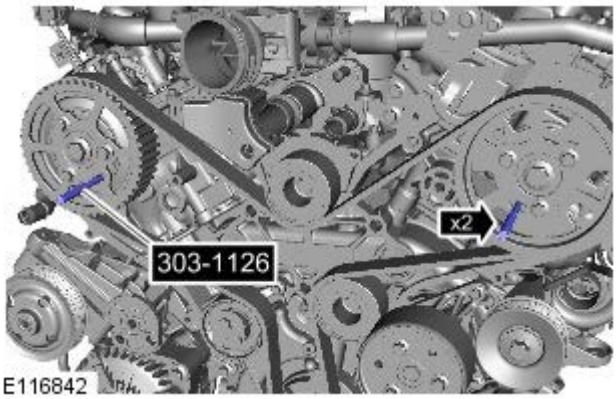
22. Install with the special tool.

    Special Tool(s): 303-1117

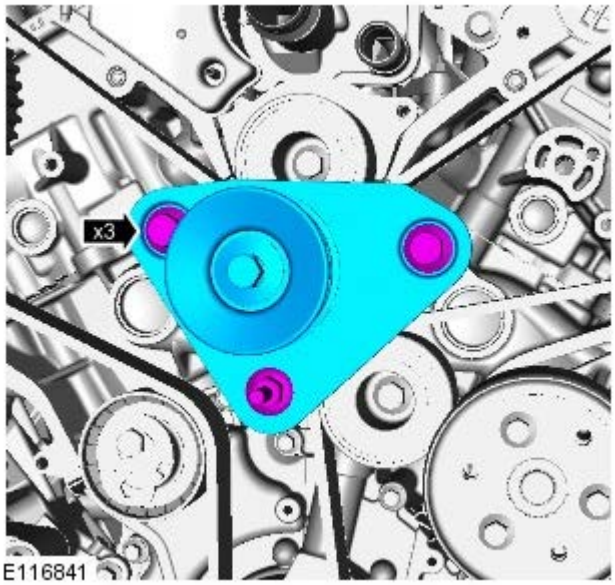


23.
- Install the special tools to the exhaust camshaft pulleys.

  Special Tool(s): 303-1126
- If the special tool does not fit correctly, repeat the timing belt installation procedure.
- Remove the special tools from the camshaft pulleys.

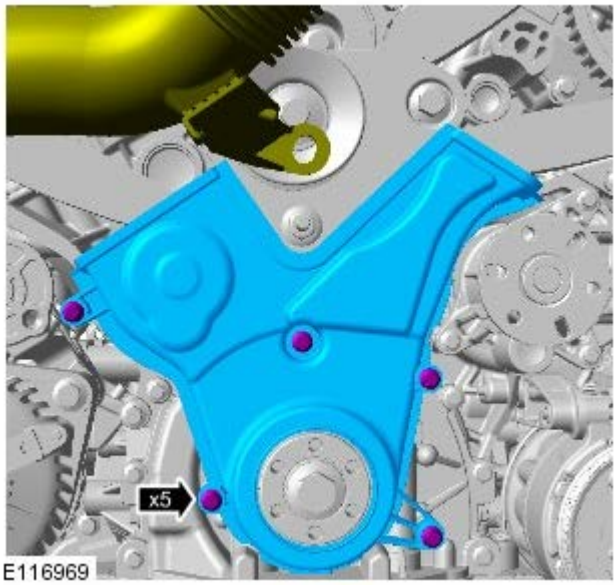


24. *Torque:* 80 Nm



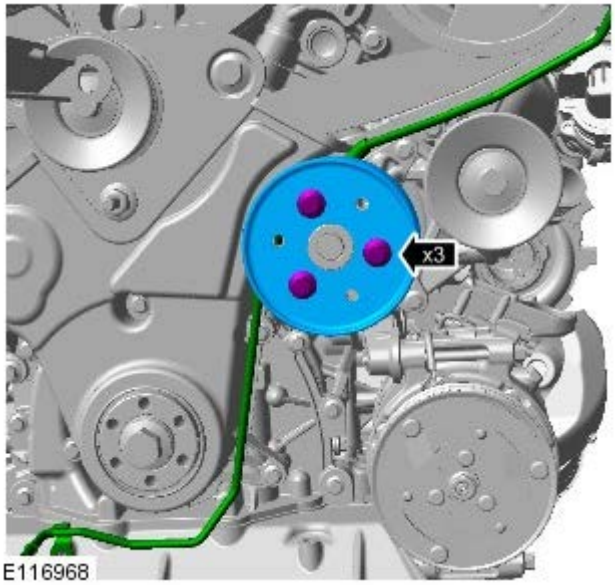
25. NOTE: Install a new gasket.

    Torque: 10 Nm

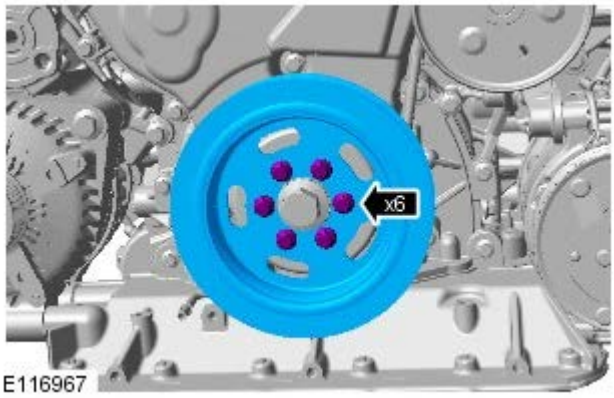


26. CAUTION: Make sure that new bolts are installed.

Torque: 24 Nm

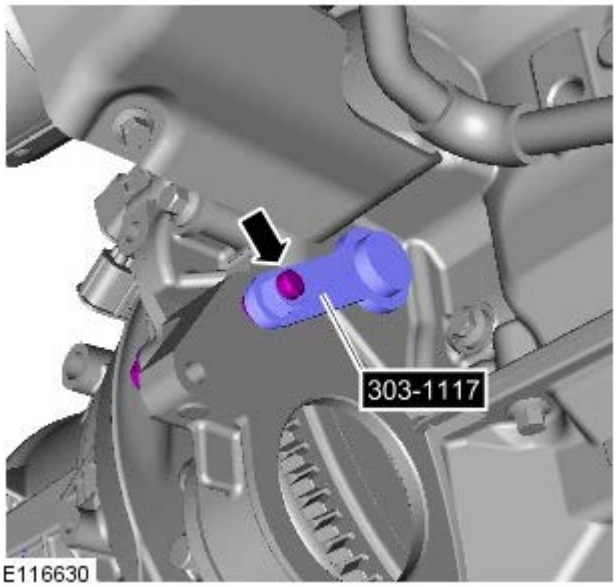


27. *Torque:* 25 Nm

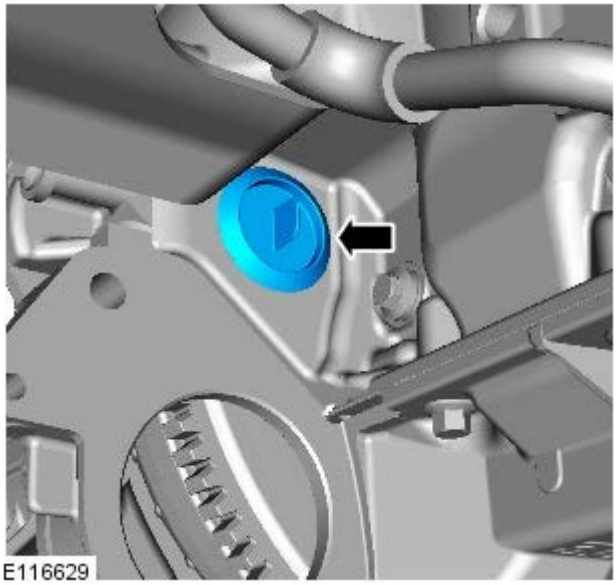


28. Remove the special tool.

Special Tool(s): 303-1117



29.



30. Refer to: Valve Cover RH (303-01A Engine - TDV6 3.0L Diesel, Removal and Installation).

31. Refer to: Brake Vacuum Pump - TDV6 3.0L Diesel (206-07, Removal and Installation).

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

33. Disconnect the battery ground cable.

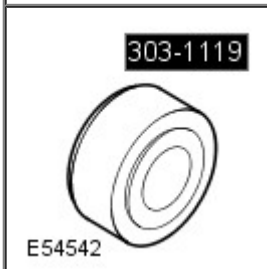
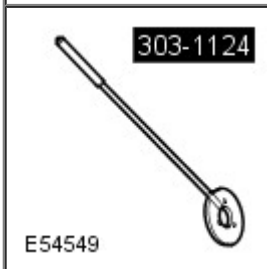
    Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 08-Aug-2012

Engine - TDV6 3.0L Diesel - Camshaft Front Seal

Removal and Installation

Special Tool(s)

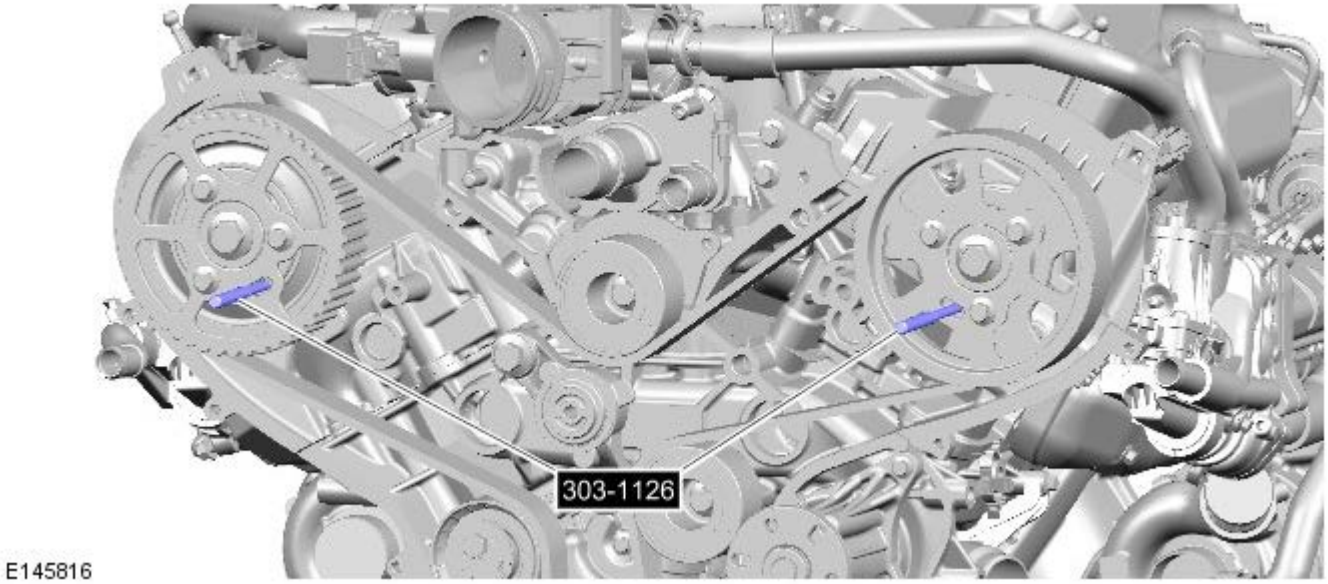
	303-1118 Remover, Camshaft Seal
	303-1119 Installer, Camshaft Seal
	303-1124 Holding Tool, Camshaft Front Pulley
	303-1126 Timing Peg, Camshaft Pulley

Removal

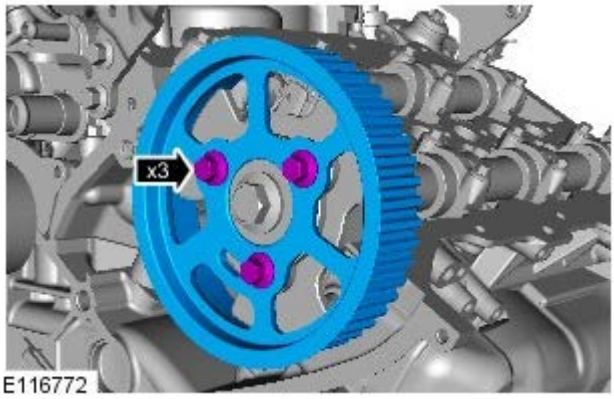
NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. Refer to: Specifications (414-00, Specifications).
2. Refer to: Timing Belt (303-01A Engine - TDV6 3.0L Diesel, 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.

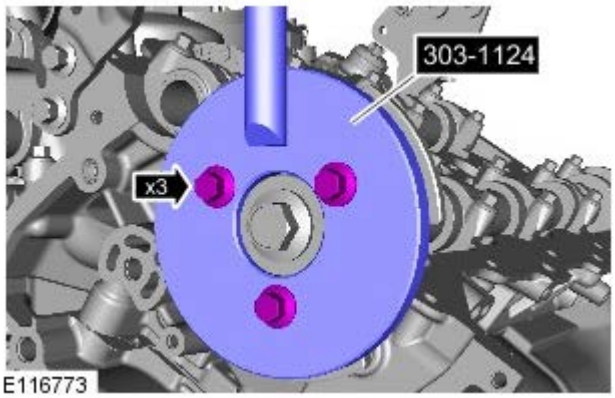
   Special Tool(s): 303-1126



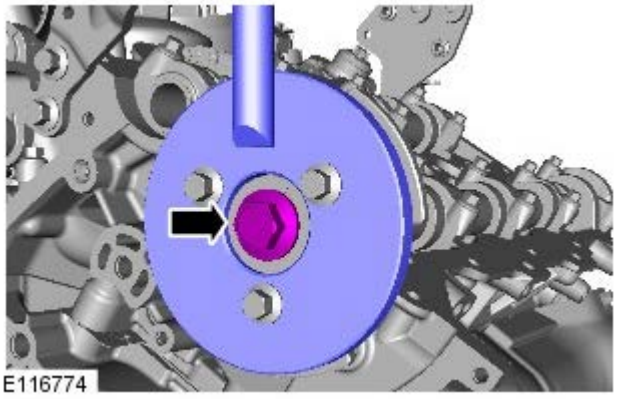
4.



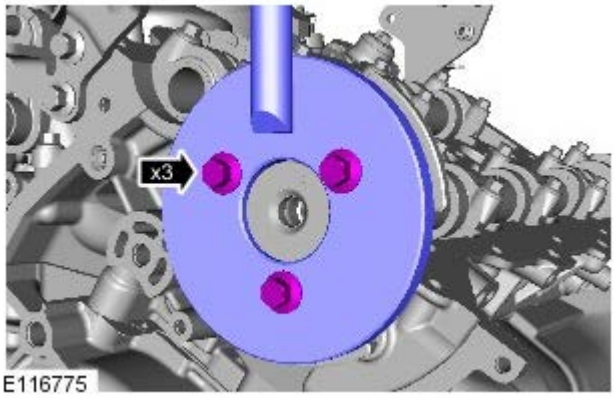
5. *Special Tool(s):* 303-1124



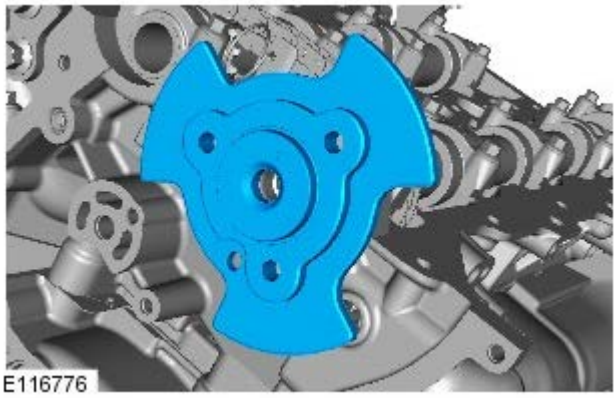
6.



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

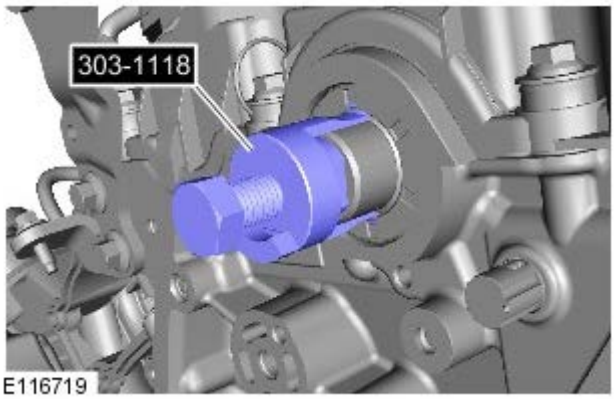


8.

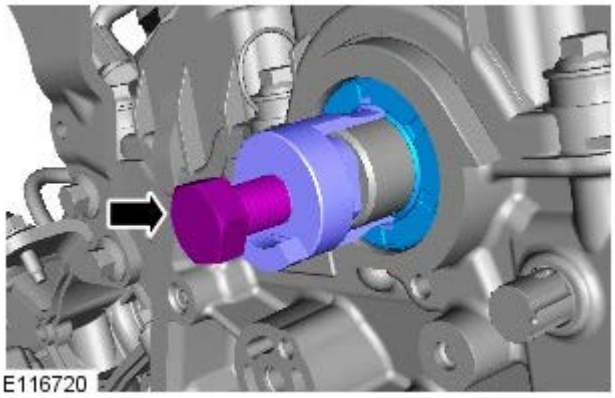


9. CAUTION: Make sure the special tool is correctly seated behind the camshaft seal. Failure to follow this instruction may result in damage to the special tool.

Special Tool(s): 303-1118

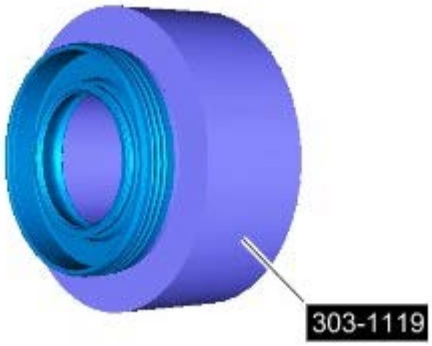


10.

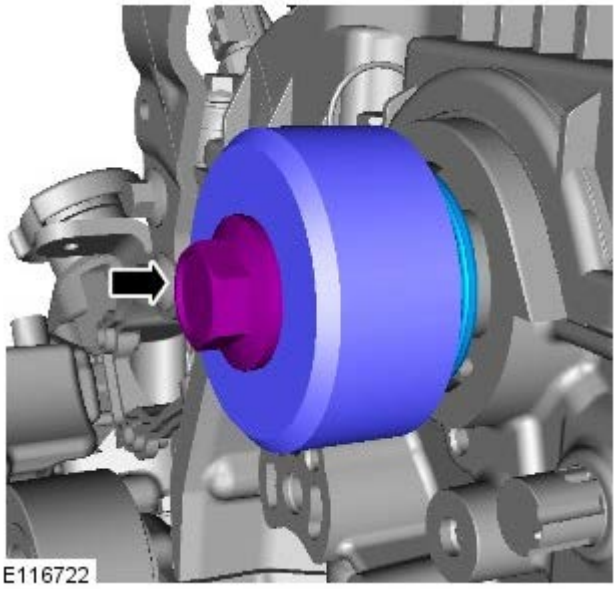


Installation

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



E116721


E116722

2. CAUTIONS:

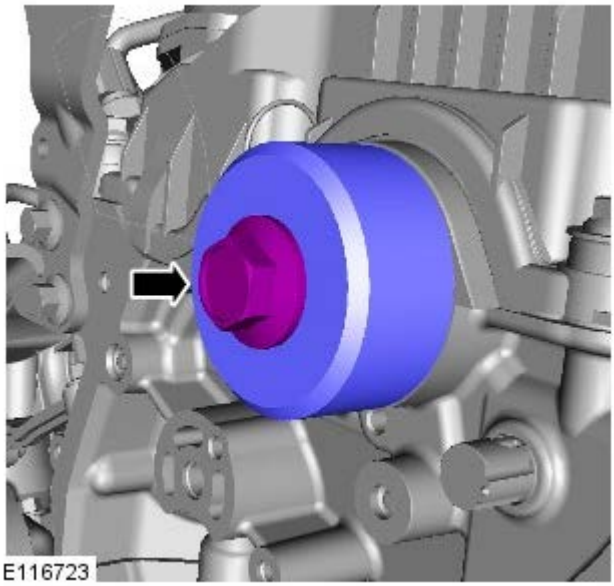
   Make sure the seal is installed correctly.

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

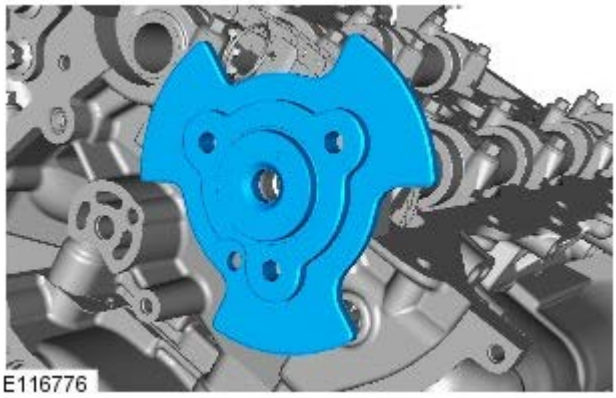
   Do not use any lubricant on the camshaft front seal or the camshaft. Failure to follow this instruction may result in damage to the vehicle.

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

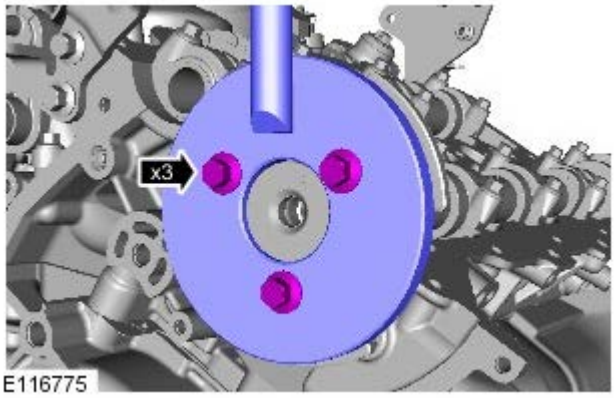
3. *Special Tool(s):* 303-1119


E116723

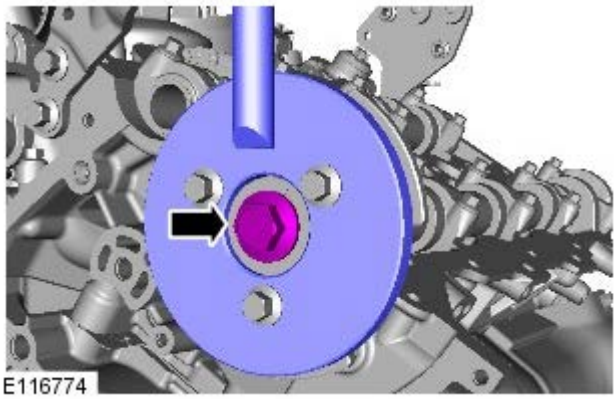
4.



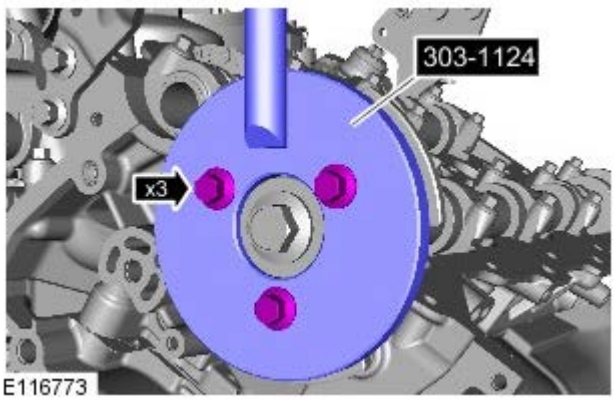
5. *Special Tool(s):* 303-1124



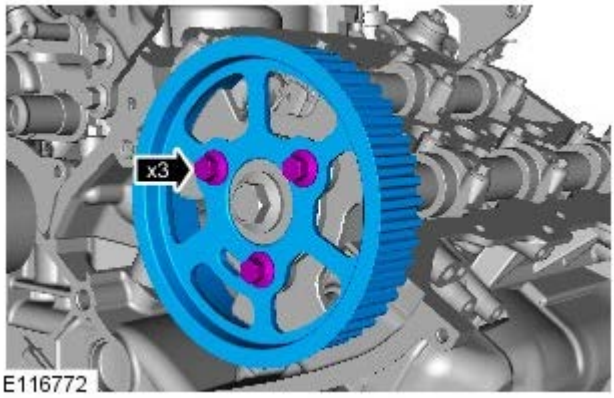
6. *Torque:*
   Stage 1: 80 Nm
   Stage 2: 80°



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

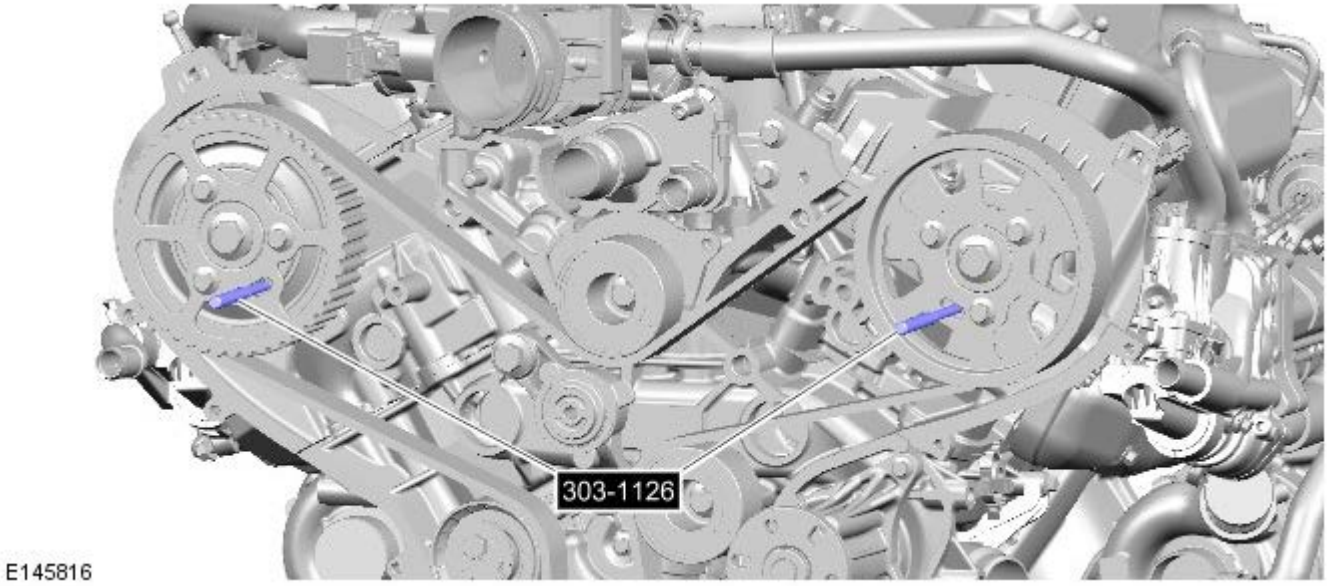


8. CAUTION: Only tighten the bolt finger-tight at this stage.



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 (303-01A Engine - TDV6 3.0L Diesel, Removal and Installation).

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

Published: 01-Aug-2012

Engine - TDV6 3.0L Diesel - Camshaft Rear Seal

Removal and Installation

Removal

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

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.

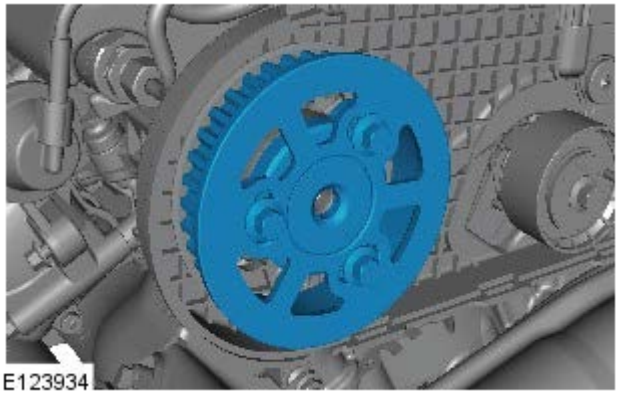


4. Using the special tool, remove the rear camshaft pulley retaining bolt.



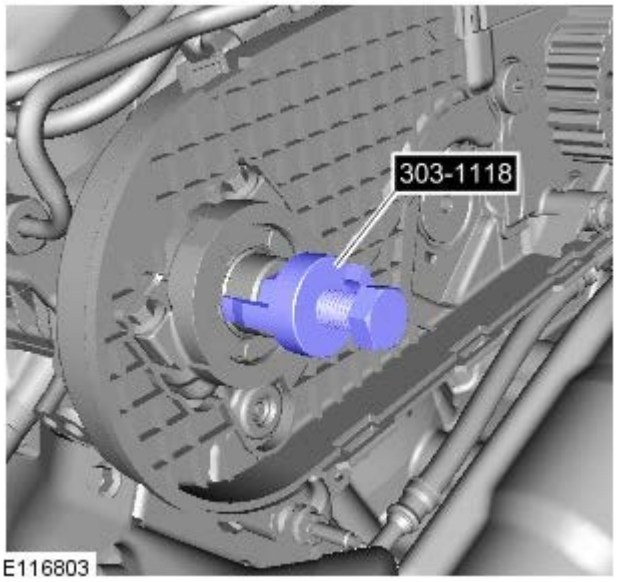
5. Remove the special tools.

6.

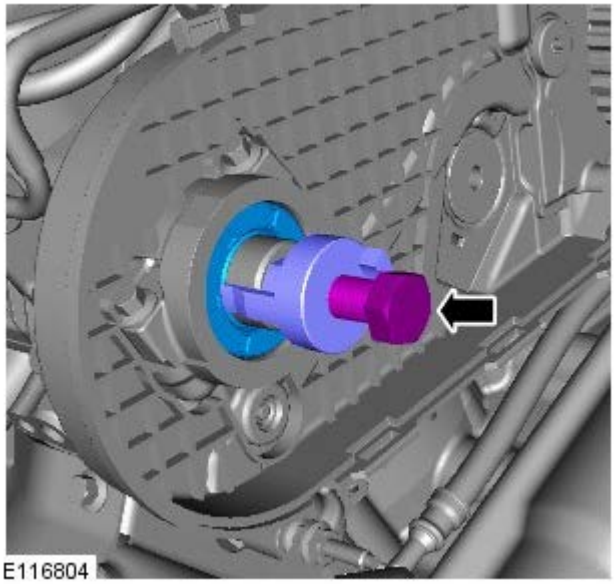


7. CAUTION: Make sure the special tool is correctly seated behind the camshaft seal. Failure to follow this instruction may result in damage to the special tool.

   Install the special tool.

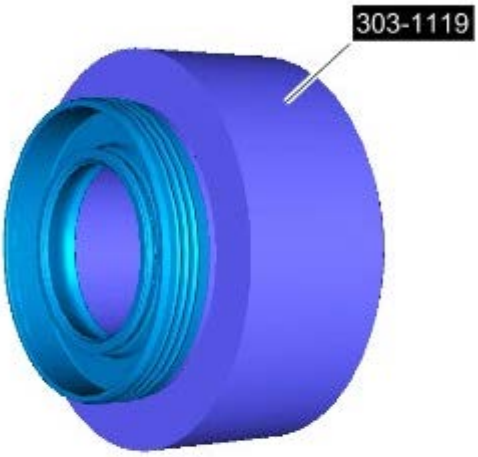


8.

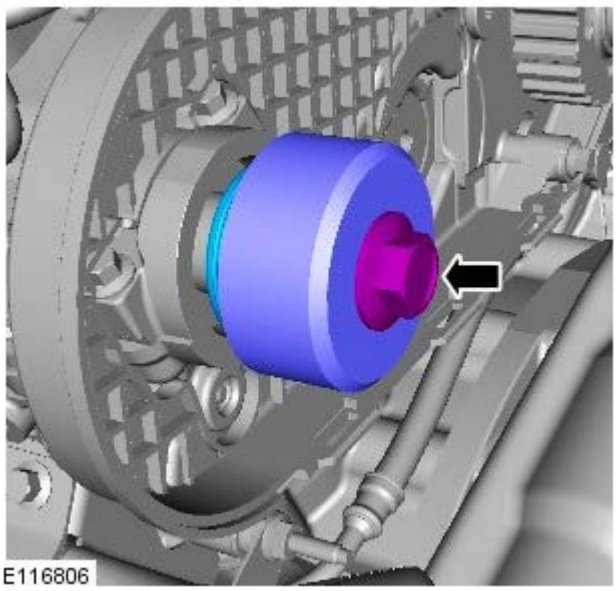

E116804

Installation

1. Install with the special tool.



E116805


E116806

2. CAUTIONS:

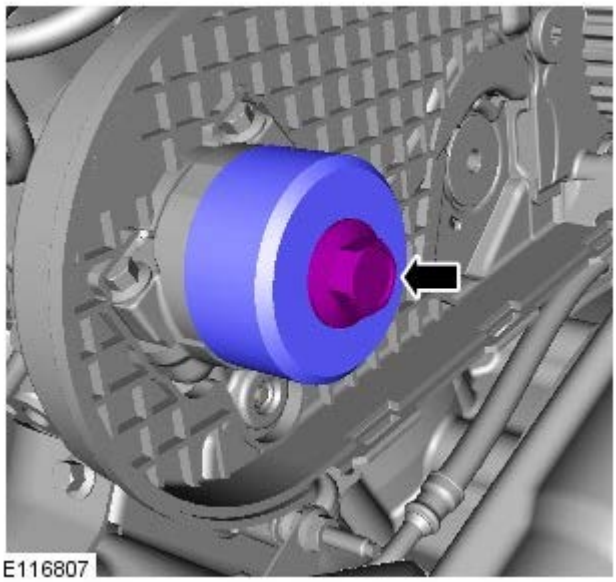
   Make sure the seal is installed correctly.

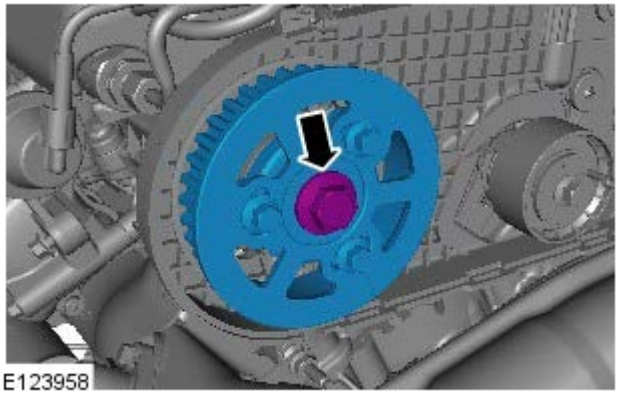
   Make sure that the mating faces are clean and free of corrosion and foreign material.

   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.



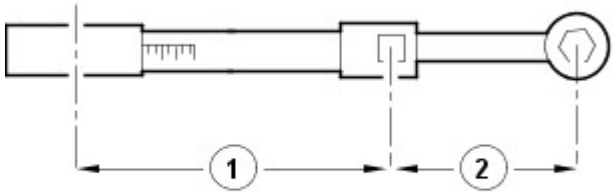
6. Install the special tool.



E123894

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.



E37107



E123895

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).

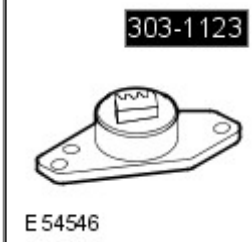
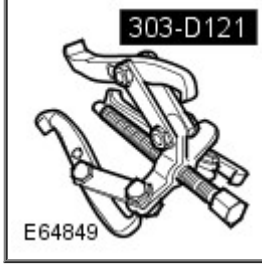
10. Remove the special tools.

Published: 17-Oct-2012

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
	303-1123 Locking Tool, Flywheel
	303-D121 Puller, General Purpose

Removal

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

1. Disconnect the battery ground cable.

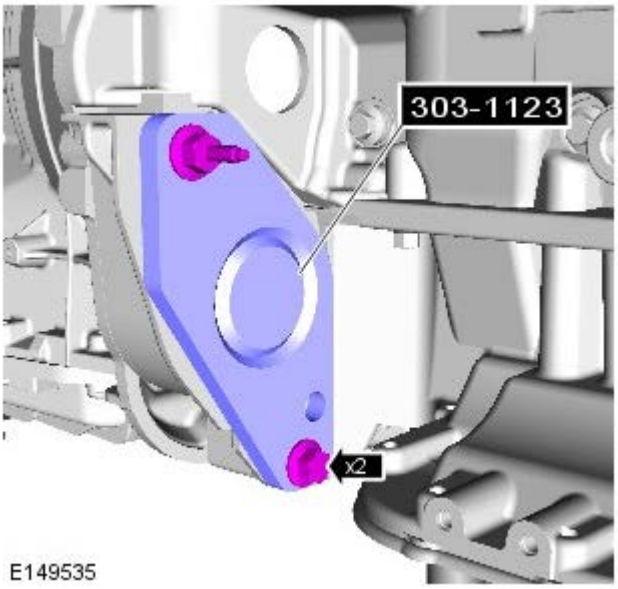
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

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

   Raise and support the vehicle.

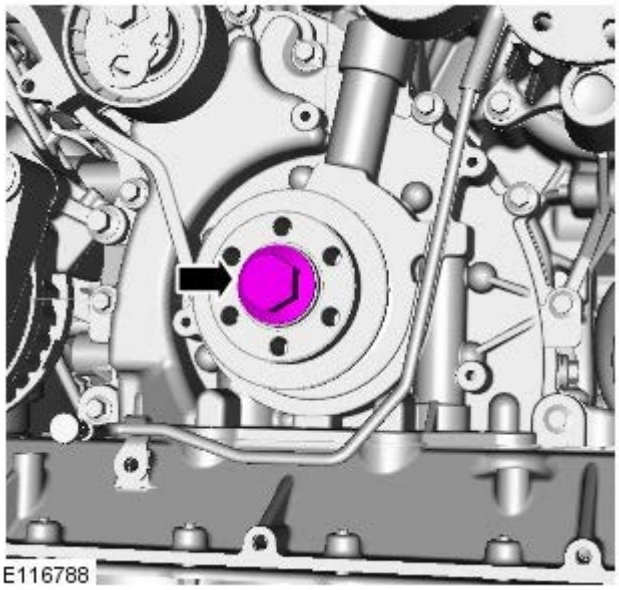
3. Refer to: Timing Belt (303-01A Engine - TDV6 3.0L Diesel, Removal and Installation).

4. Install the special tool.



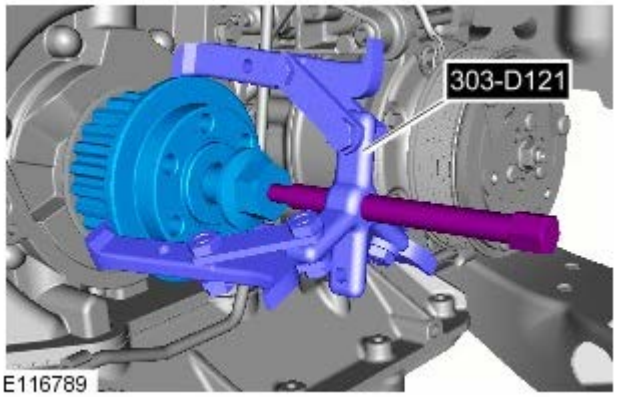
Special Tool(s): 303-1123

5.

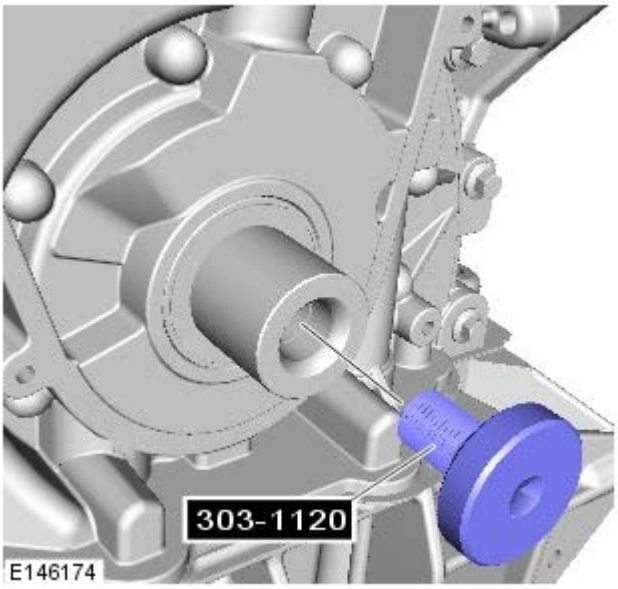


6. Install the special tool.

Special Tool(s): 303-D121

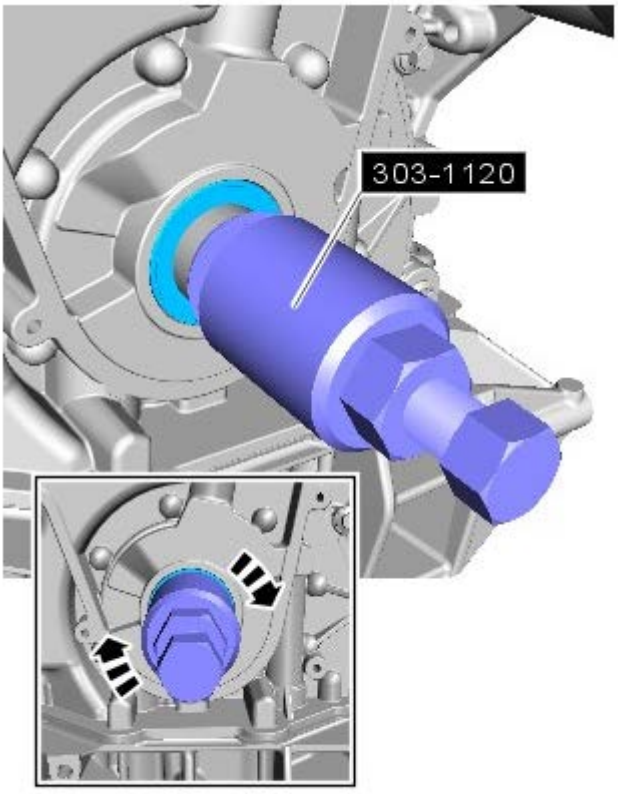


7. Install the special tool to the crankshaft.



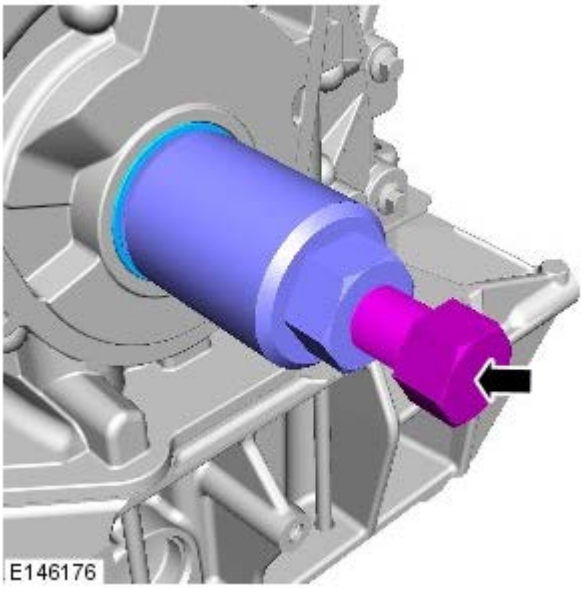
8. Install the special tool to the crankshaft, rotate the special tool to engage the crankshaft front oil seal as shown.

   Special Tool(s): 303-1120

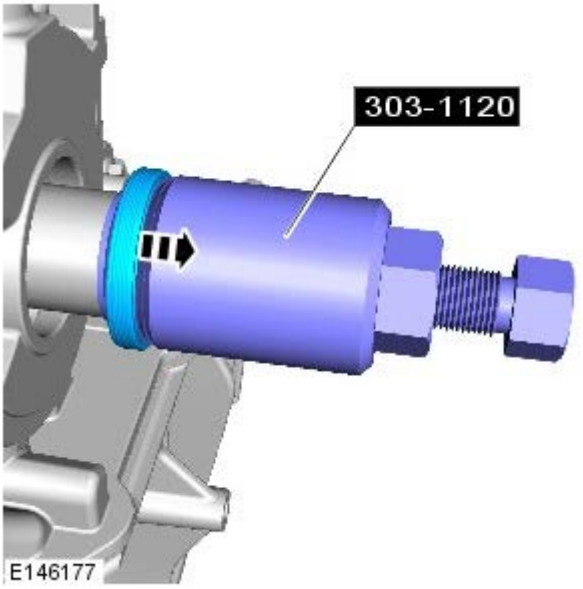


E146175

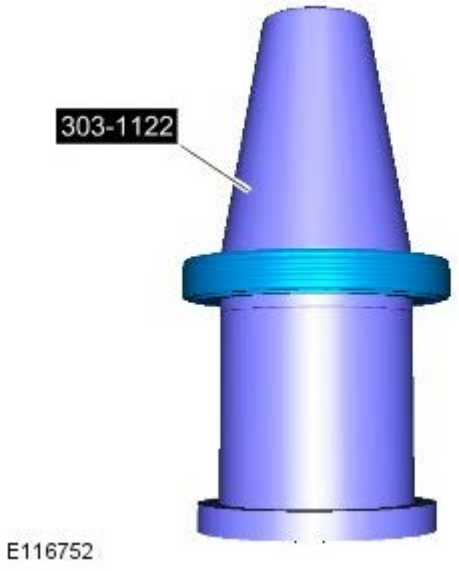
9. Rotate the special tool bolt.



10. Using the special tool, remove and discard the crankshaft front oil seal.



Installation



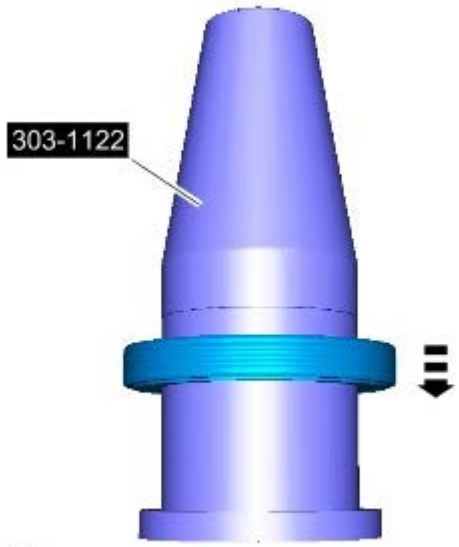
1. CAUTION: Do not use any lubricant on the crankshaft front seal, special tools or the crankshaft. Failure to follow this instruction may result in damage to the vehicle.

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

   Install a new crankshaft front seal to the special tool.

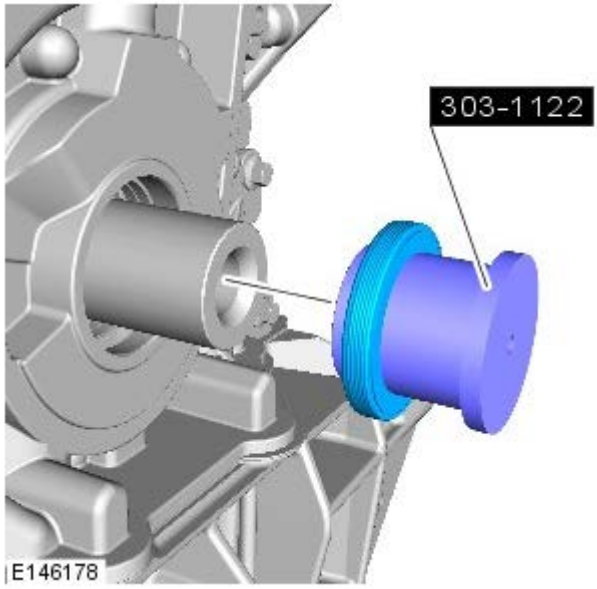
   Special Tool(s): 303-1122

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



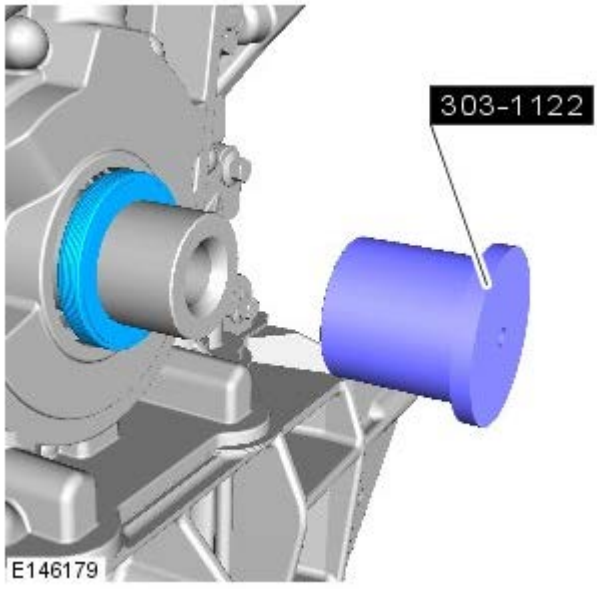
E116753

3. Install the special tool to the crankshaft.



E146178

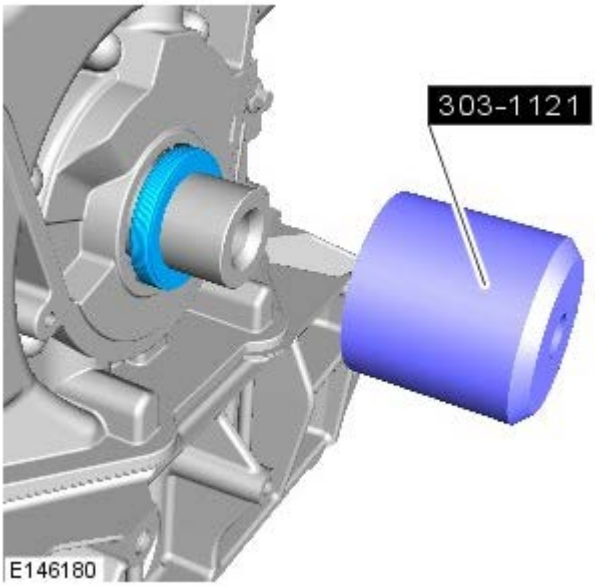
4. Install the special tool to the crankshaft.

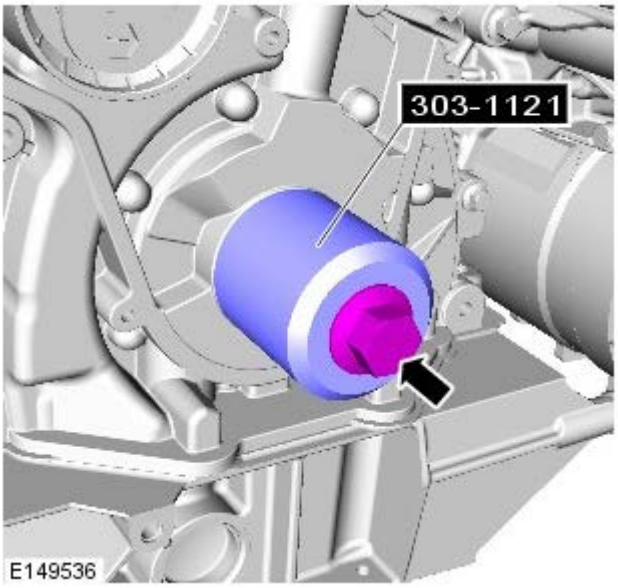


E146179

5. Install the special tool to the crankshaft.

Special Tool(s): 303-1121





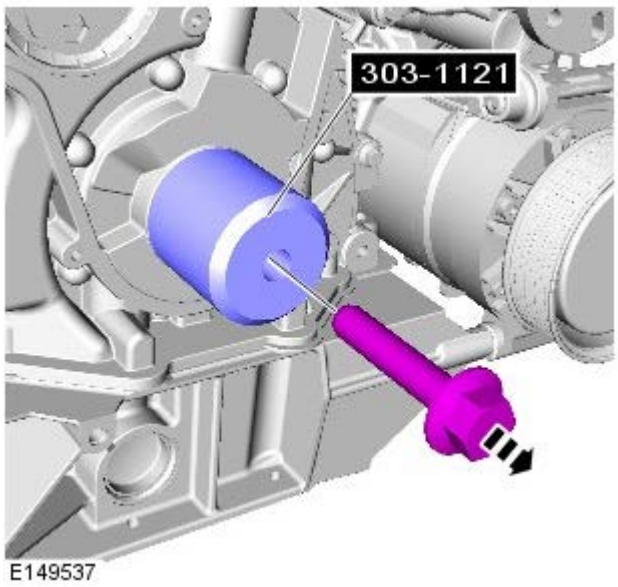
6. CAUTIONS:

   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.



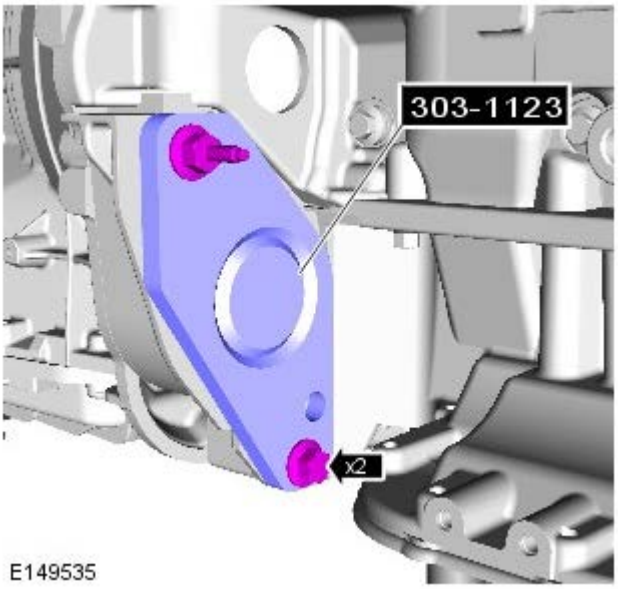
7. CAUTION: Make sure the seal is installed correctly.

   NOTE: Wait 10 seconds before removing the crankshaft seal installation tool.

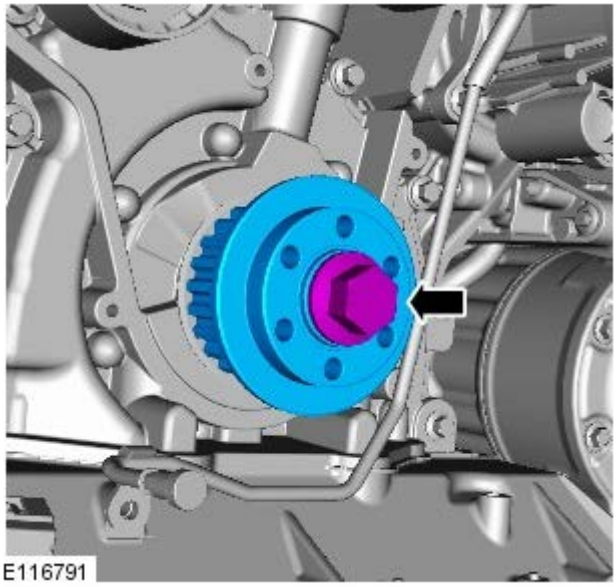
   Remove the special tool.

   Special Tool(s): 303-1121

8. Remove the special tool.



E149535


E116791

9. 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.

   Before installing the crankshaft pulley retaining bolt, note the thread size of the bolt (there are two different sized threads, M14 and M16). Failure to follow this instruction may result in damage to the engine.

   Install the crankshaft pulley.

   Torque:
   - M14 retaining bolt
     - Stage 1: 140 Nm
     - Stage 2: 90°
   - M16 retaining bolt
     - Stage 1: 100 Nm
     - Stage 2: 35°

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

11. Connect the battery ground cable.

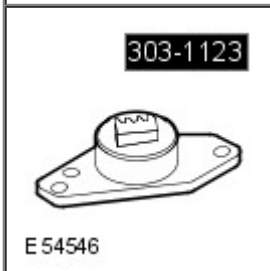
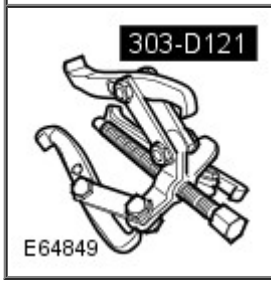
    Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 23-Jan-2014

Engine - TDV6 3.0L Diesel - Crankshaft Pulley

Removal and Installation

Special Tool(s)

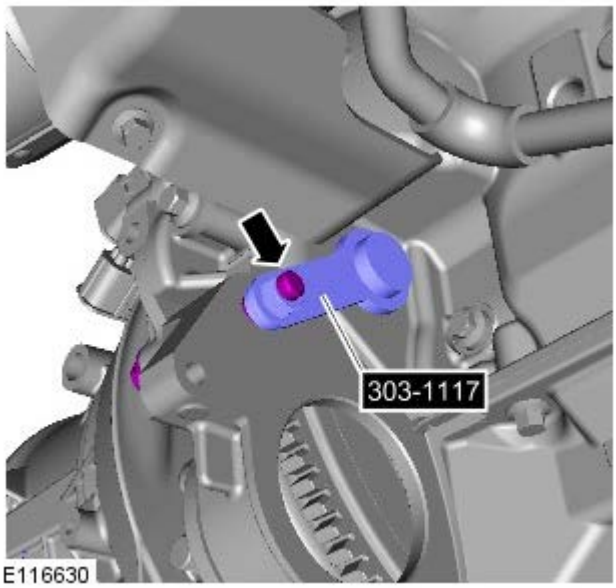
	303-1117 Timing Peg, Automatic Transmission
	303-1123 Locking Tool, Flywheel
	303-D121 Puller, General Purpose

Removal

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

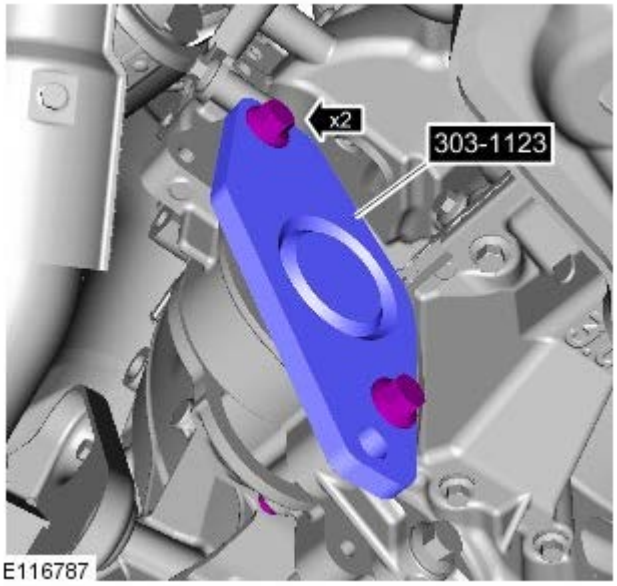
   Raise and support the vehicle.

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

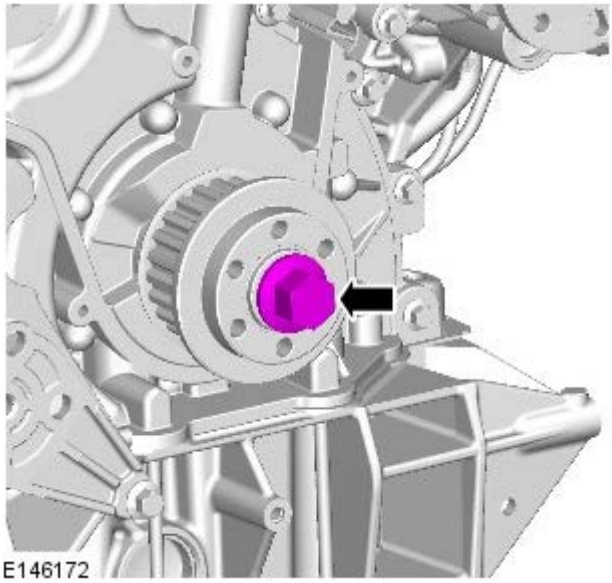
3. 

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

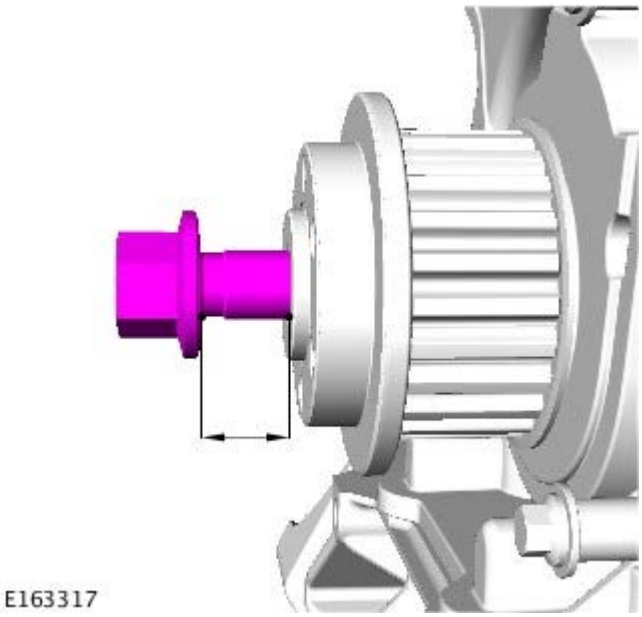
4. - Install the special tool.
   - *Special Tool(s):* 303-1123



5.

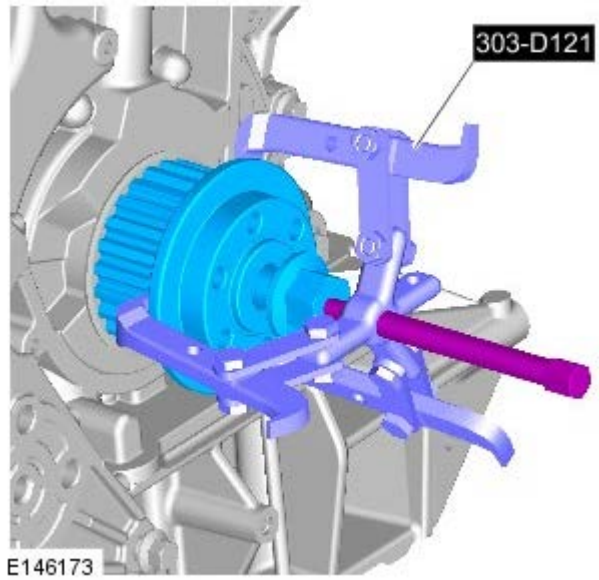


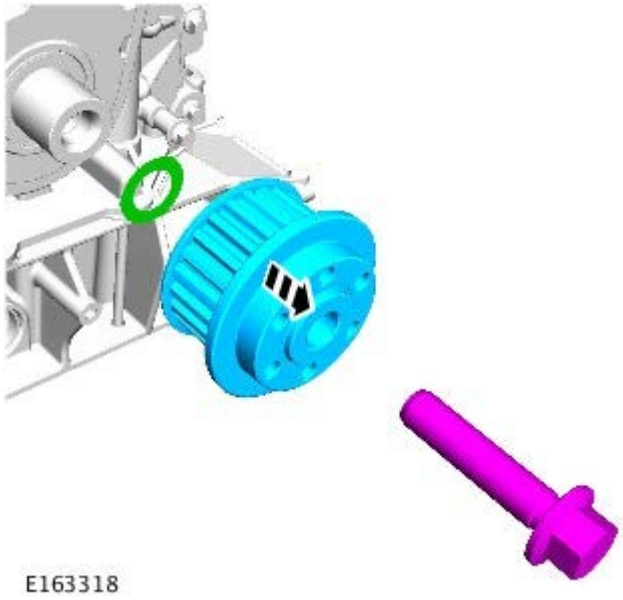
6. Loosen, but do not fully remove the bolt.



7.

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





8. CAUTIONS:

   Discard the bolt.

   Discard the friction washer.

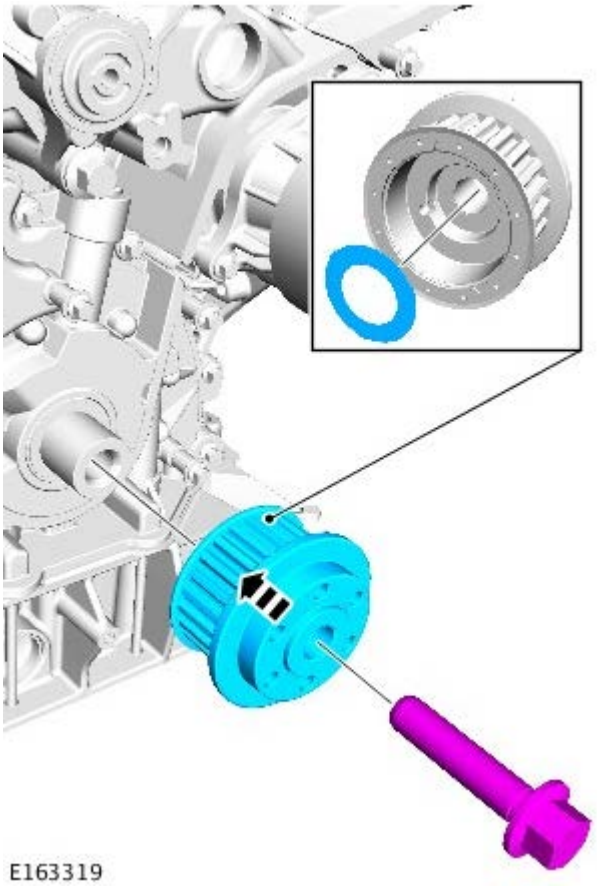
Installation

1. CAUTIONS:

   Install and new friction washer inside the pulley, make sure it is correctly seated before installing the pulley.

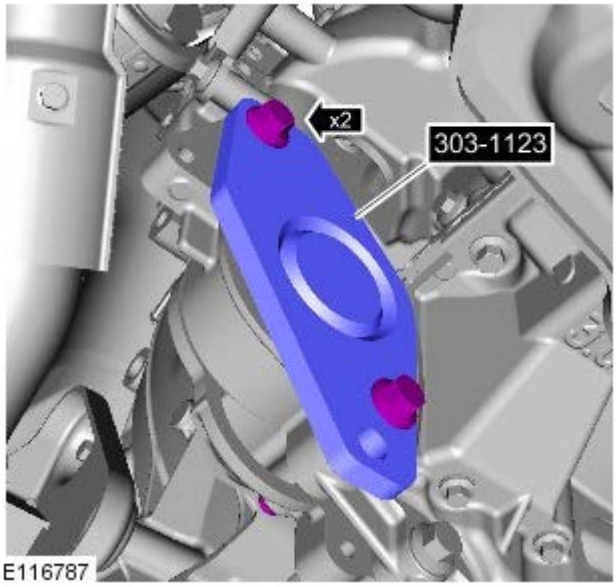
   Do not lubricate the components.

   Make sure that a new bolt is installed.



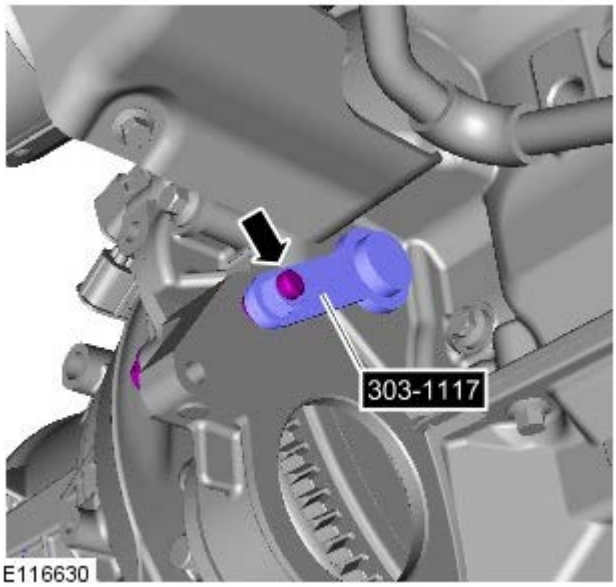
2.

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



3.

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



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

Published: 26-Jul-2013

Engine - TDV6 3.0L Diesel - Crankshaft Rear Seal

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.

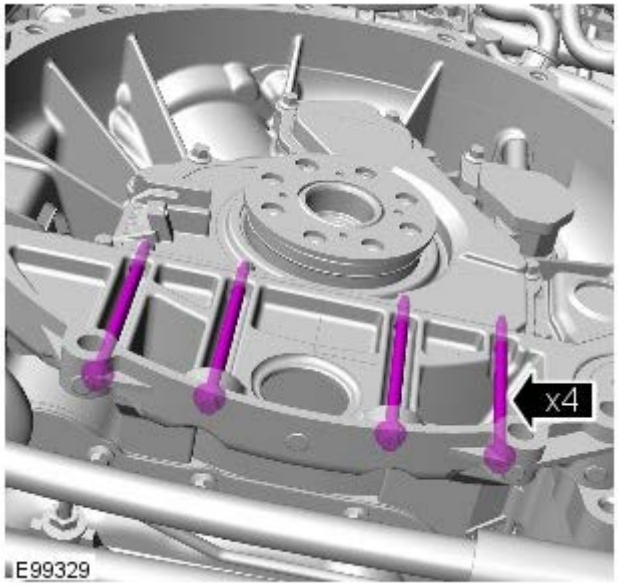
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

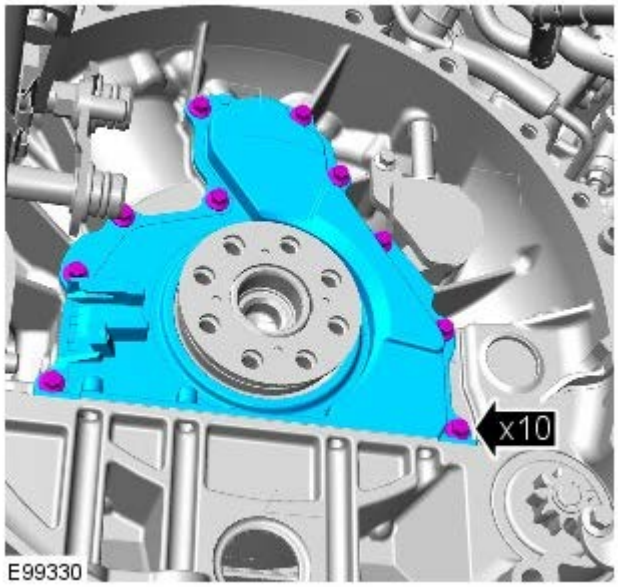
2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Refer to: Crankshaft Position (CKP) Sensor Ring (303-14A Electronic Engine Controls - TDV6 3.0L Diesel, Removal and Installation).

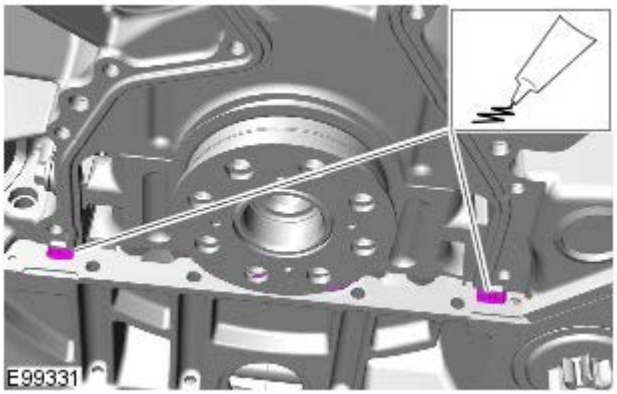
4.





5. CAUTION: Discard the seal.

Installation

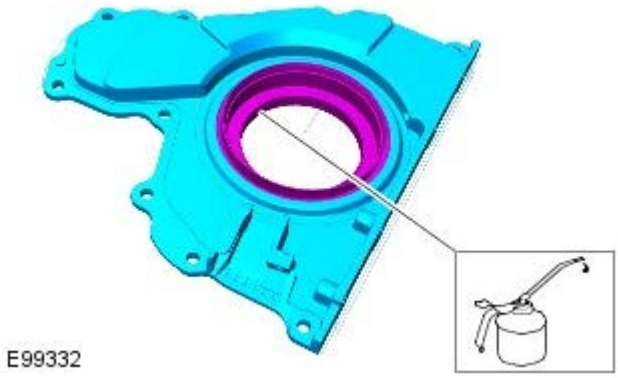


1. CAUTIONS:

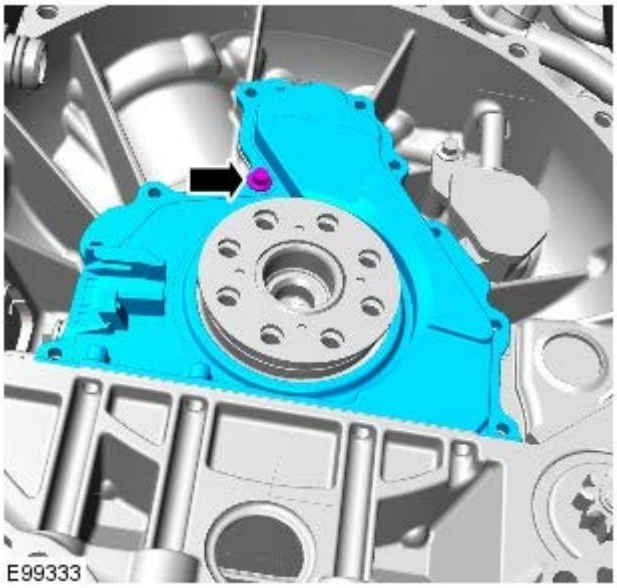
   Make sure that the crankshaft rear oil seal is correctly located.

   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.

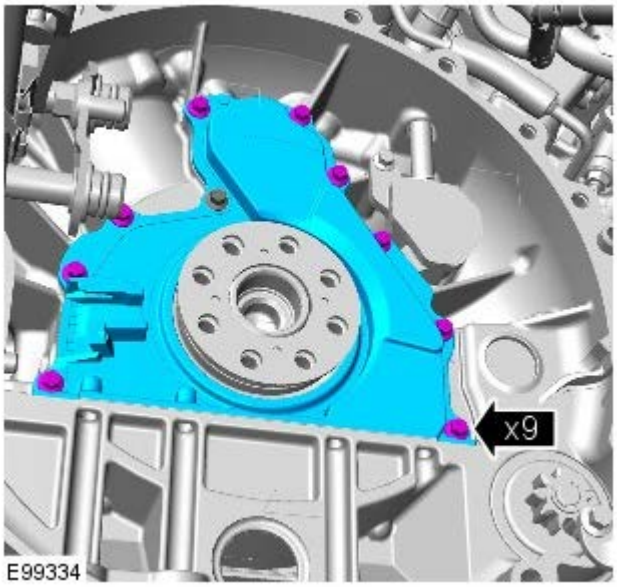


2.
   - Lubricate the oil seal.

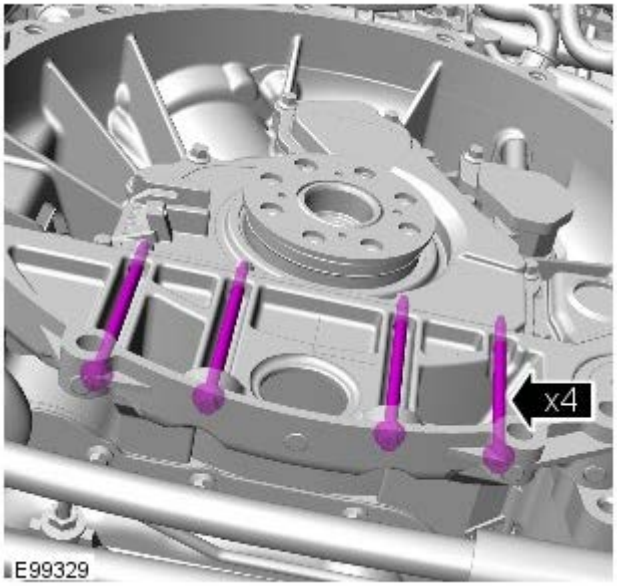


3. *Torque:* 10 Nm

4. *Torque:* 10 Nm



5. *Torque:* 10 Nm



6. Refer to: Crankshaft Position (CKP) Sensor Ring (303-14A Electronic Engine Controls - TDV6 3.0L Diesel, Removal and Installation).

7. Connect the battery ground cable

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

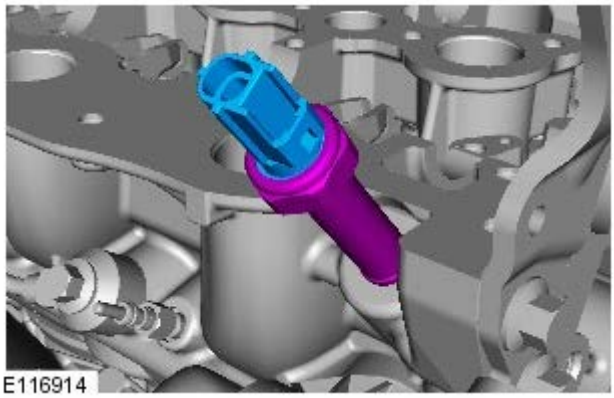
Published: 01-Aug-2012

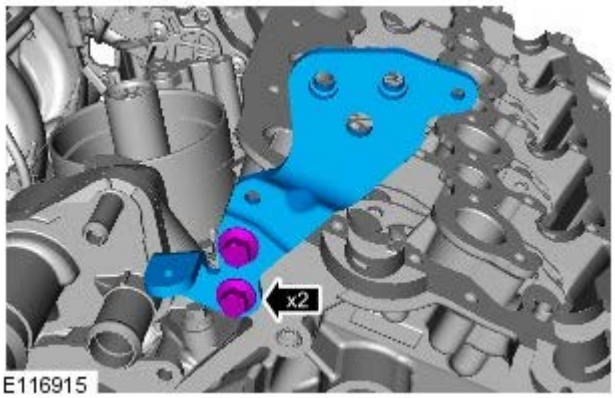
Engine - TDV6 3.0L Diesel - Cylinder Head LH

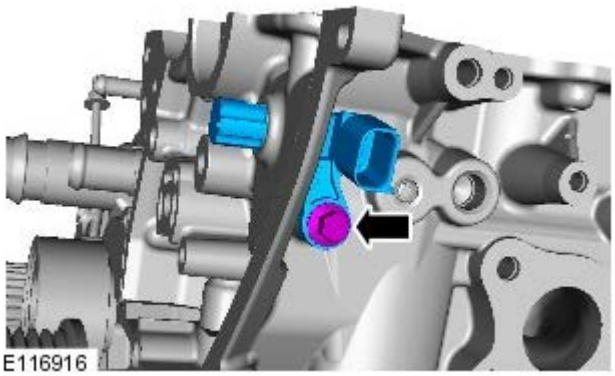
Removal and Installation

Removal

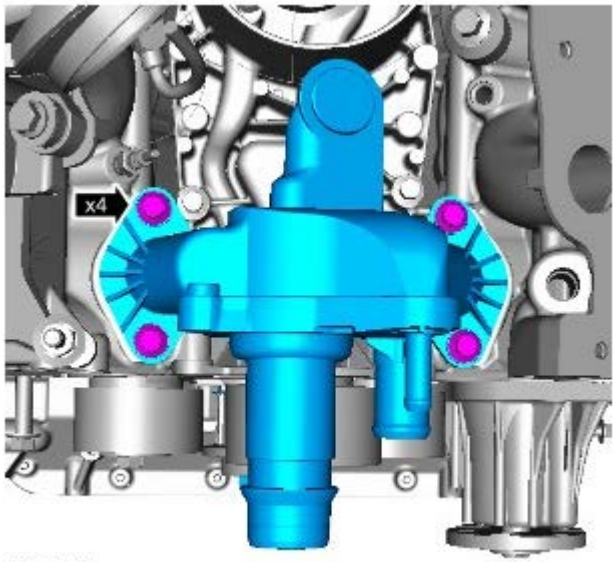
1. Refer to: Specifications (414-00, Specifications).
2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.
3. Refer to: Camshaft LH (303-01A Engine - TDV6 3.0L Diesel, Removal and Installation).
4. Refer to: Glow Plugs (303-07C Glow Plug System - TDV6 3.0L Diesel, Removal and Installation).
5. Refer to: Exhaust Manifold LH (303-01A Engine - TDV6 3.0L Diesel, Removal and Installation).
6. 

7. 

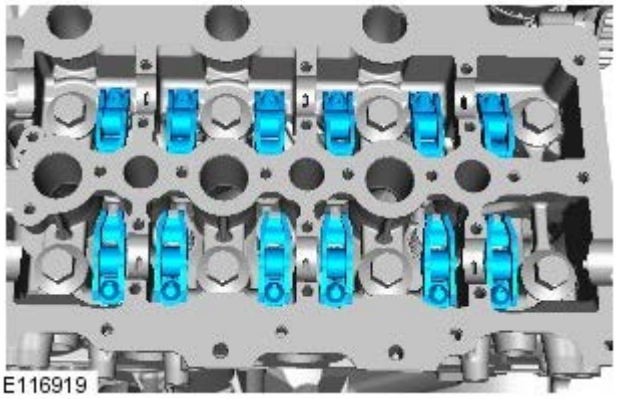
8. 

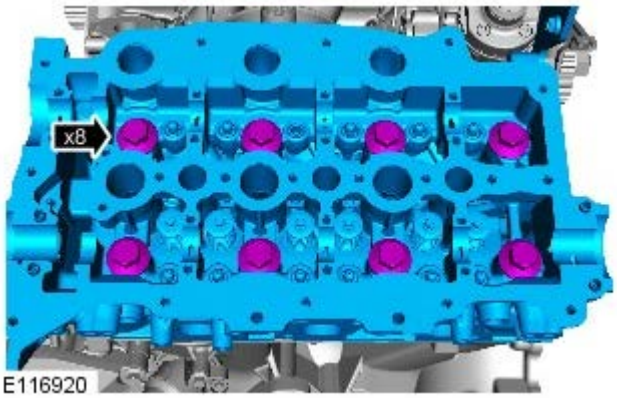
9.



E116917

10.


E116919



E116920

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.

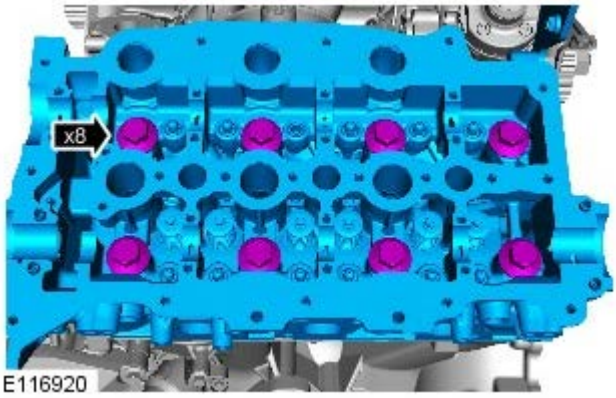
   Clean and inspect the cylinder head and cylinder block.

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.

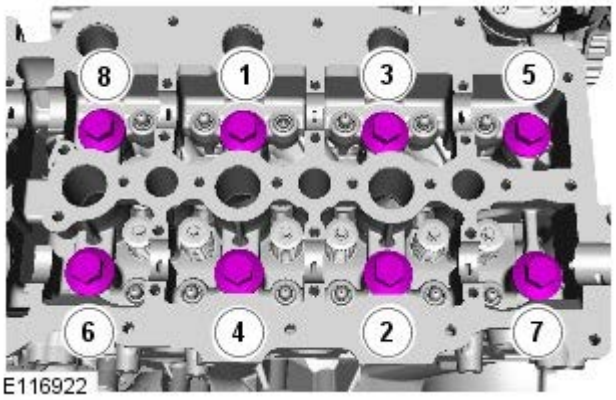


The head gasket must be installed over the cylinder block dowels.

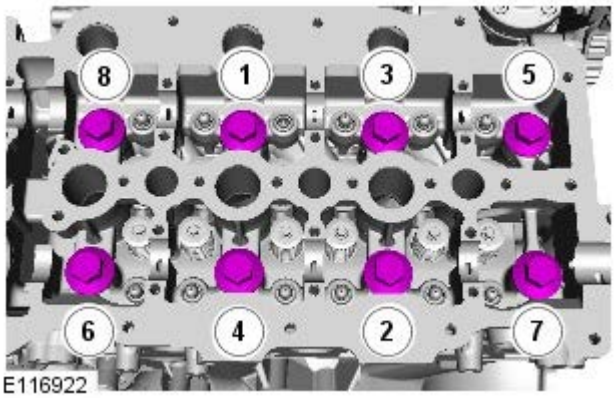
NOTES:

Install a new gasket.

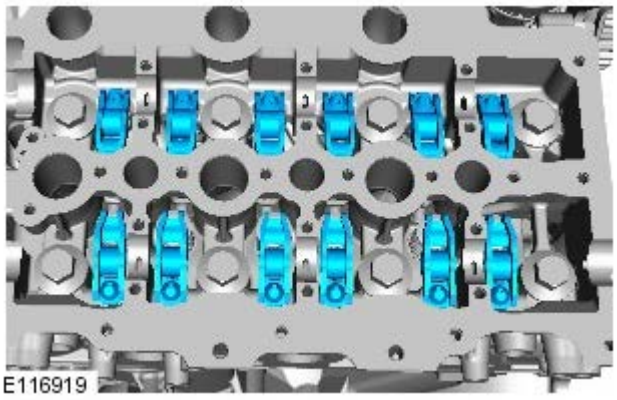
No additional lubrication to the cylinder head bolts is required.



3. NOTE: Tighten the bolts in the indicated sequence.
   - *Torque:* 80 Nm

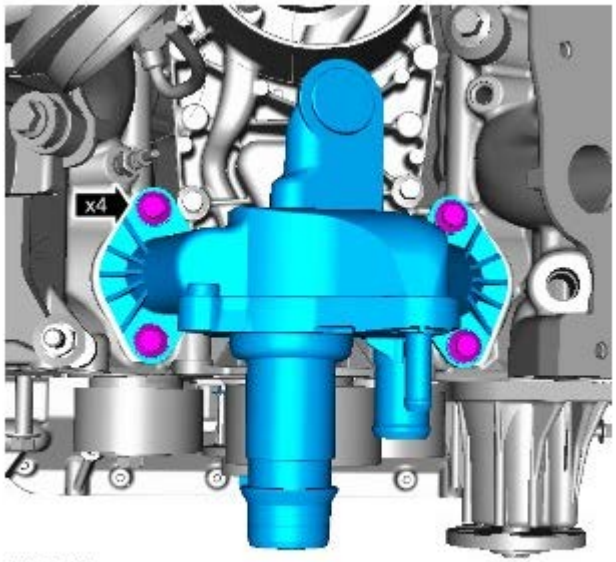


4. NOTE: Tighten the bolts in the indicated sequence.
   - *Torque:* 180°



5. .

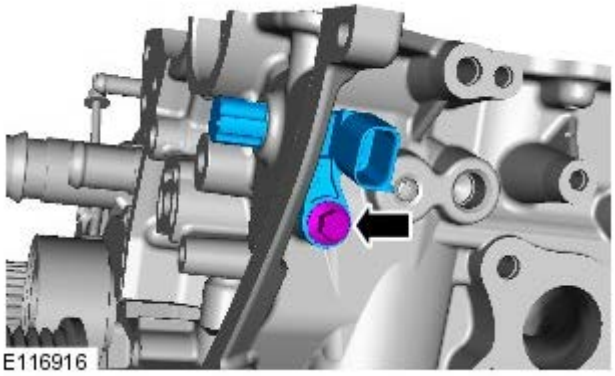
6. CAUTION: Install the new seals.



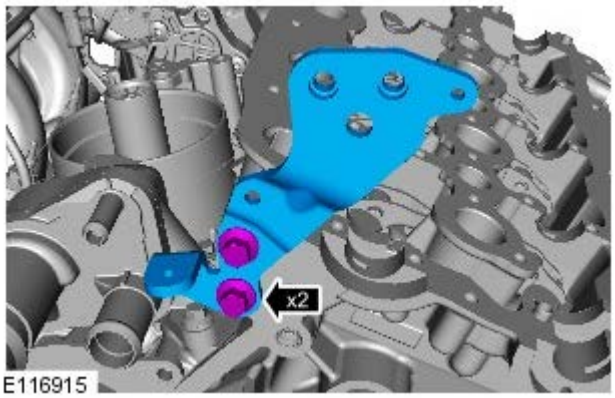
E116917

Torque: 10 Nm

7. *Torque:* 10 Nm

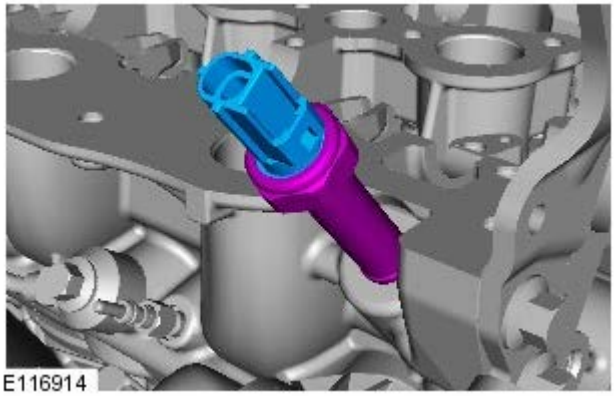

E116916

8. *Torque:* 24 Nm



E116915

9. *Torque:* 14 Nm


E116914

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

11. Refer to: Glow Plugs (303-07C Glow Plug System - TDV6 3.0L

Diesel, Removal and Installation).

12. Refer to: Camshaft LH (303-01A Engine - TDV6 3.0L Diesel, Removal and Installation).

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

Published: 17-Dec-2013

Engine - TDV6 3.0L Diesel - 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.

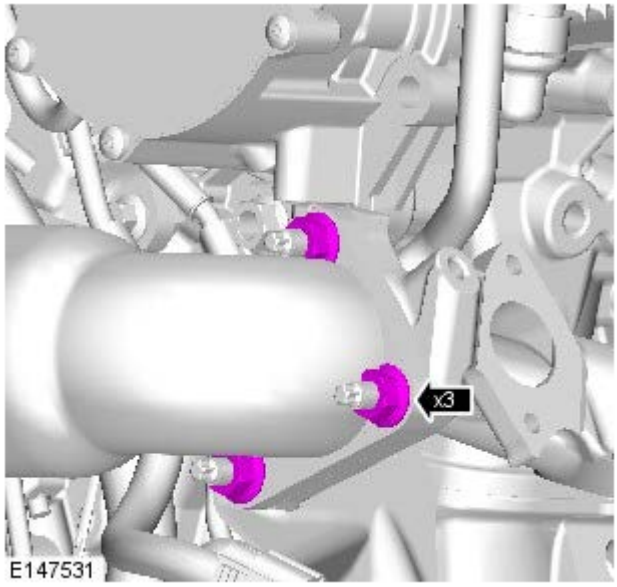
1. Disconnect the battery ground cable

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

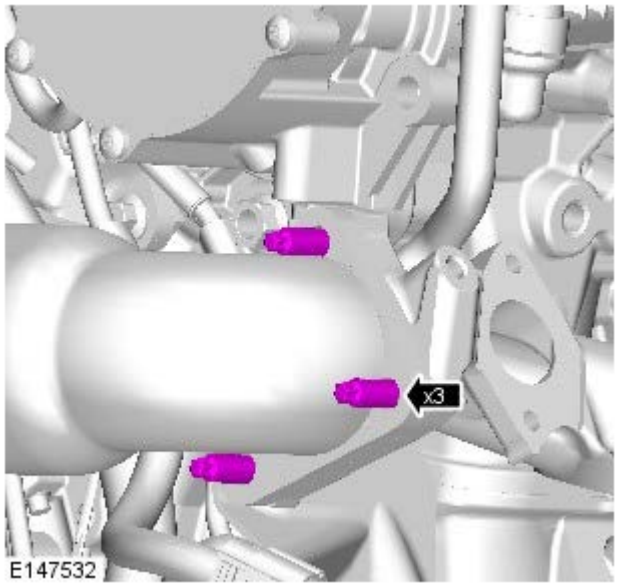
2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

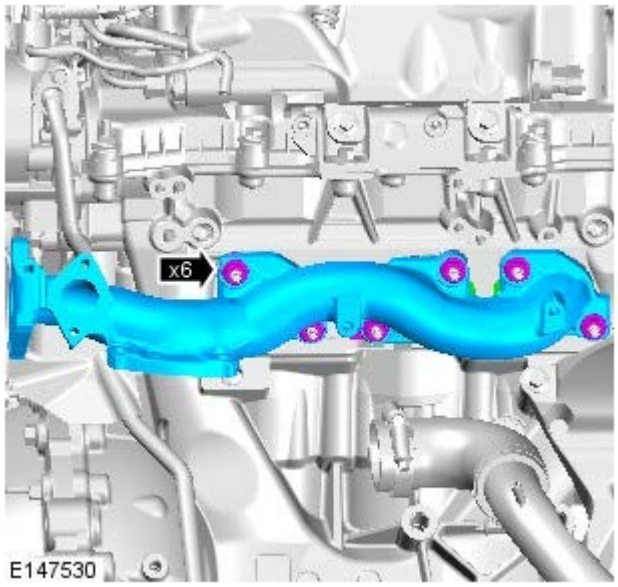
3. Refer to: Turbocharger RH (303-04B Fuel Charging and Controls - Turbocharger - SDV6 3.0L Diesel - Hybrid Electric Vehicle/TDV6 3.0L Diesel, Removal and Installation).



4. CAUTION: Discard the nuts.

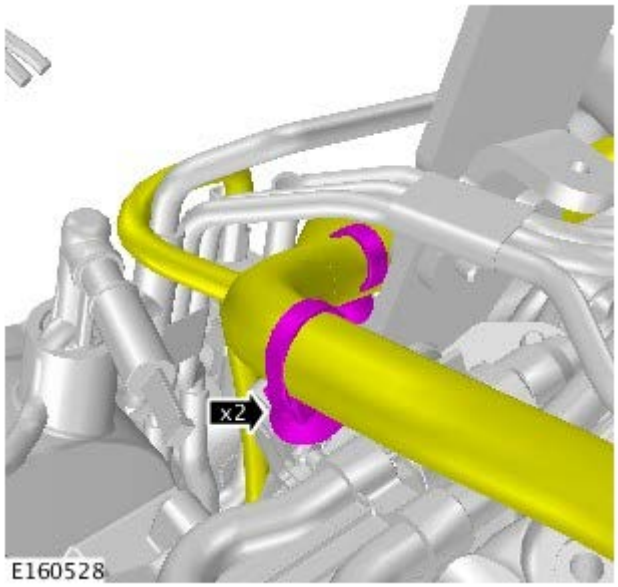


5. CAUTION: Discard the studs.

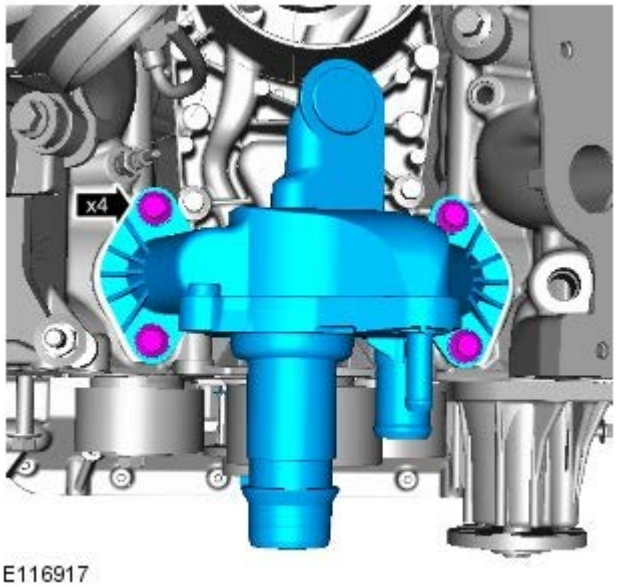


6. NOTE: Discard the gasket.

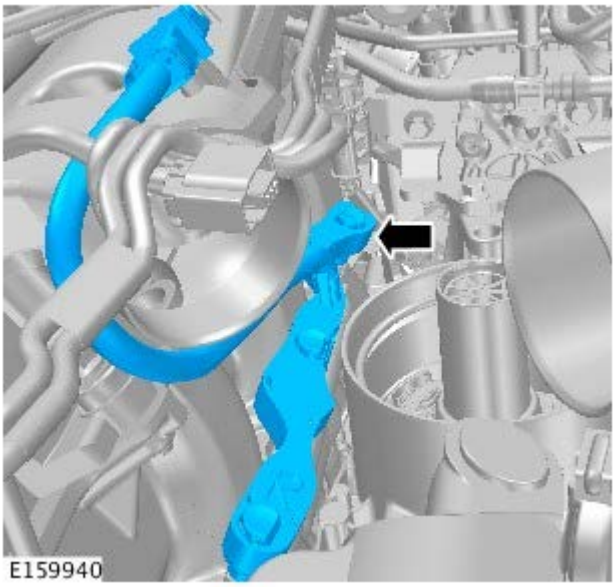
7.



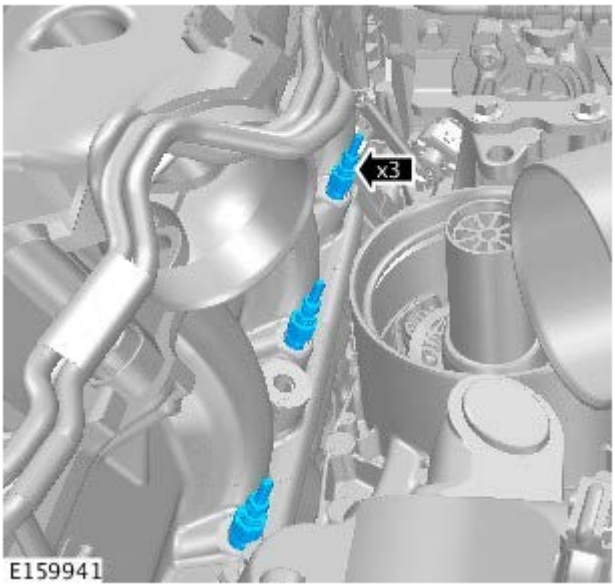
8.



9.

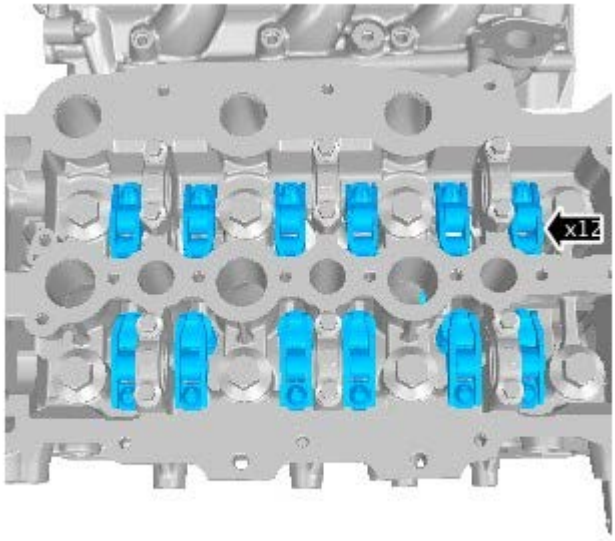


10.

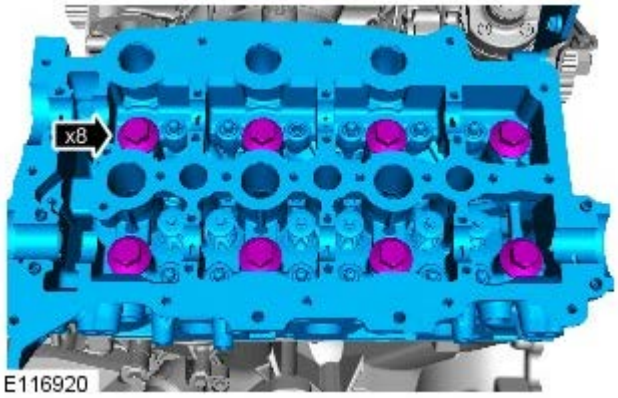


11. Refer to: Camshaft RH (303-01A Engine - TDV6 3.0L Diesel, Removal and Installation).

12.



13. CAUTION: Discard the bolts.



NOTE: Discard the gasket.

Installation

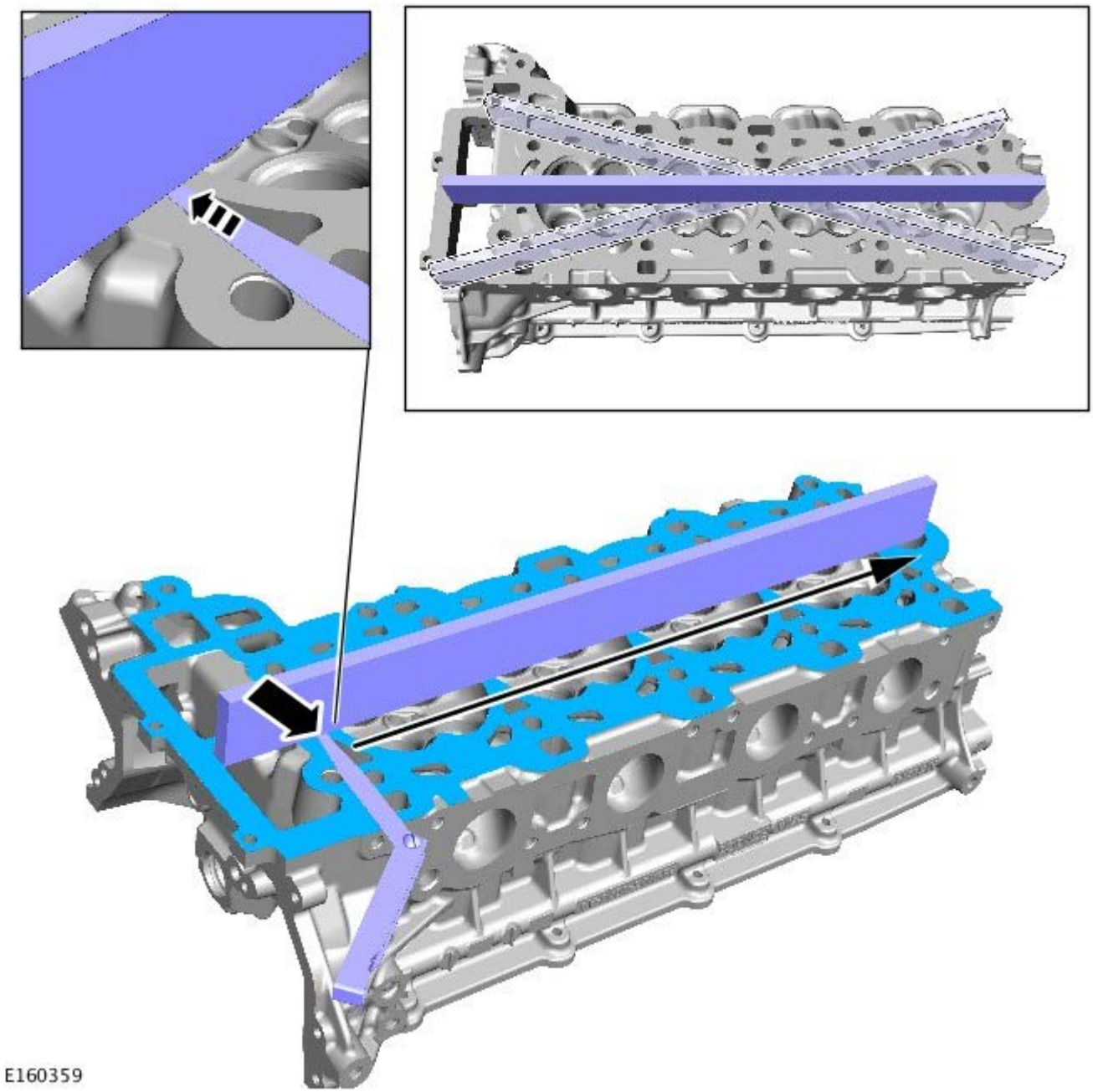
1. CAUTIONS:

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

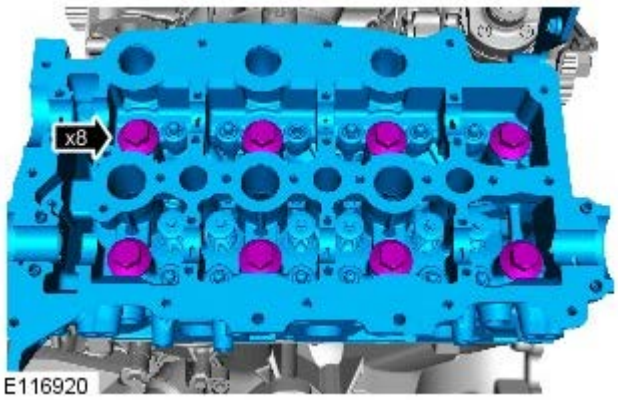
   An acceptable flatness of the cylinder head is 0.1mm.

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

   Clean and check the cylinder head face for distortion, across the center and from corner to corner.



E160359



E116920

2. CAUTIONS:

Only tighten the bolts finger-tight at this stage.

Make sure that new bolts are installed.

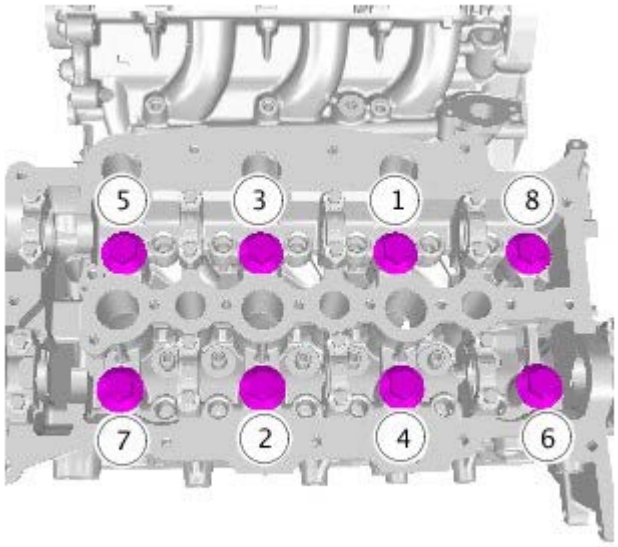
Use care when installing the cylinder head. Damage to the cylinder block, cylinder head or cylinder head gasket may result.

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

NOTES:

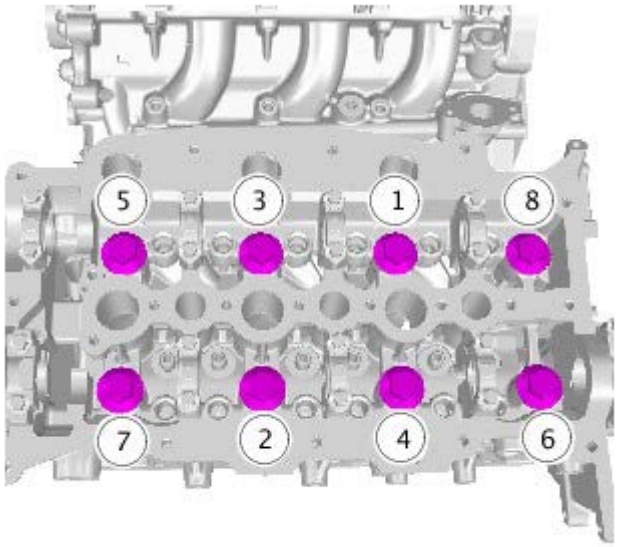
Install a new gasket.

No additional lubrication to the cylinder head bolts is required.



E159942

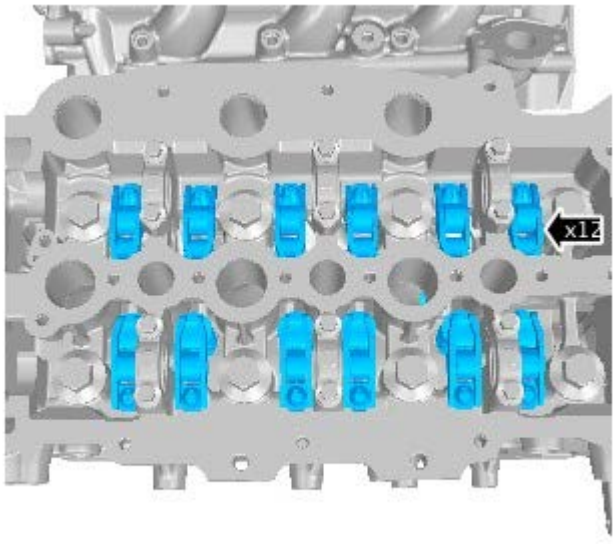
3. NOTE: Tighten the bolts in the indicated sequence.
   - *Torque:* 80 Nm



E159942

4. NOTE: Tighten the bolts in the indicated sequence.
   - *Torque:* 180°

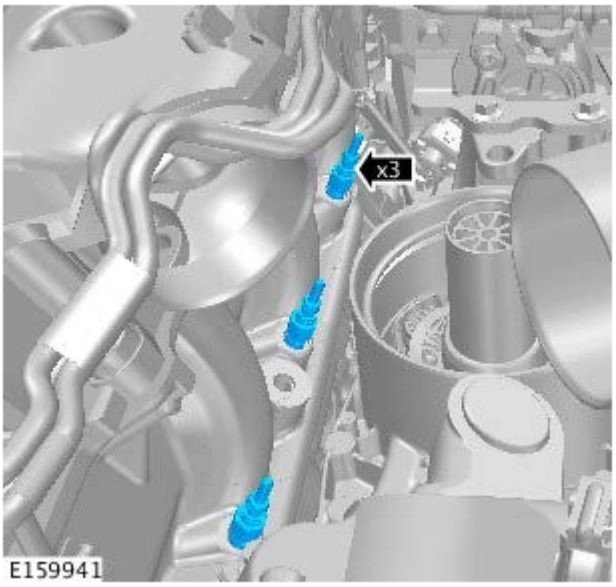
5.



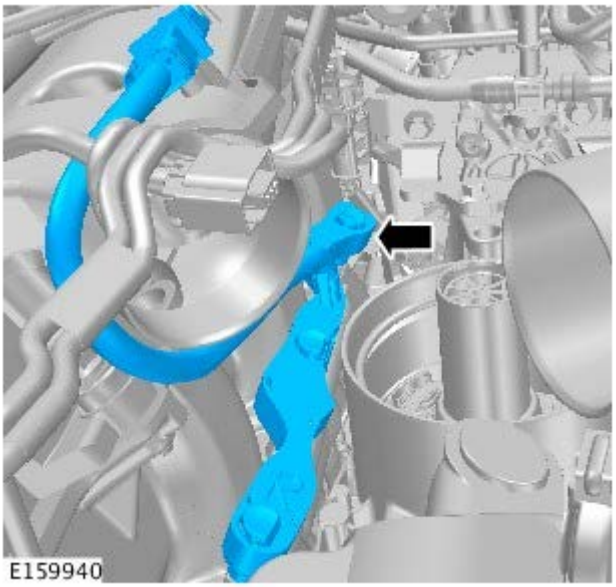
E159939

6. Refer to: Camshaft RH (303-01A Engine - TDV6 3.0L Diesel, Removal and Installation).

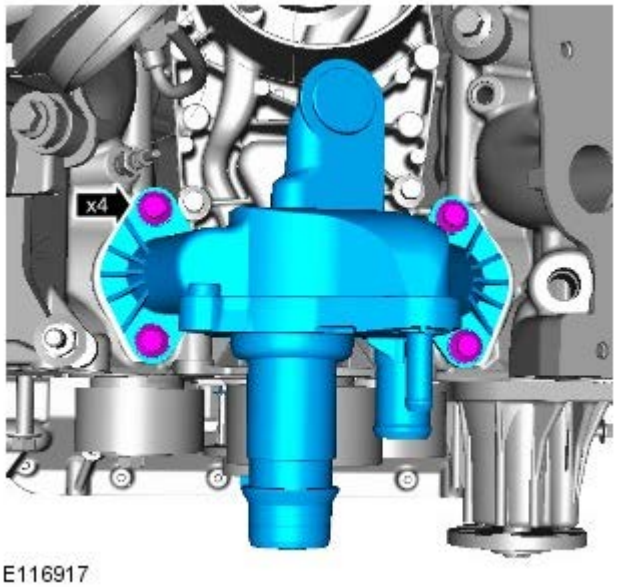
7. *Torque:* 10 Nm



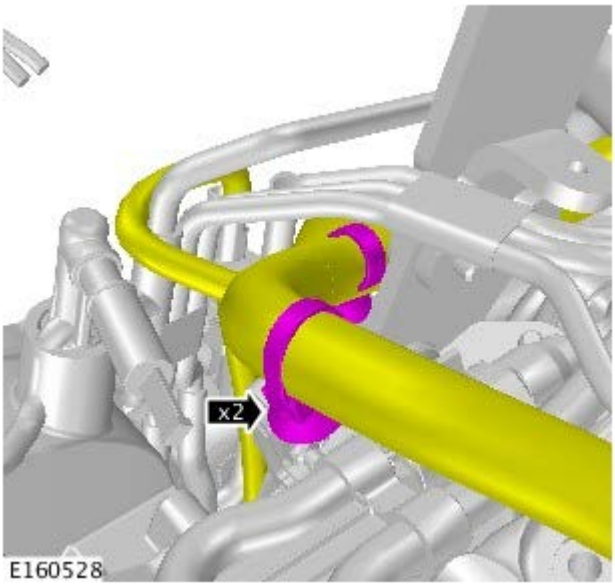
8.

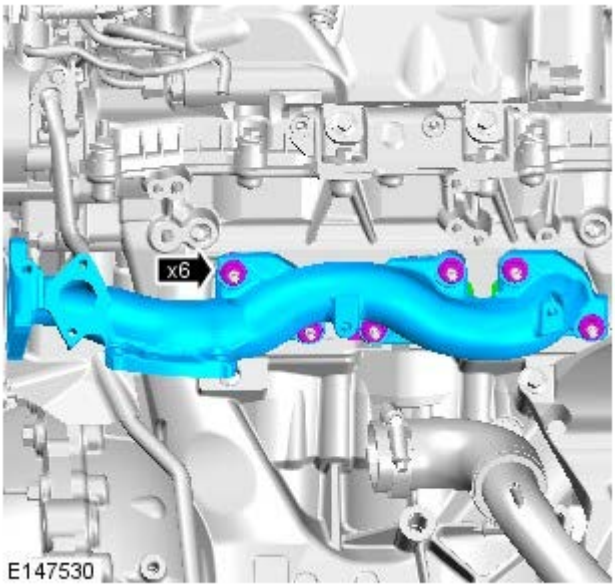


9. *Torque:* 10 Nm



10.

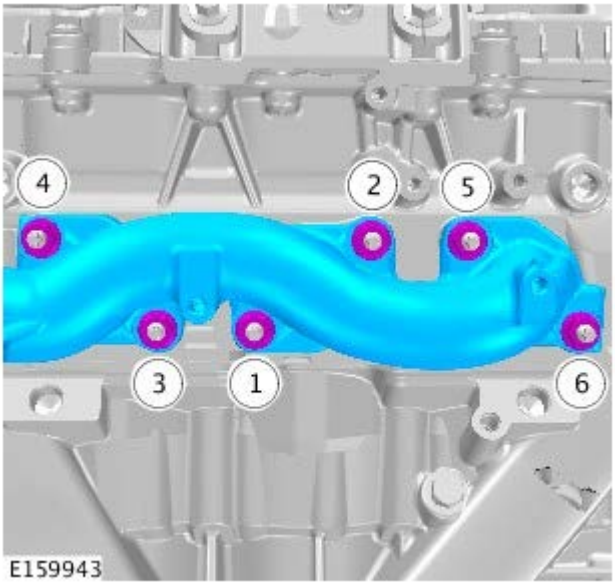




11. WARNING: Make sure that new nuts are installed.

CAUTION: Install the nuts finger tight before final tightening.

NOTE: Install a new gasket.

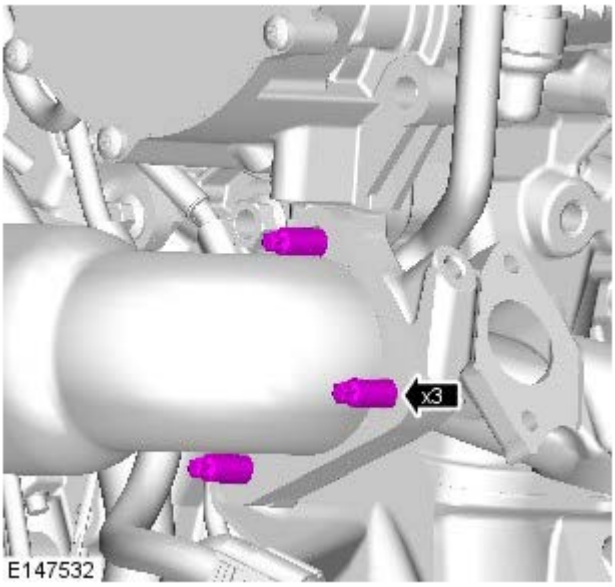


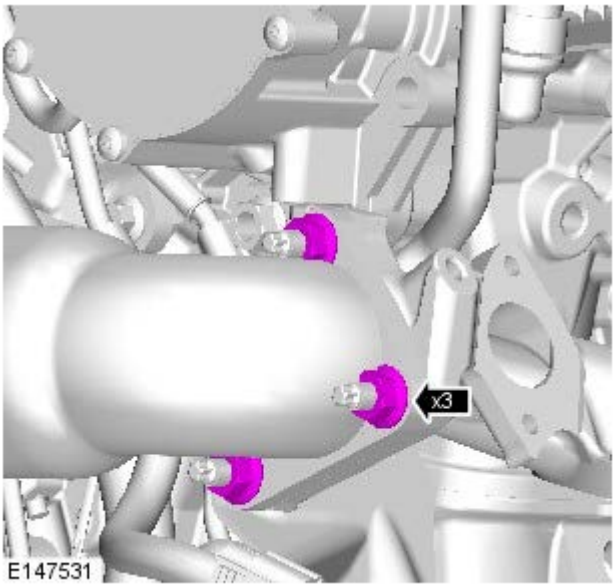
12. NOTE: Tighten the bolts in the indicated sequence.

Torque: 28 Nm

13. CAUTION: Install new studs.

Torque: 13 Nm





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

    Torque: 24 Nm

15. Refer to: Turbocharger RH (303-04B Fuel Charging and Controls - Turbocharger - SDV6 3.0L Diesel - Hybrid Electric Vehicle/TDV6 3.0L Diesel, Removal and Installation).

16. Connect the battery ground cable

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

Published: 01-Jul-2013

Engine - TDV6 3.0L Diesel - Engine Mount LH

Removal and Installation

Removal

NOTES:

Some components shown removed for clarity.

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

1. Disconnect the battery ground cable.

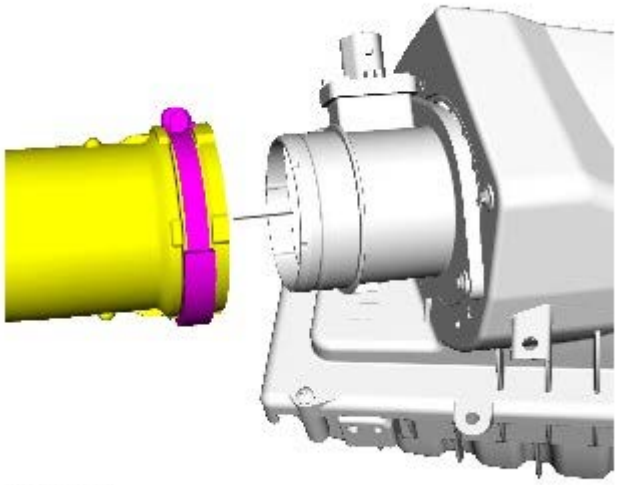
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

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

3. Refer to: Air Conditioning (A/C) Compressor - TDV6 3.0L Diesel (412-01 Climate Control, Removal and Installation).

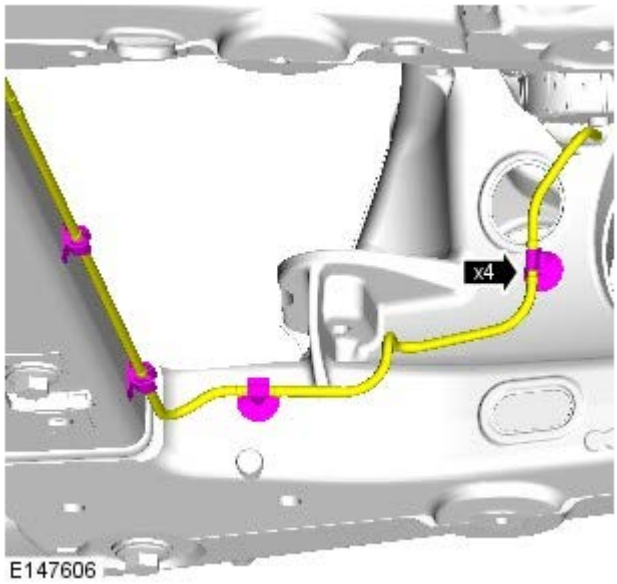
4. NOTE: Make sure the retaining clip is correctly installed and tightened.

   Torque: 3 Nm



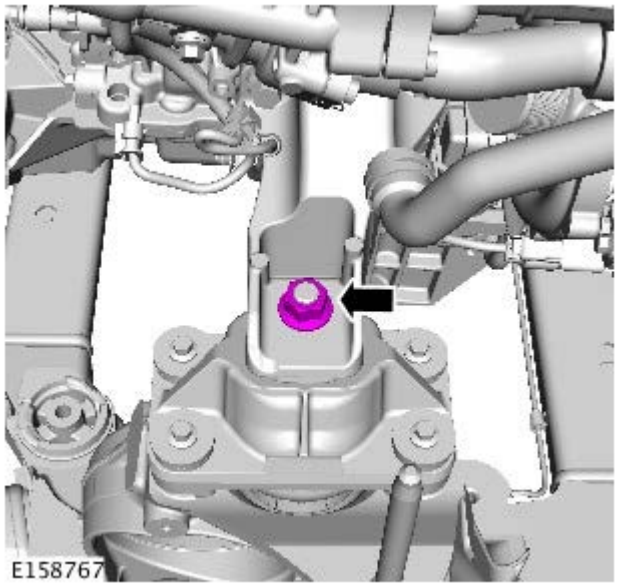
E157217

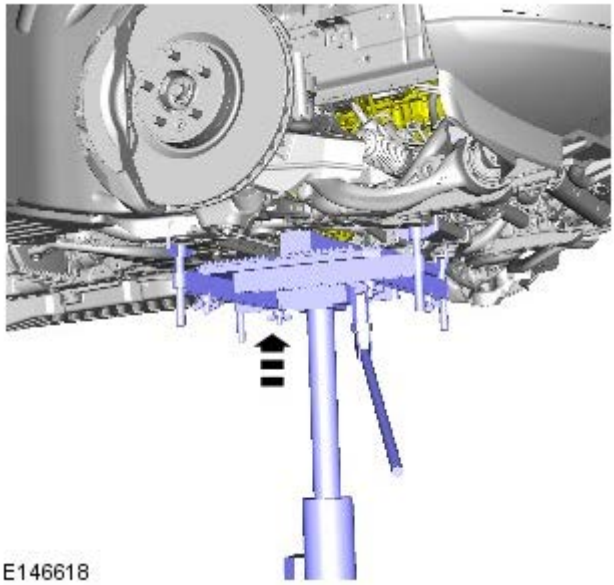
5.



E147606

6.

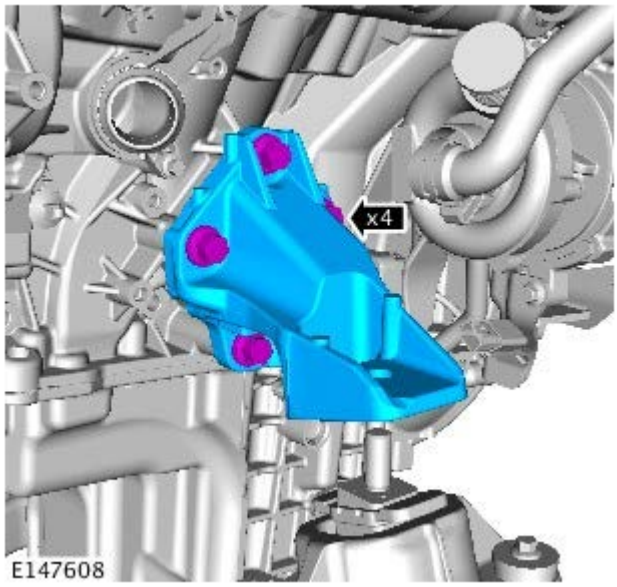




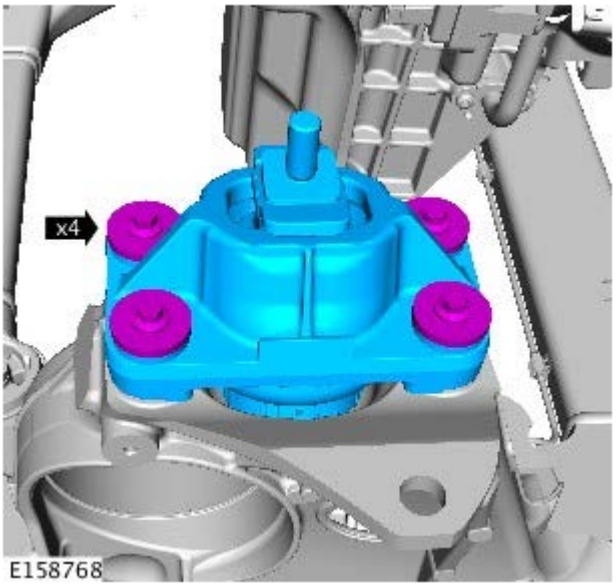
7. CAUTION: Use a wooden block to protect the oil pan when supporting the engine.

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

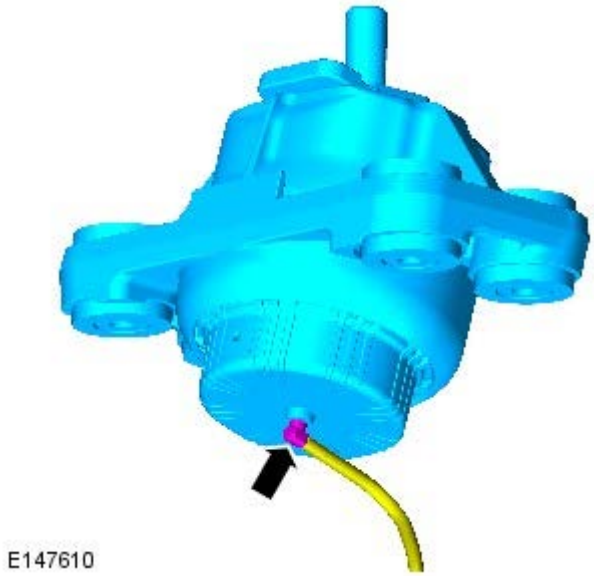
8.



9. CAUTION: Discard the bolts.

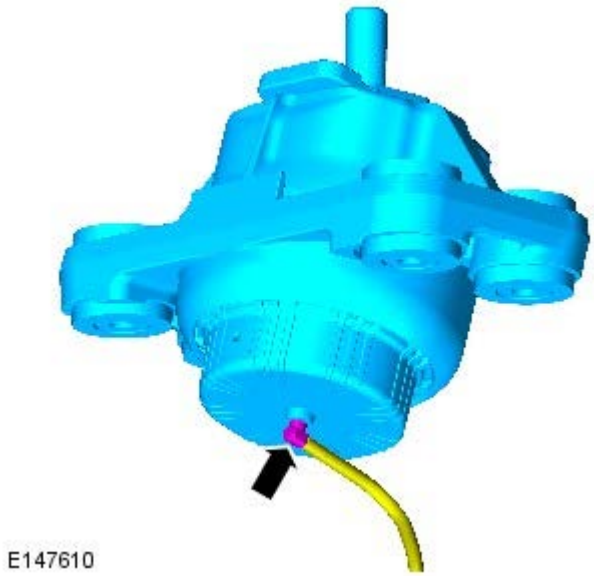


10.

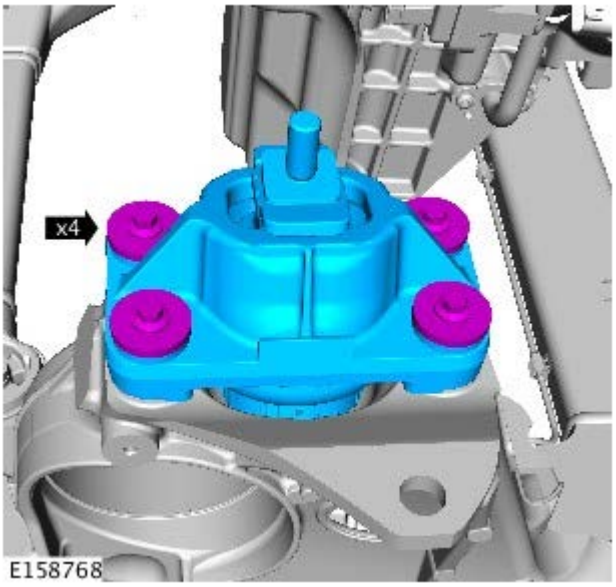


Installation

1.

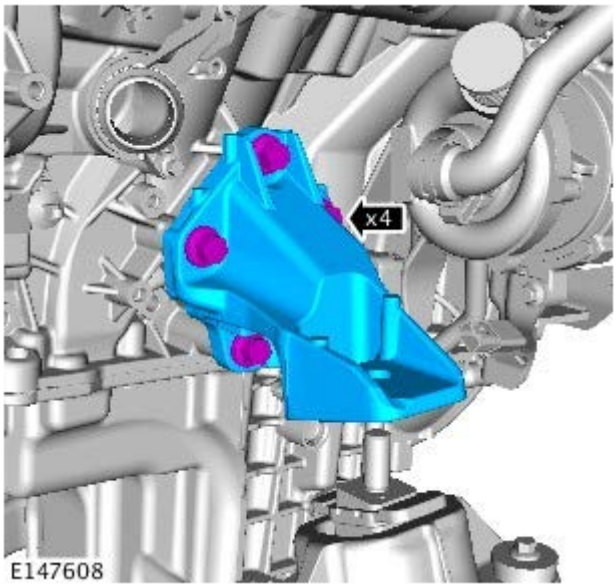


2. CAUTION: Only tighten the nut finger tight at this stage.

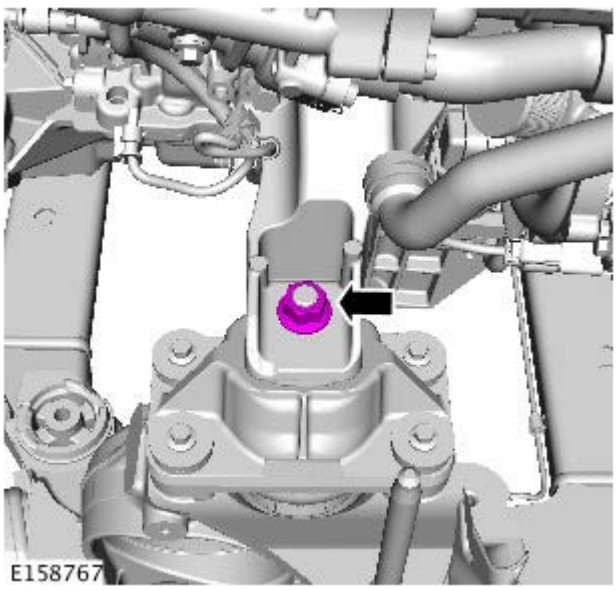


NOTE: Make sure that new bolts are installed.

3. *Torque:* 115 Nm



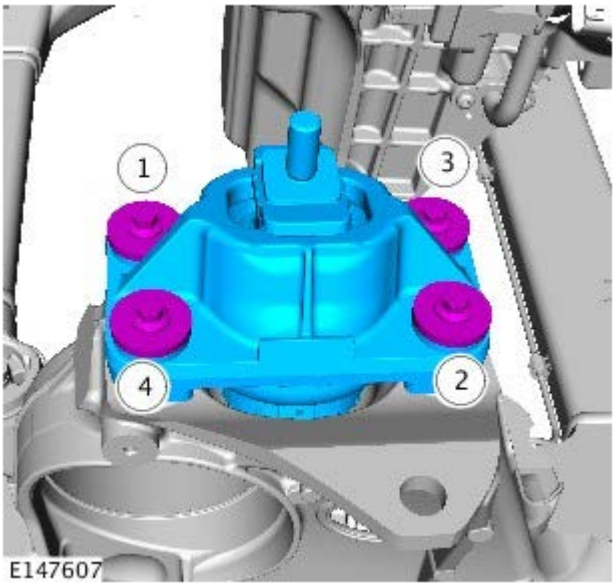
4. Lower the engine onto the mount.



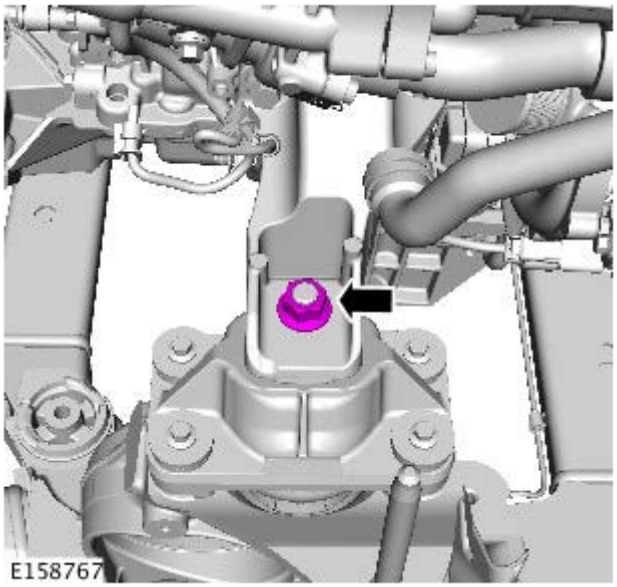
5. CAUTION: Only tighten the nut finger tight at this stage.

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

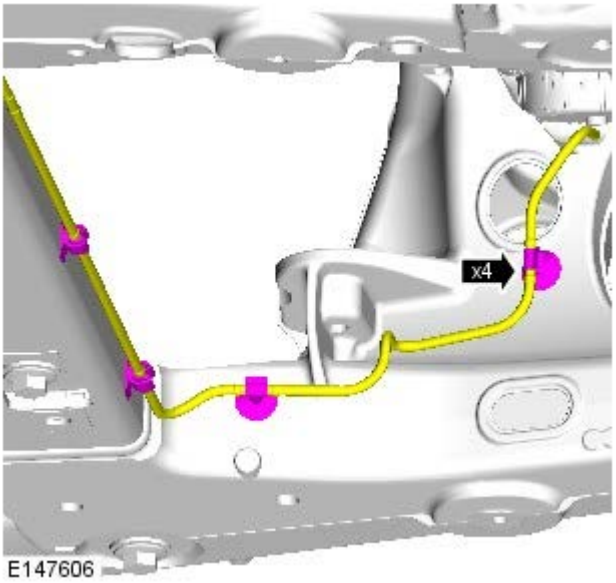
   Torque: 40 Nm



7. *Torque:* 130 Nm

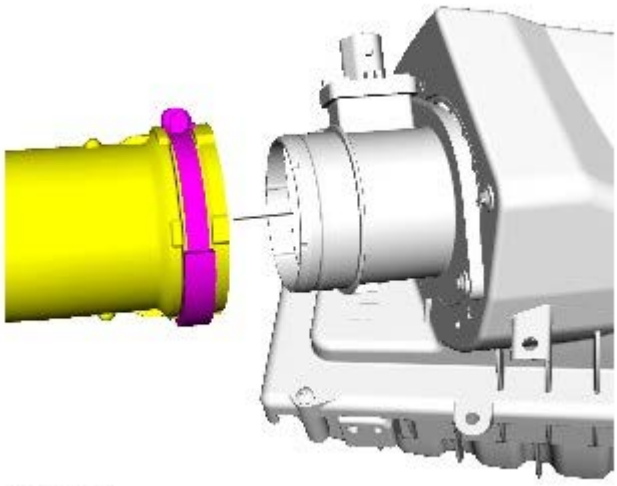


8.



9. NOTE: Make sure the retaining clip is correctly installed and tightened.

   Torque: 3 Nm



E157217

10. Refer to: Air Conditioning (A/C) Compressor - TDV6 3.0L Diesel (412-01 Climate Control, Removal and Installation).

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

12. Connect the battery ground cable.

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

Published: 01-Jul-2013

Engine - TDV6 3.0L Diesel - Engine Mount RH

Removal and Installation

Removal

NOTES:

Some components shown removed for clarity.

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

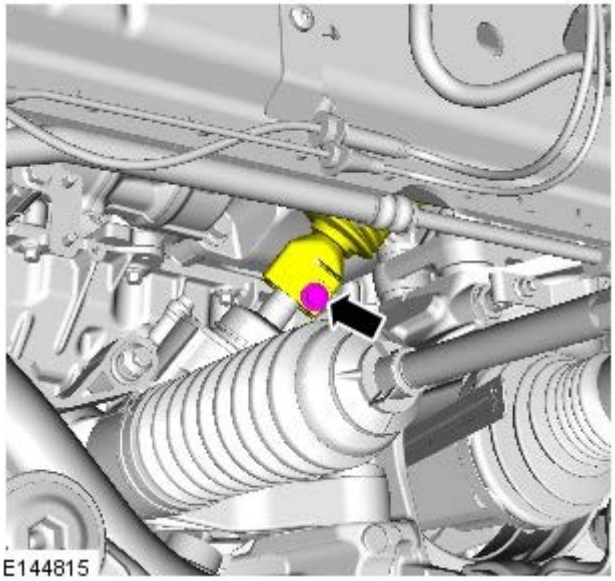
1. Disconnect the battery ground cable.

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

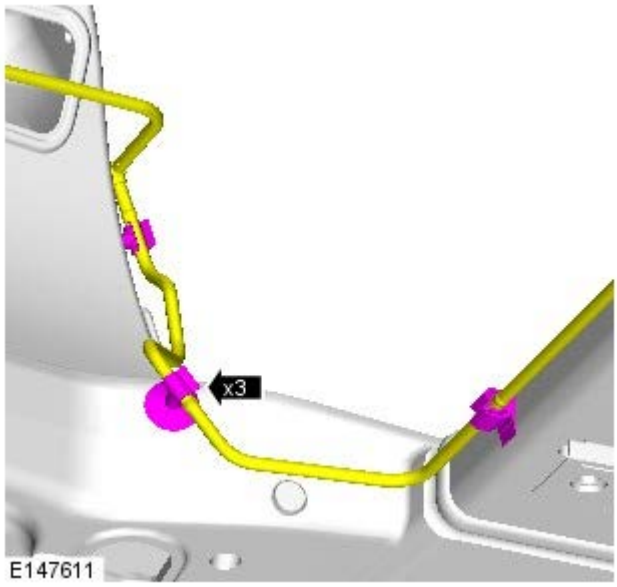
2. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

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

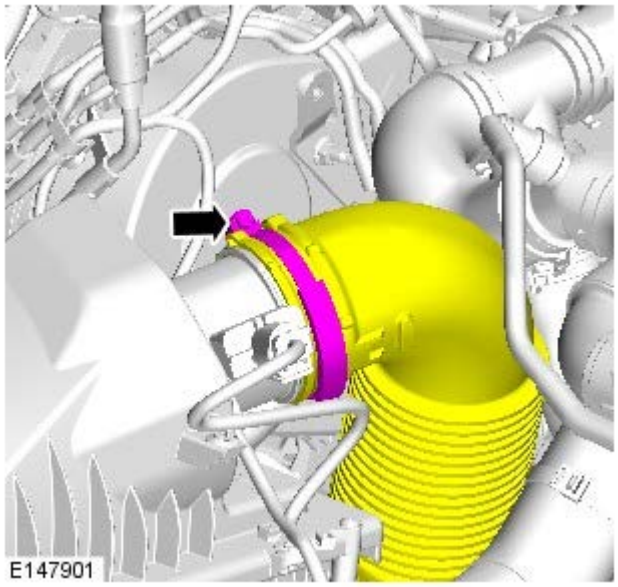
4. Align the steering wheel to straight ahead.



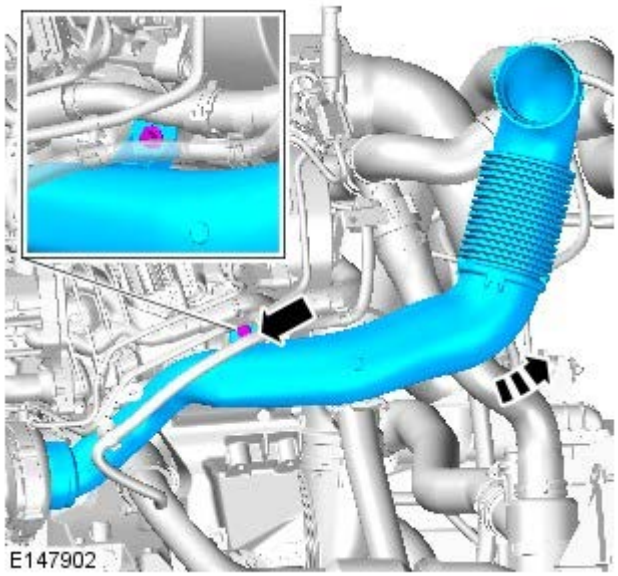
5.



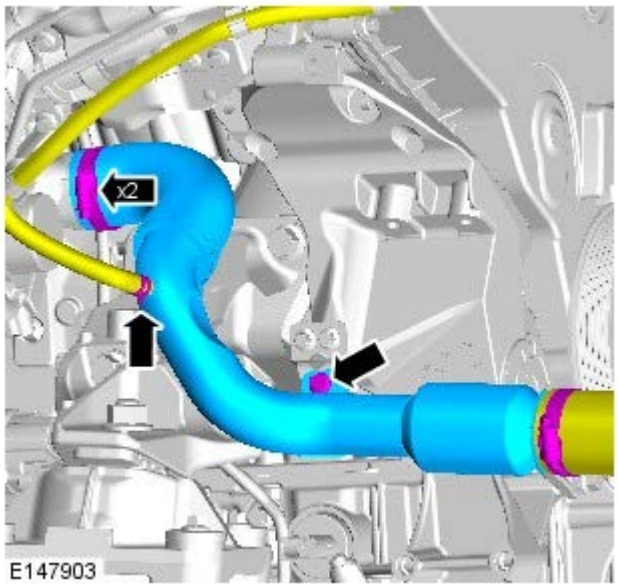
6.



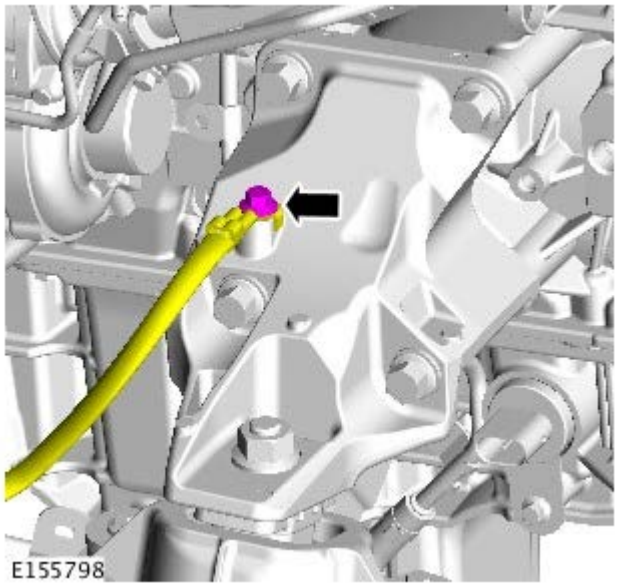
7.



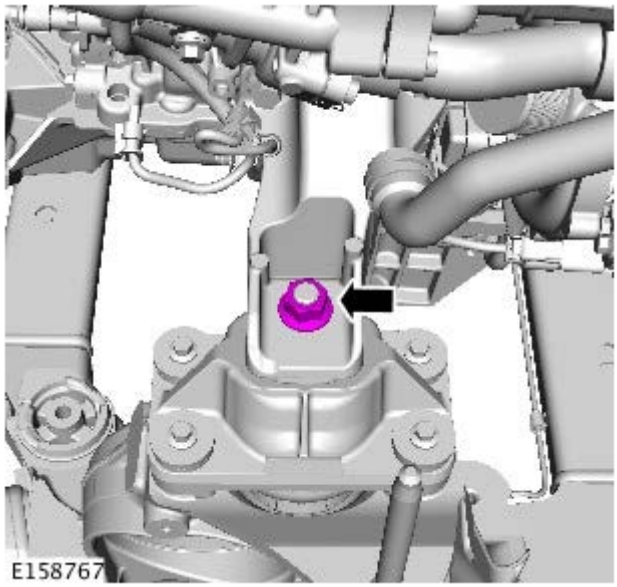
8.



9.

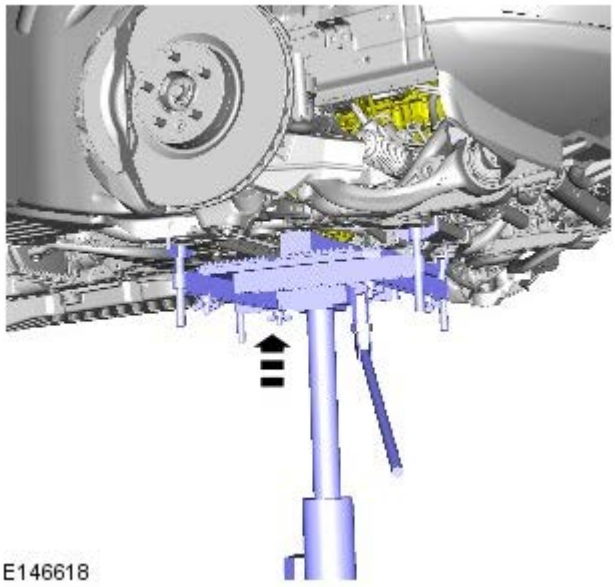


10.

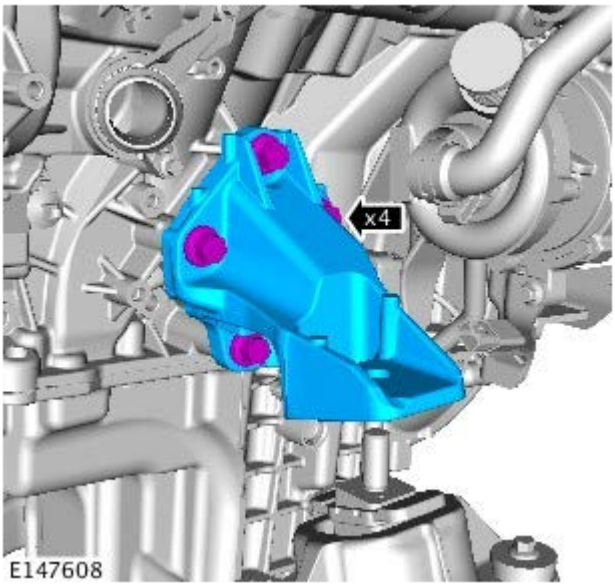


11. CAUTION: Use a wooden block to protect the oil pan when supporting the engine.

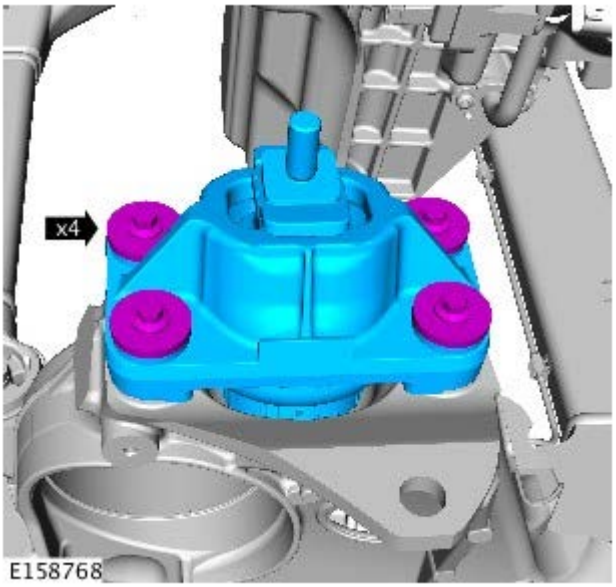
Using a suitable hydraulic jack, raise and support the engine.



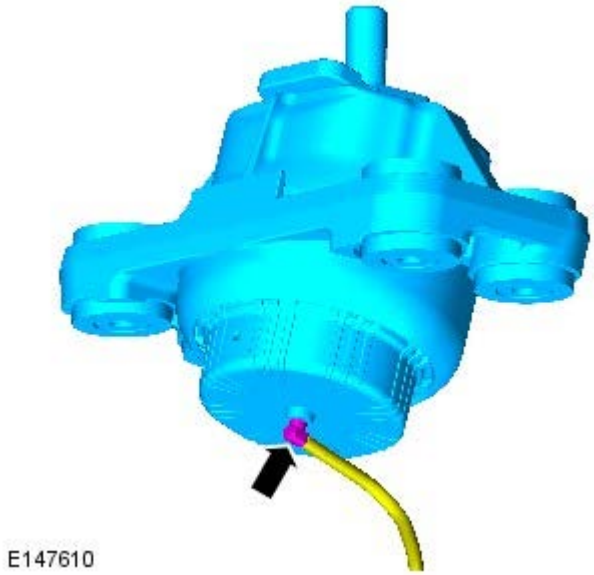
12.



13. CAUTION: Discard the bolts.

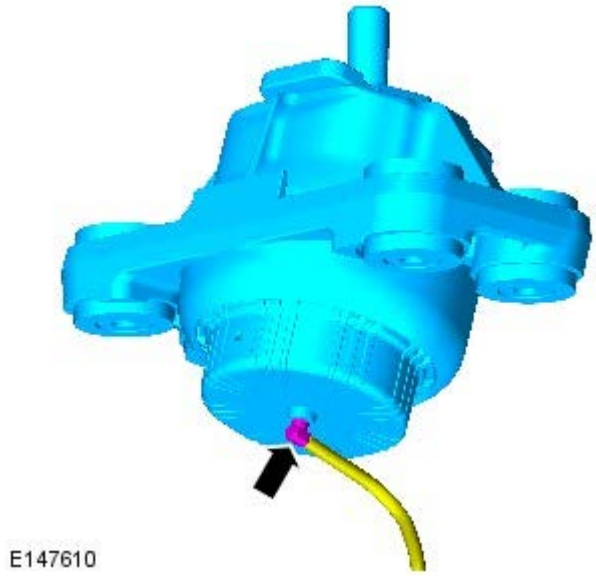


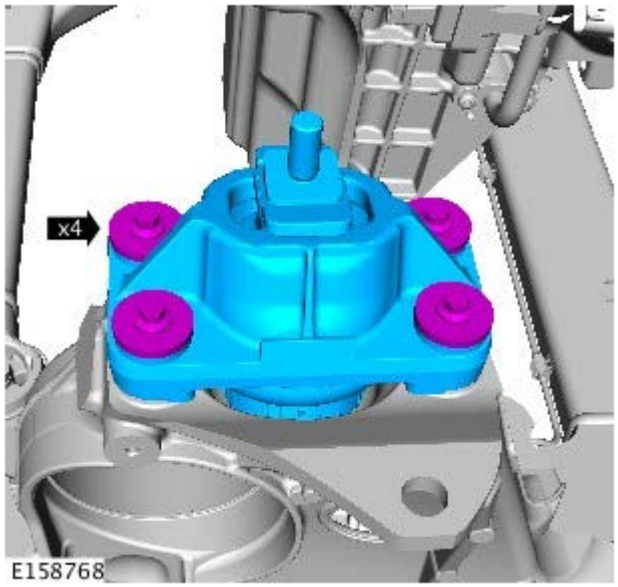
14.



Installation

1.

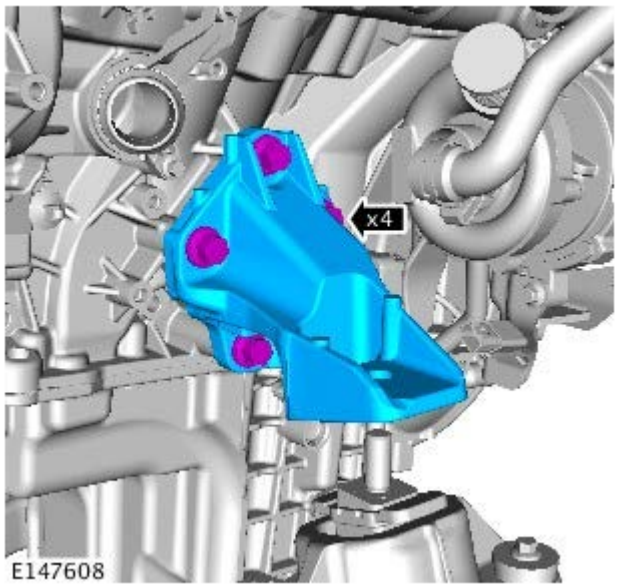




2. CAUTION: Only tighten the bolts finger tight at this stage.

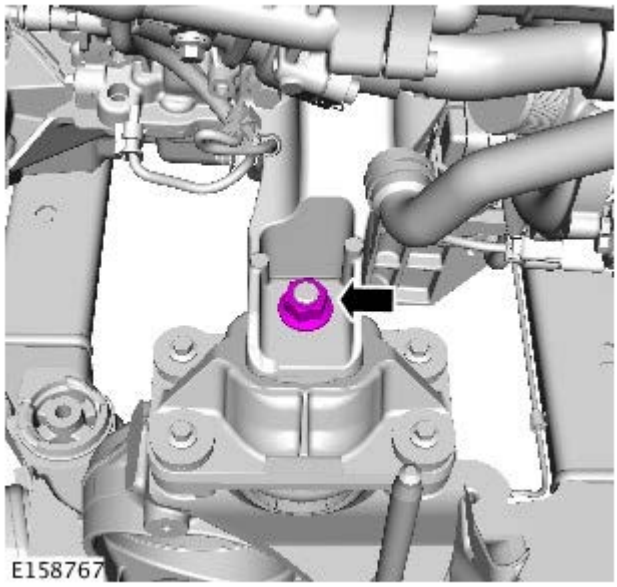
NOTE: Make sure that new bolts are installed.

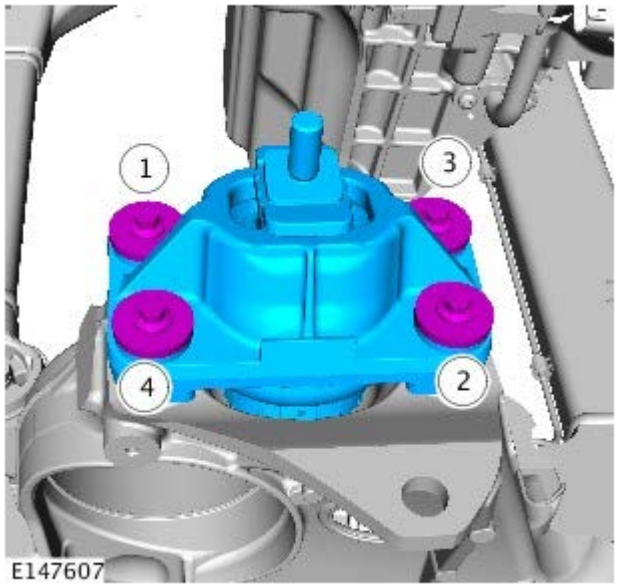
3. *Torque:* 115 Nm



4. Lower the engine onto the mount.

5. CAUTION: Only tighten the nut finger tight at this stage.

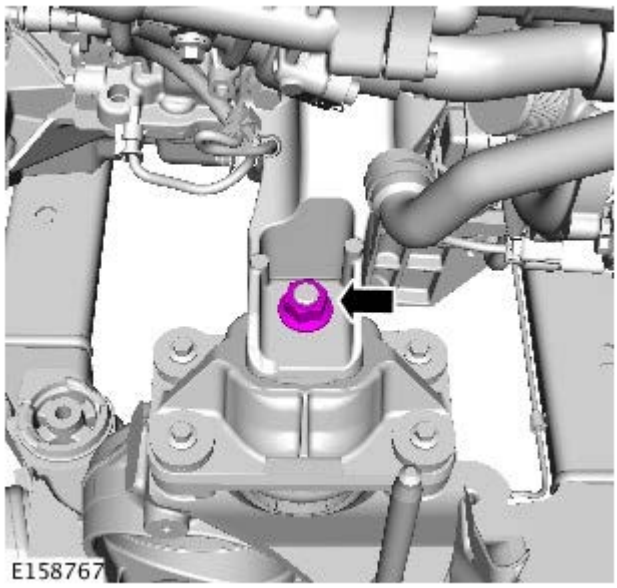




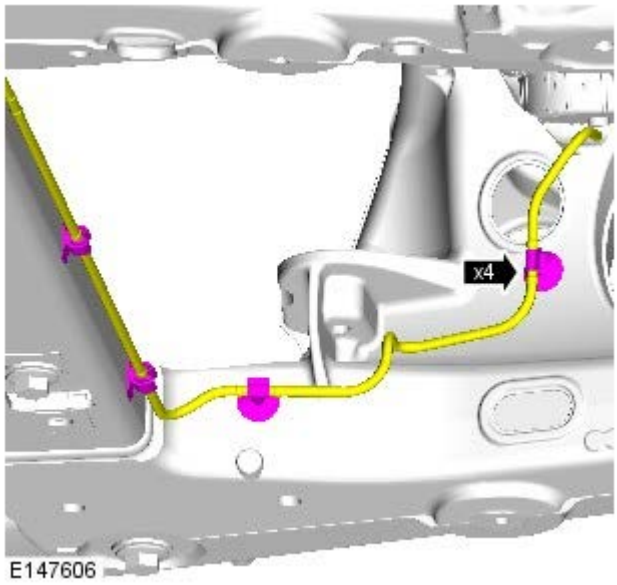
6. CAUTION: Tighten the bolts in the sequence shown.

   Torque: 40 Nm

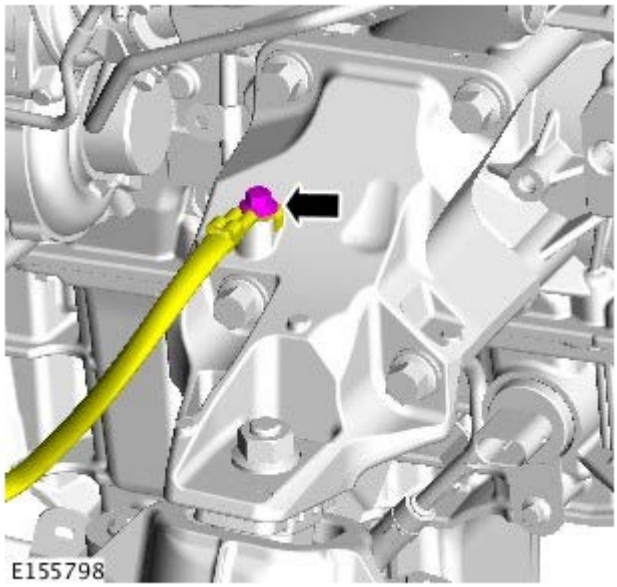
7. *Torque:* 130 Nm



8.



9. *Torque:* 25 Nm



10. CAUTION: Make sure a new bolt is installed.

NOTES:

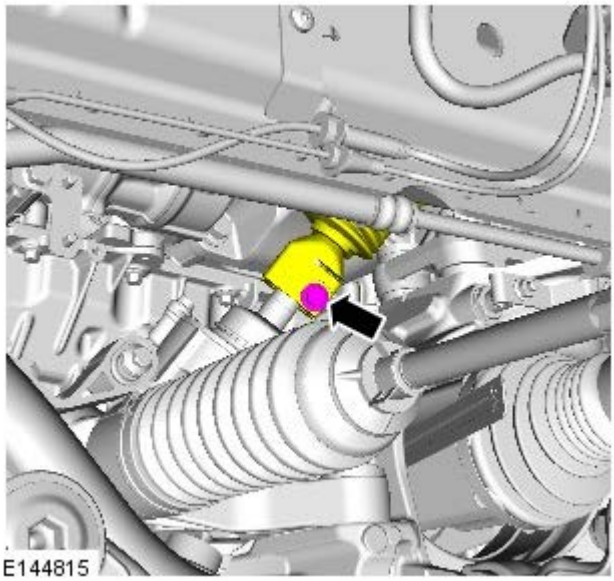
Make sure to clean the threads prior to installation.

Left-hand shown, right-hand similar.

Right hand drive only.

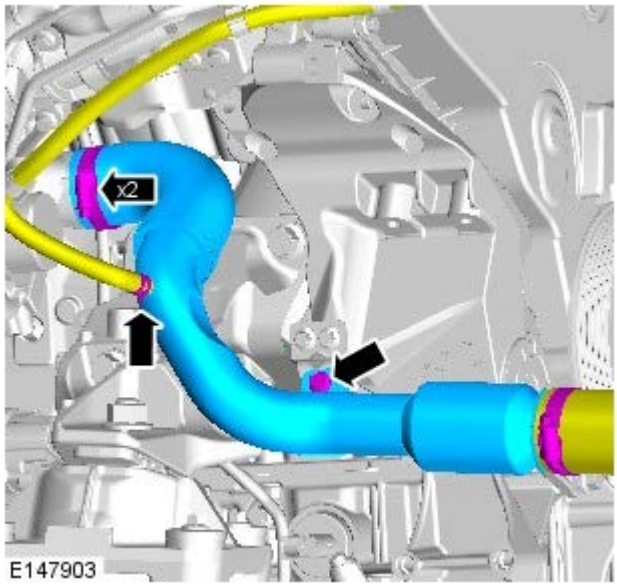
Align the steering wheel to straight ahead.

Torque: 30 Nm



11. NOTES:

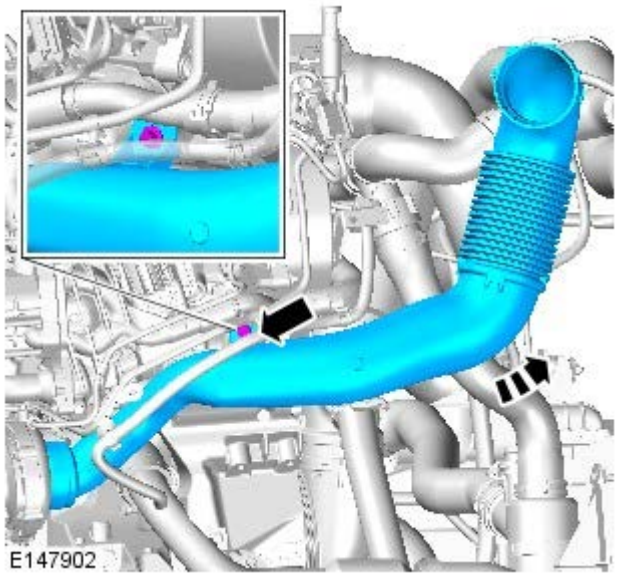
Make sure the retaining clips is correctly installed and tightened.

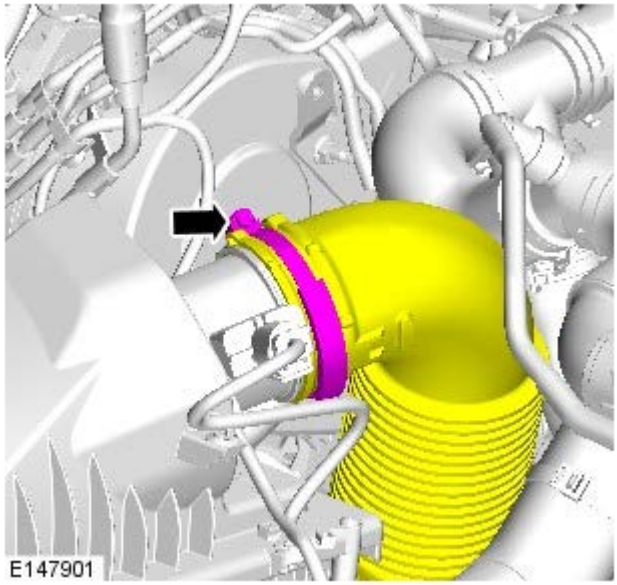


Left-hand shown, right-hand similar.

Torque: 10 Nm

12. *Torque:* 10 Nm





13. NOTE: Make sure the retaining clip is correctly installed and tightened.

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

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

16. Connect the battery ground cable.

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

Published: 15-Mar-2013

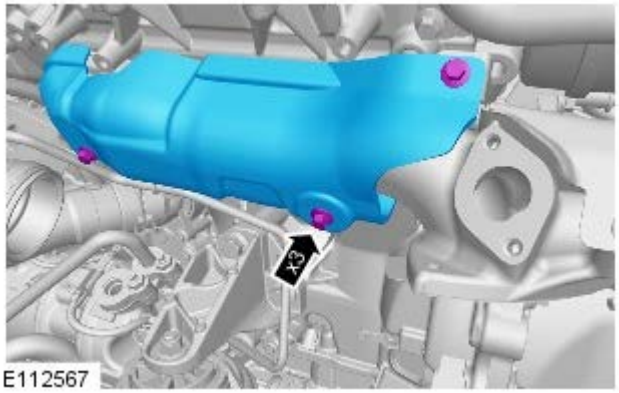
Engine - TDV6 3.0L Diesel - Exhaust Manifold LH

Removal and Installation

Removal

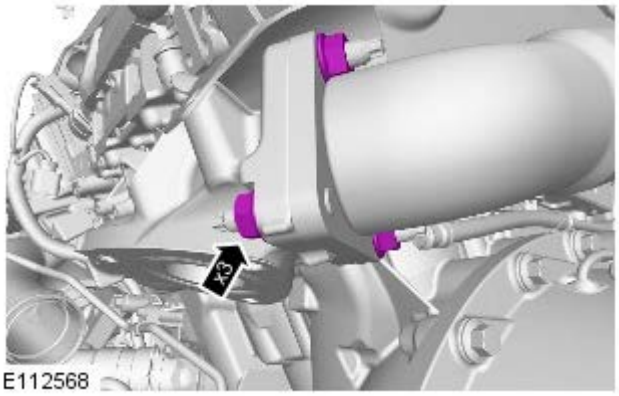
NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. Refer to: Turbocharger LH - TDV6 3.0L Diesel (303-04B Fuel Charging and Controls - Turbocharger - SDV6 3.0L Diesel - Hybrid Electric Vehicle/TDV6 3.0L Diesel, Removal and Installation).
2. Refer to: Exhaust Gas Recirculation (EGR) Valve LH (303-08A Engine Emission Control - TDV6 3.0L Diesel, Removal and Installation).
3.



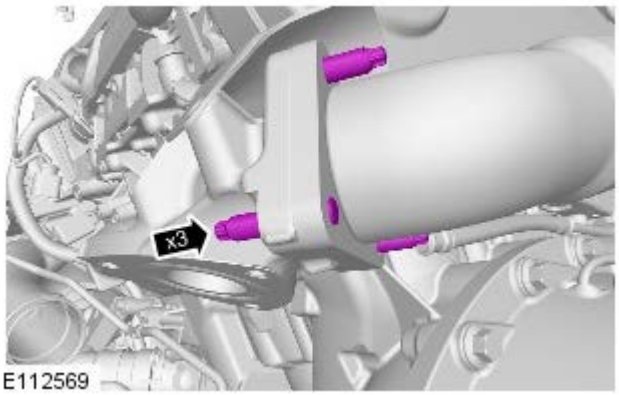
E112567

4. CAUTION: Discard the nuts.



E112568

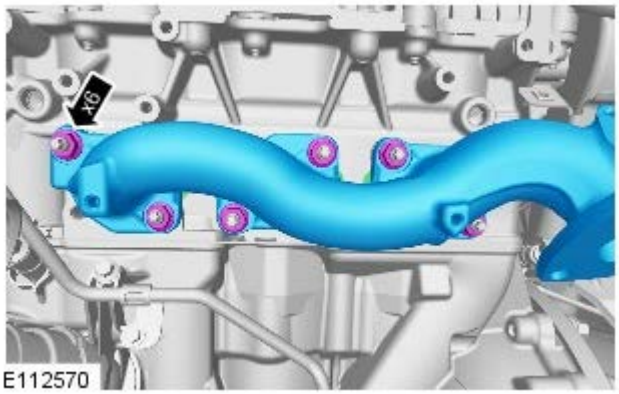
5. CAUTION: Discard the studs.



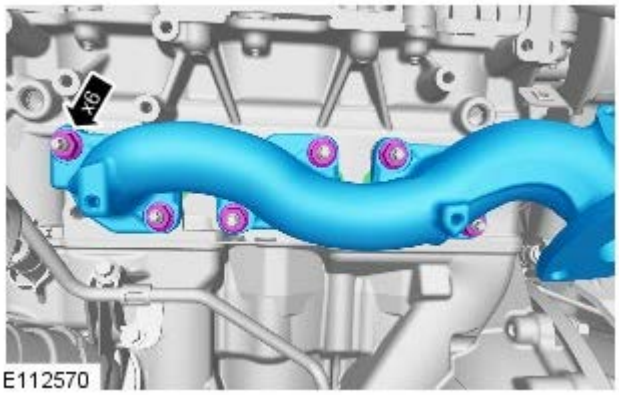
E112569

6. CAUTION: Discard the nuts.

NOTE: Discard the gasket.



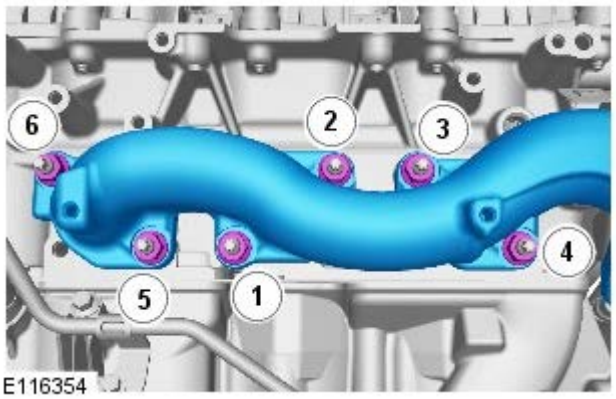
Installation



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

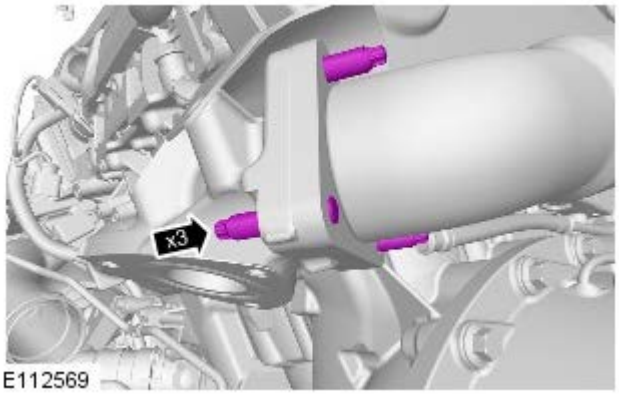
   CAUTION: Only tighten the bolt finger-tight at this stage.

   NOTE: Install a new gasket.



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

   Torque: 28 Nm

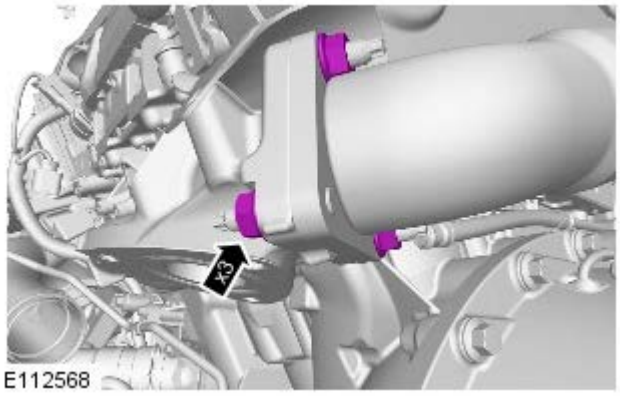


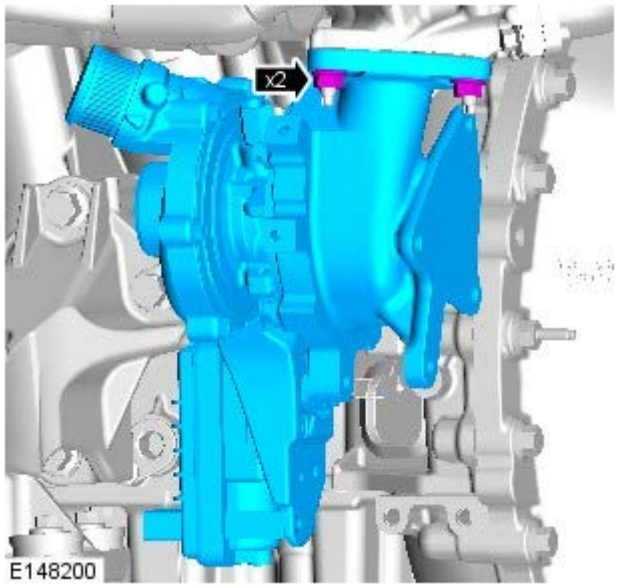
3. CAUTION: Install new studs.

   Torque: 13 Nm

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

   Torque: 24 Nm





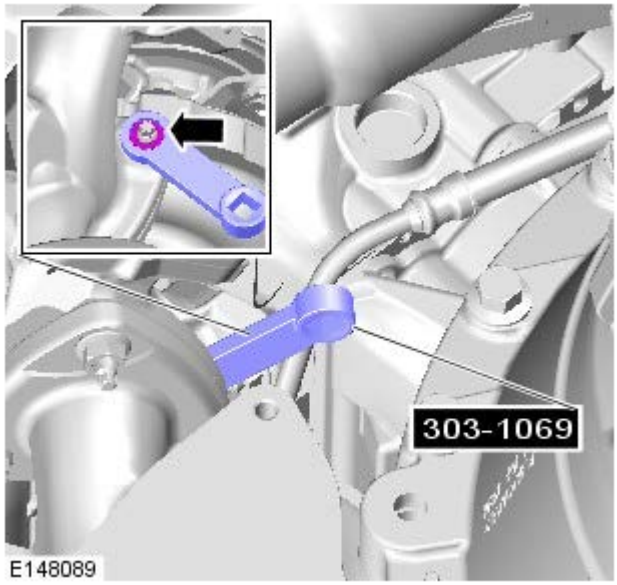
5. WARNING: Make sure that new nuts are installed.

   CAUTIONS:

   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.

   Torque: 24 Nm



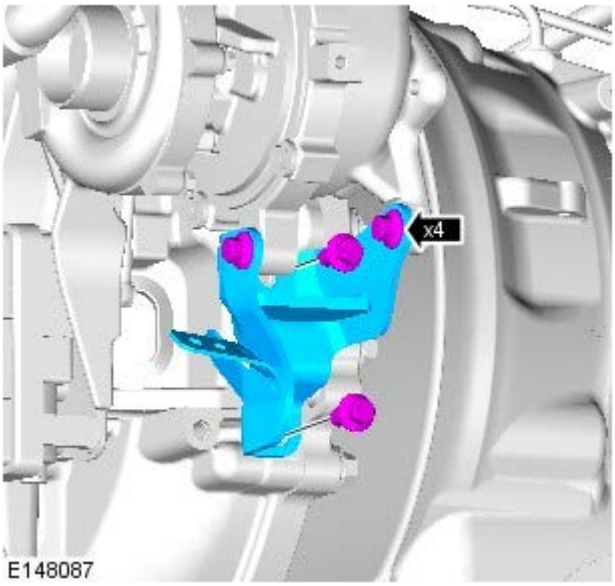
6. WARNING: Make sure that a new nut is installed.

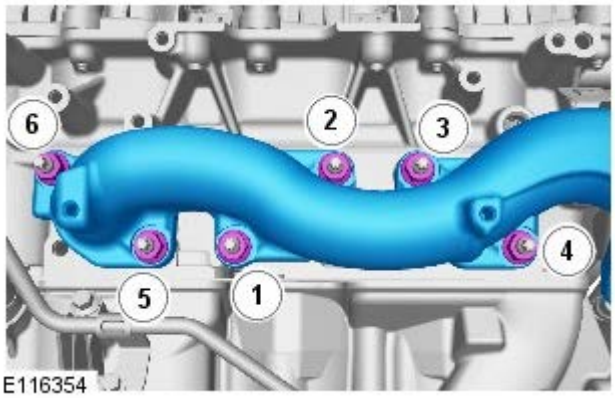
   Torque: 24 Nm

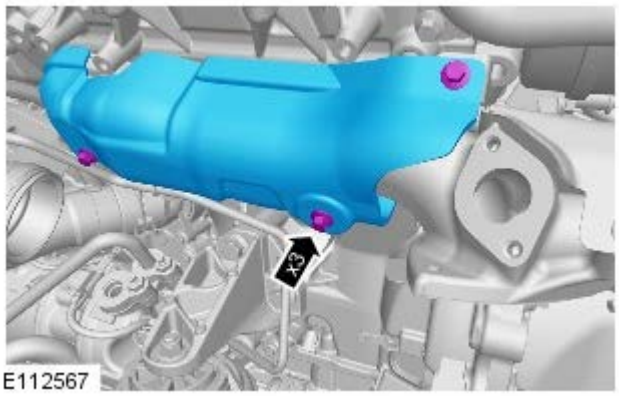
7. CAUTION: Apply Loctite 243 to the bolts.

   NOTE: Make sure to clean the threads prior to installation.

   Torque: 32 Nm







8. NOTES:

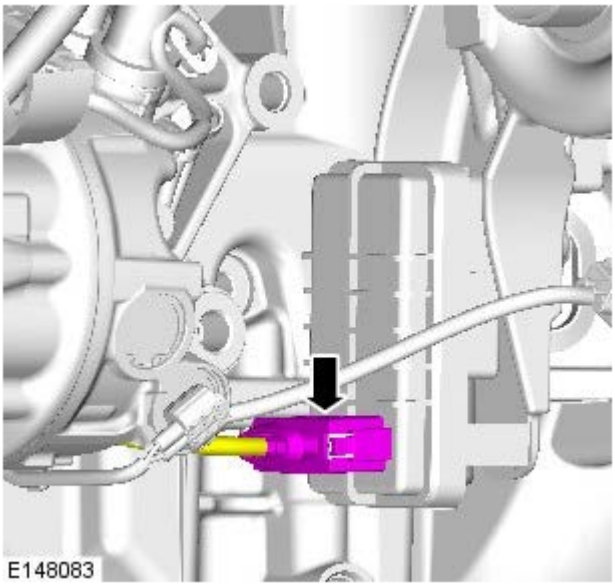
   Tighten the bolts in the indicated sequence.

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

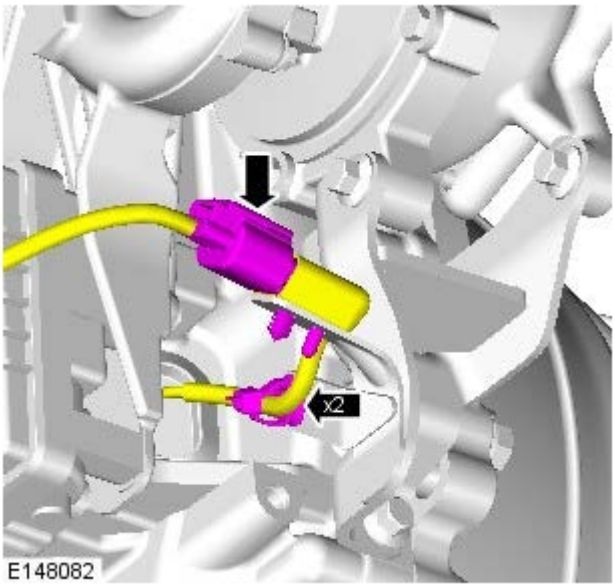
   Torque: 28 Nm

9. *Torque:* 10 Nm

10.



11.

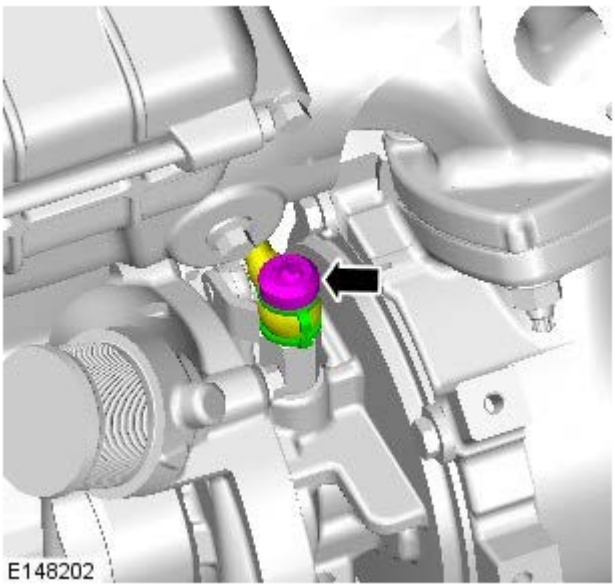


12. CAUTIONS:

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

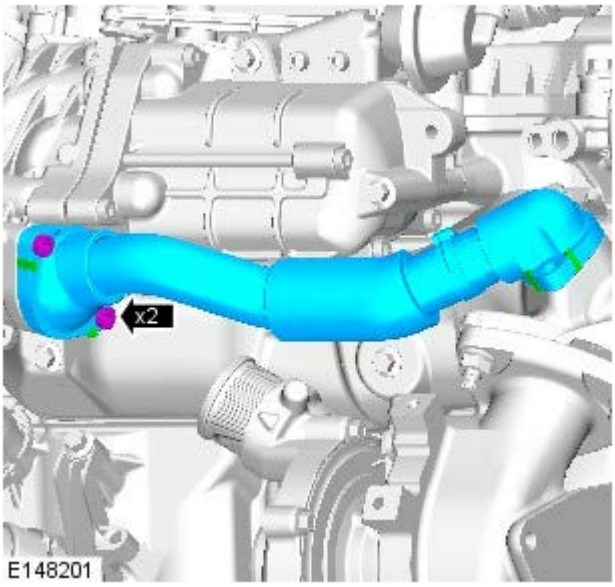
Make sure that new sealing washers are installed.

Torque: 30 Nm

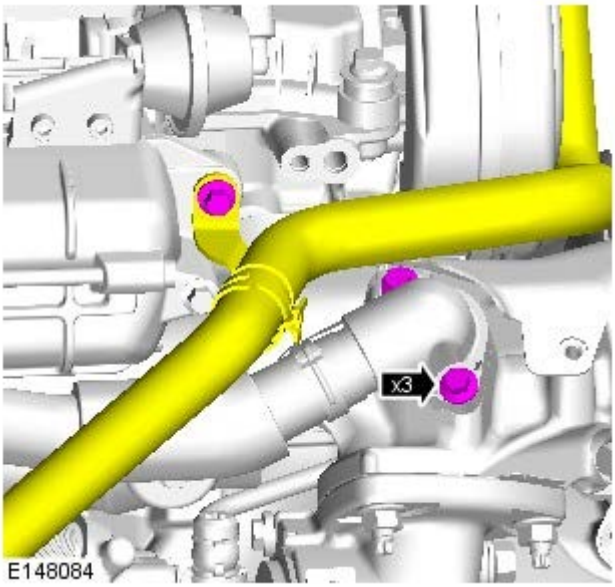


13. CAUTION: Install a new gasket.

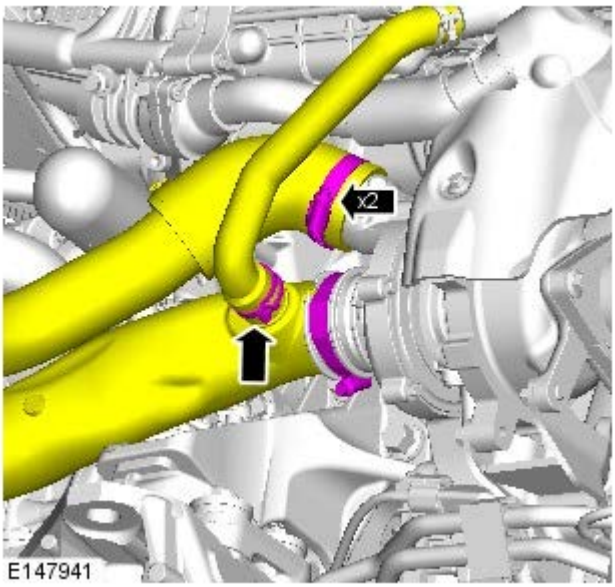
Torque: 6 Nm



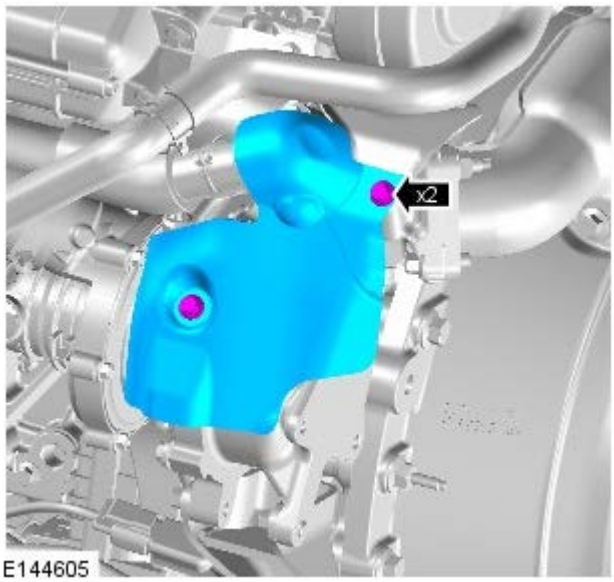
14. *Torque:* 10 Nm

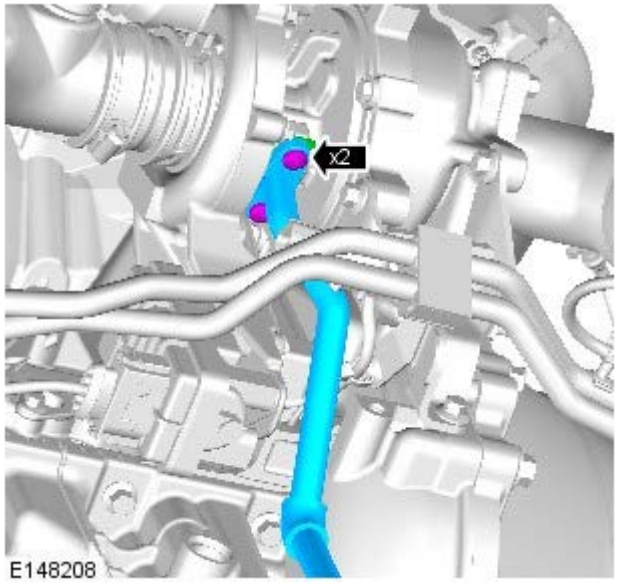


15.



16. *Torque:* 9 Nm

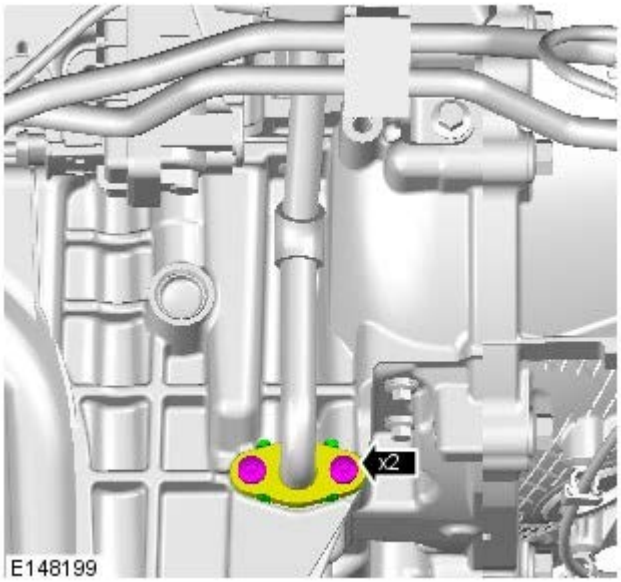




17. CAUTION: Make sure that the area around the component is clean and free of foreign material.

NOTE: Install new gaskets.

Torque: 9 Nm



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

NOTE: Install a new gasket.

Torque: 9 Nm

19. Refer to: Exhaust Gas Recirculation (EGR) Valve LH (303-08A Engine Emission Control - TDV6 3.0L Diesel, Removal and Installation).

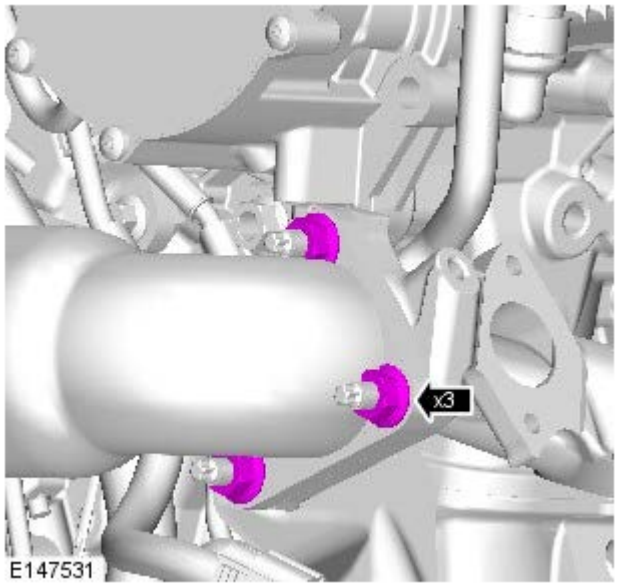
Published: 01-Aug-2012

Engine - TDV6 3.0L Diesel - Exhaust Manifold RH

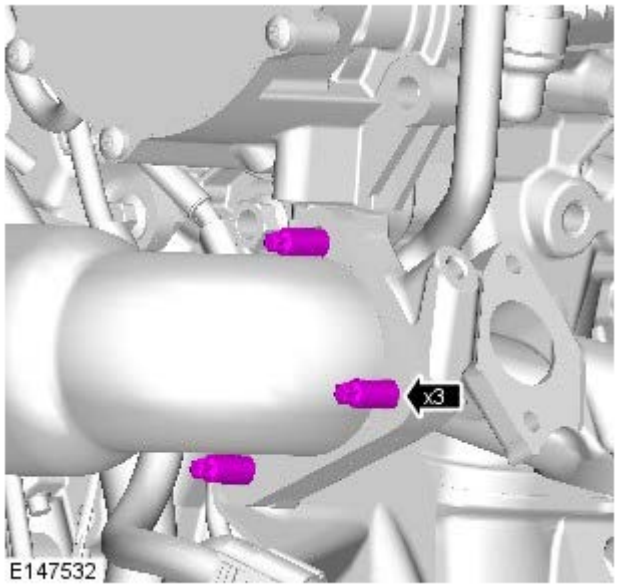
Removal and Installation

Removal

1. Refer to: Turbocharger RH (303-04, Removal and Installation).



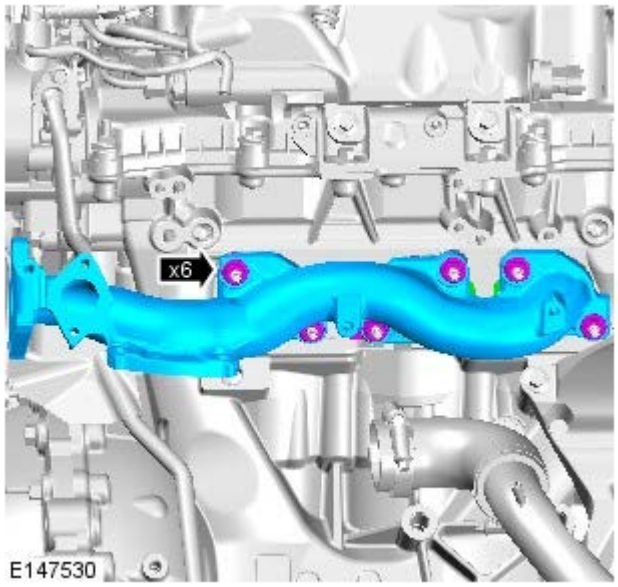
2. CAUTION: Discard the nuts.



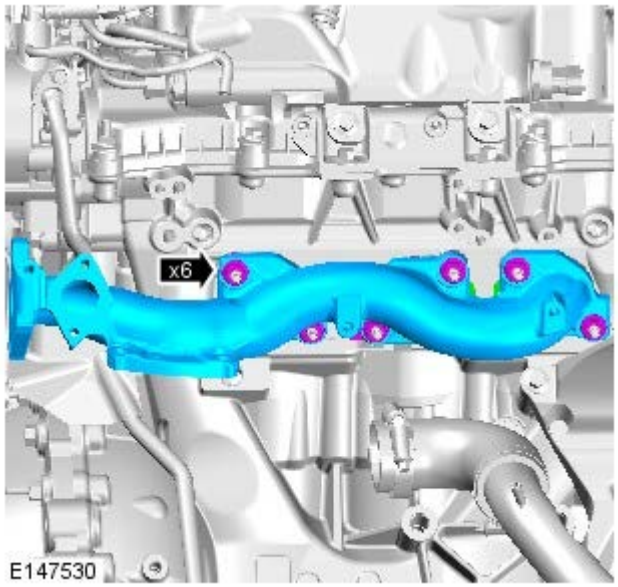
3. CAUTION: Discard the studs.

4. CAUTION: Discard the nuts.

NOTE: Remove and discard the gasket.



Installation

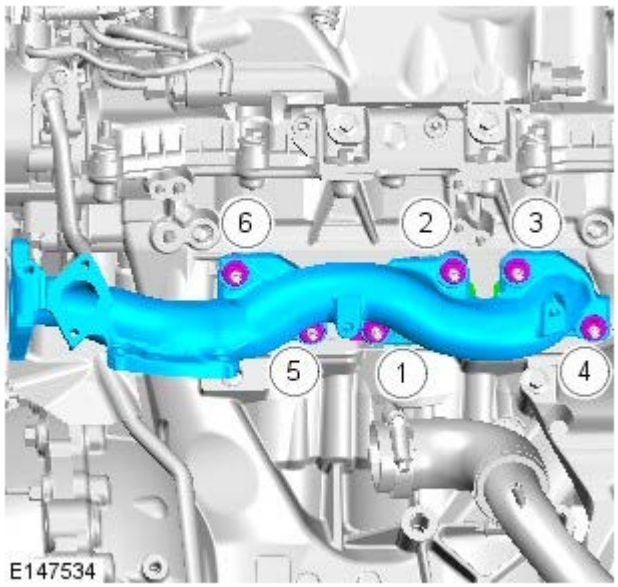


1. CAUTIONS:

   Make sure that new nuts are installed.

   Only tighten the bolts finger-tight at this stage.

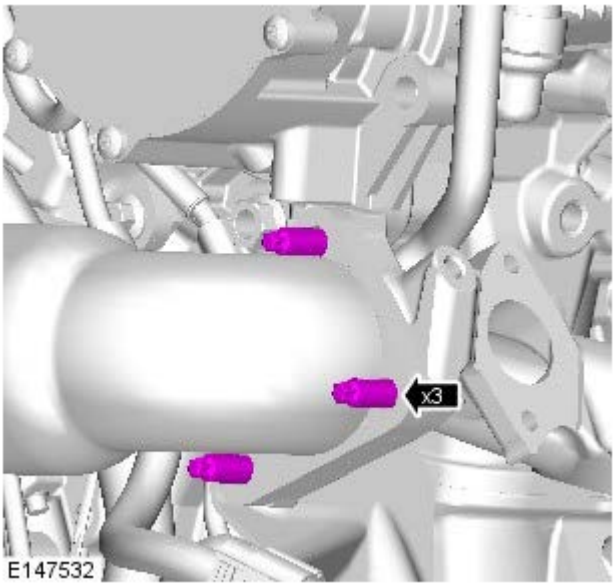
   NOTE: Install a new gasket.



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

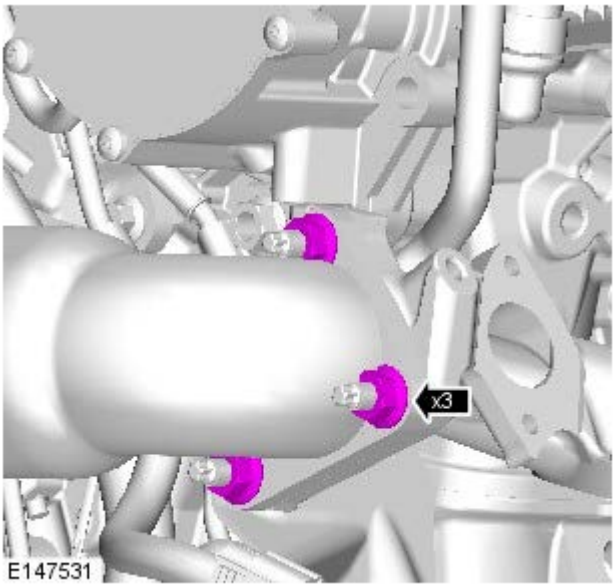
   Torque: 28 Nm

3. CAUTION: Install new studs.



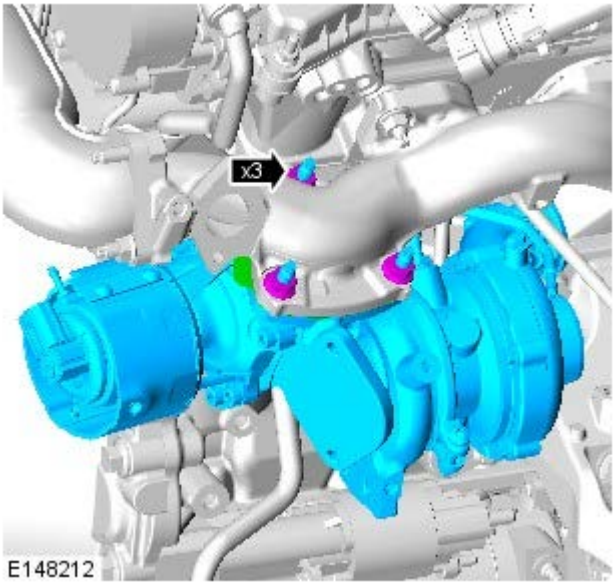
NOTE: Install a new gasket.

Torque: 13 Nm



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

Torque: 24 Nm



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

CAUTIONS:

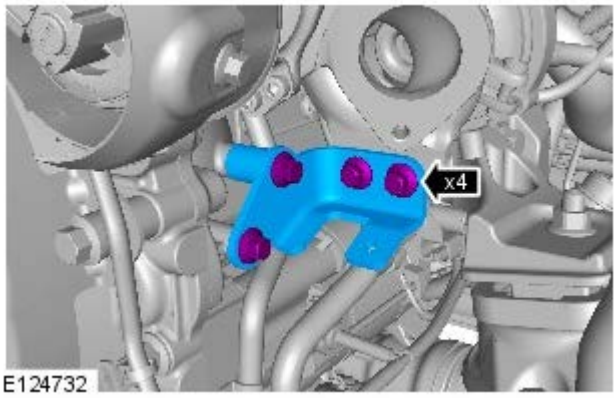
Make sure that the area around the component is clean and free of foreign material.

Install a new turbocharger to exhaust manifold gasket every time the turbocharger is removed.

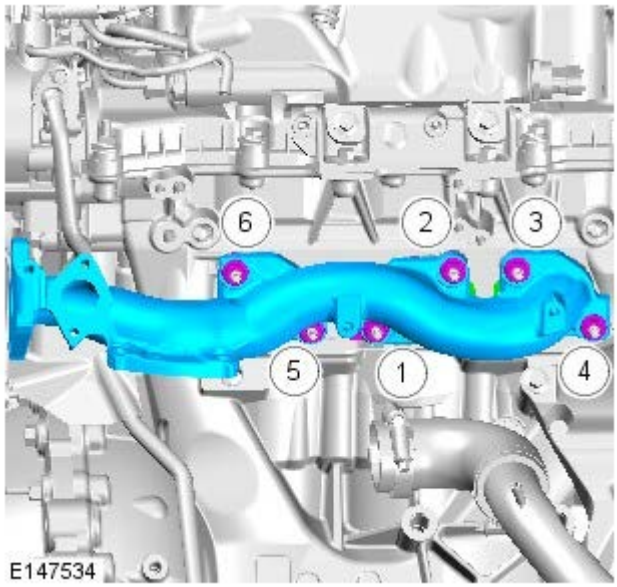
Torque: 24 Nm

6. CAUTION: Apply Loctite 243 to the bolts.

NOTE: Make sure to clean the threads prior to installation.



Torque: 32 Nm



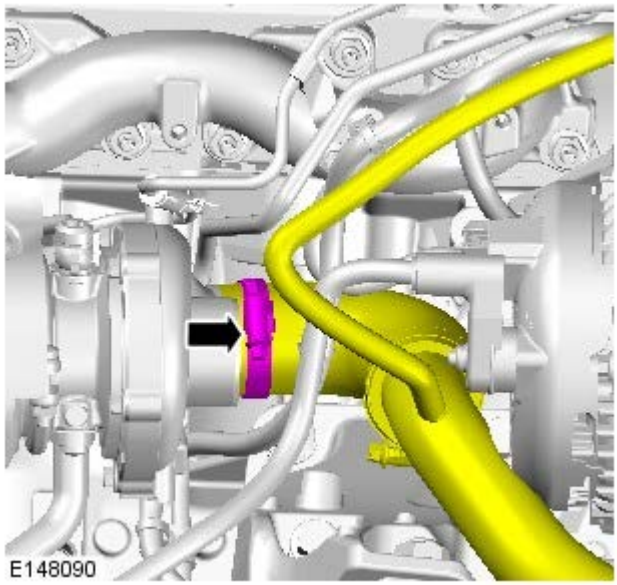
7. NOTES:

   Tighten the bolts in the indicated sequence.

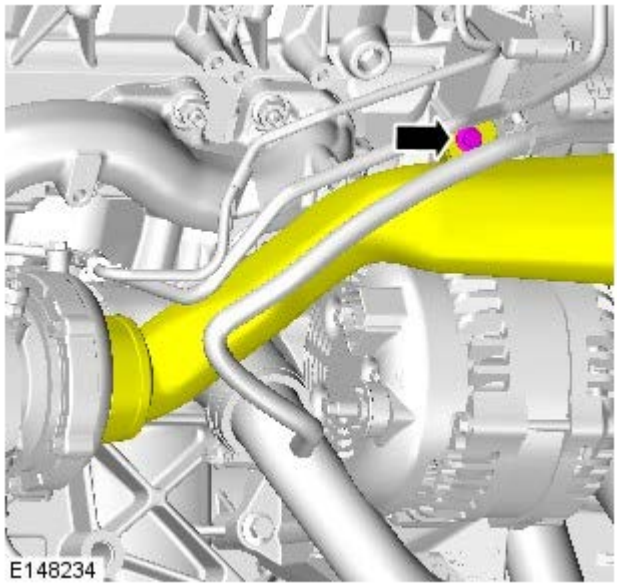
   Some variation in the illustrations may occur, but the essential information is always correct.

   Torque: 28 Nm

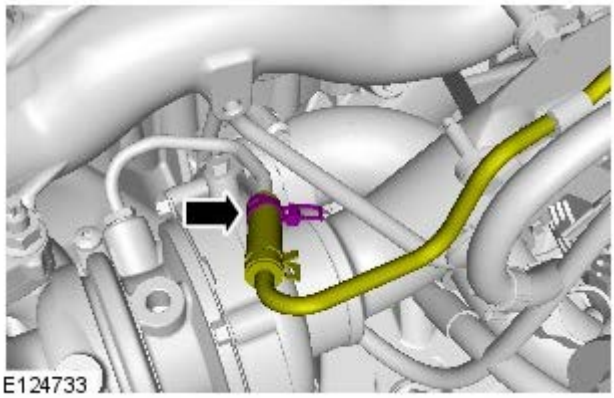
8.



9. *Torque:* 10 Nm



10.

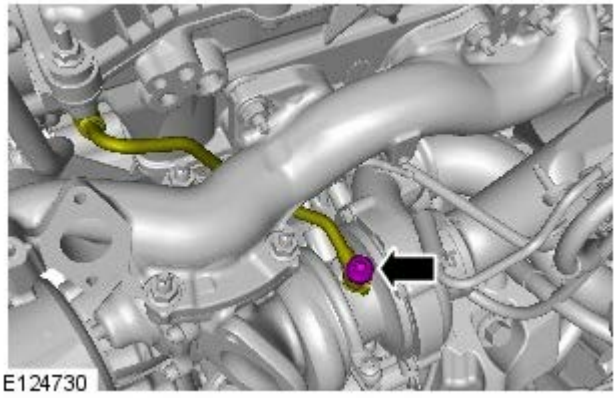


11. CAUTIONS:

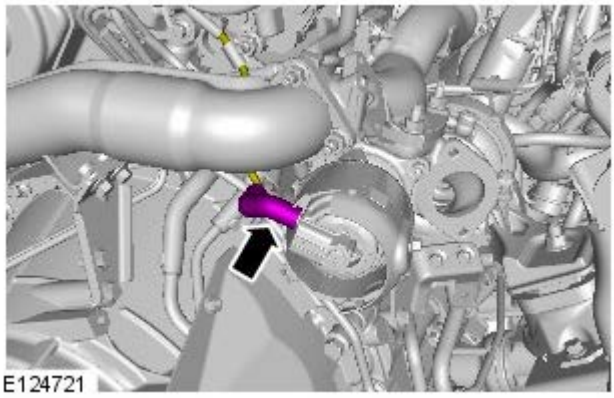
Make sure that new sealing washers are installed.

Make sure that a new bolt is installed.

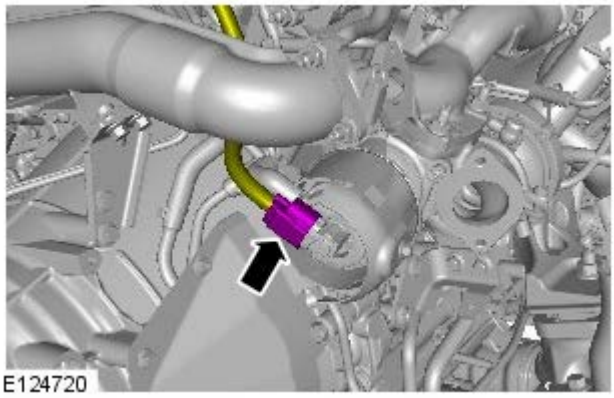
Torque: 30 Nm



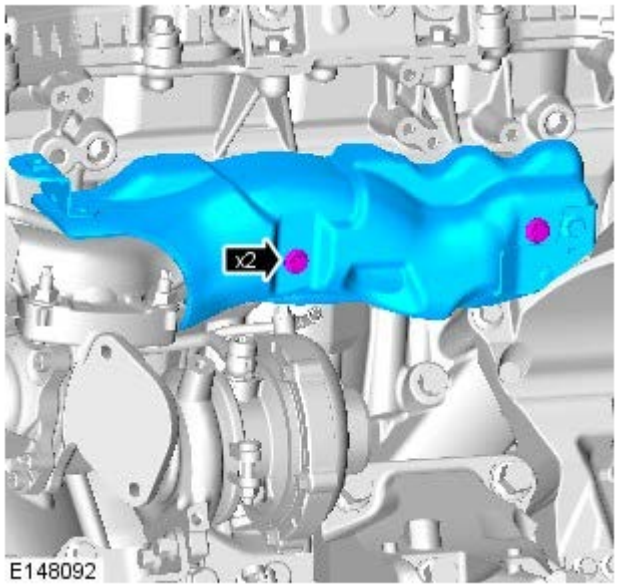
12.



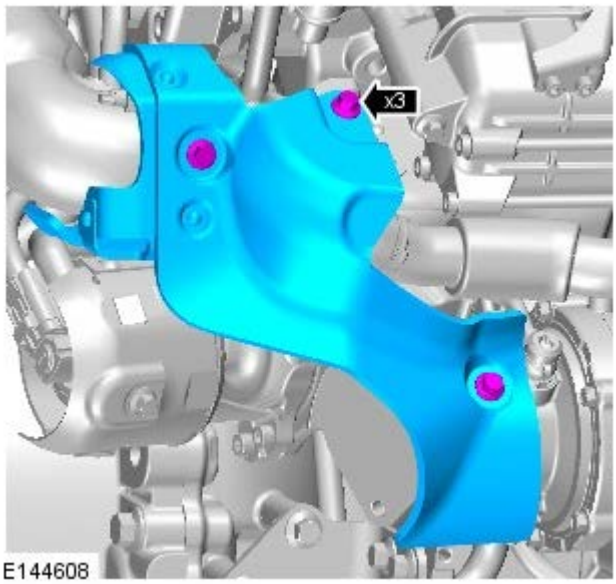
13.



14. *Torque:* 11 Nm

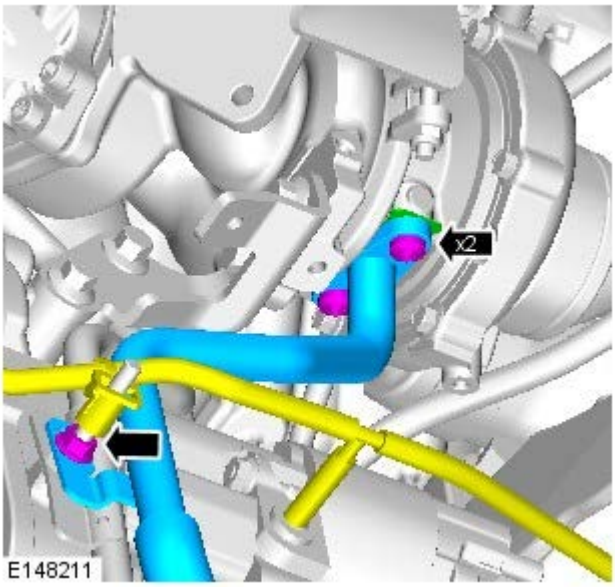


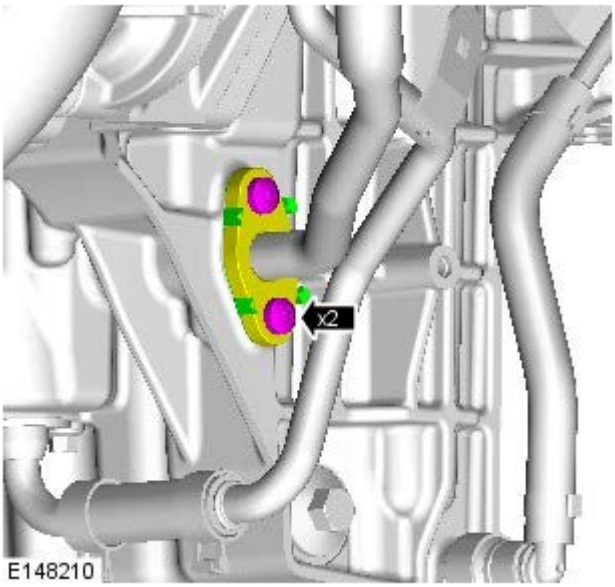
15. *Torque:* 9 Nm



16. NOTE: Install new gaskets.

Torque: 9 Nm





17. NOTE: Install a new gasket.

    Torque: 9 Nm

18. Refer to: Exhaust Gas Recirculation (EGR) Valve RH (303-08A Engine Emission Control - TDV6 3.0L Diesel, Removal and Installation).

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

Published: 08-Aug-2012

Engine - TDV6 3.0L Diesel - Exhaust Manifold Crossover Pipe

Removal and Installation

General Equipment

Transmission jack

Removal

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

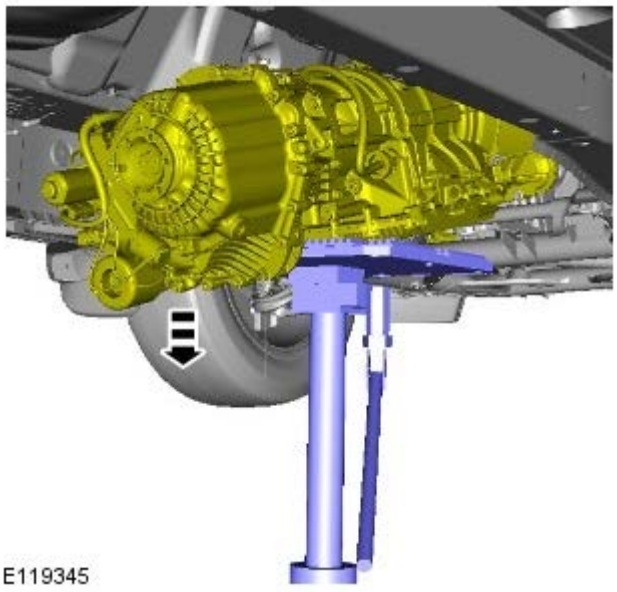
NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

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

   Raise and support the vehicle.

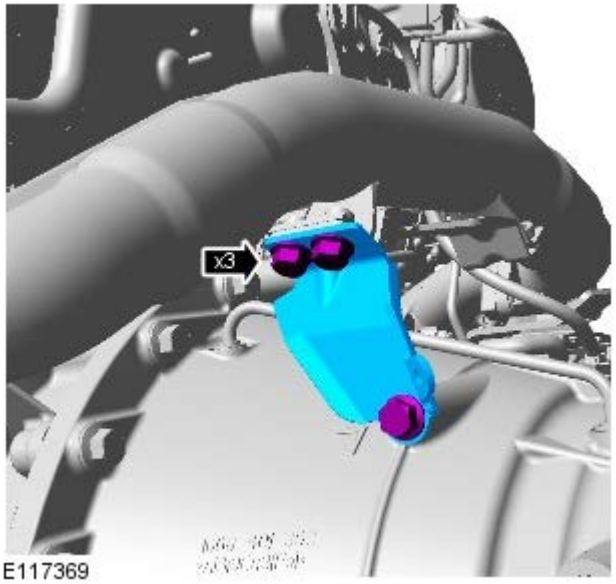
2. Refer to: Exhaust System - Vehicles With: Diesel Particulate Filter (DPF) (309-00A Exhaust System - TDV6 3.0L Diesel, Removal and Installation).
   Refer to: Exhaust System - Vehicles Without: Diesel Particulate Filter (DPF) (309-00A Exhaust System - TDV6 3.0L Diesel, Removal and Installation).

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

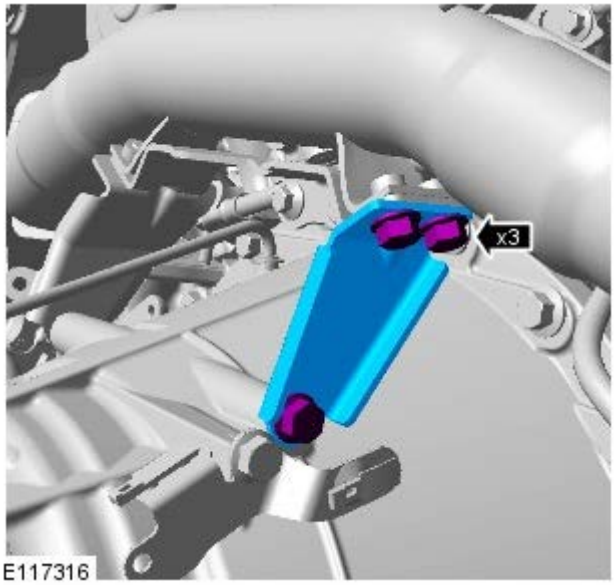


4. NOTE: The transmission is lowered for access.
   - *General Equipment:* Transmission jack

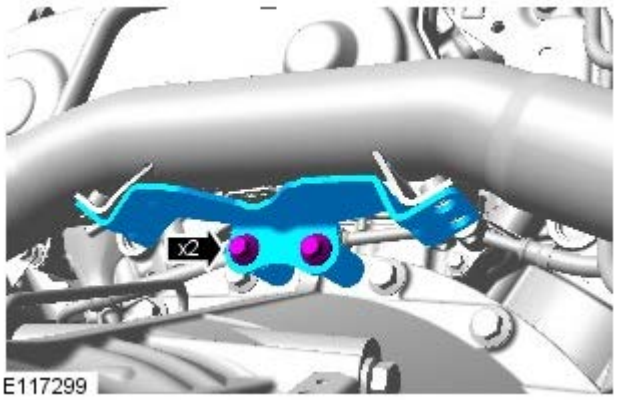
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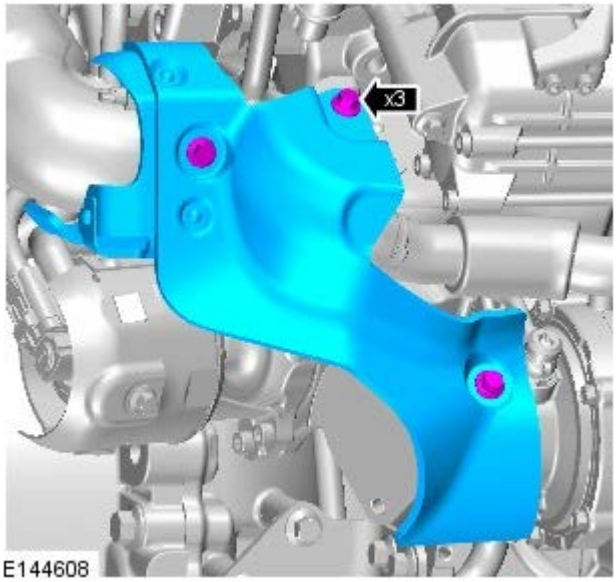
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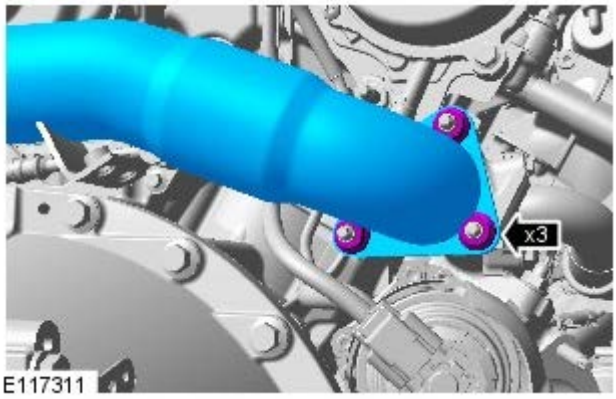
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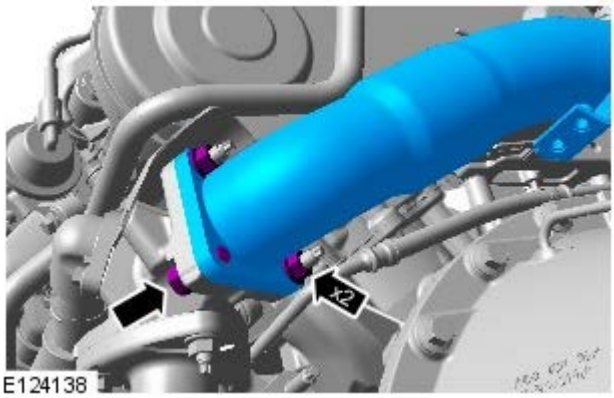
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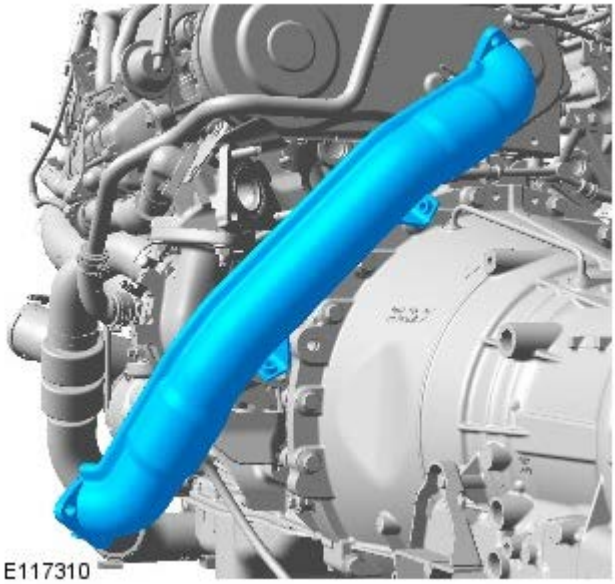
9. CAUTION: Discard the nuts.



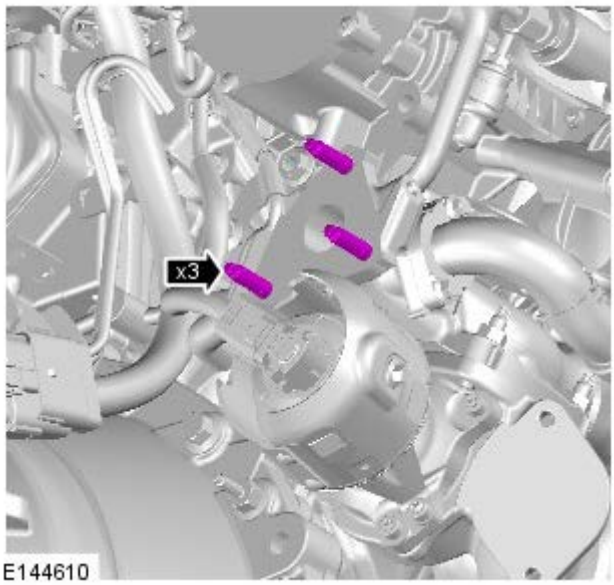
10. CAUTION: Discard the nuts and bolt.



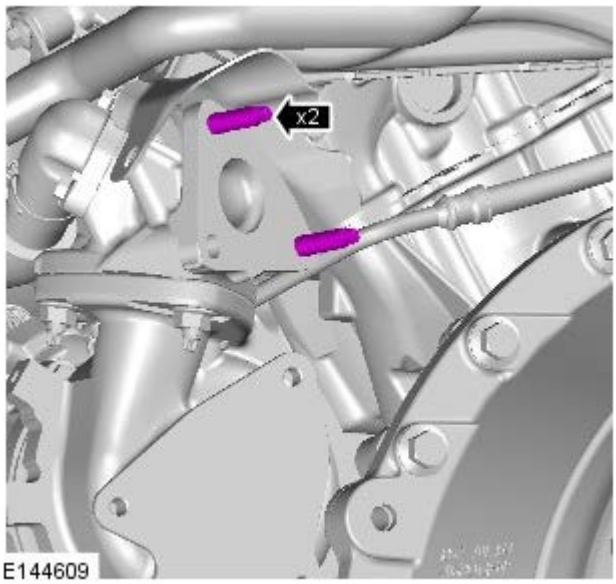
11.



12. CAUTION: Discard the studs.



13. CAUTION: Discard the studs.



14. NOTE: Discard the gasket.



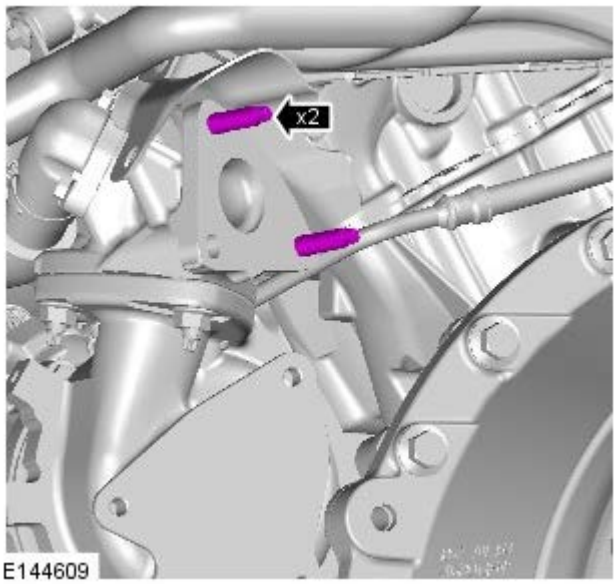
E124137

Installation



E124137

1. NOTE: Install new gaskets.

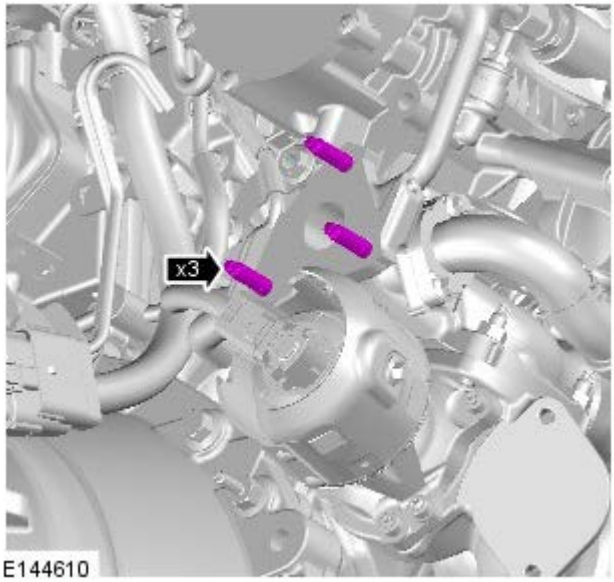


E144609

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

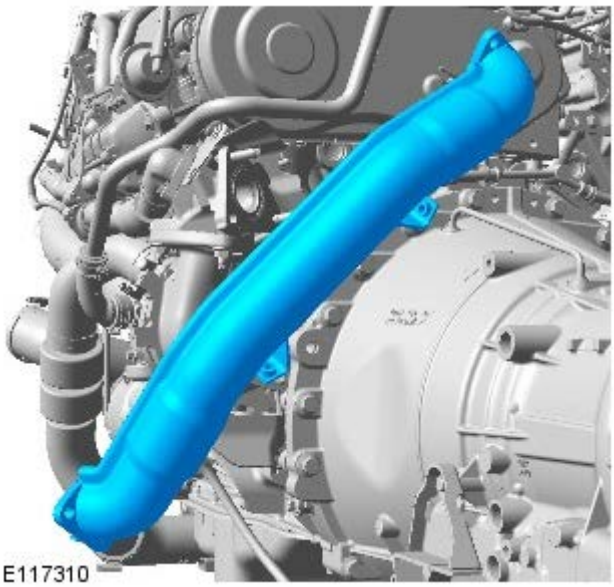
   Torque: 13 Nm

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



Torque: 13 Nm

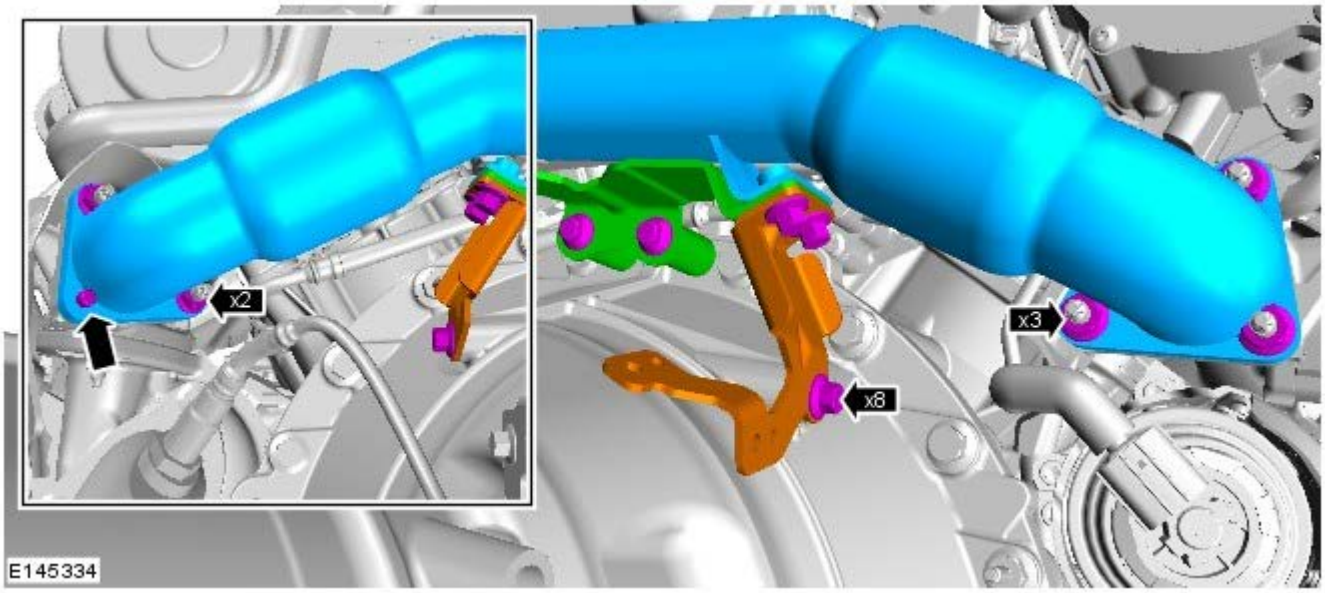
4.



5. CAUTIONS:

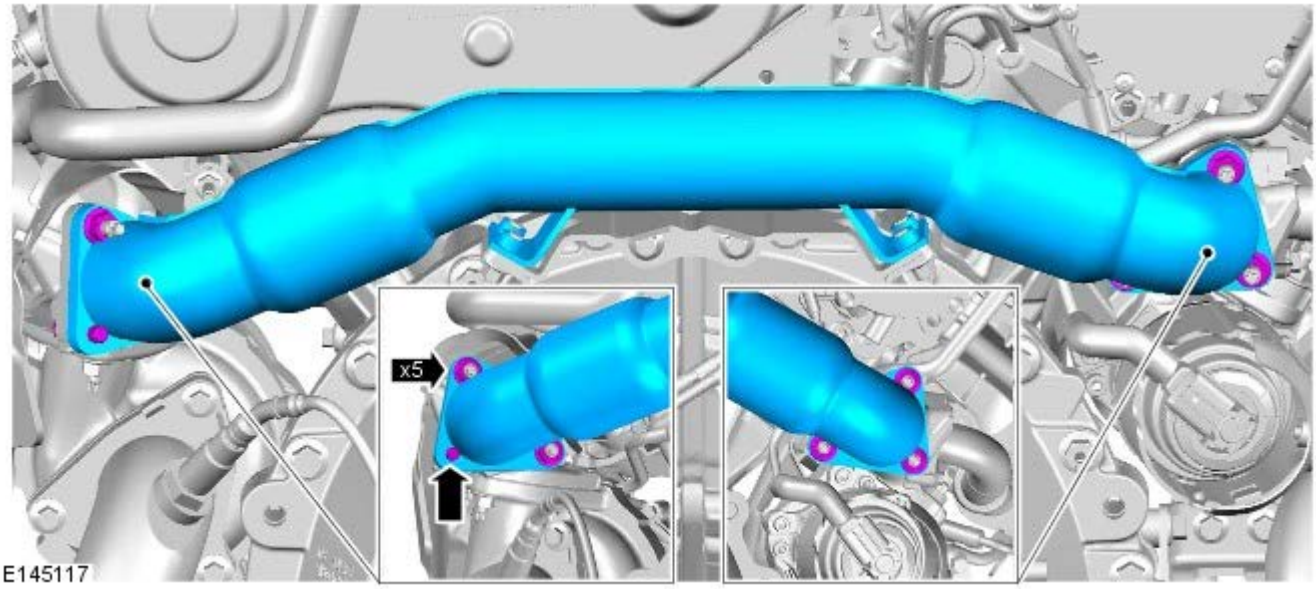
New exhaust manifold nuts and bolt must be fitted.

Only tighten the nuts finger-tight at this stage.



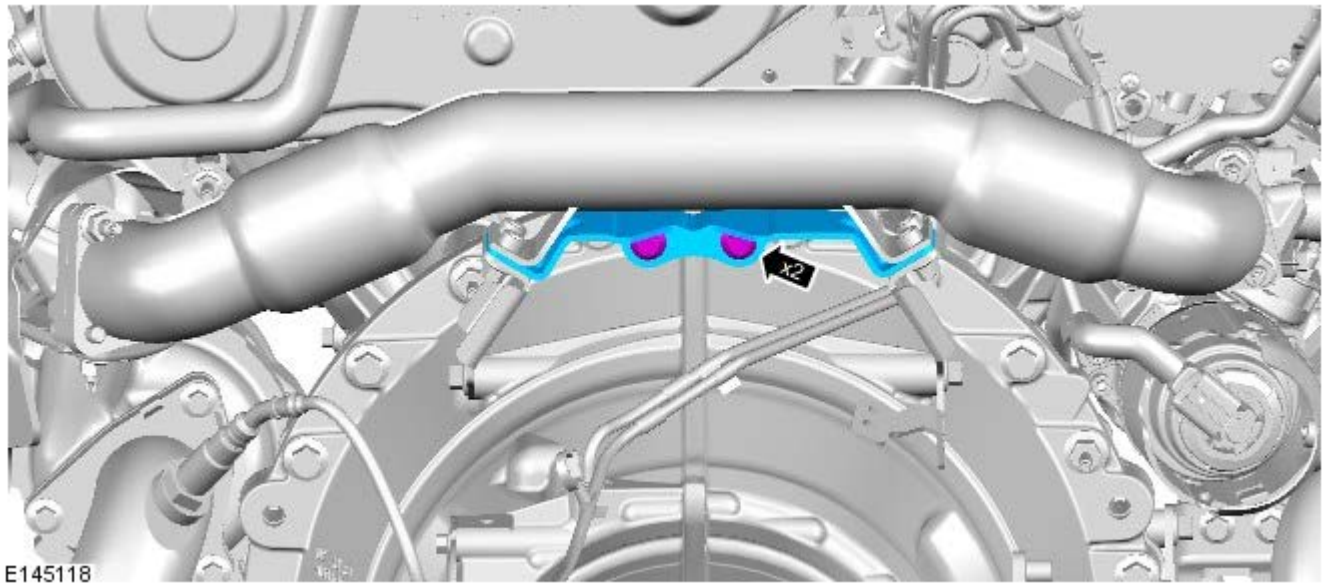
6. Check for correct alignment.

Torque: 23 Nm

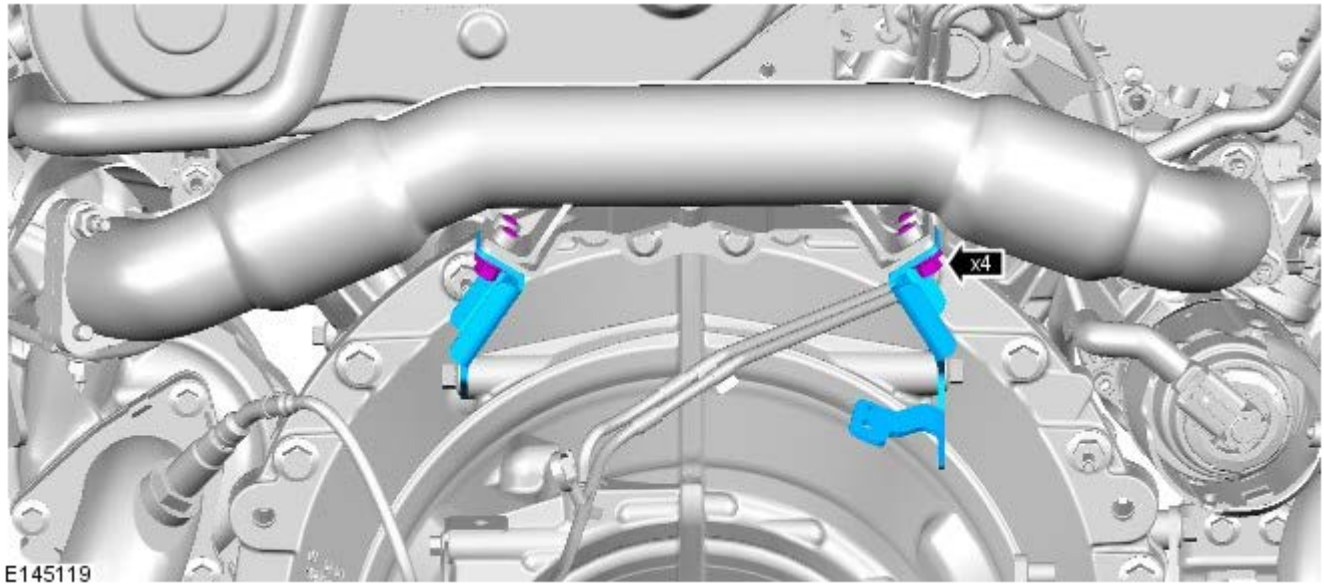


7. Check for correct alignment.

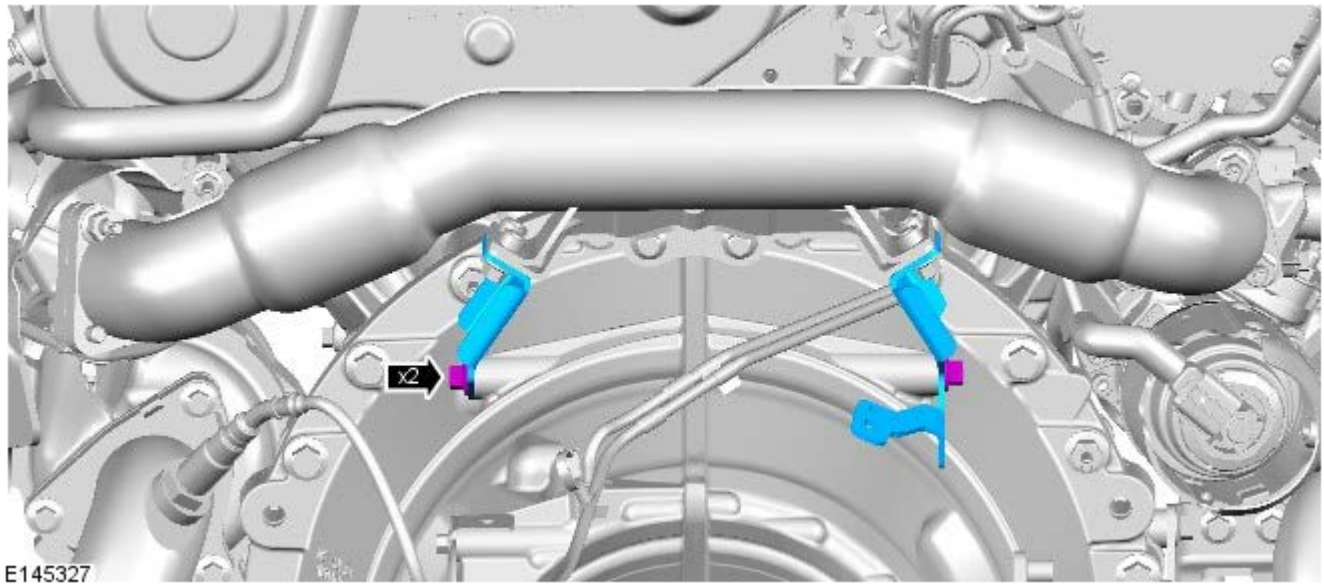
Torque: 23 Nm



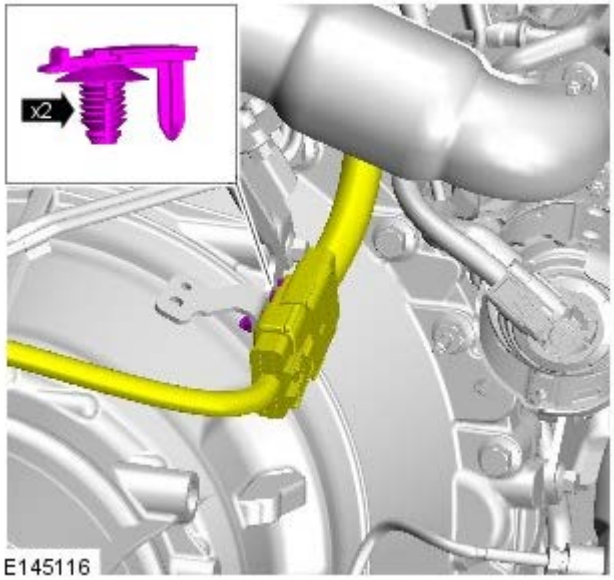
8. *Torque:* 23 Nm



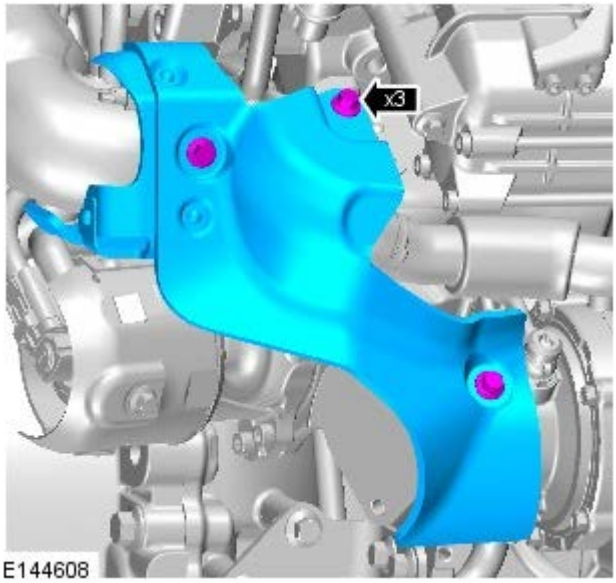
9. *Torque:* 23 Nm



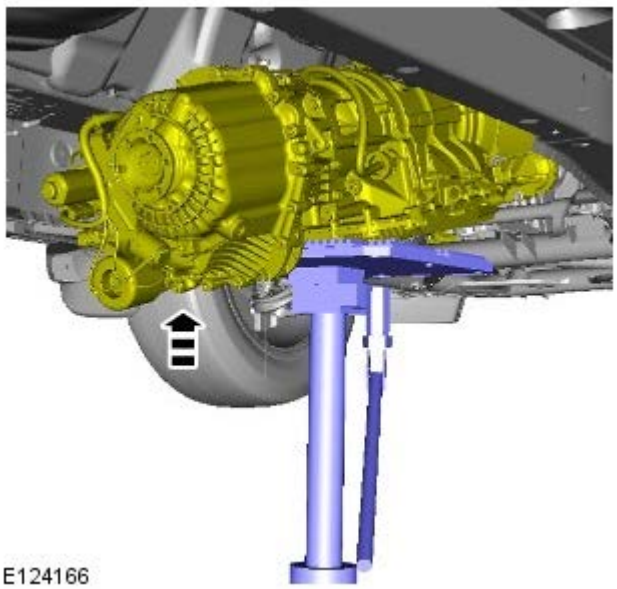
10.



11. *Torque:* 11 Nm



12. *General Equipment:* Transmission jack



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

14. Refer to: Exhaust System - Vehicles With: Diesel Particulate Filter (DPF) (309-00A Exhaust System - TDV6 3.0L Diesel, Removal and Installation).

Refer to: Exhaust System - Vehicles Without: Diesel Particulate Filter (DPF) (309-00A Exhaust System - TDV6 3.0L Diesel, Removal and Installation).

Published: 24-Aug-2012

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.

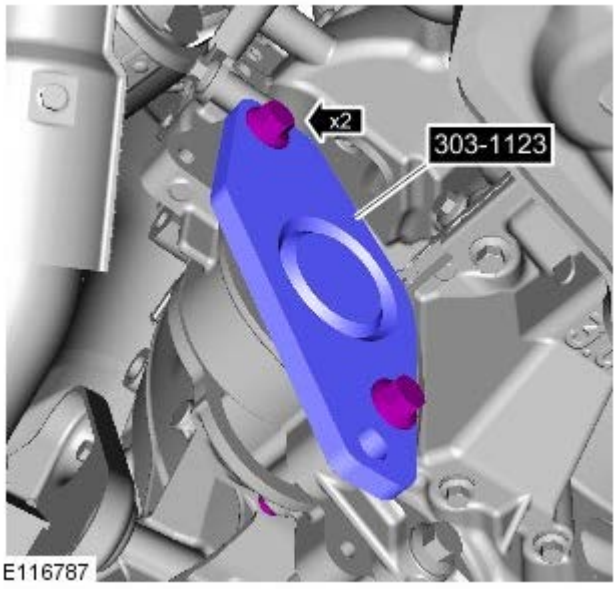
   Refer to: Specifications (414-00, Specifications).

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

   Raise and support the vehicle.

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

4. Refer to: Transmission - TDV6 3.0L Diesel (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, Removal).



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

6. CAUTION: Discard the bolts.

   NOTE: Prevent the flexplate from rotating.



Installation



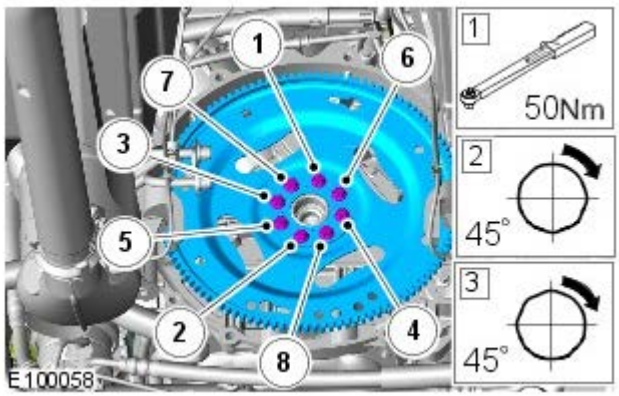
1. CAUTION: Make sure that new bolts are installed.

   NOTES:

   Make sure that all the component mating faces are clean.

   Loosely install all retaining bolts.

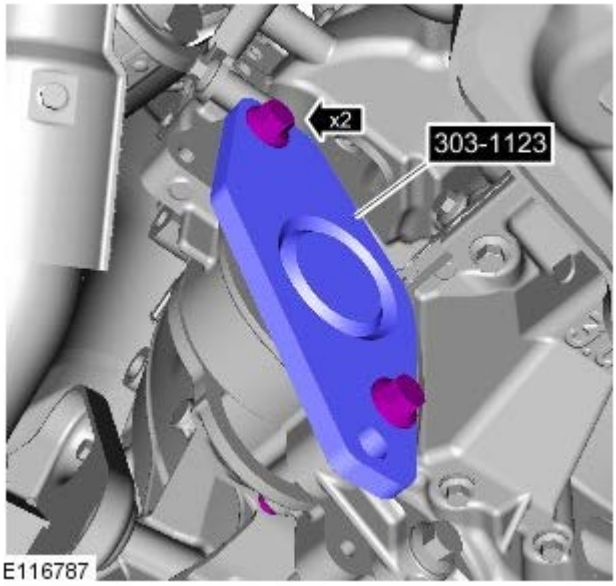
   - Prevent the flexplate from rotating.



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 - TDV6 3.0L Diesel (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, Installation).

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

6. Connect the battery ground cable.

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

Published: 24-Aug-2012

Engine - TDV6 3.0L Diesel - Oil Cooler

Removal and Installation

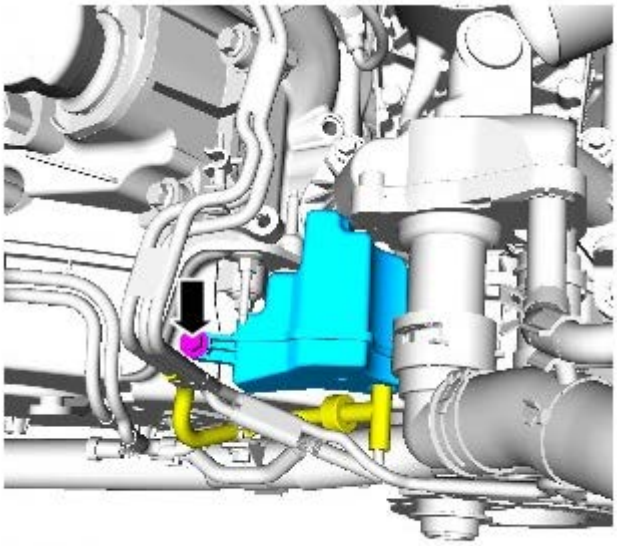
Removal

NOTES:

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

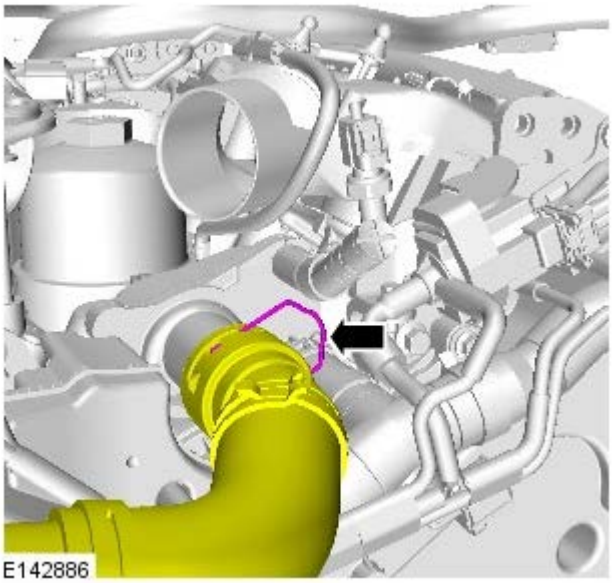
Some illustrations may show the engine removed for clarity.

1. Refer to: Cooling System Partial Draining, Filling and Bleeding (303-03A Engine Cooling - TDV6 3.0L Diesel, General Procedures).
2. Refer to: Intake Air Shutoff Throttle (303-04A Fuel Charging and Controls - TDV6 3.0L Diesel, Removal and Installation).
3. Refer to: Crankcase Vent Oil Separator (303-08A Engine Emission Control - TDV6 3.0L Diesel, Removal and Installation).
4. *Torque:* 10 Nm



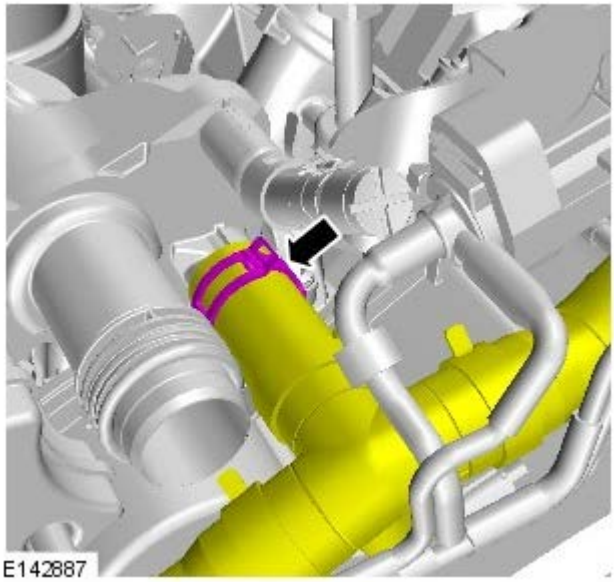
E141746

5.

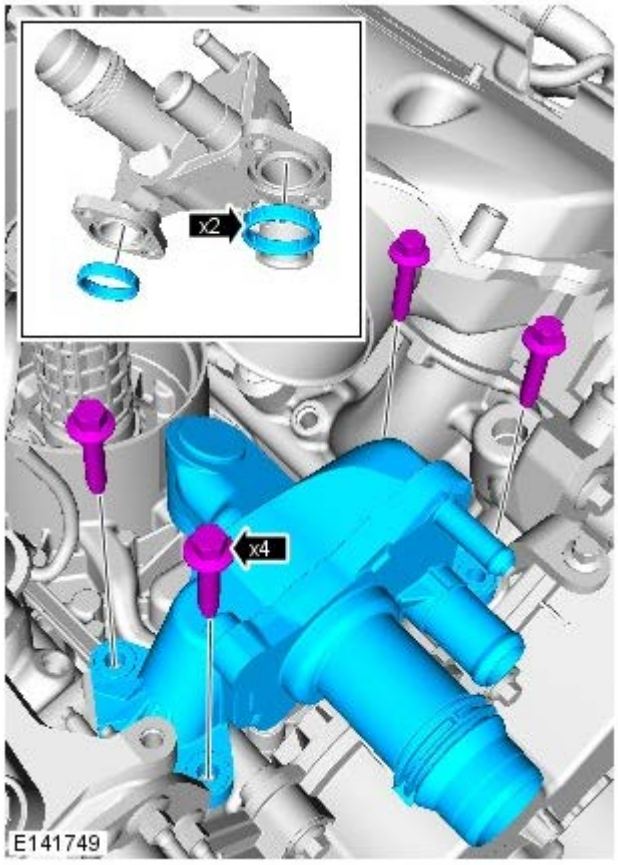


E142886

6.



7. Refer to: Oil Filter Element (303-01A Engine - TDV6 3.0L Diesel, Removal and Installation).



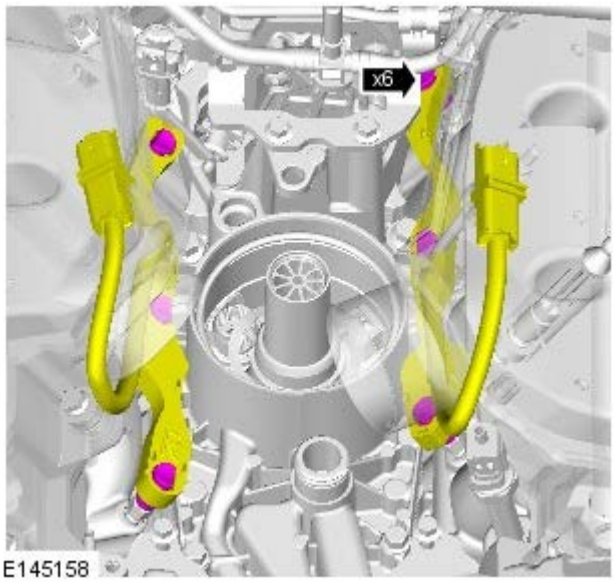
8. CAUTIONS:

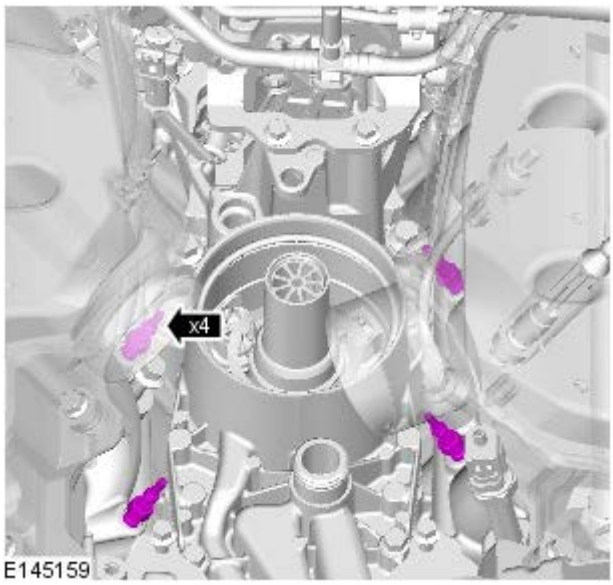
   Install new o-ring seals

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

   Torque: 10 Nm

9. CAUTION: Take extra care not to damage the component.





10. CAUTIONS:

⚠ Make sure the engine is cold before this procedure is carried out. Failure to follow this instruction may result in damage to the vehicle.

⚠ If accidentally dropped or knocked install a new module.

⚠ Fixings must be started by hand to avoid damaging threads.

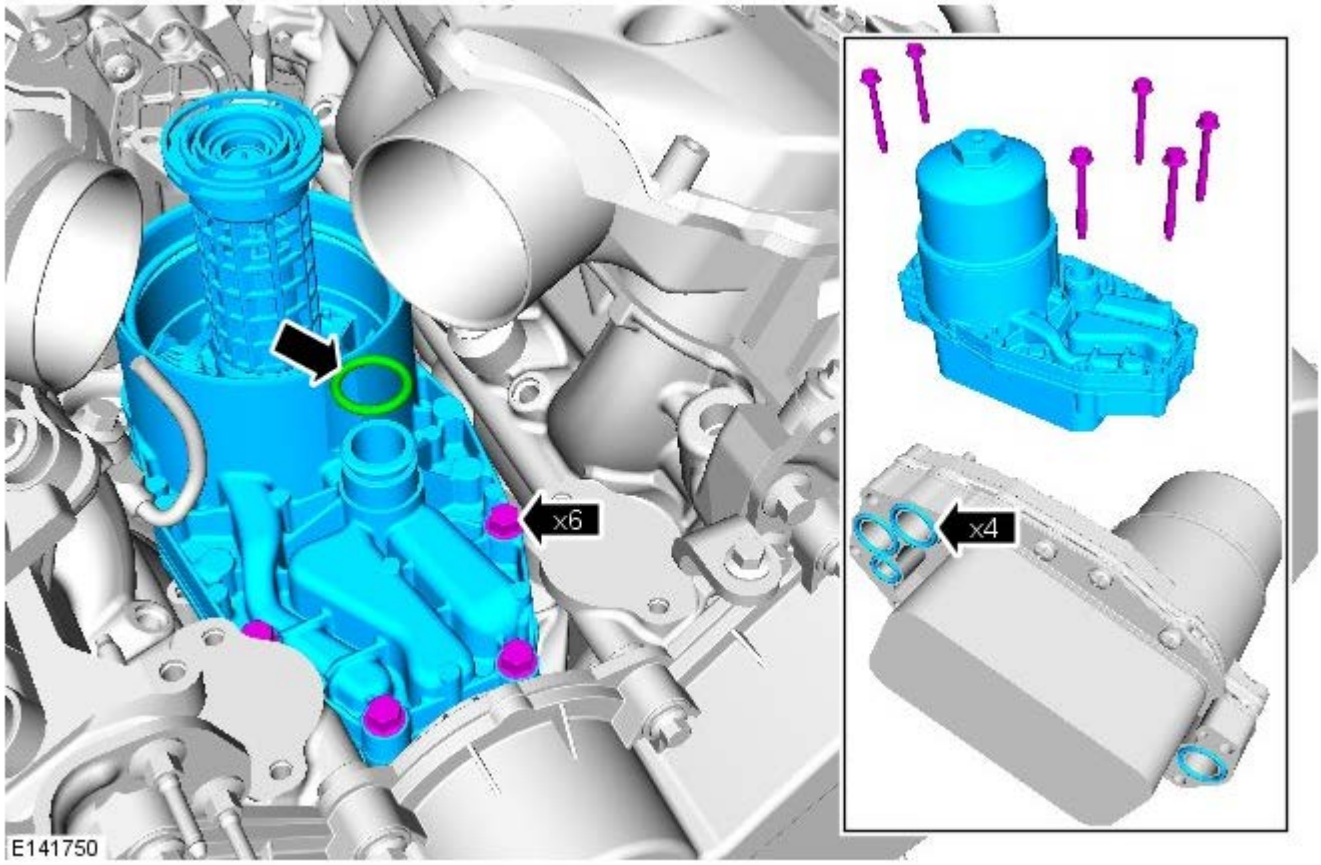
⚠ Take extra care not to damage the component.

11. CAUTIONS:

⚠ Install new o-ring seals

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

Torque: 10 Nm



Installation

1. To install, reverse the removal procedure.
2. Check and top-up the engine oil.

Published: 04-Aug-2012

Engine - TDV6 3.0L Diesel - Oil Filter Element

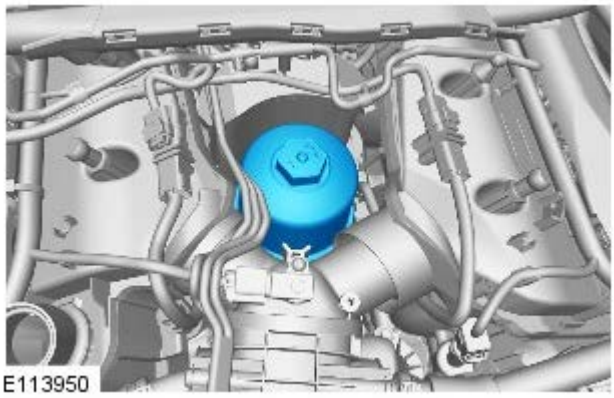
Removal and Installation

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 - TDV6 3.0L Diesel (501-05, Removal and Installation).

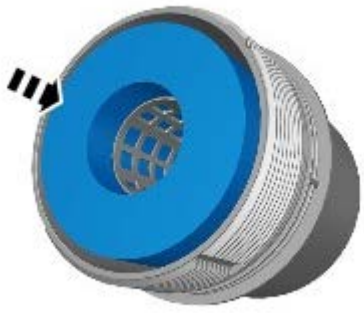

E113950

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.

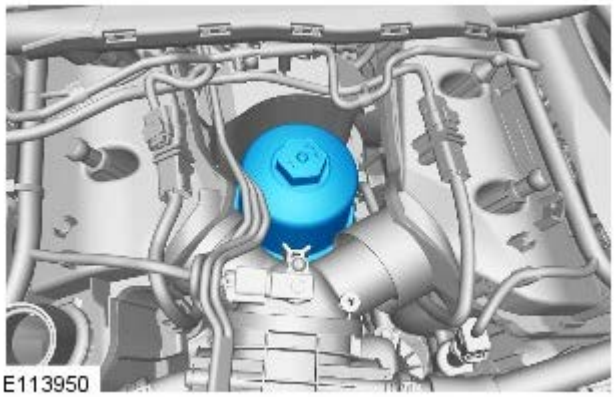
Installation


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 - TDV6 3.0L Diesel (501-05, Removal and Installation).

4. Start and run the engine.

5. Check and top-up the engine oil.

Published: 20-Mar-2013

Engine - TDV6 3.0L Diesel - Oil Pump

Removal and Installation

Removal

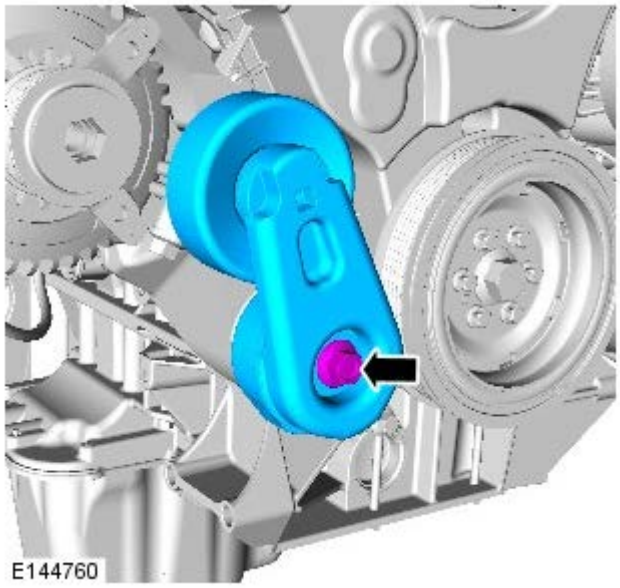
1. Disconnect the battery ground cable.

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

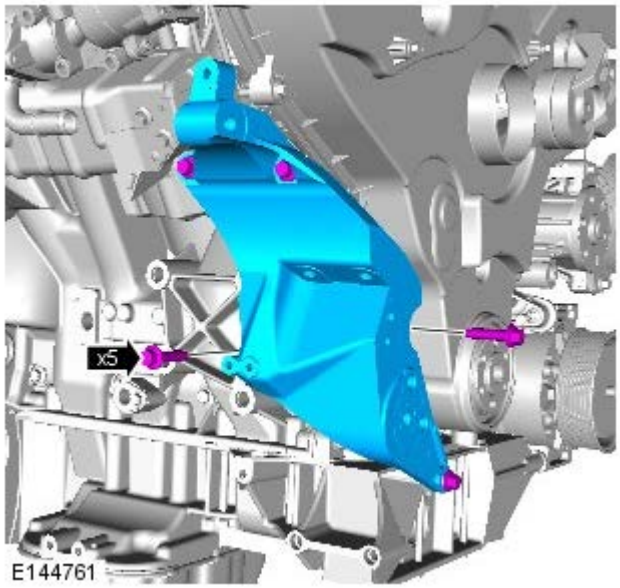
2. Remove the generator.

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

3.

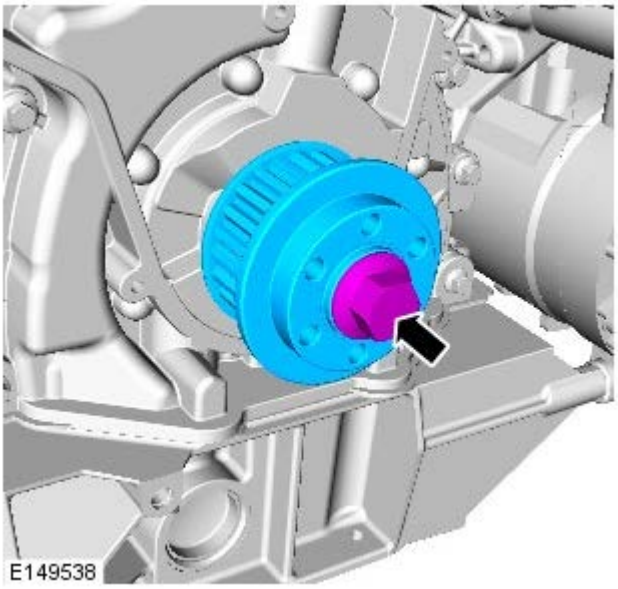


4.



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

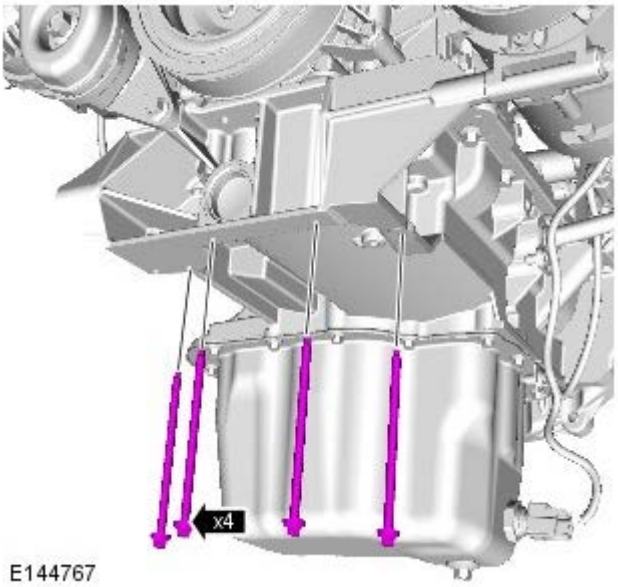
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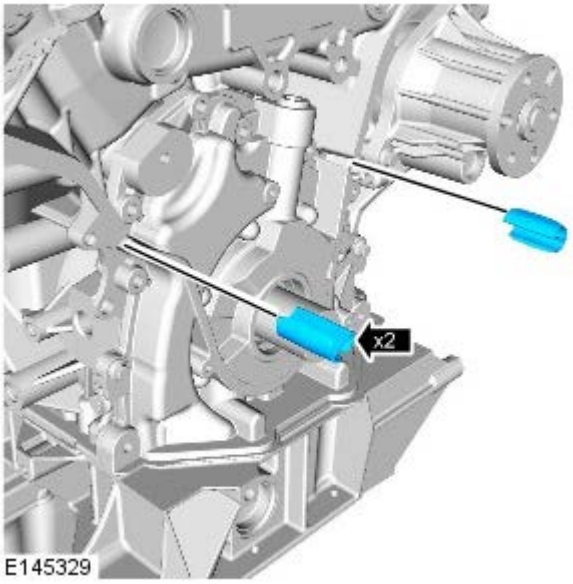
7. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

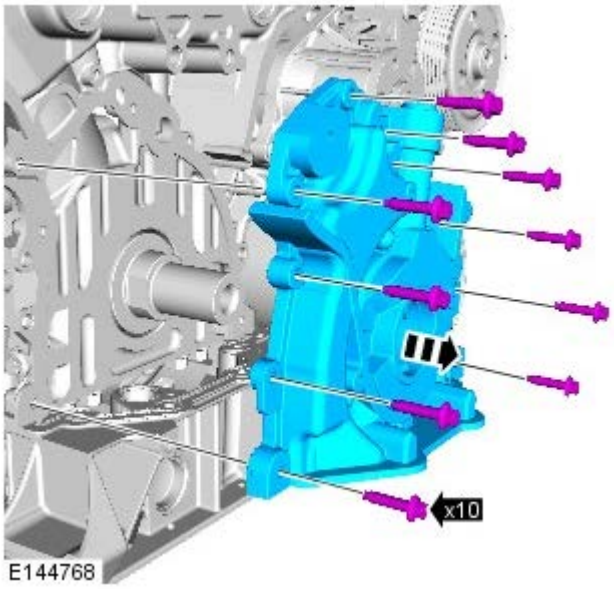
8.



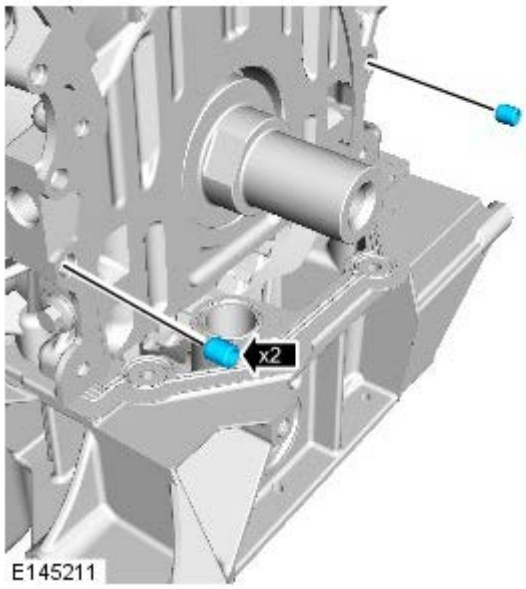
9. Remove the timing belt cover sealing strips.



10.

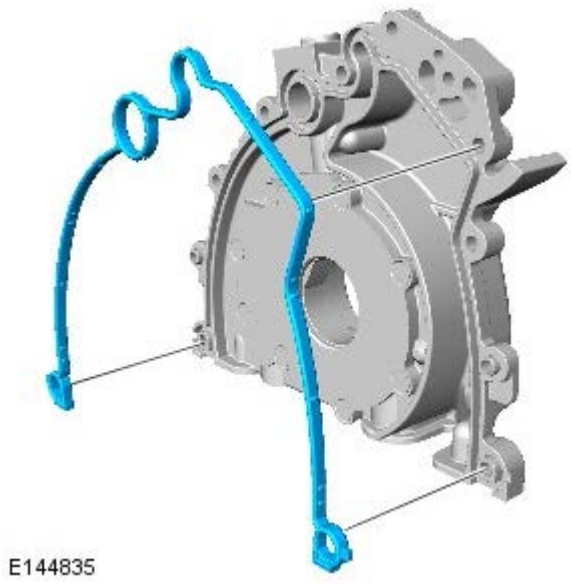


11. Remove the alignment dowels (if equipped).



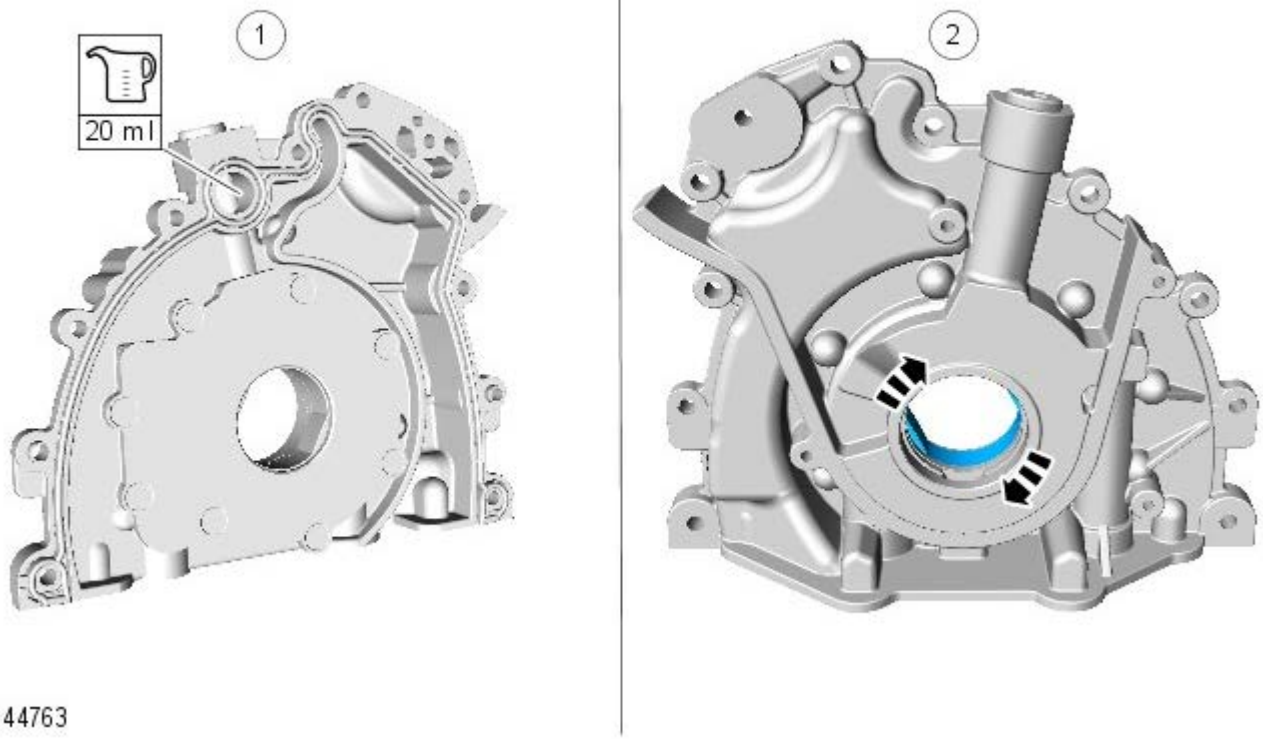
Installation

1.

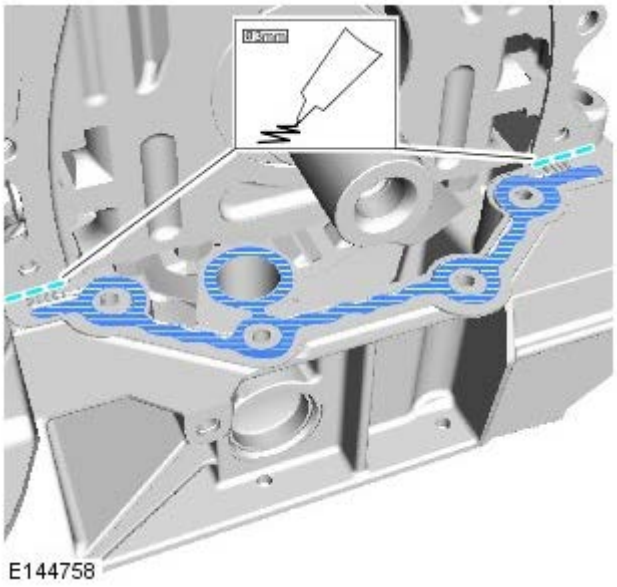


2. NOTE: **Prime the oil pump.**

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



E144763



E144758

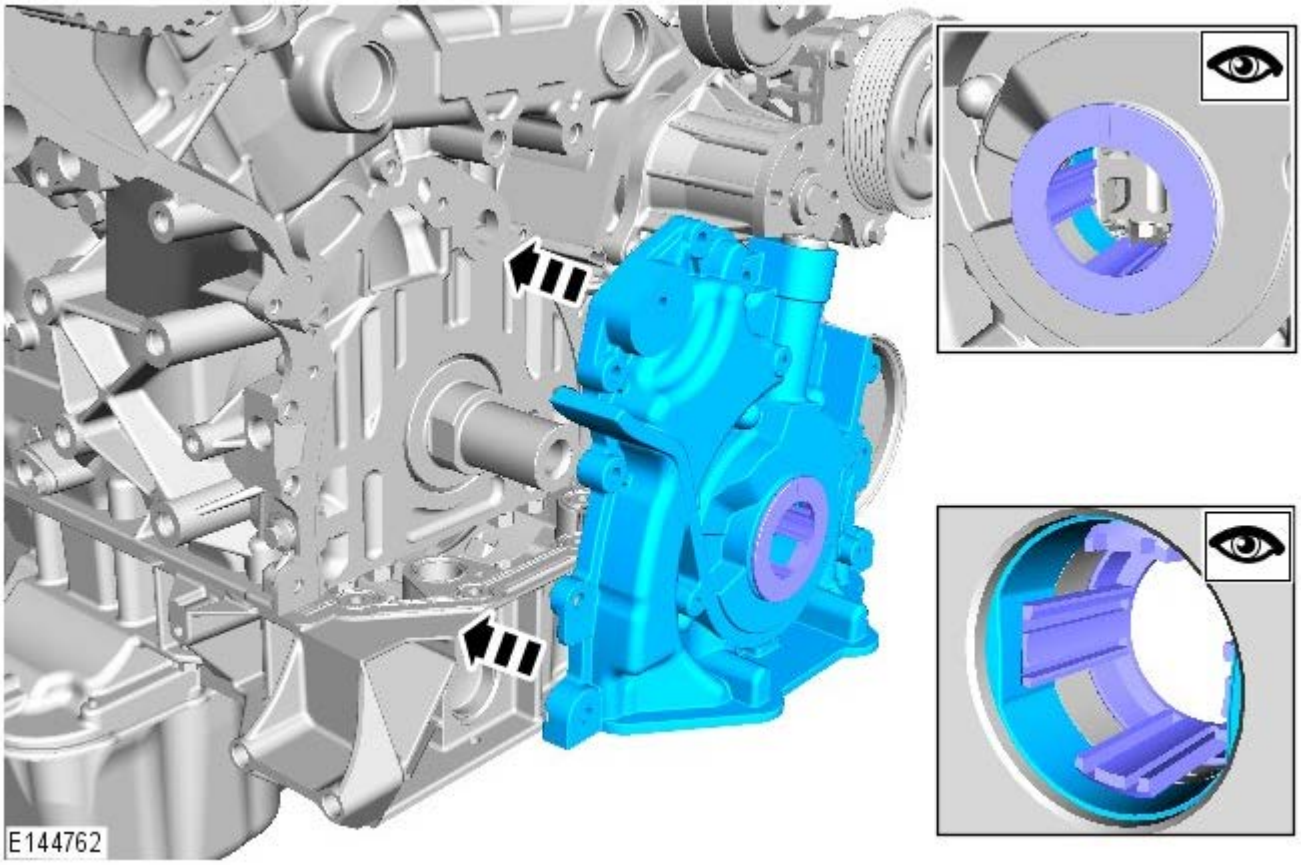
3. CAUTION: Make sure that the mating faces are clean and free of foreign material.

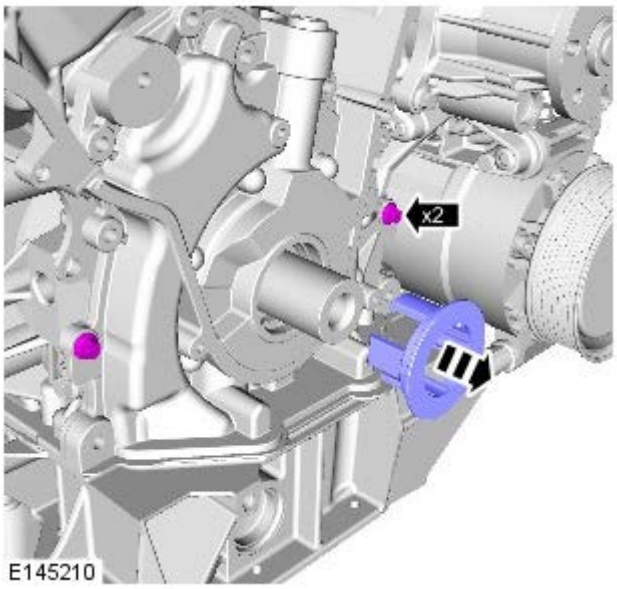
   Apply sealant WSE-M4G323-A5 in an 3mm bead to the two areas shown, also apply a smear of sealant to the gasket face as illustrated.

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

   NOTE: Make sure the gasket is installed correctly.

   Install the oil pump.



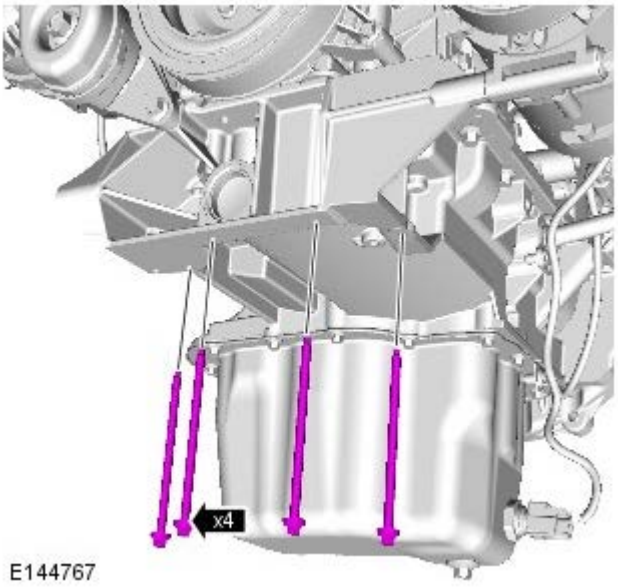


5. NOTE: Remove the oil pump locator.

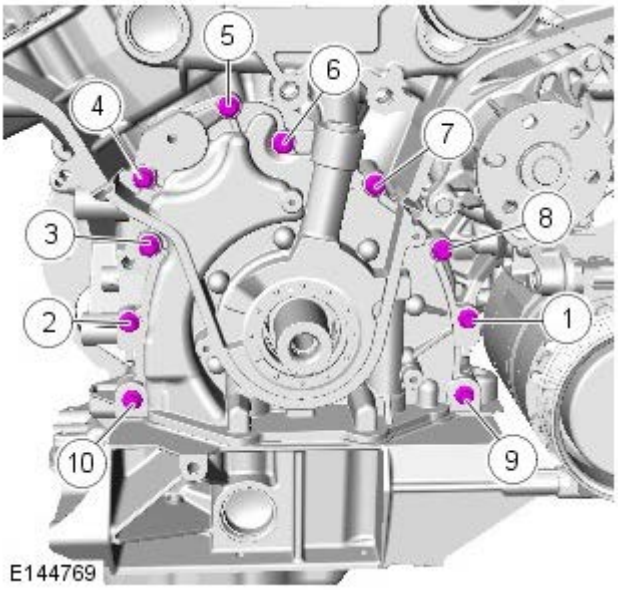
   Install two bolts to the oil pump, only finger tighten at this stage.

6. Install the oil pump lower retaining bolts.

   Torque: 10 Nm



E144767

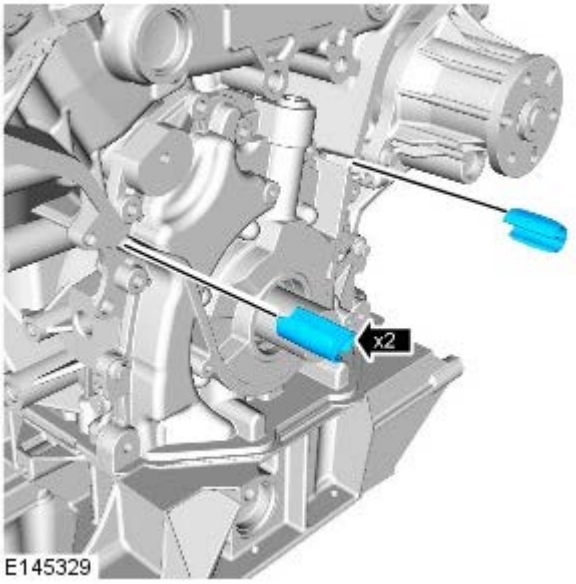


E144769

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

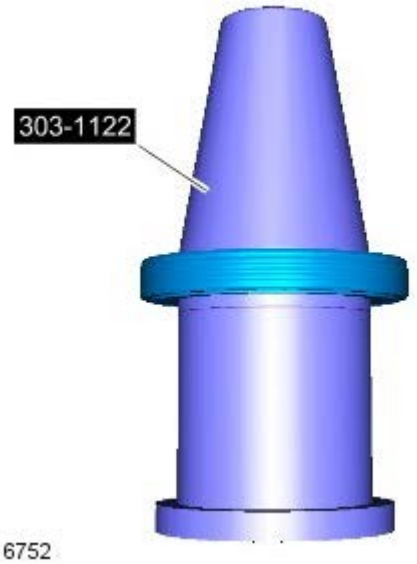
   Secure the oil pump.

8. Install the timing belt cover sealing strips.



E145329

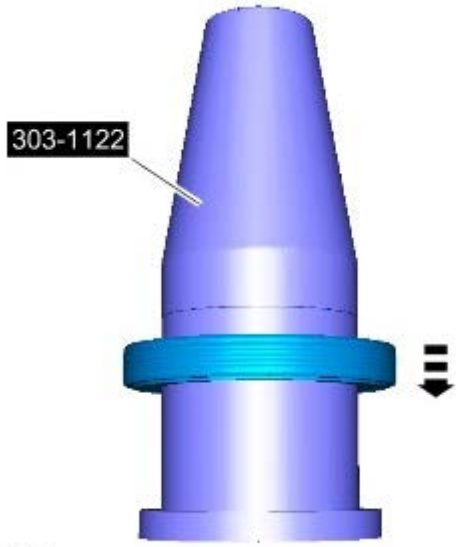
9. CAUTION: Do not use any lubricant on the crankshaft front seal, special tools or the crankshaft. Failure to follow this instruction may result in damage to the vehicle.



E116752

NOTE: Make sure all component mating faces are clean.

Install a new crankshaft front seal to the special tool.

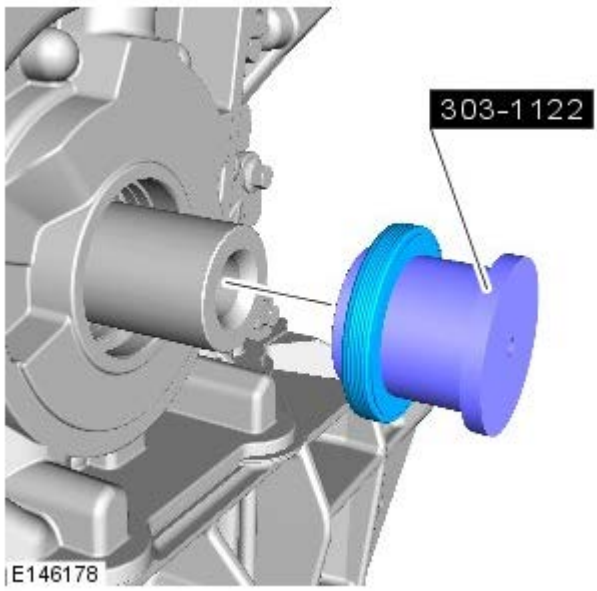


E116753

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

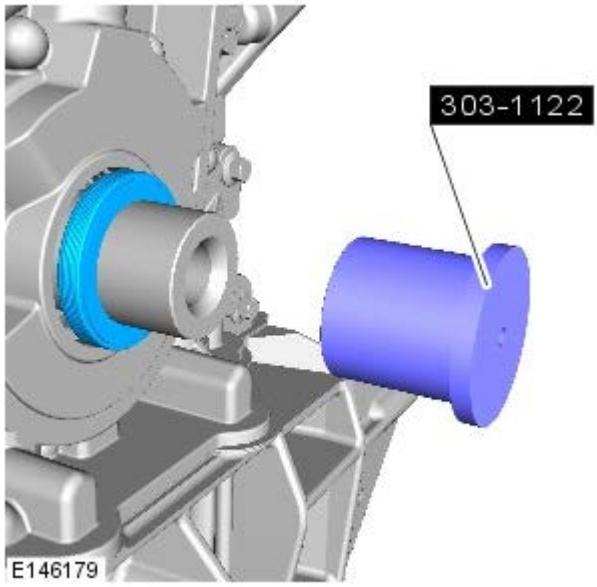
    Reposition the crankshaft front seal along the special tool.

11. Install the special tool to the crankshaft.

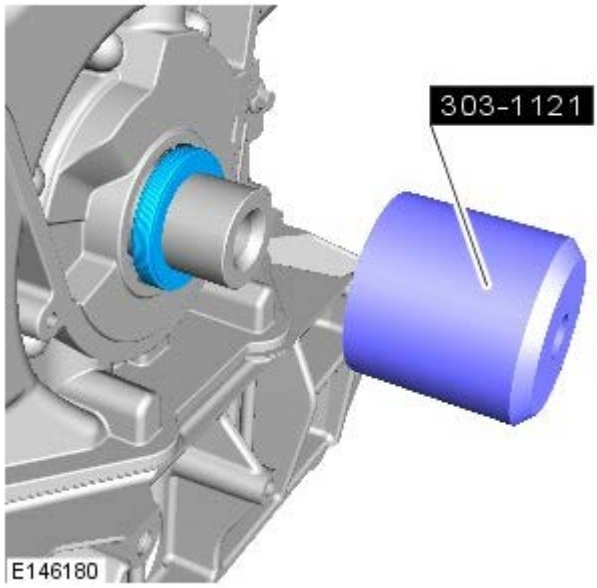


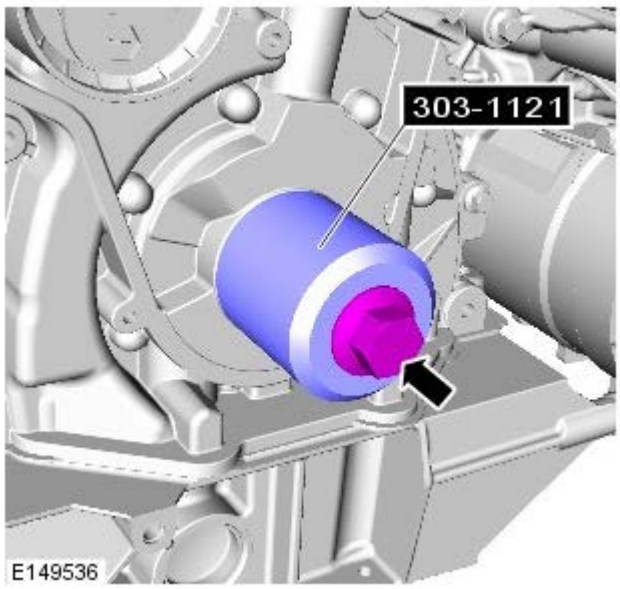
E146178

12. Remove the special tool from the crankshaft.



13. Install the special tool to the crankshaft.





14. NOTES:

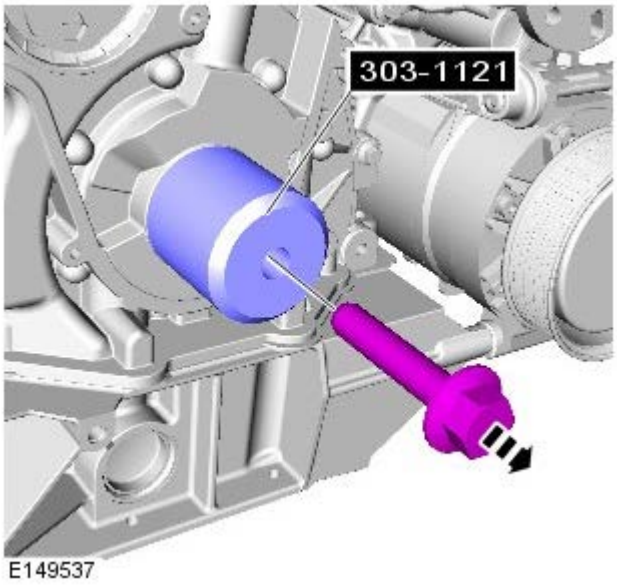
Make sure the seal is installed correctly.

Use the crankshaft bolt with the service tool.

Install the special tool to the crankshaft.

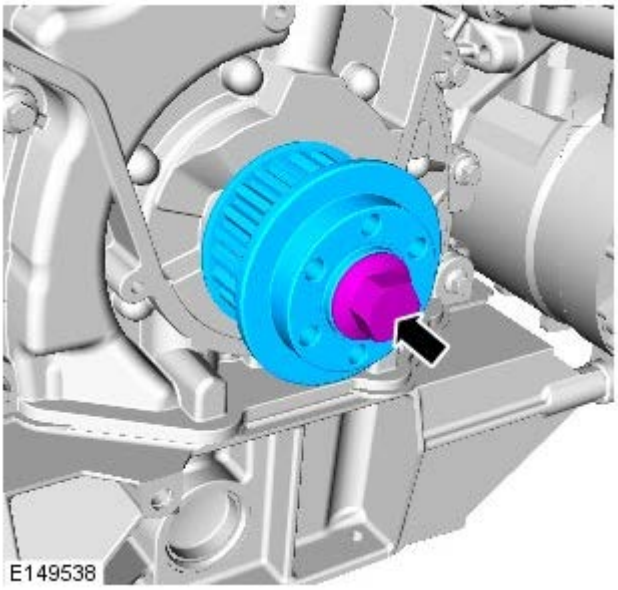
15. NOTES:

Make sure the seal is installed correctly.



Wait 10 seconds before removing the crankshaft seal installation tool.

Remove and discard the crankshaft pulley retaining bolt.



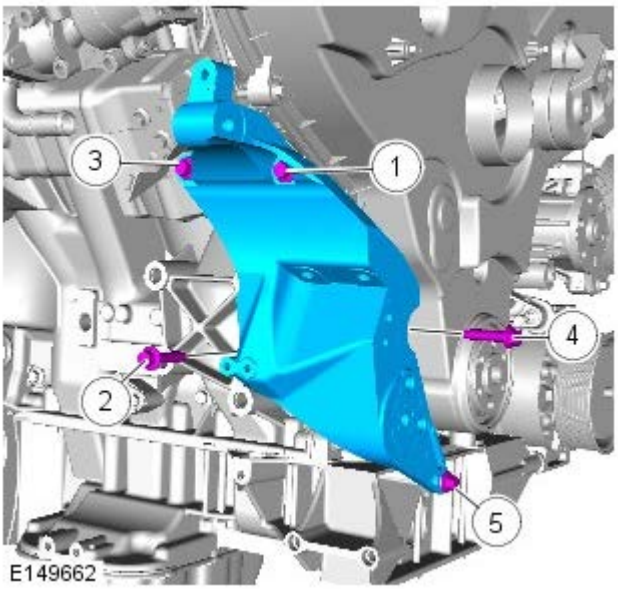
16. CAUTION: Make sure that a new crankshaft pulley bolt is installed.

NOTE: Before installing the crankshaft pulley retaining bolt, note the thread size of the bolt (there are two different sized threads, M14 and M16). Failure to follow this instruction may result in damage to the vehicle.

Install the crankshaft pulley.

Torque:
Tighten the M14 retaining bolt in two stages:
Stage 1: 140 Nm
Stage 2: 90°
Tighten the M16 retaining bolt in three stages:
Stage 1: 150 Nm
Stage 2: 300°

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



18. Tighten the bolts in the sequence shown.

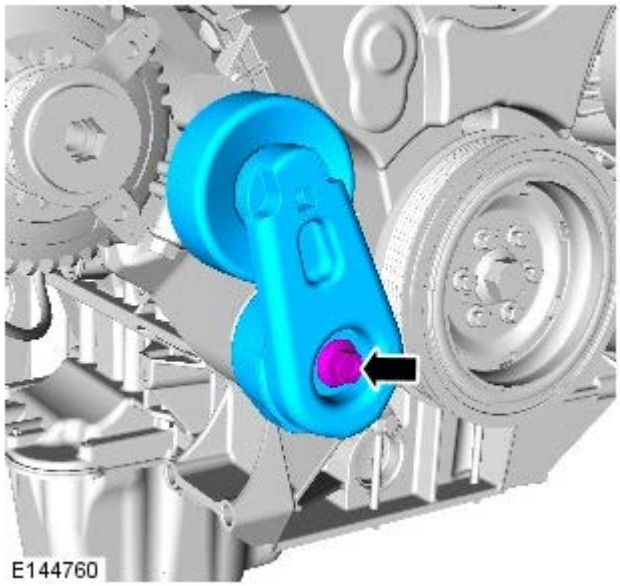
Torque: 22 Nm

19. Remove the generator.

Refer to: Generator (414-02A Generator and Regulator - TDV6 3.0L

Diesel, Removal and Installation).

20. *Torque:* 45 Nm



21. Connect the battery ground cable.

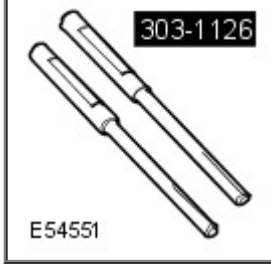
    Refer to: Specifications (414-00, Specifications).

Published: 10-Sep-2012

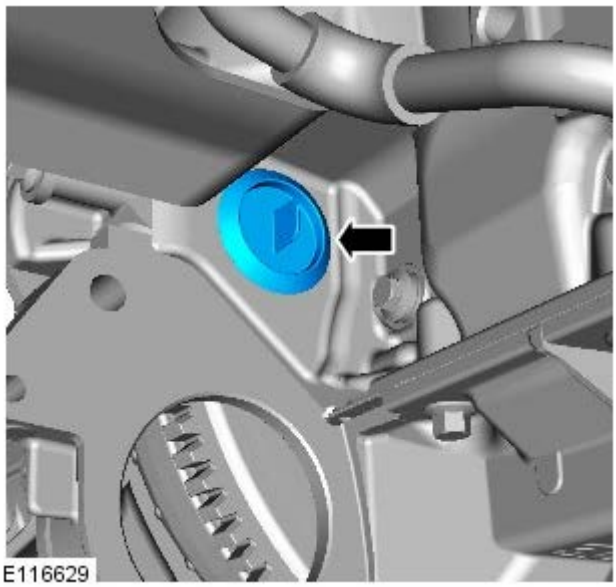
Engine - TDV6 3.0L Diesel - Timing Belt

Removal and Installation

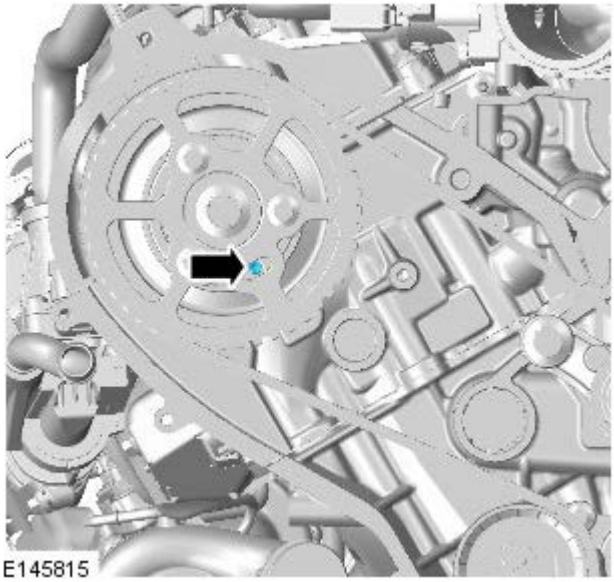
Special Tool(s)

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

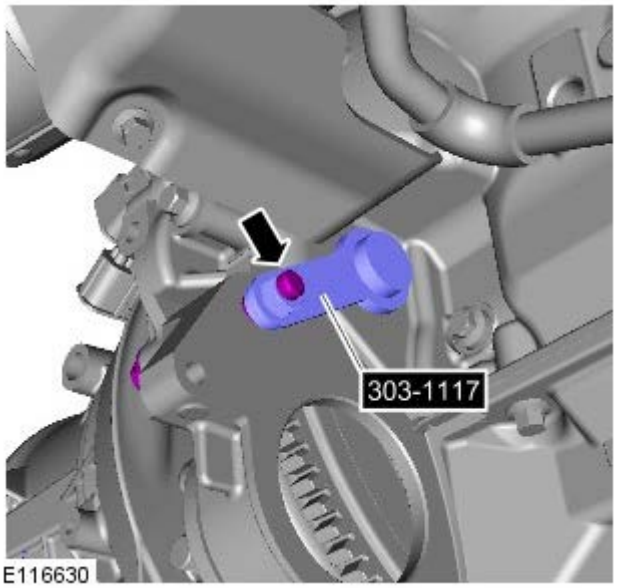
Removal

1. Refer to: Timing Cover (303-01A Engine - TDV6 3.0L Diesel, Removal and Installation).
2. Refer to: Starter Motor (303-06A Starting System - TDV6 3.0L Diesel, Removal and Installation).
3. 

4. Rotate the crankshaft clockwise to align the crankshaft alignment hole in the flywheel or flexplate with the block aperture.
5. Check the camshaft pulley alignment holes are correctly aligned. If the alignment holes are not aligned, rotate the crankshaft one full turn clockwise.

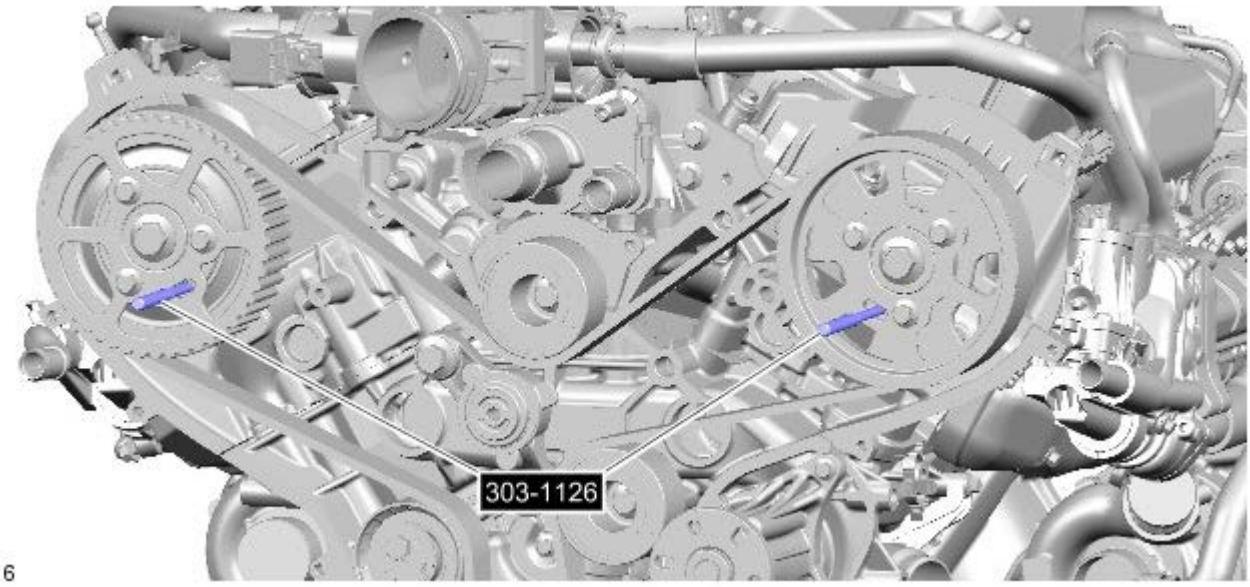

E145815

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



E116630

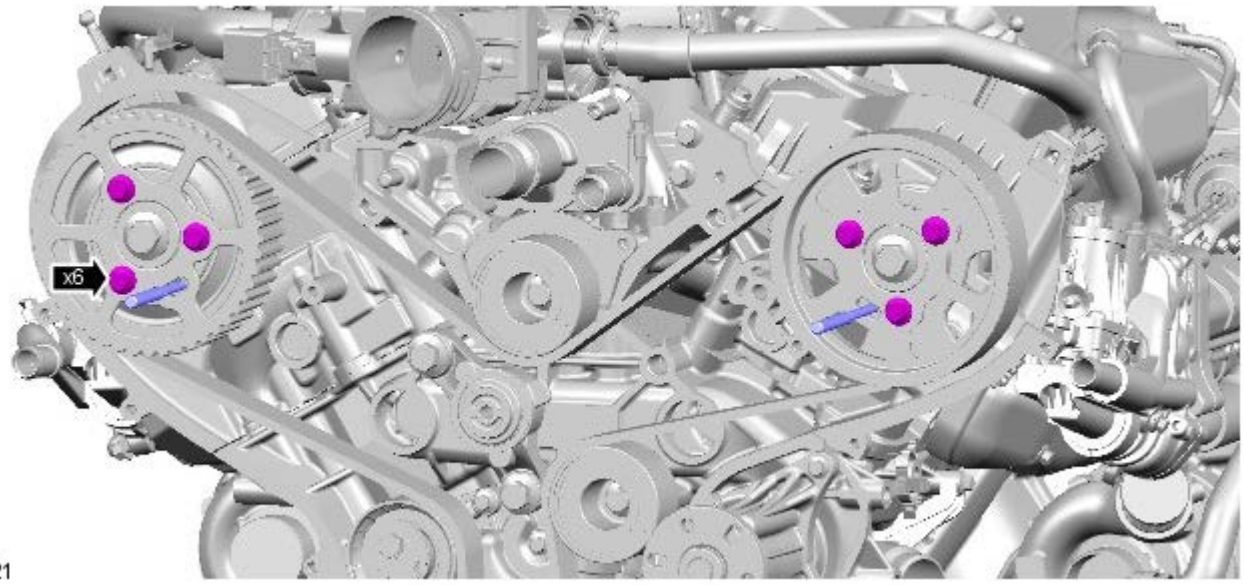
7. *Special Tool(s):* 303-1126



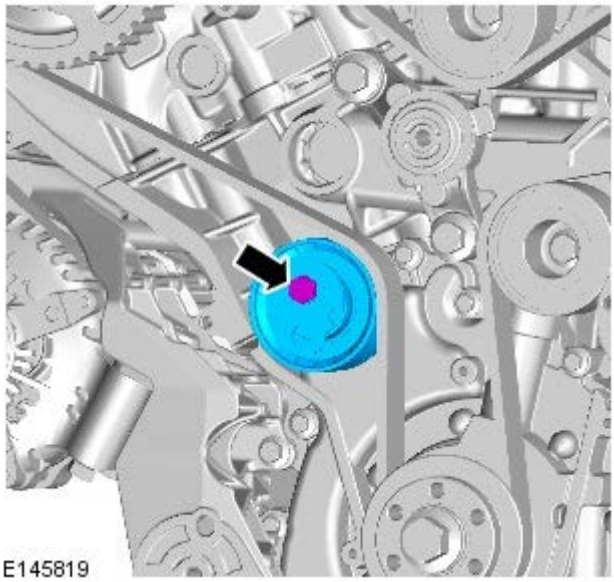
E145816

8. 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.



E145821

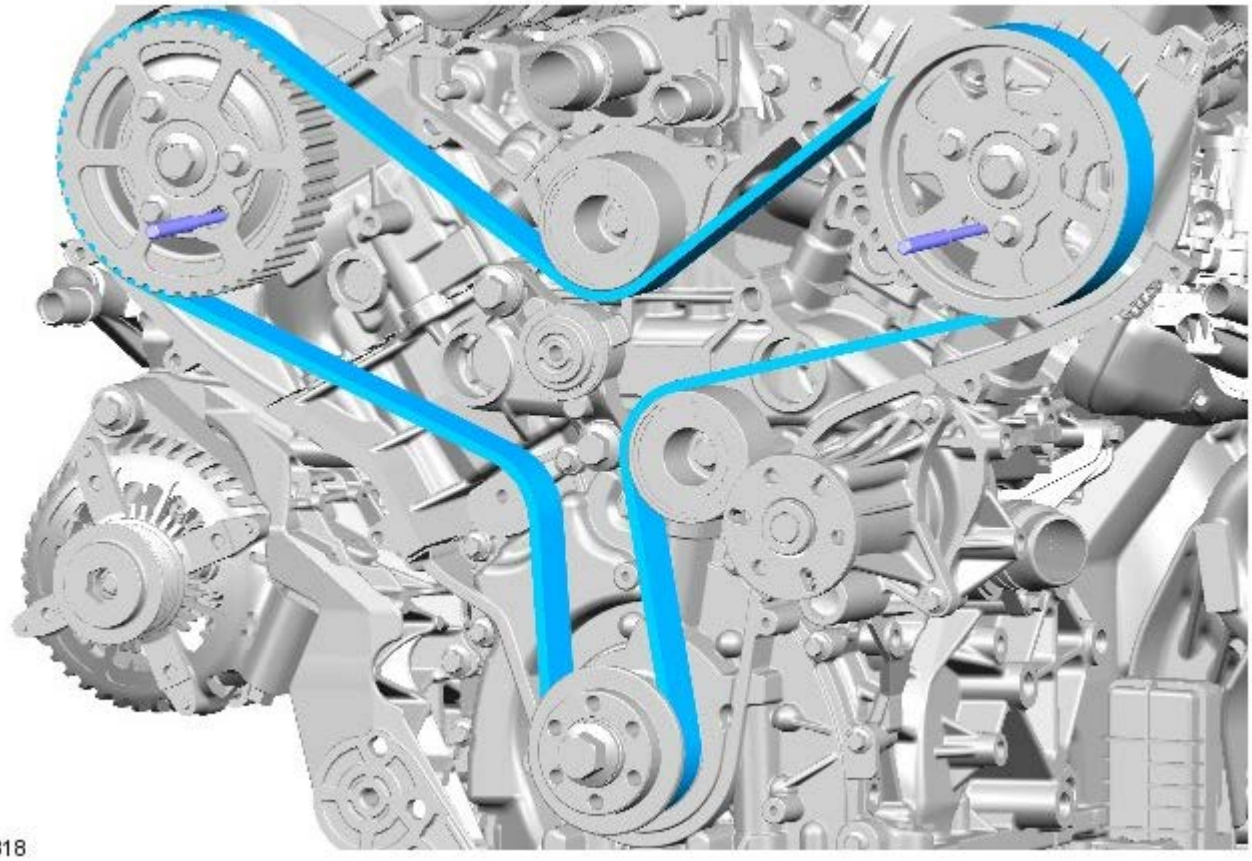

E145819

9. CAUTIONS:

   Discard the component.

   Discard the bolt.

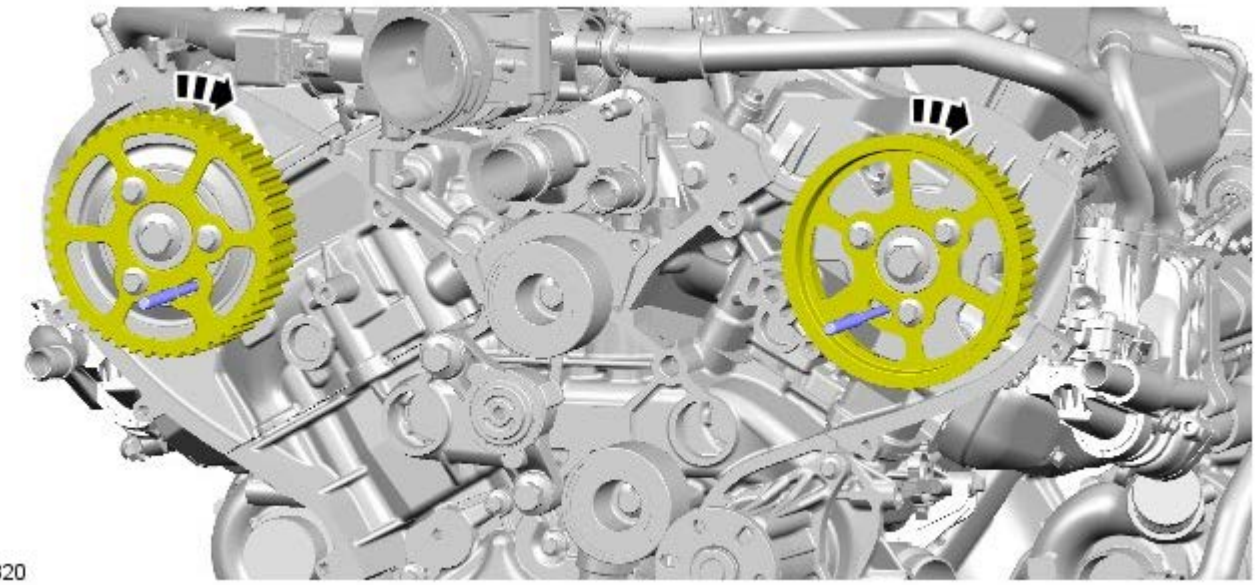
10. CAUTION: Discard the component.



E145818

Installation

1.

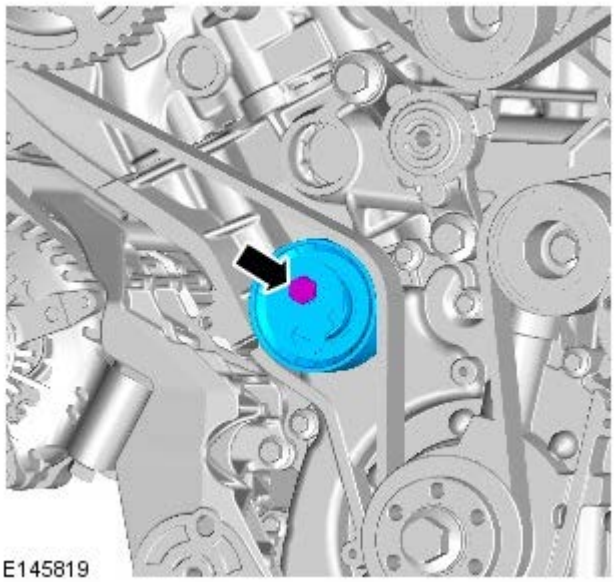


E145820

2. CAUTIONS:

Make sure that a new bolt is installed.

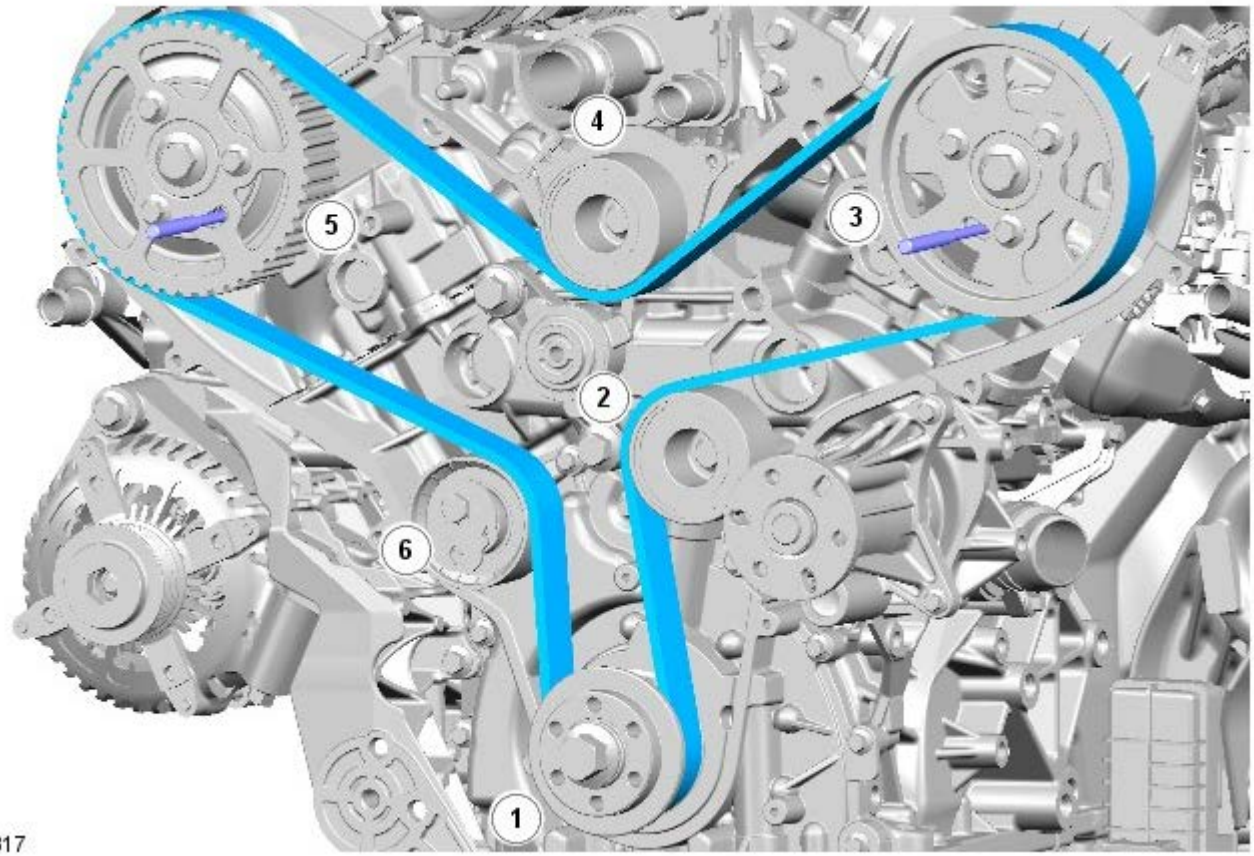
Only tighten the bolts finger-tight at this stage.



E145819

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

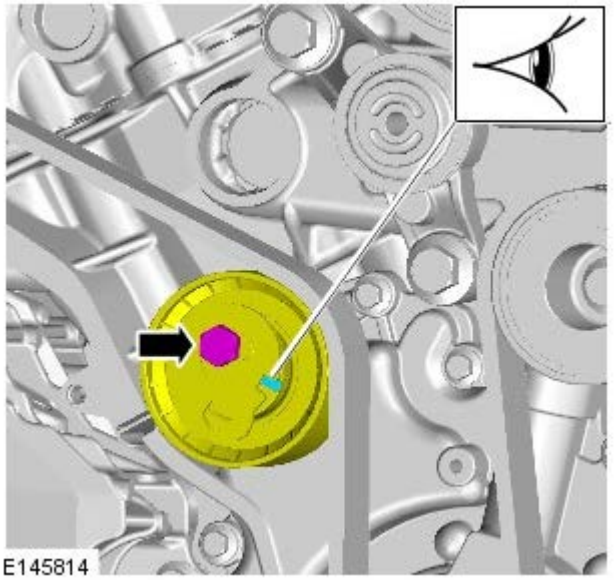
- Install the new timing belt.
- Starting at the crankshaft pulley, install the timing belt in a counter-clockwise direction, in the sequence shown.
- Stage one: Attach the timing belt to the crankshaft pulley.
- Stage two: Attach the timing belt to the idler pulley.
- Stage three: Attach the timing 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.



E145817

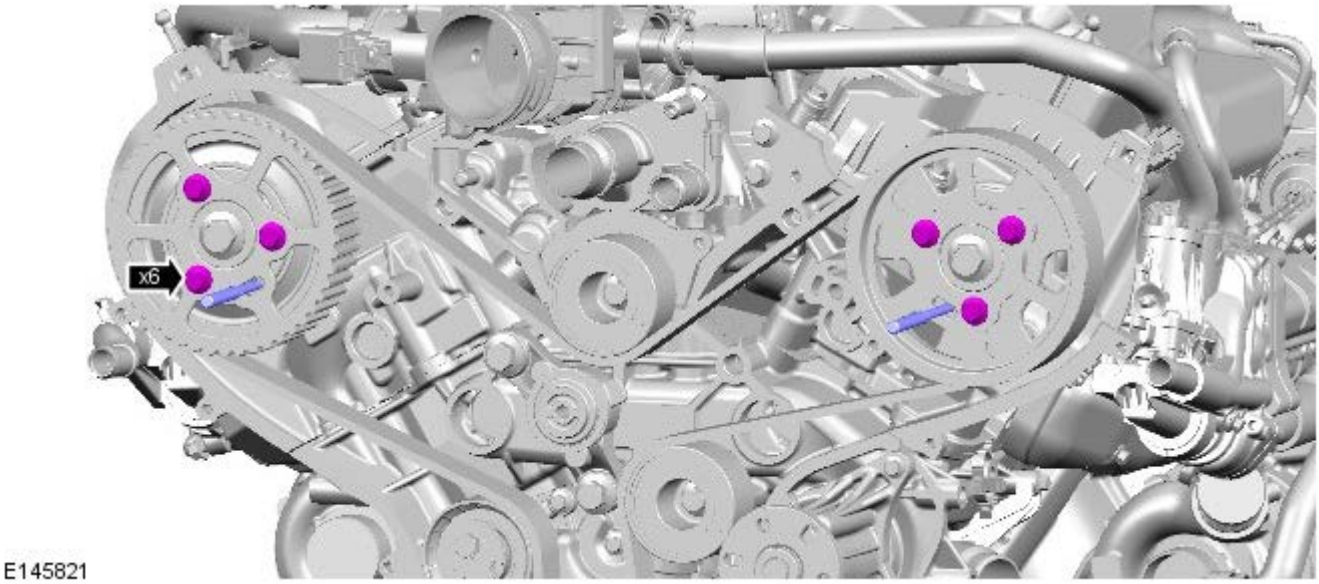
4. CAUTION: Make sure the timing belt tensioner window is aligned with the groove as illustrated.

- Tension the timing belt.
- Rotate the tensioner assembly counter-

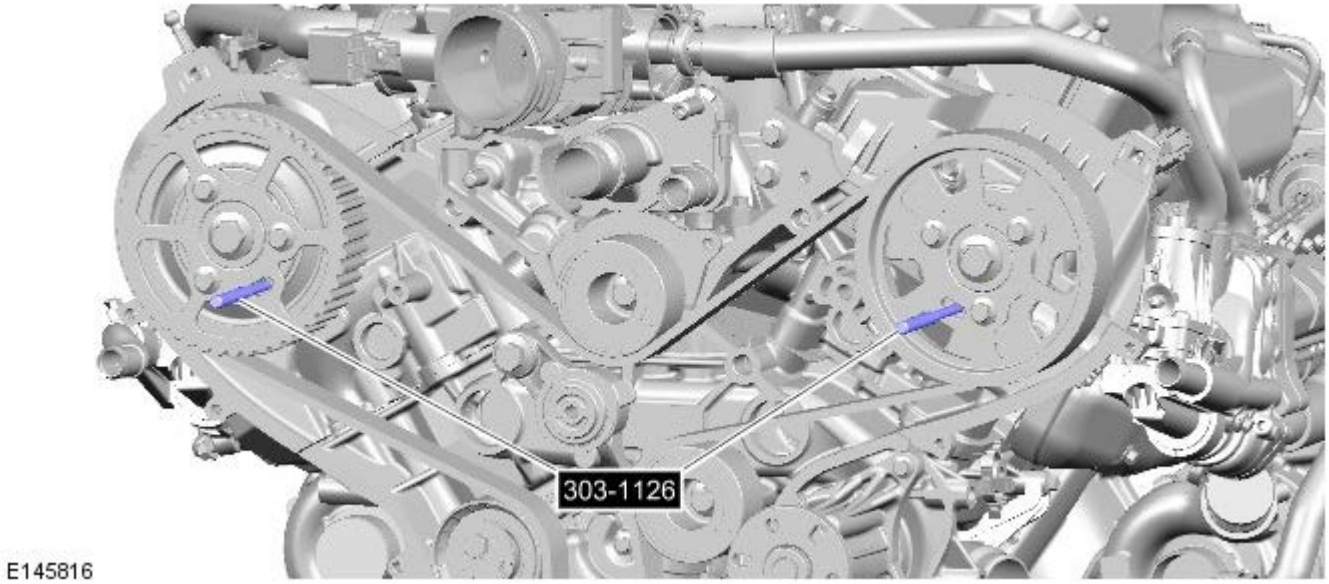


clockwise.
- *Torque:*
  Stage 1: 10 Nm
  Stage 2: 65°

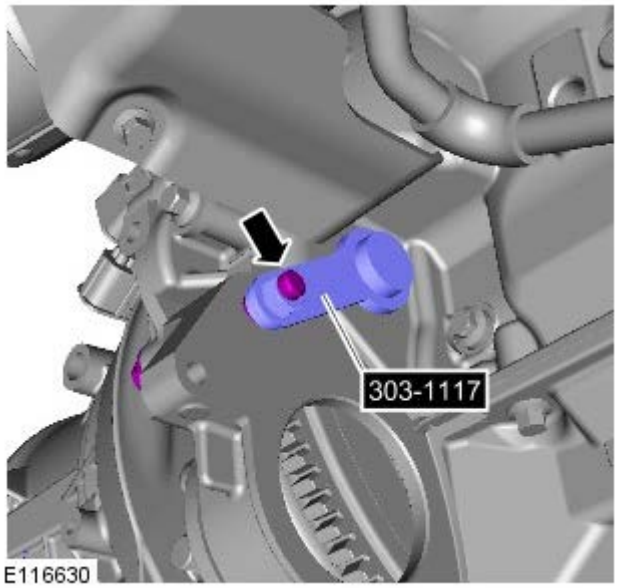
5. CAUTION: Do not use the special tools to lock the camshafts. Failure to follow this instruction may result in damage to the engine or the special tools.
   - Using a suitable tool, counterhold the camshaft pulley center retaining bolts.
   - *Torque:* 23 Nm



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



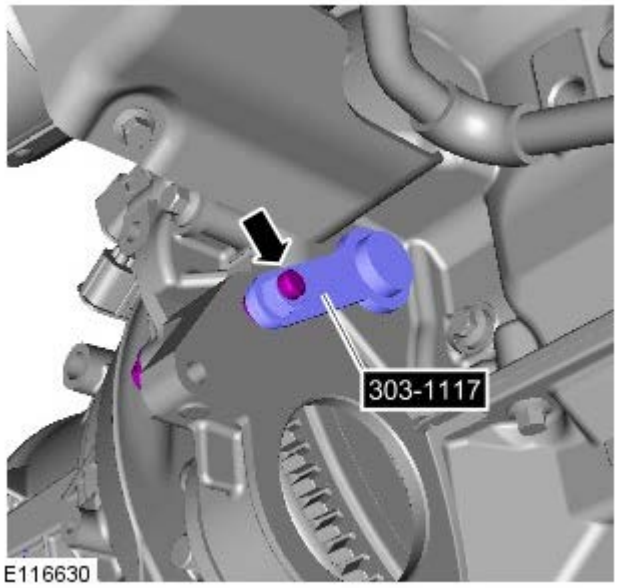
7. *Special Tool(s):* 303-1117



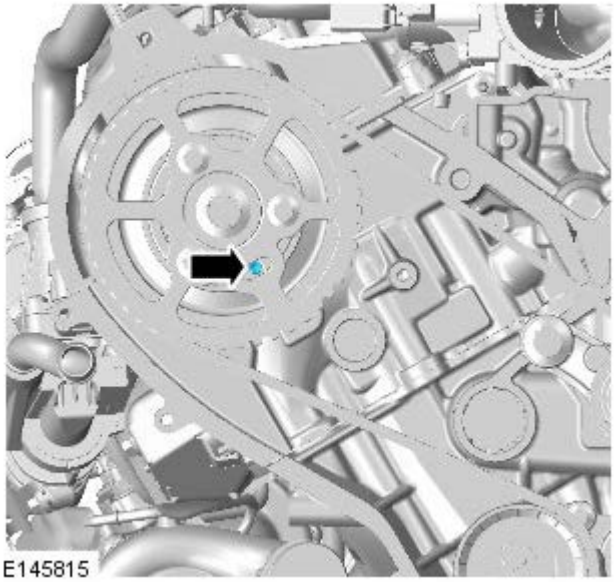
8. CAUTION: Only rotate the crankshaft clockwise.

Rotate the engine two complete turns clockwise.

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



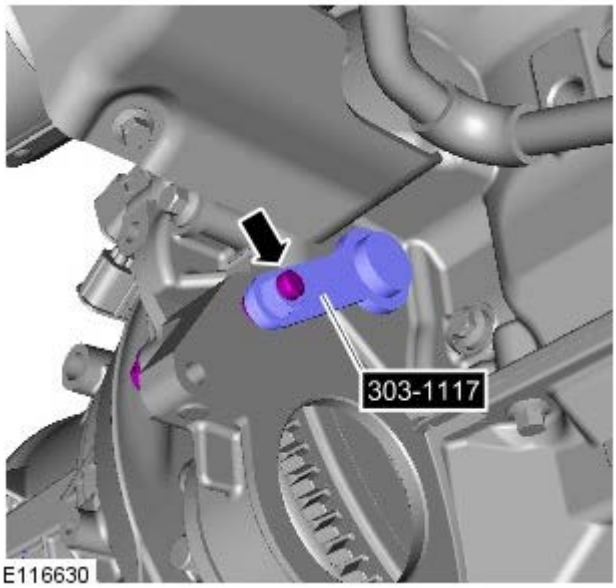
10.



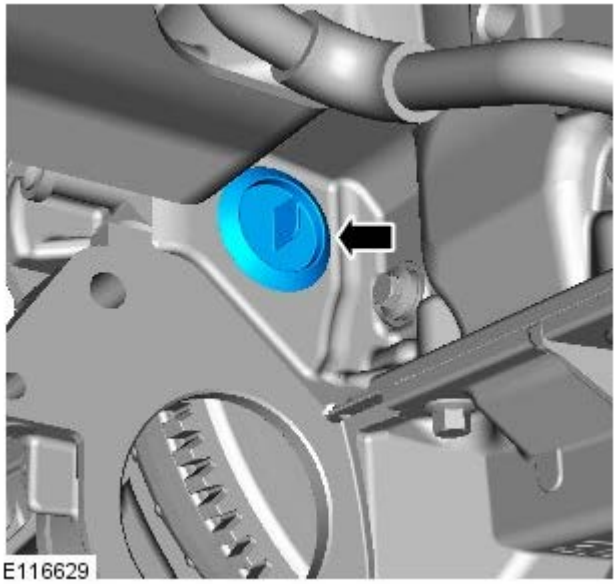
Install the special tools to the exhaust camshaft pulleys.

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

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



12.



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

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

Published: 31-Jul-2012

Engine - TDV6 3.0L Diesel - Timing Cover

Removal and Installation

Removal

1. Disconnect the battery ground cable.

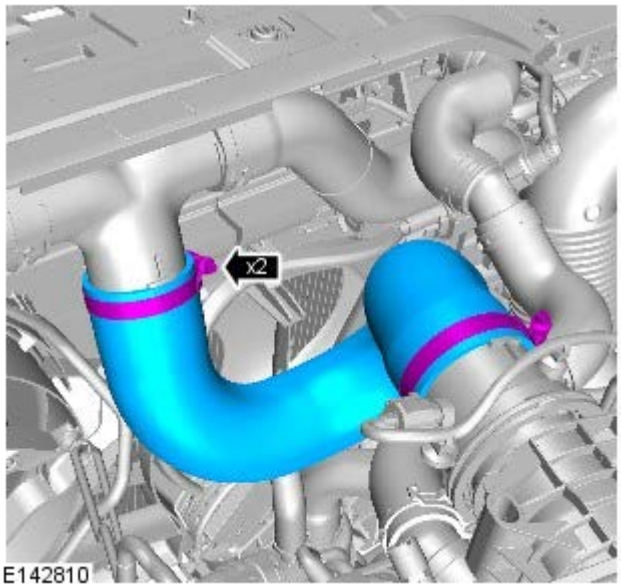
   Refer to: Specifications (414-00, Specifications).

2. Refer to: Cooling System Draining, Filling and Bleeding (303-03A Engine Cooling - TDV6 3.0L Diesel, General Procedures).

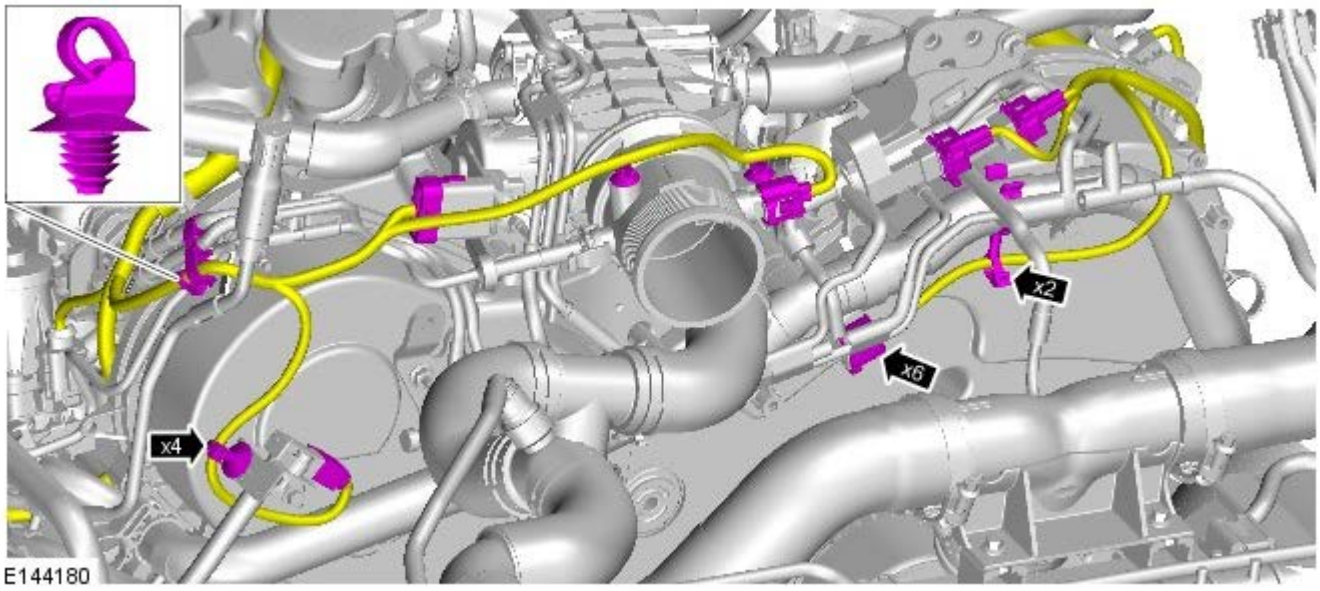
3. Refer to: Secondary Bulkhead Center Panel - TDV6 3.0L Diesel (501-02, Removal and Installation).

4. Refer to: Accessory Drive Belt Idler Pulley (303-05A Accessory Drive - TDV6 3.0L Diesel, Removal and Installation).

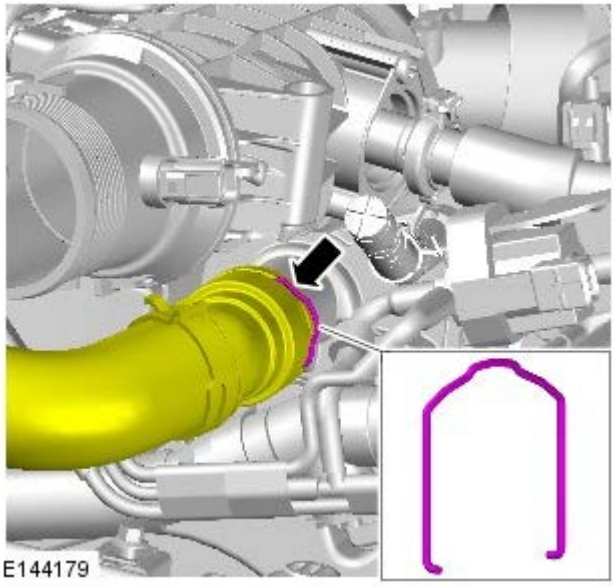
5. *Torque:* 3 Nm



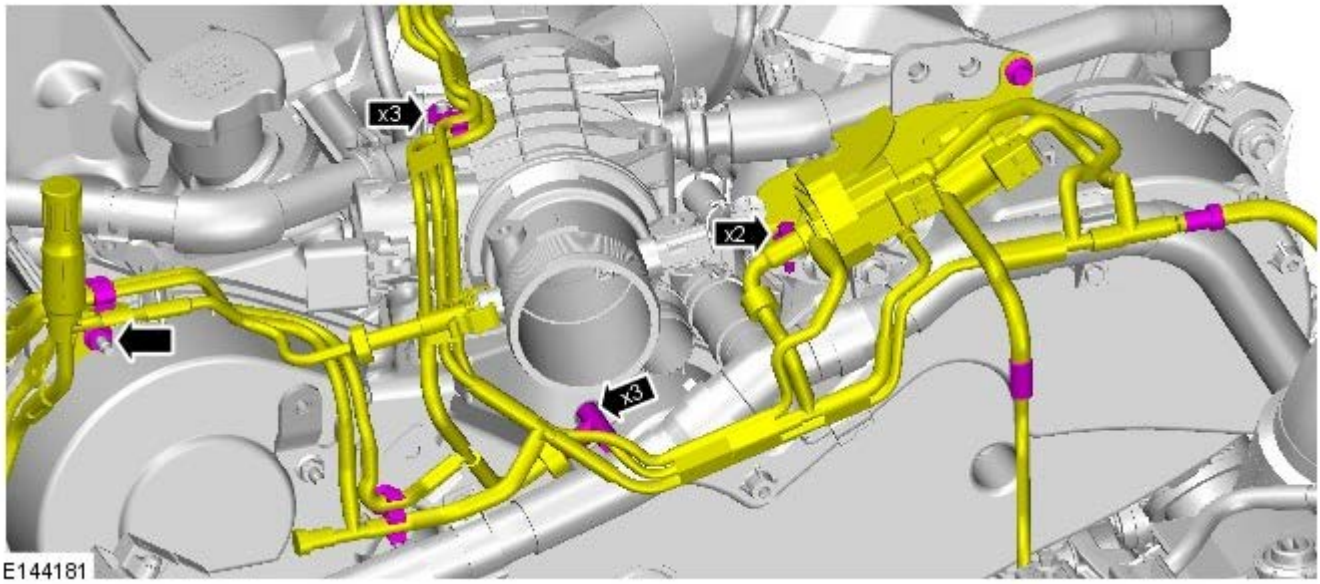
6.



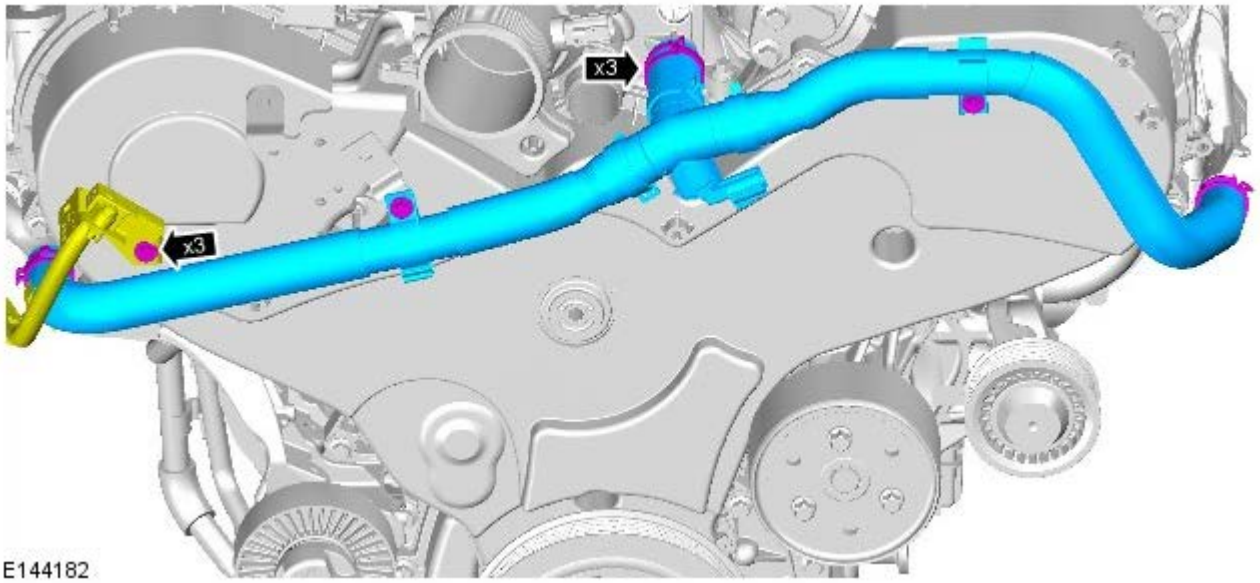
7.



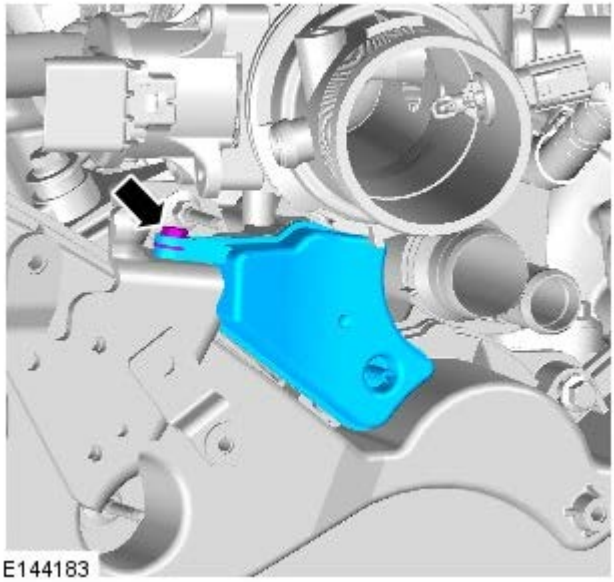
8. *Torque:* 8 Nm



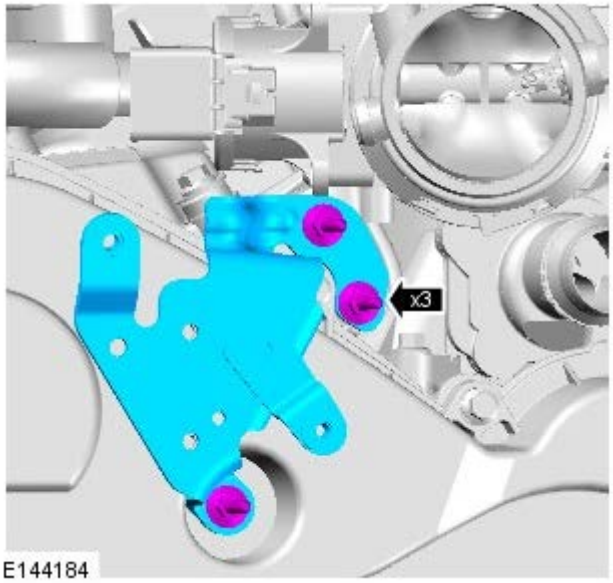
9. *Torque:* 8 Nm



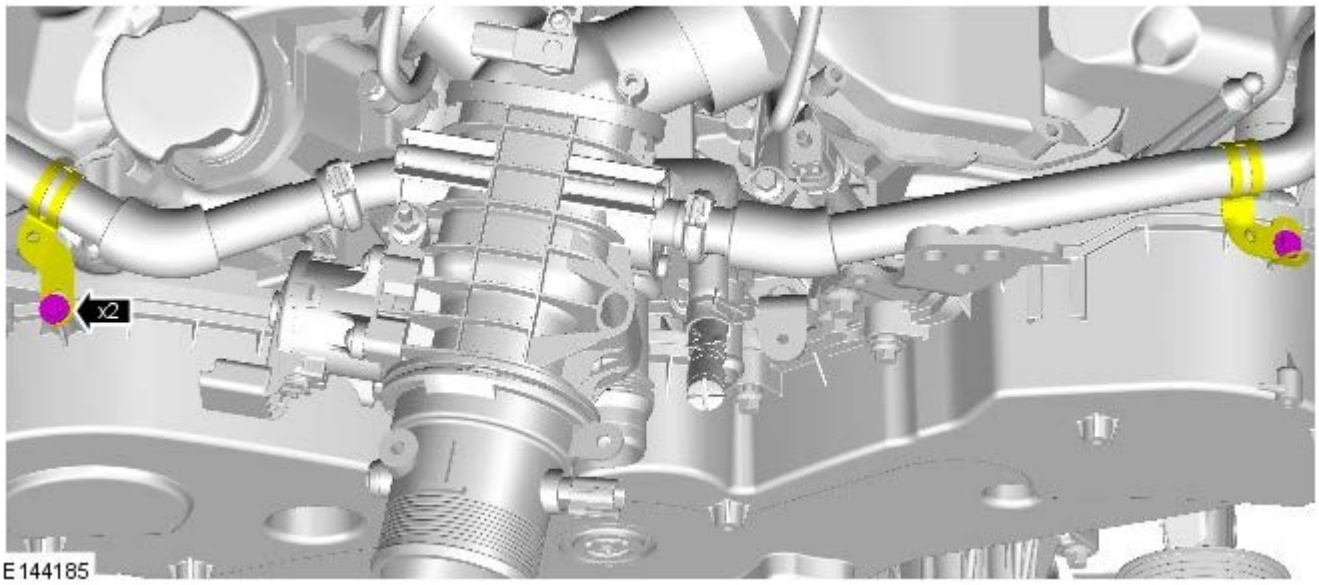
10. *Torque:* 8 Nm



11. *Torque:* 8 Nm

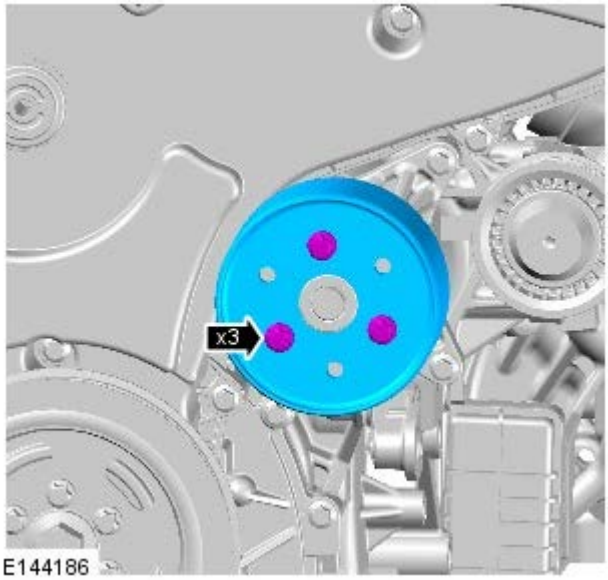


12. *Torque:* 8 Nm



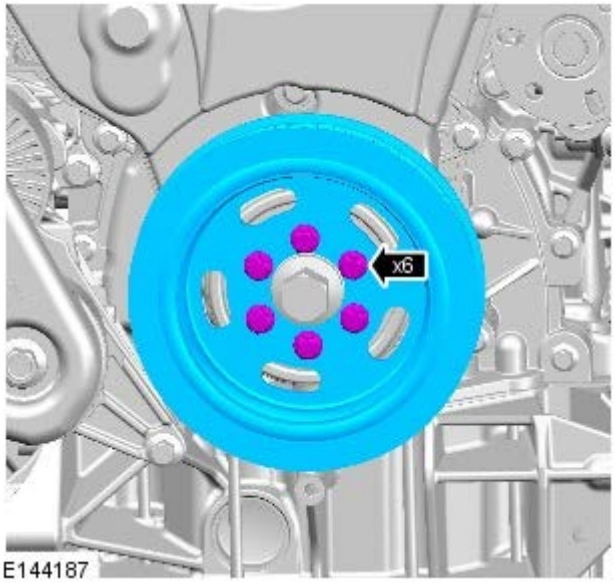
13. CAUTION: Discard the bolts.

- Using a suitable 6mm bar, retain the coolant

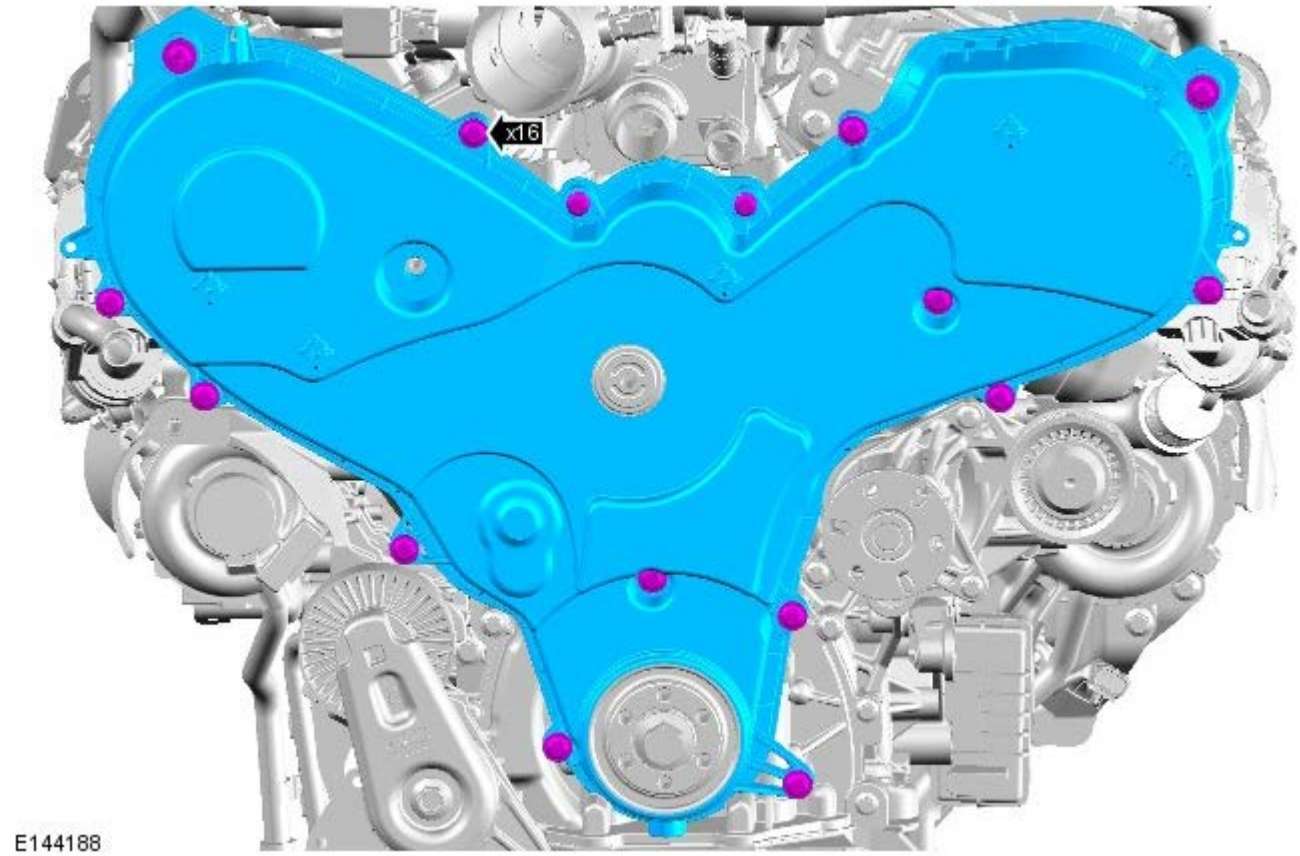


pump pulley.
- *Torque:* 25 Nm

14. *Torque:* 25 Nm



15. *Torque:* 10 Nm



Installation

1. To install, reverse the removal procedure.

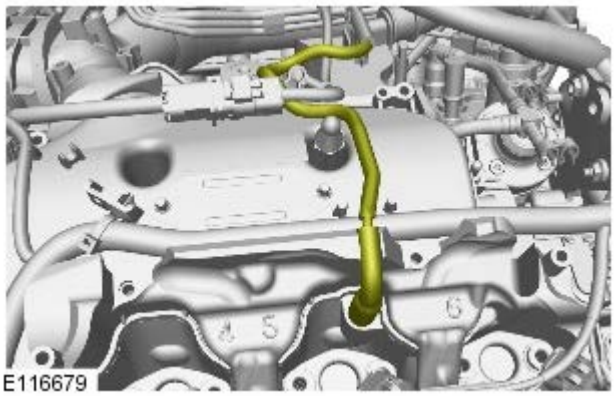
Published: 24-Aug-2012

Engine - TDV6 3.0L Diesel - Valve Cover LH

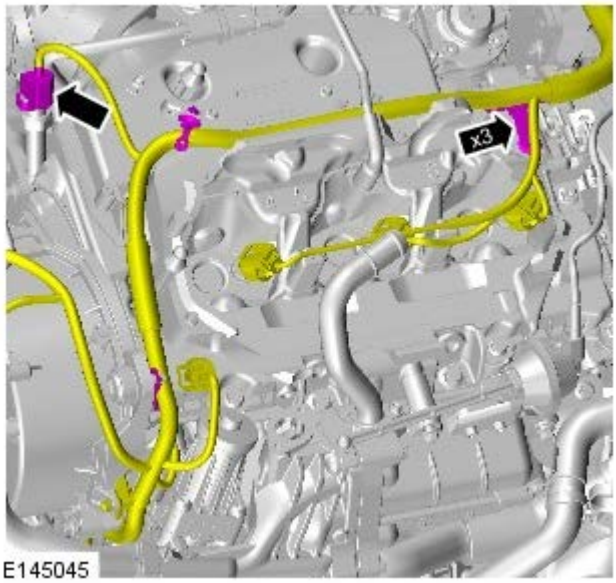
Removal and Installation

Removal

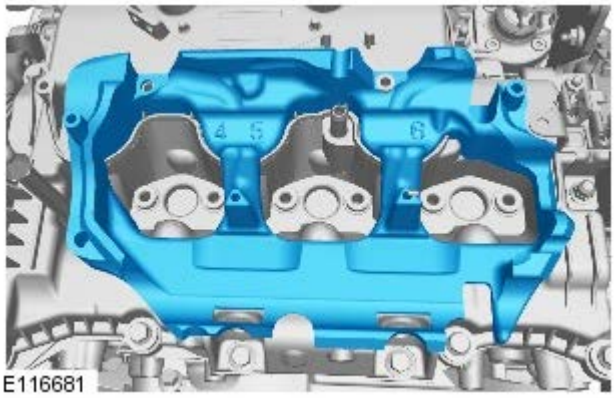
1. Refer to: Specifications (414-00, Specifications).
2. Refer to: Timing Belt (303-01A Engine - TDV6 3.0L Diesel, Removal and Installation).
3. Refer to: Fuel Injectors LH (303-04A Fuel Charging and Controls - TDV6 3.0L Diesel, Removal and Installation).
4. Refer to: Fuel Rail LH (303-04A Fuel Charging and Controls - TDV6 3.0L Diesel, Removal and Installation).
5. Refer to: Intake Air Shutoff Throttle (303-04A Fuel Charging and Controls - TDV6 3.0L Diesel, Removal and Installation).
6.



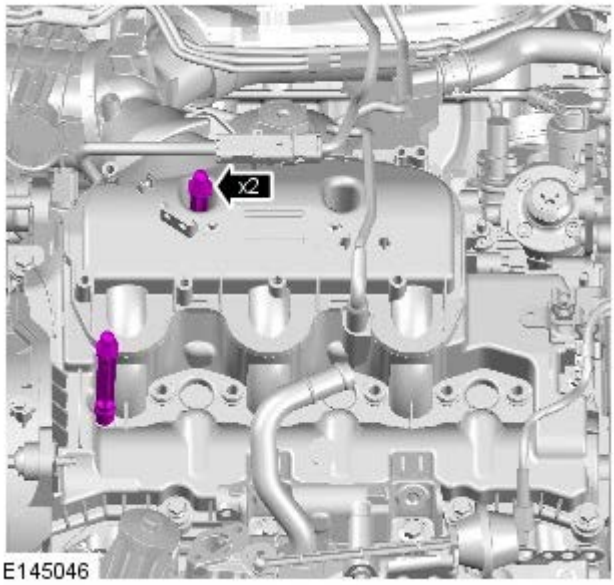
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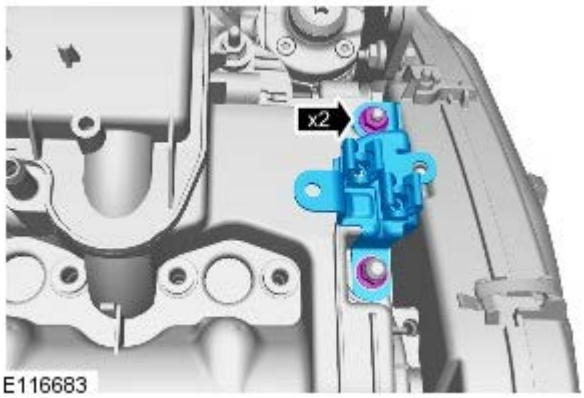
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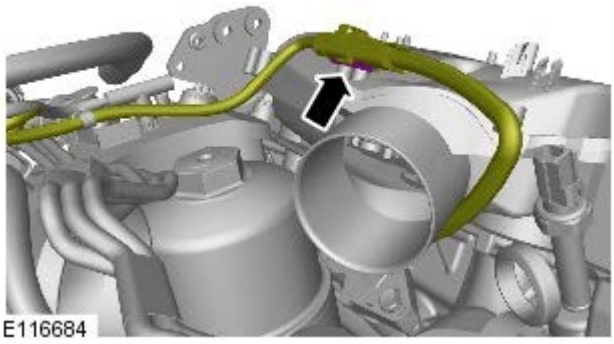
9. *Torque:* 5 Nm



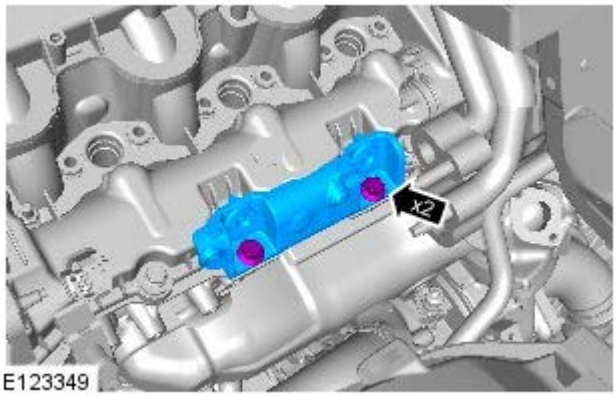
10. *Torque:* 10 Nm

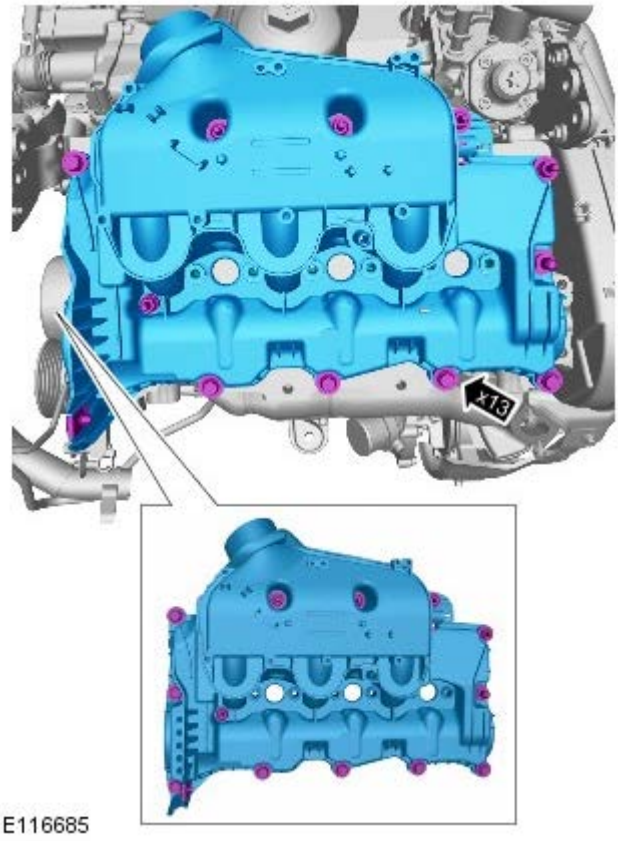


11.



12. *Torque:* 23 Nm





13. 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.

    NOTES:

    Install a new gasket.

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

    Torque: 10 Nm

Installation

1. To install, reverse the removal procedure.

Published: 13-Dec-2013

Engine - TDV6 3.0L Diesel - Valve Cover RH

Removal and Installation

Special Tool(s)

	100-012 Slide Hammer
	310-213 Fuel Injector Removal Adapter

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).

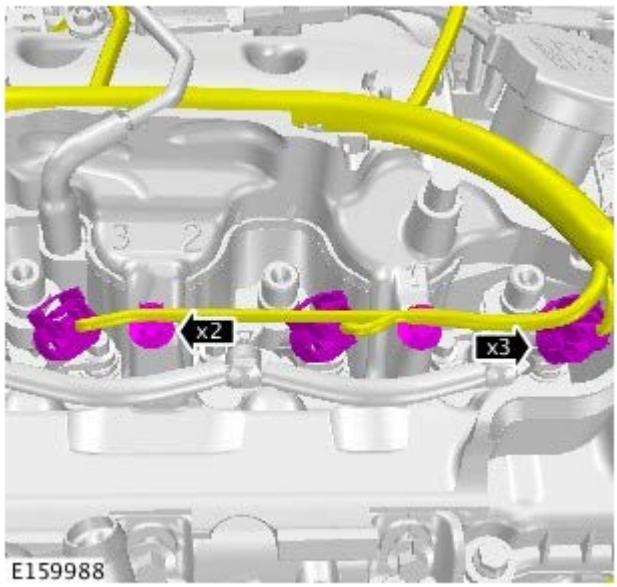
2. Raise and support the vehicle.

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

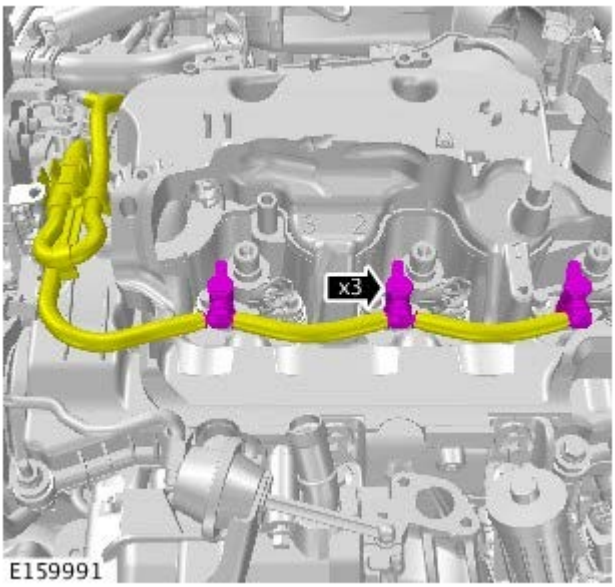
4. Refer to: Fuel Rail RH (303-04A Fuel Charging and Controls - TDV6 3.0L Diesel, Removal and Installation).

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

6.

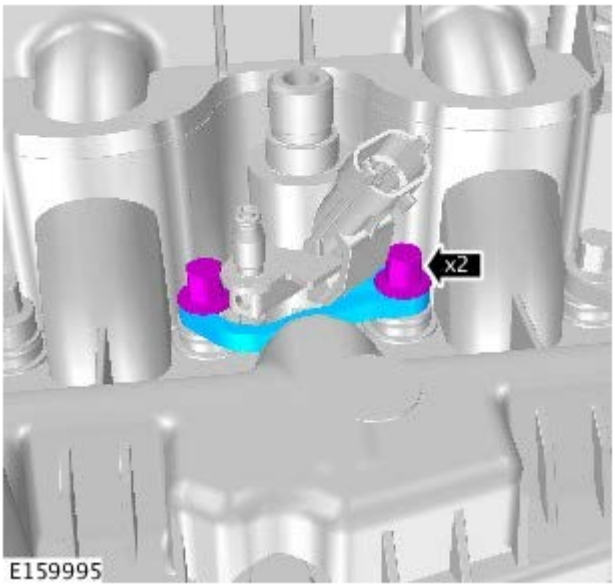


7. Refer to: Fuel Injection Component Cleaning (303-04A Fuel Charging and Controls - TDV6 3.0L Diesel, General Procedures).



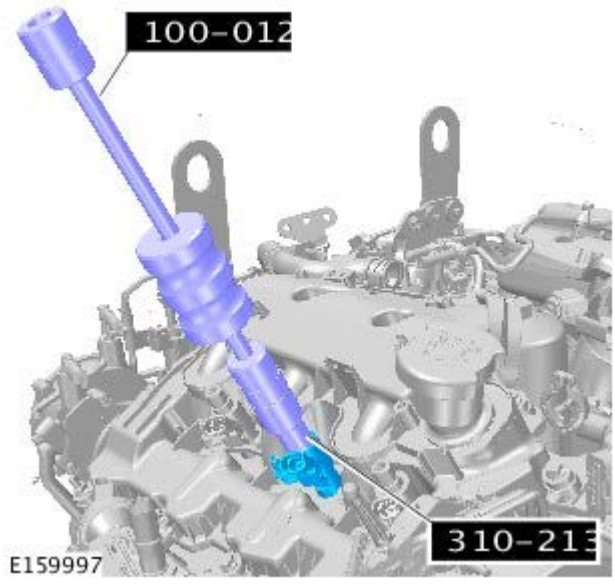
8. CAUTION: Be prepared to collect escaping fuel.

9.

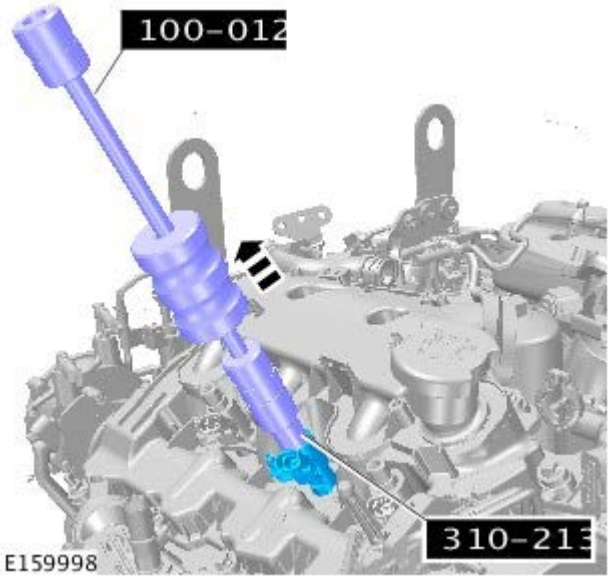


10. Install the special tool.

Special Tool(s): 100-012, 310-213

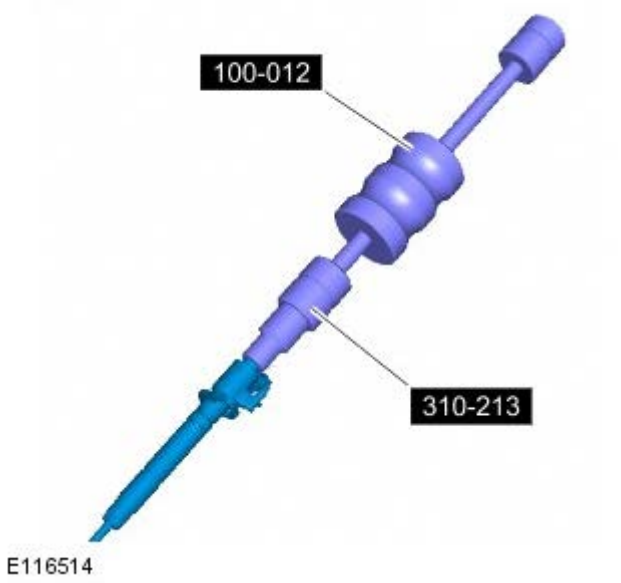


11. *Special Tool(s):* 100-012, 310-213

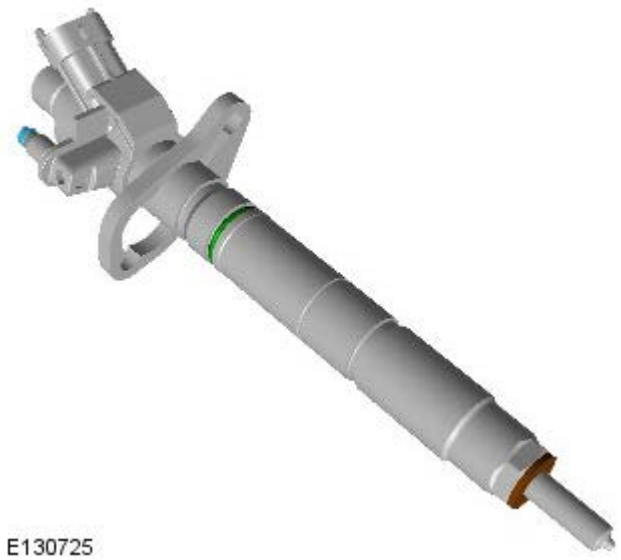


12. Remove the special tool.

    Special Tool(s): 100-012, 310-213



13. Remove the 2 remaining fuel injectors.



14. NOTES:

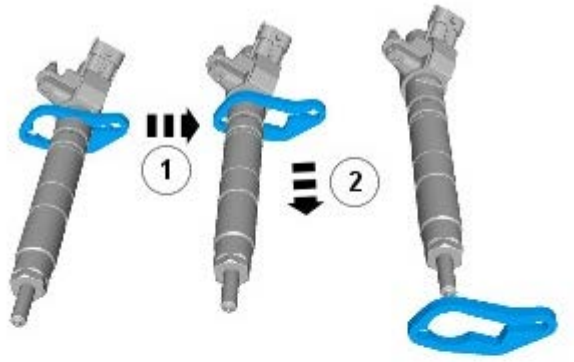
    This step is only required if new components have not been installed.

    Remove and discard the O-ring seals.

    Discard the sealing washers.

    Repeat this step for each of the fuel injectors.

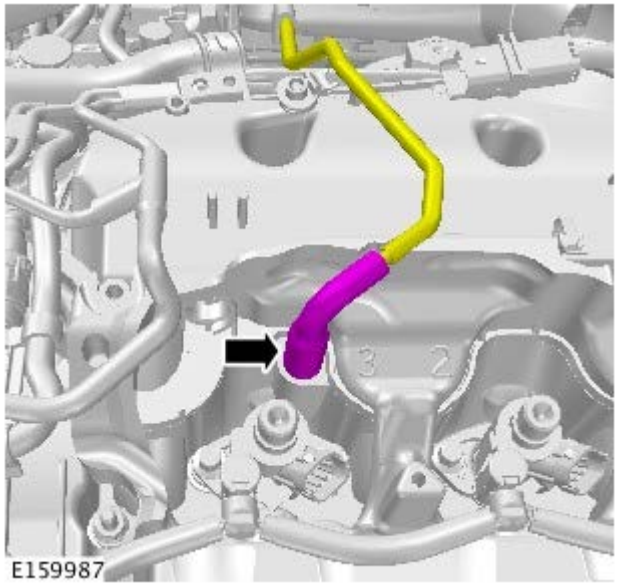
15. NOTE: This step is only required if new components have not been installed.



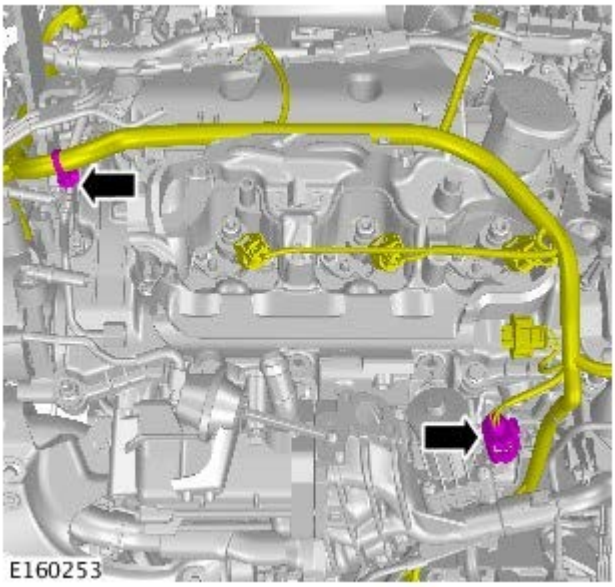


E144699

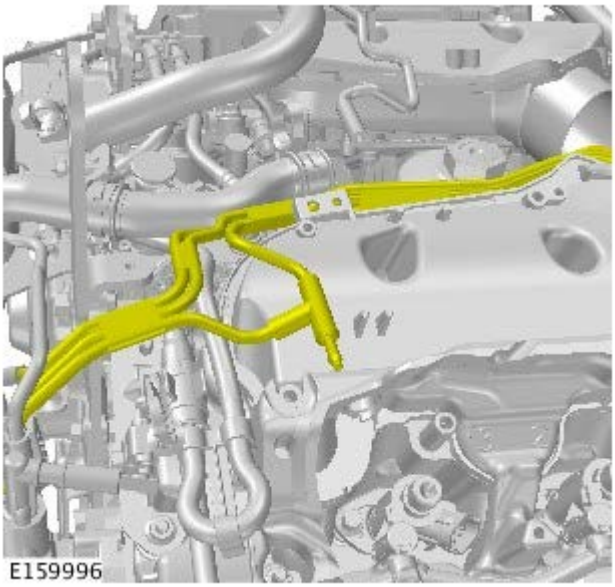
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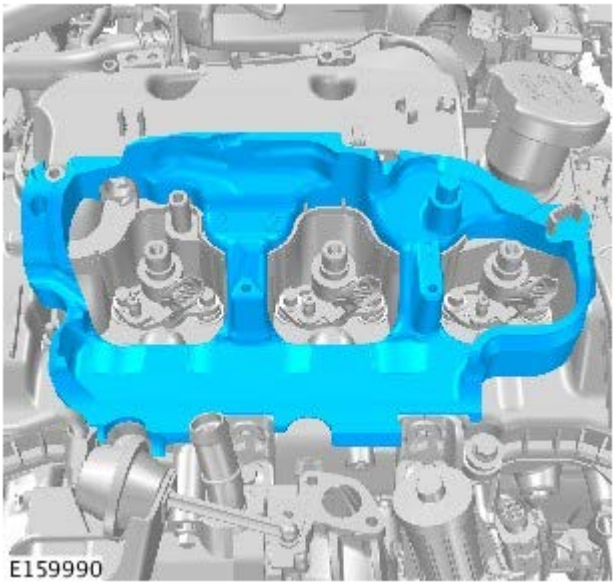
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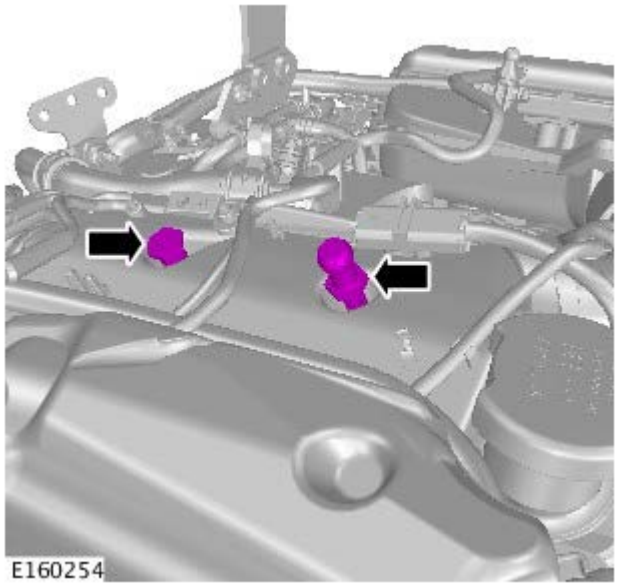
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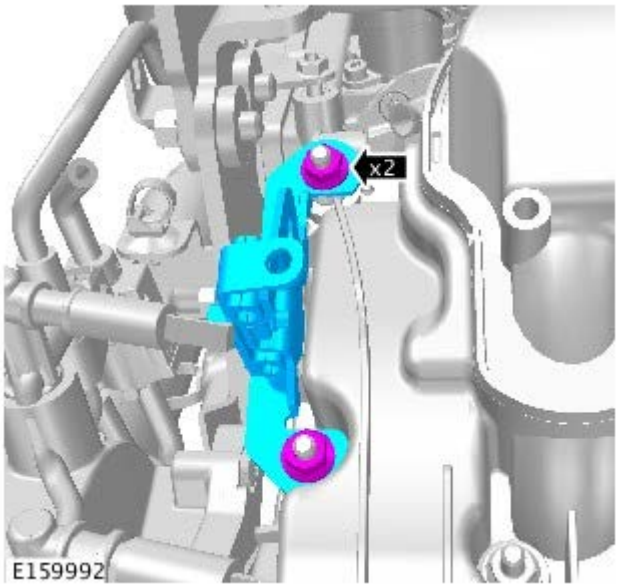
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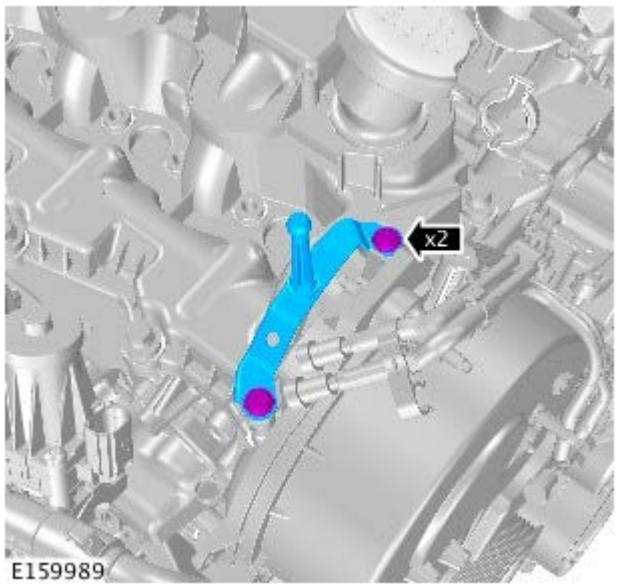
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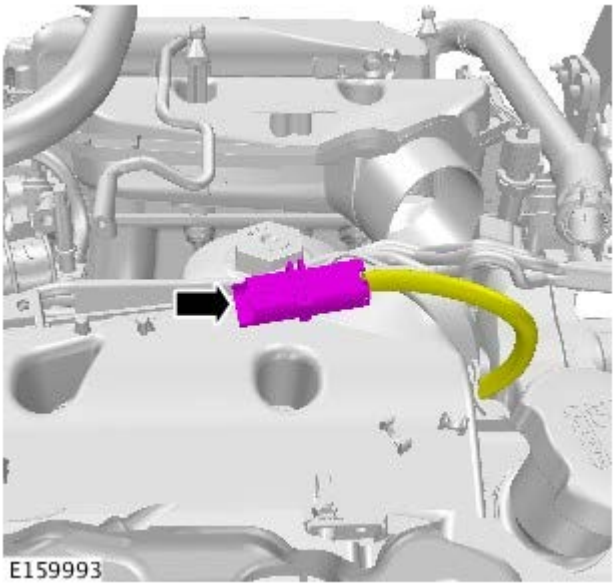
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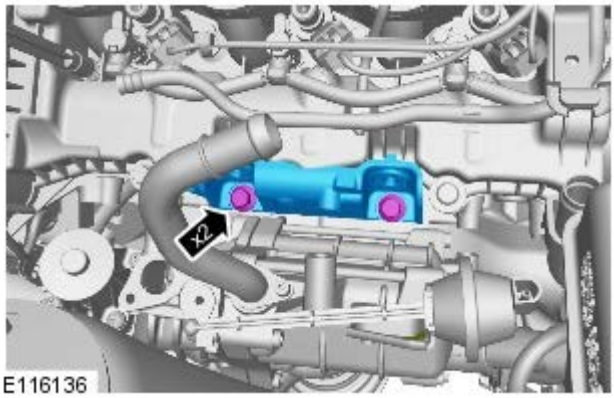
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23.



24.

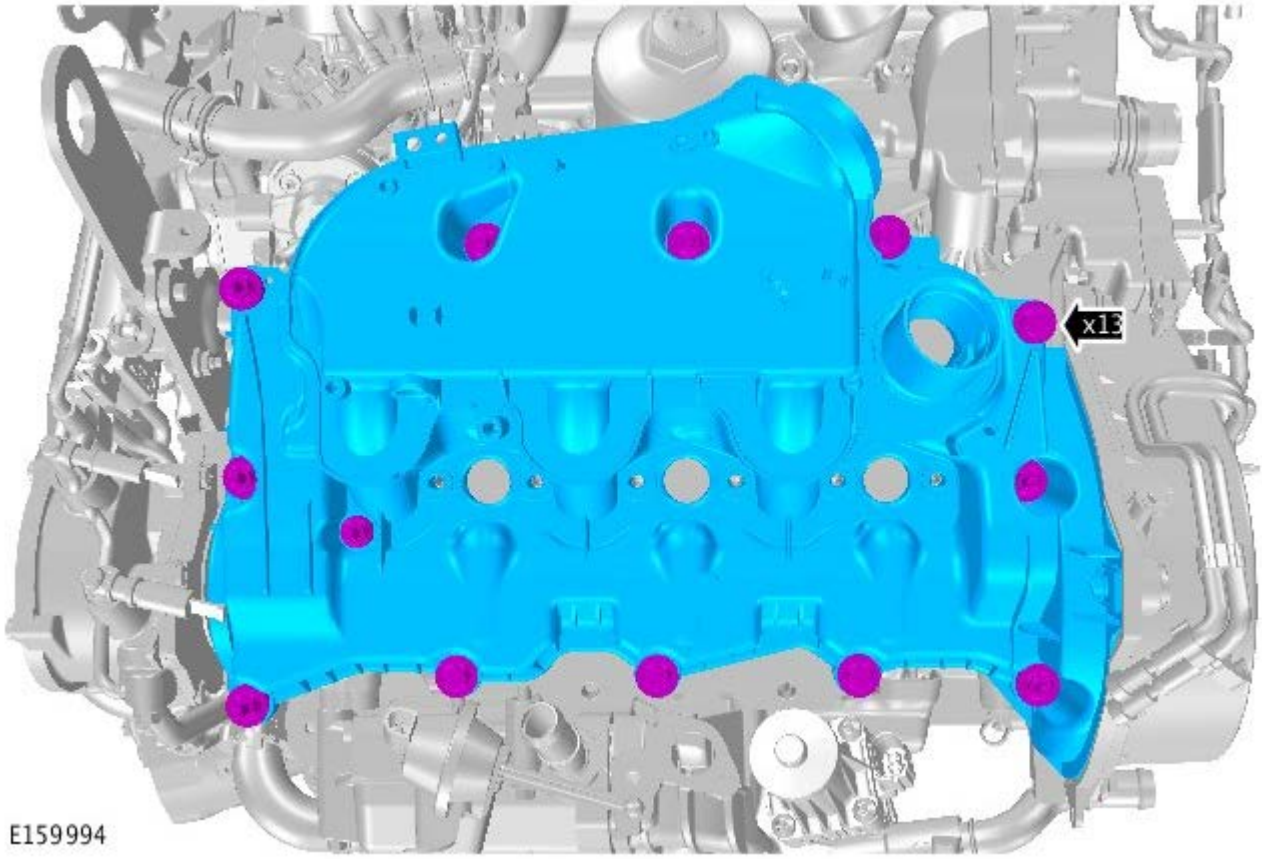


25. CAUTION: Make sure that the mating faces are clean and free of corrosion and foreign material.

NOTES:

Discard the gasket.

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



Installation

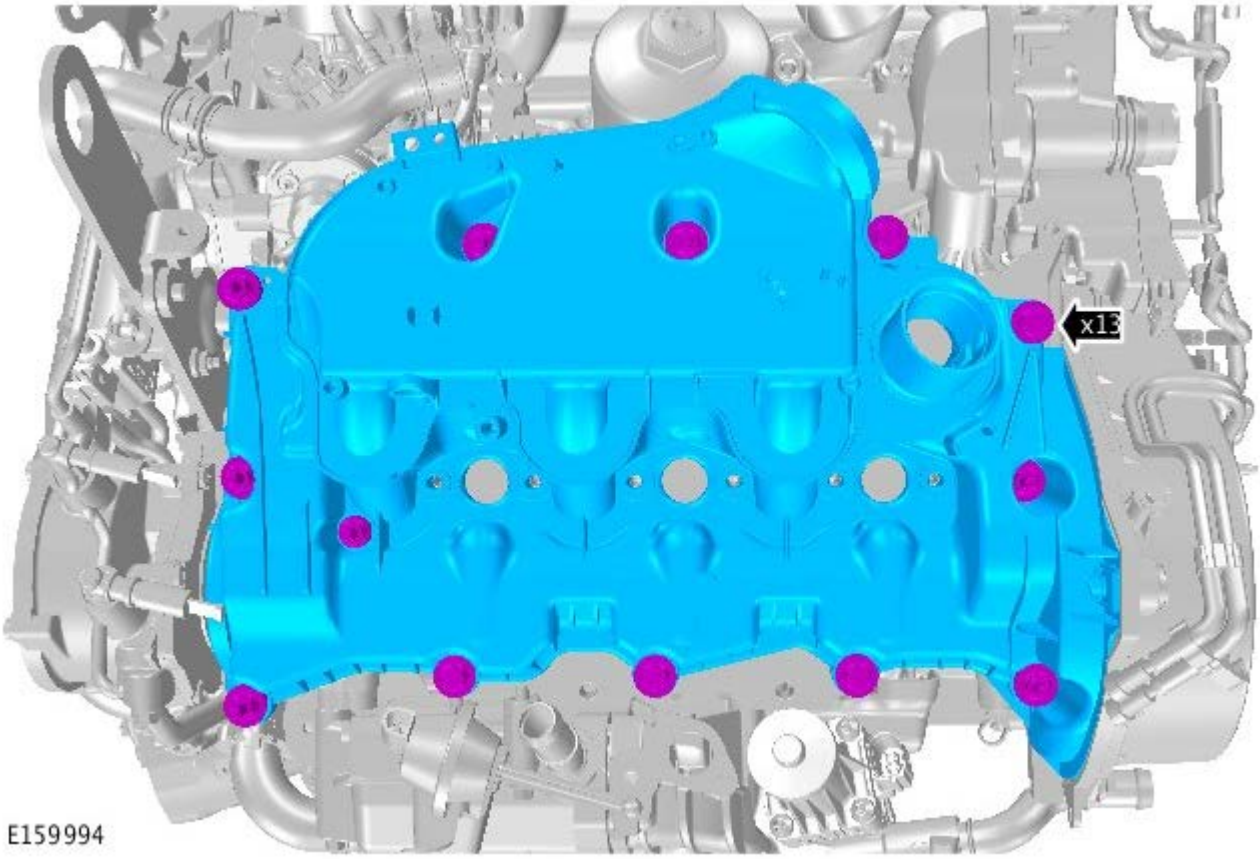
1. CAUTIONS:

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

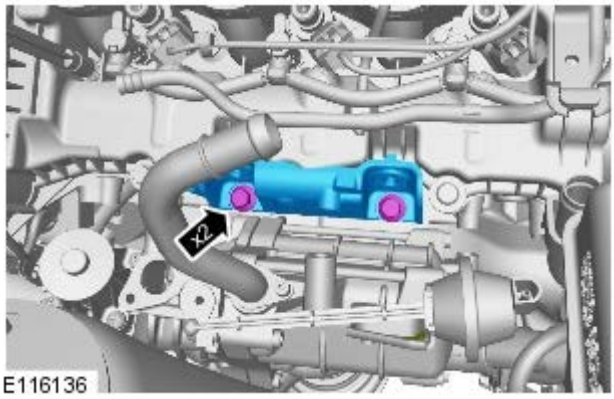
   Install all the bolts finger tight before final tightening.

   NOTE: Install a new gasket.

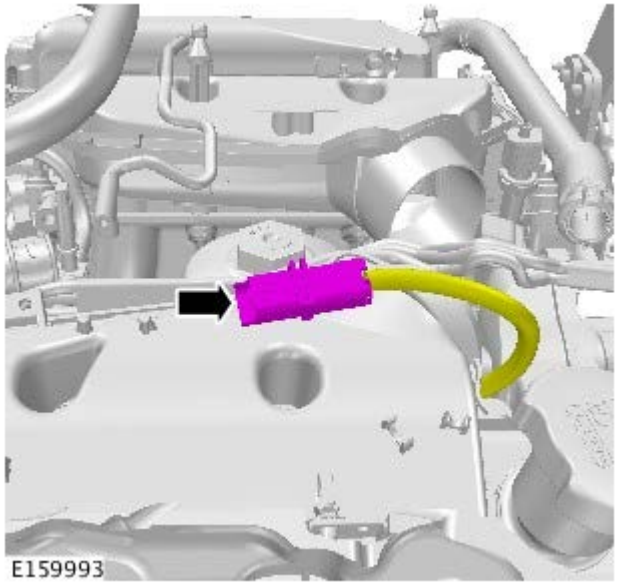
   Torque: 10 Nm



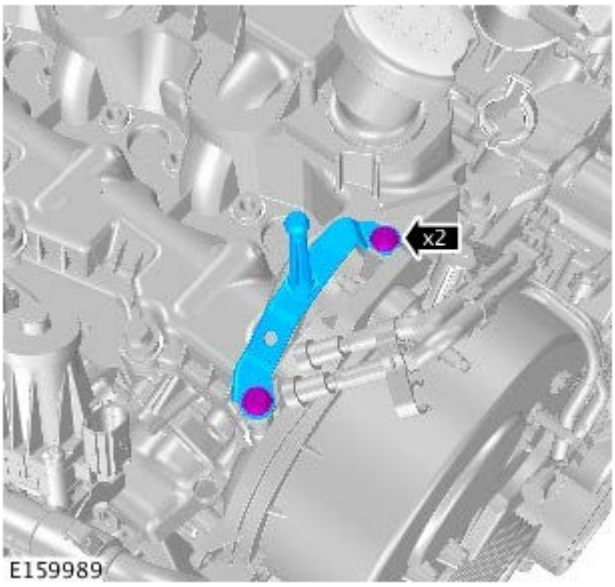
2. *Torque:* 24 Nm



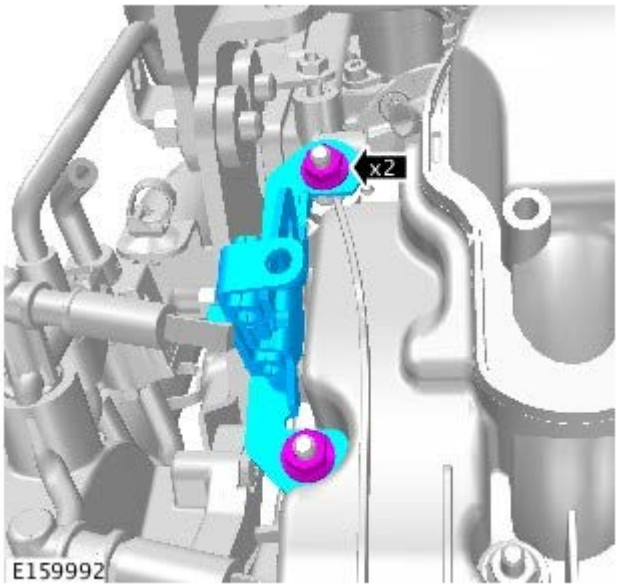
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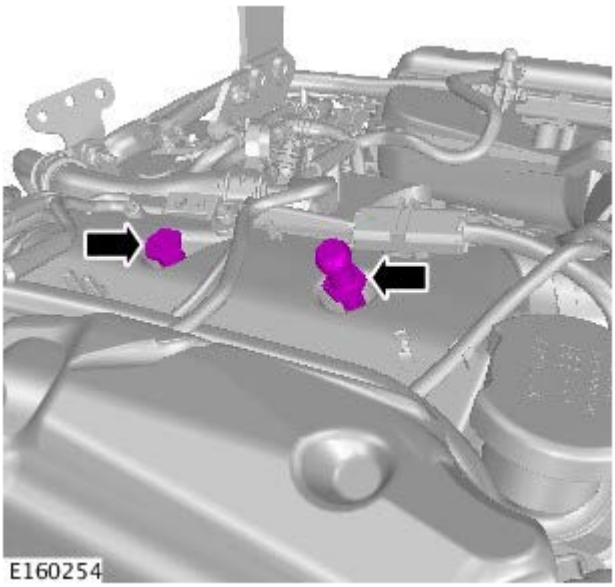
4. *Torque:* 9 Nm



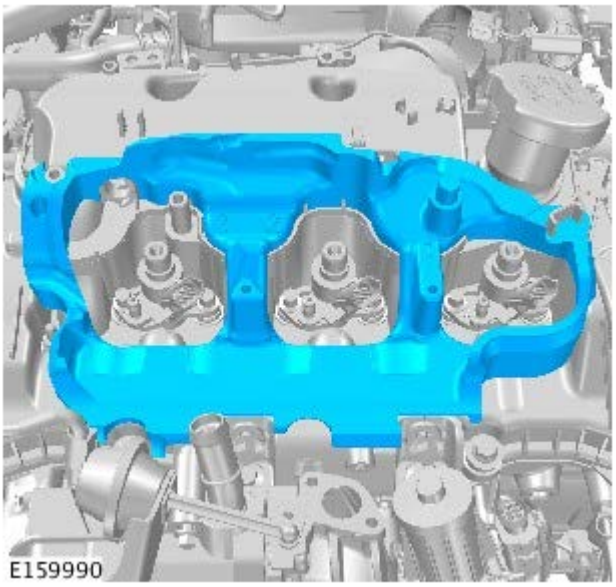
5. *Torque:* 9 Nm



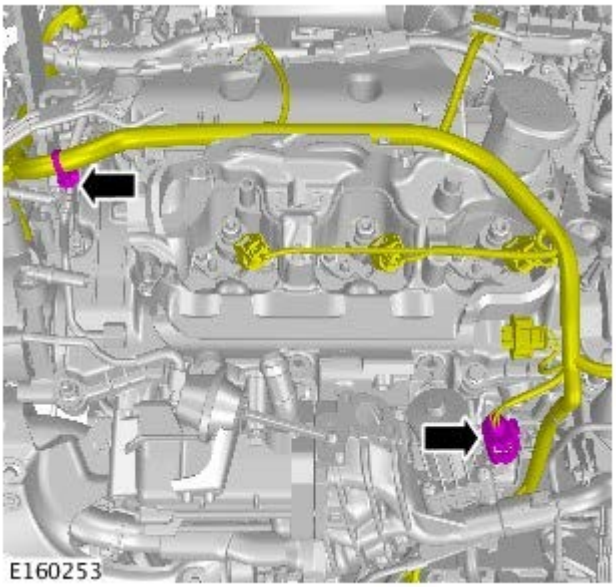
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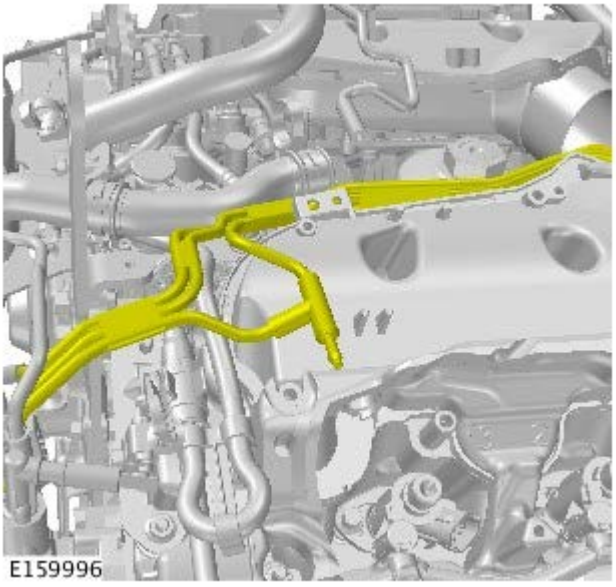
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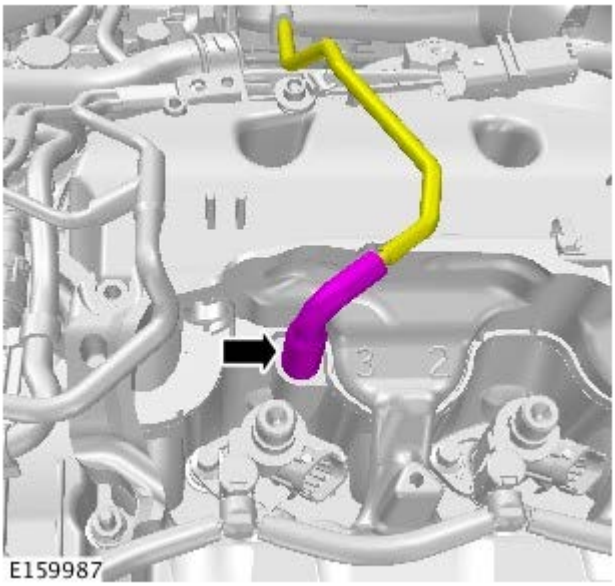
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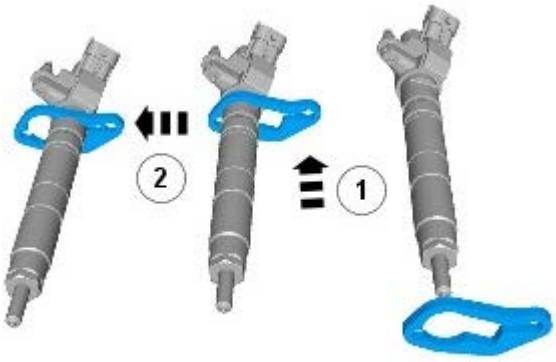


9.



10.







11. NOTE: This step is only required if previously removed.

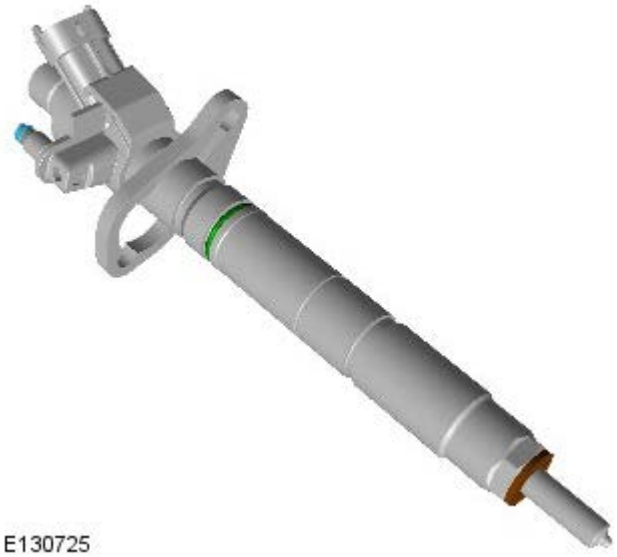
12. CAUTION: Make sure that new sealing washers are installed.

    NOTES:

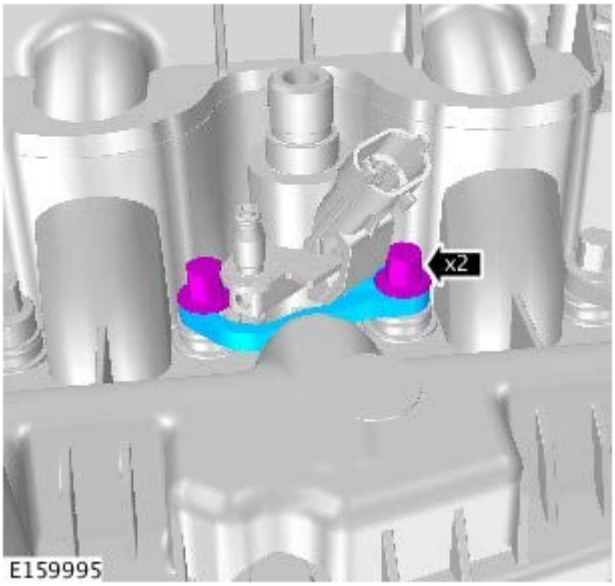
    This step is only required if new components are not installed.

    Install new O-ring seals.

    Repeat this step for each of the fuel injectors.



E130725

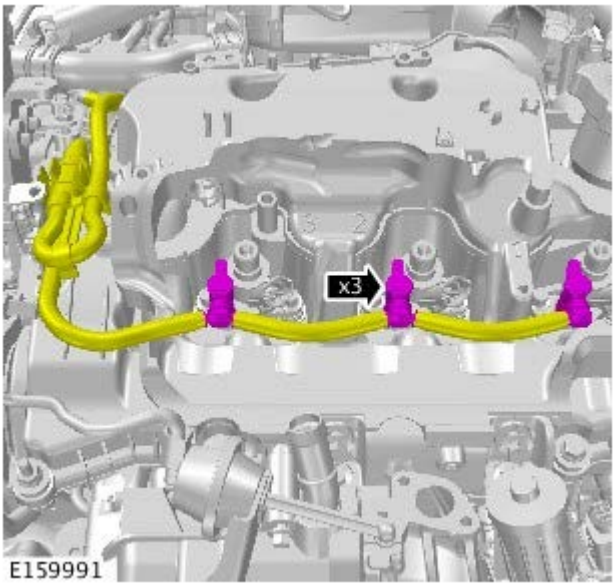


E159995

13. 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.

NOTE: Tighten the retaining bolts evenly and progressively.

Torque: 9 Nm



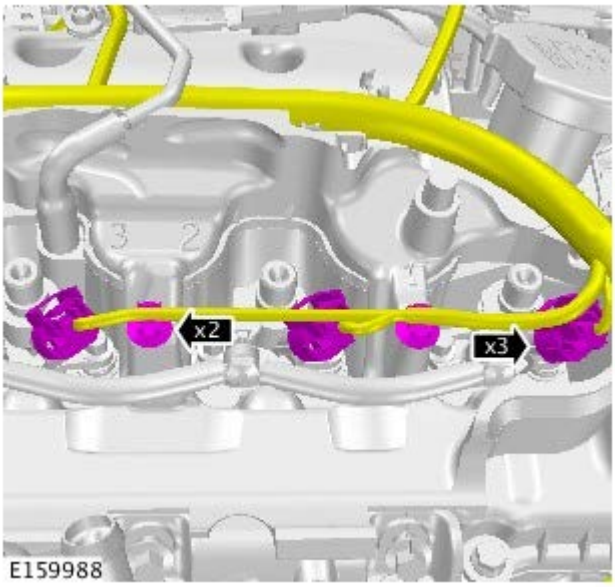
E159991

14. CAUTION: Be prepared to collect escaping fuel.

NOTE: Make sure that the fuel injector return line has a maximum of 8 uses.

15. Install the 2 remaining fuel injectors.

16.



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

18. Refer to: Fuel Rail RH (303-04A Fuel Charging and Controls - TDV6 3.0L Diesel, Removal and Installation).

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

20. Connect the battery ground cable

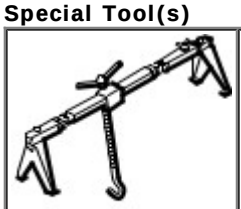
    Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 11-Sep-2013

Engine - TDV6 3.0L Diesel - Engine

Removal

Special Tool(s)

 303-021	303-021 Engine support bracket

CAUTION: 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.

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.

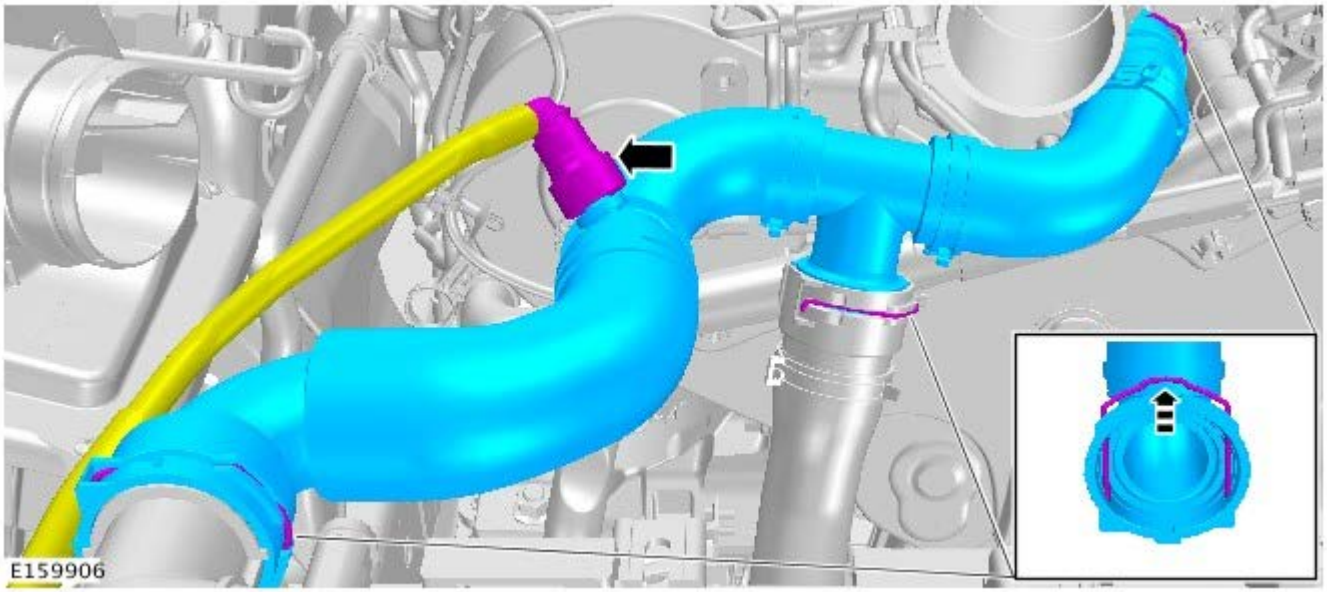
   Raise and support the vehicle.

3. Refer to: Hood (501-02, Removal and Installation).

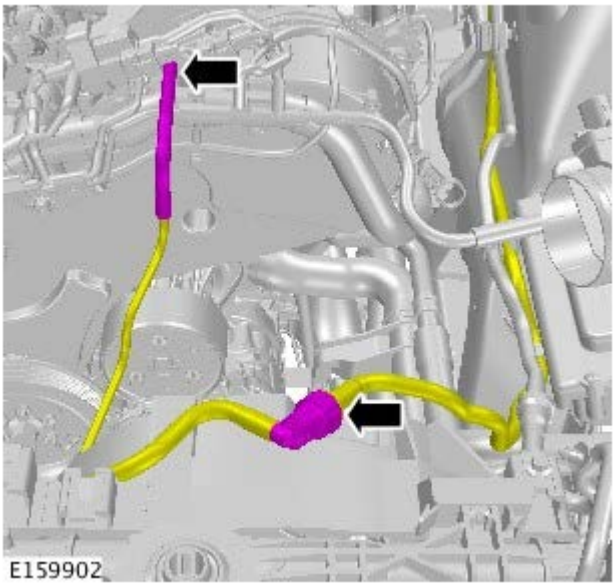
4. Refer to: Cooling System Partial Draining, Filling and Bleeding (303-03A Engine Cooling - TDV6 3.0L Diesel, General Procedures).

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

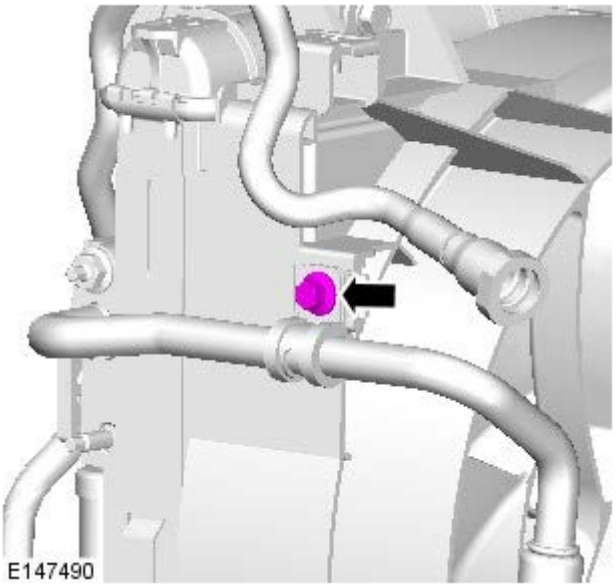
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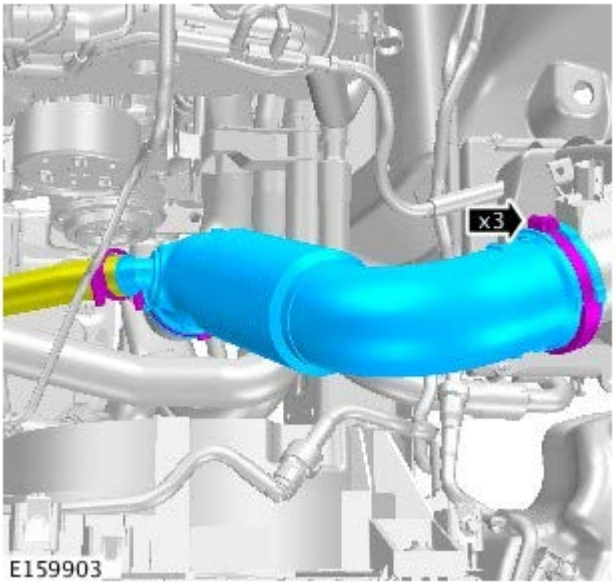
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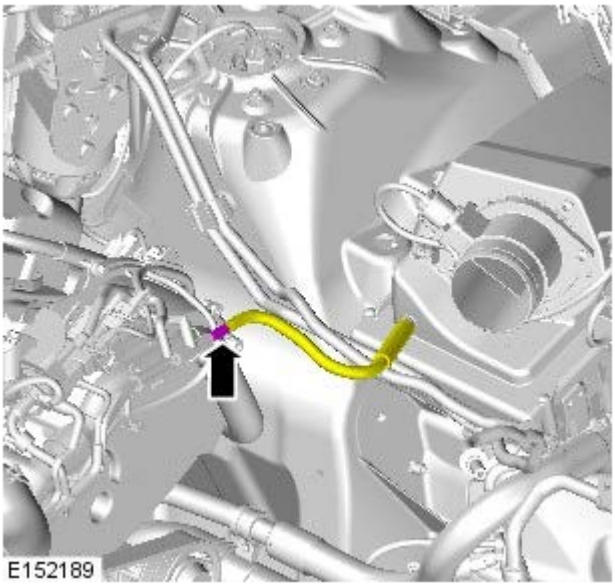
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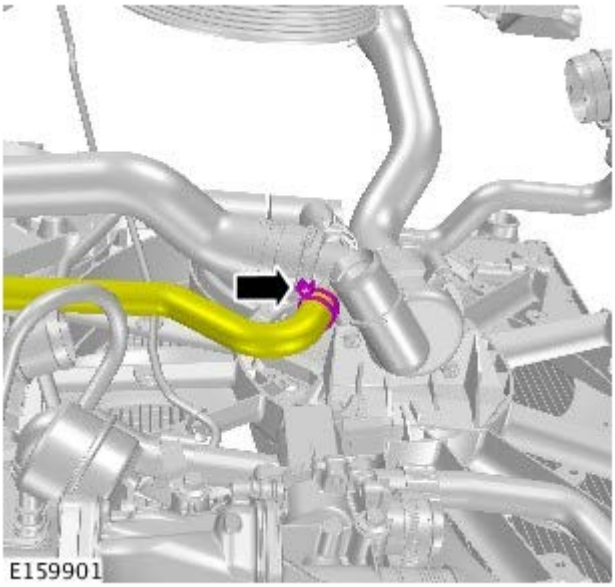
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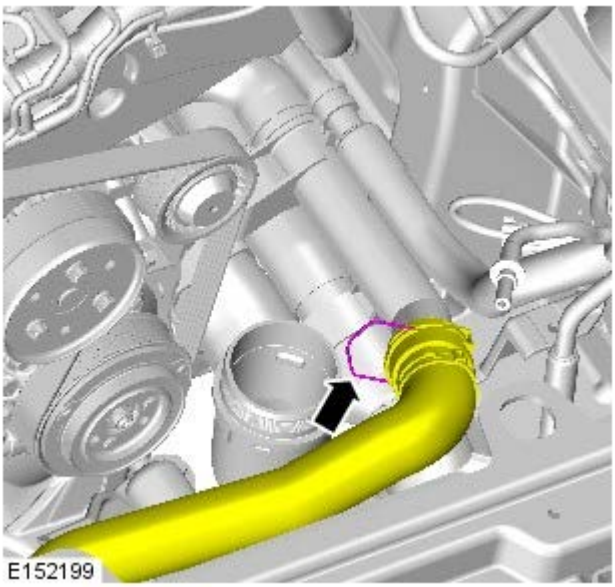
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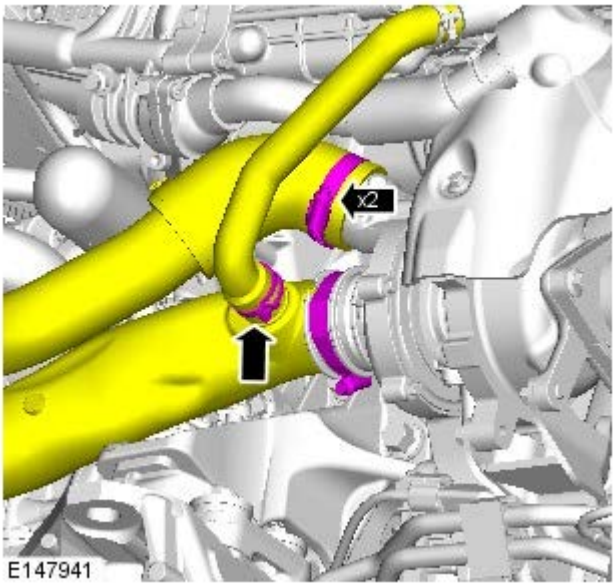
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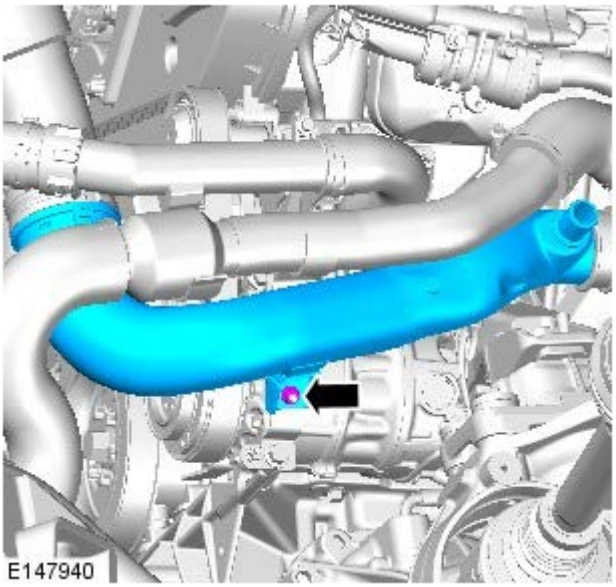
12. CAUTION: Be prepared to collect escaping coolant.



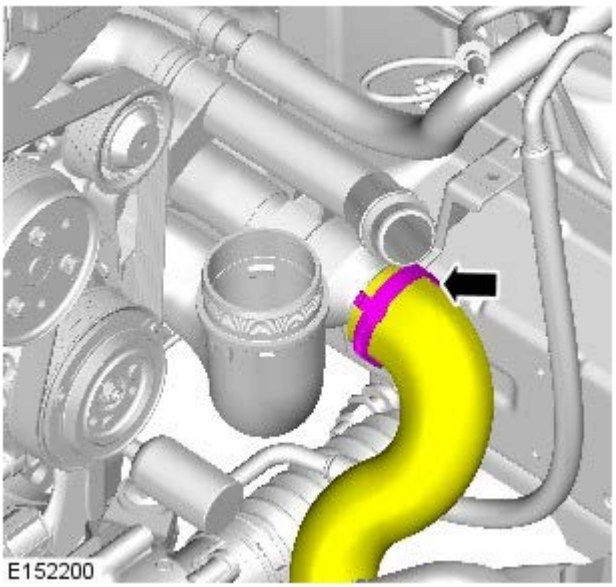
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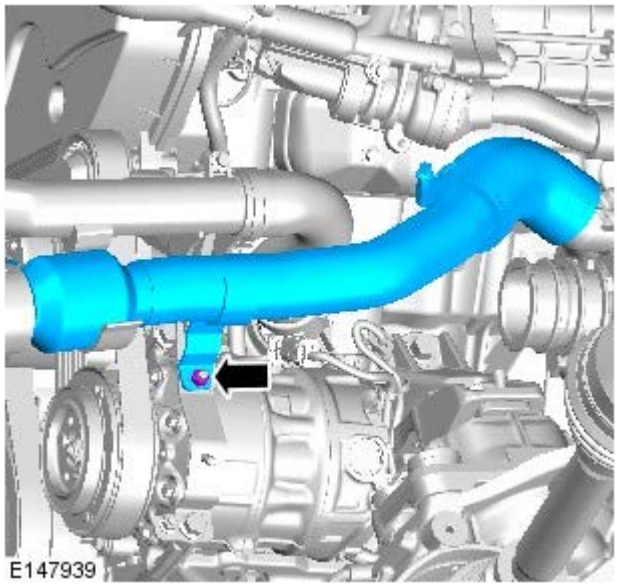
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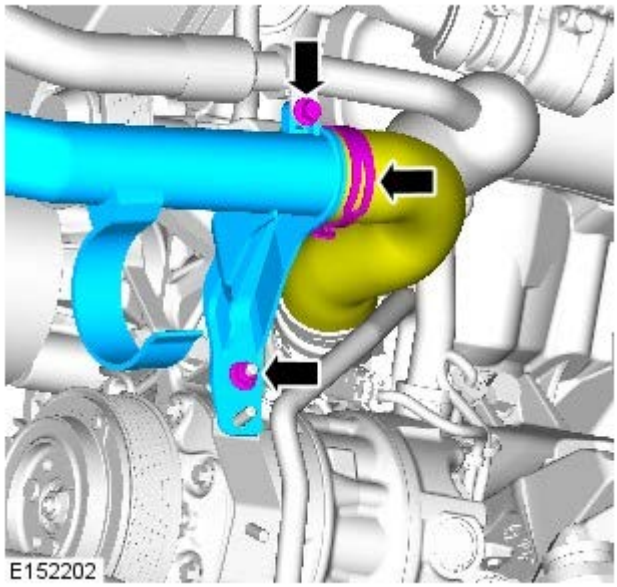


15.

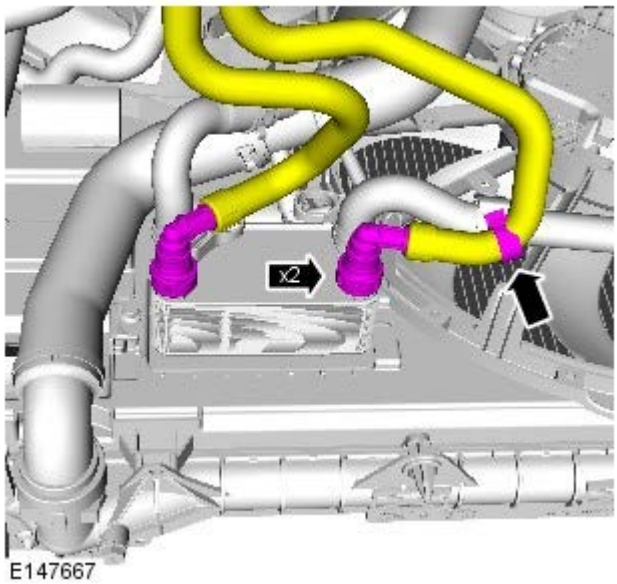


16.





17. CAUTION: Be prepared to collect escaping coolant.

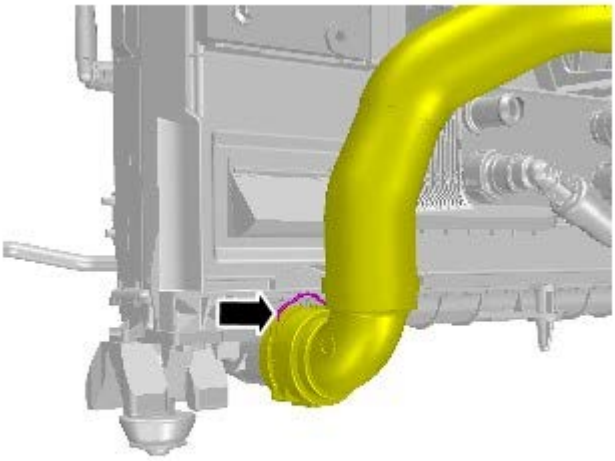


18. CAUTIONS:

    Be prepared to collect escaping fluids.

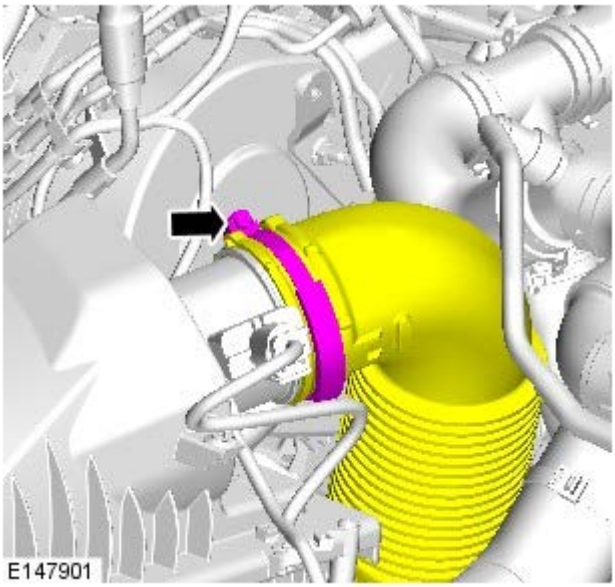
    Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean and dry. Plug open connections to prevent contamination.

19. CAUTION: Be prepared to collect escaping coolant.

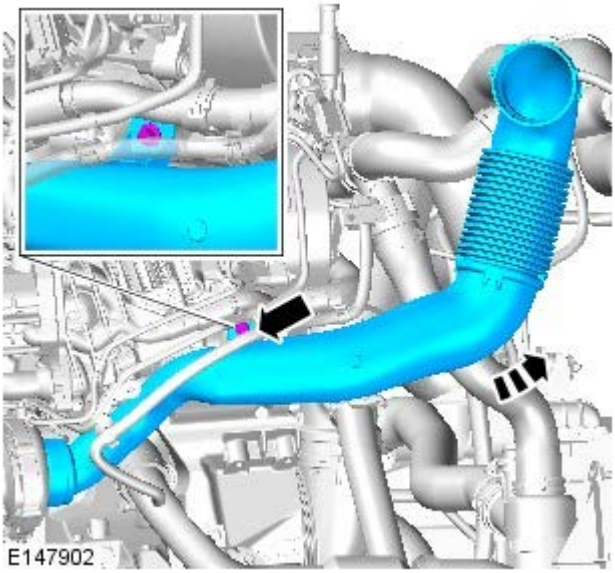


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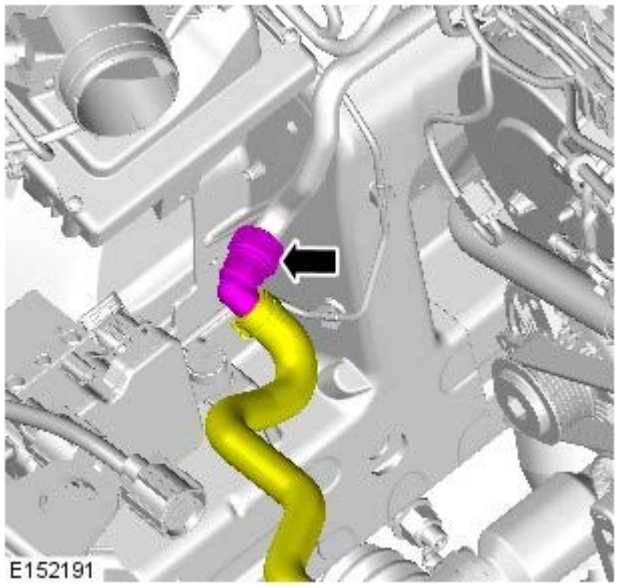
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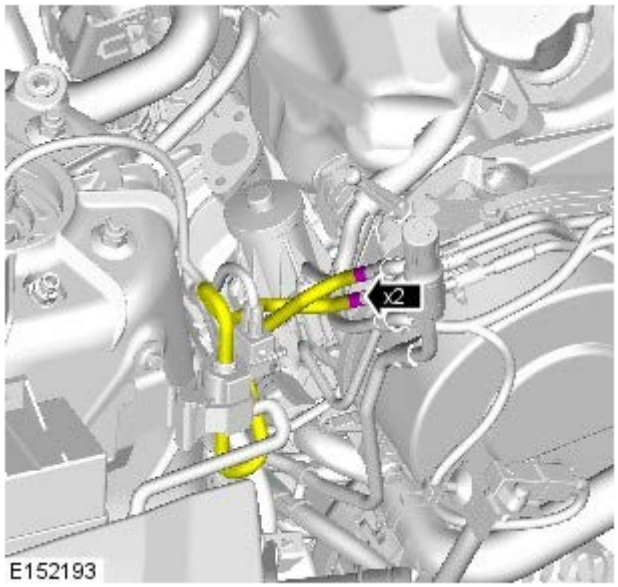
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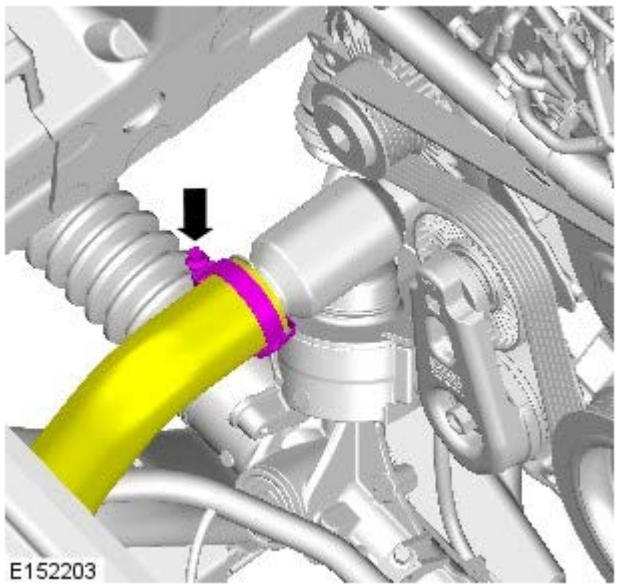
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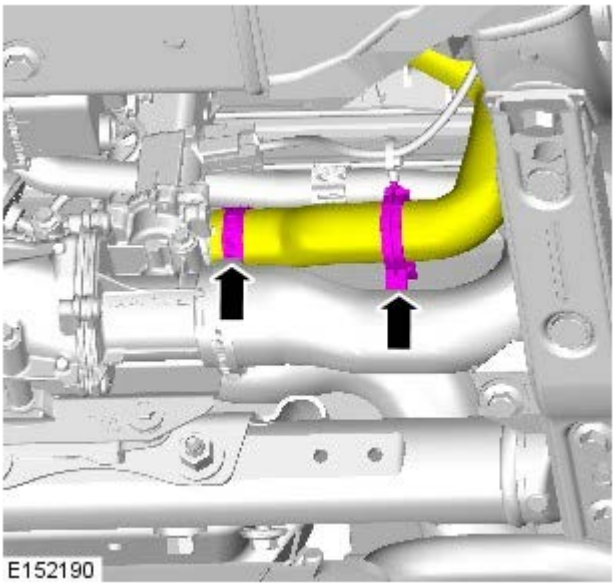
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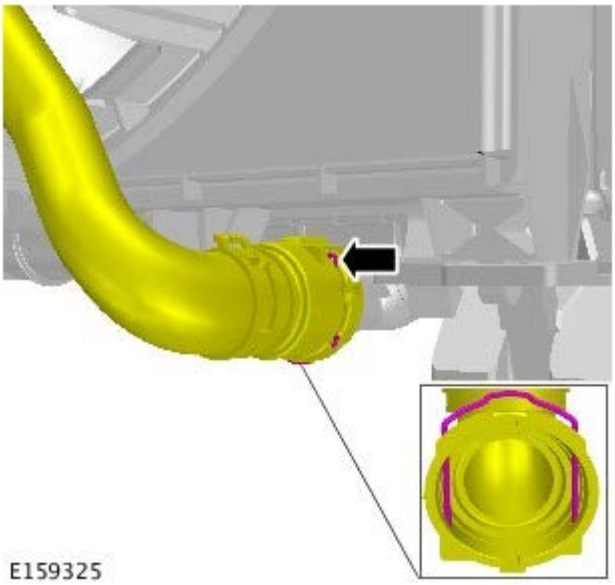
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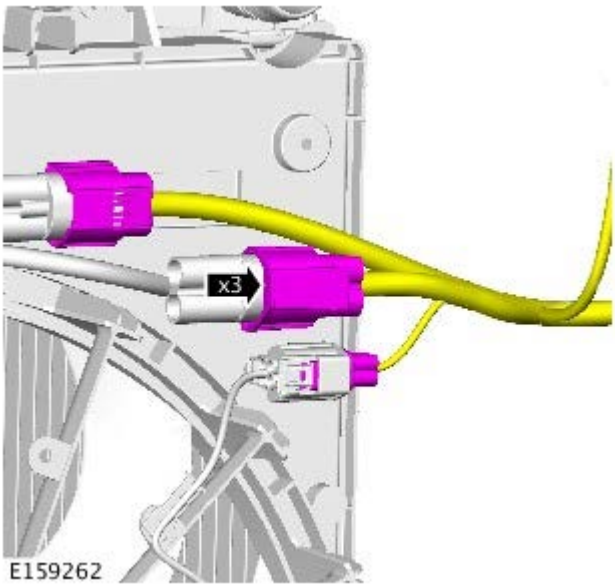
25.



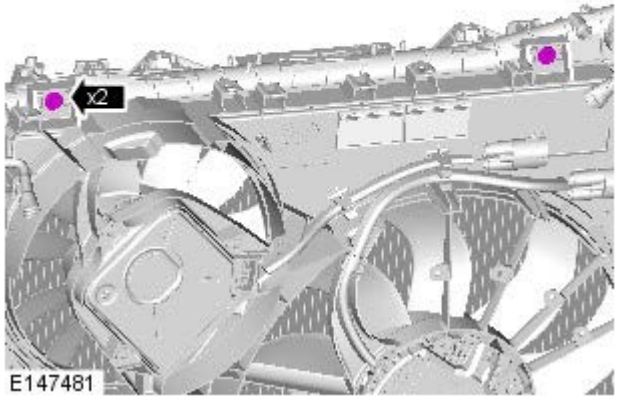
26. CAUTION: Be prepared to collect escaping coolant.



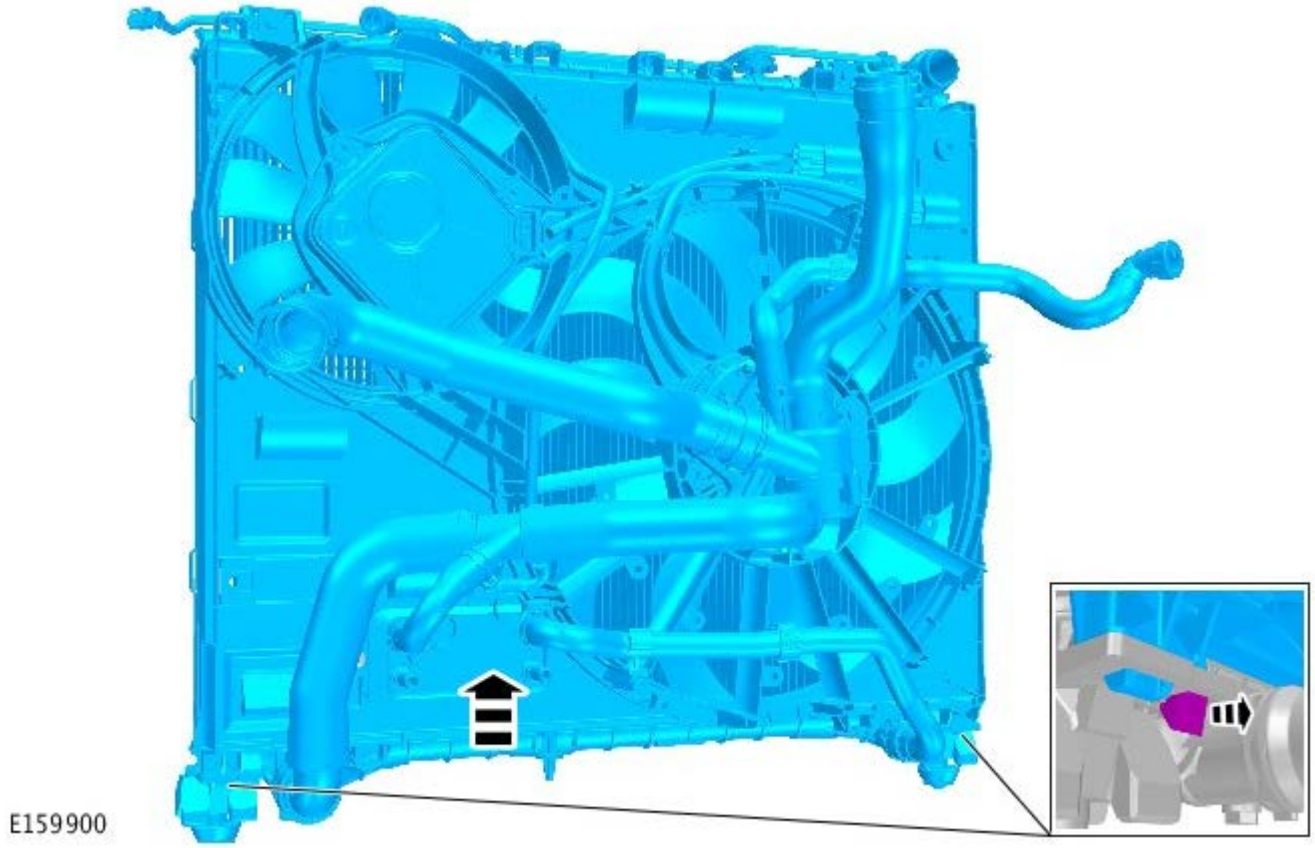
27.



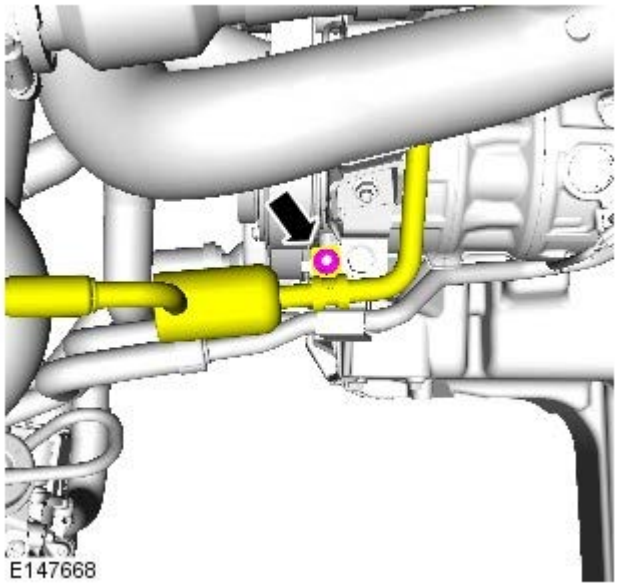
28.



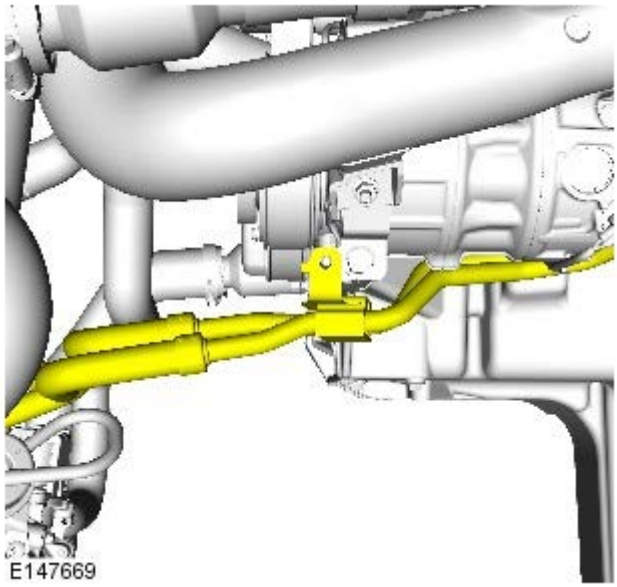
29. CAUTION: Take extra care not to damage the surrounding components.



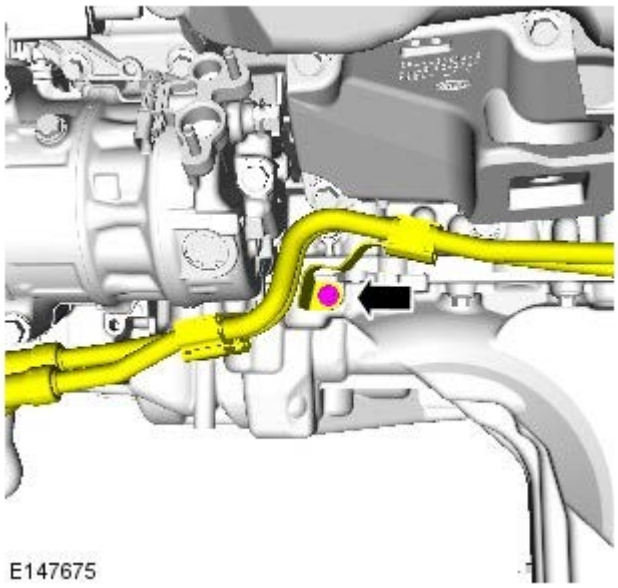
30.



31.

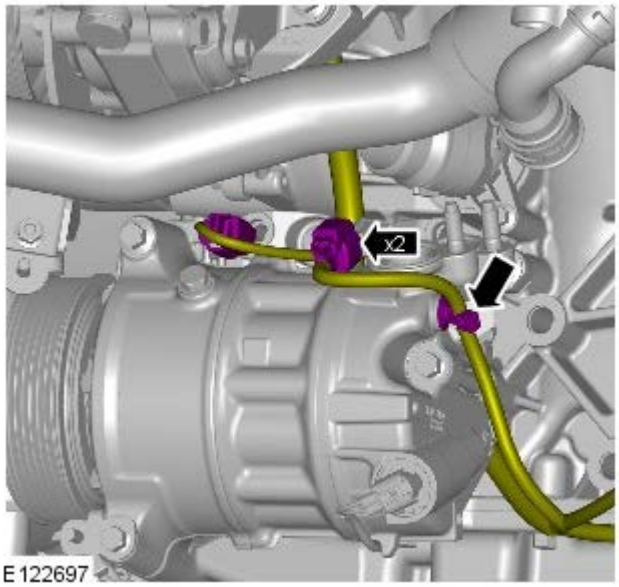


32.

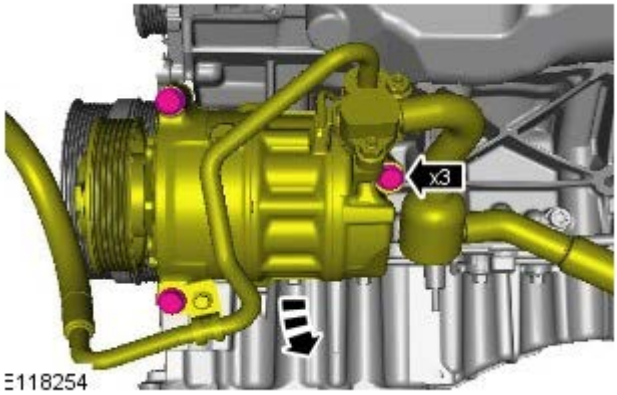


33. Refer to: Accessory Drive Belt - Vehicles Without: Dynamic Suspension (303-05A Accessory Drive - TDV6 3.0L Diesel, Removal and Installation).

34.



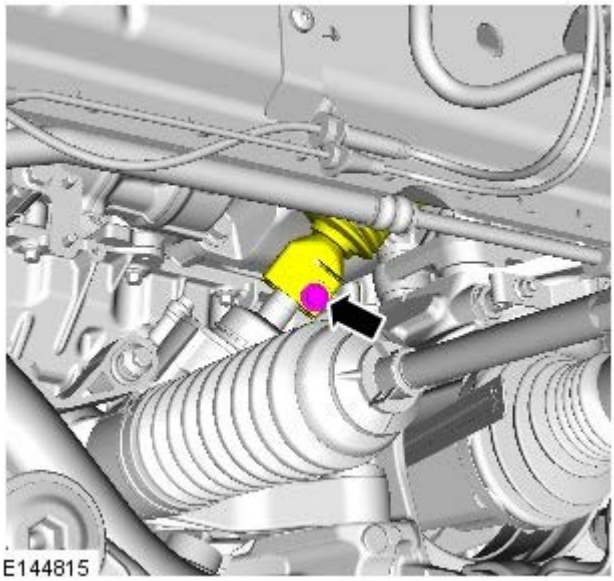
35.



36. CAUTION: Discard the bolt.

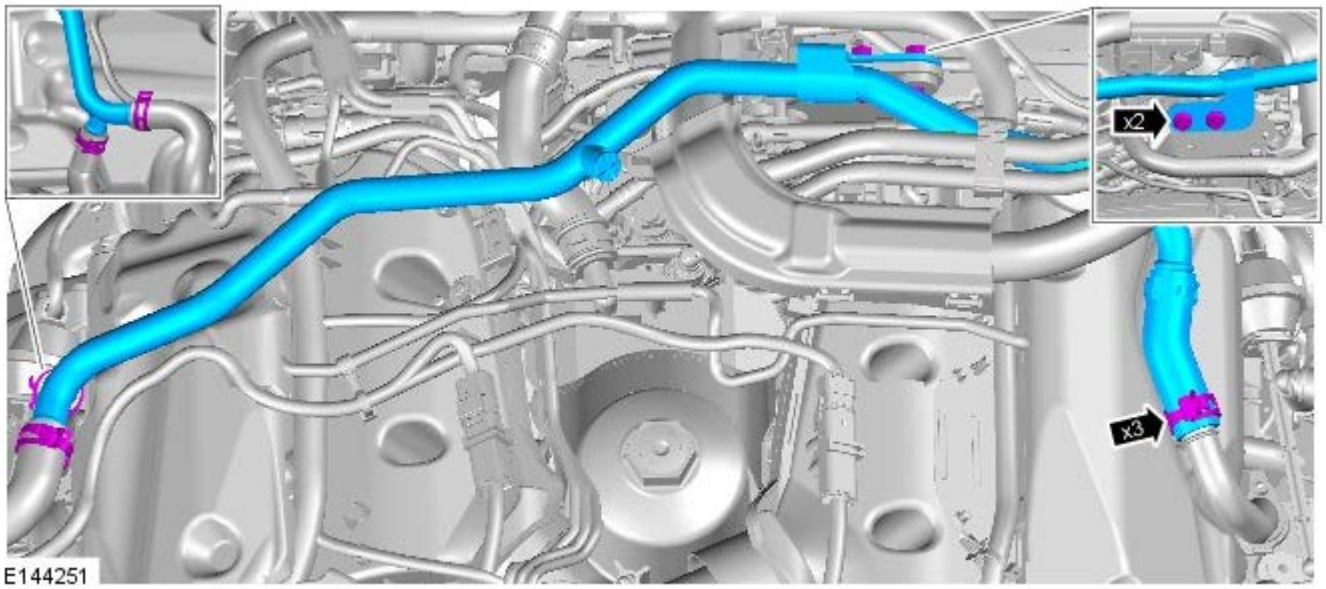
NOTE: RHD shown, LHD is similar.

Align the steering wheel to straight ahead.

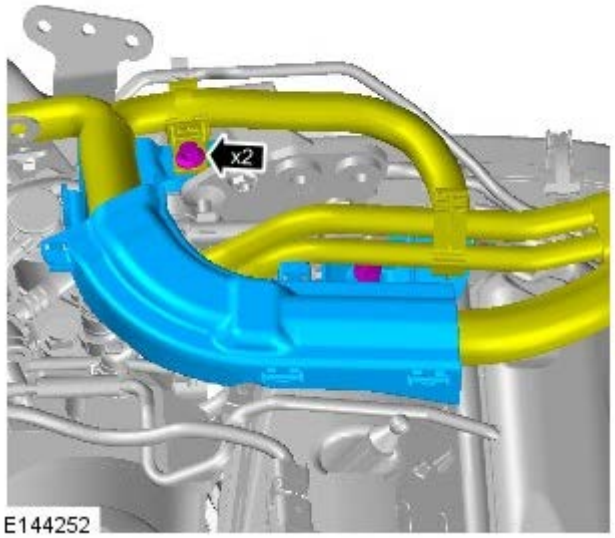


37. Refer to: Secondary Bulkhead Center Panel - TDV6 3.0L Diesel (501-02, Removal and Installation).

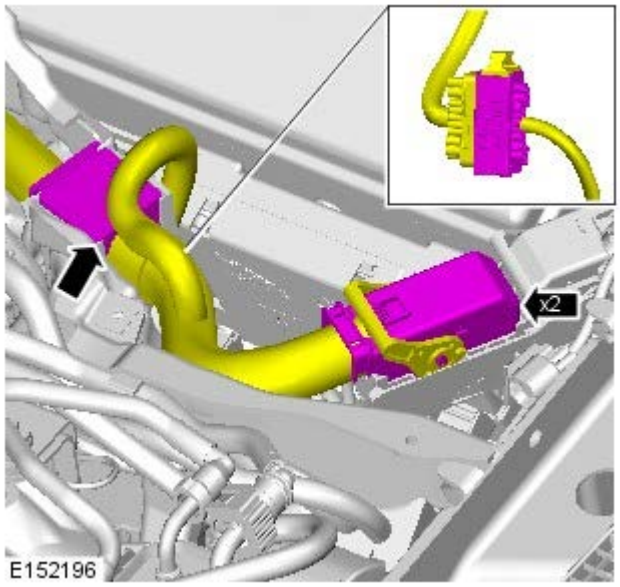
38. CAUTION: Be prepared to collect escaping coolant.



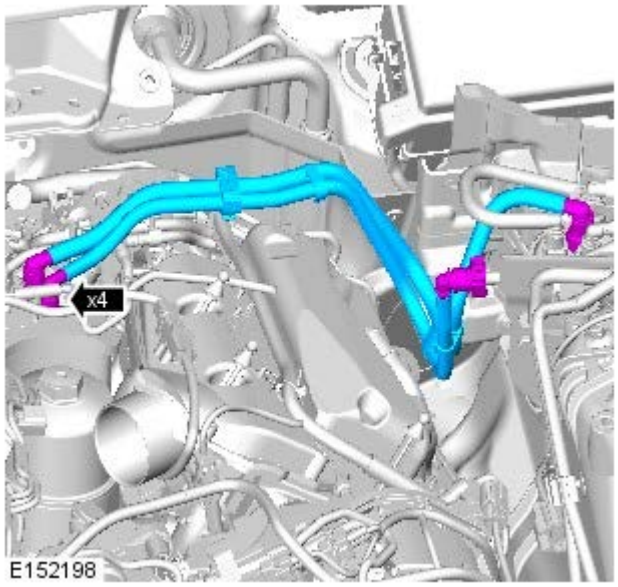
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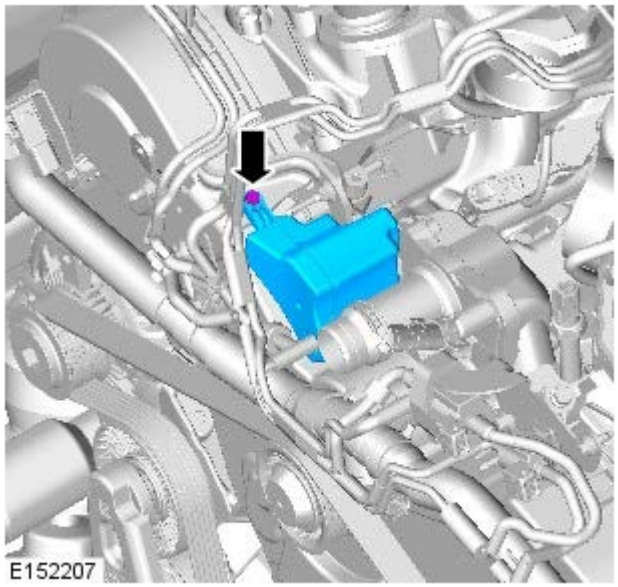
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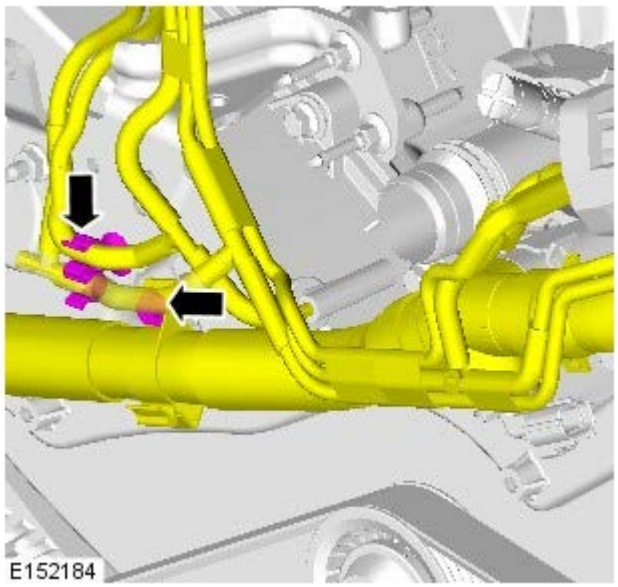
41. CAUTION: Be prepared to collect escaping fuel.



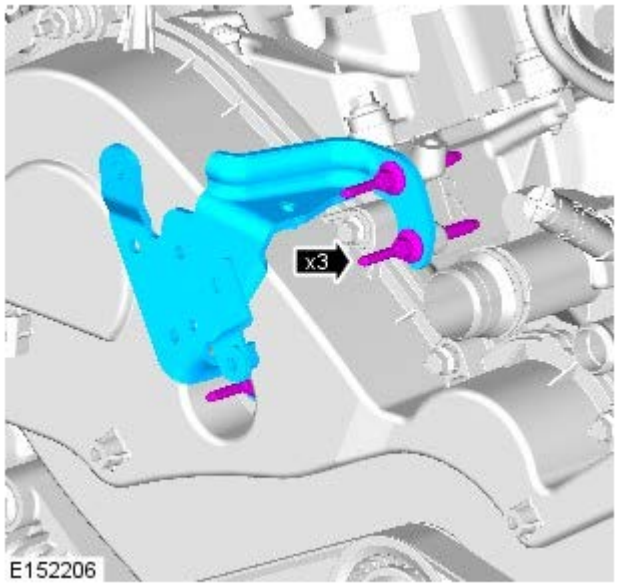
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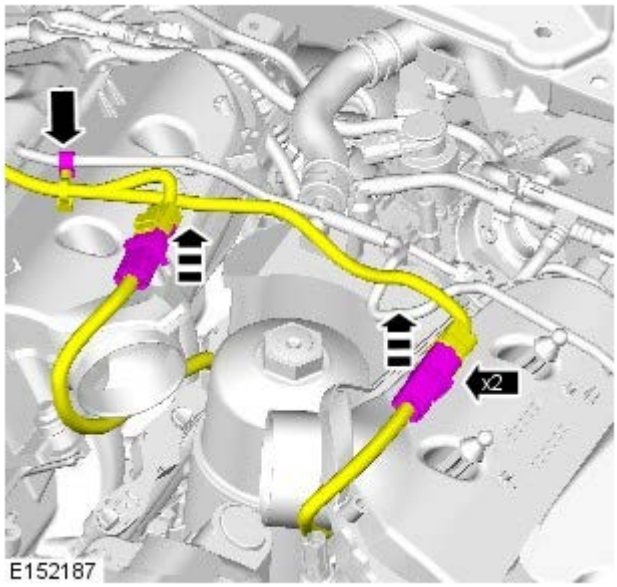
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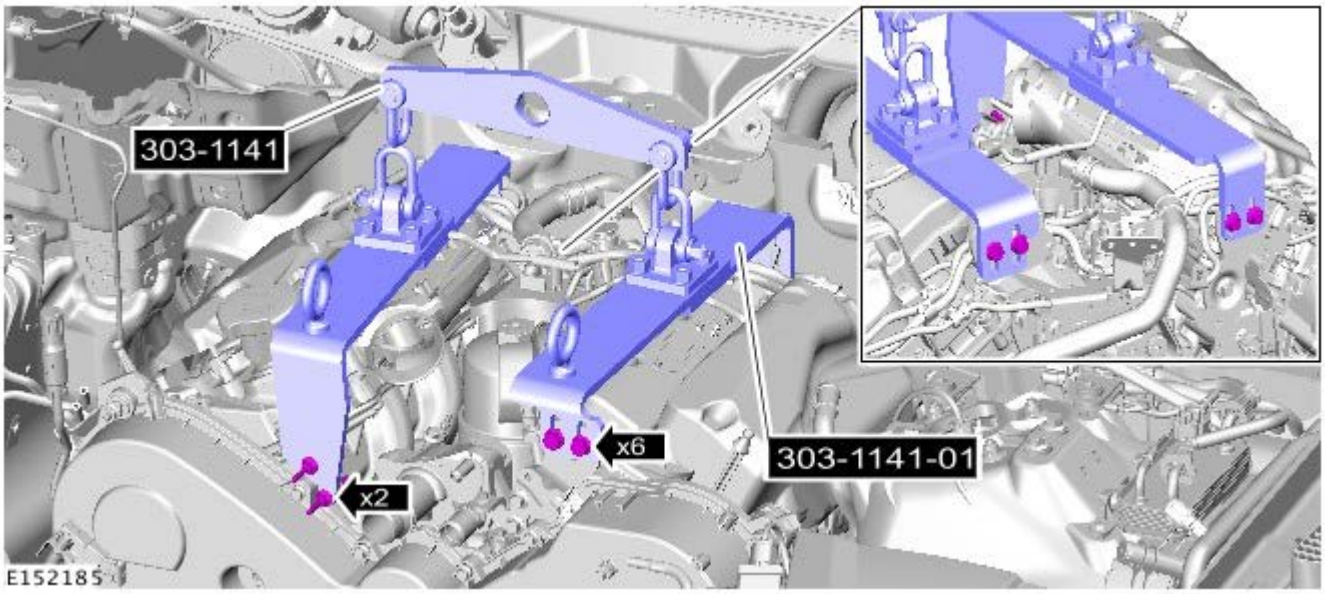
44.



45.



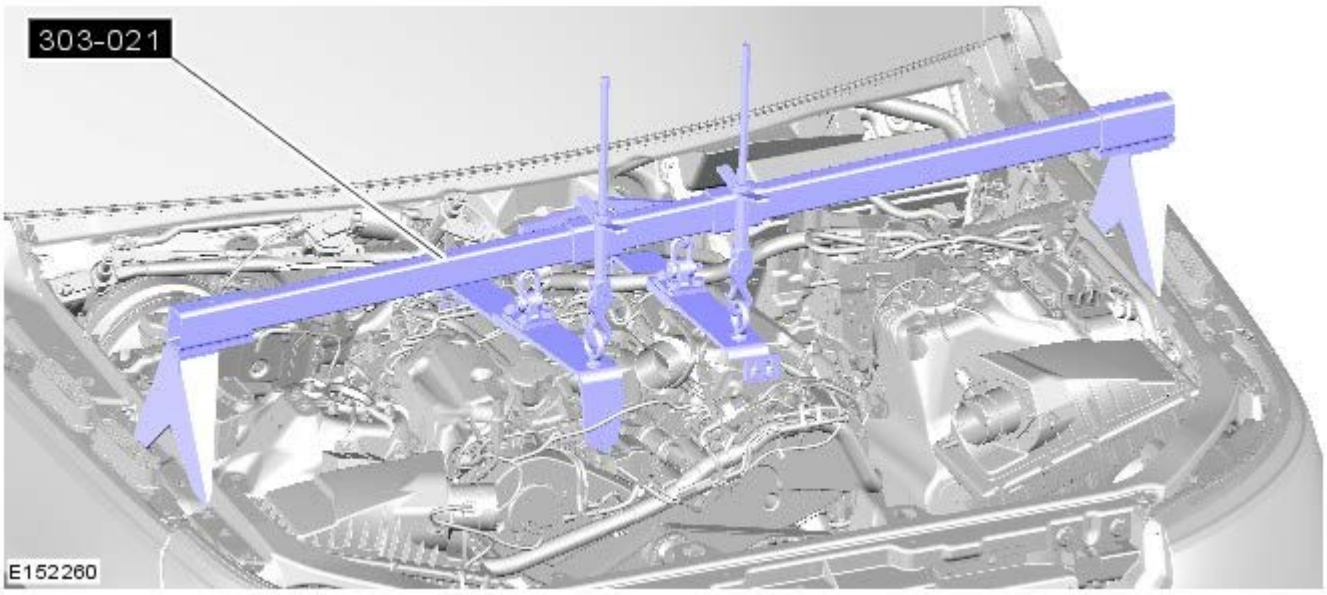
46.



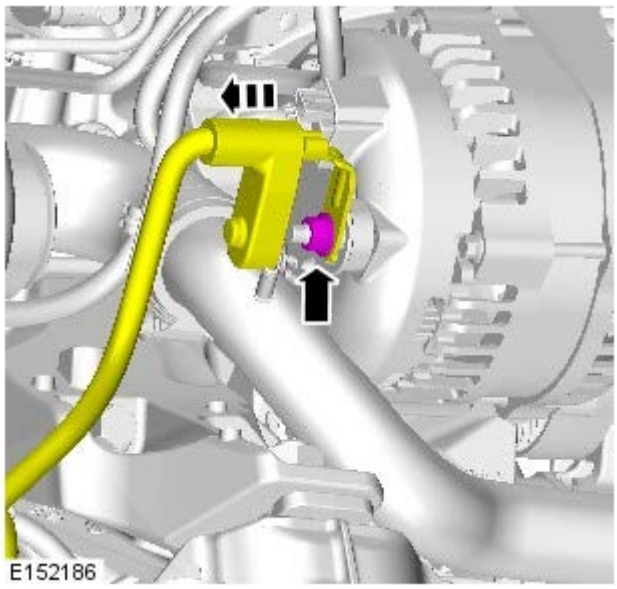
47.

- Install the special tool.

Special Tool(s): 303-021

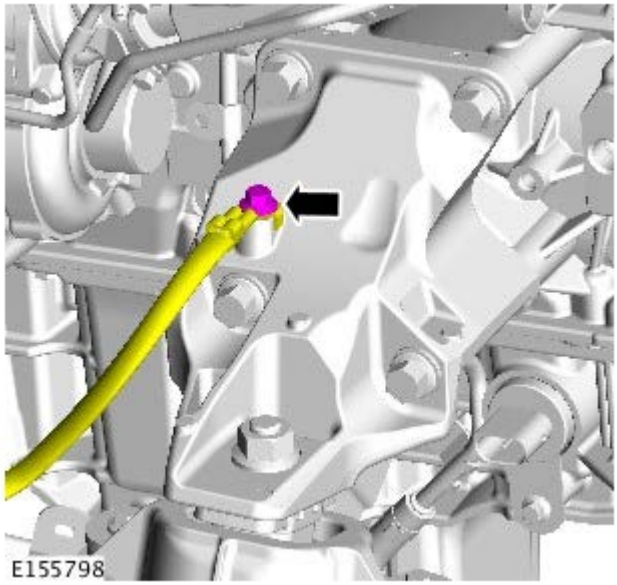


48.

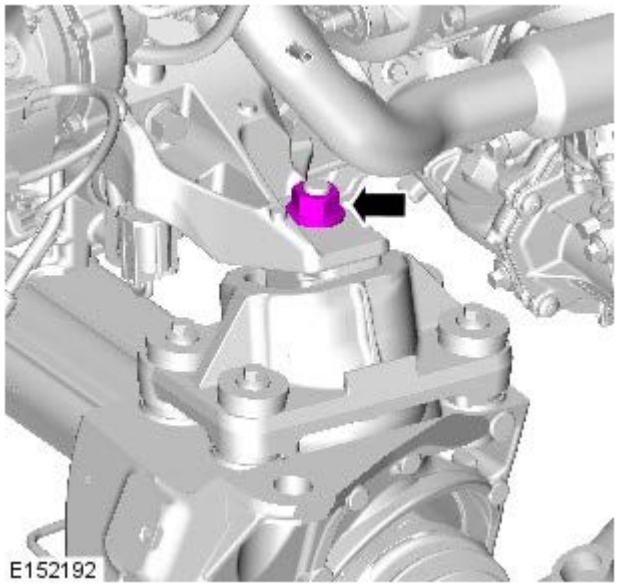


49. Refer to: Transmission - TDV6 3.0L Diesel (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, Removal).

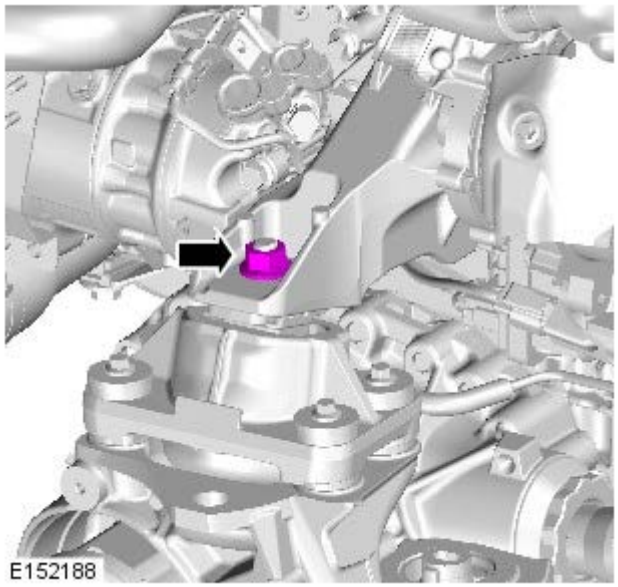
50.



51.



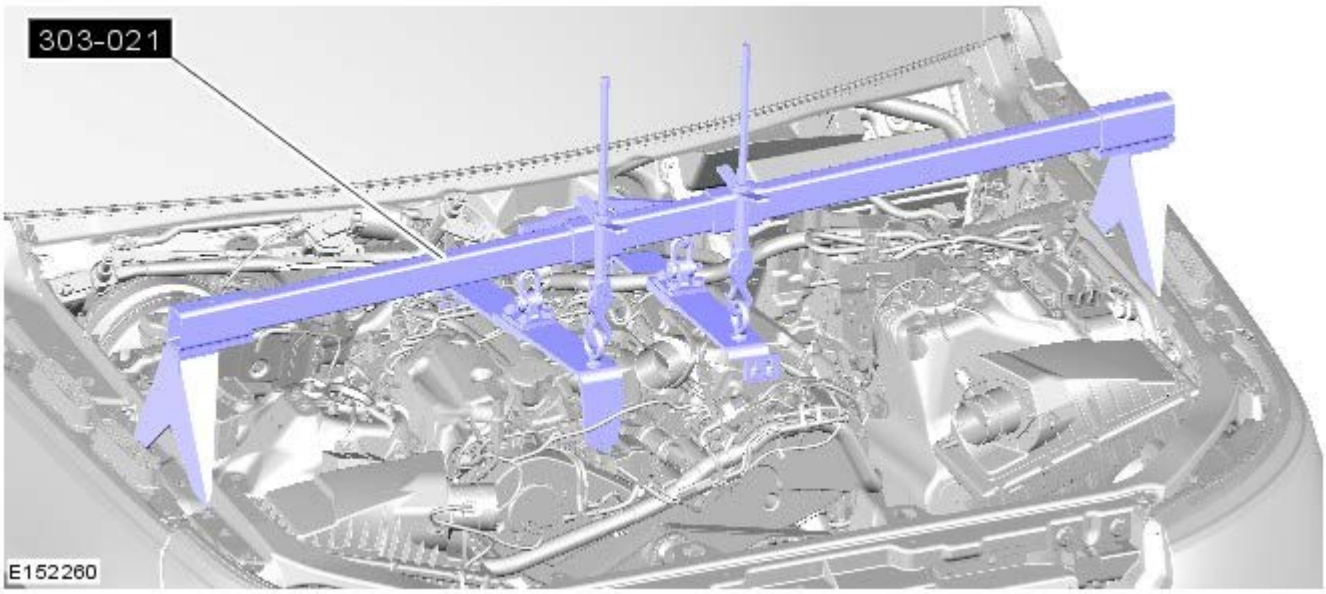
52.

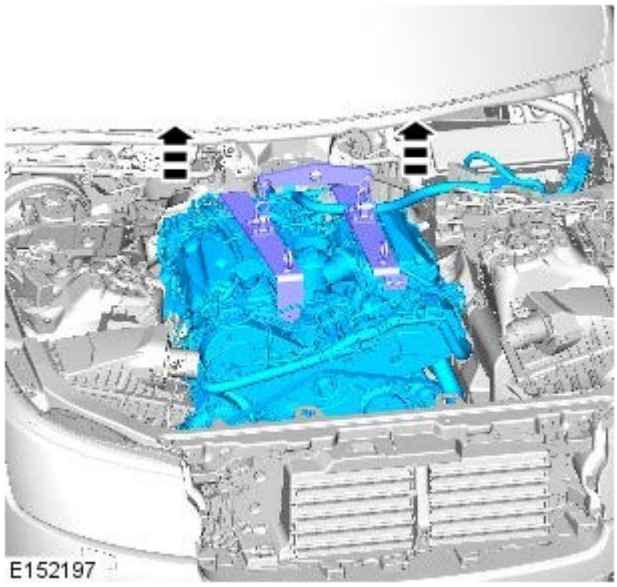


53.

- Remove the special tool.

Special Tool(s): 303-021





54. WARNING: This step requires the aid of another technician.

CAUTION: Be prepared to collect escaping fluids.

Carefully and progressively raise and remove the engine.

Published: 11-Sep-2013

Engine - TDV6 3.0L Diesel - Engine

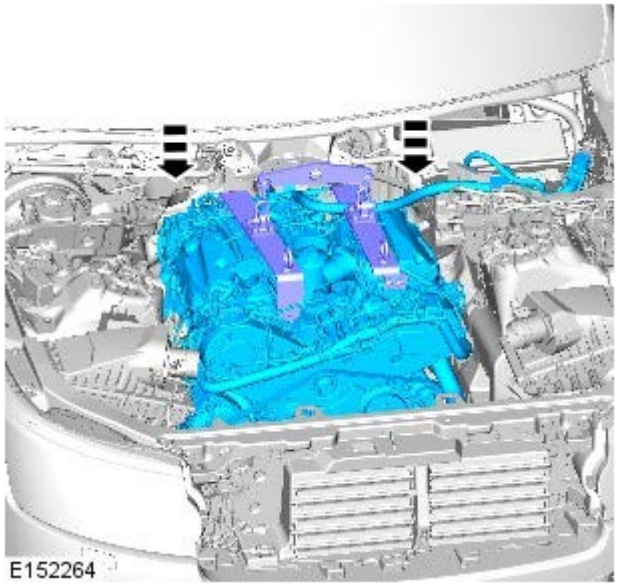
Installation

Special Tool(s)

 303-021	303-021 Engine support bracket

CAUTION: 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.

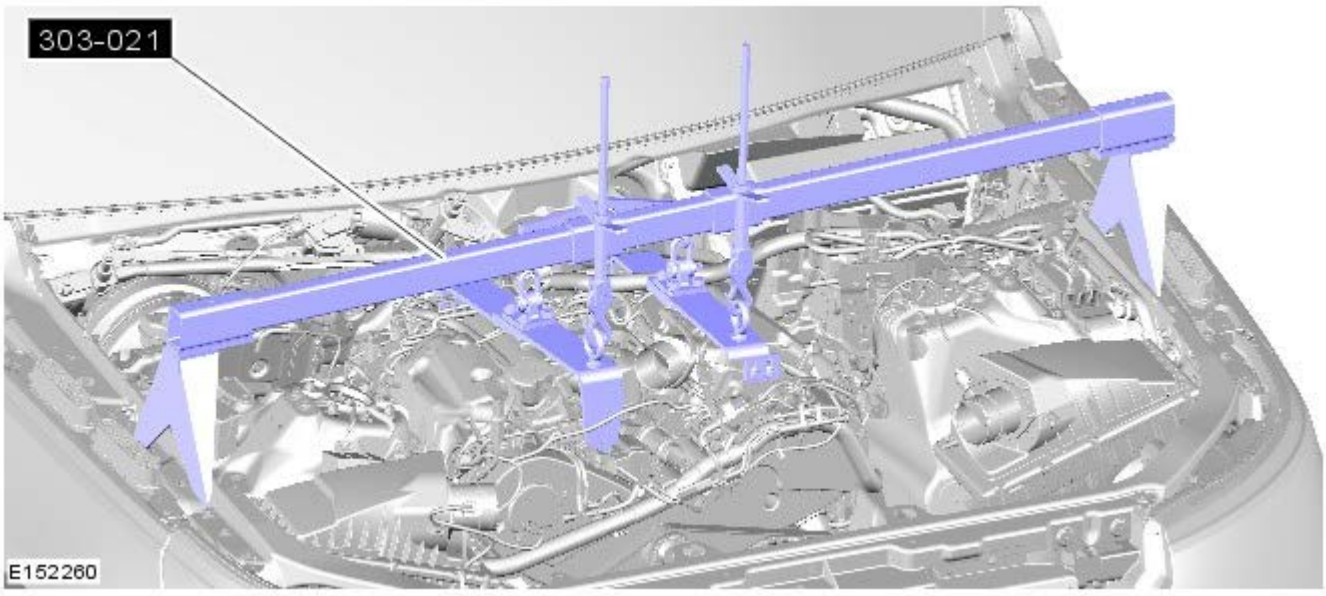


1. WARNING: This step requires the aid of another technician.

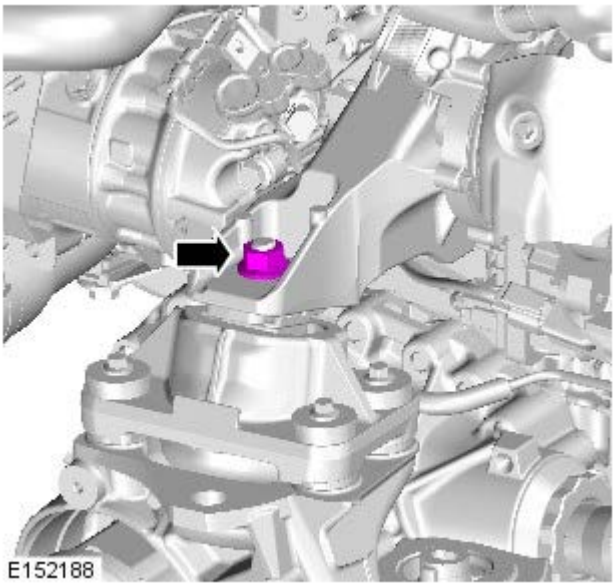
   CAUTION: Be prepared to collect escaping fluids.

2. Install the special tool.

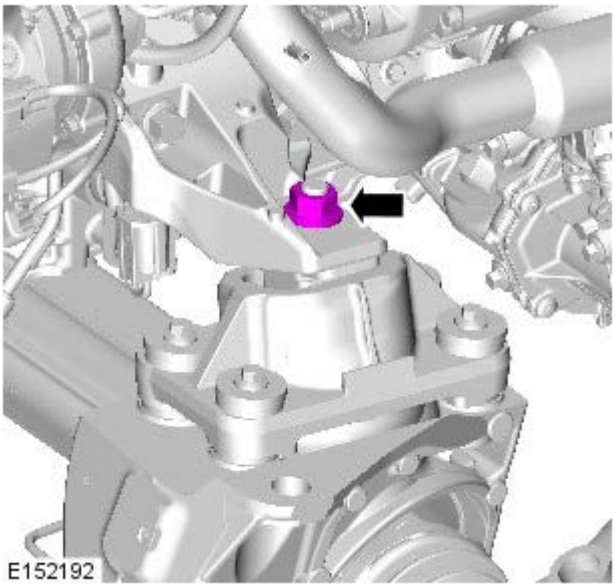
   Special Tool(s): 303-021



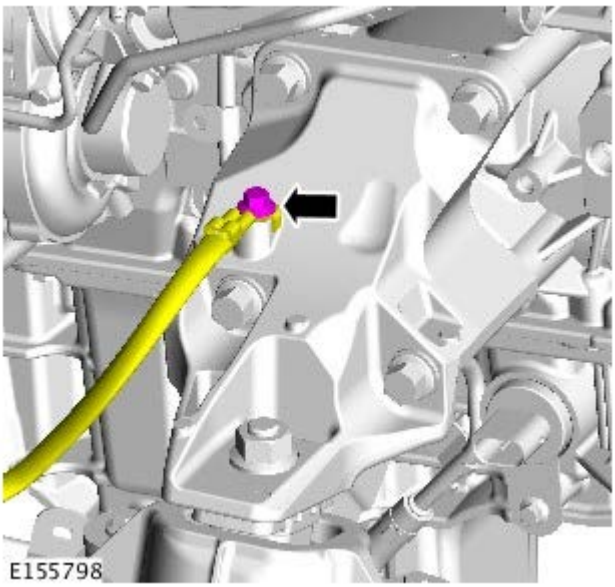
3. *Torque:* 110 Nm



4. *Torque:* 110 Nm

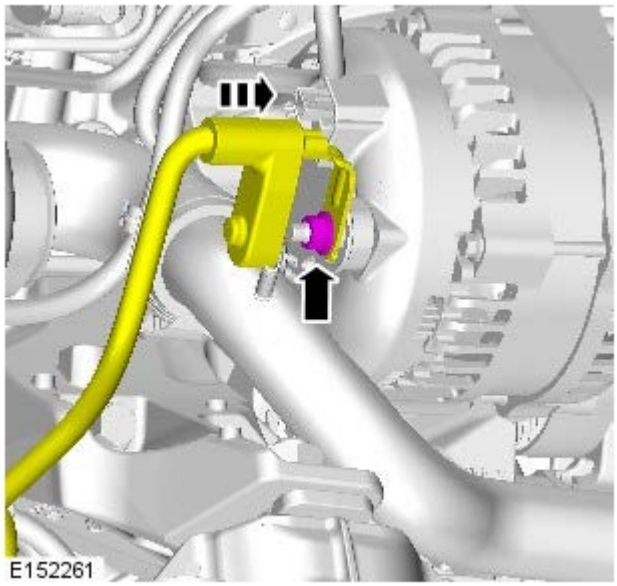


5. *Torque:* 9 Nm



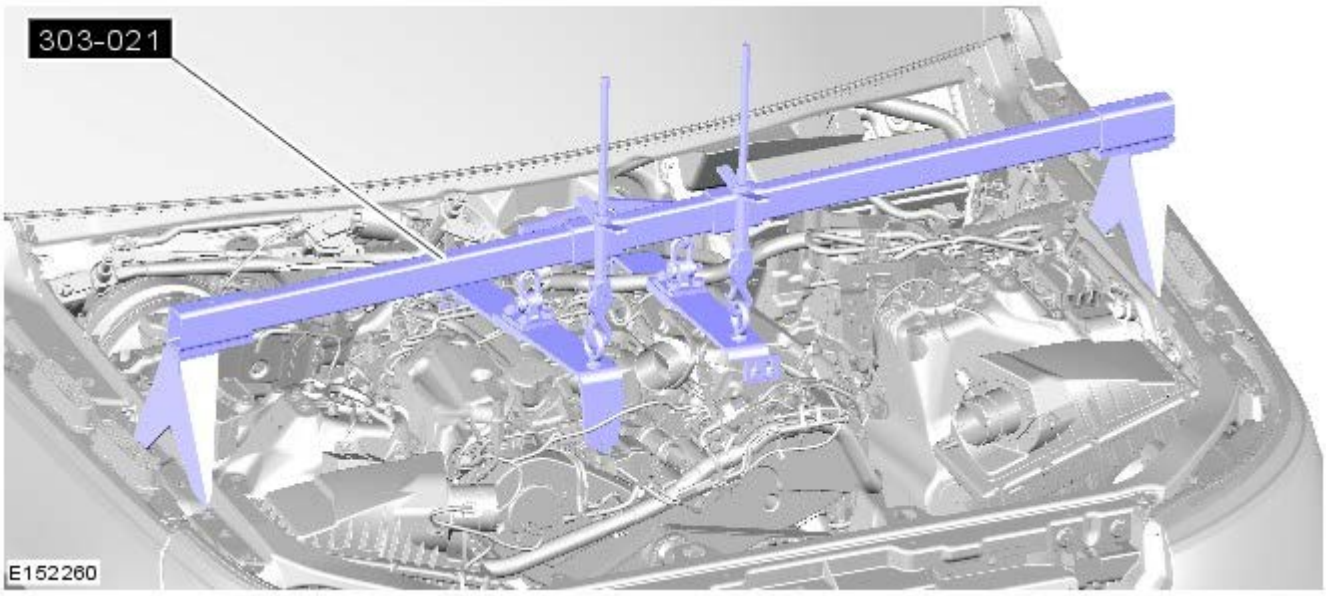
6. Refer to: Transmission - TDV6 3.0L Diesel (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, Installation).

7. *Torque:* 12 Nm

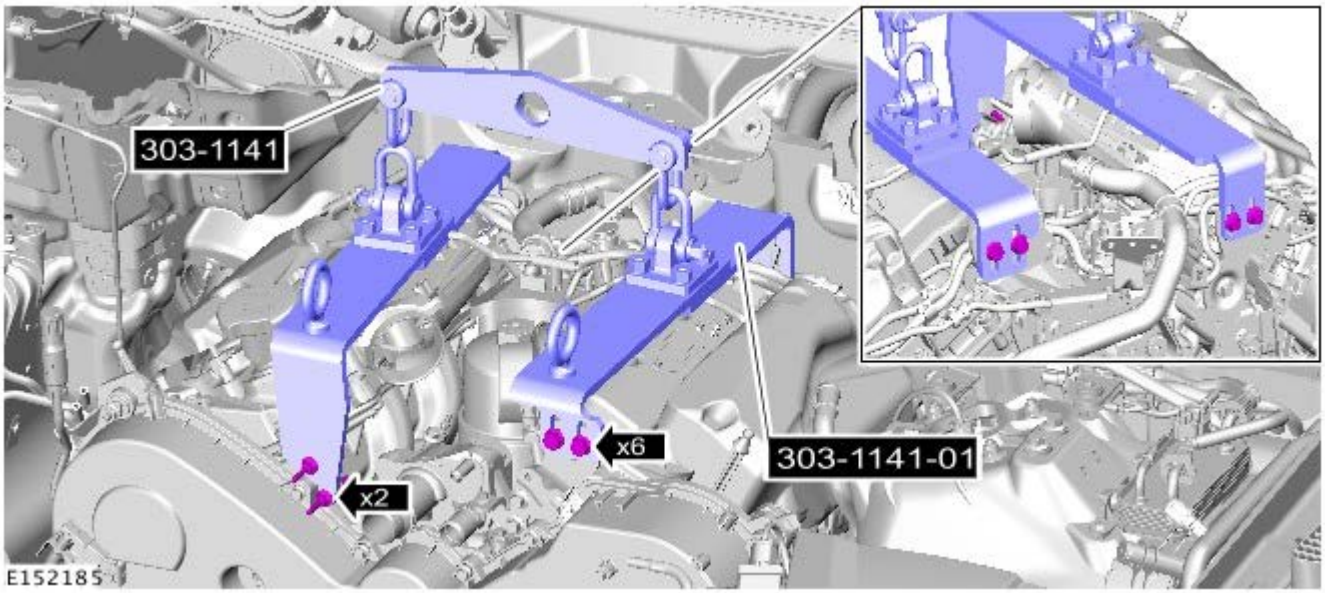


8. Remove the special tool.

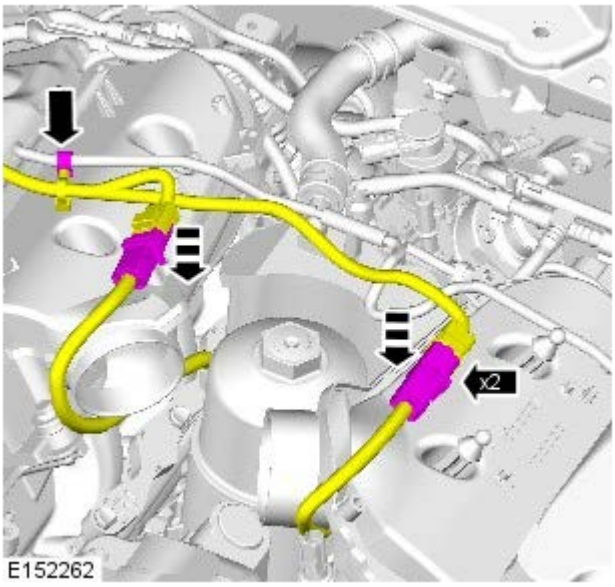
Special Tool(s): 303-021



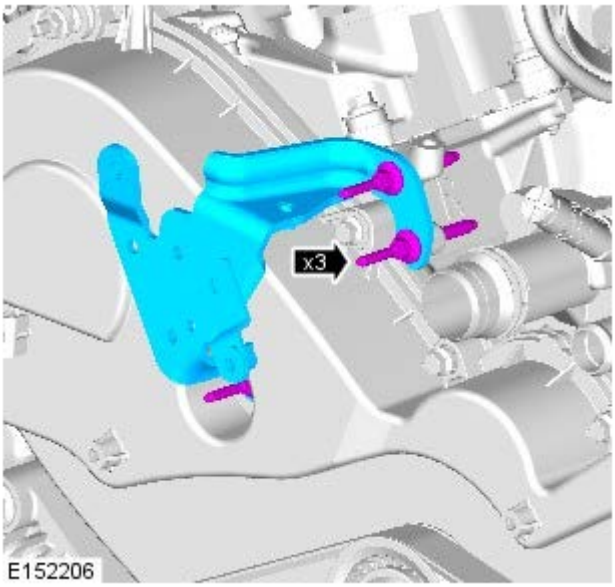
9. Remove the special tool.



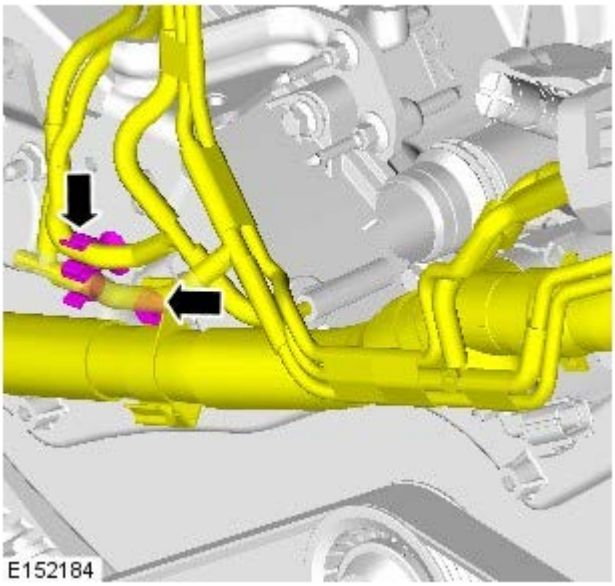
10.



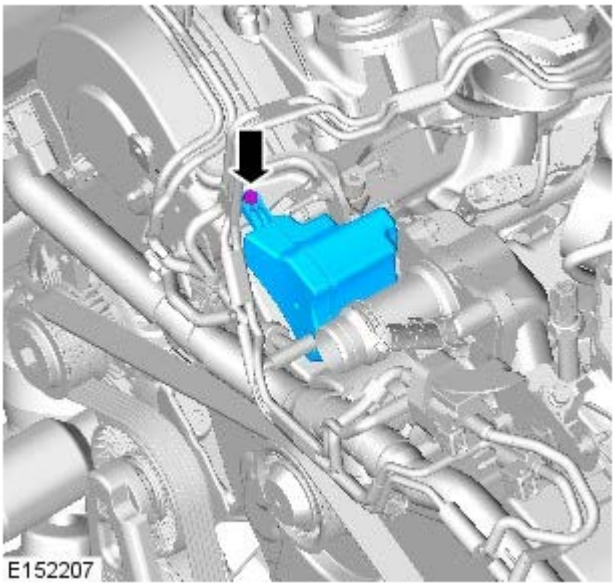
11. *Torque:* 8 Nm



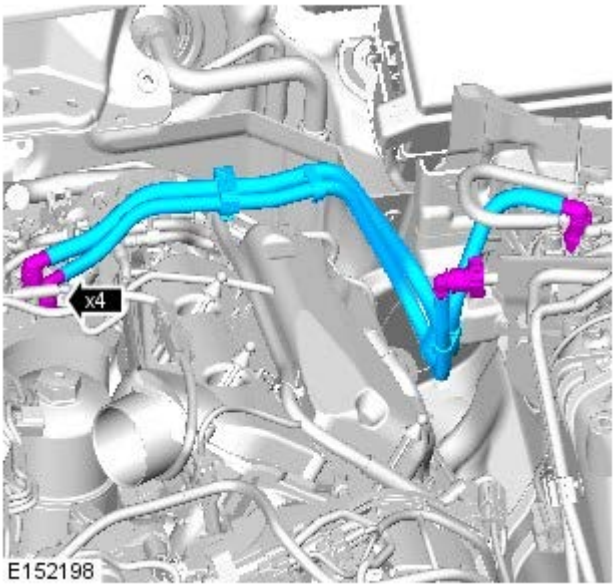
12. *Torque:* 8 Nm



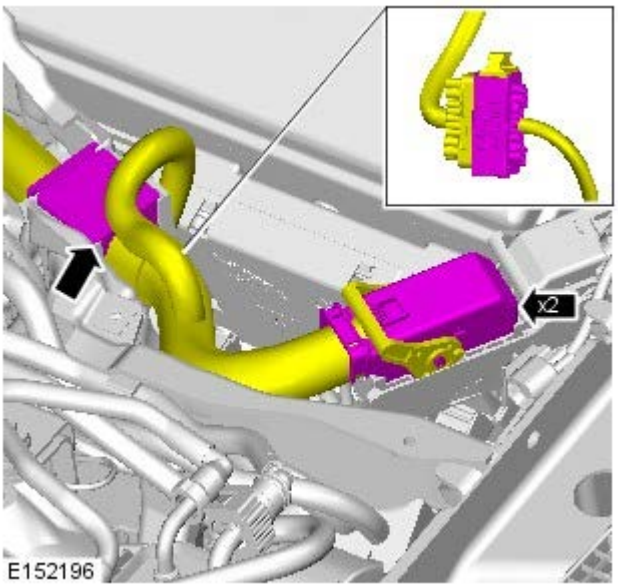
13. *Torque:* 8 Nm



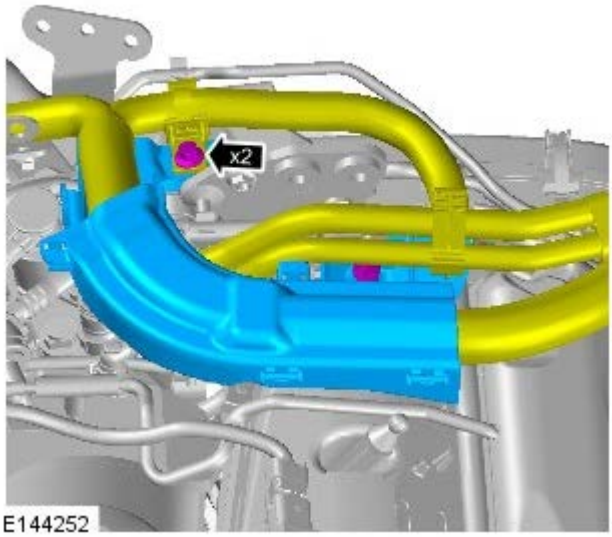
14.



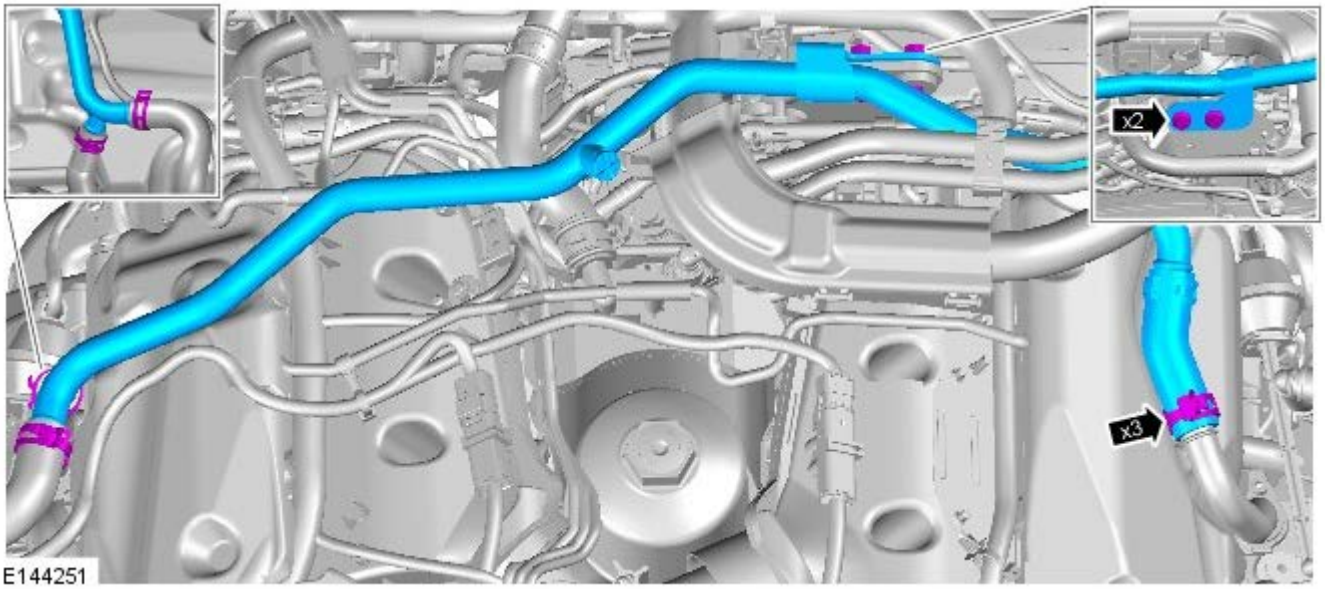
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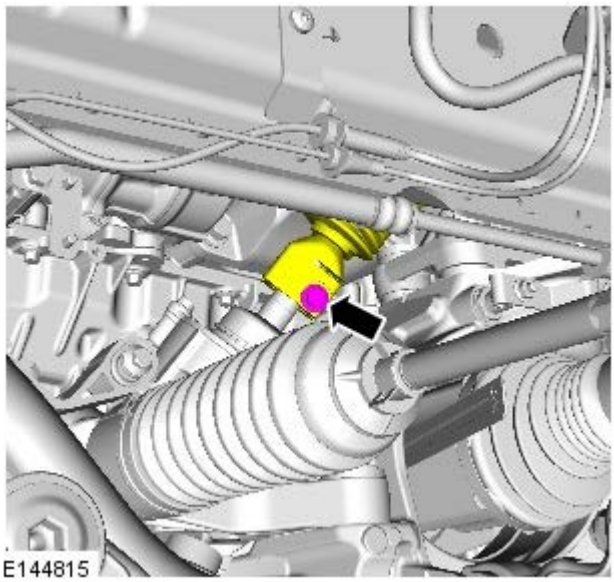
16. *Torque:* 10 Nm



17. *Torque:* 10 Nm



18. Refer to: Secondary Bulkhead Center Panel - TDV6 3.0L Diesel (501-02, Removal and Installation).

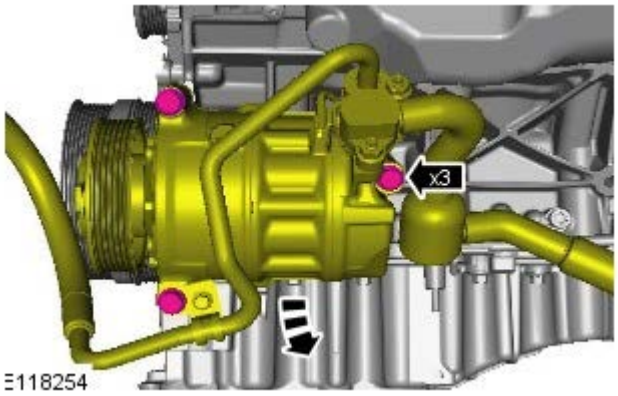


19. CAUTION: Make sure that a new bolt is installed.

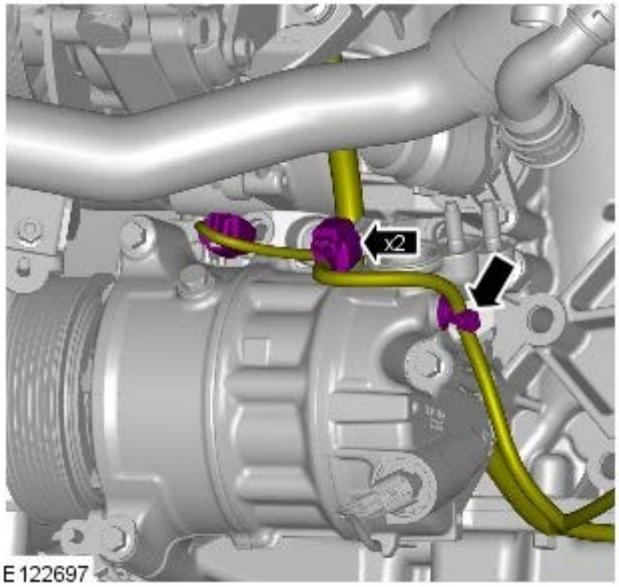
NOTE: LHD illustration shown, RHD is similar.

- *Torque:* 30 Nm

20. *Torque:* 25 Nm

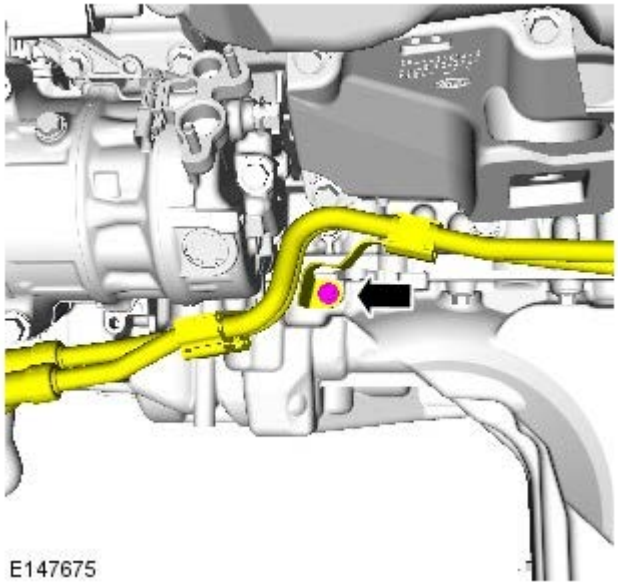


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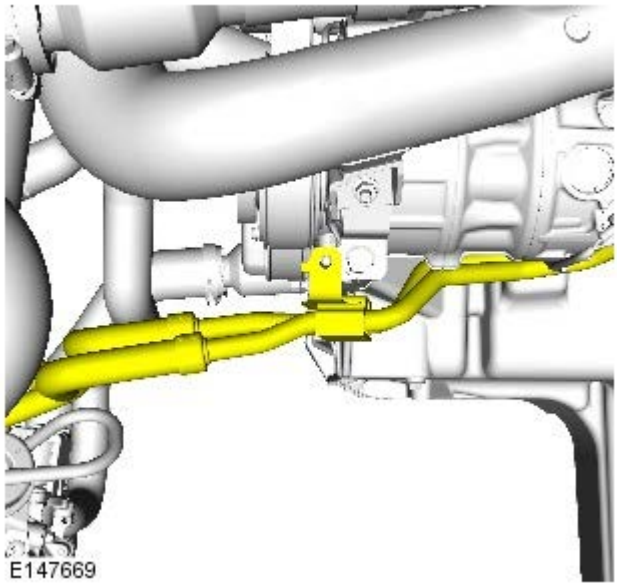


22. Refer to: Accessory Drive Belt - Vehicles Without: Dynamic Suspension (303-05A Accessory Drive - TDV6 3.0L Diesel, Removal and Installation).

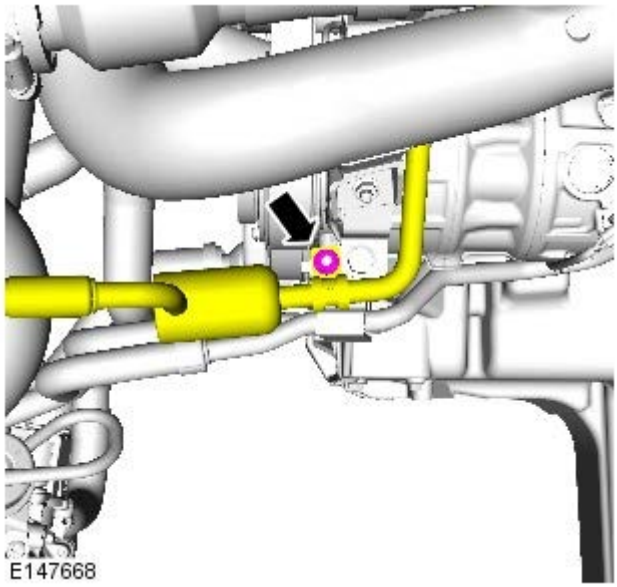
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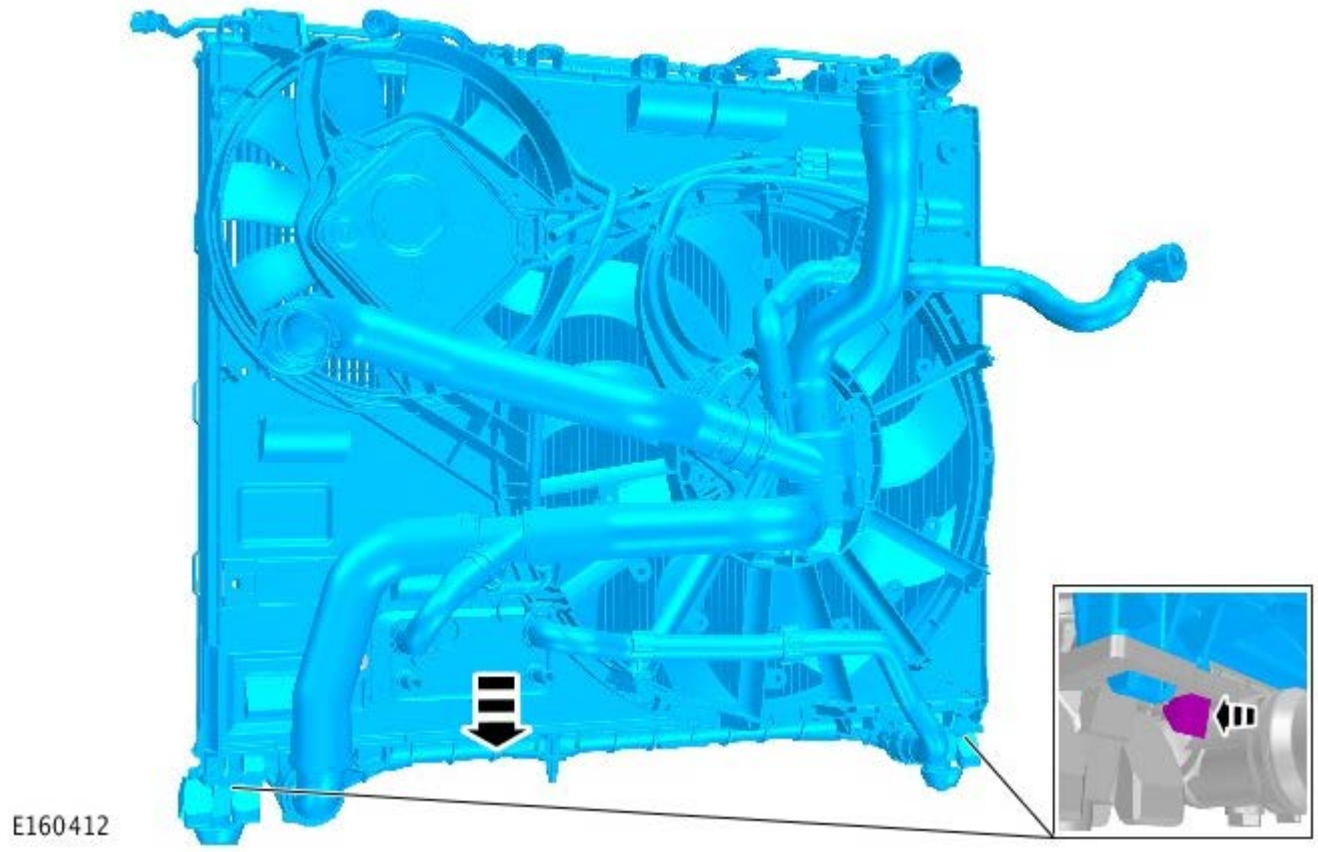
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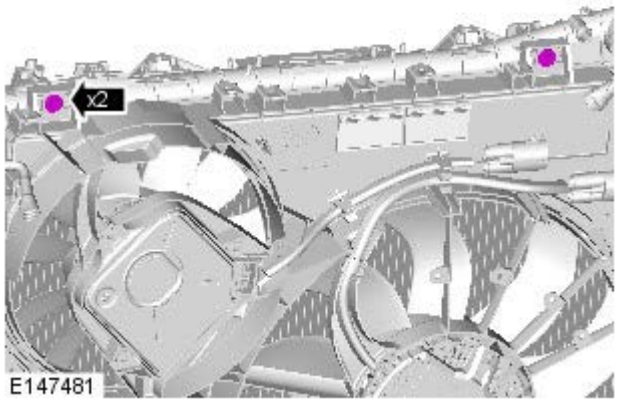
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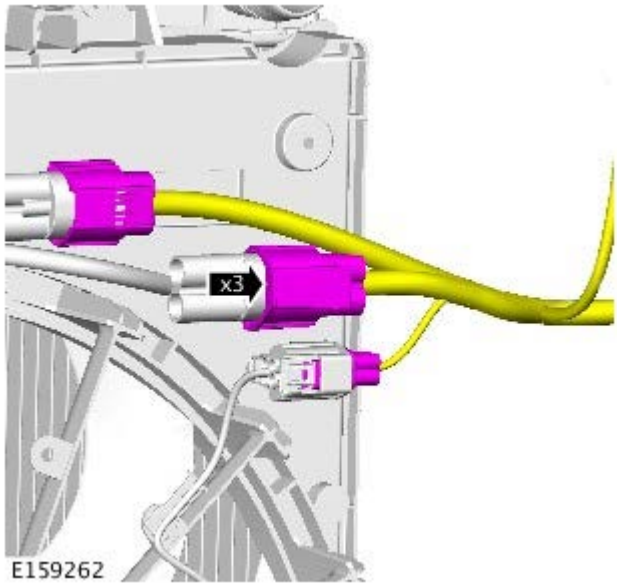
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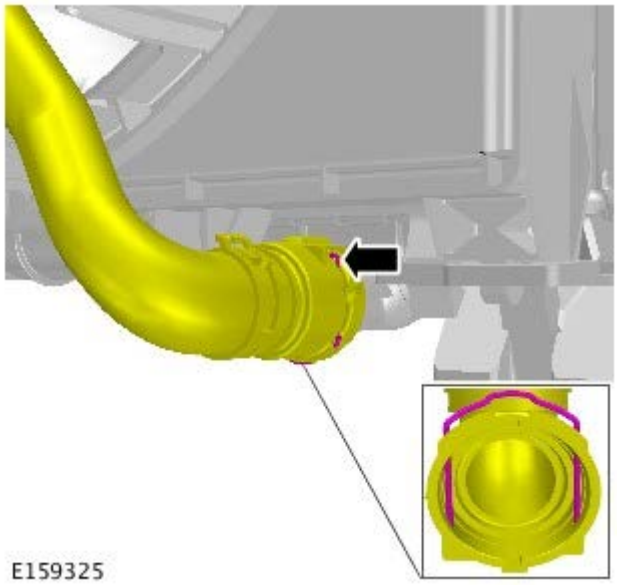
27. *Torque:* 7 Nm



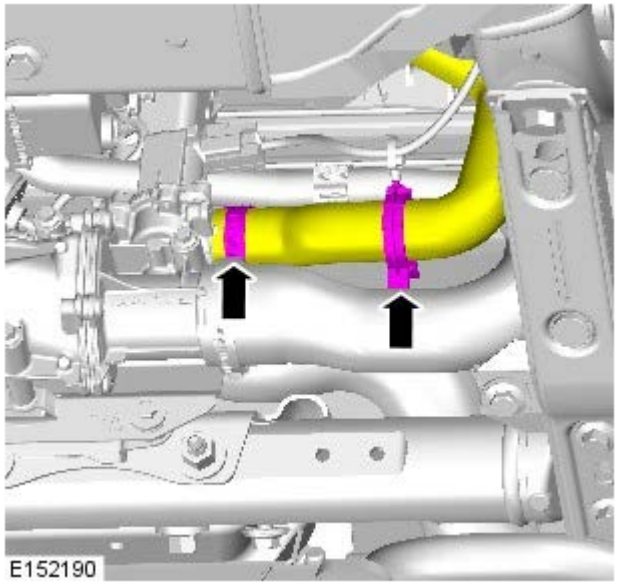
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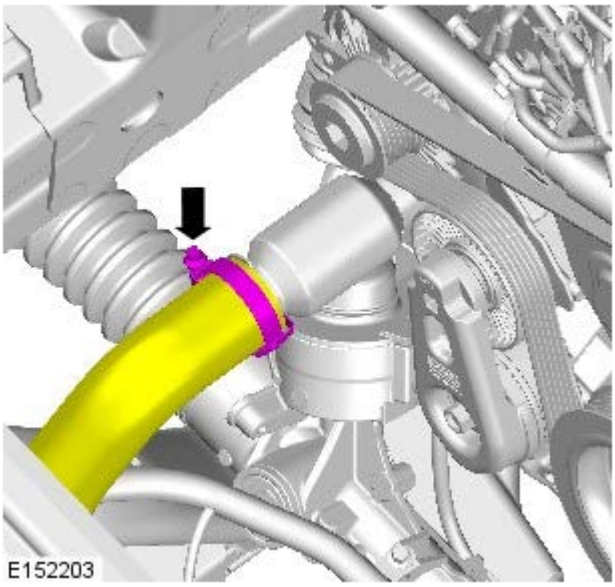
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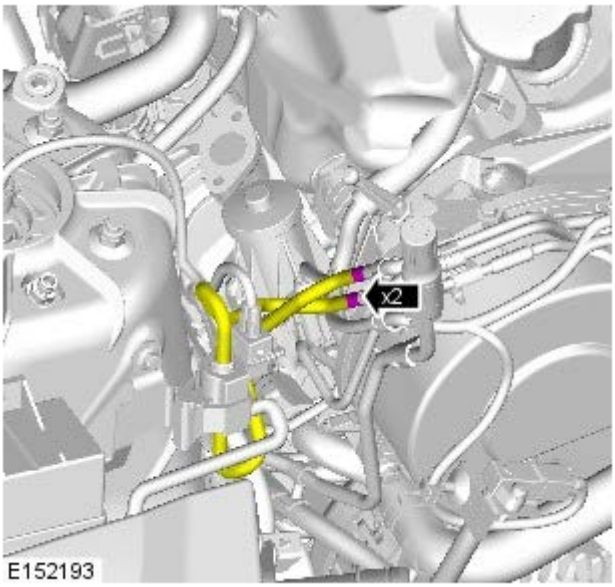
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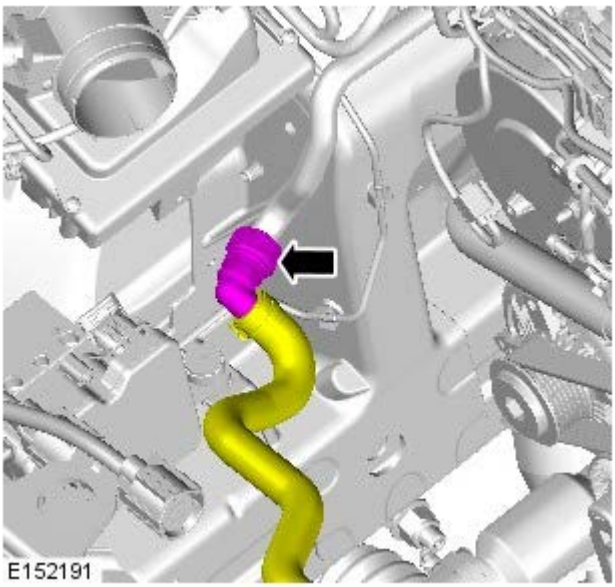
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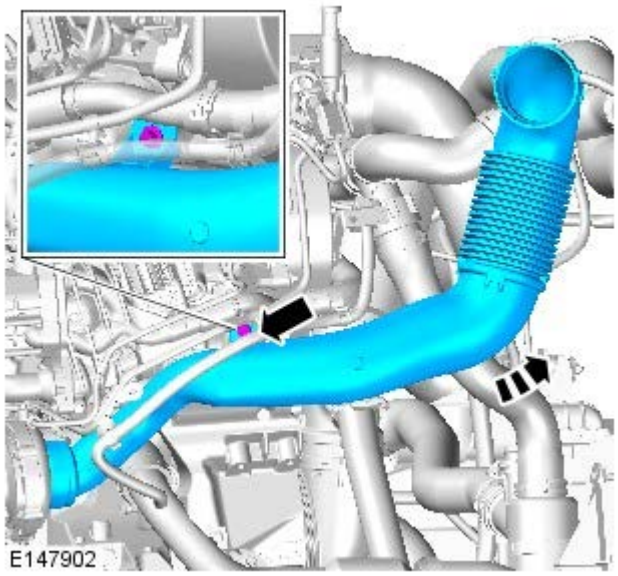
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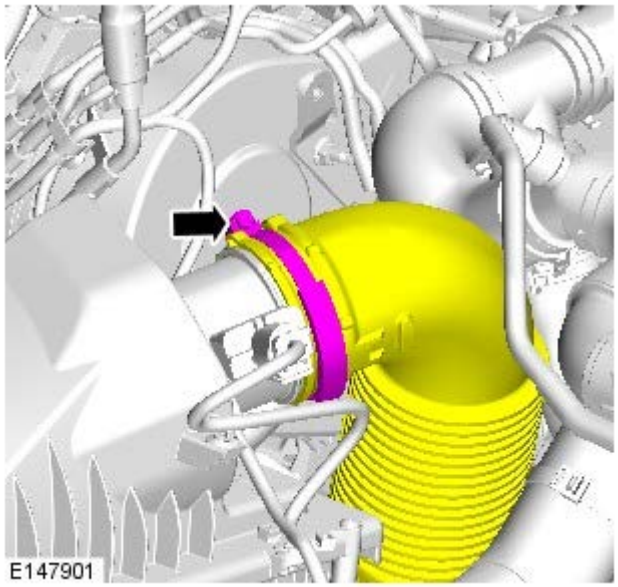
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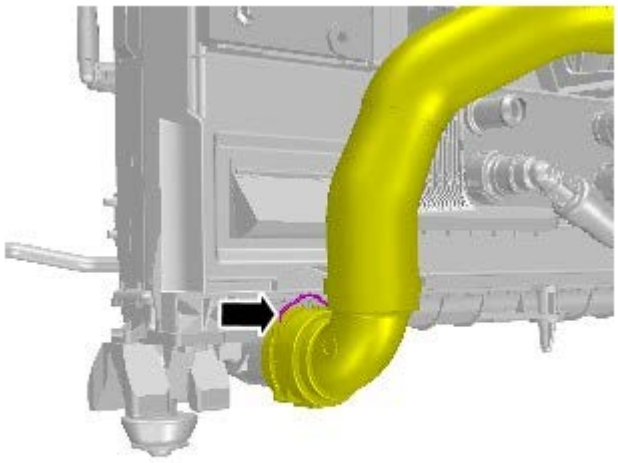
34. *Torque:* 10 Nm



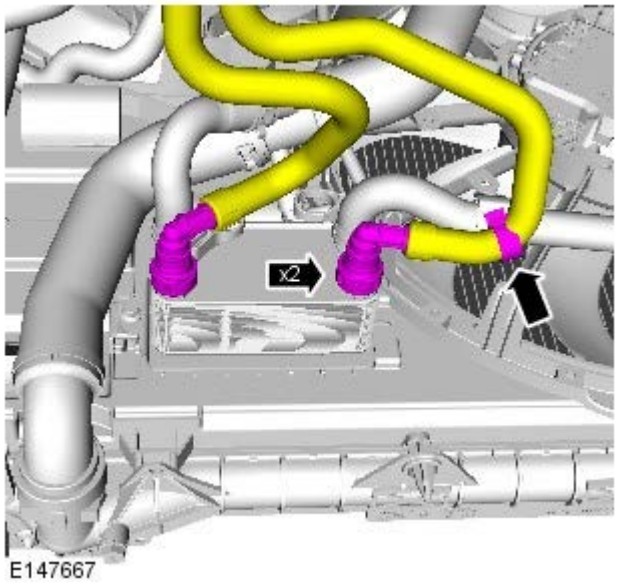
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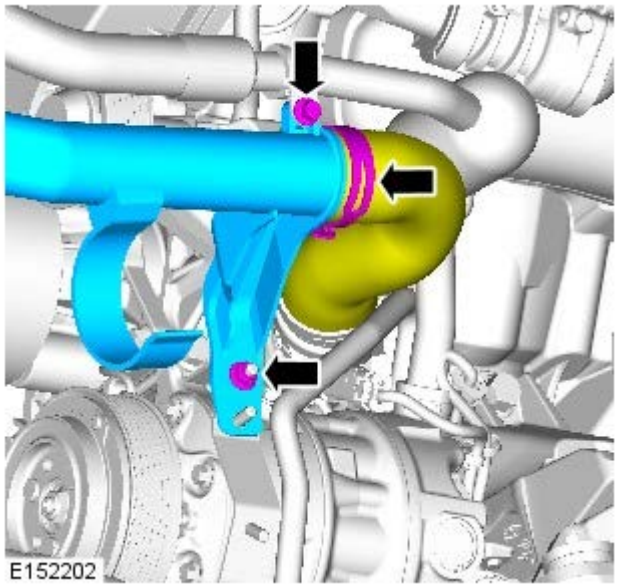


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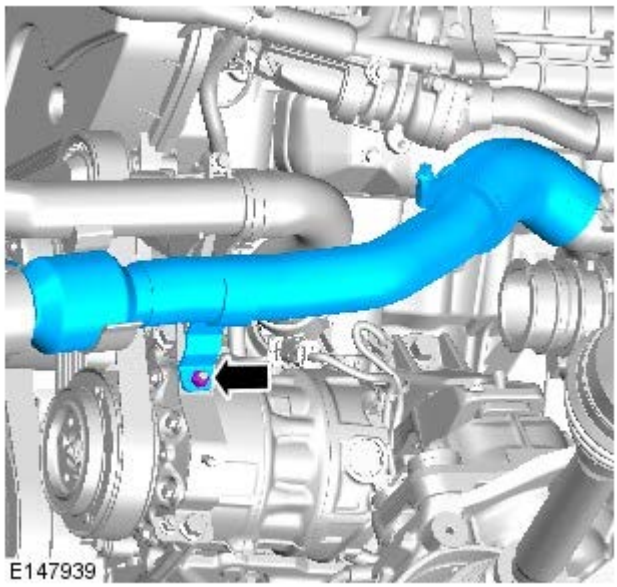


E147667

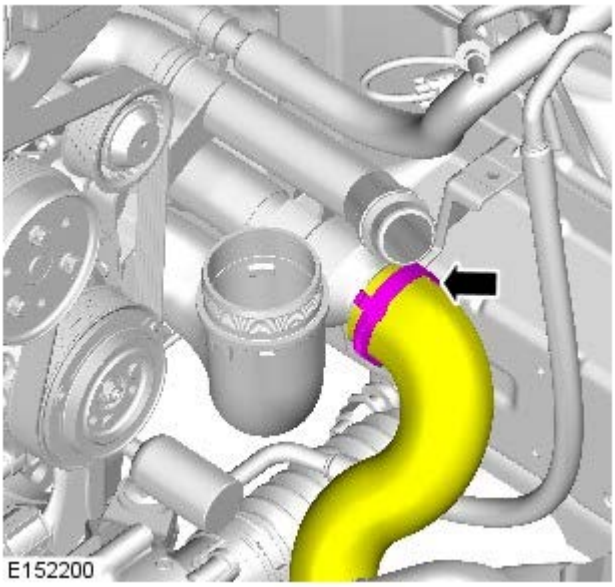
38. *Torque:* 6 Nm


E152202

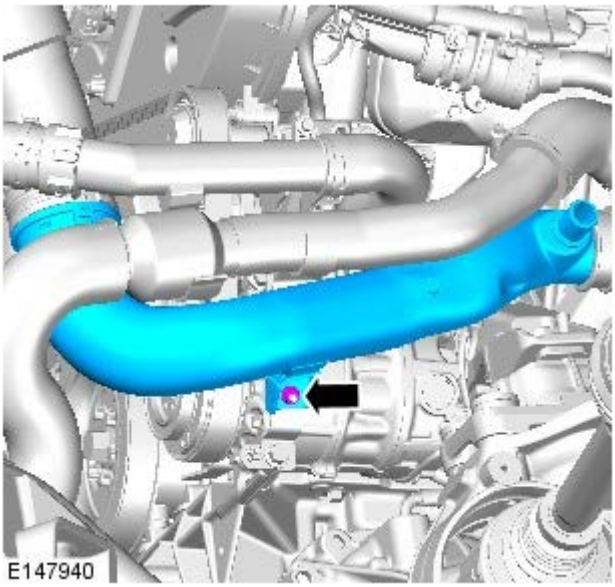
39. *Torque:* 6 Nm


E147939

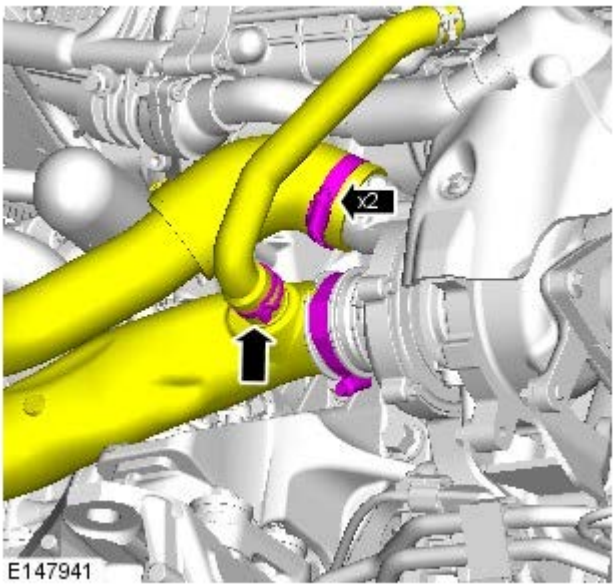
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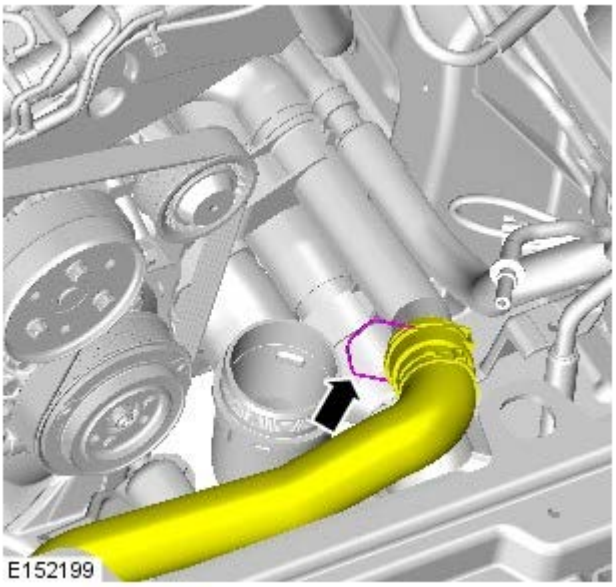
41. *Torque:* 6 Nm



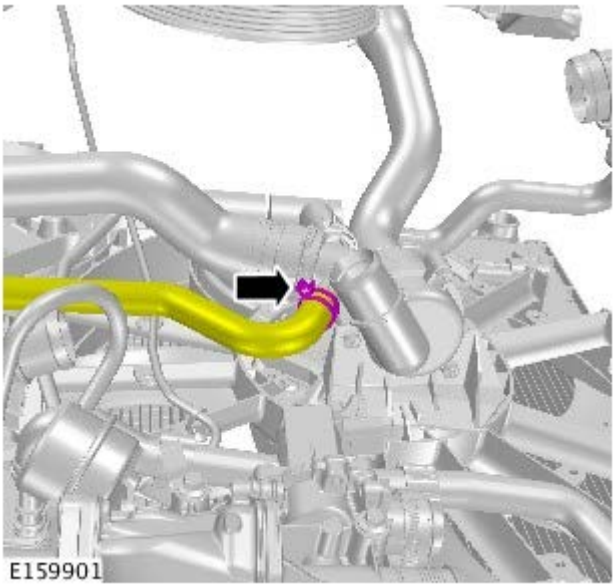
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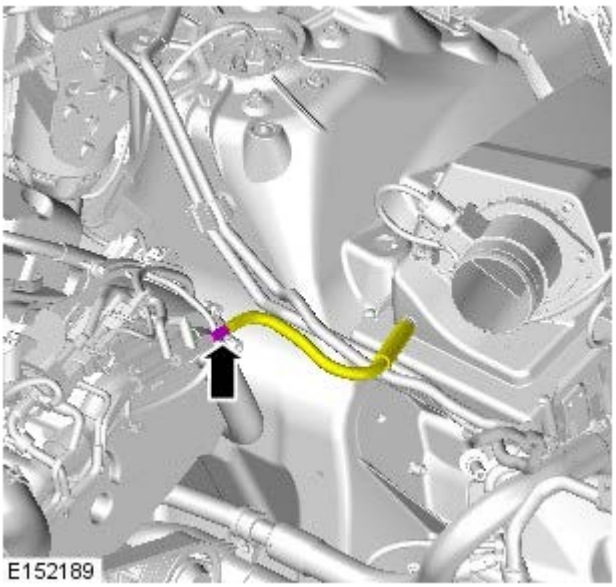
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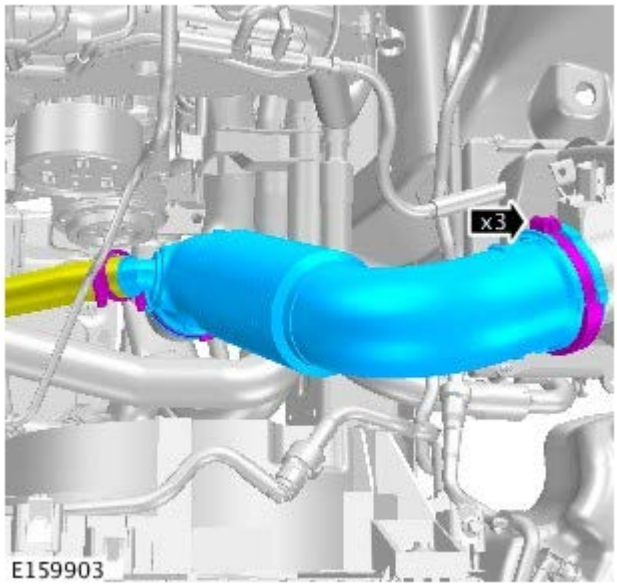
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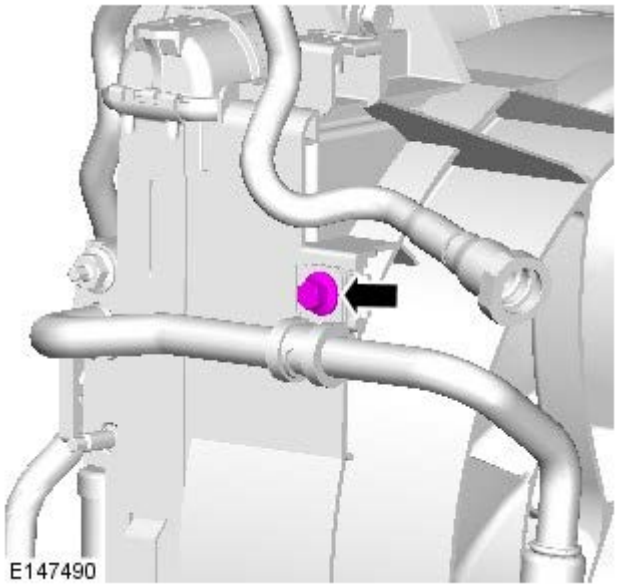
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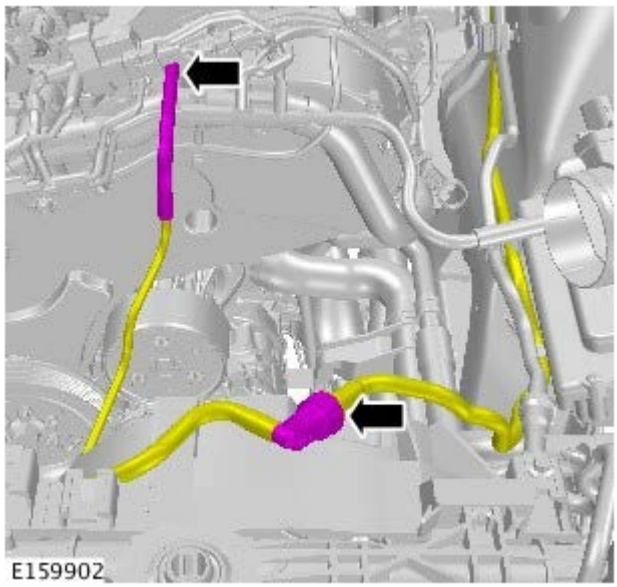
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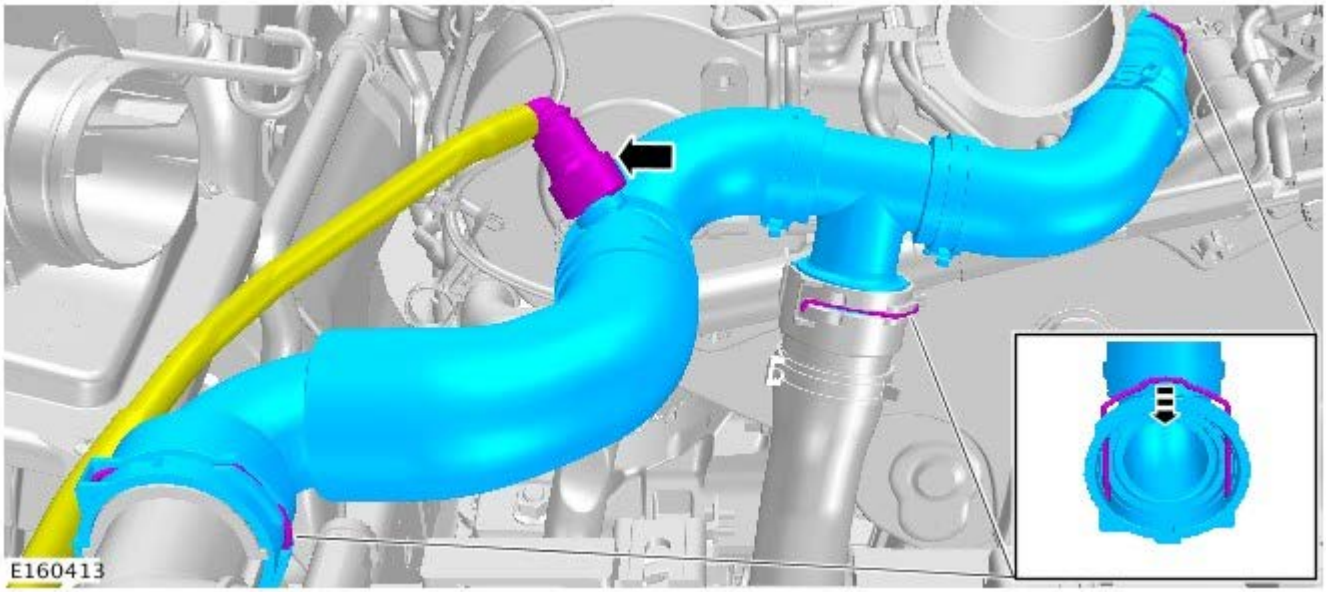
47. *Torque:* 10 Nm



48.



49.



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

51. Refer to: Hood (501-02, Removal and Installation).

52. Disconnect the battery ground cable.

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

53. Refer to: Low-Pressure Fuel System Bleeding (310-00 Fuel System - General Information, General Procedures).

Published: 06-Feb-2014

Engine - V6 S/C 3.0L Petrol -

Engine Data

Engine Description	Engine Capacity	Maximum Engine Torque (EEC) (SAE)	Maximum Engine Power (EEC) (SAE)	Compression Ratio	Bore	Stroke
• 90° "Vee" • 6 Cylinder • 24 Valves	2.995 ccm	450 Nm at 3.500 - 5.000 RPM	250 kW at 6.500 RPM	10.5 ± 0.50	84.5 ± 0.000 mm	89 ± 0.0 mm

Engine Firing Order

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

Engine Valve Clearance (cold)

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

Spark Plugs

Specification	Spark Plug Gap
SILZKAR7C-10S	0.9 - 1.0 mm

Lubricants, Fluids, Sealers and Adhesives

Description	Specification
Engine Oil	SAE 5W20 WSS-M2C925-A
Sealant	WSE-M4G323-A6
Core plug and stub pipe retainer	WSK-M2G349-A7
Jaguar Premium Cooling System Fluid	WSS-M97B44-D

Capacities

Description	Litres
Engine oil, initial fill	9.5
Engine oil, service fill with oil filter change	8.0
Engine oil, service fill without oil filter change	7.5

Cylinder Head and Valve Train

Item	Specification
Cylinder head maximum permitted warp (mm) (flatness specification)	
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

Crankshaft Pin and Bearing

NOTE: **Make sure that the crankshaft pin journal classification number is noted correctly, so that the correct bearing is installed.**

Crankshaft Pin Diameter Bearing Size (mm)	Crankshaft Pin Letter
55.982 - 55.988	A - G
55.989 - 55.994	H - N
55.995 - 56.000	P - W

Crankshaft Pin Letter	Color
A - G	Brown/Yellow (Part Number - DX23-6211-BFA)
H - N	Brown/Red (Part Number - DX23-6211-BEA)
P - W	Brown/Blue (Part Number - DX23-6211-BDA)

Torque Specification

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	48	35	-
Air conditioning compressor retaining bolts	25	18	-
Engine mounting to engine mounting bracket retaining nuts	48	35	-
Engine mounting to subframe retaining nuts	63	46	-
Engine mounting bracket to engine retaining bolts	48	35	-
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	28	21	-
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	25	18	-
Cylinder head retaining bolts	**A**	-	-
Engine oil level (EOL) sensor retaining bolt	12	9	-
Oil pan to oil sump body retaining bolts	12	9	-
Oil sump body to engine retaining bolts	25	18	-
Oil pan drain plug	24	17	-
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	-
Balance shaft assembly retaining bolts	25 + 90°	18 + 90°	-
Rear balance weight assembly retaining nuts	25 + 38°	18 + 38°	-

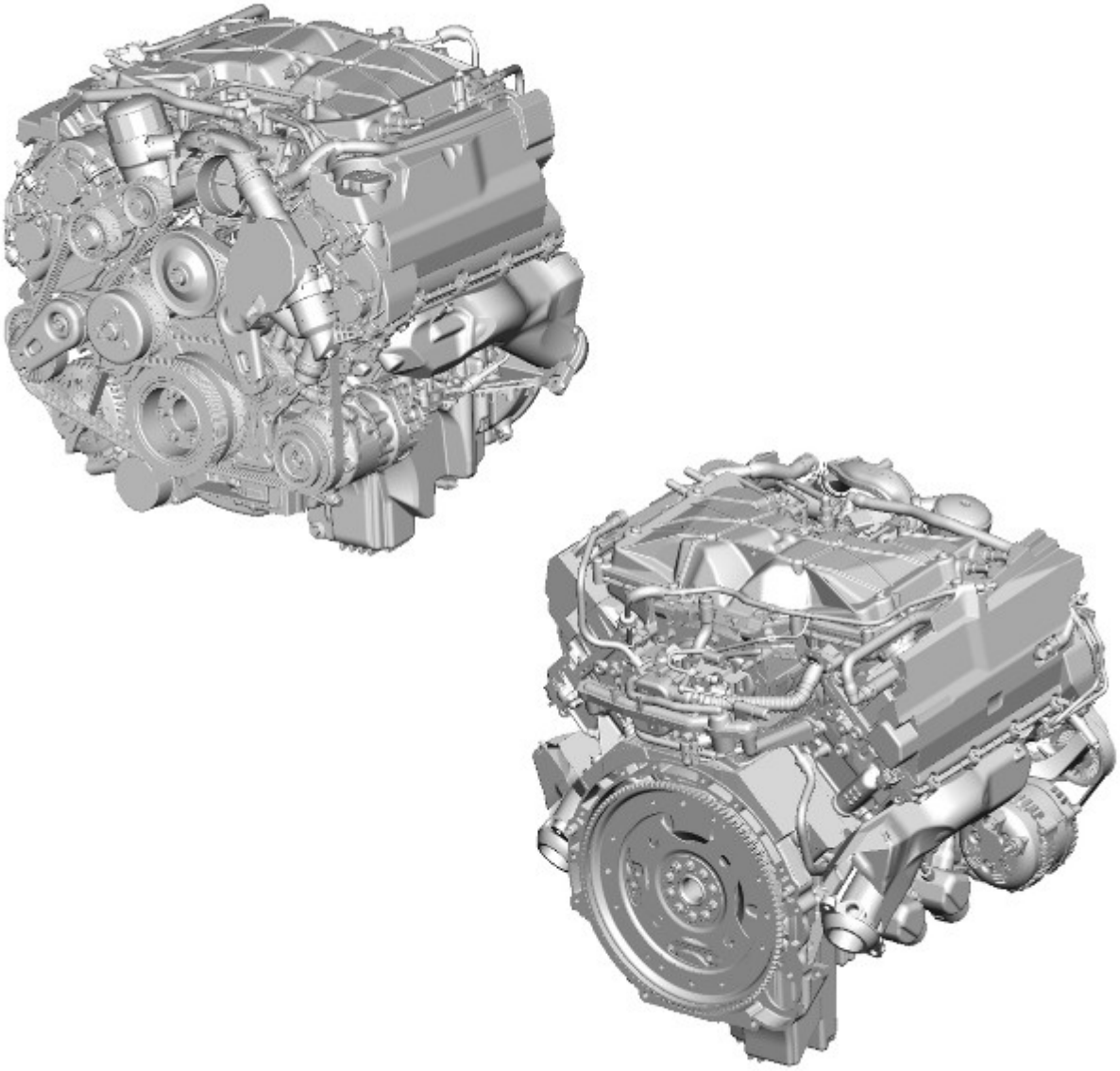
Rear balance weight assembly chain bracket retaining bolt	25	18	-
Connecting rod bolts	20 + 125°	14 + 125°	-

Published: 24-Feb-2014

Engine - V6 S/C 3.0L Petrol - Engine

Description and Operation

EXTERNAL VIEW



E152254

OVERVIEW

The V6 S/C 3.0L Petrol engine is a liquid cooled V6 unit featuring DI (direct fuel injection), four overhead camshafts and four valves per cylinder.

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 body is installed. The sump body also helps to reduce engine noise.

The engine uses a Bosch high pressure DI fuel system with fuel pressure provided by two, cam driven high pressure pumps which are driven by a dedicated camshaft. Each high pressure pump supplies a fuel rail which in turn supplies the three injectors for that bank with fuel at a controlled pressure.

The four camshafts incorporate VCT (variable camshaft timing). VCT allows the timing of the intake and exhaust valves to be adjusted independantly of each other. The VCT system is controlled by the Bosch ECM (engine control module) using information from CMP (camshaft position) sensors.

The supercharger is located in the 'vee' of the engine and is driven from the crankshaft by a dedicated secondary auxiliary drive belt.

The engine meets EU5 emission regulations in Europe and Rest of World (ROW) and ULEV 70 emission regulations in North American Specification (NAS) markets.

The DI system, advanced piston and combustion chamber design and the SC (supercharger) provide improved fuel consumption and emissions.

Various engine systems are located on the engine assembly and driven directly and indirectly by the engine operation. Refer to relevant section for the further information:

Engine cooling
For additional information, refer to: Engine Cooling (303-03B Engine Cooling - V6 S/C 3.0L Petrol, Description and Operation).

Supercharger cooling
For additional information, refer to: Supercharger Cooling (303-03D Supercharger Cooling - V6 S/C 3.0L Petrol, Description and Operation).

Fuel system
For additional information, refer to: Fuel Tank and Lines (310-01B Fuel Tank and Lines - V6 S/C 3.0L Petrol, Description and Operation).

Accessory drive
For additional information, refer to: Accessory Drive (303-05B Accessory Drive - V6 S/C 3.0L Petrol, Description and Operation).

Starting system
For additional information, refer to: Starting System (303-06B Starting System - V6 S/C 3.0L Petrol, Description and Operation).

Electronic engine controls
For additional information, refer to: Electronic Engine Controls (303-14B Electronic Engine Controls - V6 S/C 3.0L Petrol, Description and Operation).

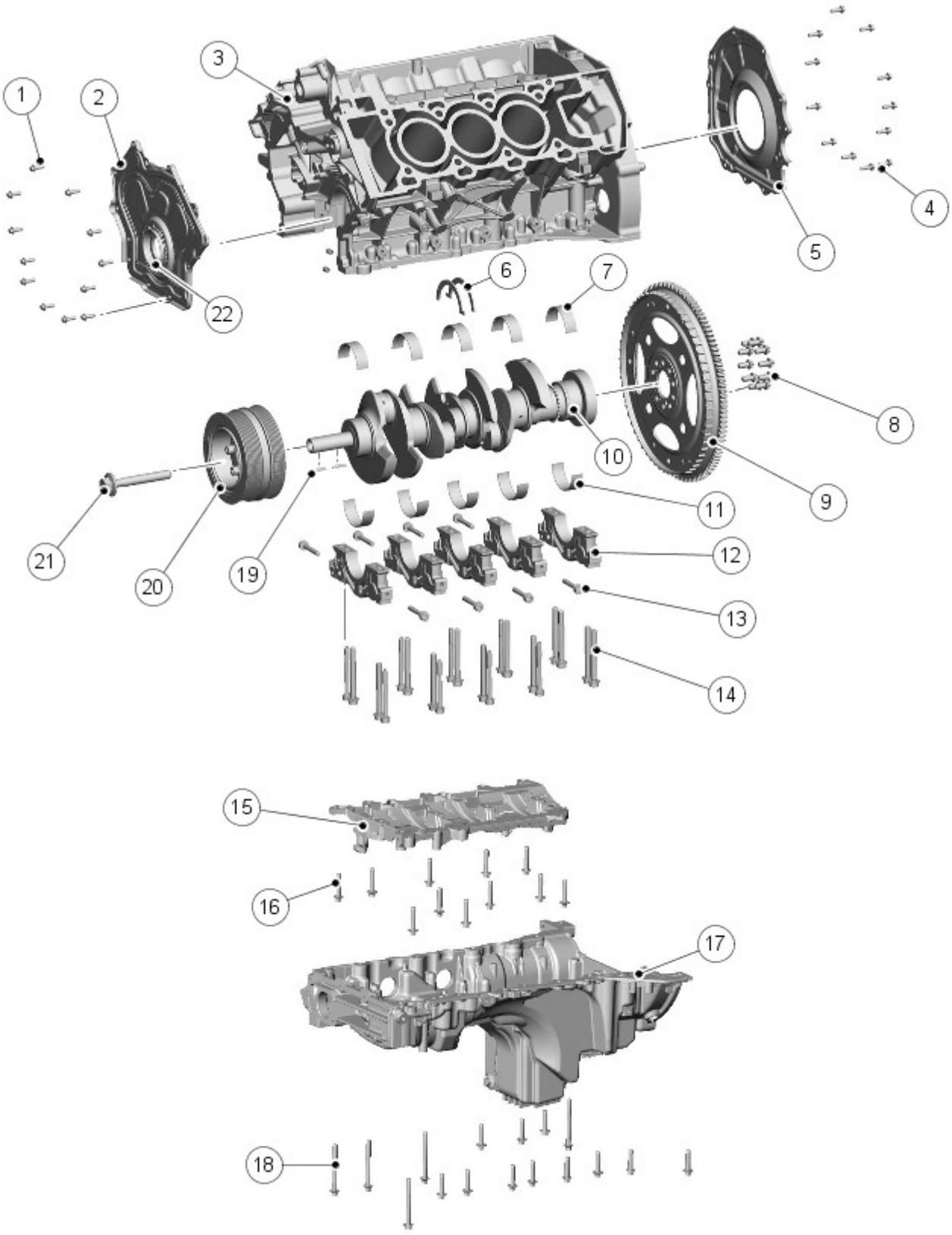
Technical Specifications

Description	Specification
Configuration	90° 'V' configuration 6 cylinder
Displacement	2995 cc
Bore and Stroke	84.5 X 89 mm
Maximum Power	340 PS @ 6500 RPM
Maximum Torque	450 Nm @ 3500 - 5000 RPM
Compression Ration	10.5:1

SYSTEM OPERATION

Operation of the engine is controlled by the ECM (Engine Control Module).
For additional information, refer to: Electronic Engine Controls (303-14B Electronic Engine Controls - V6 S/C 3.0L Petrol, Description and Operation).

Cylinder Block Components

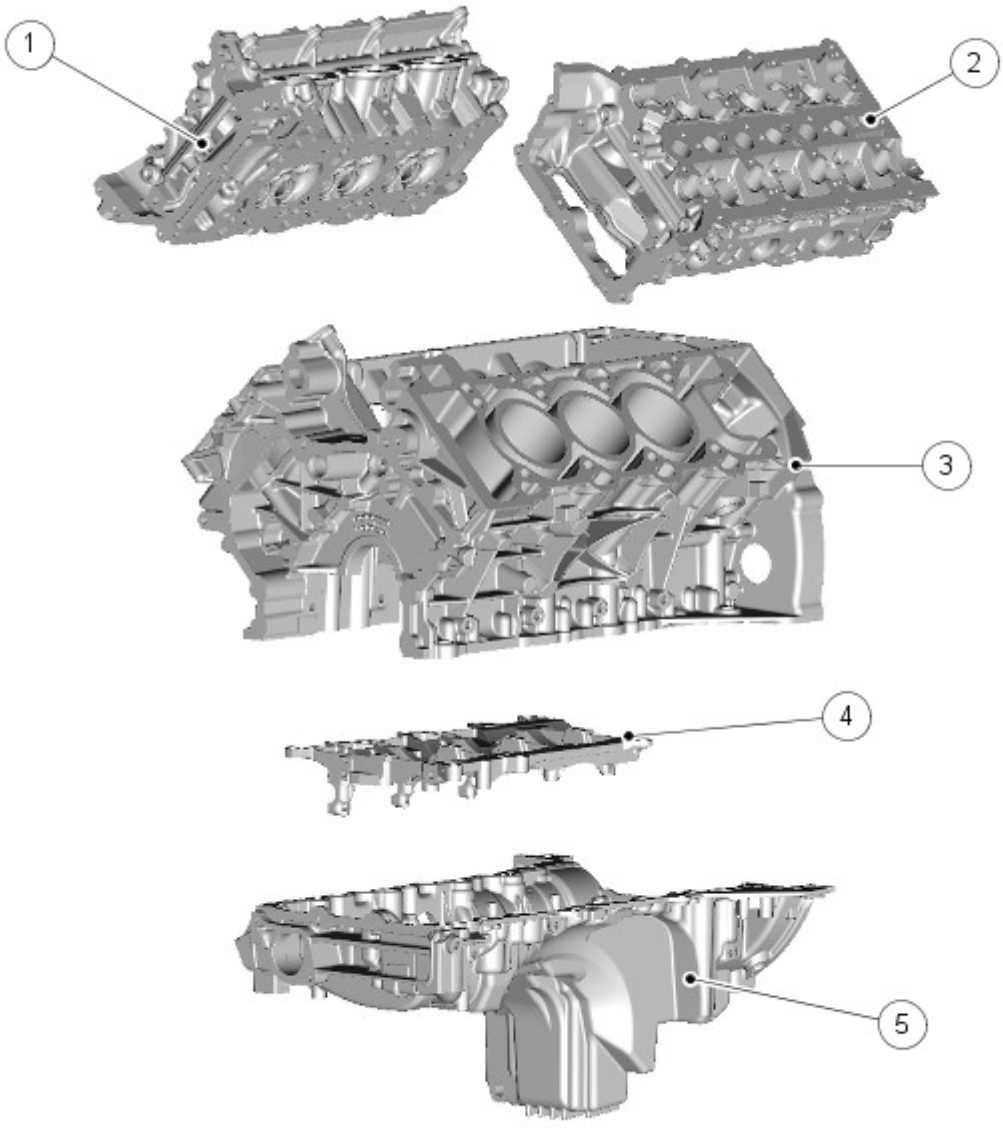


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Item	Part Number	Description
1	-	M6 bolt (12 off)
2	-	Cylinder block front cover
3	-	Cylinder block
4	-	M6 bolt (12 off)
5	-	Cylinder block rear cover and oil seal
6	-	Thrust washer (2 off)
7	-	Upper main bearing (5 off)

8	-	Bolt (10 off)
9	-	Drive plate
10	-	Crankshaft
11	-	Lower main bearing (5 off)
12	-	Crankshaft main bearing cap (5 off)
13	-	Cross bolt - crankshaft main bearing cap
14	-	Inner and outer bolts - crankshaft main bearing cap (20 off)
15	-	Windage tray
16	-	M8 bolt (11 off)
17	-	Oil pan
18	-	M8 bolt (16 off)
19	-	Woodruff key (2 off)
20	-	Crankshaft pulley/vibration damper assembly
21	-	Crankshaft damper bolt
22	-	Crankshaft front oil seal

Major Structural Components

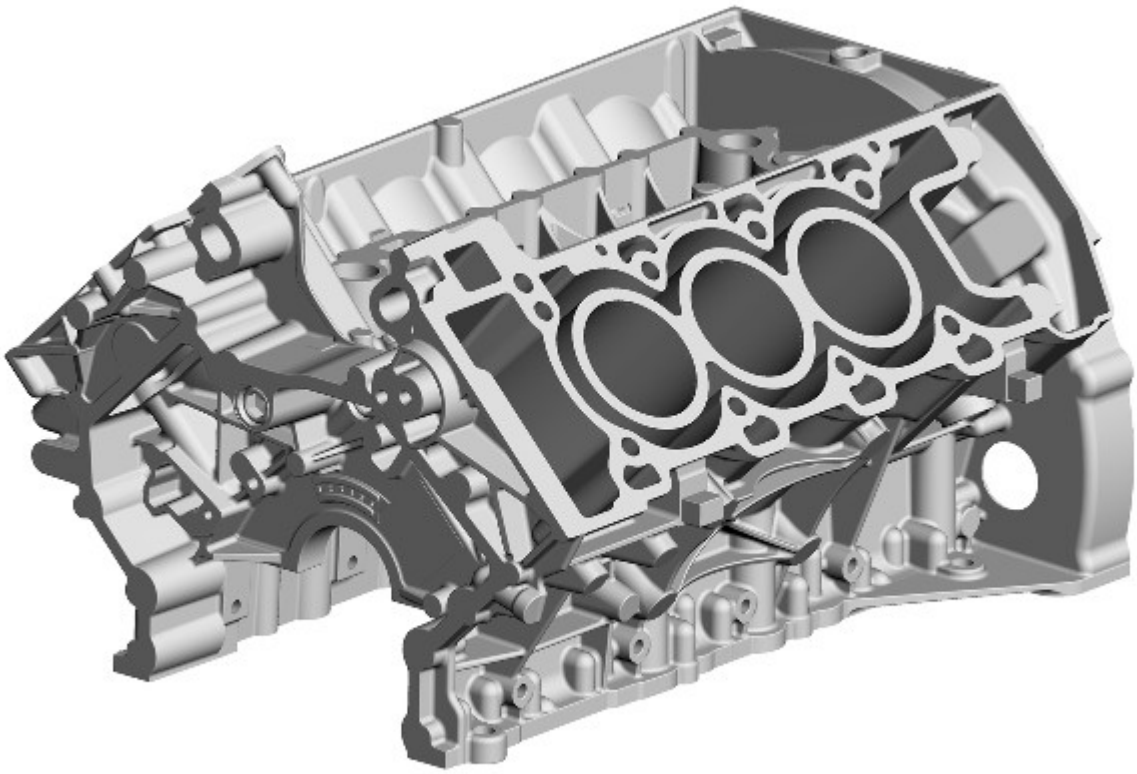


E152256

Item	Part Number	Description
1	-	Right cylinder head (Bank 1)
2	-	Left cylinder head (Bank 2)
3	-	Cylinder block
4	-	Windage tray

5 - Oil pan

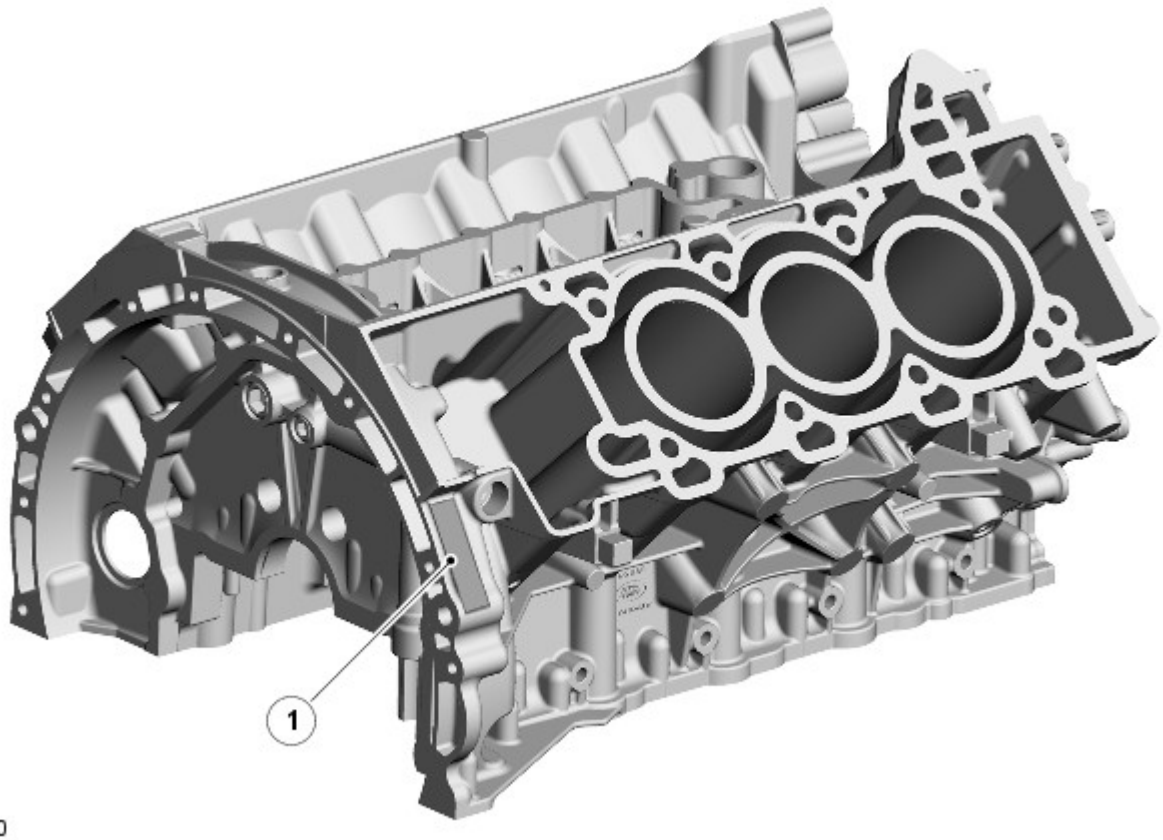
Cylinder block



E142779

The high pressure die-cast aluminum 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.

Engine Data Location

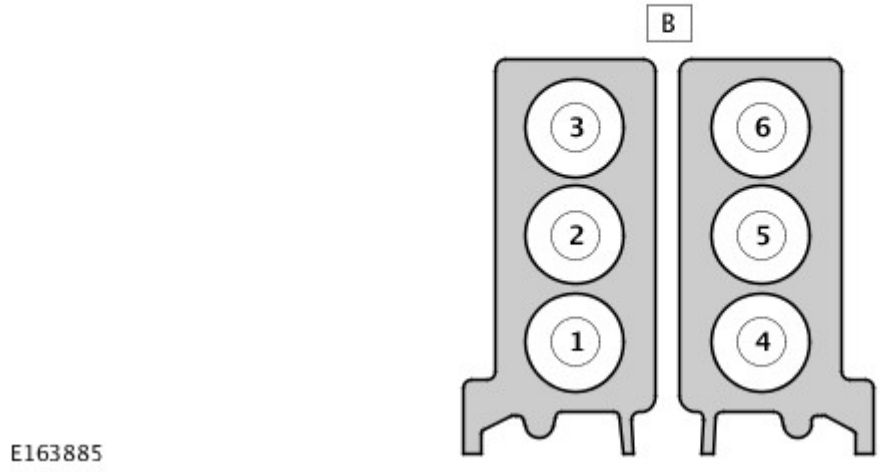


E142780

Item	Part Number	Description
1	-	Engine data location

Engine data is marked on the cylinder block at the rear of the right cylinder bank '1'.

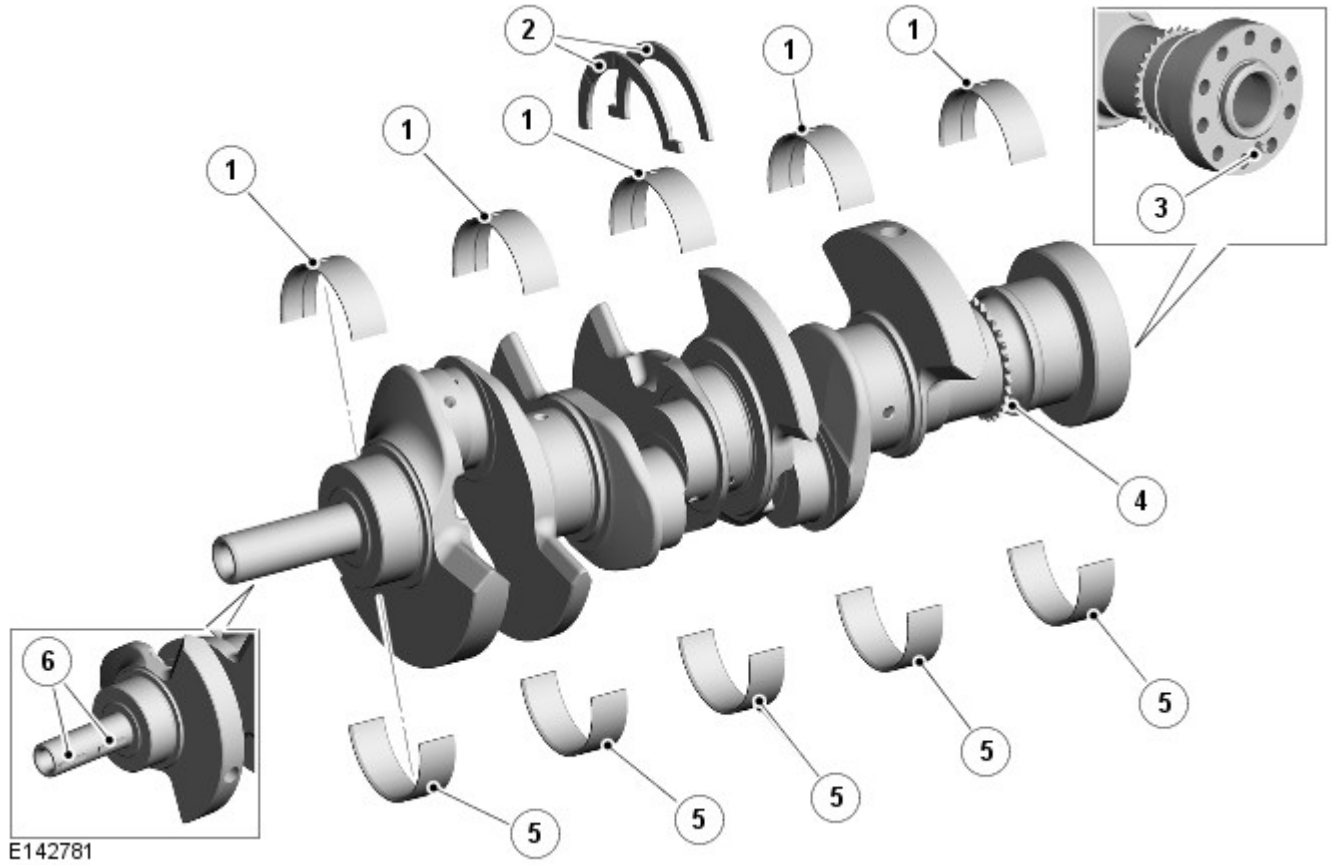
Cylinder Numbering



Item	Part Number	Description
A	-	DIN standard cylinder numbering

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

Crankshaft



Item	Part Number	Description
1	-	Upper main bearing (5 off)
2	-	Thrust washer (2 off)
3	-	Drive plate location dowel
4	-	Rear dynamic balancer drive sprocket

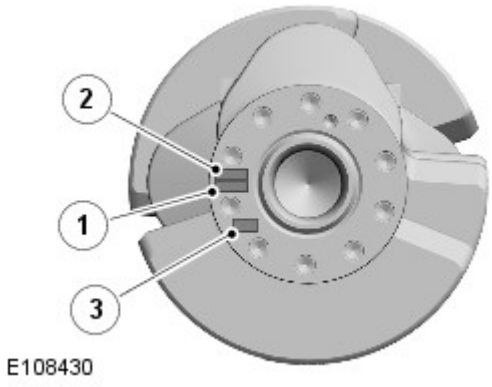
5	-	Lower main bearing (5 off)
6	-	Woodruff key locations

The crankshaft is manufactured from forged carbon steel C38 with induction hardened main and pin bearing journals. The fillets of the main journals are fillet rolled to improve strength. The fillets of the pins are induction hardened due to the split pin design, improving the strength of the crankshaft.

A six counterweight design has been used to balance the V6 split pin design ensuring less vibration.

An oil grove in the upper half of each main bearing transfers the oil into the crankshaft for lubrication of the connecting rod bearings.

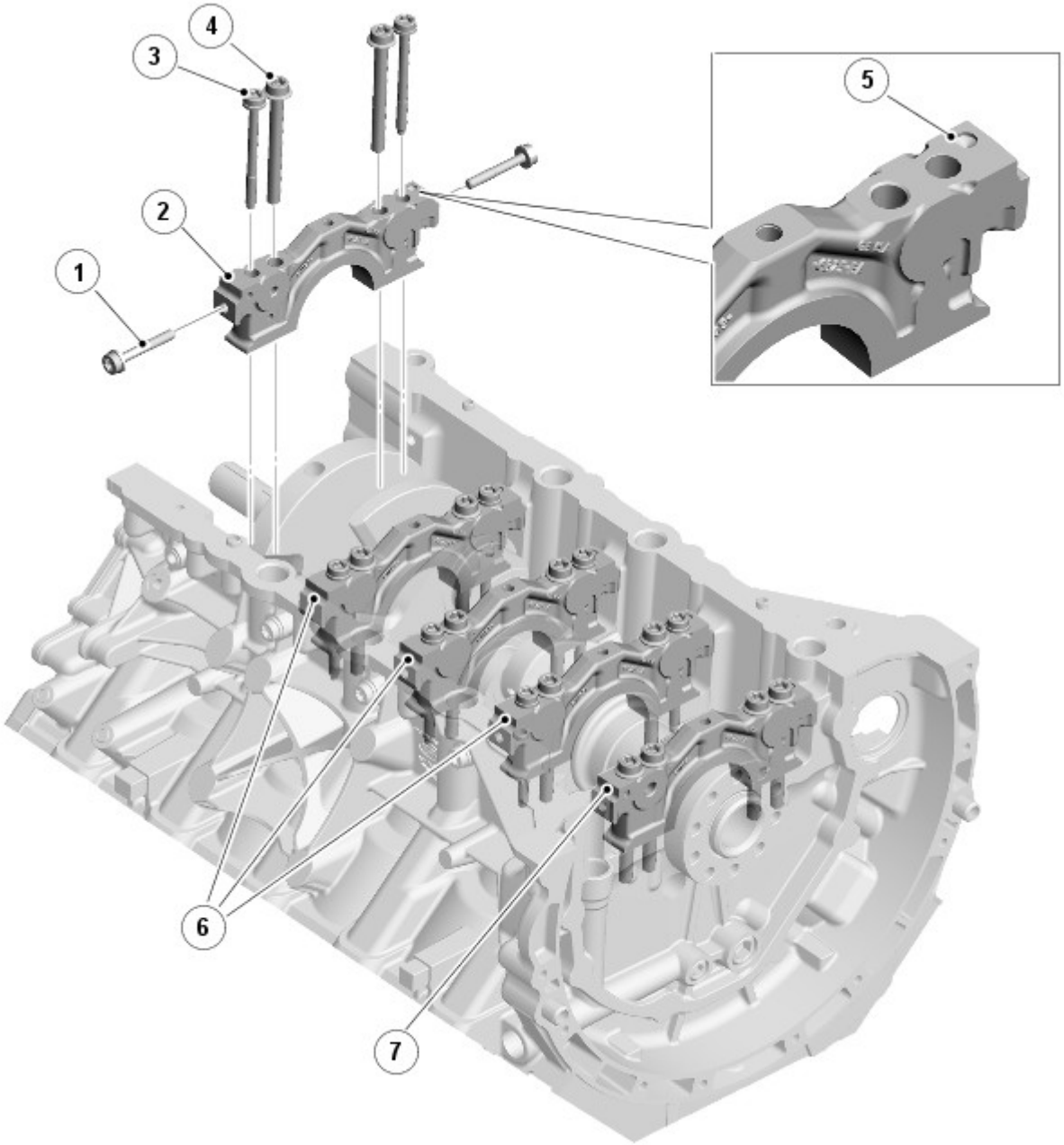
Crankshaft Data Location



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 six grades of main bearing available, each being color coded. Journal sizes are marked on the rear of the crankshaft.

Crankshaft Installation



E142783

Item	Part Number	Description
1	-	Cross cap bolt (8 off - not fitted to rear main bearing cap)
2	-	Front main bearing cap
3	-	Outer main bearing cap bolt (10 off)
4	-	Inner main bearing cap bolt (10 off)
5	-	Identification mark - must face front of engine
6	-	Main bearing caps (3 off)
7	-	Rear main bearing cap

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

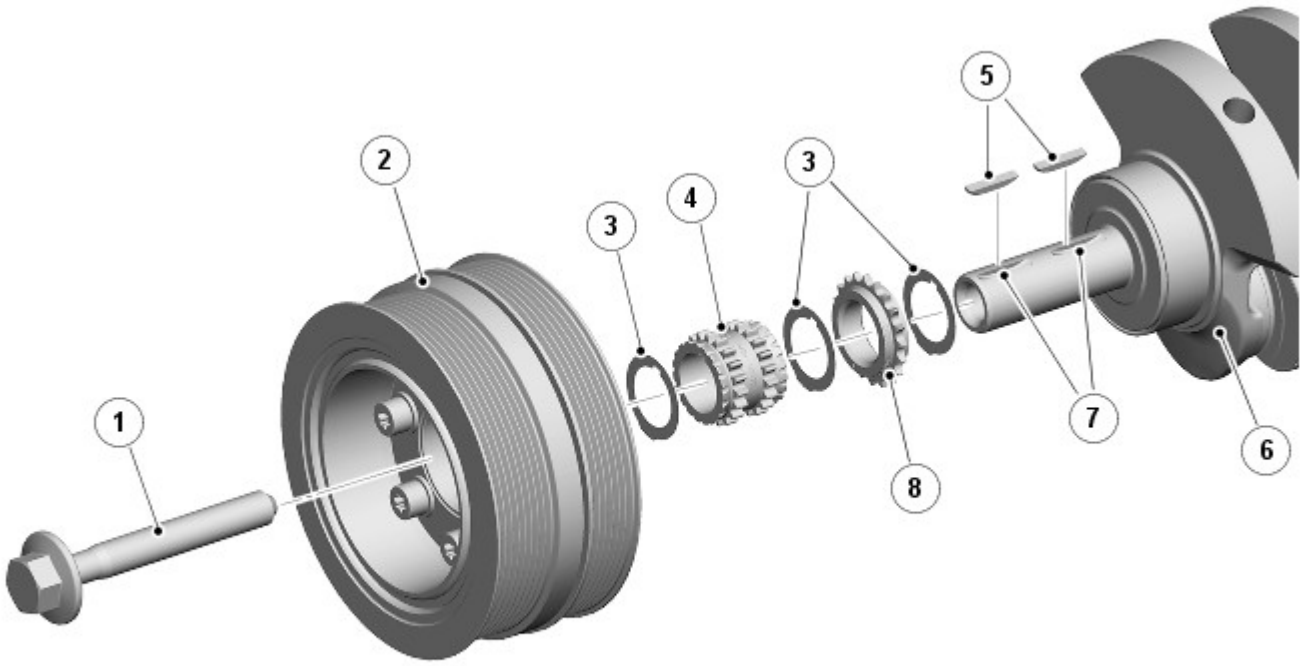
There are six grades of main bearing available, each being color coded. Journal sizes are marked on the rear of the crankshaft.

The thickness grade of all main bearing shells are to be selected to give a total running clearance of not less than 0.046mm or not greater than 0.067mm.

The main bearing shells in the cylinder block have a central hole and an internal groove to allow for main journal lubrication. The bearing shells in the main bearing caps are plain with no grooves.

Special tools are required to ensure the correct alignment of the upper and lower main bearing shells.

Crankshaft pulley/Vibration Damper



E142784

Item	Part Number	Description
1	-	Pulley bolt
2	-	Crankshaft pulley/vibration damper
3	-	Friction washer
4	-	Timing chain drive sprocket
5	-	Woodruff keys
6	-	Crankshaft
7	-	Woodruff key slots
8	-	Oil pump drive sprocket

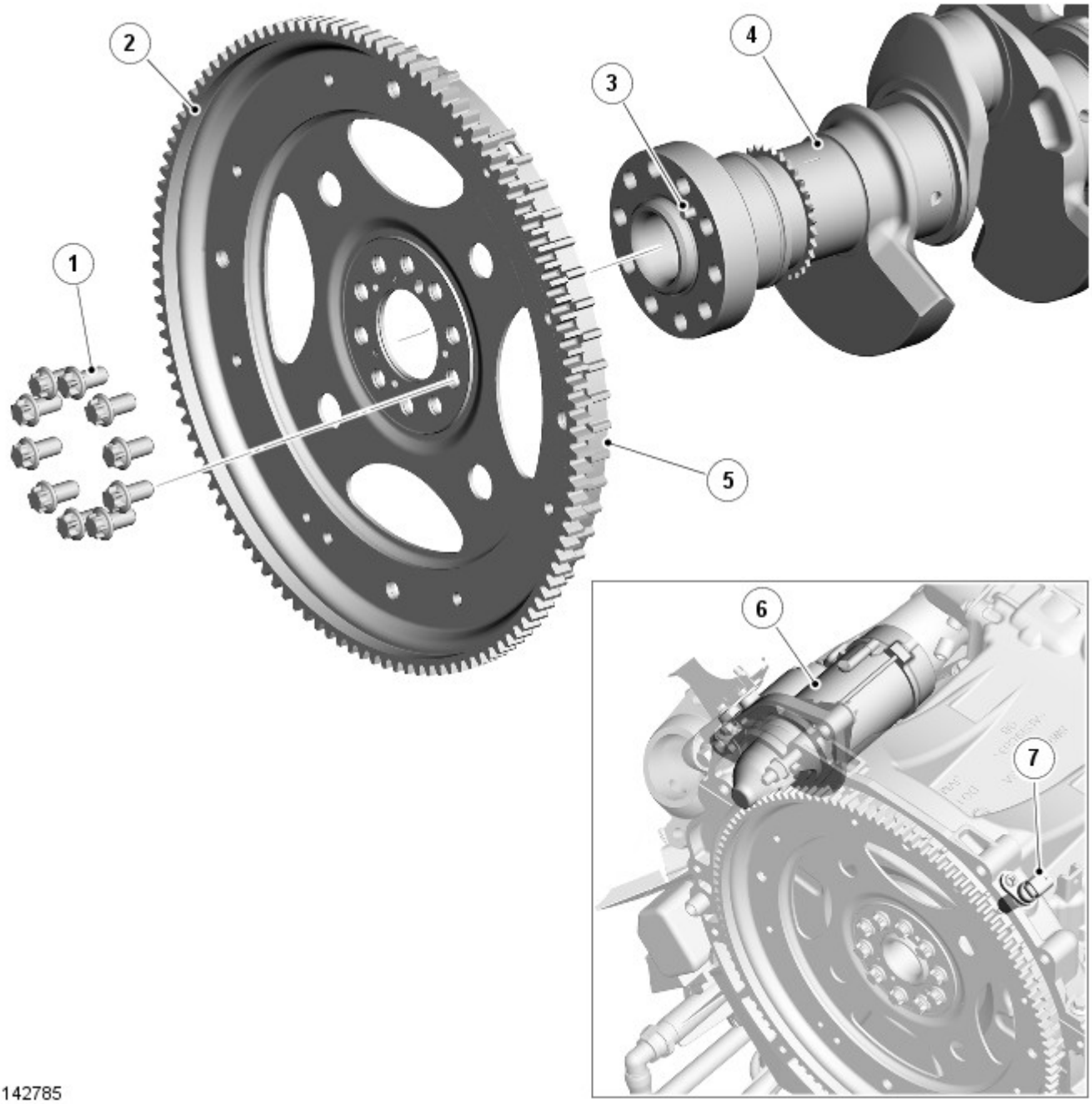
At the front of the crankshaft, a tuned torsional vibration damper is incorporated into the crankshaft pulley.

The pulley is located on two woodruff keys which are located in slots in the crankshaft. The woodruff keys are a press fit in the slots and must be correctly aligned.

If the pulley is removed, a new friction washer must be located between the timing chain drive sprocket and the crankshaft pulley and a new pulley bolt must also be used.

The crankshaft pulley/vibration damper is not a serviceable component and must not be disassembled.

Drive Plate



E142785

Item	Part Number	Description
1	-	Bolt (10 off)
2	-	Drive plate
3	-	Dowel
4	-	Crankshaft
5	-	Reluctor ring
6	-	Starter motor
7	-	Crankshaft Position (CKP) sensor

The drive plate is located at the rear of the crankshaft. The drive plate has three functions; to transfer drive from the crankshaft to the transmission, to transfer drive from the starter motor to the crankshaft and to provide the engine management system with crankshaft speed and position via a reluctor ring and a sensor.

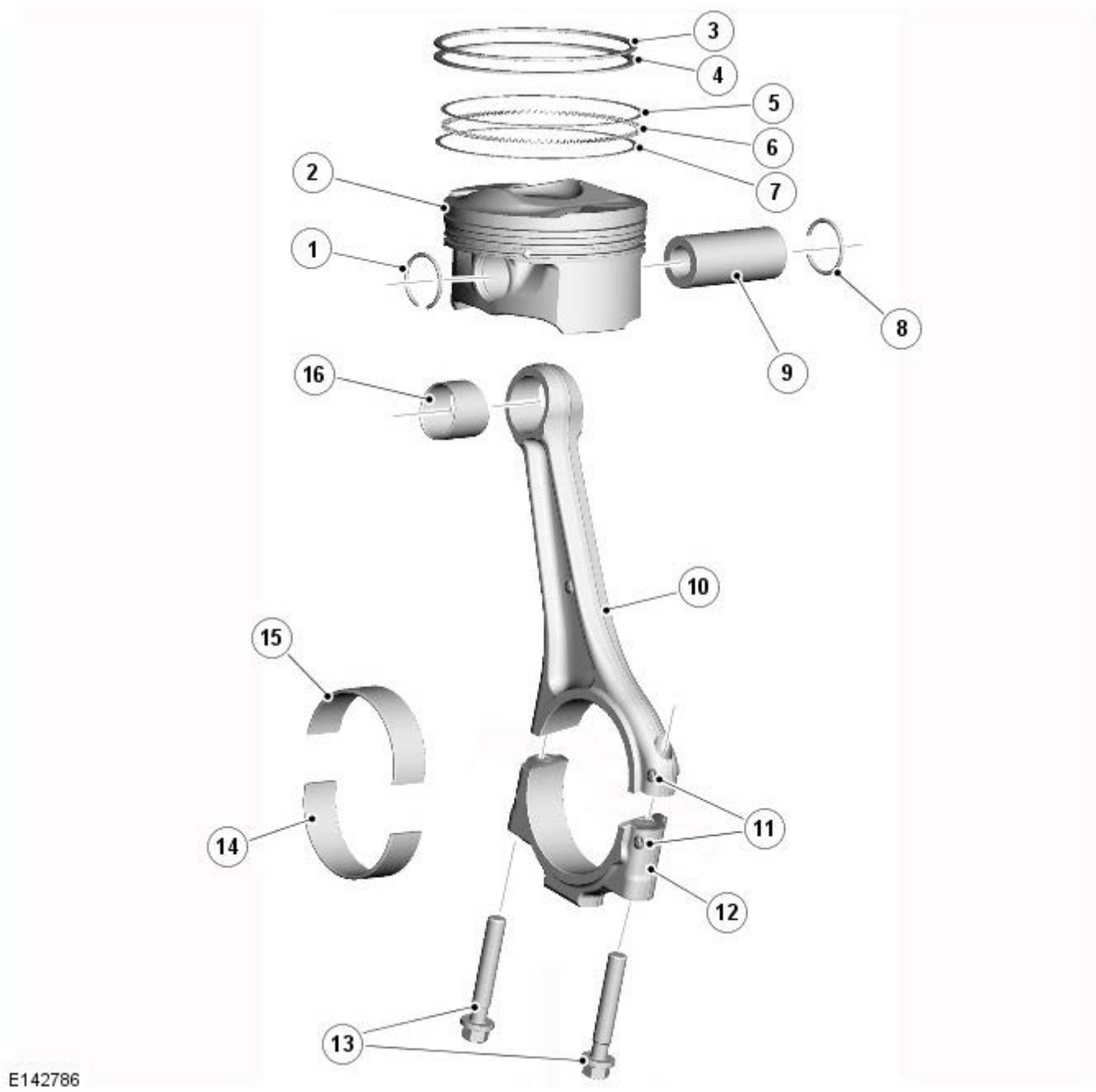
The drive plate is secured to the crankshaft flange with 10 bolts and is located with a dowel to ensure the correct timing of the reluctor ring to the crankshaft orientation.

The drive plate is a pressed and cast steel fabrication, which comprises a cast steel starter ring gear and a pressed steel drive plate and reluctor ring. The two components are riveted together as one assembly.

Four holes in the drive plate provide for the attachment of the transmission torque converter to transfer drive from the crankshaft to the transmission.

The reluctor ring has 60 teeth with 2 teeth missing to provide a gap. A Crankshaft Position (CKP) sensor is located in the oil pan casting and measures speed and position as the reluctor ring rotates.
For additional information, refer to: Electronic Engine Controls (303-14B Electronic Engine Controls - V6 S/C 3.0L Petrol, Description and Operation).

Pistons and Connecting Rods



Item	Part Number	Description
1	-	Circlip
2	-	Piston
3	-	Upper compression ring
4	-	Lower compression ring
5	-	Oil control ring
6	-	Separator
7	-	Oil control ring
8	-	Circlip
9	-	Gudgeon pin
10	-	Connecting rod
11	-	Alignment marks
12	-	Connecting rod cap
13	-	Bolts
14	-	Lower large end shell bearing
15	-	Upper large end shell bearing
16	-	Small end bearing

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 Physical Vapor Deposition (PVD) 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 two upper rings are marked with an 'R' which must face upwards, towards the top of the piston.

The pistons are cooled with engine oil from three piston cooling jets installed under the valley of the cylinder block.

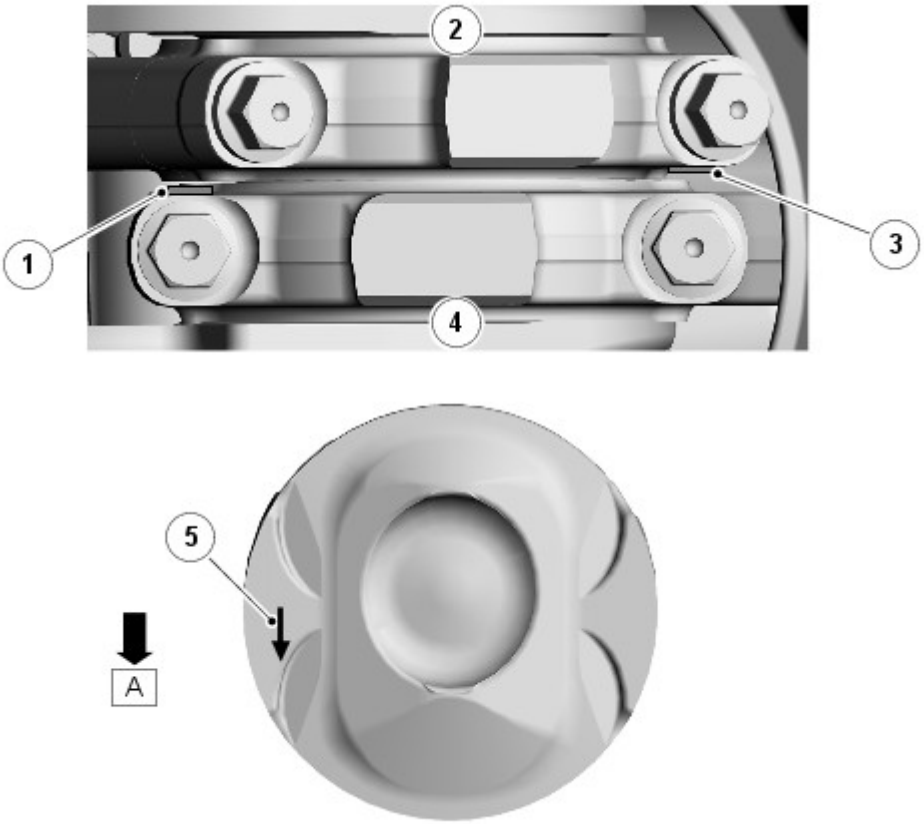
The connecting rods are forged from high strength steel. The connecting rod cap is fracture-split from the rod to ensure precision re-assembly for shell bearing alignment. There are three grades of large end bearing available, each being color coded. For additional information, refer to: (303-00 Engine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

Connecting Rod Cleaning (General Procedures),
Connecting Rod Large End Bore (General Procedures).

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

The pistons are attached to the connecting rods with a gudgeon pin, which is secured with 2 circlips. The gudgeon pin is located through the small end bearing in the connecting rod which allows the piston to articulate with the linear movement of the connecting rod. The circlips locate in grooves in the piston.

Connecting Rod and Piston Orientation



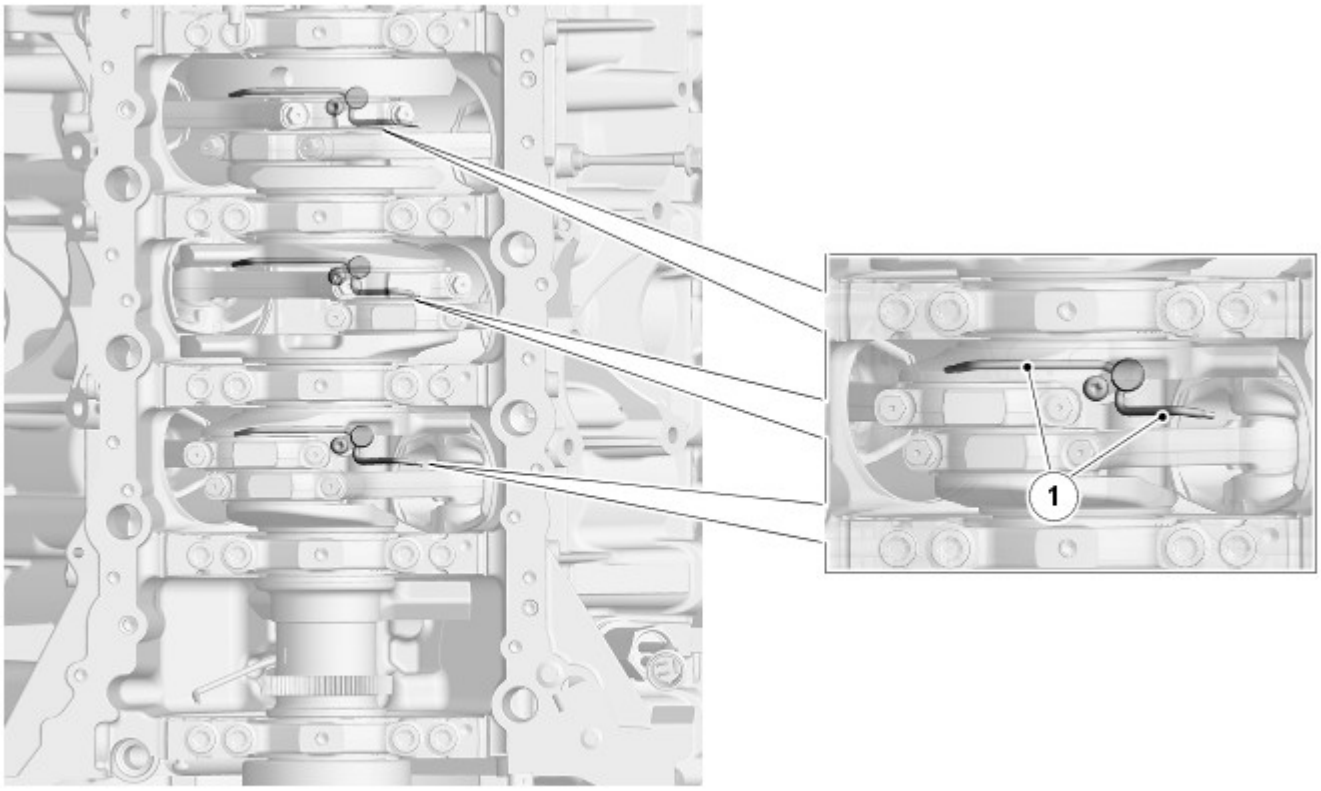
E142787

Item	Part Number	Description
A	-	Front of engine
1	-	Alignment mark
2	-	Left side (Bank 2)
3	-	Alignment mark
4	-	Right side (Bank 1)
5	-	Piston orientation arrow

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

- Bank 1 - 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 2 - 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.

Piston Cooling Jets



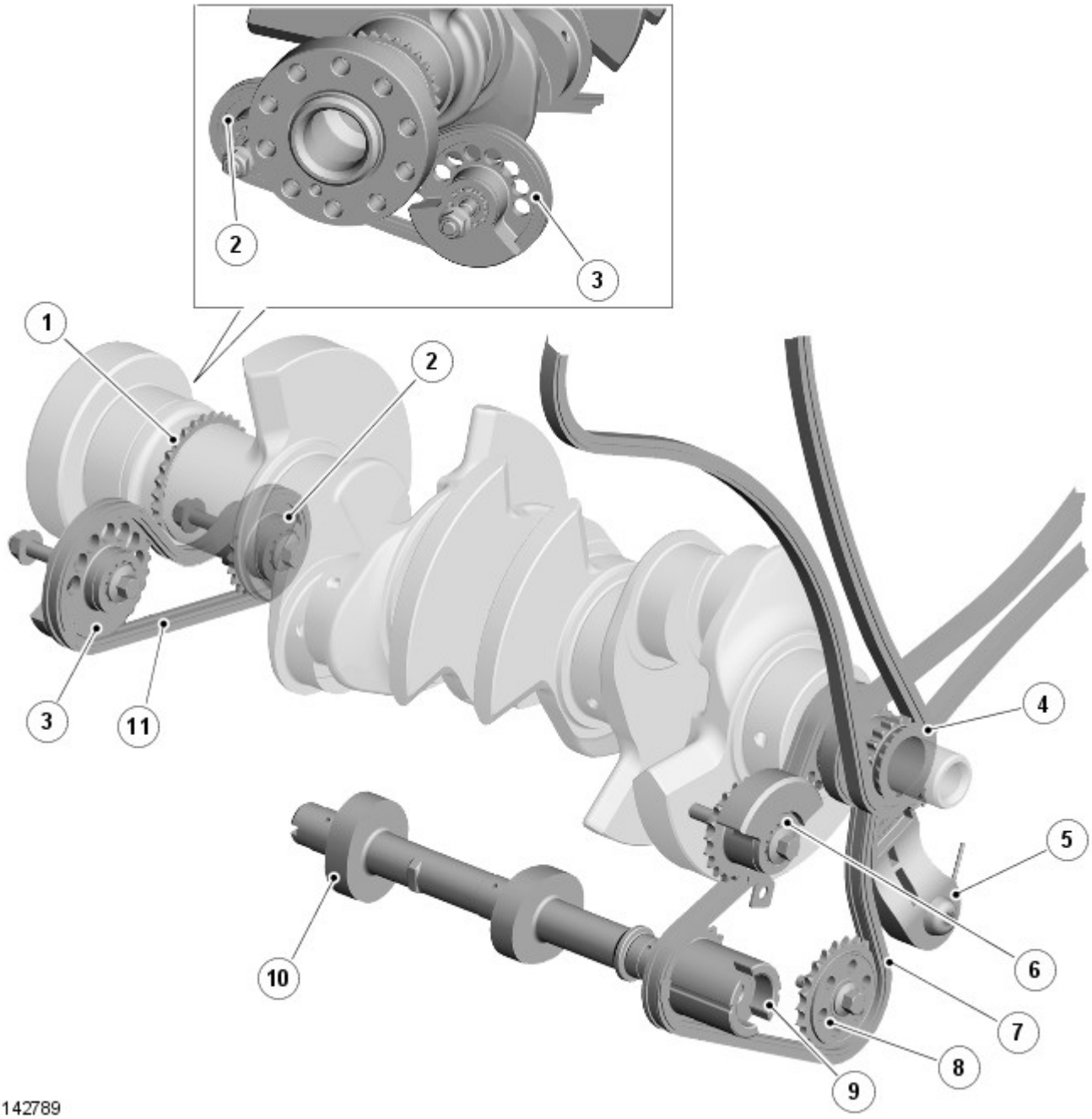
E142788

Item	Part Number	Description
1	-	Piston cooling jets

Piston cooling jets, located in the cylinder block, provide piston and piston pin cooling and lubrication. Each piston cooling jet has two outlet nozzles which spray oil onto the underside of the two adjacent pistons, one from each cylinder bank. Each jet is located in a threaded hole between the pair of cylinders and is secured with a bolt. The jets are supplied pressurized engine oil from the oil pump via a drilling in the cylinder block.

Each jet sprays oil onto the inside of the piston. The oil coats the underside of the piston to help cool each piston crown. Additionally, oil lubricates the small end bearing and gudgeon pin.

Dynamic Balancers and Auxiliary Camshaft



E142789

Item	Part Number	Description
1	-	Crankshaft rear dynamic balancer drive sprocket
2	-	Idler sprocket
3	-	Rear dynamic balancer
4	-	Crankshaft timing chain sprocket
5	-	Auxiliary drive tensonier
6	-	Front dynamic balancer
7	-	Auxiliary drive chain
8	-	Oil pump sprocket
9	-	Auxiliary shaft sprocket
10	-	Auxiliary shaft
11	-	Drive chain

Dynamic engine balancing is performed by two weighted dynamic balancers, located at the front and rear of the cylinder block. The dynamic balancers oppose and cancel out vibrations created by the engine's rotating components.

The front and rear dynamic balancers comprise a sprocket with an offset weight.

Both dynamic balancers are fitted with two needle roller bearings. A threaded shaft passes through the needle roller bearings and bolts through the rear main bearing cap for the rear dynamic balancer and idler. A threaded shaft passes through the needle roller bearings and screws into a threaded hole in the front main bearing cap for the front dynamic balancer. A shoulder on the shaft maintains the correct lateral position of the dynamic balance. Thrust bearings on either side of the dynamic balancer control lateral movement.

The rear dynamic balancer is driven by a dedicated drive chain which is driven by a sprocket which is integral with the

crankshaft. An non-weighted idler sprocket, supported on needle roller bearings, is fitted in the same way on the opposite side of the crankshaft main bearing cap. The drive chain connects the two sprockets and the drive gear on the crankshaft.

The front dynamic balancer is driven by the auxiliary drive chain, which also drives the auxiliary camshaft used to operate the two high pressure fuel pumps. The auxiliary drive chain is driven off the crankshaft sprocket, and also provides drive the auxiliary camshaft sprocket and the oil pump sprocket.

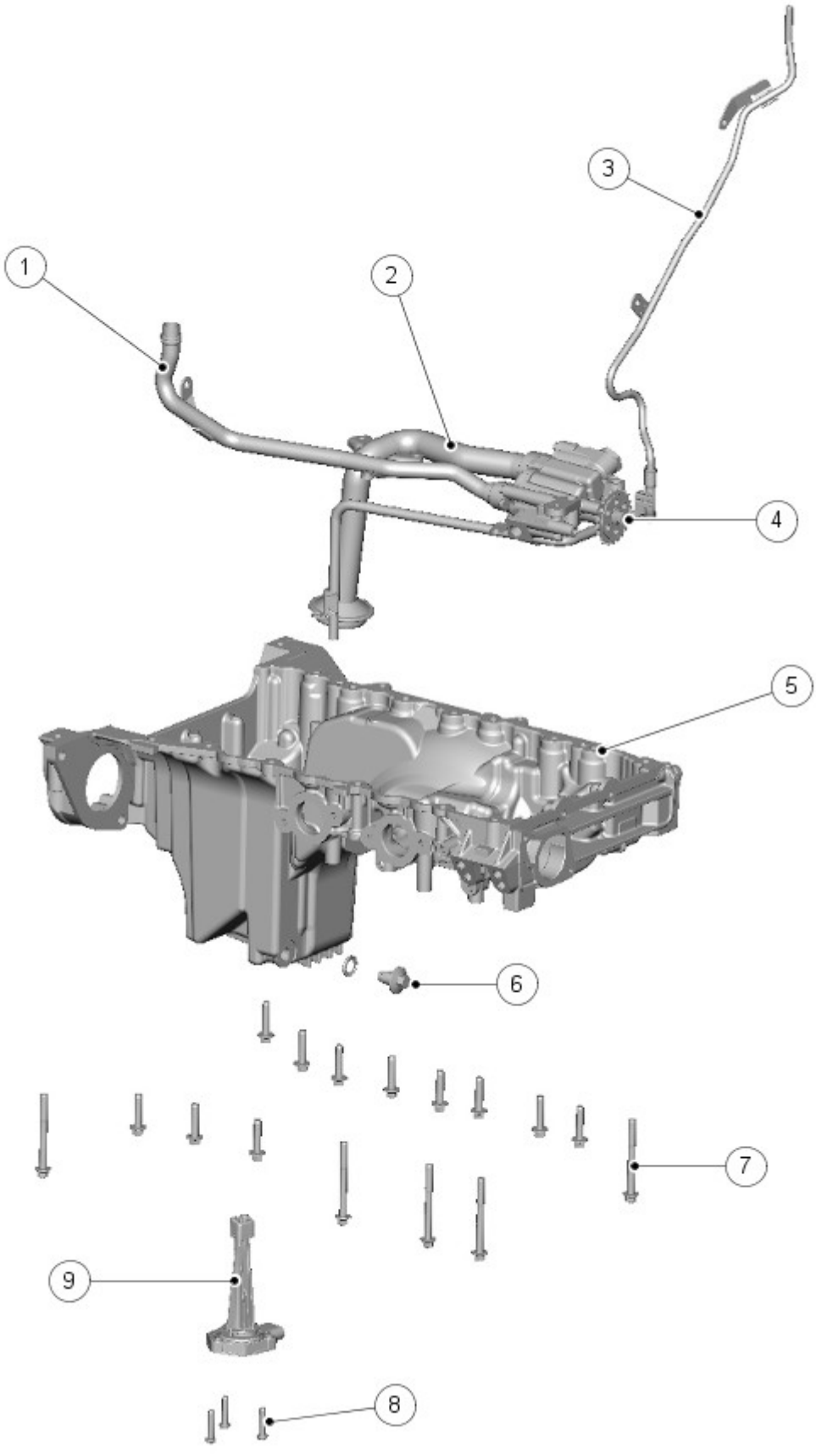
The dynamic balancers rotate at crankshaft speed in opposite directions. The equally sized weights are phased so that the inertia reaction to their counter-rotation cancels out vibration caused by the engine in both horizontal and vertical planes.

Both dynamic balancers must be timed to the crankshaft position by their position on the drive chain.
For additional information, refer to: Fuel Pump Camshaft Timing Adjustment (303-01B, General Procedures).

The auxiliary camshaft is located on two machined bosses on the windage tray and secured with a camshaft carrier which is secured to windage tray with four bolts. The auxiliary camshaft has two cam lobes, with each lobe operating a high pressure fuel pump, via a tappet. The camshaft is fitted with a drive sprocket which is a press fit on the camshaft. The sprocket is timed to the cam lobes to match the pump delivery strokes with crankshaft position and therefore must not be removed.

The auxiliary camshaft is driven at crankshaft speed by the auxiliary drive chain, which also drives the oil pump and the front dynamic balancer from the crankshaft sprocket. The two lobes on the camshaft act, through tappets located in the camshaft carrier, against a plunger on each single cylinder high pressure pump.
For additional information, refer to: Fuel Charging and Controls (303-04C Fuel Charging and Controls - V6 S/C 3.0L Petrol, Description and Operation).

Oil pan



E152258

Item	Part Number	Description
1	-	Oil pump outlet pipe to cylinder block
2	-	Oil pump pick-up pipe
3	-	Oil evacuation tube
4	-	Oil pump
5	-	Oil pan
6	-	Drain plug with washer
7	-	Oil pan body retaining bolts (16 off)

8	-	Bolt (3 off)
9	-	Oil level and temperature sensor

The oil pan body is located on the underside of the cylinder block. It is sealed to the cylinder block with a 3 mm bead of RTV sealant and is secured with 16 bolts.

The oil pan body covers the windage tray and the oil pump and also collects engine oil returning from the cylinder heads and crankshaft lubrication.

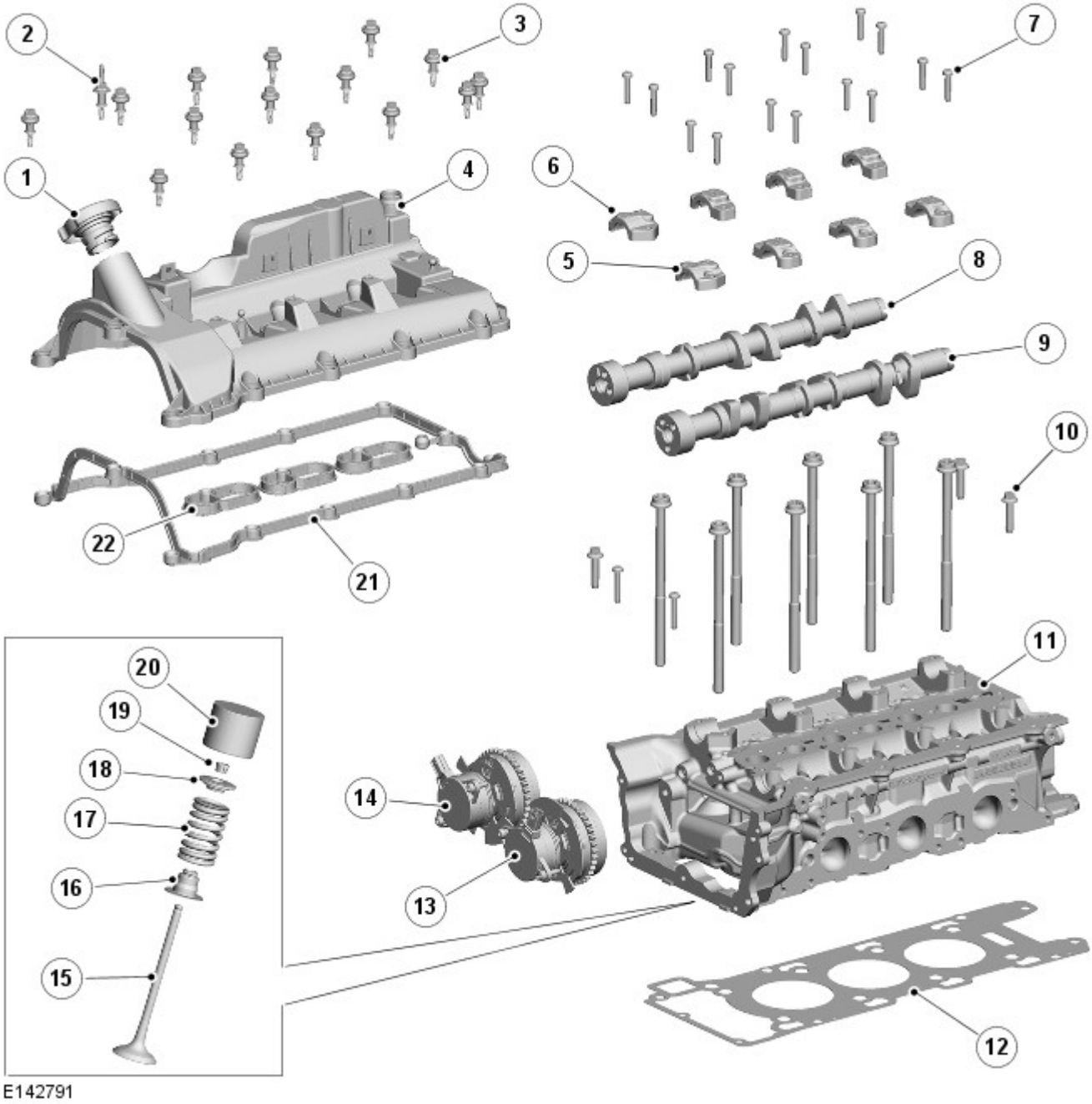
A drain plug and seal are located on the right side of the oil pan. The oil level and temperature sensor is located in the bottom of the oil pan and is sealed with a rubber gasket and secured with 3 screws.

The oil pan remains full of engine oil and provides the location for the oil pump pick-up pipe and filter. The deeper size of the oil pan ensures that engine oil is always available at the oil pump pick-up and prevents oil starvation due to vehicle inclination and oil surge due to cornering, braking and acceleration.

An oil evacuation tube is installed to allow oil to be drawn from the oil pan. The upper end of the oil evacuation tube is located under the oil filler cap in the camshaft cover.

Cylinder Head Components

NOTE: Left (Bank 2) cylinder head shown, right (Bank 1) cylinder head is similar.



Item	Part Number	Description
1	-	Oil filler cap assembly
2	-	Stud, nut, grommet and sleeve (1 off Bank 2, 2 off Bank 1)
3	-	Bolt, grommet and sleeve (15 off)

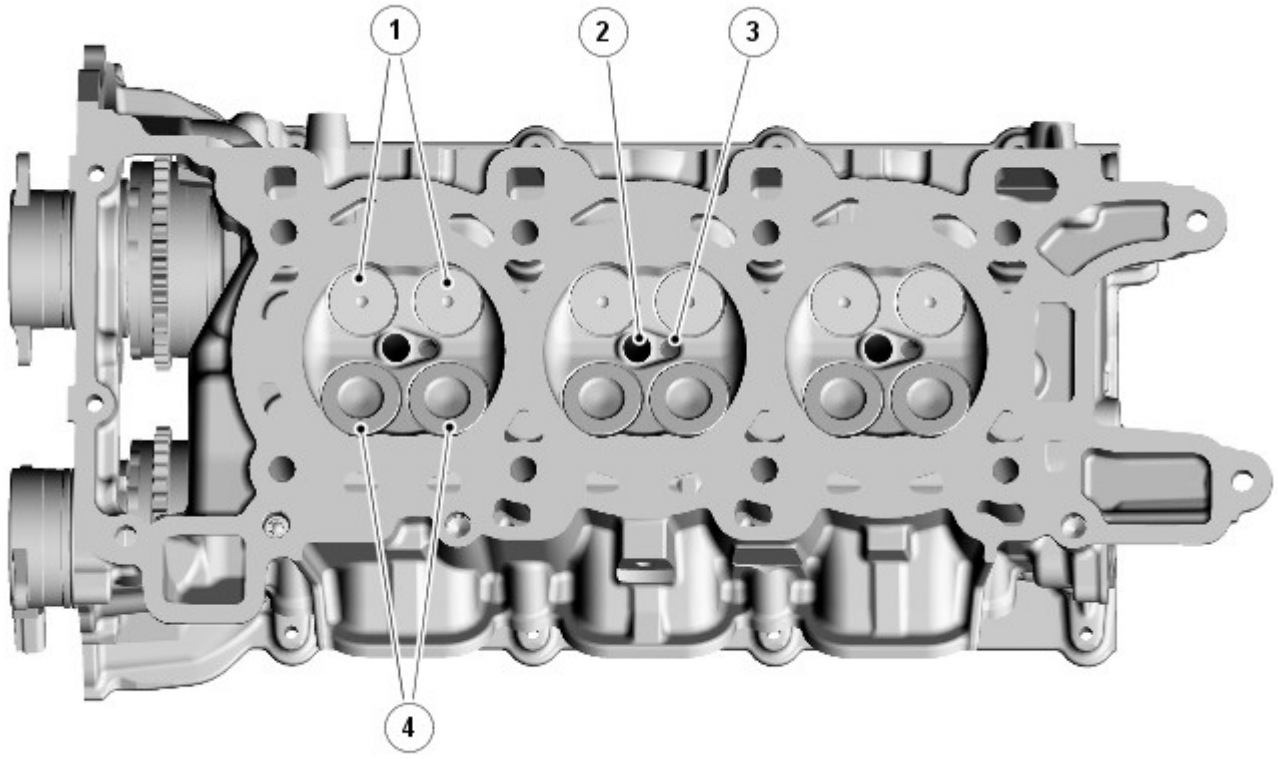
4	-	Camshaft cover
5	-	Exhaust camshaft caps (4 off)
6	-	Inlet camshaft caps (4 off)
7	-	Camshaft cap bolts (16 off)
8	-	Inlet camshaft
9	-	Exhaust camshaft
10	-	Cylinder head bolts (13 off)
11	-	Cylinder head
12	-	Cylinder head gasket
13	-	Variable Camshaft Timing (VCT) actuator (exhaust)
14	-	VCT actuator assembly (inlet)
15	-	Valve (12 off (6 inlet, 6 outlet))
16	-	Valve spring seat and stem seal (12 off)
17	-	Valve spring (12 off)
18	-	Valve spring retainer (12 off)
19	-	Valve spring collet (12 off)
20	-	Valve tappet (12 off)
21	-	Camshaft cover gasket
22	-	Camshaft cover spark plug/injector gasket (3 off)

Cylinder Heads

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 valves are a conventional arrangement, with a valve and spring assembly retained by a valve collet. The valve tappets are graded and selected on assembly to obtain the correct valve clearance dimensions.



E142792

Item	Part Number	Description
1	-	Exhaust valves
2	-	Fuel injector location
3	-	Spark plug location
4	-	Inlet valves

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

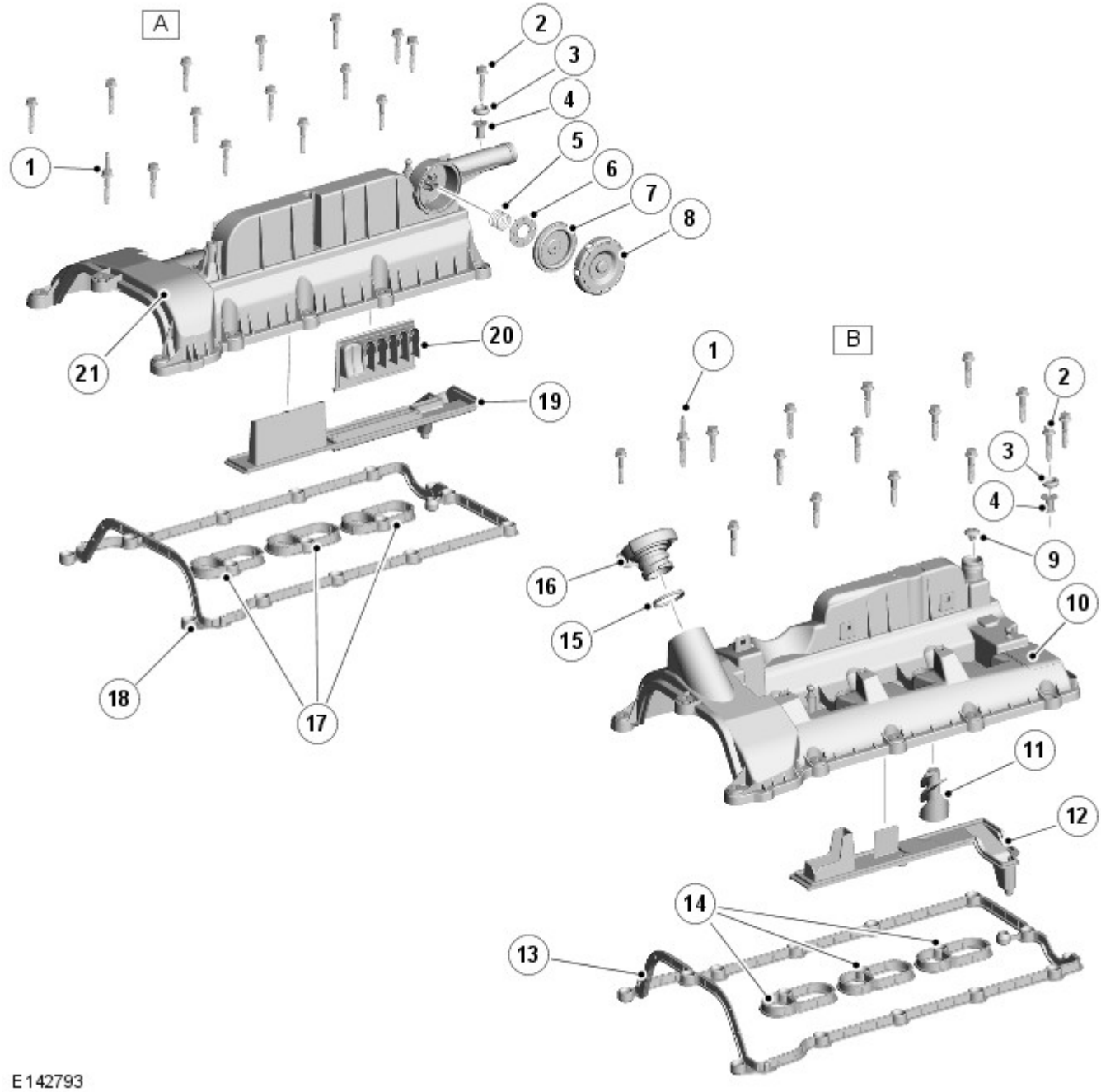
The threads for the spark plugs are machined at a precise start point to ensure that each spark plug is orientated in the

cylinder correctly. The benefits of this are optimum spark plug intrusion into the combustion chamber to improve combustion, idle stability, dilution tolerance and spark plug durability. The spark plug must be tightened to the specified torque to ensure the correct orientation.

The camshafts run on line bored journals in the cylinder head and camshaft caps. Therefore it is very important that the camshaft caps are maintained with their respective journal and the orientation is as marked on the cap.

A camshaft cover is fitted and sealed with a rubber seal and 3 smaller rubber seals. The cover is retained in position with 15 bolts which are located through a sleeve and a grommet for sealing and a single stud and nut.

Camshaft Covers



E142793

Item	Part Number	Description
A	-	Right Side Bank 1
B	-	Left Side Bank 2
1	-	Stud, nut, grommet and sleeve (1 off Bank 2, 2 off Bank 1)
2	-	Bolt (15 off per cover)
3	-	Grommet (15 off per cover)
4	-	Spacer (15 off per cover)
5	-	Pressure control valve spring
6	-	Pressure control valve inlet
7	-	Twin pressure control valve
8	-	Pressure control valve cover
9	-	Two-way valve

10	-	Camshaft cover - bank 2
11	-	Spiral oil separator
12	-	Baffle plate
13	-	Camshaft cover gasket
14	-	Camshaft cover spark plug/injector gasket (3 off)
15	-	O ring seal
16	-	Oil filler cap assembly
17	-	Camshaft cover spark plug/injector gasket (3 off)
18	-	Camshaft cover gasket
19	-	Baffle plate
20	-	Omega flap plate
21	-	Camshaft cover - bank 1

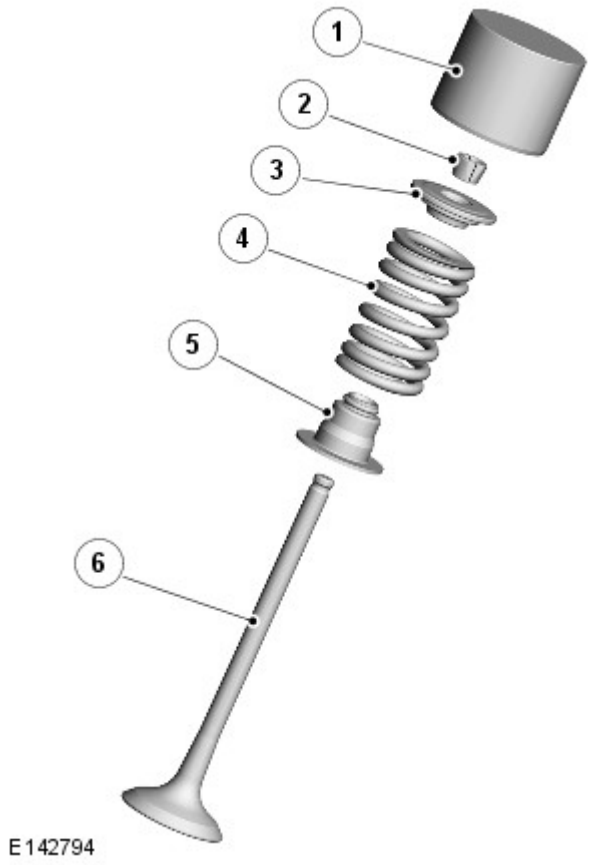
Each camshaft cover is secured to the cylinder head with 15 bolts and 1 stud and nut. A grommet seals the holes in the cover and a sleeve controls the compression of the grommet.

Threaded inserts are fitted to each cover to allow for the attachment of the ignition coils. A plastic cover is fitted over the ignition coils and is secured with snaplock studs.

Each camshaft cover is fitted with a breather. The left side cover has a baffle plate which collects oil vapor and allows it drain back into the oil pan via the cylinder block. The left side breather provides for engine full load operation and vents cylinder block emissions into the left side air filter outlet. The right side cover is fitted with an omega plate and a pressure control valve. The right side breather provides for engine part load operation and vents cylinder block emissions into the throttle which is integral with the supercharger.

A groove in the outer edge of each cover provides the location for the re-useable camshaft cover gasket. Three separate gaskets, located in the center of the camshaft cover, prevent oil leaking into the area around the fuel injectors, spark plugs and coils.

Valves and Tappets



Item	Part Number	Description
1	-	Valve tappet
2	-	Valve spring collet
3	-	Valve spring retainer
4	-	Valve spring
5	-	Valve steam seal
6	-	Valve

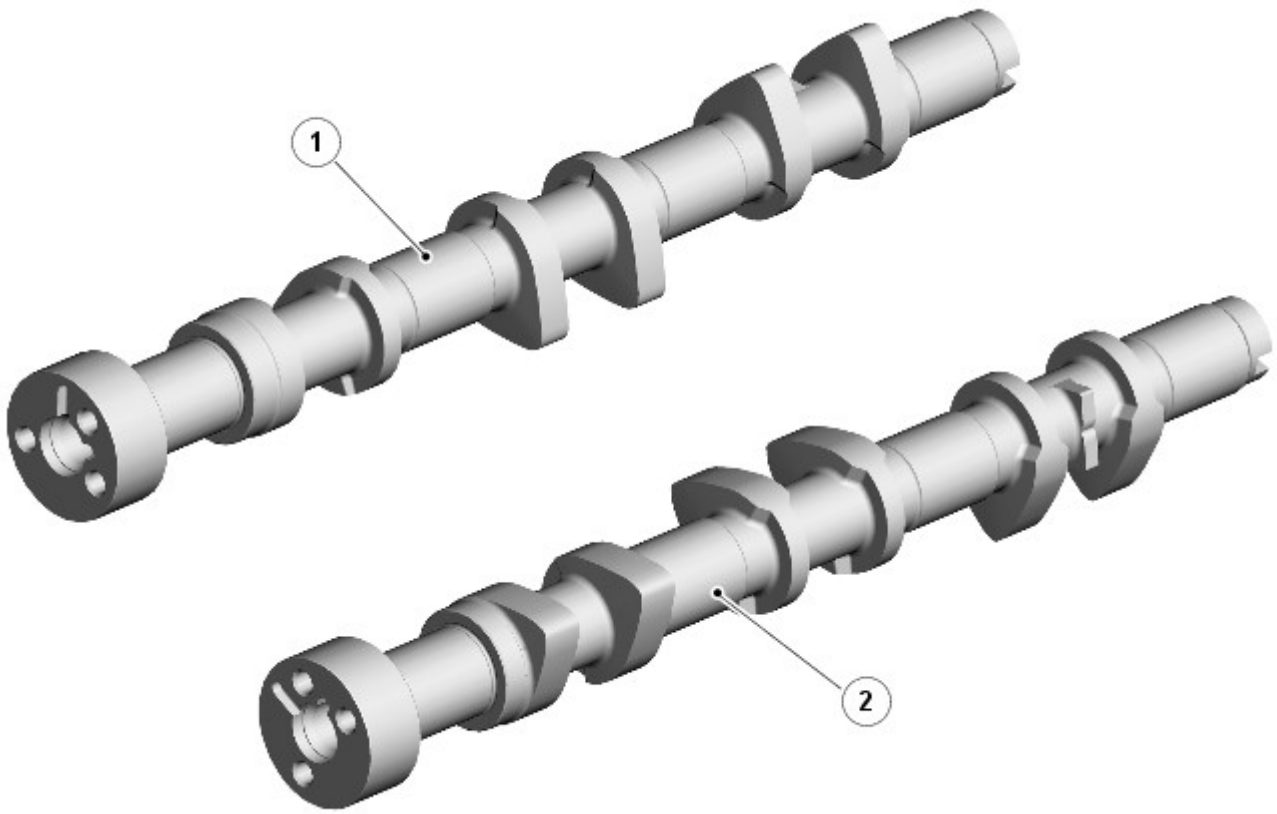
The engine uses 24 stainless steel valves; 12 inlet and 12 exhaust. The inlet valves are 33.0 mm diameter and the exhaust valves are 28.0 mm diameter. The large valve size allows for large cylinder head port sizes which assist which with engine performance and improved emissions. The valve stems are 5.4 mm diameter which allows for reduced flow

interruption through the inlet and exhaust ports assisting with performance and improved emissions.

The valves are located in conventional, non-serviceable valve guides in the cylinder head. A valve stem seal with integral valve seat is located in the cylinder head. The valve spring is retained in a compressed states on the valve stem by a valve spring seat and a pair of valve spring collects.

The valves are opened mechanically by a bucket design valve tappet which is operated directly by the associated camshaft lobe. The valve clearance is set by selection of the appropriate valve tappet to achieve the required valve clearance.

Camshafts



E142795

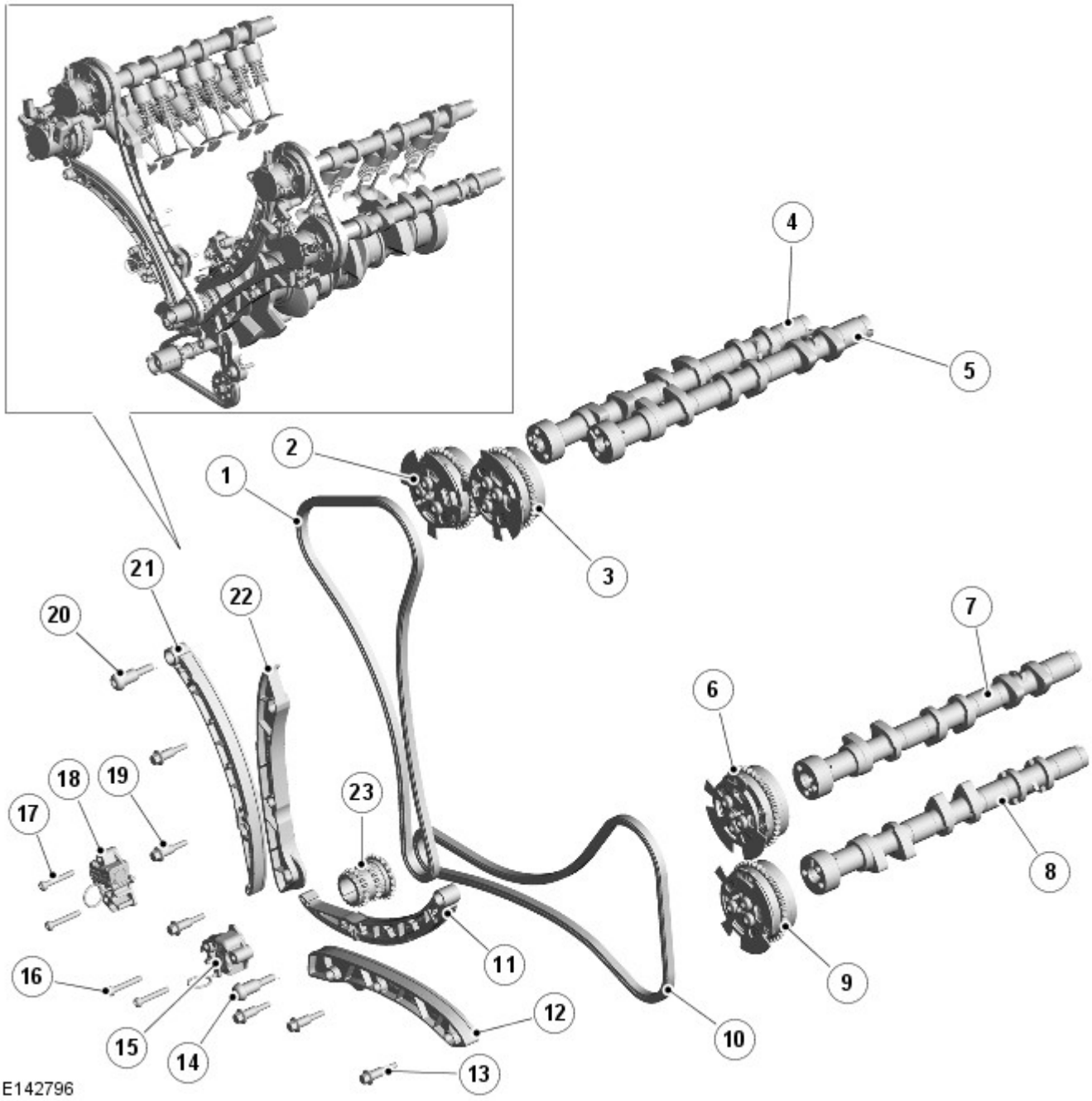
Item	Part Number	Description
1	-	Inlet camshaft
2	-	Exhaust camshaft

Each cylinder head is fitted with 2 camshafts; inlet and exhaust. The lobes on the camshafts act on the valve tappets to open and close the valves.

The camshafts run on machined bearing journals in the cylinder heads and camshaft caps. The camshaft caps are marked with 'IN' and 'EX' to denote inlet and exhaust. The caps at the front of the engine are marked 'AB'. Before removal, each camshaft cap must be marked with its position to ensure correct re-assembly. Each camshaft cap is secured with 2 M6 bolts.

Each camshaft is fitted with a VCT actuator. Each actuator contains a sprocket which drives the camshaft via a timing chain driven from the crankshaft. The VCT actuator can change the timing of the camshaft, increasing engine efficiency and performance.

Camshaft Timing Chain



Item	Part Number	Description
1	-	Timing chain - Right (Bank 1)
2	-	Exhaust Variable Camshaft Timing (VCT) actuator
3	-	Inlet VCT actuator
4	-	Exhaust camshaft
5	-	Inlet camshaft
6	-	Inlet VCT actuator
7	-	Inlet camshaft
8	-	Exhaust camshaft
9	-	Exhaust VCT actuator
10	-	Timing chain - left (Bank 2)
11	-	Tensioner arm - left
12	-	Timing chain guide - left
13	-	Shoulder bolt (3 off)
14	-	Shoulder pivot bolt
15	-	Timing chain tensioner assembly - left
16	-	Bolt (2 off)
17	-	Bolt (2 off)
18	-	Timing chain tensioner assembly - right
19	-	Shoulder bolt (3 off)
20	-	Shoulder pivot bolt

21	-	Tensioner arm - right
22	-	Timing chain guide - right
23	-	Crankshaft sprocket

Two, endless, simplex roller timing chains are used to drive the camshafts; one chain for each cylinder bank. The timing chains are driven from a crankshaft sprocket and are passed over two sprockets which are integral with the VCT actuators.

A procedure is required to ensure that the correct crankshaft to camshaft timing is achieved.
For additional information, refer to: Timing Drive Components (303-01B, Removal and Installation).

Each timing chain has a fixed timing chain guide which is secured to the cylinder block with three shoulder bolts. A tensioner arm is fitted to each timing chain which can rotate around a shoulder pivot bolt. Each timing chain has a mechanical tensioner operated by spring tension to apply a controlled tension to the timing chain. This maintains the timing chain at the correct tension and allows for and dampens backlash in the chain tension due to engine deceleration. The timing chains and tensioners are maintenance free components.

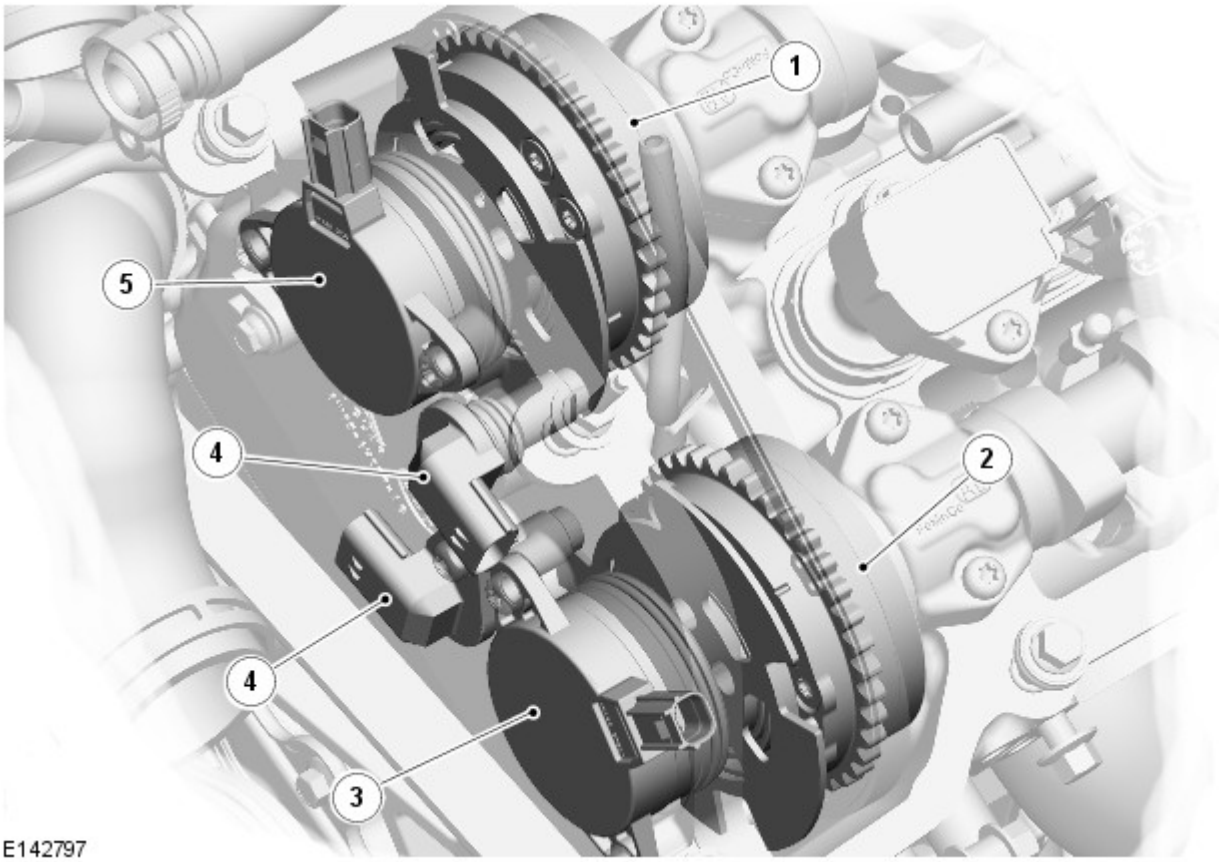
Each timing chain tensioner has a hole which allow for the locking of the tensioner to facilitate removal of the tensioner arm, guide or camshaft timing chain. The tensioner plunger can be pushed back into the housing and a pin inserted to lock the tensioner in the retracted position.

The timing chains are lubricated with engine oil from jets located at the front of the engine block.

Variable Camshaft Timing Components (VCT)

Variable Camshaft Timing

NOTE: Left (Bank 2) installation shown, right (Bank 1) is similar.



Item	Part Number	Description
1	-	Inlet camshaft VCT actuator
2	-	Exhaust camshaft VCT actuator
3	-	Exhaust VCT solenoid
4	-	Camshaft Position (CMP) sensors
5	-	Inlet VCT solenoid

The timing of the inlet and exhaust camshafts can be adjusted independently by an electro-hydraulic controlled VCT system. The ECM controls the system using information from the CMP (camshaft position) sensors and the CKP (crankshaft position) sensor.

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

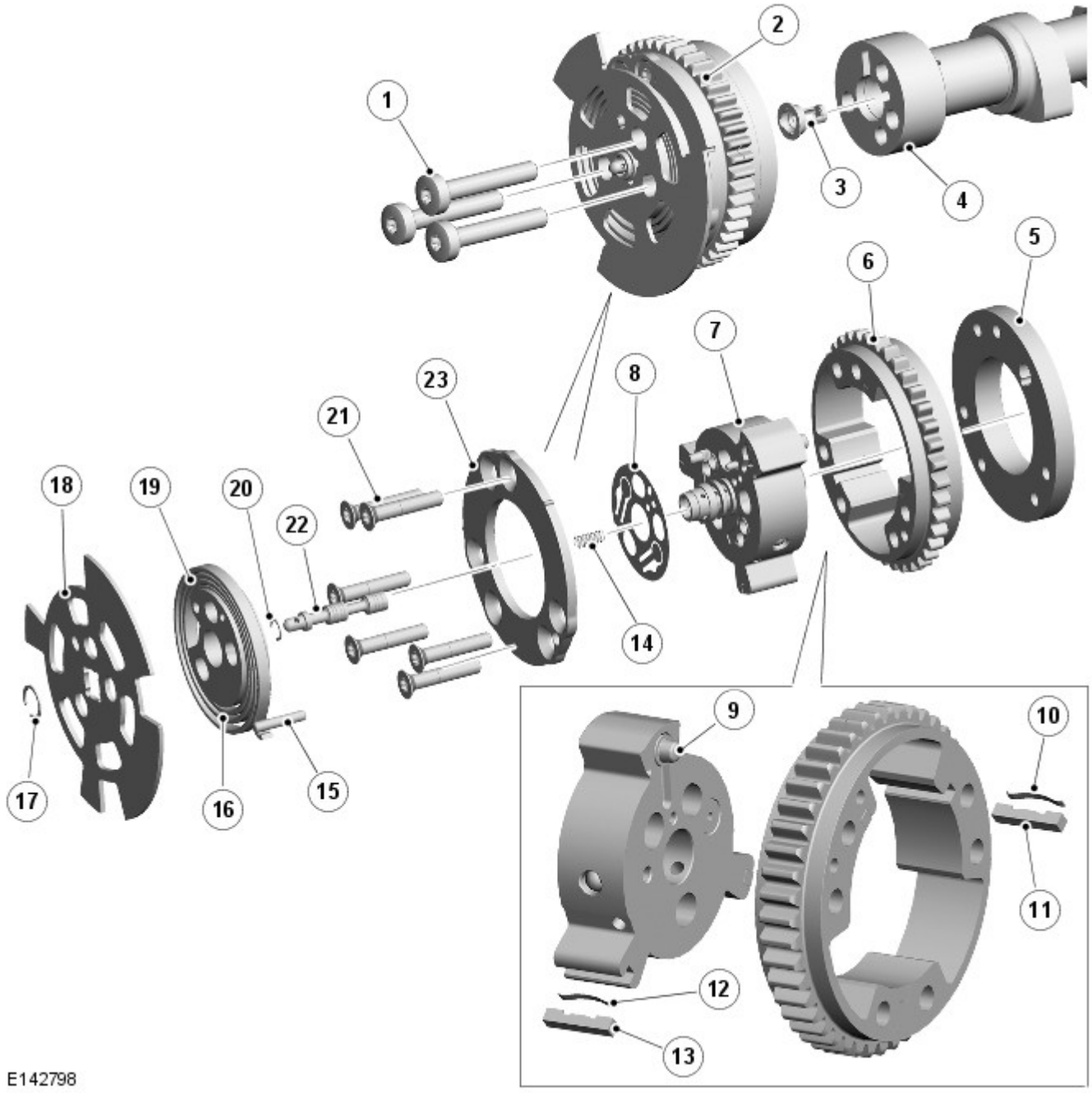
Camshaft	Valve Opens	Valve Closes
Intake	33 degrees BTDC Before Top Dead Center) to 29 degrees ATDC (After Top Dead Center)	197 to 259 ATDC
Exhaust	236 to 186 degrees BTDC	6 to 56 degrees ATDC

The system consists of a VCT unit and a VCT solenoid for each camshaft. The ECM 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	-	Sensor wheel
19	-	Center plate
20	-	Snap ring
21	-	Bolt (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 bolts.

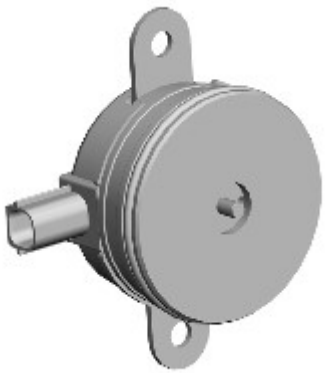
A sensor wheel, for the CMP sensor, a center plate and a bias spring are installed at the front of the VCT unit. The ends of the bias spring locate on the center plate assembly and the sprocket housing, to give a turning moment to the camshaft in the advance direction. A snap ring locates the sensor wheel 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

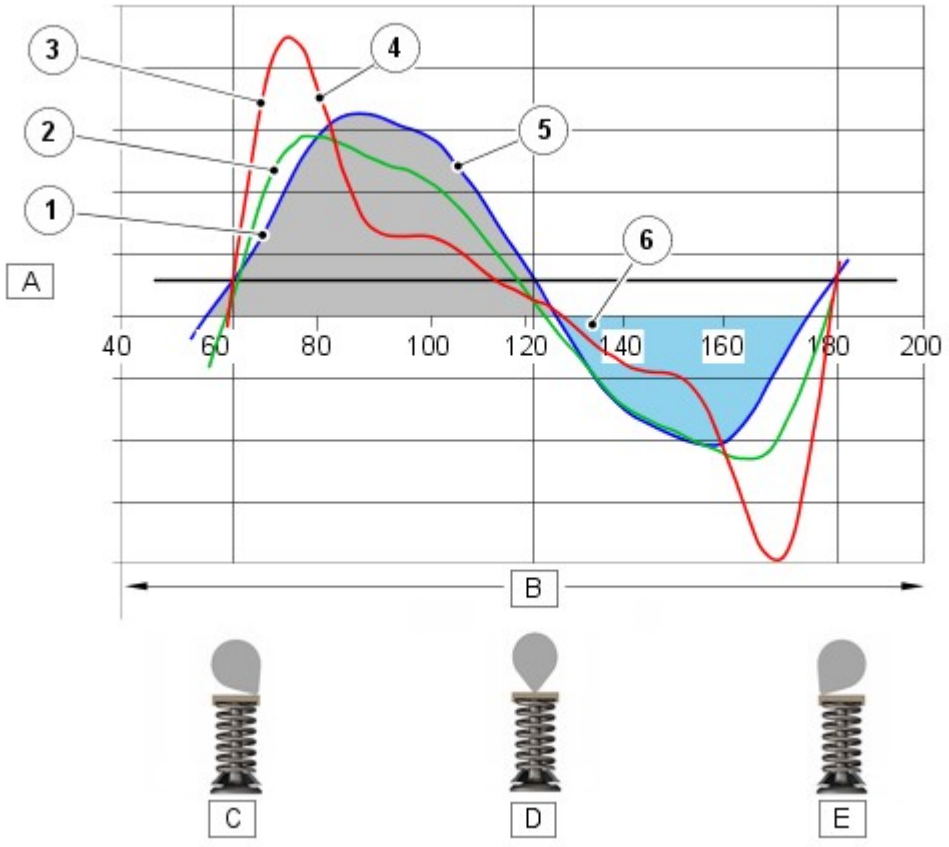
The VCT solenoids are installed in the front upper timing covers, immediately in front of their related VCT units. Each VCT solenoid is secured with two bolts and sealed with an O-ring. A two pin electrical connector provides the interface with the engine harness.

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)

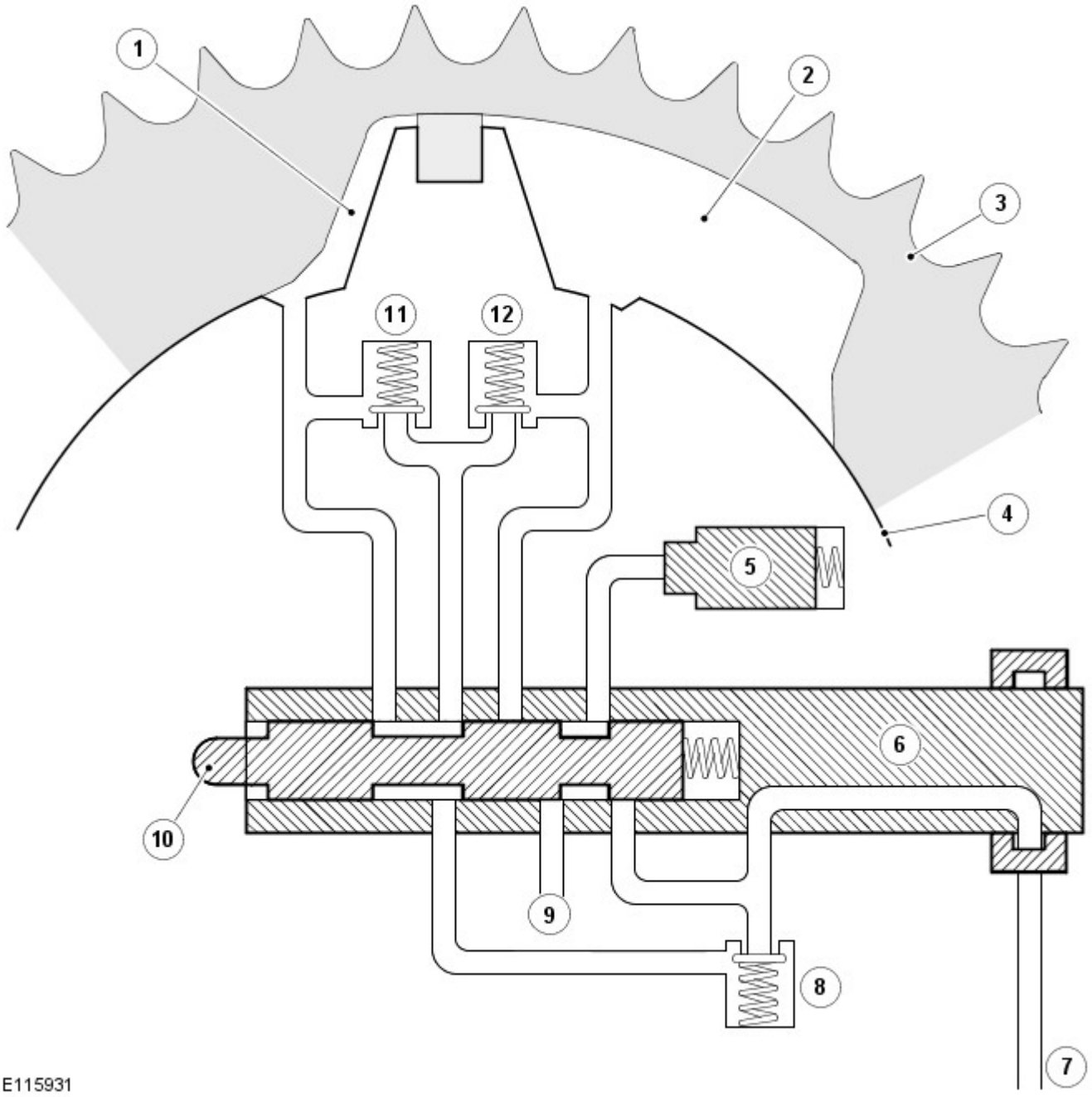


E112406

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.



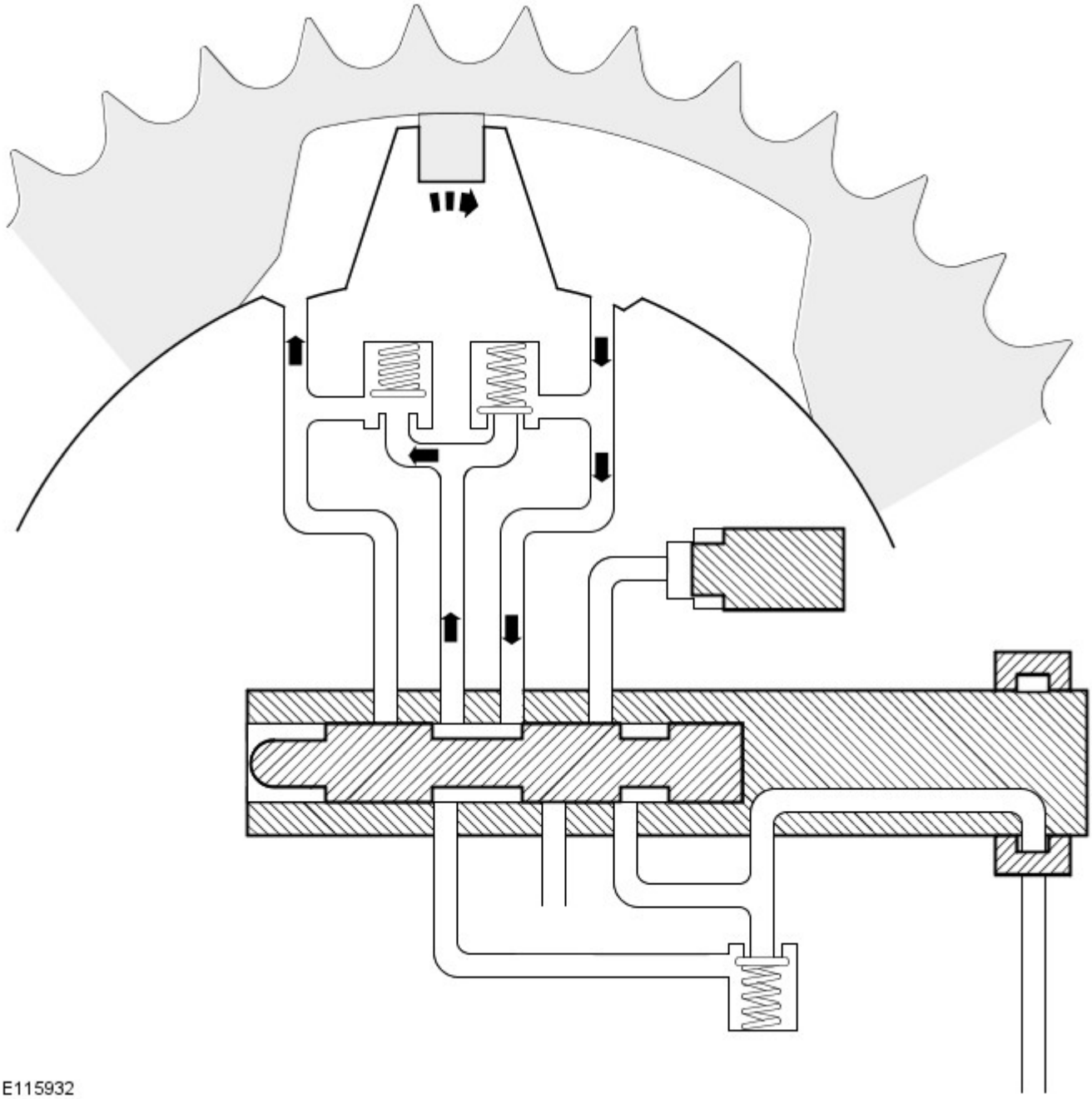
Item	Part Number	Description
1	-	Advance chamber
2	-	Retard chamber
3	-	Sprocket housing
4	-	Rotor assembly
5	-	Lock pin
6	-	Sleeve
7	-	Engine oil supply from camshaft
8	-	Inlet check valve
9	-	Lock pin drain
10	-	Spool valve
11	-	Advance check valve
12	-	Retard check valve

The following description is for intake camshaft VCT units. For exhaust camshaft VCT units, read advance for retard, and retard for advance.

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

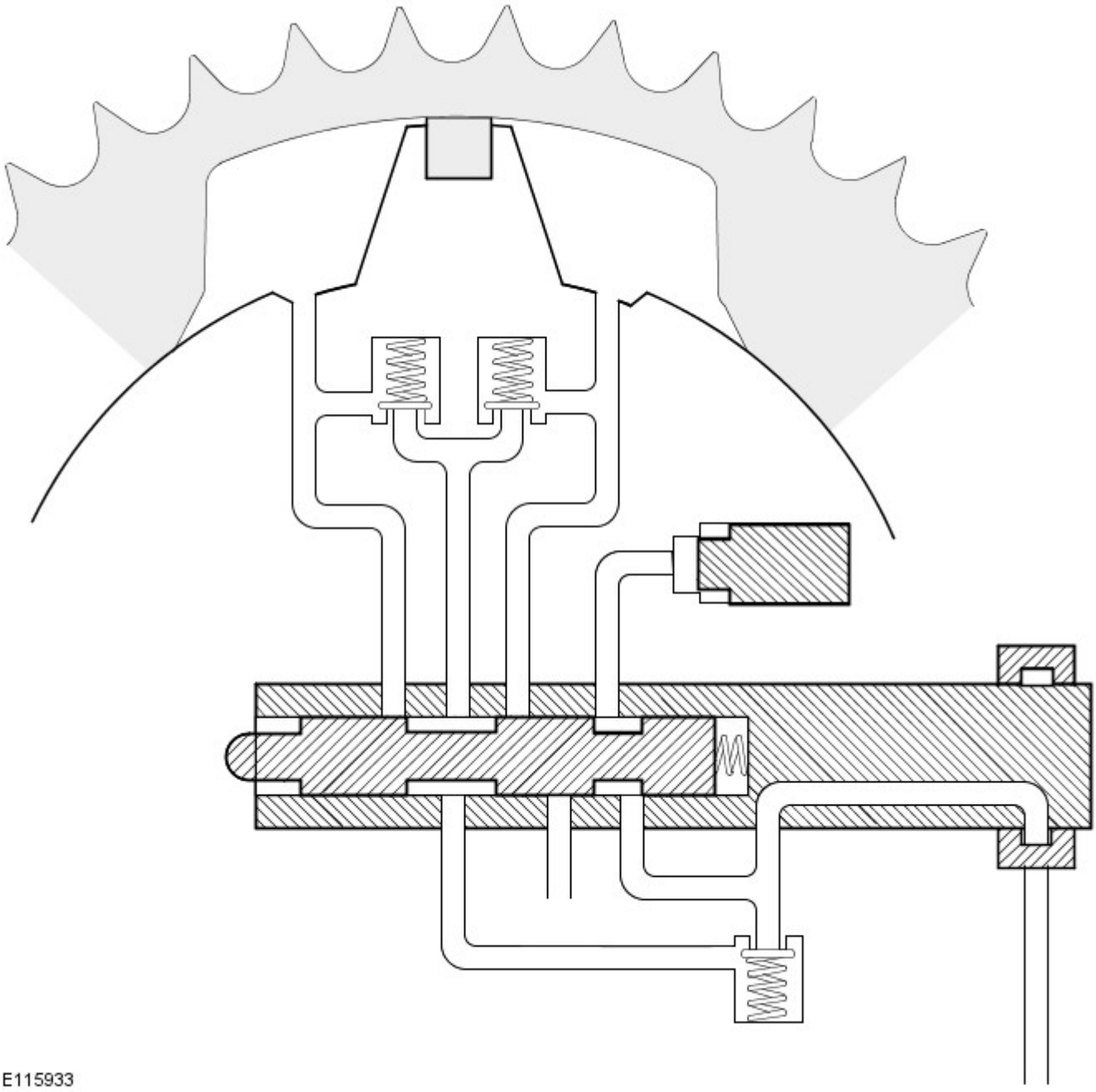


E115932

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.

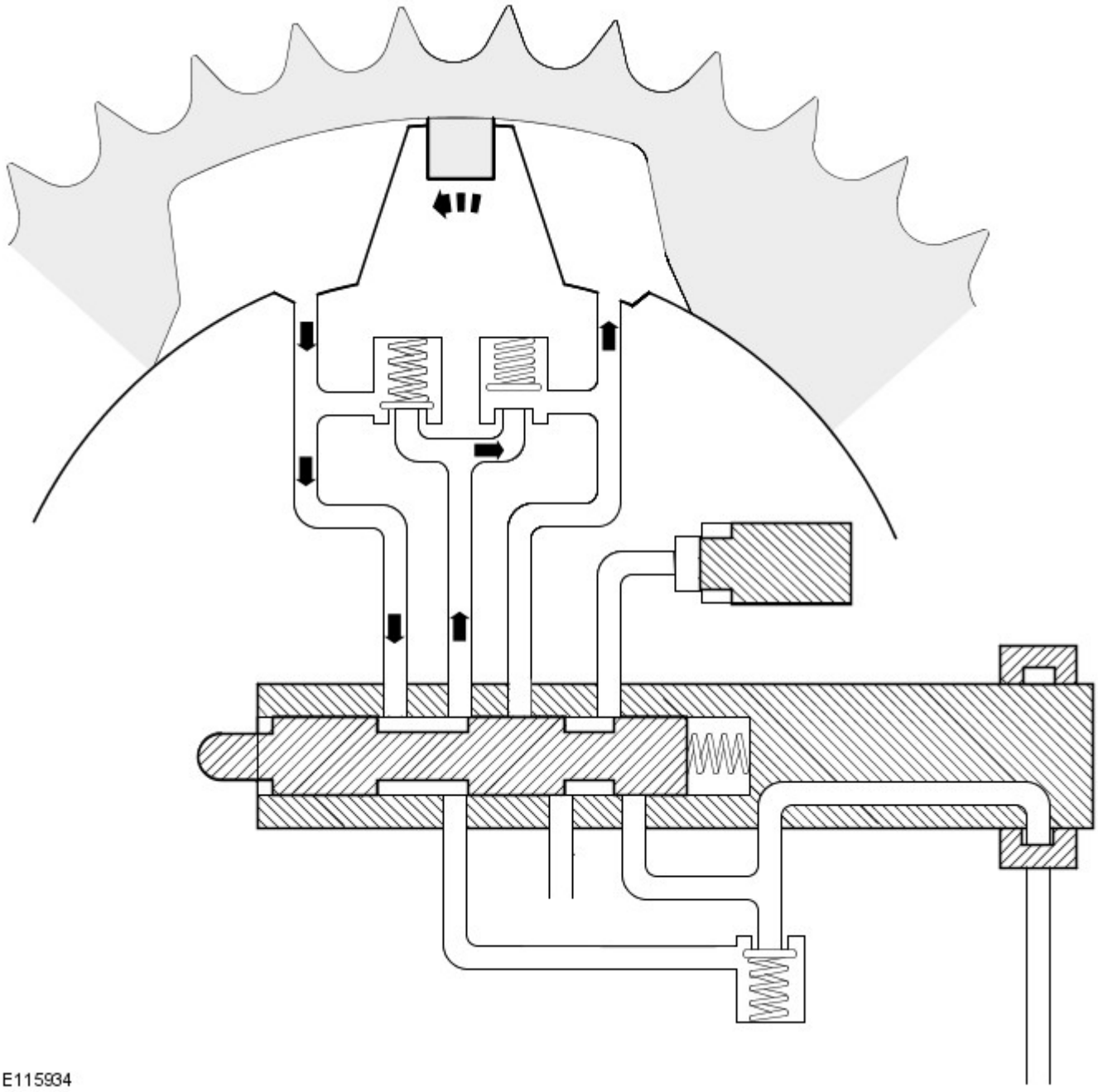
Variable Camshaft Timing Unit Schematic - Null



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

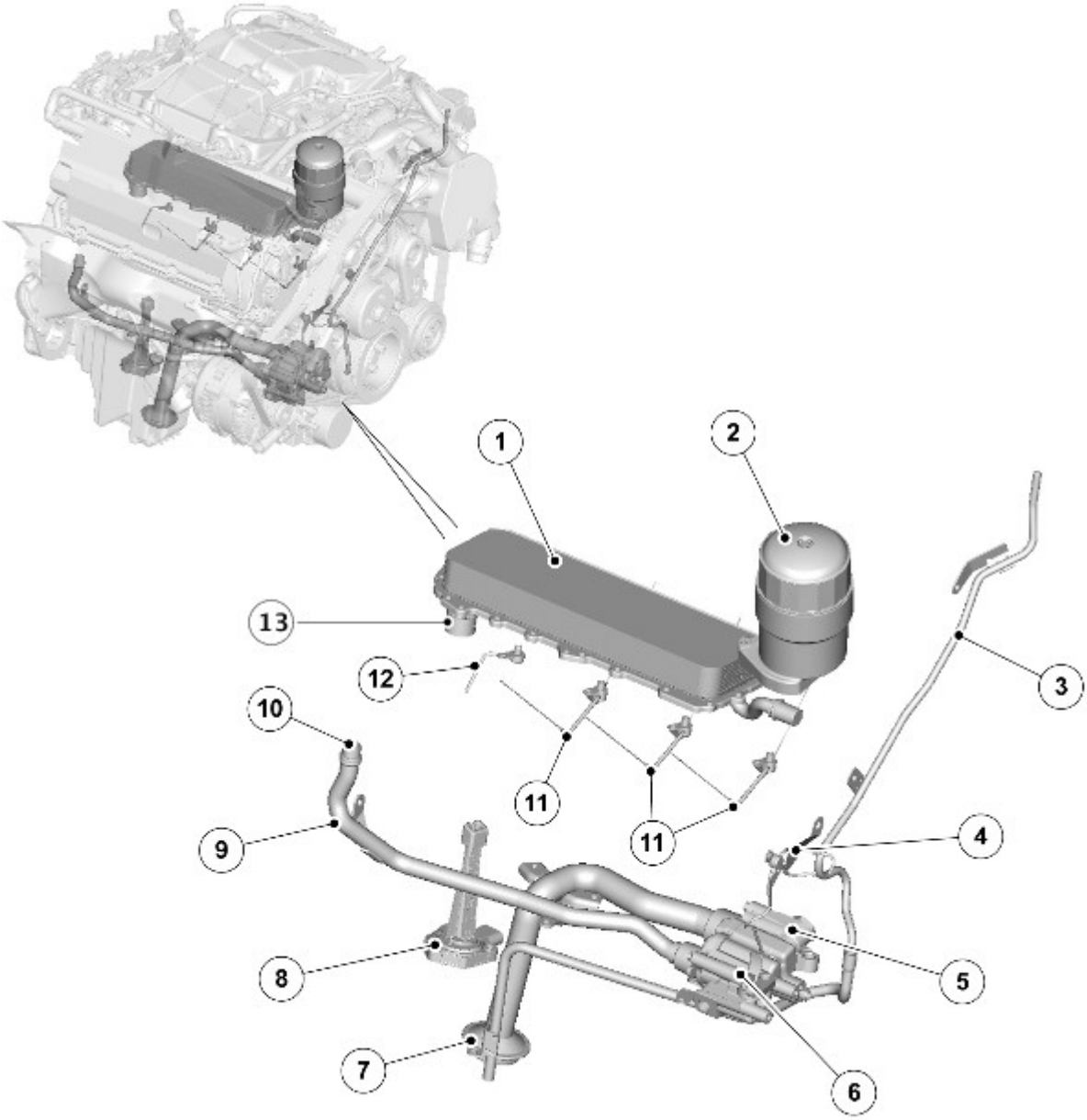


E115934

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.

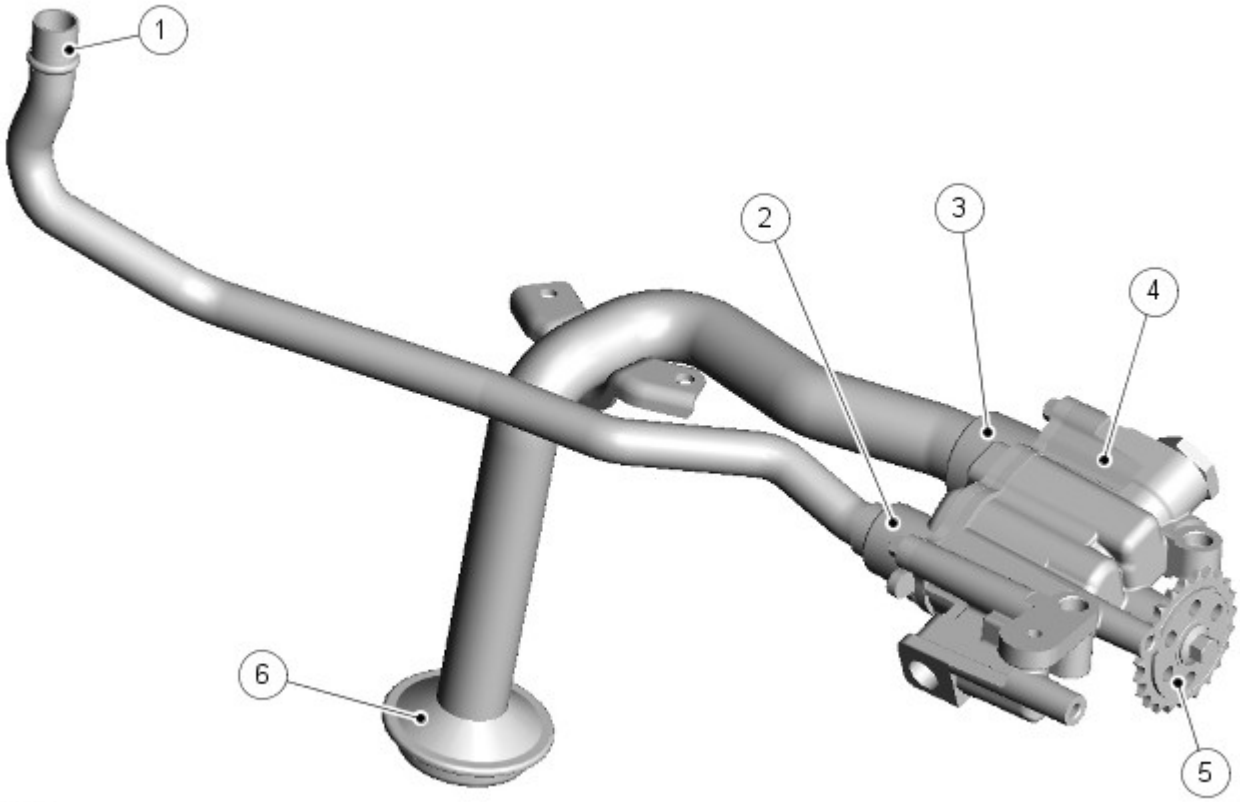
LUBRICATION SYSTEM



E152257

Item	Part Number	Description
1	-	Oil cooler
2	-	Oil filter
3	-	Oil evacuation tube
4	-	Upper timing chain lubrication jet
5	-	Oil pump
6	-	Lower timing chain lubrication jet
7	-	Oil pick-up
8	-	Oil level and temperature sensor
9	-	Oil pump outlet tube
10	-	Outlet tube connection to right cylinder block
11	-	Piston cooling jets
12	-	Rear dynamic balancer drive chain lubrication jet

Oil Pump



E152259

Item	Part Number	Description
1	-	Pressurized oil outlet to cylinder block
2	-	Pump pressure outlet
3	-	Pump inlet
4	-	Oil pump
5	-	Oil pump drive sprocket
6	-	Oil pick-up pipe

The oil pump is attached to the underside of the windage tray with 3 bolts. 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 oil pan 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 right (bank 1) cylinder head.

The output from the oil filter is distributed through oil galleries in the cylinder heads and the cylinder block. All moving parts are lubricated by pressure or splash oil. Pressurized oil is also provided for the VCT system, 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 oil pan. System replenishment is through the oil filler cap on the left cylinder head cover.

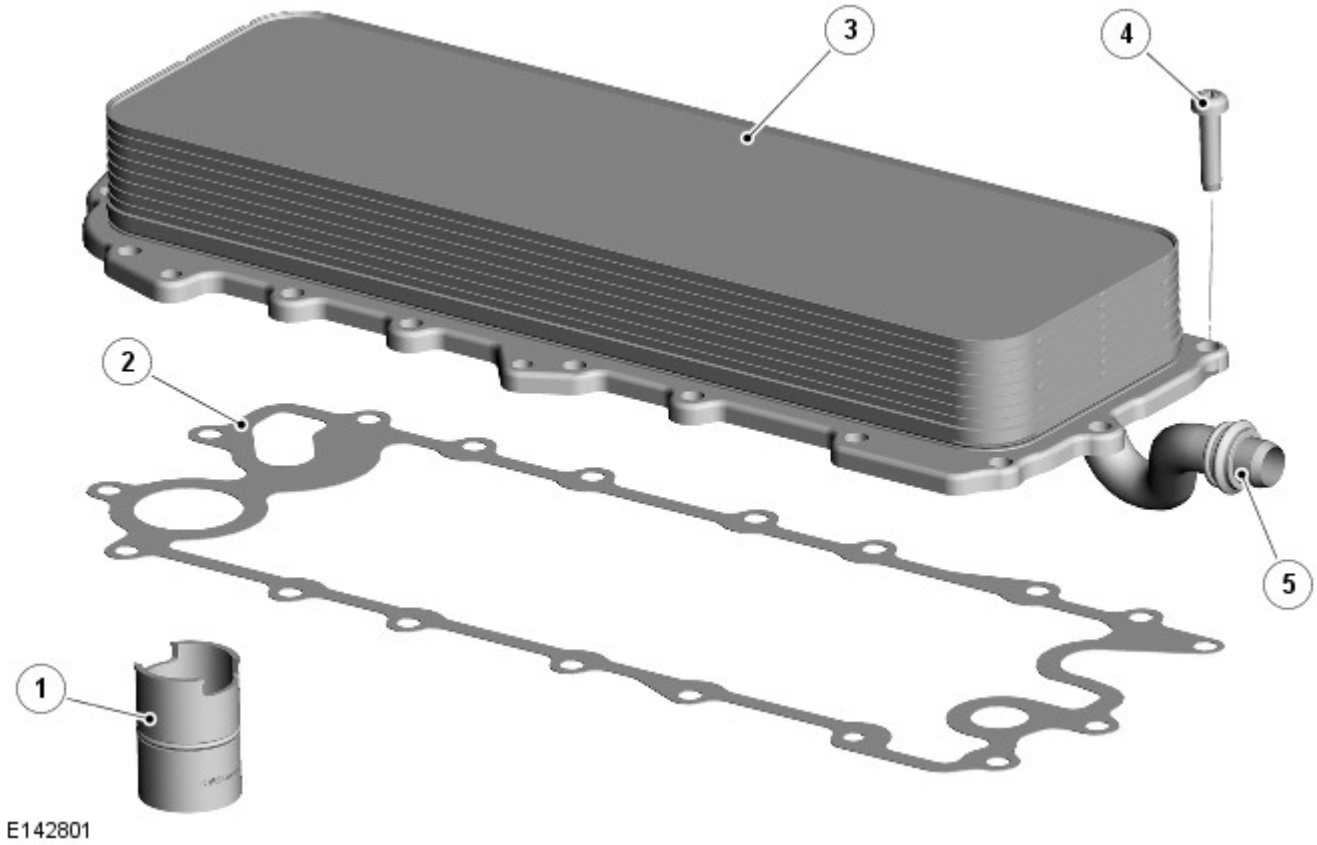
An oil evacuation tube is installed to allow oil to be drawn from the oil pan. The upper end of the oil evacuation tube is located under the oil filler cap.

An oil drain plug is installed in the right side of the oil pan.

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 (230)	4.0 (58.0)

Engine Oil Cooler



Item	Part Number	Description
1	-	Anti-drain valve assembly
2	-	Gasket
3	-	Engine oil cooler
4	-	Screw (18 off)
5	-	Engine coolant inlet from water pump

The engine oil cooler is located on the top of the cylinder block, in the 'V' between the cylinder heads. The cooler is sealed to the cylinder block with a gasket and secured with 18 screws.

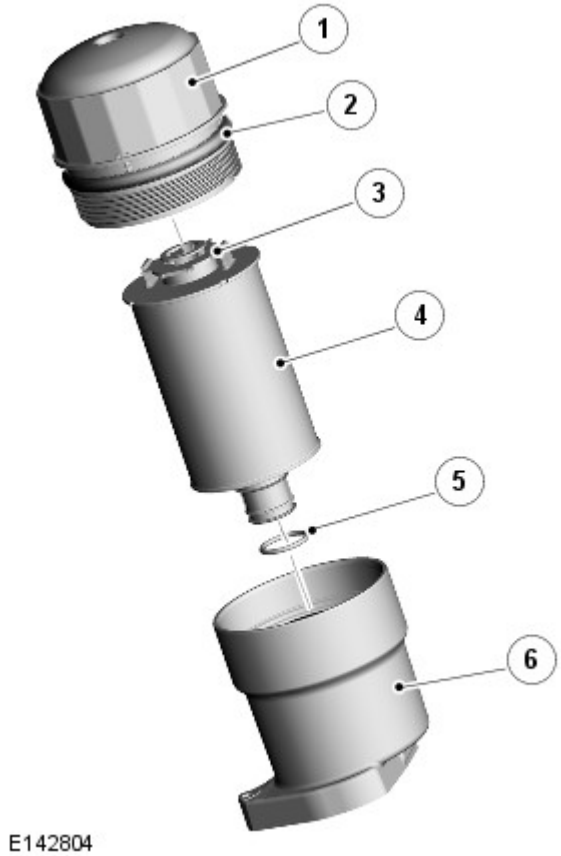
There are four ports on the underside of the cooler; an engine oil inlet and outlet and an engine coolant inlet and outlet. The engine oil cooler is an aluminum housing comprising louvered fins and plates. The plates allow a cross-flow of engine oil and engine coolant through the cooler but keeping the two fluids separate.

The engine coolant is directed from the engine coolant pump into the cooler via a hose.

The plates are immersed in engine coolant from the engine coolant pump which provides cooling of the engine oil by the temperature differential between the engine oil and the engine coolant.

An anti-drain valve is located in the cylinder block and prevents the engine oil cooler draining of oil when the engine is not running.

Engine Oil Filter



Item	Part Number	Description
1	-	Cap
2	-	O-ring seal
3	-	By-pass valve
4	-	Filter element
5	-	O-ring seal
6	-	Oil filter body

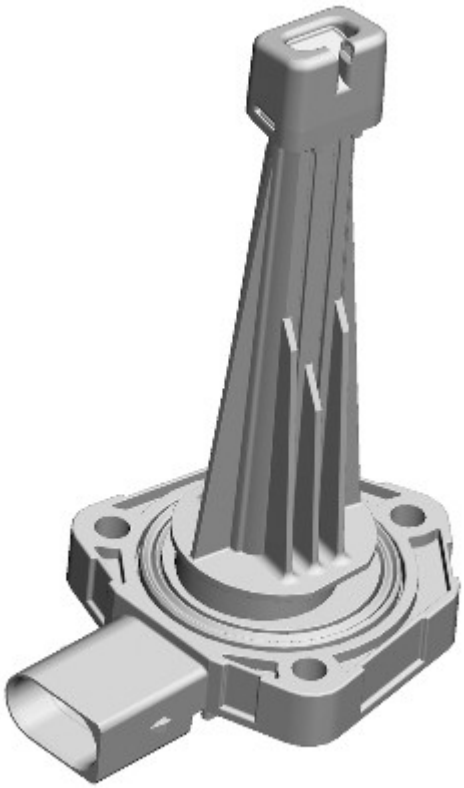
The oil filter assembly is located on a casting which is integral with the right cylinder head. The oil filter body is sealed with a gasket and secured to the cylinder head with 3 screws.

A replaceable cartridge filter element is located in the oil filter body. An O-ring seal seals the filter element to the filter body.

The filter element is fitted with an integral by-pass valve. If the filter becomes contaminated, to the point that oil flow is restricted, the by-pass valve opens to allow oil to flow through the oil filter body to avoid starving the engine of engine oil.

Oil Level Monitoring

Oil level monitoring is provided by an oil level and temperature sensor that measures the oil level in the oil pan. The oil level can be displayed in the message center of the IC (Instrument Cluster).
For additional information, refer to: Instrument Cluster (413-01 Instrument Cluster, Description and Operation).



E115936

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

The temperature function of the oil level and temperature sensor is not operational on the 3.0L V6 S/C engine.

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 transmitted in a PWM signal to the ECM.

Oil Level and Temperature Sensor Specifications

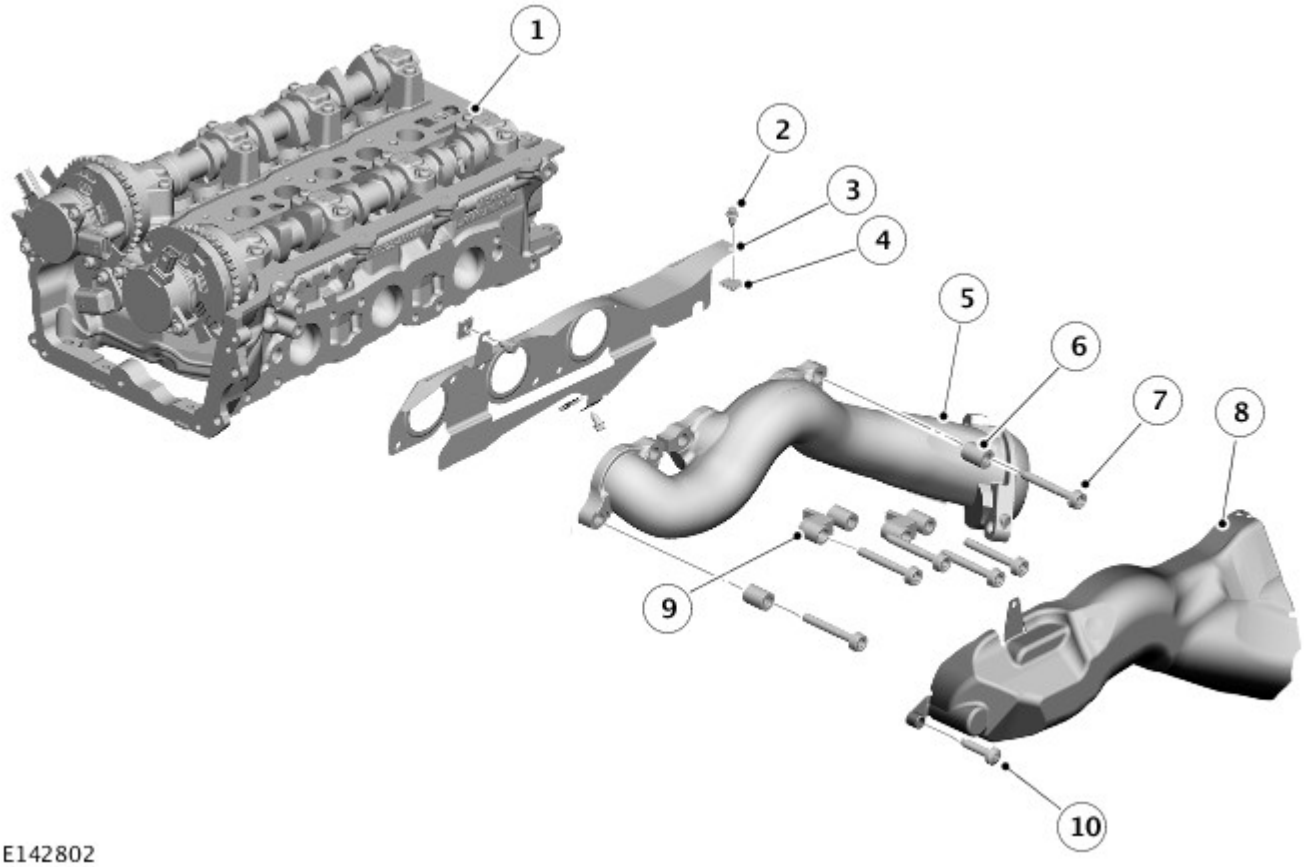
Feature	Details
Power source	Battery Voltage
Temperature Accuracy	±2 °C (±3.6 °F)
Operating Level Range	18 to 147 mm (0.71 to 5.79 in.)
Operating Temperature Range	-40 to 160 °C (-40 to 320 °F)

Oil Level Check

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 oil pan and the oil level to stabilize. The oil level system will not give a reading until the oil level has stabilized.
For additional information, refer to: Engine Oil Draining and Filling (303-01B, General Procedures) /
Engine Oil Vacuum Draining and Filling (303-01B, General Procedures).

Exhaust manifolds

NOTE: Left (Bank 2) installation shown, right (Bank 1) is similar.



E142802

Item	Part Number	Description
1	-	Cylinder head
2	-	Bolt (3 off)
3	-	Layered gasket
4	-	Threaded insert (3 off)
5	-	Exhaust manifold
6	-	Spacer (4 off)
7	-	Bolt (6 off)
8	-	Heat shield
9	-	Machined spacer (2 off)

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

Published: 09-Nov-2012

Engine - V6 S/C 3.0L Petrol - Engine

Diagnosis and Testing

For additional information, refer to Diagnosis and Testing, Engine - V6 3.0 Petrol.
REFER to: Engine - V6 S/C 3.0L Petrol (303-00 Engine System - General Information, Diagnosis and Testing).

Published: 28-May-2013

Engine - V6 S/C 3.0L 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.

CAUTIONS:

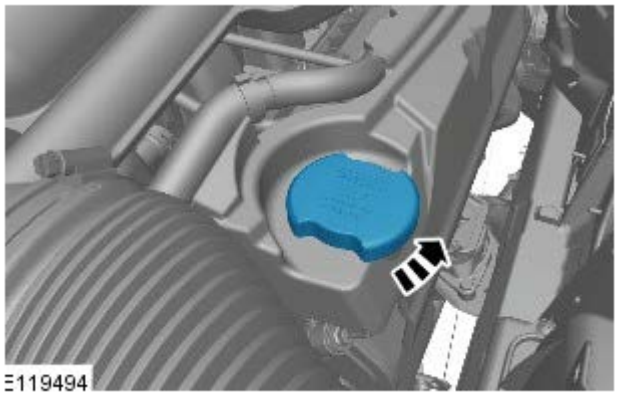
Correct installation of the oil filler cap can be obtained by tightening the cap until hard stop.

Make sure the engine is warm.

NOTE: Clean the components general area prior to dismantling.

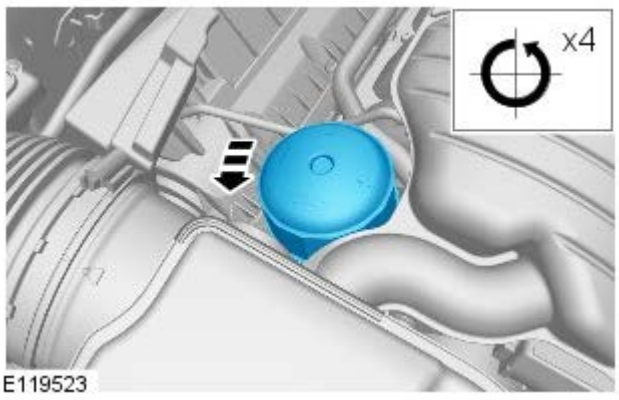
1.
- Start the engine and allow to run for 10 minutes, stop the engine.

2.



3. Refer to: Engine Cover - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (501-05 Interior Trim and Ornamentation, Removal and Installation).

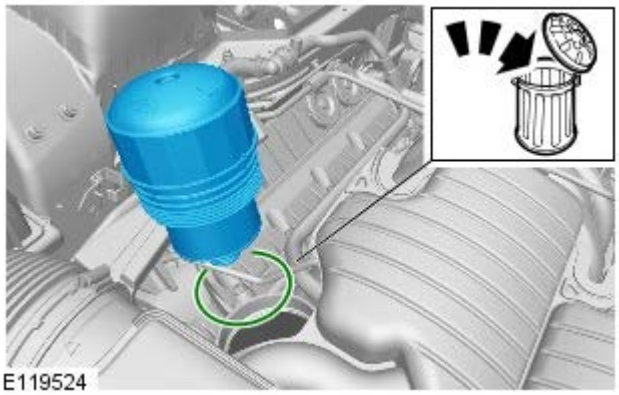
4.
- Loosen the element cover 4 complete turns to allow engine oil to drain from the filter cover.
- Make sure that the O-ring seal is exposed.



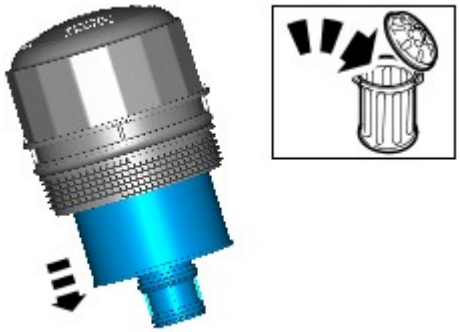
5. NOTES:

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

Remove and discard the O-ring seal.


E119524

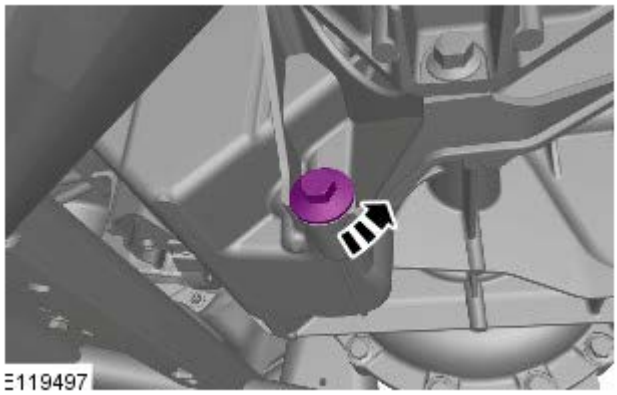
6. Remove and discard the oil filter element.


E107394

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

   Raise and support the vehicle.

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


E119497

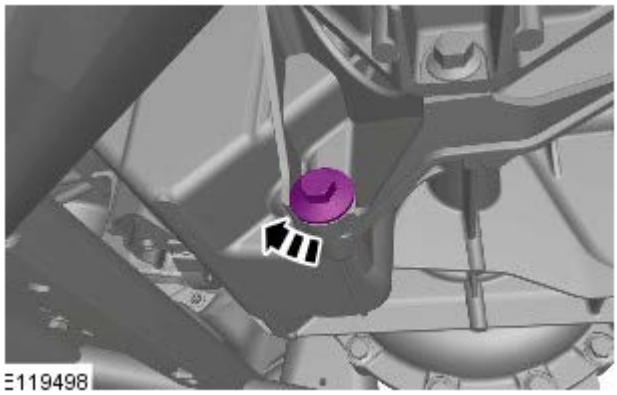
9. CAUTIONS:

   Be prepared to collect escaping oil.

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

   NOTE: Discard the sealing washer.

Filling


E119498

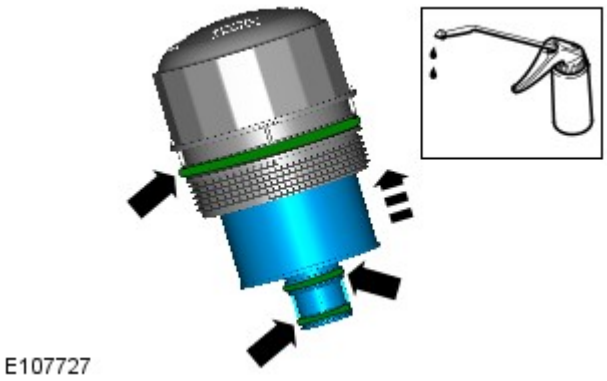
1. CAUTION: Make sure that the area around the component is clean and free of foreign material.

   NOTE: Install a new sealing washer.

   Torque: 24 Nm

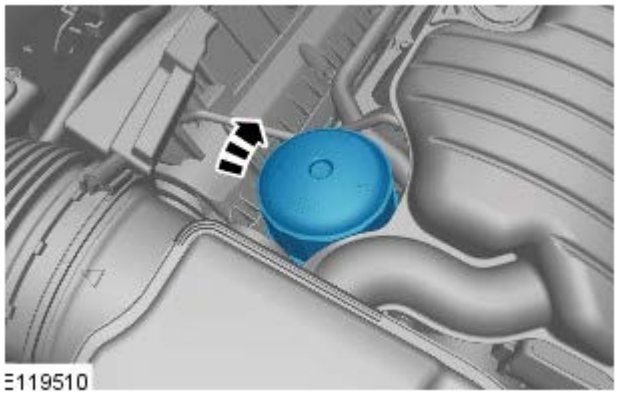
2. Refer to: Engine Undershield (501-02 Front End Body Panels,

Removal and Installation).


E107727

3. NOTE: Install new O-ring seals.

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


E119510

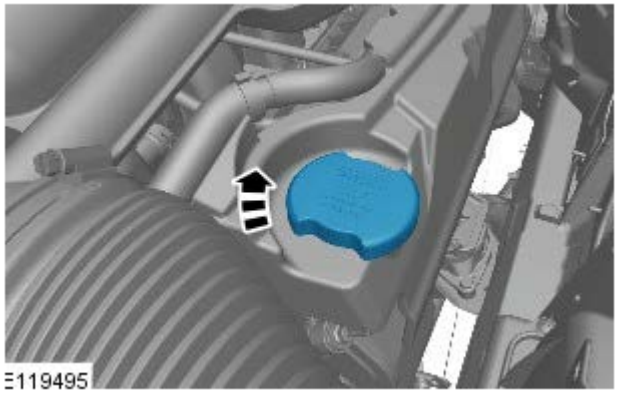
4. CAUTION: Tighten the component finger tight first.
   - *Torque:* 25 Nm

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 9-16), 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 (303-01C Engine - V8 S/C 5.0L Petrol, 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.
   - Start the engine and allow to run for 10 minutes, stop the engine.
   - Check for leaks.

8. CAUTIONS:

Make sure that the selector lever is in the park (P) position.

Make sure that the hood is open.

- Set the ignition to the ON position.

9.

- Press the left-hand OK button to access the Instrument Cluster (IC) Main Menu.



10.

- Press the left-hand directional button and select Service Menu.



11.

- Press the left-hand OK button.



12.

- Press the left-hand directional button and select the Oil Level display.



13.

- Press the left-hand OK button to access the Oil Level display.




E147181

14. CAUTION: Make sure that the hood is open.

- Press the speed control cancel button twice within 2 seconds while being on the oil level display.

15.

- The message center displays the actual oil level in service mode.
- Only after having started and run the engine for 10 minutes (as indicated in Step 7), 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.



16. Set the ignition to the OFF position.
17. Allow 10 minutes for the engine oil level to stabilize if there has been additional oil top up.

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

18. Repeat step 8 to 14 to access the oil level display in service mode.



19. NOTE: The actual volume displayed on the bar graph will be written into the electronic control unit as a new value.
    - Press and hold the speed control cancel button for more than 5 seconds.
    - The message center display the current oil level.

NOTE: Close the hood.

20. Set the ignition to the OFF position.
21. Set the ignition to the ON position.
22. NOTE: The following steps are to check the



current oil level in a customer mode.

- Press the left-hand OK button to access the Instrument Cluster (IC) Main Menu.

23.



- Press the left-hand directional button and select Service Menu.

24.

- Press the left-hand OK button.



E147184

25.

- Press the left-hand directional button and select the Oil Level display.

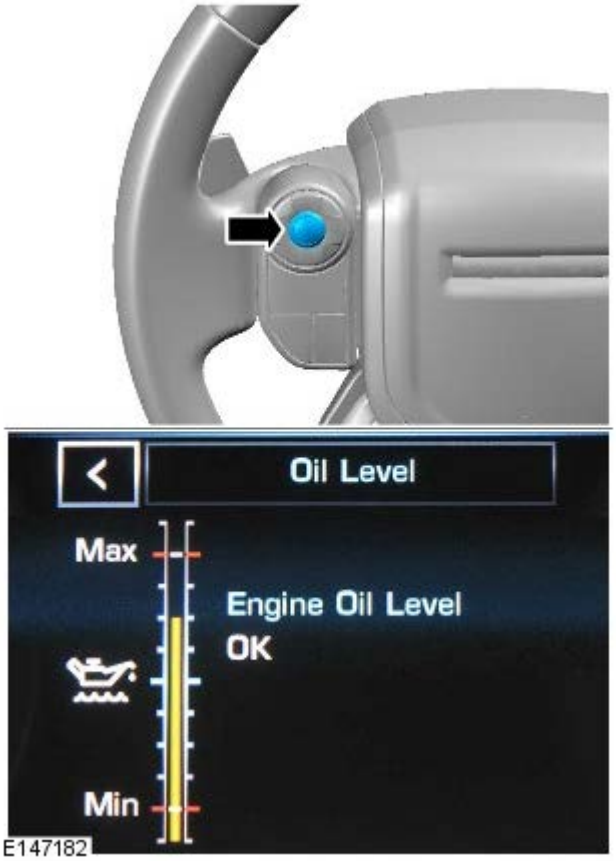


E147185

26.

- Press the left-hand OK button and follow the instructions.
- NOTE: If the message shows "Not available" wait for further 10 mins to allow the oil level to stabilize.

  Make sure that the average oil level value has now been updated.



27. Refer to: Engine Cover - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (501-05 Interior Trim and Ornamentation, Removal and Installation).

Published: 28-May-2013

Engine - V6 S/C 3.0L 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.

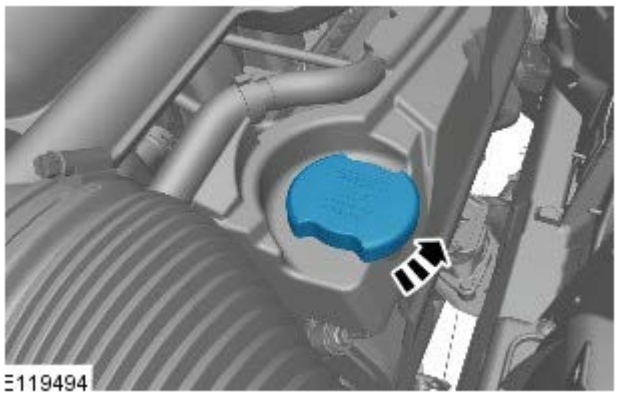
CAUTIONS:

Make sure the engine is warm.

Make sure that the vehicle is parked on level ground.

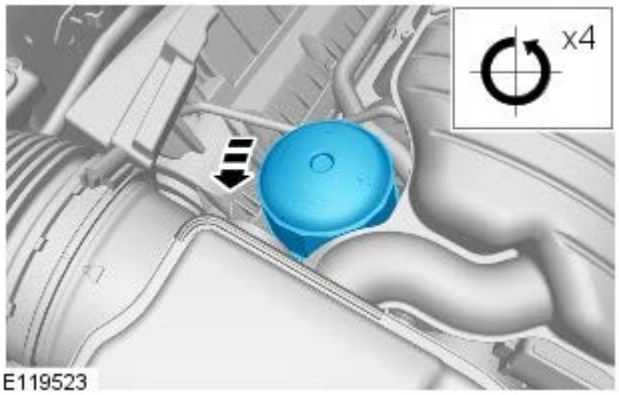
1.
- Start the engine and allow to run for 10 minutes, stop the engine.

2. Refer to: Engine Cover - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (501-05 Interior Trim and Ornamentation, Removal and Installation).


E119494

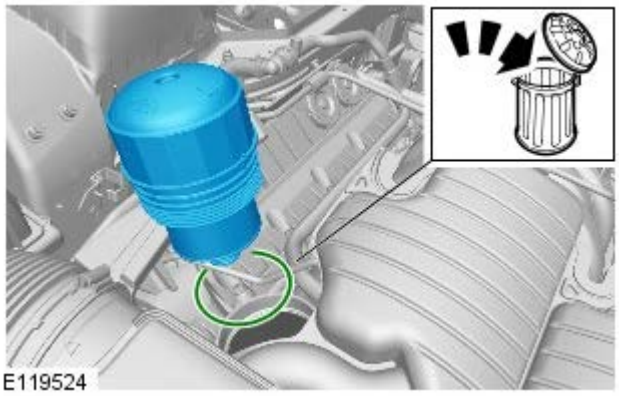
3. CAUTION: Allow 10 minutes from turning the engine off before starting oil extraction.

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

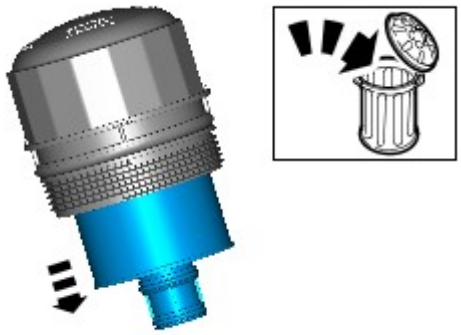


E119523

5.


E119524

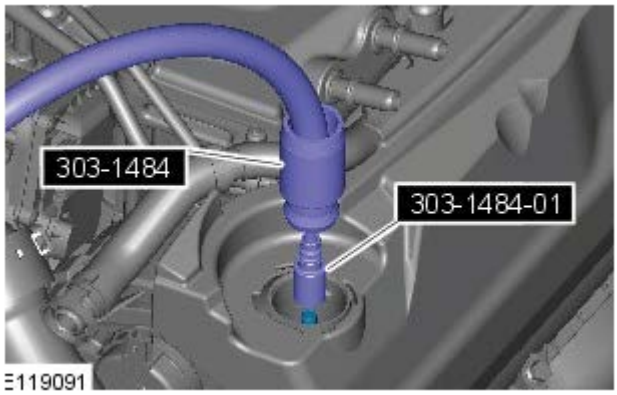
6. CAUTION: Discard the seal.


E107394

7.

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

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



E119091

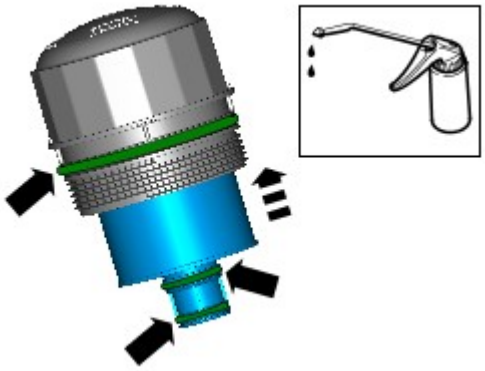
8.

- Remove the oil vacuum pump.

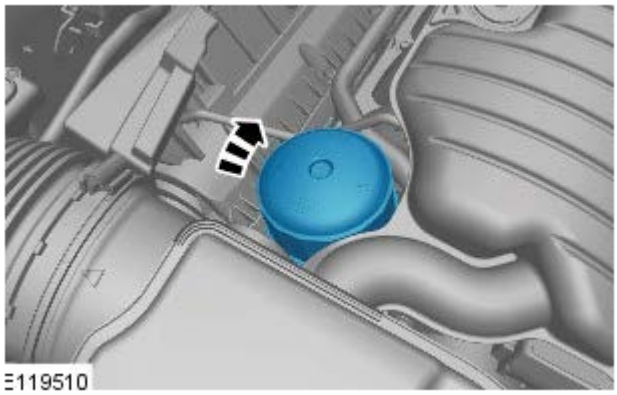
Filling

1. NOTE: Install new O-ring seals.

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



E107727

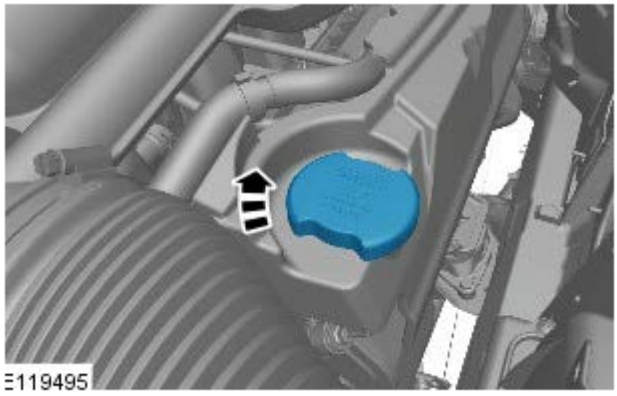


E119510

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

3.
   - Fill the engine with the recommended oil to the correct level.
   - 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.
   - Start the engine and allow to run for 10 minutes, stop the engine.
   - Check for leaks.

6. CAUTIONS:

   Make sure that the selector lever is in the park (P) position.

   Make sure that the hood is open.
   - Set the ignition to the ON position.

7.
   - Press the left-hand OK button to access the Instrument Cluster (IC) Main Menu.



8.

- Press the left-hand directional button and select Service Menu.



9.

- Press the left-hand OK button.



E147184

10.

- Press the left-hand directional button and select the Oil Level display.



E147185

11.

- Press the left-hand OK button to access the Oil Level display.




E147181

12. CAUTION: Make sure that the hood is open.

- Press the speed control cancel button twice within 2 seconds while being on the oil level display.

13.

- The message center displays the actual oil level in service mode.
- Only after having started and run the engine for 10 minutes (as indicated in Step 5), 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.



14. Set the ignition to the OFF position.
15. Allow 10 minutes for the engine oil level to stabilize if there has been additional oil top up.

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

16. Repeat step 6 to 12 to access the oil level display in service mode.



17. NOTE: The actual volume displayed on the bar graph will be written into the electronic control unit as a new value.
    - Press and hold the speed control cancel button for more than 5 seconds.
    - The message center display the current oil level.

NOTE: Close the hood.

18. Set the ignition to the OFF position.
19. Set the ignition to the ON position.
20. NOTE: The following steps are to check the



current oil level in a customer mode.

- Press the left-hand OK button to access the Instrument Cluster (IC) Main Menu.

21.



- Press the left-hand directional button and select Service Menu.

22.

- Press the left-hand OK button.



E147184

23.

- Press the left-hand directional button and select the Oil Level display.

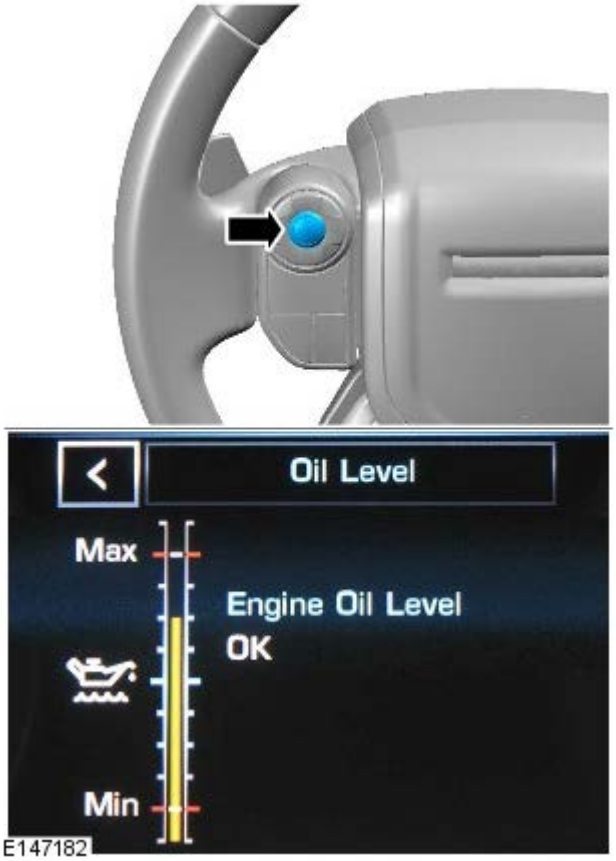


E147185

24.

- Press the left-hand OK button and follow the instructions.
- NOTE: If the message shows "Not available" wait for further 10 mins to allow the oil level to stabilize.

  Make sure that the average oil level value has now been updated.



25. Refer to: Engine Cover - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (501-05 Interior Trim and Ornamentation, Removal and Installation).

Published: 16-Dec-2013

Engine - V6 S/C 3.0L Petrol - Fuel Pump Camshaft Timing Check

General Procedures

Special Tool(s)

 E152575	JLR-303-1303 Timing Tool
 E140377	JLR-303-1621 Alignment Tool, Fuel Pump Camshaft Timing

Check

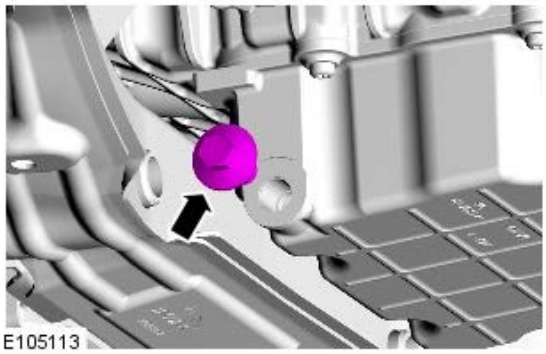
1. Disconnect the battery ground cable.

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


E105113

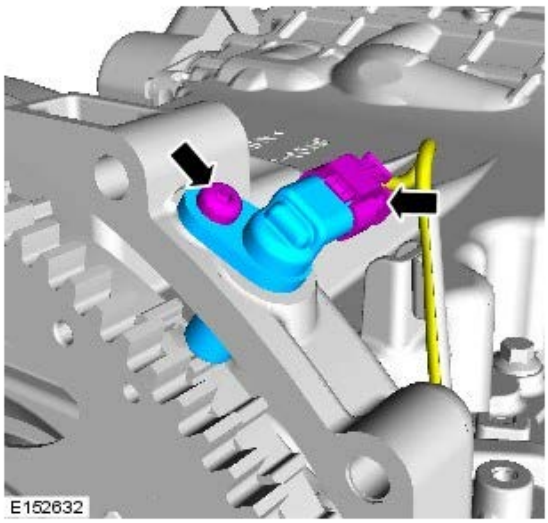
4. CAUTION: Be prepared to collect escaping oil.

   NOTES:

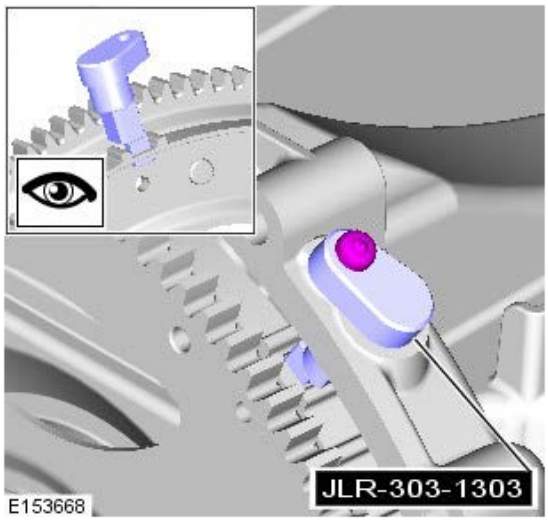
   Discard the sealing washer.

   Collect the engine oil in a clean container.

5.


E152632

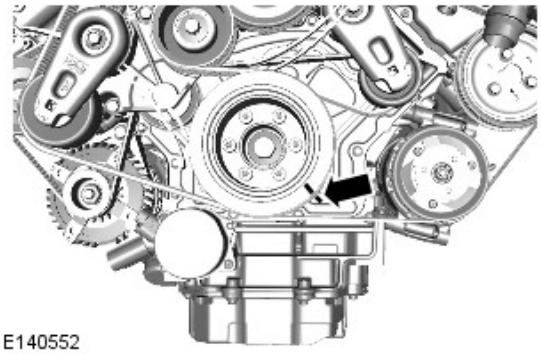
6. CAUTIONS:



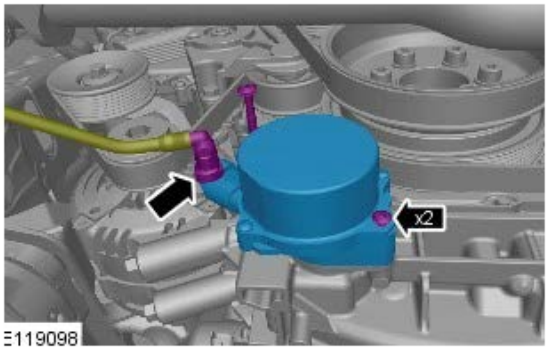
Only rotate the crankshaft clockwise.

Make sure that the crankshaft is fully locked.

Special Tool(s): JLR-303-1303

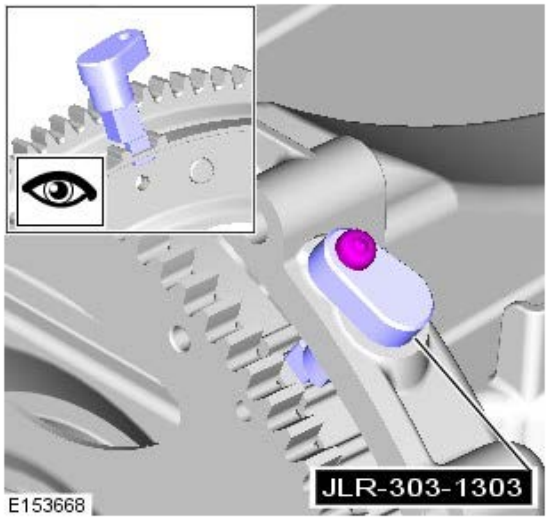


7. Using a suitable marker, mark the position of the crankshaft pulley as illustrated.

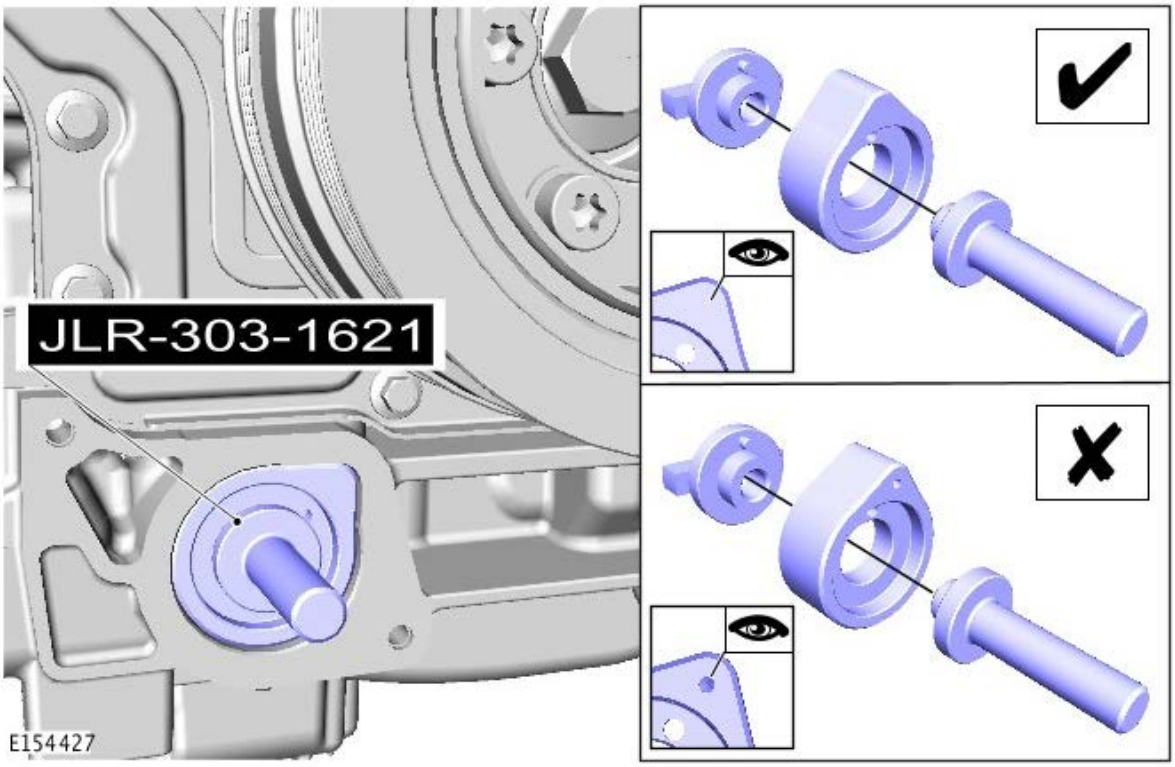


8. CAUTION: Discard the seal.

9. *Special Tool(s):* JLR-303-1303

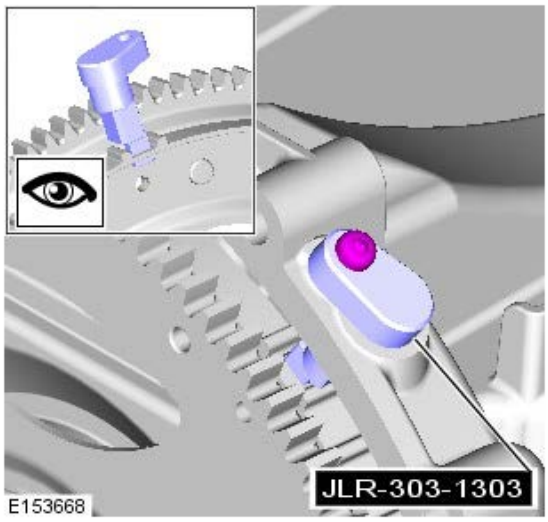


10. If required, carefully adjust the crankshaft position to allow



correct installation of the special tool.

Special Tool(s): JLR-303-1621



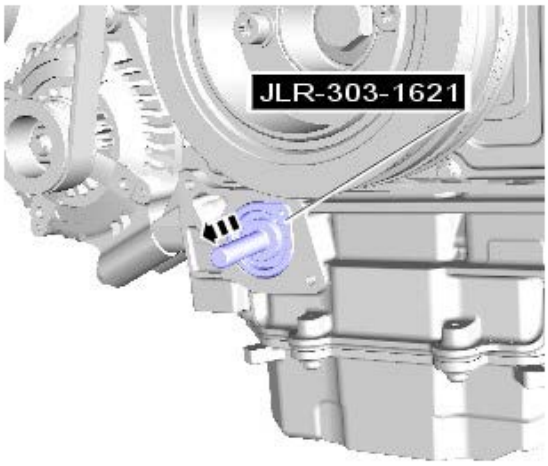
11. CAUTION: Do not use excessive force when adjusting the crankshaft position.

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.
- *Special Tool(s):* JLR-303-1303
- If the crankshaft timing tool cannot be installed, adjustment of the fuel pump camshaft timing will be required.

12.

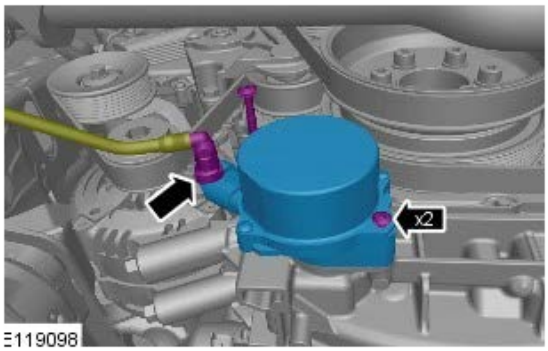
- *Special Tool(s):* JLR-303-1621



E154428

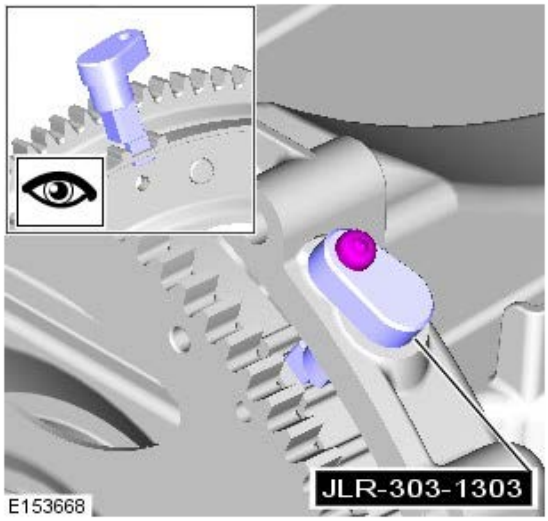
13. CAUTION: Install a new seal.

- *Torque:* 12 Nm



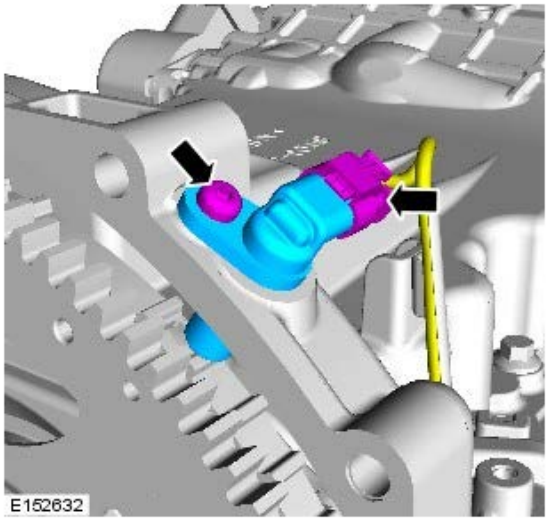
14.

- *Special Tool(s):* JLR-303-1303



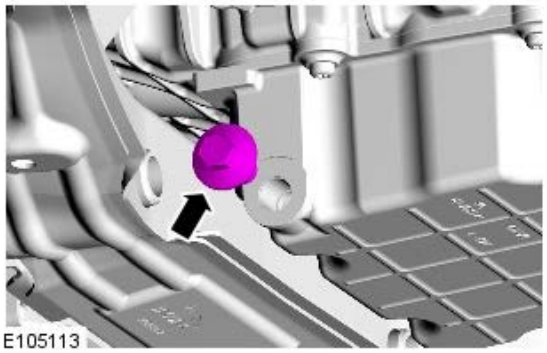
15.

- *Torque:* 10 Nm



16. NOTE: Install a new sealing washer.

Torque: 24 Nm



17. Connect the battery ground cable.

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

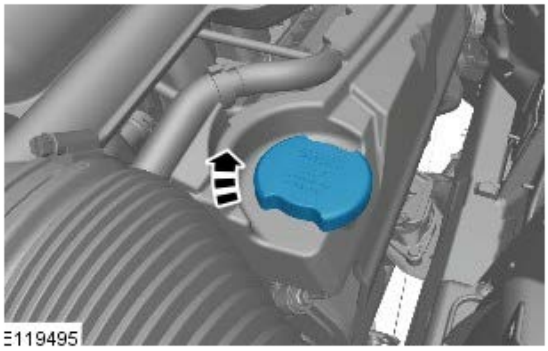
18.

- Fill the engine with oil - for filling values:

Refer to: Specifications (303-01B Engine - V6 S/C 3.0L Petrol, Specifications).

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

19.



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

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

21. CAUTIONS:

Make sure that the selector lever is in the park (P) position.

Make sure that the hood is open.

- Set the ignition to the ON position.

22.

- Press the left-hand OK button to access the Instrument Cluster (IC) Main Menu.



23.

- Press the left-hand directional button and select Service Menu.



E147186

24.

- Press the left-hand OK button.


E147184

25.

- Press the left-hand directional button and select the Oil Level display.



26.

- Press the left-hand OK button to access the Oil Level display.



27. CAUTION: Make sure that the hood is open.

- Press the speed control cancel button twice within 2 seconds while being on the oil level display.



E147181

28.

- The message center displays the actual oil level in service mode.
- Only after having started and run the engine for 15 minutes (as indicated in Step 20), 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.



E147272

29. Set the ignition to the OFF position.

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

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

31. Repeat step 21 to 27 to access the oil level display in service mode.

32. NOTE: The actual volume displayed on the bar graph will be written into the electronic control unit as a new value.

- Press and hold the speed control cancel button for more than 5 seconds.
- The message center display the current oil level.



33. Set the ignition to the OFF position.

34. Set the ignition to the ON position.

35.
- Press the left-hand OK button to access the Instrument Cluster (IC) Main Menu.



36.
- Press the left-hand directional button and select Service Menu.



E147186

37.

- Press the left-hand OK button.


E147184

38.

- Press the left-hand directional button and select the Oil Level display.



39.

- Press the left-hand OK button and follow the instructions.
- NOTE: If the message shows "Not available" wait for further 10 mins to allow the oil level to stabilize.

  Make sure that the average oil level value has now been updated.



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

Published: 23-Jan-2014

Engine - V6 S/C 3.0L Petrol - Fuel Pump Camshaft Timing Adjustment

General Procedures

Special Tool(s)

 E152575	JLR-303-1303 Timing Tool
 E140377	JLR-303-1621 Alignment Tool, Fuel Pump Camshaft Timing

Check

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

1. Disconnect the battery ground cable.

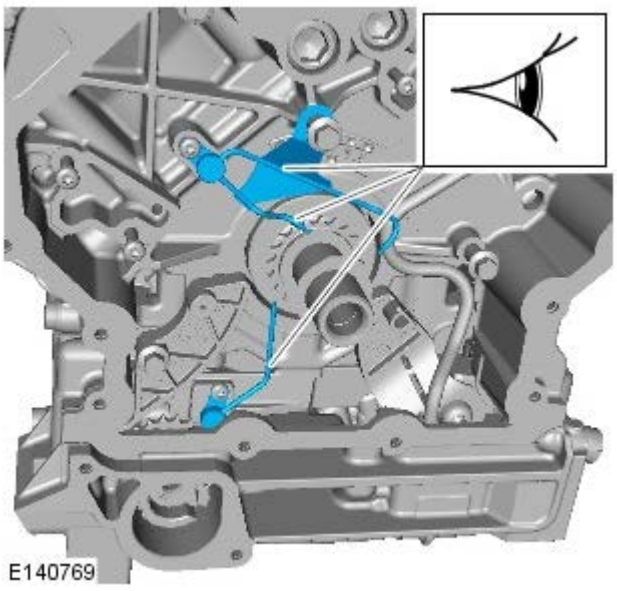
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

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

   Raise and support the vehicle.

3. Refer to: Fuel Pump Camshaft Timing Check (303-01B Engine - V6 S/C 3.0L Petrol, General Procedures).

4. Refer to: Lower Timing Cover (303-01B Engine - V6 S/C 3.0L Petrol, Removal and Installation).


E140769

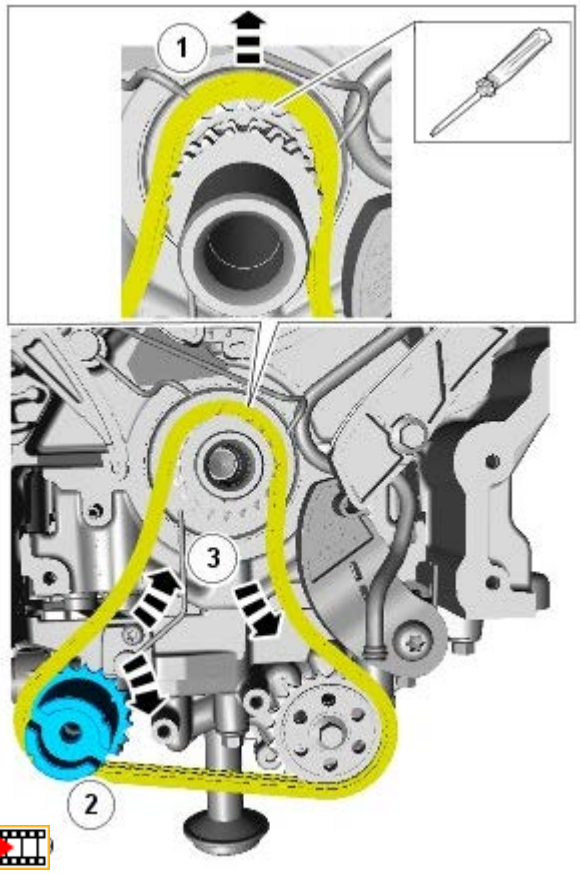
5. CAUTIONS:

   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. CAUTIONS:

   Using a suitable tie strap, position the tensioner to one side.



Take extra care when removing the component. Make sure the washers fitted both sides of the balance weight do not fall into the engine oil pan.

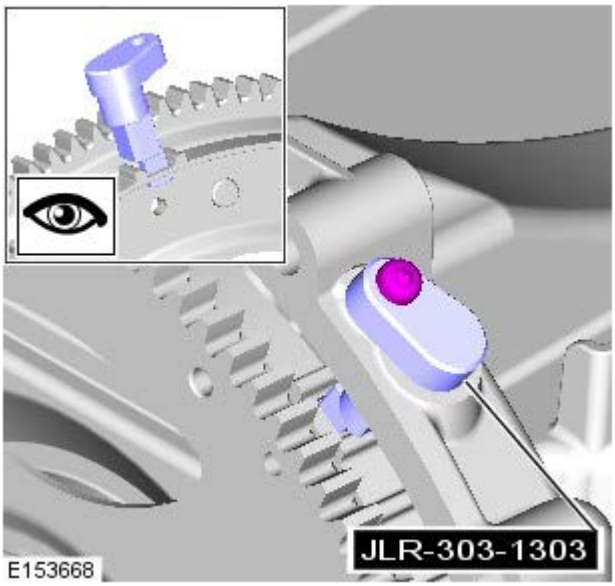
- Make sure the coloured chain links align correctly with the fuel rail high-pressure fuel pumps camshaft, balance shaft and crankshaft sprocket markings.

  Special Tool(s): JLR-303-1621
  Torque:
  Stage 1:25 Nm
  Stage 2:90°

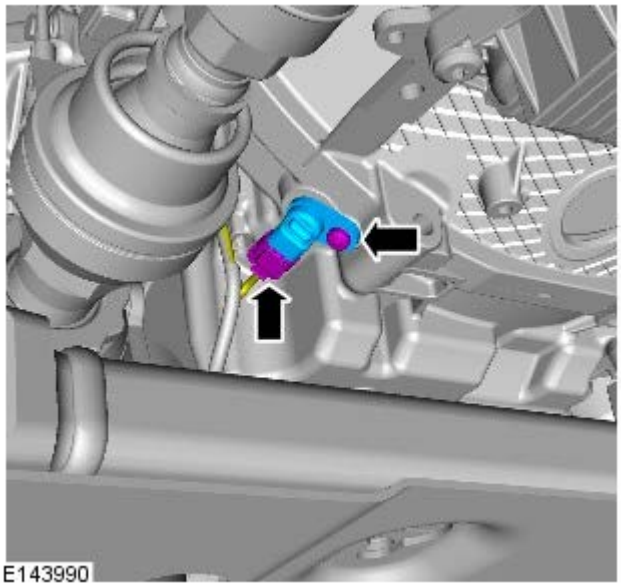
7. Refer to: Lower Timing Cover (303-01B Engine - V6 S/C 3.0L Petrol, Removal and Installation).

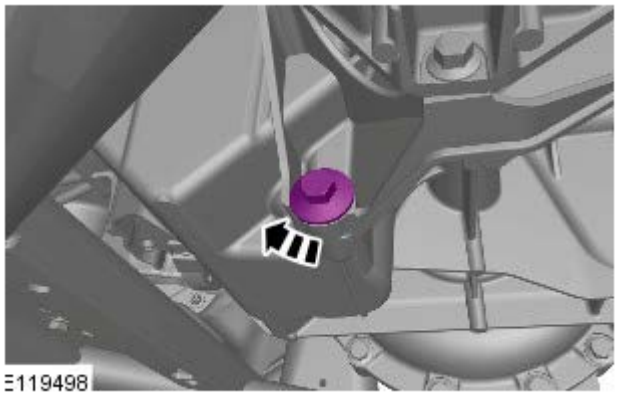
8. Remove the special tool.

   Special Tool(s): JLR-303-1303



9.
   - *Torque:* 10 Nm





10. NOTE: Install a new sealing washer.

    Torque: 24 Nm

11. Connect the battery ground cable.

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

12.
    - Fill the engine with oil - for filling values on vehicles with supercharger:

      Refer to: Specifications (303-01B Engine - V6 S/C 3.0L Petrol, 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.
    - Start the engine and allow to run for 10 minutes, stop the engine.
    - Check for leaks.

14. CAUTIONS:

    Make sure that the selector lever is in the park (P) position.

    Make sure that the hood is open.
    - Set the ignition to the ON position.

15.
    - Press the left-hand OK button to access the Instrument Cluster (IC) Main Menu.



16.

- Press the left-hand directional button and select Service Menu.



17.

- Press the left-hand OK button.


E147184

18.

- Press the left-hand directional button and select the Oil Level display.



E147185

19.

- Press the left-hand OK button to access the Oil Level display.




E147181

20. CAUTION: Make sure that the hood is open.

- Press the speed control cancel button twice within 2 seconds while being on the oil level display.

21.

- The message center displays the actual oil level in service mode.
- Only after having started and run the engine for 15 minutes (as indicated in Step 13), 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. Set the ignition to the OFF position.
23. Allow 10 minutes for the engine oil level to stabilize if there has been additional oil top up.

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

24. Repeat step 14 to 20 to access the oil level display in service mode.



25. NOTE: The actual volume displayed on the bar graph will be written into the electronic control unit as a new value.
    - Press and hold the speed control cancel button for more than 5 seconds.
    - The message center display the current oil level.
26. Set the ignition to the OFF position.
27. Set the ignition to the ON position.
28.
    - Press the left-hand OK button to access the Instrument Cluster (IC) Main Menu.



29.

- Press the left-hand directional button and select Service Menu.



30.

- Press the left-hand OK button.


E147184

31.

- Press the left-hand directional button and select the Oil Level display.

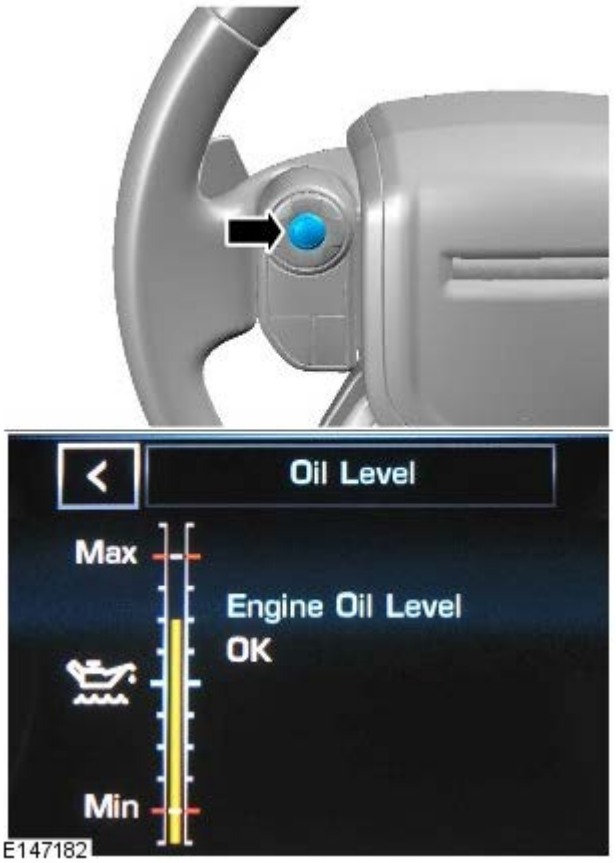


E147185

32.

- Press the left-hand OK button and follow the instructions.
- NOTE: If the message shows "Not available" wait for further 10 mins to allow the oil level to stabilize.

  Make sure that the average oil level value has now been updated.


Oil Level
Max
Engine Oil Level
OK
Min
E147182

Published: 10-Jul-2013

Engine - V6 S/C 3.0L Petrol - Valve Clearance Check

General Procedures

Check

1. 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: Valve Cover LH (303-01B Engine - V6 S/C 3.0L Petrol, Removal and Installation).

4. Refer to: Valve Cover RH (303-01B Engine - V6 S/C 3.0L Petrol, Removal and Installation).

5. CAUTIONS:

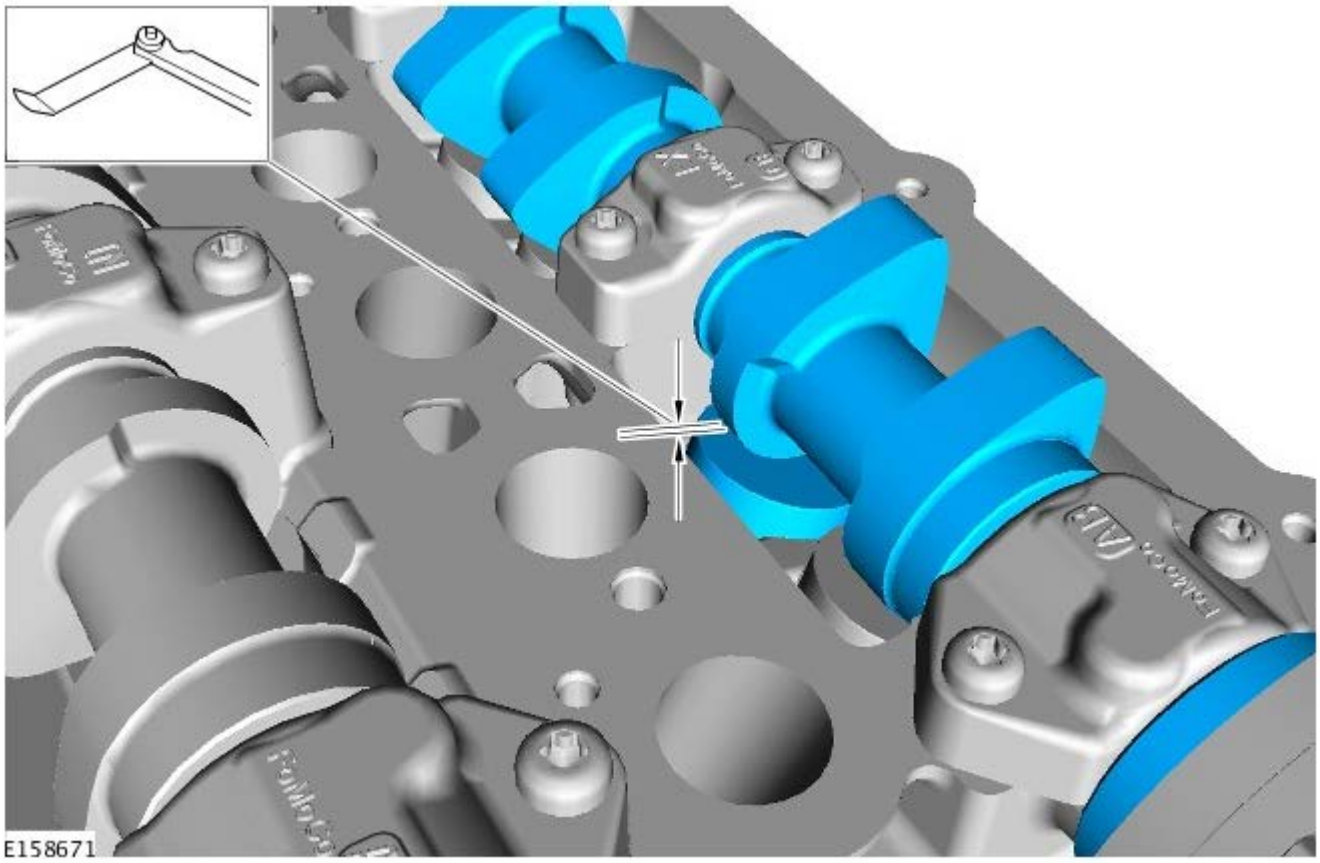
   Rotate the engine clockwise until the camshafts are positioned as shown.

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

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

   NOTE: Using feeler gauge check the gap between the tappet and the camshaft lobe and check against specifications table.

   - Using feeler gauge check the gap between the tappet and the camshaft lobe and check against specifications table.
   - Repeat this step for the remaining valve tappets.



Published: 10-Jul-2013

Engine - V6 S/C 3.0L Petrol - Valve Clearance Adjustment

General Procedures

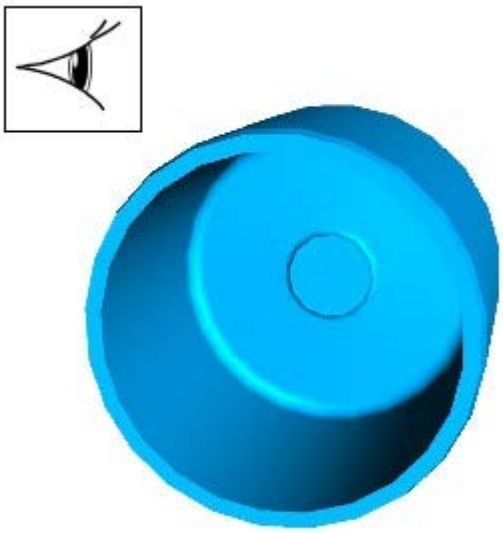
Check

1. 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: Valve Clearance Check (303-01B Engine - V6 S/C 3.0L Petrol, General Procedures).

Adjustment

1. Refer to: Camshaft RH (303-01B Engine - V6 S/C 3.0L Petrol, Removal and Installation).
2. Refer to: Camshaft LH (303-01B Engine - V6 S/C 3.0L Petrol, Removal and Installation).
3.



E158863

Published: 02-May-2013

Engine - V6 S/C 3.0L 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.

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

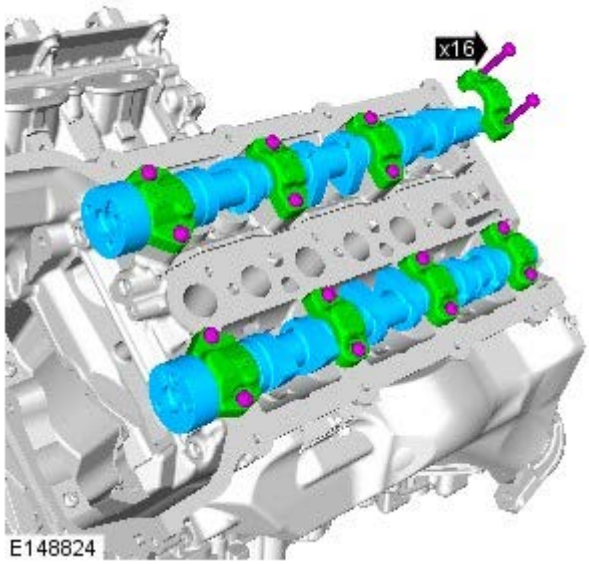
1. Disconnect the battery ground cable.

   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: Timing Drive Components (303-01B Engine - V6 S/C 3.0L Petrol, 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:

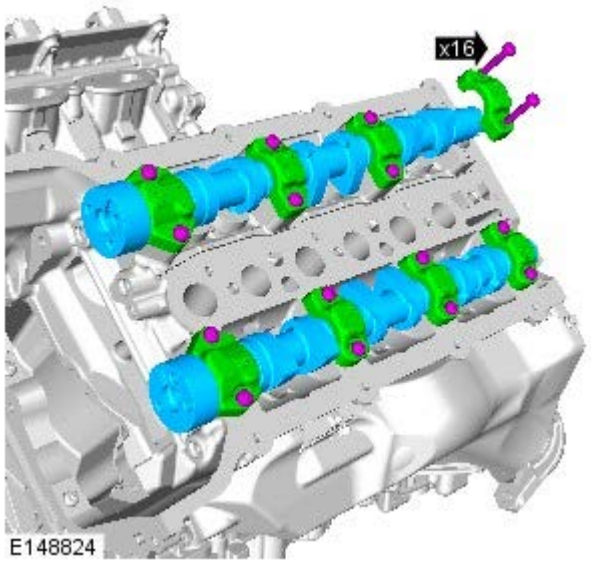
   Prior to installing the camshafts, position the crankshaft 45 degrees ATDC cylinder 1A to prevent valve/piston collision.

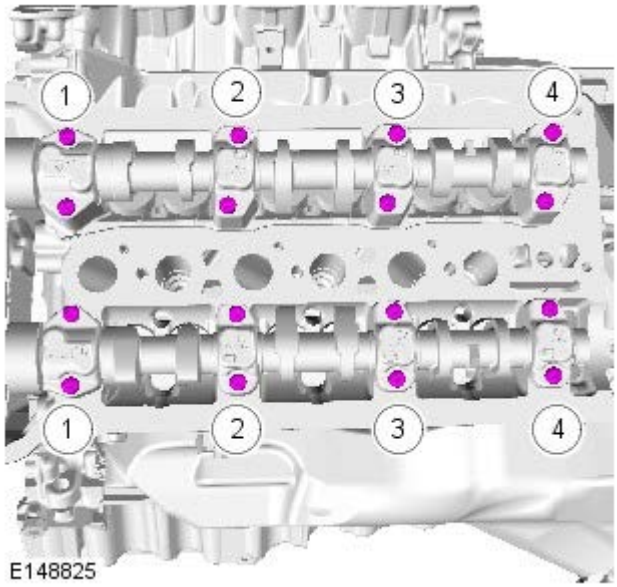
   Make sure that the camshafts and camshaft bearing caps are installed in their original locations.

   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. NOTE: If the valve clearance is incorrect, continue to the next step. If the valve clearance is correct, continue to step 8.

   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 (303-01B Engine - V6 S/C 3.0L Petrol, Removal and Installation).

9. Connect the battery ground cable.

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

Published: 02-May-2013

Engine - V6 S/C 3.0L 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.

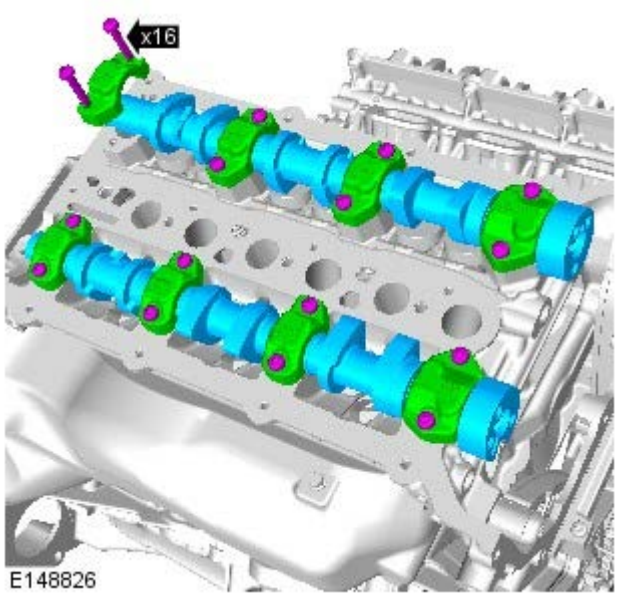
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 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 Drive Components (303-01B Engine - V6 S/C 3.0L Petrol, 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

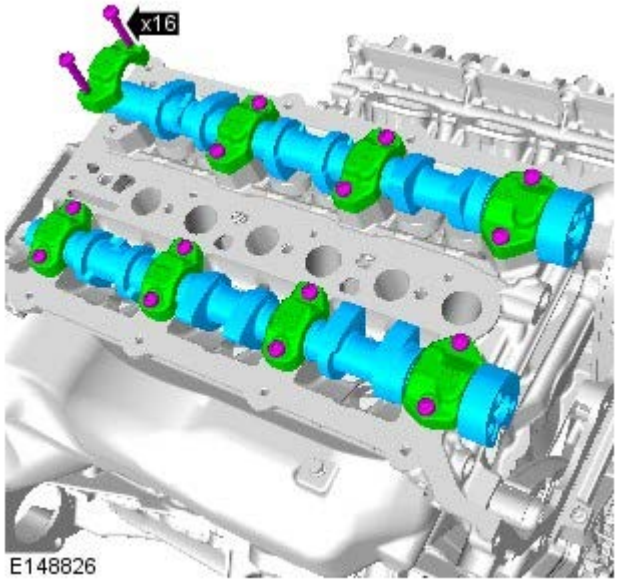
1. CAUTIONS:

   Prior to installing the camshafts, position the crankshaft 45 degrees ATDC cylinder 1A to prevent valve/piston collision.

   Evenly and progressively install and tighten the camshaft bearing caps.

   Make sure that the camshafts and camshaft bearing caps are installed in their original locations.

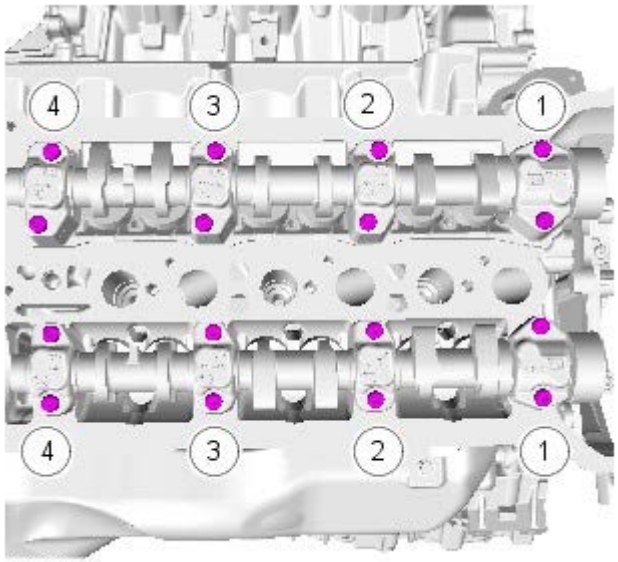
   NOTE: Lubricate the camshafts and the camshaft



E148826

bearing caps with EP90 oil (or 75/90 viscosity oil will suffice) prior to installation.

Torque: 3 Nm



E148827

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. NOTE: If the valve clearance is incorrect, continue to the next step. If the valve clearance is correct, continue to step 8.

   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 (303-01B Engine - V6 S/C 3.0L Petrol, Removal and Installation).

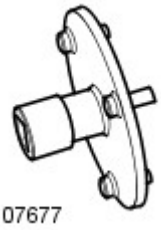
9. Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 02-May-2013

Engine - V6 S/C 3.0L 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.

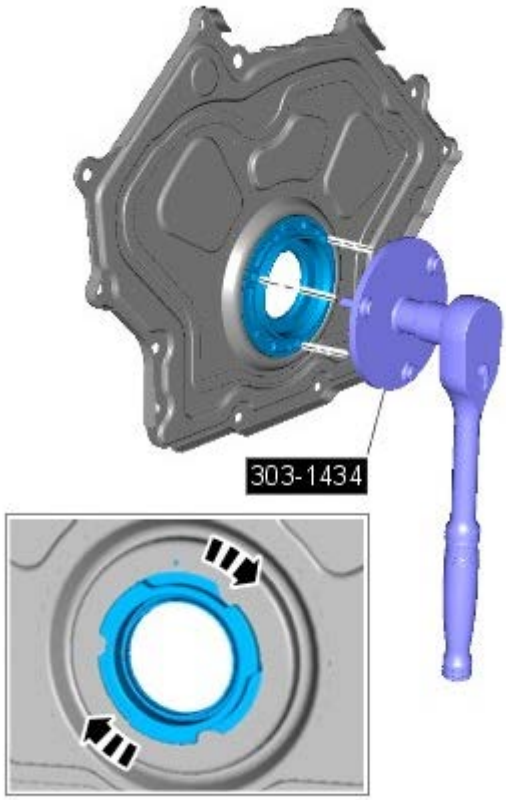
Some variation in the illustrations may occur, but the essential information is always correct.

1. Disconnect the battery ground cable.

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

2. Refer to: Crankshaft Pulley (303-01B Engine - V6 S/C 3.0L Petrol, Removal and Installation).

3. *Special Tool(s):* 303-1434



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.

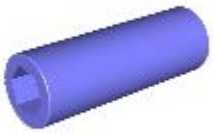
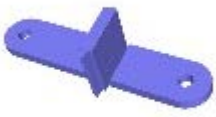
To install, reverse the removal procedure.

Published: 23-May-2013

Engine - V6 S/C 3.0L 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
 E152576	JLR-303-1304 Locking 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.

All vehicles

1. Disconnect the battery ground cable.

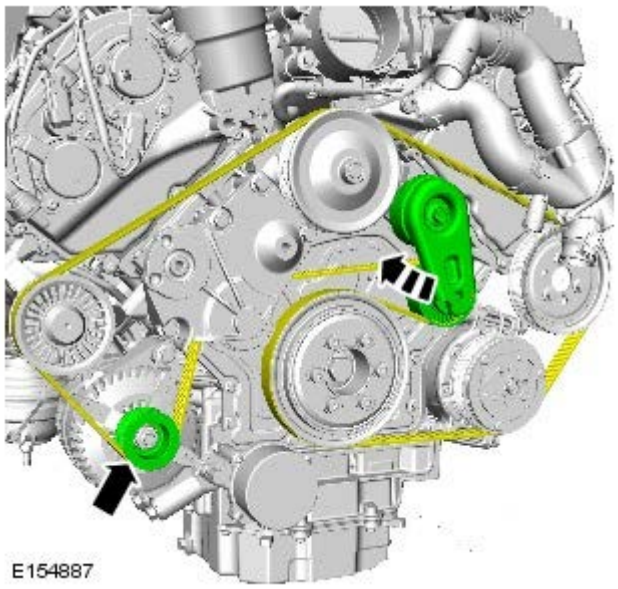
2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Refer to: Cooling Fan Shroud (303-03B Engine Cooling - V6 S/C 3.0L Petrol, Removal and Installation).

4. Refer to: Starter Motor (303-06B Starting System - V6 S/C 3.0L Petrol, Removal and Installation).

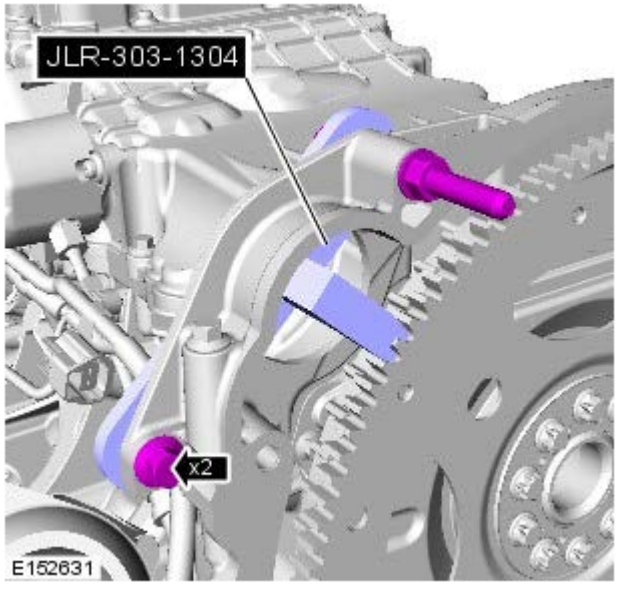
5.



Vehicles with Stop/Start

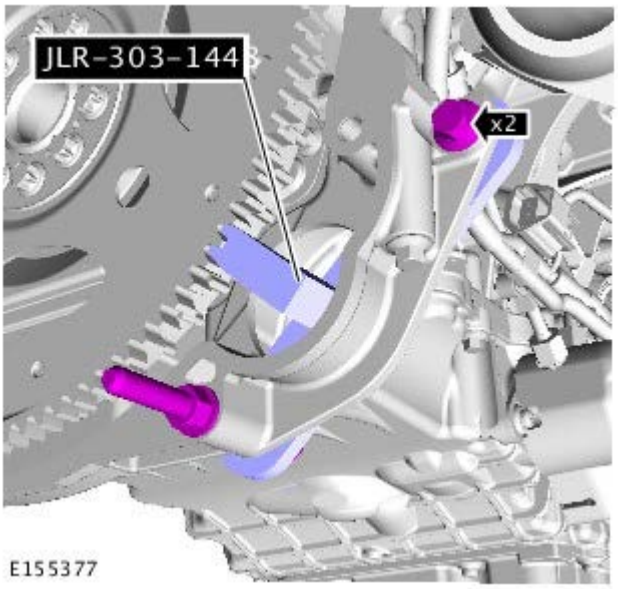
6. Install the special tool.

   Special Tool(s): JLR-303-1304



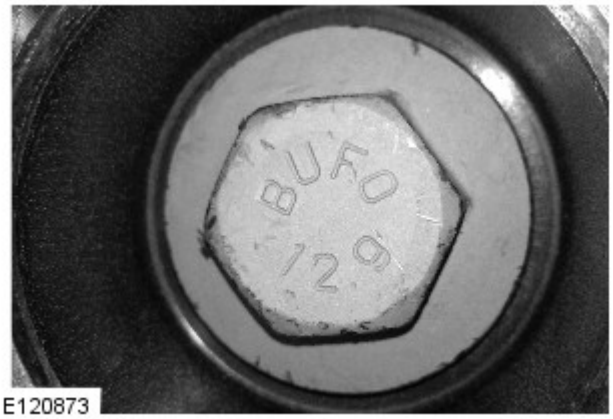
All vehicles

7. Install the special tool.



Special Tool(s): 303-1448

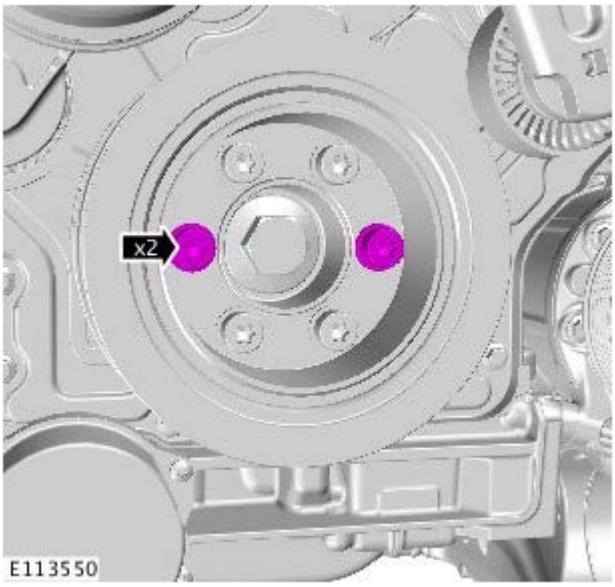




8. CAUTION: Before removing the crankshaft pulley bolt, note the numbers on the bolt head. If the bolt head shows 10.9, the bolt must be removed counter clockwise. If the bolt head shows 12.9, the bolt must be removed clockwise. Failure to follow this instruction may result in damage to the crankshaft.

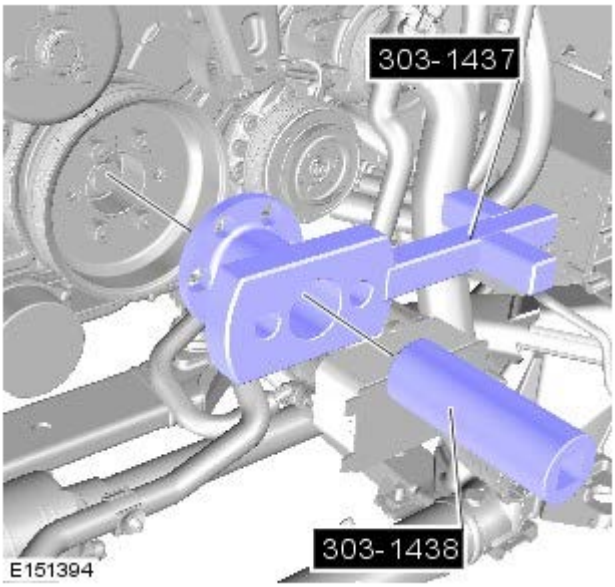
   Note the markings on the crankshaft pulley bolt.

9.

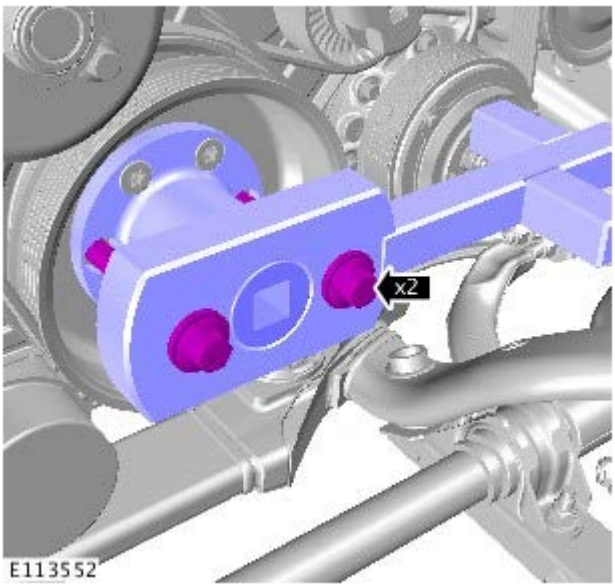


10. Install the special tool.

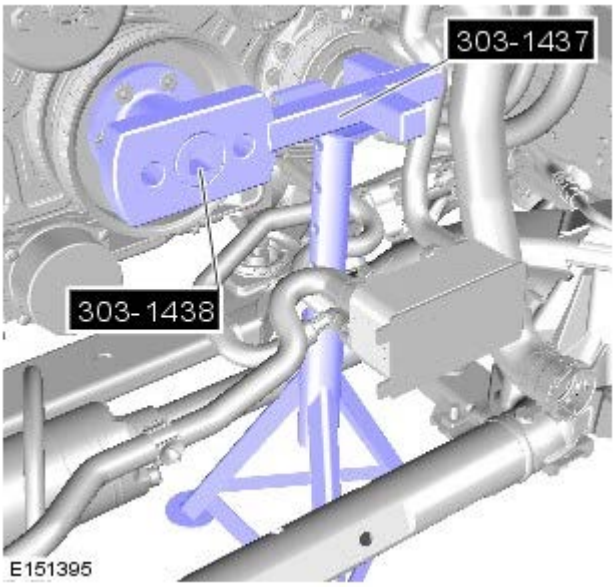
    Special Tool(s): 303-1438, 303-1437



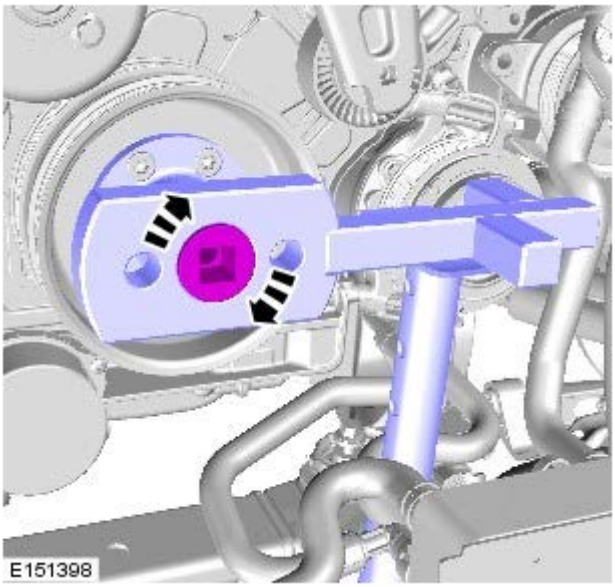
11. *Torque:* 25 Nm



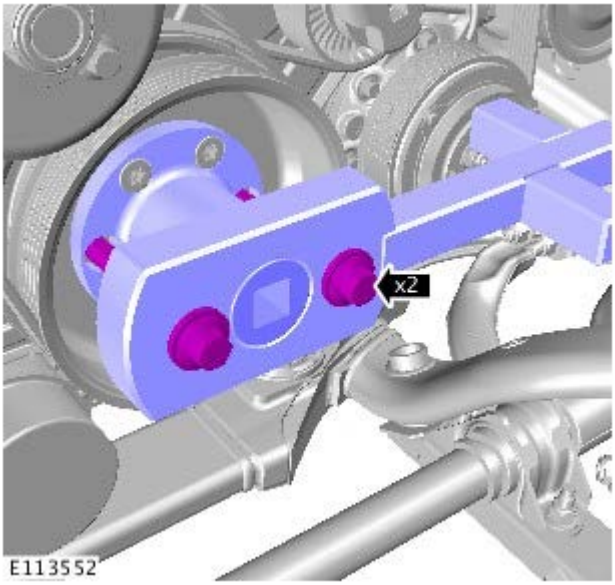
12. Support the special tool using a suitable vehicle stand.



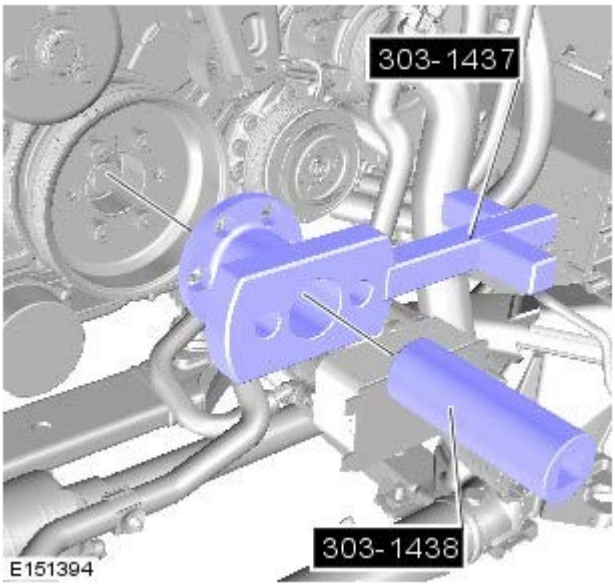
13. NOTE: The crankshaft pulley bolt will be very tight.



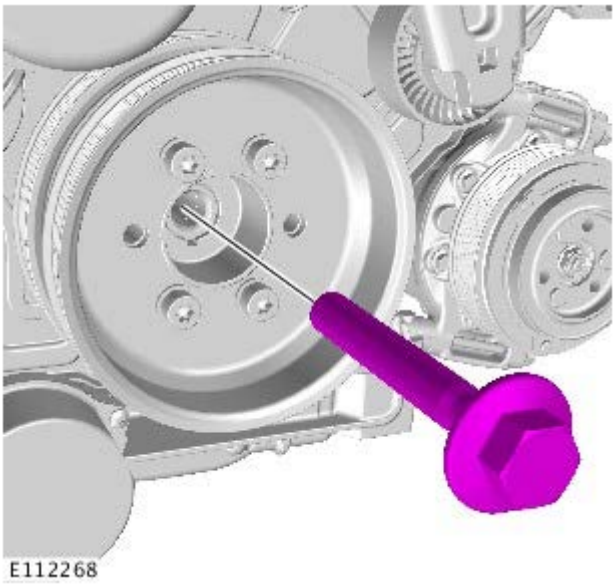
14.



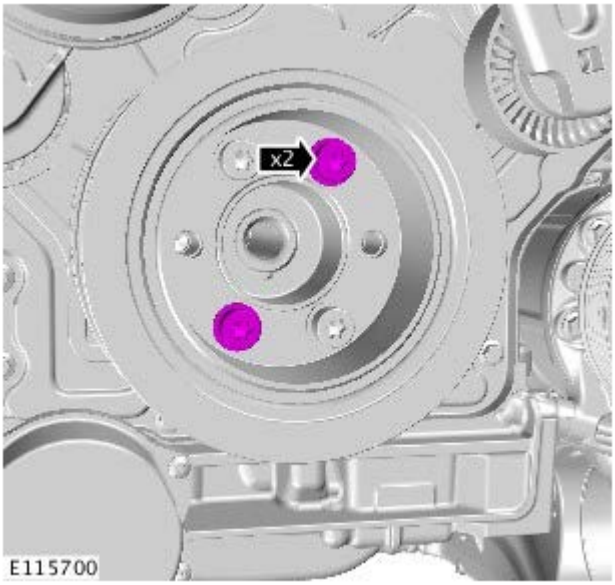
15. Remove the special tools.



16. NOTE: Discard the bolt after removal.

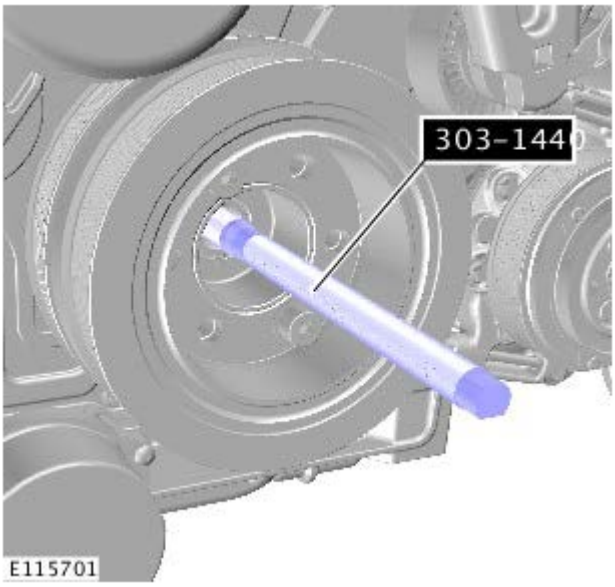


17.



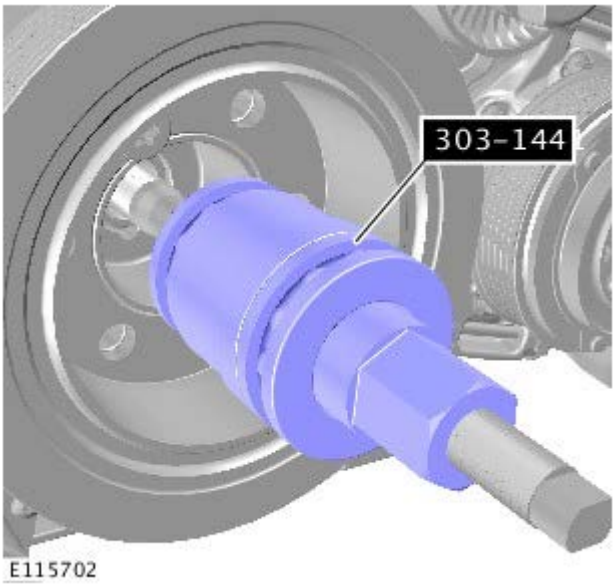
18. NOTE: If the crankshaft damper is fitted with an early RH thread crankshaft bolt then the pulley can be removed with a standard puller.

Install the special tool.



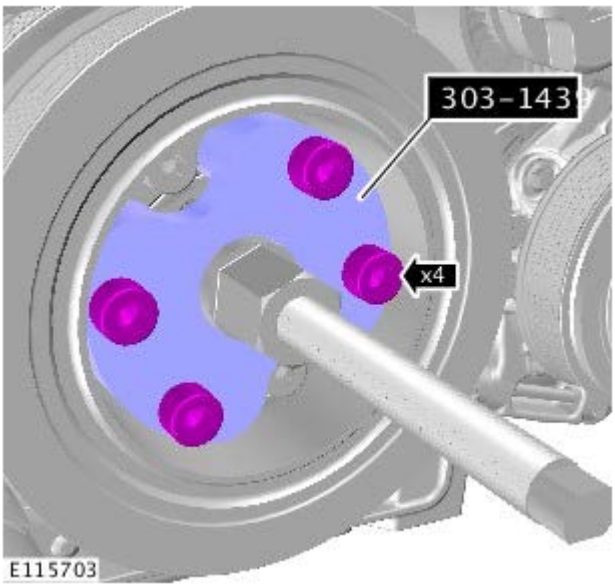
Special Tool(s): 303-1440

19. Install the special tool.



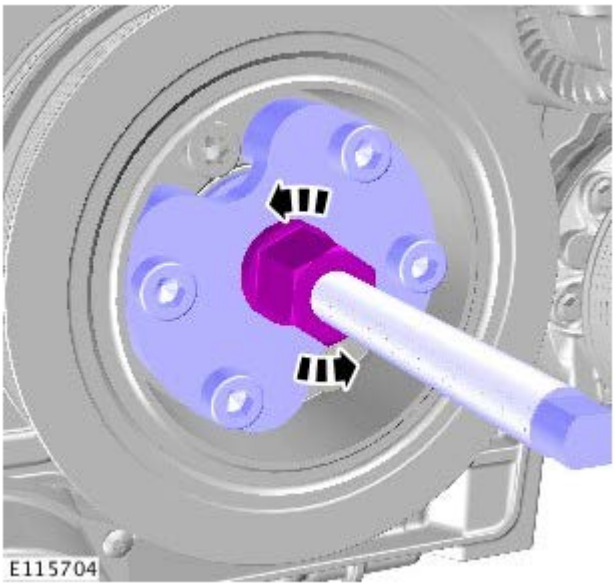
Special Tool(s): 303-1441

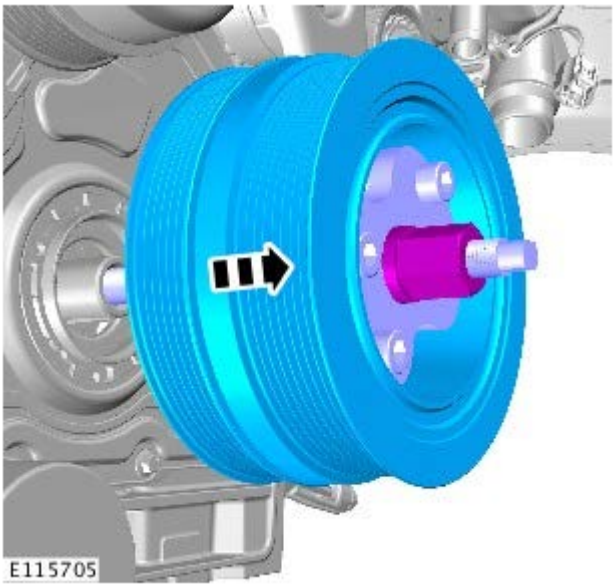
20. Install the special tool.



Special Tool(s): 303-1439
Torque: 25 Nm

21.

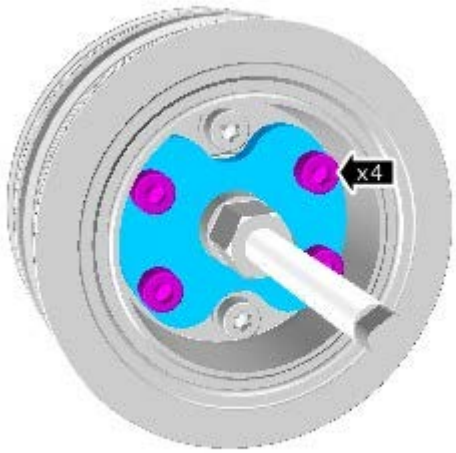




22. CAUTION: Discard the friction washer after removing the crankshaft pulley.

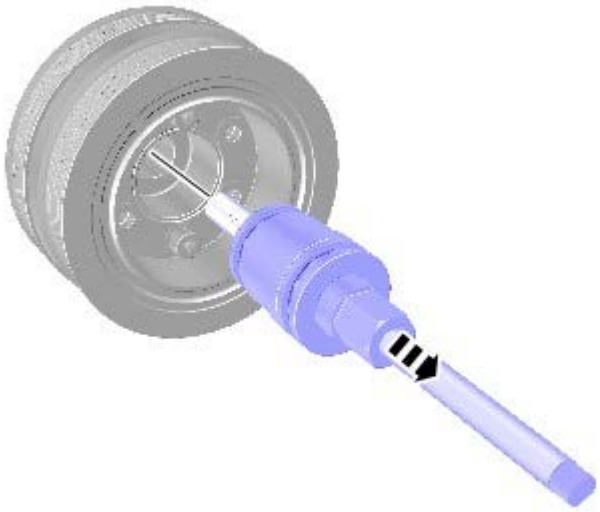
NOTE: Make sure to clean the threads in the end of the crankshaft and that the crank nose is free of any foreign materials.

23.



E115706

24.



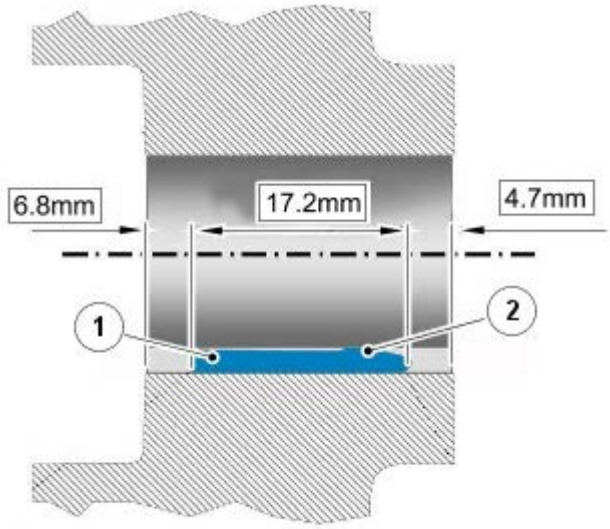
E115707

Installation

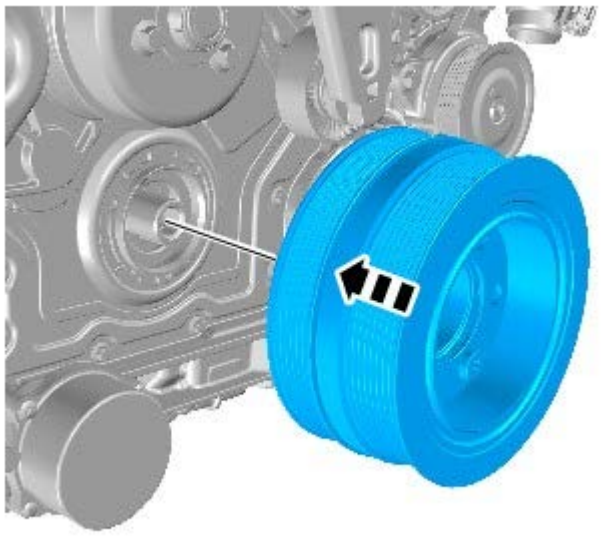
All vehicles

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.



E115889

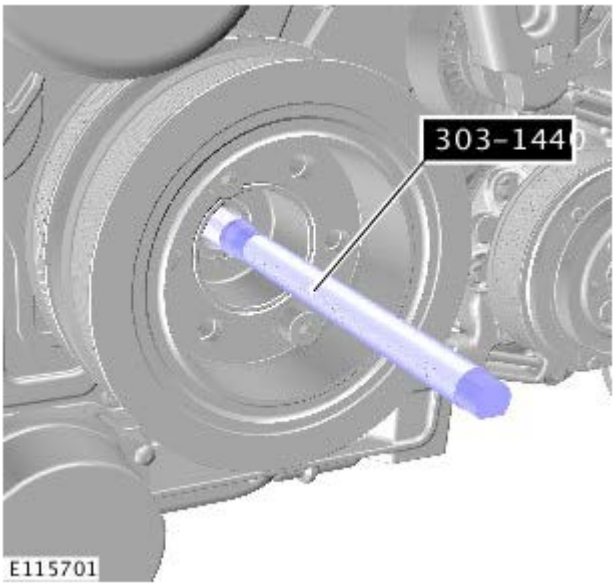


E112288

2. CAUTION: Install a new friction washer before installing the crankshaft pulley.

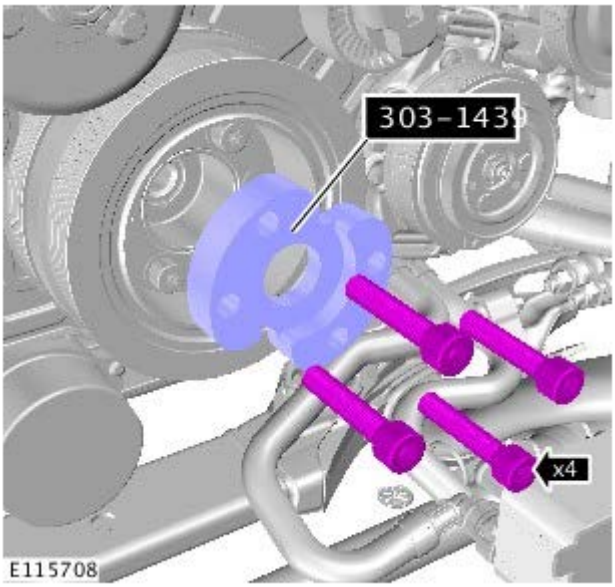
NOTE: Make sure to clean the threads in the end of the crankshaft and that the crank nose is free of any foreign materials.

3. Install the special tool.

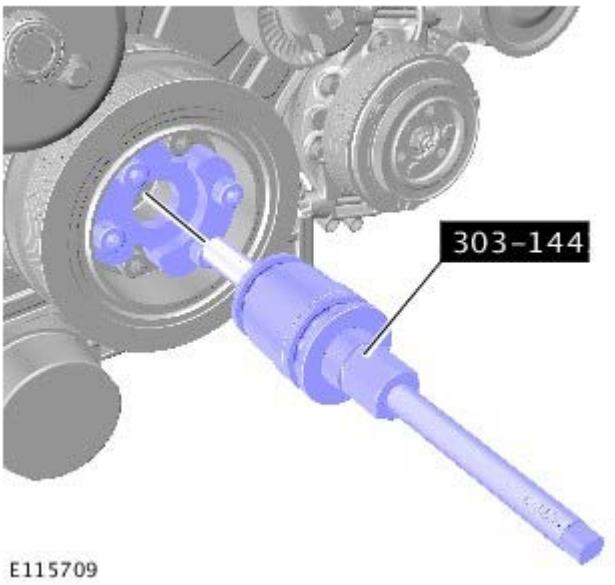


4. Install the special tool.

   Torque: 25 Nm



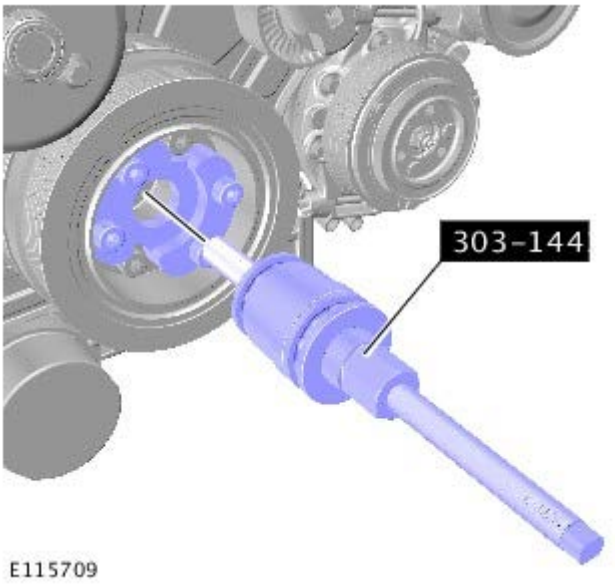
5. Install the special tool.



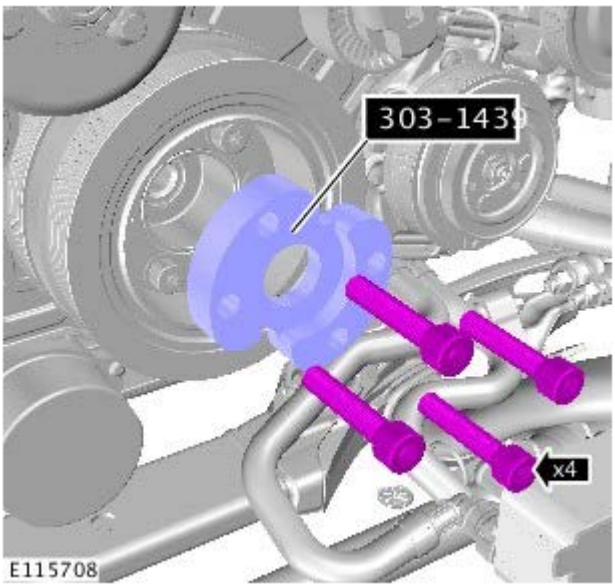
6. CAUTION: Rotate the crankshaft pulley installation tool until the pulley is fully located, do not over tighten. Failure to do this may result in damage to the components.



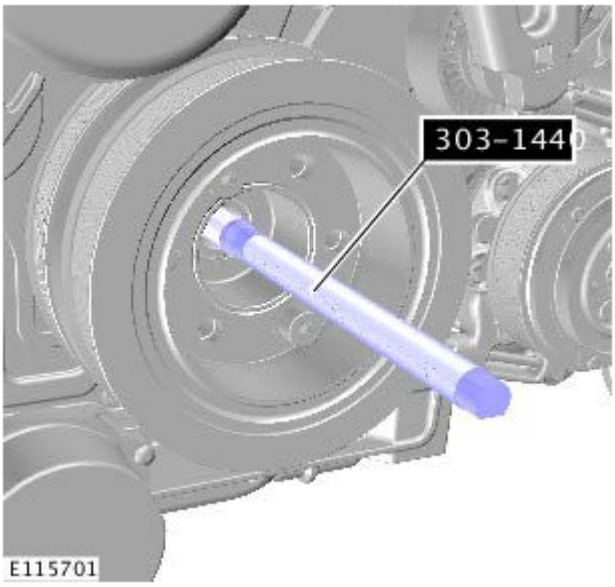
7. Remove the special tool.



8.
- Remove the special tool.

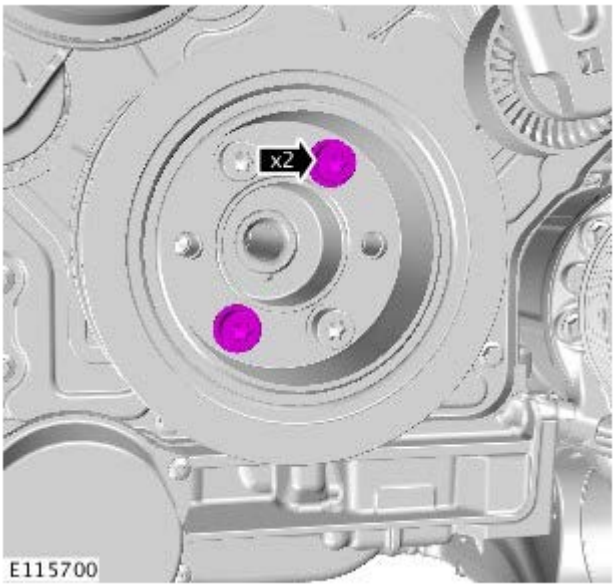


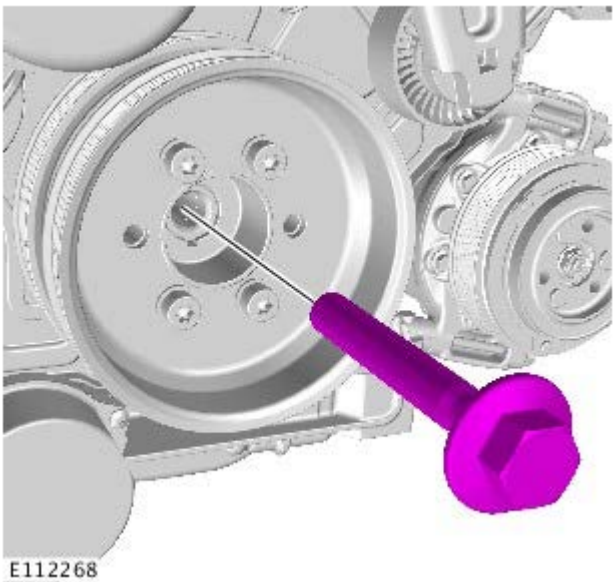
9. Remove the special tool.



10.

- Apply loctite 270 to the thread of the bolts.
- *Torque:* 65 Nm





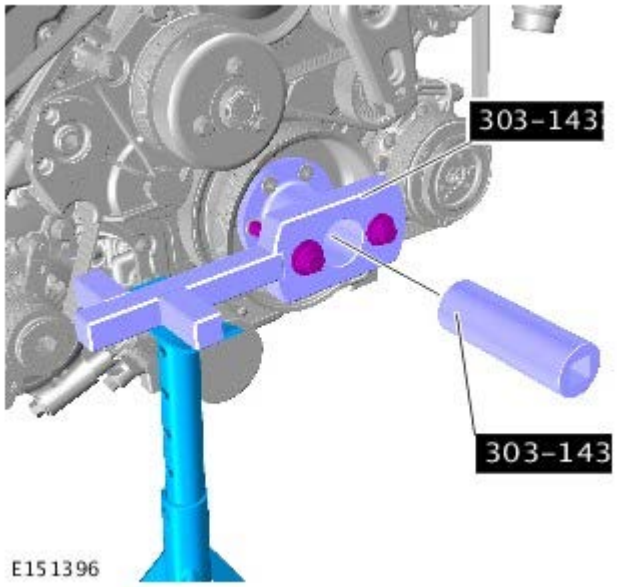
11. WARNING: Make sure that a new bolt is installed.

CAUTION: Tighten the component finger tight first.

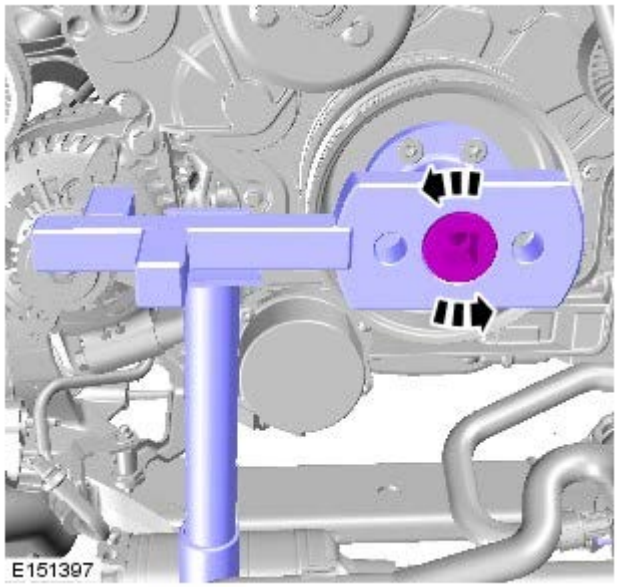
Install the crankshaft pulley bolt.

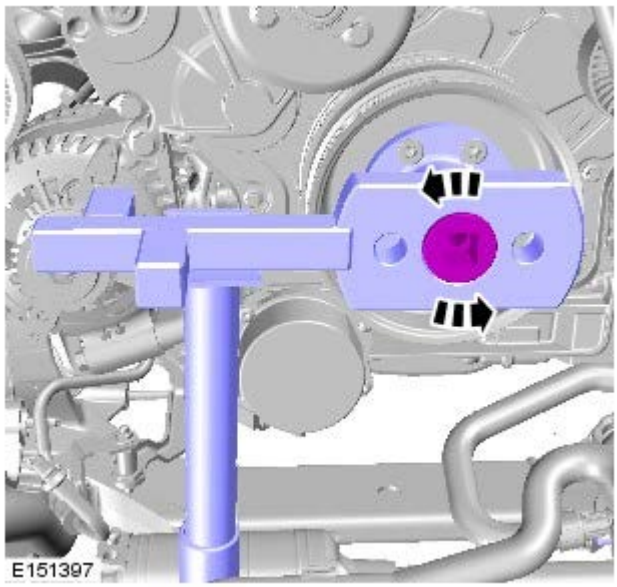
12. NOTE: The graphic shows the step for LH thread only, RH thread will be the opposite.

Torque: 25 Nm



13. *Torque:* 200 Nm



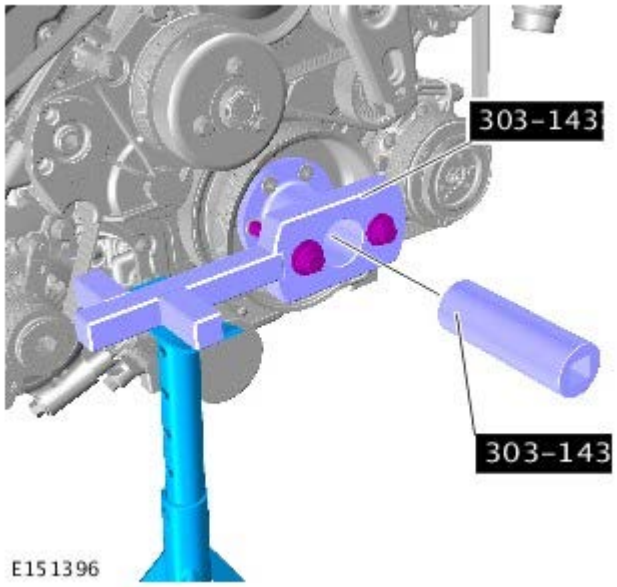


14. CAUTION: Make sure that the socket is turned through 270 degrees not the torque wrench.

NOTE: The use of a torque multiplier capable of 600Nm will be required.

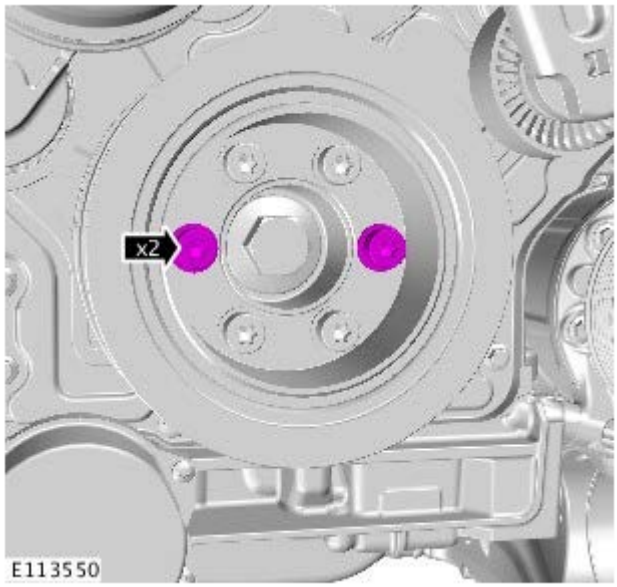
Torque: 270°

15. Remove the special tools.

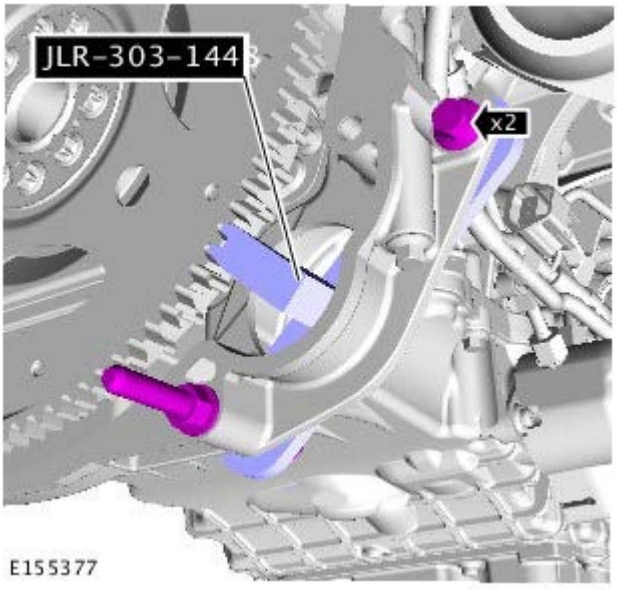


16.

- Apply loctite 270 to the thread of the bolts.
- *Torque:* 65 Nm

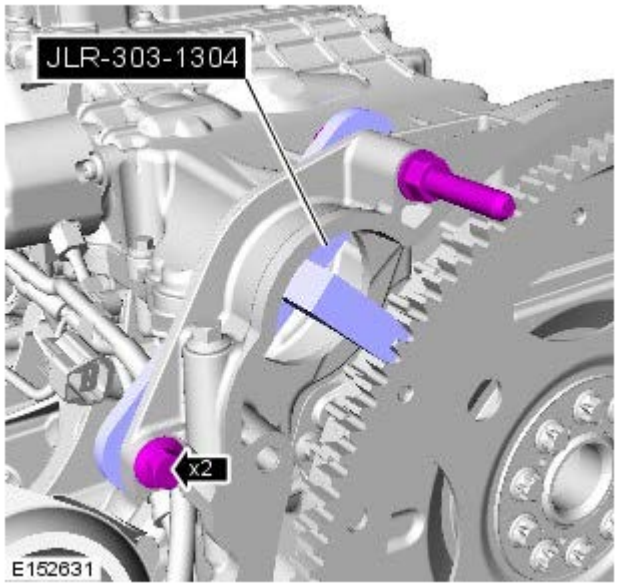


17. Remove the special tool.



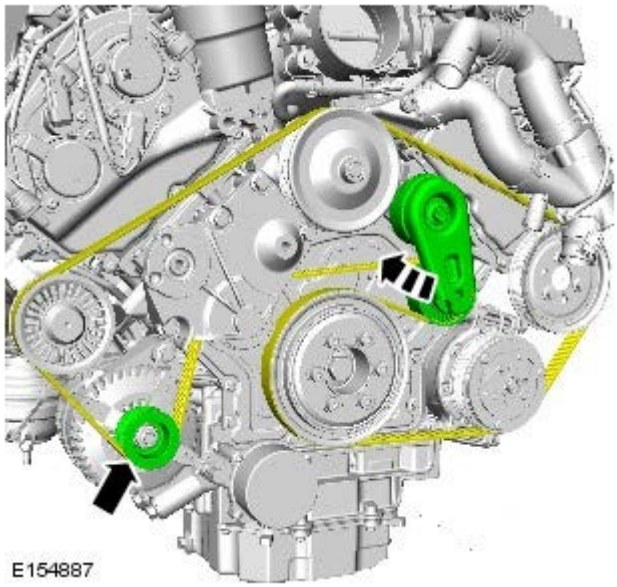
Vehicles with Stop/Start

18. Remove the special tool.



All vehicles

19.



20. Refer to: Cooling Fan Shroud (303-03B Engine Cooling - V6 S/C 3.0L Petrol, Removal and Installation).

21. Refer to: Starter Motor (303-06B Starting System - V6 S/C 3.0L Petrol, Removal and Installation).

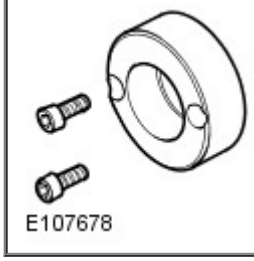
22. Connect the battery ground cable.

Published: 02-May-2013

Engine - V6 S/C 3.0L Petrol - Crankshaft Rear Seal

Removal and Installation

Special Tool(s)

 E107678	303-1442 Rear Crankshaft Seal Installer

Removal

NOTES:

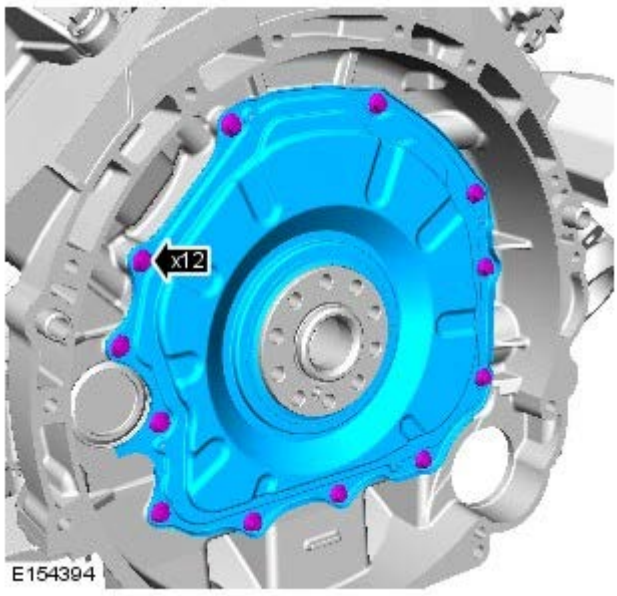
Removal steps in this procedure may contain installation details.

Some illustrations may show the engine removed for clarity.

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

1. Refer to: Flexplate (303-01B Engine - V6 S/C 3.0L Petrol, Removal and Installation).

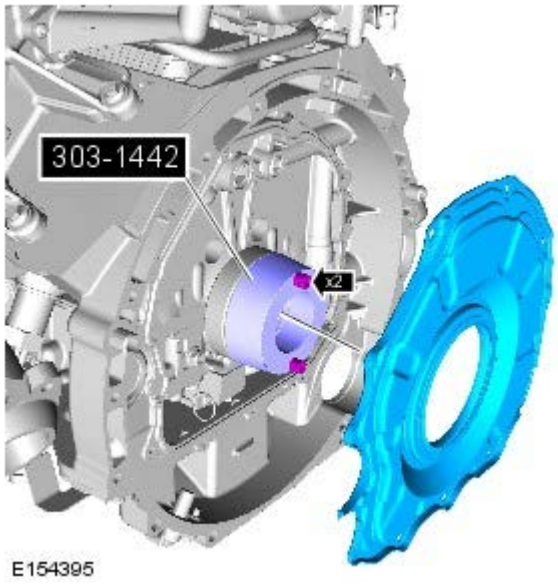
2.



Installation

1. Install the special tool.

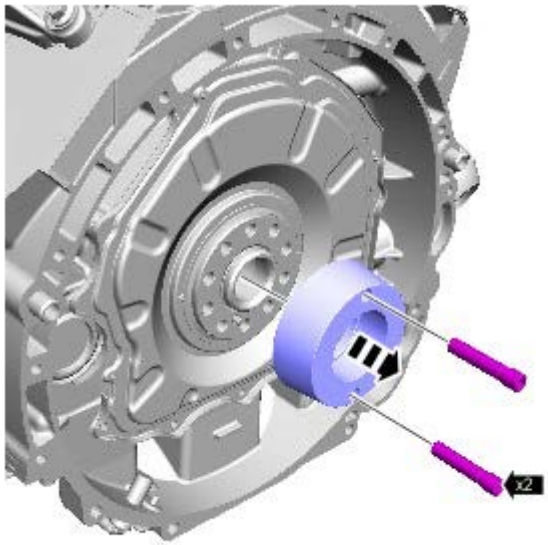
   Special Tool(s): 303-1442



E154395

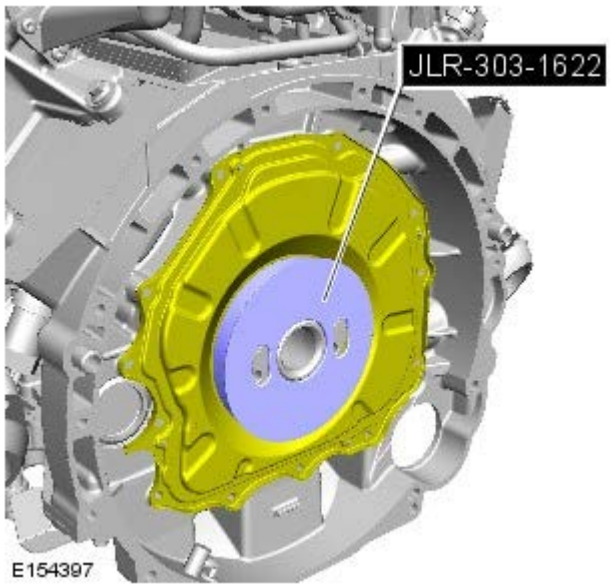
2. Remove the special tool.

   Special Tool(s): 303-1442



E154396

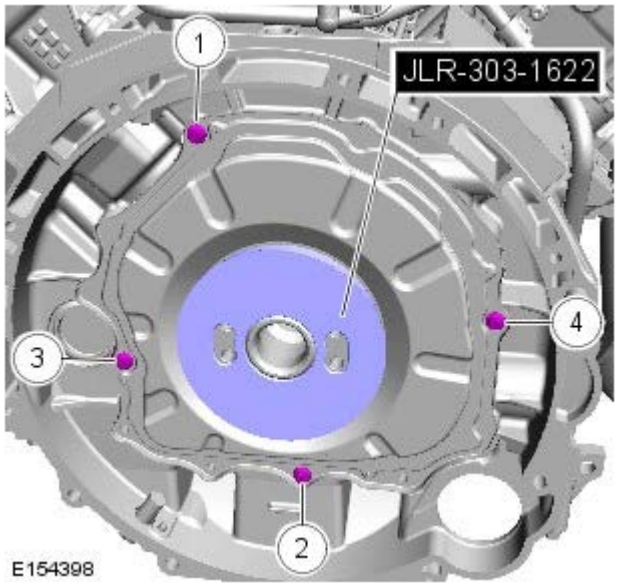
3. Align the engine rear oil seal plate using the special tool.



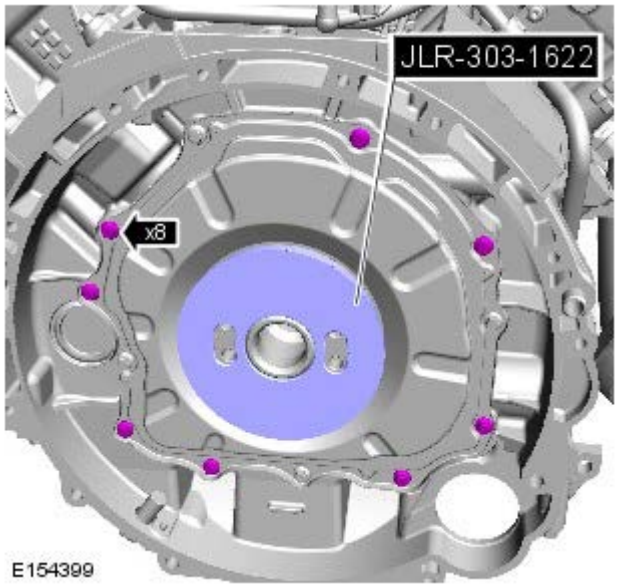
E154397

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

   Torque: 11 Nm



5. *Torque:* 11 Nm



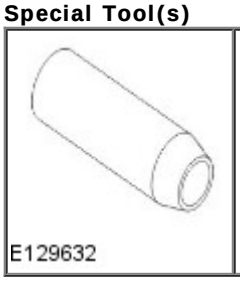
6. Refer to: Flexplate (303-01B Engine - V6 S/C 3.0L Petrol, Removal and Installation).

Published: 02-May-2013

Engine - V6 S/C 3.0L Petrol - Cylinder Head LH

Removal and Installation

Special Tool(s)

 E129632	303-1492 Guide Sleeve, Cylinder Head Bolt

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 Battery and Charging System - General Information, Specifications).

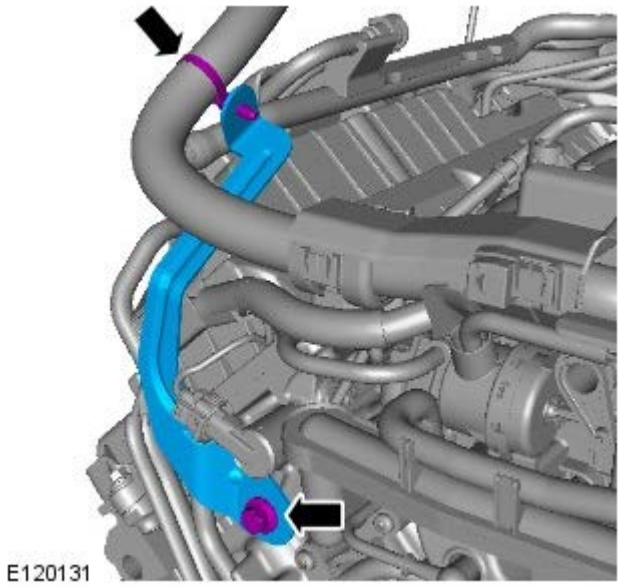
2. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

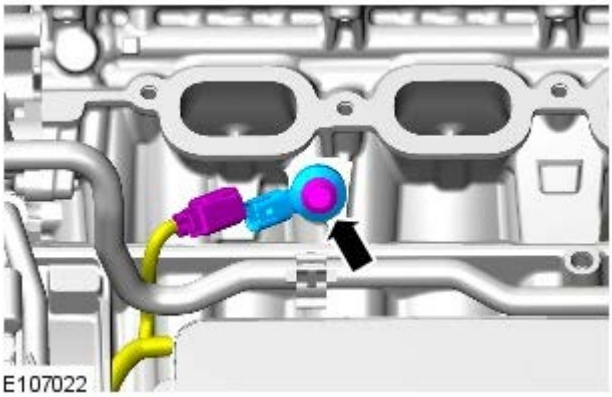
3. Refer to: Exhaust Manifold LH (303-01B Engine - V6 S/C 3.0L Petrol, Removal and Installation).

4. Refer to: Camshaft LH (303-01C Engine - V8 S/C 5.0L Petrol, Removal and Installation).

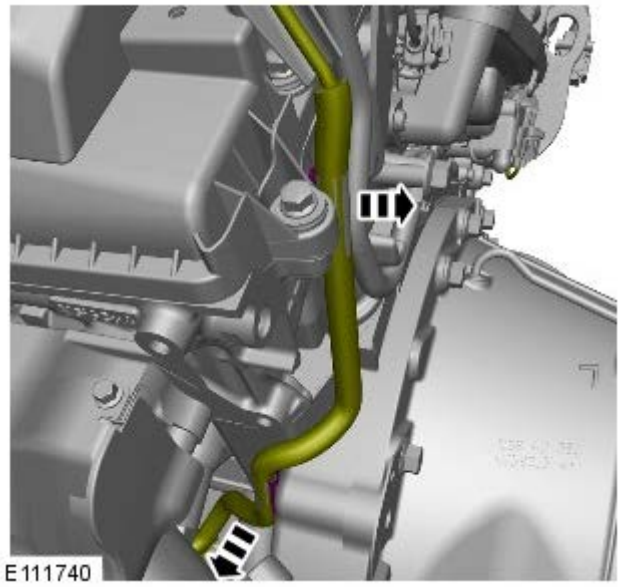
5.


E120131

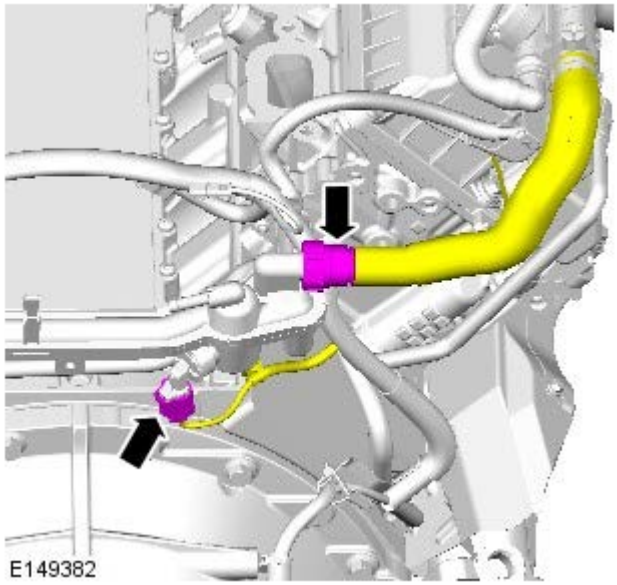
6.



7.



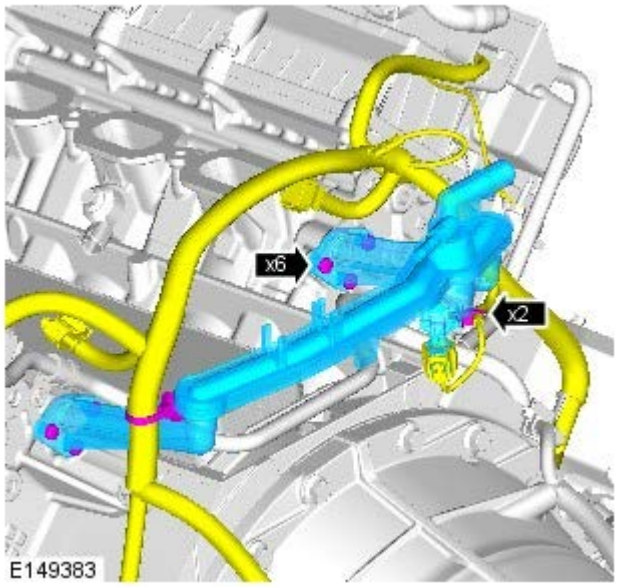
8. NOTE: Clamp the hose to minimize coolant loss.



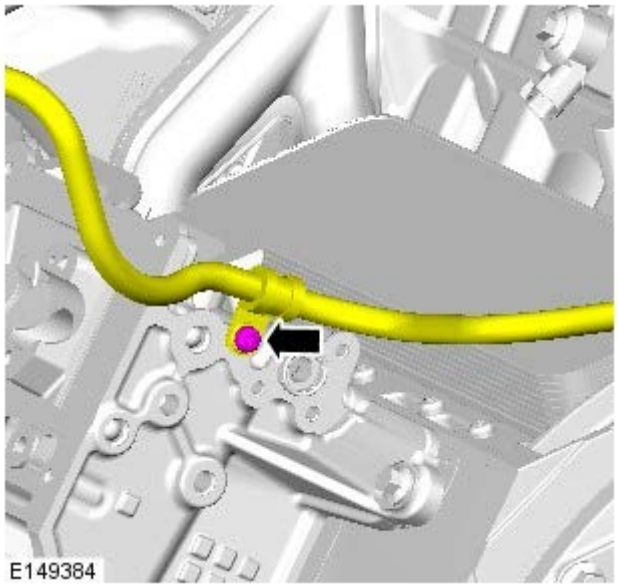
9. CAUTIONS:

Be prepared to collect escaping coolant.

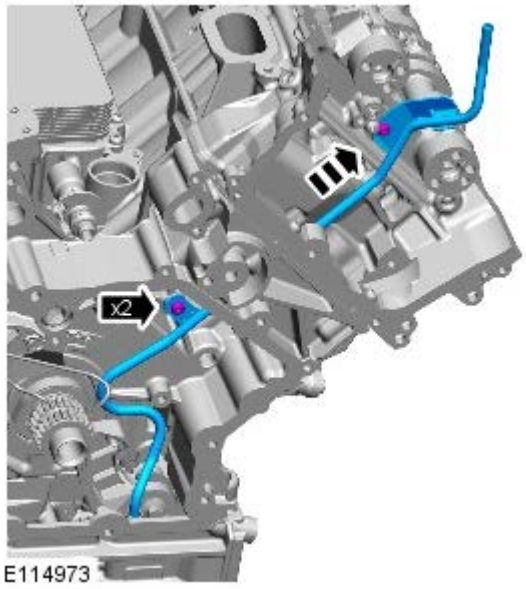
Discard the seals.



10.

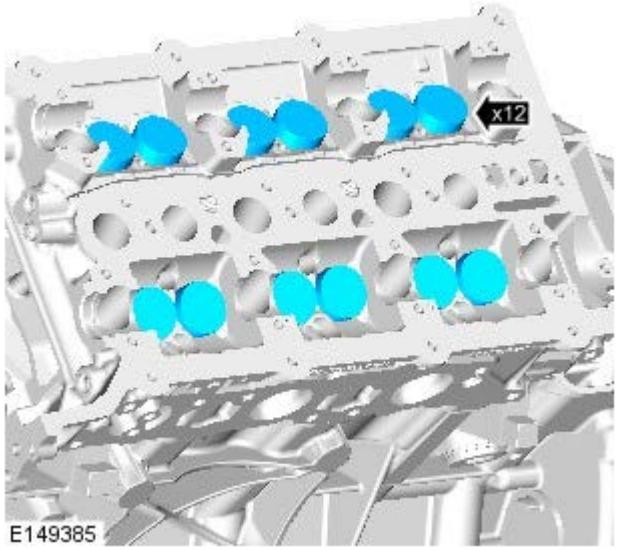


11.



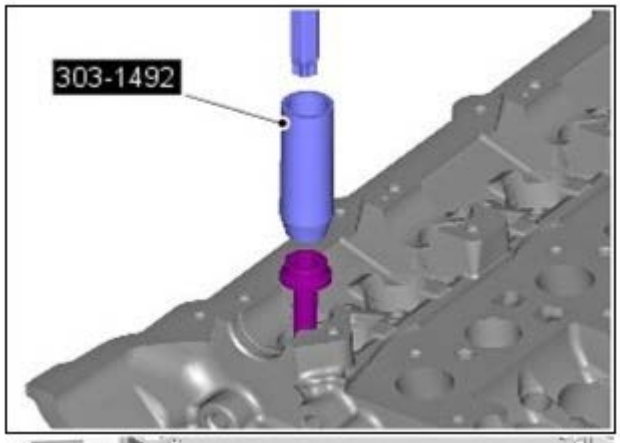
12. CAUTIONS:

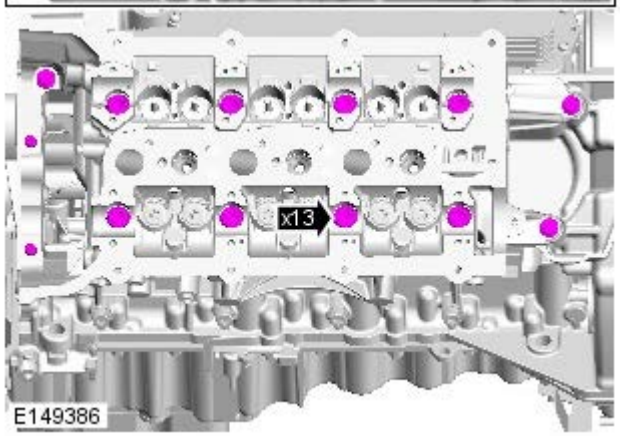
If a new cylinder head has been installed then new tappets must be installed.



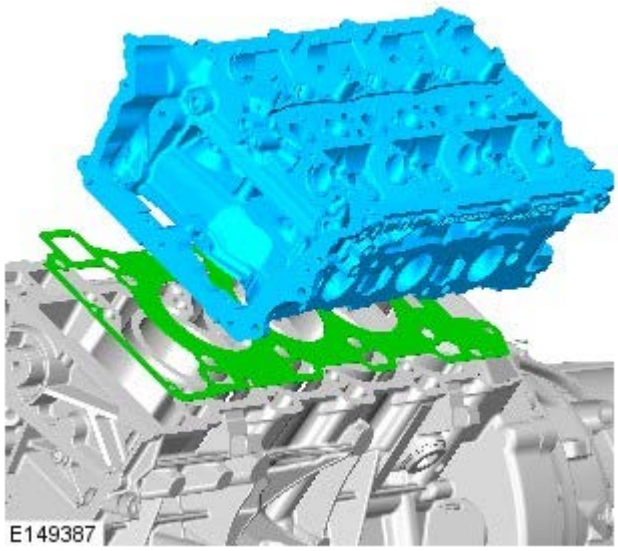
If the cylinder head is being removed without a new component being installed, the tappets must be installed in their original positions.

13. *Special Tool(s):* 303-1492

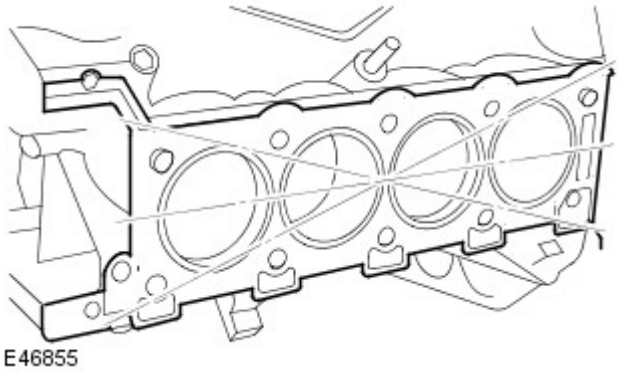




14.

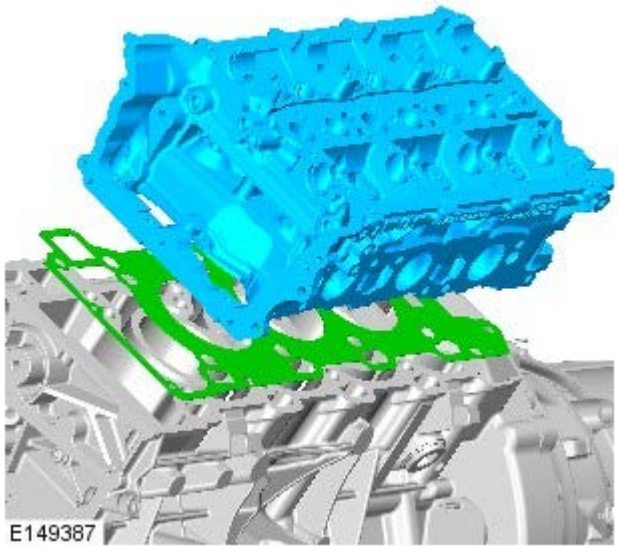


Installation



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.

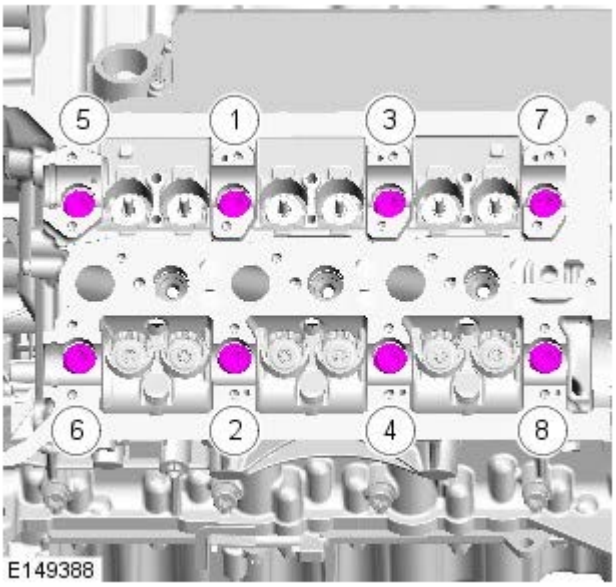
   Make sure that the mating faces are clean and free of foreign material.

   NOTE: Install a new cylinder head gasket.

3. CAUTION: Make sure that new cylinder head bolts are installed.

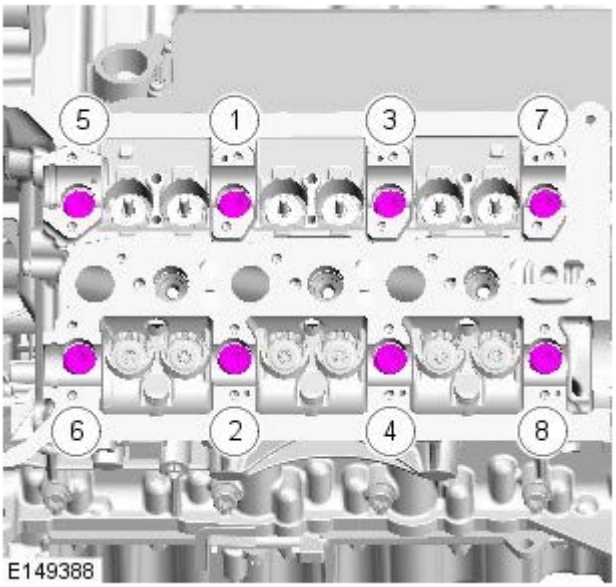
   NOTE: Tighten the bolts in the indicated sequence.

   Torque: 20 Nm

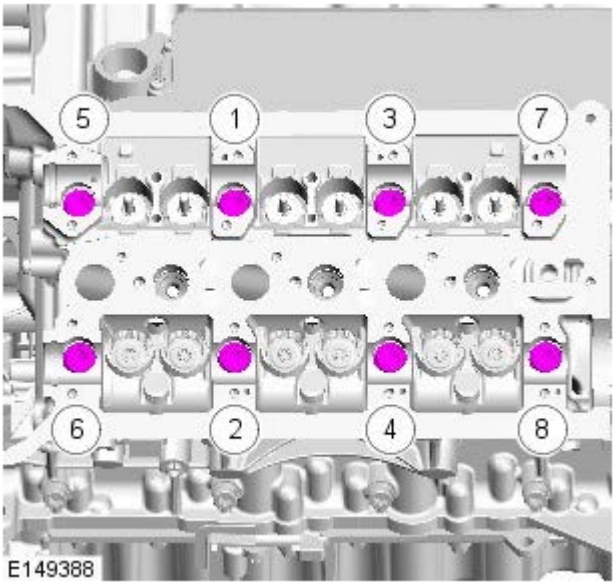


4. NOTE: Tighten the bolts in the indicated sequence.

Torque: 35 Nm

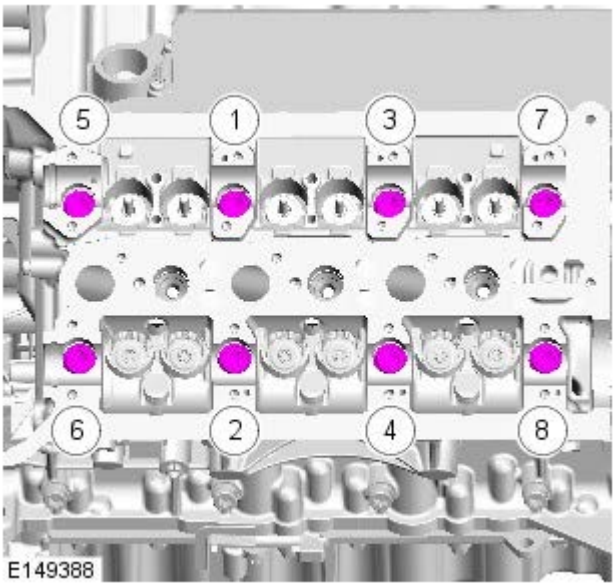


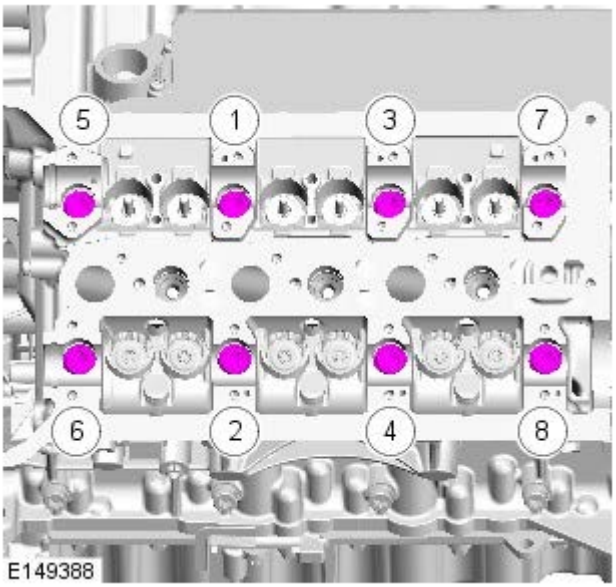
5. NOTE: Slacken the bolts in the sequence shown.



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

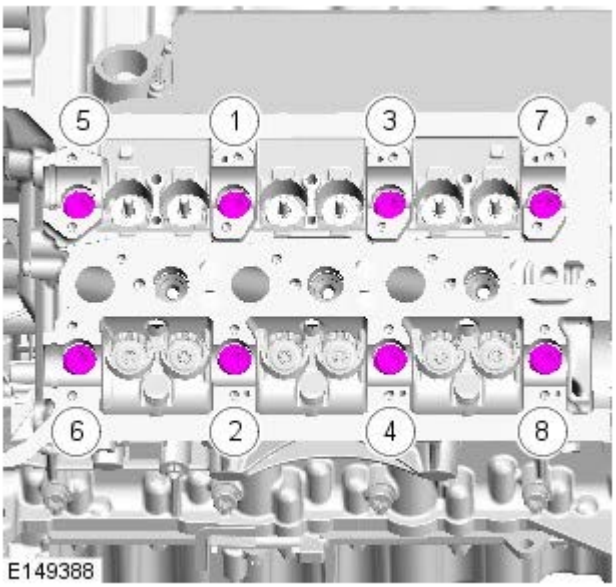
Torque: 35 Nm





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

   Tighten the bolts 1 to 8, a further 90 degrees.

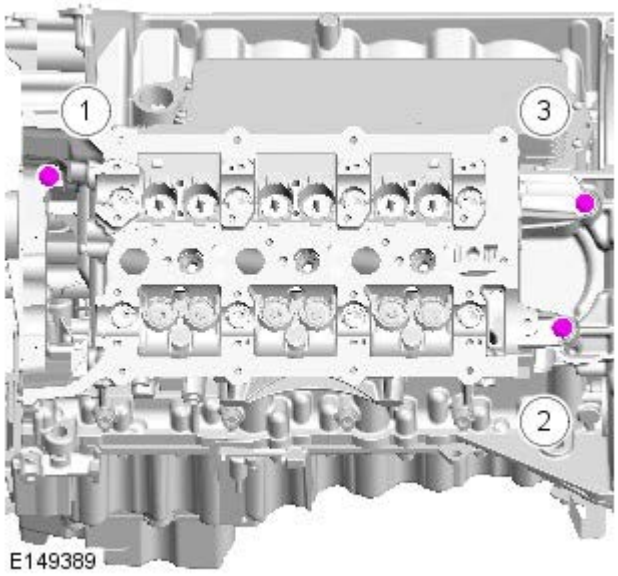


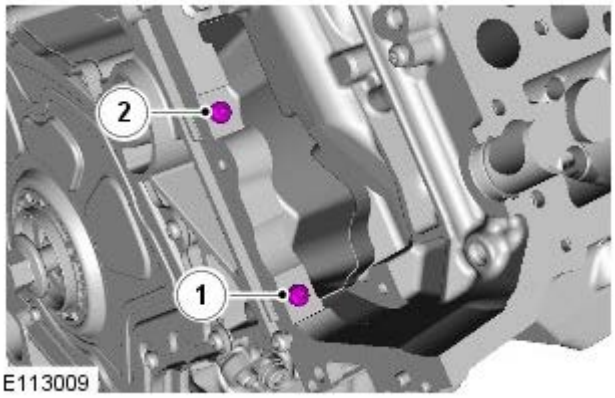
8. NOTE: Tighten the bolts in the indicated sequence.

   Tighten the bolts 1 to 8, a further 120 degrees.

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

   Torque: 25 Nm





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

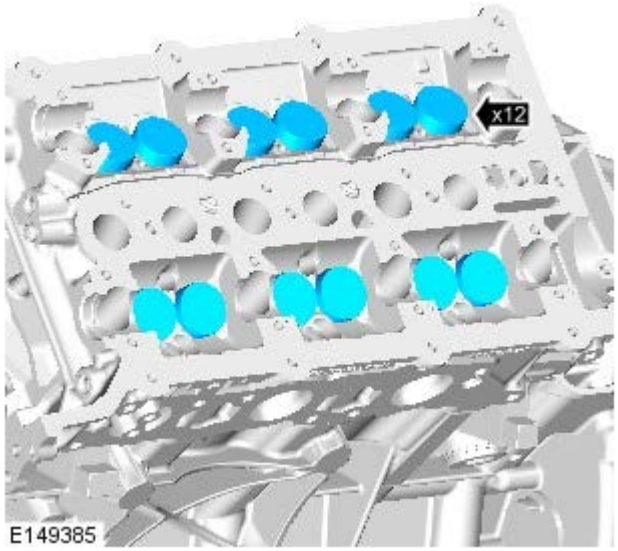
    Torque: 12 Nm

11. CAUTIONS:

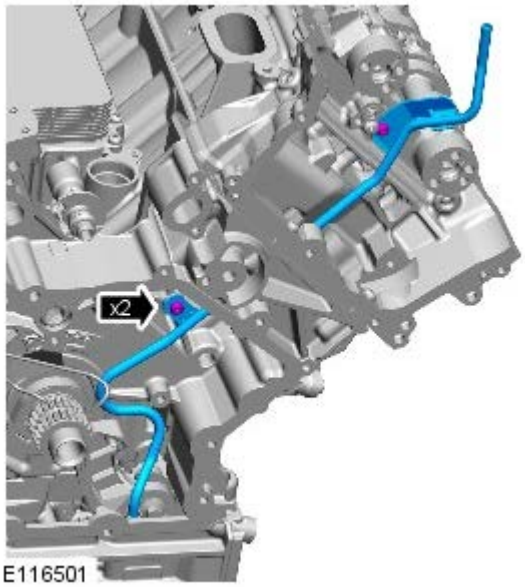
    If a new cylinder head has been installed then new tappets must be installed.

    If the cylinder head is being removed without a new component being installed, the tappets must be installed in their original positions.

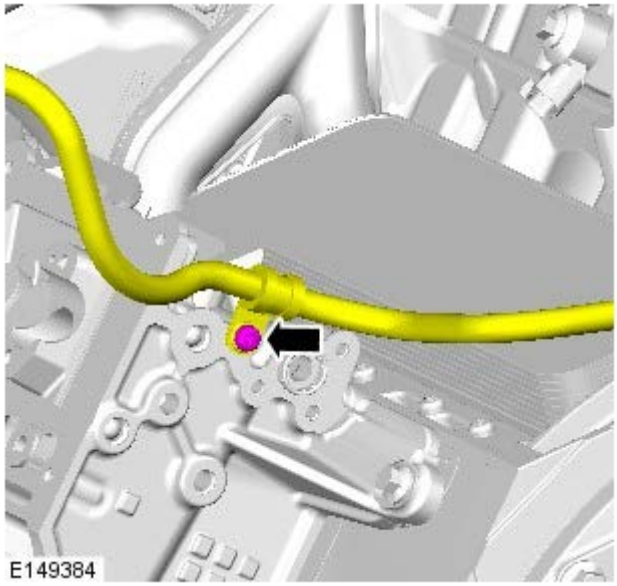
    Lubricate the valve tappets with clean engine oil.



12. *Torque:* 12 Nm

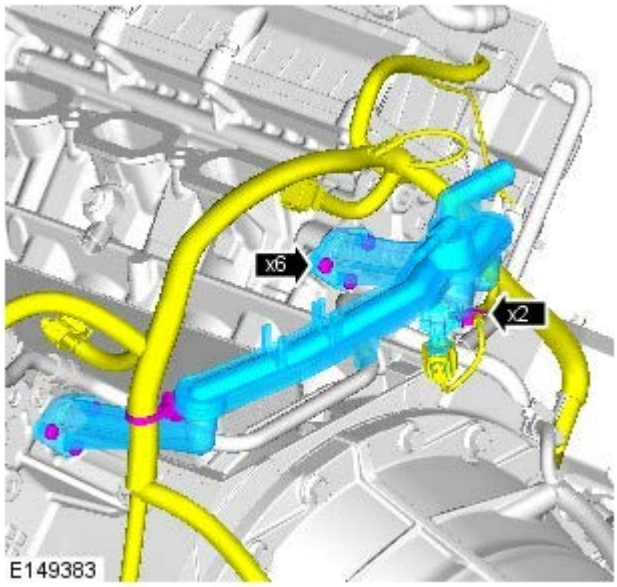


13. *Torque:* 10 Nm

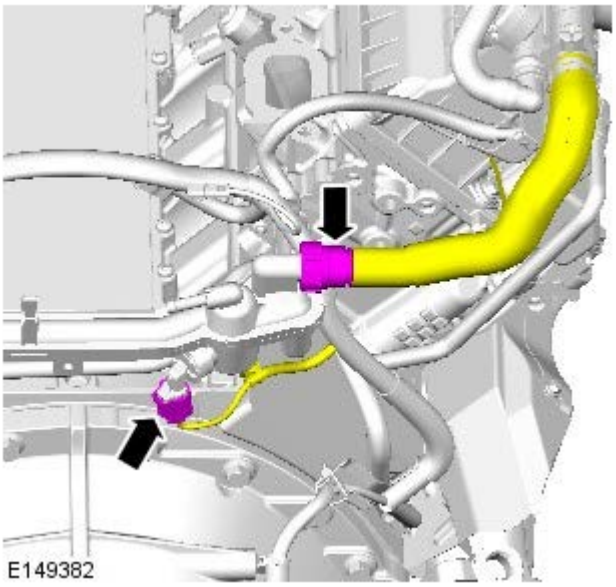


14. CAUTION: Install the new seals.

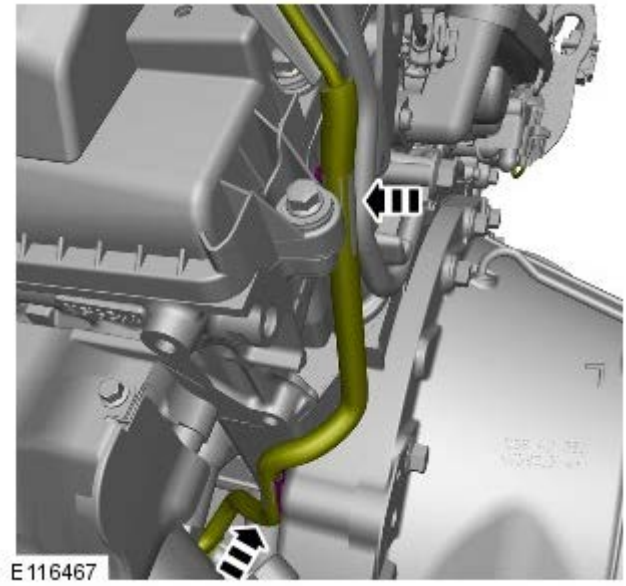
Torque: 10 Nm



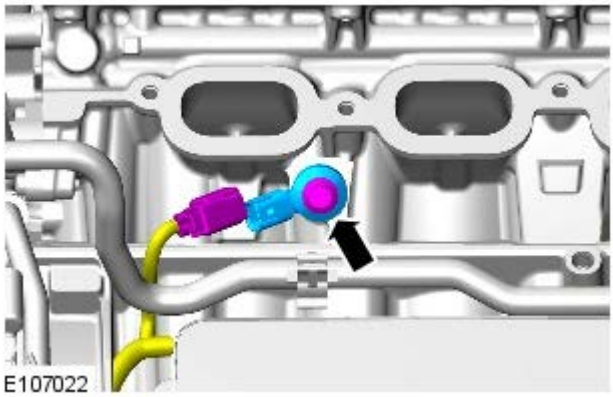
15.



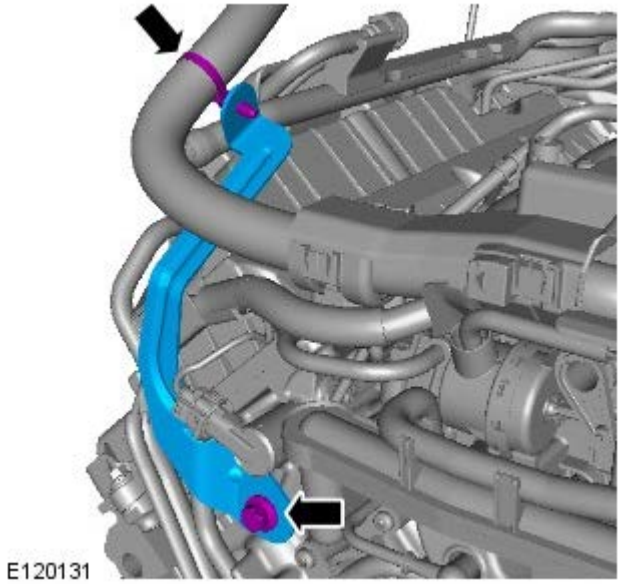
16.



17. *Torque:* 20 Nm



18. *Torque:* 25 Nm


E120131

19. Refer to: Camshaft LH (303-01C Engine - V8 S/C 5.0L Petrol, Removal and Installation).

20. Refer to: Exhaust Manifold LH (303-01B Engine - V6 S/C 3.0L Petrol, Removal and Installation).

21. Reconnect the battery ground cable.

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

Published: 02-May-2013

Engine - V6 S/C 3.0L Petrol - Cylinder Head RH

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.

1. Disconnect the battery ground cable.

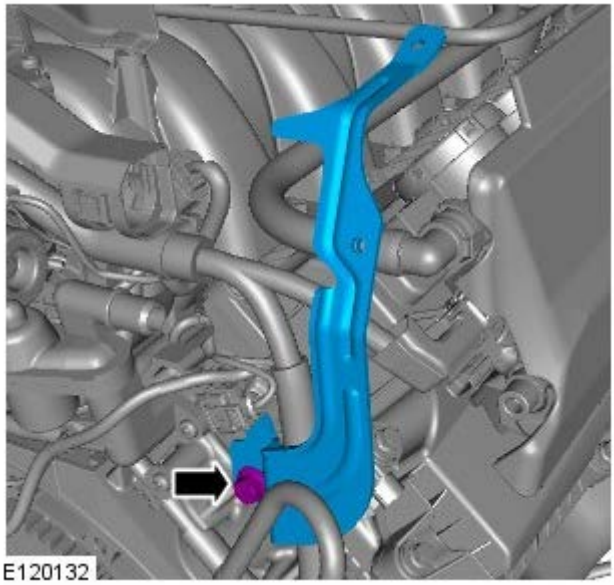
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

2. Raise and support the vehicle.

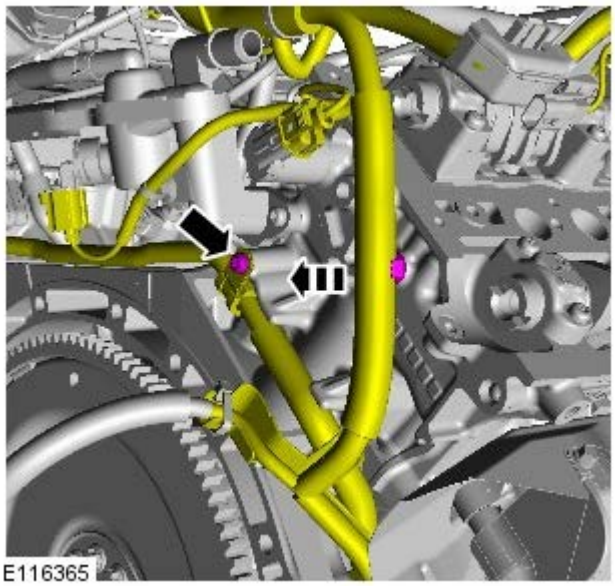
3. Refer to: Exhaust Manifold RH (303-01B Engine - V6 S/C 3.0L Petrol, Removal and Installation).

4. Refer to: Camshaft RH (303-01B Engine - V6 S/C 3.0L Petrol, Removal and Installation).

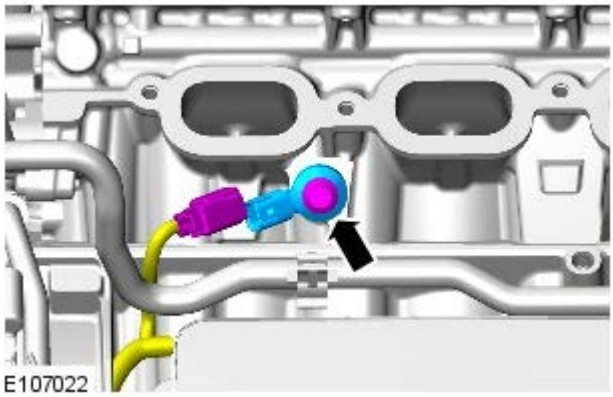
5.



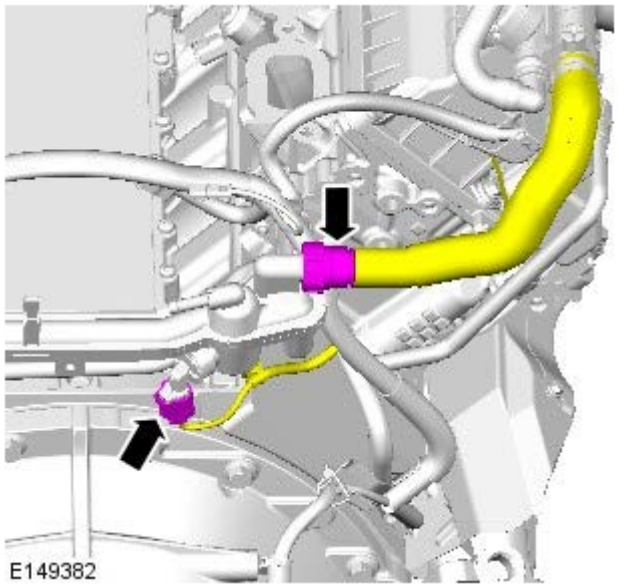
6.



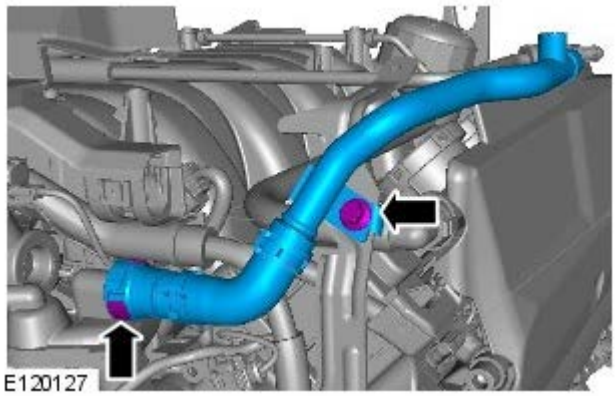
7.



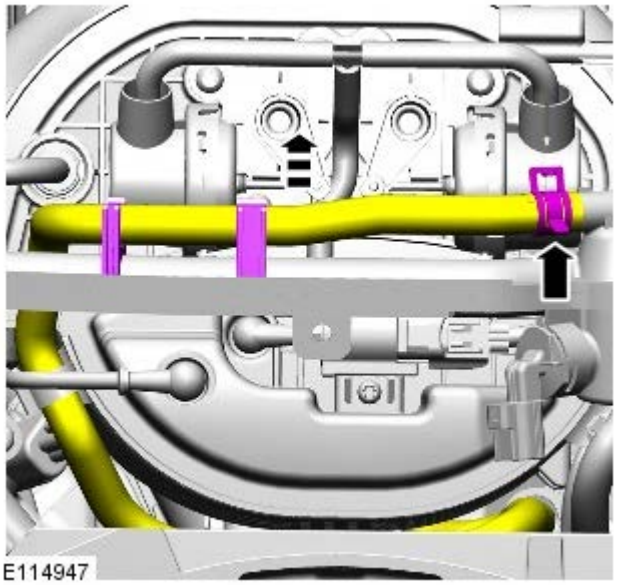
8. NOTE: Clamp the hose to minimize coolant loss.



9.



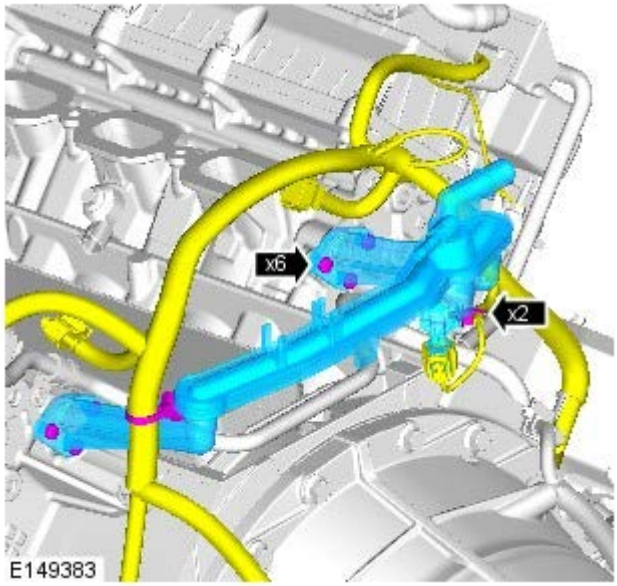
10. CAUTION: Clamp the hoses to minimize coolant loss.



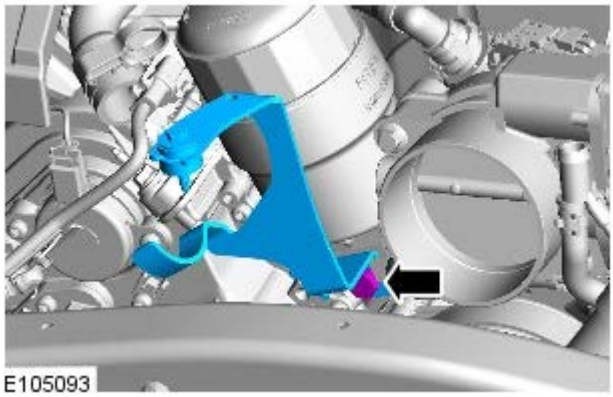
11. CAUTIONS:

    Discard the seals.

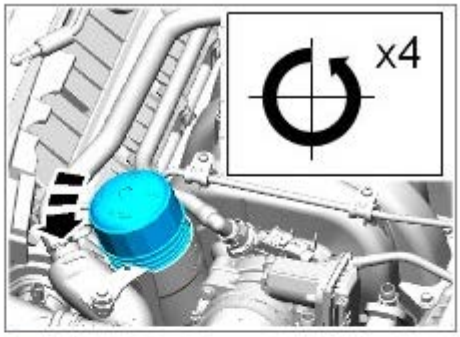
    Be prepared to collect escaping coolant.

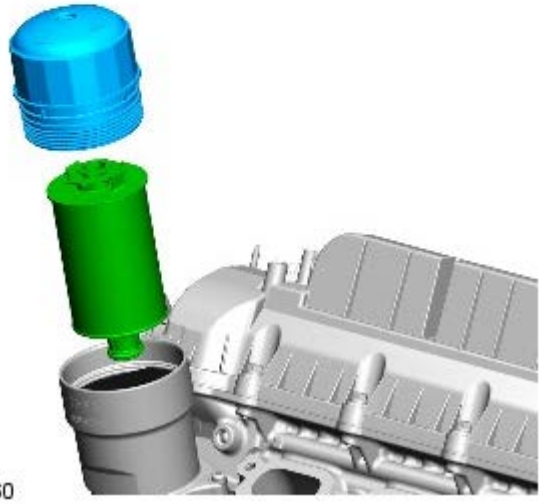


12.



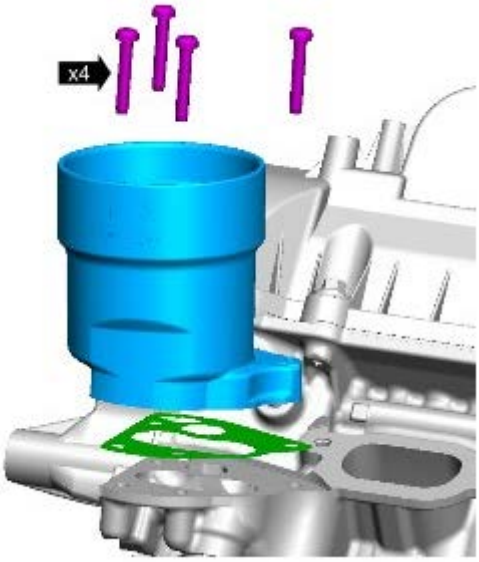
13. NOTE: Remove and discard the O-ring seal.





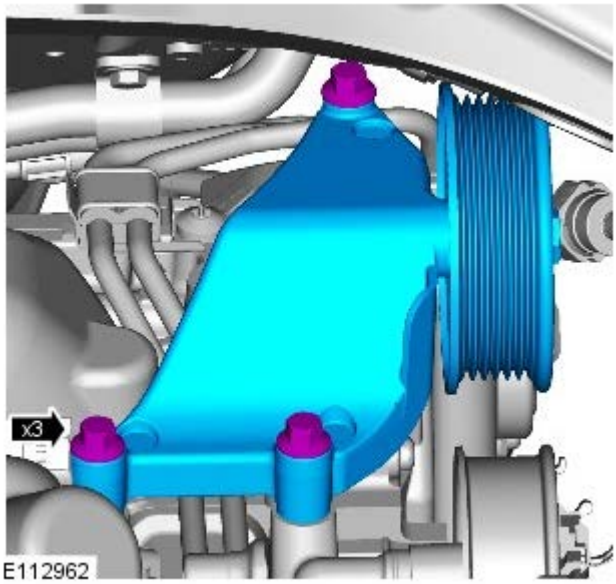
E114960

14. NOTE: Discard the gasket.



E114959

15.

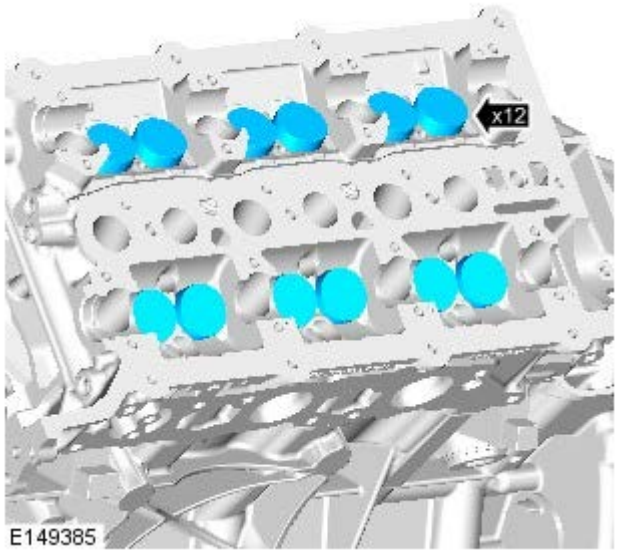


16. CAUTIONS:

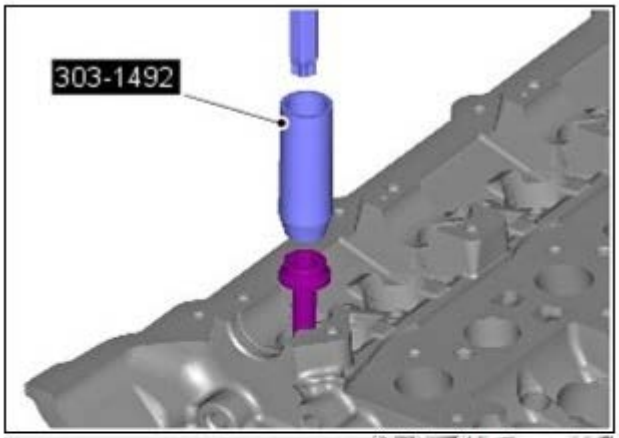
If a new cylinder head has been installed then new tappets must be installed.

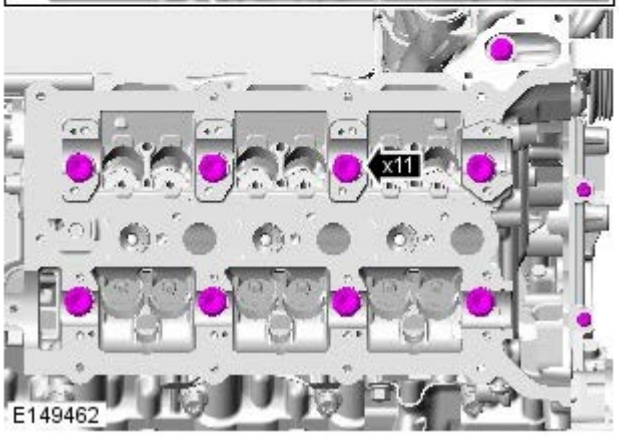
If the cylinder head is being removed without a new component being installed, the tappets must be installed in their original positions.

NOTE: Left-hand shown, right-hand similar.

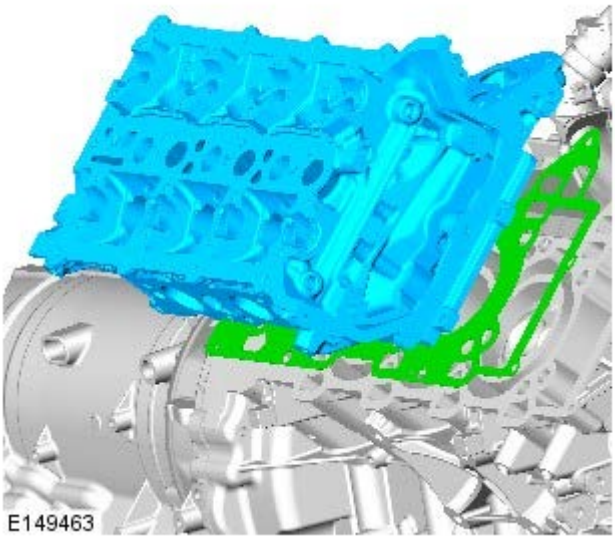


17. CAUTION: Discard the bolts.

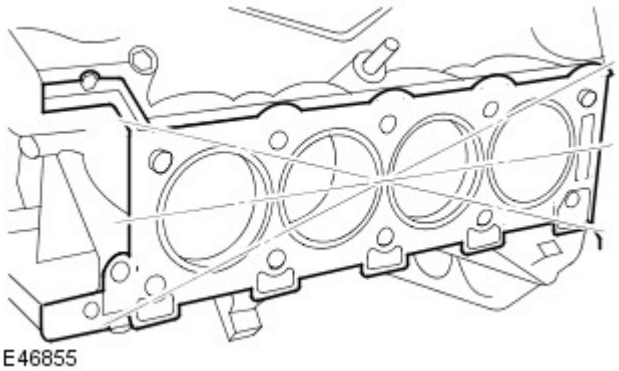




18.

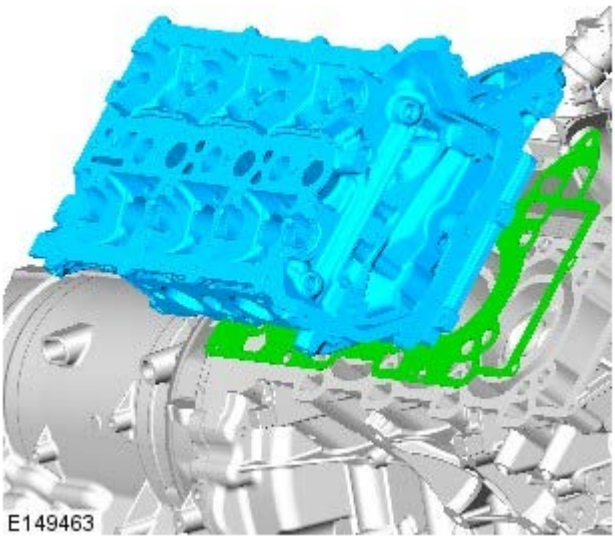


Installation



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.



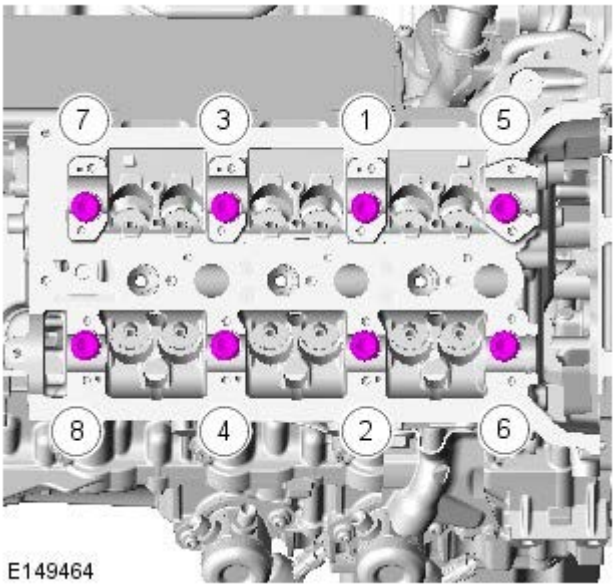
2. WARNING: Make sure care is taken when handling the cylinder head gasket.

   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.

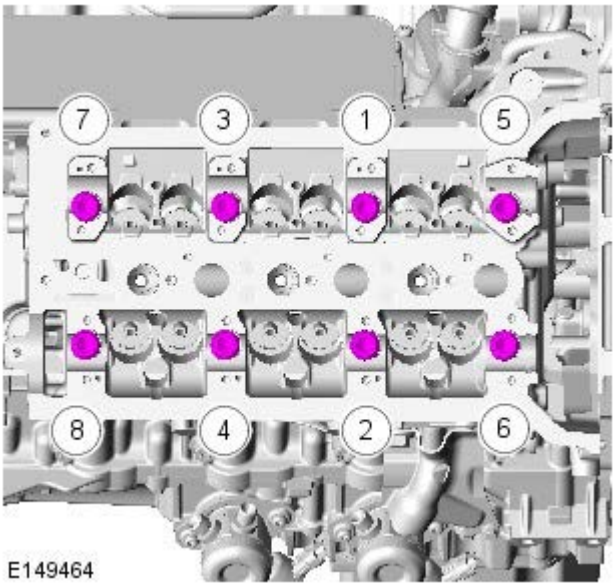
   NOTE: Install a new cylinder head gasket.



3. CAUTION: Make sure that new cylinder head bolts are installed.

   NOTE: Tighten the bolts in the indicated sequence.

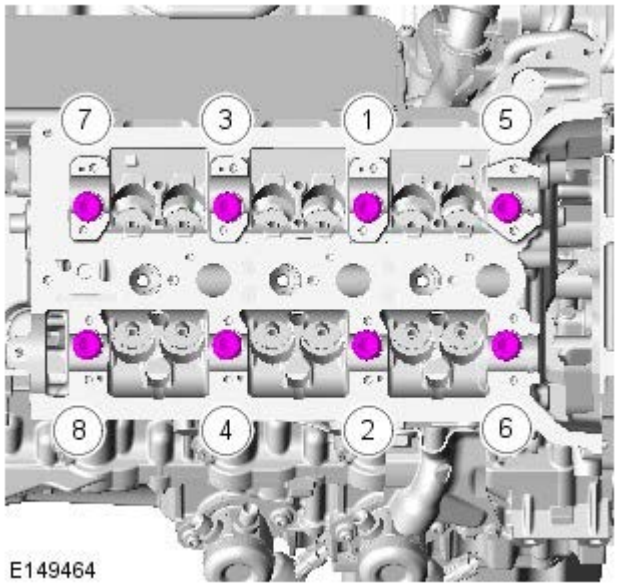
   Torque: 20 Nm

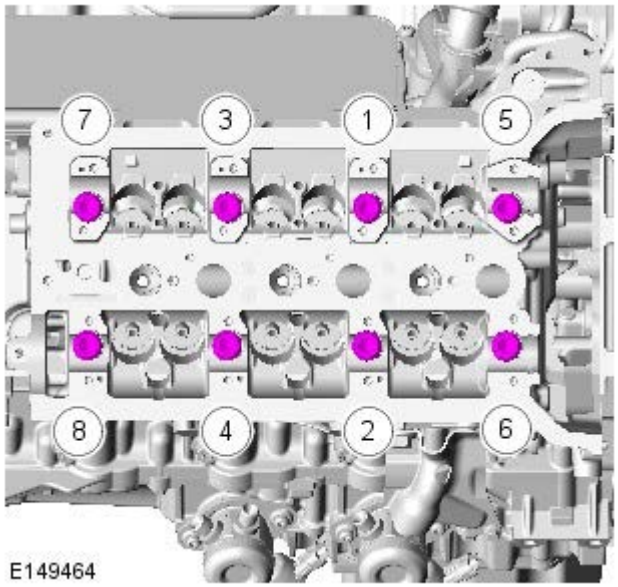


4. NOTE: Tighten the bolts in the indicated sequence.

   Torque: 35 Nm

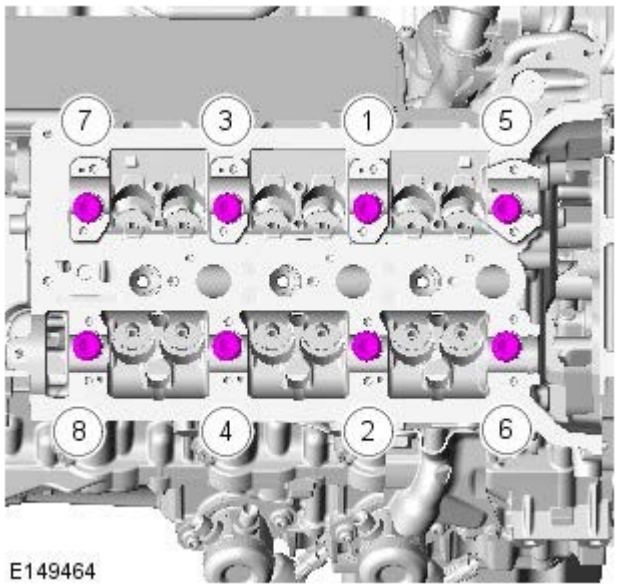
5. NOTE: Slacken the bolts in the sequence shown.





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

Torque: 35 Nm

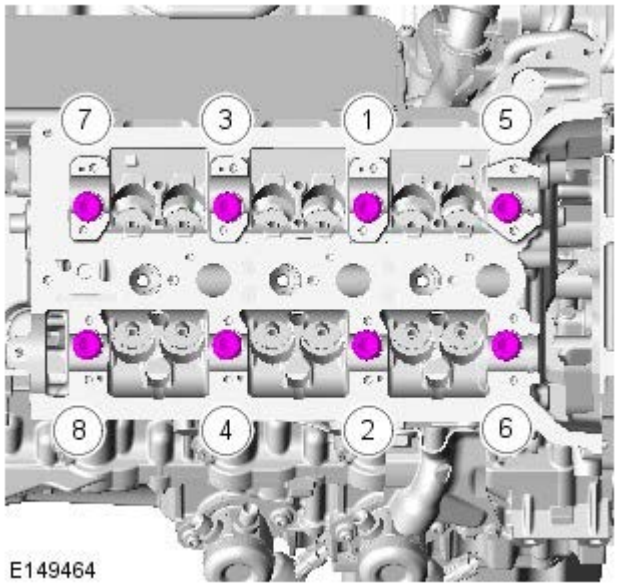


7. NOTE: Tighten the bolts in the indicated sequence.

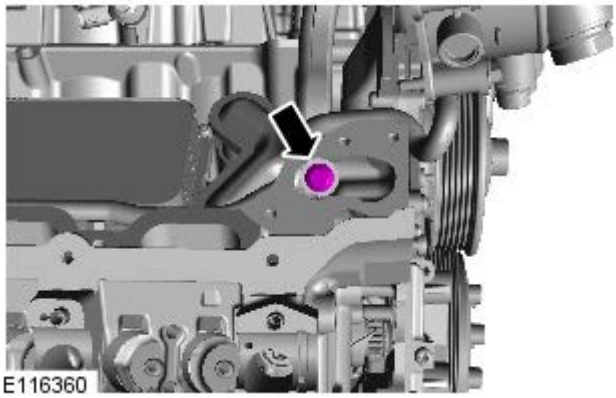
Tighten the bolts 1 to 8, a further 90 degrees.

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

Tighten the bolts 1 to 8, a further 120 degrees.

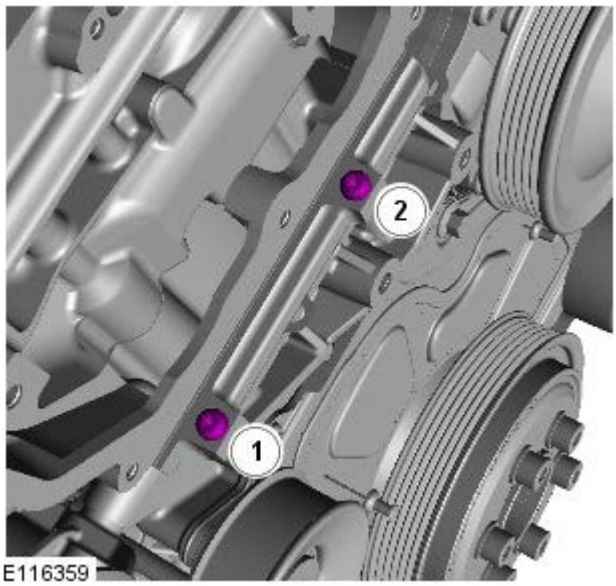


9. *Torque:* 25 Nm



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

Torque: 12 Nm

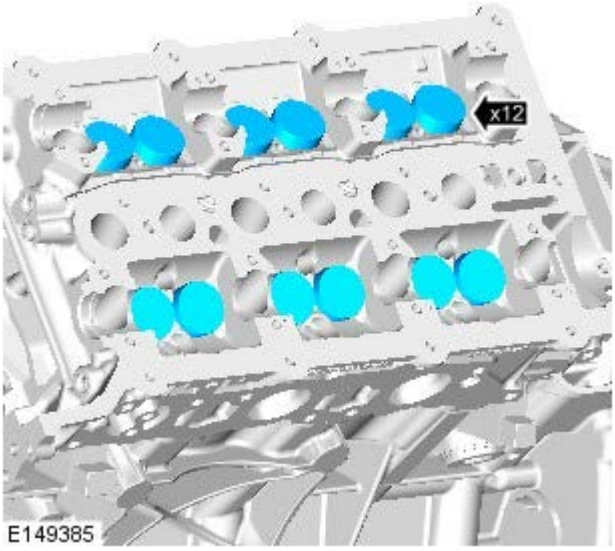


11. CAUTIONS:

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.

NOTES:

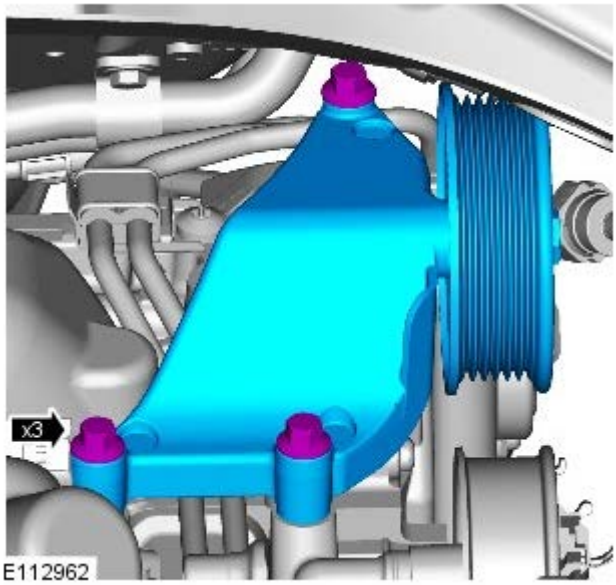


Some variation in the illustrations may occur, but the essential information is always correct.

Left-hand shown, right-hand similar.

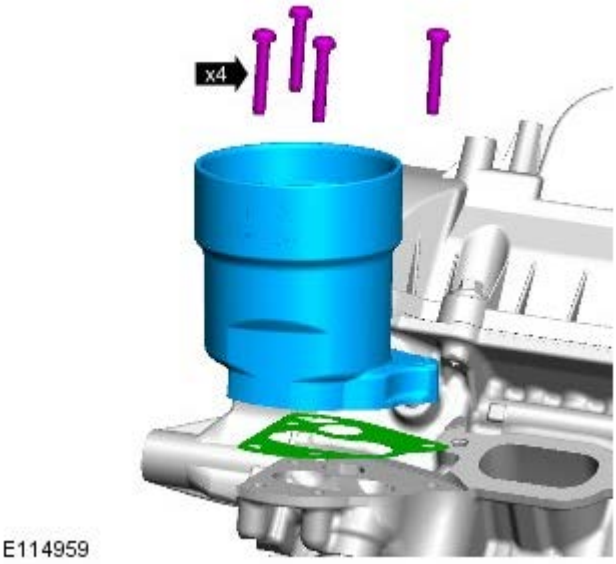
Lubricate the valve tappets with clean engine oil.

12. *Torque:* 25 Nm



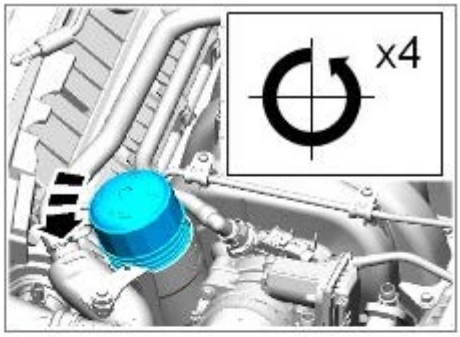
13. NOTE: Install a new gasket.

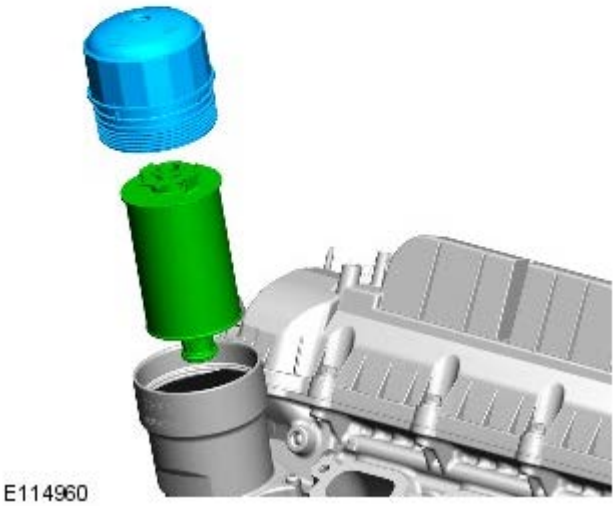
Torque: 12 Nm



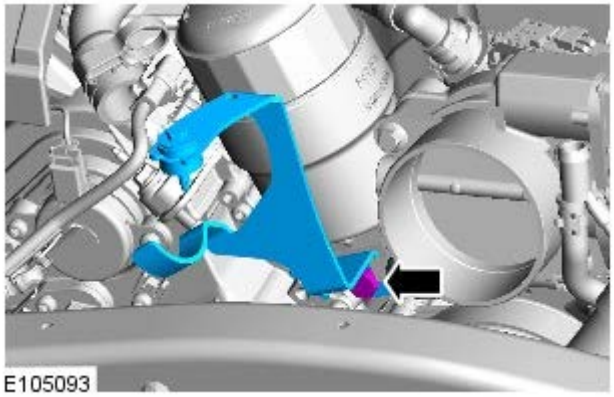
14. CAUTION: A new O-ring seal is to be installed.

NOTE: Install a new engine oil filter.



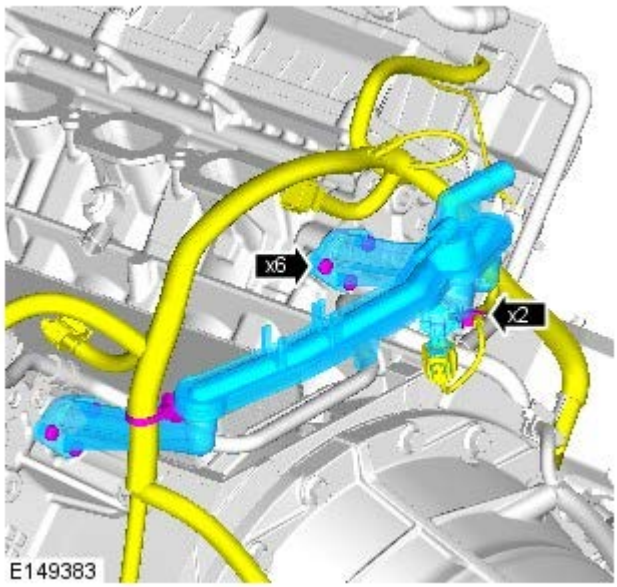


15. *Torque:* 10 Nm

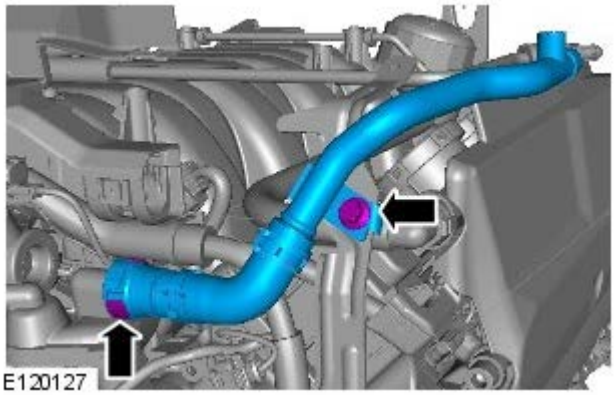


16. CAUTION: Install the new seals.

Torque: 10 Nm

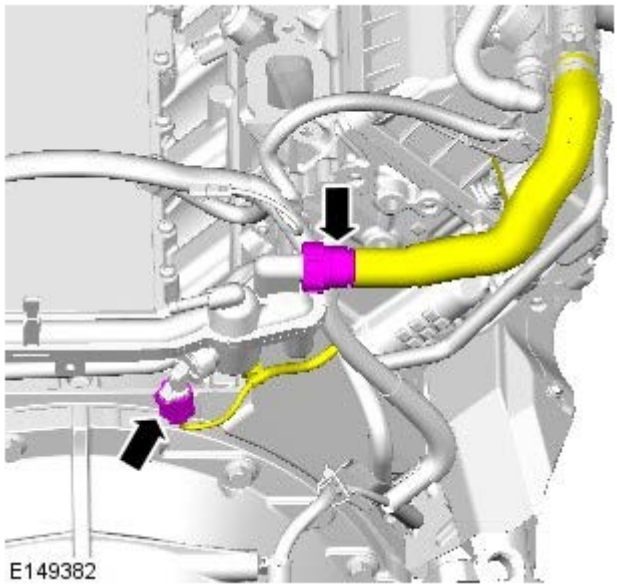


17. CAUTION: Be prepared to collect escaping coolant.

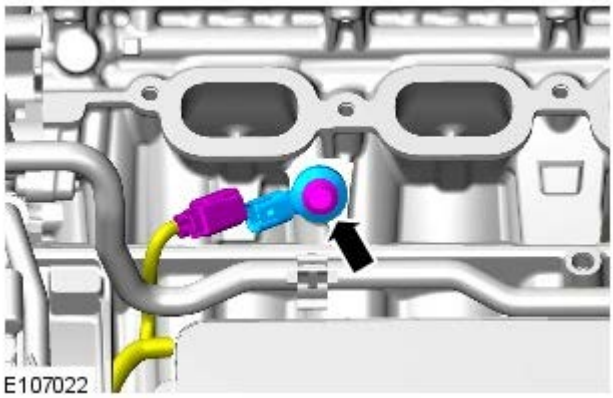


Torque: 10 Nm

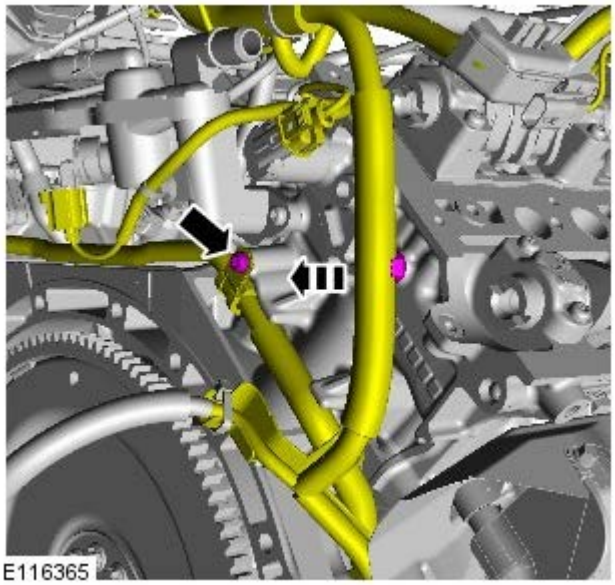
18.



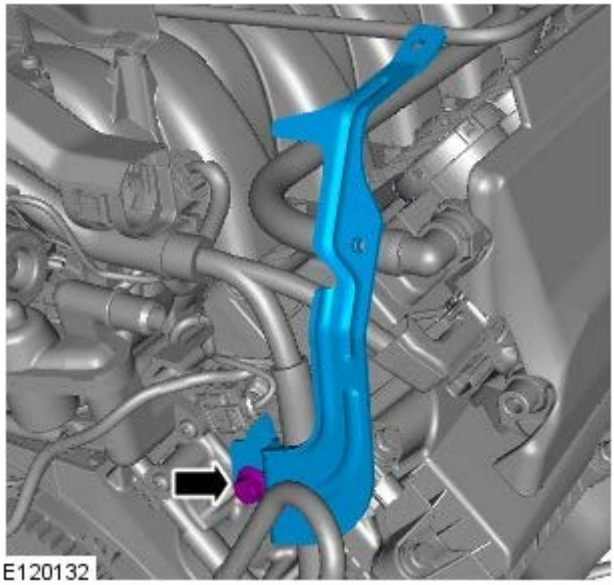
19. *Torque:* 20 Nm



20. *Torque:* 10 Nm


E116365

21.


E120132

22. Refer to: Camshaft RH (303-01B Engine - V6 S/C 3.0L Petrol, Removal and Installation).

23. Refer to: Exhaust Manifold RH (303-01B Engine - V6 S/C 3.0L Petrol, Removal and Installation).

24. Reconnect the battery ground cable.

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

Published: 22-Oct-2013

Engine - V6 S/C 3.0L Petrol - Engine Mount LH

Removal and Installation

Removal

NOTES:

Some components shown removed for clarity.

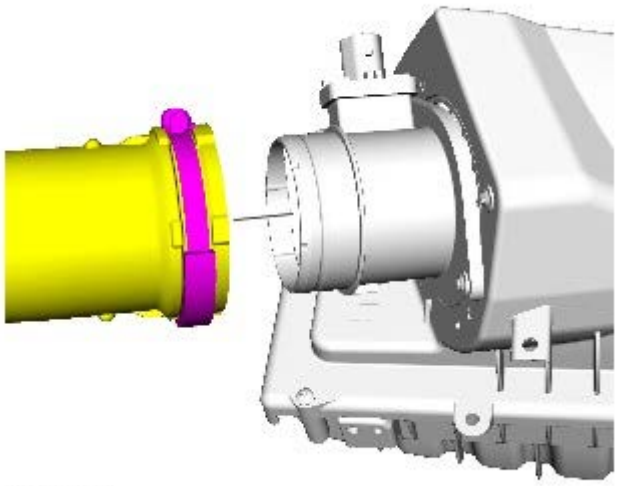
Some variation in the illustrations may occur, but the essential information is always correct.

All vehicles

1. Disconnect the battery ground cable.

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

2.



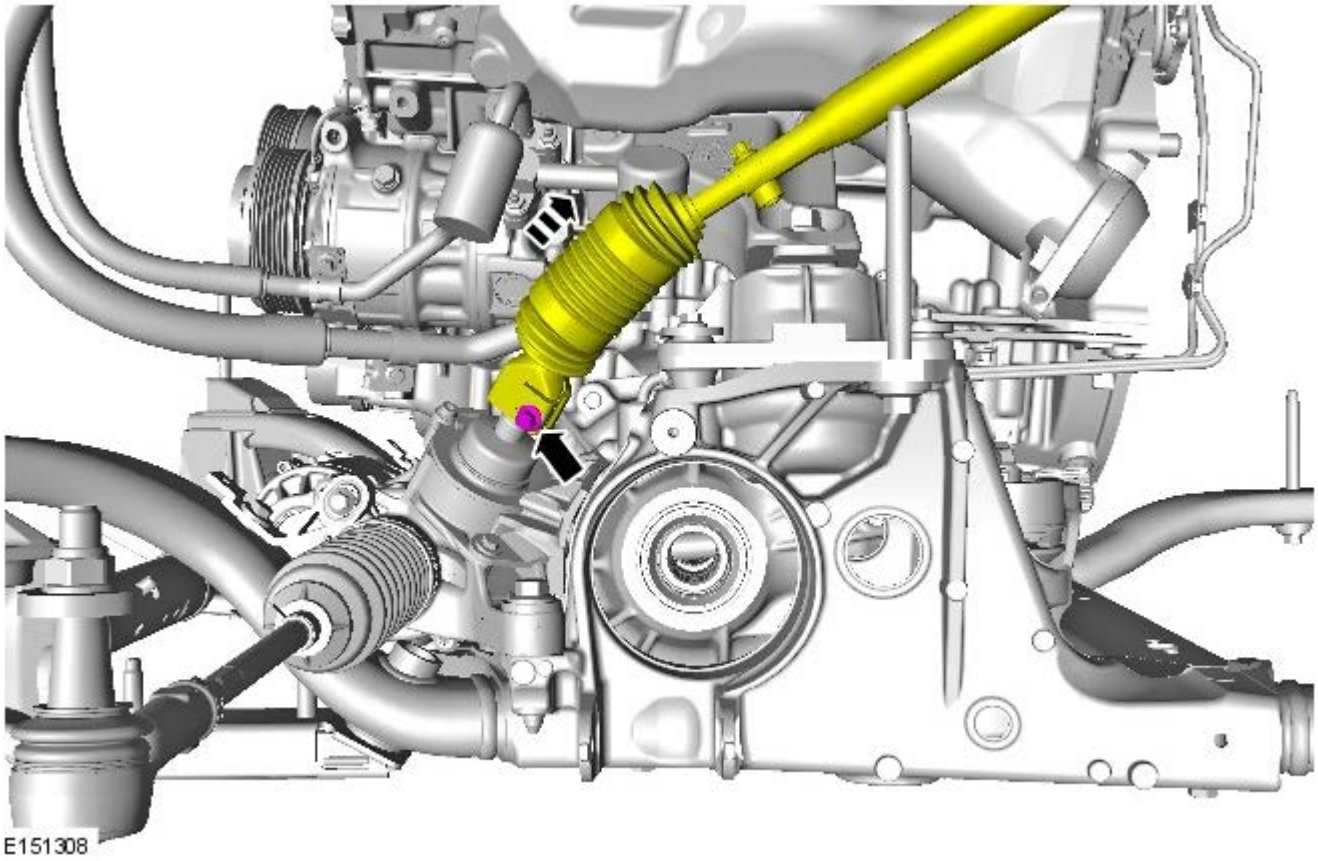
E157217

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

   Raise and support the vehicle.

Left-hand drive vehicles

4. CAUTION: Discard the bolt.

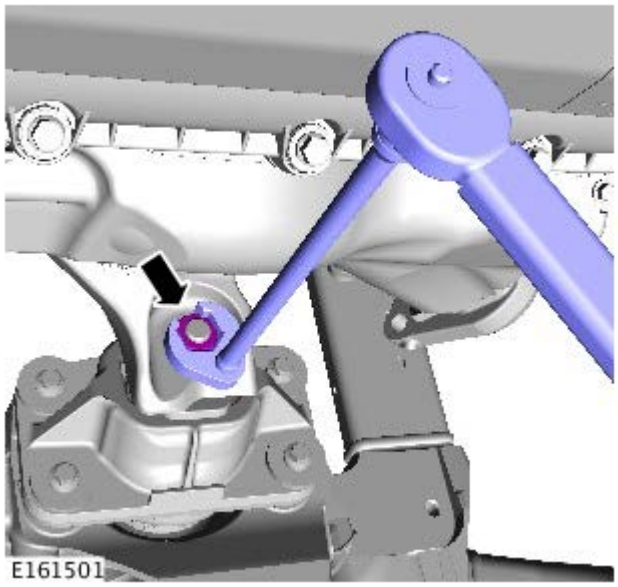


All vehicles

5. Refer to: Catalytic Converter LH (309-00C Exhaust System - V8 S/C 5.0L Petrol, Removal and Installation).

6. Refer to: Front Driveshaft - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (205-01 Driveshaft, Removal and Installation).

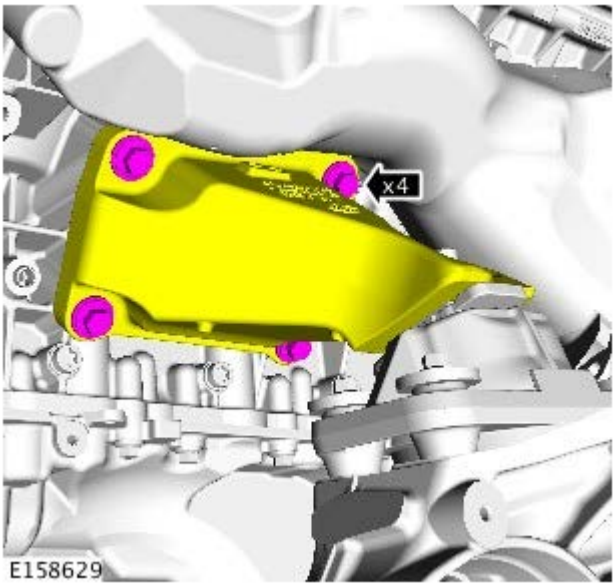
7.



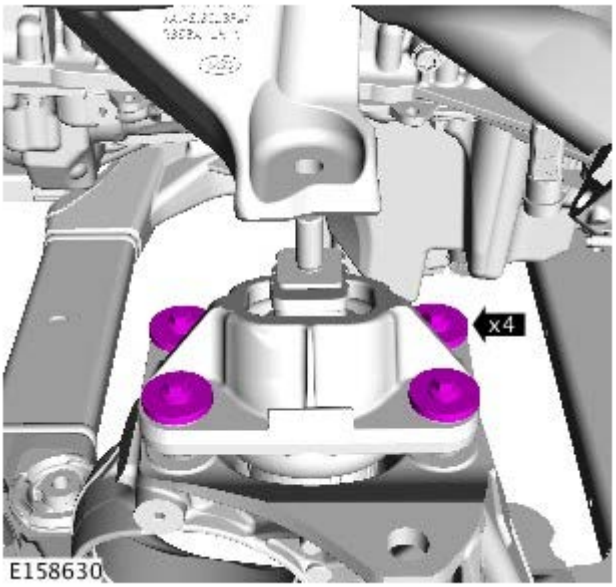
8. CAUTION: Use a wooden block to protect the oil pan when supporting the engine.

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

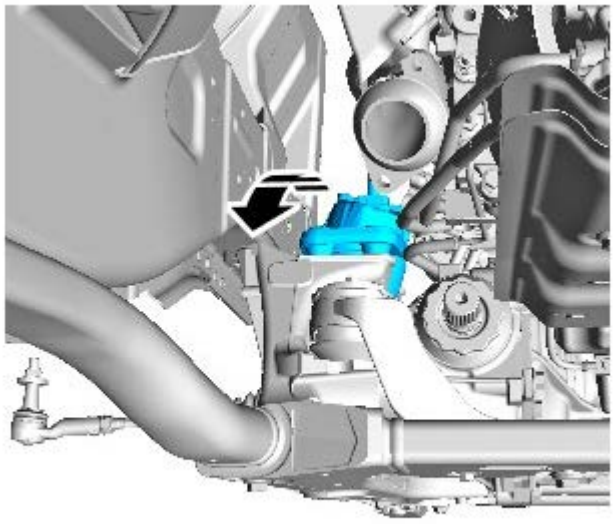
9. NOTE: Loosen the bolts, but do not fully remove.



10. CAUTION: Discard the bolts.



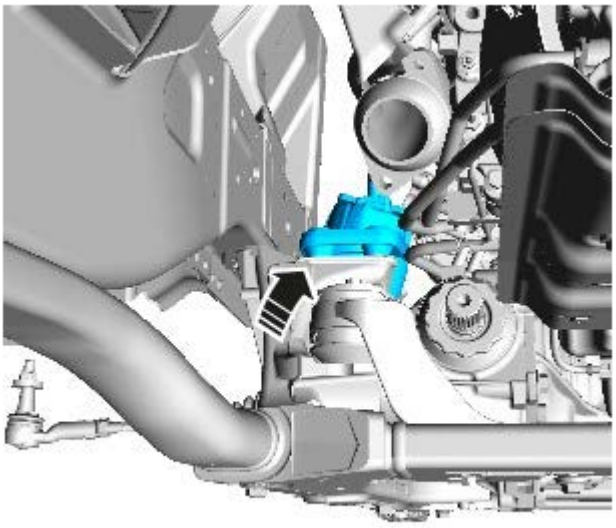
11.



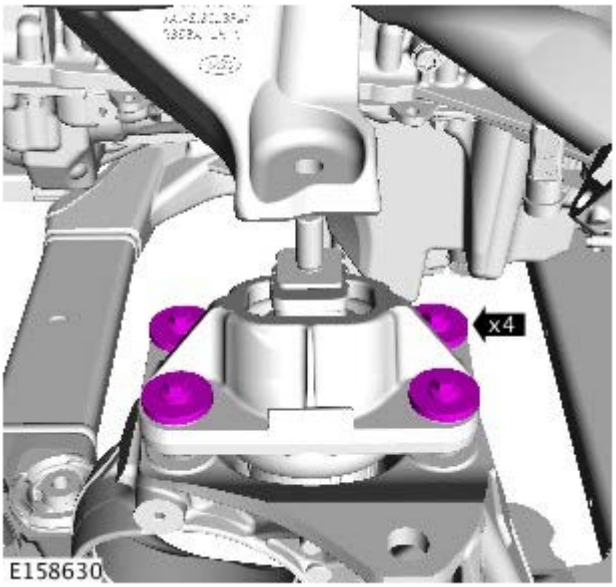
Installation

All vehicles

1.



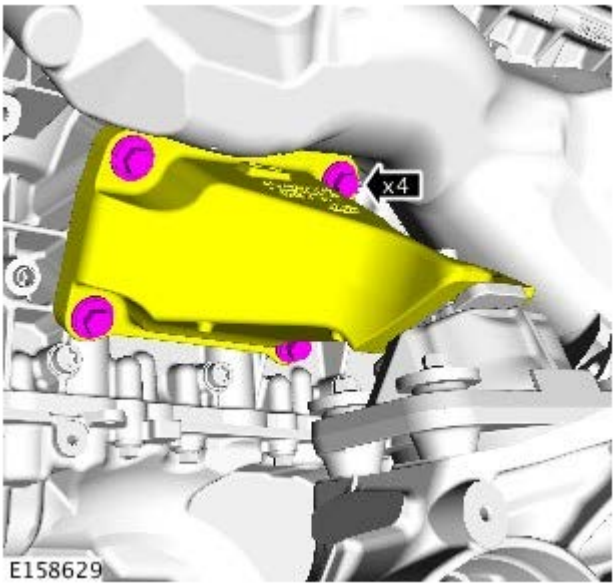
E158631



E158630

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

   NOTE: Make sure that new bolts are installed.

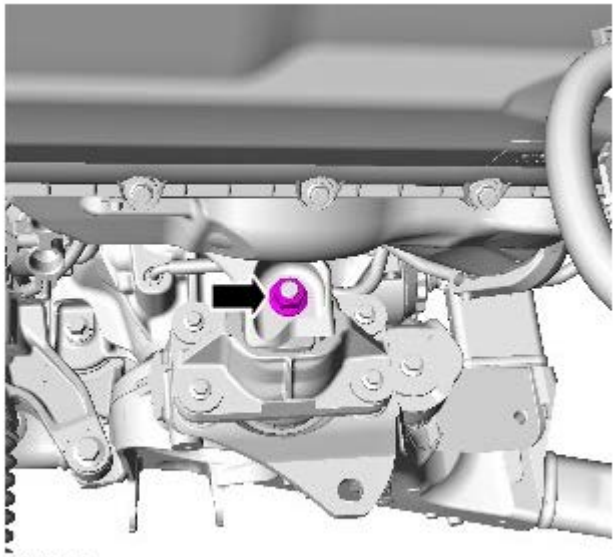


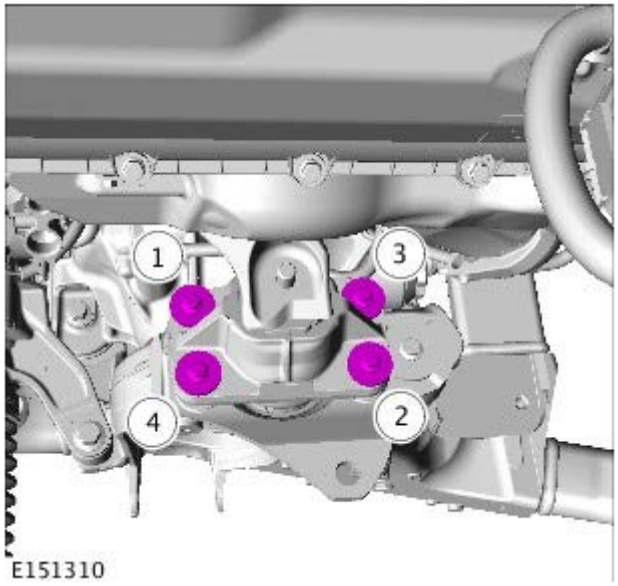
E158629

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

4. Lower the engine onto the mount.

5. CAUTION: Only tighten the nut finger tight at this stage.


E151309

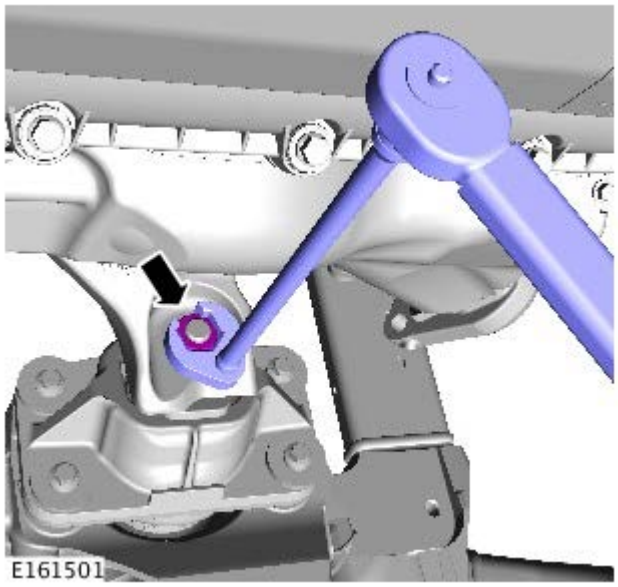


E151310

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

   Torque: 40 Nm

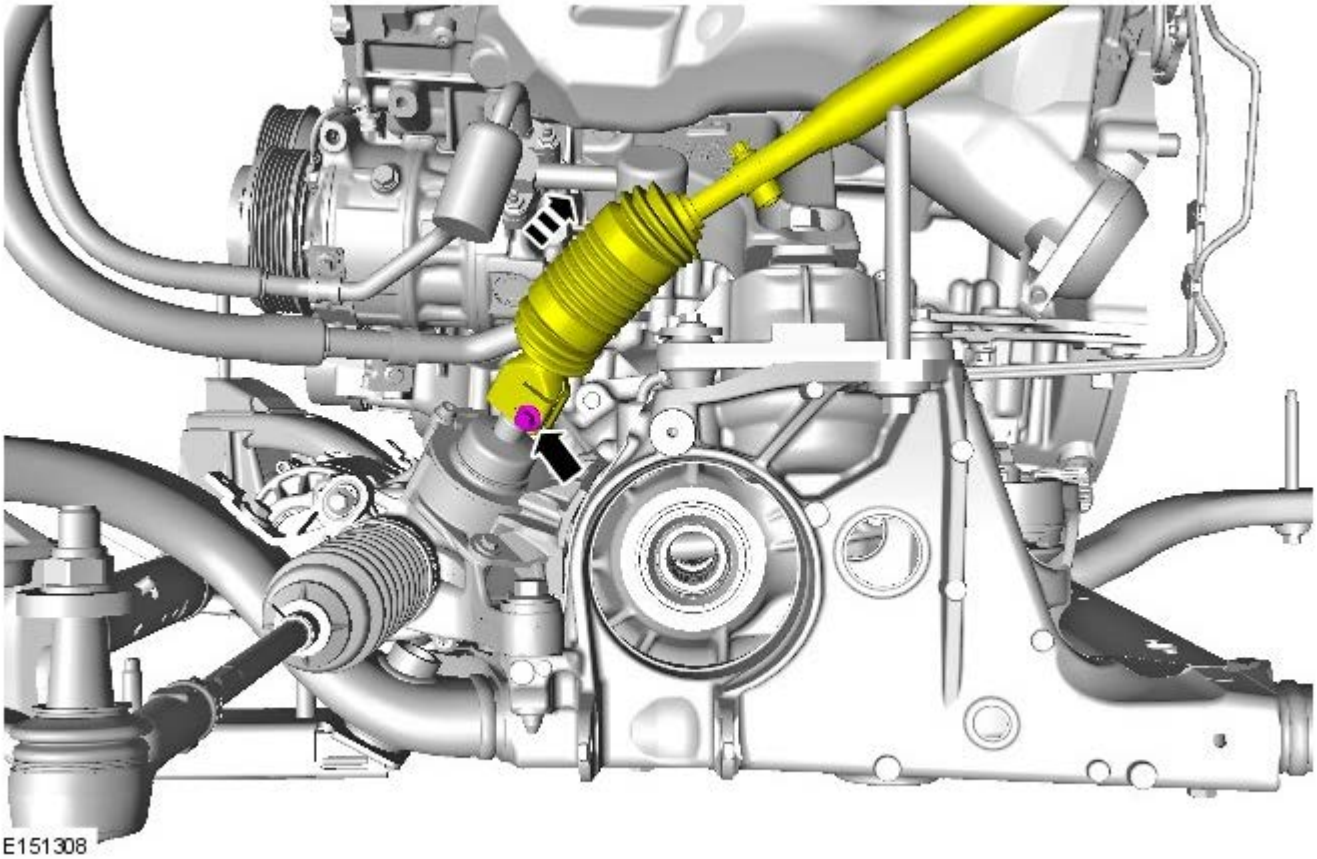
7. *Torque:* 110 Nm


E161501

Left-hand drive vehicles

8. WARNING: Make sure that a new bolt is installed.

   CAUTION: Discard the bolt.


E151308

All vehicles

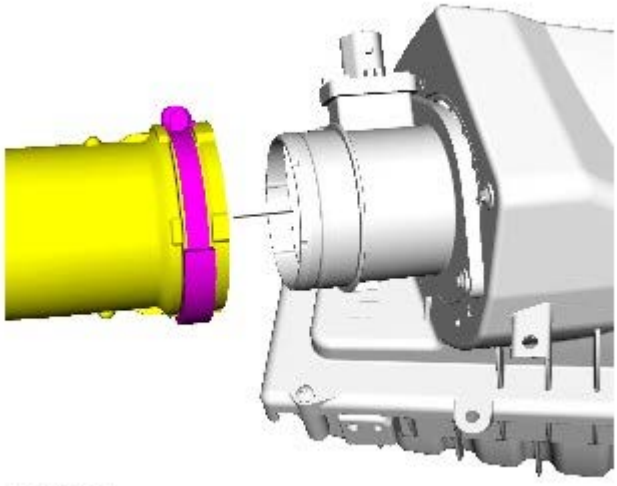
9. Refer to: Front Driveshaft - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (205-01 Driveshaft, Removal and Installation).

10. Refer to: Catalytic Converter LH (309-00C Exhaust System - V8 S/C 5.0L Petrol, Removal and Installation).

11. Connect the battery ground cable.

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

12.


E157217

Published: 28-Jun-2013

Engine - V6 S/C 3.0L Petrol - Engine Mount RH

Removal and Installation

Removal

NOTES:

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

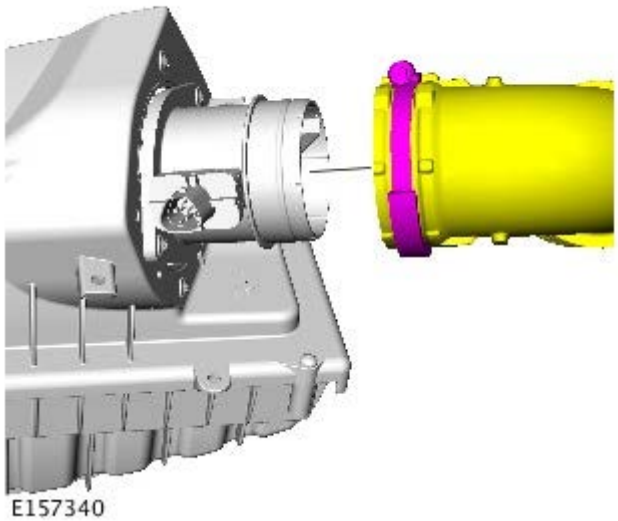
Some components shown removed for clarity.

All vehicles

1. Disconnect the battery ground cable.

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

2.



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

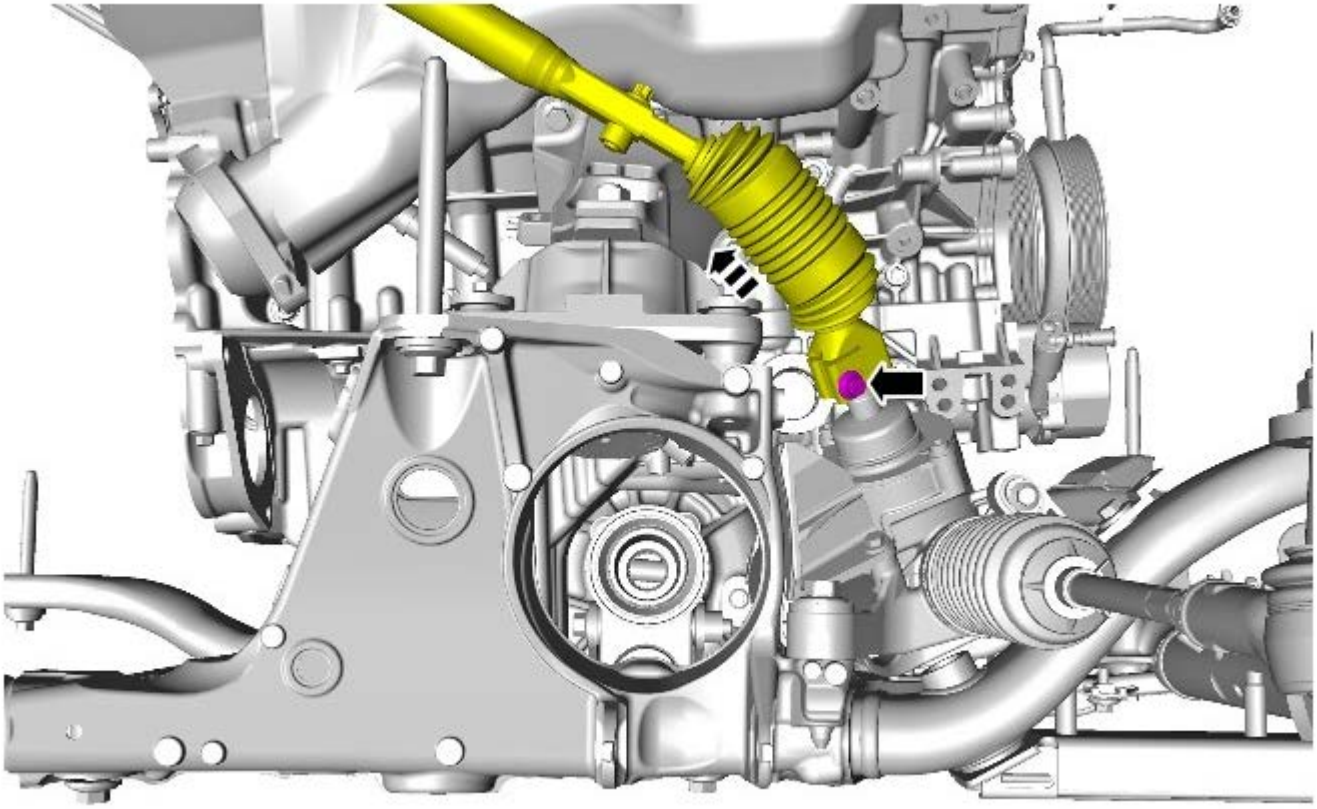
   Raise and support the vehicle.

4. Refer to: Catalytic Converter RH (309-00C Exhaust System - V8 S/C 5.0L Petrol, Removal and Installation).

5. Refer to: Starter Motor (303-06C Starting System - V8 S/C 5.0L Petrol, Removal and Installation).

Right-hand drive vehicles

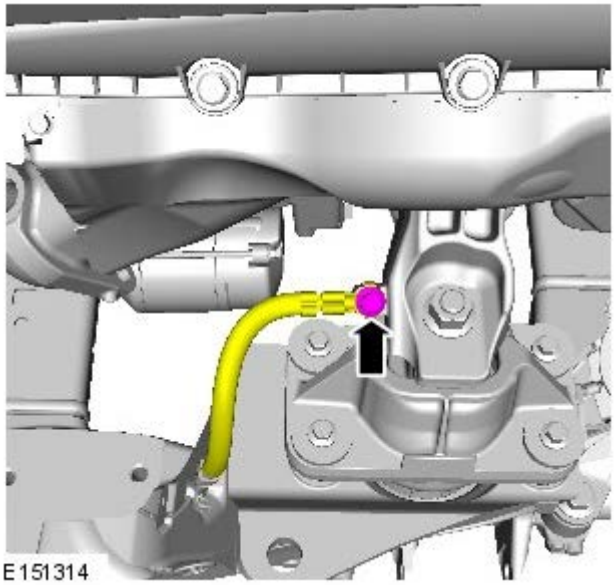
6. CAUTION: Discard the bolt.



E151313

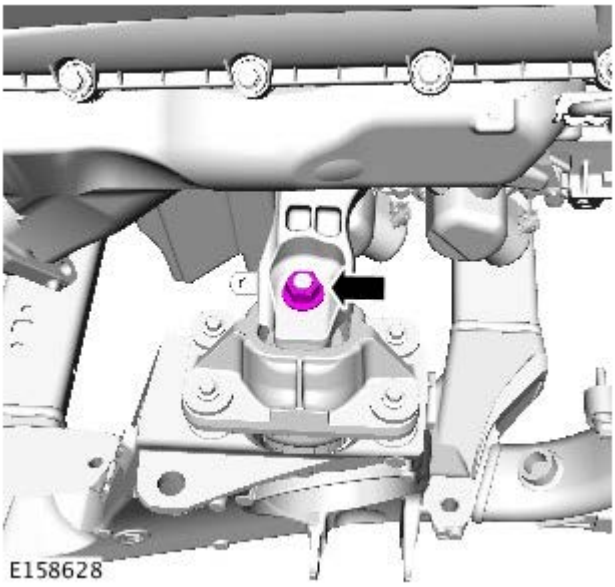
All vehicles

7.



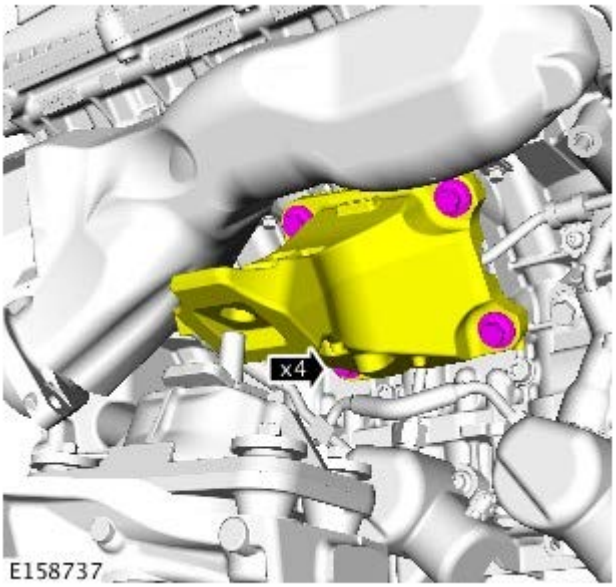
E151314

8.

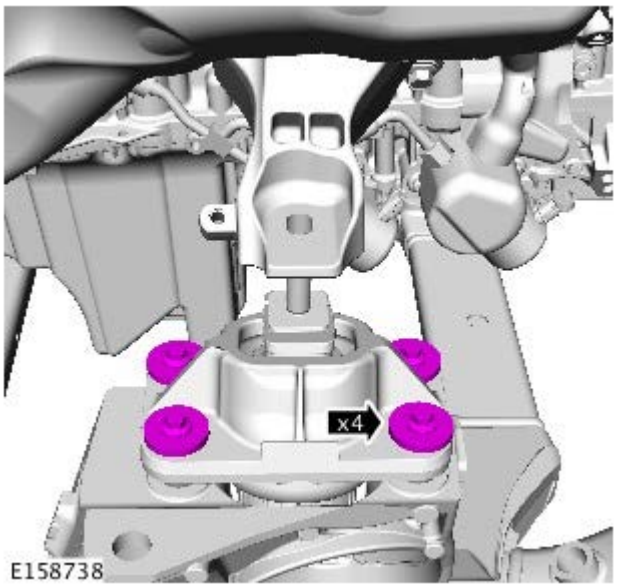


9. CAUTION: Use a wooden block to protect the oil pan when supporting the engine.

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

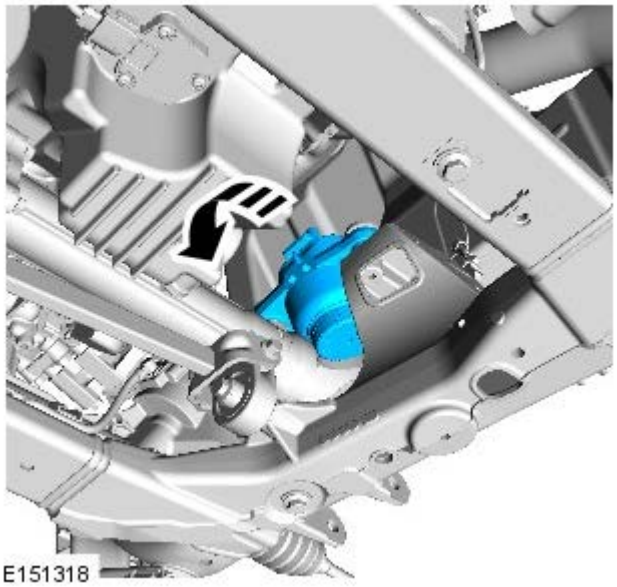


10. NOTE: Loosen the bolts, but do not fully remove.



11. CAUTION: Discard the bolts.

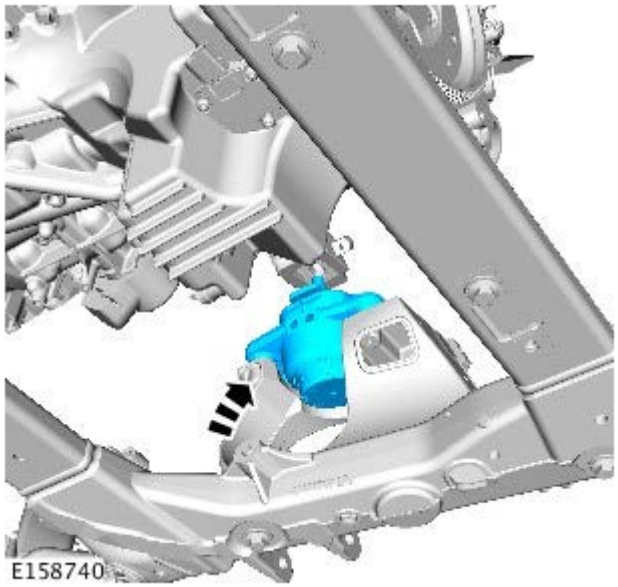
12.

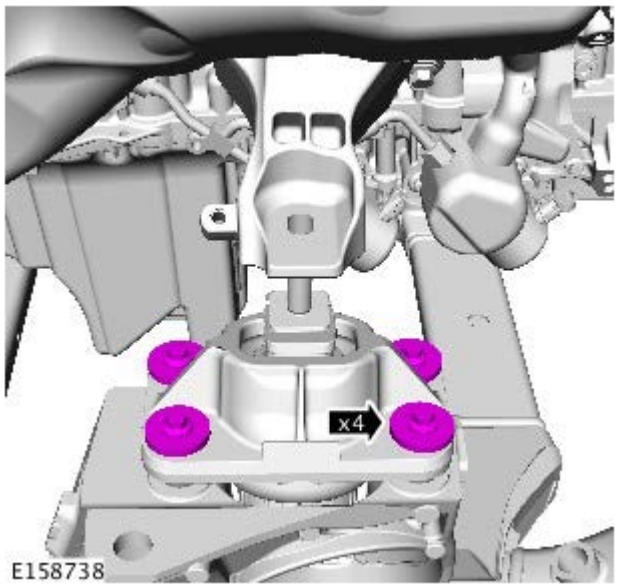


Installation

All vehicles

1.



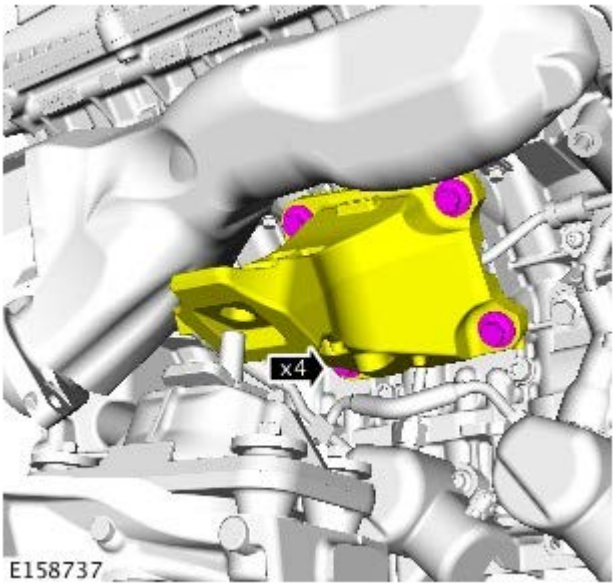


2. CAUTIONS:

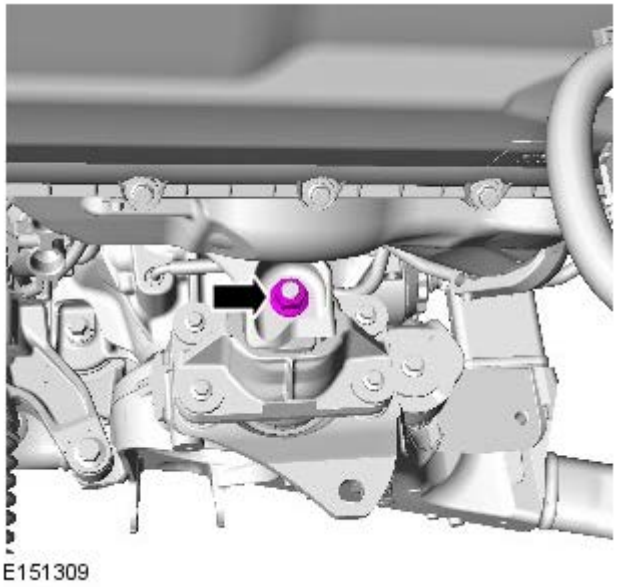
Make sure that new bolts are installed.

Only tighten the bolts finger-tight at this stage.

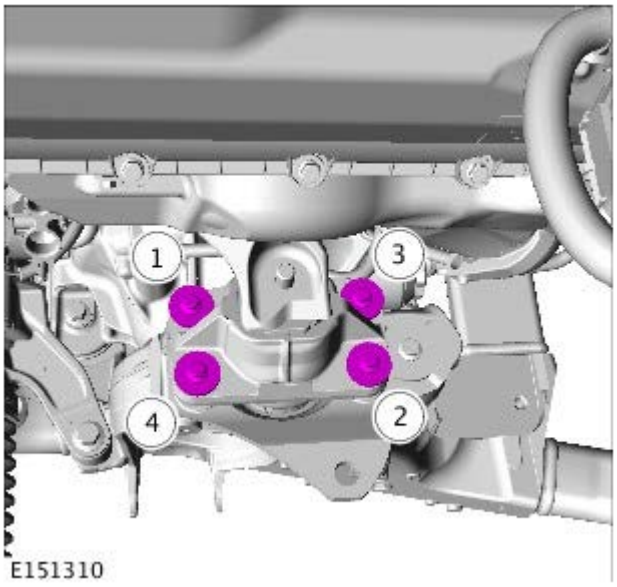
3. *Torque:*
   Stage 1: 45 Nm
   Stage 2: 60°



4. Lower the engine onto the mount.



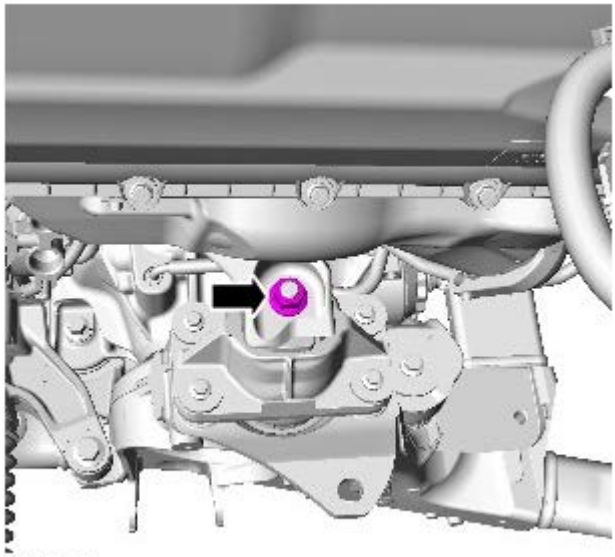
5. CAUTION: Only tighten the nut finger tight at this stage.



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

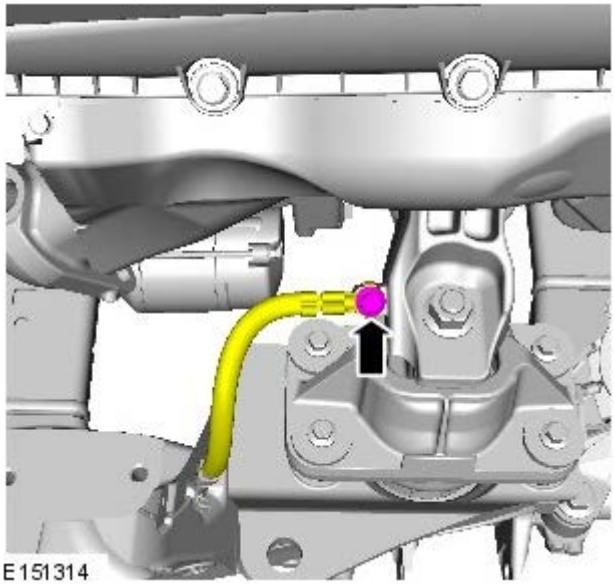
Torque: 40 Nm

7. *Torque:* 130 Nm



E151309

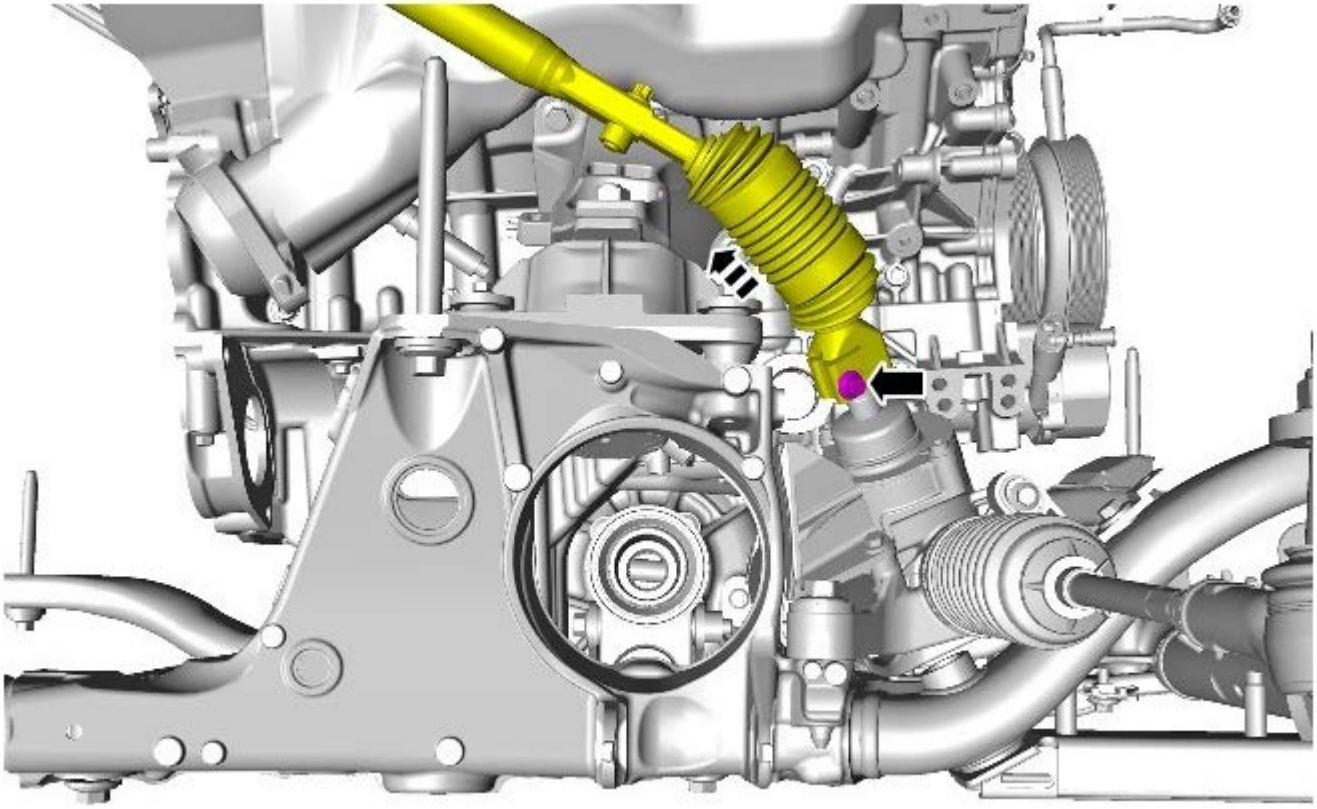
8.



E151314

Right-hand drive vehicles

9. CAUTION: Make sure that a new bolt is installed.



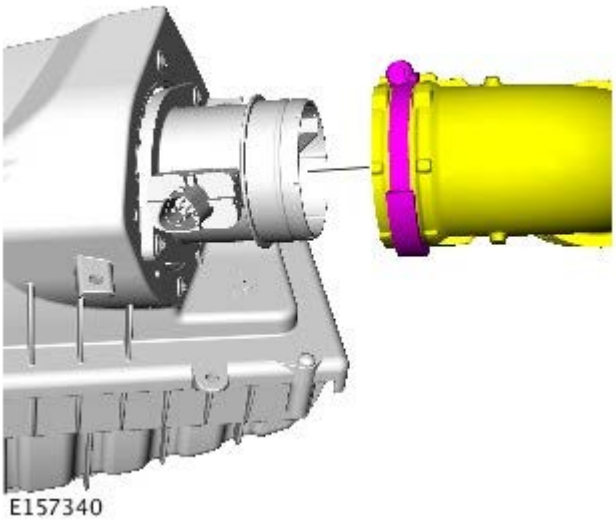
E151313

All vehicles

10. Refer to: Starter Motor (303-06C Starting System - V8 S/C 5.0L Petrol, Removal and Installation).

11. Refer to: Catalytic Converter RH (309-00C Exhaust System - V8 S/C 5.0L Petrol, Removal and Installation).

12.



E157340

13. Connect the battery earth lead.

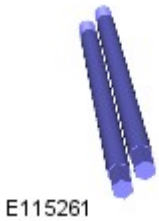
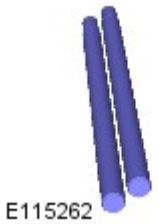
    Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 02-May-2013

Engine - V6 S/C 3.0L 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 Battery and Charging System - General Information, Specifications).

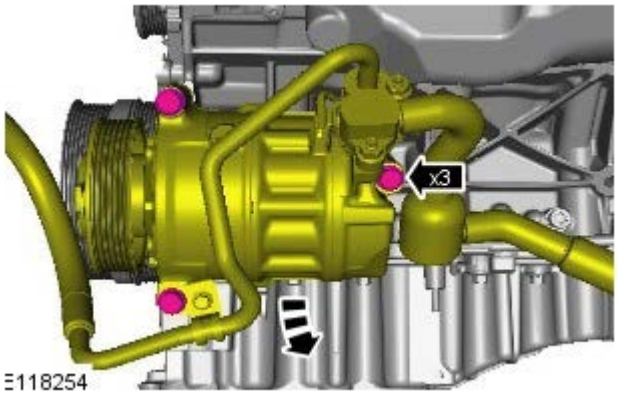
2. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

3. Refer to: Exhaust System (309-00B Exhaust System - V6 S/C 3.0L Petrol, Removal and Installation).

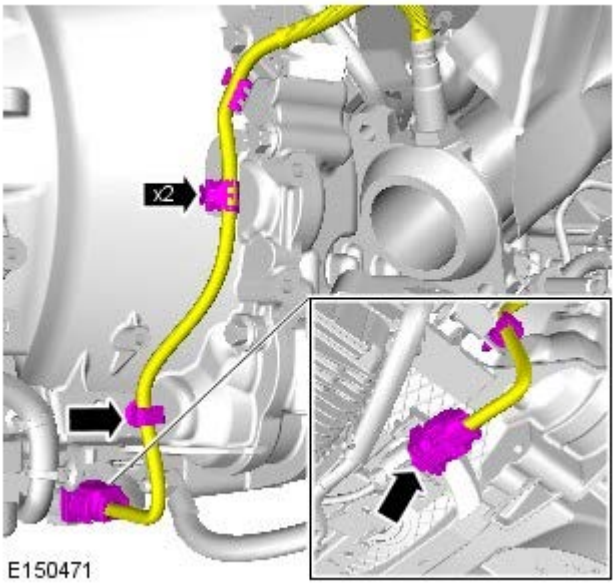
4. Refer to: Accessory Drive Belt (303-05B Accessory Drive - V6 S/C 3.0L Petrol, Removal and Installation).

5. NOTE: Loosen the bolts, but do not fully remove.

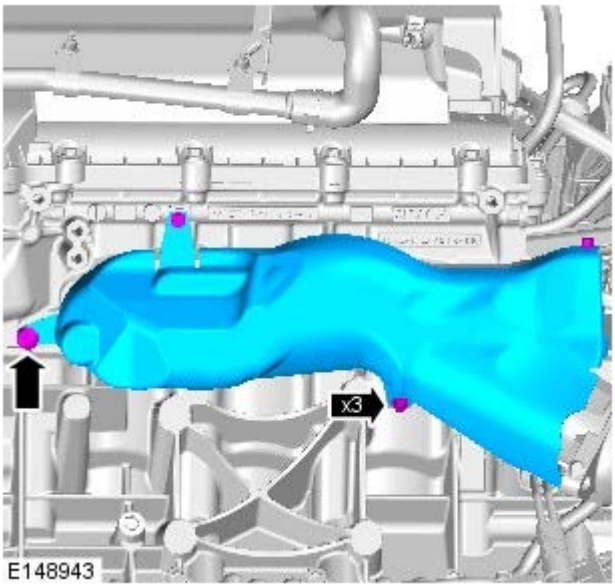


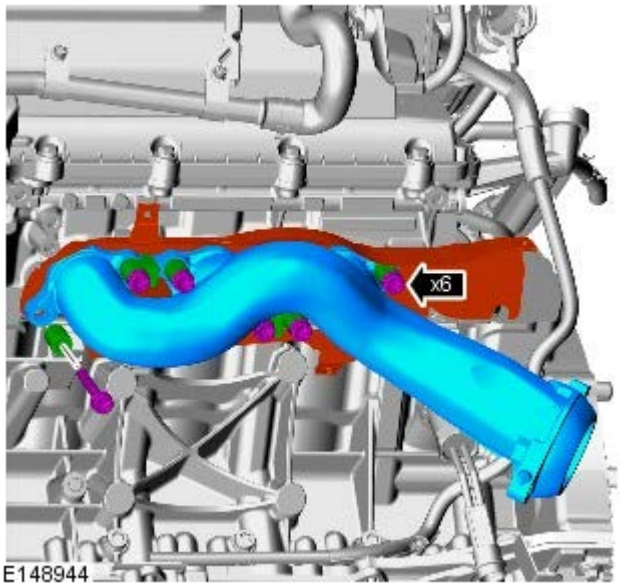
E118254

6.



7.





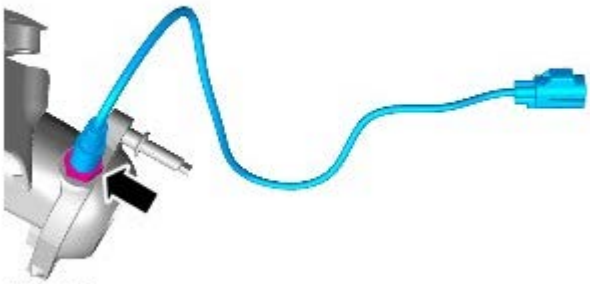
8. CAUTION: Discard the bolts.

NOTES:

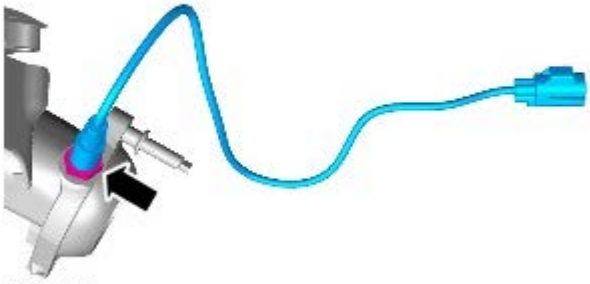
Discard the gasket.

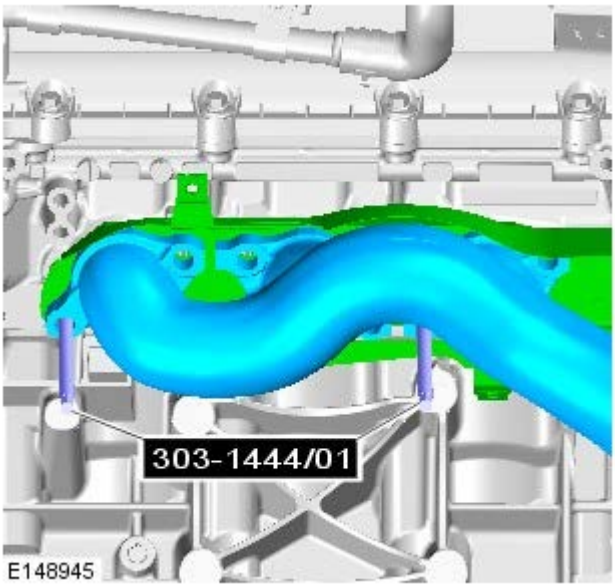
Make sure that the position of the spacers is noted before removal of the manifold.

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


E104334

Installation


E104334



E148945

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 HO2S tip.

   NOTE: If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.

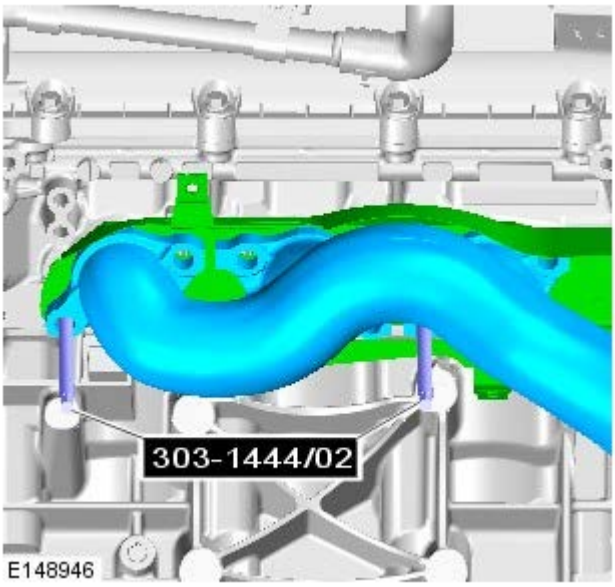
   Torque: 45 Nm

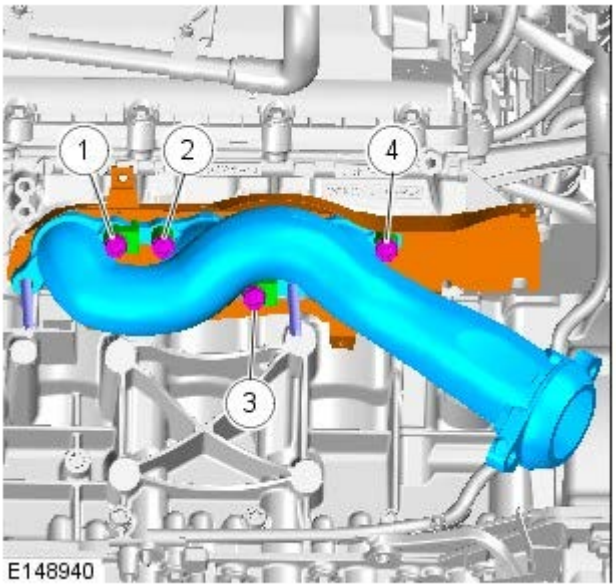
2. NOTE: Install a new gasket.

   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



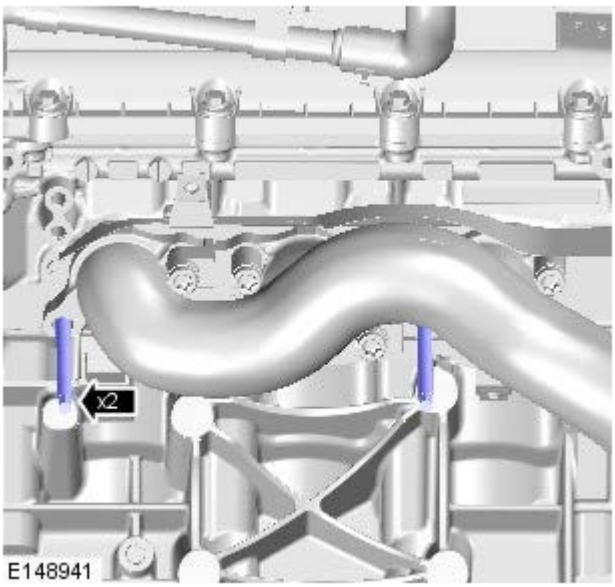


4. CAUTION: Make sure that new bolts are installed.

NOTE: Install the spacers in the noted position.

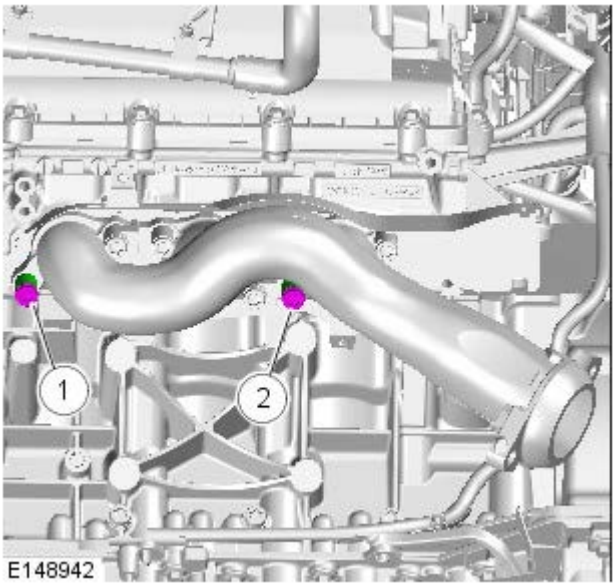
Torque: 10 Nm

5. Remove the special tool.



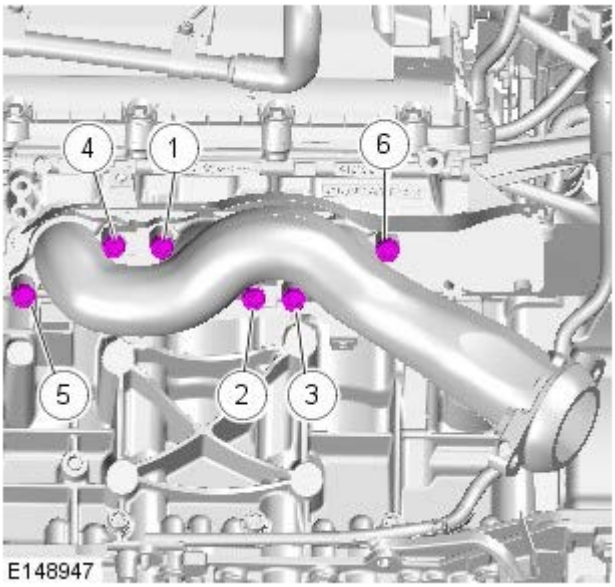
6. NOTES:

Make sure that new bolts are installed.



Install the spacers in the noted position.

Torque: 10 Nm



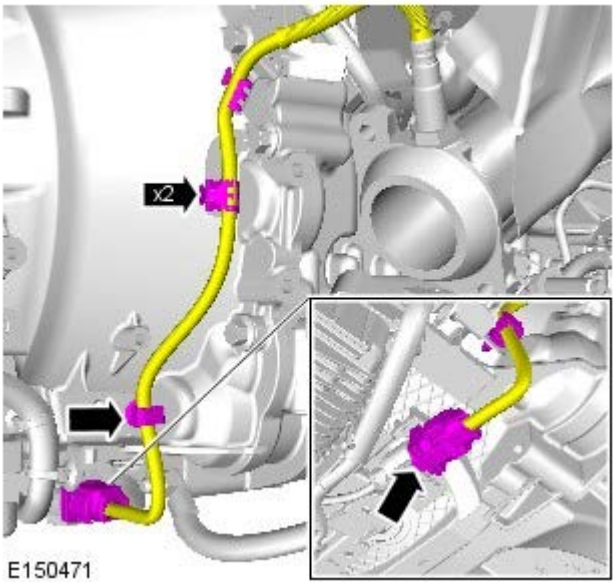
7. CAUTION: Tighten the bolts in the sequence shown.

   Torque: 18 Nm

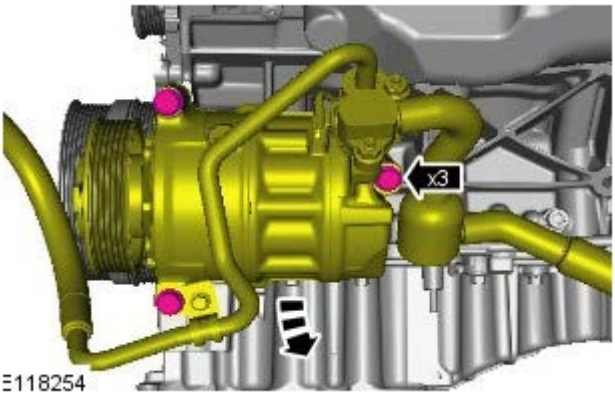


8. *Torque:*
   Bolt 6.3 x 13 3 Nm
   M8 25 Nm

9.



10. *Torque:* 25 Nm



11. Refer to: Accessory Drive Belt (303-05B Accessory Drive - V6 S/C 3.0L Petrol, Removal and Installation).

12. Refer to: Exhaust System (309-00B Exhaust System - V6 S/C 3.0L Petrol, Removal and Installation).

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

Published: 02-May-2013

Engine - V6 S/C 3.0L 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

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

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).

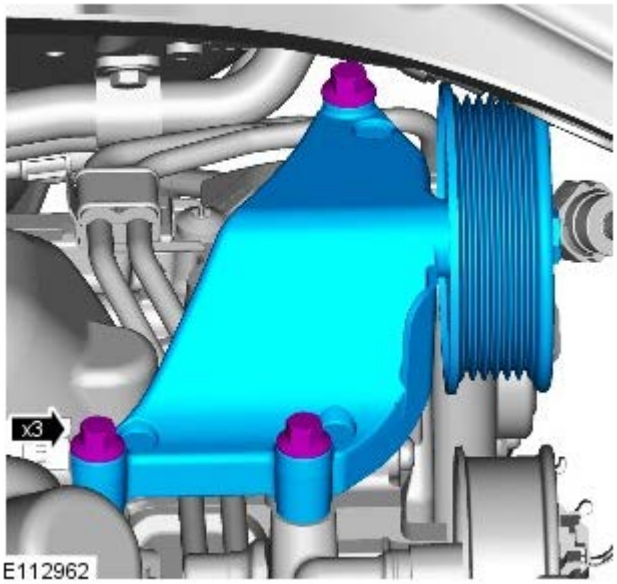
2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

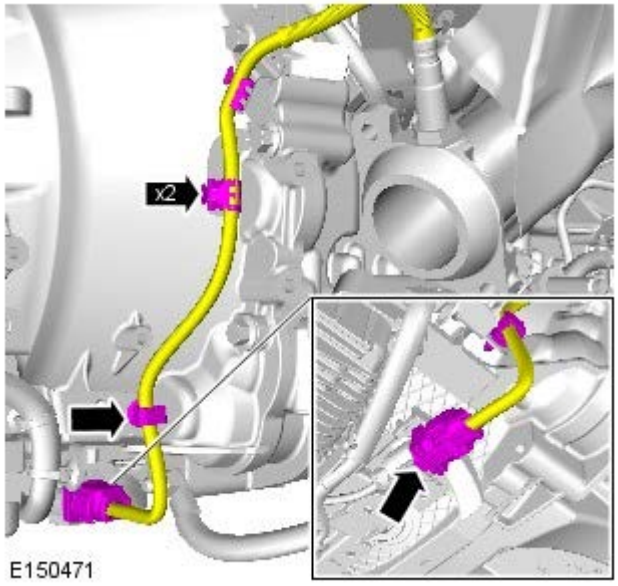
3. Refer to: Exhaust System (309-00B Exhaust System - V6 S/C 3.0L Petrol, Removal and Installation).

4. Refer to: Accessory Drive Belt (303-05B Accessory Drive - V6 S/C 3.0L Petrol, Removal and Installation).

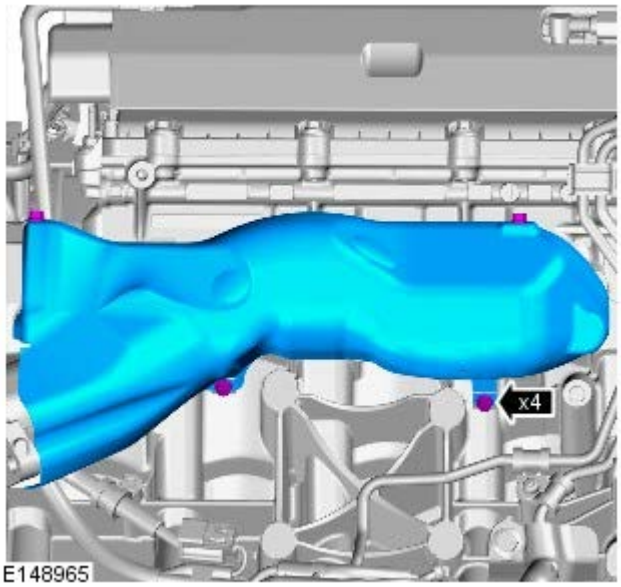
5.



6.

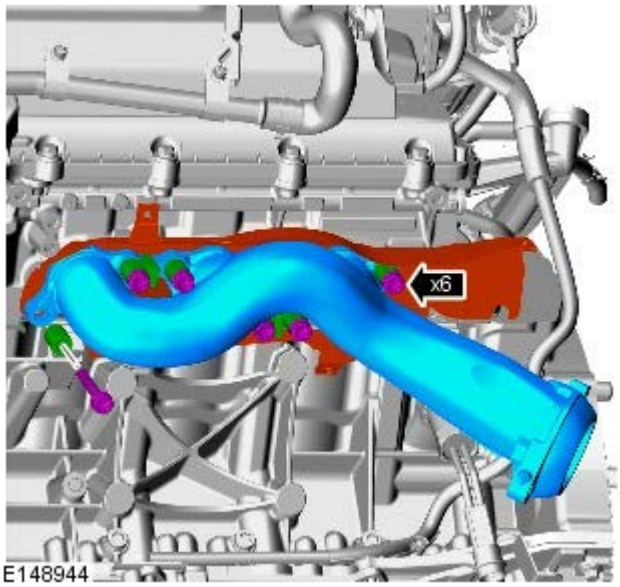


7.



8. CAUTIONS:

Discard the bolts.



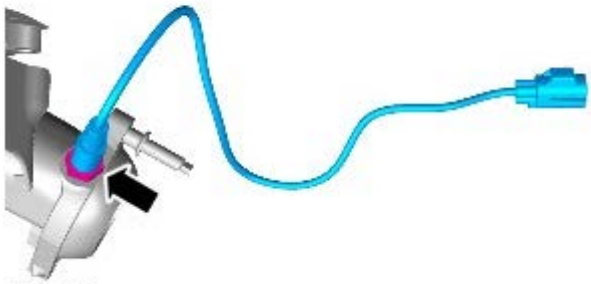
LH illustration shown, RH is similar.

NOTES:

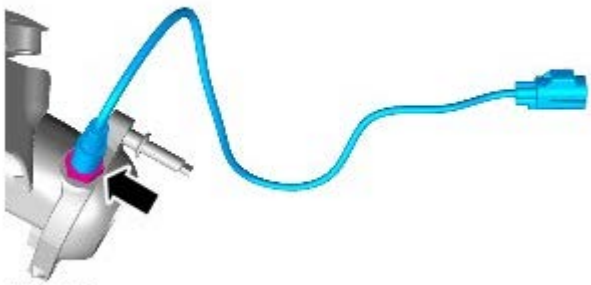
Discard the gasket.

Make sure that the position of the spacers is noted before removal of the manifold.

9. 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 HO2S tip.

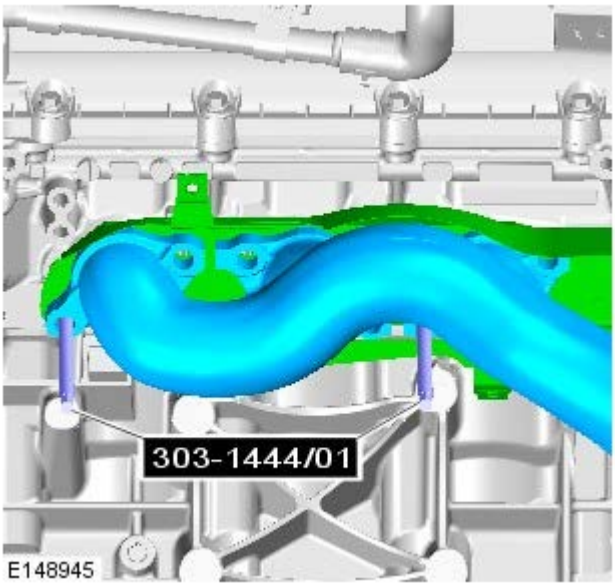
   NOTE: If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.

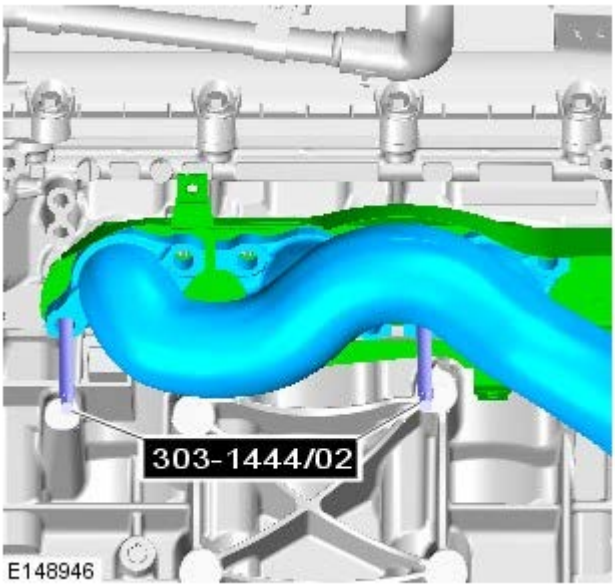
   Torque: 45 Nm

2. CAUTION: LH illustration shown, RH is similar.

   NOTE: Install a new gasket.

   Special Tool(s): 303-1444-01

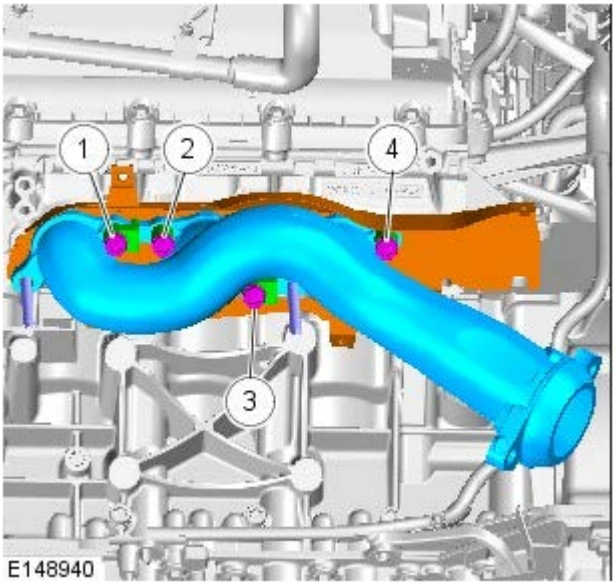




3. CAUTION: LH illustration shown, RH is similar.

NOTE: If a new cylinder head is installed use the special tools in the illustration.

Special Tool(s): 303-1444-02



4. CAUTIONS:

Make sure that new bolts are installed.

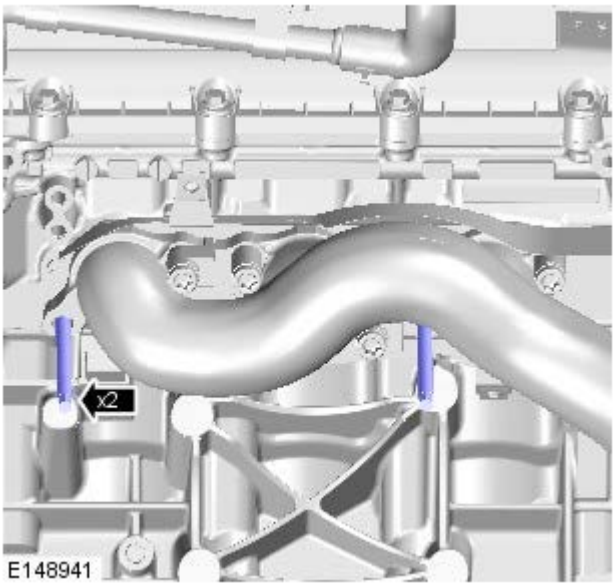
LH illustration shown, RH is similar.

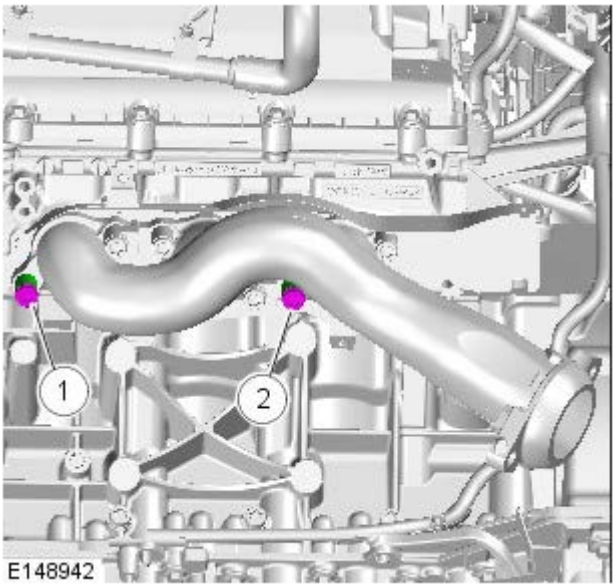
NOTE: Install the spacers in the noted position.

Torque: 10 Nm

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

Remove the special tool.





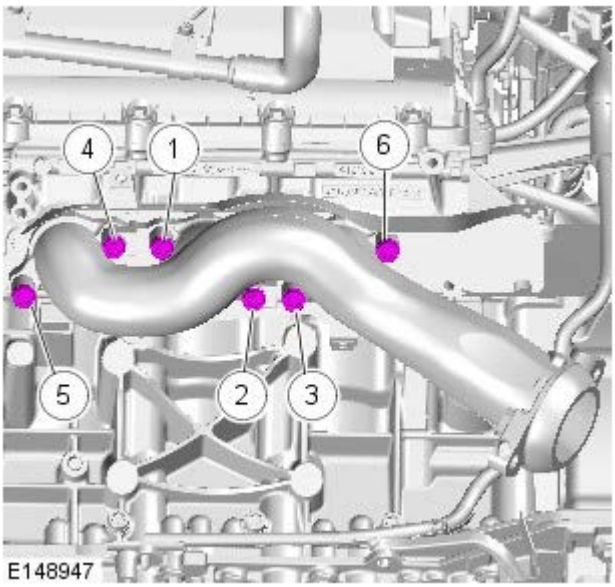
6. CAUTION: LH illustration shown, RH is similar.

NOTES:

Make sure that new bolts are installed.

Install the spacers in the noted position.

Torque: 10 Nm



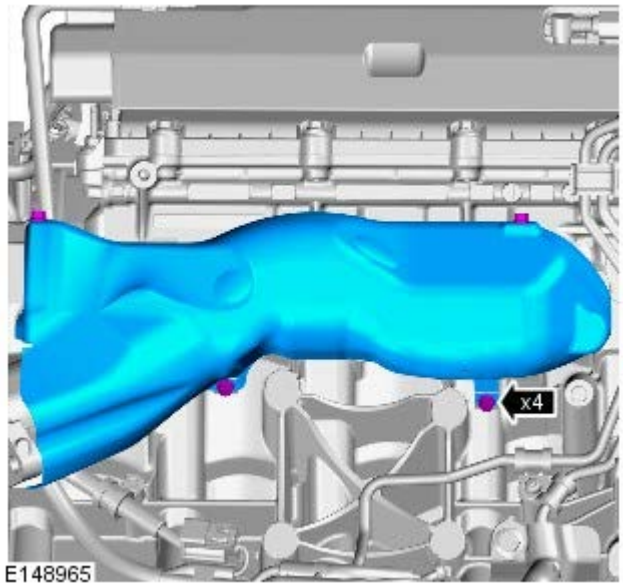
7. CAUTIONS:

LH illustration shown, RH is similar.

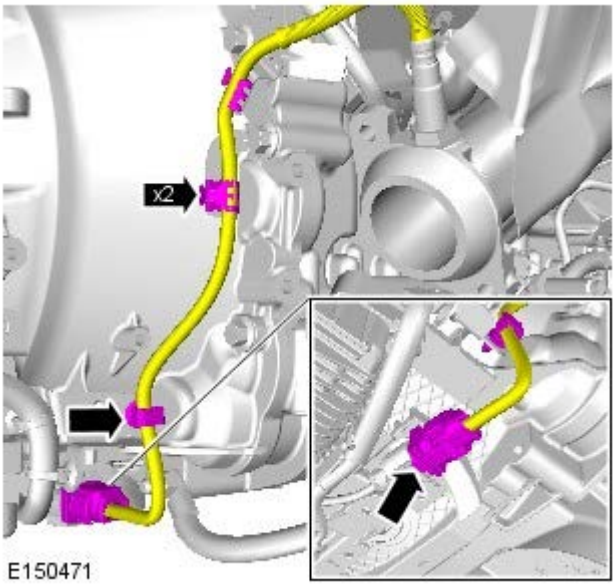
Tighten the bolts in the sequence shown.

Torque: 18 Nm

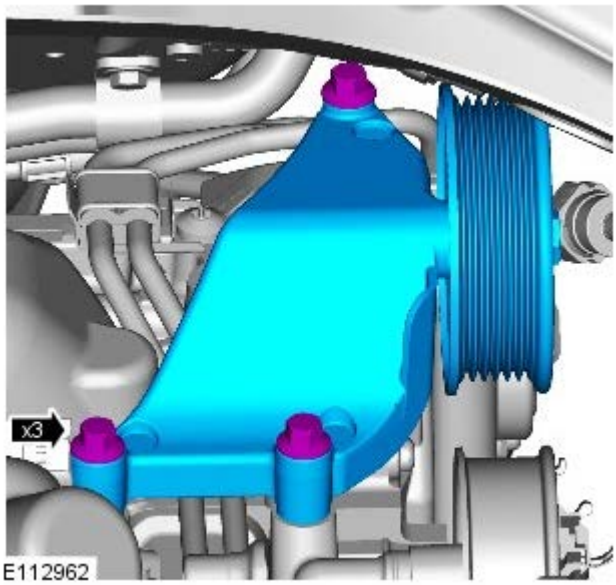
8. *Torque:* 3 Nm



9.



10. *Torque:* 25 Nm



11. Refer to: Accessory Drive Belt (303-05B Accessory Drive - V6 S/C 3.0L Petrol, Removal and Installation).

12. Refer to: Exhaust System (309-00B Exhaust System - V6 S/C 3.0L Petrol, Removal and Installation).

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

Published: 02-May-2013

Engine - V6 S/C 3.0L 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 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 - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, 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: 02-May-2013

Engine - V6 S/C 3.0L 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).

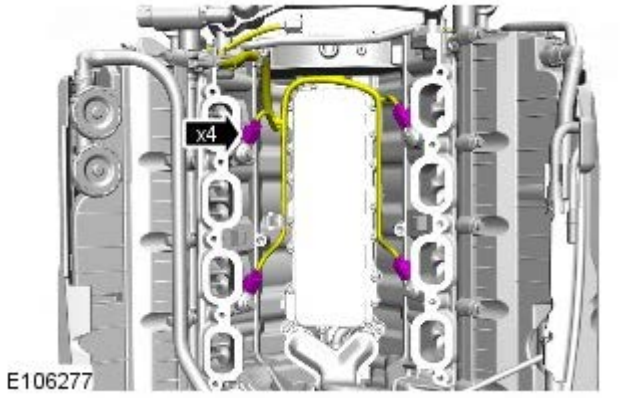
2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

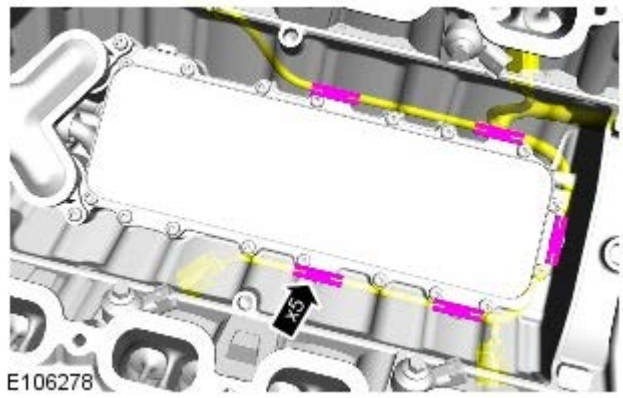
3. Refer to: Engine Oil Draining and Filling (303-01B Engine - V6 S/C 3.0L Petrol, General Procedures).

4. Refer to: Supercharger (303-12B Intake Air Distribution and Filtering - V6 S/C 3.0L Petrol, Removal and Installation).

5.



6.

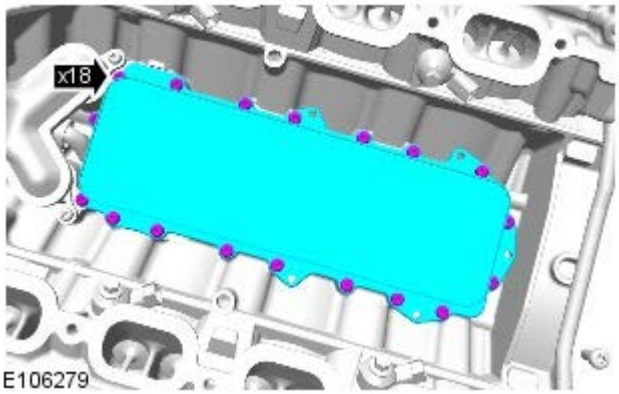


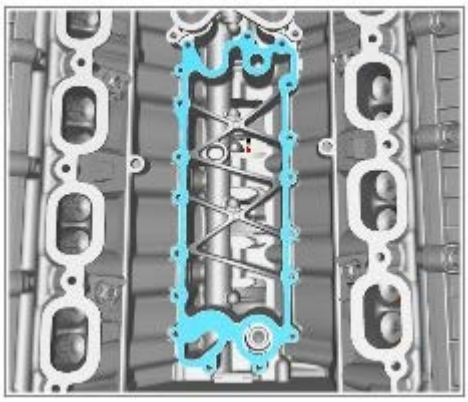
7. CAUTIONS:

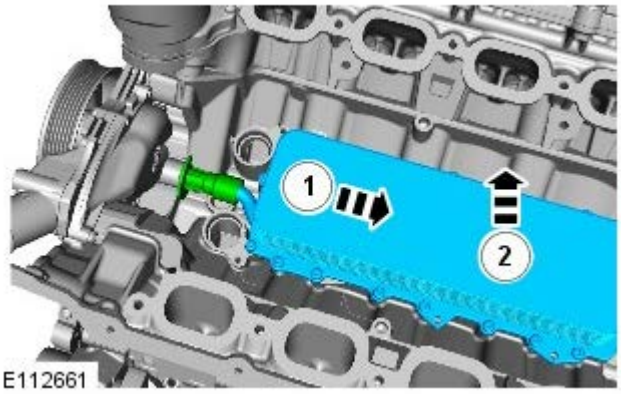
   Be prepared to collect escaping oil.

   Be prepared to collect escaping coolant.

   Torque: 13 Nm







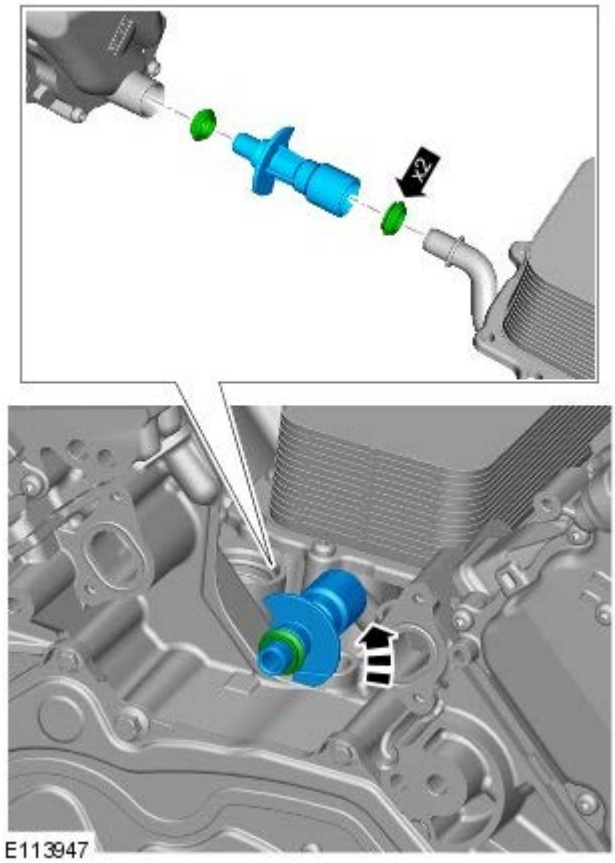
8. CAUTION: Make sure that these components are installed to the noted removal position.

NOTE: Install a new gasket.

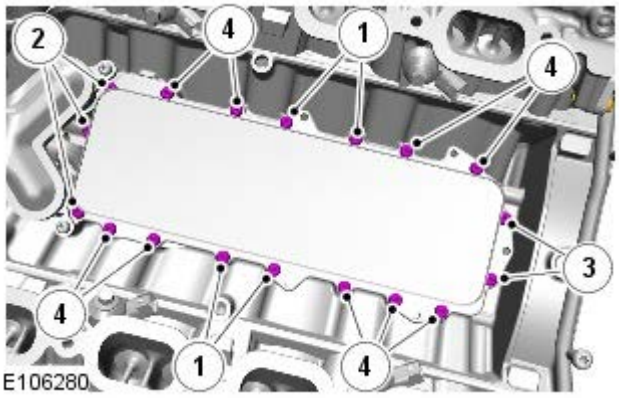
9. CAUTIONS:

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: 02-May-2013

Engine - V6 S/C 3.0L Petrol - Oil Filter Element

Removal and Installation

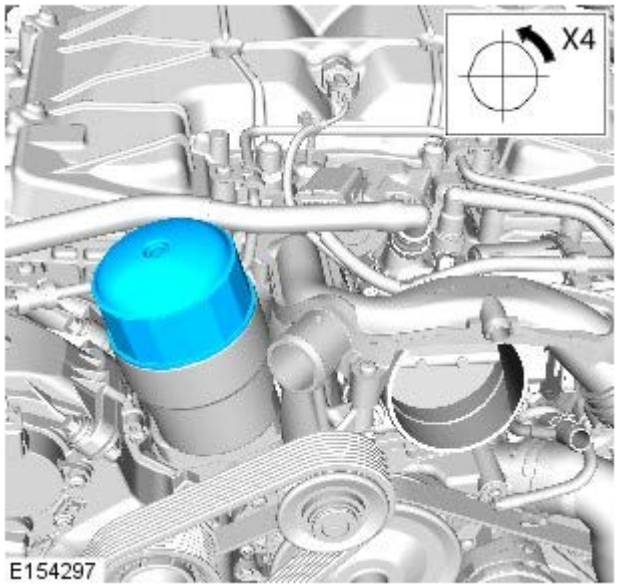
Removal

NOTES:

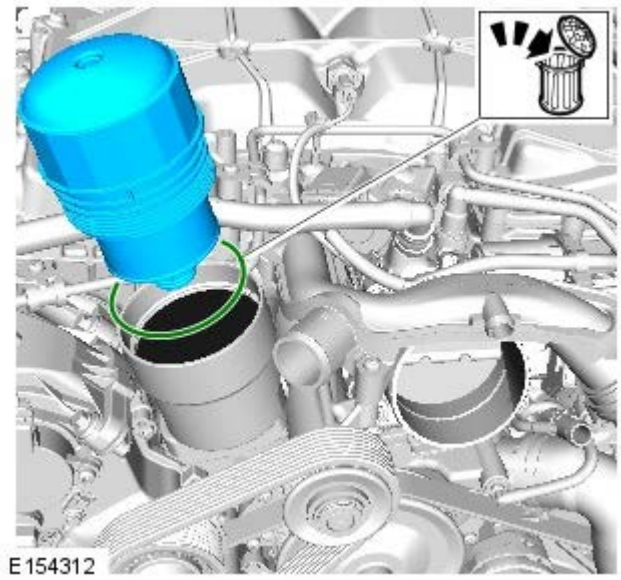
Some variation in the illustrations may occur, but the essential information is always correct.

Removal steps in this procedure may contain installation details.

1. Refer to: Engine Cover - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (501-05 Interior Trim and Ornamentation, Removal and Installation).

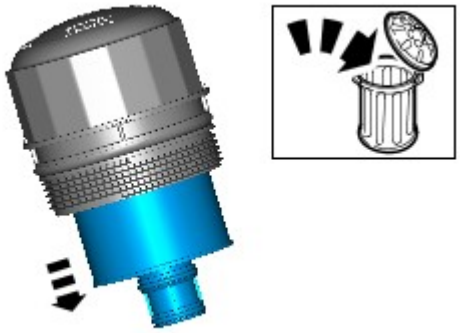


2. NOTE: Allow 10 minutes for the engine oil to drain from the oil filter housing.



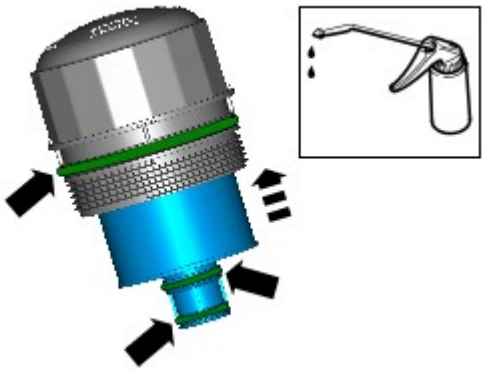
3. CAUTION: Remove and discard the O-ring seal.

4. CAUTION: Remove and discard the element.



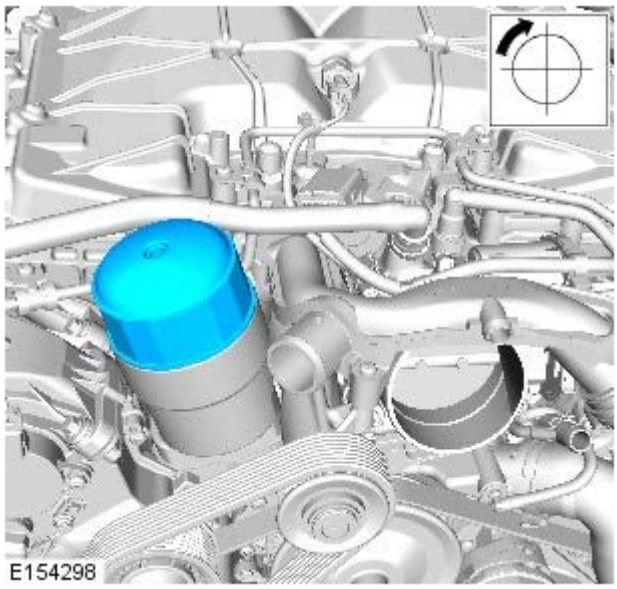
E107394

Installation



E107727

1. CAUTION: Install new O-ring seals.



E154298

2. CAUTION: Tighten the component finger tight first.

   Torque: 25 Nm

3. Start and run the engine.
4. NOTE: Allow 10 minutes from the engine switch off for the engine oil level to stabilize.
5. Check and top-up the engine oil.
6. Refer to: Engine Cover - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (501-05 Interior Trim and Ornamentation, Removal and Installation).

Published: 24-May-2013

Engine - V6 S/C 3.0L Petrol - Oil Pan Extension

Removal and Installation

Special Tool(s)

 E107678	303-1442 Rear Crankshaft Seal Installer

Removal

NOTES:

Some components shown removed for clarity.

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

1. Disconnect the battery ground cable.

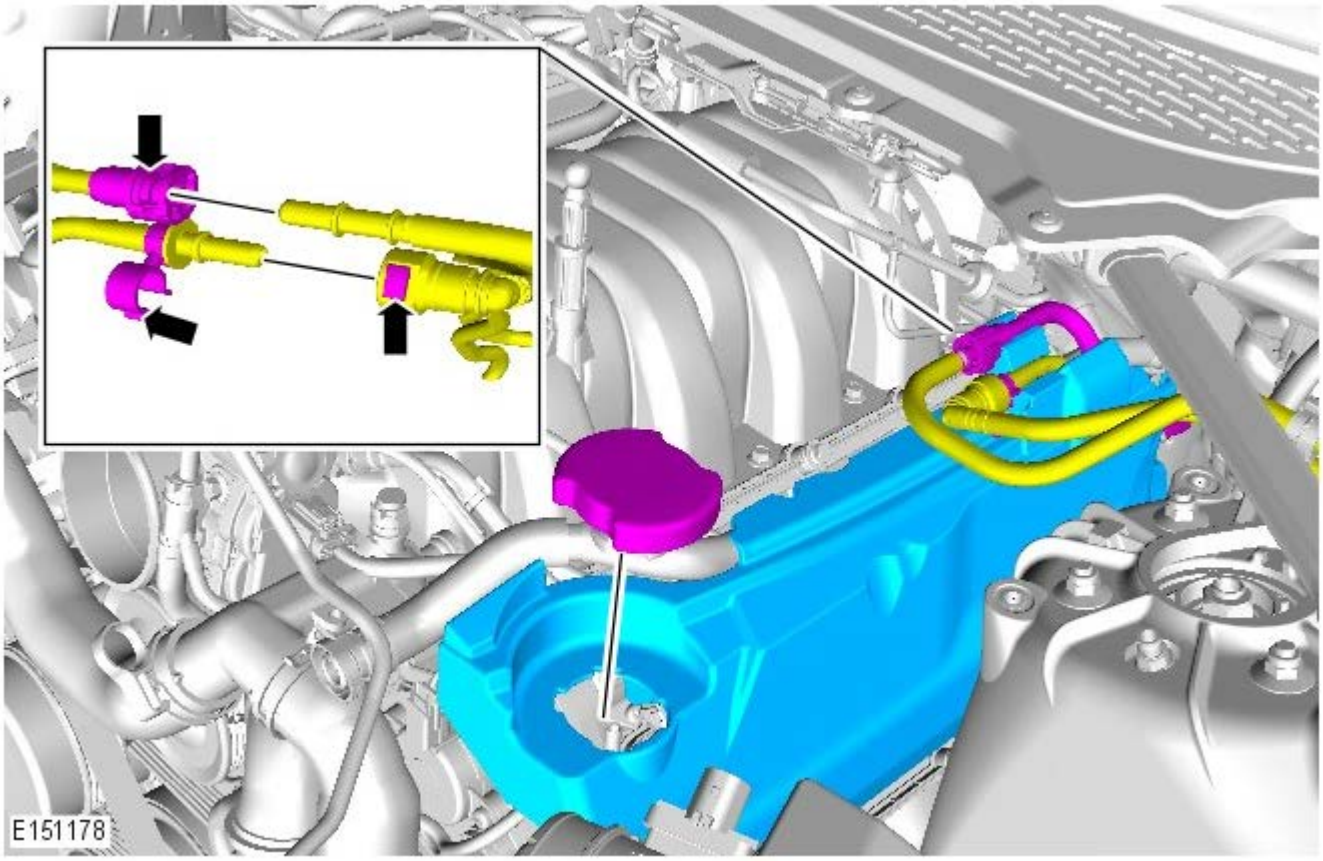
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

2. Refer to: Engine Oil Draining and Filling (303-01B Engine - V6 S/C 3.0L Petrol, General Procedures).

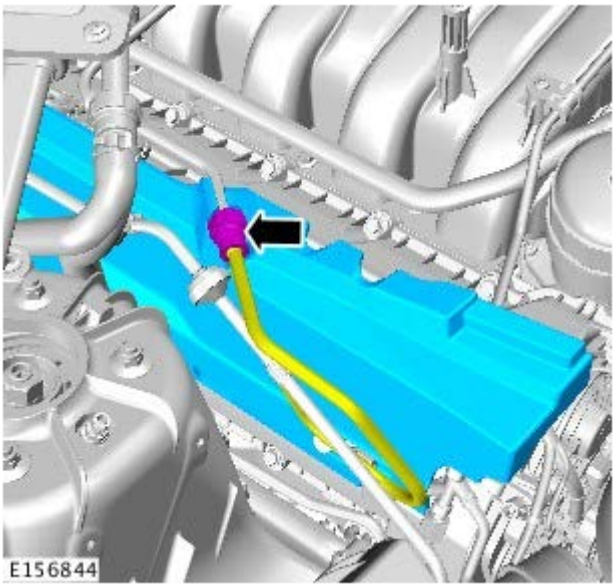
3. Refer to: Fuel System Pressure Release - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (310-00 Fuel System - General Information, General Procedures).

4. Refer to: Fuel Injection Component Cleaning (303-04C Fuel Charging and Controls - V6 S/C 3.0L Petrol, General Procedures).

5. CAUTION: Be prepared to collect escaping fuel.



6.

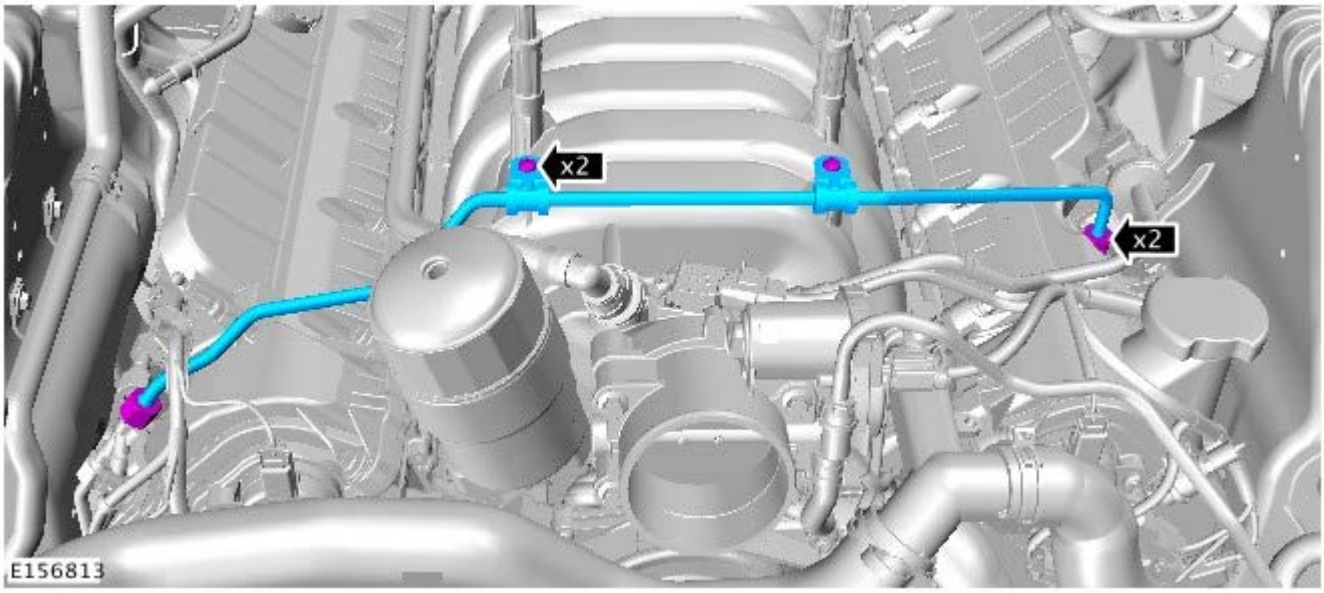


7. WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable mixtures are always present and may ignite. Failure to follow these instructions may result in personal injury.

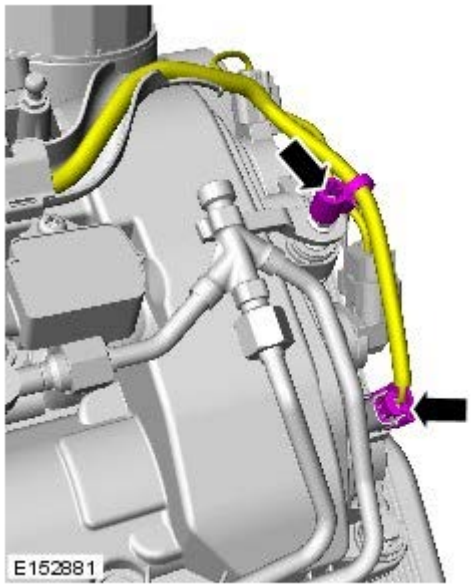
CAUTIONS:

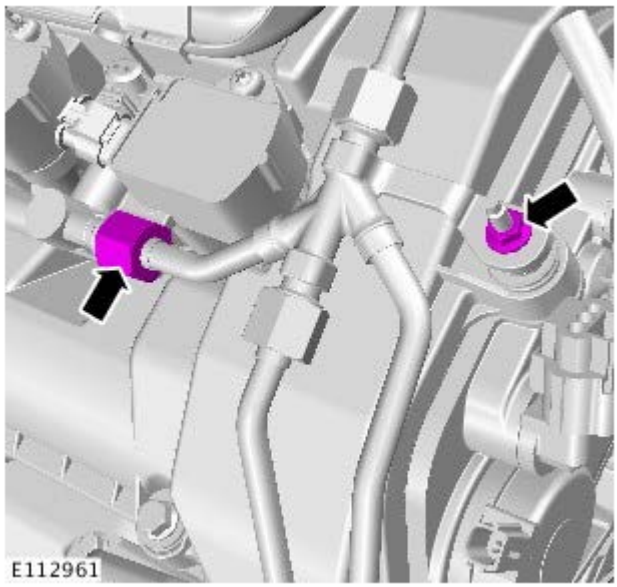
Be prepared to collect escaping fuel.

Remove and discard the high-pressure fuel supply lines.



8.





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 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.

10. 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.

11. Refer to: Generator (414-02B Generator and Regulator - V6 S/C

3.0L Petrol, Removal and Installation).

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

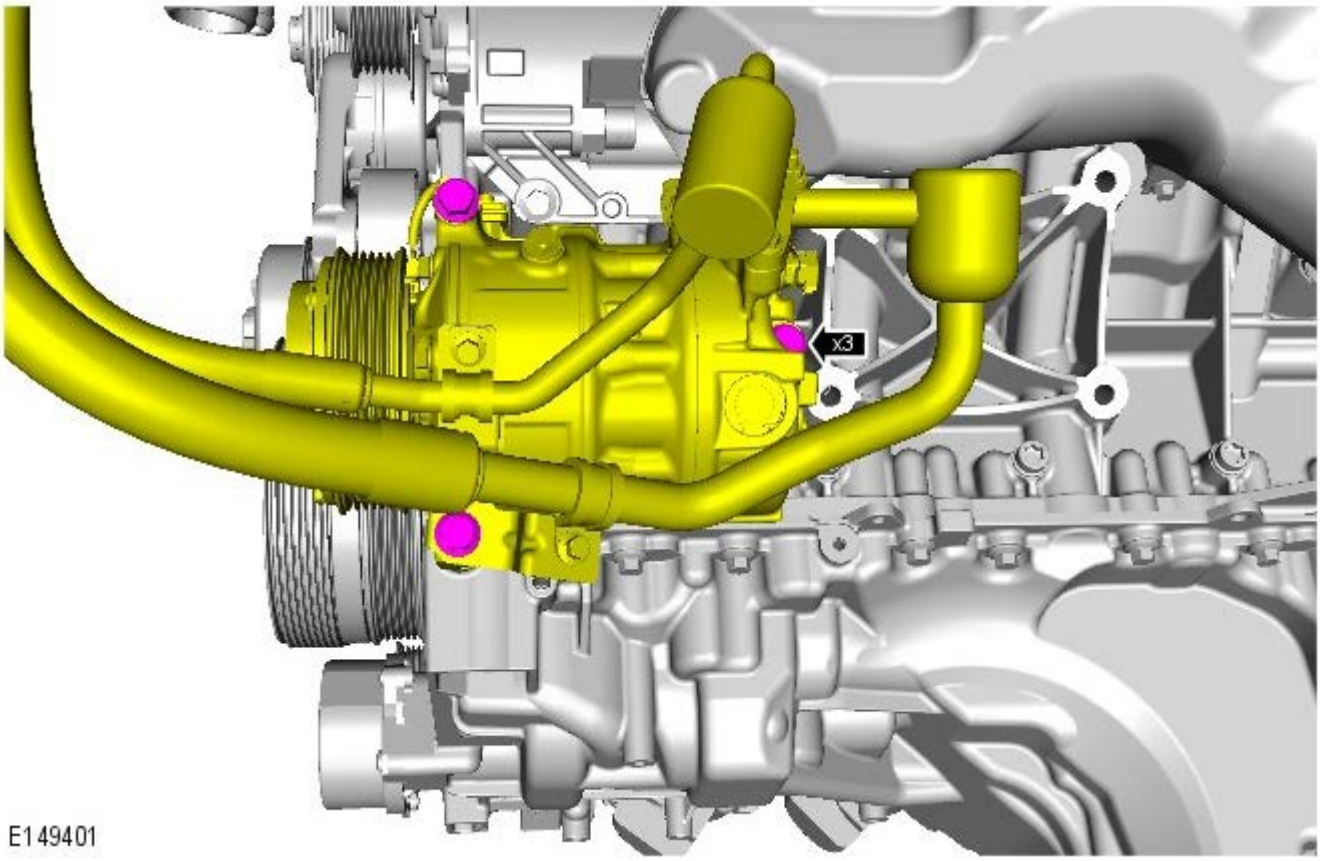
13. Refer to: Transmission - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, Removal).

14. Refer to: Starter Motor (303-06B Starting System - V6 S/C 3.0L Petrol, Removal and Installation).

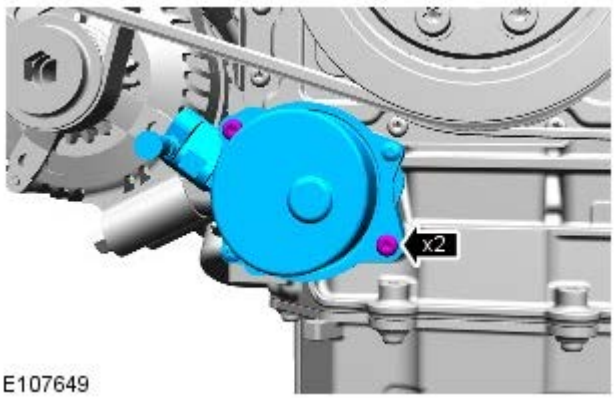
15. NOTES:

Using suitable cable tie secure the A/C compressor.

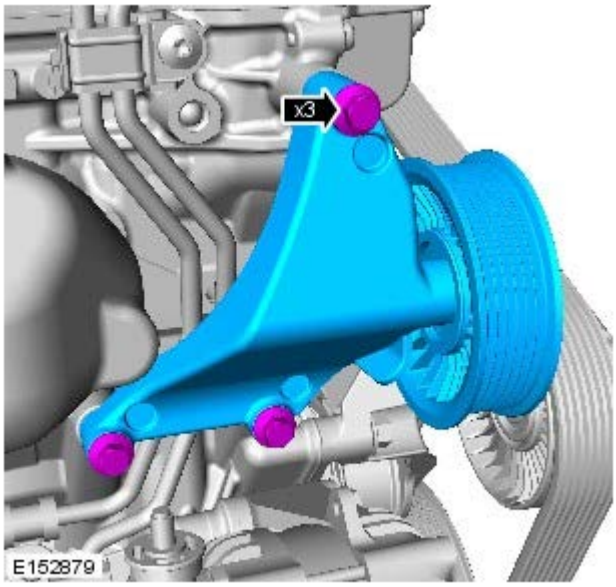
Engine shown removed for clarity.



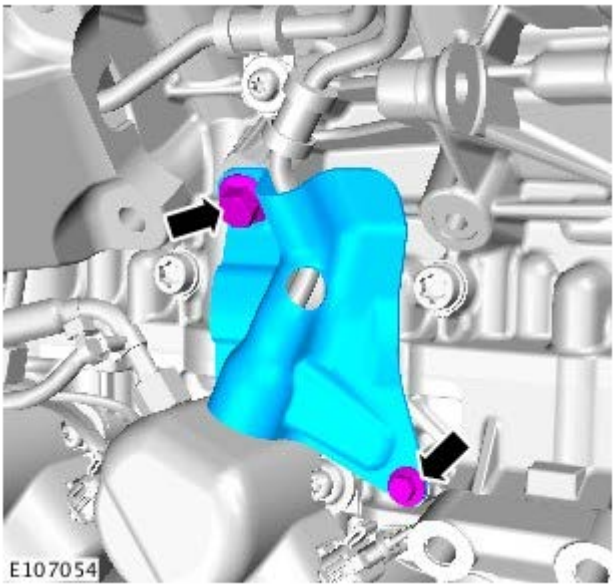
16.



17.

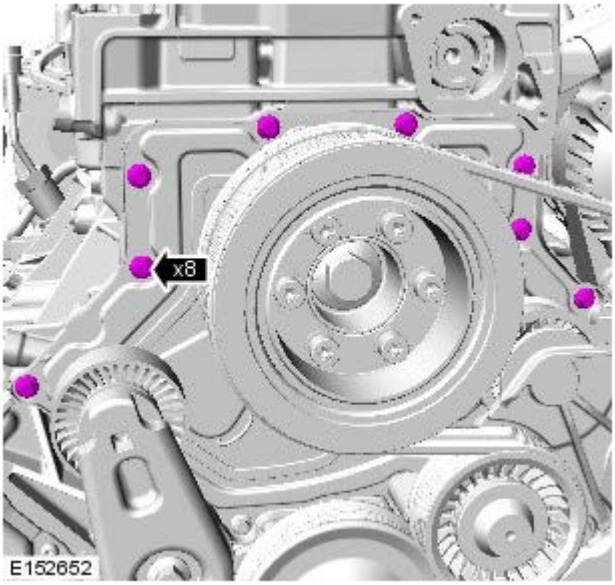


18.

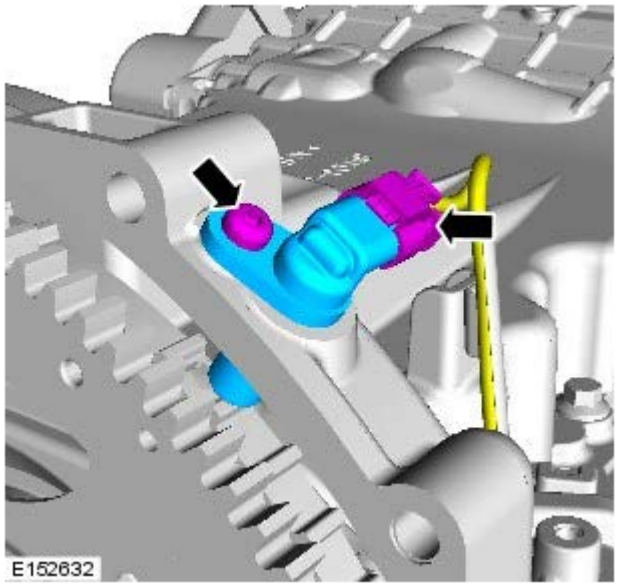


19. CAUTION: Only remove the bolts shown in the illustration, do not remove the crankshaft damper.

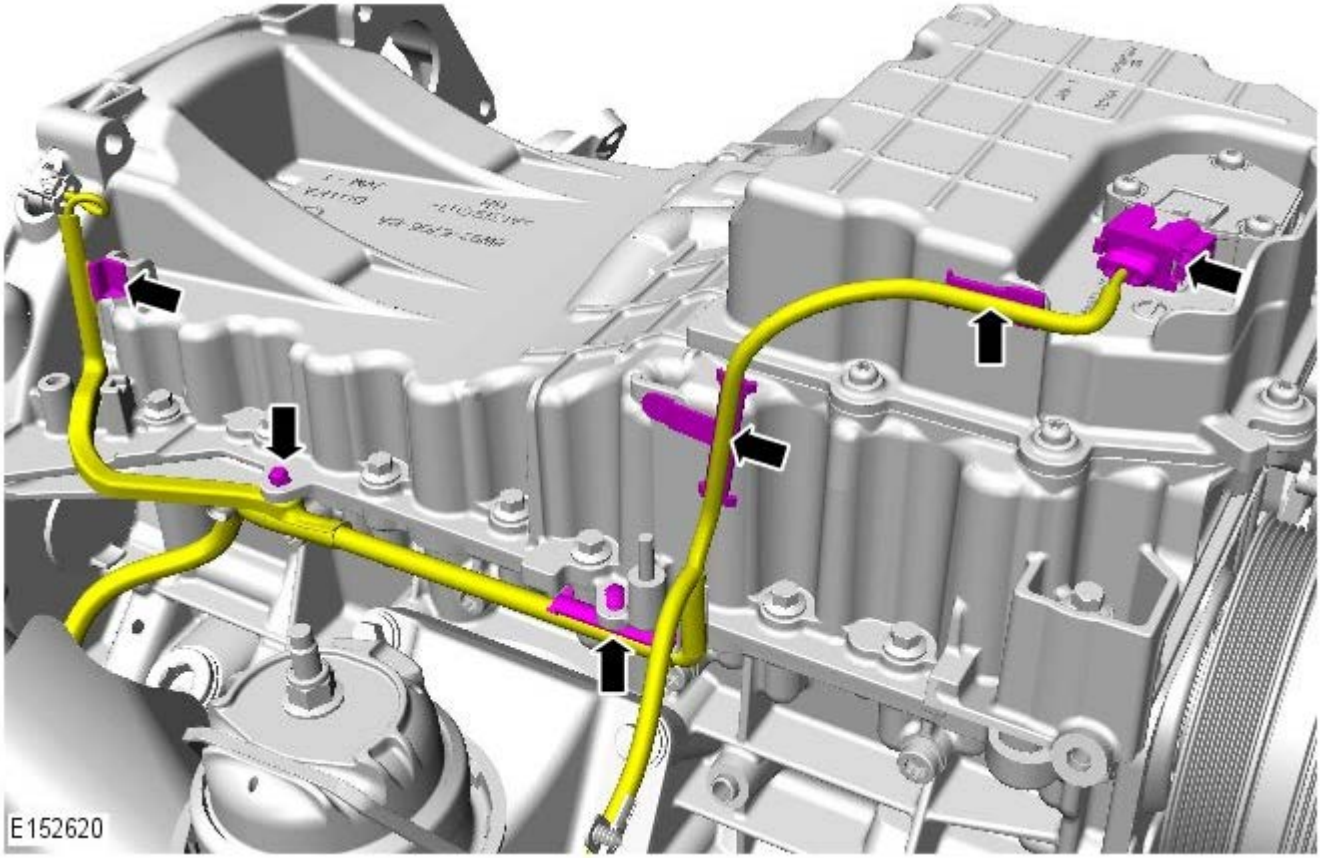
NOTE: Engine shown removed for clarity.



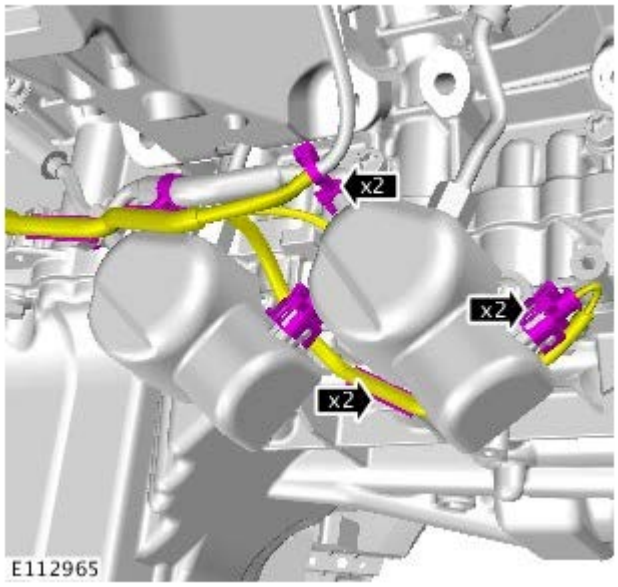
20.



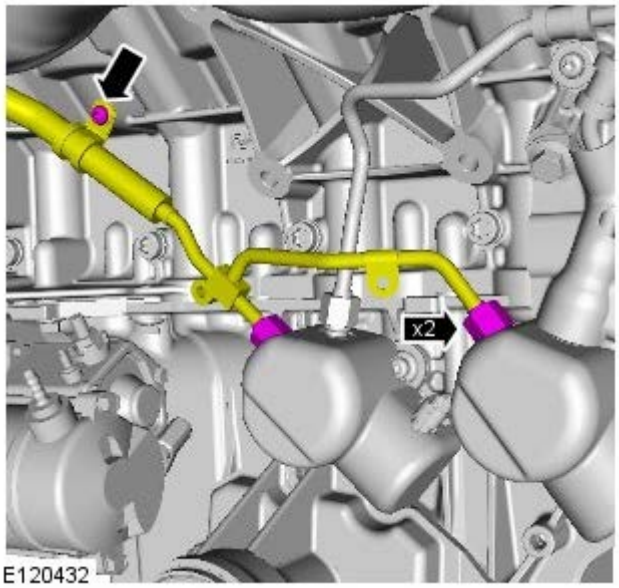
21. NOTE: Engine shown removed for clarity.



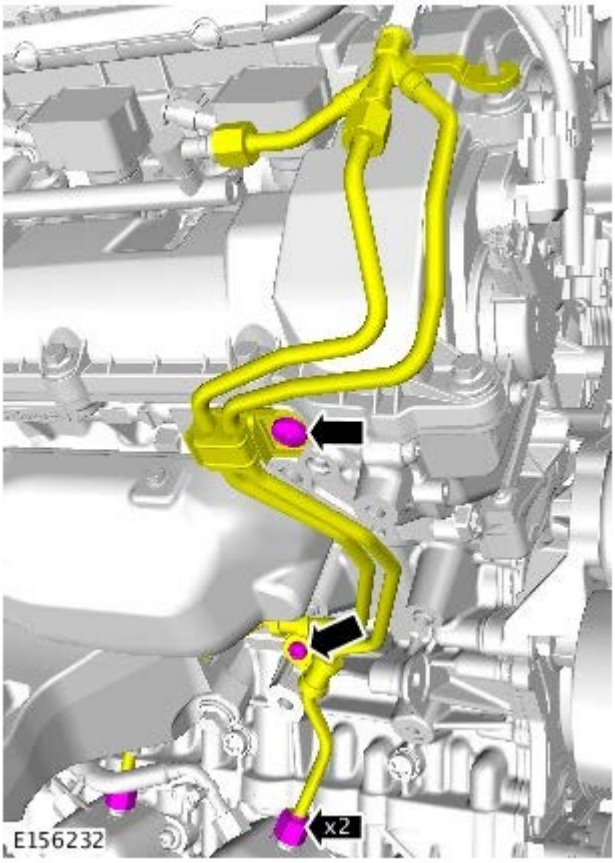
22.



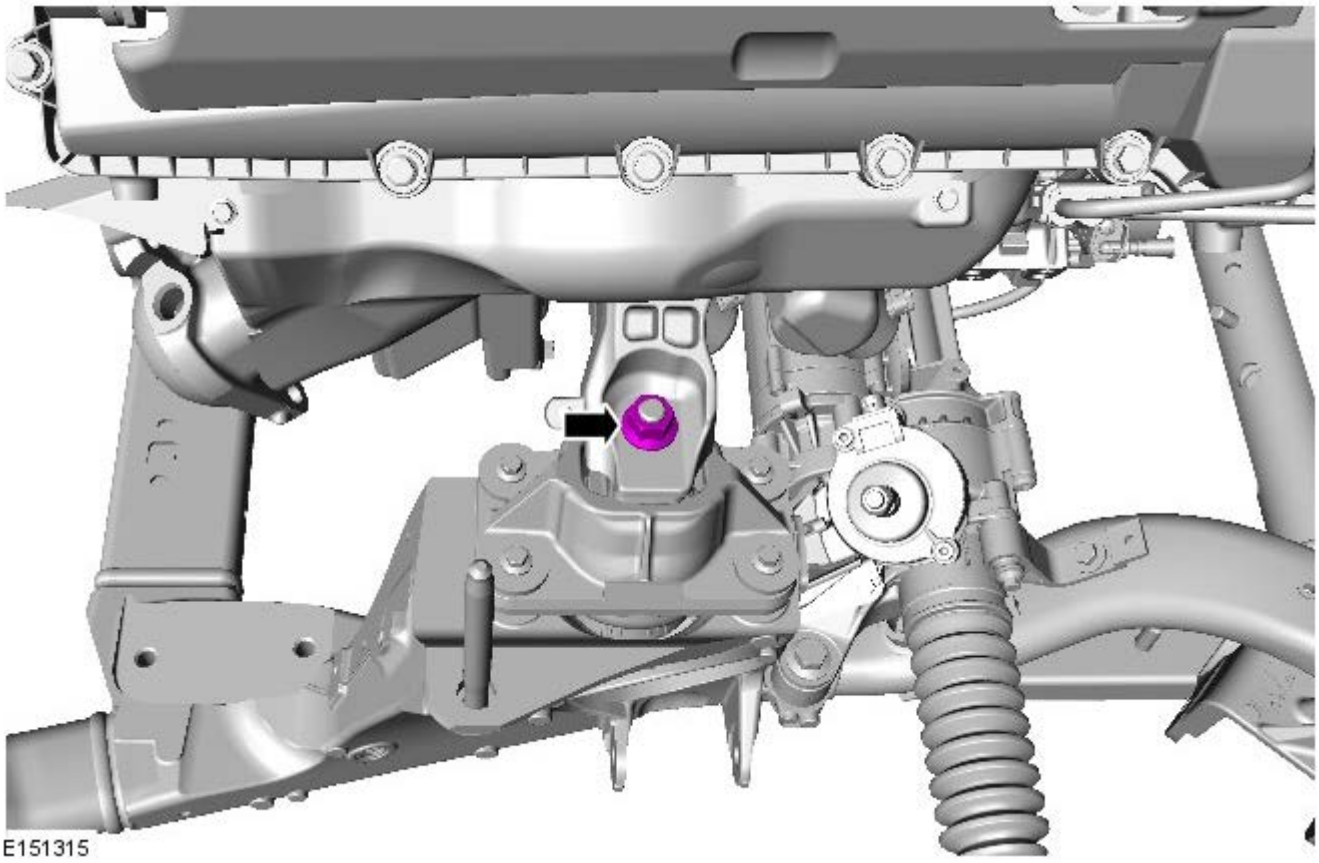
23.



24.

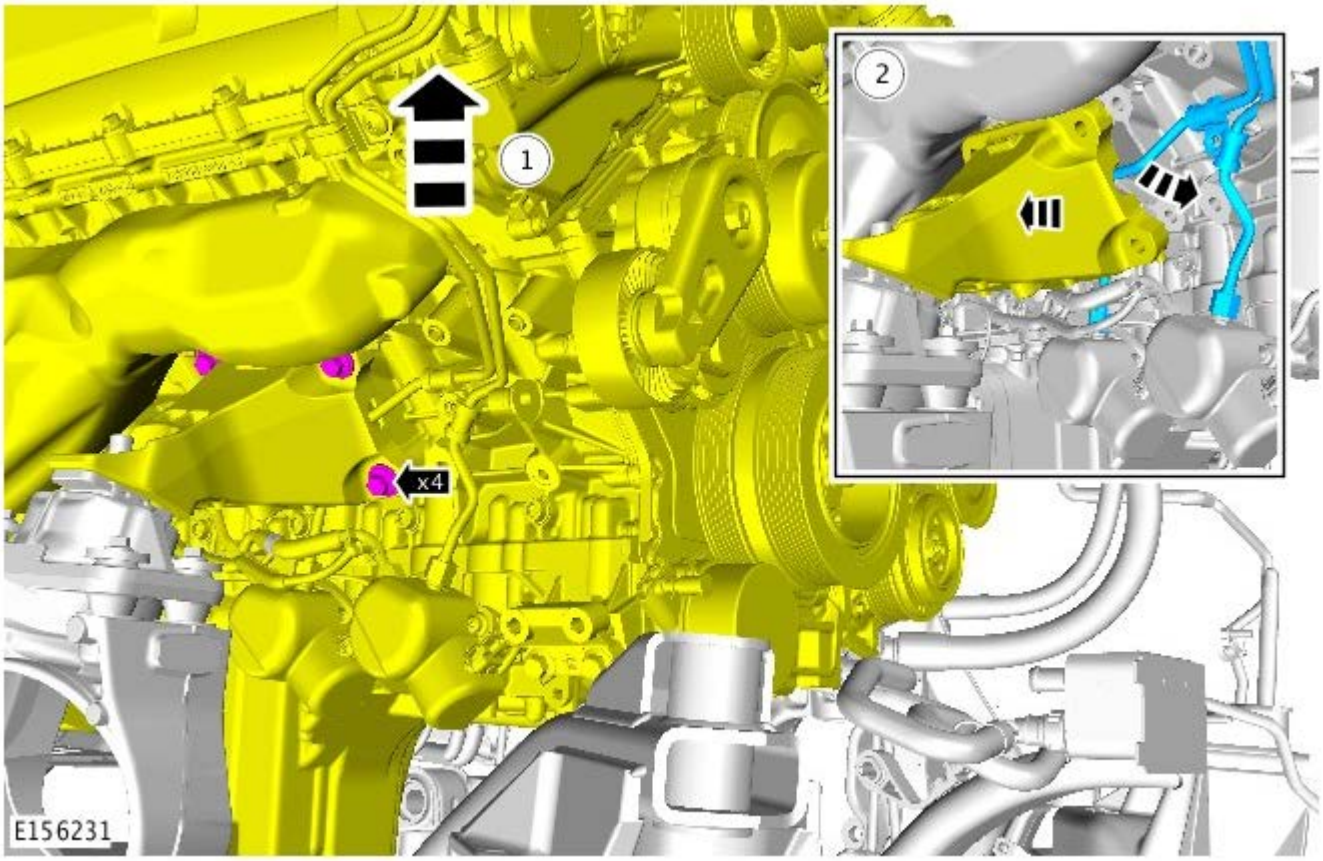


25.



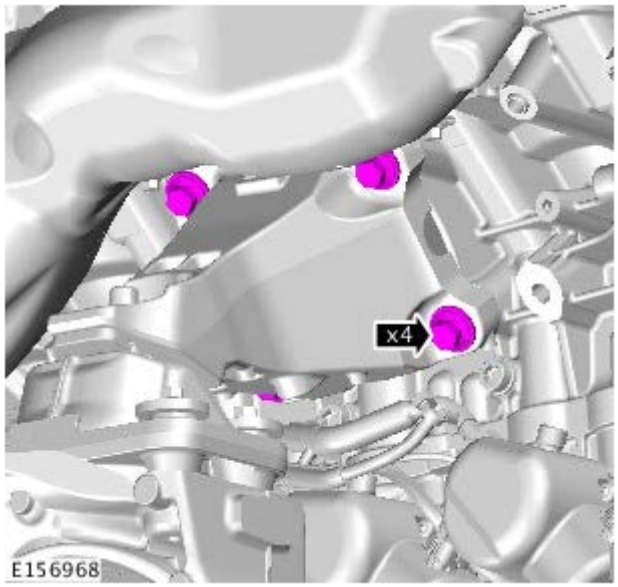
26. CAUTION: Use a wooden block to protect the oil pan when supporting the engine.

Using a suitable hydraulic jack, raise and support the engine to release the fuel pipe.

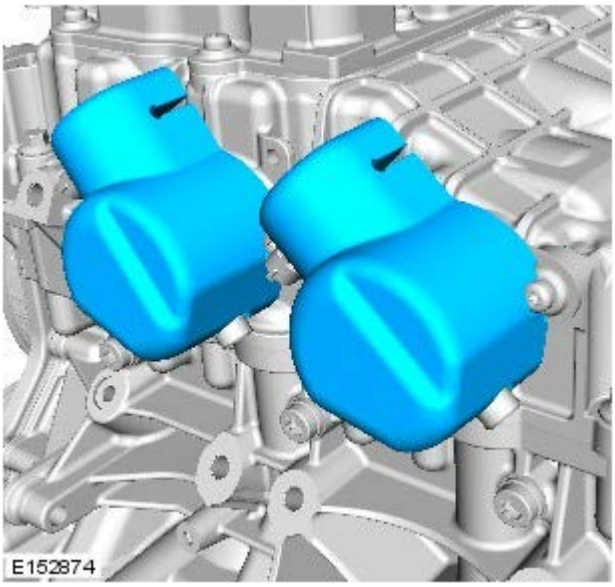


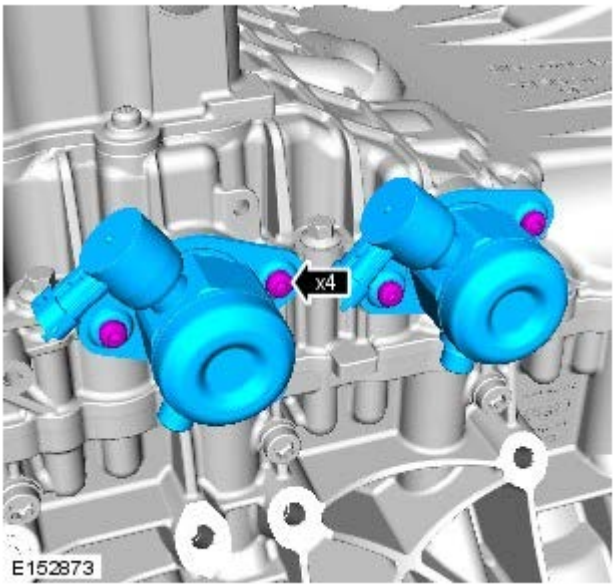
27. Carefully lower the engine onto the engine mounts.

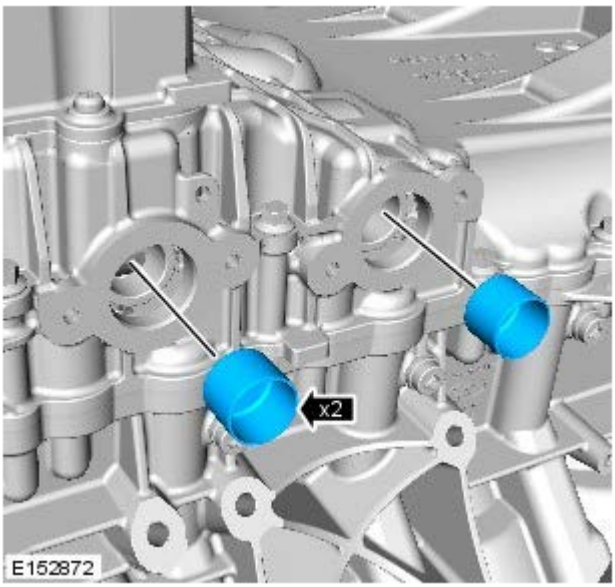
    Torque: 20 Nm



28.







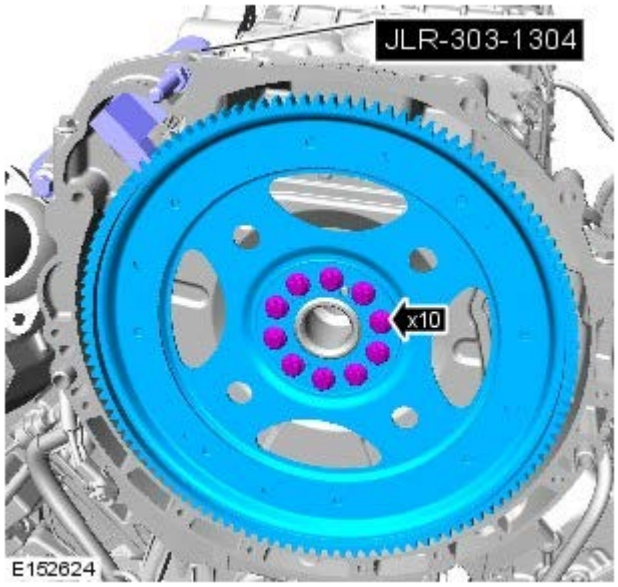
29. CAUTION: Be prepared to collect escaping fluids.

30. CAUTION: Be prepared to collect escaping fluids.

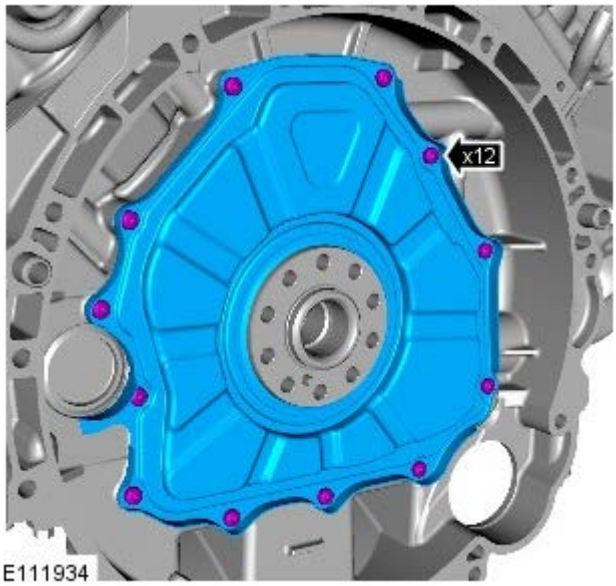
NOTE: Note the orientation of the component prior to removal.

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

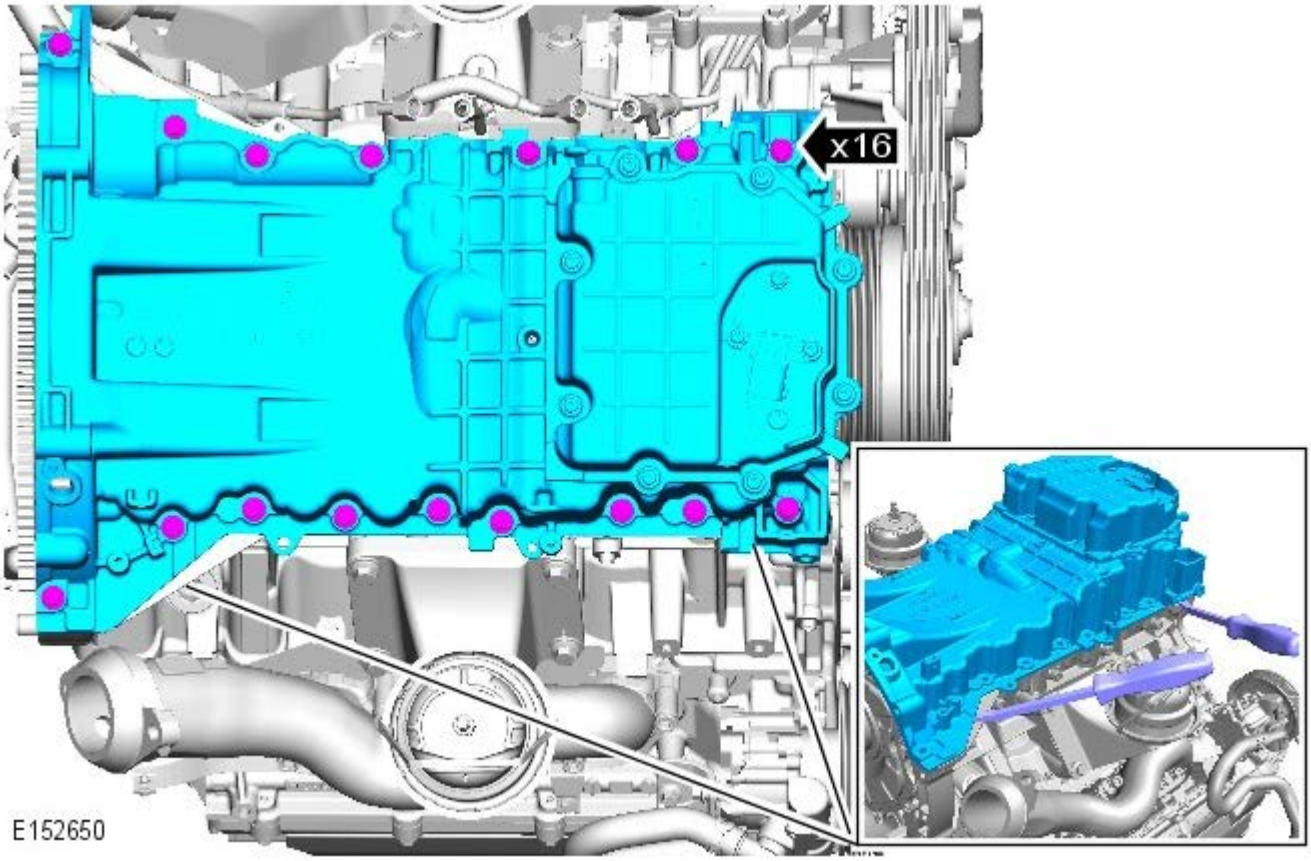
Install the special tool as shown.



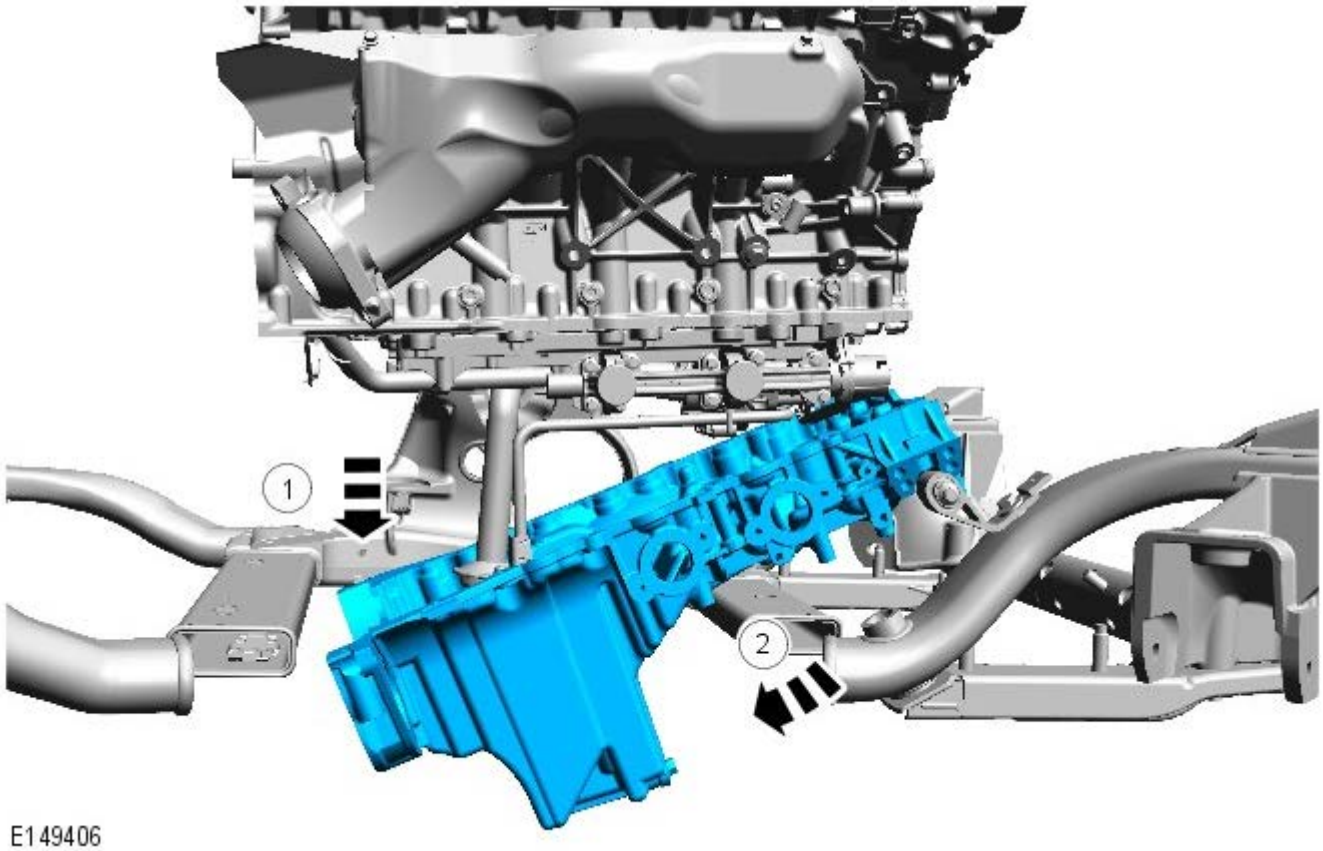
32.



33. NOTE: Make sure to use the aluminium lug provided on the oil pan extension to lever against.



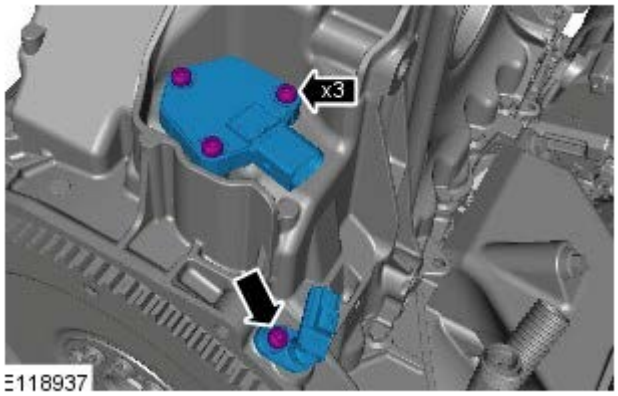
34.



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

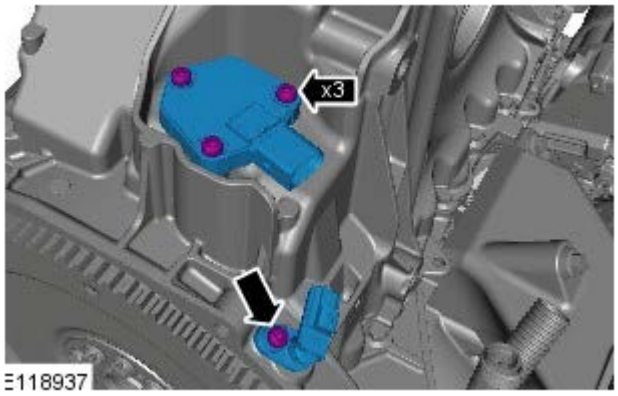


36.



Installation

1.
   - *Torque:* 11 Nm

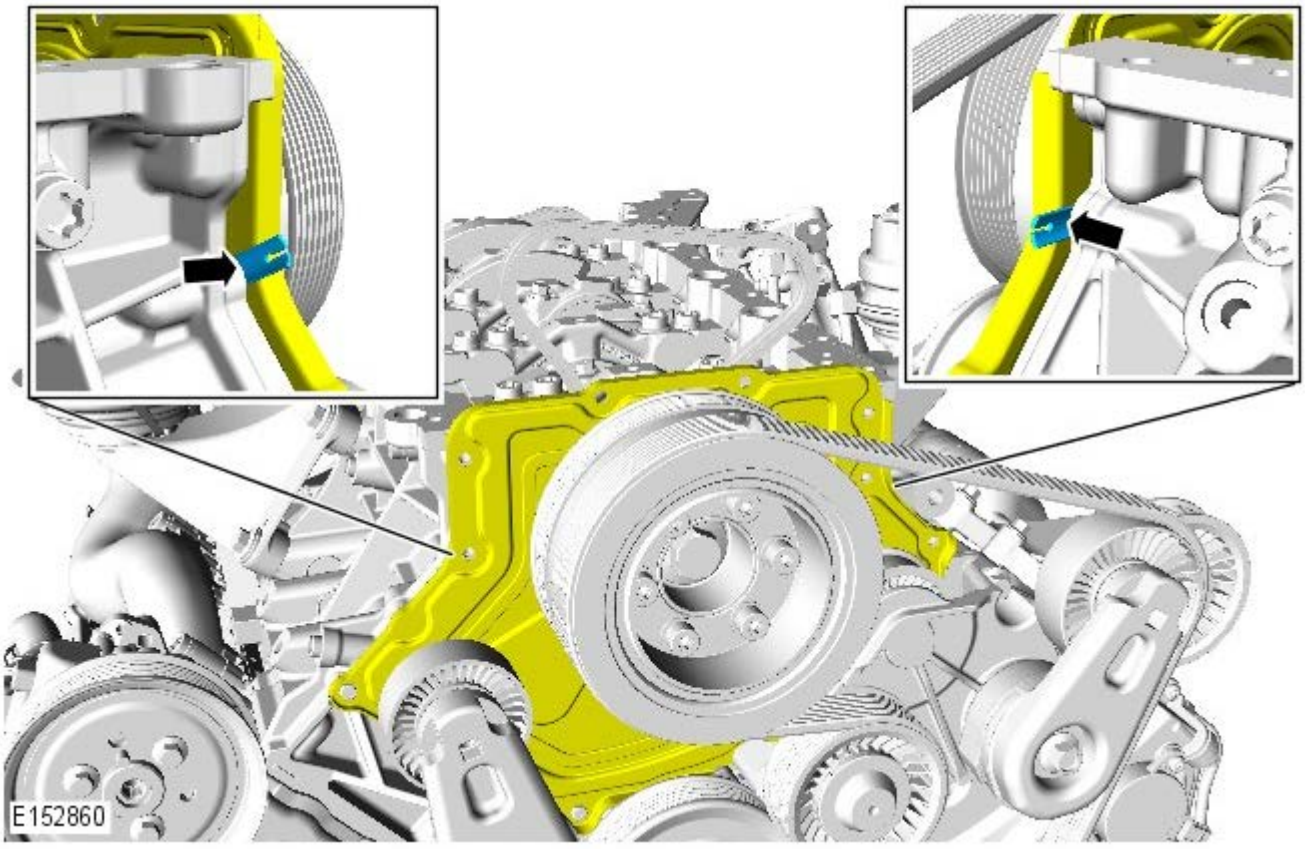


2. *Torque:* 10 Nm



3. NOTE: Engine shown removed for clarity.

   Using a folded cable tie, pack the two areas between the front cover plate and the cylinder block as illustrated. Care must be taken to avoid bending the front cover.

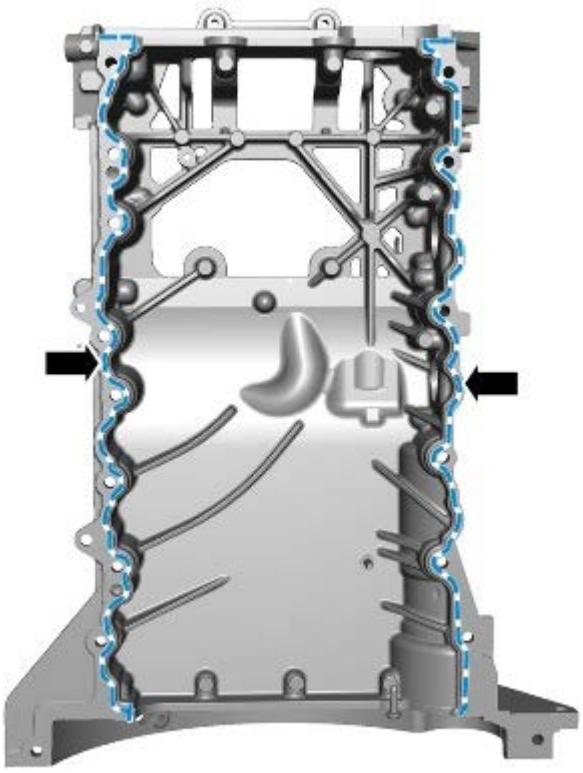


4. CAUTIONS:

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

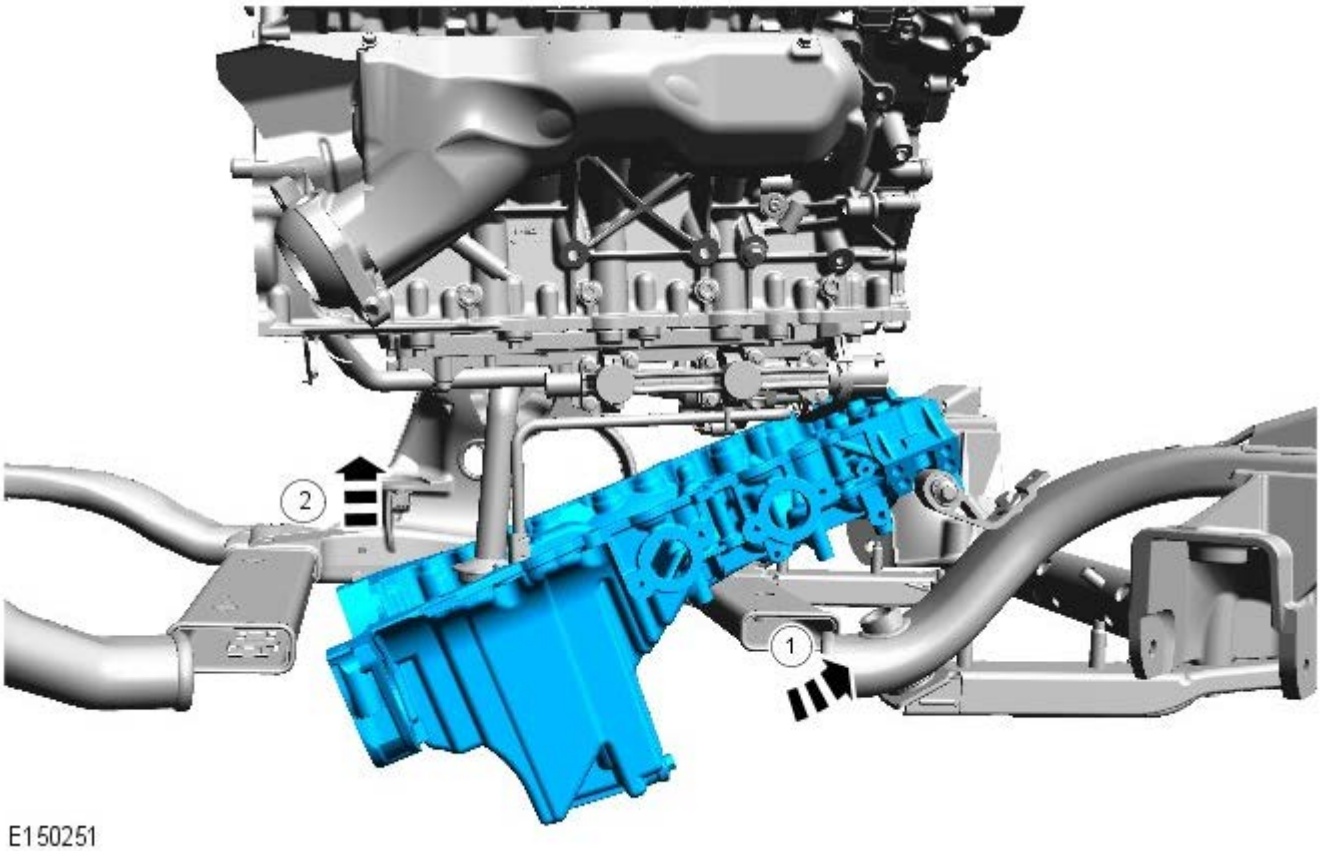
   Use only a plastic scraper when removing the sealing material.

   - Apply RTV sealant WSE-M4G323-A6 (Loctite 5901G) to the areas shown, and tighten the bolts within 7 minutes.



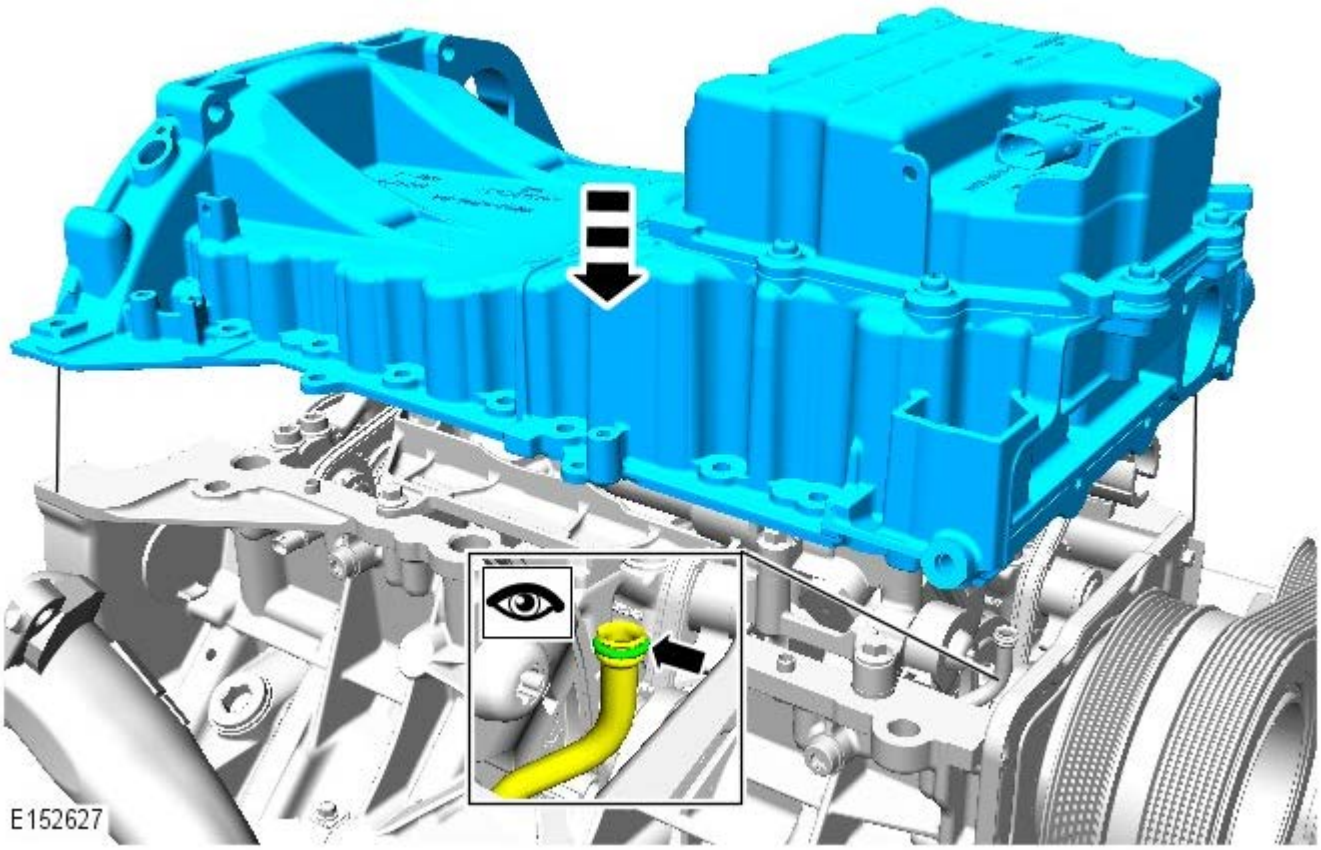
E107654

5.



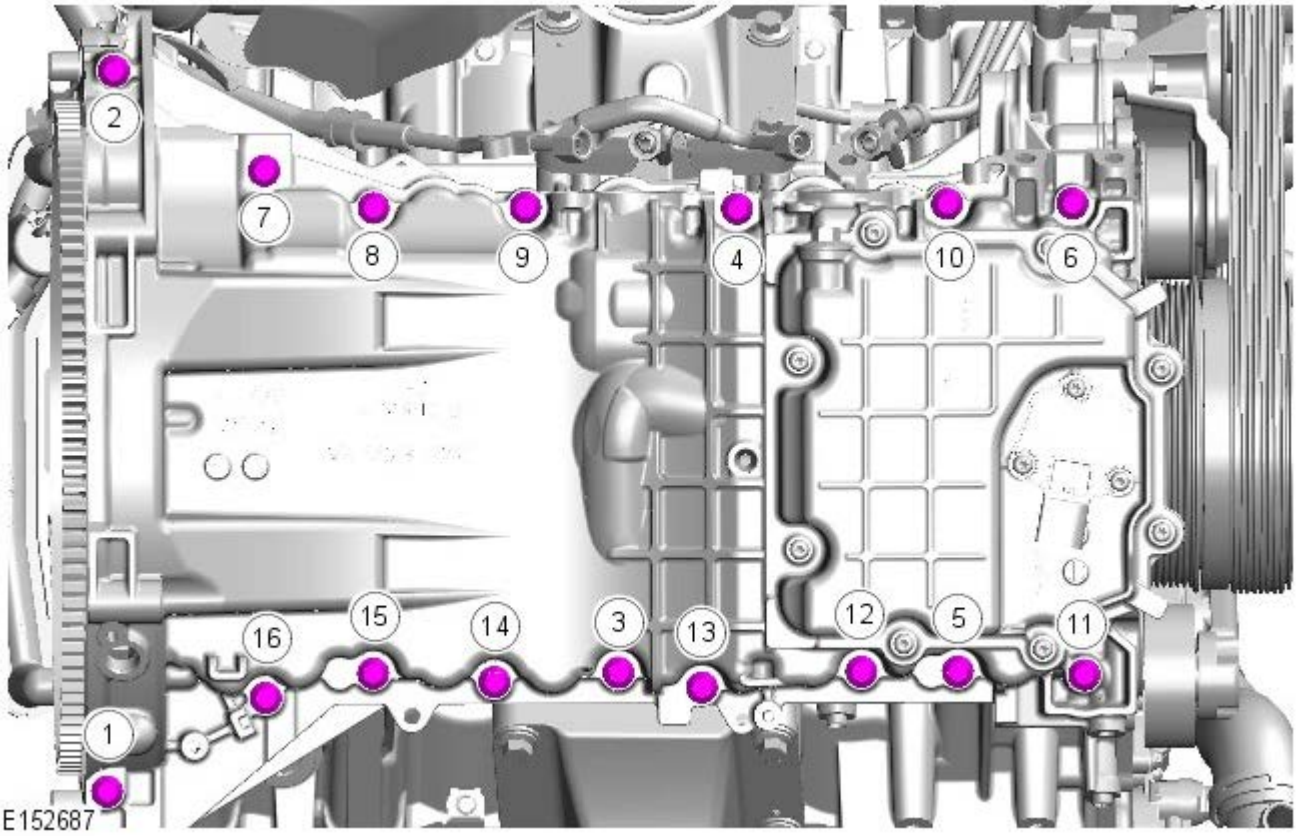
E150251

6.



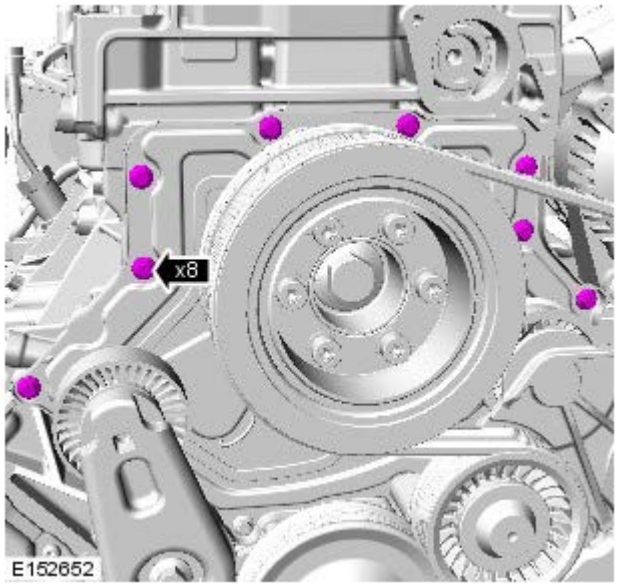
7. NOTE: Tighten the bolts in the indicated sequence.

Torque: 25 Nm



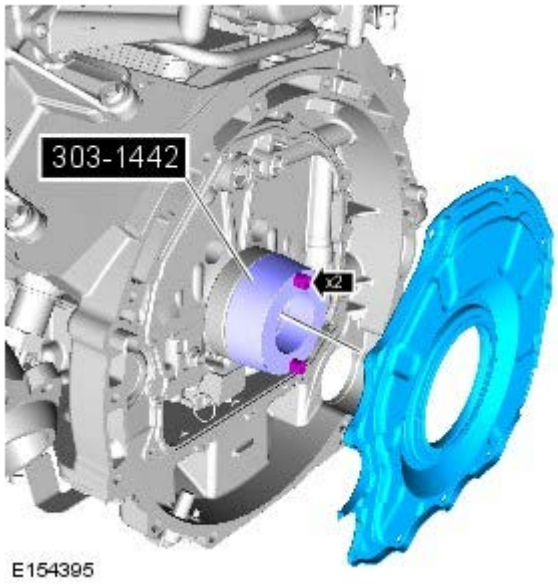
8. CAUTION: Make sure the front cover spacers are removed before installing the bolts.

Torque: 12 Nm



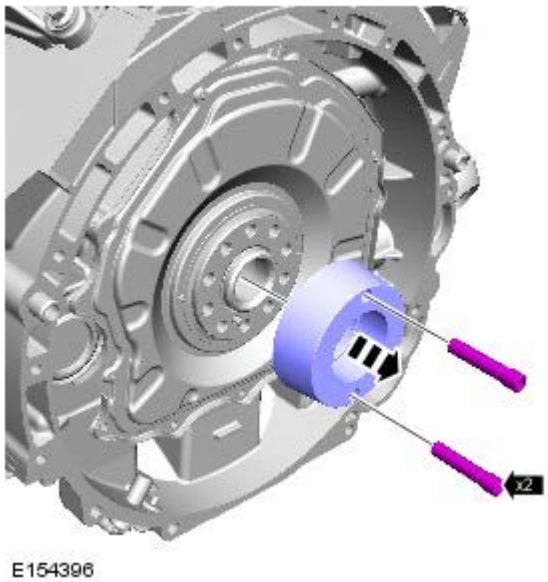
9. Install the special tool.

   Special Tool(s): 303-1442

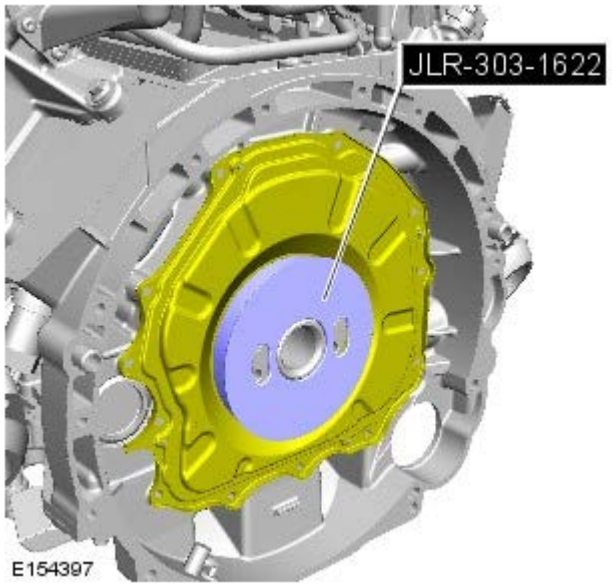


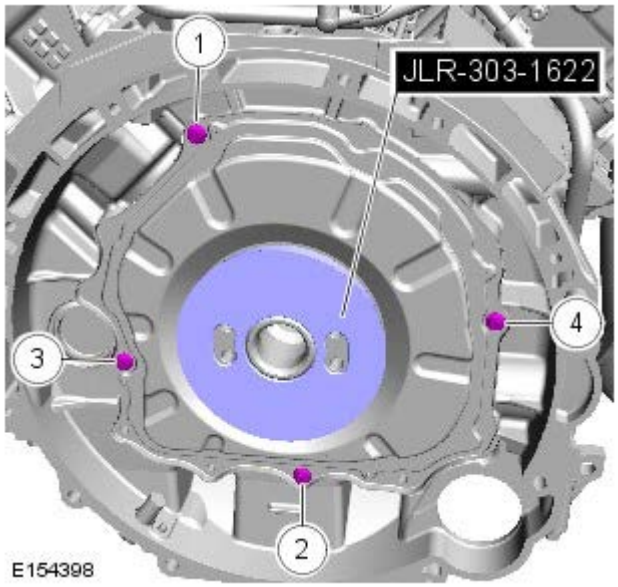
10. Remove the special tool.

    Special Tool(s): 303-1442



11. Align the engine rear oil seal plate using the special tool.

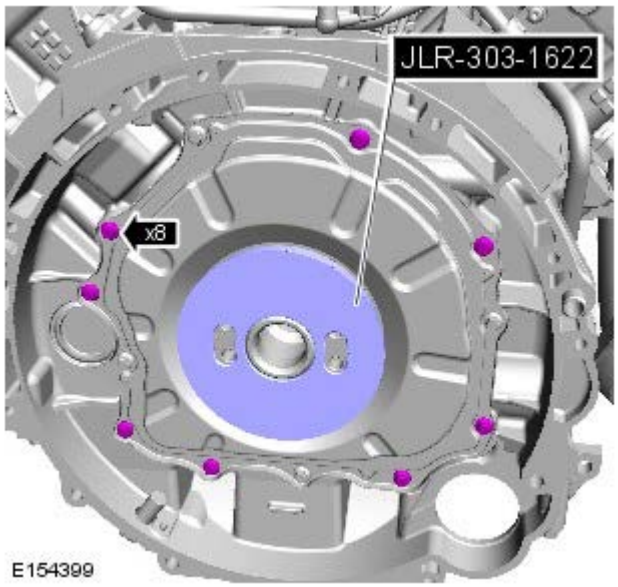




12. NOTE: Tighten the bolts in the indicated sequence.

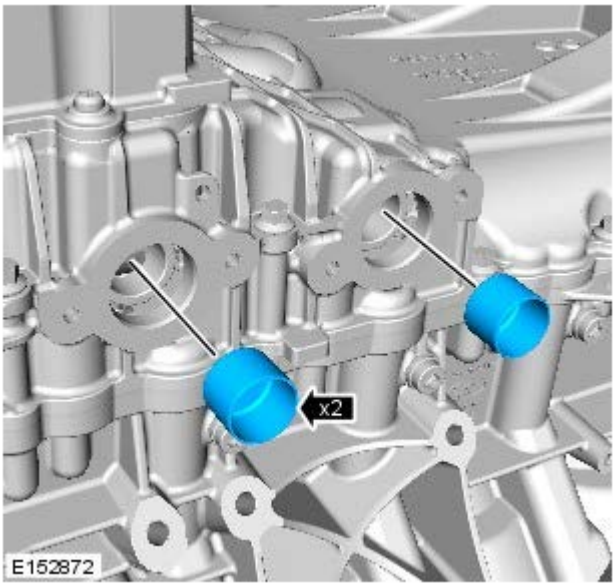
    Torque: 11 Nm

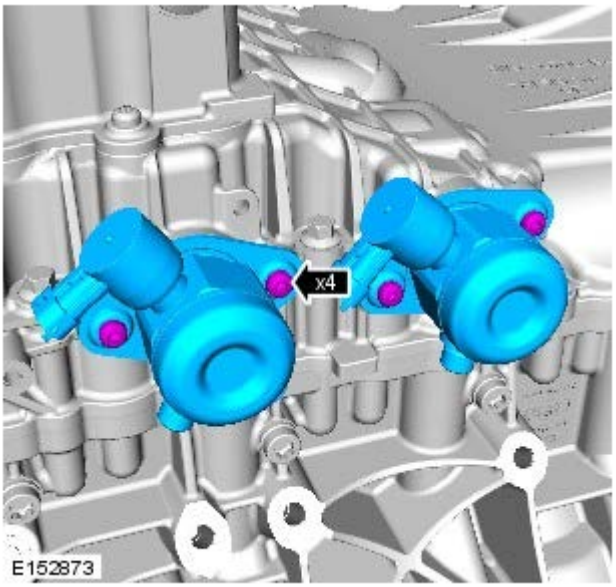
13. *Torque:* 11 Nm



14. Remove the special tools.

15. NOTE: Lubricate the fuel rail high-pressure fuel pump bucket with clean engine oil.



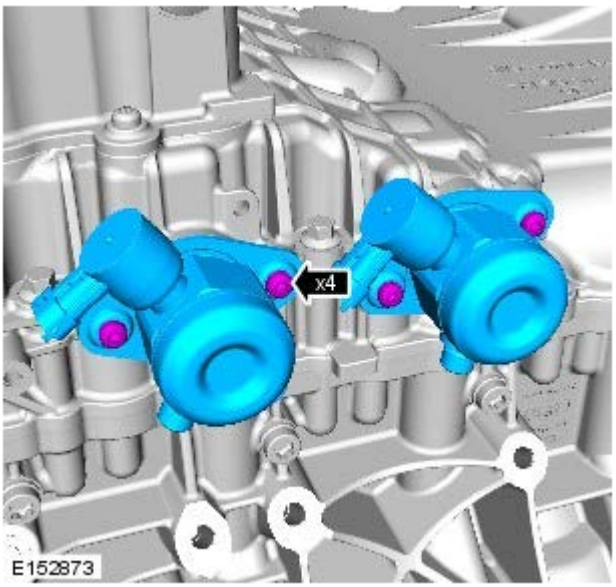


16. CAUTION: Tighten the Torx screws a turn at a time until the correct torque is achieved.

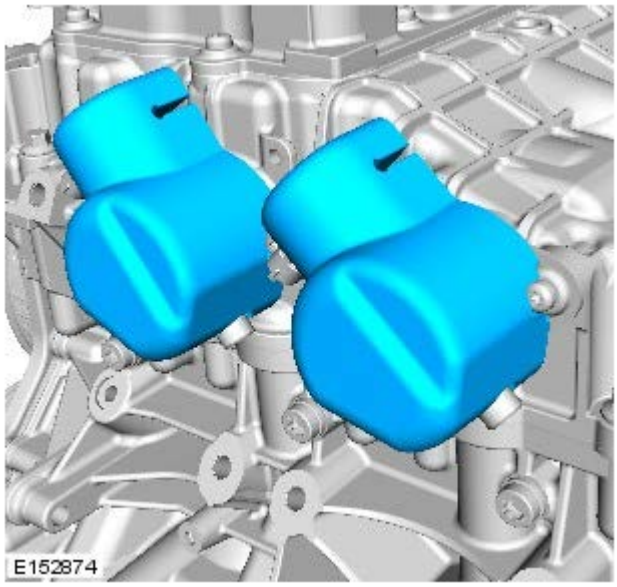
    NOTE: Lubricate the fuel rail high-pressure fuel pump O-ring seal with clean engine oil.

    Torque: 12 Nm

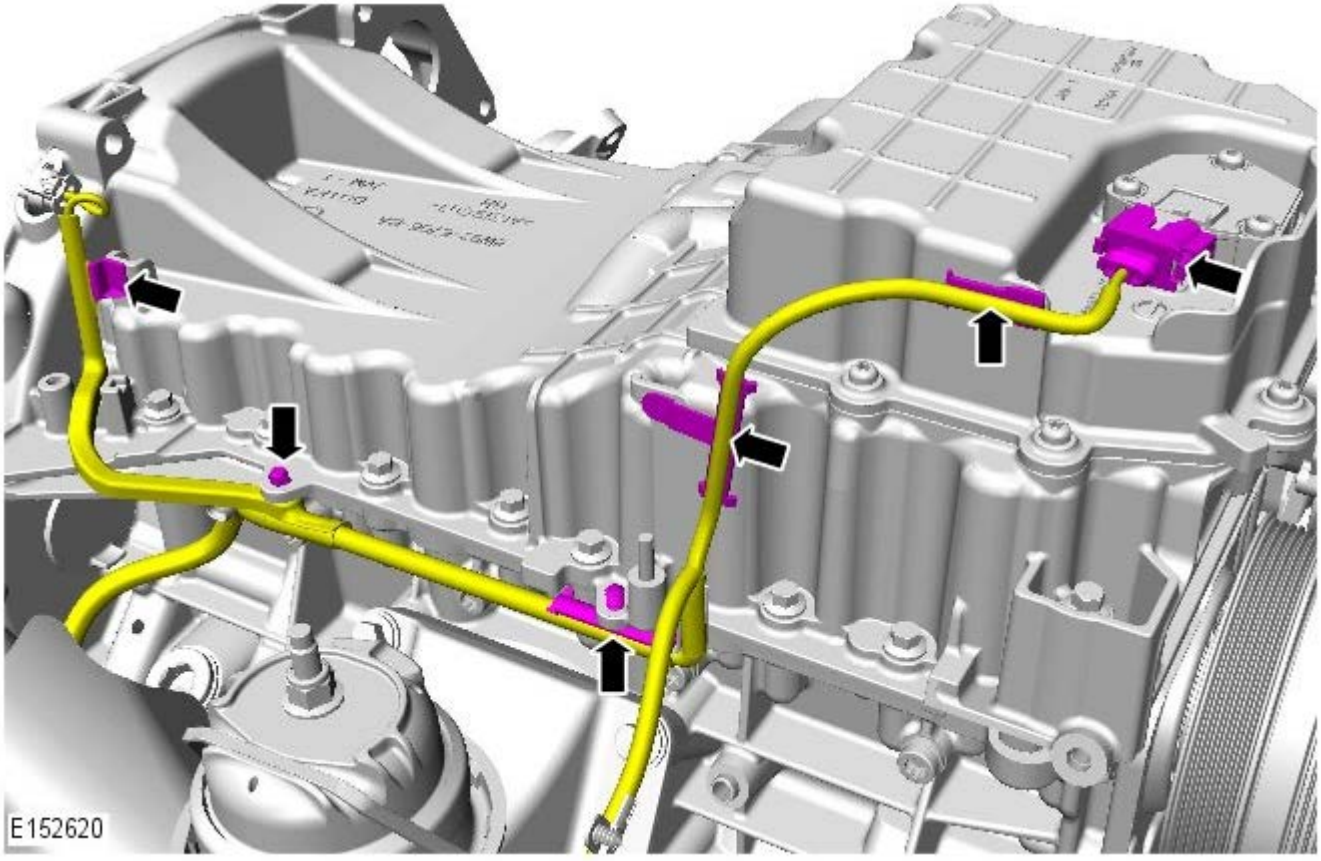
17. Loosen the Torx screws half a turn each.



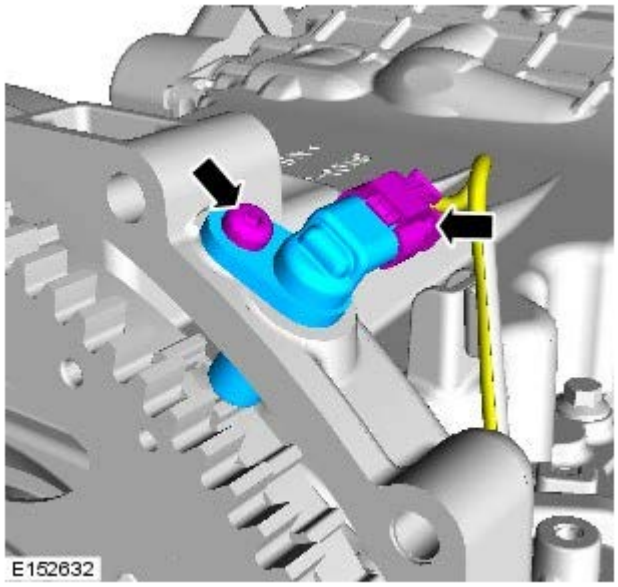
18.



19.



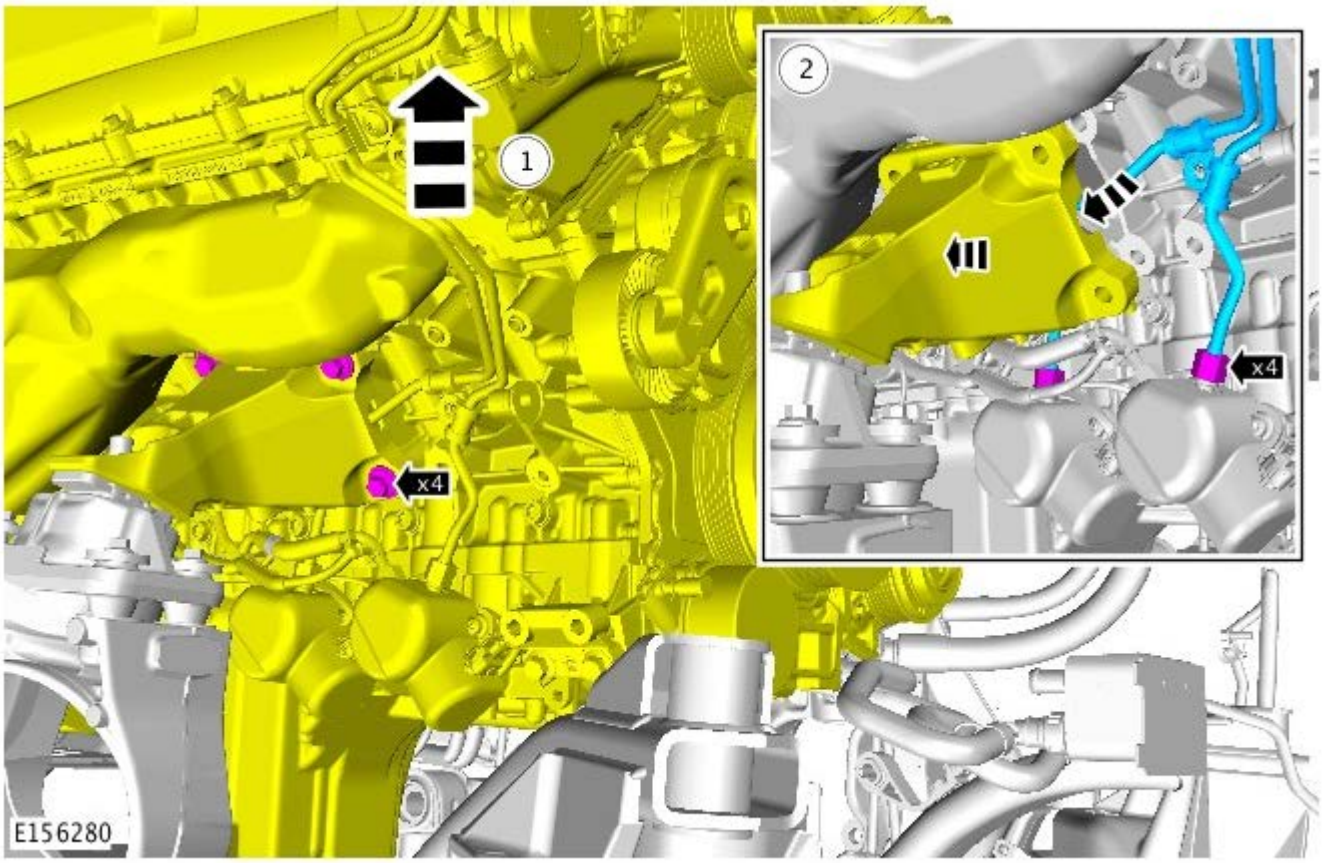
20. *Torque:* 10 Nm



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

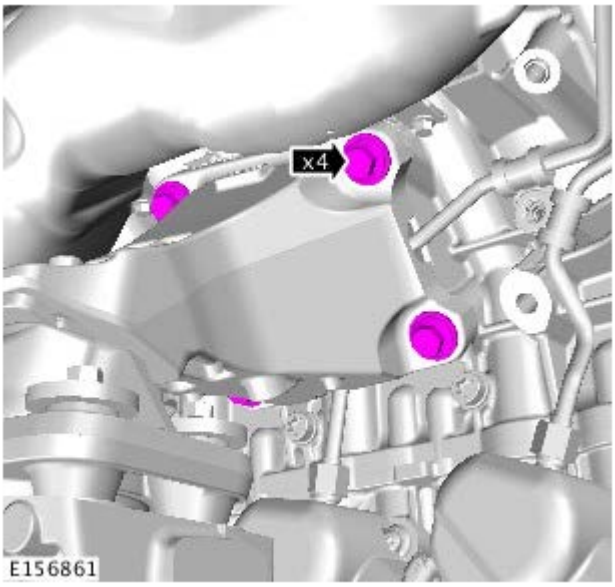
NOTE: Install the unions finger tight before final tightening.

Using a suitable hydraulic jack, raise and support the engine to install the fuel pipe.

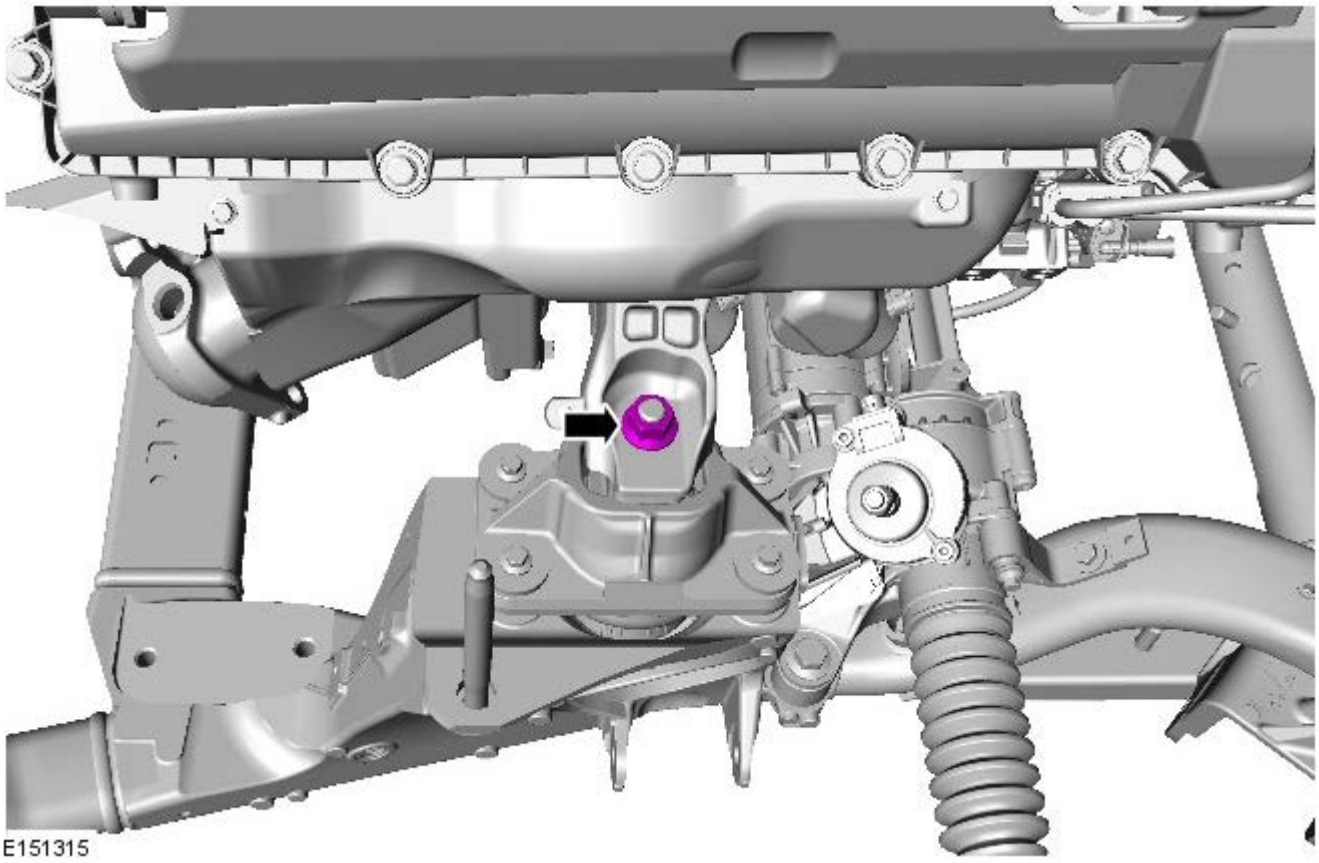


22. Carefully lower the engine onto the engine mounts.

Torque:
Stage 1: 45 Nm
Stage 2: 60°



23. *Torque:* 110 Nm



24. CAUTIONS:

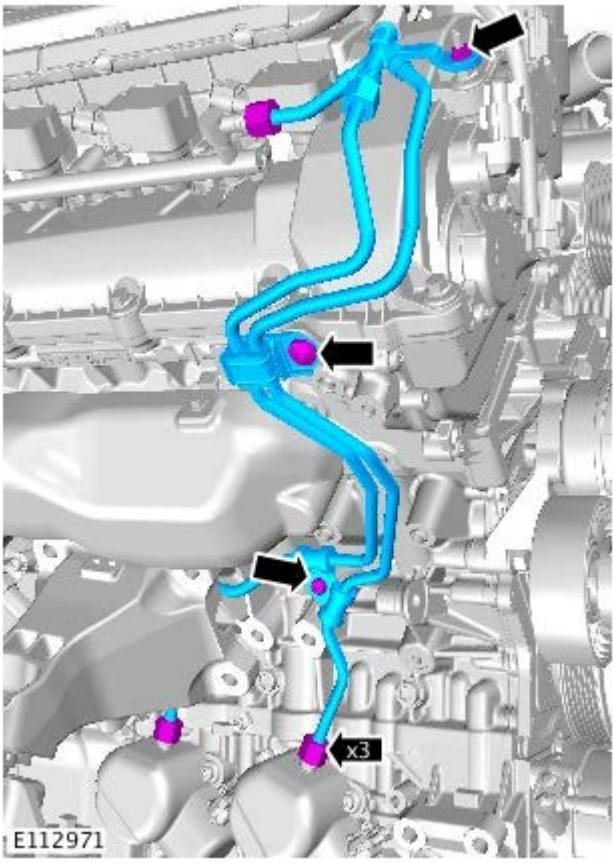
Install new high-pressure fuel supply lines.

Lubricate only the union threads with clean engine oil.

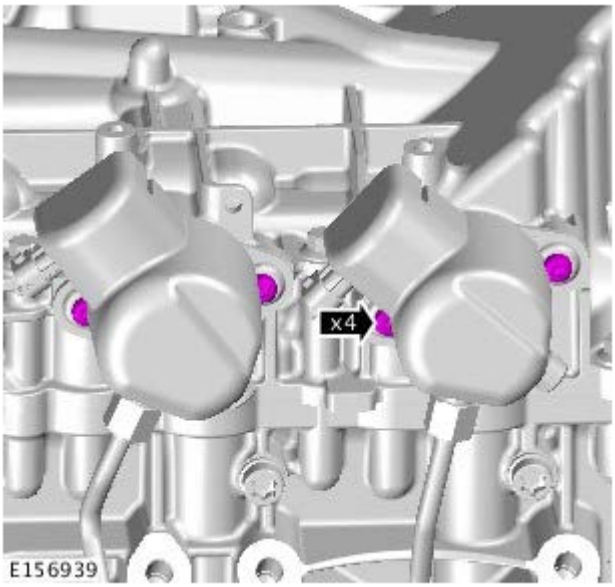
NOTES:

Remove and discard the blanking caps.

Install the bolt and unions fully finger tight before final tightening.



Do not fully tighten at this stage.

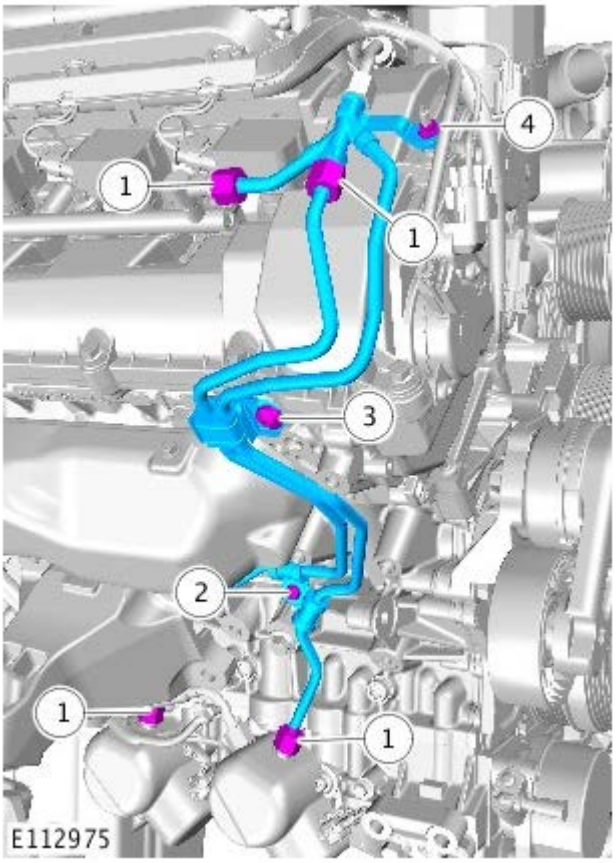


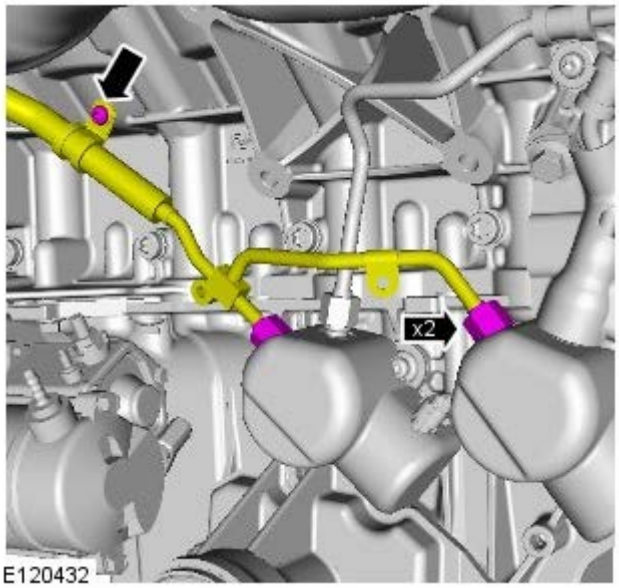
25. CAUTION: Tighten the Torx screws a turn at a time until the correct torque is achieved.

Torque: 12 Nm

26. NOTE: Engine shown removed for clarity.

Torque:
Unions (1) 21 Nm
M6 (2) 11 Nm
M8 (3) 25 Nm
M5 nut (4) 6 Nm





27. NOTES:

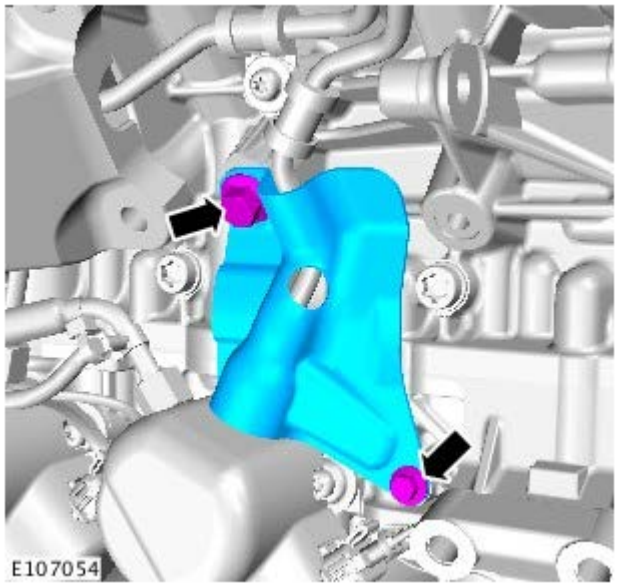
Install the bolt and unions finger tight before final tightening.

Remove and discard the blanking caps.

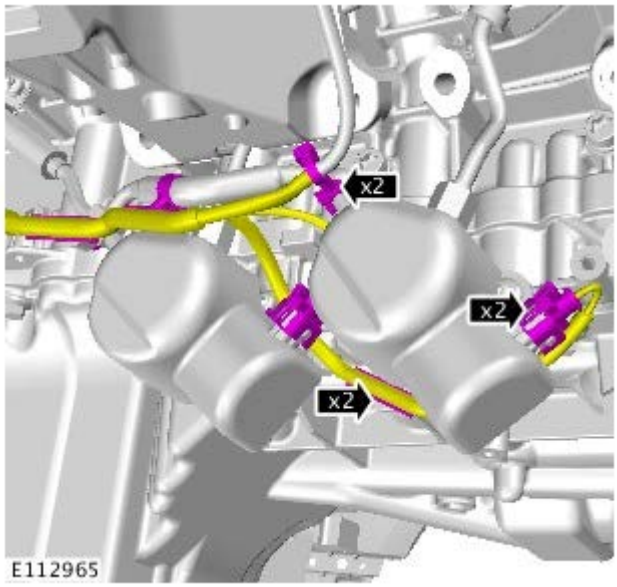
Torque:
Unions 21 Nm
M6 11 Nm

28. NOTE: Engine shown removed for clarity.

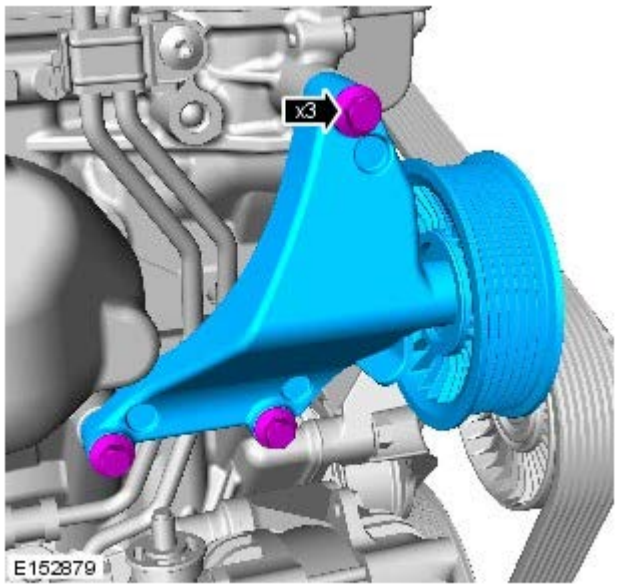
Torque:
M10 29 Nm
M6 11 Nm



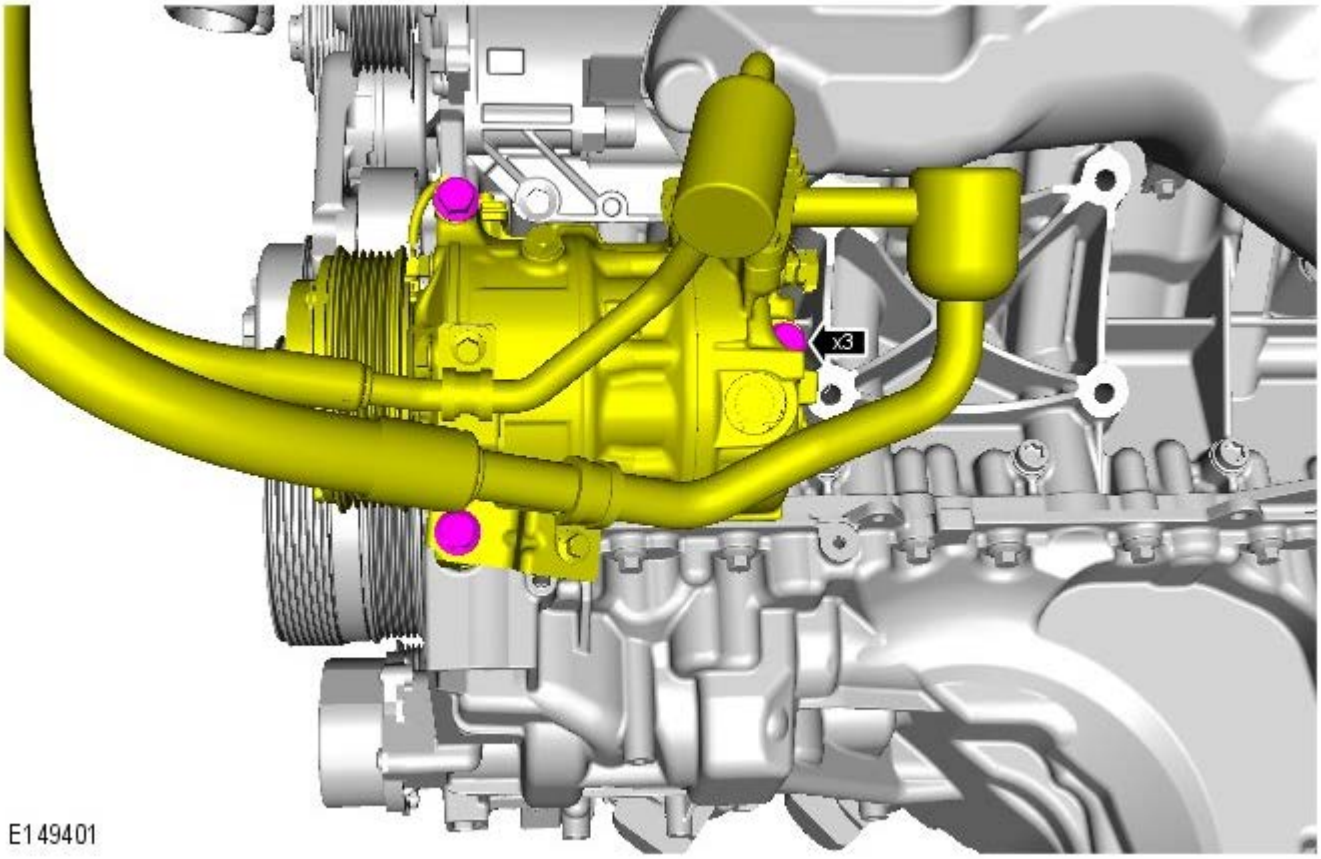
29. NOTE: Engine shown removed for clarity.



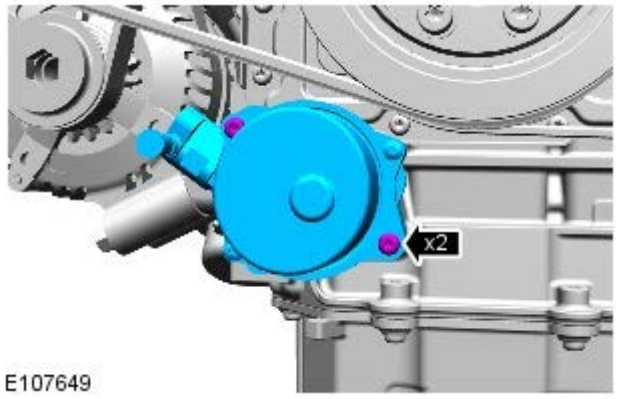
30. *Torque:* 25 Nm

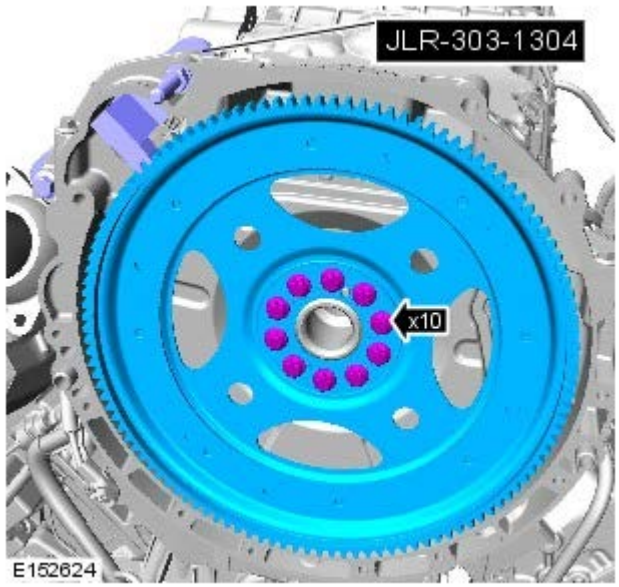


31. *Torque:* 25 Nm



32. *Torque:* 12 Nm





33. CAUTIONS:

Install all the bolts finger tight before final tightening.

The bolts can only be used 3 times, mark the bolts with a centre punch. If 2 punch marks are visible, discard the bolts.

NOTES:

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°

34. Refer to: Starter Motor (303-06B Starting System - V6 S/C 3.0L Petrol, Removal and Installation).

35. Refer to: Transmission - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, Installation).

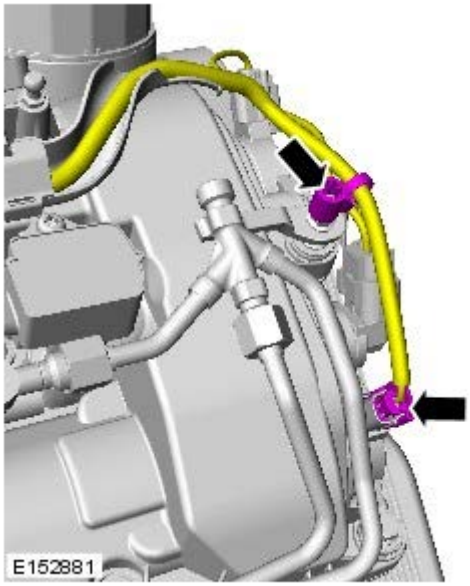
36. Refer to: Differential Case (205-03 Front Drive Axle/Differential, Removal and Installation).

37. Refer to: Generator (414-02B Generator and Regulator - V6 S/C 3.0L Petrol, Removal and Installation).

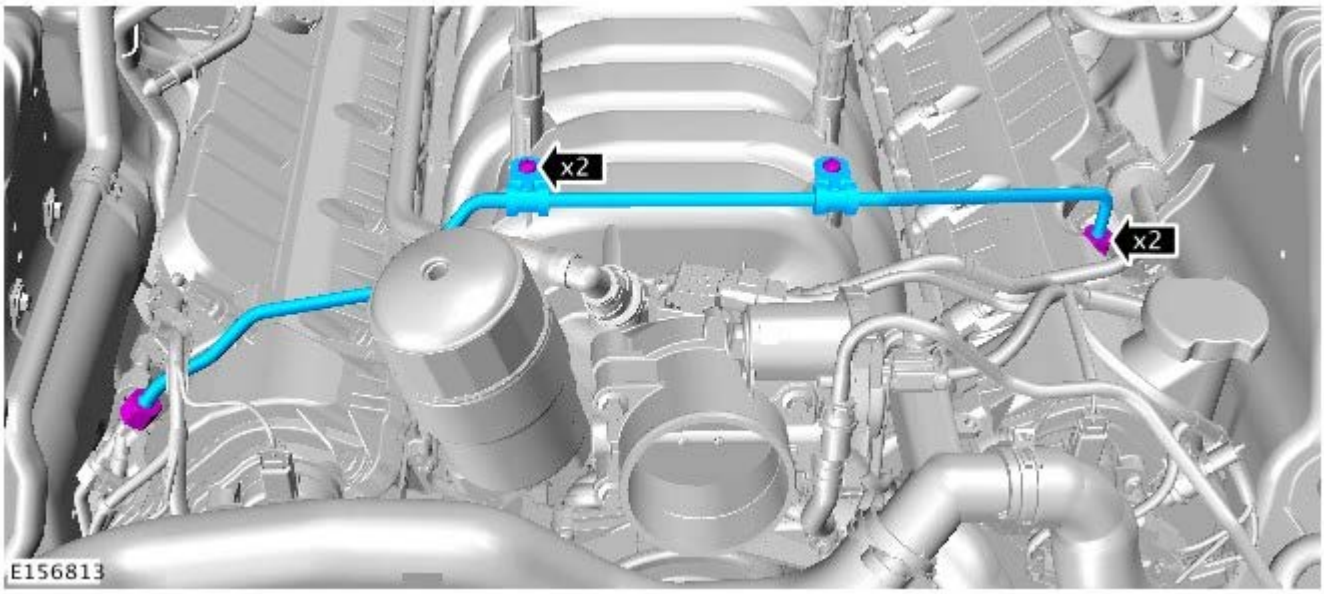
38. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

    Raise and support the vehicle.

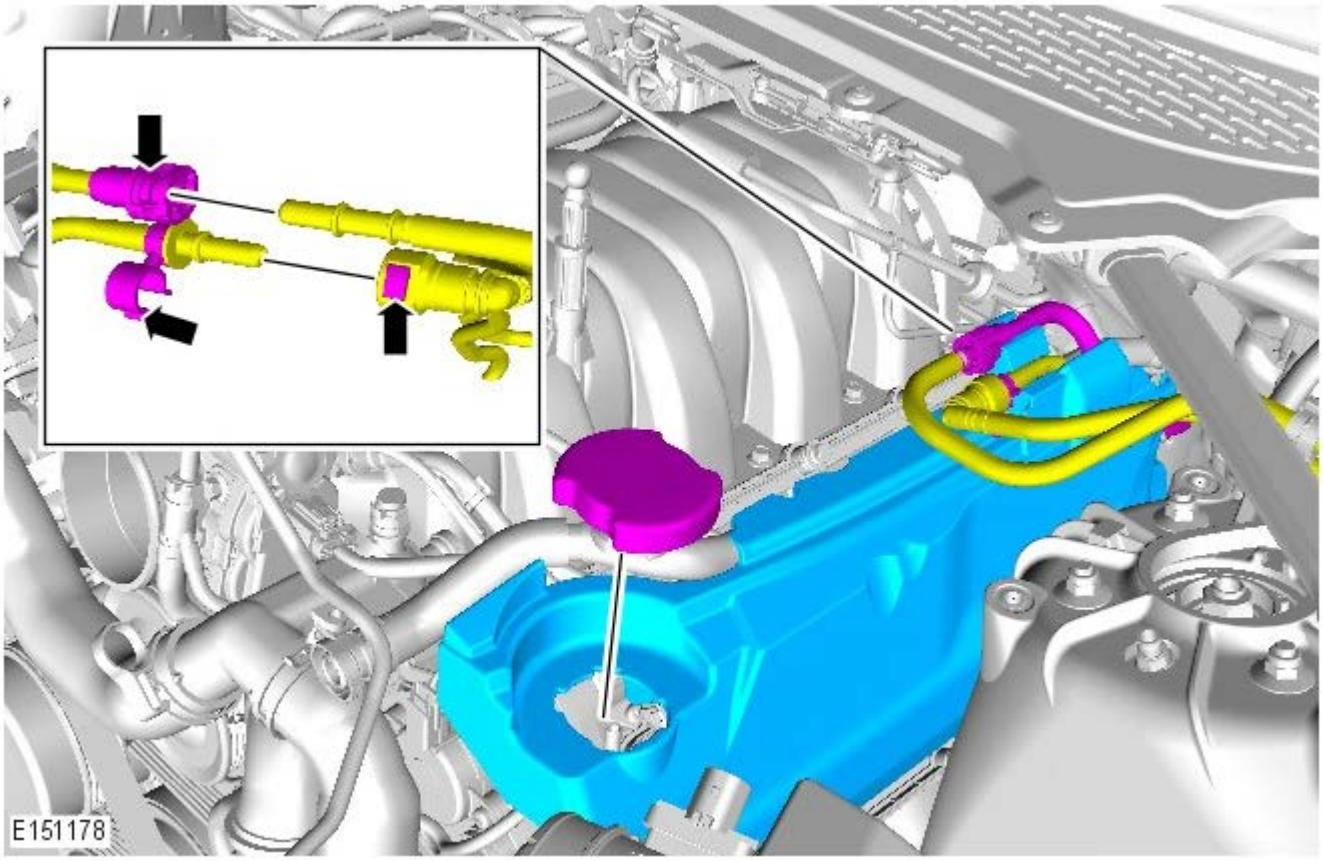
39.



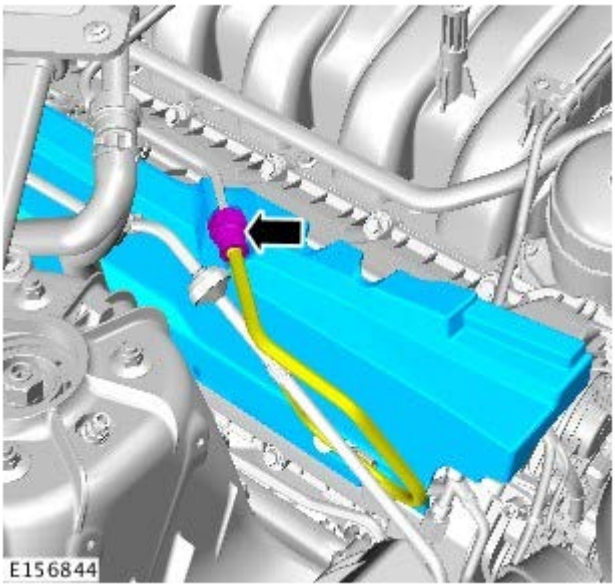
40. *Torque:*
    Unions 21 Nm
    M6 8 Nm



41.



42.



43. Refer to: Engine Oil Draining and Filling (303-01B Engine - V6 S/C 3.0L Petrol, General Procedures).

44. Connect the battery ground cable.

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

Published: 02-May-2013

Engine - V6 S/C 3.0L Petrol - Oil Pump

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.

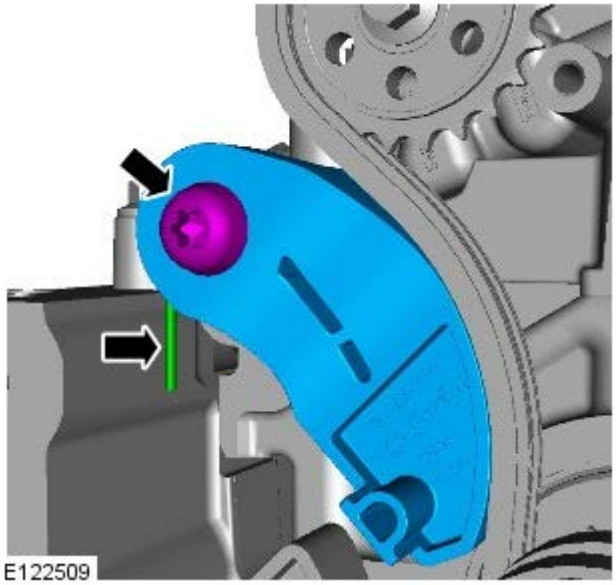
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

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

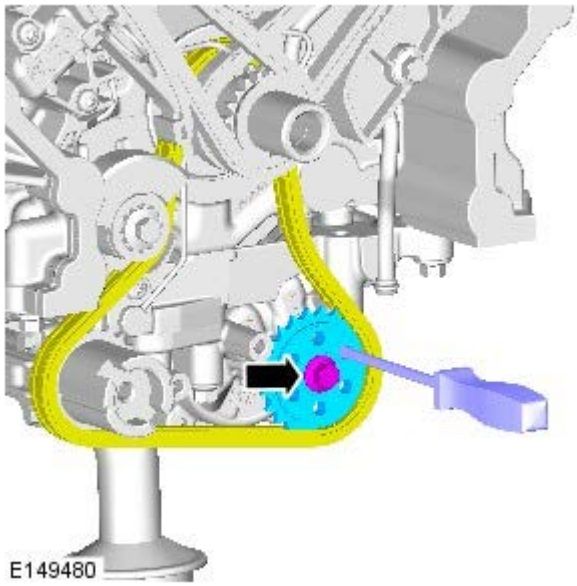
   Raise and support the vehicle.

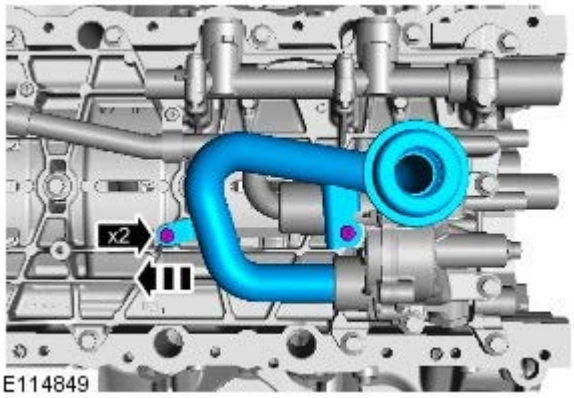
3. Refer to: Oil Pan Extension (303-01B Engine - V6 S/C 3.0L Petrol, Removal and Installation).

4.



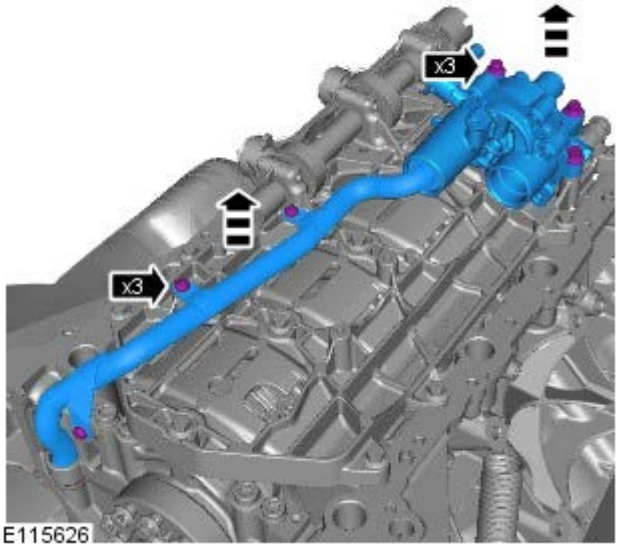
5.





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

7. CAUTION: Remove and discard the O-ring seals.



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



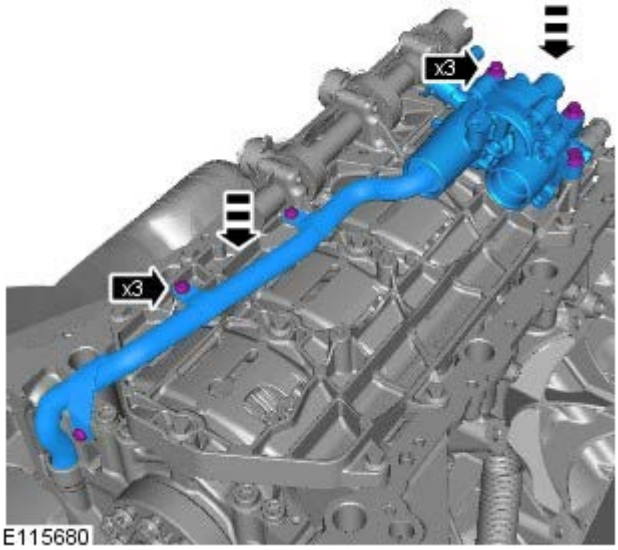
Installation

1. Lubricate and install the new O-ring seals.



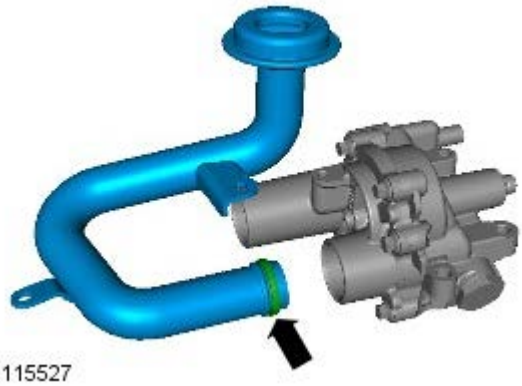
E139628

2. *Torque:*
   M8 25 Nm
   M6 12 Nm



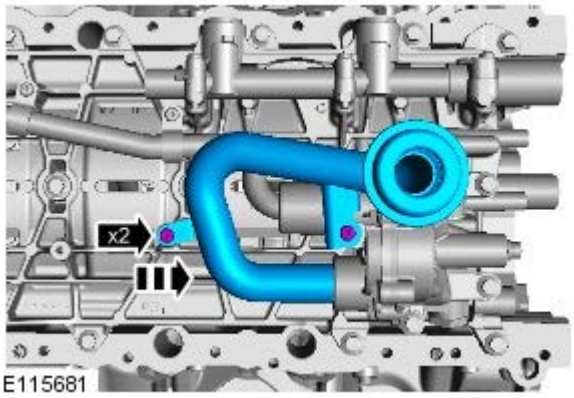
E115680

3. Lubricate and install a new O-ring seal.

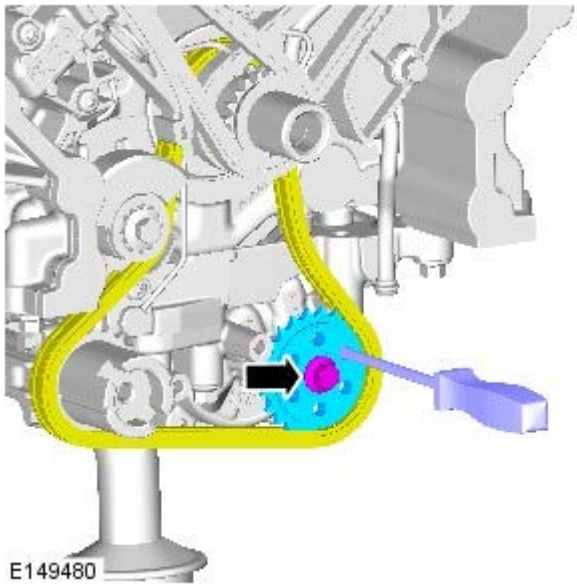


E115527

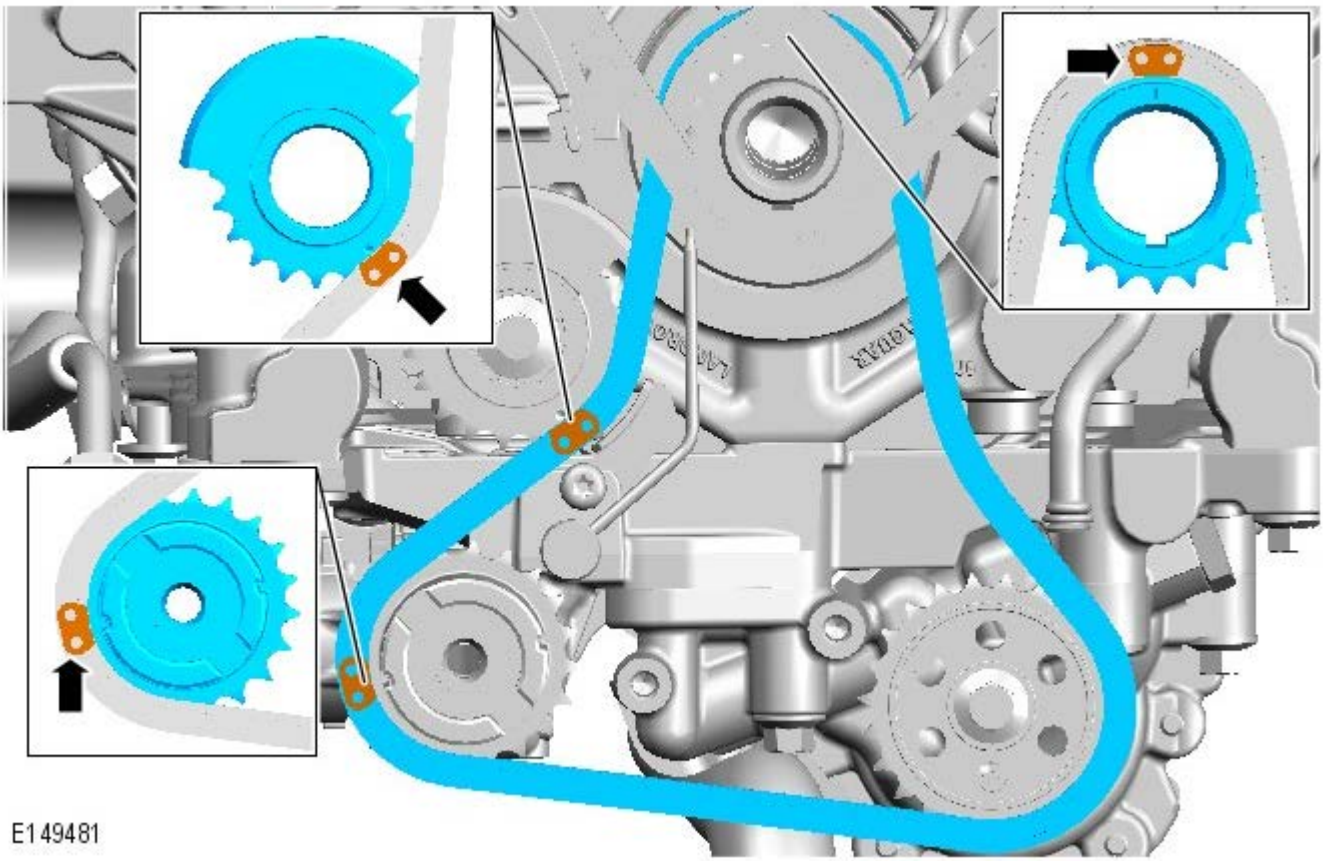
4. *Torque:* 12 Nm

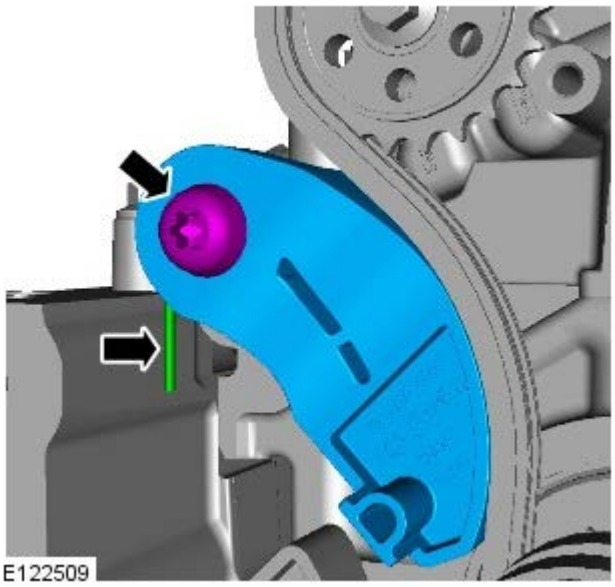


5. *Torque:* 21 Nm



6. 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.

   Torque: 21 Nm

8. Refer to: Oil Pan Extension (303-01B Engine - V6 S/C 3.0L Petrol, Removal and Installation).

9. Connect the battery ground cable.

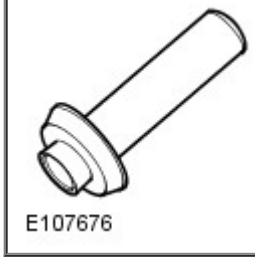
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 02-May-2013

Engine - V6 S/C 3.0L 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.

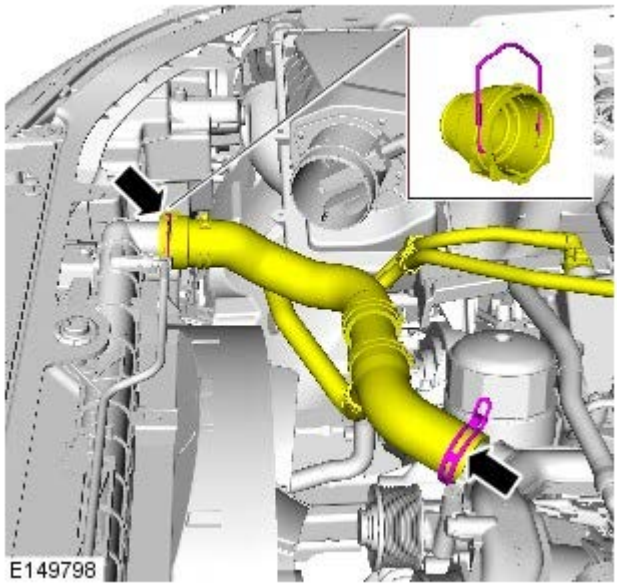
3. Refer to: Crankshaft Pulley (303-01B Engine - V6 S/C 3.0L Petrol, Removal and Installation).

4. Refer to: Valve Cover LH (303-01B Engine - V6 S/C 3.0L Petrol, Removal and Installation).

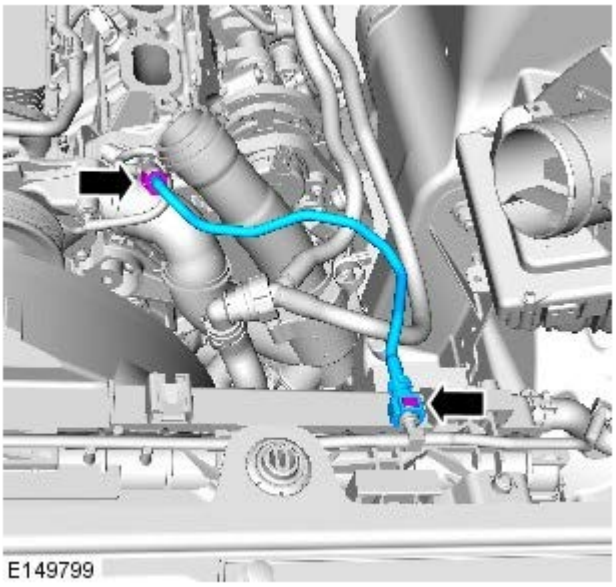
5. Refer to: Valve Cover RH (303-01B Engine - V6 S/C 3.0L Petrol, Removal and Installation).

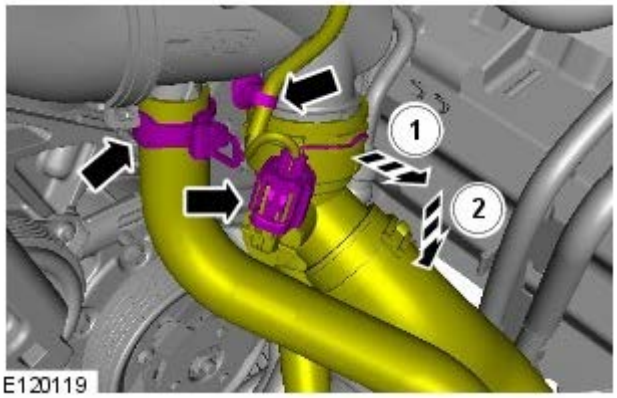
6. Refer to: Cooling System Partial Draining, Filling and Bleeding (303-03B Engine Cooling - V6 S/C 3.0L Petrol, General Procedures).

7.



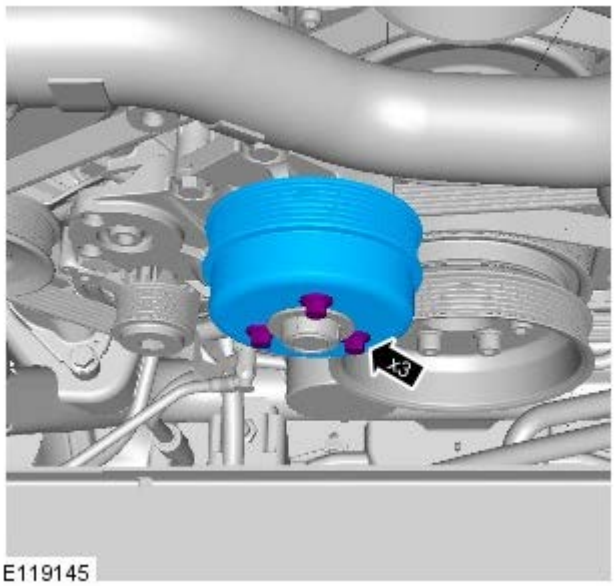
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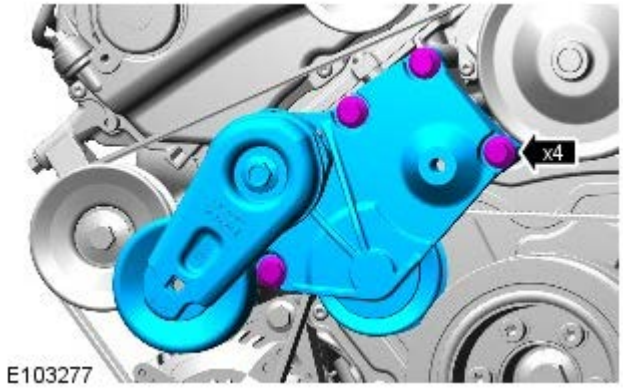


9. CAUTION: Be prepared to collect escaping coolant.

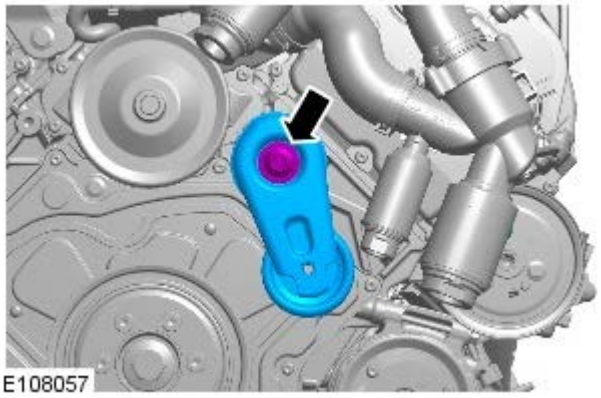
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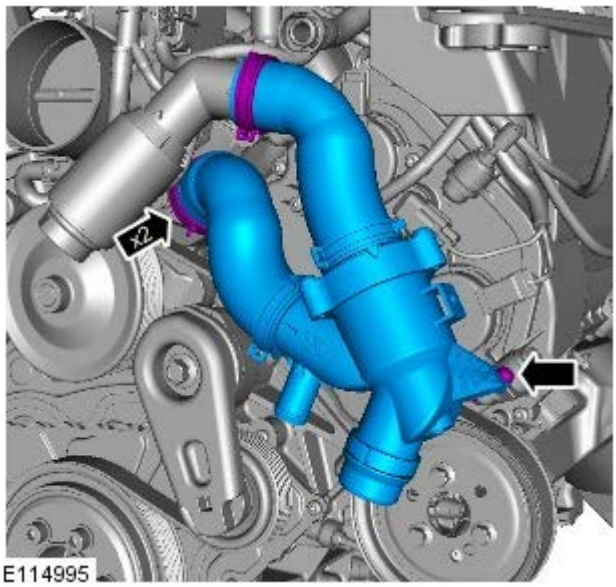
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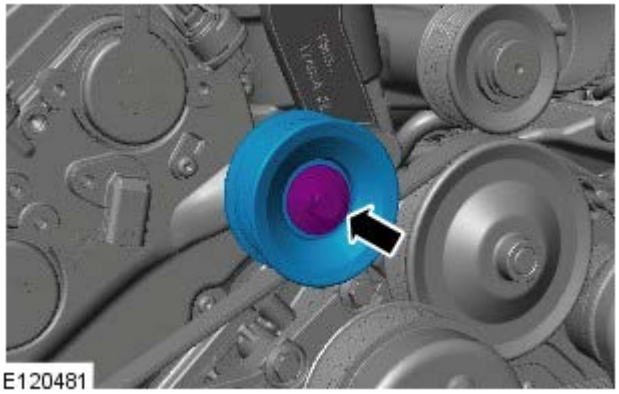
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13.



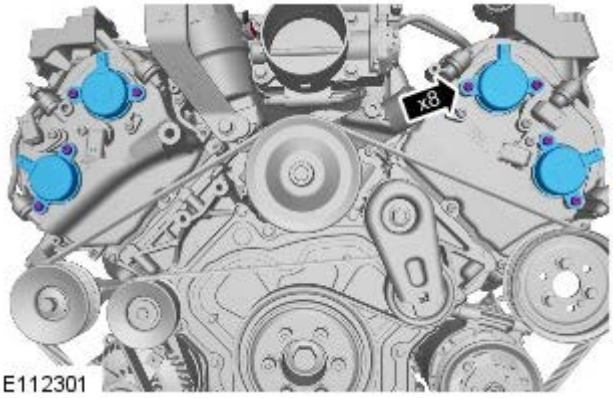
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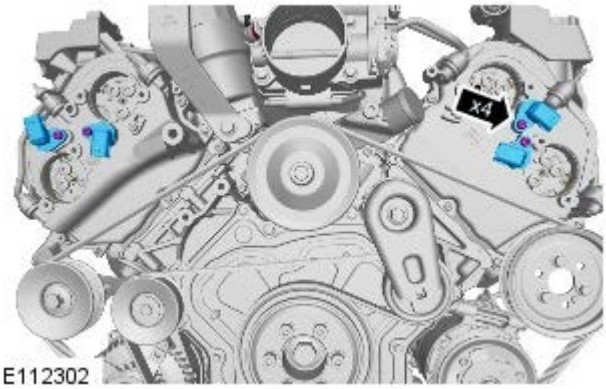
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16.



17.

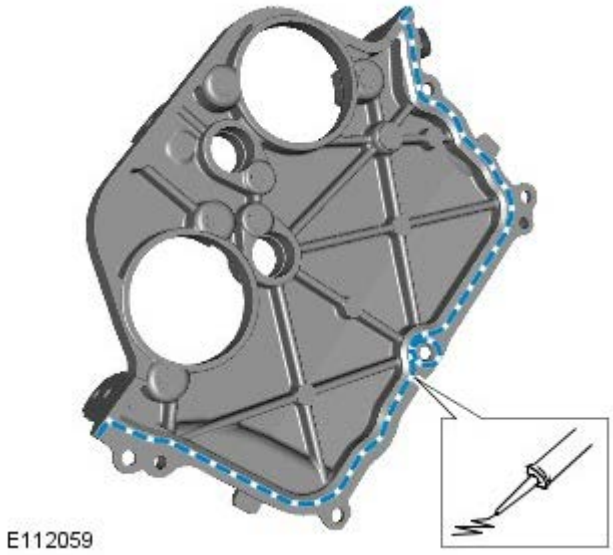


18.



E112055

Installation


E112059

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.


E112060

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.

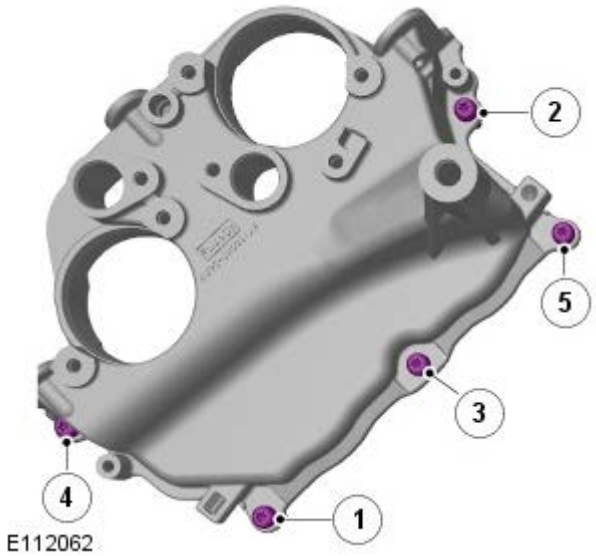
3. NOTE: Tighten the bolts in the indicated sequence.



E112061

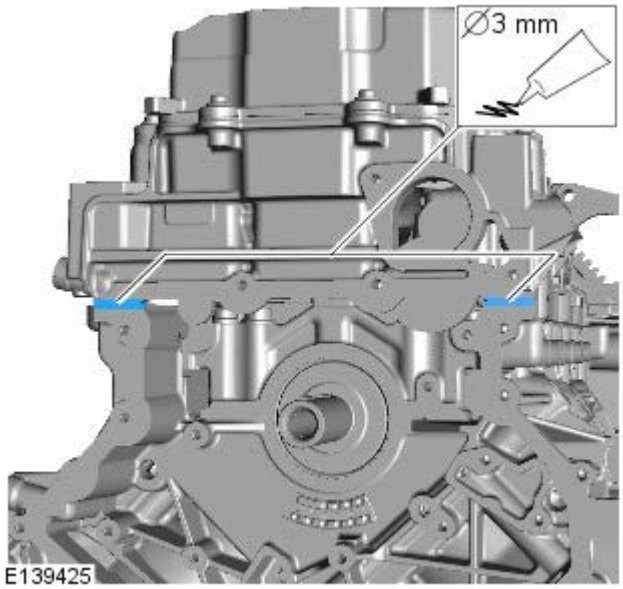
Torque: 12 Nm

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



E112062

Torque: 12 Nm



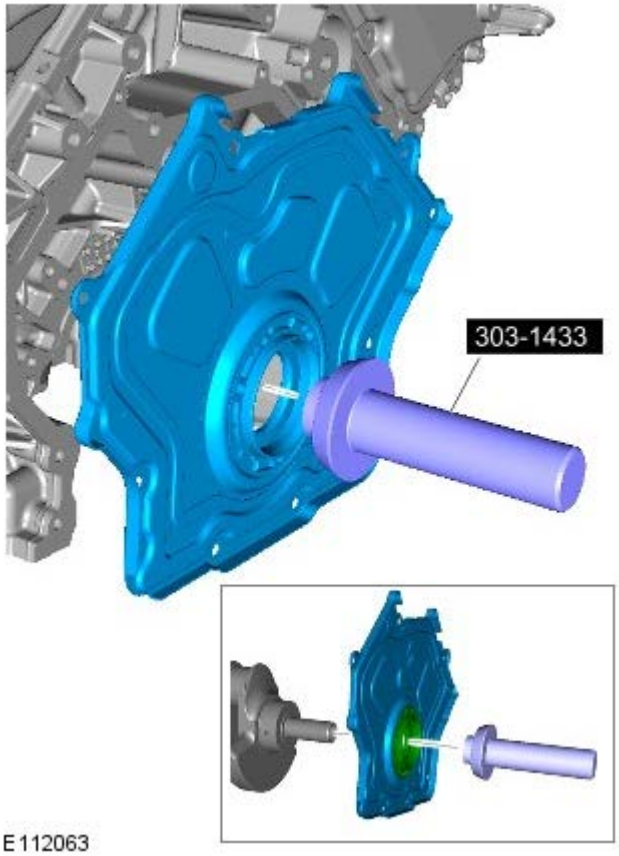
E139425

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.

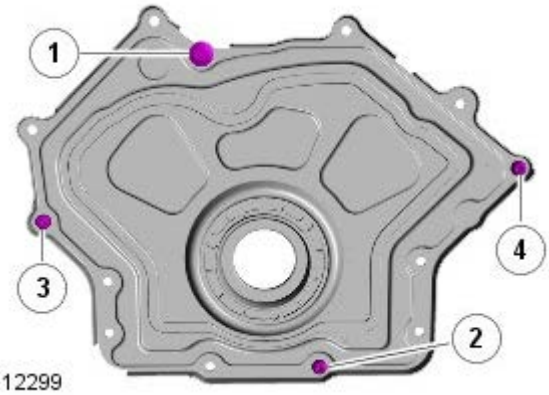
Install the bolts, but do not tighten fully at this stage.



E112063

Special Tool(s): 303-1433

7. *Torque:*
   M6 12 Nm
   M8 20 Nm



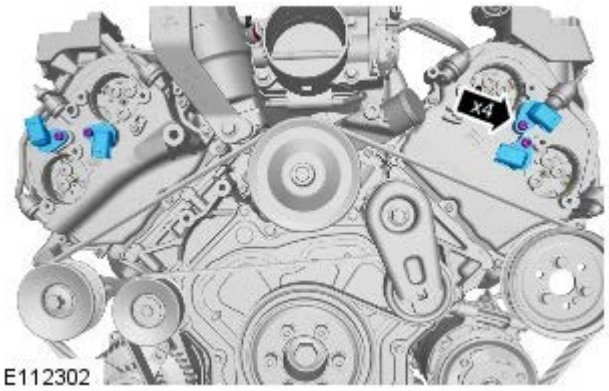
E112299

8. *Torque:* 12 Nm



E112300

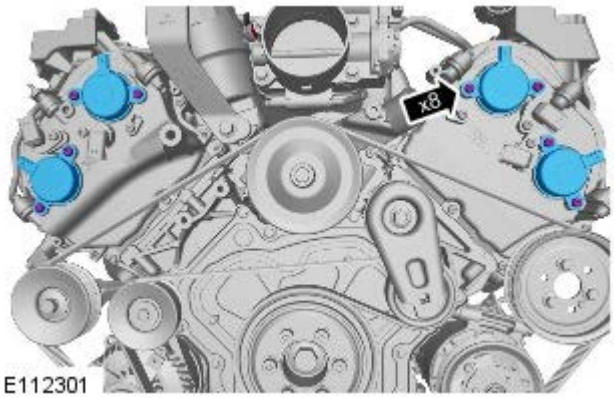
9. *Torque:* 12 Nm



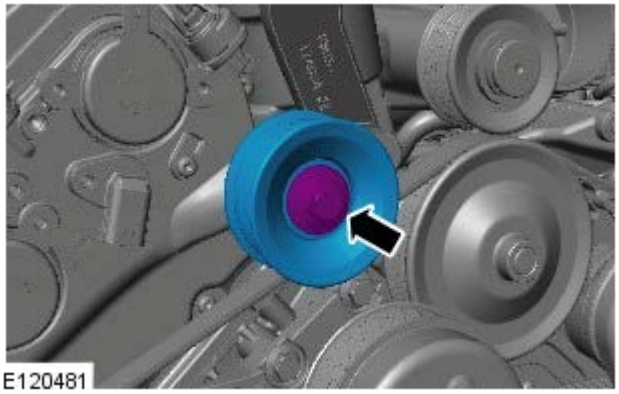
10. *Torque:* 25 Nm



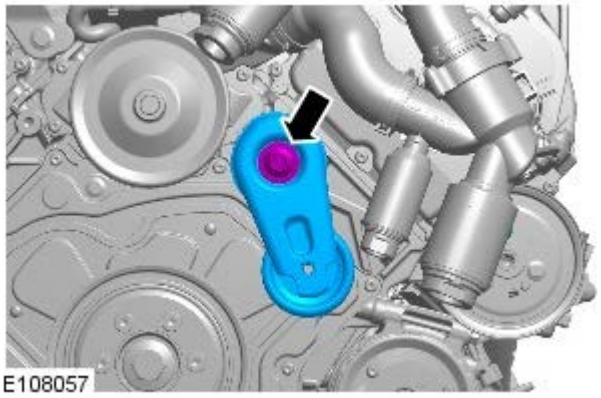
11. *Torque:* 12 Nm



12. *Torque:* 40 Nm

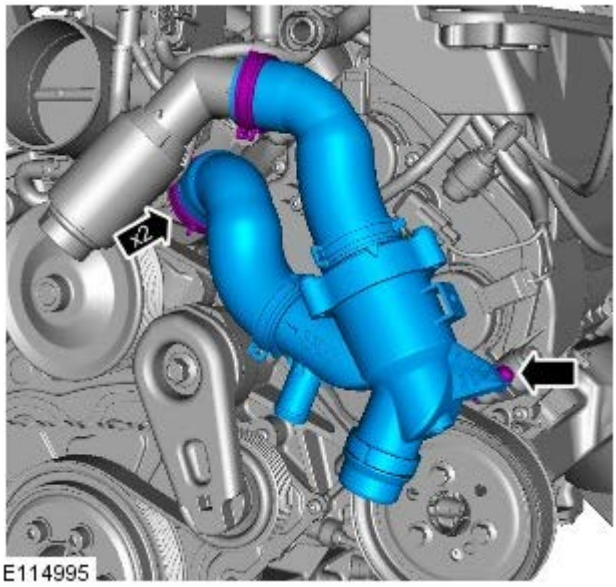


13. NOTE: Install the bolt finger tight before final tightening.

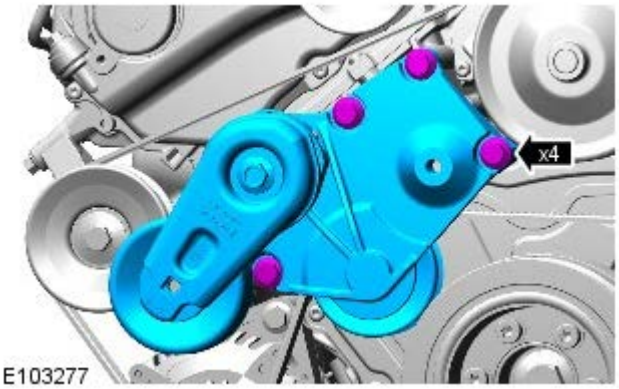


Torque: 40 Nm

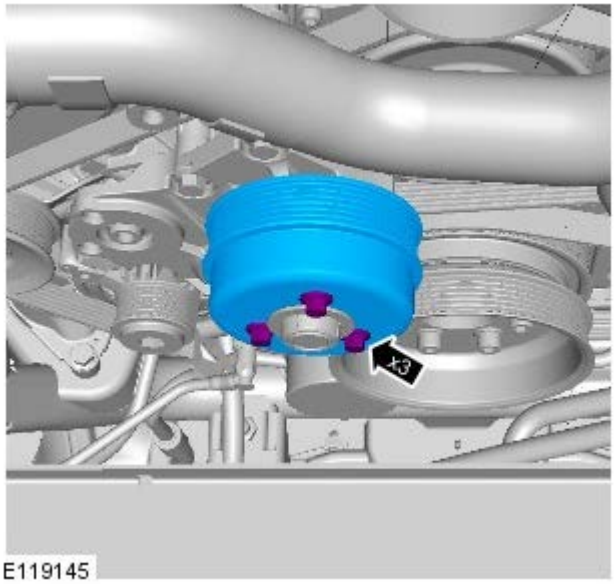
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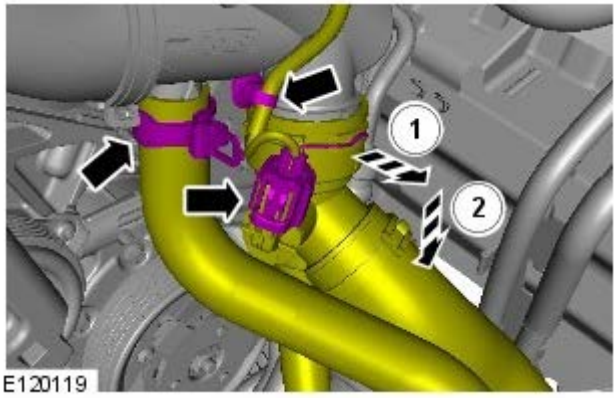
15. *Torque:* 25 Nm



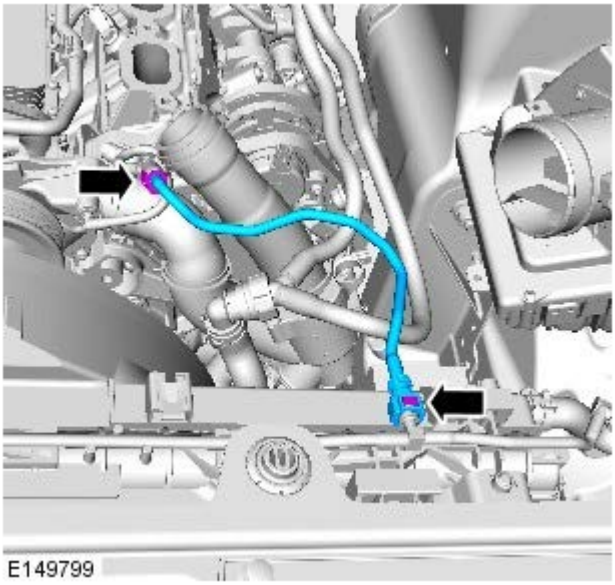
16. *Torque:* 25 Nm



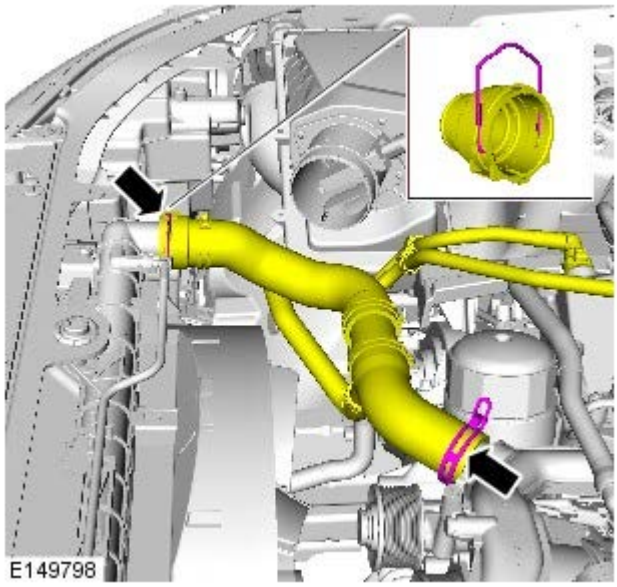
17.



18.



19.



20. Refer to: Crankshaft Pulley (303-01B Engine - V6 S/C 3.0L Petrol, Removal and Installation).

21. Refer to: Valve Cover LH (303-01B Engine - V6 S/C 3.0L Petrol, Removal and Installation).

22. Refer to: Valve Cover RH (303-01B Engine - V6 S/C 3.0L Petrol, Removal and Installation).

23. Refer to: Cooling System Partial Draining, Filling and Bleeding (303-03B Engine Cooling - V6 S/C 3.0L Petrol, General Procedures).

24. Connect the battery ground cable.

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

Published: 13-May-2013

Engine - V6 S/C 3.0L Petrol - Timing Drive Components

Removal and Installation

Special Tool(s)

 E115263	303-1445 Timing Tool – Camshaft Alignment
 E115270	303-1452 Camshaft Rotating Tool
 E115271	303-1482 Tensioner Tool
 E152575	JLR-303-1303 Timing Tool
 E152576	JLR-303-1304 Locking 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.

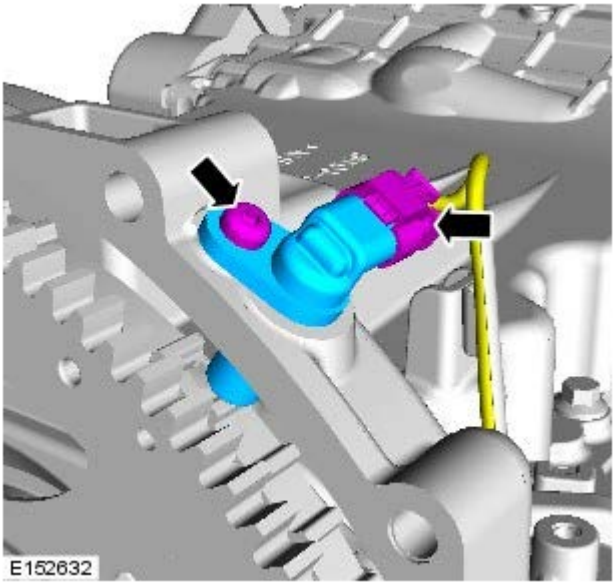
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

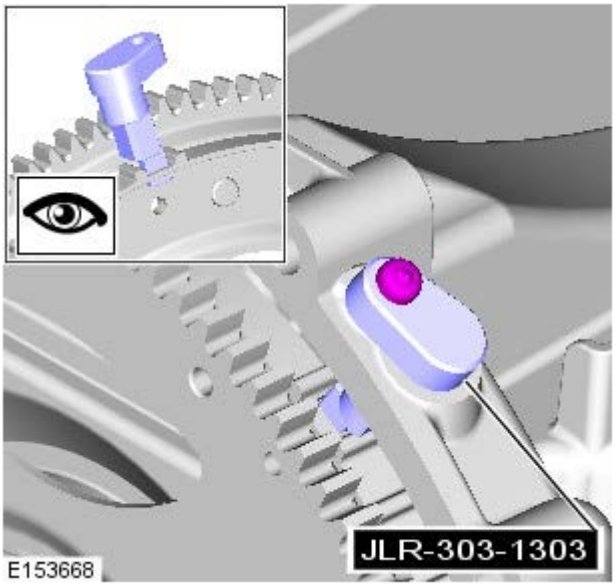
2. WARNING: Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

3. Refer to: Timing Cover (303-01B Engine - V6 S/C 3.0L Petrol, Removal and Installation).

4.





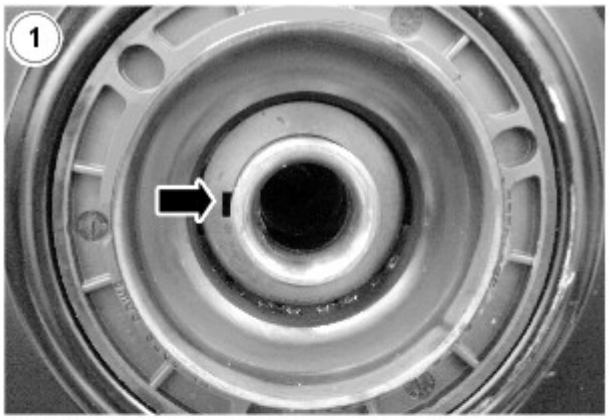
5. CAUTION: Only rotate the crankshaft clockwise.

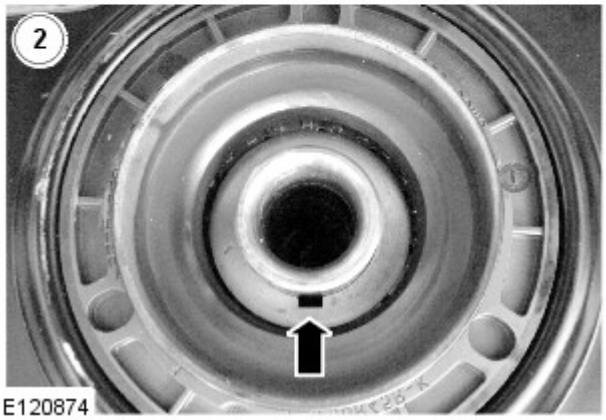
Install the special tool.

Special Tool(s): JLR-303-1303

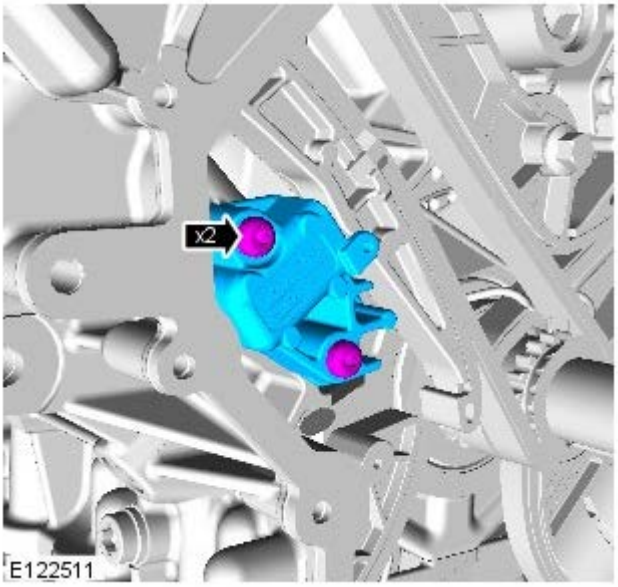
6. CAUTION: If the noted position of the woodruff key is at the 9 o'clock position, then a new flexplate must be installed. If the woodruff key is in the 6 o'clock position then proceed with the next step

Note the position of the crankshaft woodruff key.

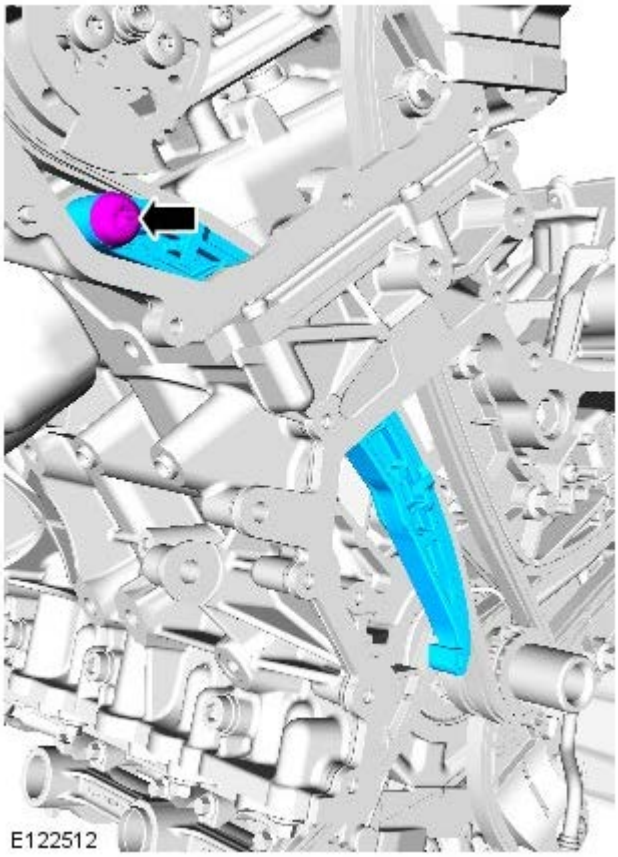




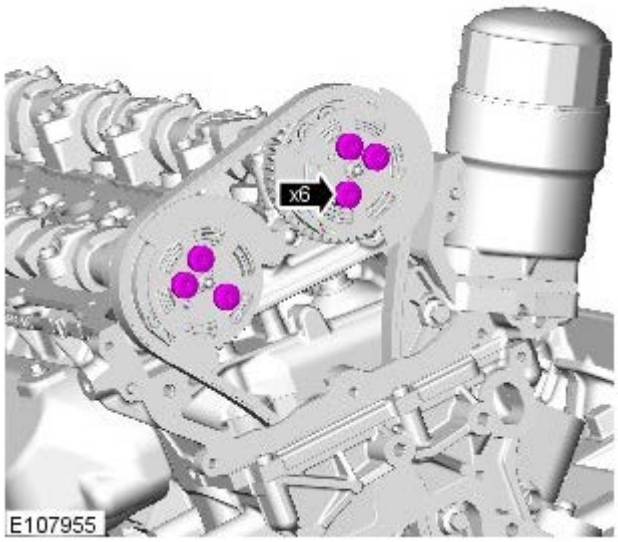
7.



8.

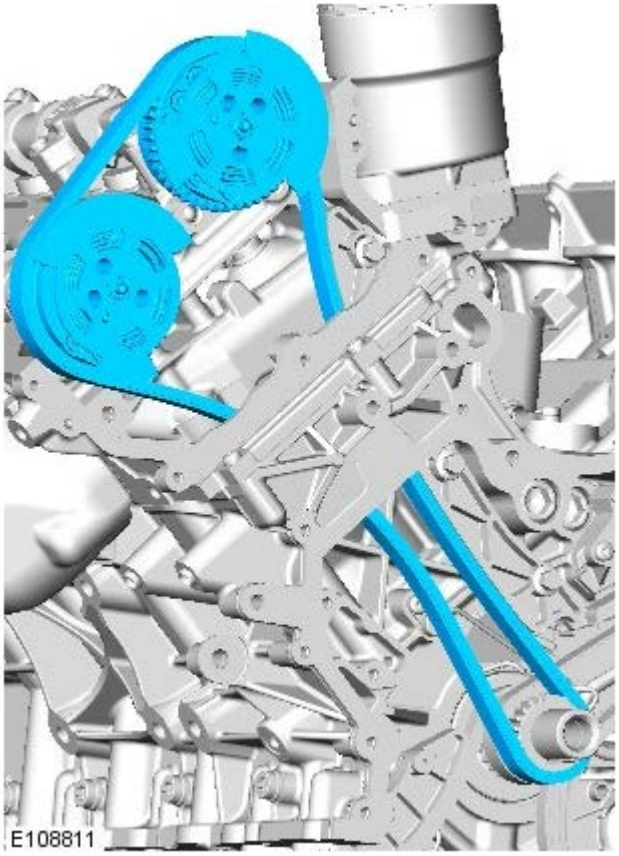


9.

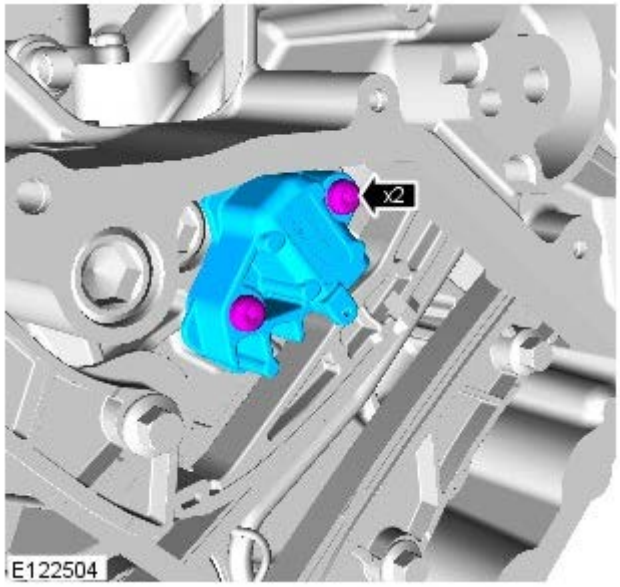


10. CAUTION: If the variable valve timing (VVT) units are knocked or dropped then the VVT must be replaced.

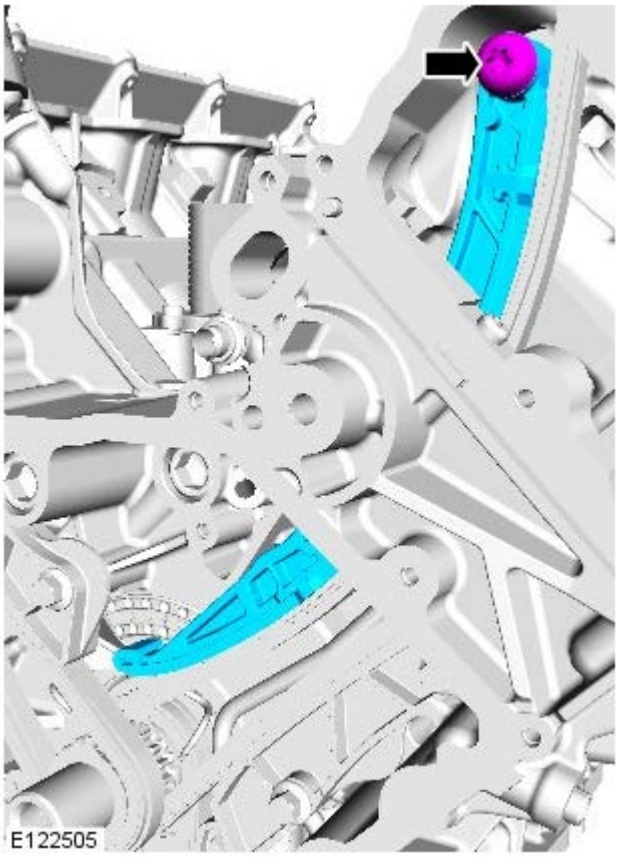
Remove the timing chain with the VVT units.



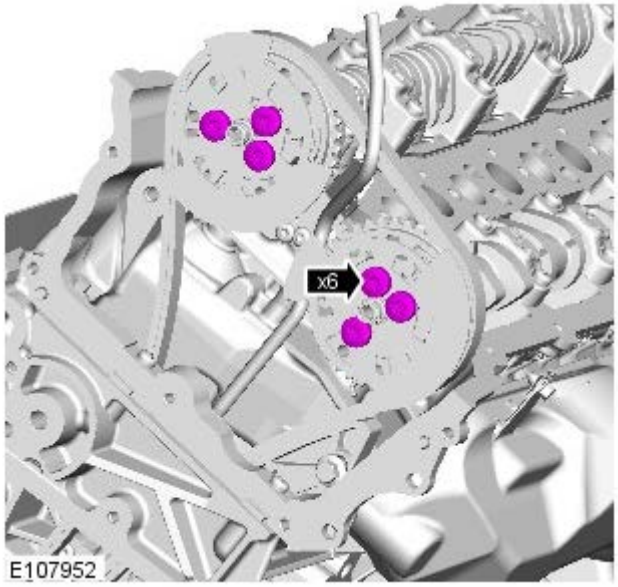
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12.

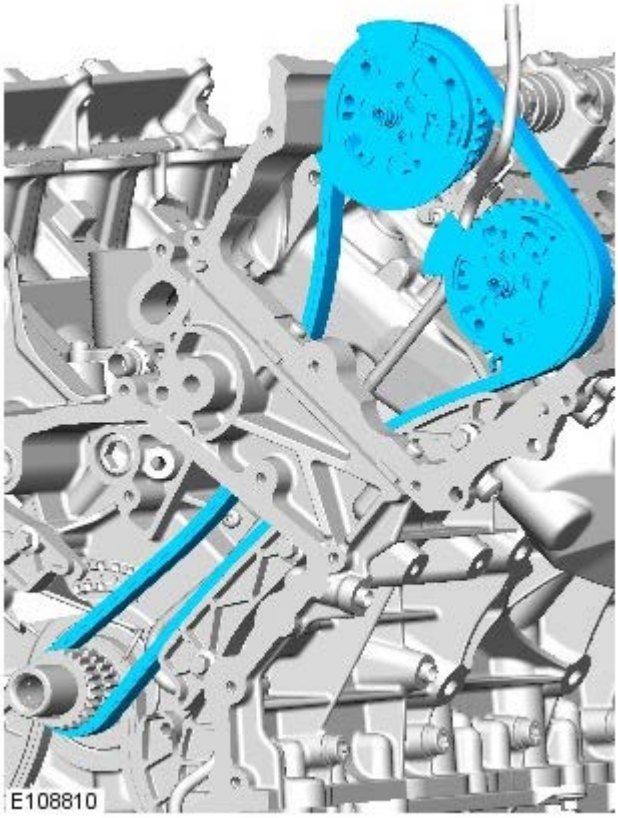


13.

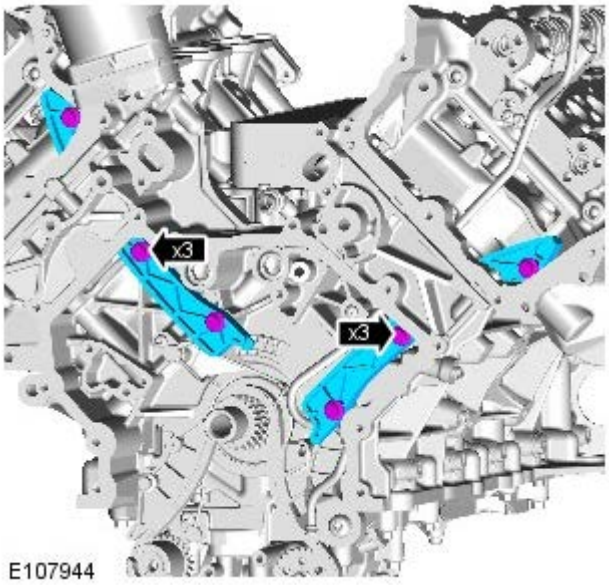


14. CAUTION: If the VVT is knocked or dropped then the VVT must be replaced.

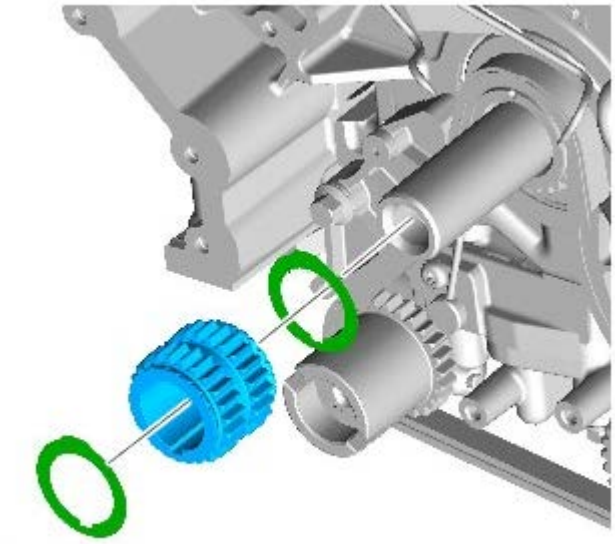
Remove the timing chain with the VVT units.



15.

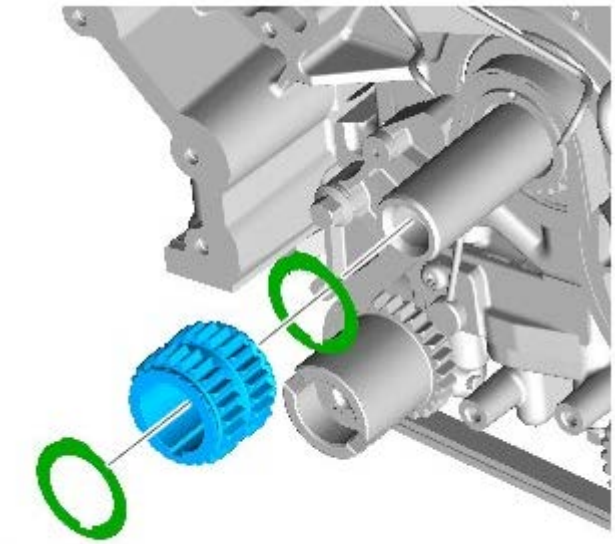


16. CAUTION: Discard the friction washer.



E107945

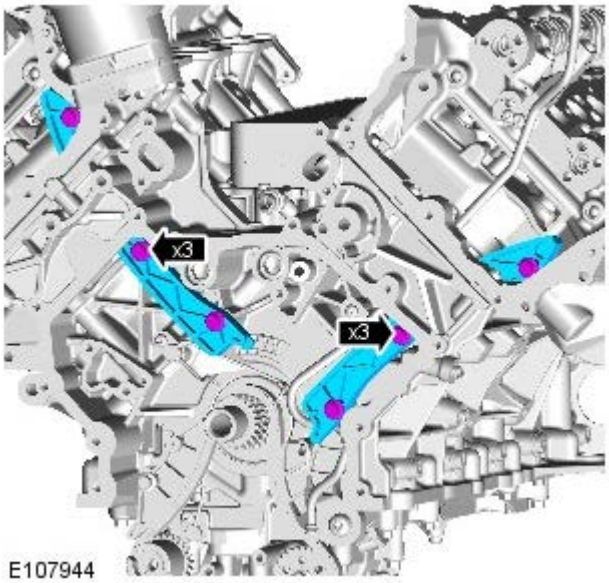
Installation



E107945

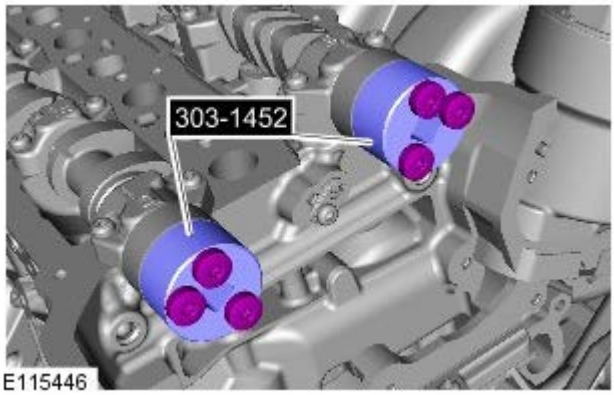
1. CAUTION: Install a new friction washer.

2. *Torque:* 12 Nm



E107944

3.
   - Install the special tool to each Camshaft.
   - *Special Tool(s):* 303-1452
   - *Torque:* 10 Nm



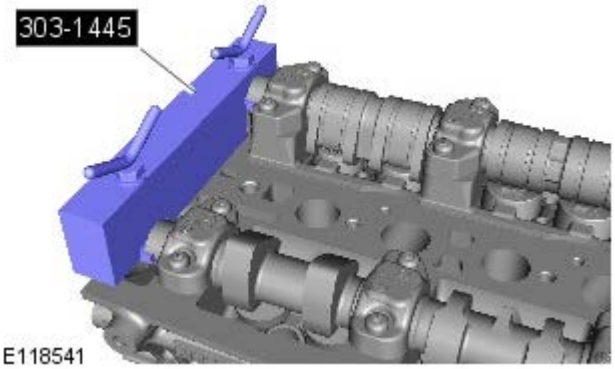
4.

- 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.

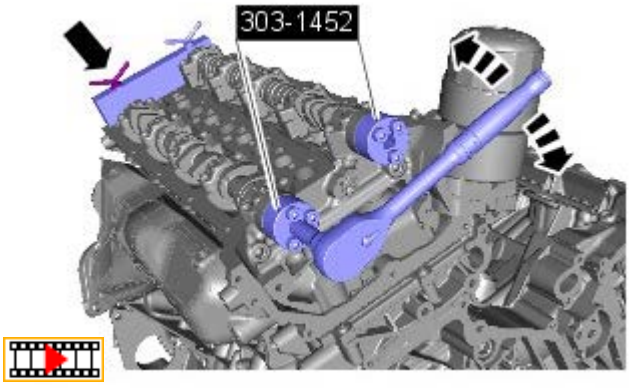


6. CAUTIONS:

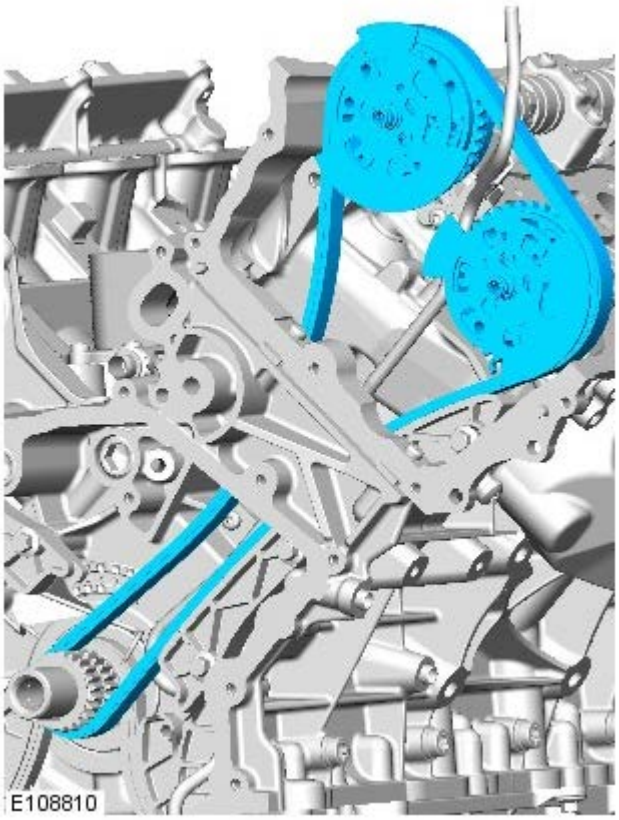
Do not overturn the camshafts.

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.

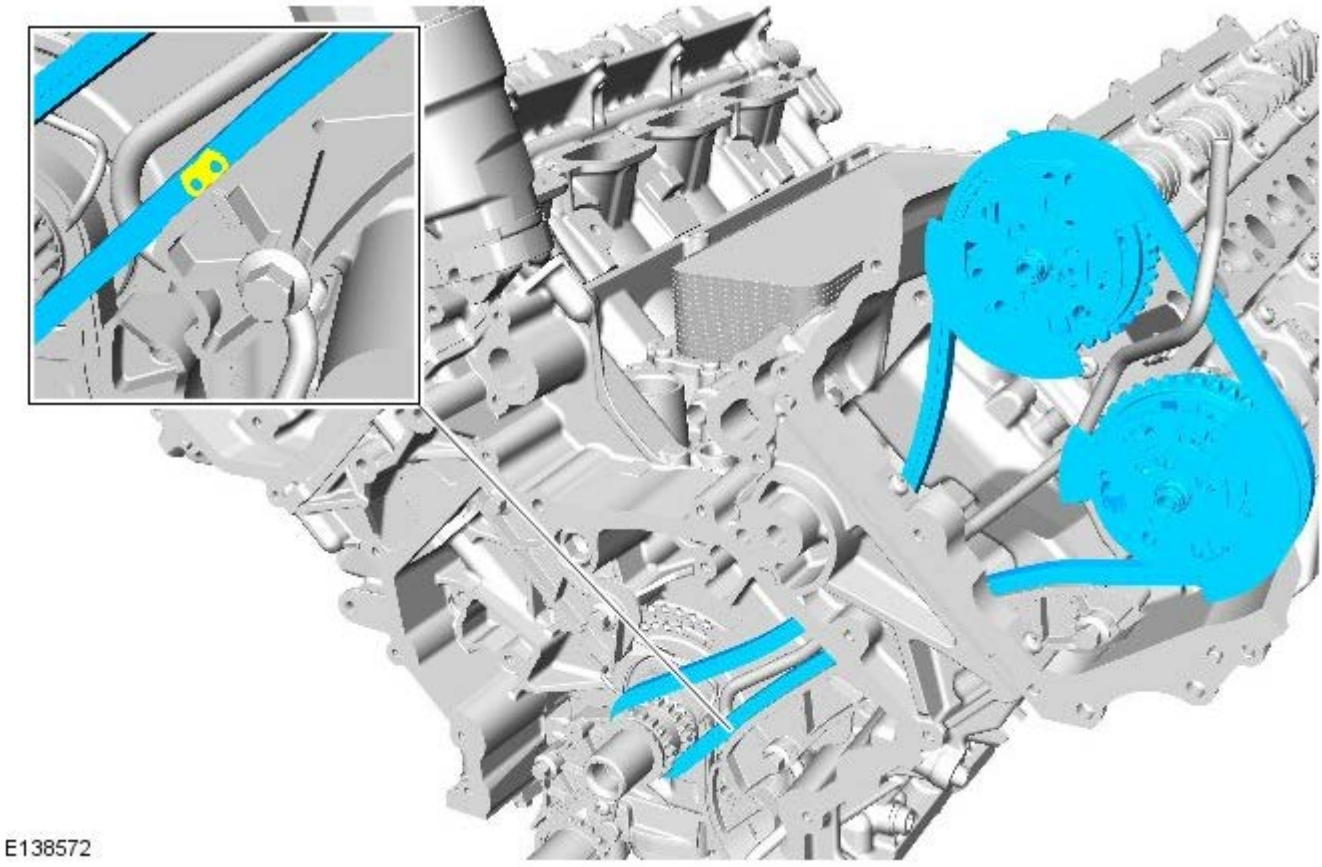
If the VVT is knocked or dropped then the VVT must be replaced.

NOTE: Do not tighten at this stage.

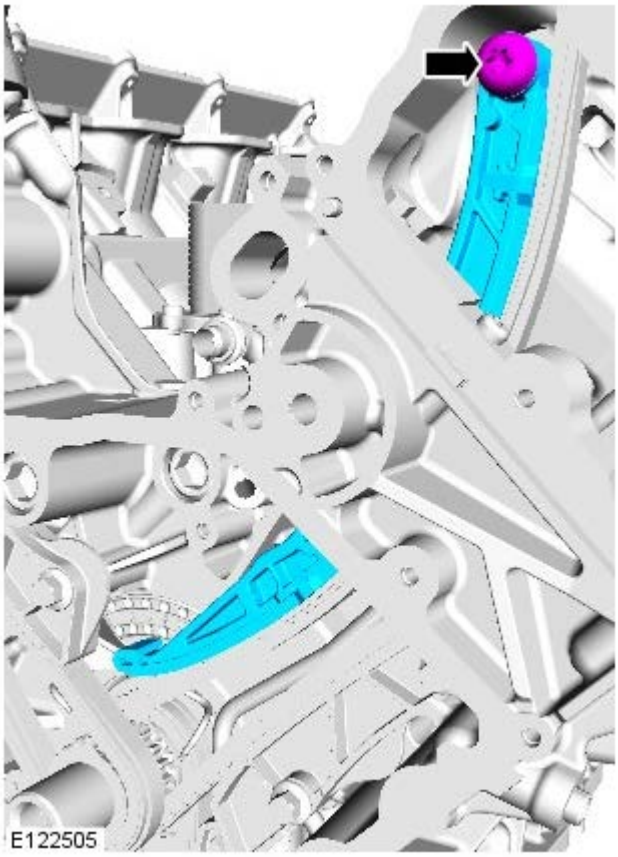
- Install the timing chain with the variable valve timing (VVT) units.

8.

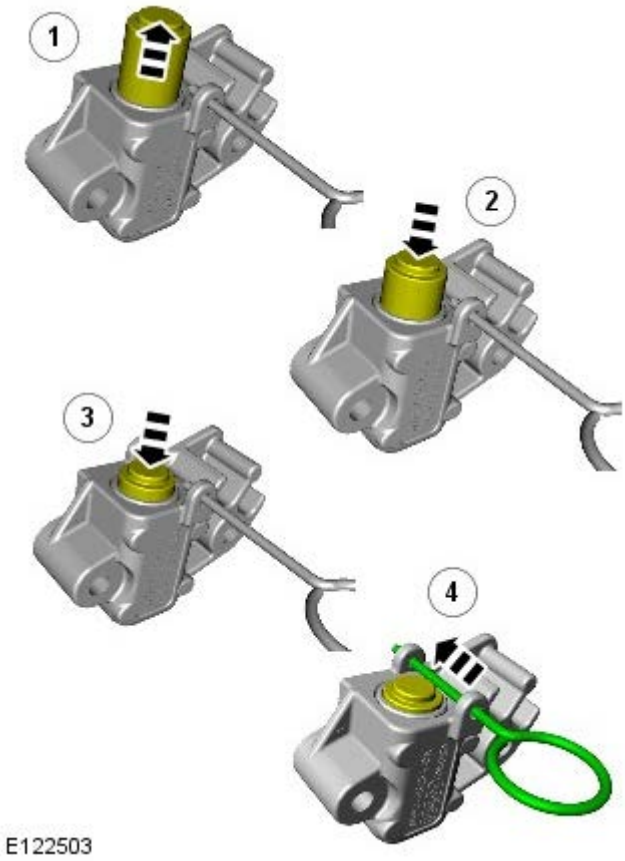
- Make sure that all the timing chain alignment marks are in the positions shown.



9. *Torque:* 25 Nm

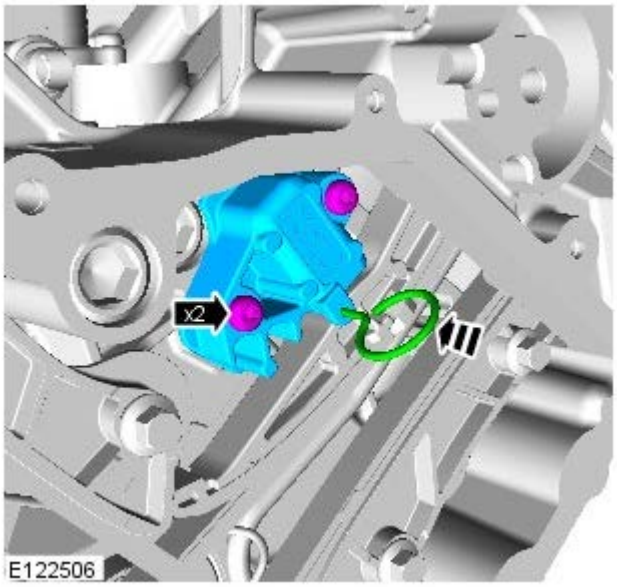


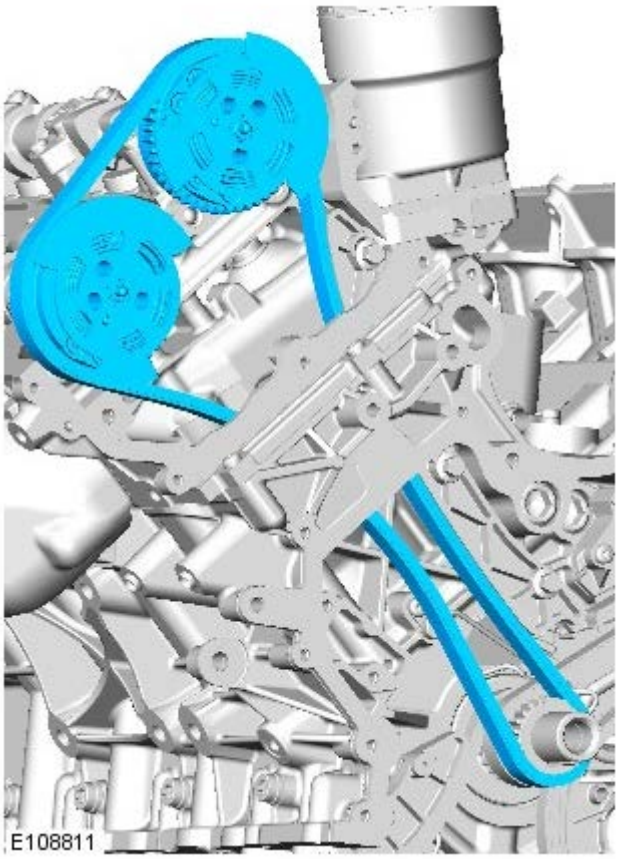
10. Make sure the tensioner piston is fully extended. Then fully depress and lock the tensioner piston with the grenade pin before installation, failure to do this may result in damage to the engine.



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.

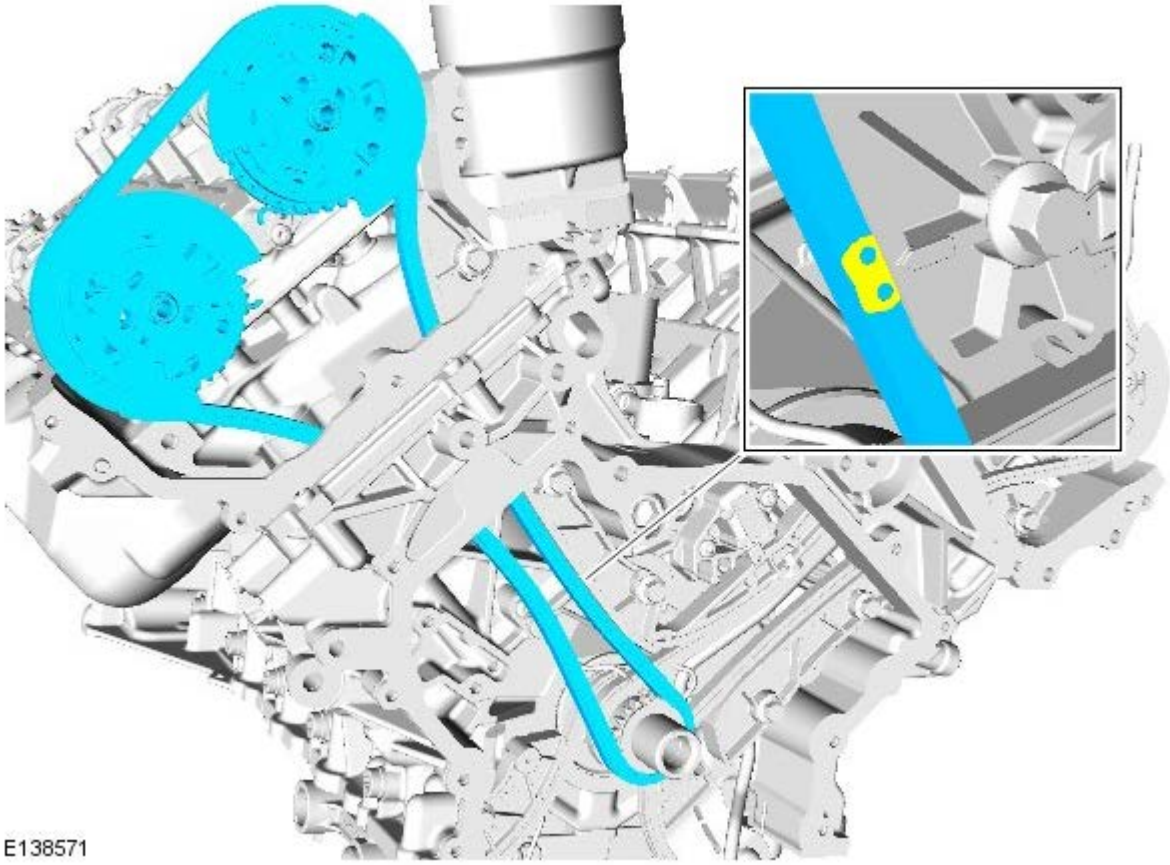
If the VVT is knocked or dropped then the VVT must be replaced.

NOTE: Do not tighten at this stage.

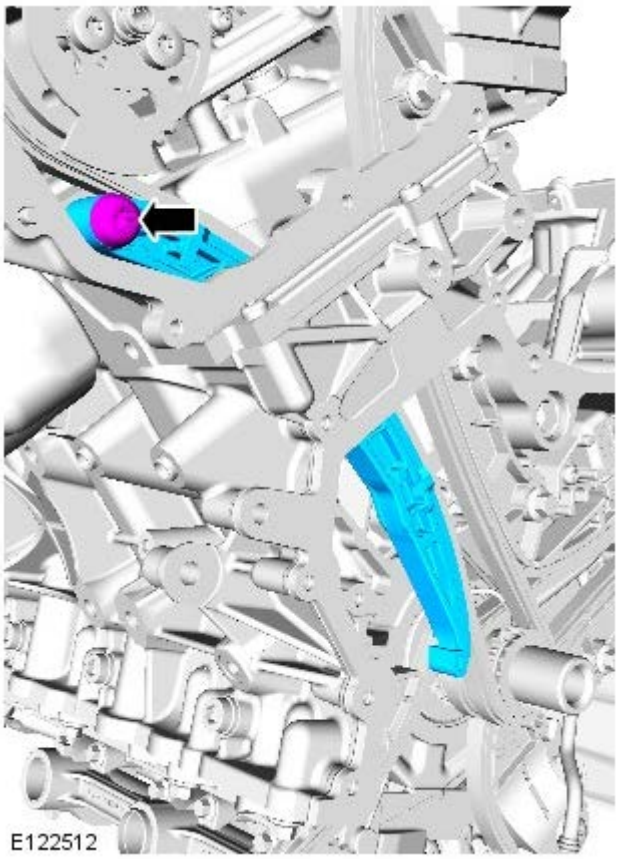
- Install the timing chain with the VVT units.

13.

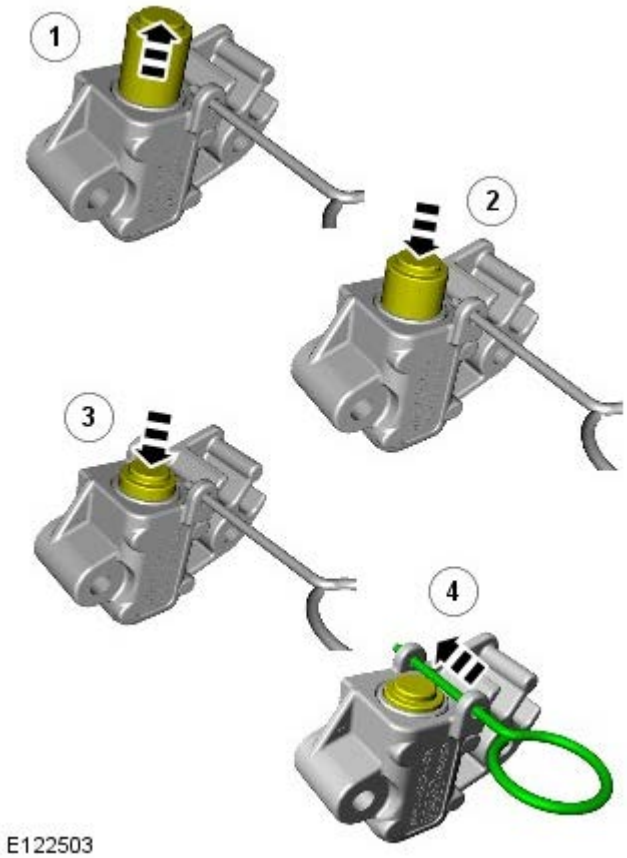
- Make sure that all the timing chain alignment marks are in the positions shown.



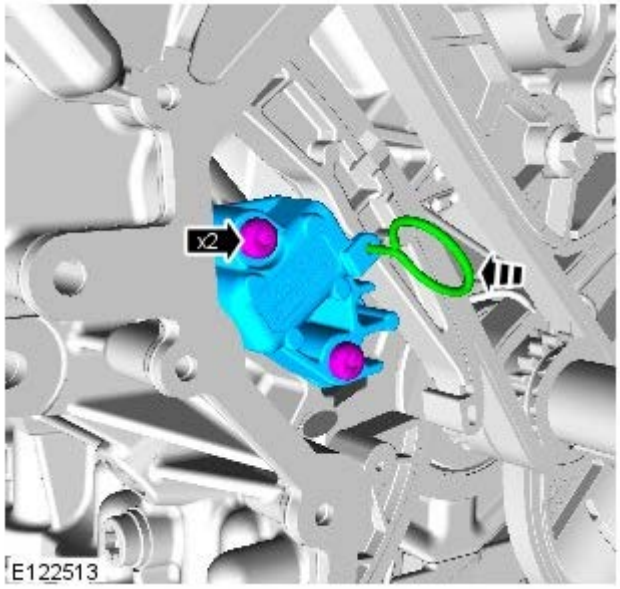
14. *Torque:* 25 Nm



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.



E122503

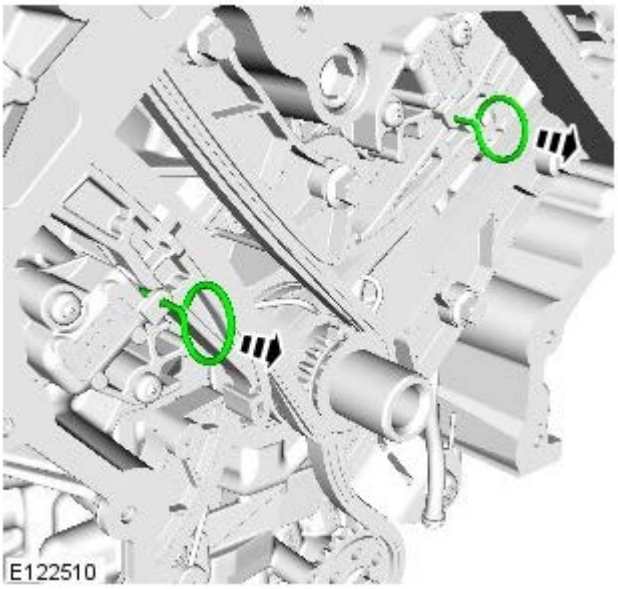


E122513

16. CAUTION: Do not release the timing chain tensioner locking pin at this stage.

Torque: 10 Nm

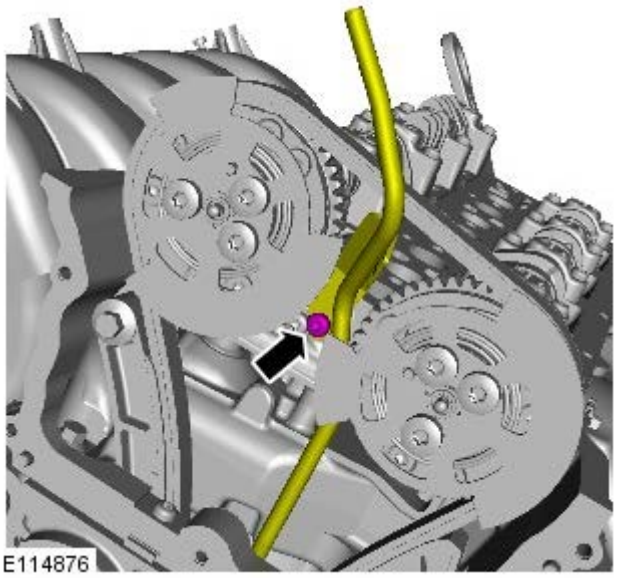
17.



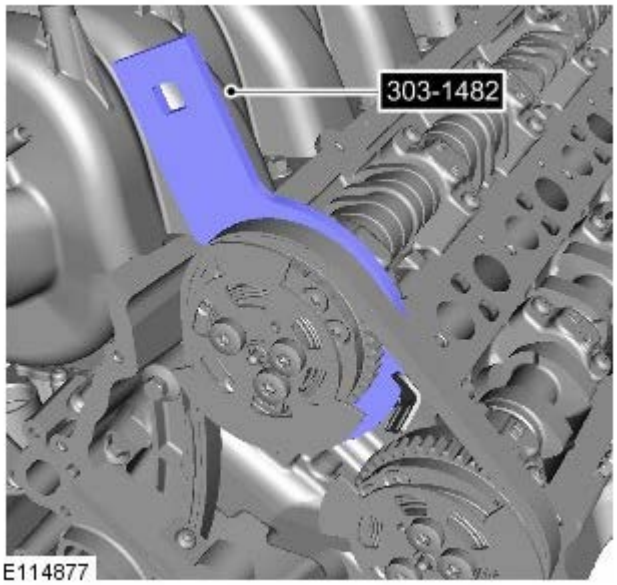
18. CAUTION: Do not use mechanical force.

    Make sure that the tensioners are fully deployed.

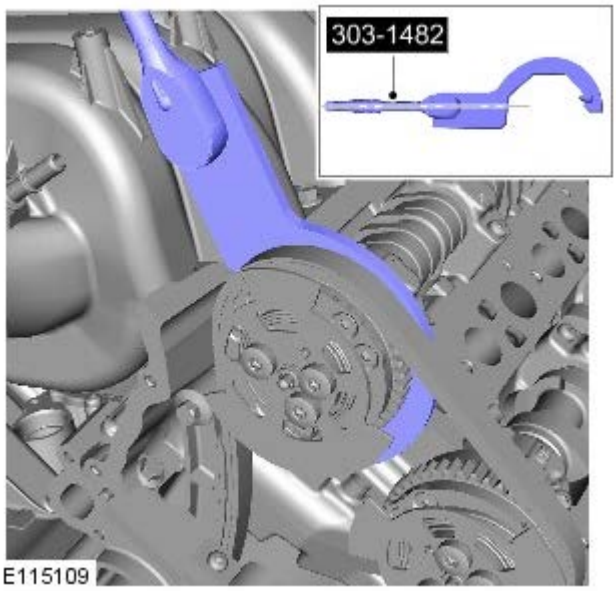
19.
    - Release and reposition the oil suction tube to one side.



20.
    - Install the special tool.
    - *Special Tool(s):* 303-1482



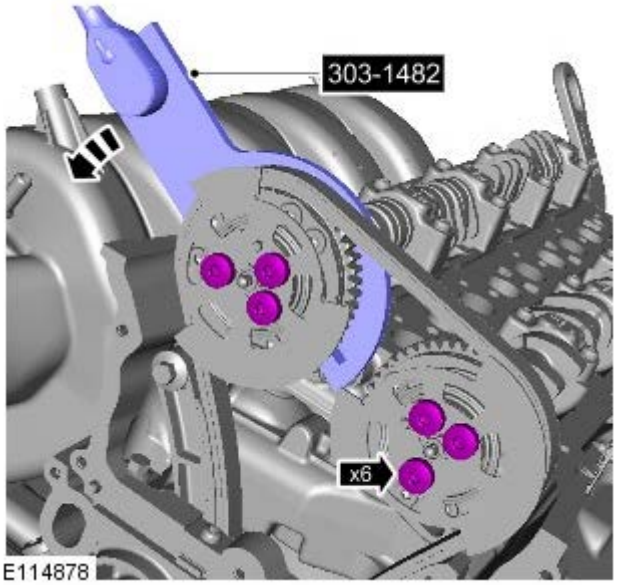
21. CAUTIONS:



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.

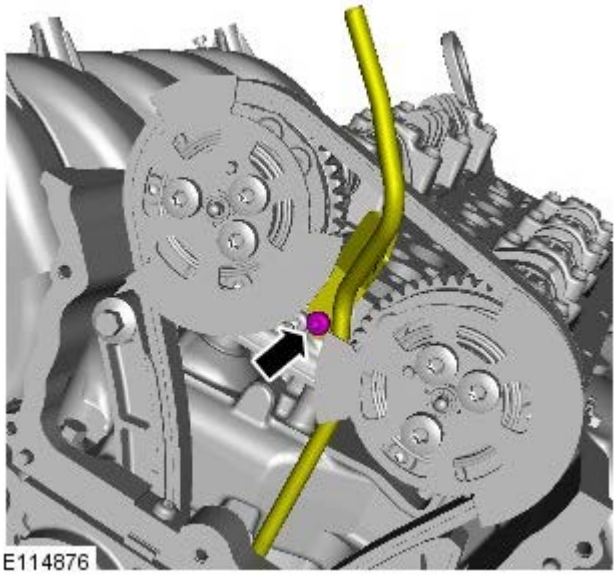
- Install the torque wrench to the special tool.
- *Torque:* 35 Nm



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

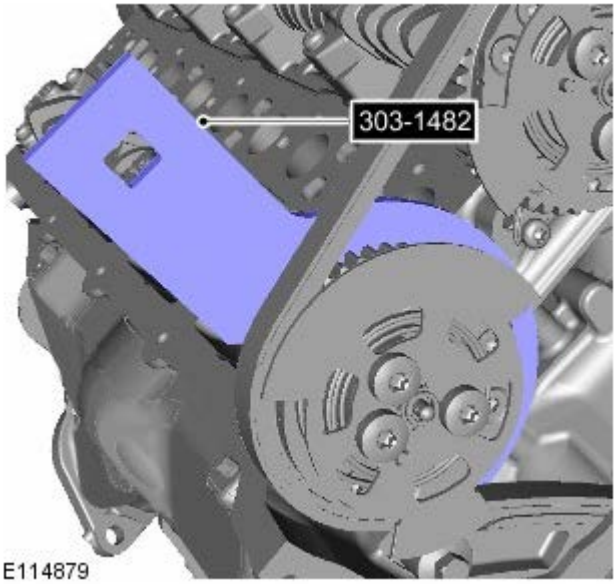


23.

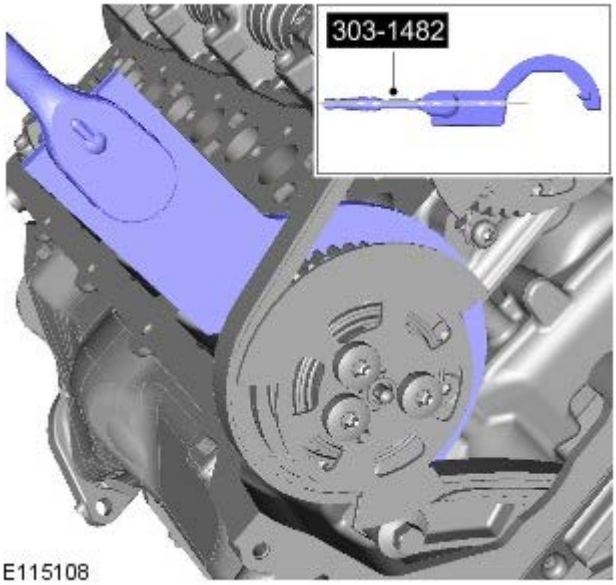
- Install the oil suction tube.
- *Torque:* 10 Nm

24.

- Install the special tool.
- *Special Tool(s):* 303-1482



E114879



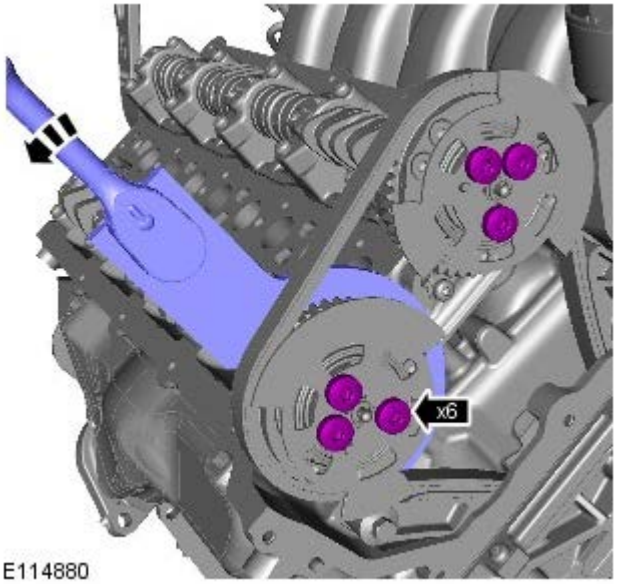
E115108

25. 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



E114880

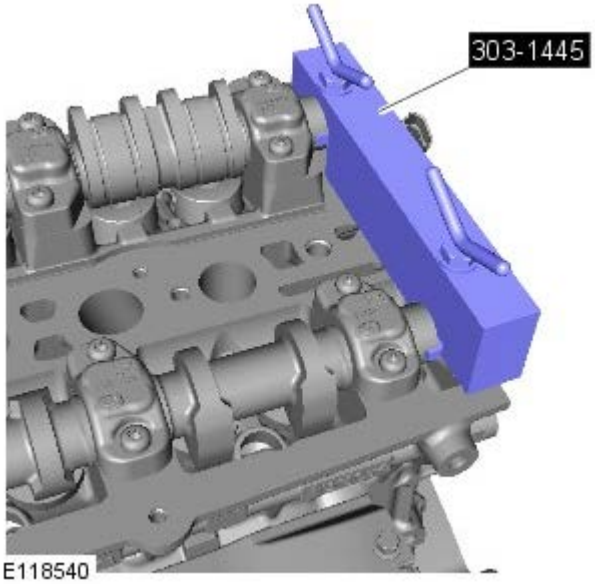
26. ⚠ CAUTION: Make sure that the torque wrench does not move whilst tightening the VVT bolts.

NOTE: Make sure to tighten the inlet VVT unit bolts first.

Torque: 32 Nm

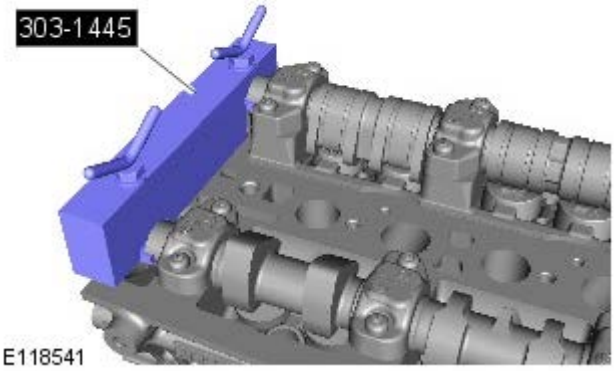
27.

- Remove the special tool.



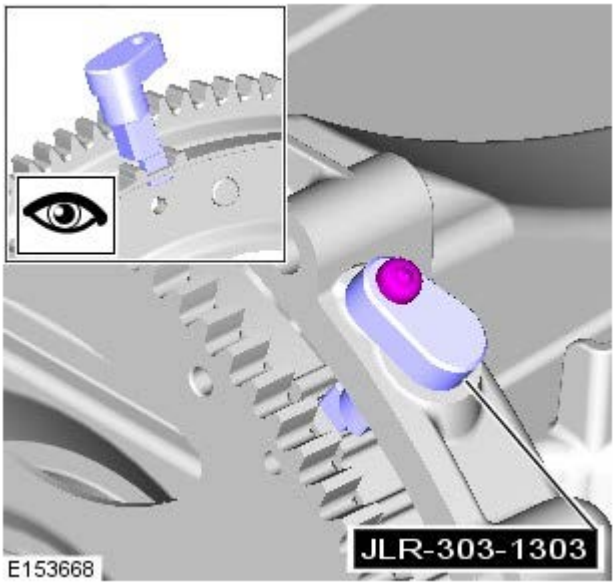
28.

- Remove the special tool.



29.

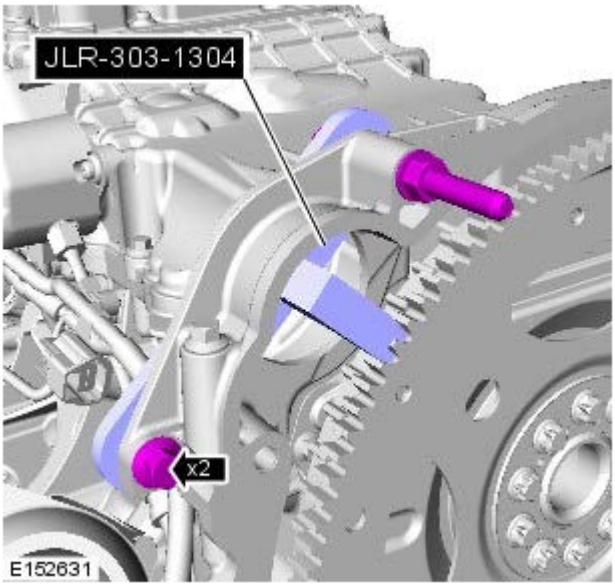
- Remove the special tool.
- *Special Tool(s):* JLR-303-1303

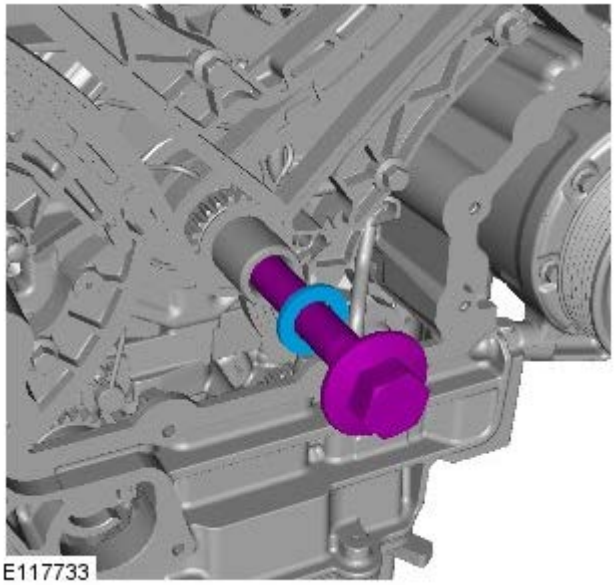


30.

- Install the special tool.

  Special Tool(s): JLR-303-1304





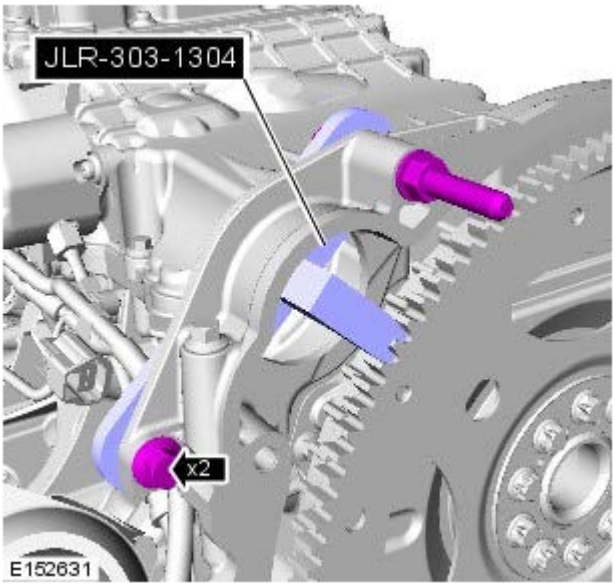
31. CAUTION: Install the crankshaft pulley bolt with an M16 washer to prevent damage to the crankshaft on installation.

Torque: 50 Nm

32.

- Remove the special tool.

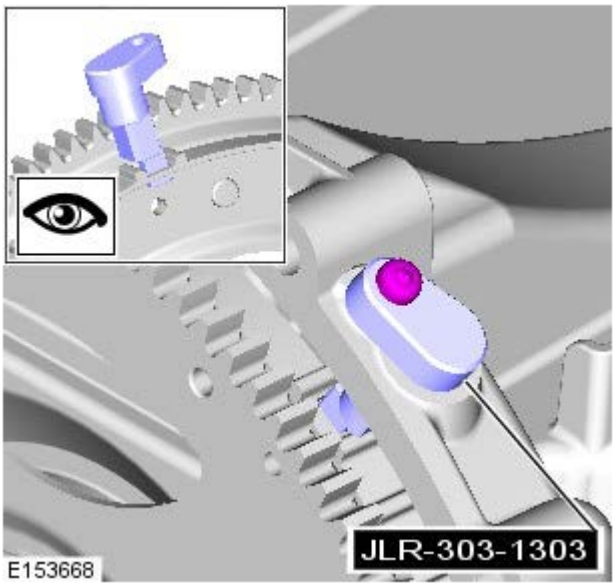
Special Tool(s): JLR-303-1304



33. Rotate the engine two complete turns clockwise.

34. CAUTION: Only rotate the crankshaft clockwise.

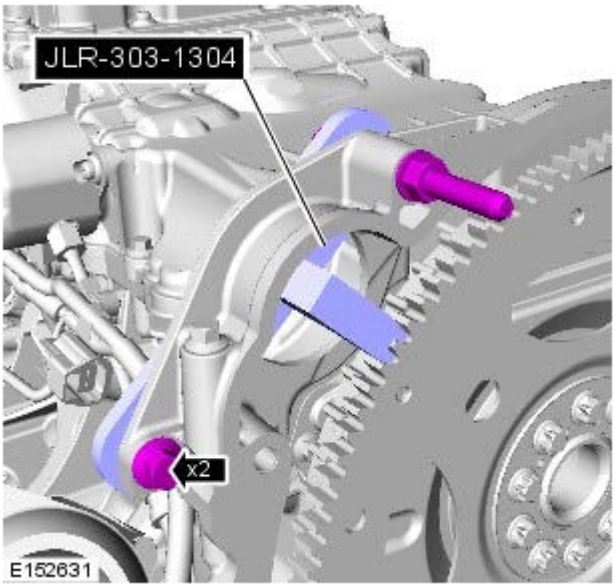
- Install the special tool.



Special Tool(s): JLR-303-1303

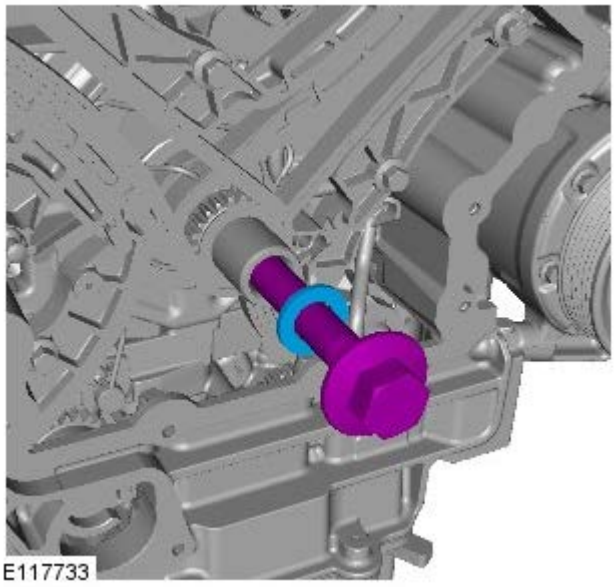
35.

- Install the special tool.



Special Tool(s): JLR-303-1304

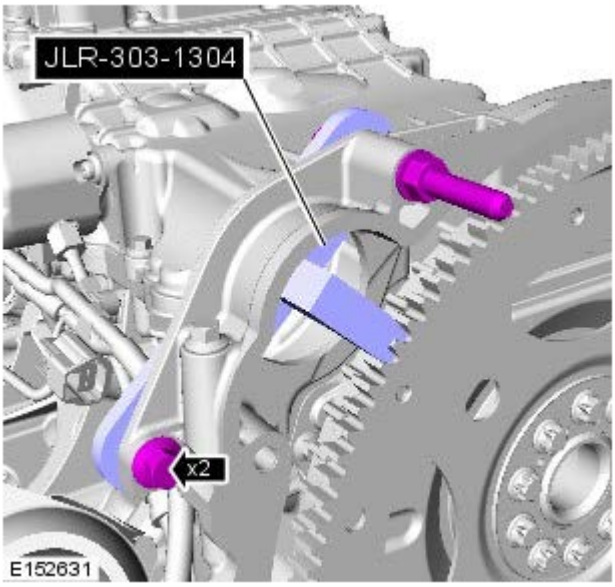
36.

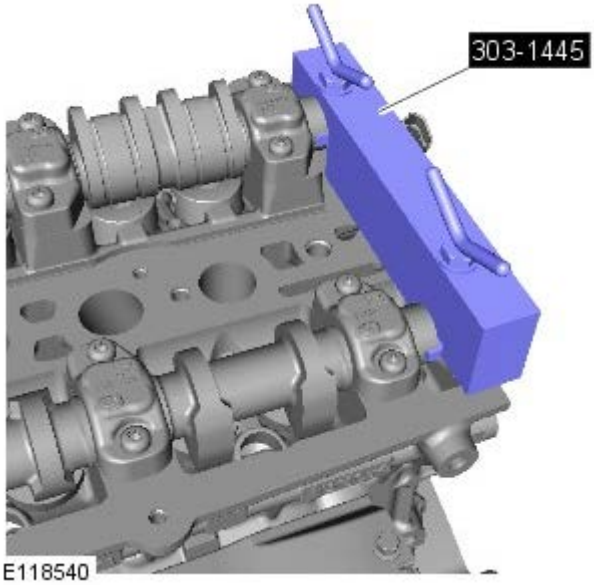


37.

- Remove the special tool.

Special Tool(s): JLR-303-1304





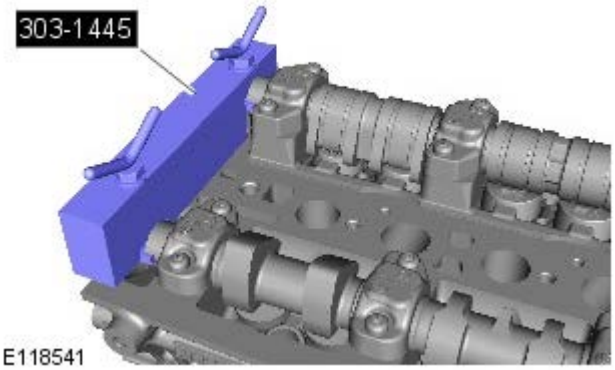
38. CAUTIONS:

    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.

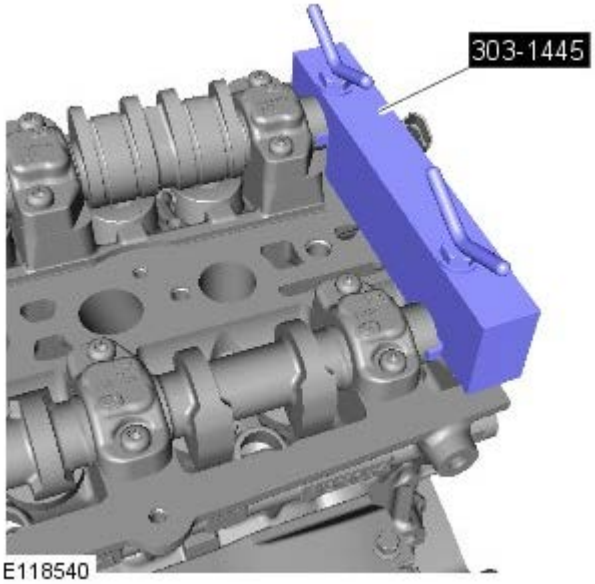
    Special Tool(s): 303-1445



39. CAUTION: If the special tool cannot be installed, the timing chain installation steps must be repeated.

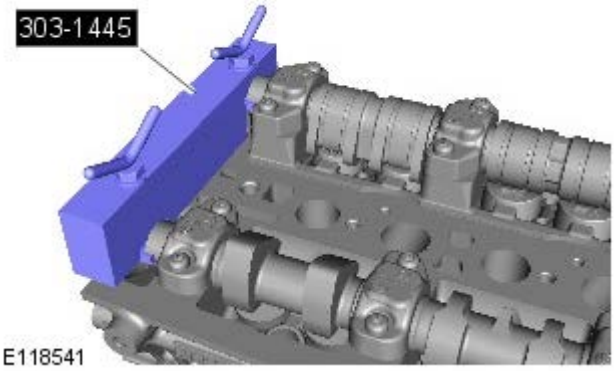
    Install the special tool.

40.
    - Remove the special tool.



41.

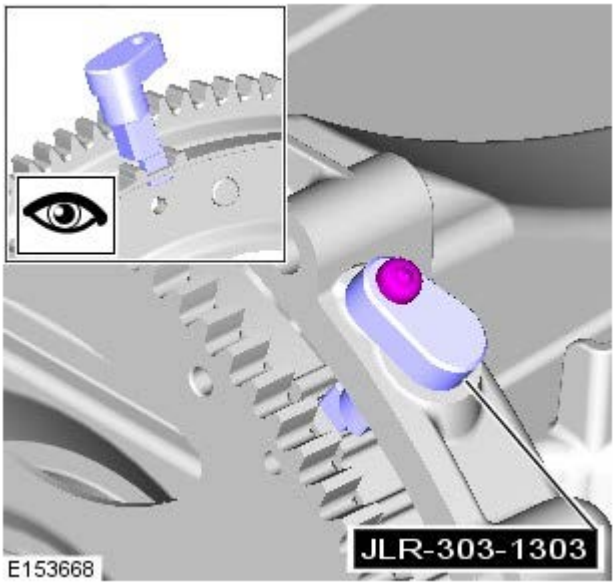
- Remove the special tool.



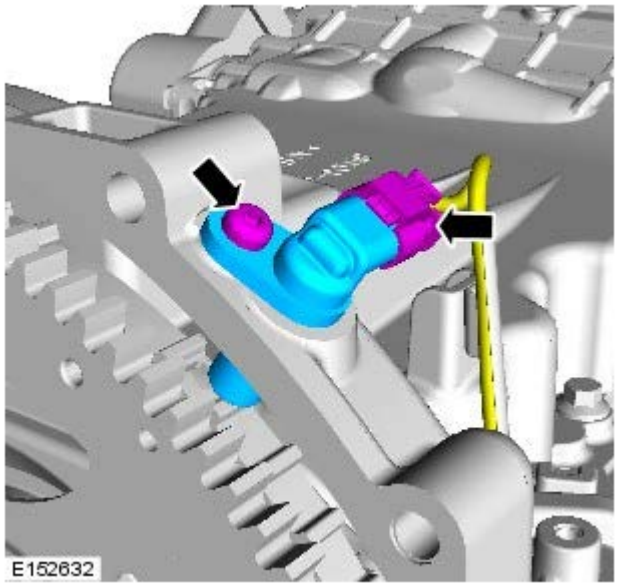
42.

- Remove the special tool.

  Special Tool(s): JLR-303-1303



43. *Torque:* 10 Nm



44. Refer to: Timing Cover (303-01B Engine - V6 S/C 3.0L Petrol, Removal and Installation).

45. Connect the battery ground cable.

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

Published: 02-May-2013

Engine - V6 S/C 3.0L 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.

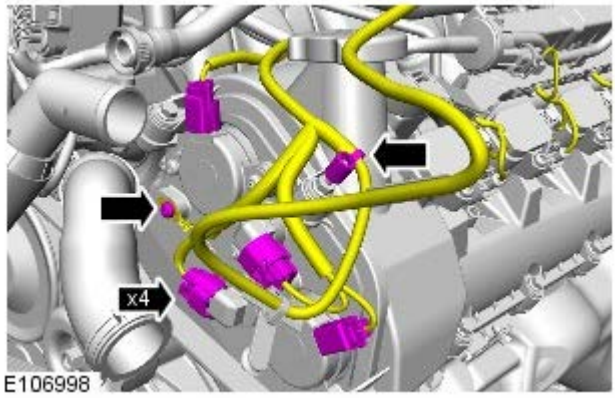
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

2. Refer to: Supercharger (303-12B Intake Air Distribution and Filtering - V6 S/C 3.0L Petrol, Removal and Installation).

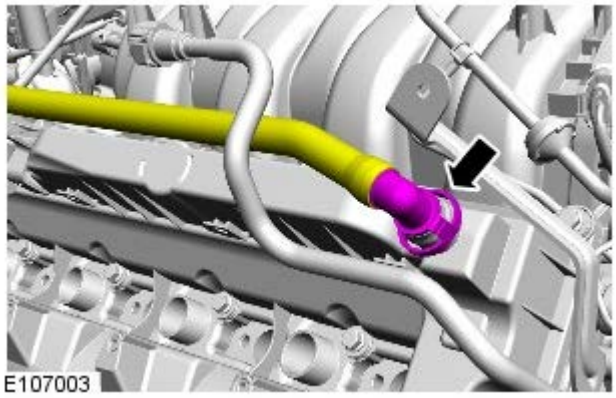
3. Refer to: Air Cleaner Outlet Pipe LH (303-12B Intake Air Distribution and Filtering - V6 S/C 3.0L Petrol, Removal and Installation).

4. Refer to: Fuel Rail LH (303-04C Fuel Charging and Controls - V6 S/C 3.0L Petrol, Removal and Installation).

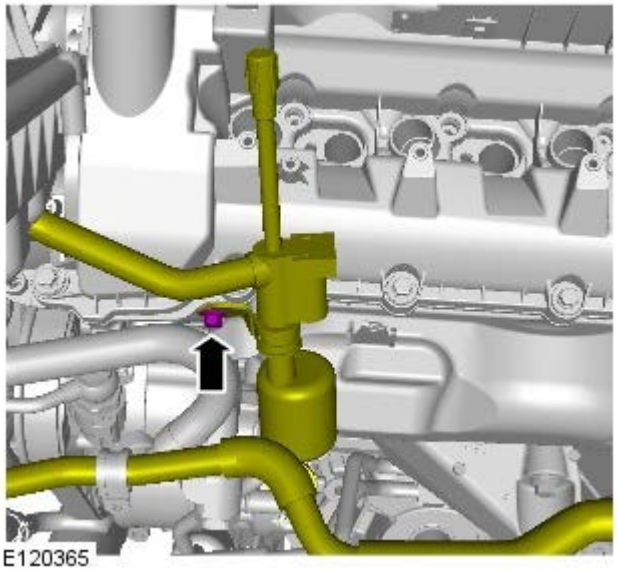
5. *Torque:* 10 Nm



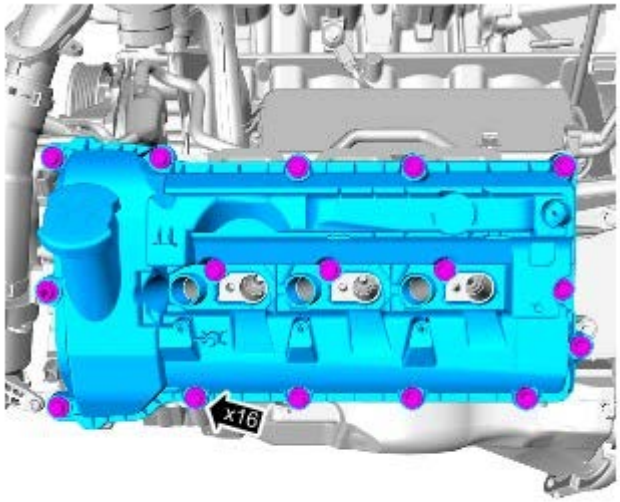
6.



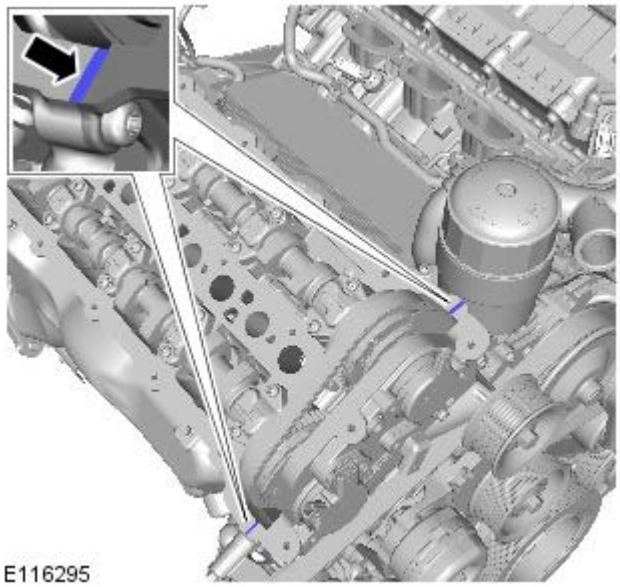
7. *Torque:* 25 Nm



8.



Installation



1. CAUTIONS:

   Use only a plastic scraper when removing the sealing material.

   Use lint free cloth.

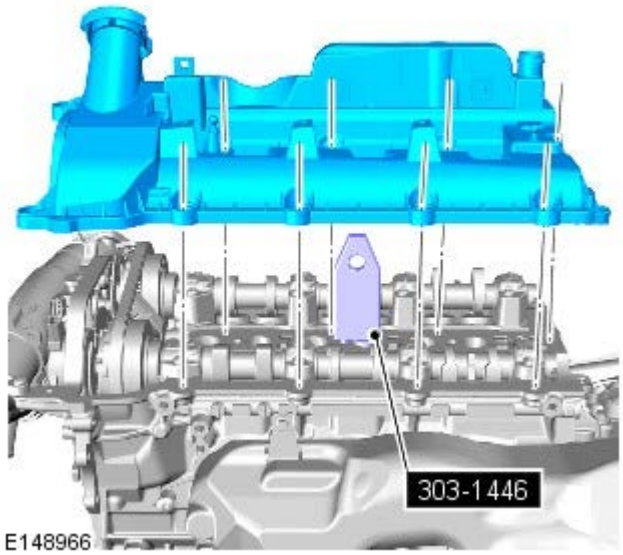
   Make sure that the mating faces are clean and free of corrosion and foreign material.

   Installation of the valve cover and tightening must be carried out within 7 minutes of applying the sealant.

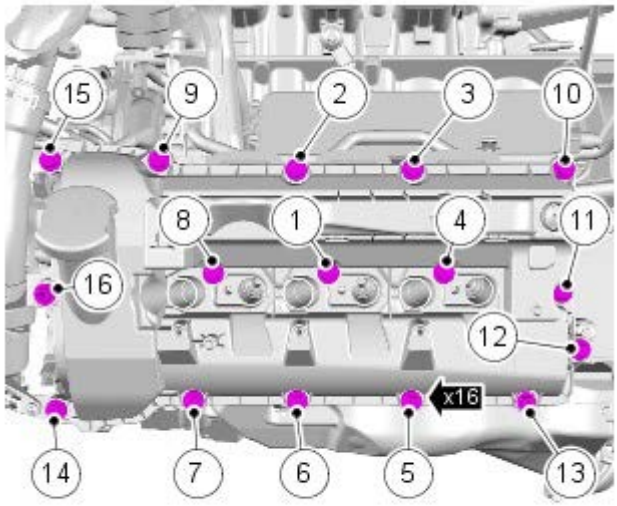
   NOTE: Apply two beads of silcone gasket sealant (Loctite 5901) as shown on the illustration. The application of the sealant must be 1.5mm diameter 12mm long. Install the valve cover immediately after applying the sealant. The cover should be fitted directly to the head without smearing the sealant or the seals.

   To install, reverse the removal procedure.

2. *Special Tool(s):* 303-1446



E148966



E148968

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

Torque: 13 Nm

Published: 02-May-2013

Engine - V6 S/C 3.0L 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.

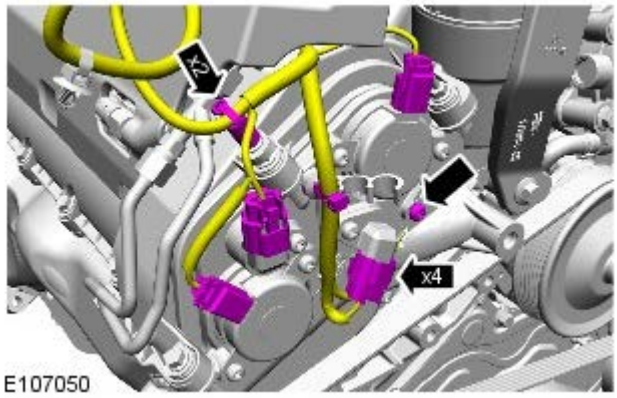
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

2. Refer to: Supercharger (303-12B Intake Air Distribution and Filtering - V6 S/C 3.0L Petrol, Removal and Installation).

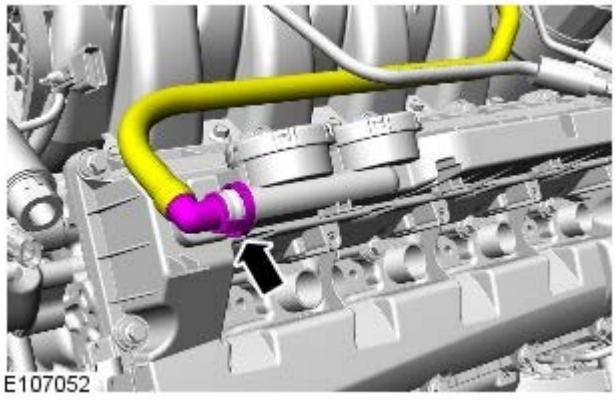
3. Refer to: Air Cleaner Outlet Pipe RH (303-12B Intake Air Distribution and Filtering - V6 S/C 3.0L Petrol, Removal and Installation).

4. Refer to: Fuel Rail RH (303-04C Fuel Charging and Controls - V6 S/C 3.0L Petrol, Removal and Installation).

5.



6.

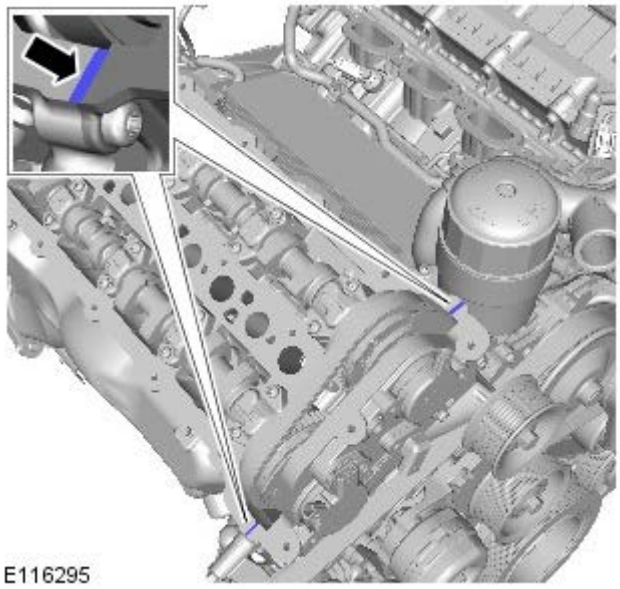


7.



E148969

Installation



E116295

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.

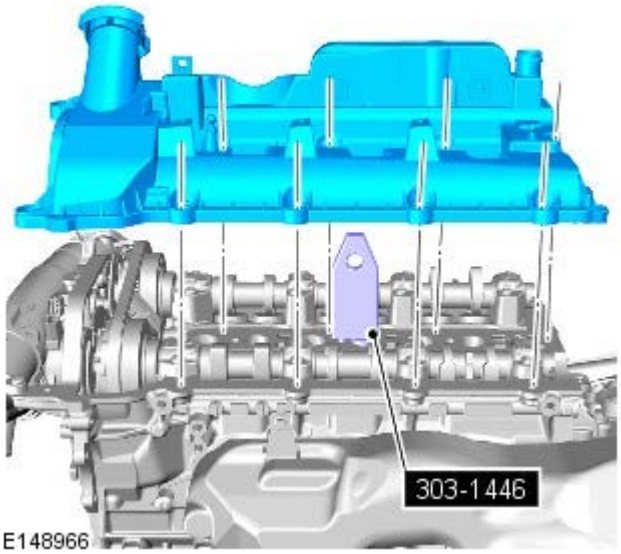
   Installation of the valve cover and tightening must be carried out within 7 minutes of applying the sealant.

   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.

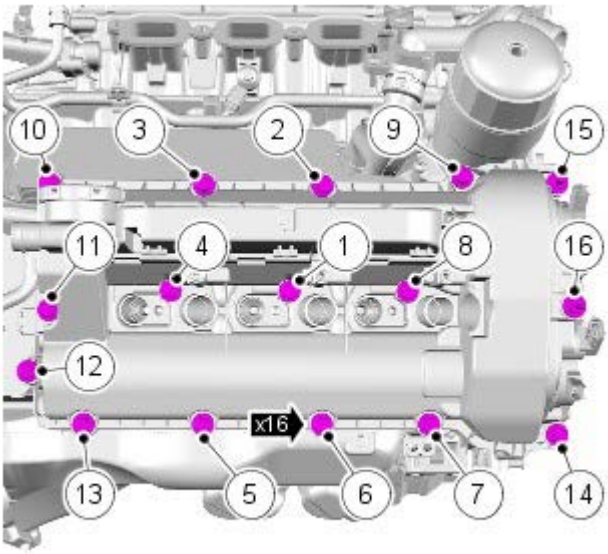
   To install, reverse the removal procedure.

2. NOTE: LH illustration shown, RH is similar

   Special Tool(s): 303-1446



E148966



E148981

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

Torque: 13 Nm

Published: 02-May-2013

Engine - V6 S/C 3.0L Petrol - Fuel Pump Camshaft

Removal and Installation

Removal

NOTE: Some illustrations may show the engine removed for clarity.

1. Disconnect the battery ground cable.

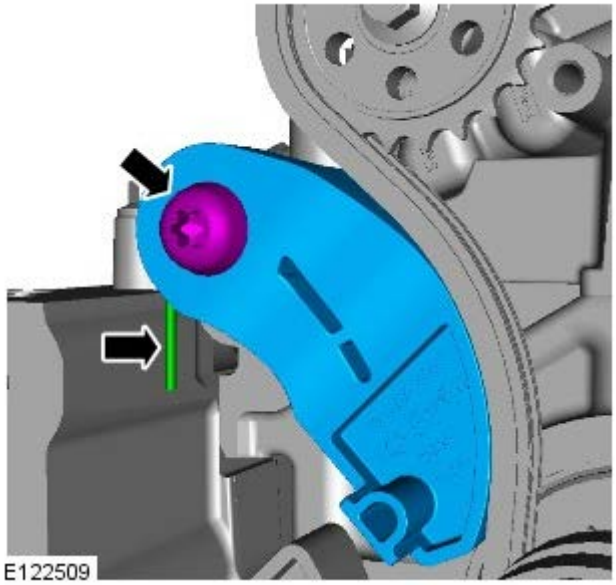
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

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

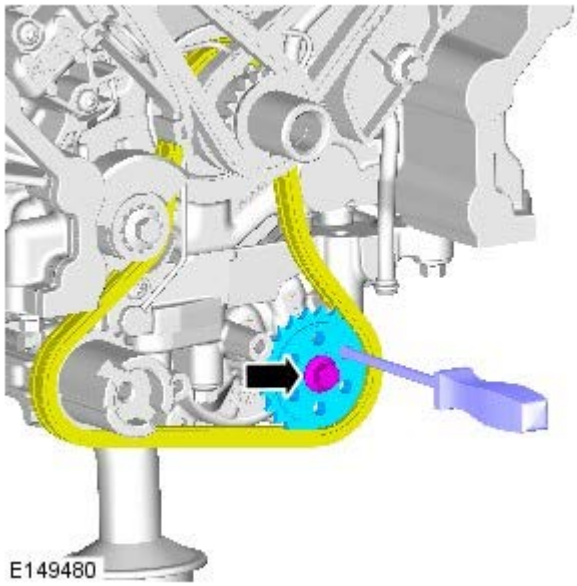
   Raise and support the vehicle.

3. Refer to: Oil Pan Extension (303-01B Engine - V6 S/C 3.0L Petrol, Removal and Installation).

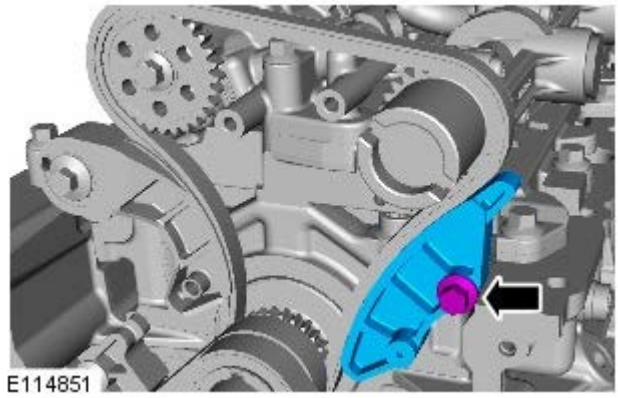
4.

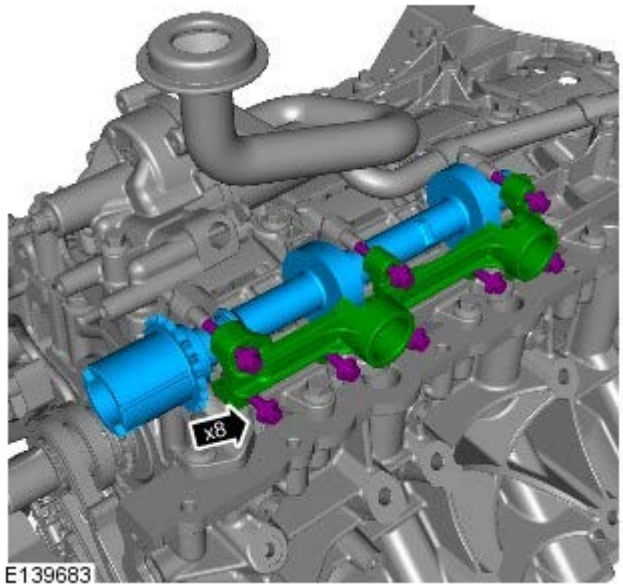


5.



6.

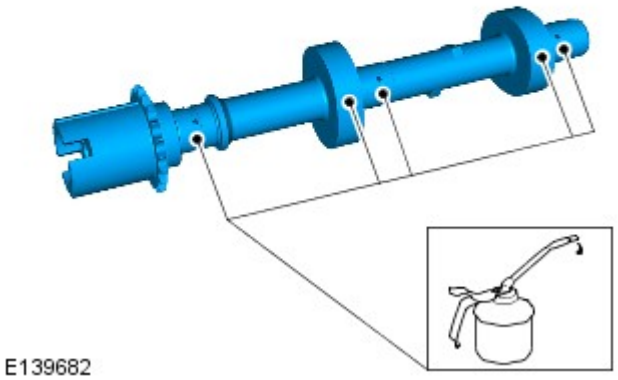




7. CAUTION: Take extra care when removing the component, prevent damage to the mating faces.

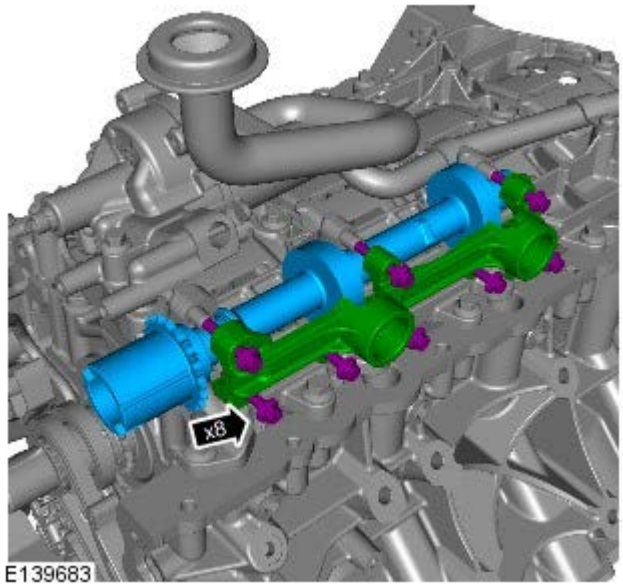
Installation

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

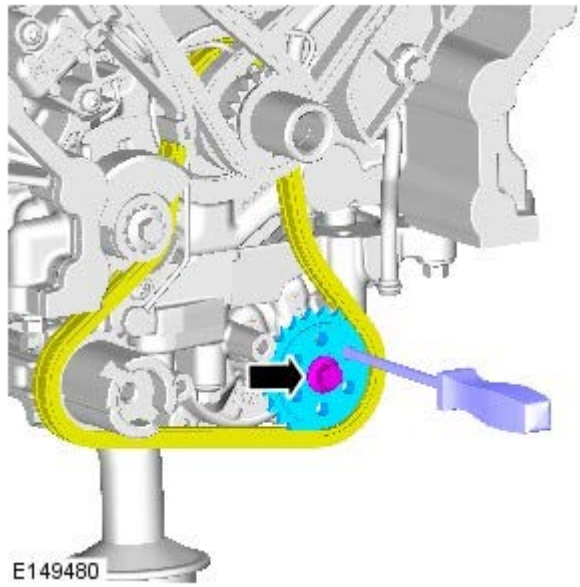


2. CAUTION: Take extra care not to damage the mating faces.

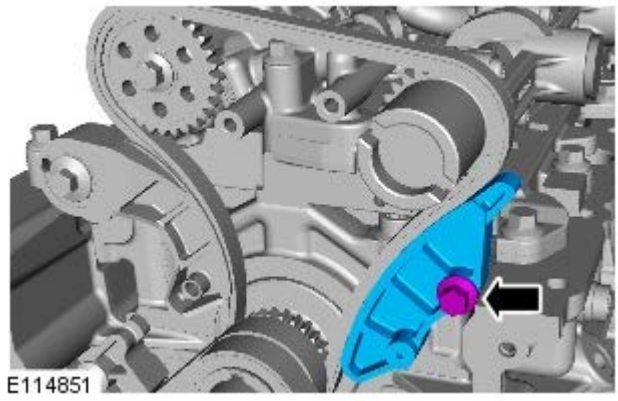
   Torque: 12 Nm



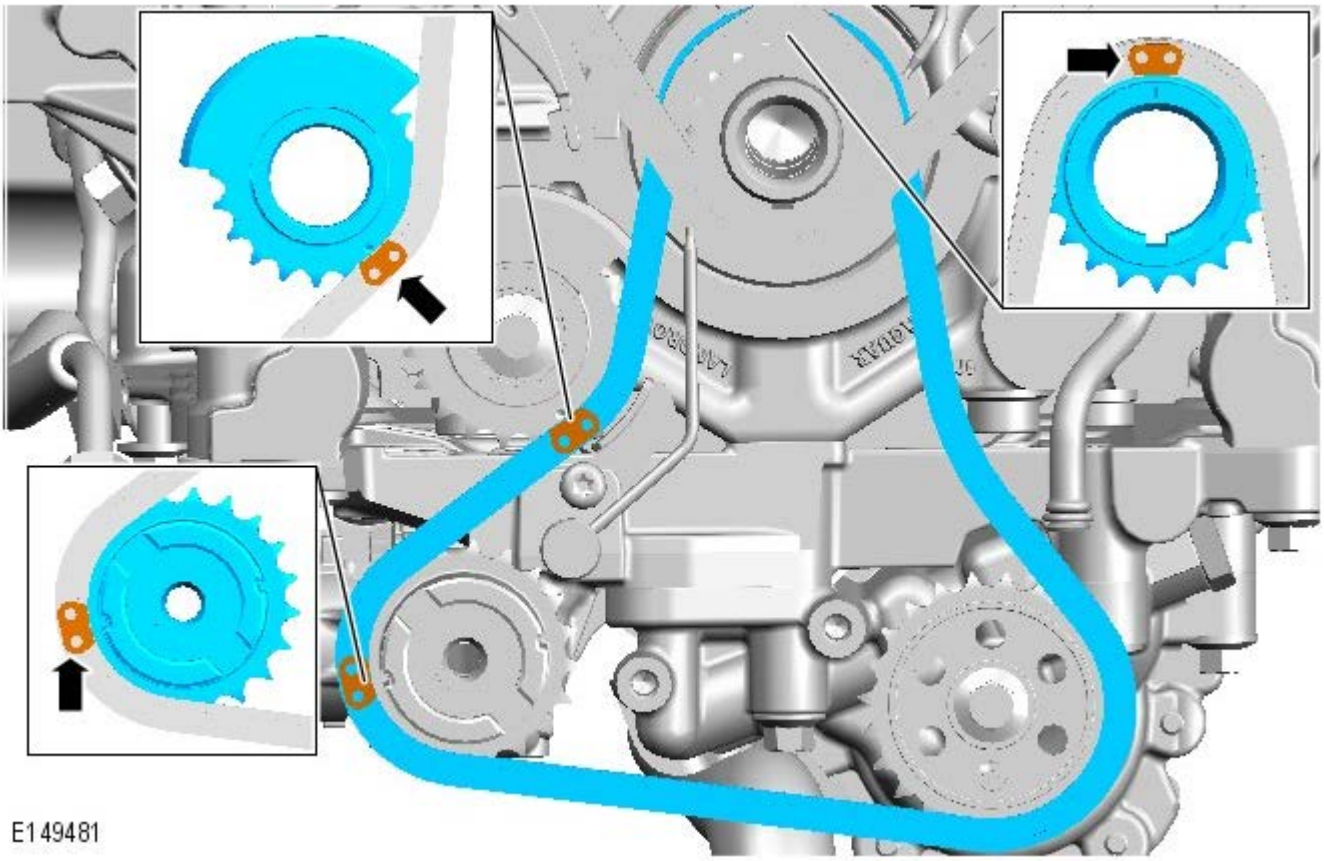
3. *Torque:* 21 Nm

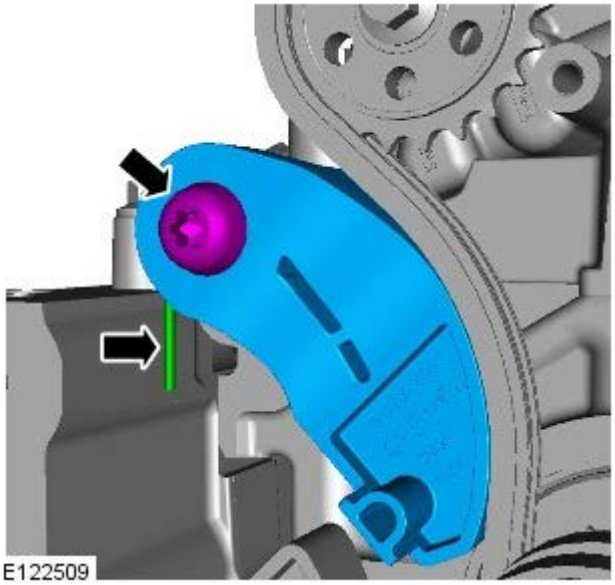


4. *Torque:* 12 Nm



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 (303-01B Engine - V6 S/C 3.0L Petrol, Removal and Installation).

8. Connect the battery ground cable.

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

Published: 02-May-2013

Engine - V6 S/C 3.0L Petrol - Lower Timing Cover

Removal and Installation

Special Tool(s)

 E107676	303-1433 Lower Timing Cover Alignment tool

Removal

NOTES:

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

Engine shown removed for clarity.

1. Disconnect the battery ground cable.

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

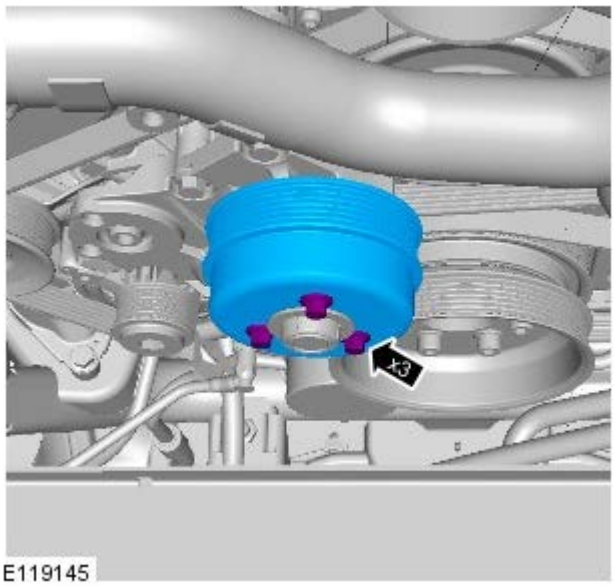
2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Refer to: Crankshaft Pulley (303-01B Engine - V6 S/C 3.0L Petrol, Removal and Installation).

4. Refer to: Brake Vacuum Pump - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (206-07 Power Brake Actuation, Removal and Installation).

5.

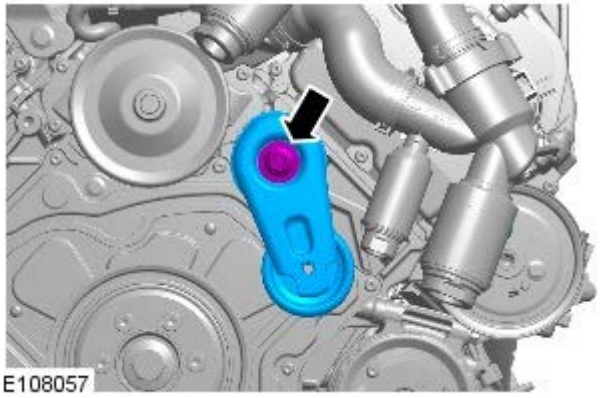


E119145

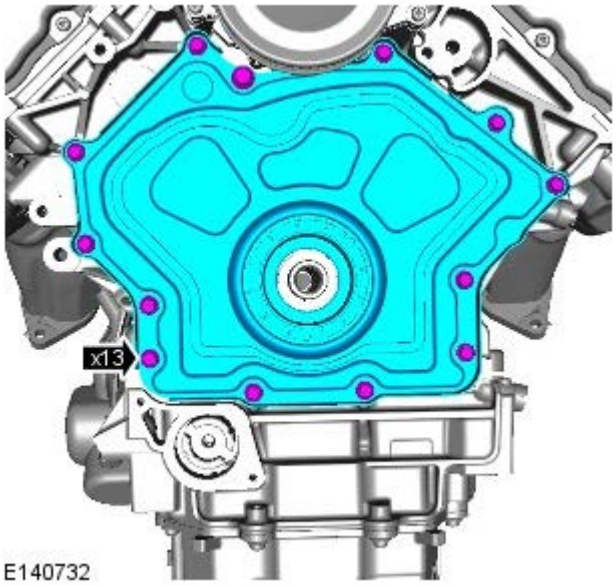
6.



7.

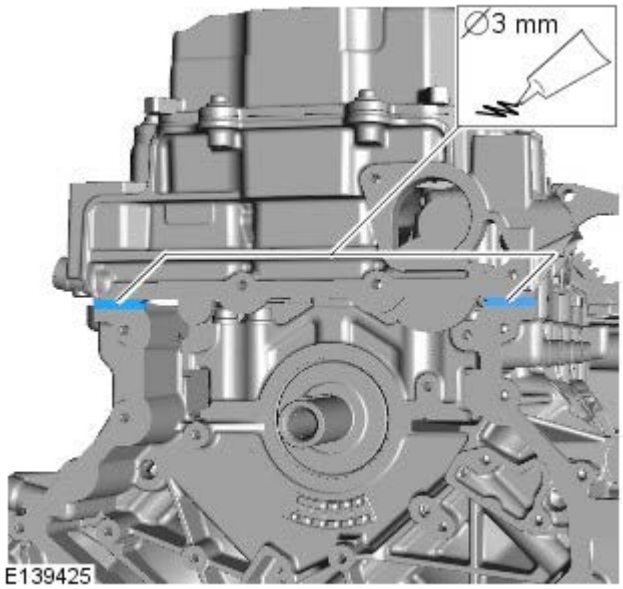


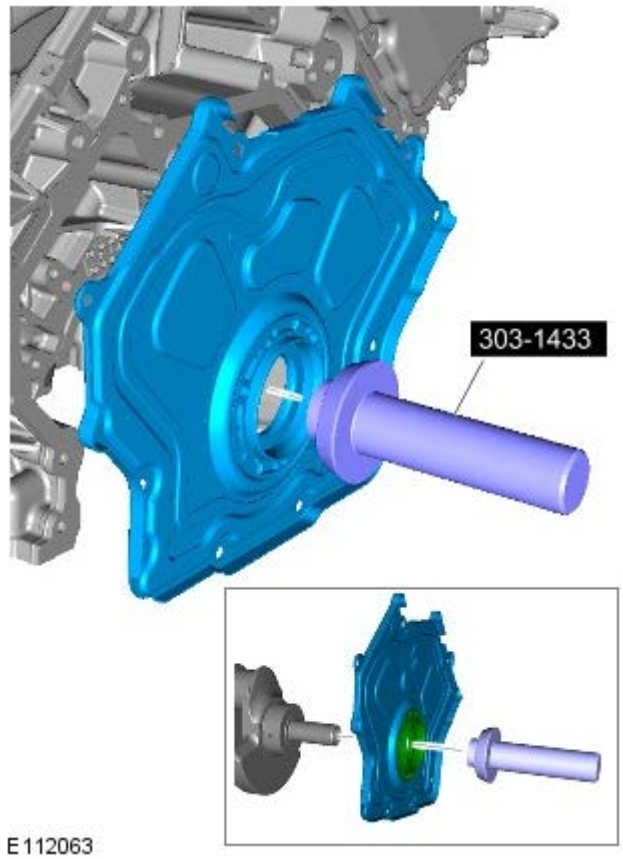
8.



Installation

1. Apply RTV sealant WSE-M4G323-A6 (Loctite 5901G) to the areas shown, and tighten the bolts within 7 minutes.

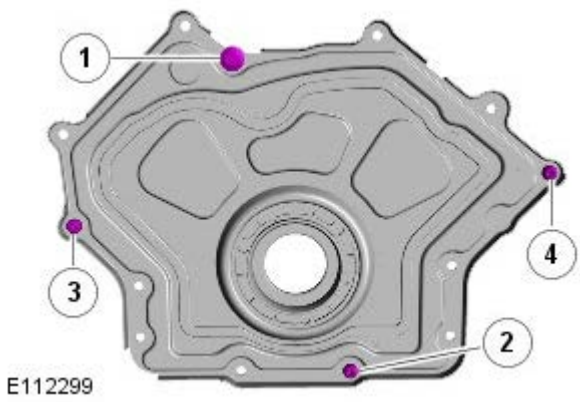




2. CAUTION: Make sure that the mating faces are clean and free of foreign material.

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

   Special Tool(s): 303-1433



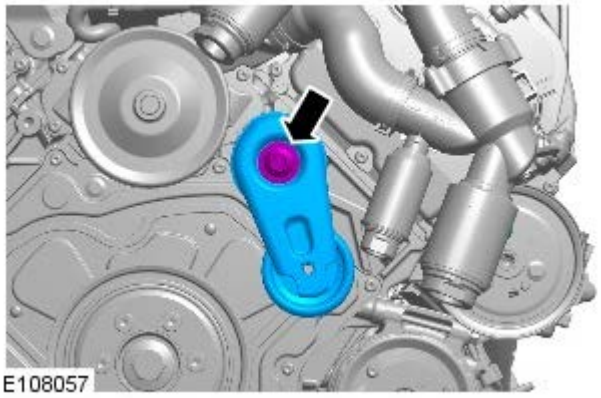
3. *Torque:*
   M6 12 Nm
   M8 20 Nm

4. *Torque:* 12 Nm



E112300

5. *Torque:* 40 Nm

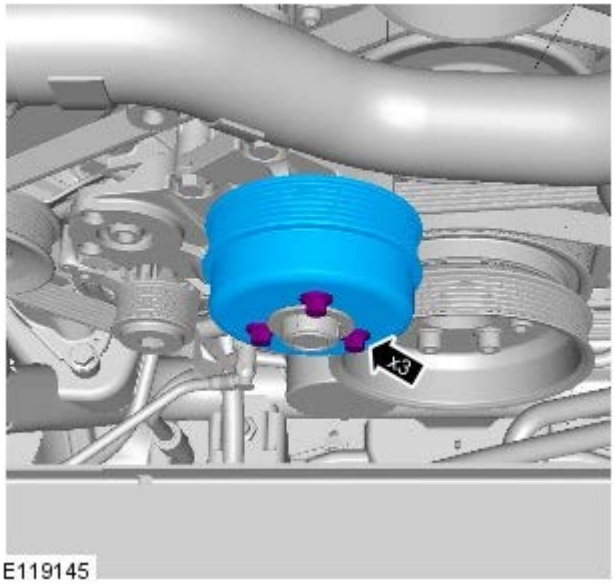

E108057

6. *Torque:* 25 Nm



E119365

7. *Torque:* 25 Nm



8. Refer to: Brake Vacuum Pump - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (206-07 Power Brake Actuation, Removal and Installation).

9. Refer to: Crankshaft Pulley (303-01B Engine - V6 S/C 3.0L Petrol, Removal and Installation).

10. Connect the battery ground cable.

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

11. 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 12 to 20), before starting the engine.

    - Fill the engine with oil - for filling values on vehicles without supercharger:
    - Refer to: Engine Oil Draining and Filling (303-01B Engine - V6 S/C 3.0L Petrol, General Procedures).

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

    - 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.

    - Set the ignition to the ON position.

14.
    - Press the left-hand OK button to access the Instrument Cluster (IC) Main Menu.



15.

- Press the left hand directional button and select Service Menu.



16.

- Press the left hand OK button.


E147184

17.

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



E147185

18.

- Press the left hand OK button to access the Oil Level display.




E147181

19. CAUTION: Make sure that the hood is open.

- Press the speed control cancel button twice within 2 seconds while being on the oil level display.

20.

- The message center displays the actual oil level in service mode.
- 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.



21. Set the ignition to the OFF position.
22. Allow 10 minutes for the engine oil level to stabilize if there has been additional oil top up.
23. NOTE: The following steps are to update the average oil level value.
24. Repeat steps 13 to 19 to access the oil level display in service mode.



25. NOTE: The actual volume displayed on the bar graph will be written into the electronic control unit as a new value.
    - Press and hold the speed control cancel button for more than 5 seconds.
    - The message center displays the current oil level.
26. Set the ignition to the OFF position.
27. Set the ignition to the ON position.
28.
    - Press the left hand OK button to access the Instrument Cluster (IC) Main Menu.



29.

- Press the left-hand directional button and select Service Menu.



30.

- Press the left hand OK button.


E147184

31.

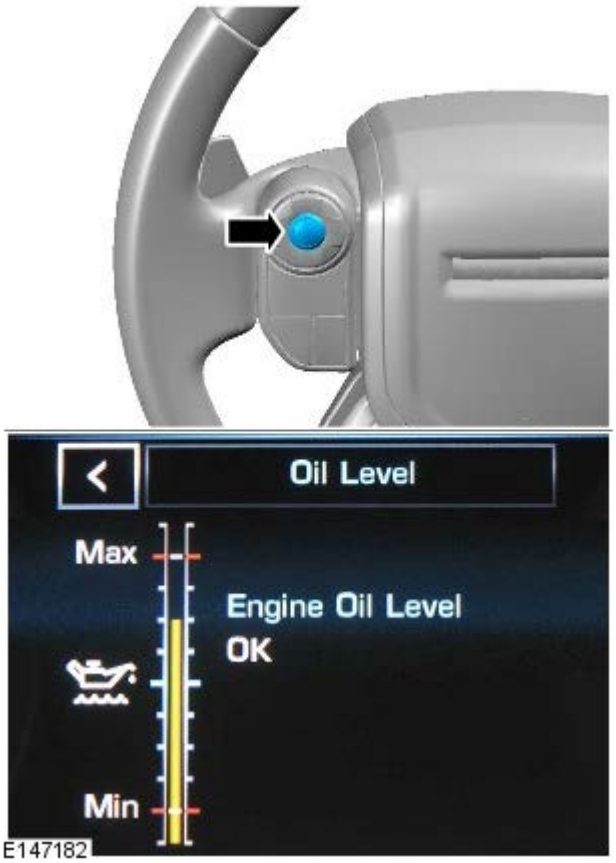
- Press the left-hand directional button and select the Oil Level display.



E147185

32.

- Press the left-hand OK button and follow the instructions.
- NOTE: If the message shows "Not available" wait for further 10 minutes to allow the oil level to stabilize.
- Make sure that the average oil level value has now been updated.


Oil Level
Max
Engine Oil Level
OK
Min
E147182

Published: 10-Jul-2013

Engine - V6 S/C 3.0L Petrol - Valves

Removal and Installation

Removal

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

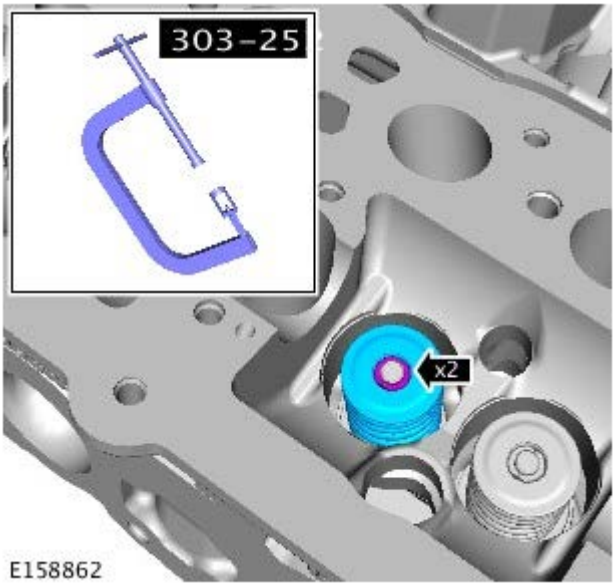
2. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

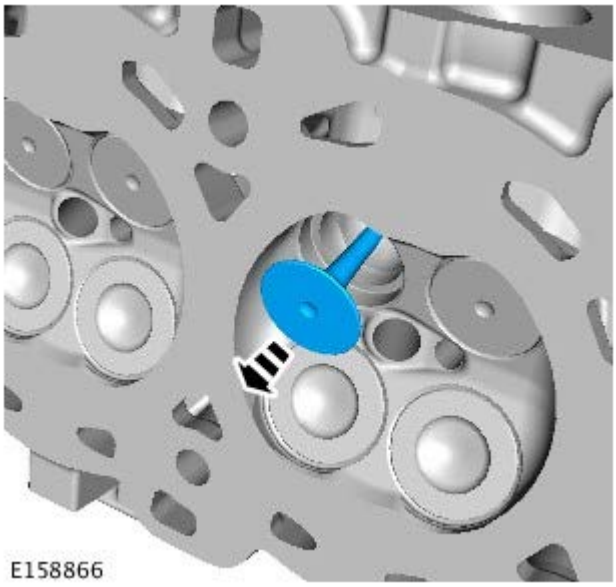
3. Refer to: Cylinder Head LH (303-01B Engine - V6 S/C 3.0L Petrol, Removal and Installation).

4. Refer to: Cylinder Head RH (303-01B Engine - V6 S/C 3.0L Petrol, Removal and Installation).

5.

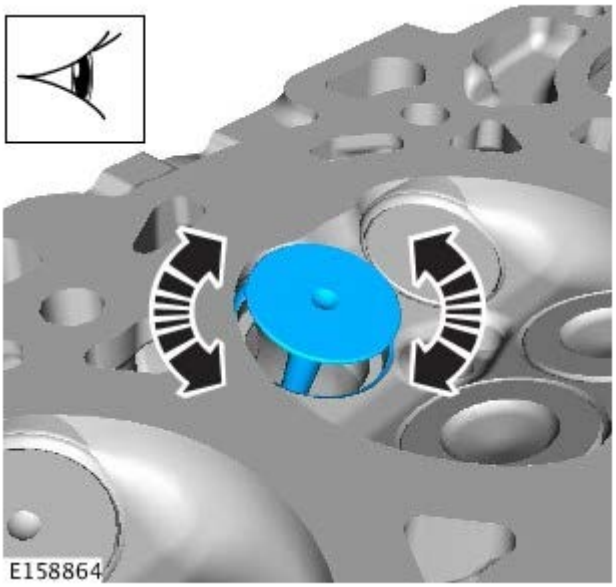


6.



7.





8. CAUTIONS:

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

   Make sure the working surfaces are thoroughly clean to avoid contamination of the sensitive components.

   Make sure that the valve grinding paste is kept away from the valve stem.

   - Place a small amount of fine valve grinding paste evenly around the contact face of the valve.
   - Place the valve in position and, using a suitable valve grinding tool, rotate the valve back and forth a few degrees on its seat, using light pressure.
   - Raise the valve frequently during lapping and turn it into a new position after a few laps or rotations.
   - Lap only until a continuous but narrow lapping mark is visible on both the valve seat and valve face.
   - Thoroughly clean all surfaces to remove traces of valve grinding paste from the cylinder head, valve seat and valve face.

Installation

1. CAUTION: Make sure the working surfaces are thoroughly clean to avoid contamination of the sensitive components.

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

   To install reverse the removal procedure.

Published: 02-May-2013

Engine - V6 S/C 3.0L Petrol - Engine

Removal

NOTES:

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

Some components shown removed for clarity.

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: Secondary Bulkhead Center Panel - V6 S/C 3.0L Petrol (501-02 Front End Body Panels, Removal and Installation).

4. Refer to: Hood (501-02 Front End Body Panels, Removal and Installation).

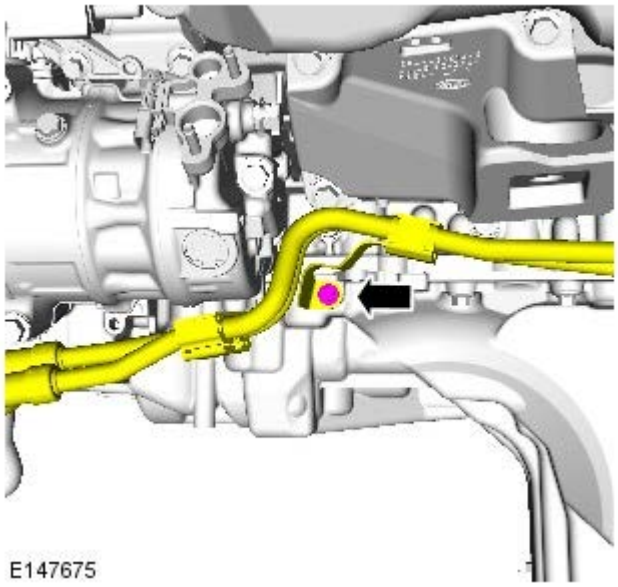
5. Refer to: Radiator (303-03B Engine Cooling - V6 S/C 3.0L Petrol, Removal and Installation).

6. Refer to: Accessory Drive Belt (303-05B Accessory Drive - V6 S/C 3.0L Petrol, Removal and Installation).

7. Refer to: Engine Oil Draining and Filling (303-01B Engine - V6 S/C 3.0L Petrol, General Procedures).

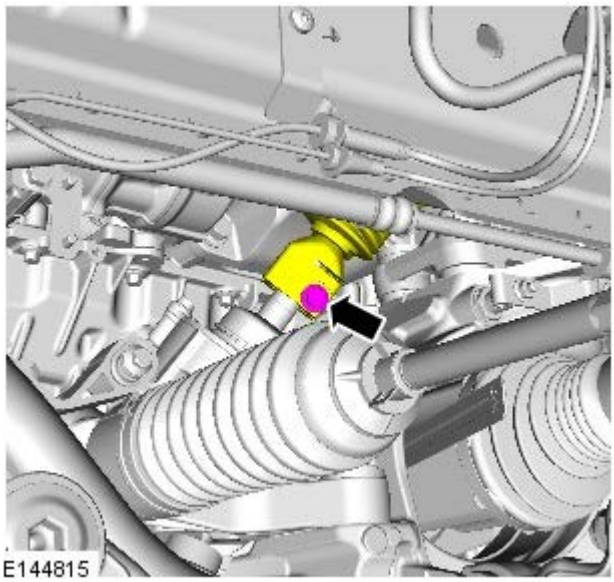
8. Refer to: Transmission - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, Removal).

9.

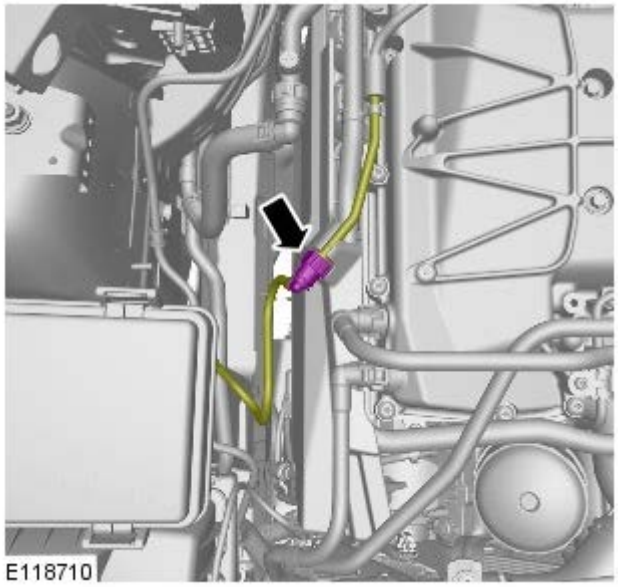


10. NOTE: Left hand drive only.

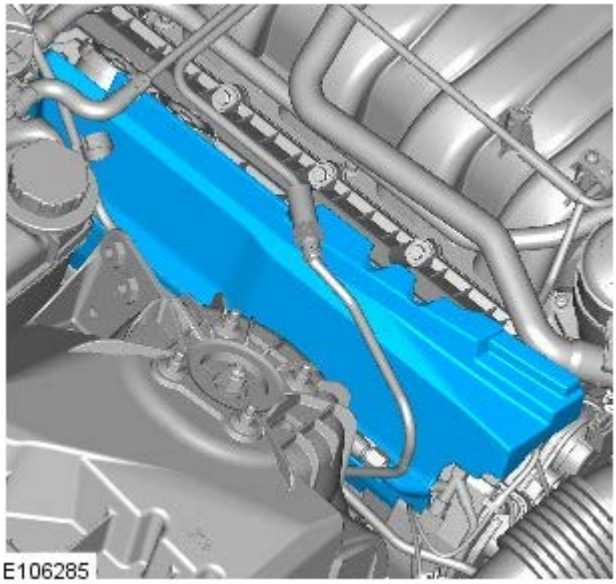
    Discard the bolt.



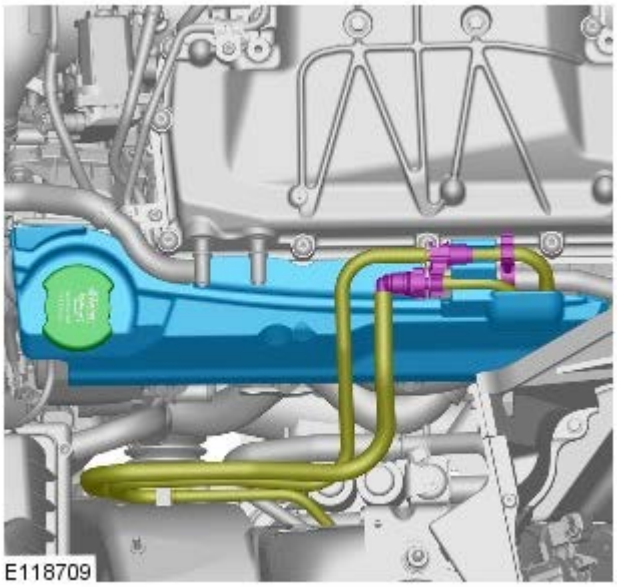
11.



12.

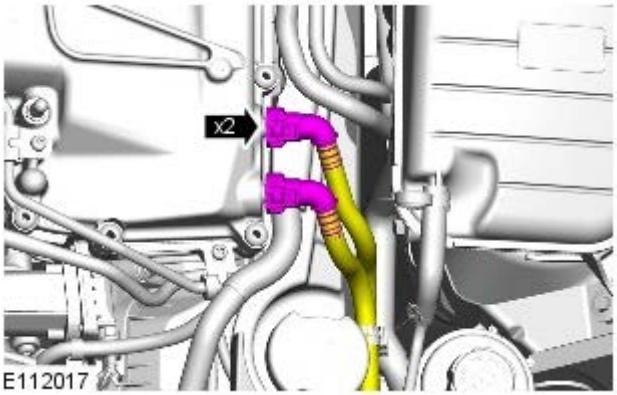


13. WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

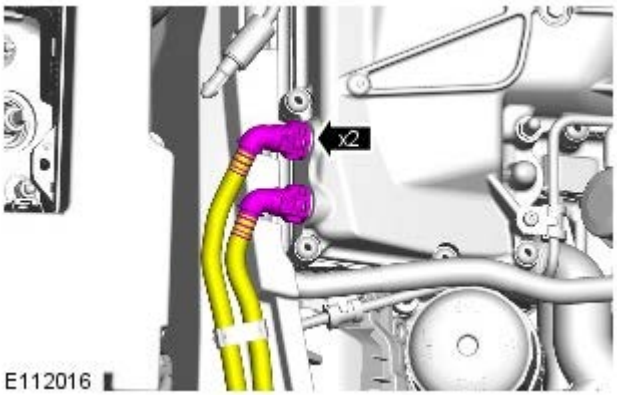


CAUTION: Be prepared to collect escaping fuel.

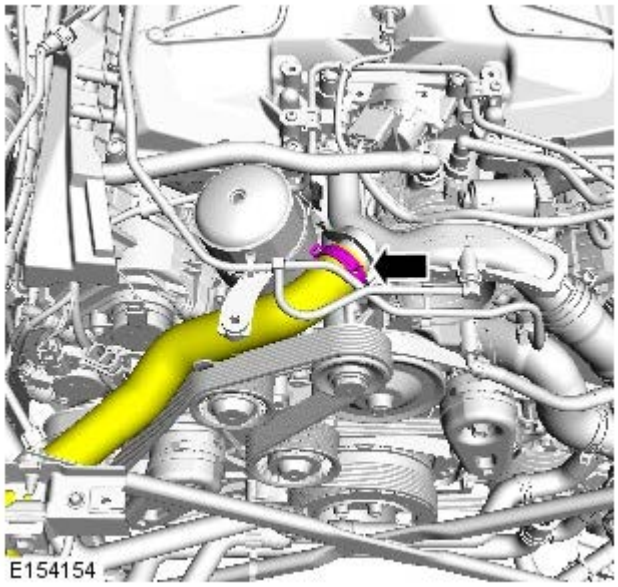
14. WARNING: Be prepared to collect escaping fluids.

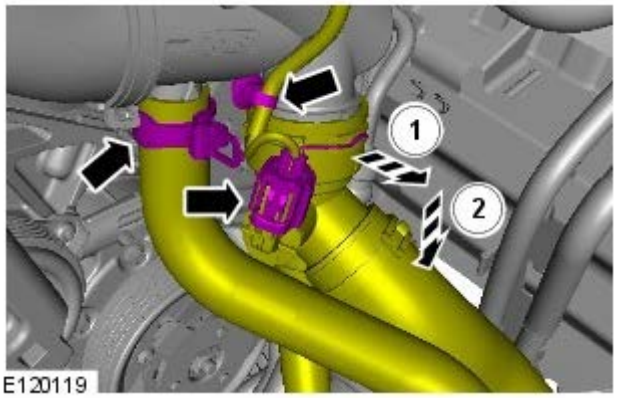


15. WARNING: Be prepared to collect escaping fluids.



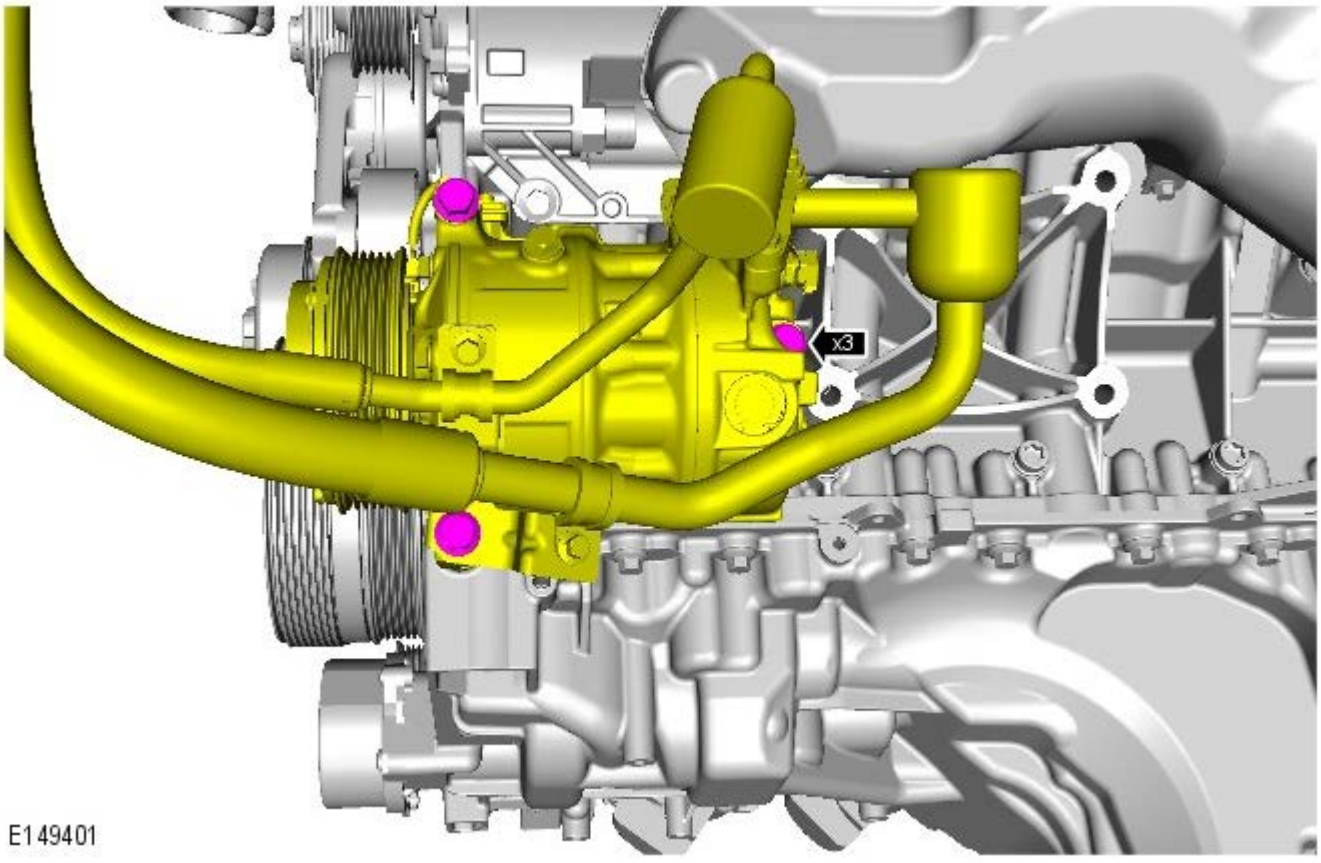
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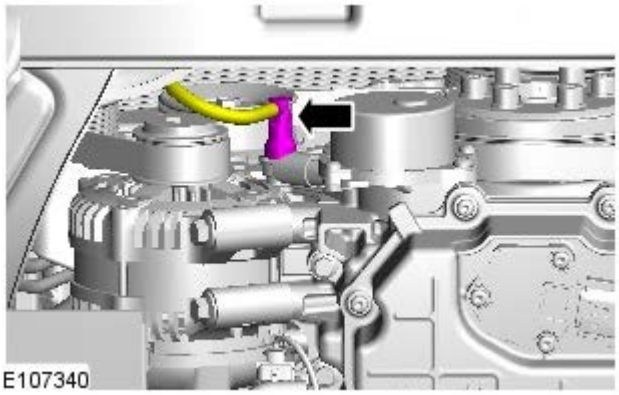


17. CAUTION: Be prepared to collect escaping coolant.

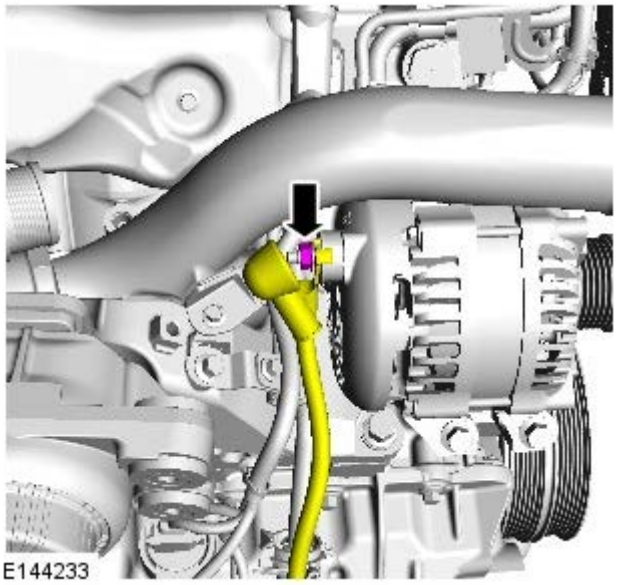
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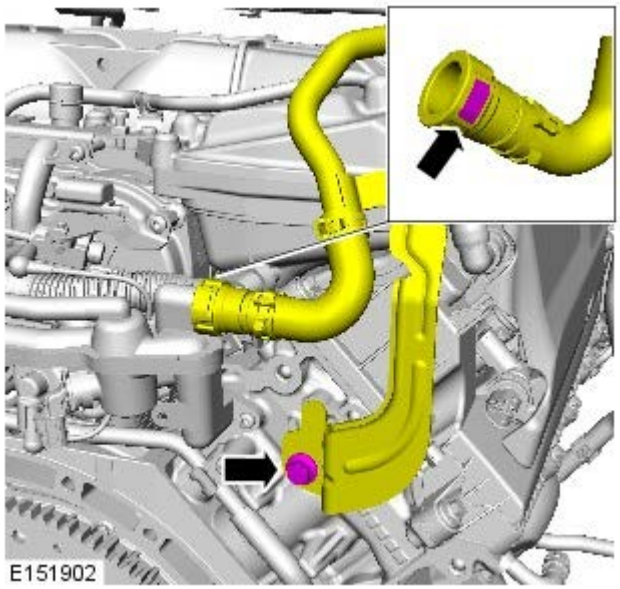
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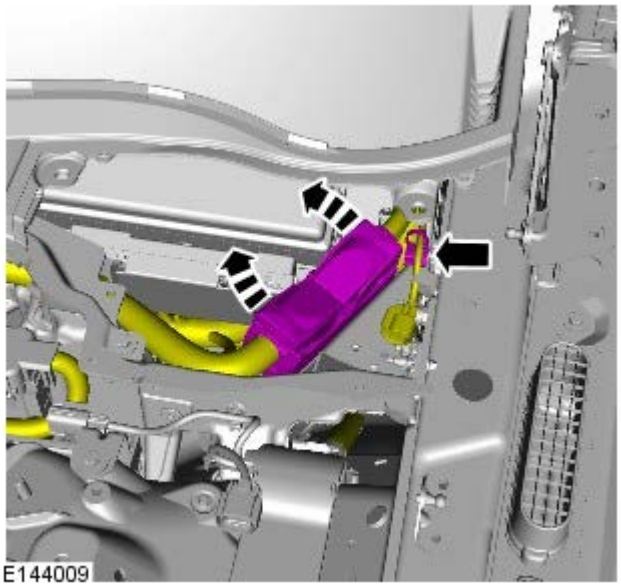
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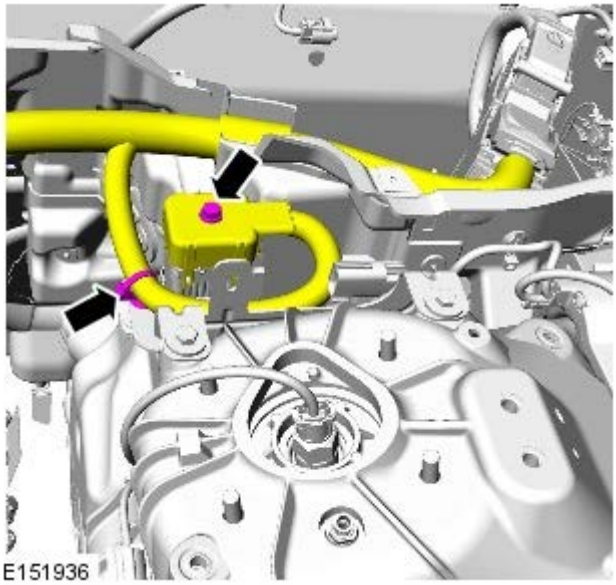
21. CAUTION: Be prepared to collect escaping coolant.



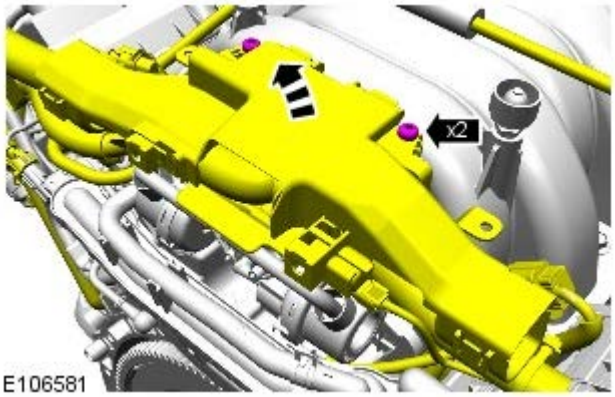
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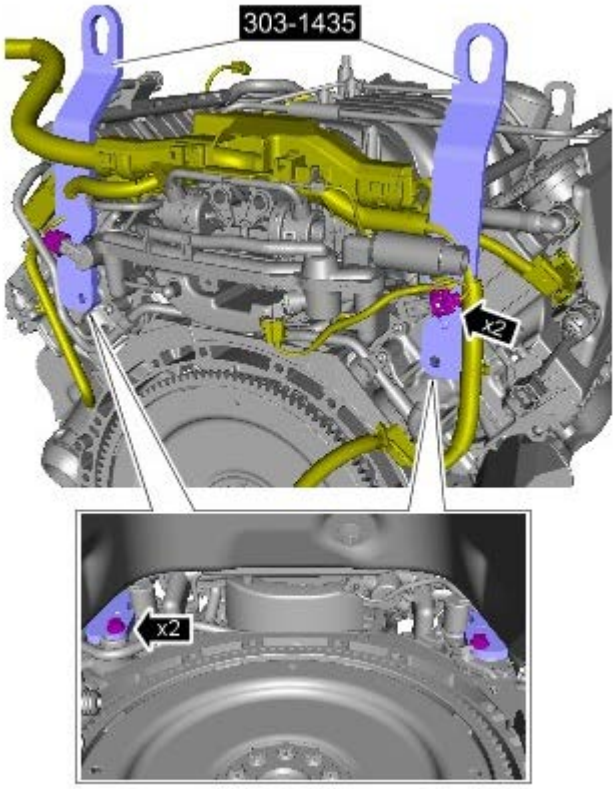
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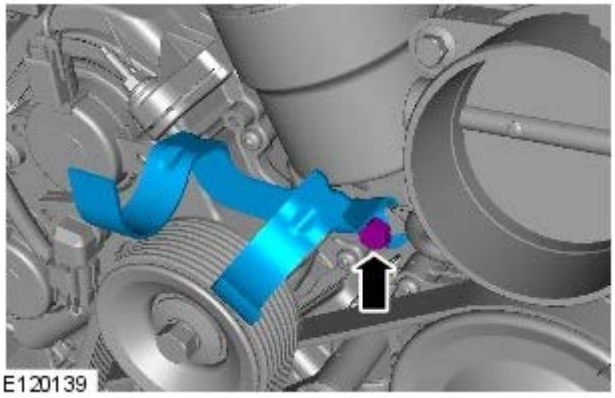


25. *Torque:* 25 Nm

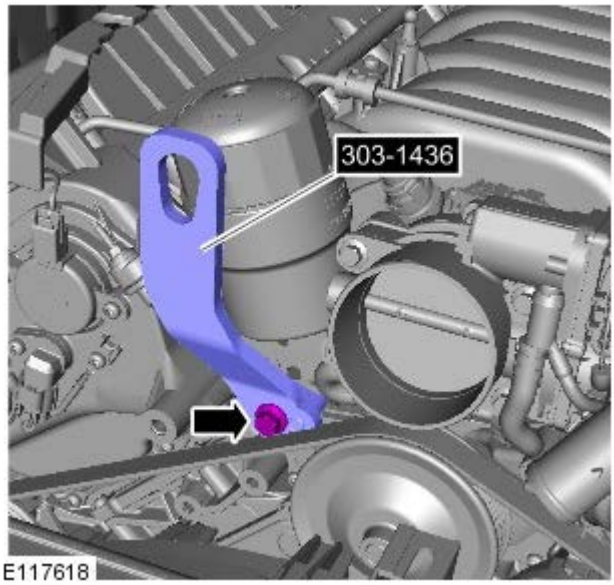


E117619

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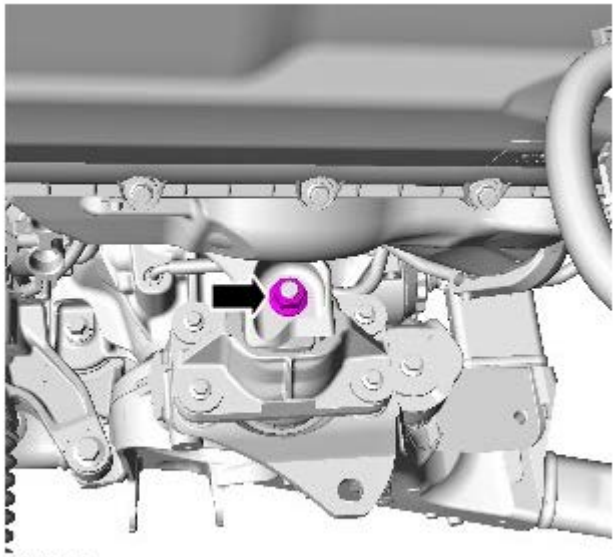

E120139

27. *Torque:* 25 Nm



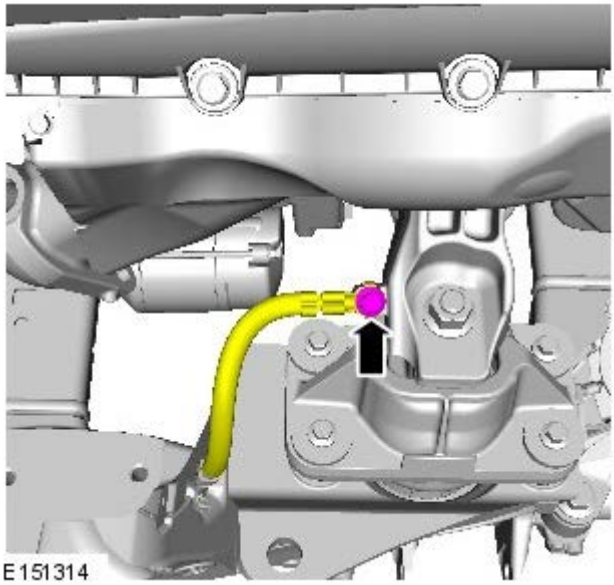
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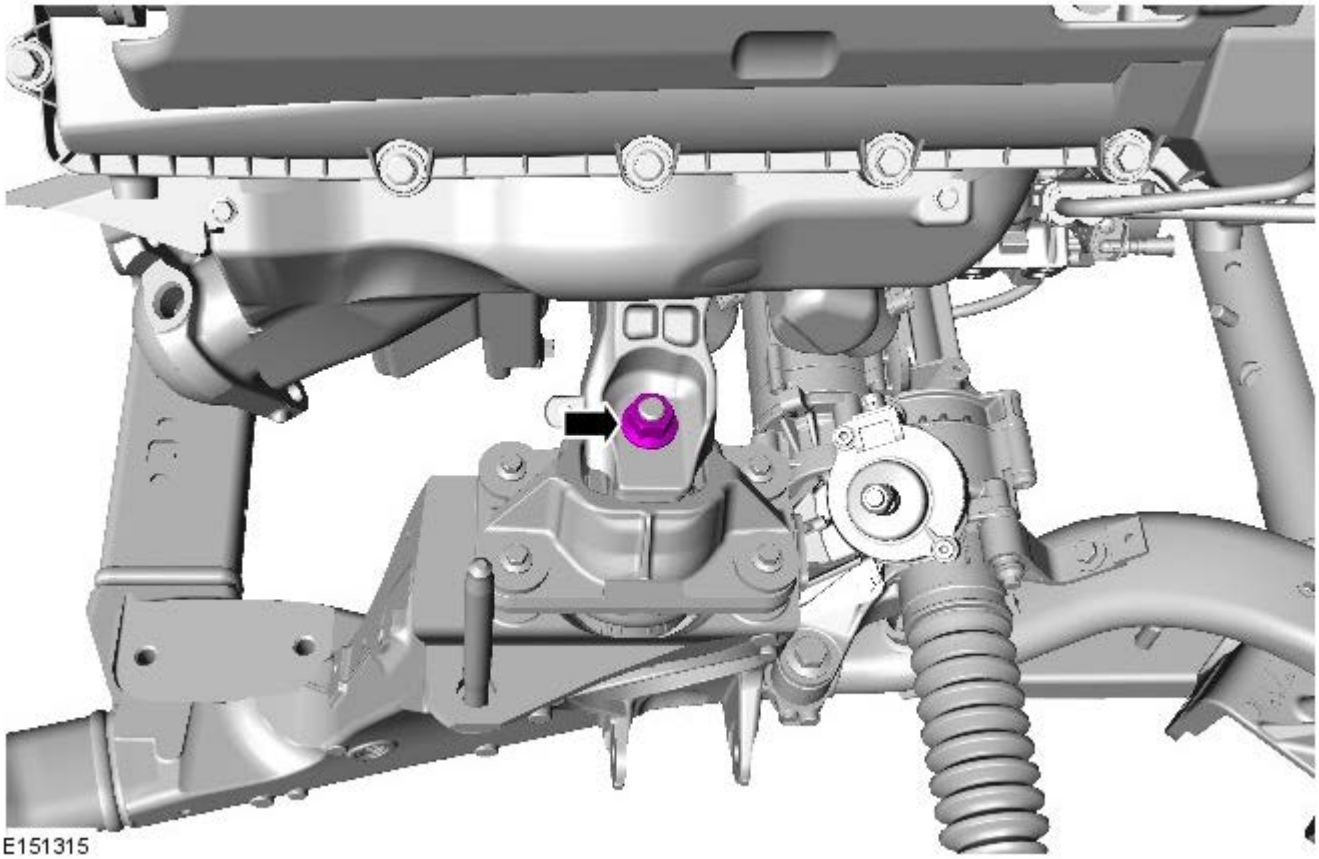
E151309

29.



E151314

30.



E151315



E149361

31. NOTE: This step requires the aid of another technician.

Published: 02-May-2013

Engine - V6 S/C 3.0L Petrol - Engine

Installation

NOTES:

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

Some components shown removed for clarity.

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

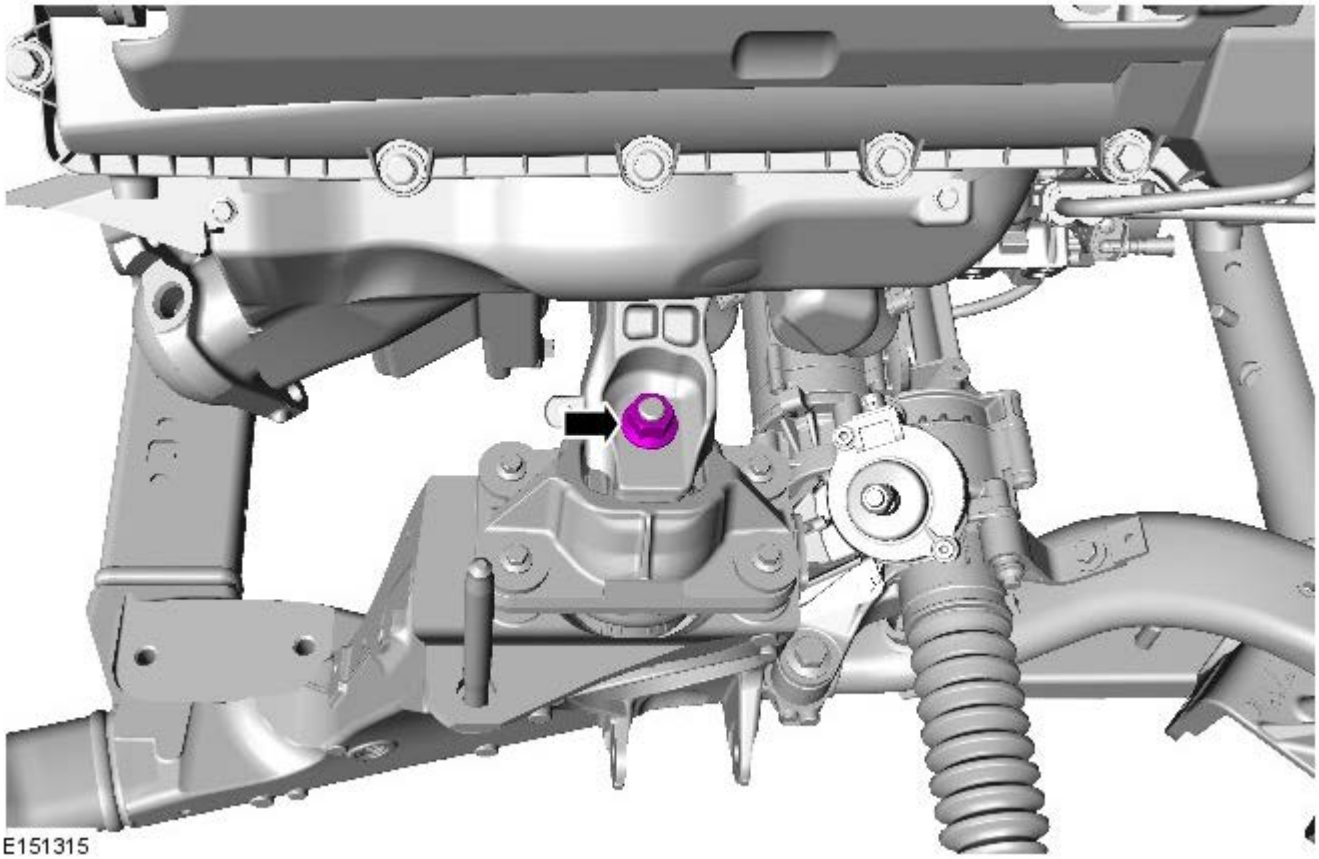
   Raise and support the vehicle.

2. NOTE: This step requires the aid of another technician.



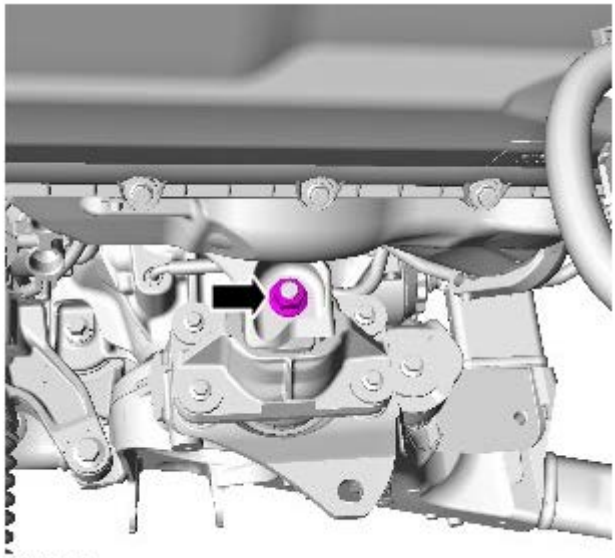
E149361

3. *Torque:* 110 Nm



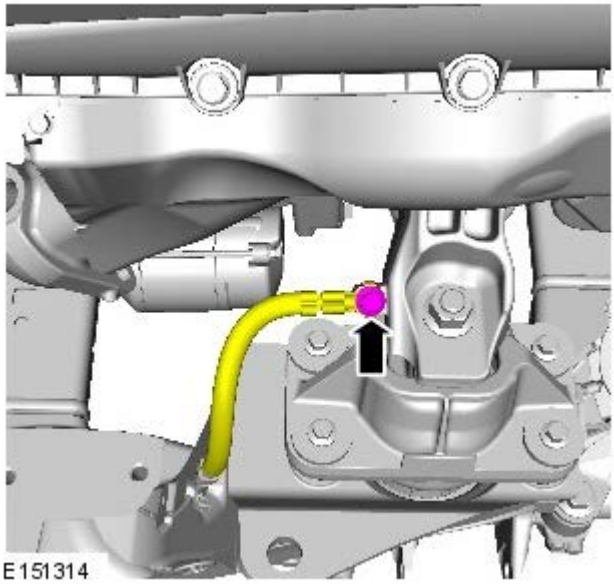
E151315

4. *Torque:* 110 Nm

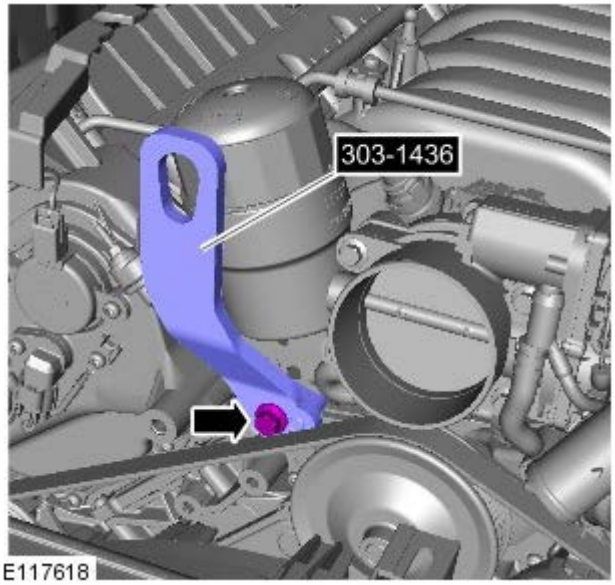


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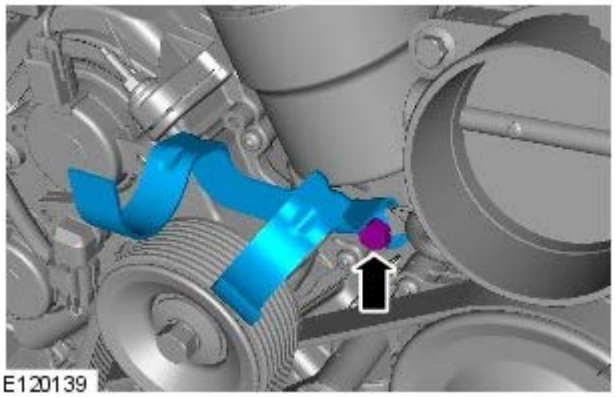
5. *Torque:* 9 Nm



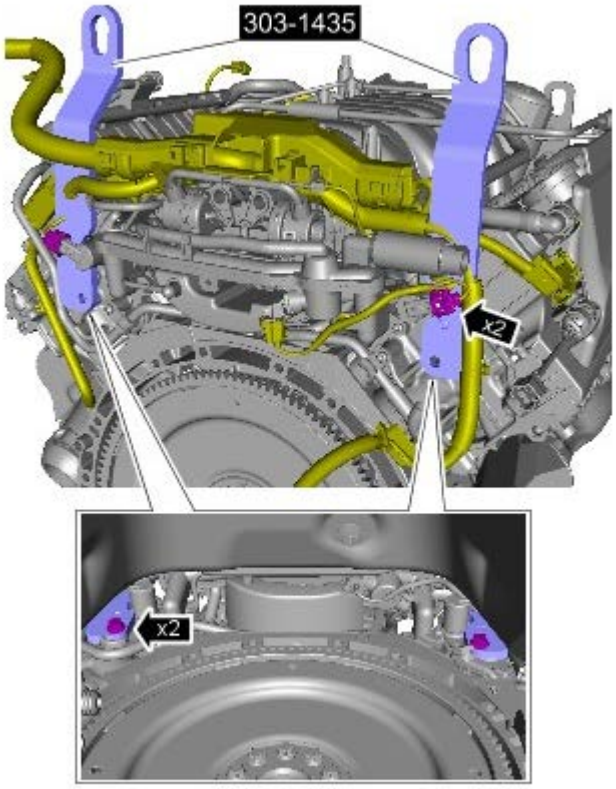
6.



7. *Torque:* 25 Nm

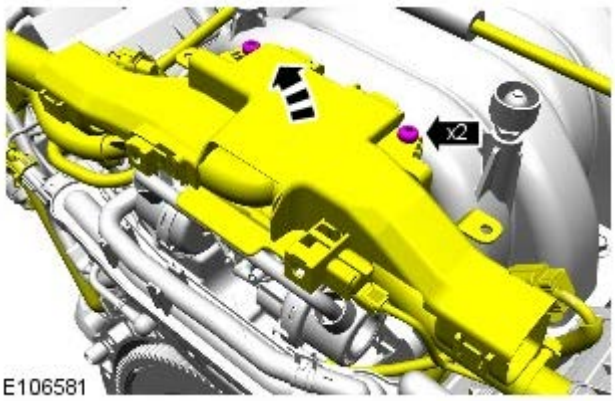


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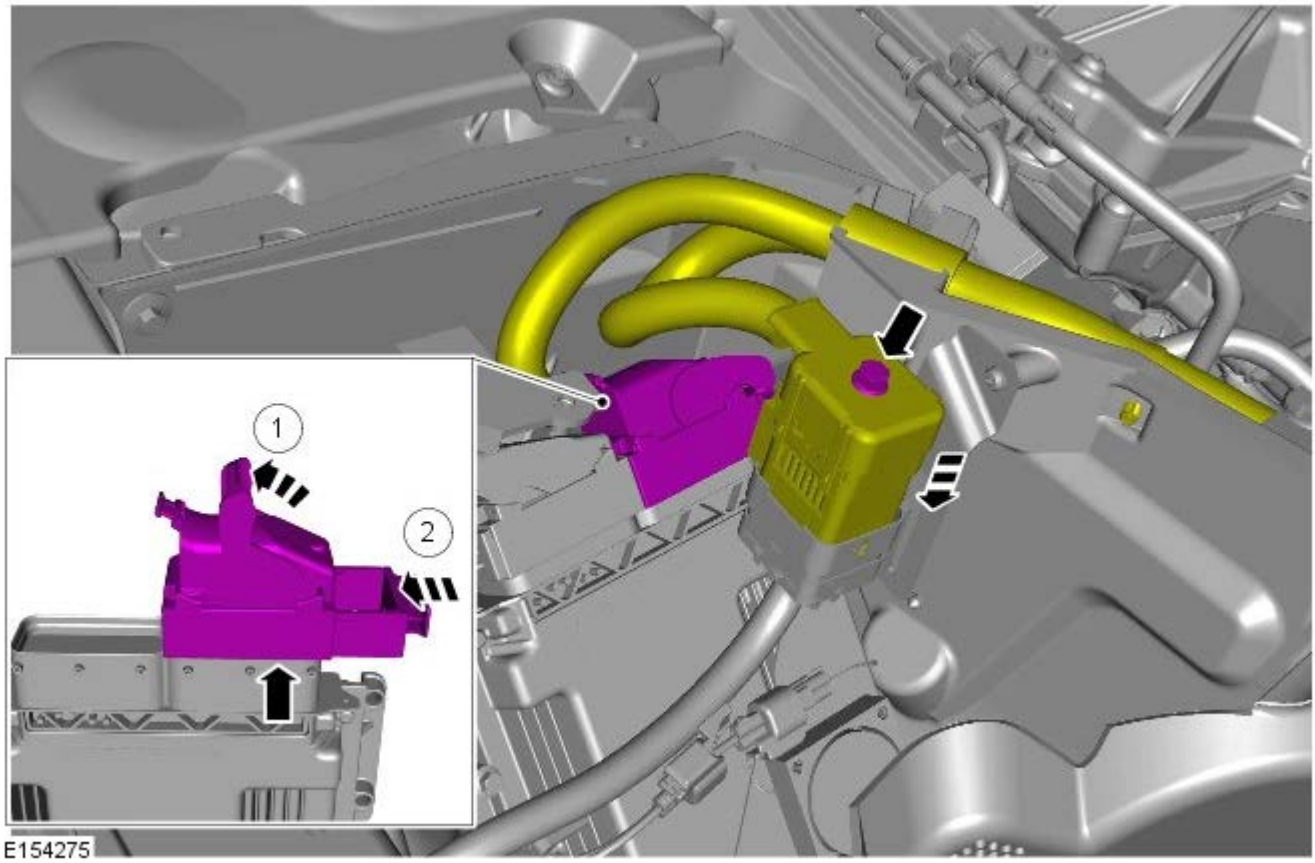
E117619

9. *Torque:* 10 Nm

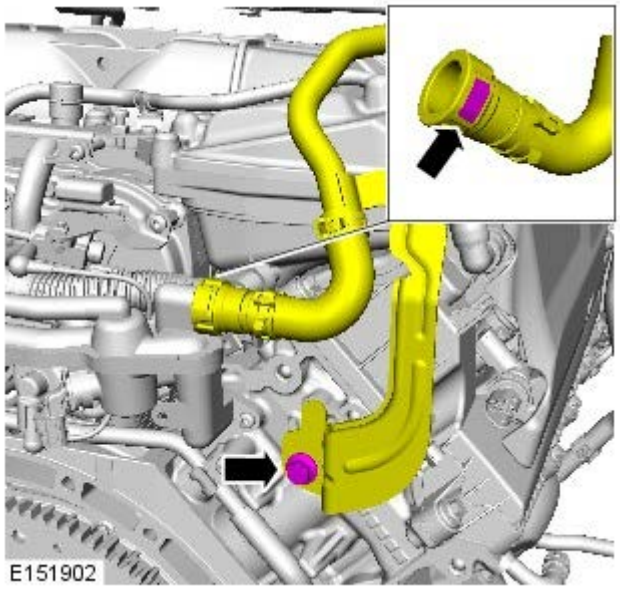


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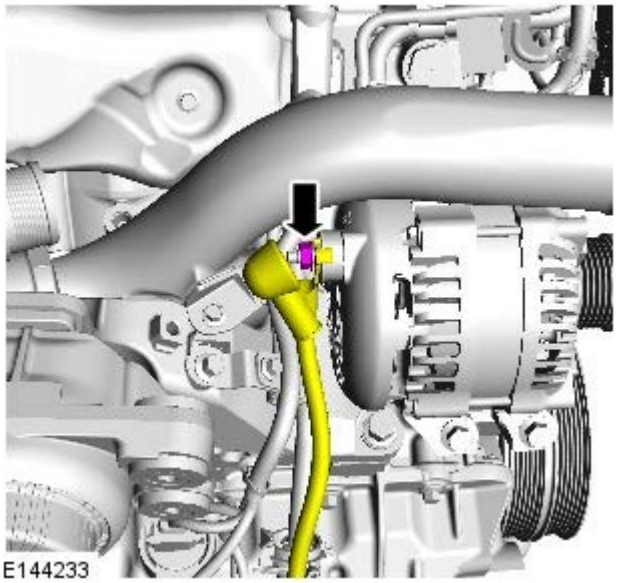
10. *Torque:* 7 Nm



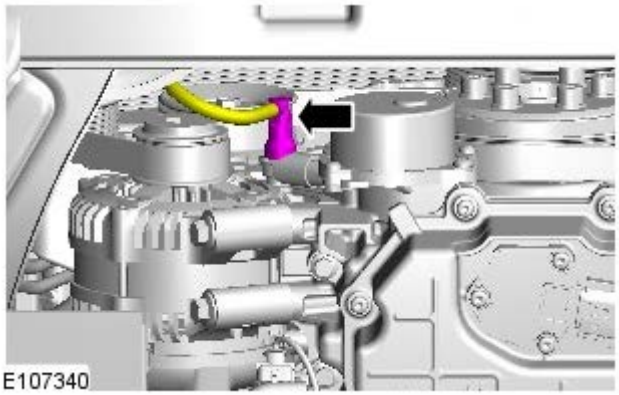
11. *Torque:* 25 Nm



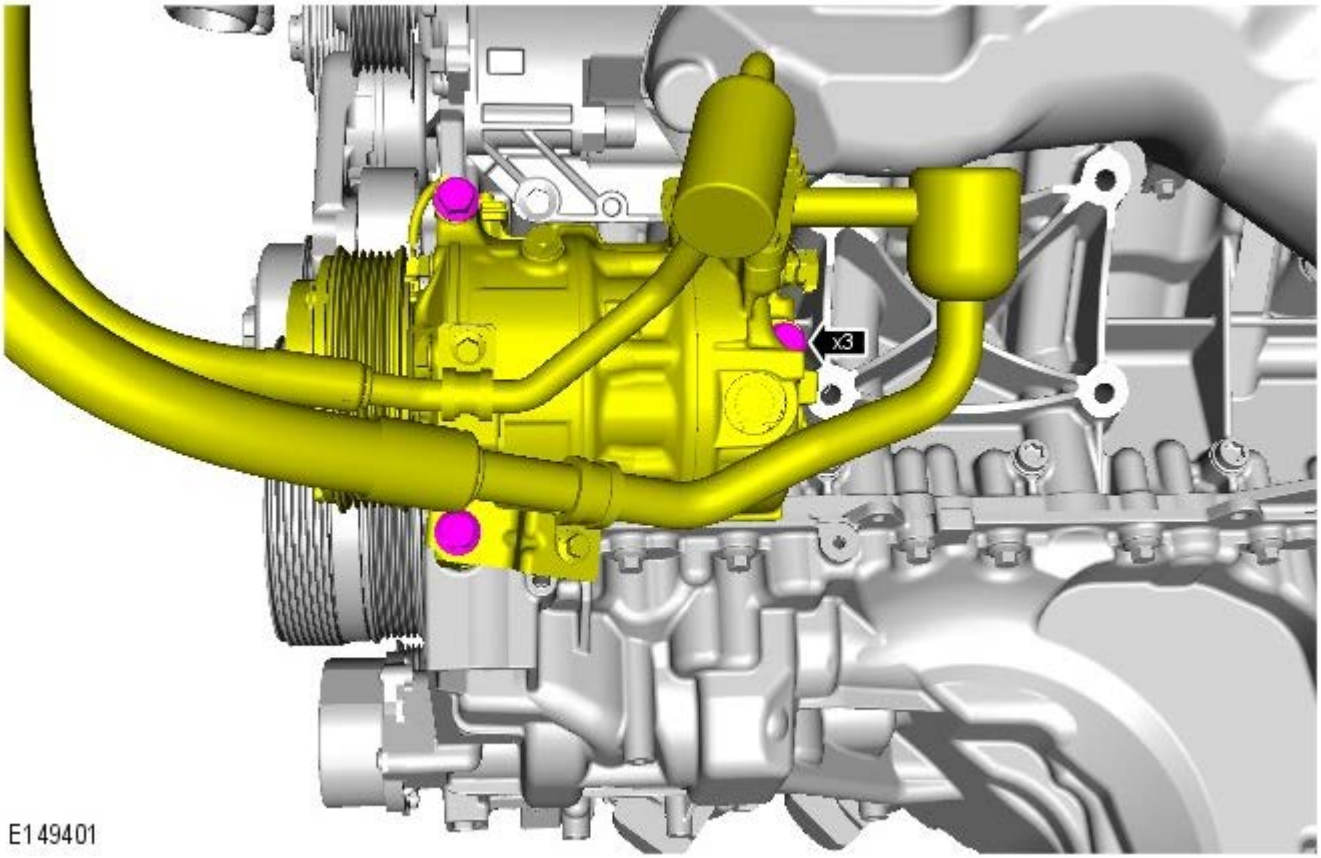
12. *Torque:* 12 Nm



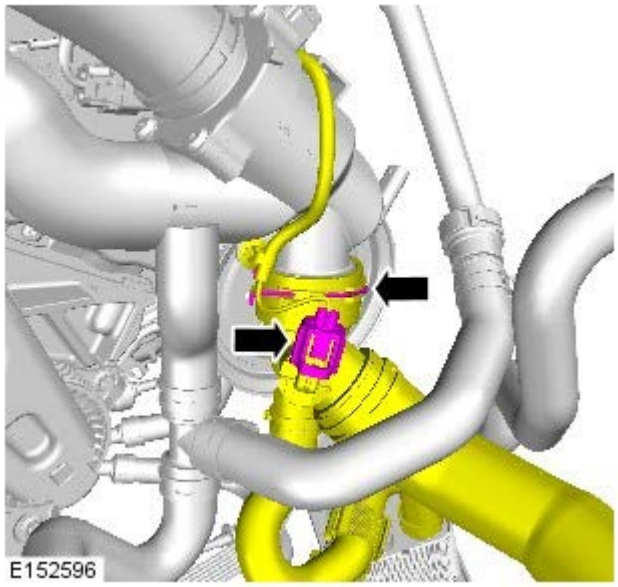
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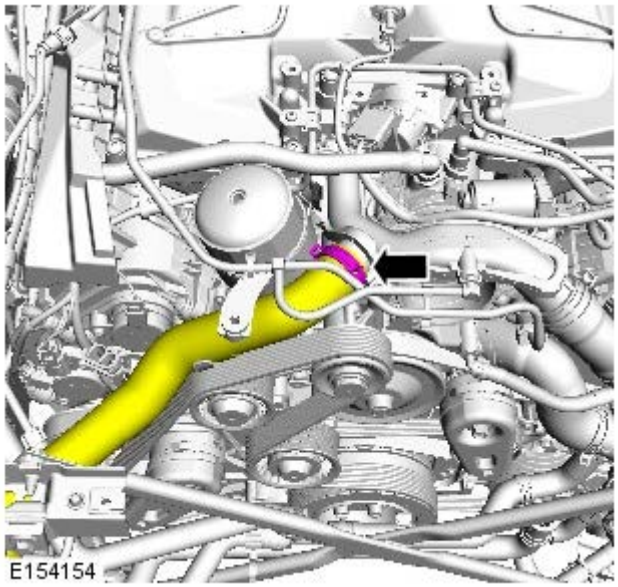
14. *Torque:* 25 Nm



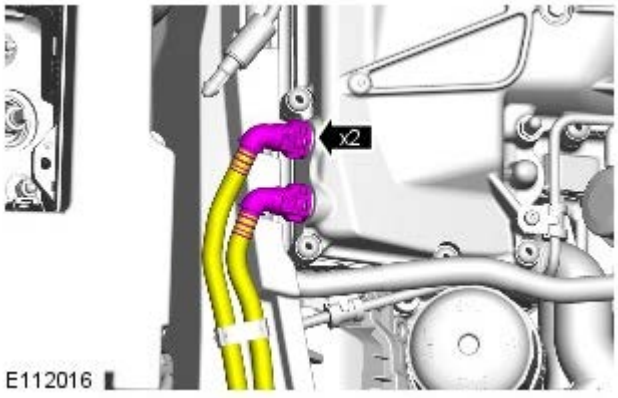
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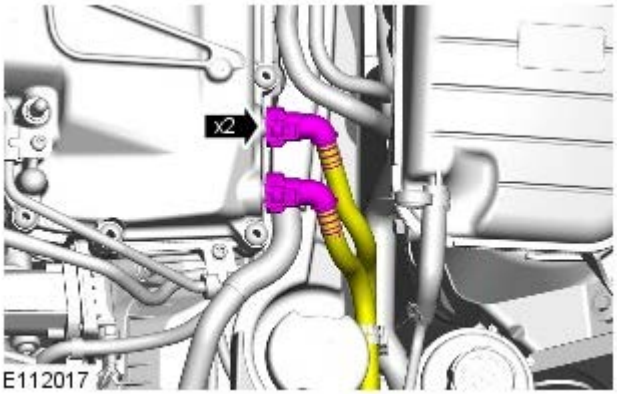
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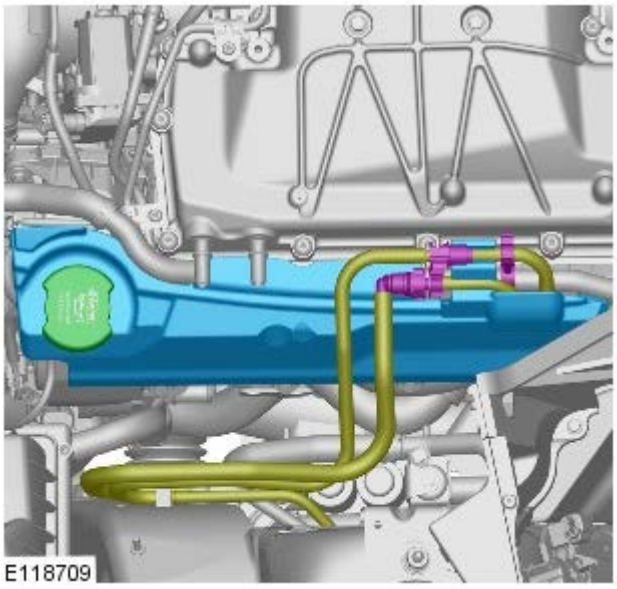


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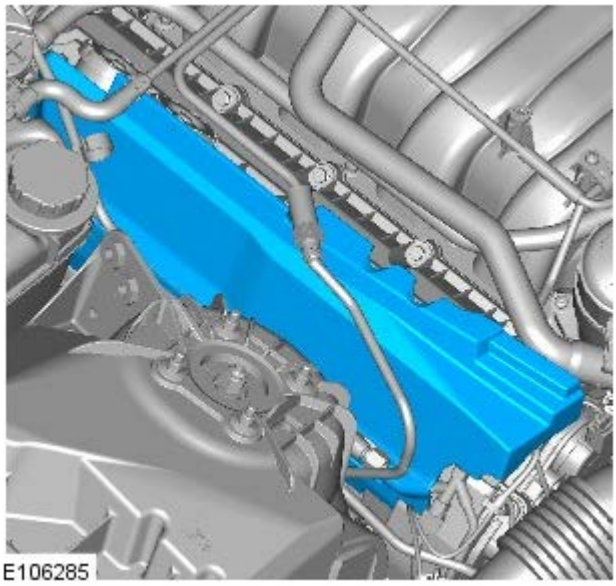


19. WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

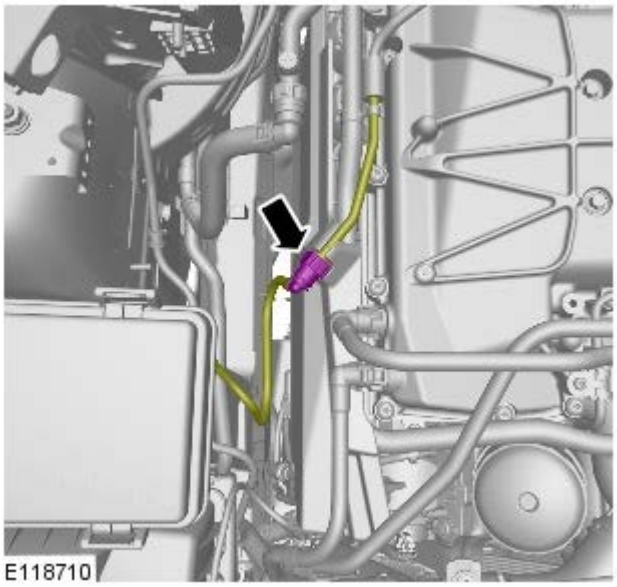
CAUTION: Be prepared to collect escaping fuel.

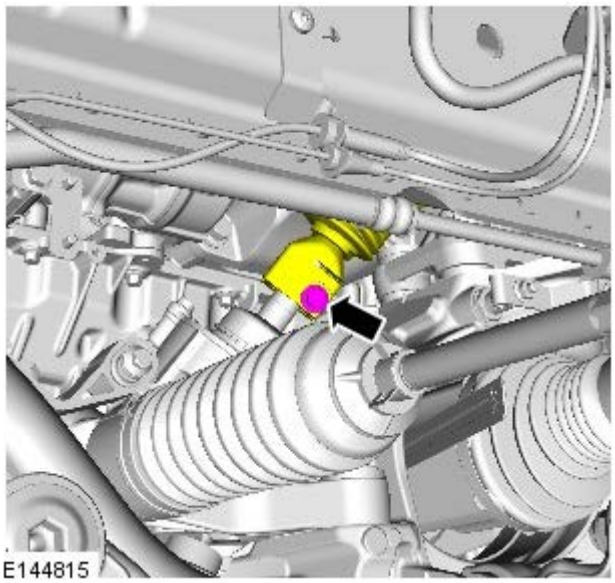


20.



21.



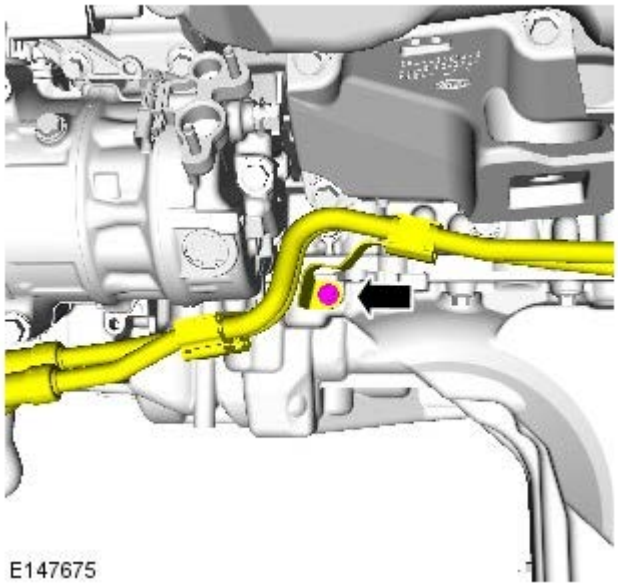


22. NOTE: Left hand drive only.

    Install a new bolt.

    Torque: 30 Nm

23. *Torque:* 9 Nm



24. Refer to: Transmission - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, Removal).

25. Refer to: Accessory Drive Belt (303-05B Accessory Drive - V6 S/C 3.0L Petrol, Removal and Installation).

26. Refer to: Radiator (303-03B Engine Cooling - V6 S/C 3.0L Petrol, Removal and Installation).

27. Refer to: Hood (501-02 Front End Body Panels, Removal and Installation).

28. Refer to: Secondary Bulkhead Center Panel - V6 S/C 3.0L Petrol (501-02 Front End Body Panels, Removal and Installation).

29. Reconnect the battery ground cable.

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

30. Refer to: Engine Oil Draining and Filling (303-01B Engine - V6 S/C 3.0L Petrol, General Procedures).

Published: 01-Jul-2013

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	92.5 mm	93 mm

Engine Firing Order

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

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	5W/20 WSS-M2C925-A. ILSAC GF4, API SM
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	48	35	-
Supercharger belt tensioner bracket retaining bolts	25	18	-
Supercharger belt idler pulley bolt	48	35	-
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	130	96	-
Engine mounting to subframe retaining bolts	**A**	-	-
Engine mounting bracket to engine retaining bolts	45 + 60°	33 + 60°	-
Crankshaft damper pulley retaining LH threaded bolt	200 + 270°	148 + 180°	-
Driveplate 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 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°	-

This section contains no data

Published: 11-May-2011

Engine - V8 S/C 5.0L Petrol - Engine

Diagnosis and Testing

For additional information.
REFER to: Engine - 5.0L Petrol (303-00, Diagnosis and Testing).

Published: 28-May-2013

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.

CAUTIONS:

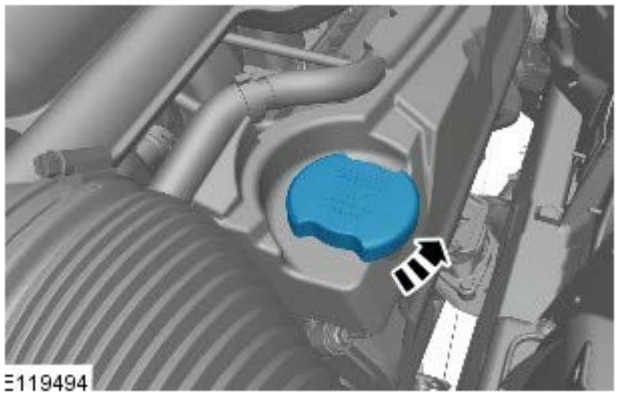
Correct installation of the oil filler cap can be obtained by tightening the cap until hard stop.

Make sure the engine is warm.

NOTE: Clean the components general area prior to dismantling.

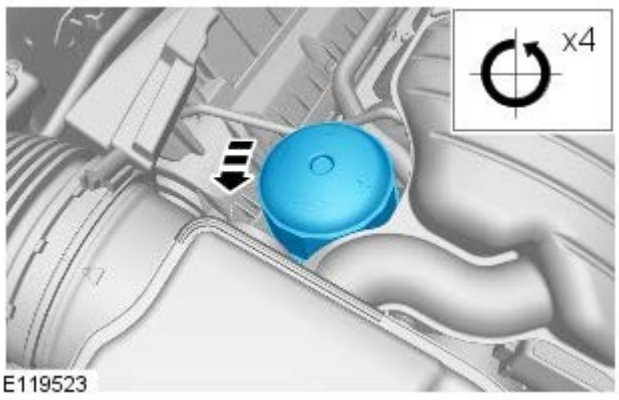
1.
- Start the engine and allow to run for 10 minutes, stop the engine.

2.



3. Refer to: Engine Cover - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (501-05 Interior Trim and Ornamentation, Removal and Installation).

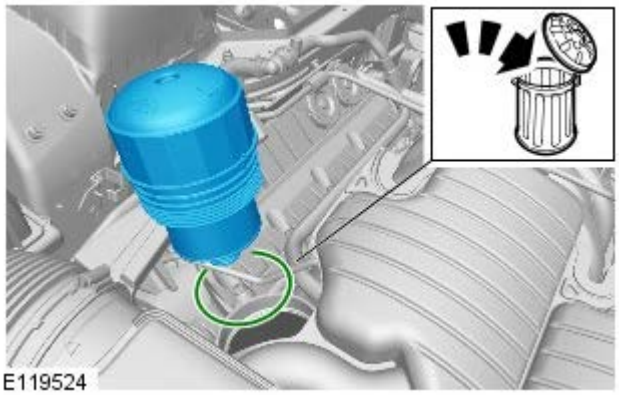
4.
- Loosen the element cover 4 complete turns to allow engine oil to drain from the filter cover.
- Make sure that the O-ring seal is exposed.



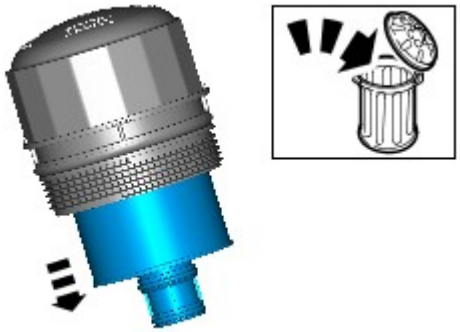
5. NOTES:

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

Remove and discard the O-ring seal.


E119524

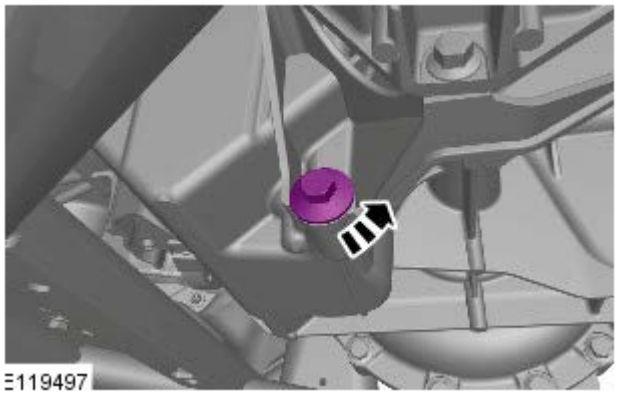
6. Remove and discard the oil filter element.


E107394

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

   Raise and support the vehicle.

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


E119497

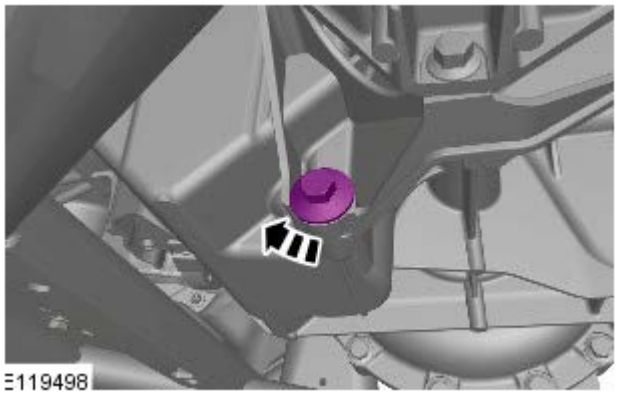
9. CAUTIONS:

   Be prepared to collect escaping oil.

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

   NOTE: Discard the sealing washer.

Filling


E119498

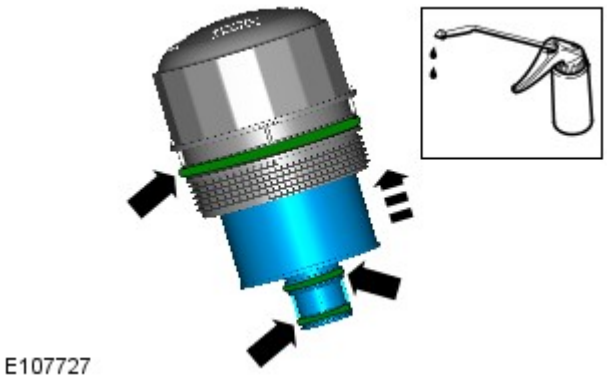
1. CAUTION: Make sure that the area around the component is clean and free of foreign material.

   NOTE: Install a new sealing washer.

   Torque: 24 Nm

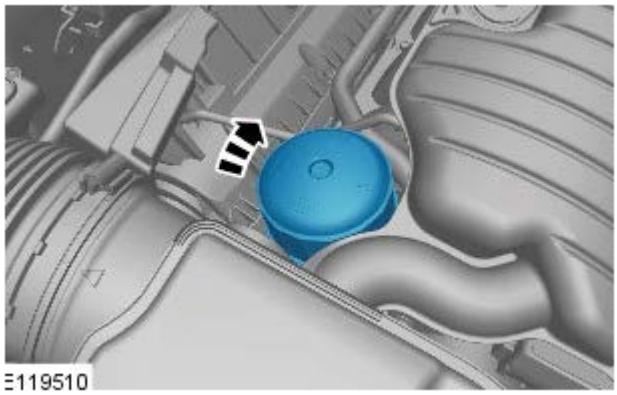
2. Refer to: Engine Undershield (501-02 Front End Body Panels,

Removal and Installation).


E107727

3. NOTE: Install new O-ring seals.

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


E119510

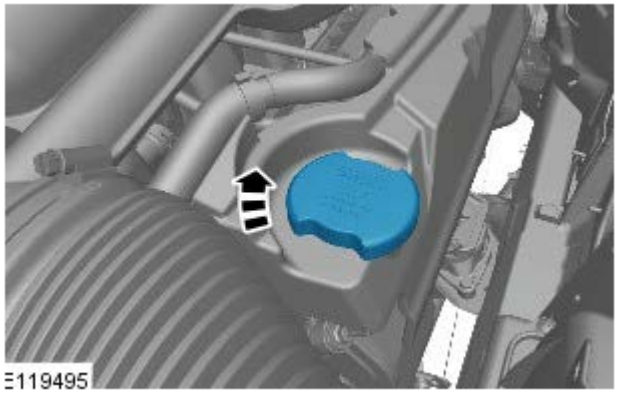
4. CAUTION: Tighten the component finger tight first.
   - *Torque:* 25 Nm

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 9-16), 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 (303-01C Engine - V8 S/C 5.0L Petrol, 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.
   - Start the engine and allow to run for 10 minutes, stop the engine.
   - Check for leaks.

8. CAUTIONS:

Make sure that the selector lever is in the park (P) position.

Make sure that the hood is open.

- Set the ignition to the ON position.

9.

- Press the left-hand OK button to access the Instrument Cluster (IC) Main Menu.



10.

- Press the left-hand directional button and select Service Menu.



11.

- Press the left-hand OK button.



12.

- Press the left-hand directional button and select the Oil Level display.



13.

- Press the left-hand OK button to access the Oil Level display.




E147181

14. CAUTION: Make sure that the hood is open.

- Press the speed control cancel button twice within 2 seconds while being on the oil level display.

15.

- The message center displays the actual oil level in service mode.
- Only after having started and run the engine for 10 minutes (as indicated in Step 7), 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.



16. Set the ignition to the OFF position.
17. Allow 10 minutes for the engine oil level to stabilize if there has been additional oil top up.

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

18. Repeat step 8 to 14 to access the oil level display in service mode.



19. NOTE: The actual volume displayed on the bar graph will be written into the electronic control unit as a new value.
    - Press and hold the speed control cancel button for more than 5 seconds.
    - The message center display the current oil level.

NOTE: Close the hood.

20. Set the ignition to the OFF position.
21. Set the ignition to the ON position.
22. NOTE: The following steps are to check the



current oil level in a customer mode.

- Press the left-hand OK button to access the Instrument Cluster (IC) Main Menu.

23.



- Press the left-hand directional button and select Service Menu.

24.

- Press the left-hand OK button.



E147184

25.

- Press the left-hand directional button and select the Oil Level display.

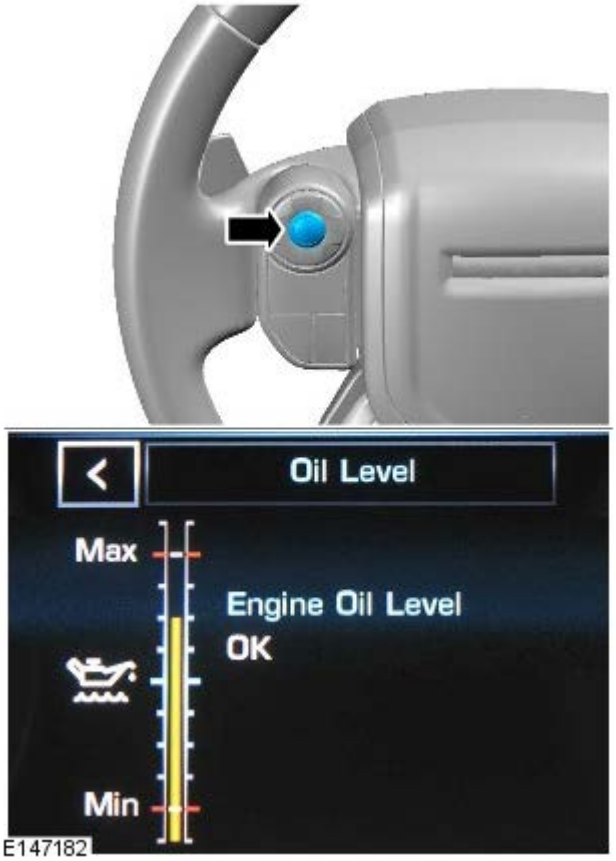


E147185

26.

- Press the left-hand OK button and follow the instructions.
- NOTE: If the message shows "Not available" wait for further 10 mins to allow the oil level to stabilize.

  Make sure that the average oil level value has now been updated.



27. Refer to: Engine Cover - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (501-05 Interior Trim and Ornamentation, Removal and Installation).

Published: 28-May-2013

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.

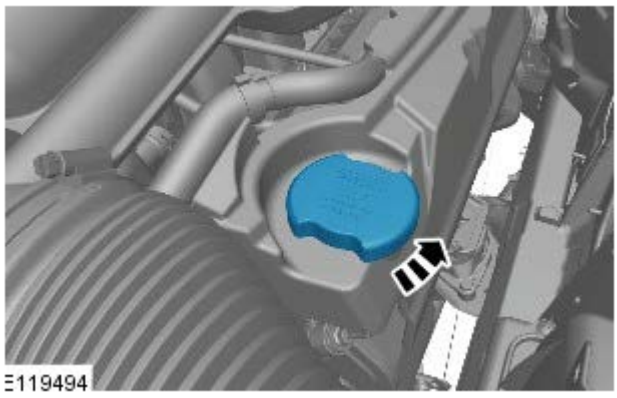
CAUTIONS:

Make sure the engine is warm.

Make sure that the vehicle is parked on level ground.

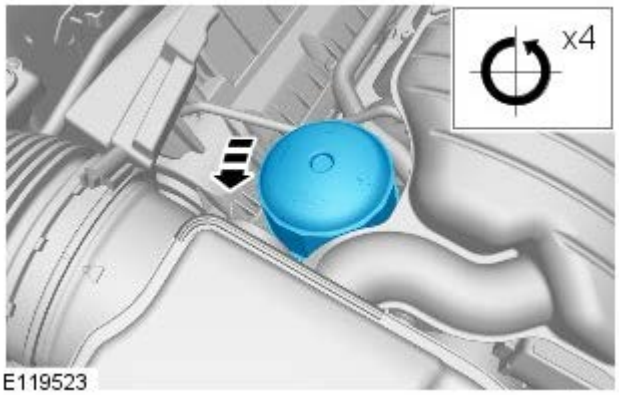
1.
   - Start the engine and allow to run for 10 minutes, stop the engine.

2. Refer to: Engine Cover - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (501-05 Interior Trim and Ornamentation, Removal and Installation).


E119494

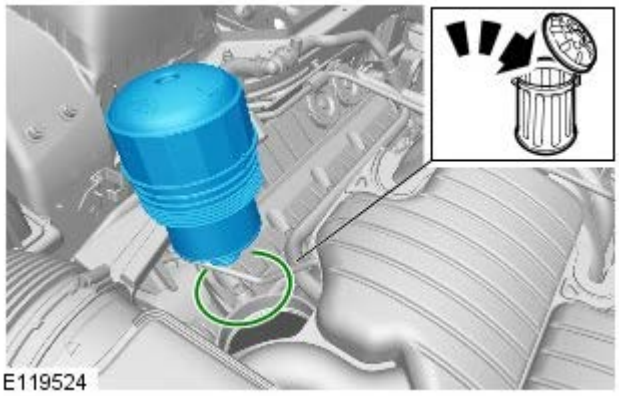
3. CAUTION: Allow 10 minutes from turning the engine off before starting oil extraction.

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

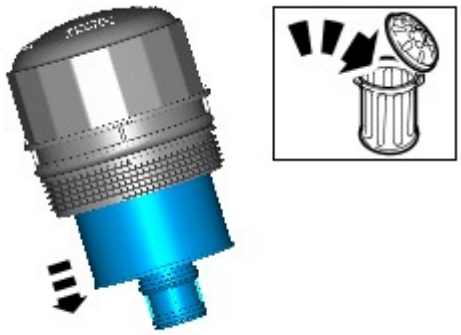


E119523

5.


E119524

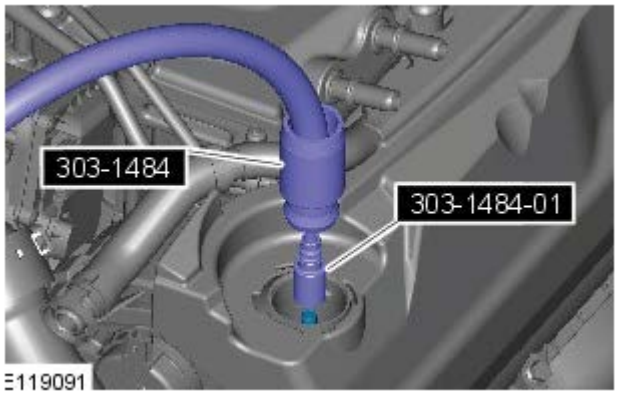
6. CAUTION: Discard the seal.


E107394

7.

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

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



E119091

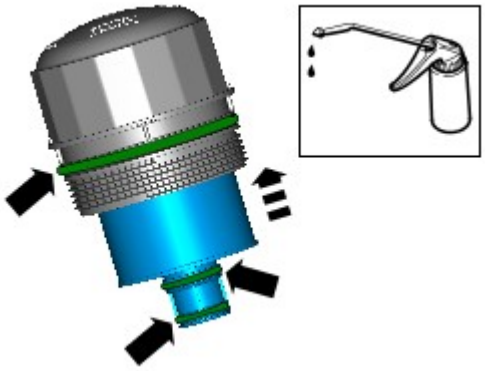
8.

- Remove the oil vacuum pump.

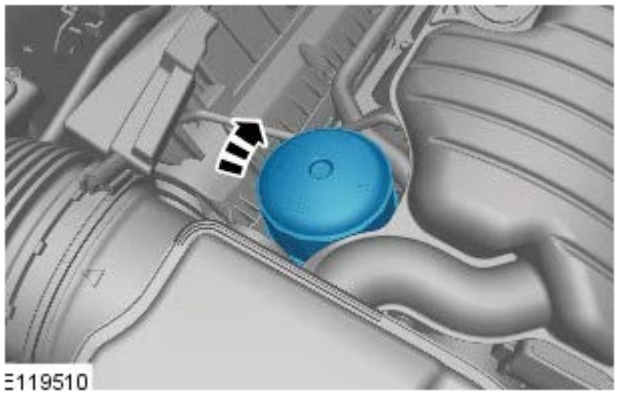
Filling

1. NOTE: Install new O-ring seals.

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



E107727

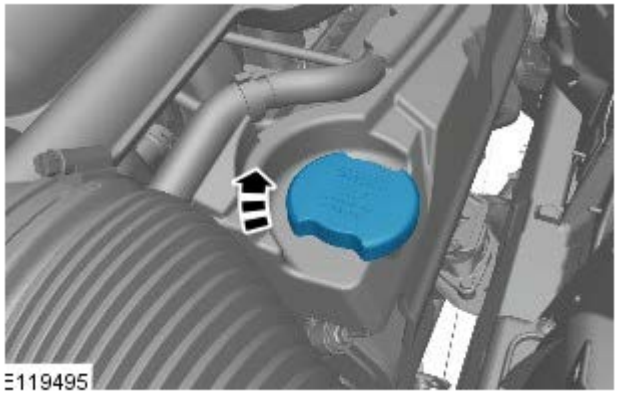


E119510

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

3.
   - Fill the engine with the recommended oil to the correct level.
   - 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.
   - Start the engine and allow to run for 10 minutes, stop the engine.
   - Check for leaks.

6. CAUTIONS:

   Make sure that the selector lever is in the park (P) position.

   Make sure that the hood is open.
   - Set the ignition to the ON position.

7.
   - Press the left-hand OK button to access the Instrument Cluster (IC) Main Menu.



8.

- Press the left-hand directional button and select Service Menu.



9.

- Press the left-hand OK button.



E147184

10.

- Press the left-hand directional button and select the Oil Level display.



E147185

11.

- Press the left-hand OK button to access the Oil Level display.




E147181

12. CAUTION: Make sure that the hood is open.

- Press the speed control cancel button twice within 2 seconds while being on the oil level display.

13.

- The message center displays the actual oil level in service mode.
- Only after having started and run the engine for 10 minutes (as indicated in Step 5), 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.



14. Set the ignition to the OFF position.
15. Allow 10 minutes for the engine oil level to stabilize if there has been additional oil top up.

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

16. Repeat step 6 to 12 to access the oil level display in service mode.



17. NOTE: The actual volume displayed on the bar graph will be written into the electronic control unit as a new value.
    - Press and hold the speed control cancel button for more than 5 seconds.
    - The message center display the current oil level.

NOTE: Close the hood.

18. Set the ignition to the OFF position.
19. Set the ignition to the ON position.
20. NOTE: The following steps are to check the



current oil level in a customer mode.

- Press the left-hand OK button to access the Instrument Cluster (IC) Main Menu.

21.



- Press the left-hand directional button and select Service Menu.

22.

- Press the left-hand OK button.



E147184

23.

- Press the left-hand directional button and select the Oil Level display.

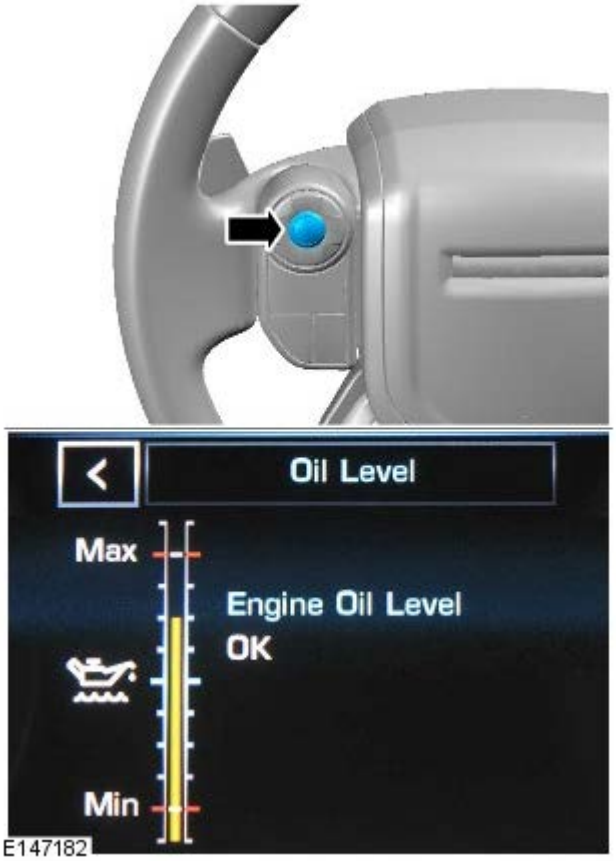


E147185

24.

- Press the left-hand OK button and follow the instructions.
- NOTE: If the message shows "Not available" wait for further 10 mins to allow the oil level to stabilize.

  Make sure that the average oil level value has now been updated.



25. Refer to: Engine Cover - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (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)

 E152575	JLR-303-1303 Timing Tool
 E140377	JLR-303-1621 Alignment Tool, Fuel Pump Camshaft Timing

Check

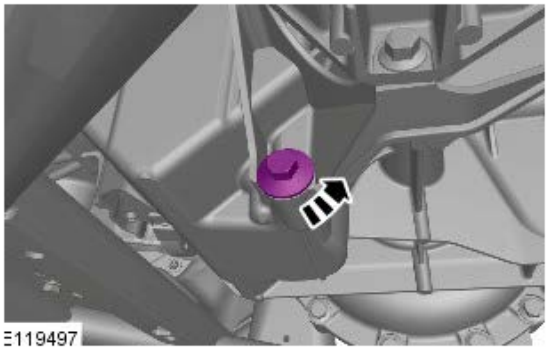
1. Disconnect the battery ground cable.

   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 Undershield (501-02 Front End Body Panels, Removal and Installation).

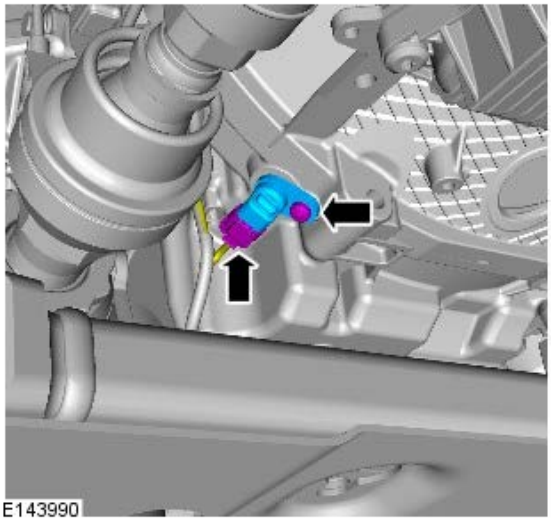

E119497

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

   NOTES:

   Discard the sealing washer.

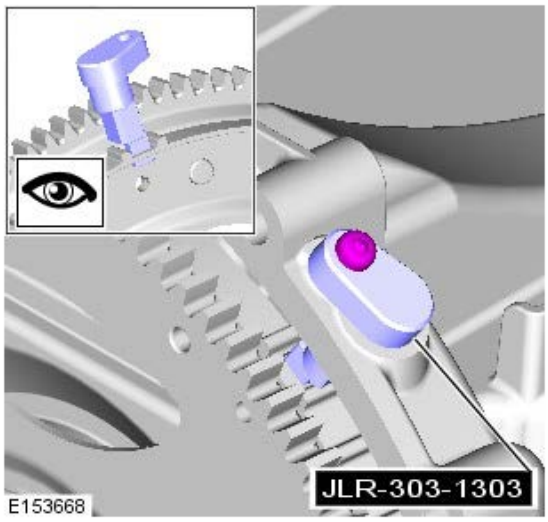
   Collect the engine oil in a clean container.


E143990

5.

6. CAUTIONS:

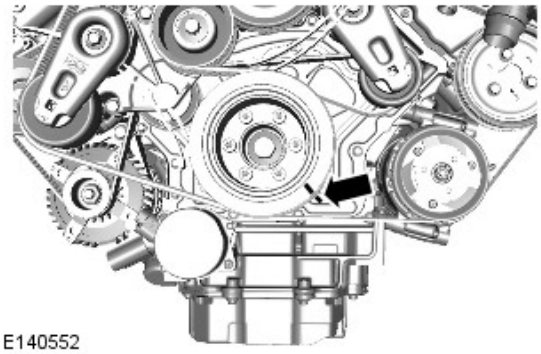
   Only rotate the crankshaft clockwise.



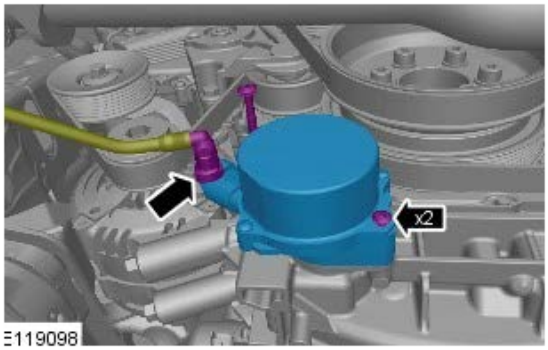
Make sure that the crankshaft is fully locked.

- *Special Tool(s):* JLR-303-1303

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



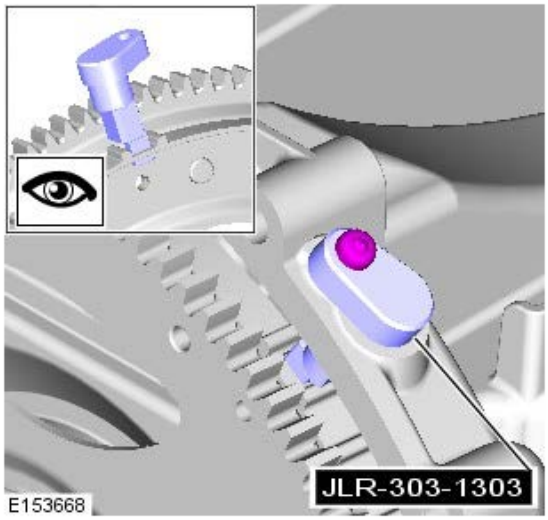
8. CAUTION: Discard the seal.



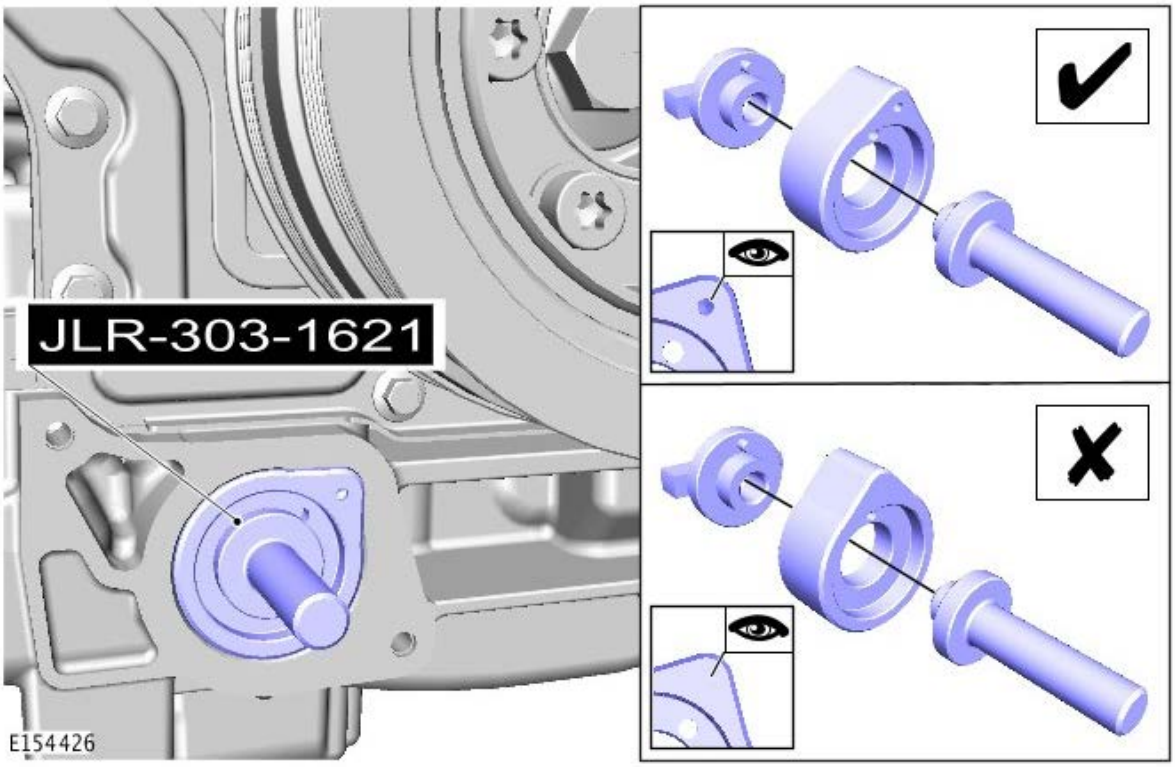
9.

- Remove the special tool.

  Special Tool(s): JLR-303-1303

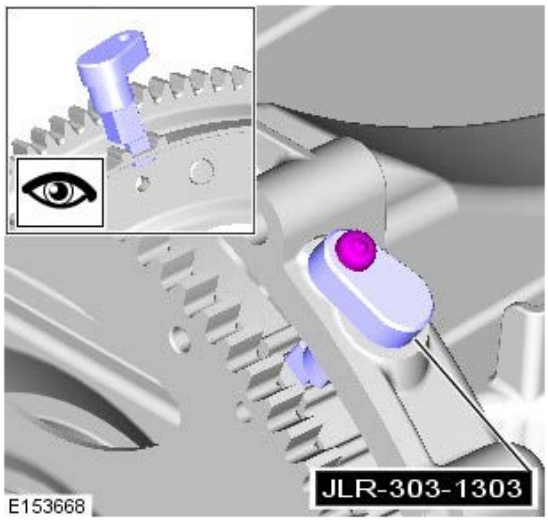


10. If required, carefully adjust the crankshaft position to allow



correct installation of the special tool.

Special Tool(s): JLR-303-1621



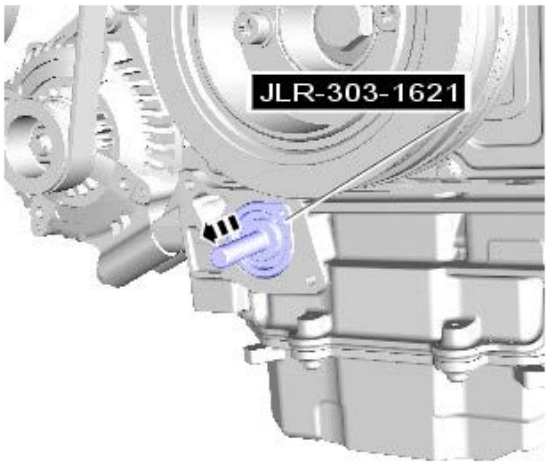
11. CAUTION: Do not use excessive force when adjusting the crankshaft position.

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.

  Special Tool(s): JLR-303-1303

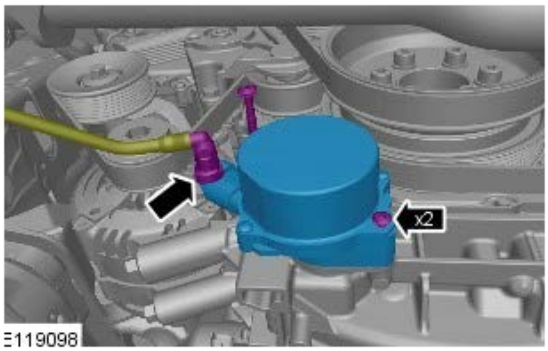
12. *Special Tool(s):* JLR-303-1621



E154428

13. CAUTION: Install a new seal.

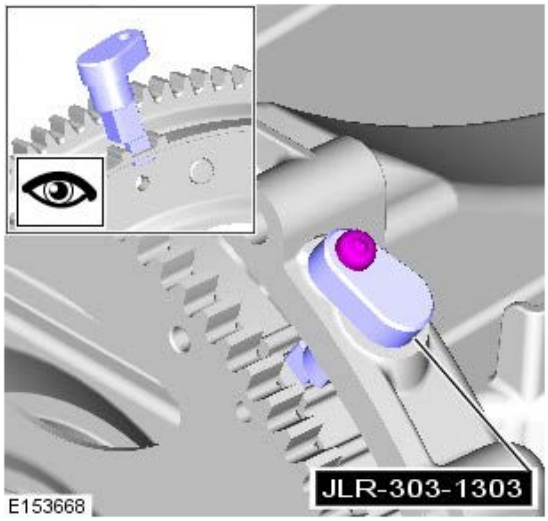
- *Torque:* 12 Nm



14.

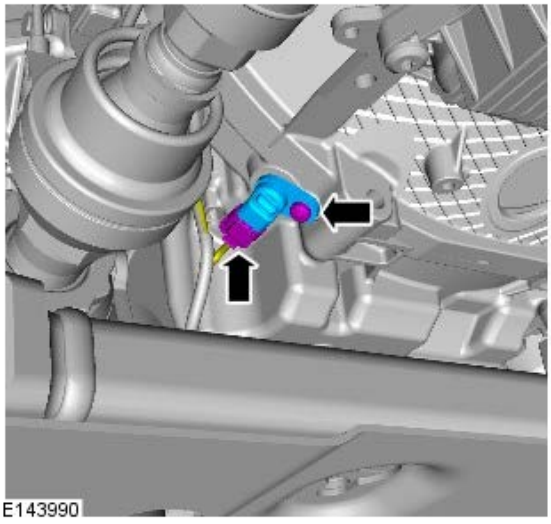
- Remove the special tool.

  Special Tool(s): JLR-303-1303



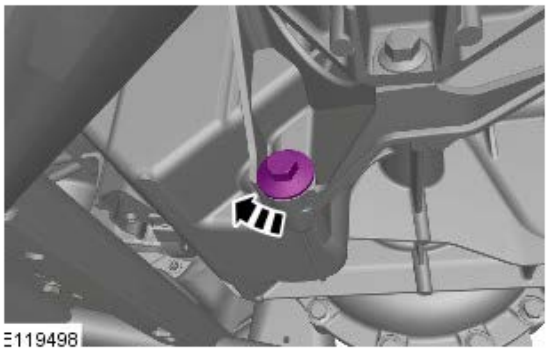
15.

- *Torque:* 10 Nm



16. NOTE: Install a new sealing washer.

Torque: 24 Nm



17. Connect the battery ground cable.

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

18.

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

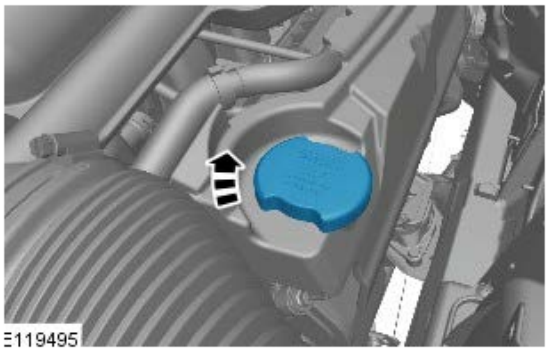
Refer to: Specifications (303-01C Engine - V8 S/C 5.0L Petrol, Specifications).

- 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.

19.



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

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

21. CAUTIONS:

Make sure that the selector lever is in the park (P) position.

Make sure that the hood is open.

- Set the ignition to the ON position.

22.

- Press the left-hand OK button to access the Instrument Cluster (IC) Main Menu.



23.

- Press the left-hand directional button and select Service Menu.



E147186

24.

- Press the left-hand OK button.


E147184

25.

- Press the left-hand directional button and select the Oil Level display.



26.

- Press the left-hand OK button to access the Oil Level display.



27. CAUTION: Make sure that the hood is open.

- Press the speed control cancel button twice within 2 seconds while being on the oil level display.



E147181

28.

- The message center displays the actual oil level in service mode.
- Only after having started and run the engine for 15 minutes (as indicated in Step 20), 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.



E147272

29. Set the ignition to the OFF position.

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

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

31. Repeat step 21 to 27 to access the oil level display in service mode.

32. NOTE: The actual volume displayed on the bar graph will be written into the electronic control unit as a new value.

- Press and hold the speed control cancel button for more than 5 seconds.
- The message center display the current oil level.



33. Set the ignition to the OFF position.

34. Set the ignition to the ON position.

35.
- Press the left-hand OK button to access the Instrument Cluster (IC) Main Menu.



36.
- Press the left-hand directional button and select Service Menu.



E147186

37.

- Press the left-hand OK button.


E147184

38.

- Press the left-hand directional button and select the Oil Level display.



39.

- Press the left-hand OK button and follow the instructions.
- NOTE: If the message shows "Not available" wait for further 10 mins to allow the oil level to stabilize.

  Make sure that the average oil level value has now been updated.



40. Refer to: Engine Cover - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (501-05 Interior Trim and Ornamentation, Removal and Installation).

Published: 10-May-2013

Engine - V8 S/C 5.0L Petrol - Fuel Pump Camshaft Timing Adjustment

General Procedures

Special Tool(s)

 E152575	JLR-303-1303 Timing Tool
 E140377	JLR-303-1621 Alignment Tool, Fuel Pump Camshaft Timing

Check

1. Disconnect the battery ground cable.

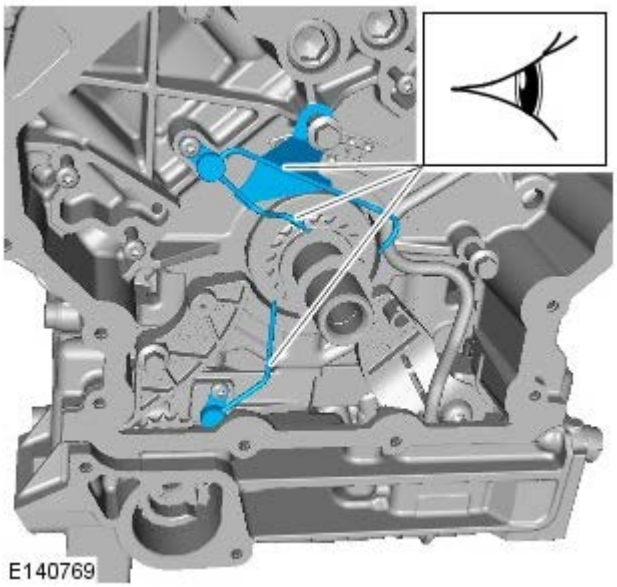
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

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

   Raise and support the vehicle.

3. Refer to: Fuel Pump Camshaft Timing Check (303-01 Engine - V8 S/C 5.0L Petrol, General Procedures).

4. Refer to: Lower Timing Cover (303-01C Engine - V8 S/C 5.0L Petrol, Removal and Installation).


E140769

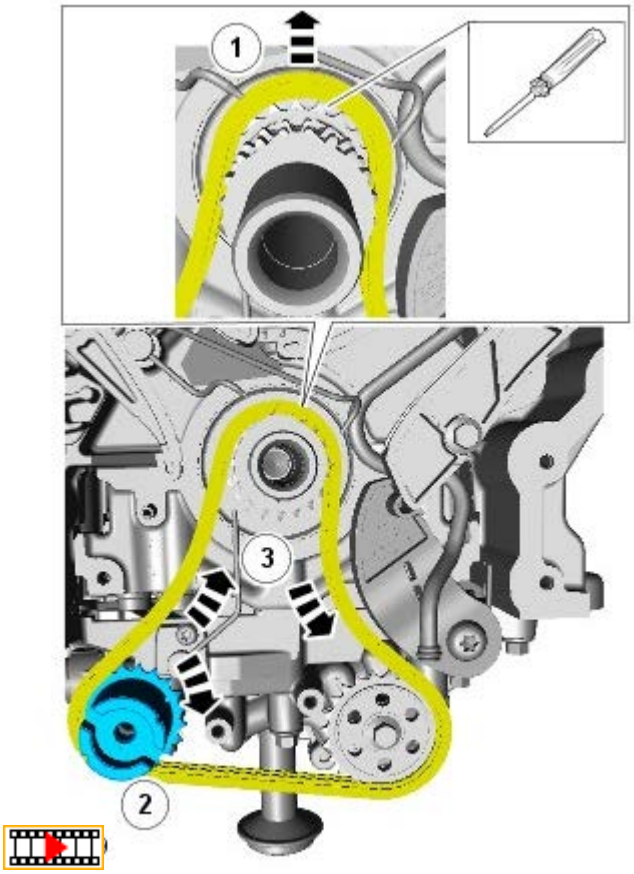
5. CAUTIONS:

   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. CAUTION: Using a suitable tie strap, position the tensioner to one side.

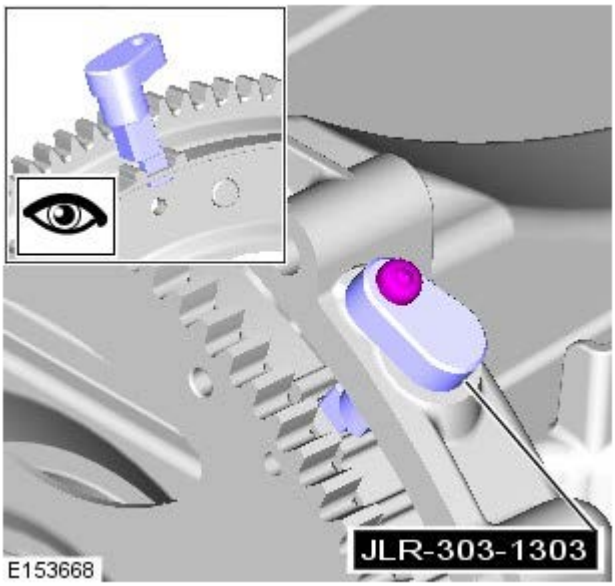
   - *Special Tool(s):* JLR-303-1621
     Torque: 12 Nm



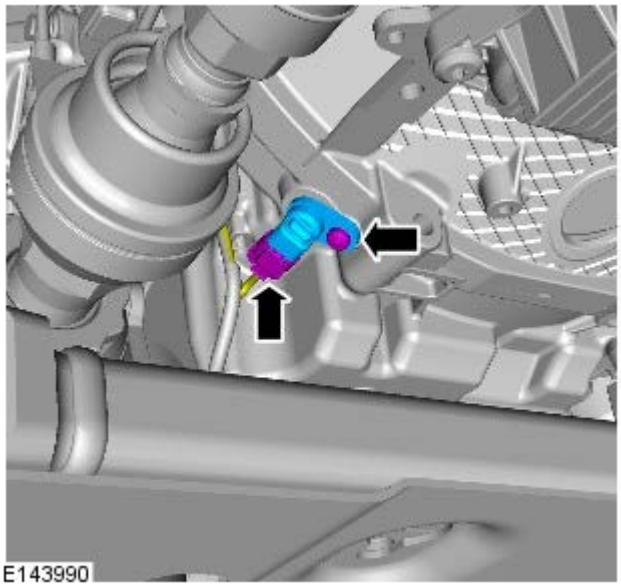
7. Refer to: Lower Timing Cover (303-01C Engine - V8 S/C 5.0L Petrol, Removal and Installation).

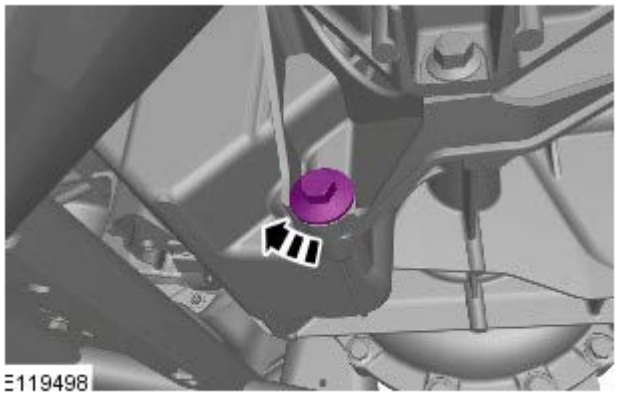
8. Remove the special tool.

   Special Tool(s): JLR-303-1303



9.
   - *Torque:* 10 Nm





10. NOTE: Install a new sealing washer.

    Torque: 24 Nm

11. Connect the battery ground cable.

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

12.
    - 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.

13. CAUTION: Make sure that the vehicle has been left for 5 minutes from filling with oil.
    - Start the engine and allow to run for 10 minutes, stop the engine.
    - Check for leaks.

14. CAUTIONS:

    Make sure that the selector lever is in the park (P) position.

    Make sure that the hood is open.
    - Set the ignition to the ON position.

15.
    - Press the left-hand OK button to access the Instrument Cluster (IC) Main Menu.



16.

- Press the left-hand directional button and select Service Menu.



17.

- Press the left-hand OK button.


E147184

18.

- Press the left-hand directional button and select the Oil Level display.



E147185

19.

- Press the left-hand OK button to access the Oil Level display.




E147181

20. CAUTION: Make sure that the hood is open.

- Press the speed control cancel button twice within 2 seconds while being on the oil level display.

21.

- The message center displays the actual oil level in service mode.
- Only after having started and run the engine for 15 minutes (as indicated in Step 13), 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. Set the ignition to the OFF position.
23. Allow 10 minutes for the engine oil level to stabilize if there has been additional oil top up.

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

24. Repeat step 14 to 20 to access the oil level display in service mode.



25. NOTE: The actual volume displayed on the bar graph will be written into the electronic control unit as a new value.
    - Press and hold the speed control cancel button for more than 5 seconds.
    - The message center display the current oil level.
26. Set the ignition to the OFF position.
27. Set the ignition to the ON position.
28.
    - Press the left-hand OK button to access the Instrument Cluster (IC) Main Menu.



29.

- Press the left-hand directional button and select Service Menu.



30.

- Press the left-hand OK button.


E147184

31.

- Press the left-hand directional button and select the Oil Level display.

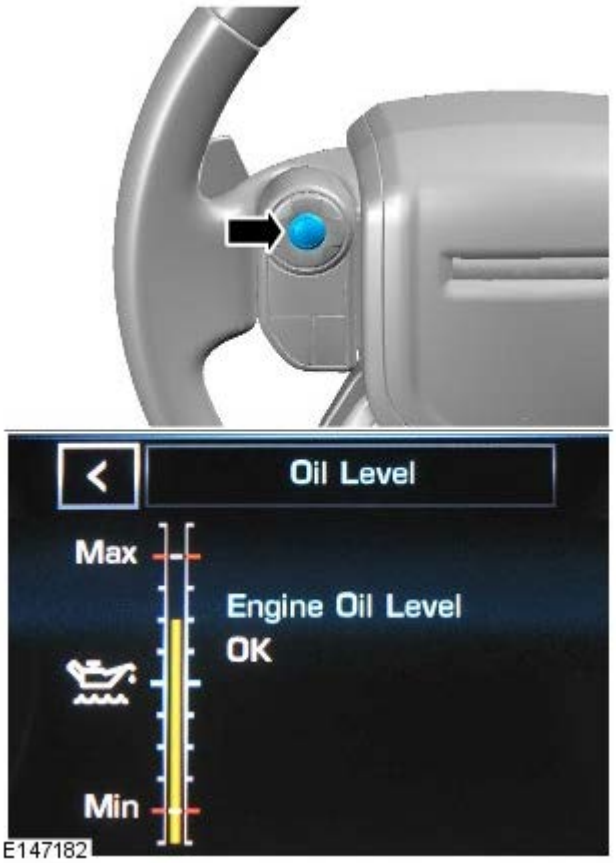


E147185

32.

- Press the left-hand OK button and follow the instructions.
- NOTE: If the message shows "Not available" wait for further 10 mins to allow the oil level to stabilize.

  Make sure that the average oil level value has now been updated.


Oil Level
Max
Engine Oil Level
OK
Min
E147182

Published: 10-Jul-2013

Engine - V8 S/C 5.0L Petrol - Valve Clearance Check

General Procedures

Check

1. 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: Valve Cover LH (303-01C, Removal and Installation).

4. Refer to: Valve Cover RH (303-01C, Removal and Installation).

5. CAUTIONS:

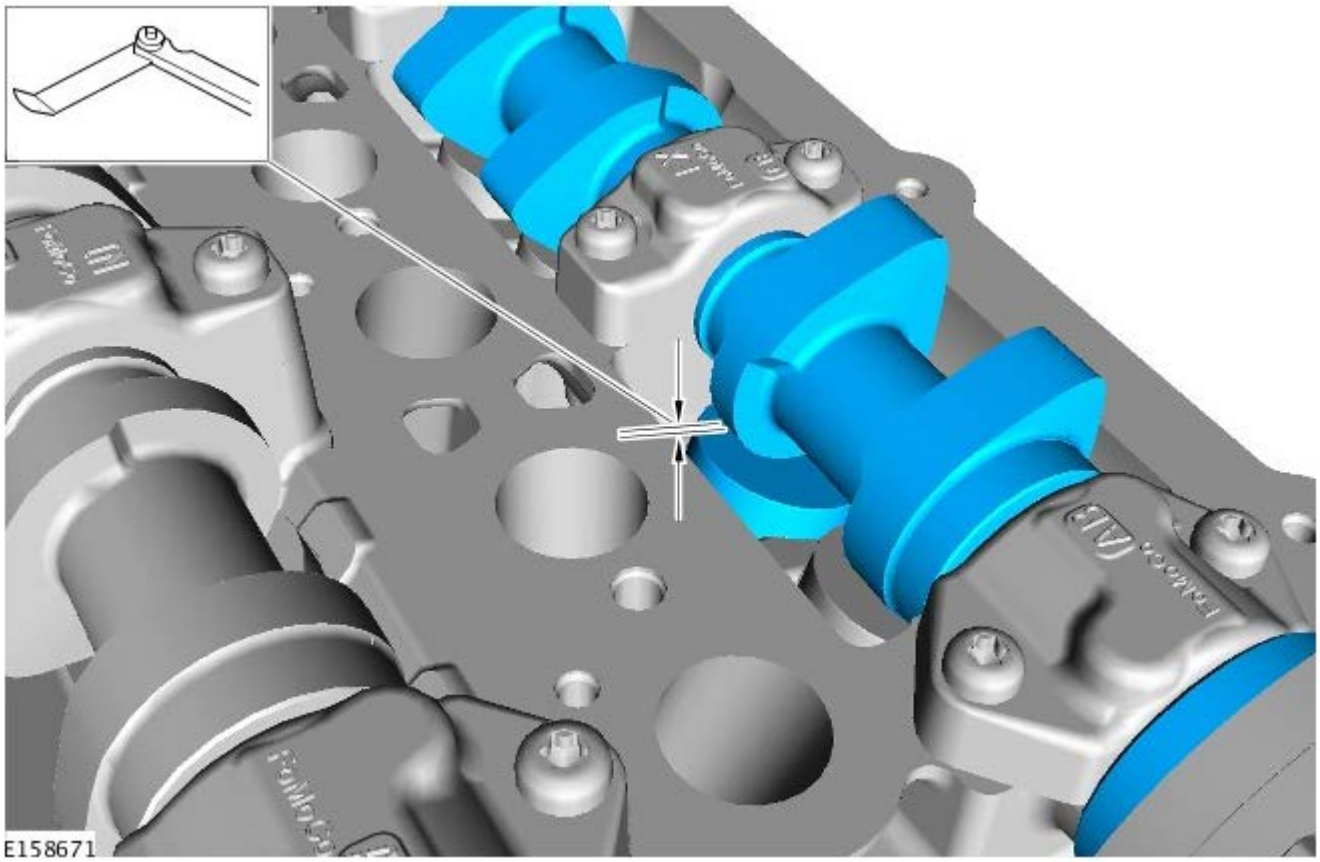
   Rotate the engine clockwise until the camshafts are positioned as shown.

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

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

   NOTE: Using feeler gauge check the gap between the tappet and the camshaft lobe and check against specifications table.

   - Using feeler gauge check the gap between the tappet and the camshaft lobe and check against specifications table.
   - Repeat this step for the remaining valve tappets.



Published: 10-Jul-2013

Engine - V8 S/C 5.0L Petrol - Valve Clearance Adjustment

General Procedures

Check

1. 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.

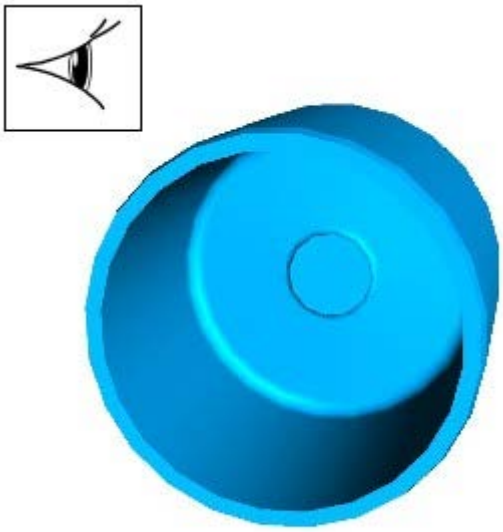
3. Refer to: Valve Clearance Check (303-01C Engine - V8 S/C 5.0L Petrol, General Procedures).

Adjustment

1. Refer to: Camshaft LH (303-01C, Removal and Installation).

2. Refer to: Camshaft RH (303-01C, Removal and Installation).

3.



E158863

Published: 10-Sep-2012

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.

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

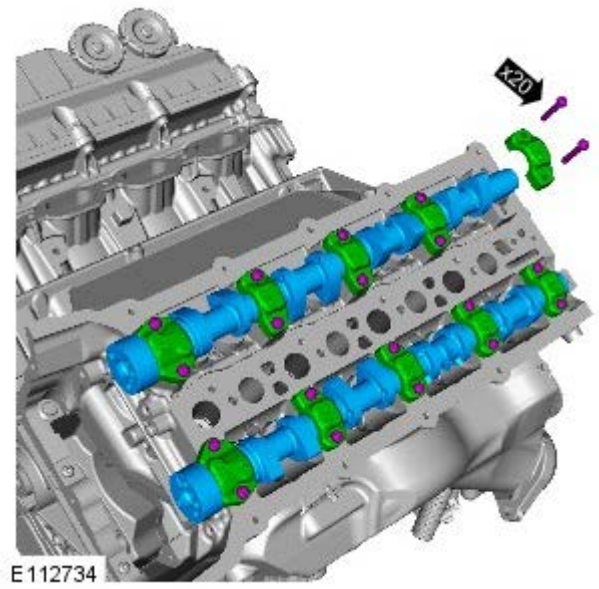
1. Disconnect the battery ground cable.

   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: Timing Drive Components (303-01C Engine - V8 S/C 5.0L Petrol, 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:

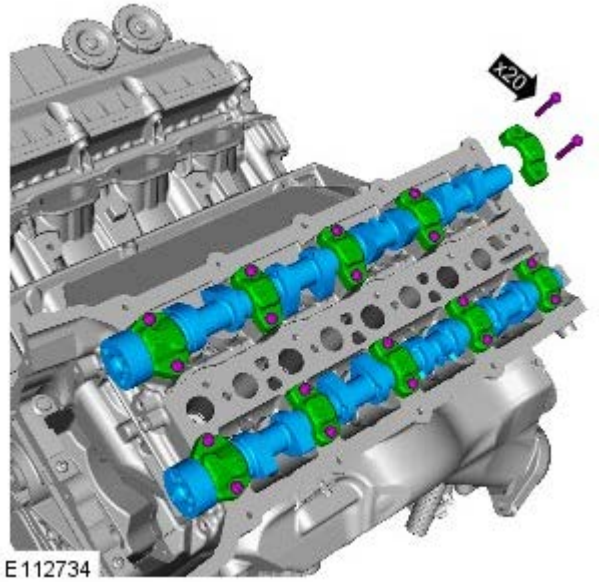
   Prior to installing the camshafts, position the crankshaft 45 degrees ATDC cylinder 1A to prevent valve/piston collision.

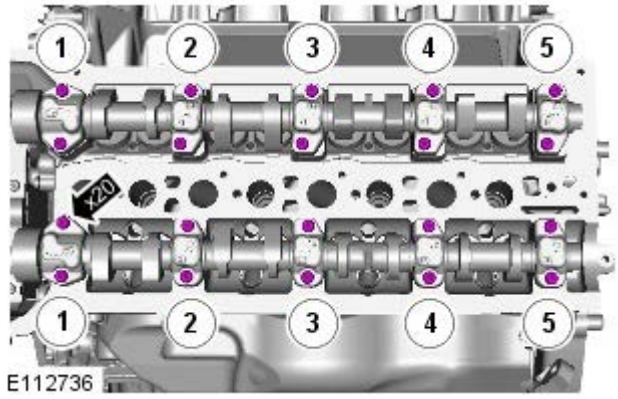
   Make sure that the camshafts and camshaft bearing caps are installed in their original locations.

   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. NOTE: If the valve clearance is incorrect, continue to the next step. If the valve clearance is correct, continue to step 8.

   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 (303-01C Engine - V8 S/C 5.0L Petrol, Removal and Installation).

9. Connect the battery ground cable.

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

Published: 10-Sep-2012

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.

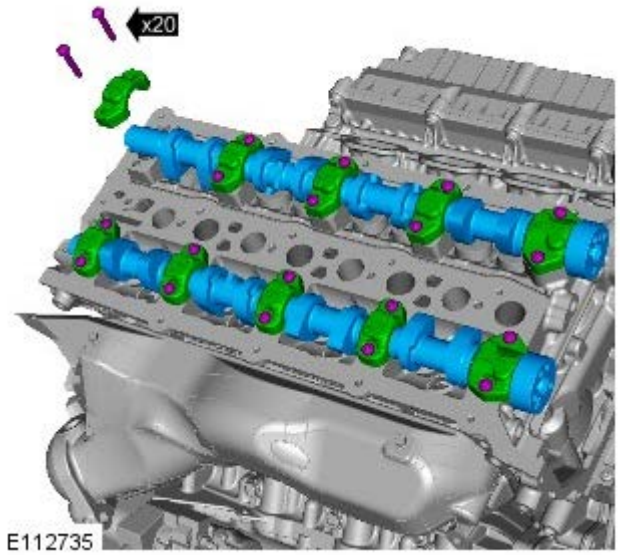
NOTES:

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 (414-00, Specifications).
2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.
3. Refer to: Timing Drive Components (303-01C Engine - V8 S/C 5.0L Petrol, 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:

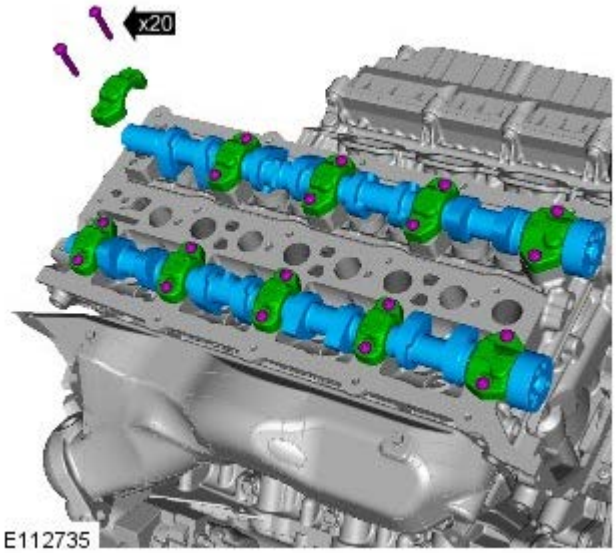
   Prior to installing the camshafts, position the crankshaft 45 degrees ATDC cylinder 1A to prevent valve/piston collision.

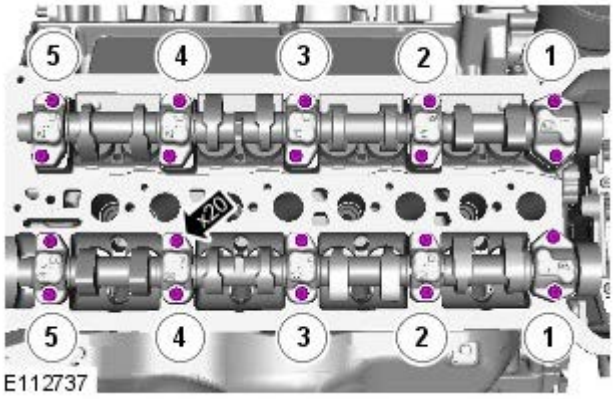
   Evenly and progressively install and tighten the camshaft bearing caps.

   Make sure that the camshafts and camshaft bearing caps are installed in their original locations.

   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. NOTE: If the valve clearance is incorrect, continue to the next step. If the valve clearance is correct, continue to step 8.

   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 (303-01C Engine - V8 S/C 5.0L Petrol, Removal and Installation).

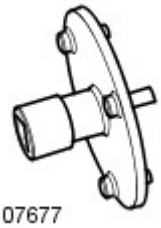
9. Refer to: Specifications (414-00, Specifications).

Published: 10-Sep-2012

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.

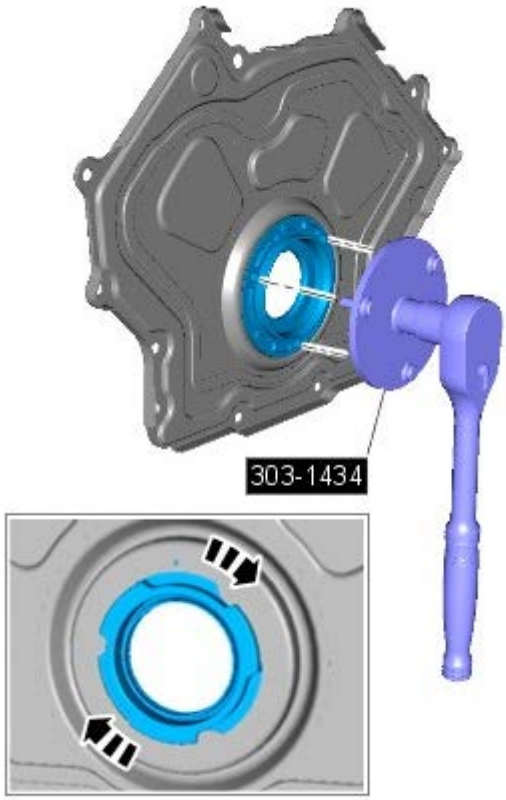
Some variation in the illustrations may occur, but the essential information is always correct.

1. Disconnect the battery ground cable.

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

2. Refer to: Crankshaft Pulley (303-01C Engine - V8 S/C 5.0L Petrol, Removal and Installation).

3. *Special Tool(s):* 303-1434



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.

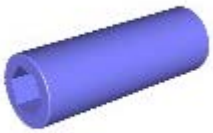
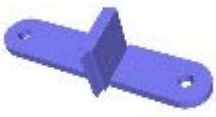
To install, reverse the removal procedure.

Published: 21-May-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
 E152576	JLR-303-1304 Locking Tool

Removal

NOTES:

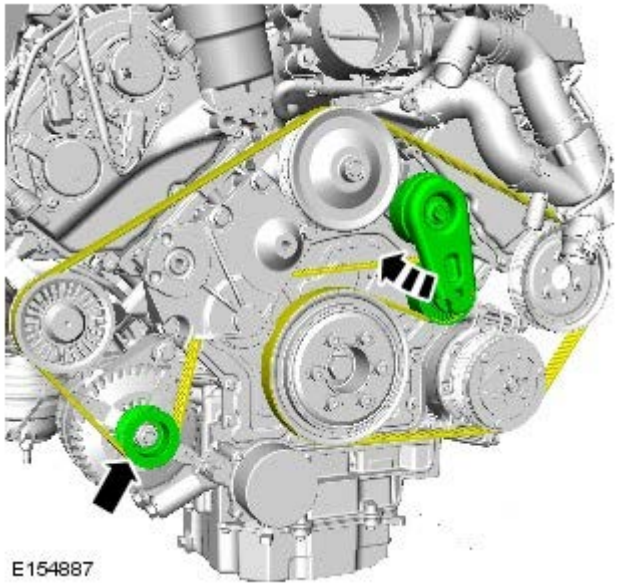
Some illustrations may show the engine removed for clarity.

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

All vehicles

1. Disconnect the battery ground cable.
2. WARNING: Make sure to support the vehicle with axle stands.

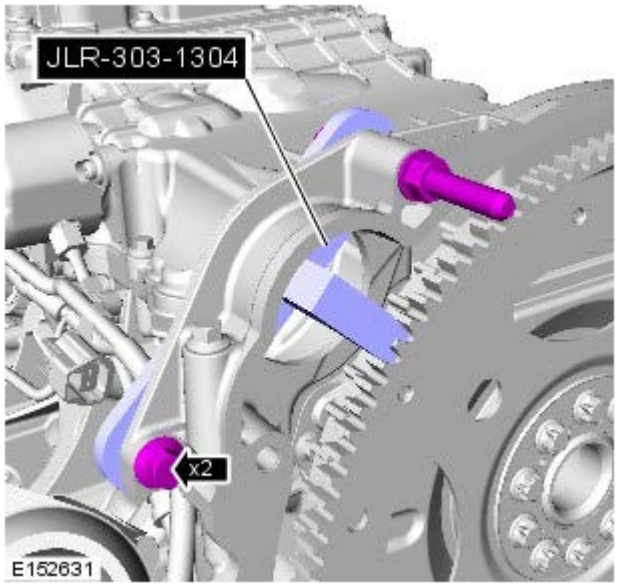
   Raise and support the vehicle.
3. Refer to: Cooling Fan Shroud (303-03C, Removal and Installation).
4. Refer to: Starter Motor (303-06C Starting System - V8 S/C 5.0L Petrol, Removal and Installation).
5.



Vehicles with Stop/Start

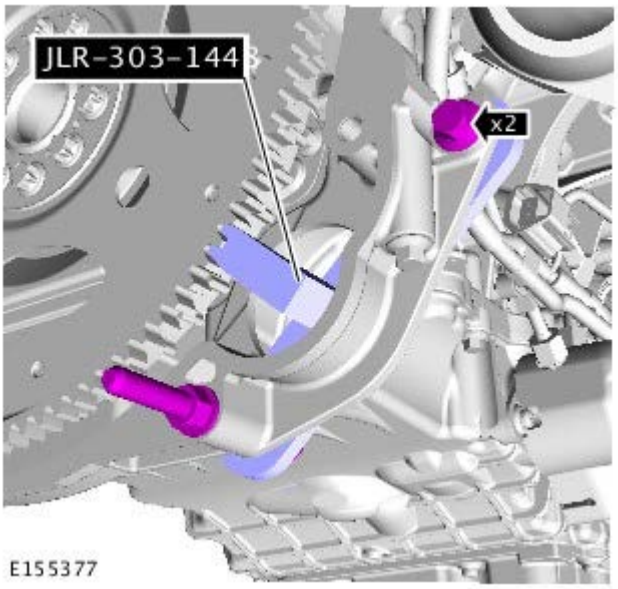
6. Install the special tool.

   Special Tool(s): JLR-303-1304



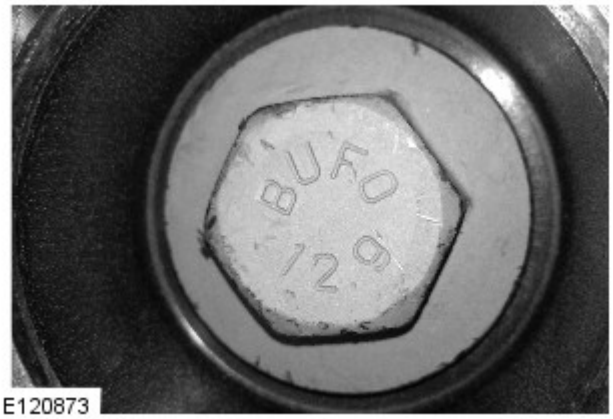
All vehicles

7. Install the special tool.



Special Tool(s): 303-1448

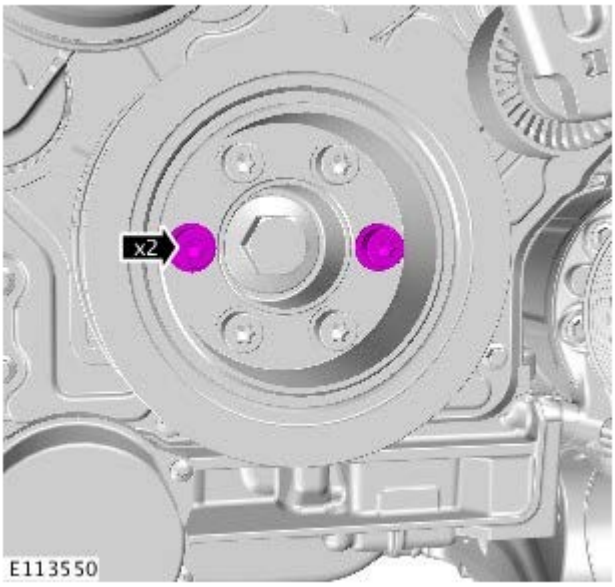




8. CAUTION: Before removing the crankshaft pulley bolt, note the numbers on the bolt head. If the bolt head shows 10.9, the bolt must be removed counter clockwise. If the bolt head shows 12.9, the bolt must be removed clockwise. Failure to follow this instruction may result in damage to the crankshaft.

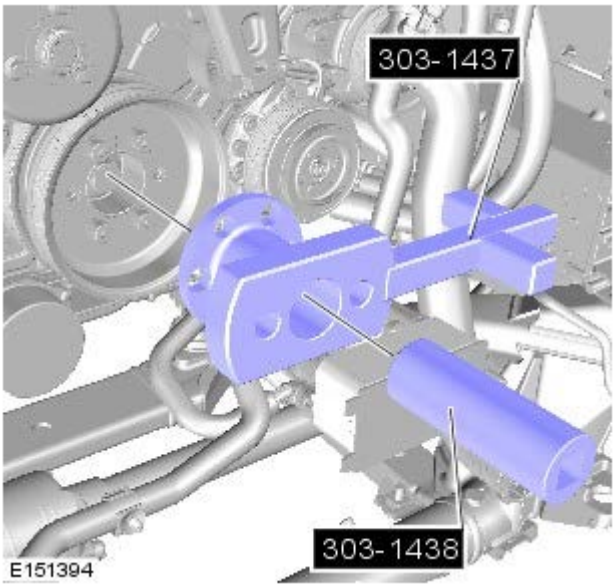
   Note the markings on the crankshaft pulley bolt.

9.

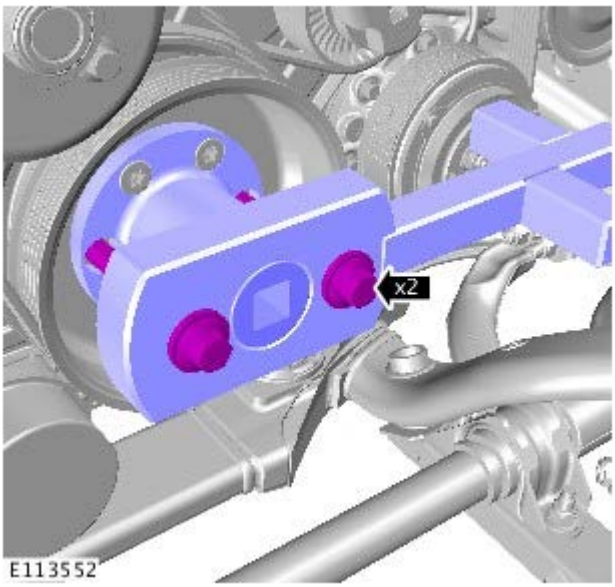


10. Install the special tool.

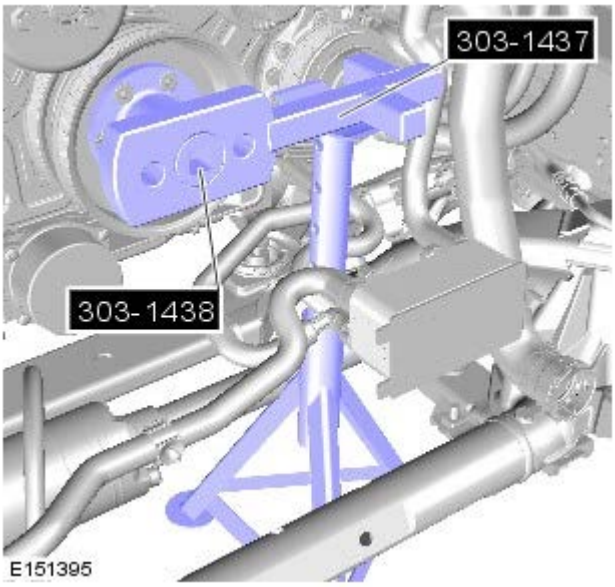
    Special Tool(s): 303-1438, 303-1437



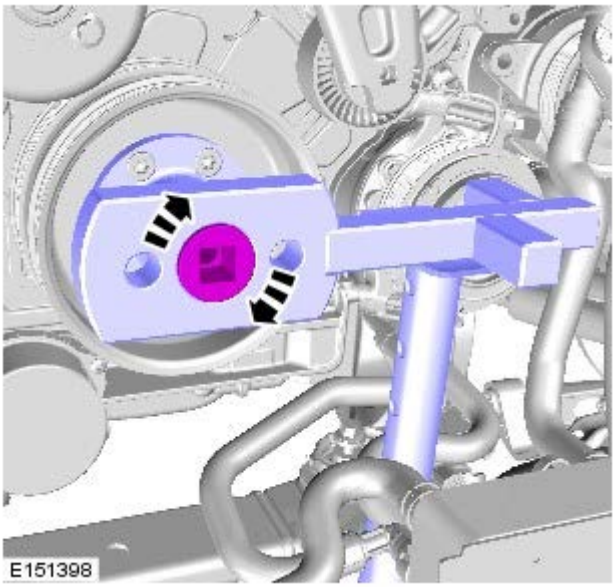
11. *Torque:* 25 Nm



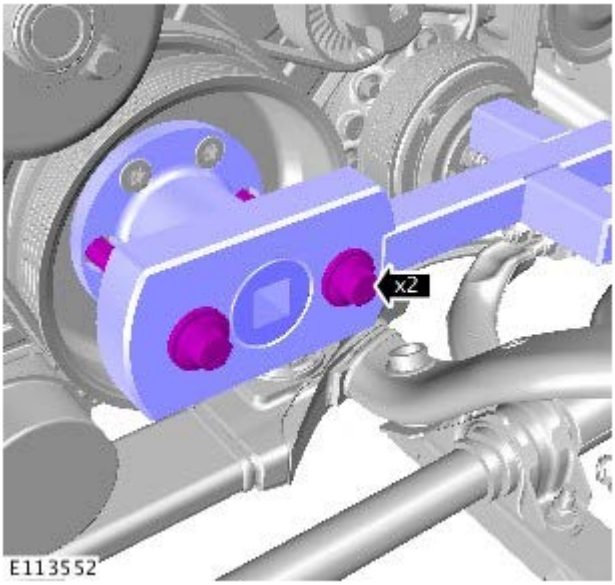
12. Support the special tool using a suitable vehicle stand.



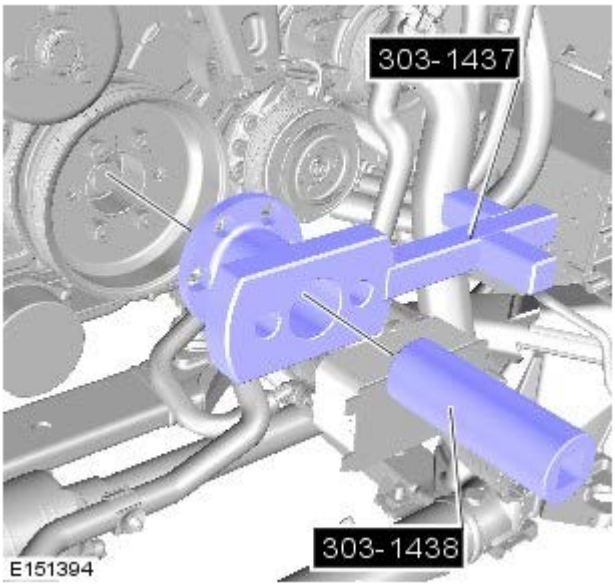
13. NOTE: The crankshaft pulley bolt will be very tight.



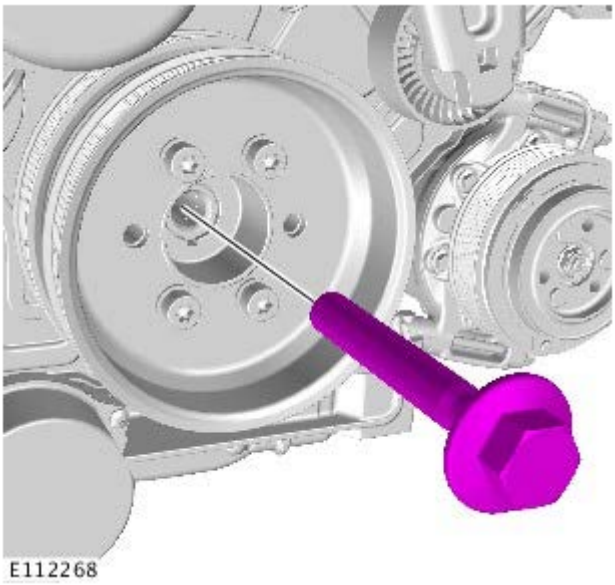
14.



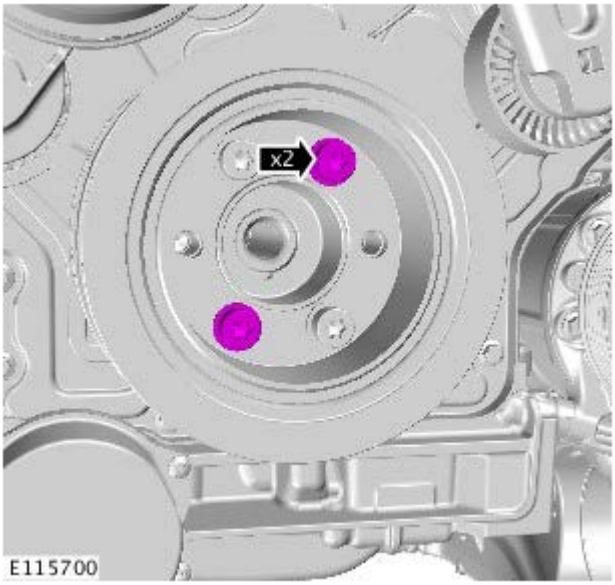
15. Remove the special tools.



16. NOTE: Discard the bolt after removal.

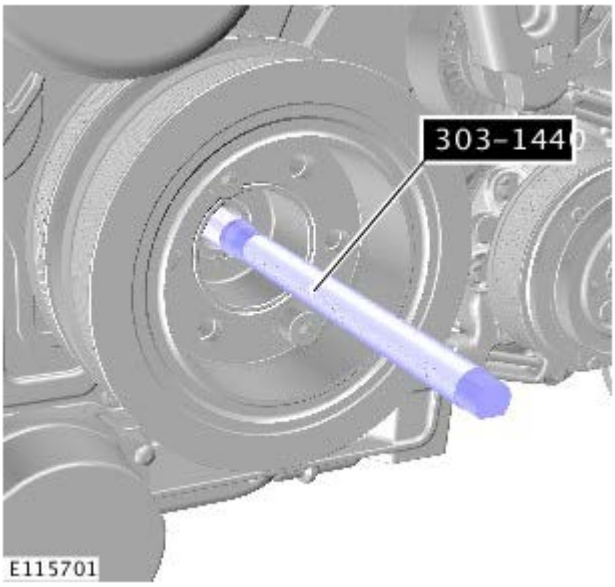


17.



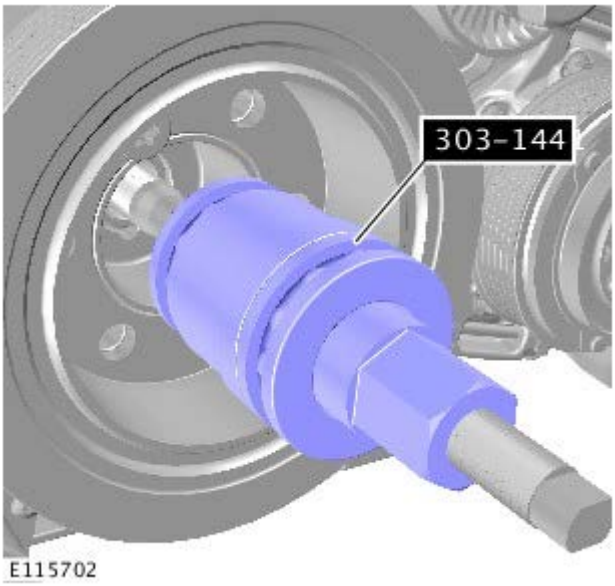
18. NOTE: If the crankshaft damper is fitted with an early RH thread crankshaft bolt then the pulley can be removed with a standard puller.

Install the special tool.



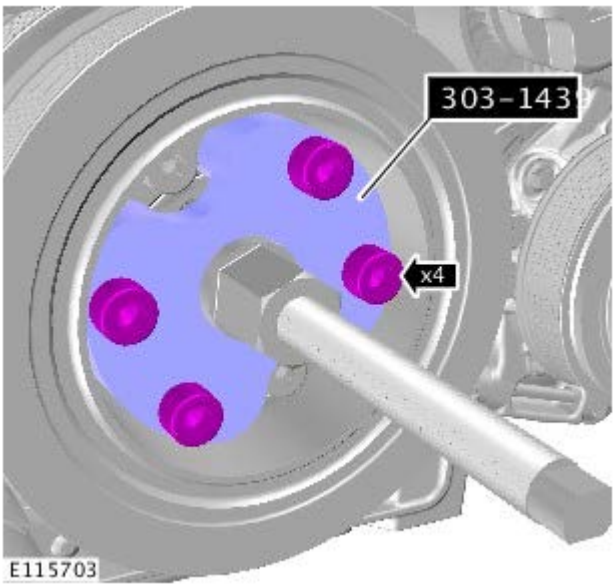
Special Tool(s): 303-1440

19. Install the special tool.



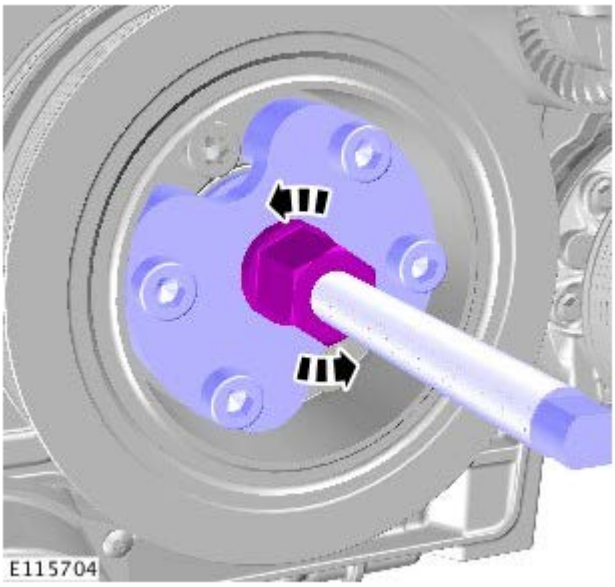
Special Tool(s): 303-1441

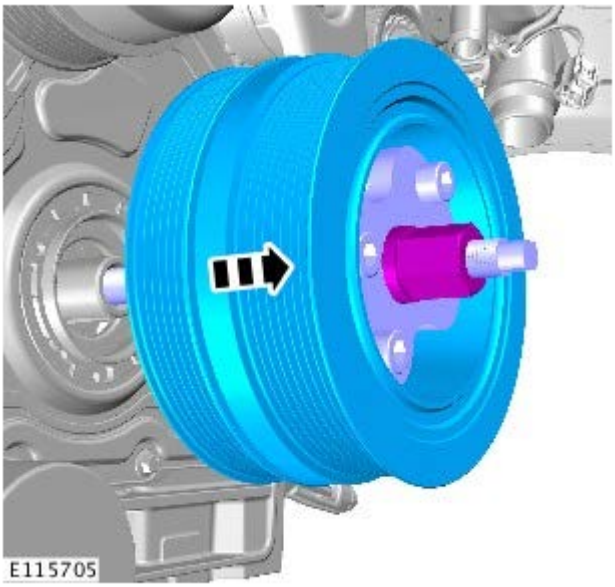
20. Install the special tool.



Special Tool(s): 303-1439
Torque: 25 Nm

21.

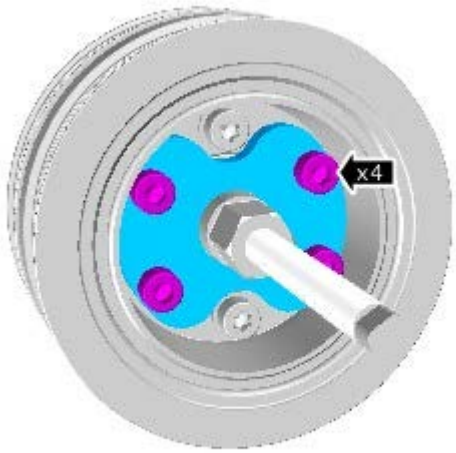




22. CAUTION: Discard the friction washer after removing the crankshaft pulley.

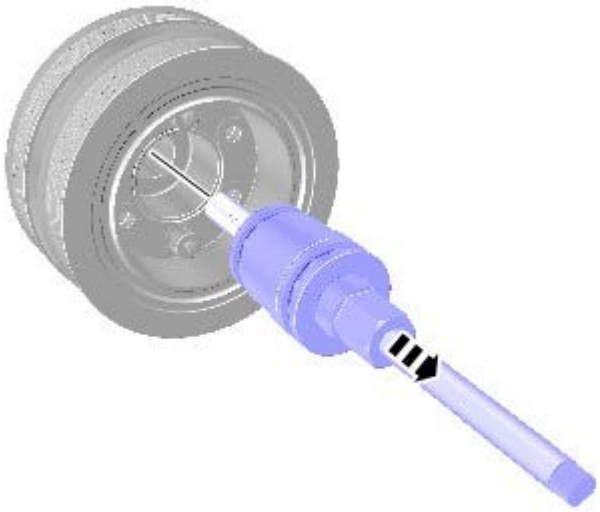
NOTE: Make sure to clean the threads in the end of the crankshaft and that the crank nose is free of any foreign materials.

23.



E115706

24.



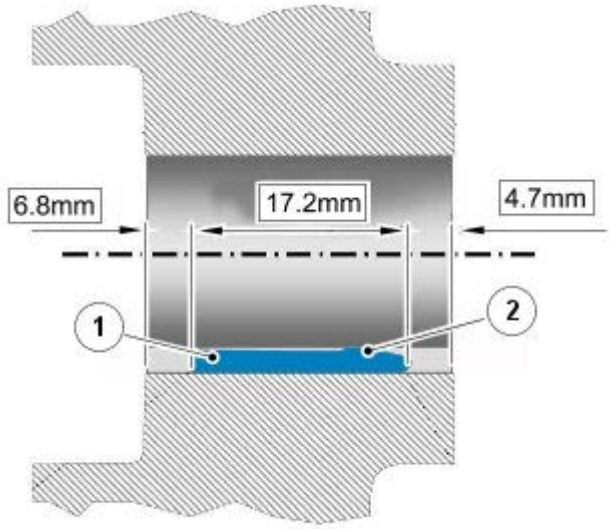
E115707

Installation

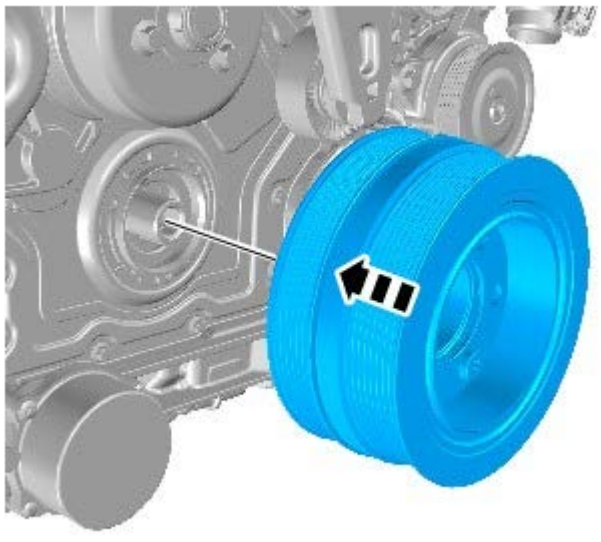
All vehicles

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.



E115889

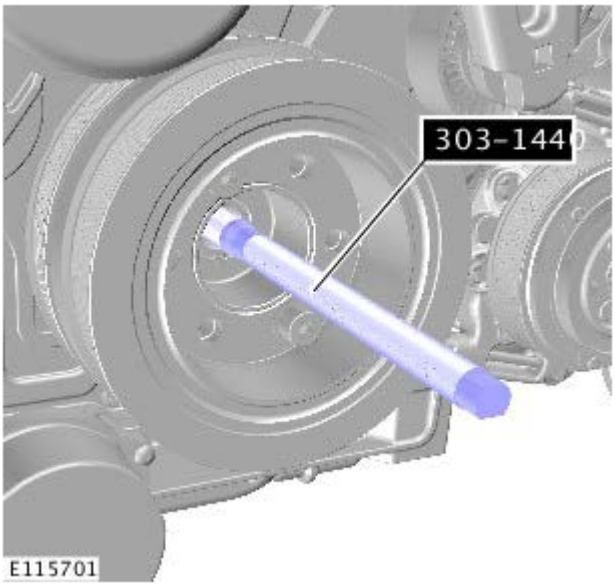


E112288

2. CAUTION: Install a new friction washer before installing the crankshaft pulley.

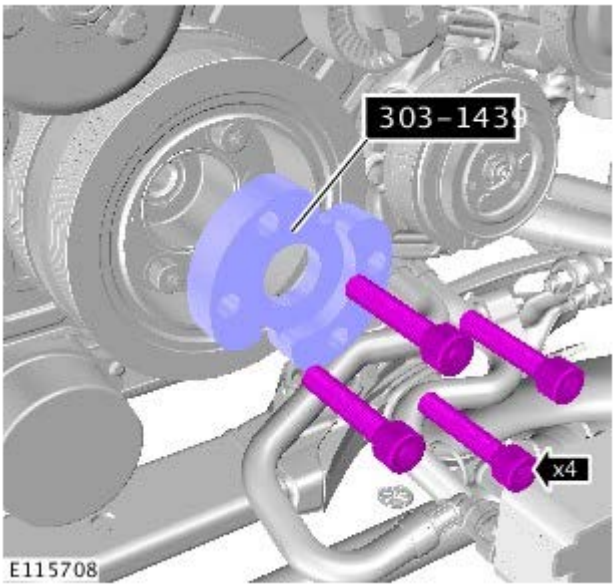
NOTE: Make sure to clean the threads in the end of the crankshaft and that the crank nose is free of any foreign materials.

3. Install the special tool.

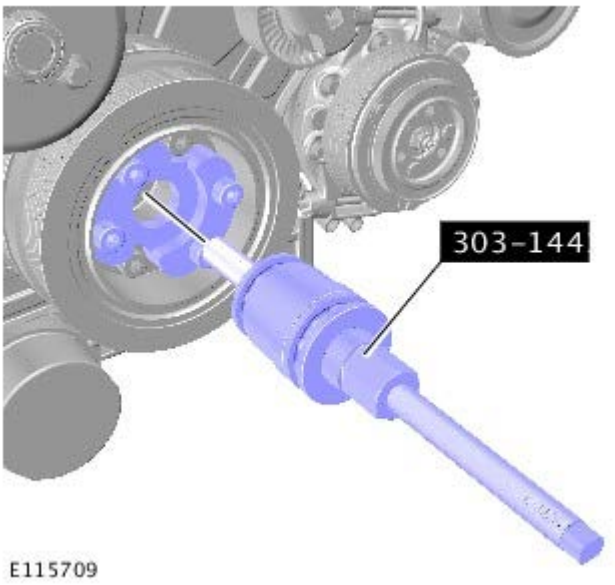


4. Install the special tool.

   Torque: 25 Nm



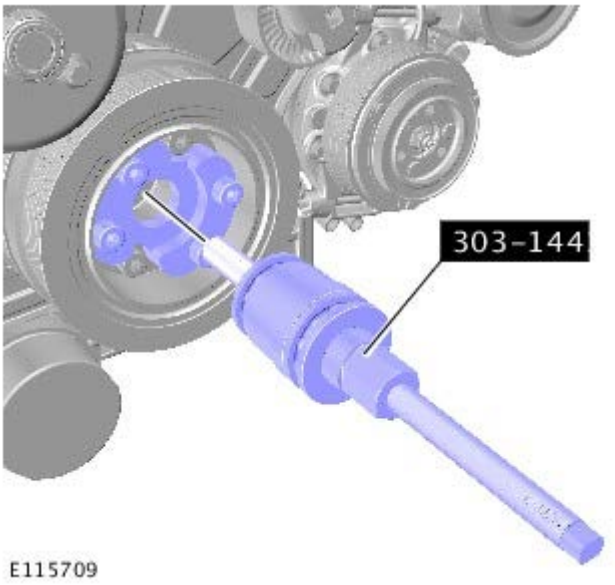
5. Install the special tool.



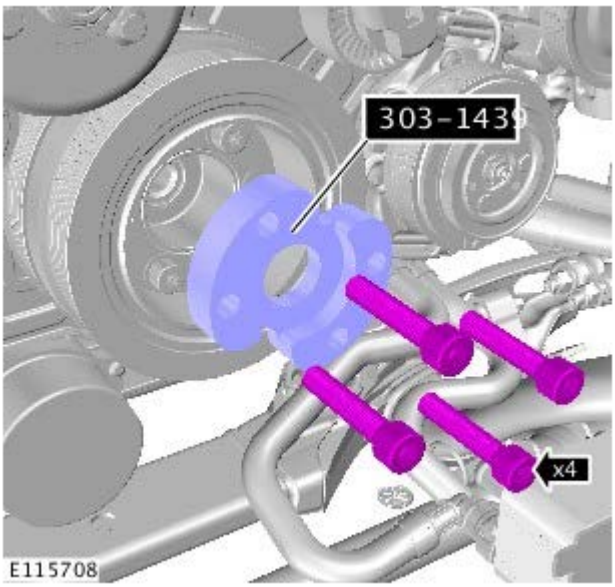
6. CAUTION: Rotate the crankshaft pulley installation tool until the pulley is fully located, do not over tighten. Failure to do this may result in damage to the components.



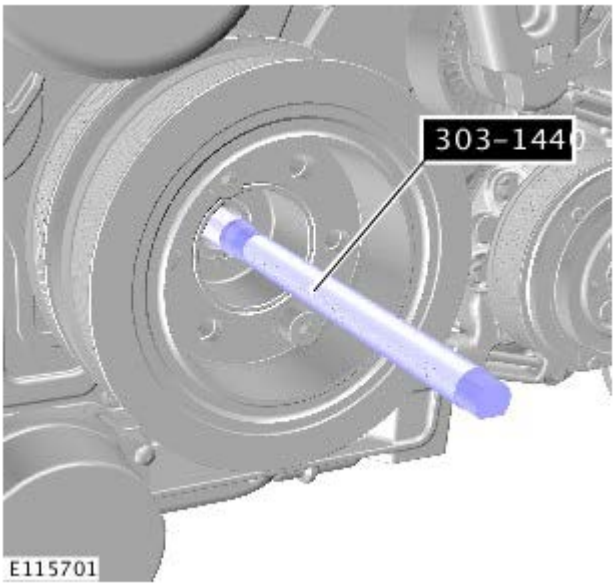
7. Remove the special tool.



8.
- Remove the special tool.



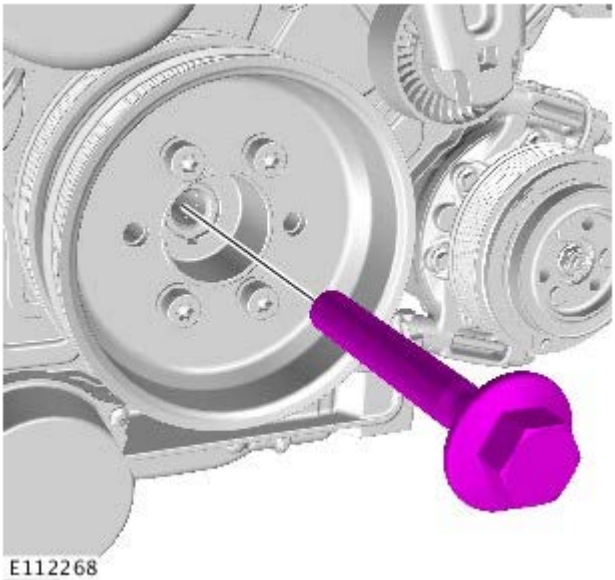
9. Remove the special tool.



10.

- Apply loctite 270 to the thread of the bolts.
- *Torque:* 65 Nm





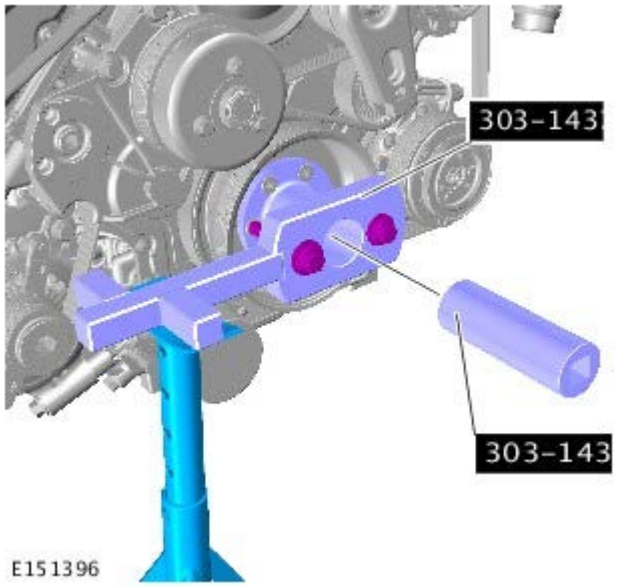
11. WARNING: Make sure that a new bolt is installed.

CAUTION: Tighten the component finger tight first.

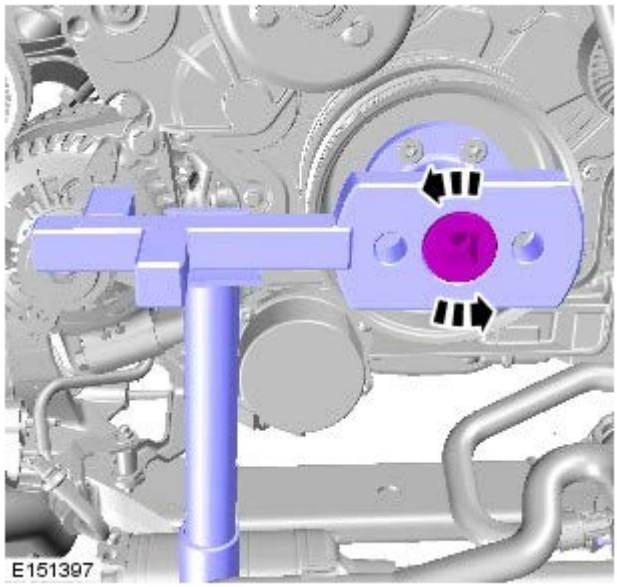
Install the crankshaft pulley bolt.

12. NOTE: The graphic shows the step for LH thread only, RH thread will be the opposite.

Torque: 25 Nm

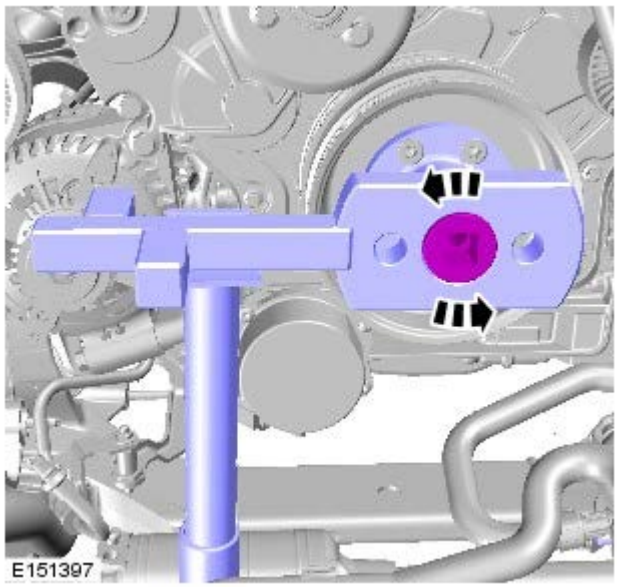


13. *Torque:* 200 Nm

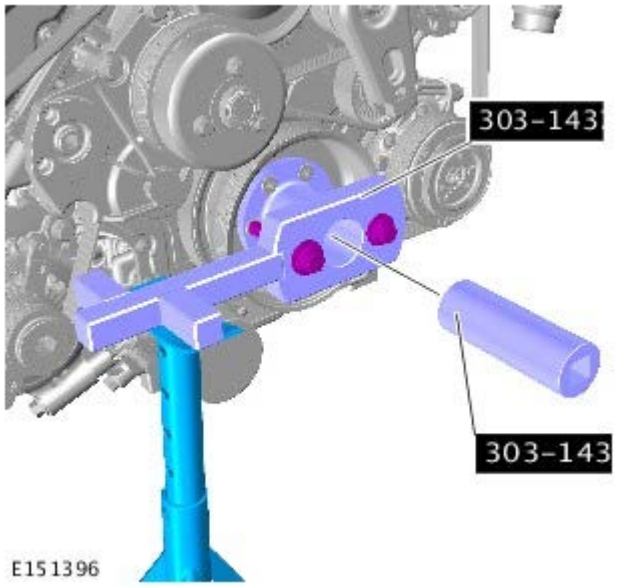


14. NOTE: The use of a torque multiplier capable of 600Nm will be required.

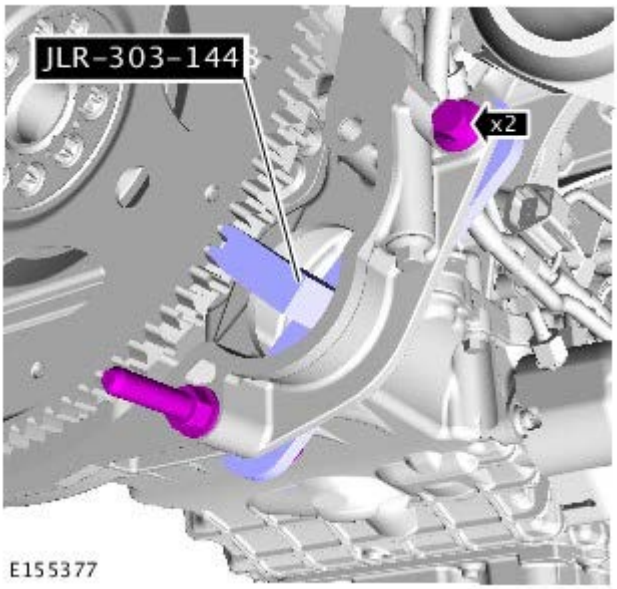
    Torque: 270°



15. Remove the special tools.

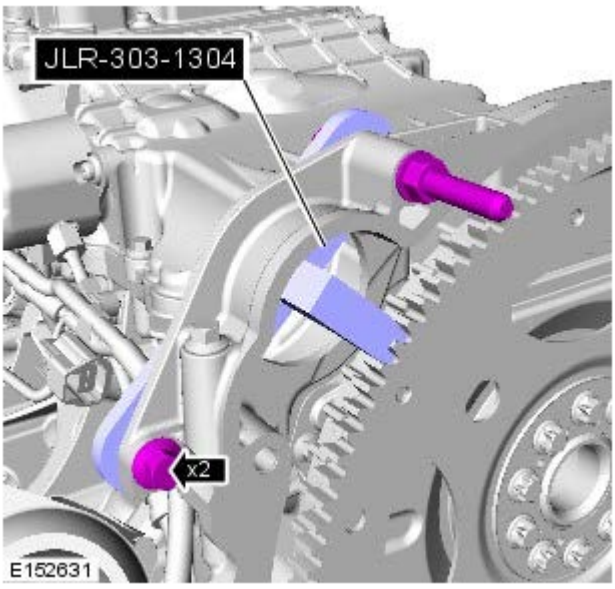


16. Remove the special tool.



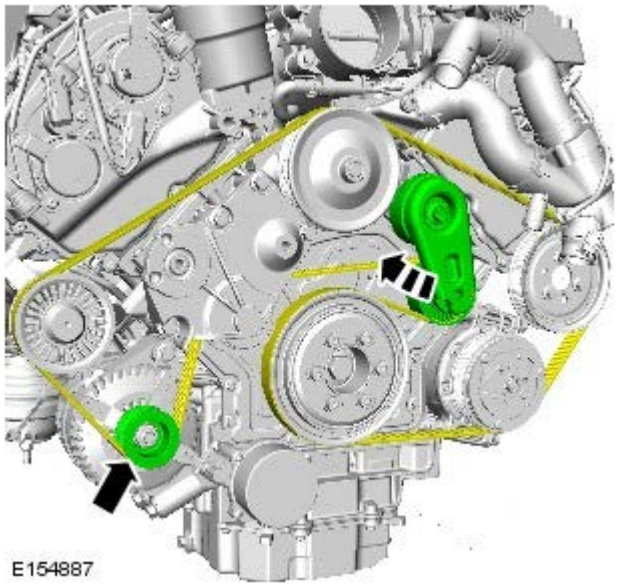
Vehicles with Stop/Start

17. Remove the special tool.



All vehicles

18.



19. Refer to: Starter Motor (303-06C Starting System - V8 S/C 5.0L Petrol, Removal and Installation).

20. Refer to: Cooling Fan Shroud (303-03C, Removal and Installation).

21. Connect the battery ground cable.

Published: 18-Apr-2013

Engine - V8 S/C 5.0L Petrol - Crankshaft Rear Seal

Removal and Installation

Special Tool(s)

 E107678	303-1442 Rear Crankshaft Seal Installer

Removal

NOTES:

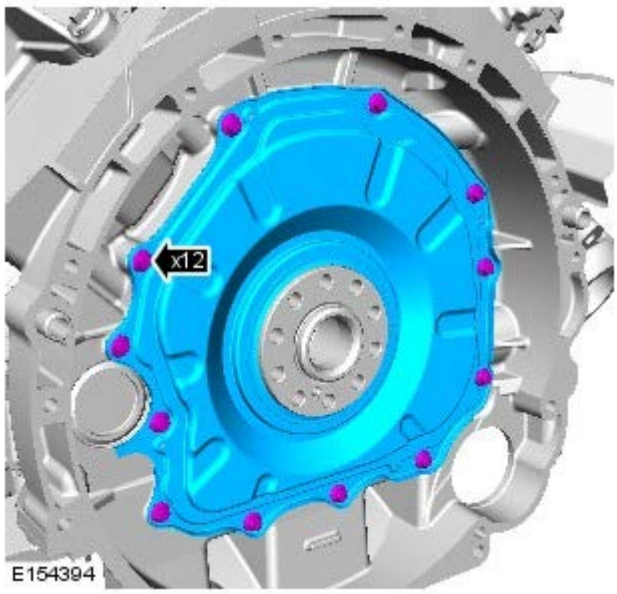
Removal steps in this procedure may contain installation details.

Some illustrations may show the engine removed for clarity.

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

1. Refer to: Flexplate (303-01C Engine - V8 S/C 5.0L Petrol, Removal and Installation).

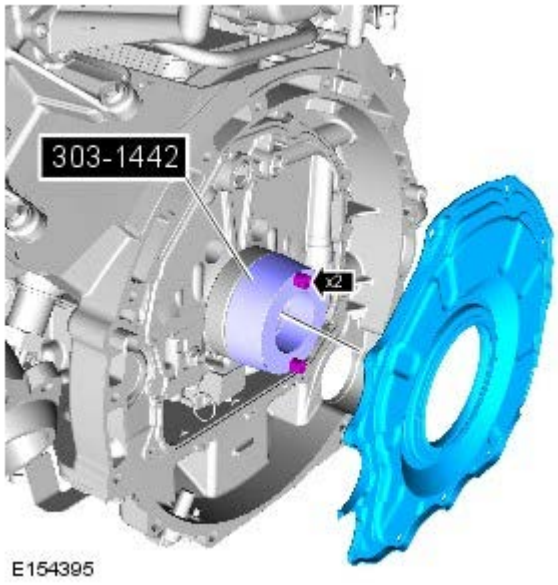
2.



Installation

1. Install the special tool.

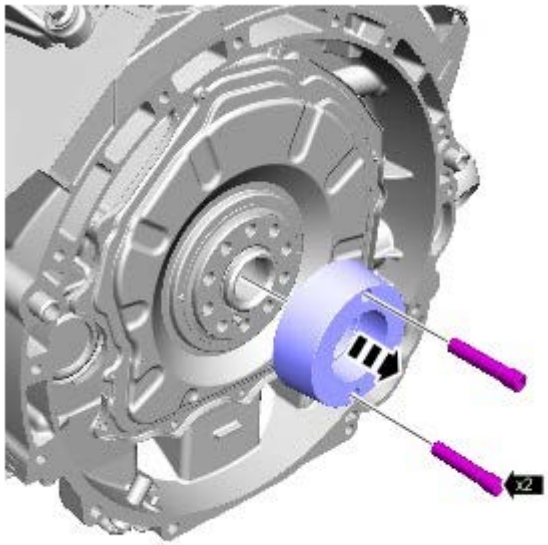
   Special Tool(s): 303-1442



E154395

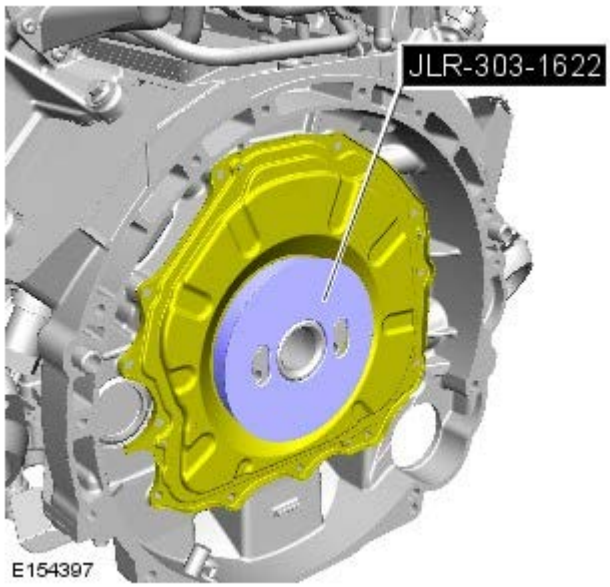
2. Remove the special tool.

   Special Tool(s): 303-1442



E154396

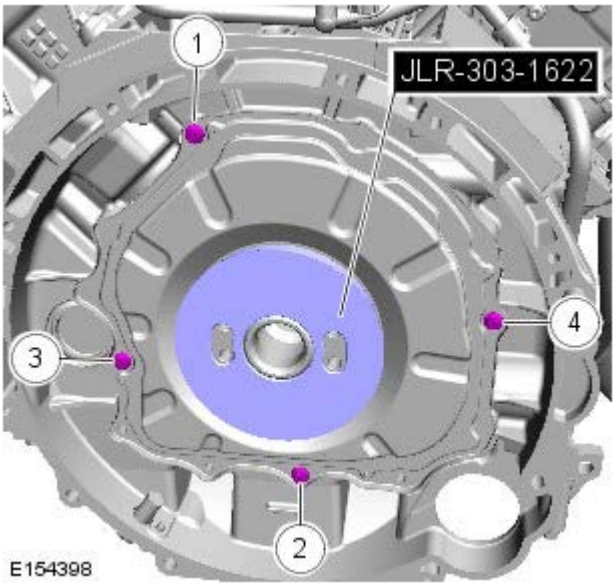
3. Align the engine rear oil seal plate using the special tool.



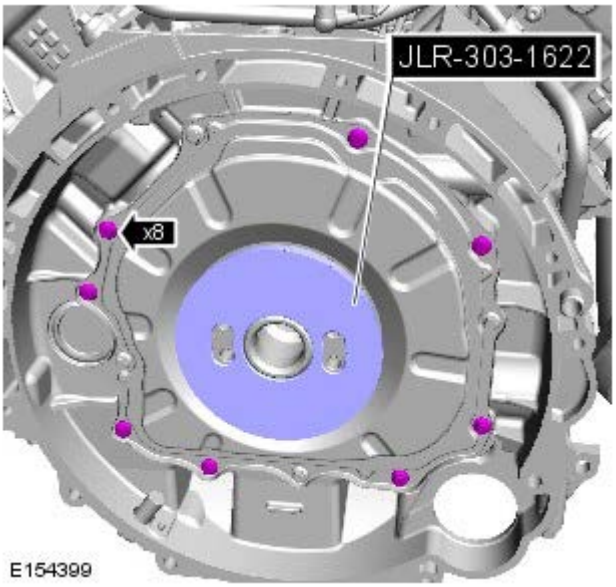
E154397

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

   Torque: 11 Nm



5. *Torque:* 11 Nm



6. Refer to: Flexplate (303-01C Engine - V8 S/C 5.0L Petrol, Removal and Installation).

Published: 16-Apr-2013

Engine - V8 S/C 5.0L Petrol - Cylinder Head LH

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).

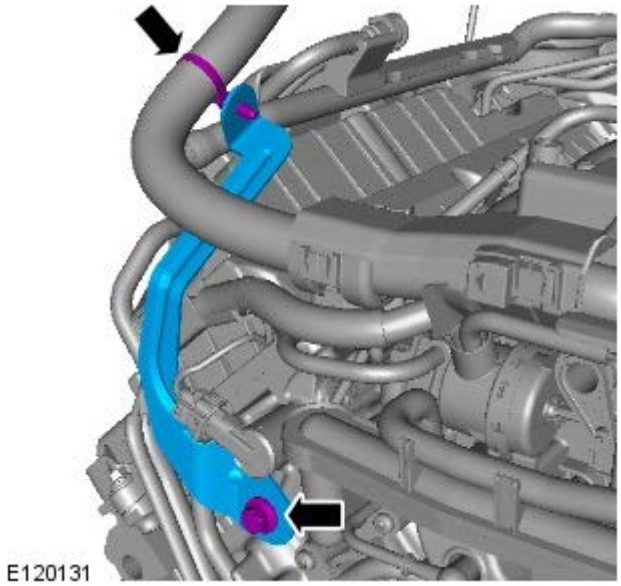
2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

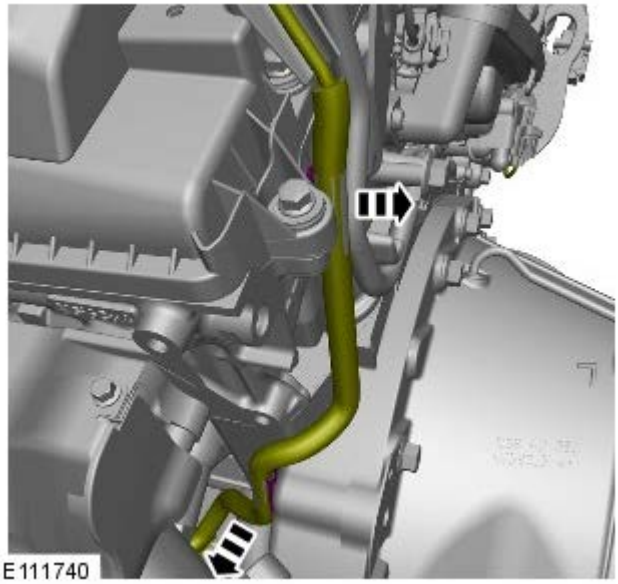
3. Refer to: Camshaft LH (303-01C Engine - V8 S/C 5.0L Petrol, Removal and Installation).

4. Refer to: Exhaust Manifold LH (303-01C Engine - V8 S/C 5.0L Petrol, Removal and Installation).

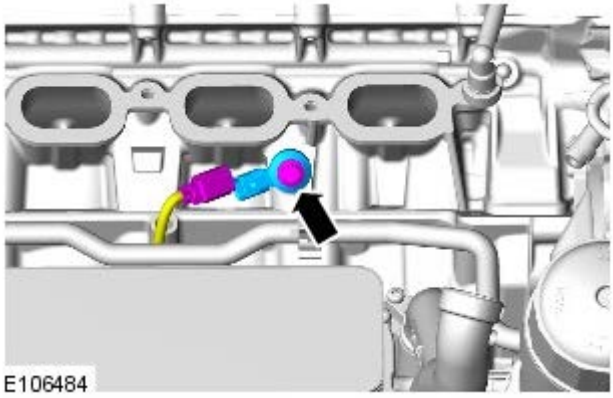
5.



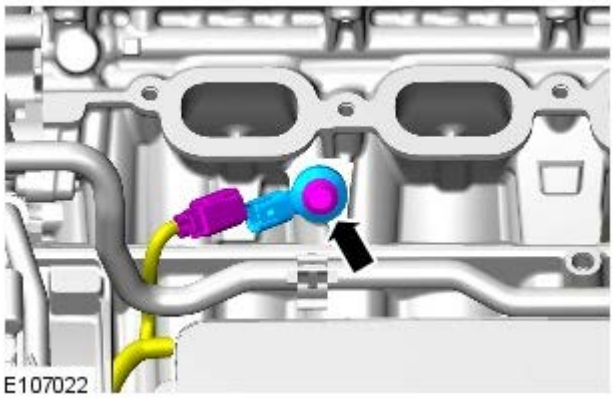
6.



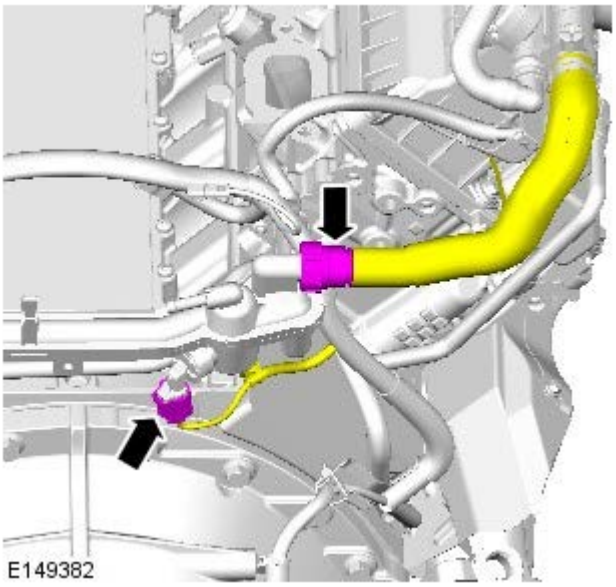
7.



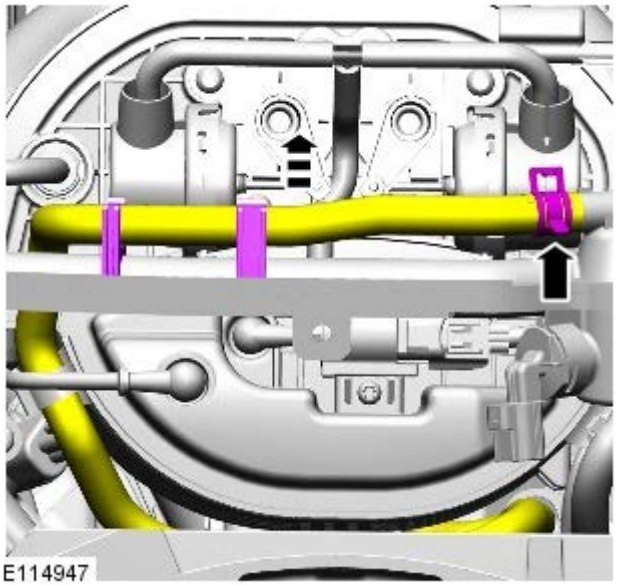
8.



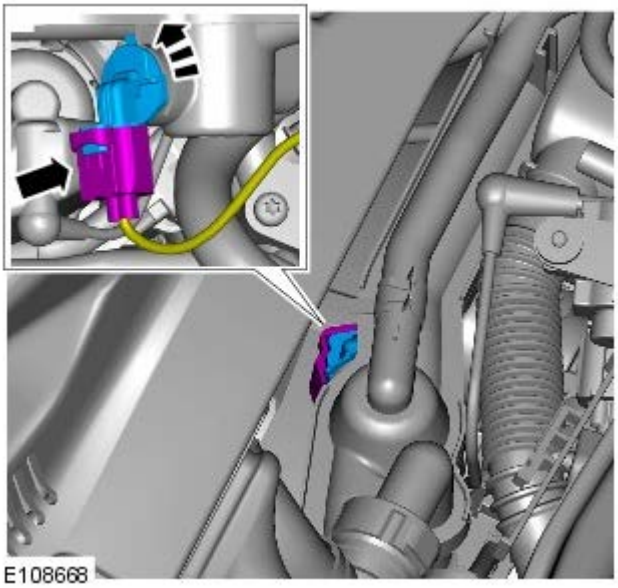
9. CAUTION: Be prepared to collect escaping coolant.



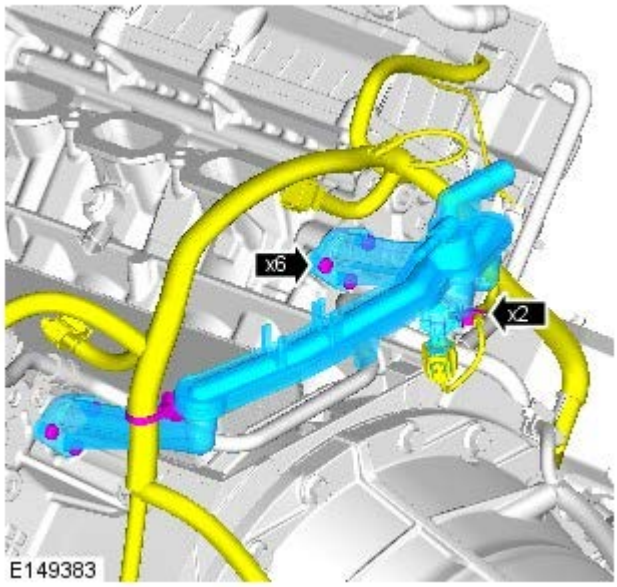
10. NOTE: Clamp the hose to minimize coolant loss.



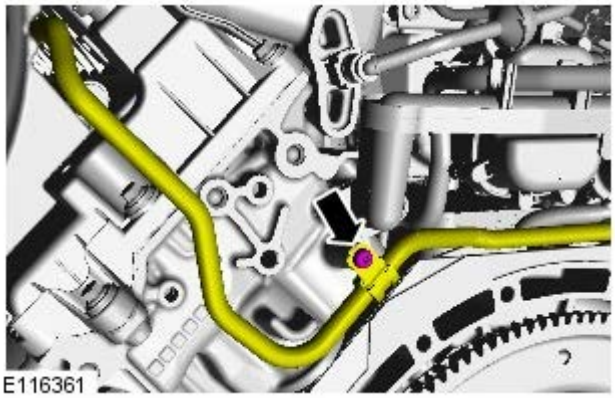
11.



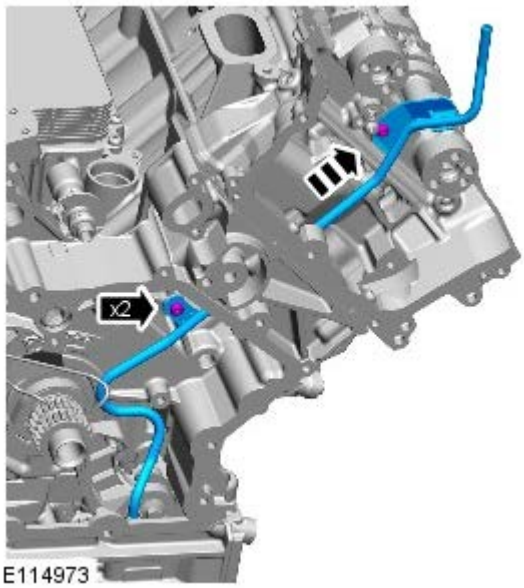
12. CAUTION: Discard the seals.



13.



14.

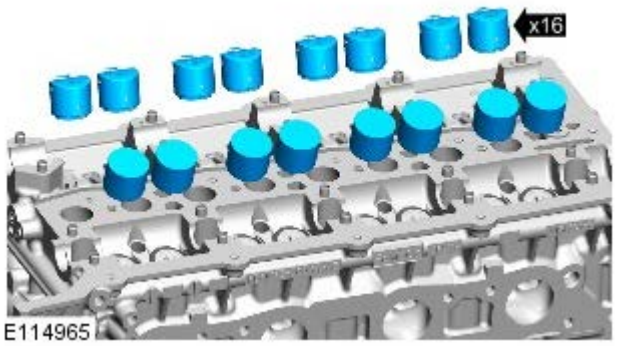


15. CAUTIONS:

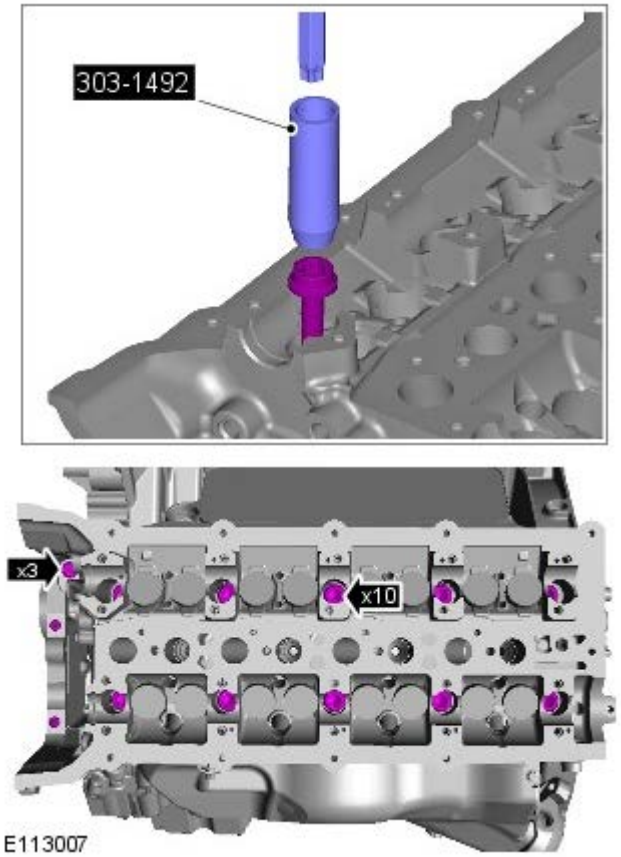
If a new cylinder head has been installed then new tappets must be installed.

If the cylinder head is being removed without a new component being installed, the tappets must be installed in their original positions.

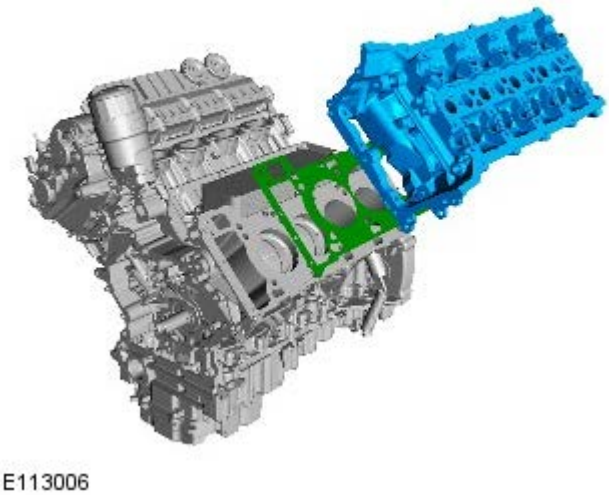
NOTE: Left-hand shown, right-hand similar.



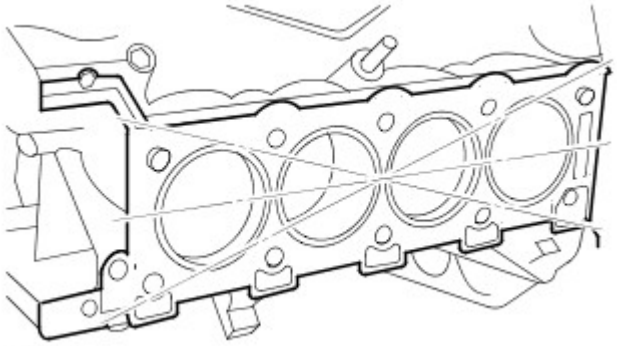
16.



17.



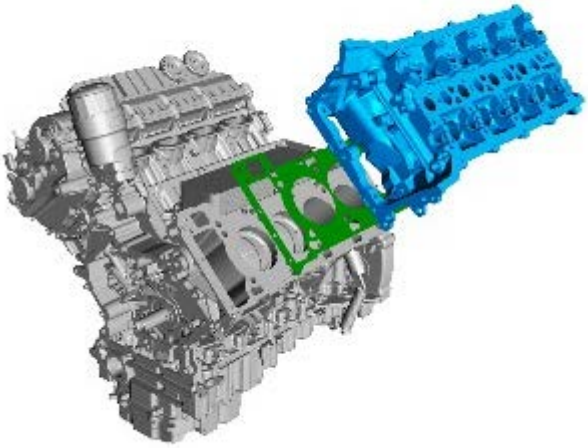
Installation



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.



E113006

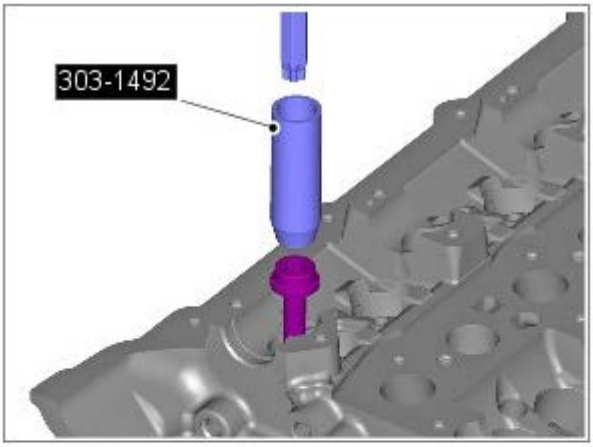
2. WARNING: Make sure care is taken when handling the cylinder head gasket.

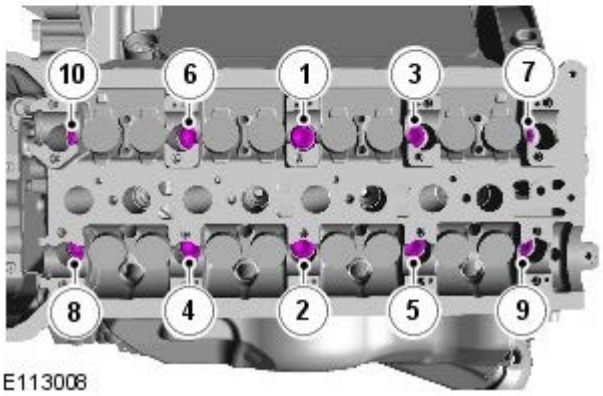
   CAUTIONS:

   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.





E113008

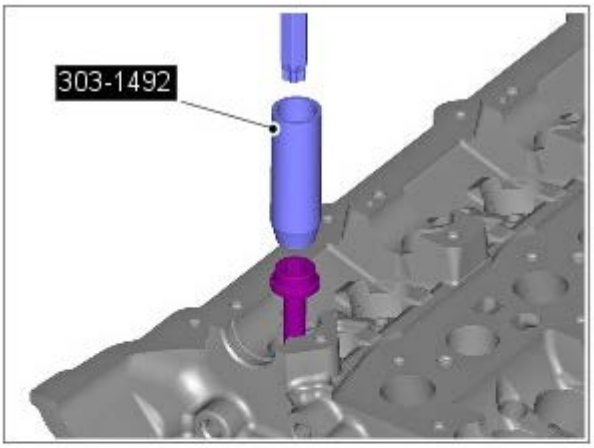
3. CAUTION: Make sure that new cylinder head bolts are installed.

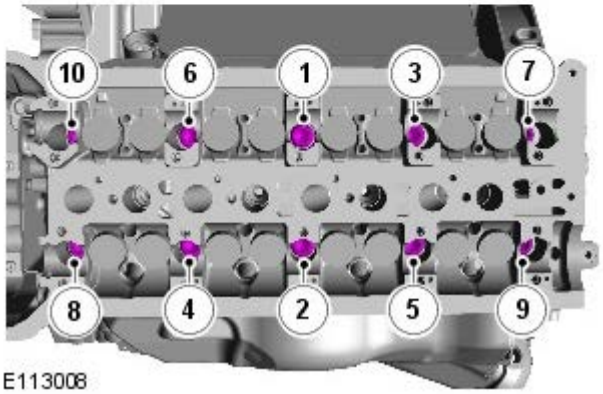
   NOTE: Tighten the bolts in the indicated sequence.

   Torque: 20 Nm

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

   Torque: 35 Nm

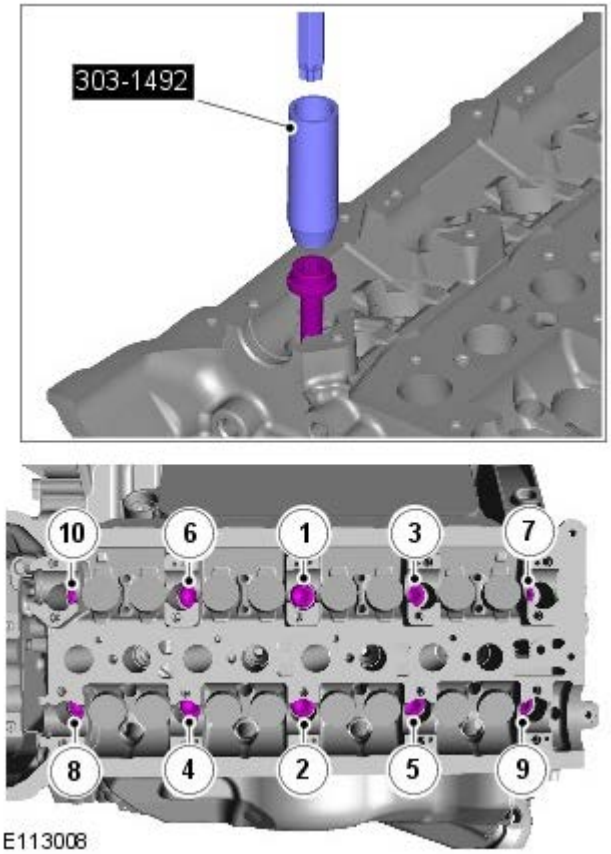




E113008

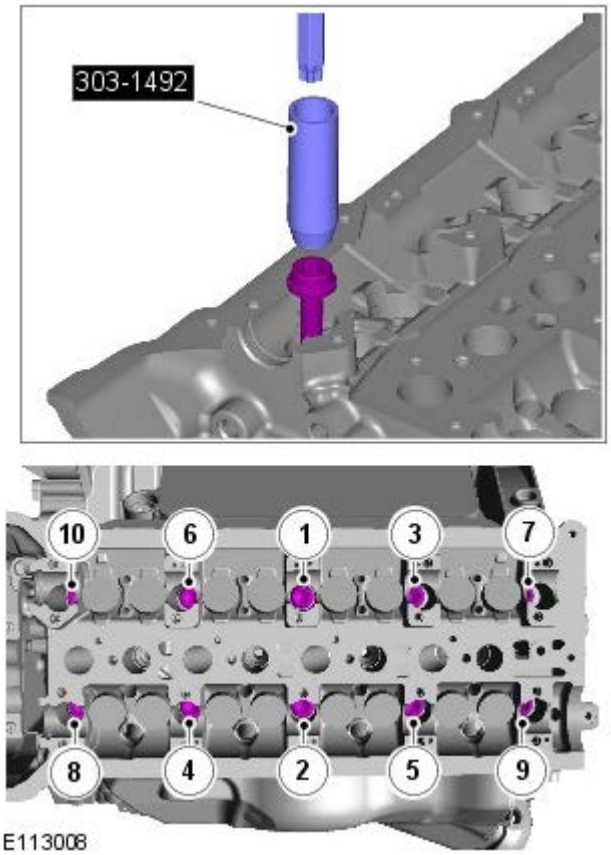
5. NOTE: Tighten the bolts in the indicated sequence.

   Tighten the bolts 1 to 10, a further 90 degrees.

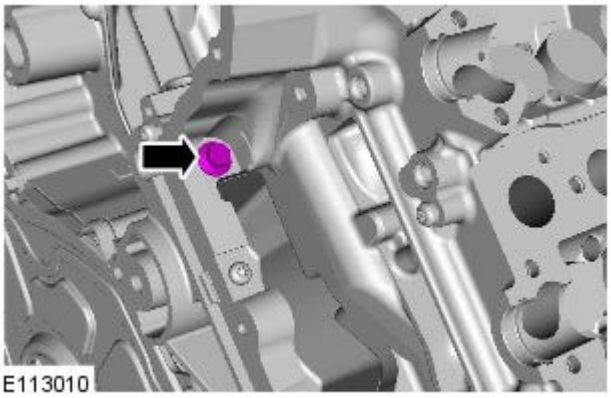


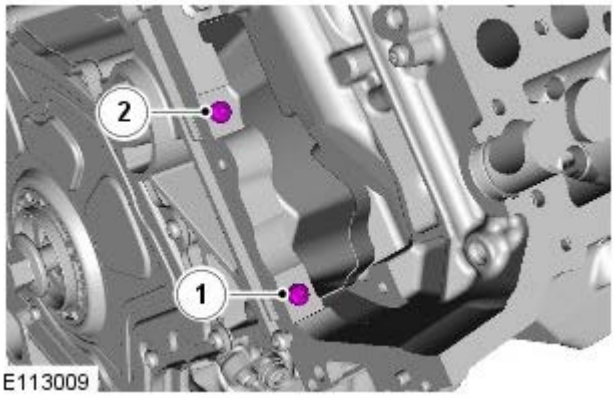
6. NOTE: Tighten the bolts in the indicated sequence.

   Tighten the bolts 1 to 10, a further 120 degrees.



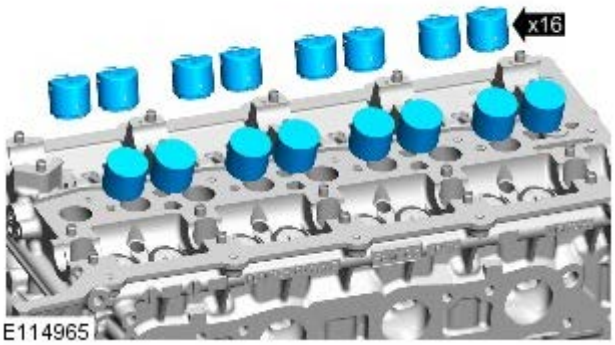
7. *Torque:* 25 Nm





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

   Torque: 12 Nm



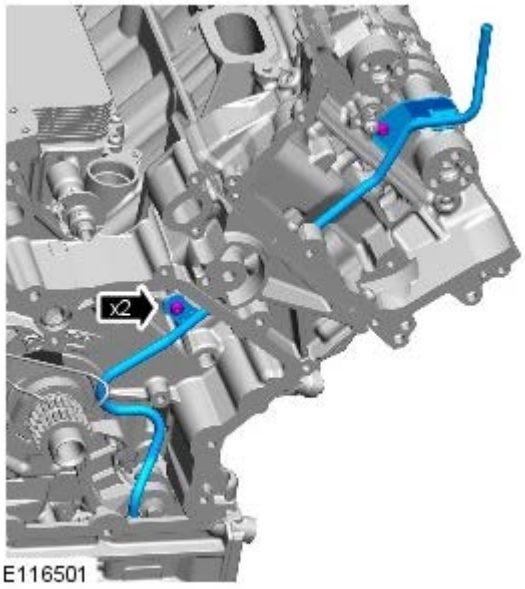
9. CAUTIONS:

   If a new cylinder head has been installed then new tappets must be installed.

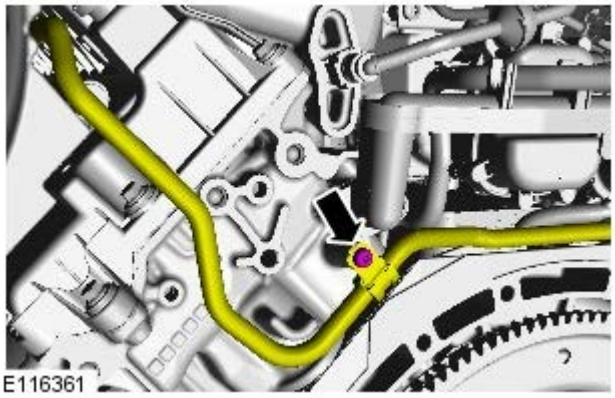
   If the cylinder head is being removed without a new component being installed, the tappets must be installed in their original positions.

   Lubricate the valve tappets with clean engine oil.

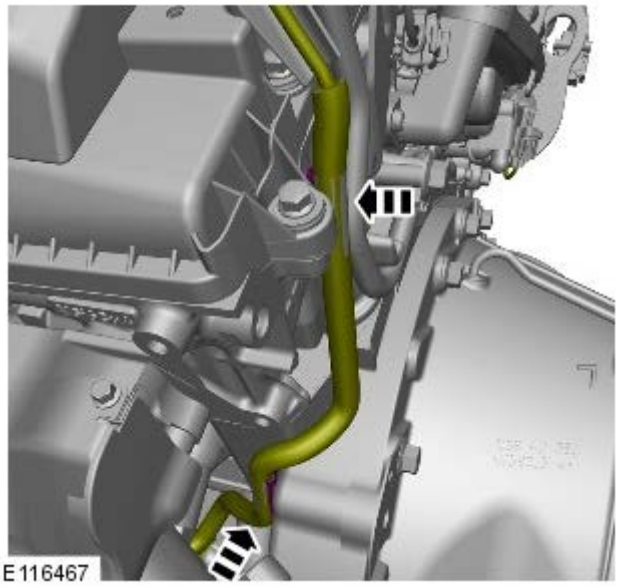
10. *Torque:* 12 Nm



11. *Torque:* 10 Nm

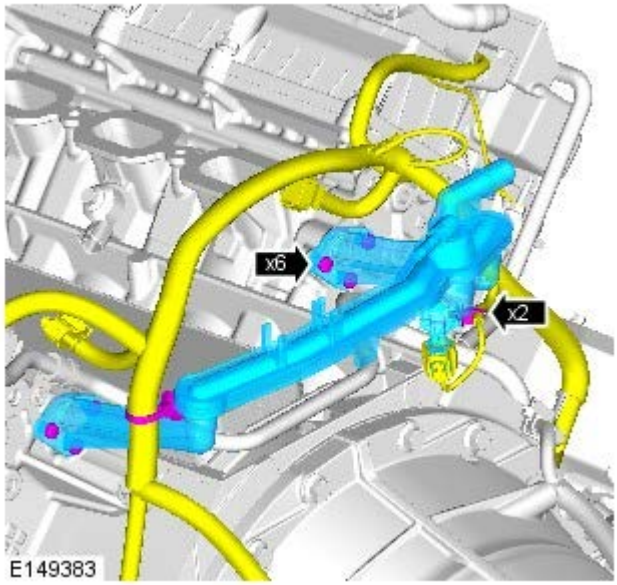


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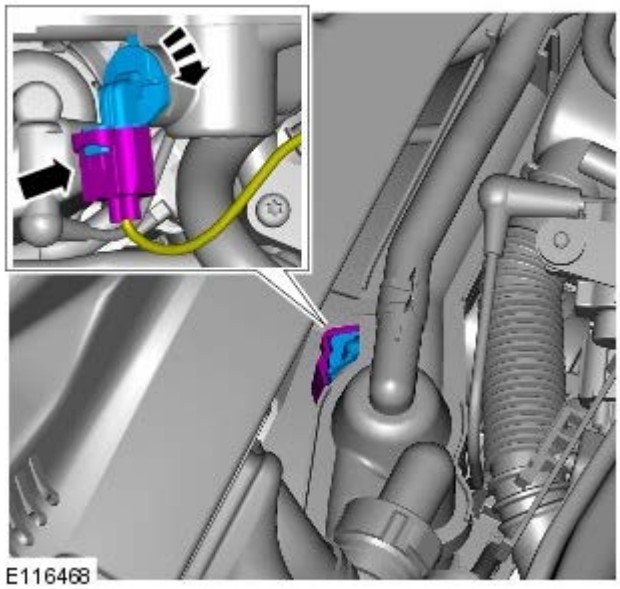


13. CAUTION: Install the new seals.

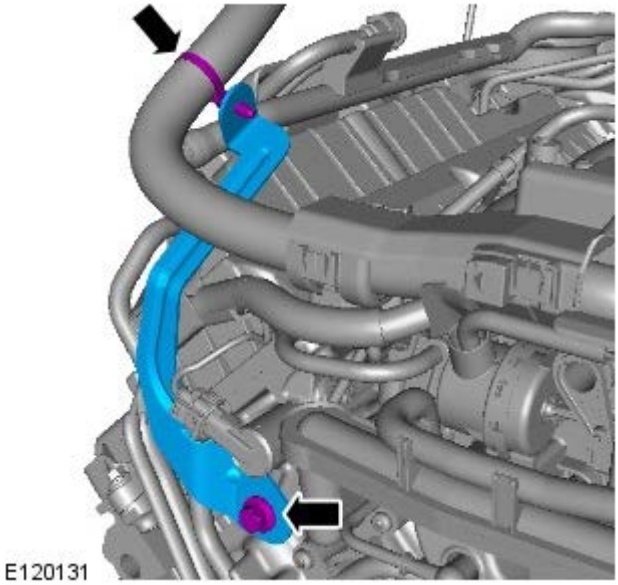
Torque: 10 Nm



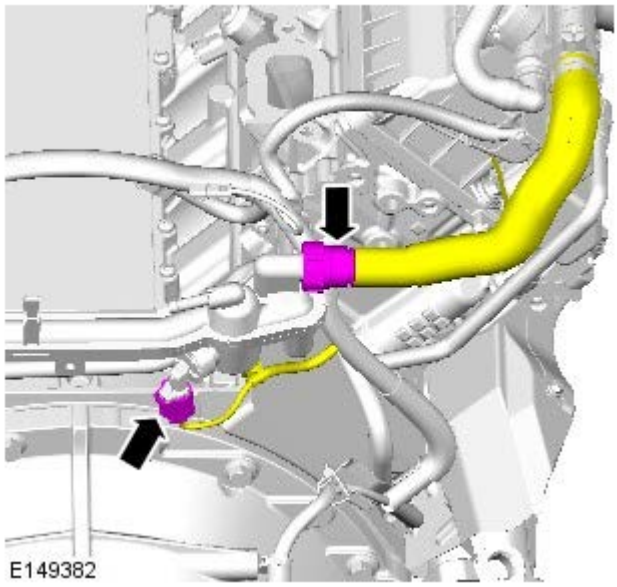
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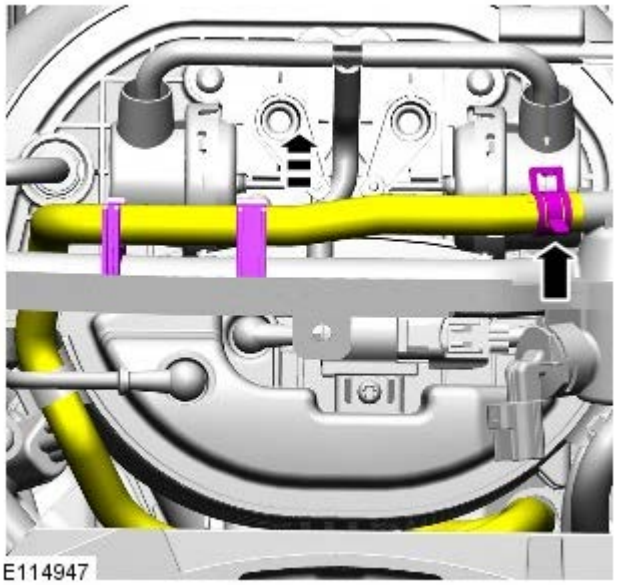
15. *Torque:* 25 Nm



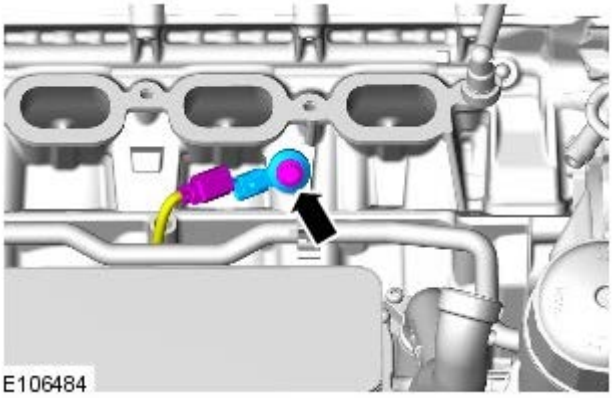
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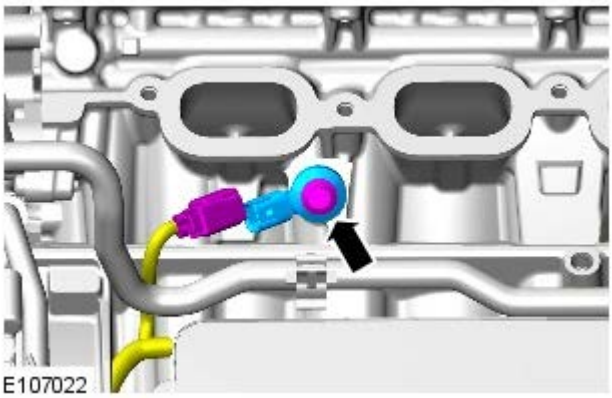
17.



18. *Torque:* 20 Nm



19. *Torque:* 20 Nm



20. Refer to: Exhaust Manifold LH (303-01C Engine - V8 S/C 5.0L Petrol, Removal and Installation).

21. Refer to: Camshaft LH (303-01C Engine - V8 S/C 5.0L Petrol, Removal and Installation).

22. Connect the battery ground cable.

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

Published: 16-Apr-2013

Engine - V8 S/C 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).

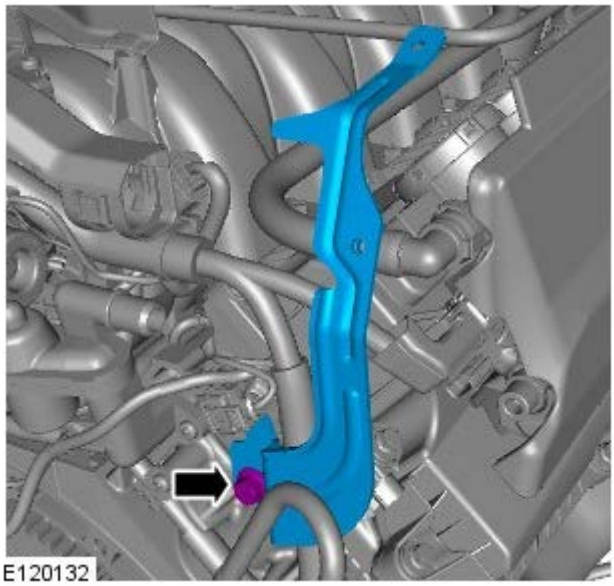
2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

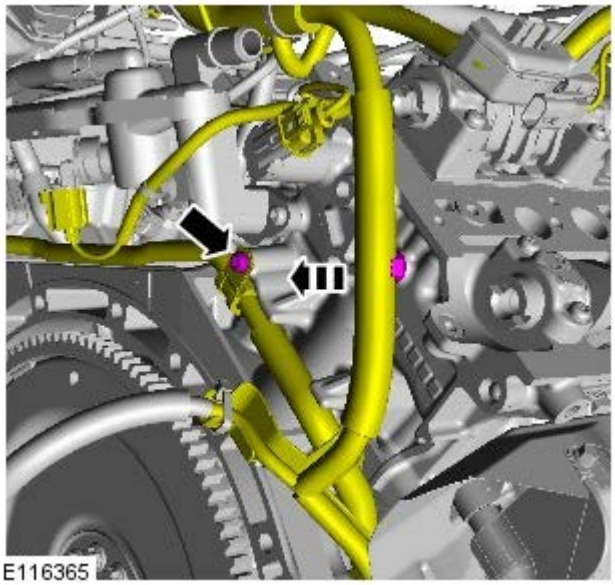
3. Refer to: Camshaft RH (303-01C Engine - V8 S/C 5.0L Petrol, Removal and Installation).

4. Refer to: Exhaust Manifold RH (303-01C Engine - V8 S/C 5.0L Petrol, Removal and Installation).

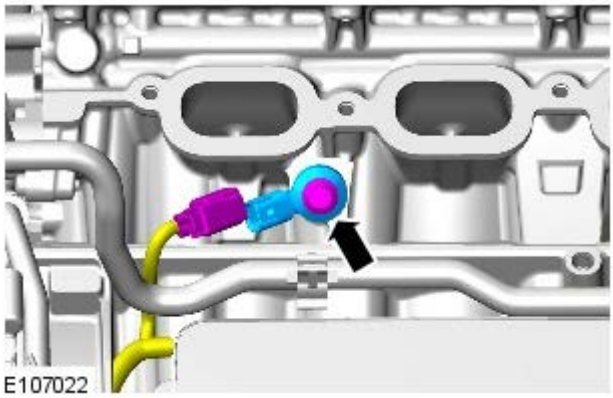
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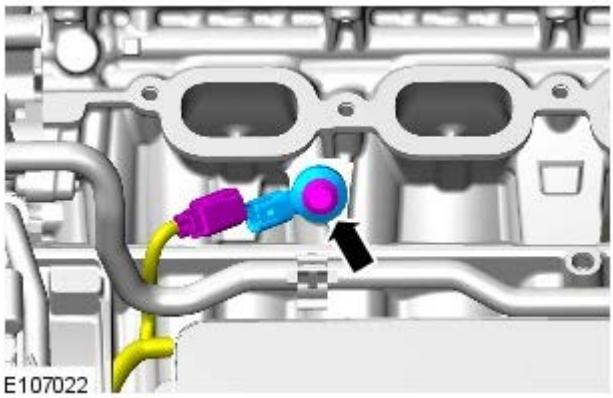
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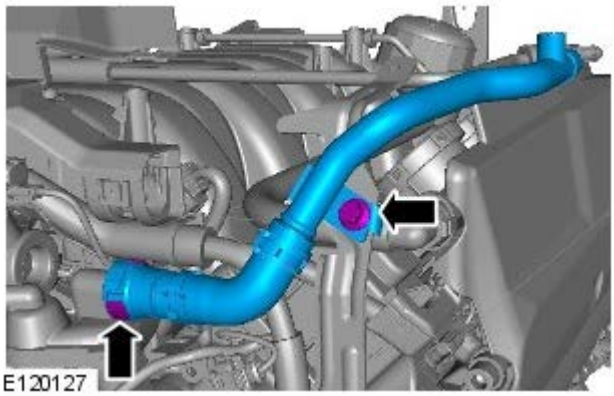
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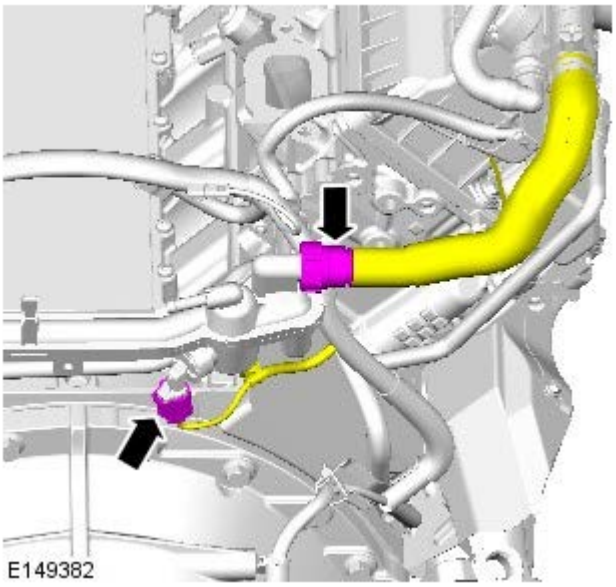
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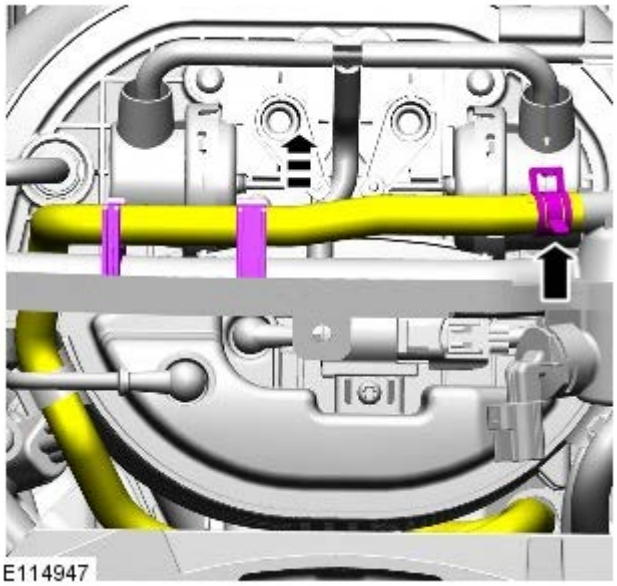
9. CAUTION: Be prepared to collect escaping coolant.



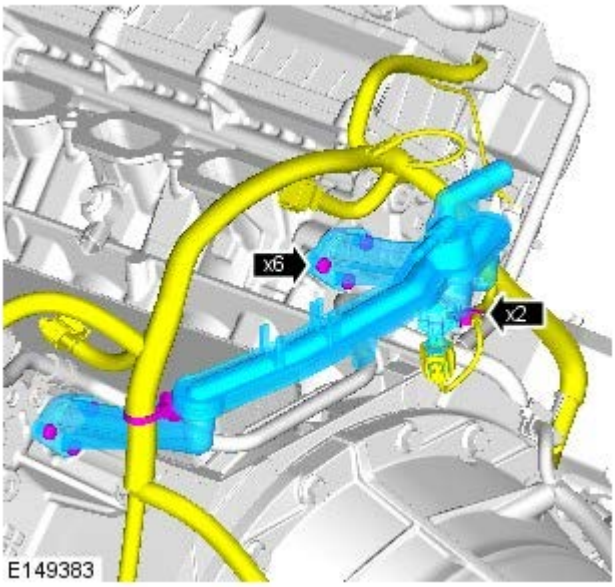
10. CAUTION: Be prepared to collect escaping coolant.



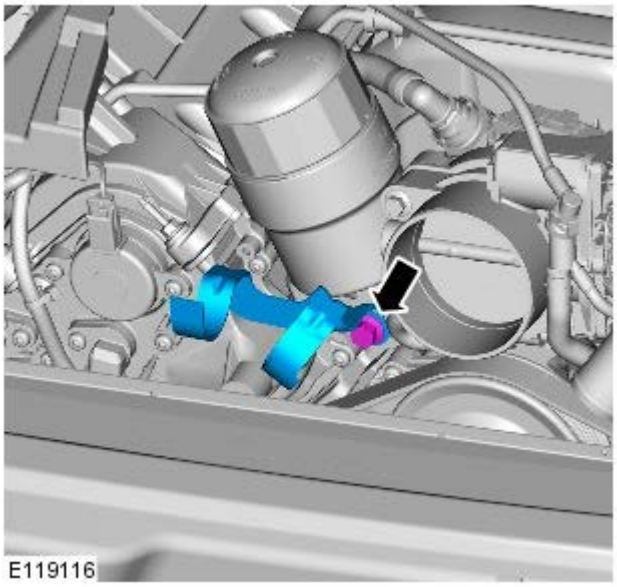
11. NOTE: Clamp the hose to minimize coolant loss.



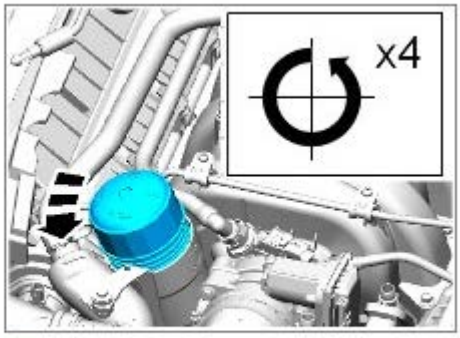
12. CAUTION: Discard the seals.

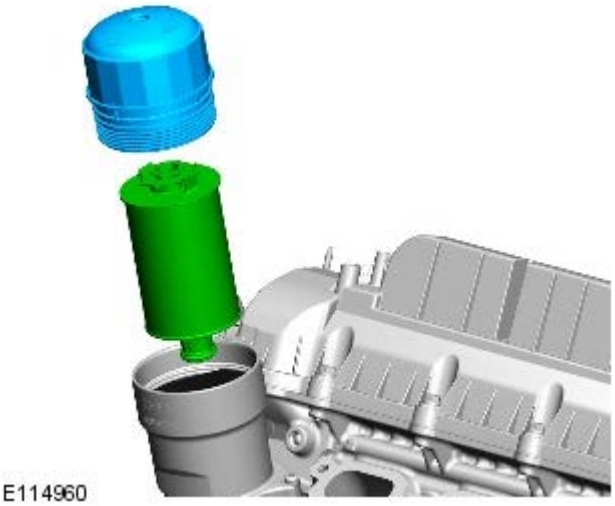


13.

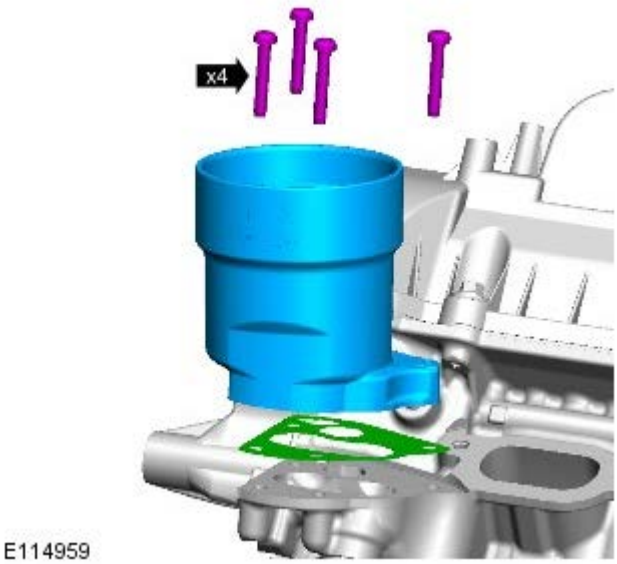


14. NOTE: Remove and discard the O-ring seal.



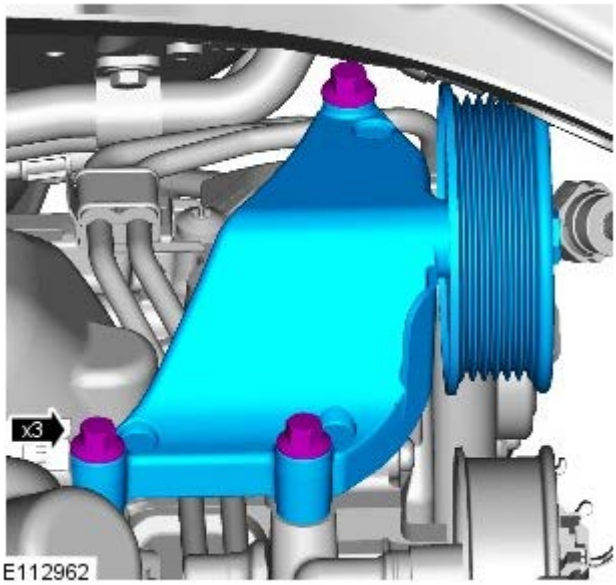


15. NOTE: Discard the gasket.



E114959

16.



E112962

17. CAUTIONS:

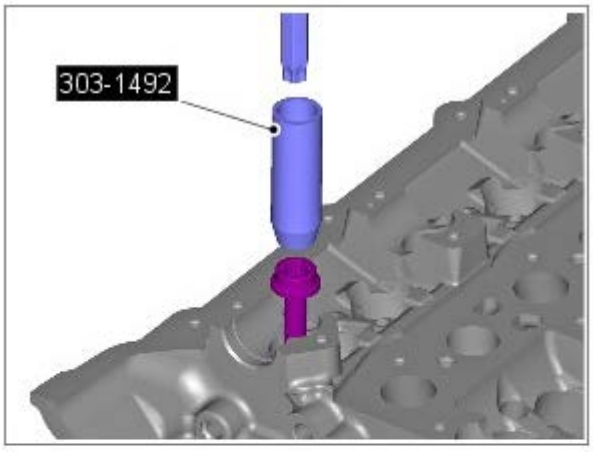
If a new cylinder head has been installed then new tappets must be installed.

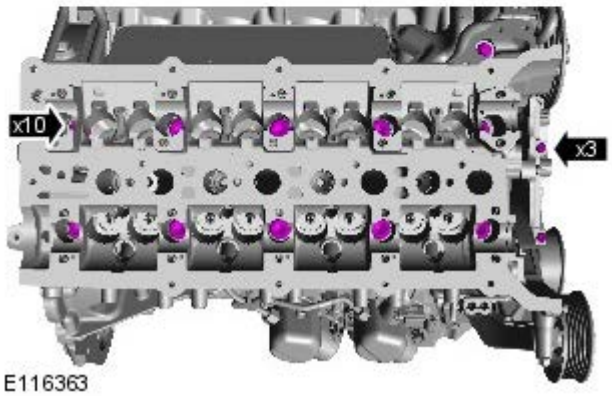
If the cylinder head is being removed without a new component being installed, the tappets must be installed in their original positions.



E114965

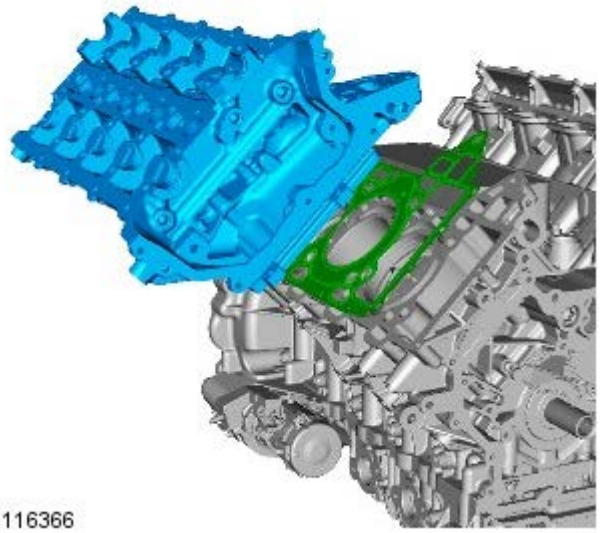
18. CAUTION: Discard the bolts.





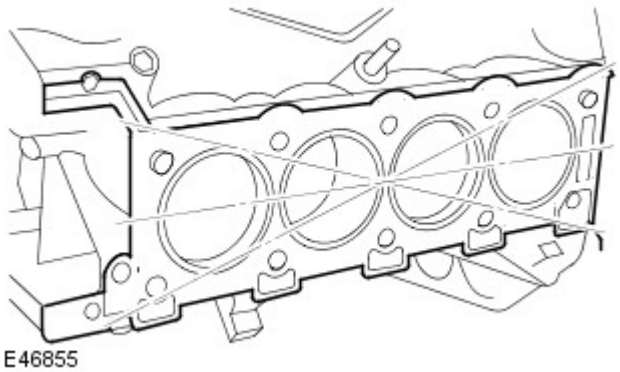
E116363

19. NOTE: Discard the gasket.



E116366

Installation

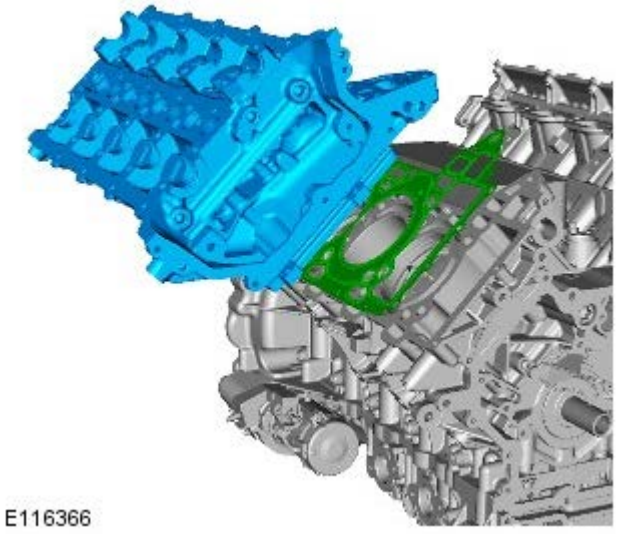


E46855

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.

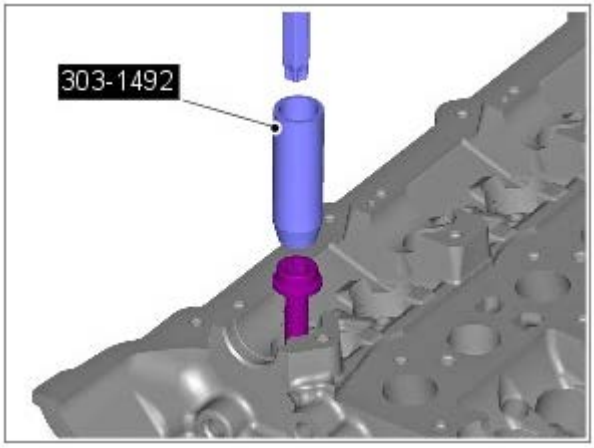

E116366

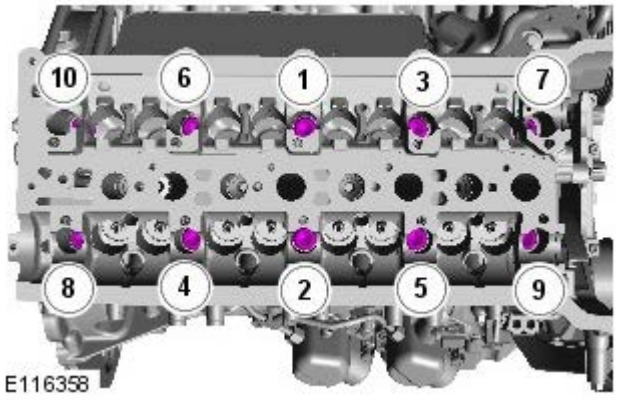
2. WARNING: Make sure care is taken when handling the cylinder head gasket.

NOTE: Install a new gasket.

3. CAUTION: Make sure that new cylinder head bolts are installed.

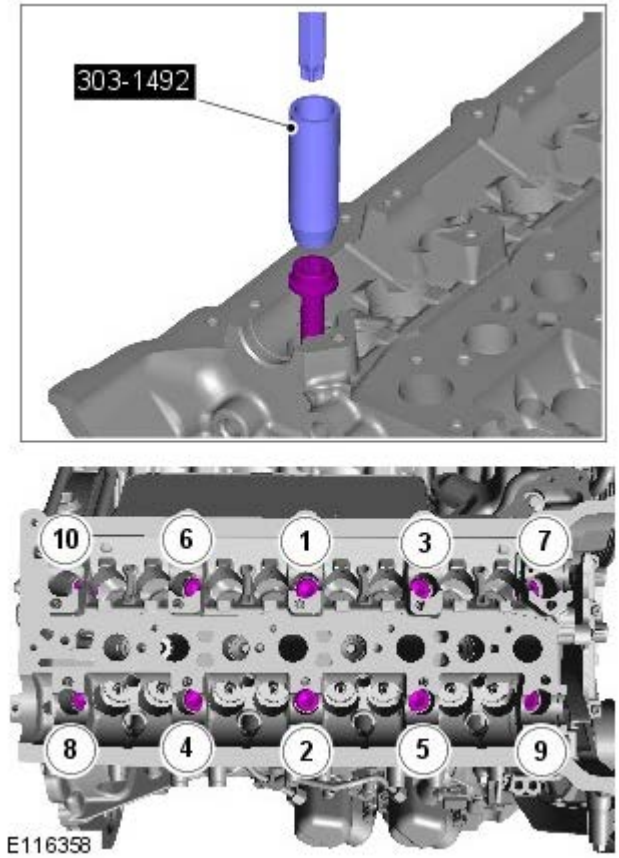
Torque: 20 Nm



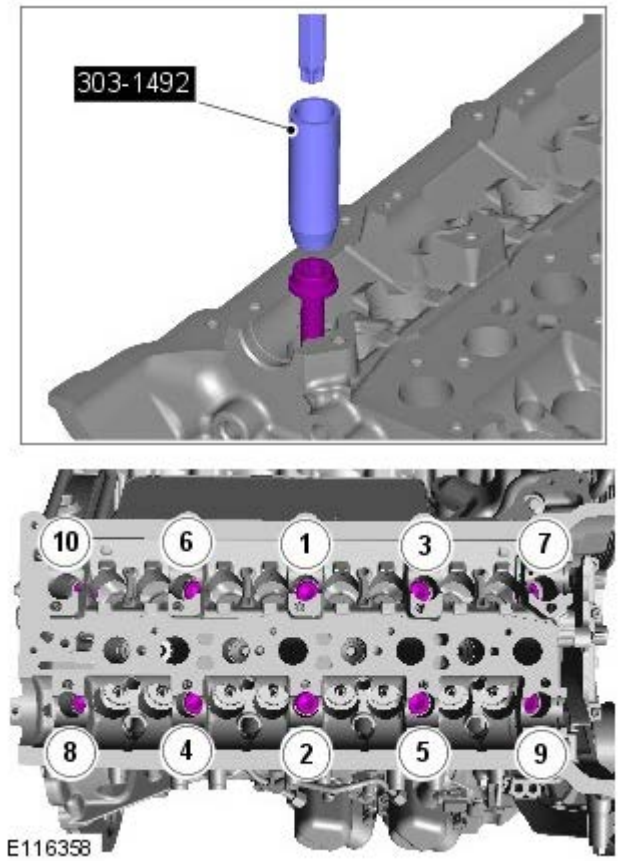


E116358

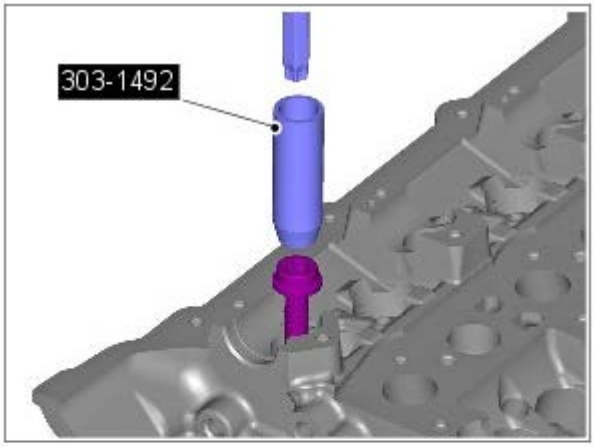
4. *Torque:* 35 Nm

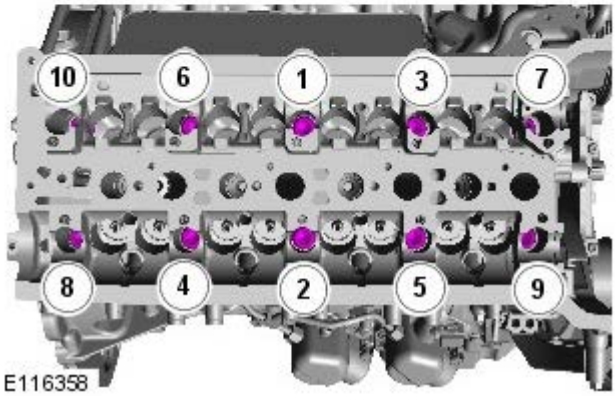


5. Tighten the bolts 1 to 10, a further 90 degrees.

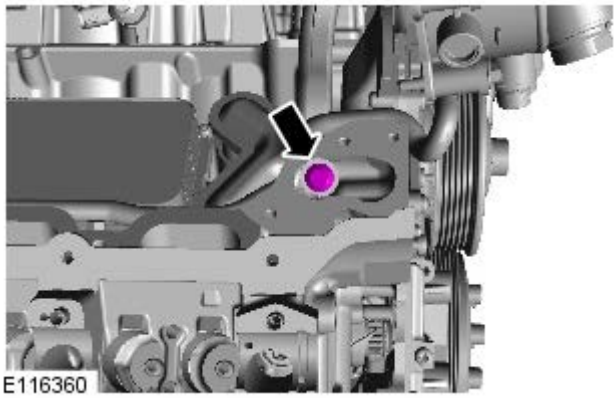


6. Tighten the bolts 1 to 10, a further 120 degrees.

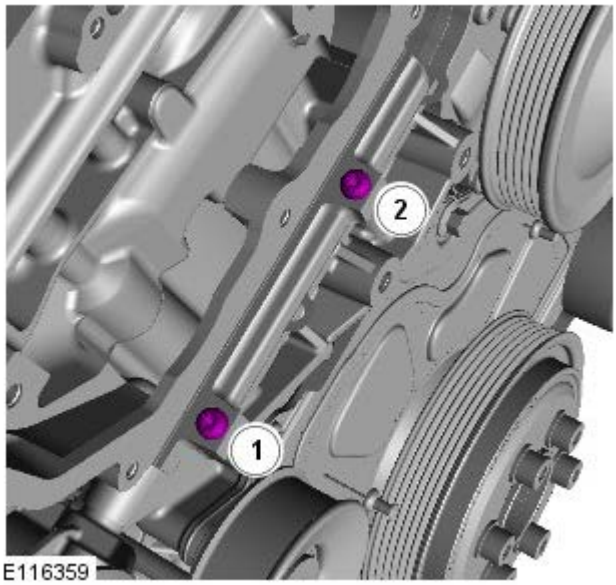




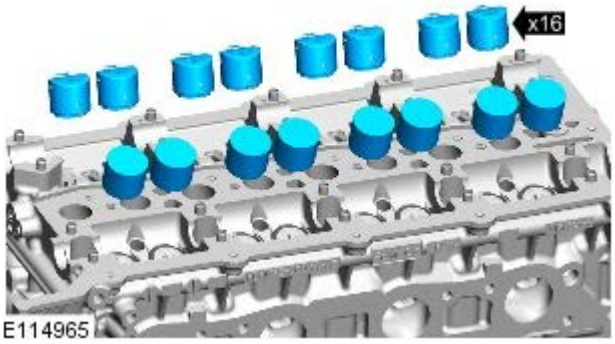
7. *Torque:* 25 Nm



8. *Torque:* 12 Nm



9. CAUTIONS:

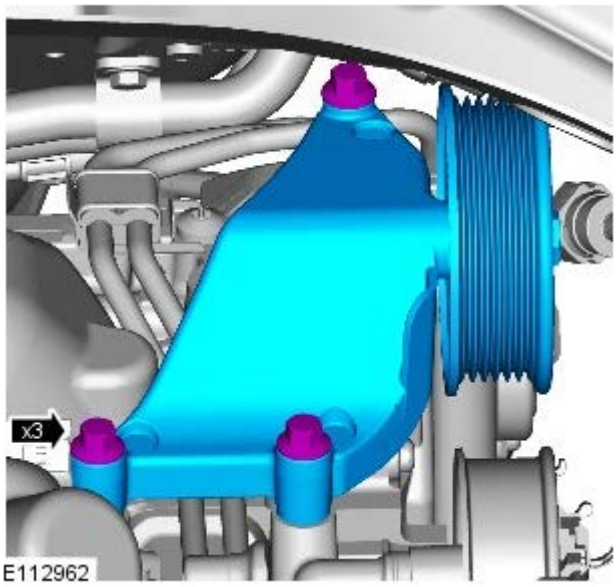


If a new cylinder head has been installed then new tappets must be installed.

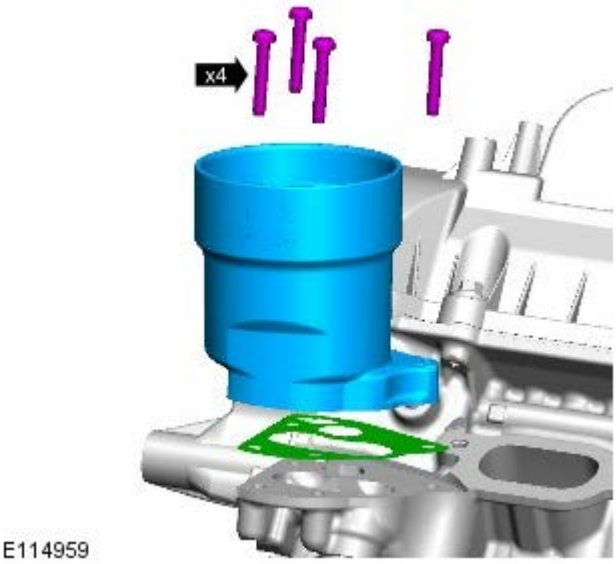
If the cylinder head is being removed without a new component being installed, the tappets must be installed in their original positions.

Lubricate the valve tappets with clean engine oil.

10. *Torque:* 25 Nm

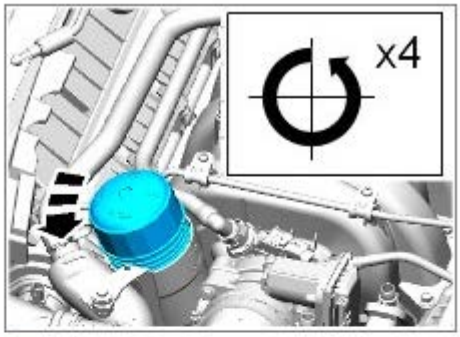


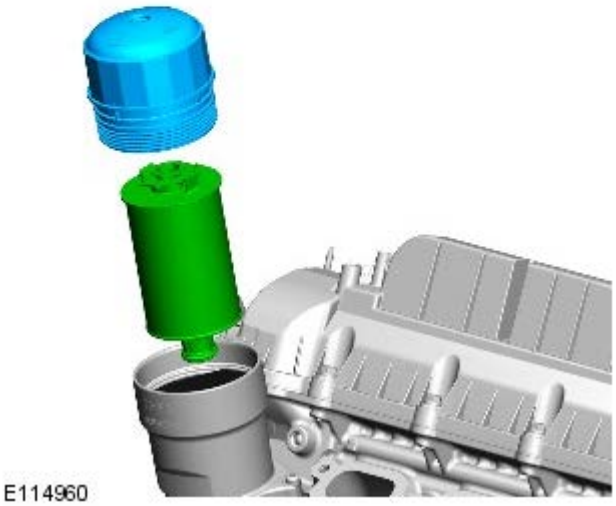
11. NOTE: Install a new gasket.



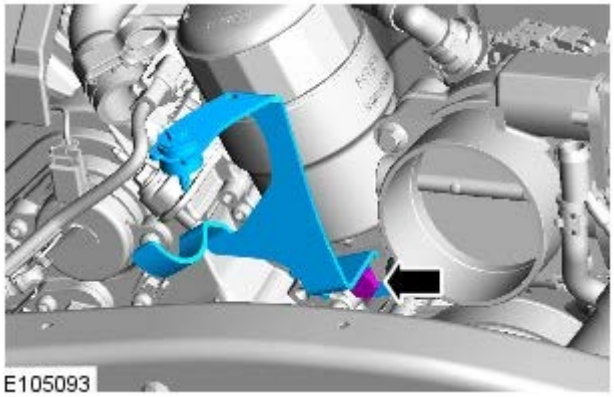
12. CAUTION: A new O-ring seal is to be installed.

NOTE: Install a new engine oil filter.



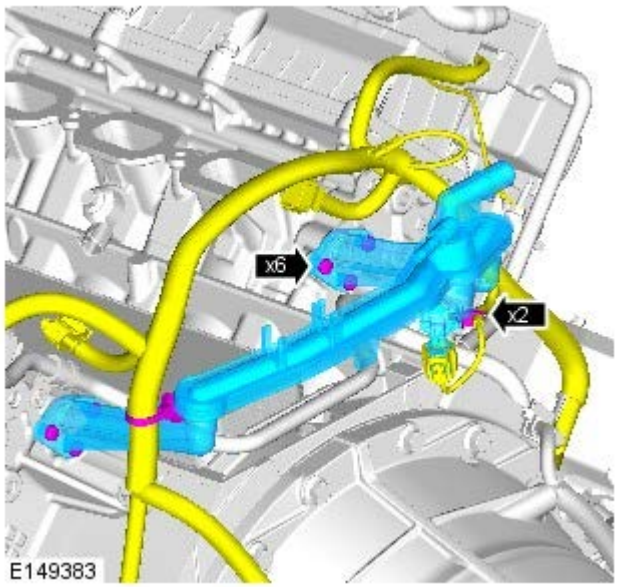


13. *Torque:* 25 Nm

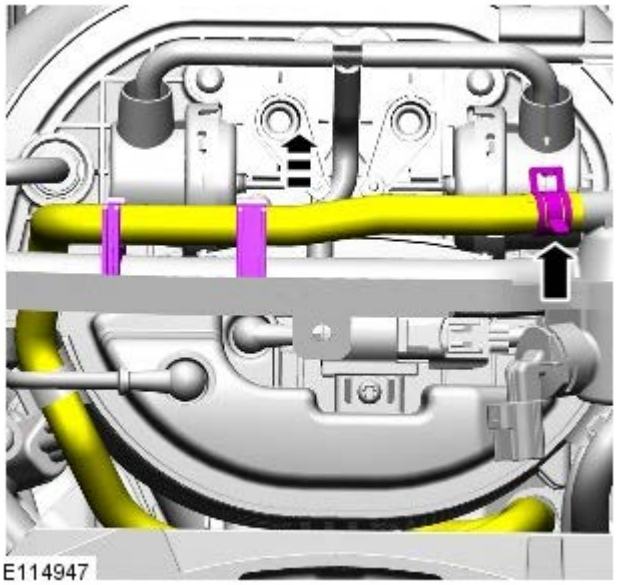


14. CAUTION: Install the new seals.

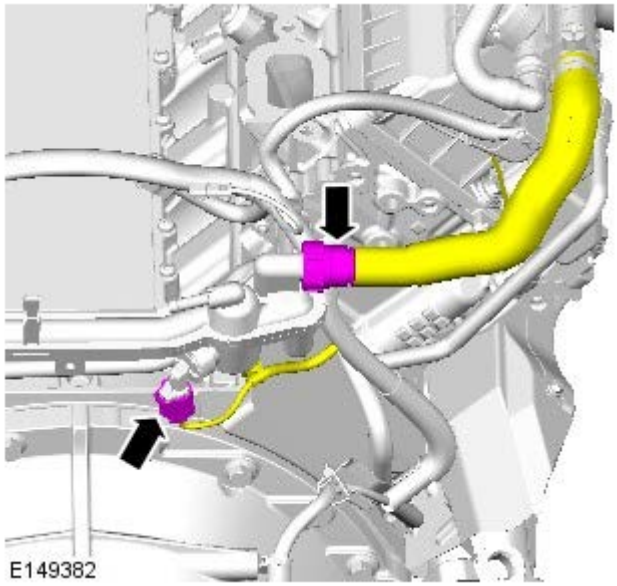
Torque: 10 Nm



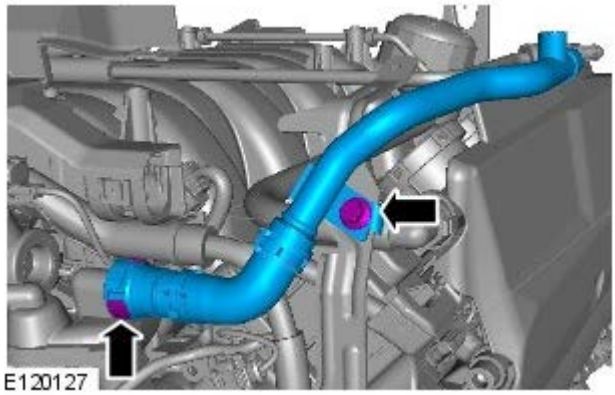
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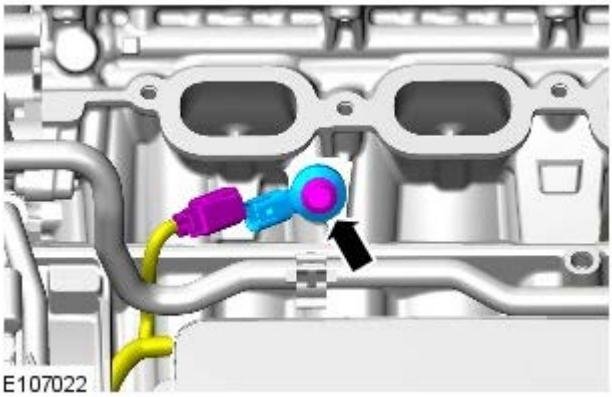
16.



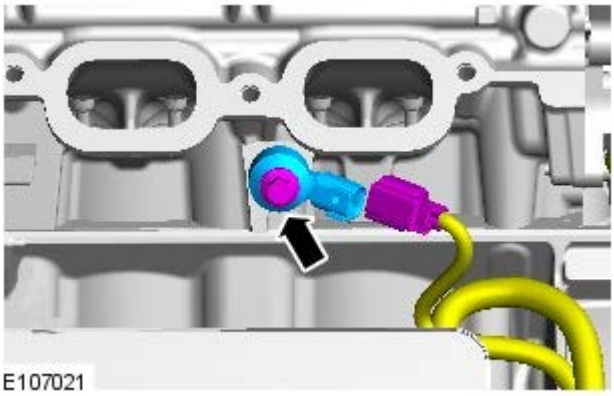
17. *Torque:* 10 Nm



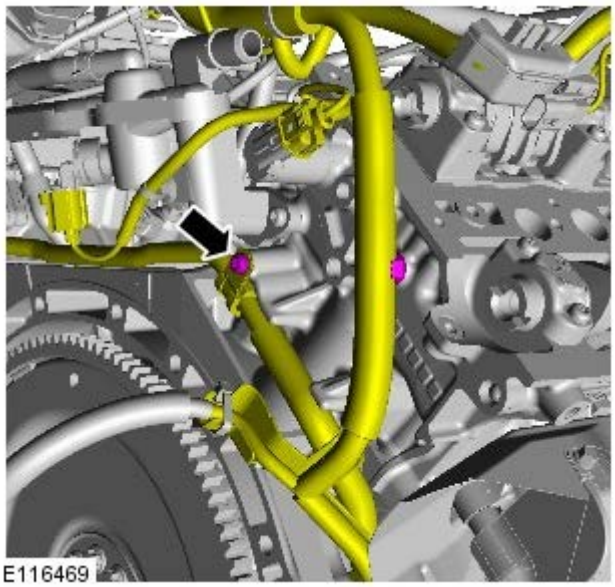
18. *Torque:* 20 Nm



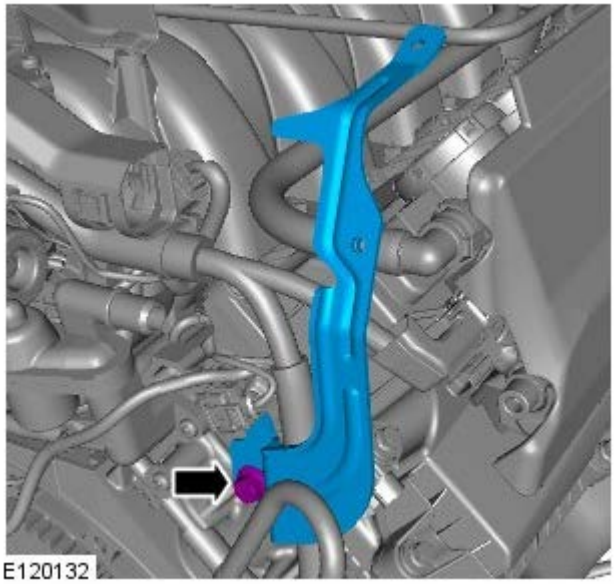
19. *Torque:* 20 Nm



20. *Torque:* 12 Nm



21.



22. Refer to: Exhaust Manifold RH (303-01C Engine - V8 S/C 5.0L Petrol, Removal and Installation).

23. Refer to: Camshaft RH (303-01C Engine - V8 S/C 5.0L Petrol, Removal and Installation).

24. Connect the battery ground cable.

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

Published: 22-Oct-2013

Engine - V8 S/C 5.0L Petrol - Engine Mount LH

Removal and Installation

Removal

NOTES:

Some components shown removed for clarity.

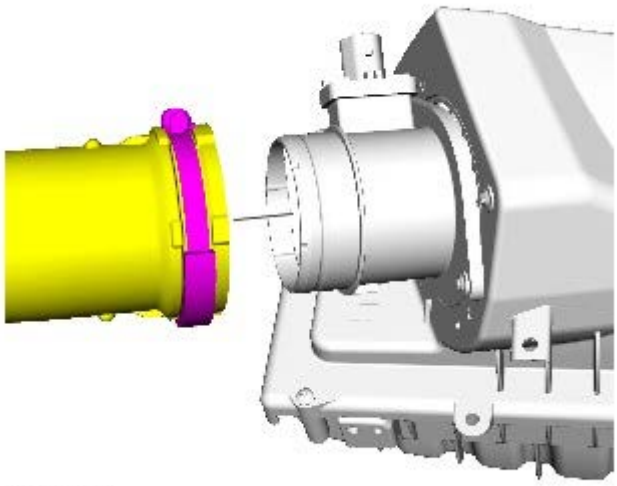
Some variation in the illustrations may occur, but the essential information is always correct.

All vehicles

1. Disconnect the battery ground cable.

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

2.



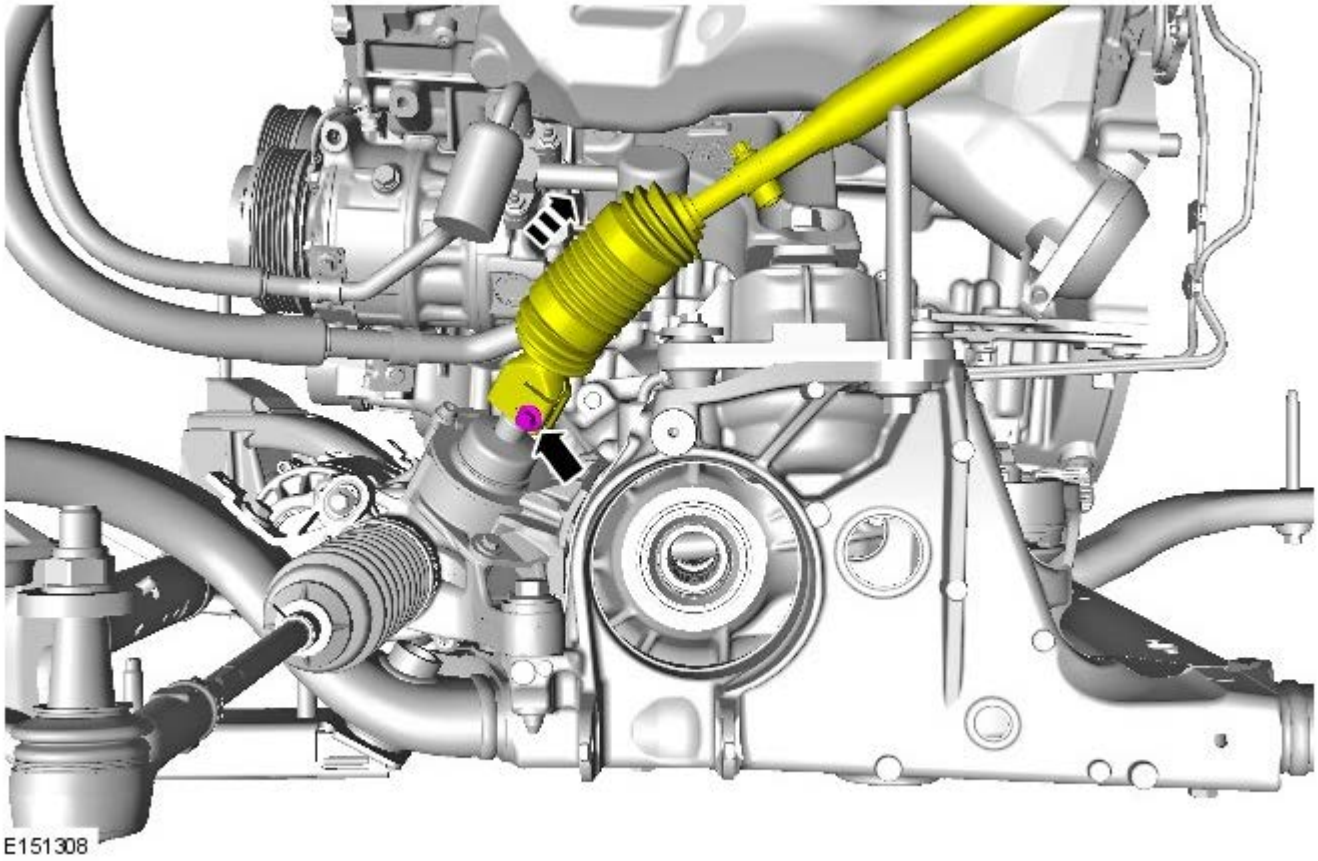
E157217

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

   Raise and support the vehicle.

Left-hand drive vehicles

4. CAUTION: Discard the bolt.

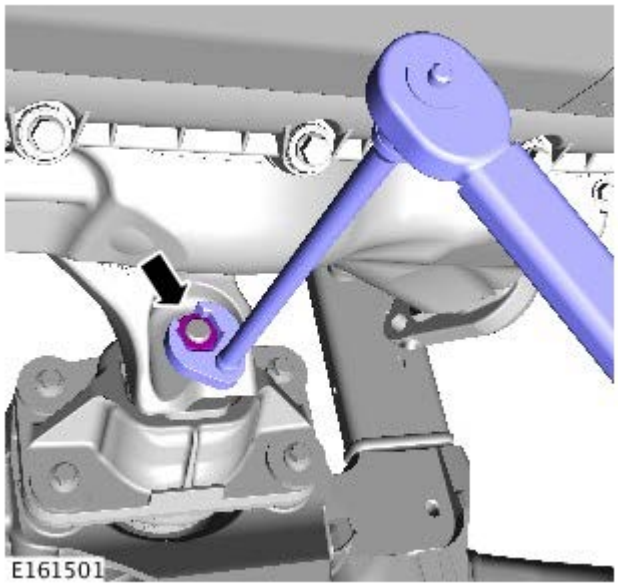


All vehicles

5. Refer to: Catalytic Converter LH (309-00C Exhaust System - V8 S/C 5.0L Petrol, Removal and Installation).

6. Refer to: Front Driveshaft - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (205-01 Driveshaft, Removal and Installation).

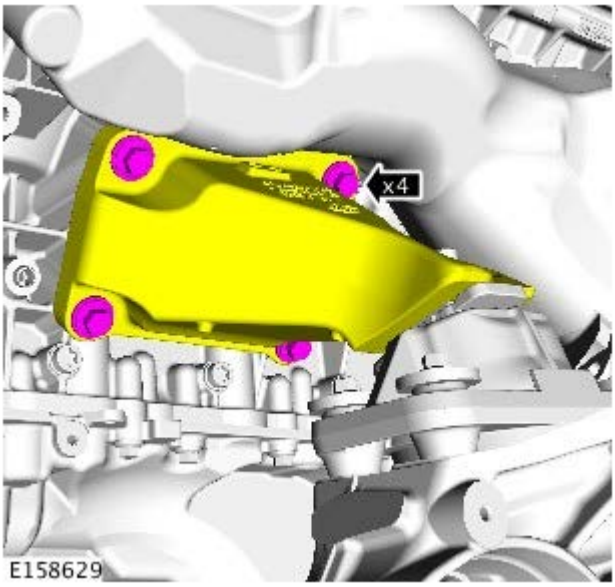
7.



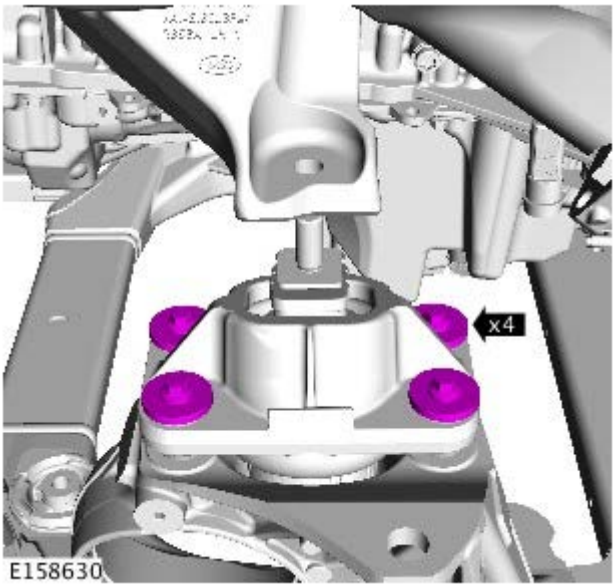
8. CAUTION: Use a wooden block to protect the oil pan when supporting the engine.

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

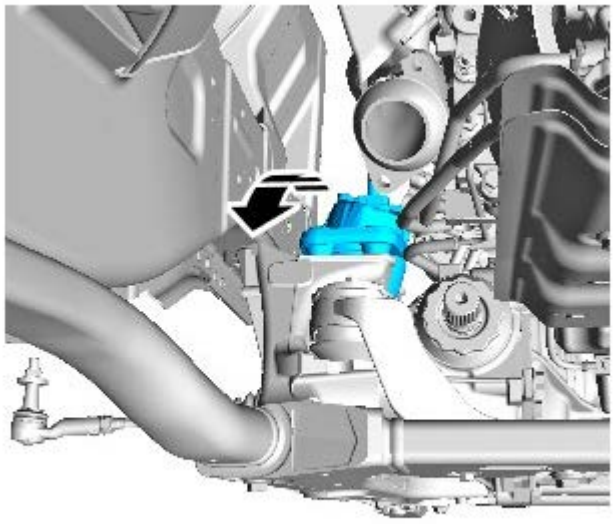
9. NOTE: Loosen the bolts, but do not fully remove.



10. CAUTION: Discard the bolts.



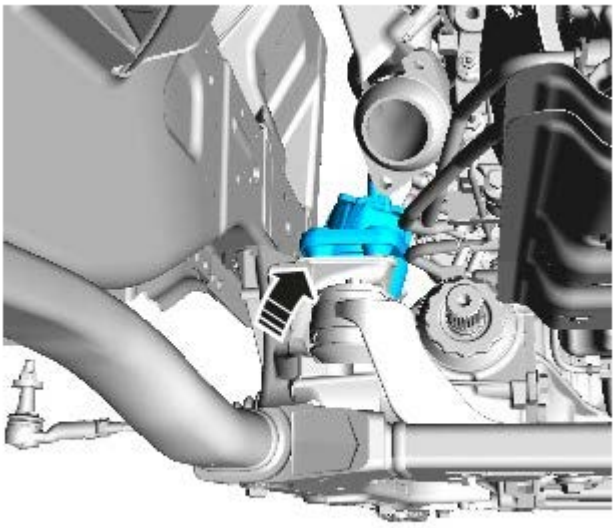
11.



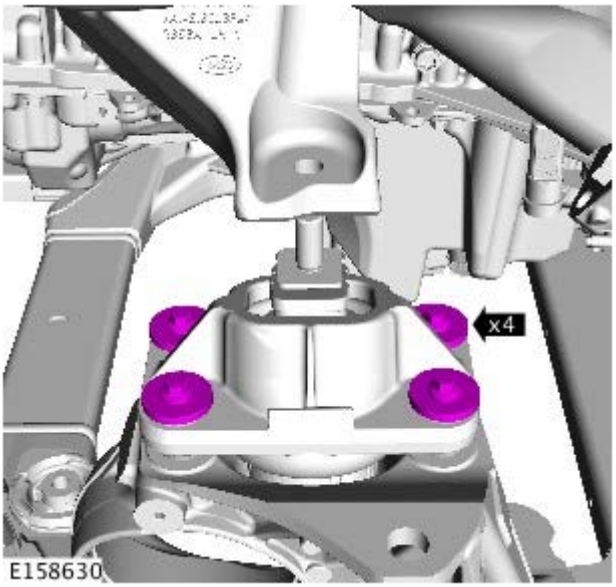
Installation

All vehicles

1.



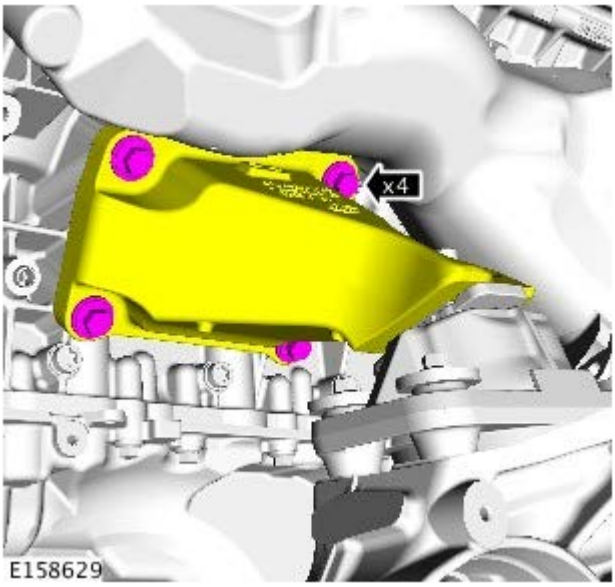
E158631



E158630

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

   NOTE: Make sure that new bolts are installed.

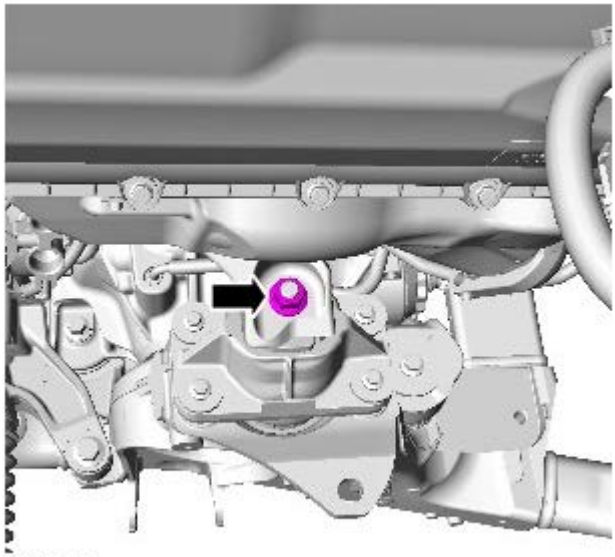


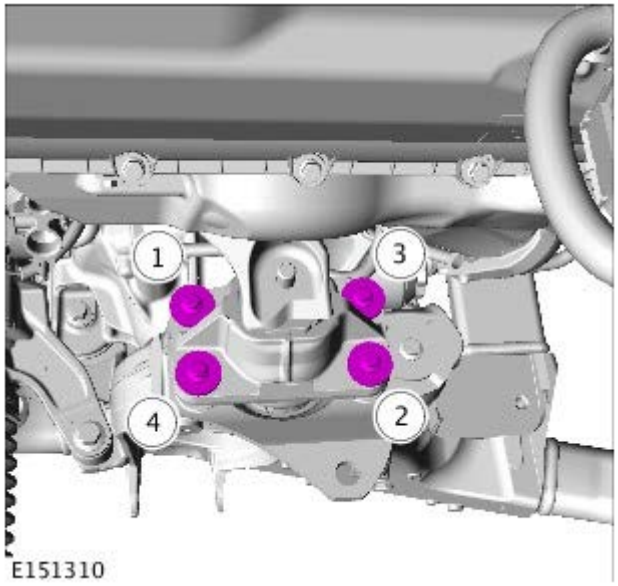
E158629

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

4. Lower the engine onto the mount.

5. CAUTION: Only tighten the nut finger tight at this stage.


E151309

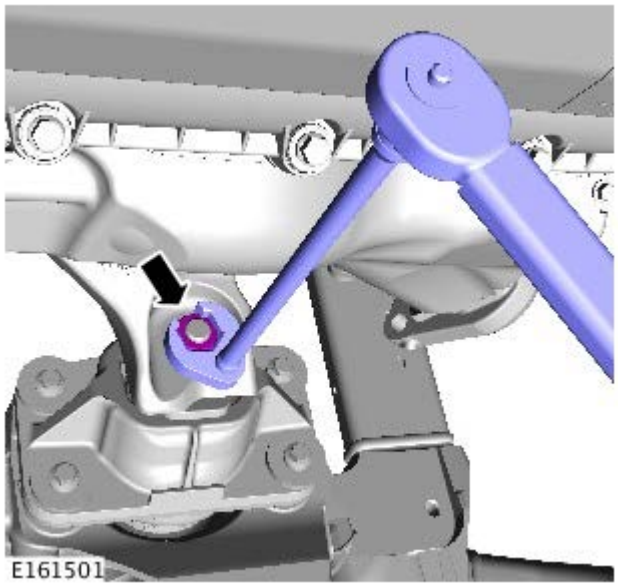


E151310

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

   Torque: 40 Nm

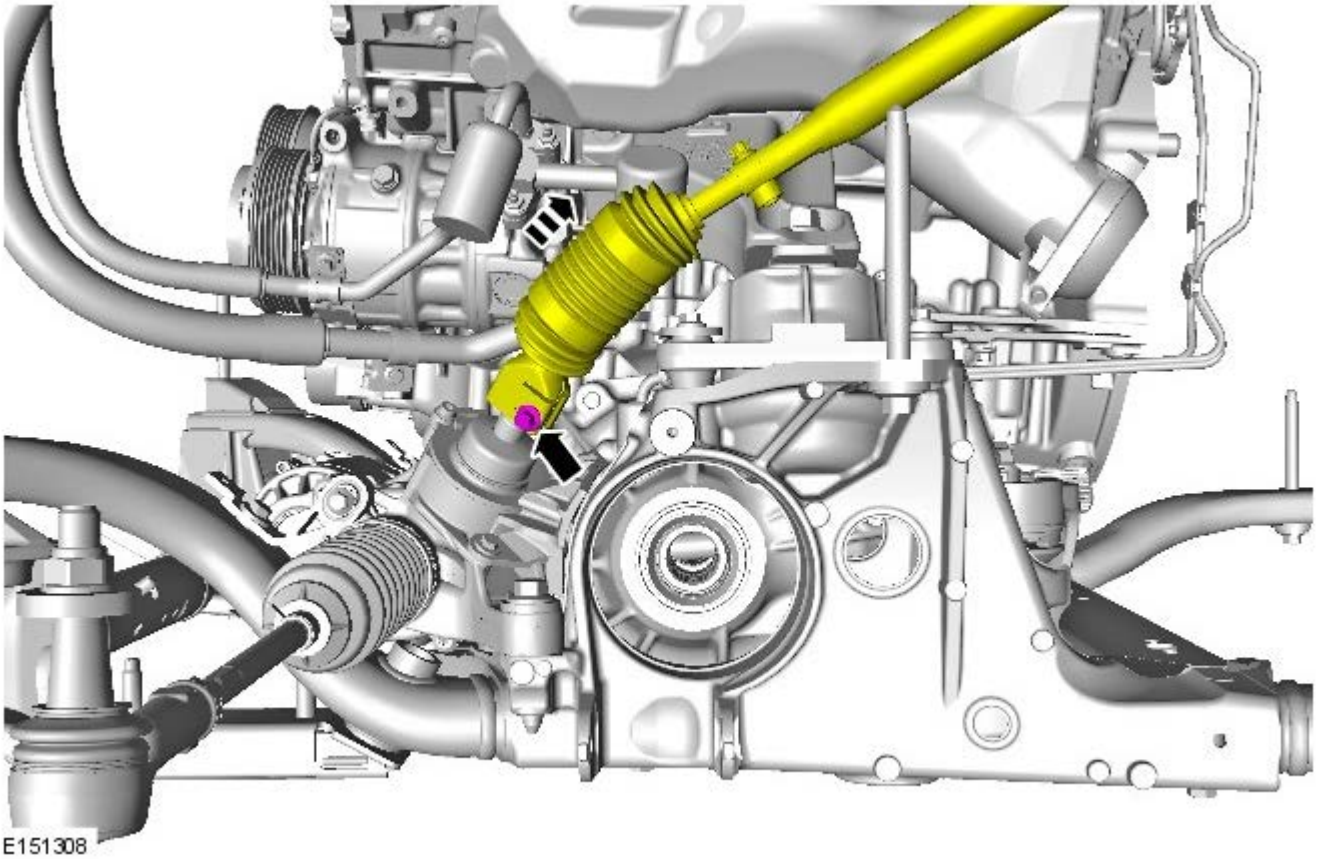
7. *Torque:* 110 Nm


E161501

Left-hand drive vehicles

8. WARNING: Make sure that a new bolt is installed.

   CAUTION: Discard the bolt.


E151308

All vehicles

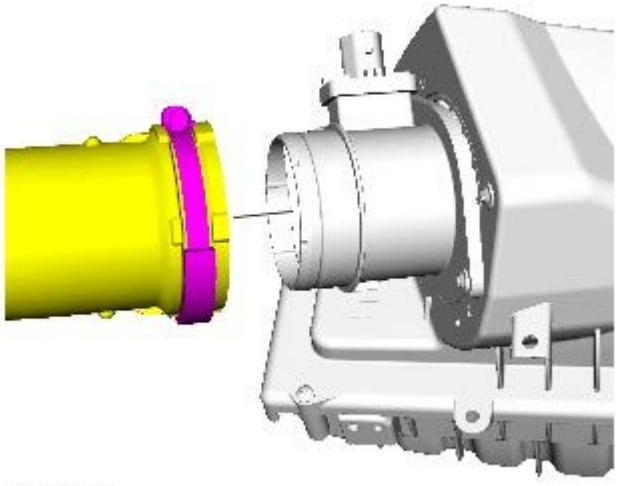
9. Refer to: Front Driveshaft - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (205-01 Driveshaft, Removal and Installation).

10. Refer to: Catalytic Converter LH (309-00C Exhaust System - V8 S/C 5.0L Petrol, Removal and Installation).

11. Connect the battery ground cable.

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

12.


E157217

Published: 28-Jun-2013

Engine - V8 S/C 5.0L Petrol - Engine Mount RH

Removal and Installation

Removal

NOTES:

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

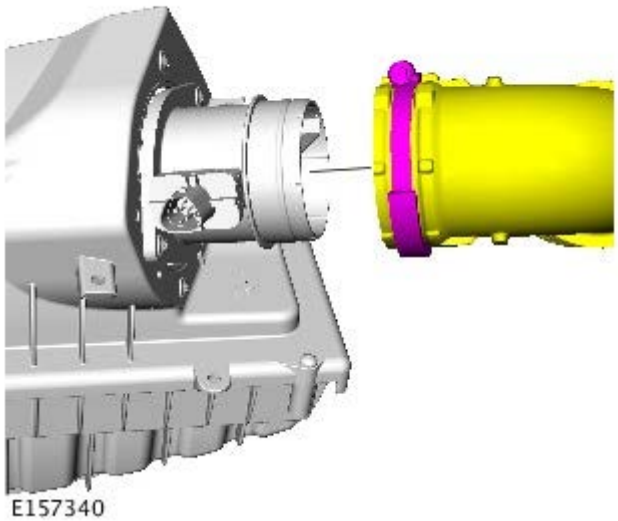
Some components shown removed for clarity.

All vehicles

1. Disconnect the battery ground cable.

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

2.


E157340

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

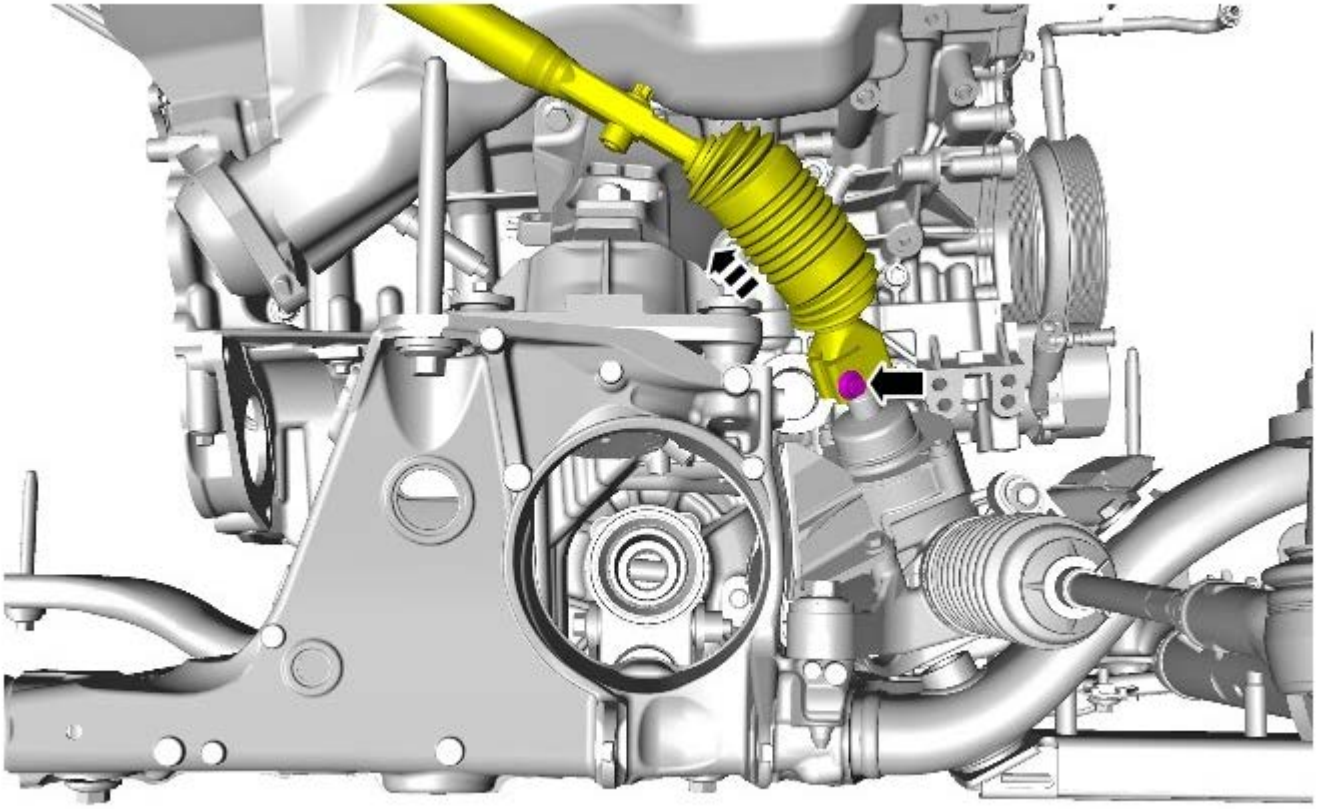
   Raise and support the vehicle.

4. Refer to: Catalytic Converter RH (309-00C Exhaust System - V8 S/C 5.0L Petrol, Removal and Installation).

5. Refer to: Starter Motor (303-06C Starting System - V8 S/C 5.0L Petrol, Removal and Installation).

Right-hand drive vehicles

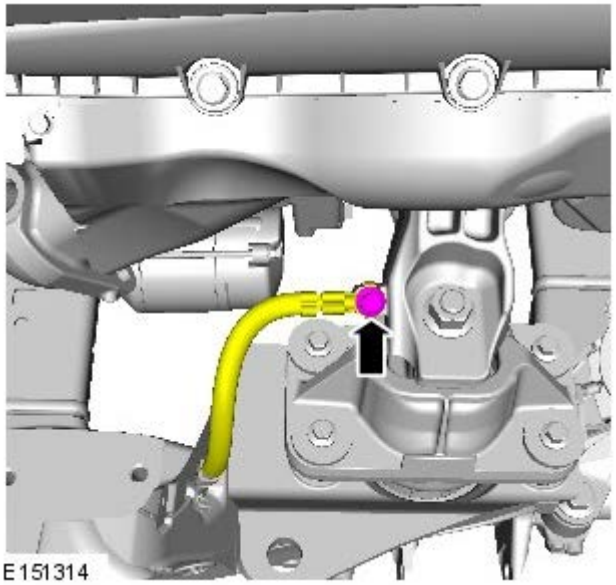
6. CAUTION: Discard the bolt.



E151313

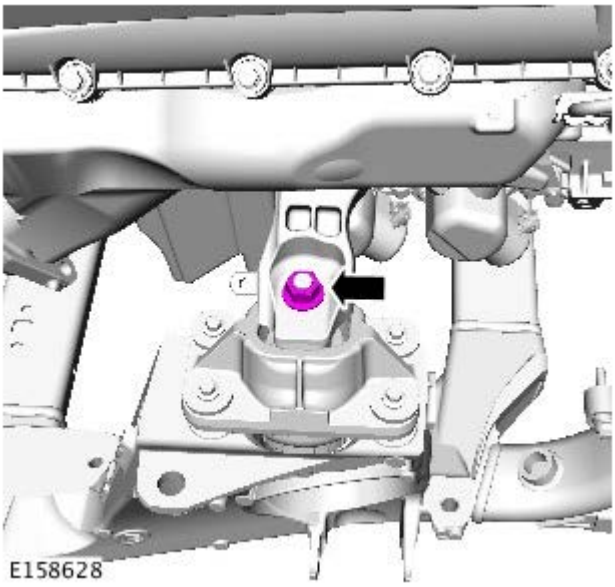
All vehicles

7.



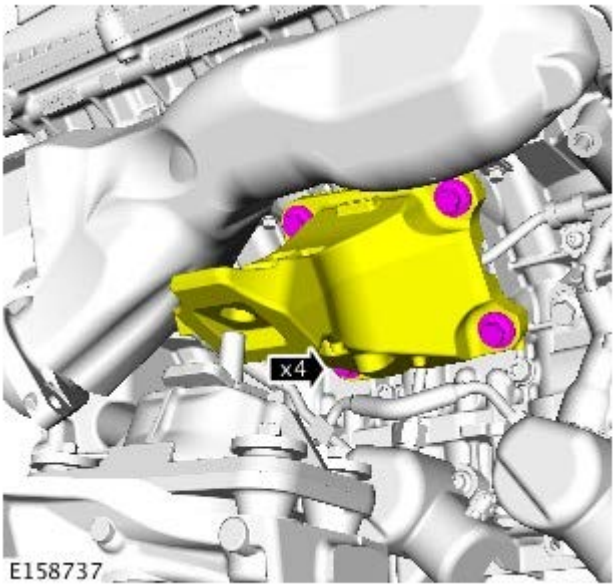
E151314

8.

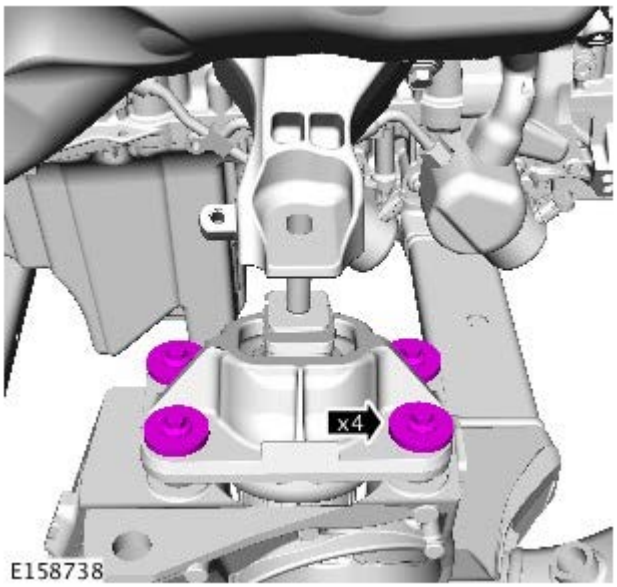


9. CAUTION: Use a wooden block to protect the oil pan when supporting the engine.

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

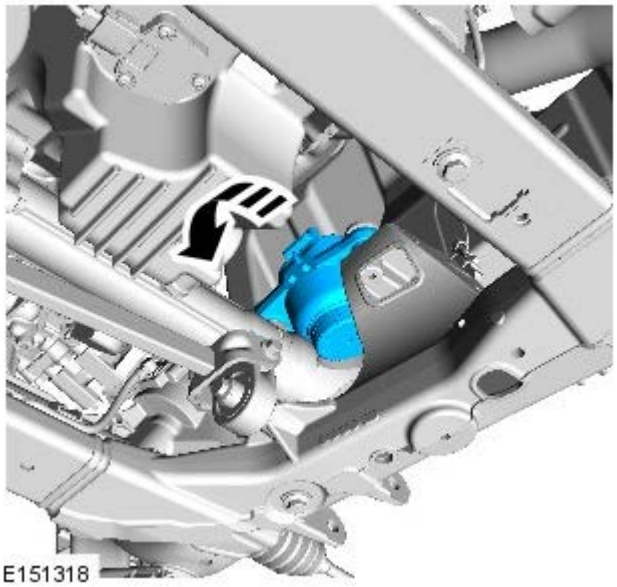


10. NOTE: Loosen the bolts, but do not fully remove.



11. CAUTION: Discard the bolts.

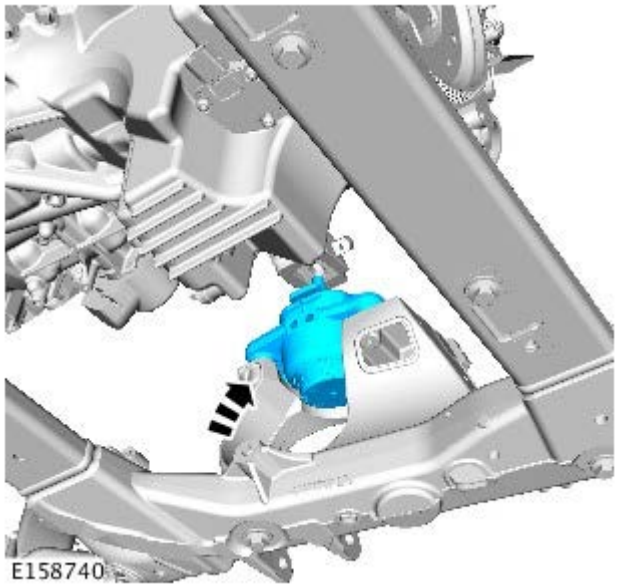
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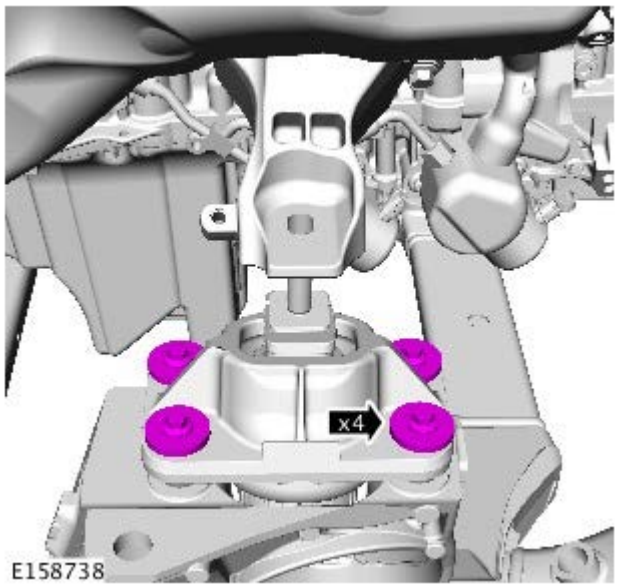


Installation

All vehicles

1.



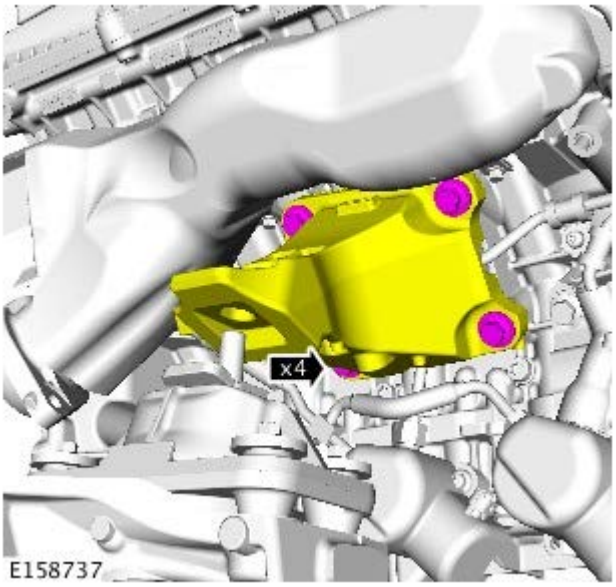


2. CAUTIONS:

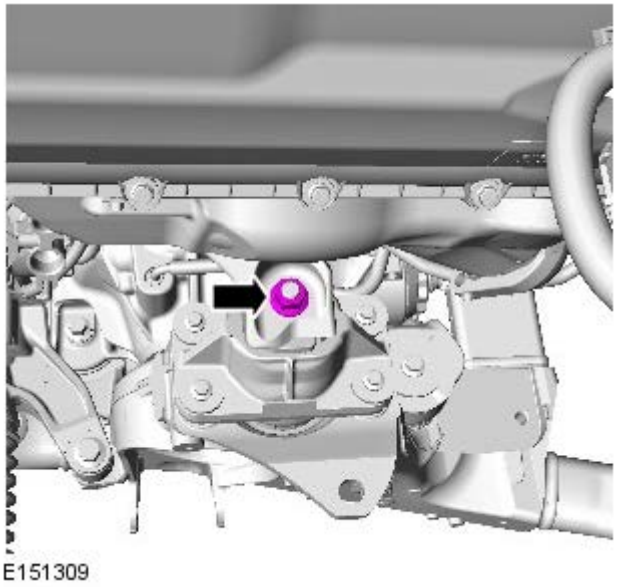
Make sure that new bolts are installed.

Only tighten the bolts finger-tight at this stage.

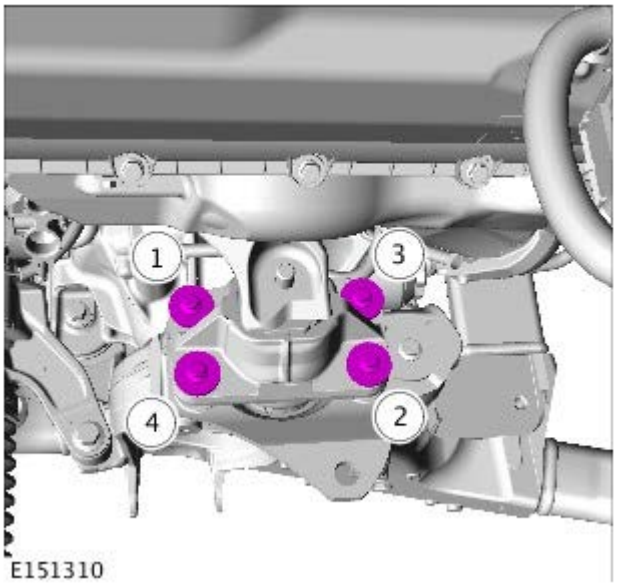
3. *Torque:*
   Stage 1: 45 Nm
   Stage 2: 60°



4. Lower the engine onto the mount.



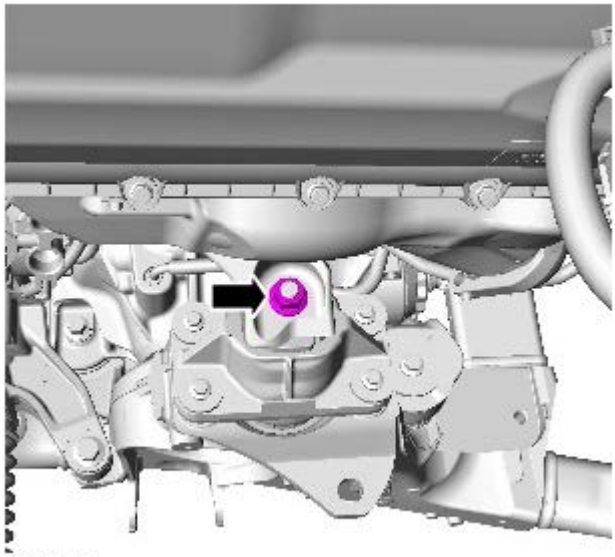
5. CAUTION: Only tighten the nut finger tight at this stage.



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

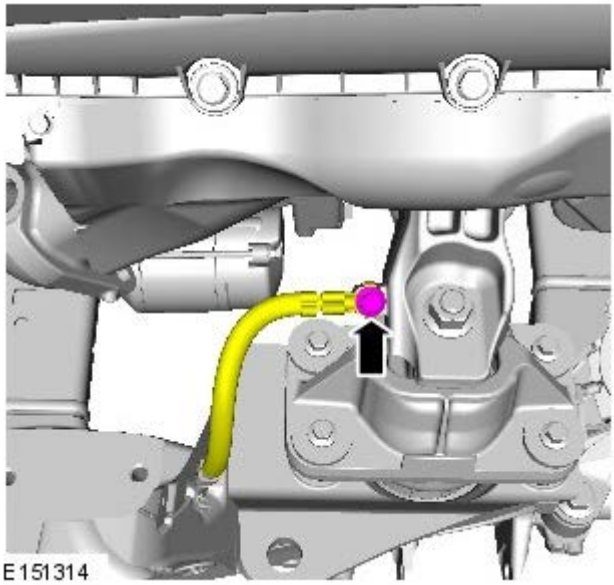
Torque: 40 Nm

7. *Torque:* 130 Nm



E151309

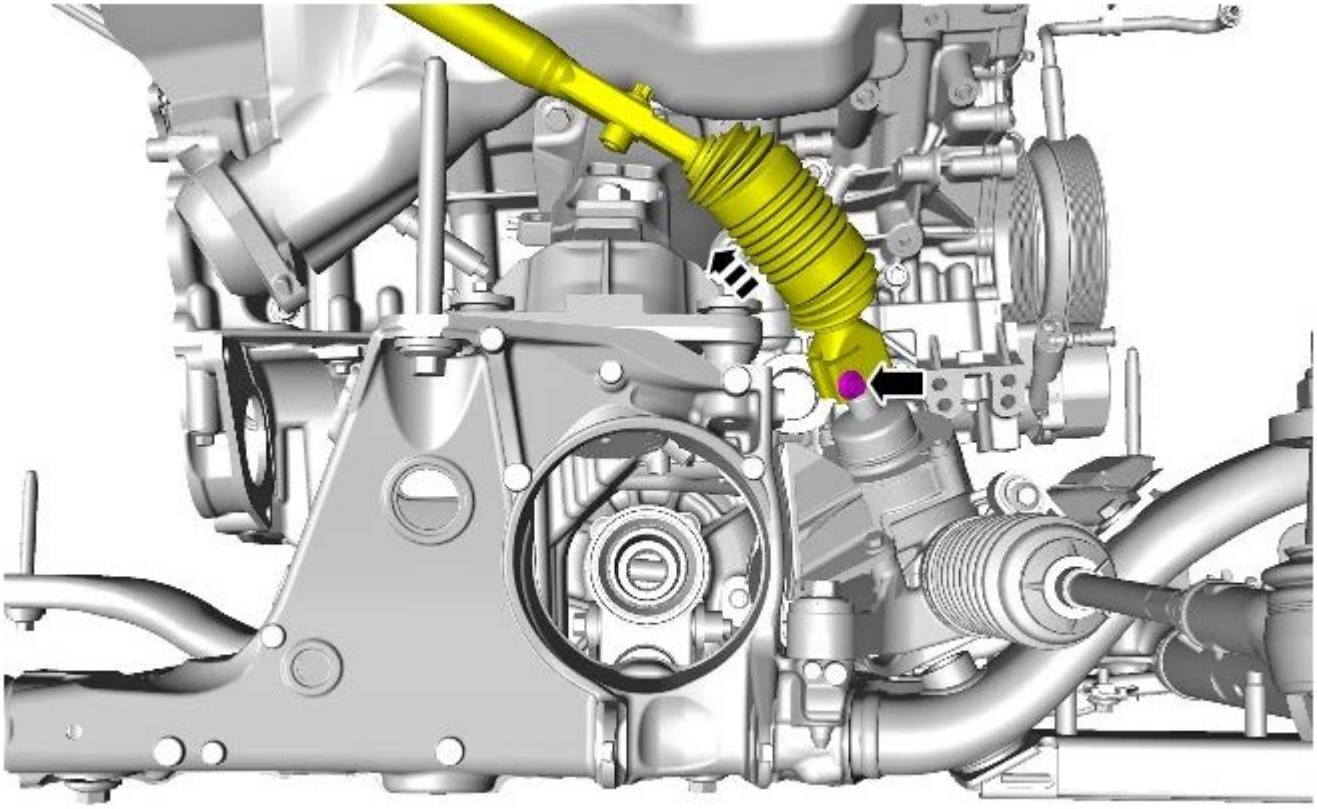
8.



E151314

Right-hand drive vehicles

9. CAUTION: Make sure that a new bolt is installed.



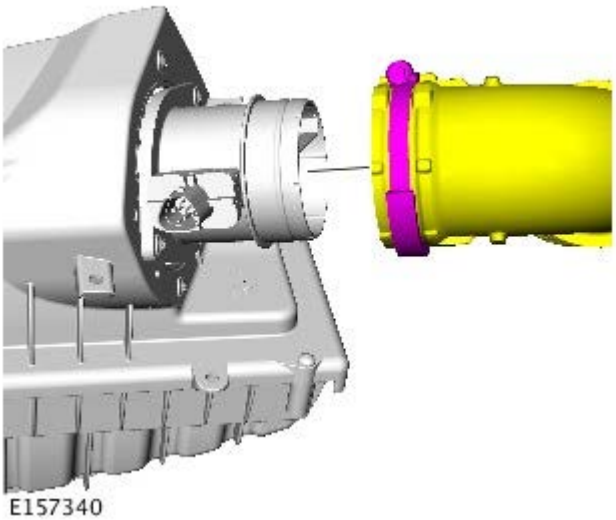
E151313

All vehicles

10. Refer to: Starter Motor (303-06C Starting System - V8 S/C 5.0L Petrol, Removal and Installation).

11. Refer to: Catalytic Converter RH (309-00C Exhaust System - V8 S/C 5.0L Petrol, Removal and Installation).

12.



E157340

13. Connect the battery earth lead.

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

Published: 24-Mar-2013

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 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.

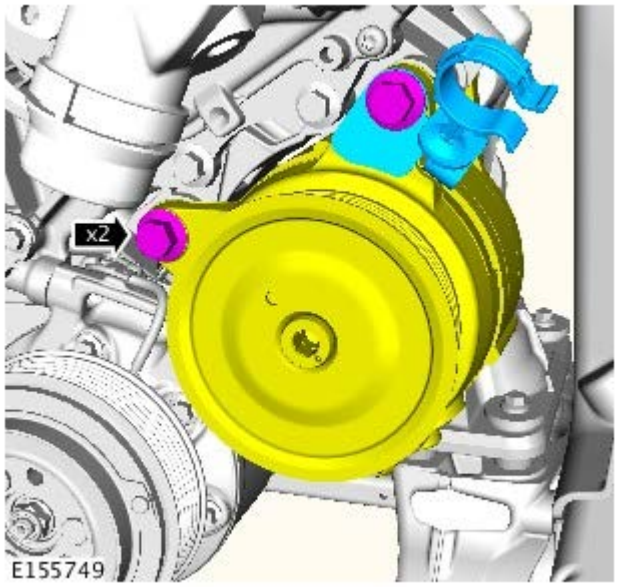
3. Refer to: Exhaust System (309-00C Exhaust System - V8 S/C 5.0L Petrol, Removal and Installation).

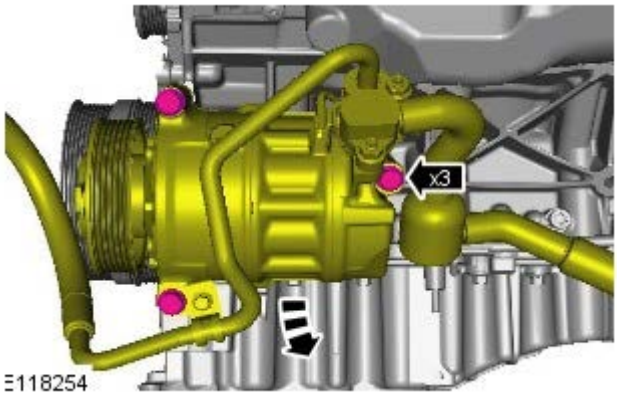
4. NOTE: If equipped with Dynamic Response.

   Refer to: Thermostat Housing (303-03C Engine Cooling - V8 S/C 5.0L Petrol, Removal and Installation).

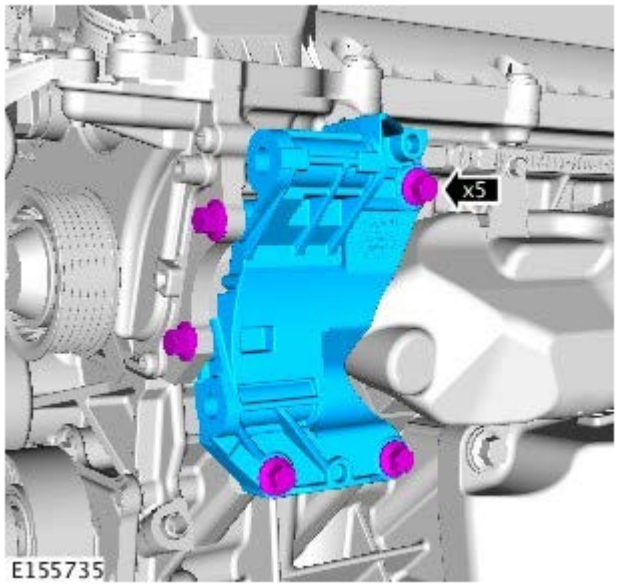
5. Refer to: Accessory Drive Belt (303-05C Accessory Drive - V8 S/C 5.0L Petrol, Removal and Installation).

6. NOTE: If equipped with Dynamic Response.



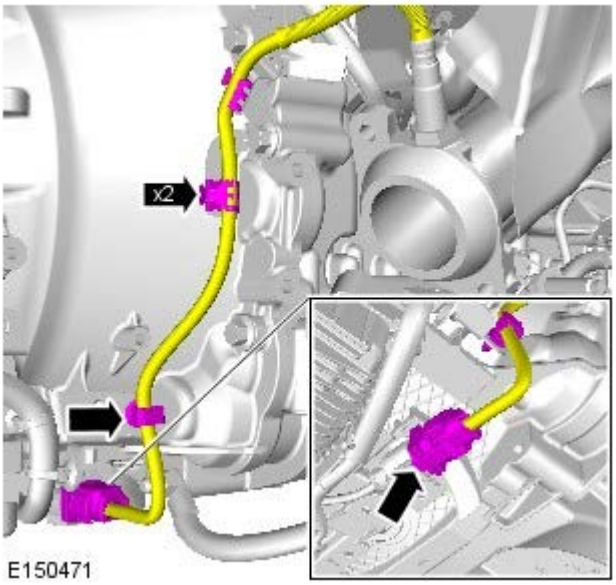


7. NOTE: Loosen the bolts, but do not fully remove.

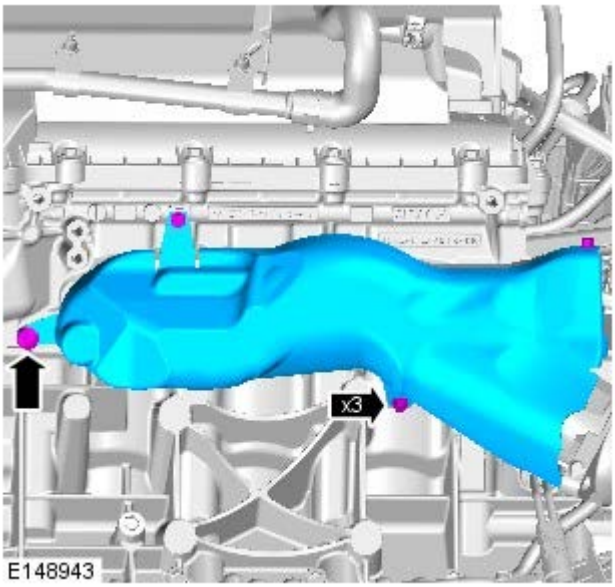


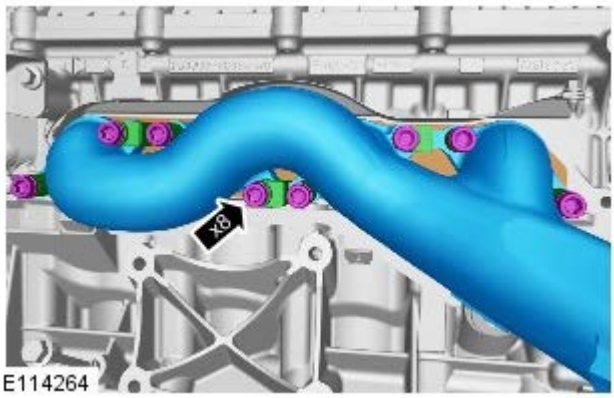
8. NOTE: If equipped with Dynamic Response.

9.



10.





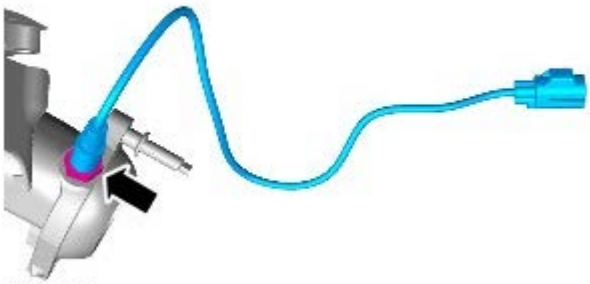
11. CAUTION: Discard the bolts.

NOTES:

Discard the gasket.

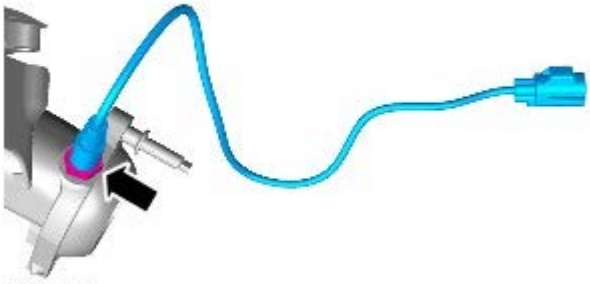
Make sure that the position of the spacers is noted before removal of the manifold.

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



E104334

Installation



E104334

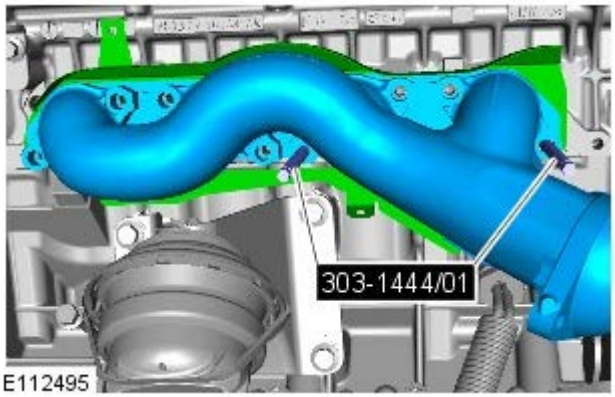
1. CAUTIONS:

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

   Make sure the anti-seize compound does not contact the HO2S tip.

   NOTE: If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.

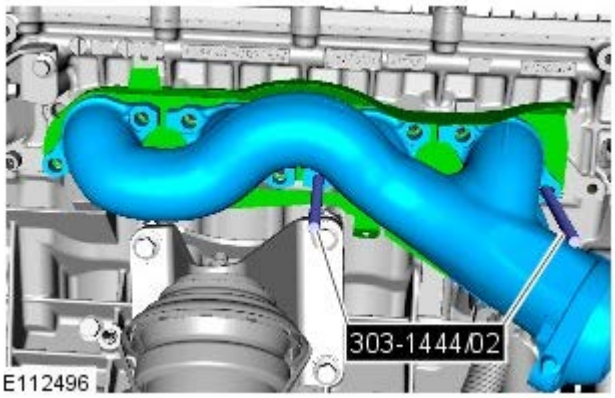
   Torque: 45 Nm



E112495

2. NOTE: Install a new gasket.

   Special Tool(s): 303-1444-01



E112496

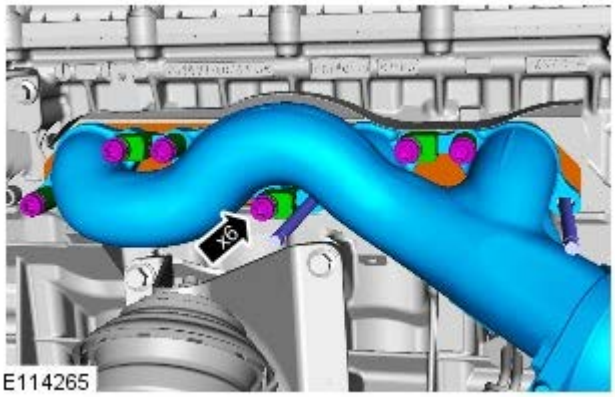
3. NOTE: If a new cylinder head is installed use the special tools in the illustration.

   Special Tool(s): 303-1444-02

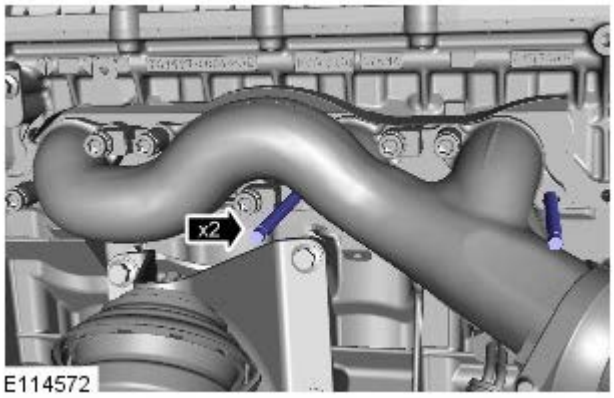
4. CAUTION: Make sure that new bolts are installed.

   NOTE: Install the spacers in the noted position.

   Torque: 10 Nm



5. Remove the special tool.

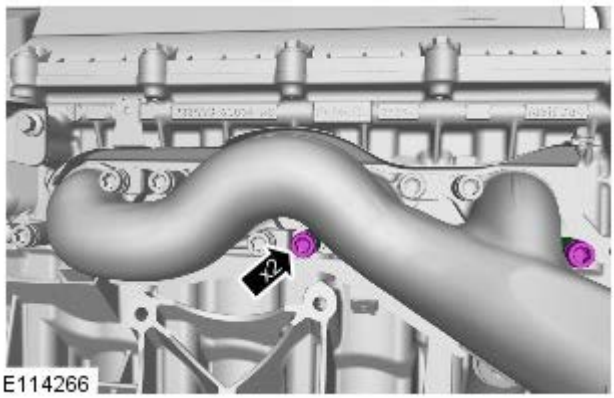


6. NOTES:

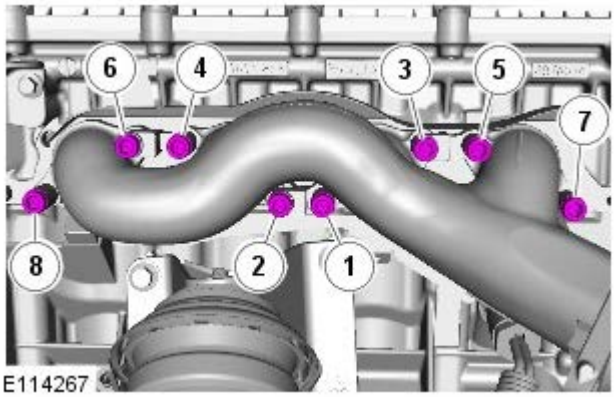
Make sure that new bolts are installed.

Install the spacers in the noted position.

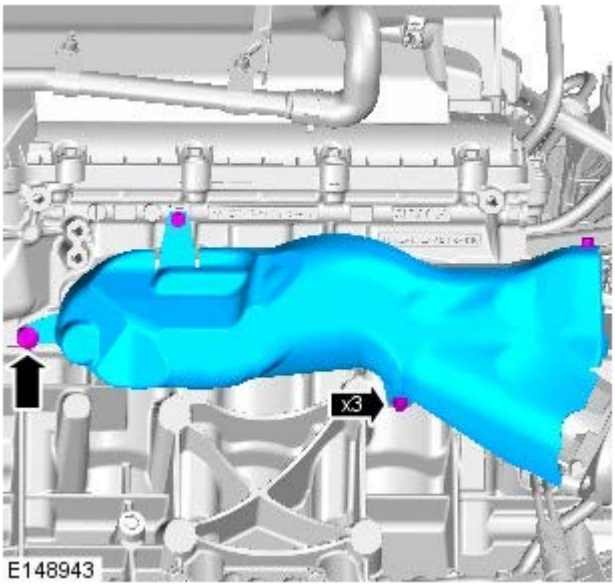
Torque: 10 Nm



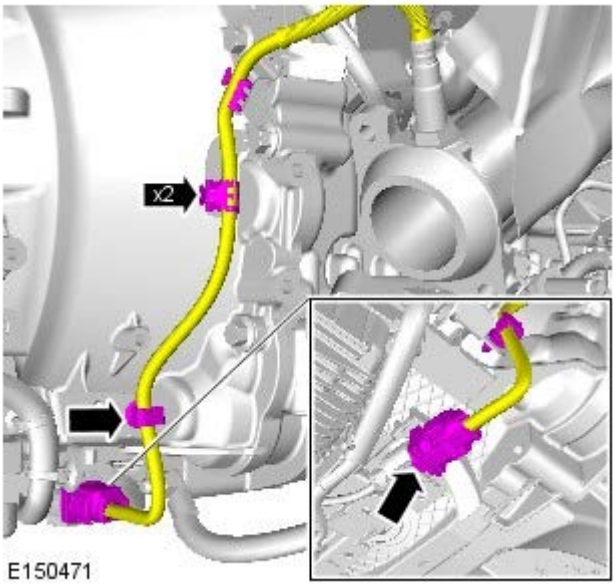
7. *Torque:* 18 Nm



8. *Torque:*
   Bolt 6.3 x 13 3 Nm
   M8 25 Nm

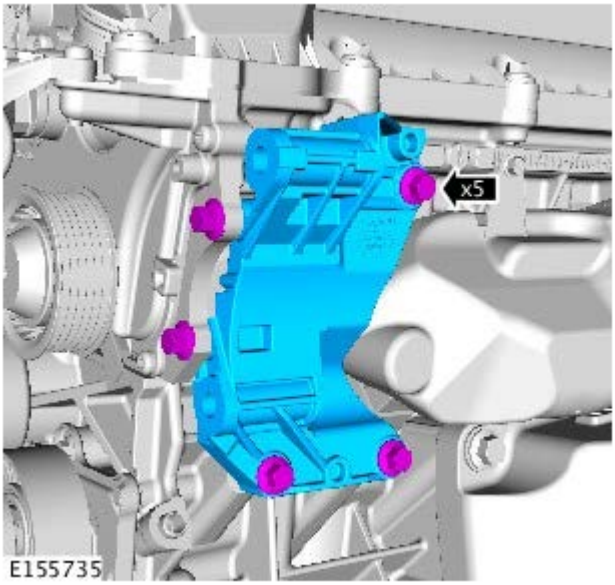


9.

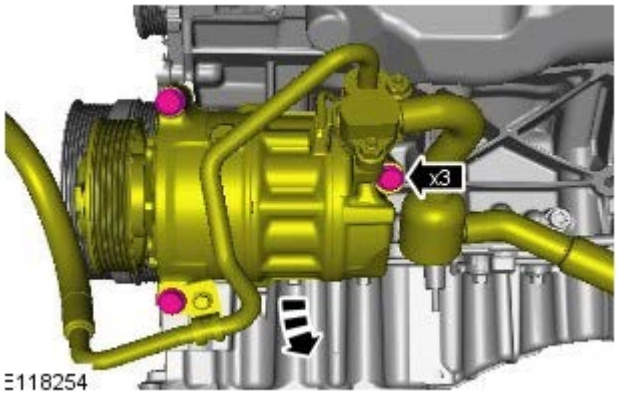


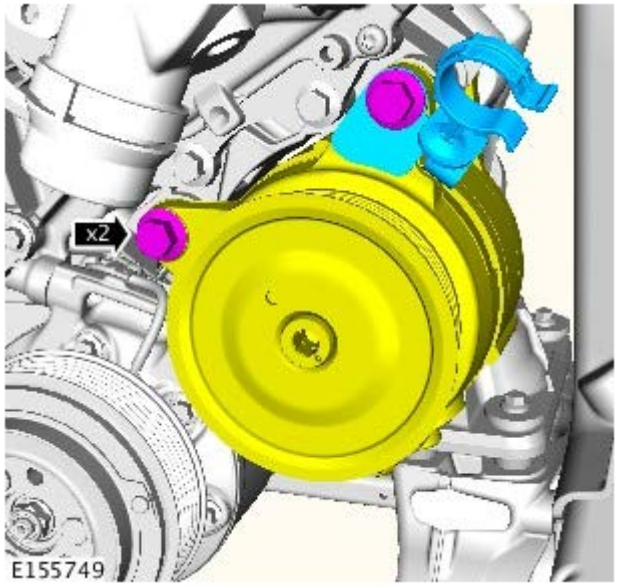
10. NOTE: If equipped with Dynamic Response.

Torque: 48 Nm



11. *Torque:* 25 Nm





12. NOTE: If equipped with Dynamic Response.

    Torque: 48 Nm

13. Refer to: Accessory Drive Belt (303-05C Accessory Drive - V8 S/C 5.0L Petrol, Removal and Installation).

14. NOTE: If equipped with Dynamic Response.

    Refer to: Thermostat Housing (303-03C Engine Cooling - V8 S/C 5.0L Petrol, Removal and Installation).

15. Refer to: Exhaust System (309-00C Exhaust System - V8 S/C 5.0L Petrol, Removal and Installation).

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

Published: 20-Mar-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

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

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).

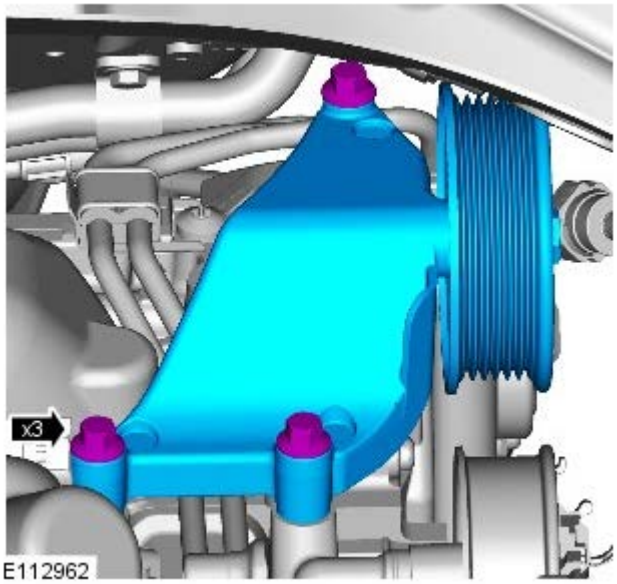
2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

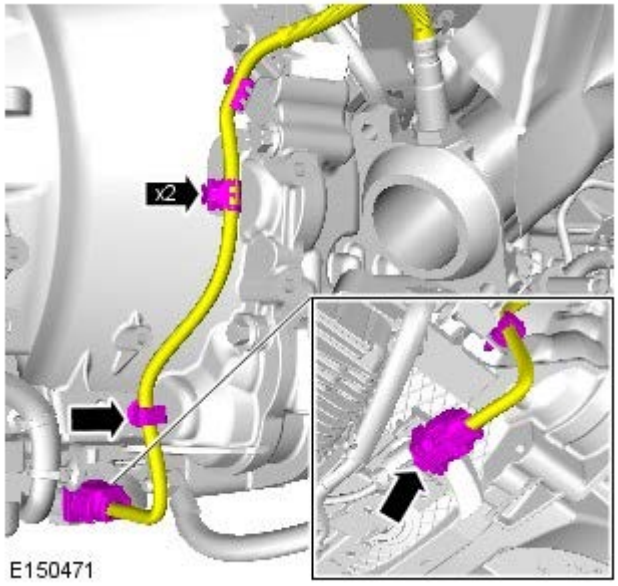
3. Refer to: Exhaust System (309-00C Exhaust System - V8 S/C 5.0L Petrol, Removal and Installation).

4. Refer to: Accessory Drive Belt (303-05C Accessory Drive - V8 S/C 5.0L Petrol, Removal and Installation).

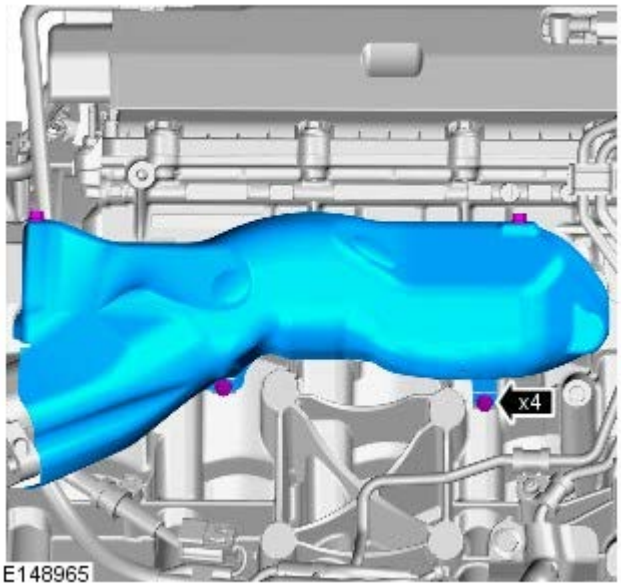
5.



6.

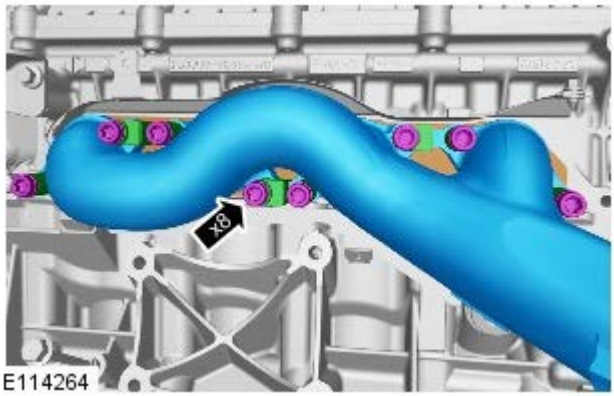


7.



8. CAUTIONS:

Discard the bolts.



E114264

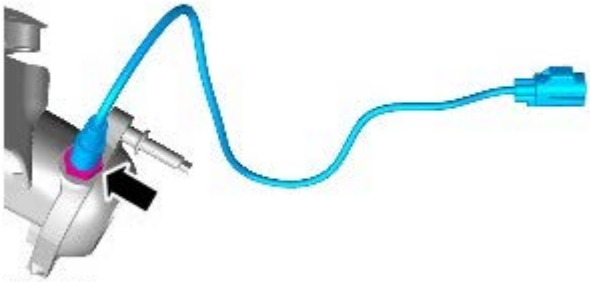
LH illustration shown, RH is similar.

NOTES:

Discard the gasket.

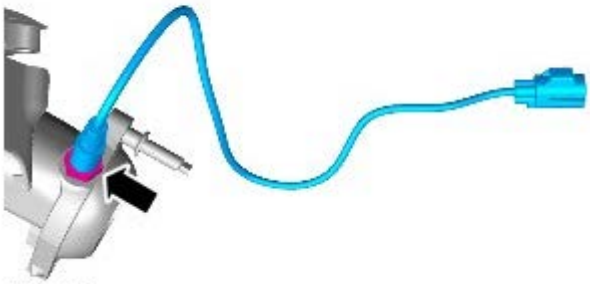
Make sure that the position of the spacers is noted before removal of the manifold.

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


E104334

Installation

1. CAUTIONS:

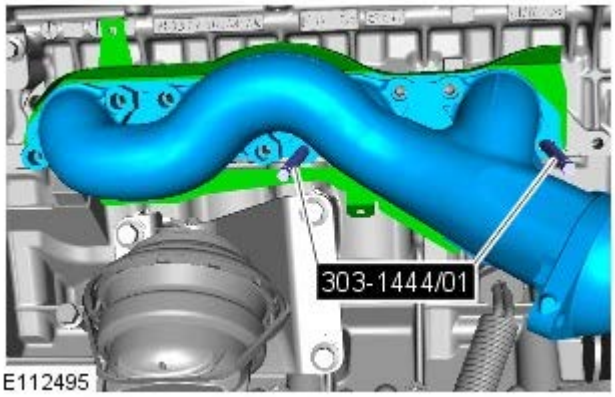

E104334

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

Make sure the anti-seize compound does not contact the HO2S tip.

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



E112495

2. CAUTION: LH illustration shown, RH is similar.

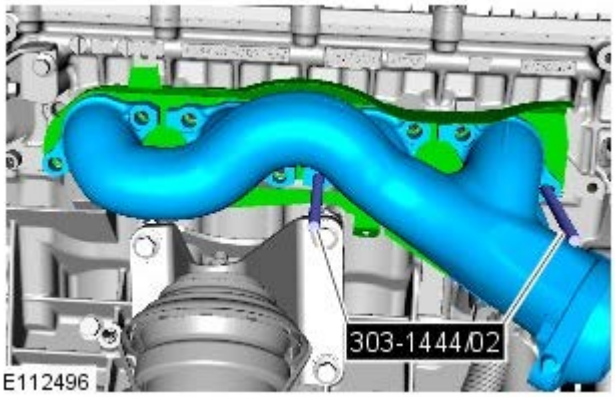
NOTE: Install a new gasket.

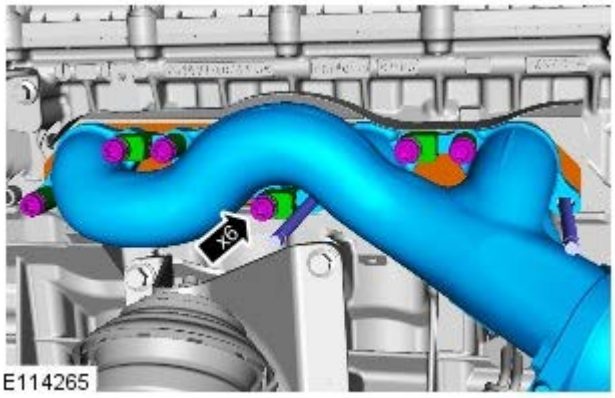
Special Tool(s): 303-1444-01

3. CAUTION: LH illustration shown, RH is similar.

NOTE: If a new cylinder head is installed use the special tools in the illustration.

Special Tool(s): 303-1444-02





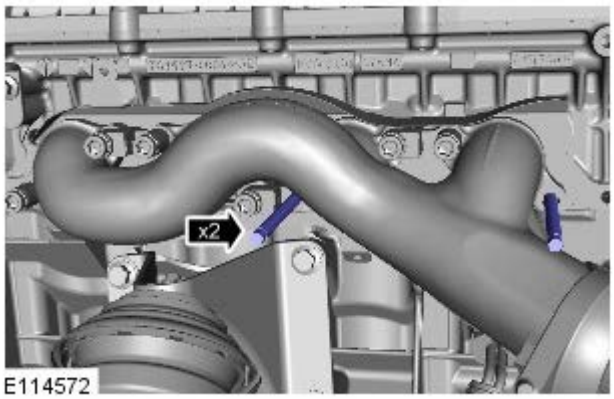
4. CAUTIONS:

   Make sure that new bolts are installed.

   LH illustration shown, RH is similar.

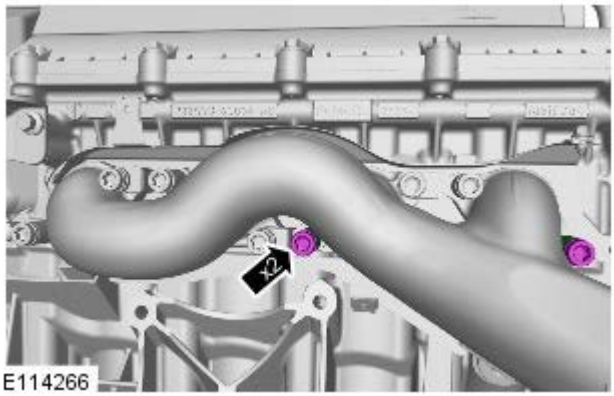
   NOTE: Install the spacers in the noted position.

   Torque: 10 Nm



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

   Remove the special tool.



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

   NOTES:

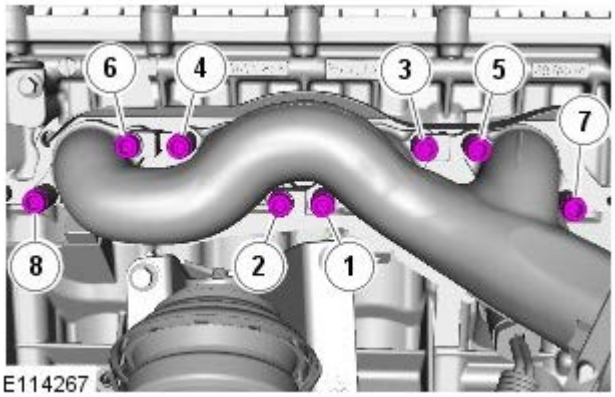
   Make sure that new bolts are installed.

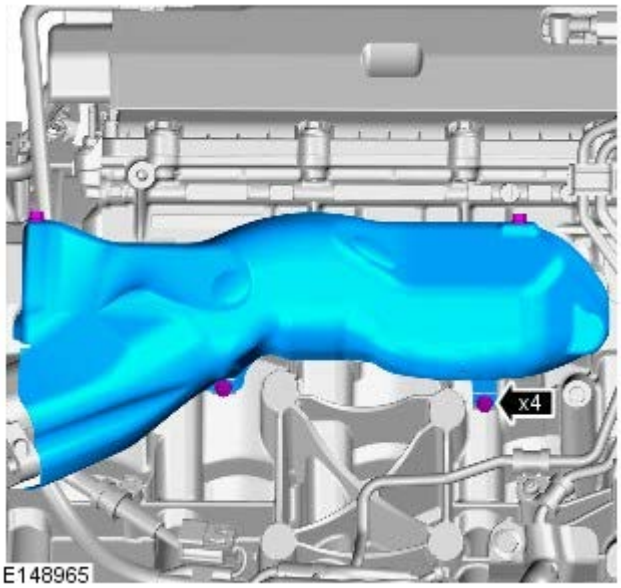
   Install the spacers in the noted position.

   Torque: 10 Nm

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

   Torque: 18 Nm

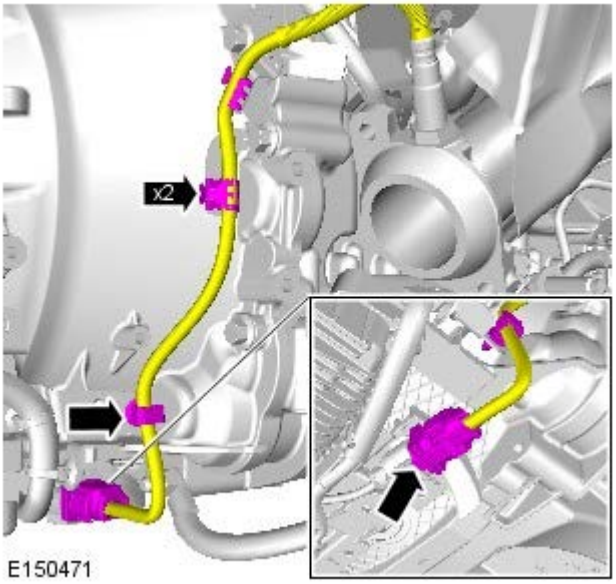




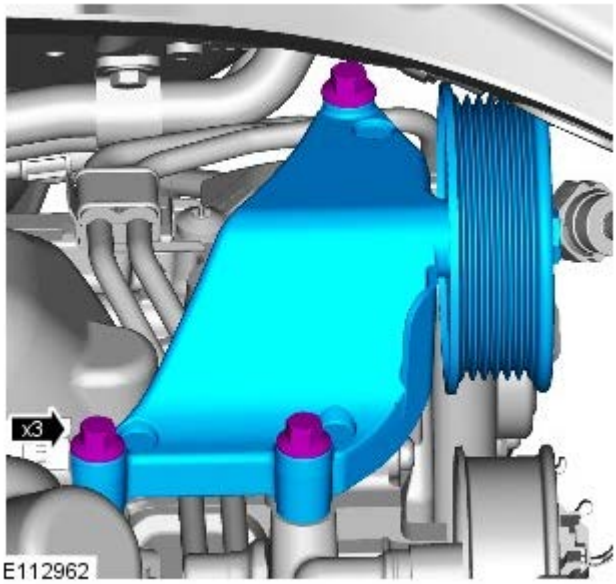
8. CAUTION: LH illustration shown, RH is similar.

   Torque: 3 Nm

9.



10. *Torque:* 25 Nm



11. Refer to: Accessory Drive Belt (303-05C Accessory Drive - V8 S/C 5.0L Petrol, Removal and Installation).

12. Refer to: Exhaust System (309-00C Exhaust System - V8 S/C 5.0L Petrol, Removal and Installation).

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

Published: 31-Jul-2012

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 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 - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, 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: 10-Sep-2012

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 Battery and Charging System - General Information, Specifications).

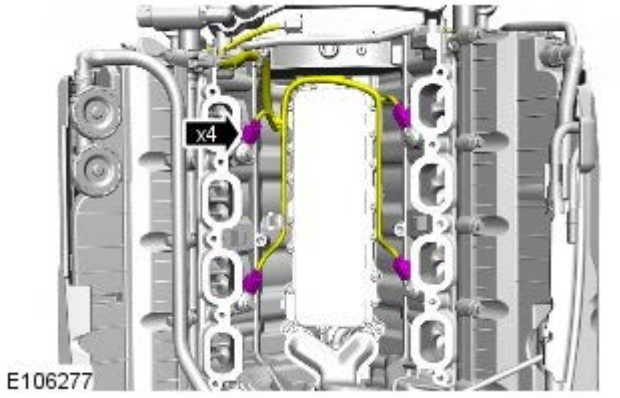
2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

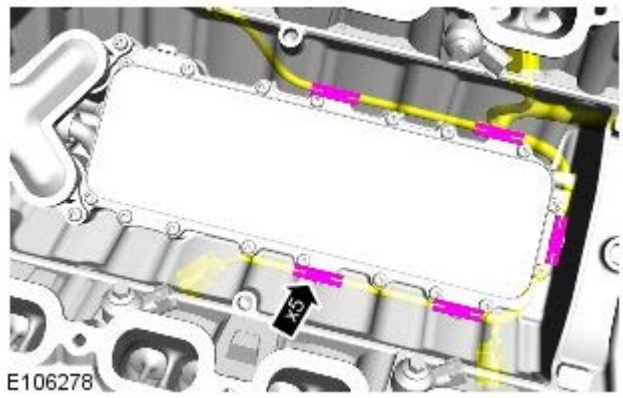
3. Refer to: Engine Oil Draining and Filling (303-01 Engine - V8 S/C 5.0L Petrol, General Procedures).

4. Refer to: Supercharger (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).

5.



6.

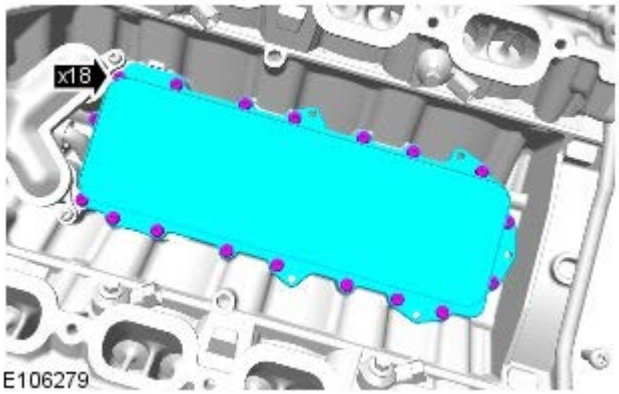


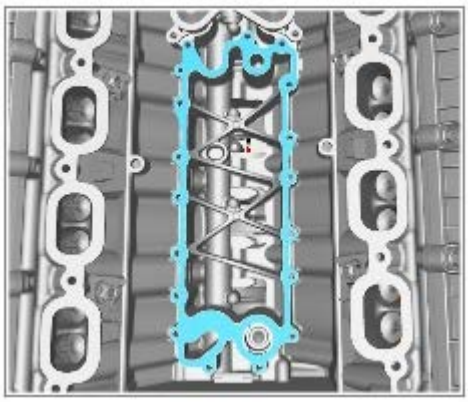
7. CAUTIONS:

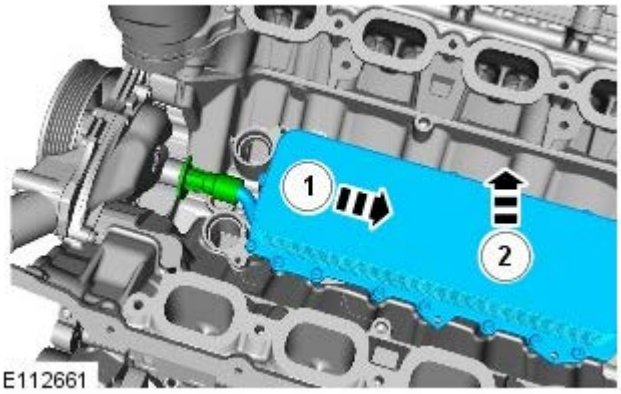
   Be prepared to collect escaping oil.

   Be prepared to collect escaping coolant.

   Torque: 13 Nm







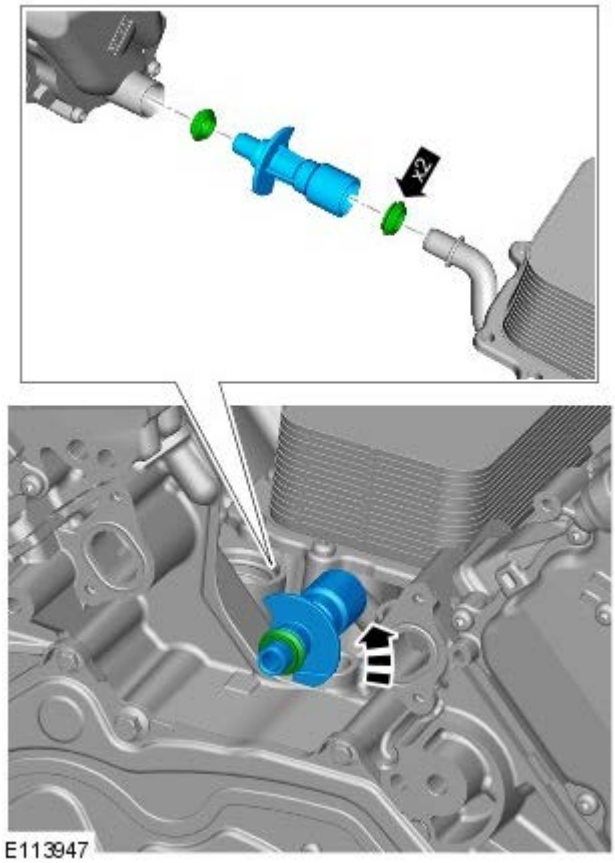
8. CAUTION: Make sure that these components are installed to the noted removal position.

NOTE: Install a new gasket.

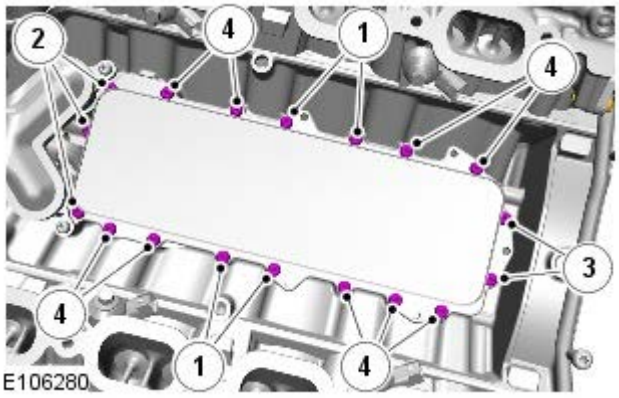
9. CAUTIONS:

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: 15-Mar-2013

Engine - V8 S/C 5.0L Petrol - Oil Filter Element

Removal and Installation

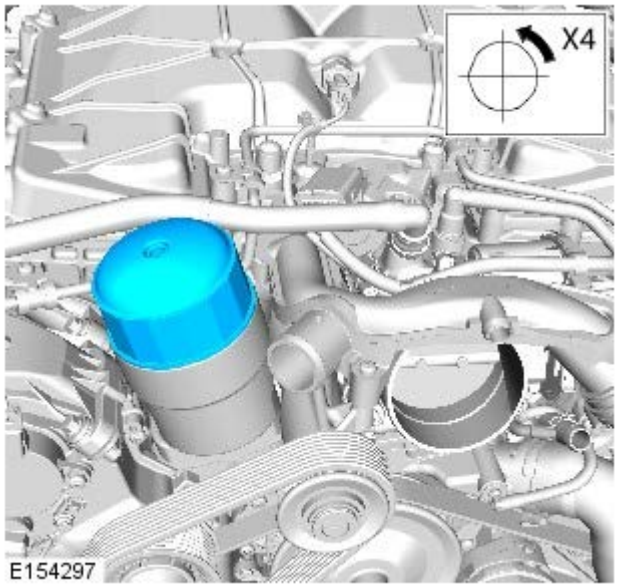
Removal

NOTES:

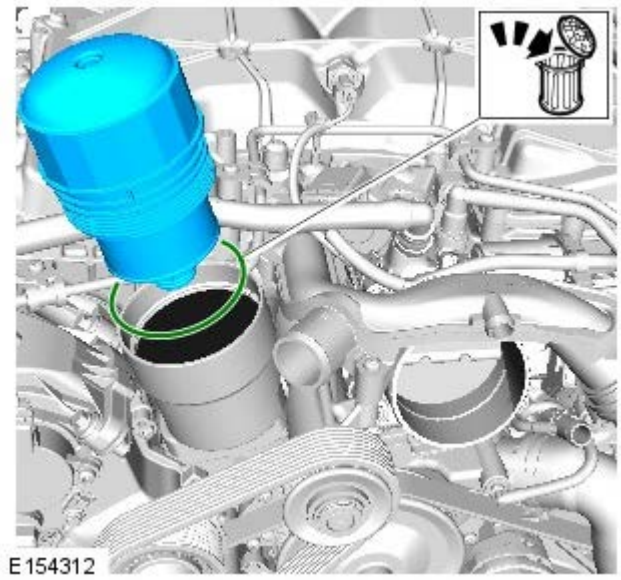
Some variation in the illustrations may occur, but the essential information is always correct.

Removal steps in this procedure may contain installation details.

1. Refer to: Engine Cover - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (501-05 Interior Trim and Ornamentation, Removal and Installation).

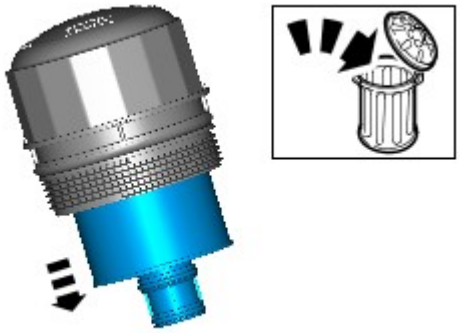


2. NOTE: Allow 10 minutes for the engine oil to drain from the oil filter housing.



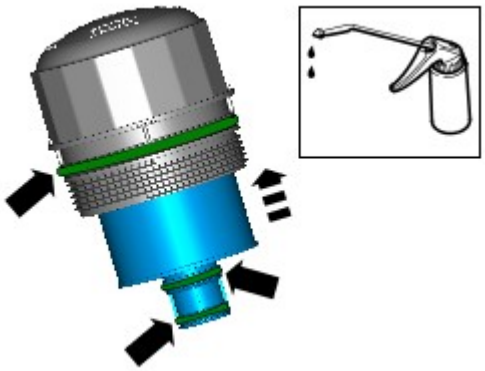
3. CAUTION: Remove and discard the O-ring seal.

4. CAUTION: Remove and discard the element.



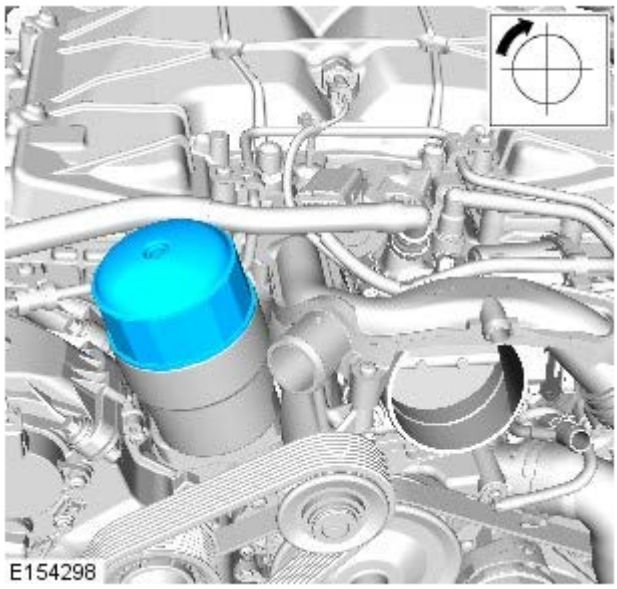
E107394

Installation



E107727

1. CAUTION: Install new O-ring seals.



E154298

2. CAUTION: Tighten the component finger tight first.

   Torque: 25 Nm

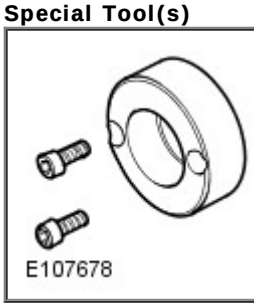
3. Start and run the engine.
4. NOTE: Allow 10 minutes from the engine switch off for the engine oil level to stabilize.
5. Check and top-up the engine oil.
6. Refer to: Engine Cover - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (501-05 Interior Trim and Ornamentation, Removal and Installation).

Published: 13-May-2013

Engine - V8 S/C 5.0L Petrol - Oil Pan Extension

Removal and Installation

Special Tool(s)

 E107678	303-1442 Rear Crankshaft Seal Installer

Removal

NOTES:

Some components shown removed for clarity.

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

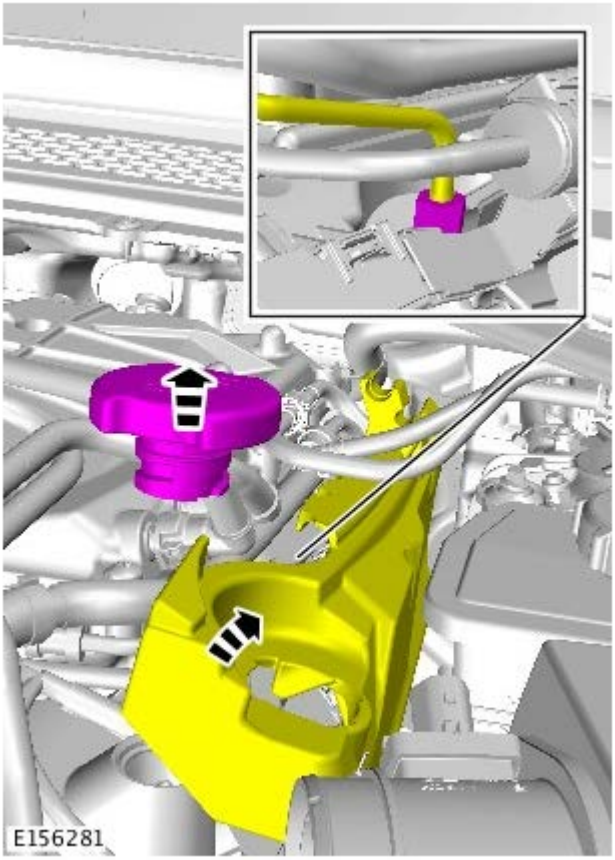
1. Disconnect the battery ground cable.

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

2. Refer to: Engine Oil Draining and Filling (303-01C Engine - V8 S/C 5.0L Petrol, General Procedures).

3. Refer to: High-Pressure Fuel System Bleeding (310-00 Fuel System - General Information, General Procedures).

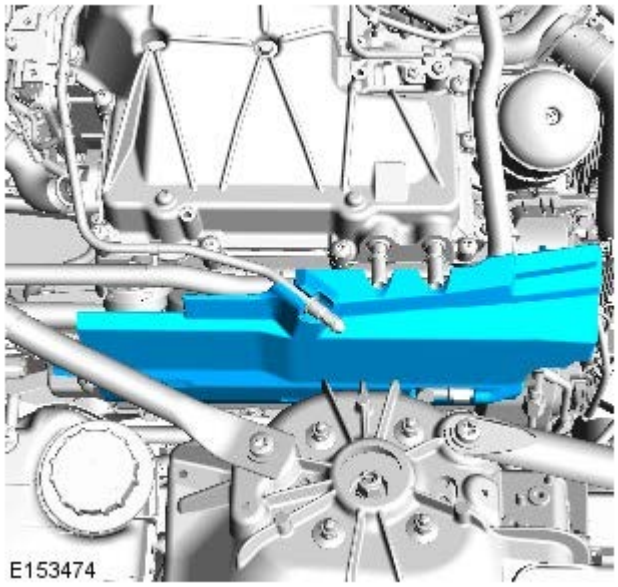
4. Refer to: Fuel Injection Component Cleaning (303-04D Fuel Charging and Controls - V8 S/C 5.0L Petrol, General Procedures).



5. CAUTION: Be prepared to collect escaping fuel.

   Loosen the high-pressure fuel supply line.

6.

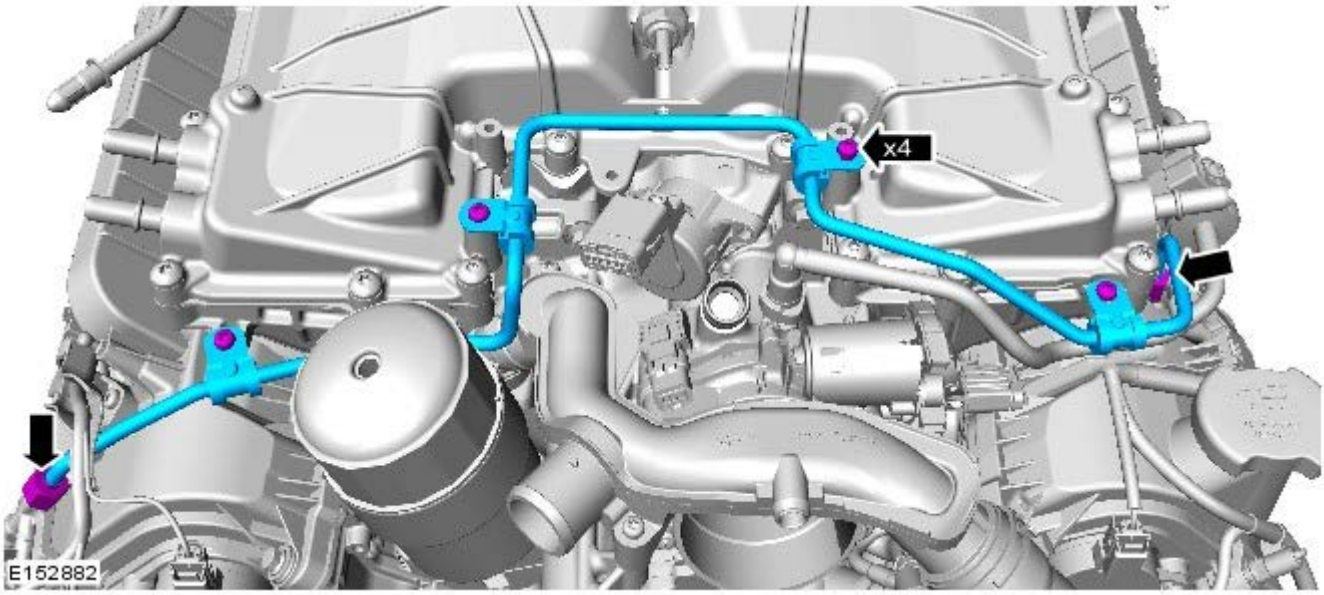


7. WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable mixtures are always present and may ignite. Failure to follow these instructions may result in personal injury.

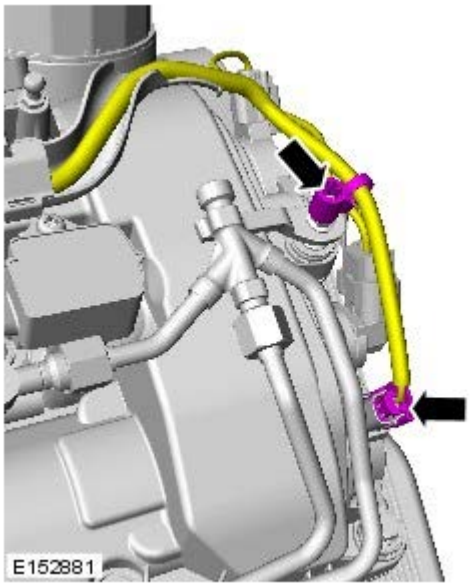
   CAUTIONS:

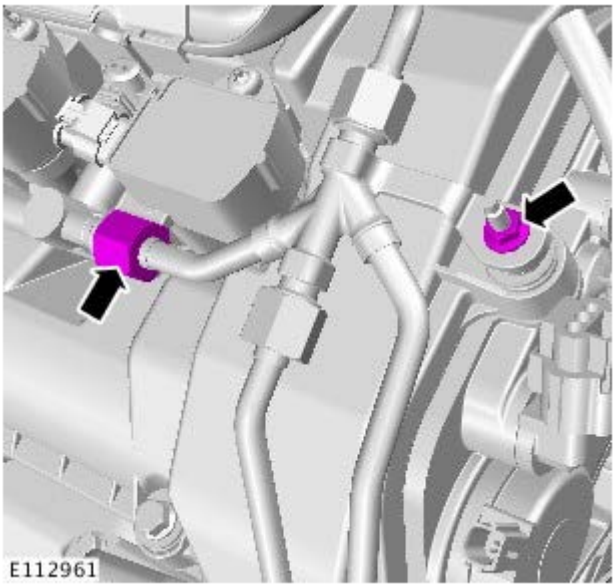
   Be prepared to collect escaping fuel.

   Remove and discard the high-pressure fuel supply lines.



8.





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 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.

10. 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.

11. Refer to: Generator - V8 S/C 5.0L Petrol (414-02 Generator and Regulator - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Removal and Installation).

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

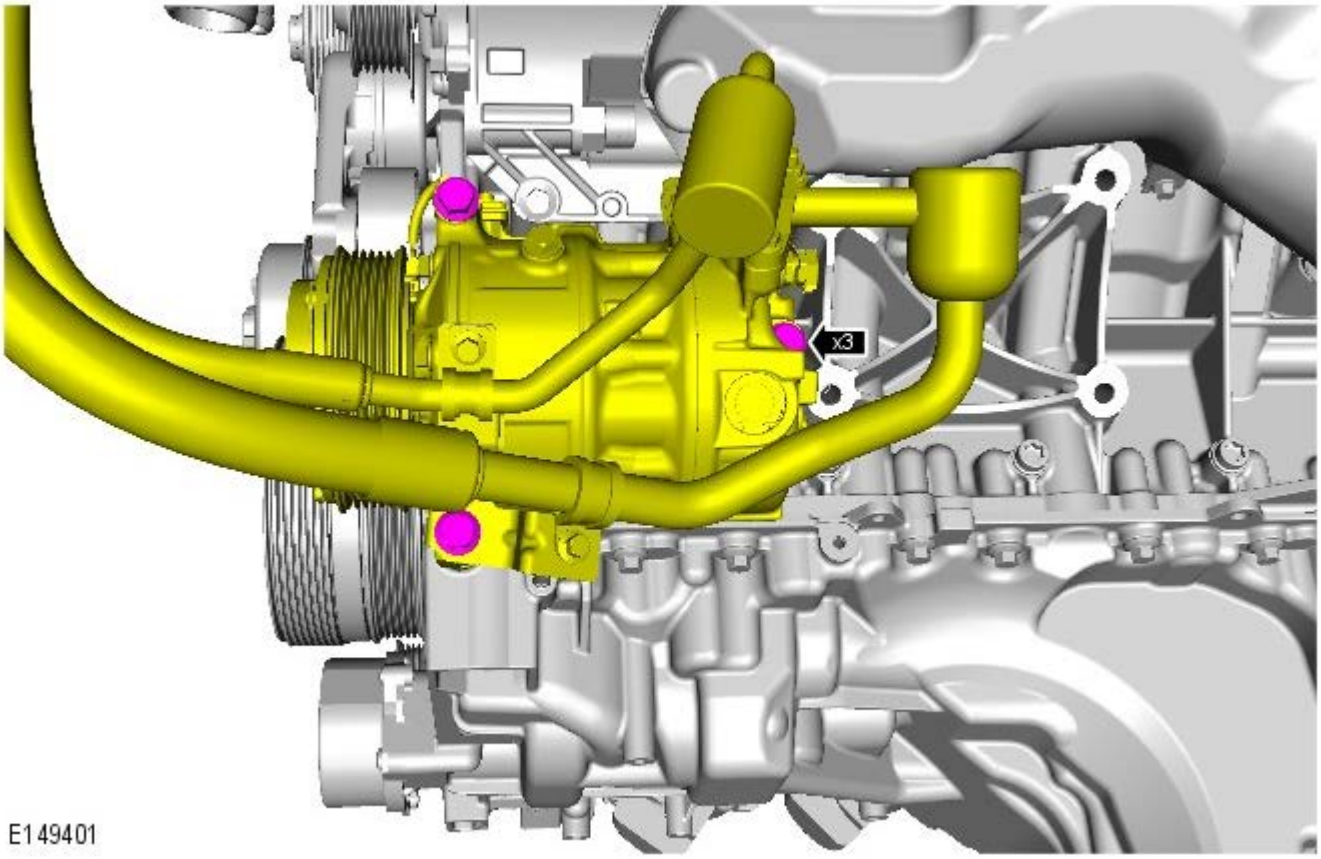
13. Refer to: Transmission - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, Removal).

14. Refer to: Starter Motor (303-06C Starting System - V8 S/C 5.0L Petrol, Removal and Installation).

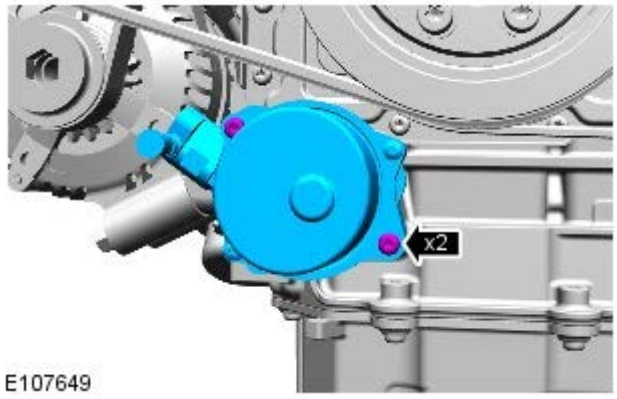
15. NOTES:

    Using suitable cable tie secure the A/C compressor.

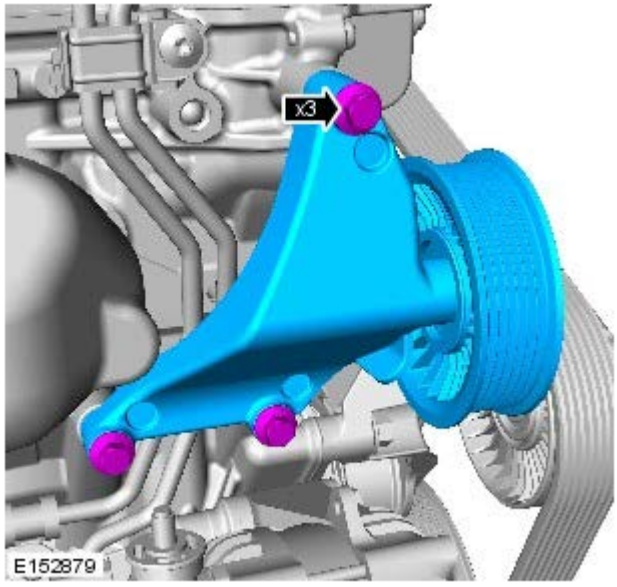
    Engine shown removed for clarity.



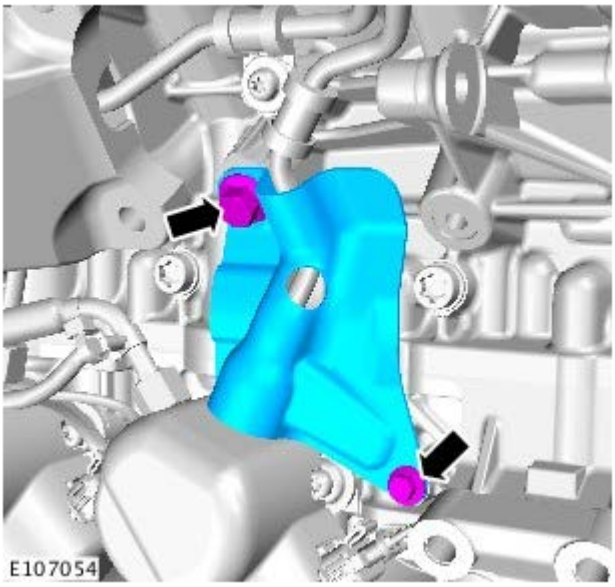
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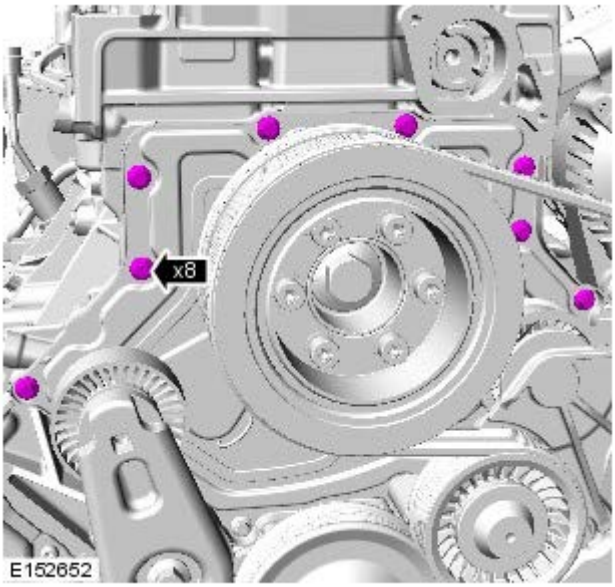


17.



18.

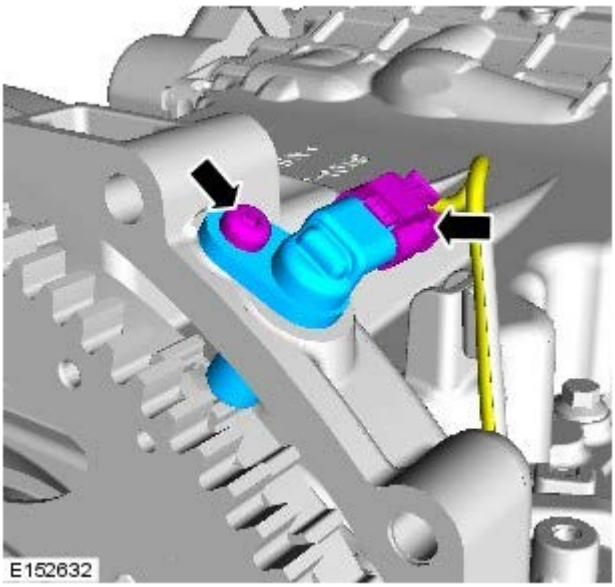




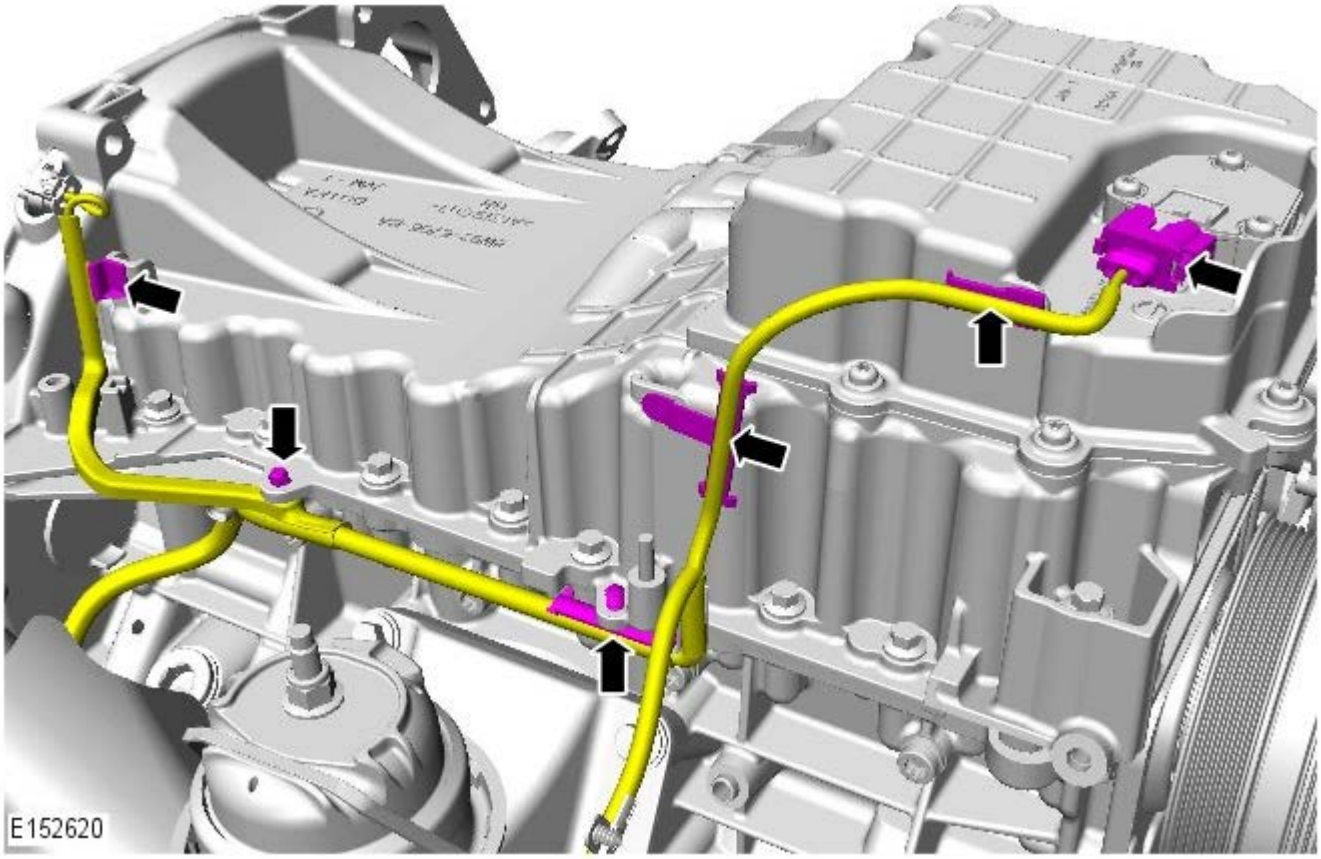
19. CAUTION: Only remove the bolts shown in the illustration, do not remove the crankshaft damper.

NOTE: Engine shown removed for clarity.

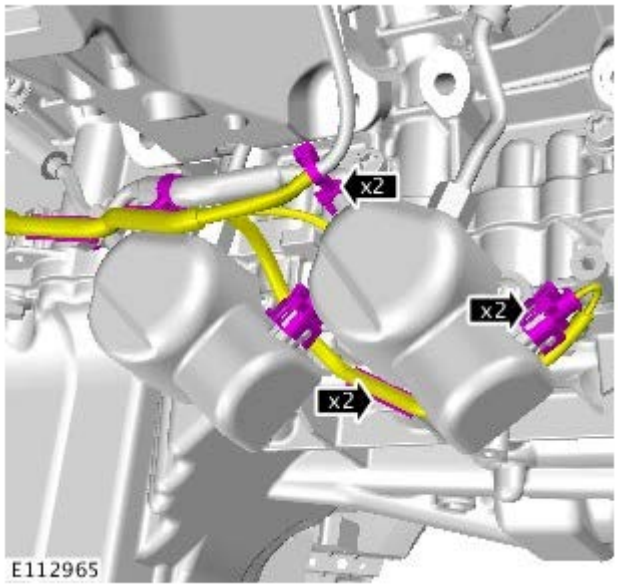
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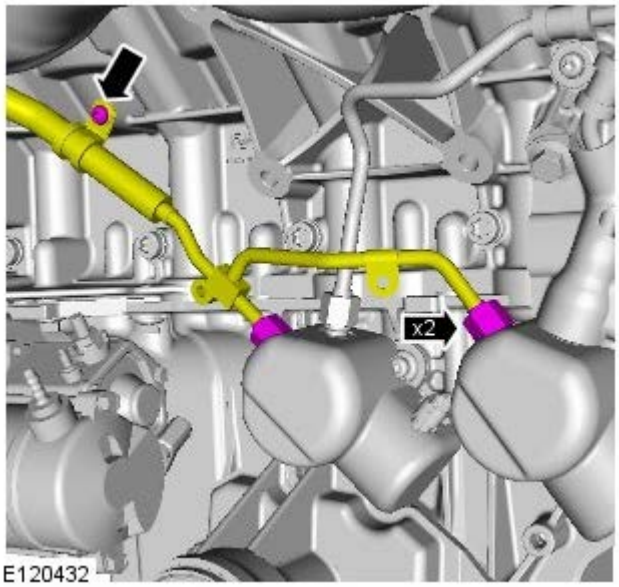
21. NOTE: Engine shown removed for clarity.



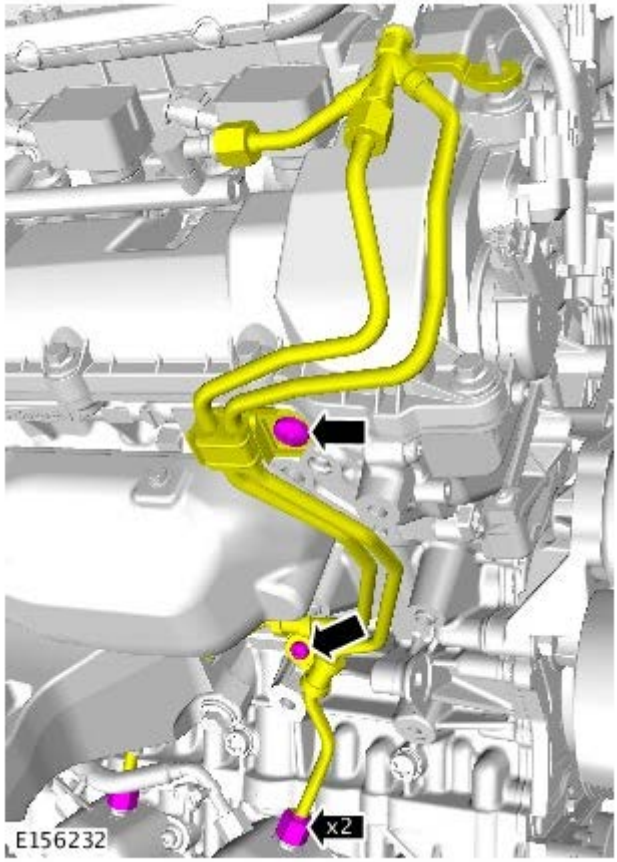
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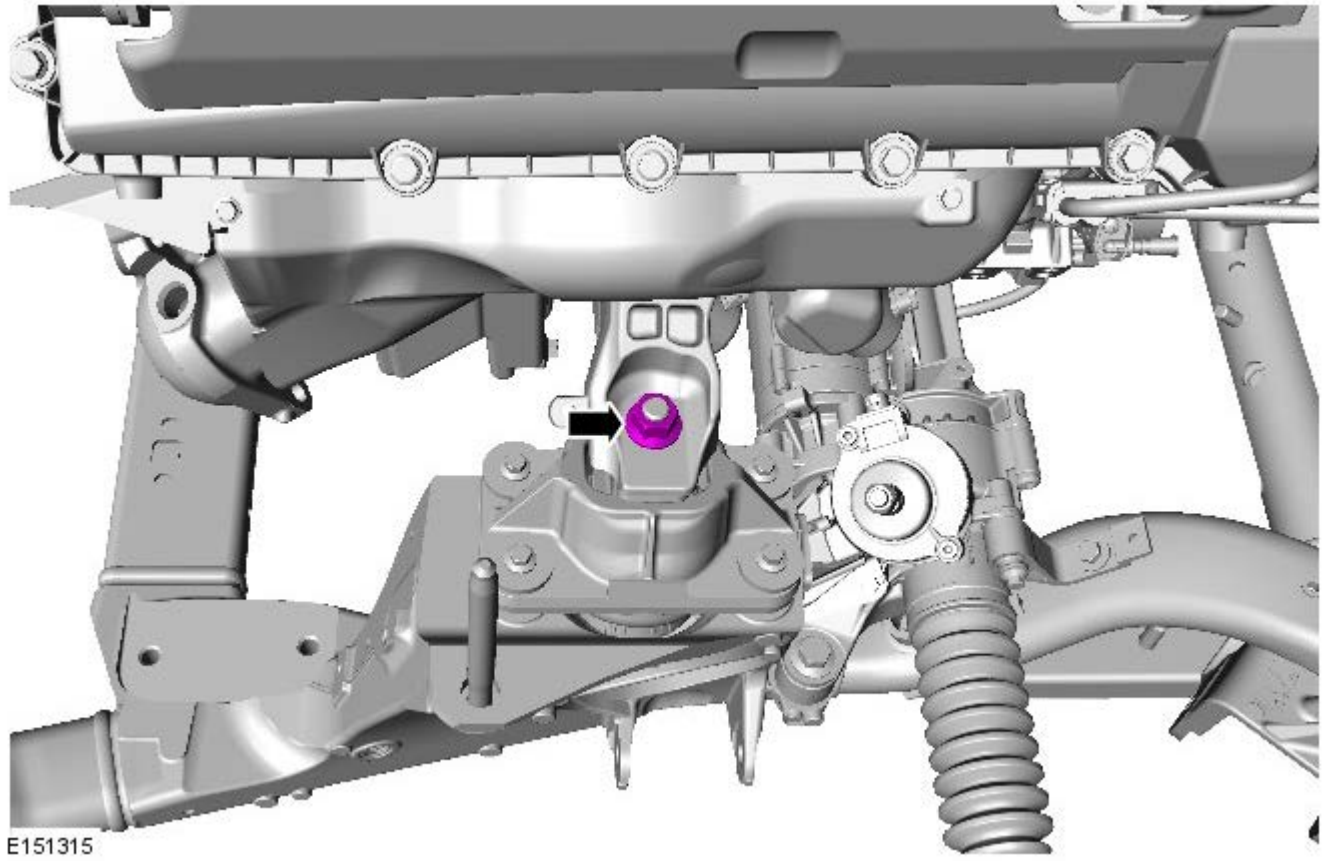
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24.

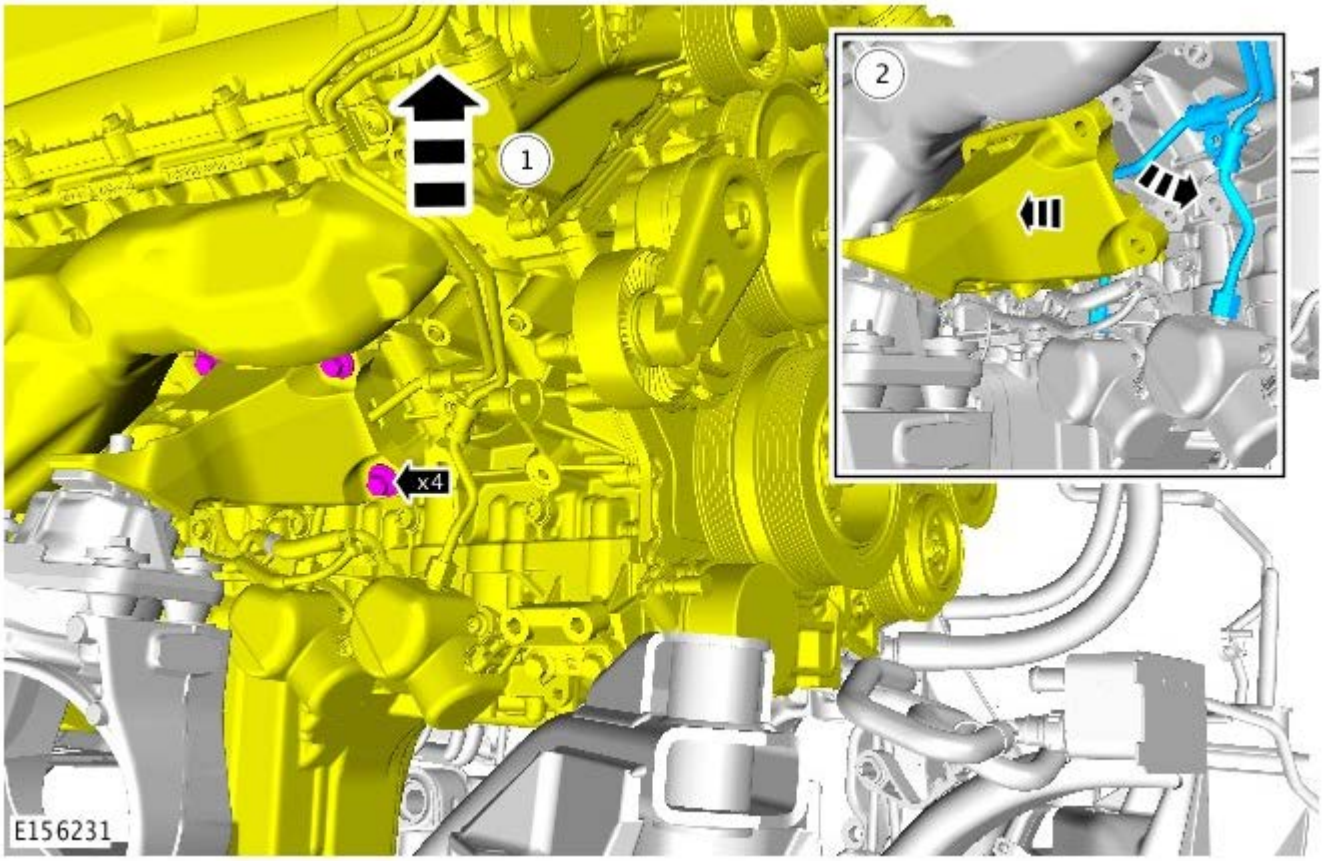


25.



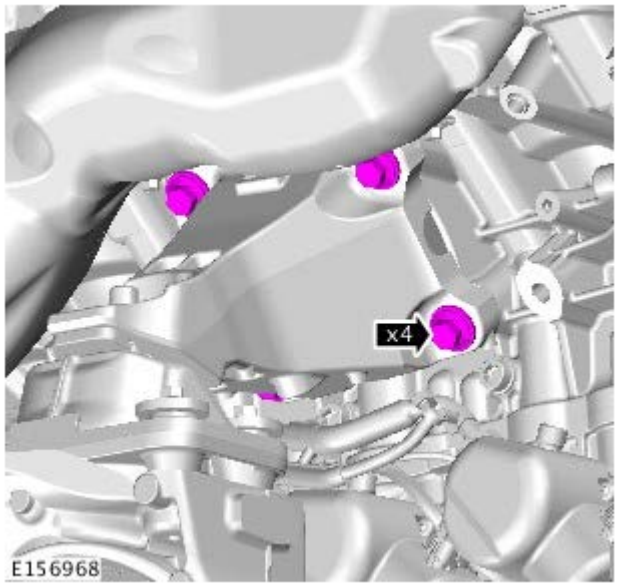
26. CAUTION: Use a wooden block to protect the oil pan when supporting the engine.

    Using a suitable hydraulic jack, raise and support the engine to release the fuel pipe.

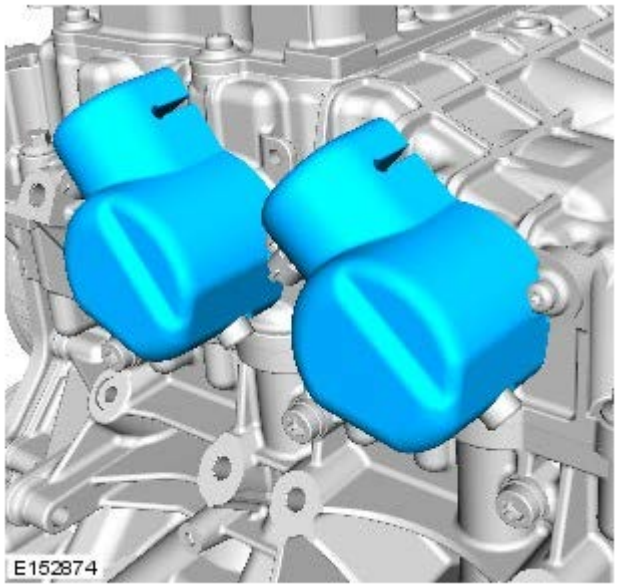


27. Carefully lower the engine onto the engine mounts.

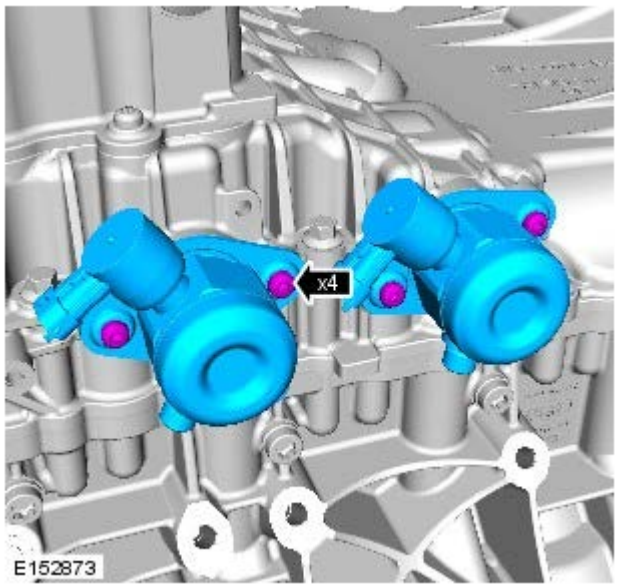
    Torque: 20 Nm



28.

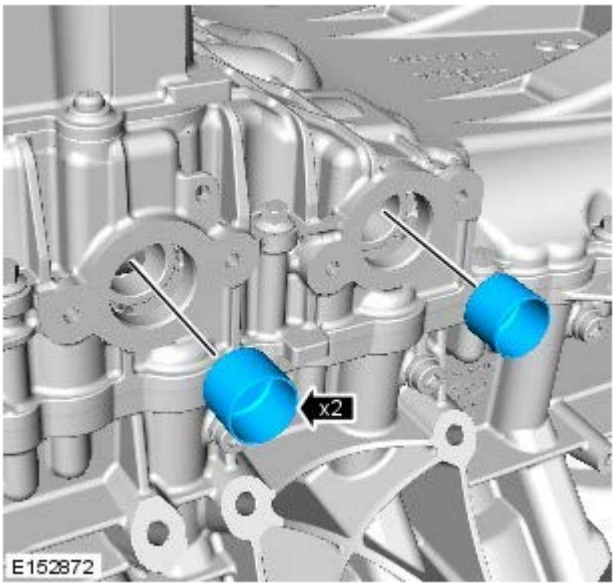


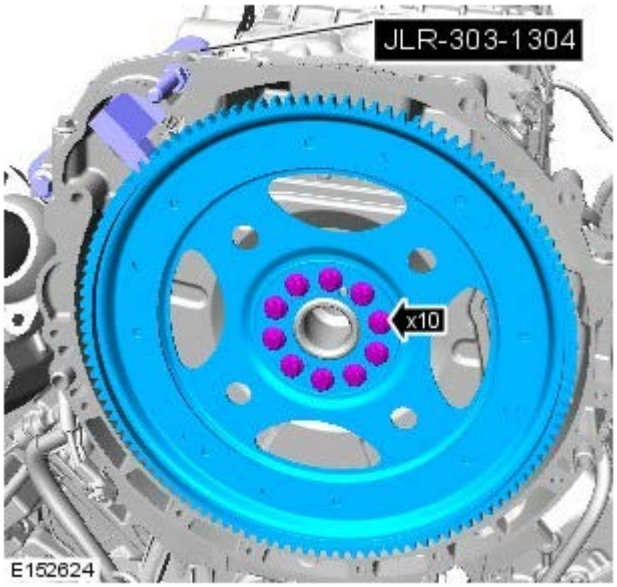
29. CAUTION: Be prepared to collect escaping fluids.



30. CAUTION: Be prepared to collect escaping fluids.

NOTE: Note the orientation of the component prior to removal.

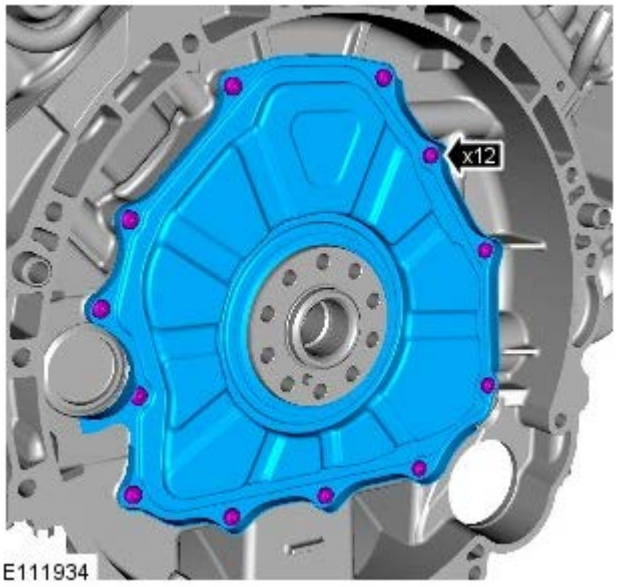




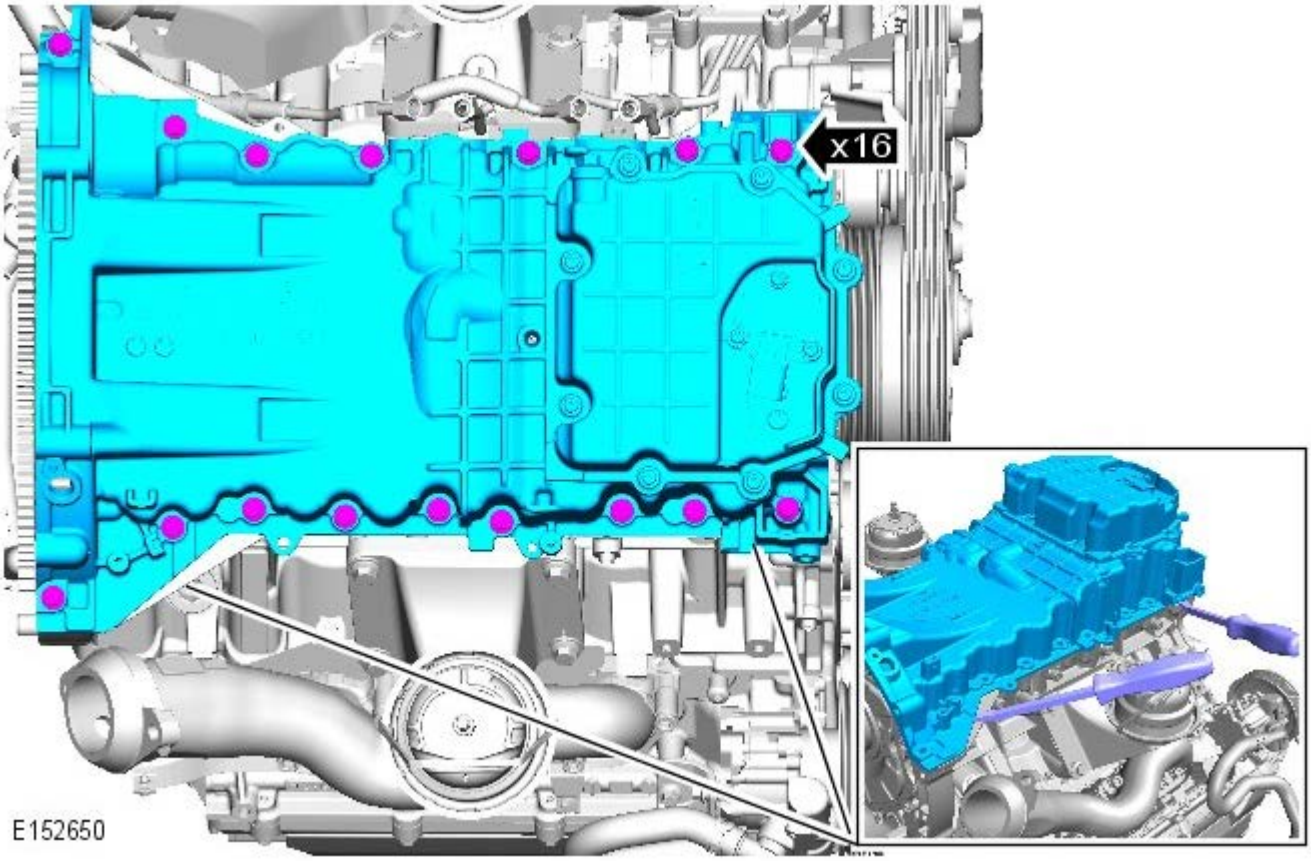
31. CAUTION: The bolts can only be used 3 times, mark the bolts with a center punch. If 2 punch marks are visible, discard the bolts.

    Install the special tool as shown.

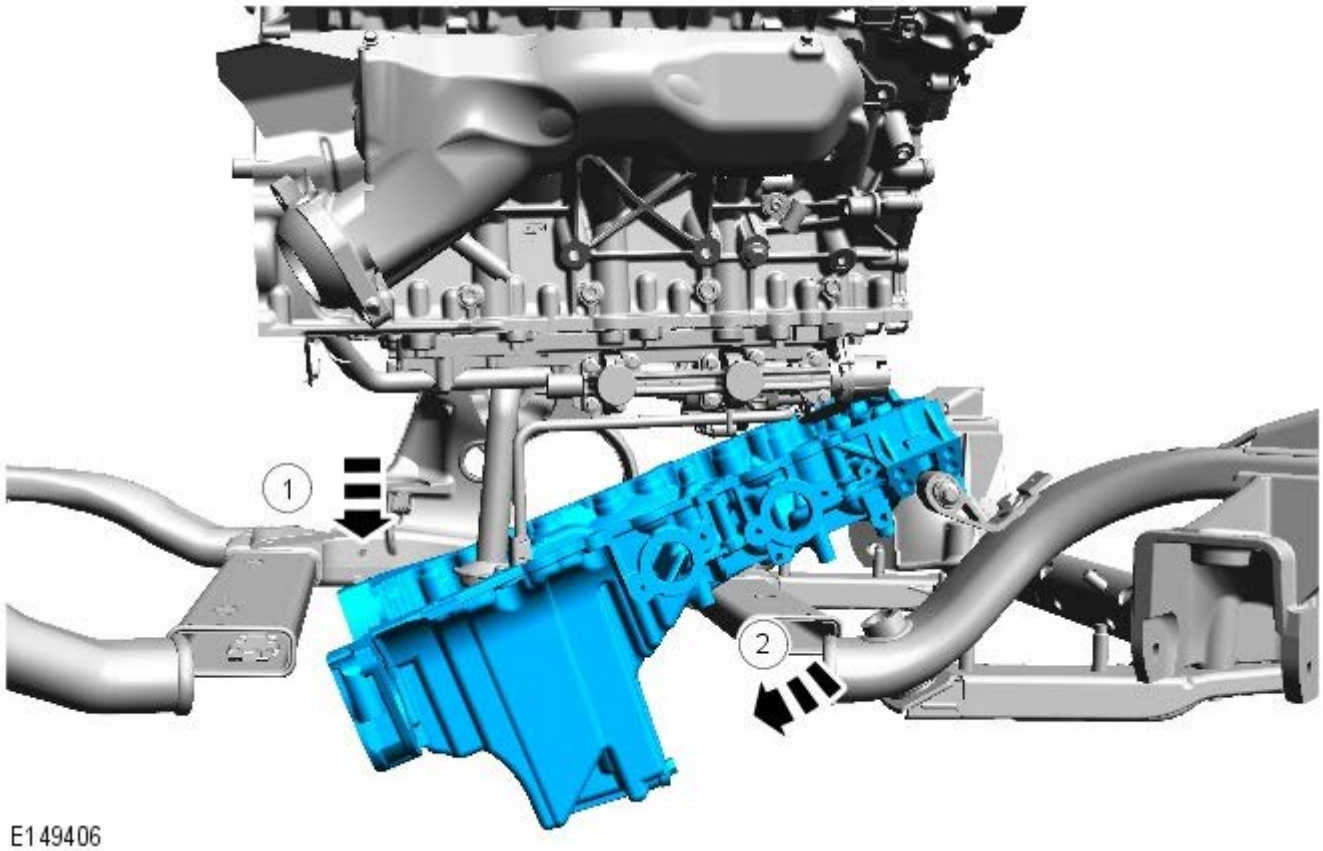
32.



33. NOTE: Make sure to use the aluminium lug provided on the oil pan extension to lever against.



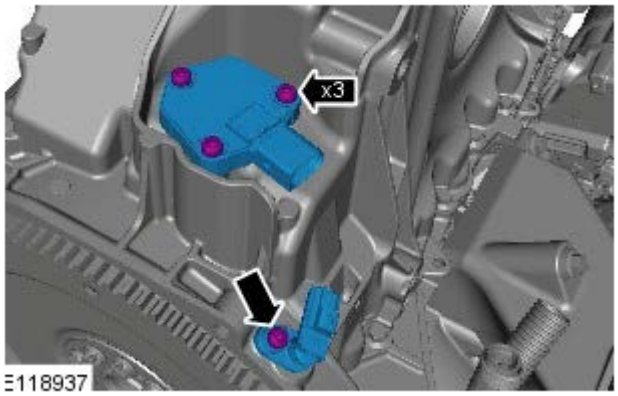
34.



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

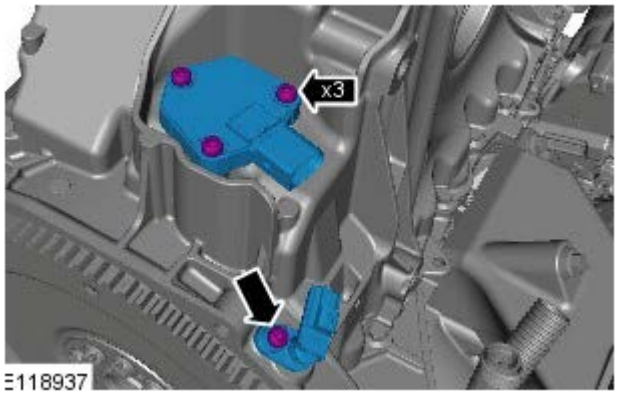


36.



Installation

1.
   - *Torque:* 11 Nm

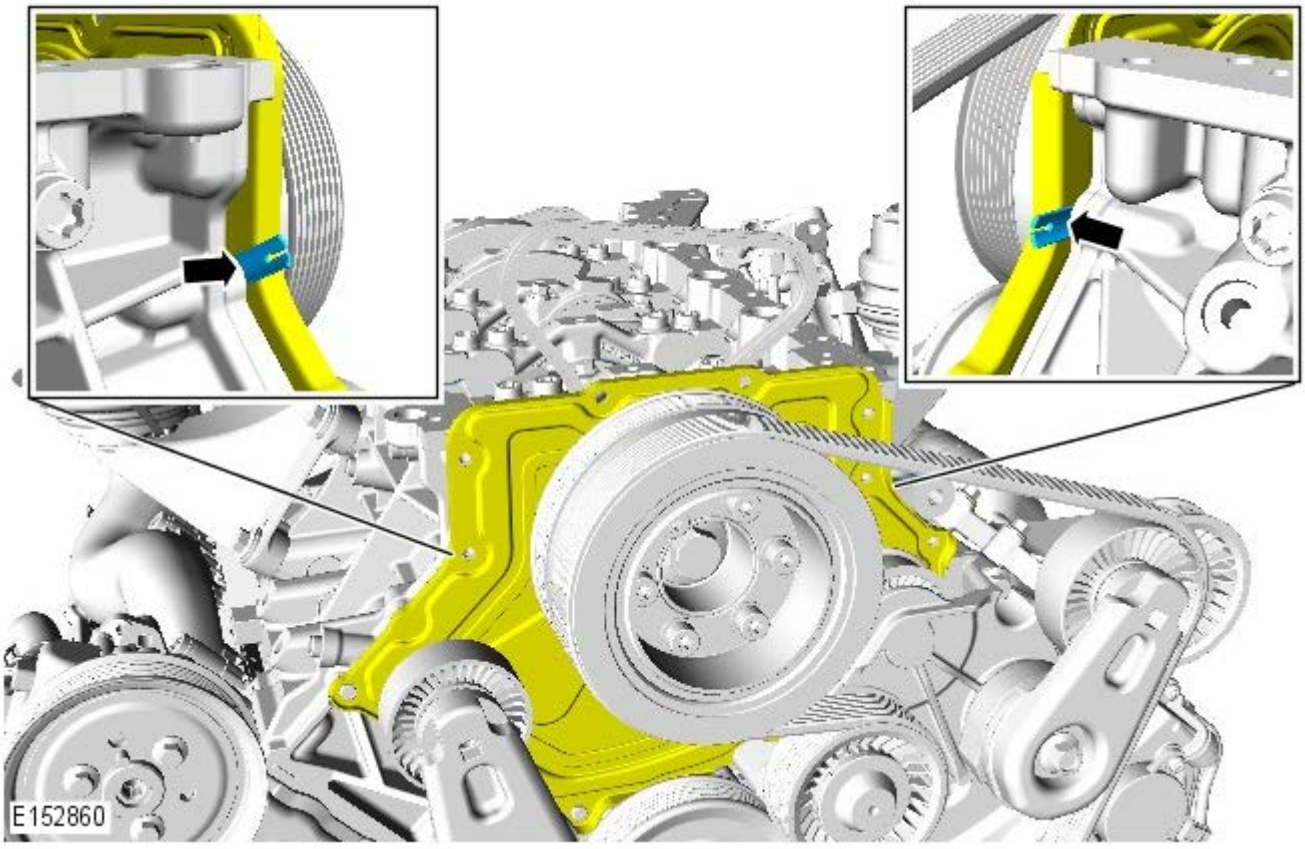


2. *Torque:* 10 Nm



3. NOTE: Engine shown removed for clarity.

   Using a folded cable tie, pack the two areas between the front cover plate and the cylinder block as illustrated. Care must be taken to avoid bending the front cover.

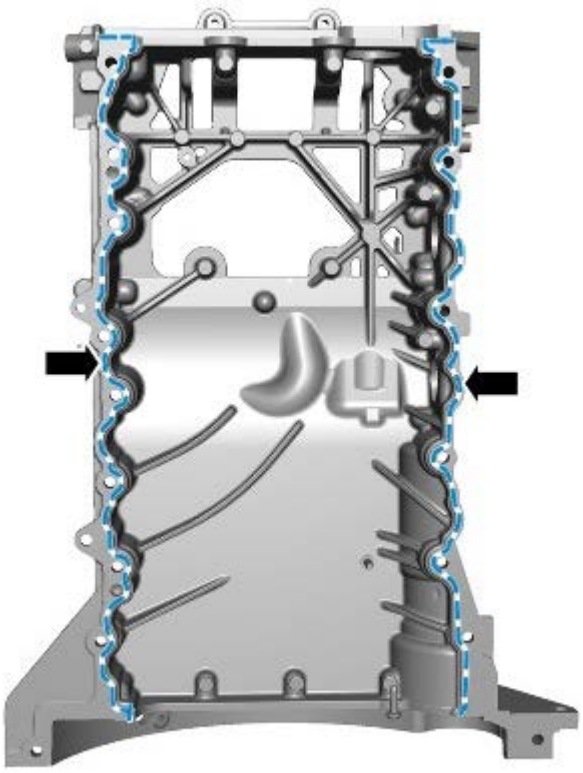


4. CAUTIONS:

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

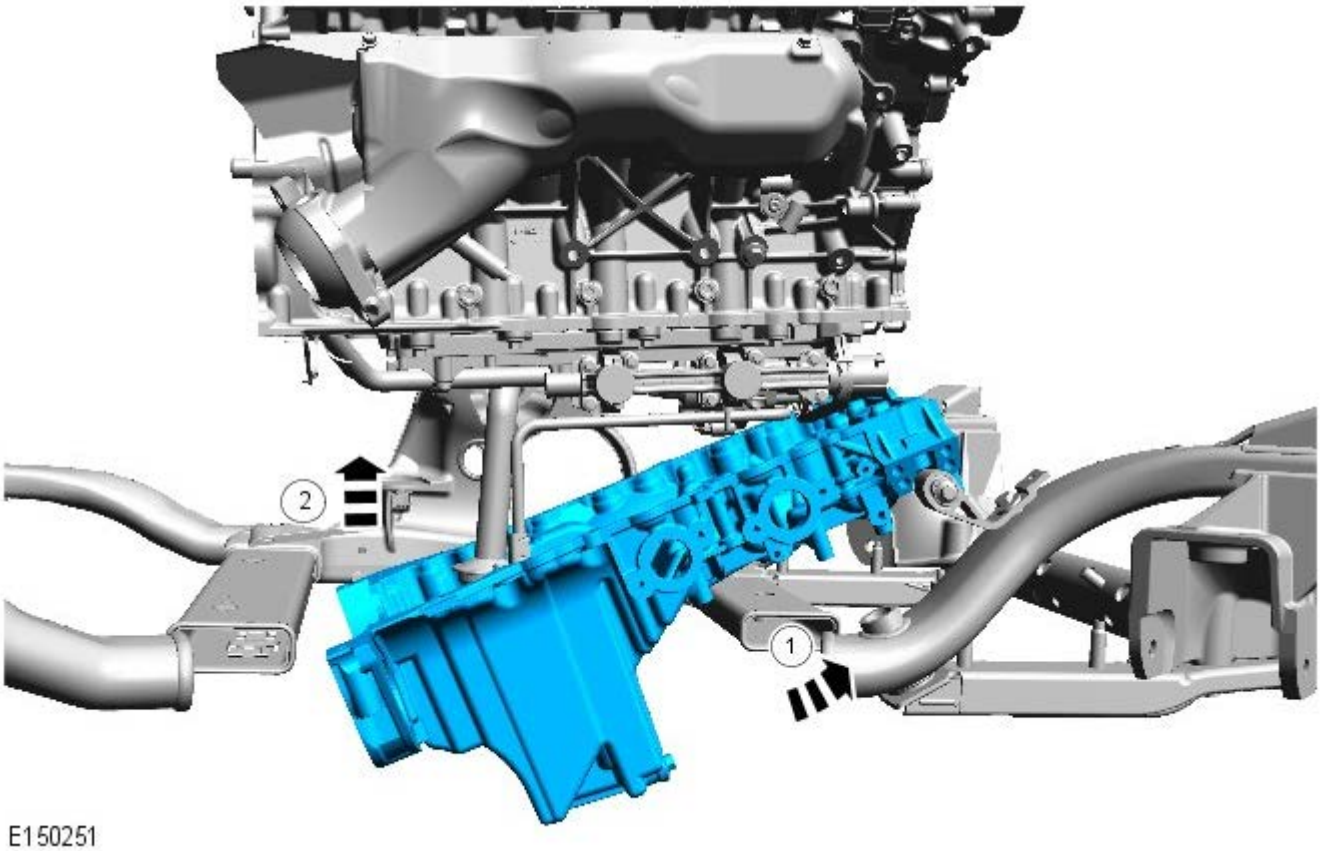
   Use only a plastic scraper when removing the sealing material.

   - Apply RTV sealant WSE-M4G323-A6 (Loctite 5901G) to the areas shown, and tighten the bolts within 7 minutes.



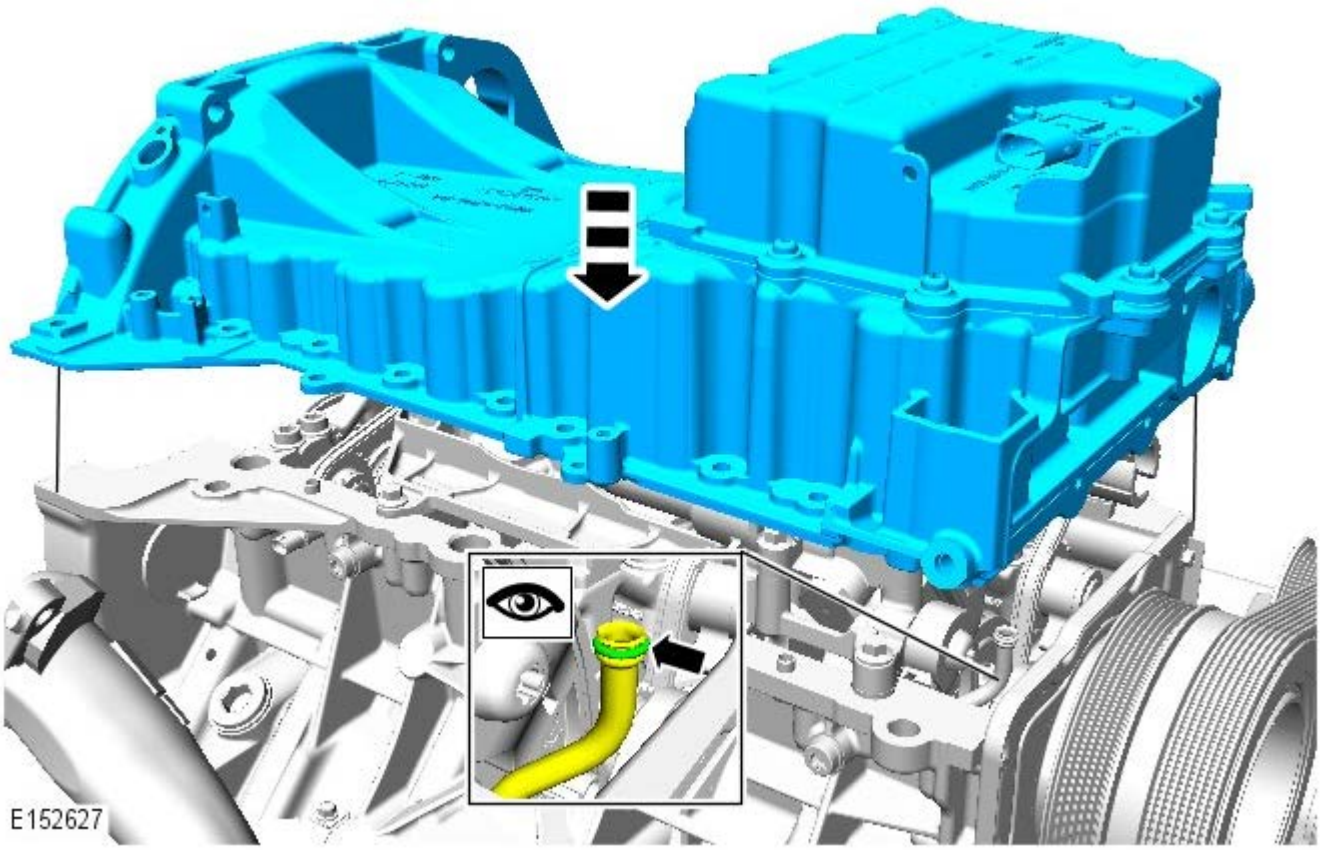
E107654

5.



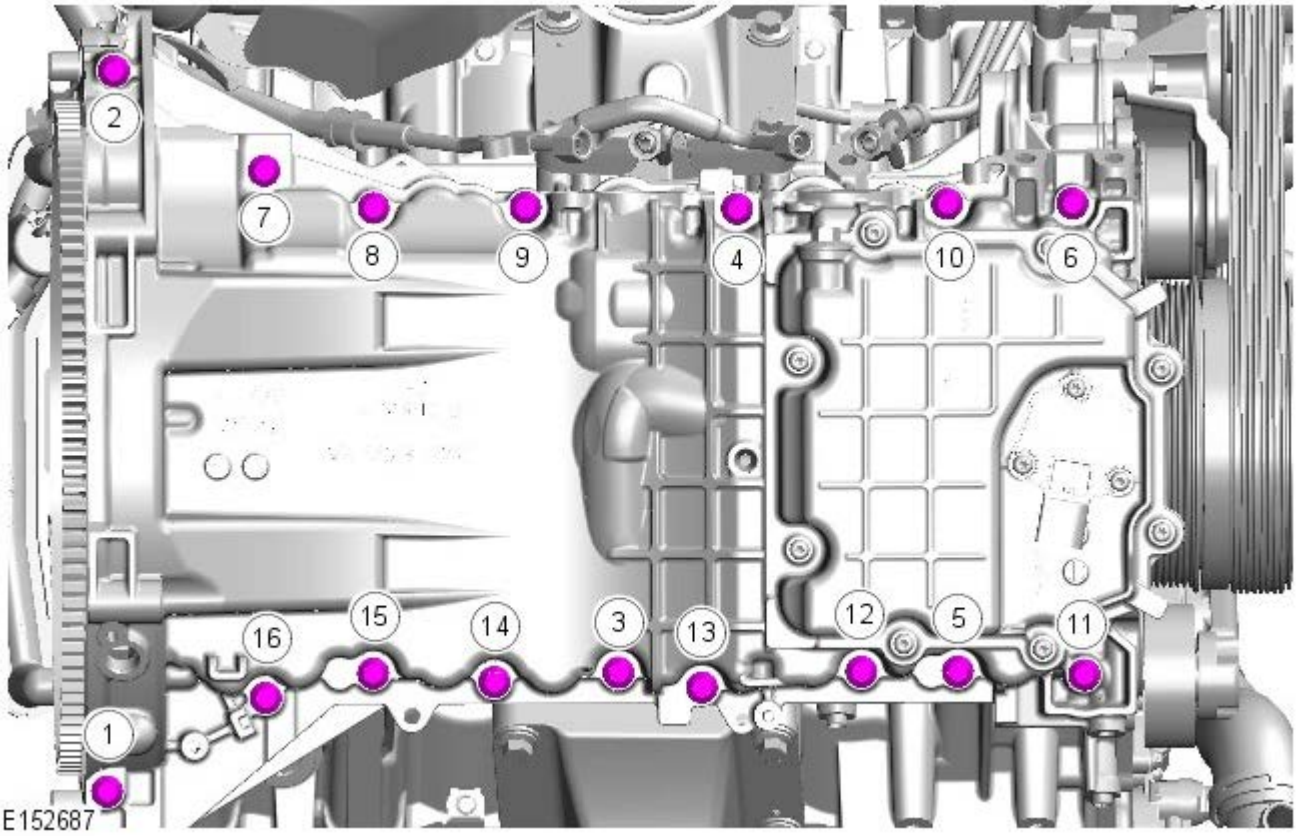
E150251

6.



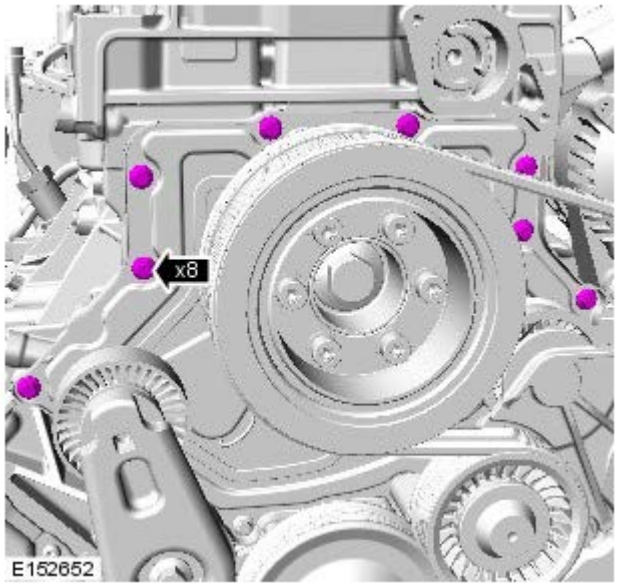
7. NOTE: Tighten the bolts in the indicated sequence.

Torque: 25 Nm



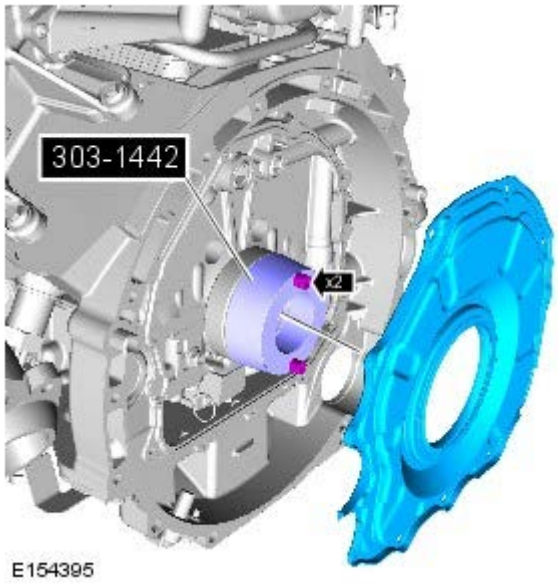
8. CAUTION: Make sure the front cover spacers are removed before installing the bolts.

Torque: 12 Nm



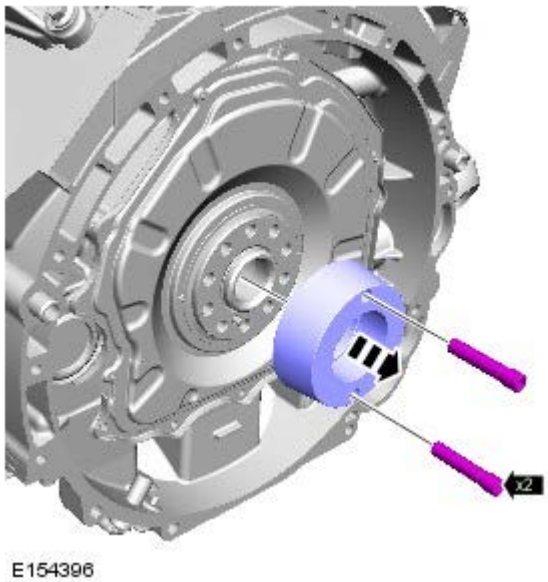
9. Install the special tool.

   Special Tool(s): 303-1442

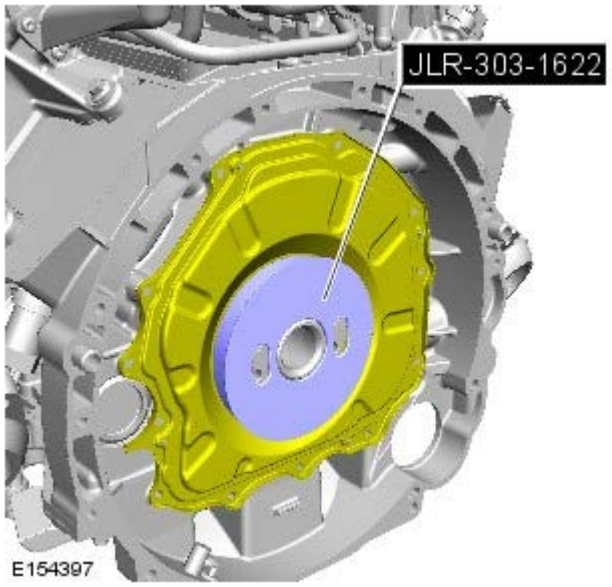


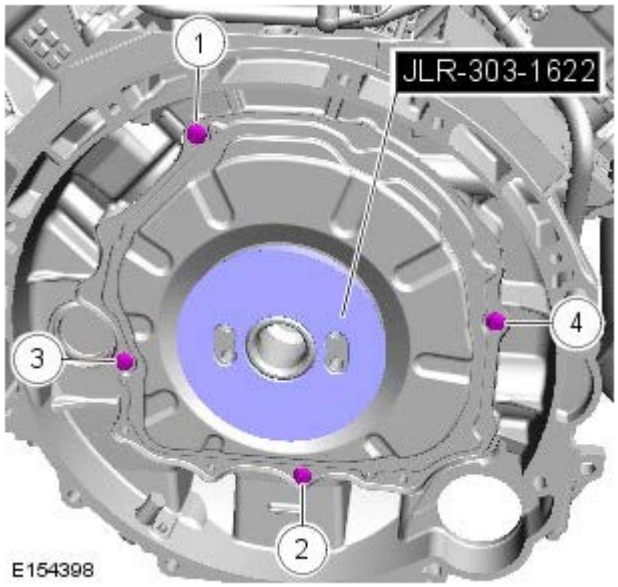
10. Remove the special tool.

    Special Tool(s): 303-1442



11. Align the engine rear oil seal plate using the special tool.

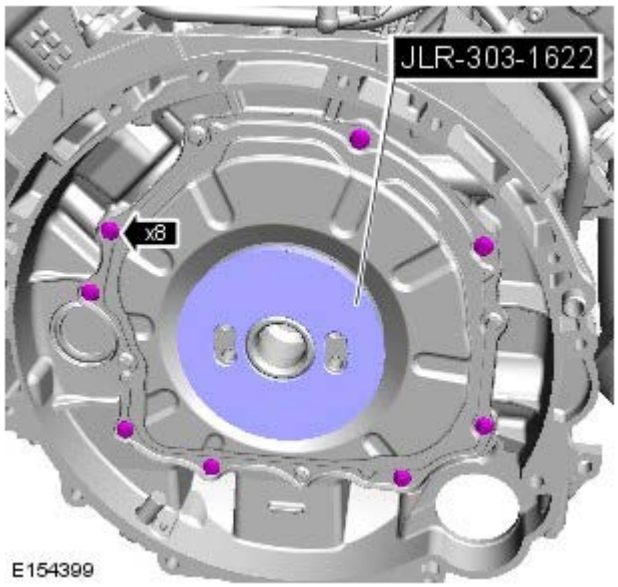




12. NOTE: Tighten the bolts in the indicated sequence.

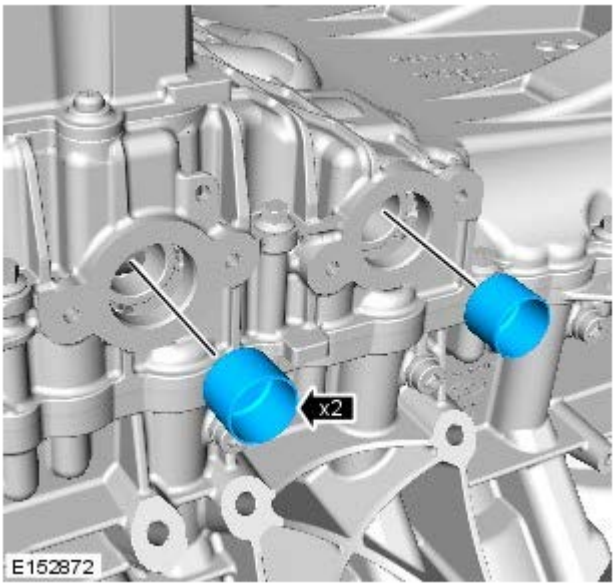
    Torque: 11 Nm

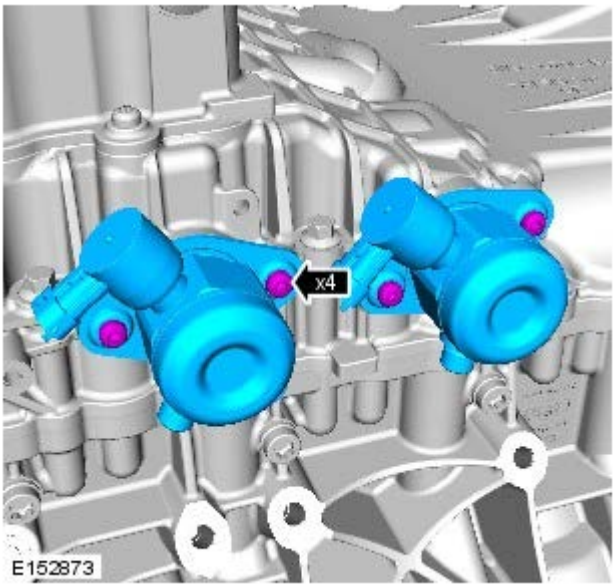
13. *Torque:* 11 Nm



14. Remove the special tools.

15. NOTE: Lubricate the fuel rail high-pressure fuel pump bucket with clean engine oil.



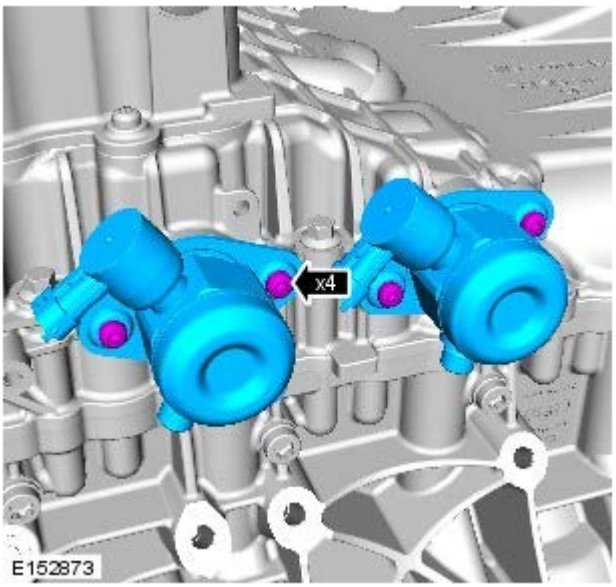


16. CAUTION: Tighten the Torx screws a turn at a time until the correct torque is achieved.

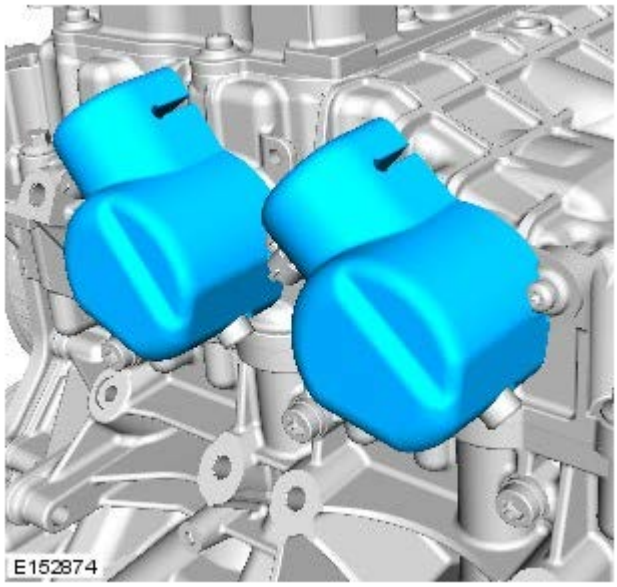
    NOTE: Lubricate the fuel rail high-pressure fuel pump O-ring seal with clean engine oil.

    Torque: 12 Nm

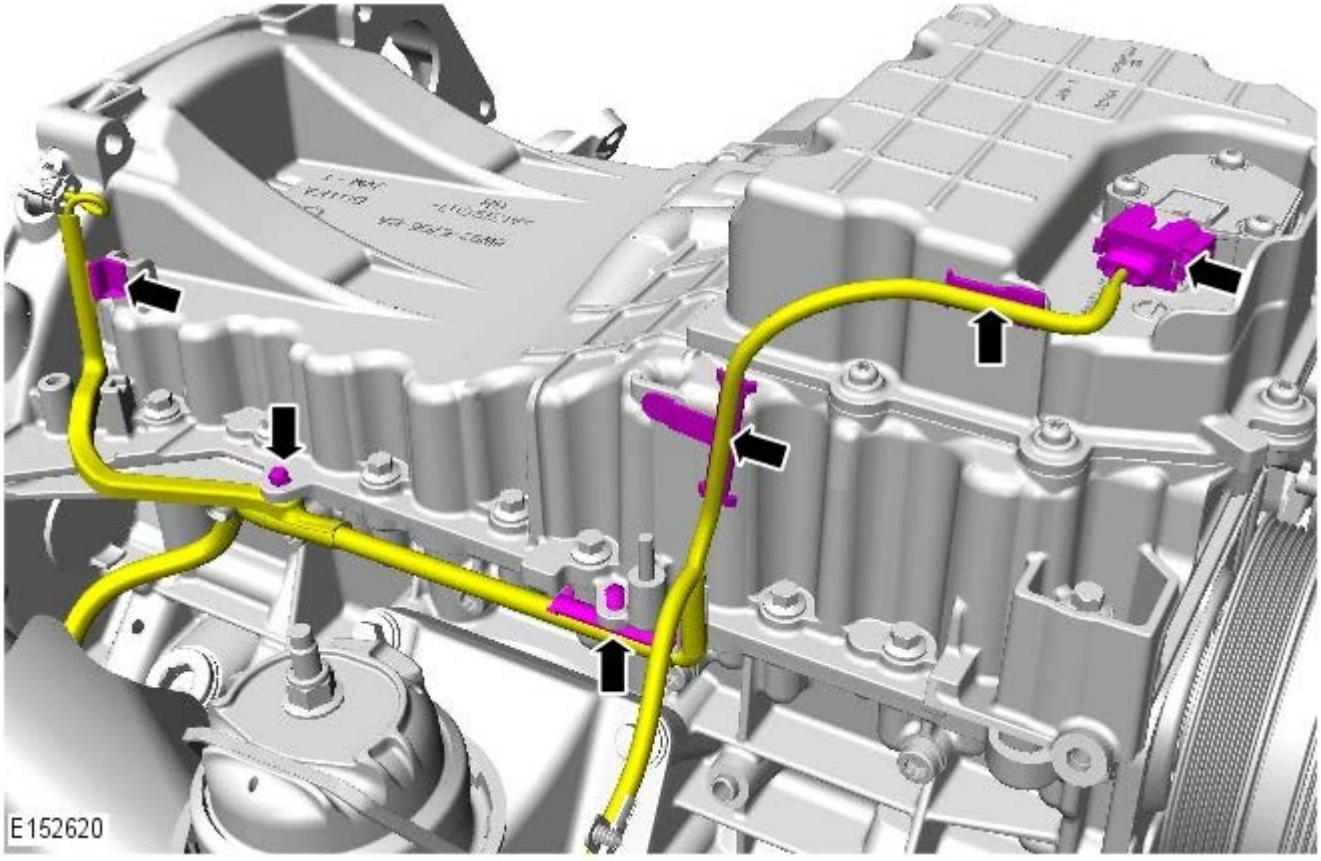
17. Loosen the Torx screws half a turn each.



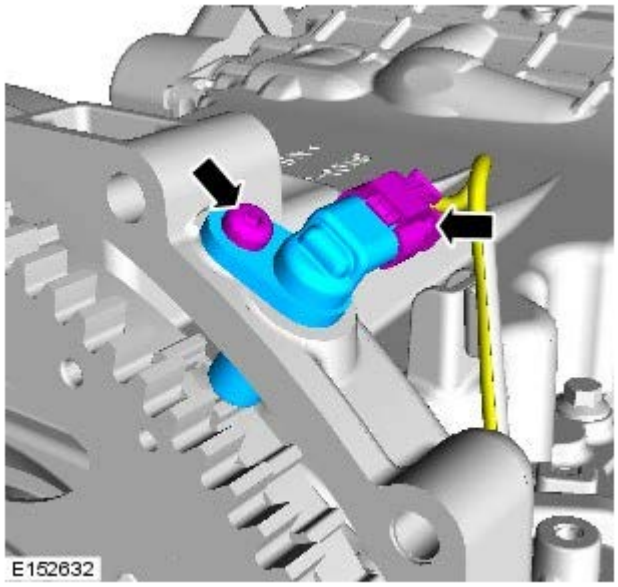
18.



19.



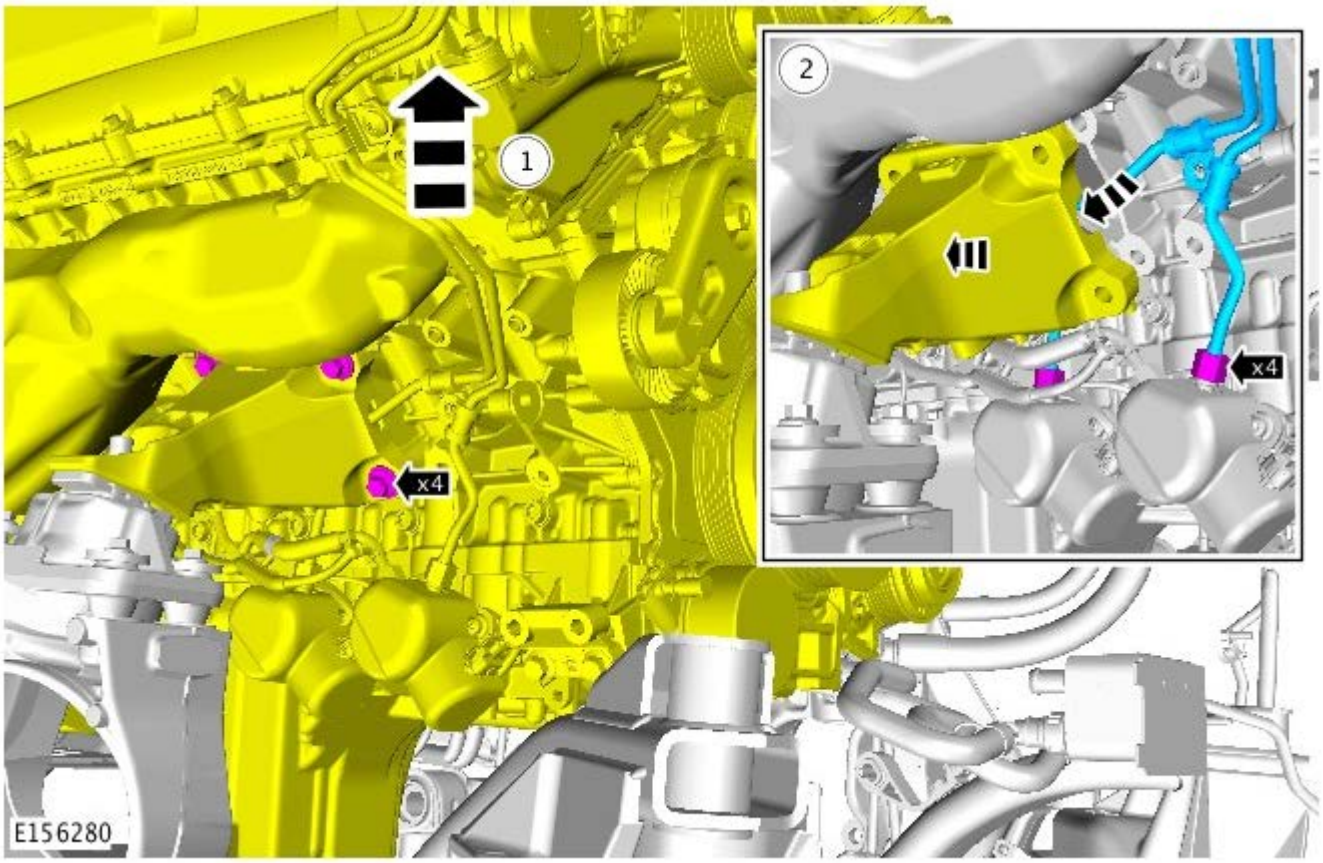
20. *Torque:* 10 Nm



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

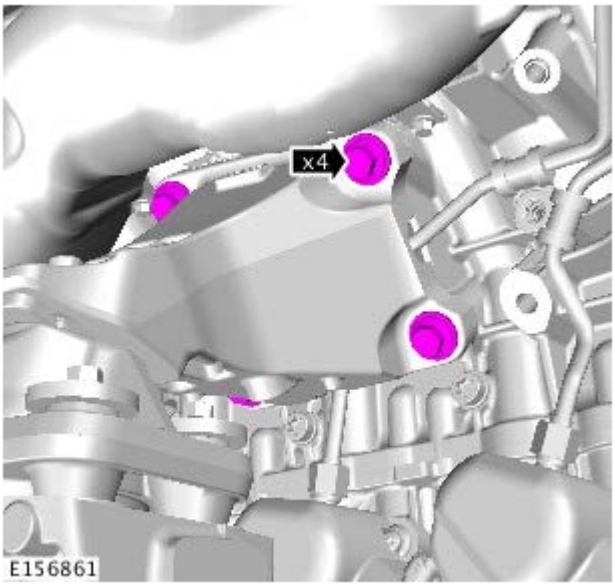
NOTE: Install the unions finger tight before final tightening.

Using a suitable hydraulic jack, raise and support the engine to install the fuel pipe.

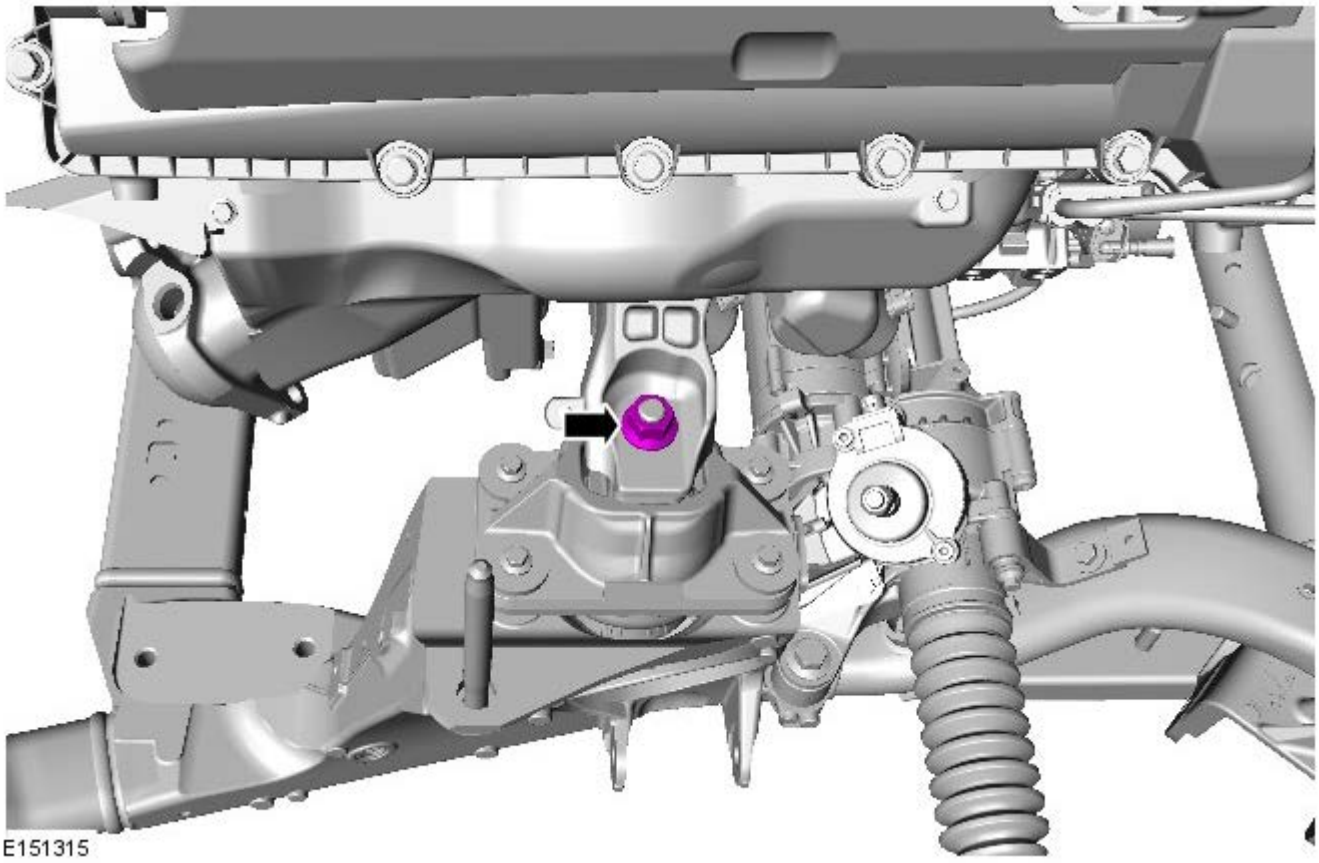


22. Carefully lower the engine onto the engine mounts.

Torque:
Stage 1: 45 Nm
Stage 2: 60°



23. *Torque:* 110 Nm



24. CAUTIONS:

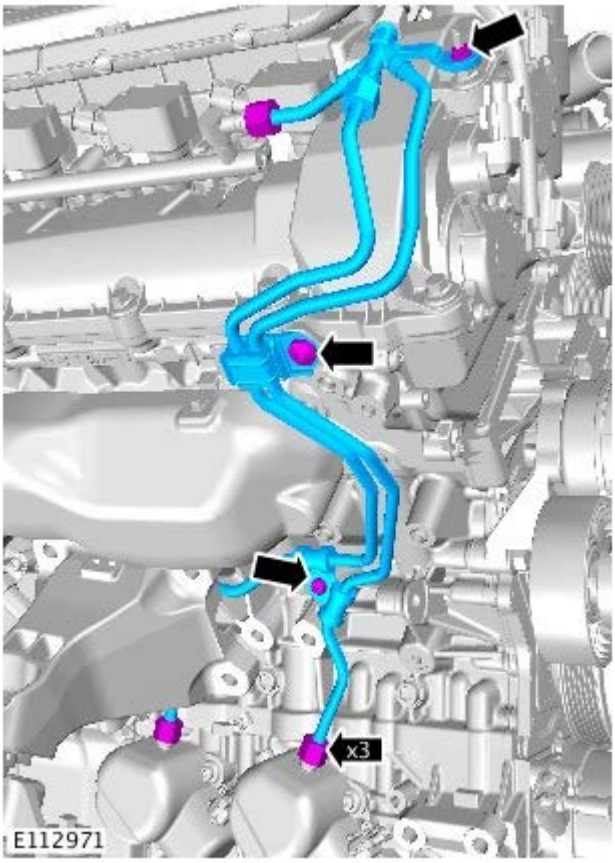
Install new high-pressure fuel supply lines.

Lubricate only the union threads with clean engine oil.

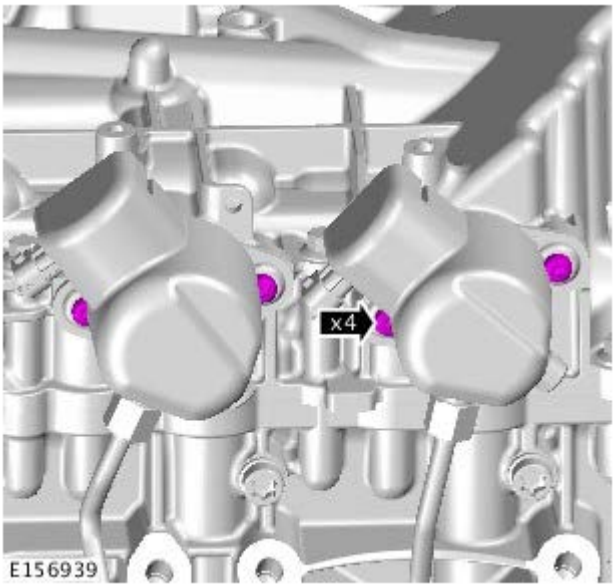
NOTES:

Remove and discard the blanking caps.

Install the bolt and unions fully finger tight before final tightening.



Do not fully tighten at this stage.

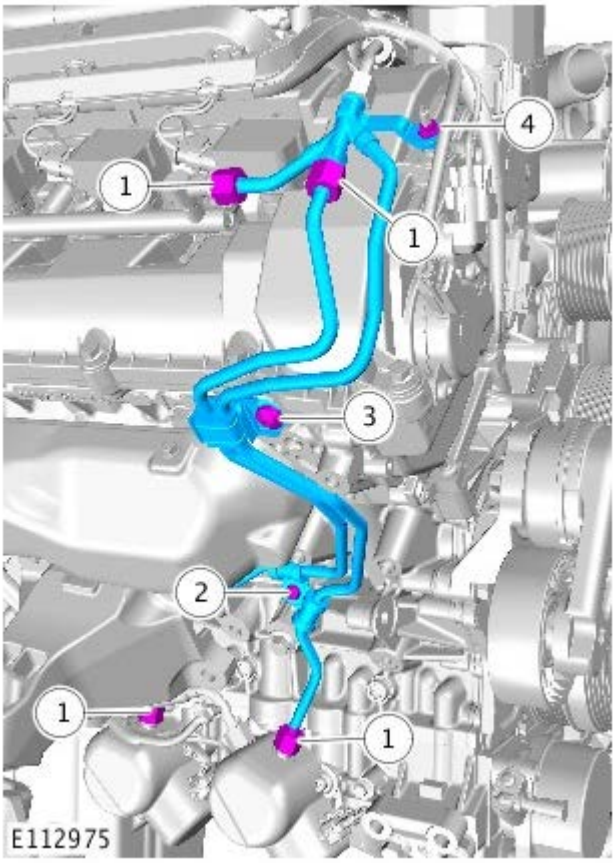


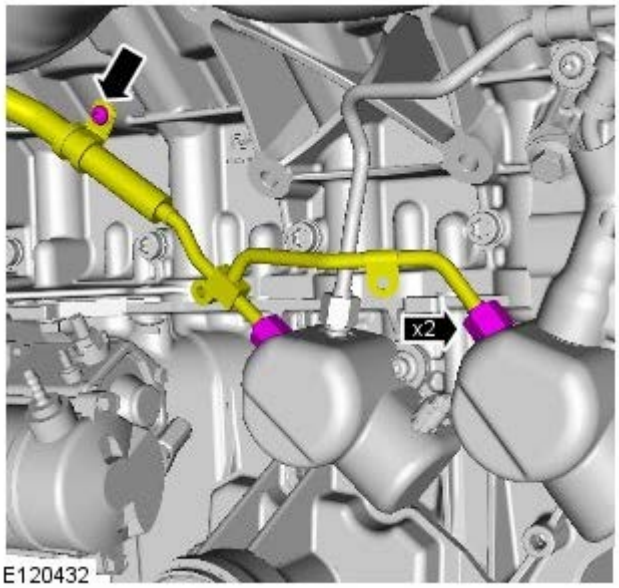
25. CAUTION: Tighten the Torx screws a turn at a time until the correct torque is achieved.

Torque: 12 Nm

26. NOTE: Engine shown removed for clarity.

Torque:
Unions (1) 21 Nm
M6 (2) 11 Nm
M8 (3) 25 Nm
M5 nut (4) 6 Nm





27. NOTES:

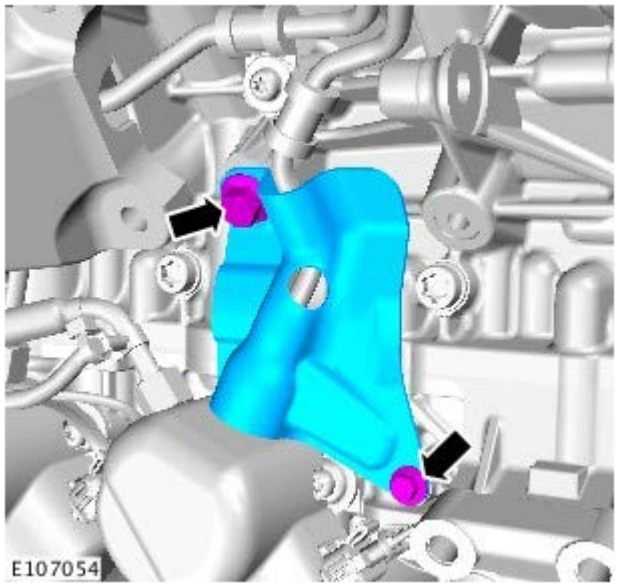
Install the bolt and unions finger tight before final tightening.

Remove and discard the blanking caps.

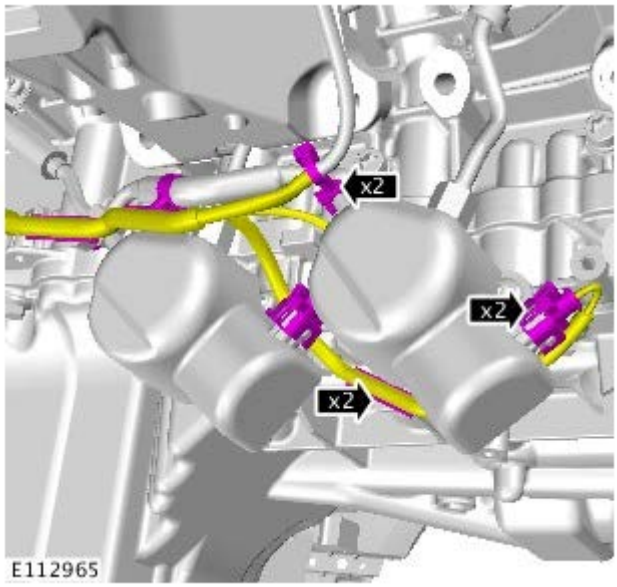
Torque:
Unions 21 Nm
M6 11 Nm

28. NOTE: Engine shown removed for clarity.

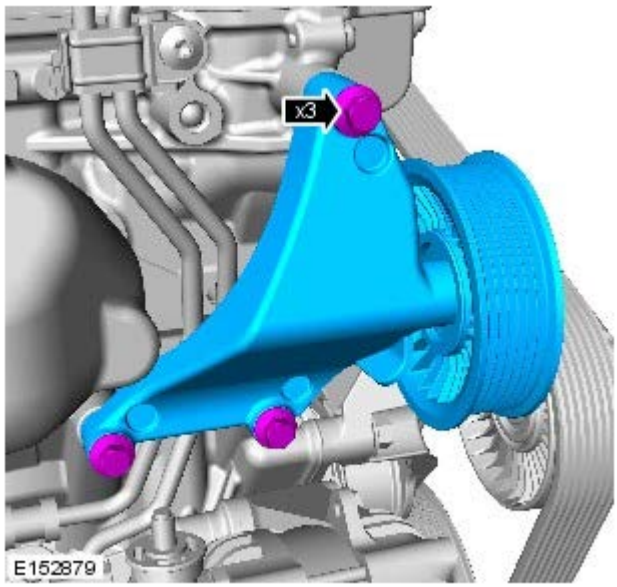
Torque:
M10 29 Nm
M6 11 Nm



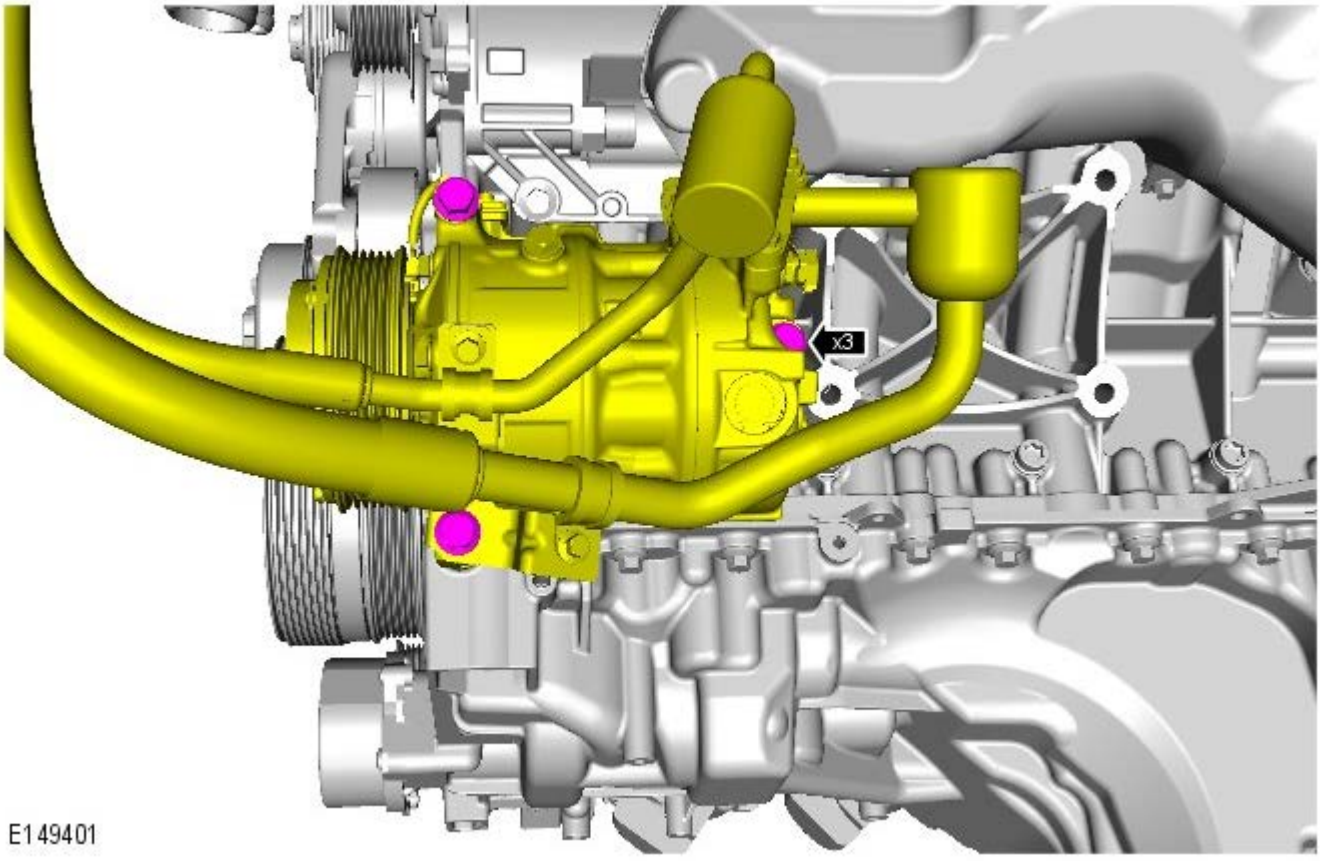
29. NOTE: Engine shown removed for clarity.



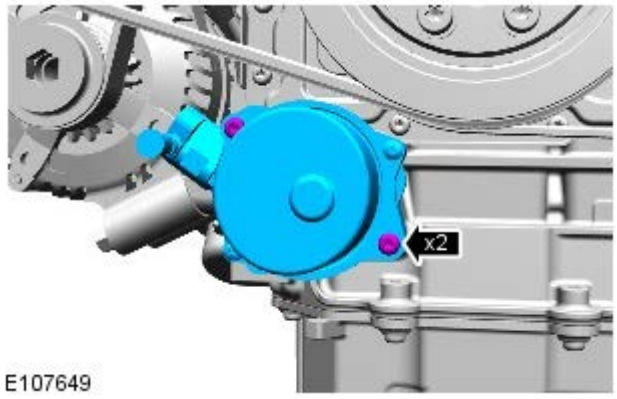
30. *Torque:* 25 Nm

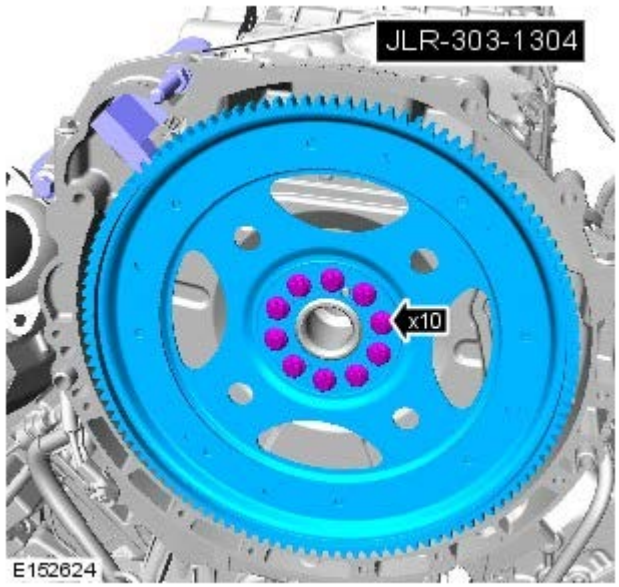


31. *Torque:* 25 Nm



32. *Torque:* 12 Nm





33. CAUTIONS:

Install all the bolts finger tight before final tightening.

The bolts can only be used 3 times, mark the bolts with a centre punch. If 2 punch marks are visible, discard the bolts.

NOTES:

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°

34. Refer to: Starter Motor (303-06C Starting System - V8 S/C 5.0L Petrol, Removal and Installation).

35. Refer to: Transmission - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, Installation).

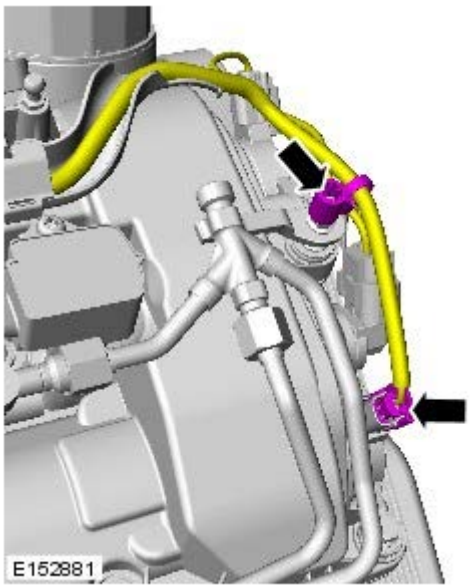
36. Refer to: Axle Assembly (205-03 Front Drive Axle/Differential, Removal and Installation).

37. Refer to: Generator - V8 S/C 5.0L Petrol (414-02 Generator and Regulator - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Removal and Installation).

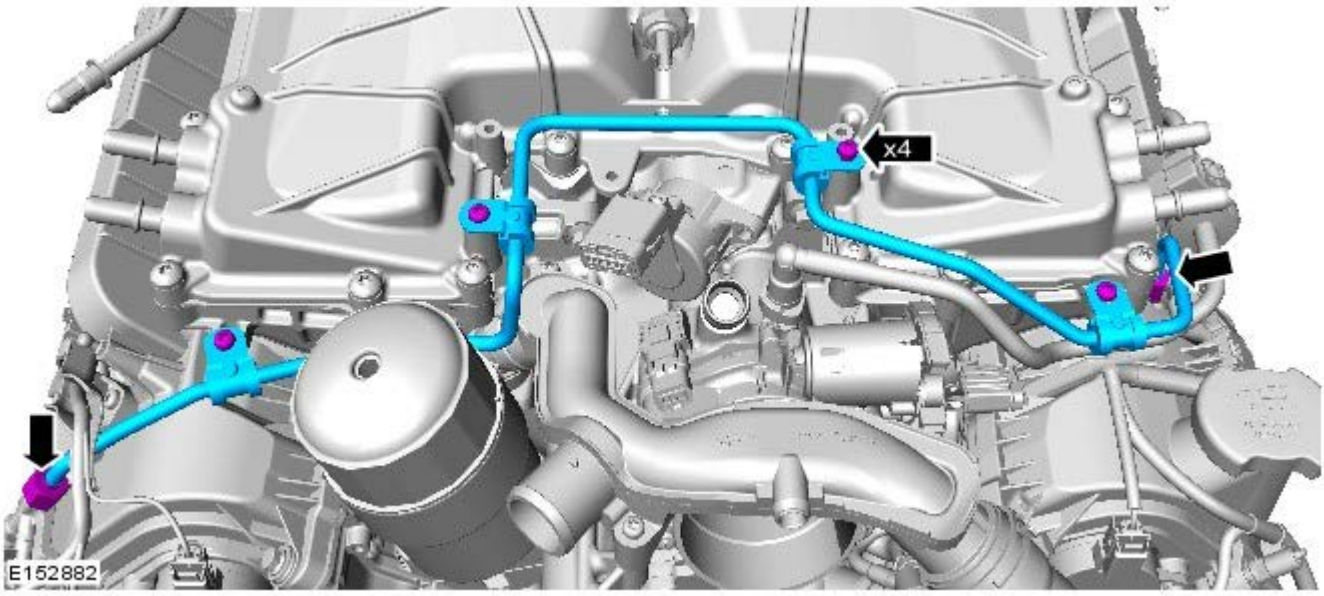
38. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

    Raise and support the vehicle.

39.



40. *Torque:*
    Unions 21 Nm
    M6 8 Nm



41. Refer to: Engine Oil Draining and Filling (303-01C Engine - V8 S/C 5.0L Petrol, General Procedures).

42. Connect the battery ground cable.

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

Published: 10-May-2013

Engine - V8 S/C 5.0L Petrol - Oil Pump

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.

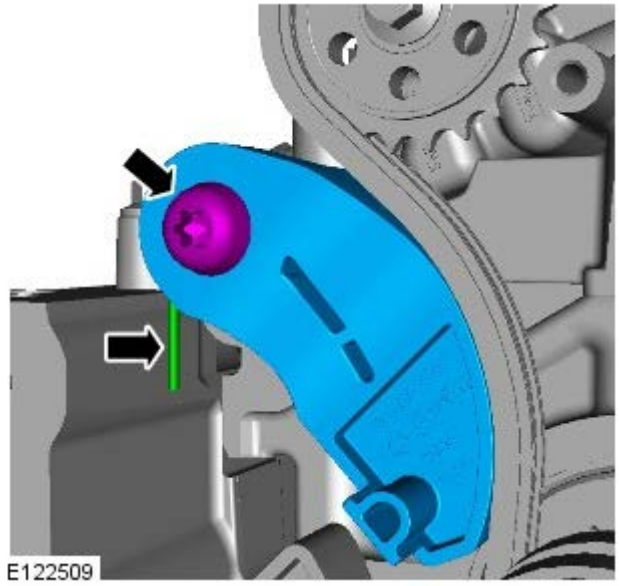
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

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

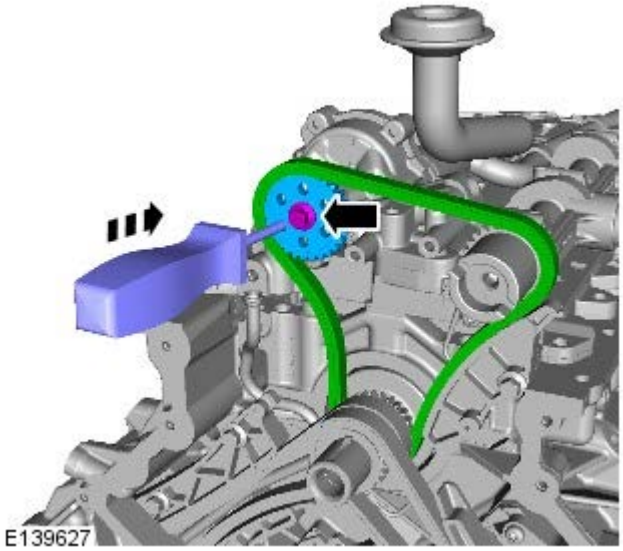
   Raise and support the vehicle.

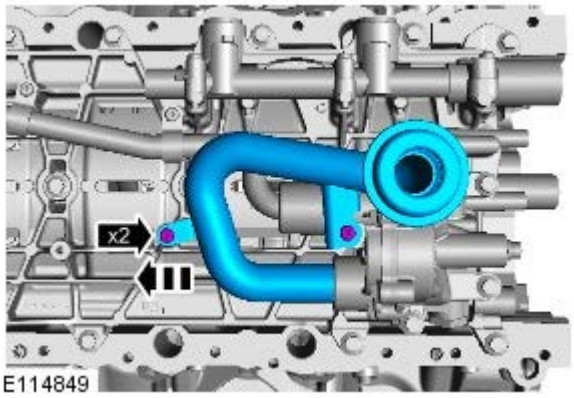
3. Refer to: Oil Pan Extension (303-01C Engine - V8 S/C 5.0L Petrol, Removal and Installation).

4.



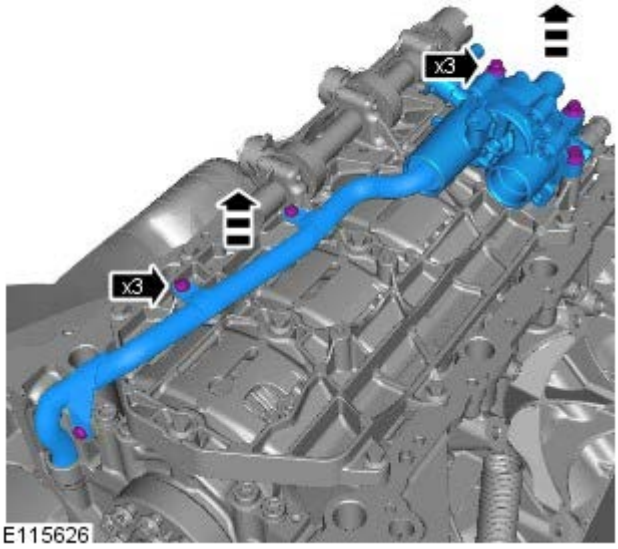
5.





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

7. CAUTION: Remove and discard the O-ring seals.



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



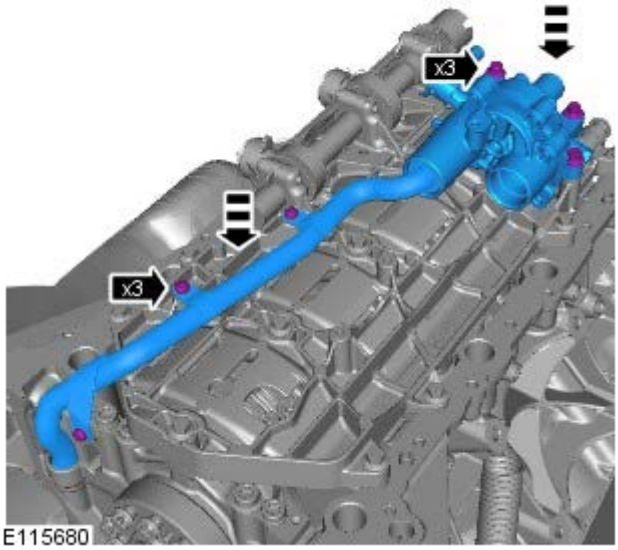
Installation

1. Lubricate and install the new O-ring seals.



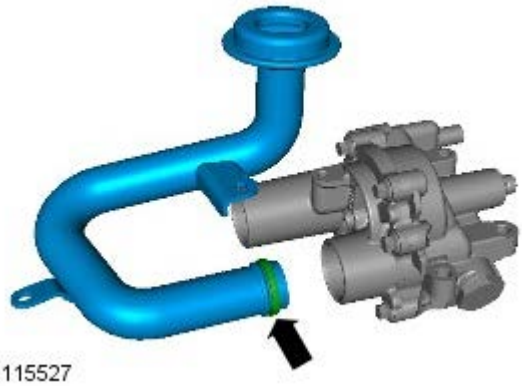
E139628

2. *Torque:*
   M8 25 Nm
   M6 12 Nm



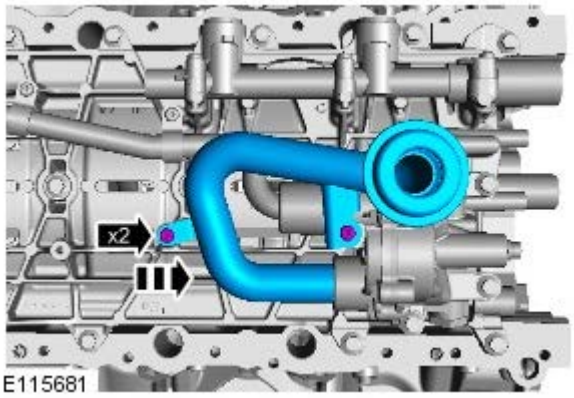
E115680

3. Lubricate and install a new O-ring seal.

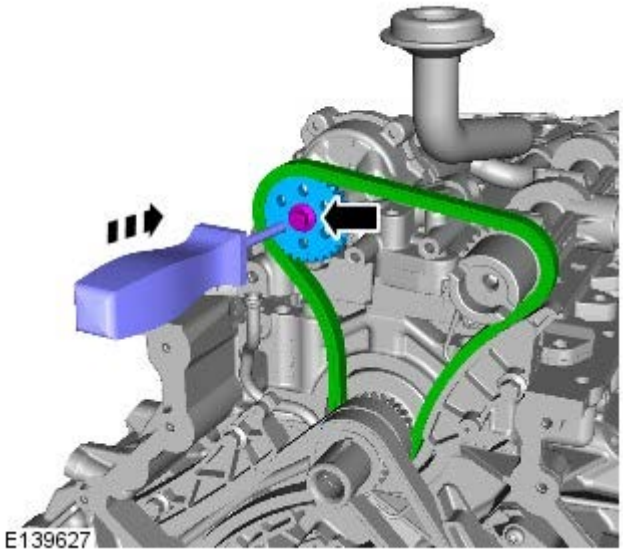


E115527

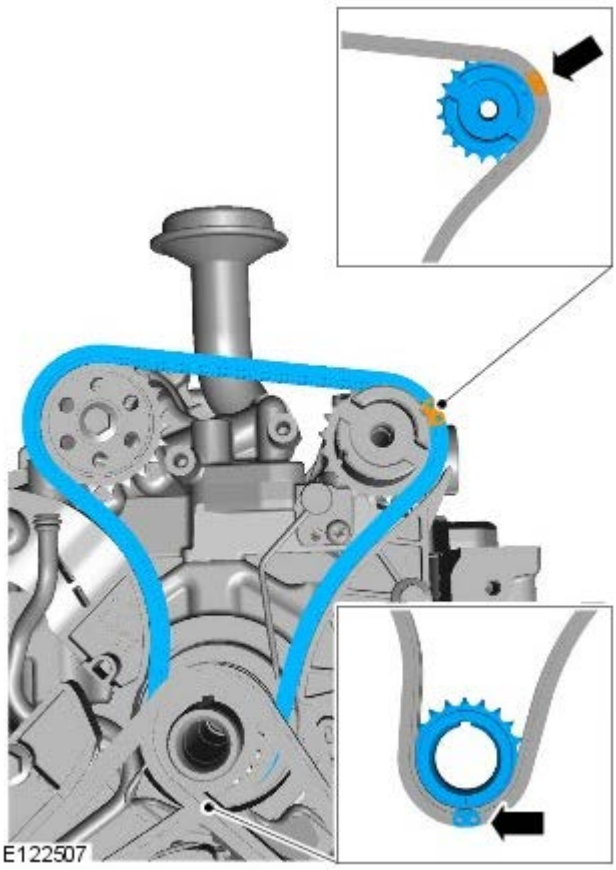
4. *Torque:* 12 Nm



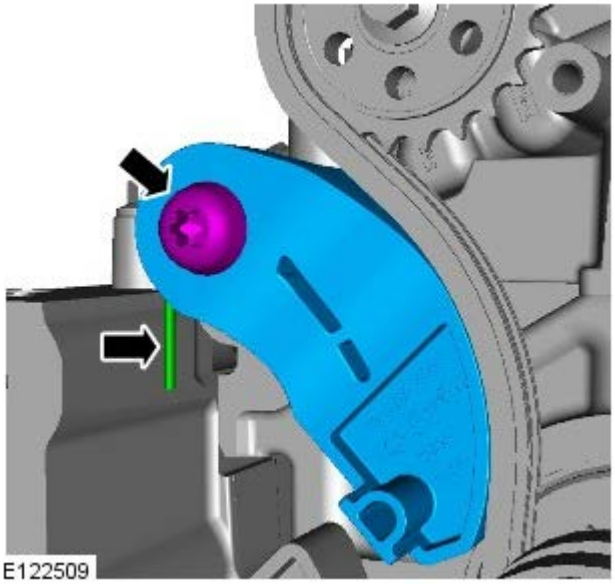
5. *Torque:* 21 Nm



6. 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.



Torque: 21 Nm

8. Refer to: Oil Pan Extension (303-01C Engine - V8 S/C 5.0L Petrol, Removal and Installation).

9. Connect the battery ground cable.

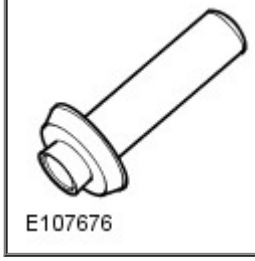
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 14-Sep-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, Specifications).

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

   Raise and support the vehicle.

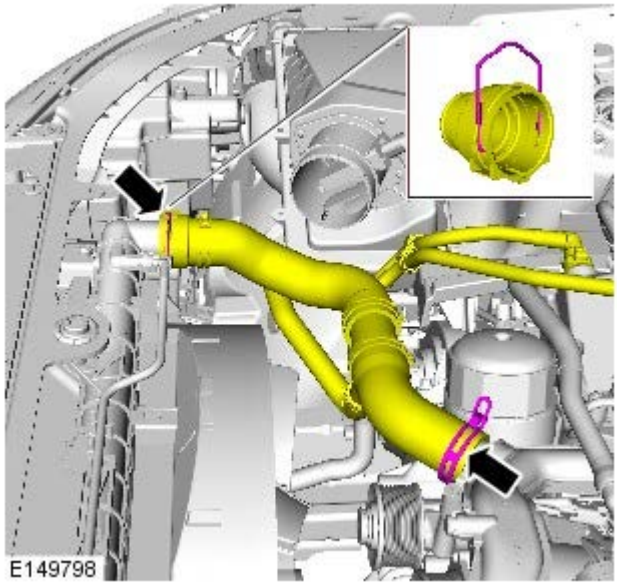
3. Refer to: Crankshaft Pulley (303-01C Engine - V8 S/C 5.0L Petrol, Removal and Installation).

4. Refer to: Valve Cover LH (303-01C Engine - V8 S/C 5.0L Petrol, Removal and Installation).

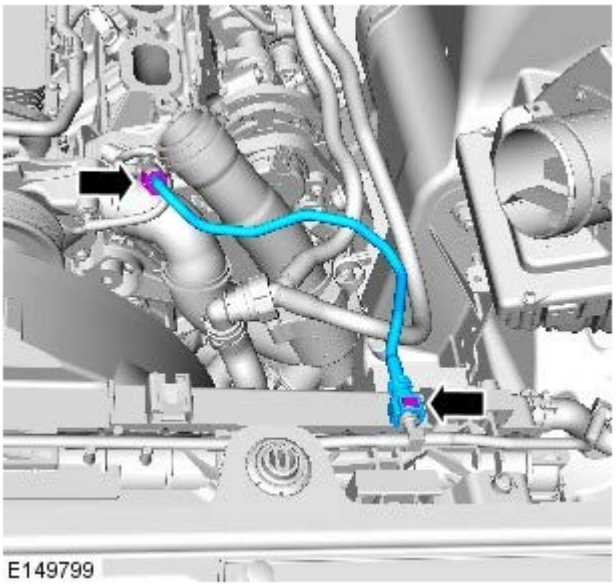
5. Refer to: Valve Cover RH (303-01C Engine - V8 S/C 5.0L Petrol, Removal and Installation).

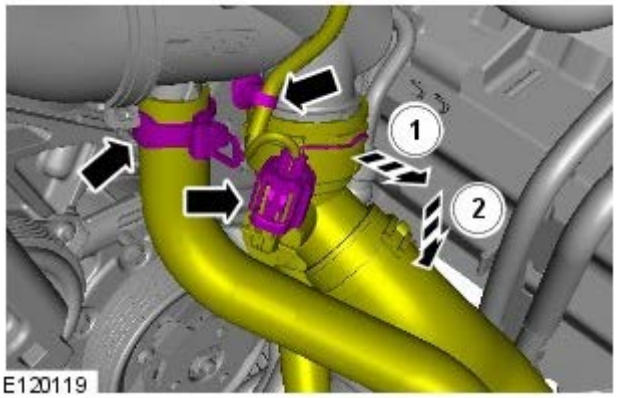
6. Refer to: Cooling System Partial Draining, Filling and Bleeding - V8 S/C 5.0L Petrol (303-03C, General Procedures).

7.



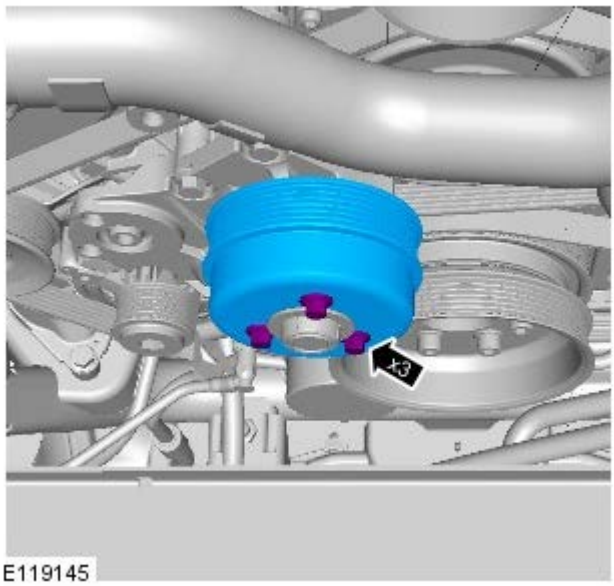
8.



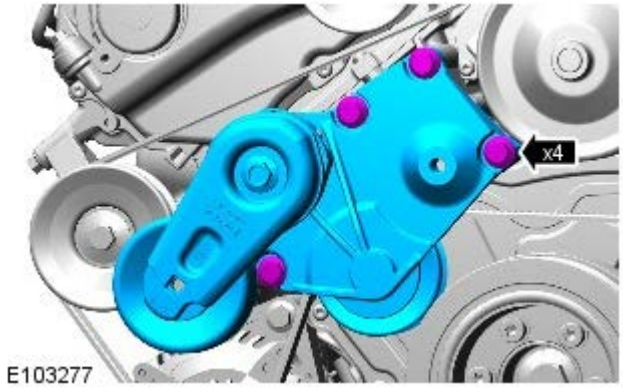


9. CAUTION: Be prepared to collect escaping coolant.

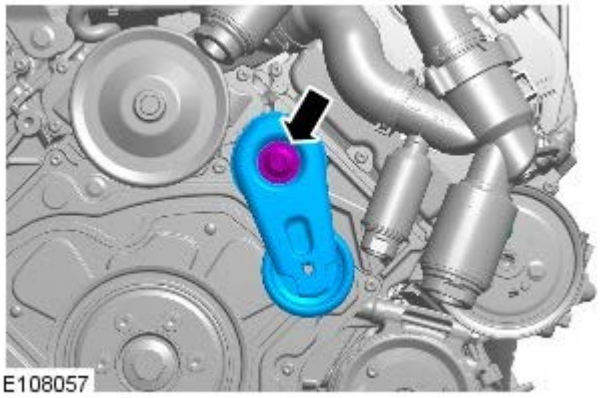
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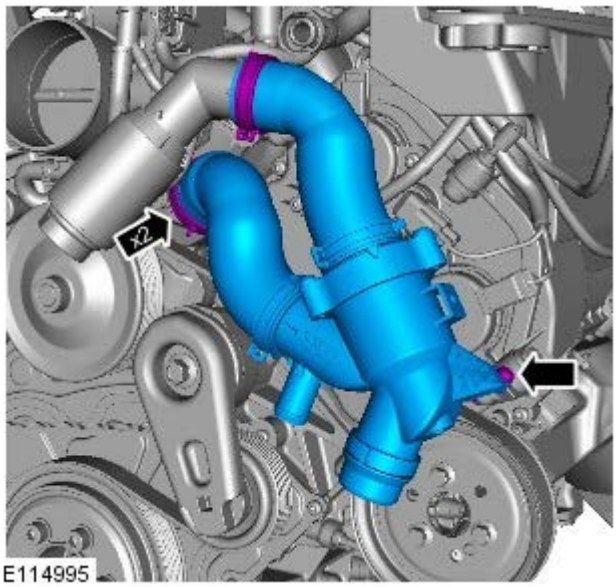
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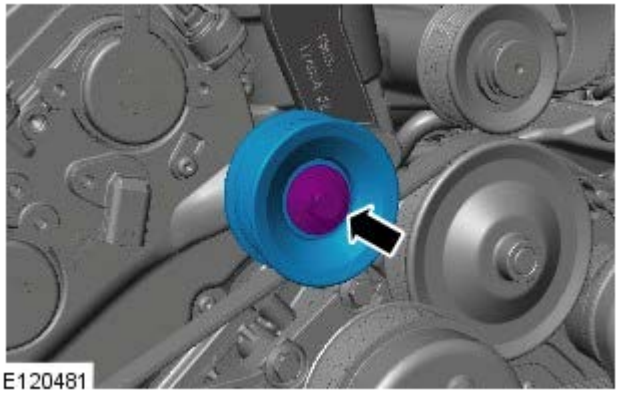
12.



13.



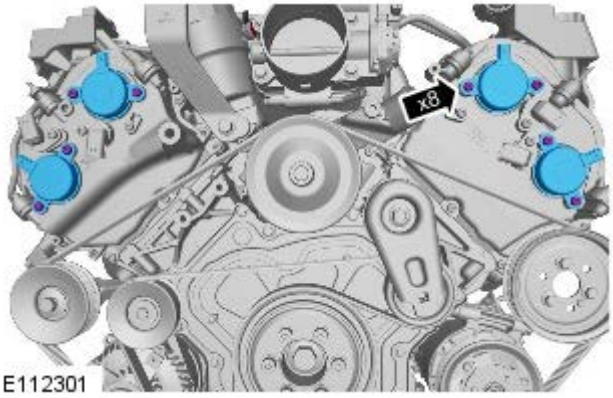
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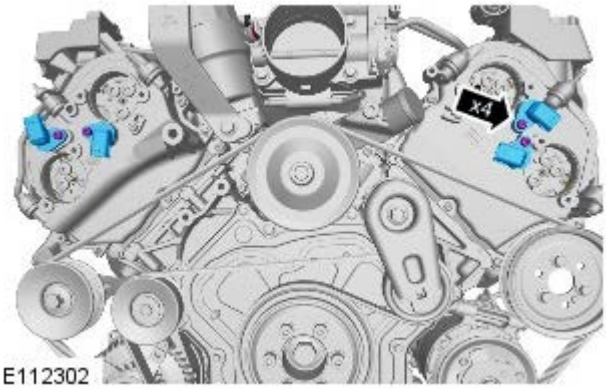
15.



16.



17.

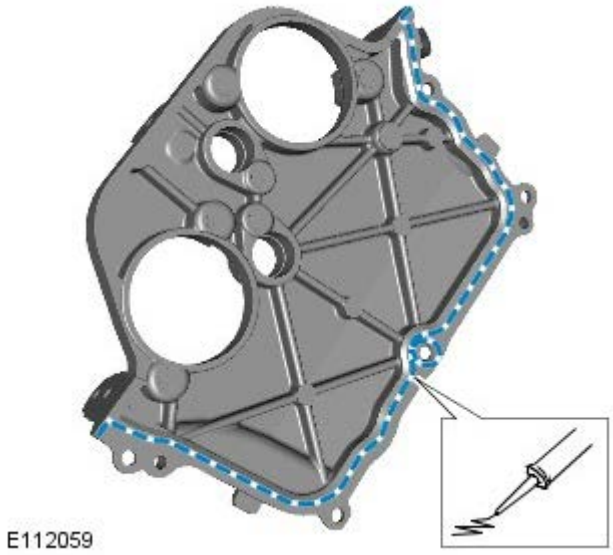


18.



E112055

Installation


E112059

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.


E112060

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.

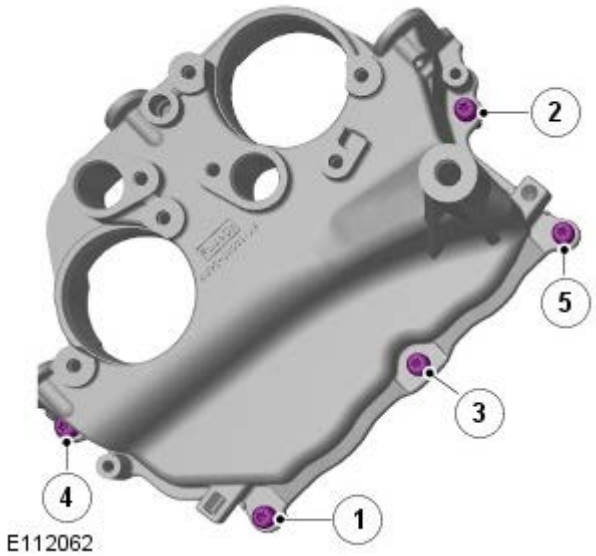
3. NOTE: Tighten the bolts in the indicated sequence.



E112061

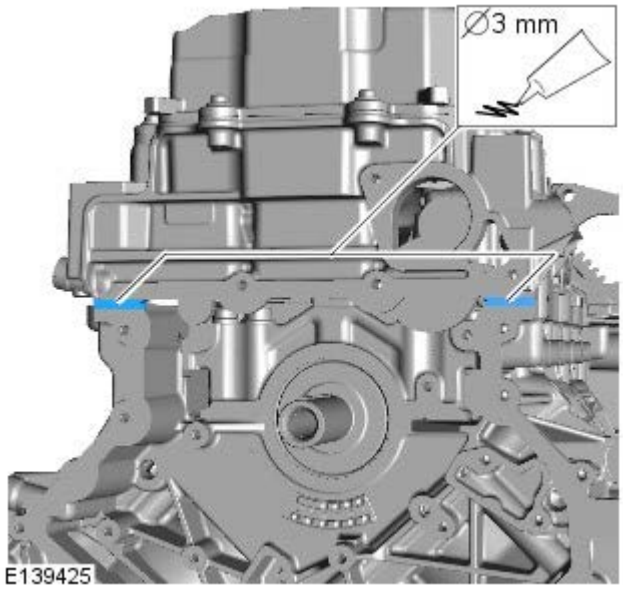
Torque: 12 Nm

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



E112062

Torque: 12 Nm



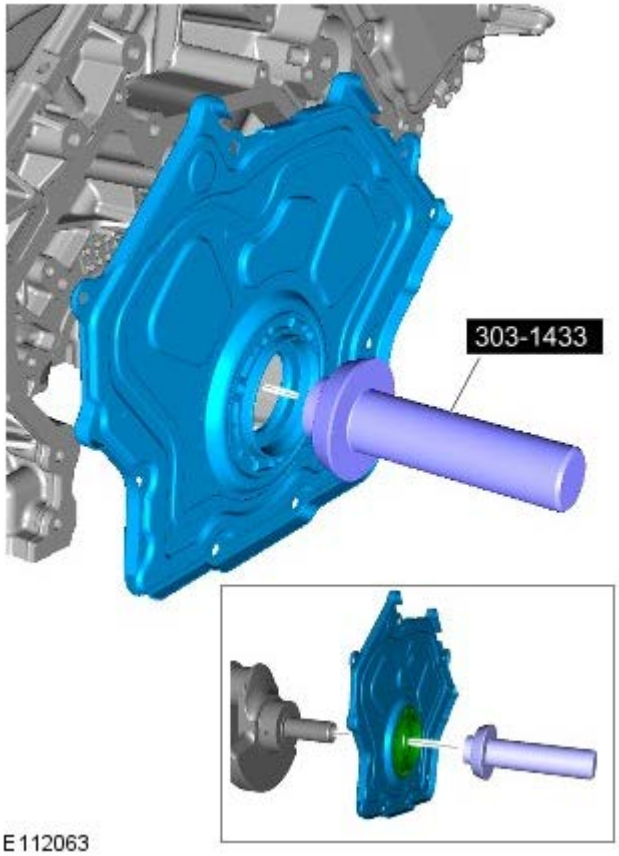
E139425

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.

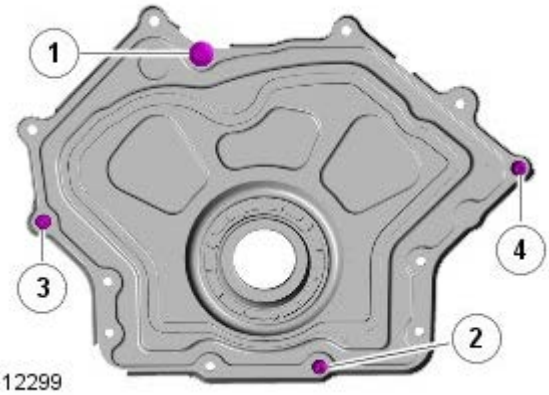
Install the bolts, but do not tighten fully at this stage.



E112063

Special Tool(s): 303-1433

7. *Torque:*
   M6 12 Nm
   M8 20 Nm



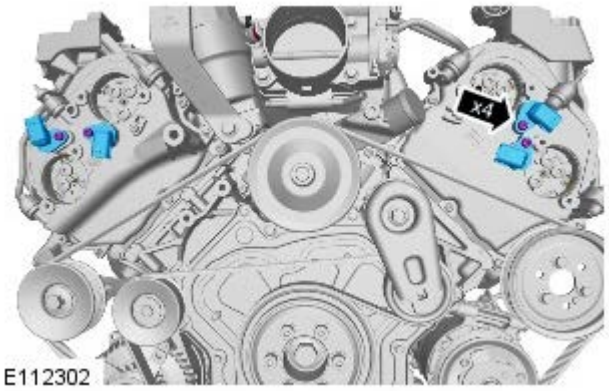
E112299

8. *Torque:* 12 Nm



E112300

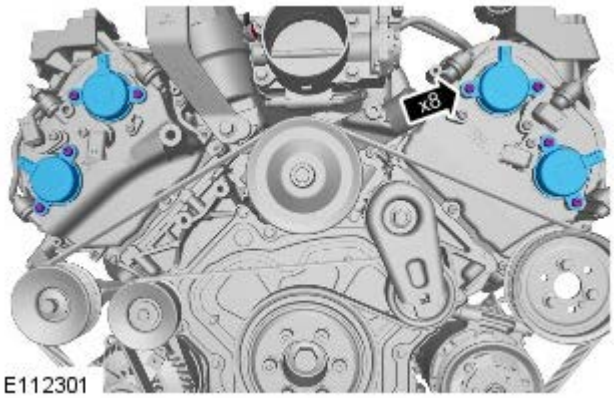
9. *Torque:* 12 Nm



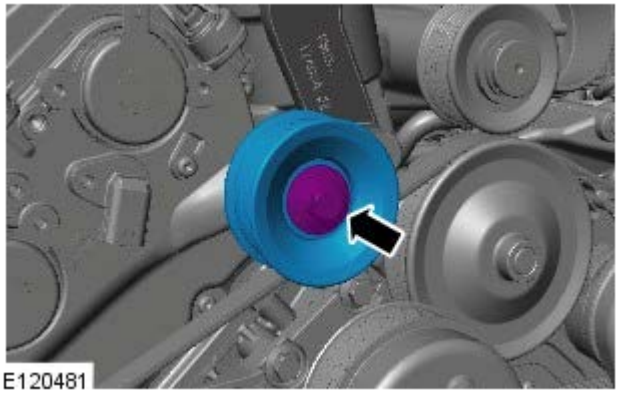
10. *Torque:* 25 Nm



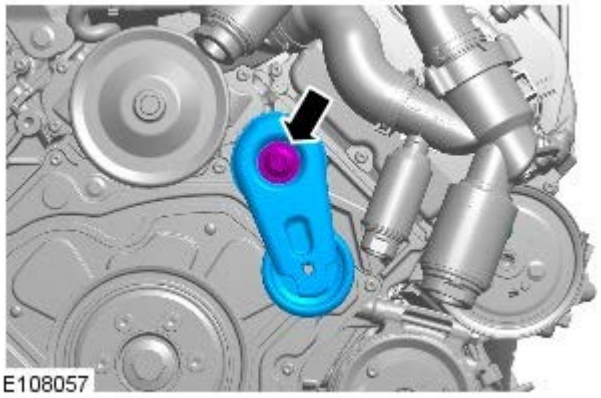
11. *Torque:* 12 Nm



12. *Torque:* 40 Nm

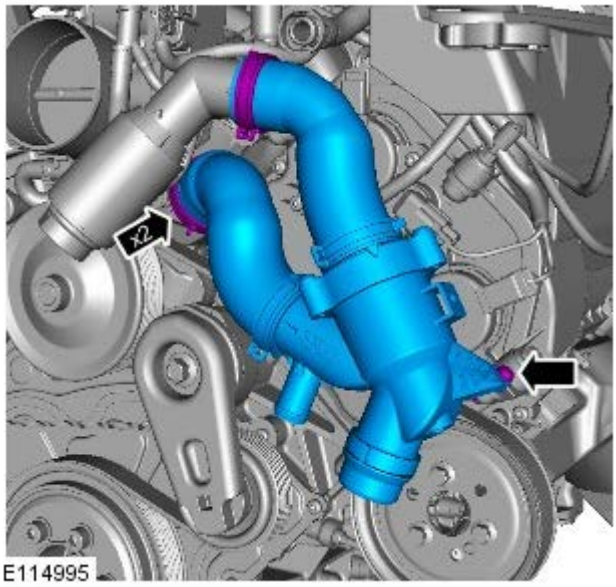


13. NOTE: Install the bolt finger tight before final tightening.

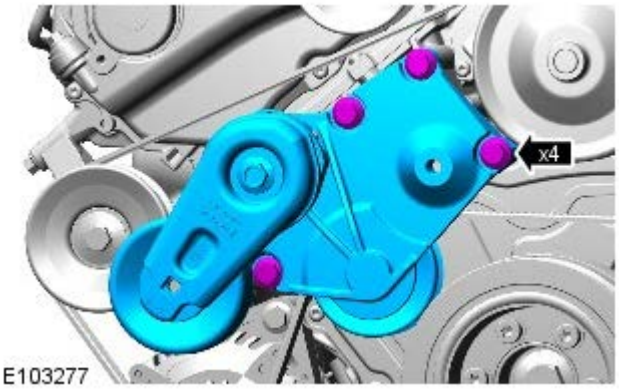


Torque: 40 Nm

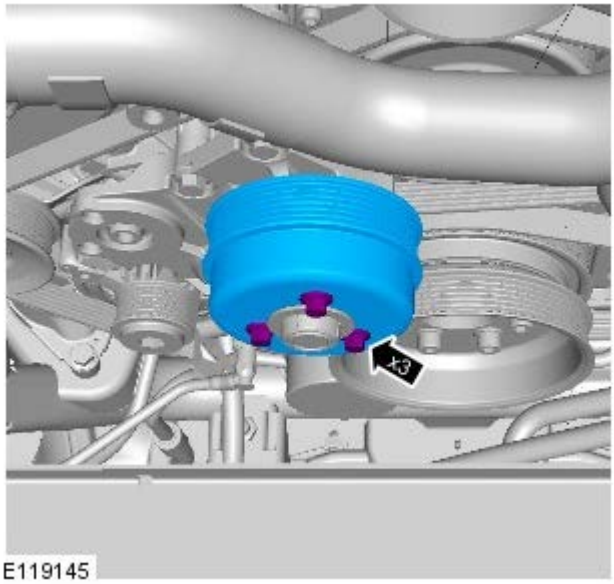
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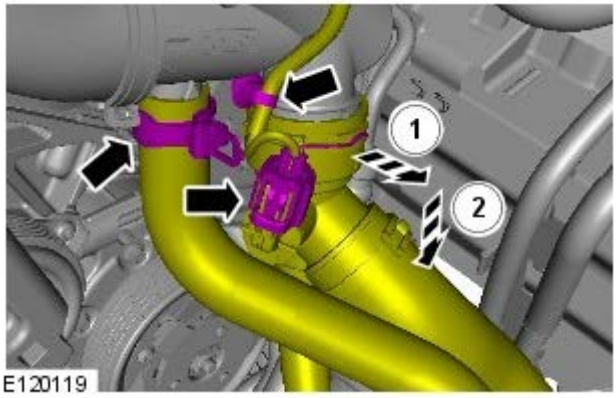
15. *Torque:* 25 Nm



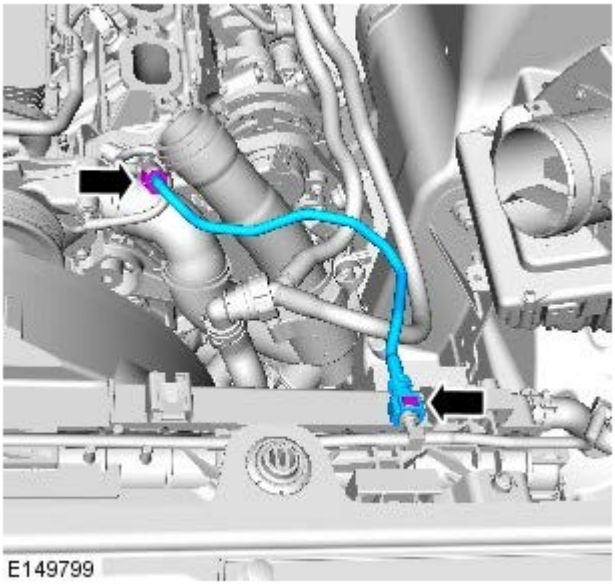
16. *Torque:* 25 Nm



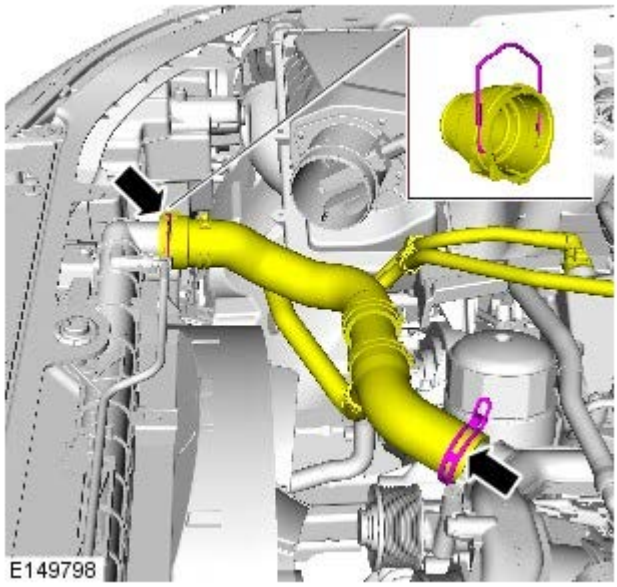
17.



18.



19.



20. Refer to: Crankshaft Pulley (303-01C Engine - V8 S/C 5.0L Petrol, Removal and Installation).

21. Refer to: Valve Cover LH (303-01C Engine - V8 S/C 5.0L Petrol, Removal and Installation).

22. Refer to: Valve Cover RH (303-01C Engine - V8 S/C 5.0L Petrol, Removal and Installation).

23. Refer to: Cooling System Partial Draining, Filling and Bleeding - V8 S/C 5.0L Petrol (303-03C, General Procedures).

24. Connect the battery ground cable.

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

Published: 10-May-2013

Engine - V8 S/C 5.0L Petrol - Timing Drive Components

Removal and Installation

Special Tool(s)

 E115263	303-1445 Timing Tool – Camshaft Alignment
 E115270	303-1452 Camshaft Rotating Tool
 E115271	303-1482 Tensioner Tool
 E152575	JLR-303-1303 Timing Tool
 E152576	JLR-303-1304 Locking 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.

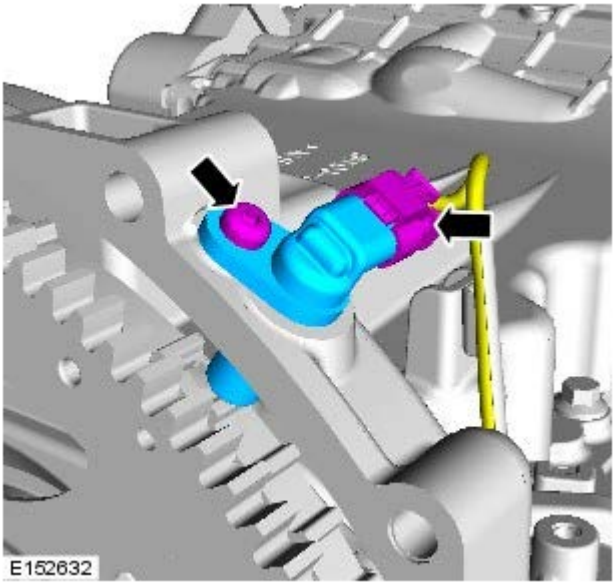
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

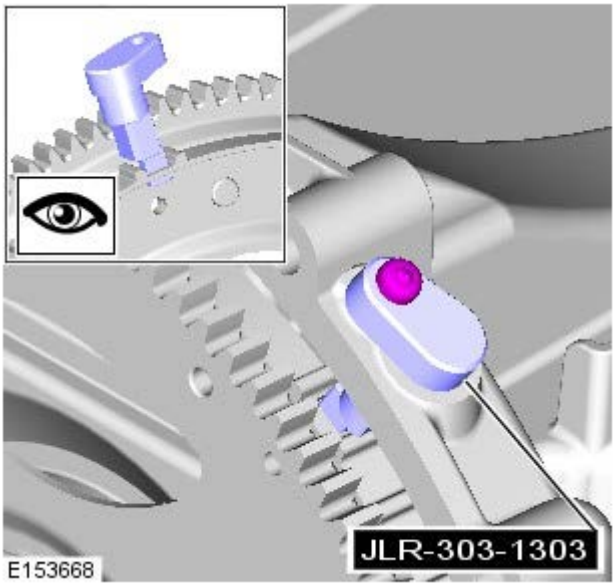
2. WARNING: Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

3. Refer to: Timing Cover (303-01C Engine - V8 S/C 5.0L Petrol, Removal and Installation).

4.





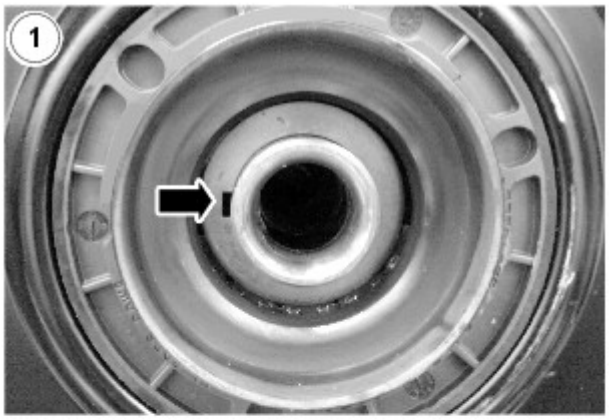
5. CAUTION: Only rotate the crankshaft clockwise.

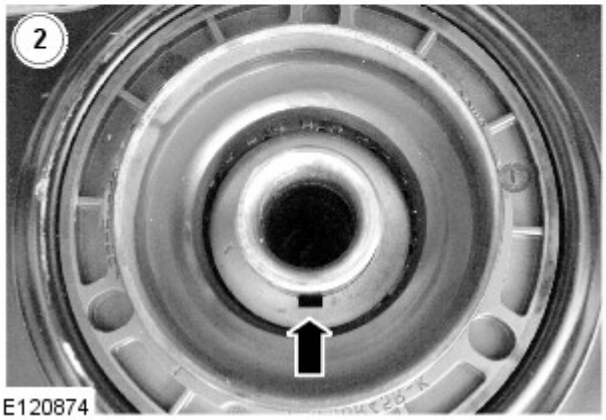
Install the special tool.

Special Tool(s): JLR-303-1303

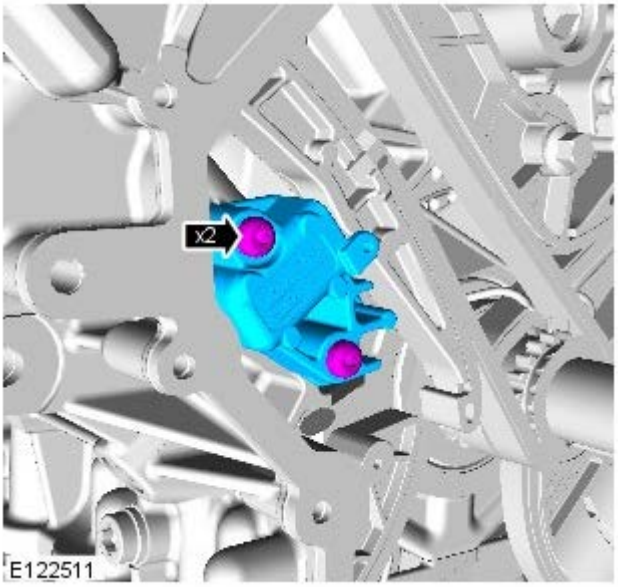
6. CAUTION: If the noted postion of the woodruff key is at the 9 o'clock position, then a new flexplate must be installed. If the woodruff key is in the 6 o'clock position then proceed with the next step.

Note the position of the crankshaft woodruff key.

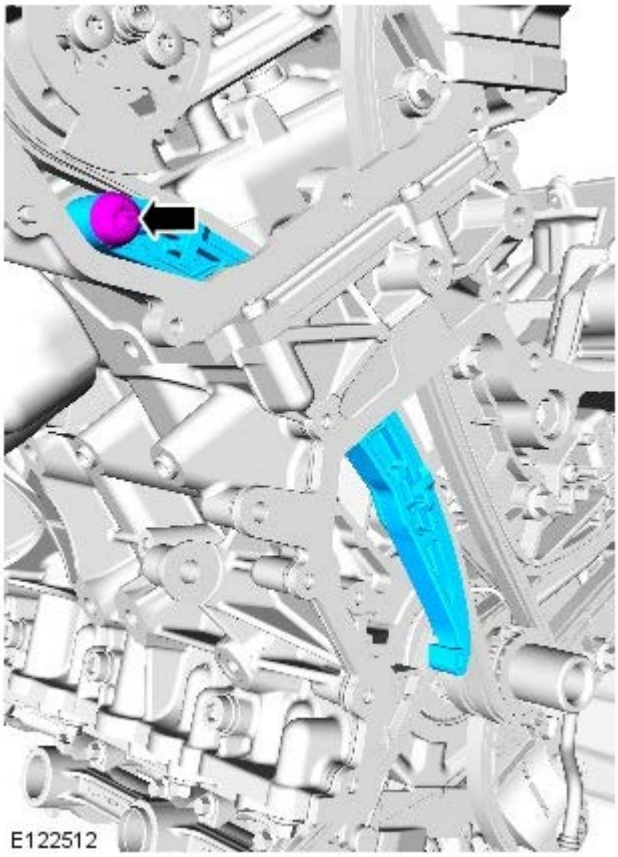




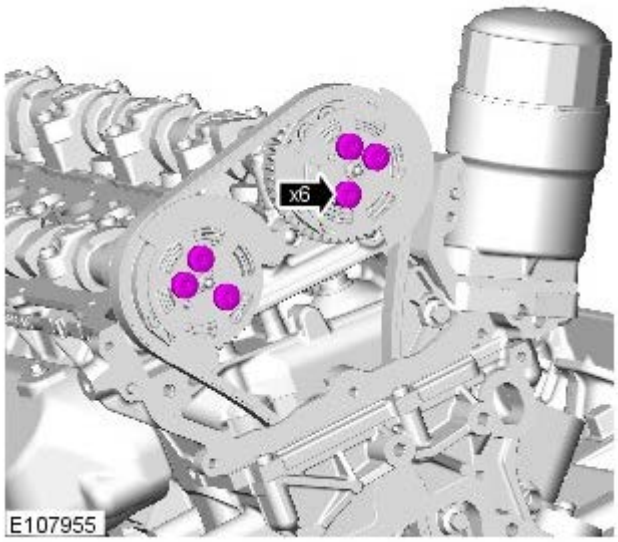
7.



8.

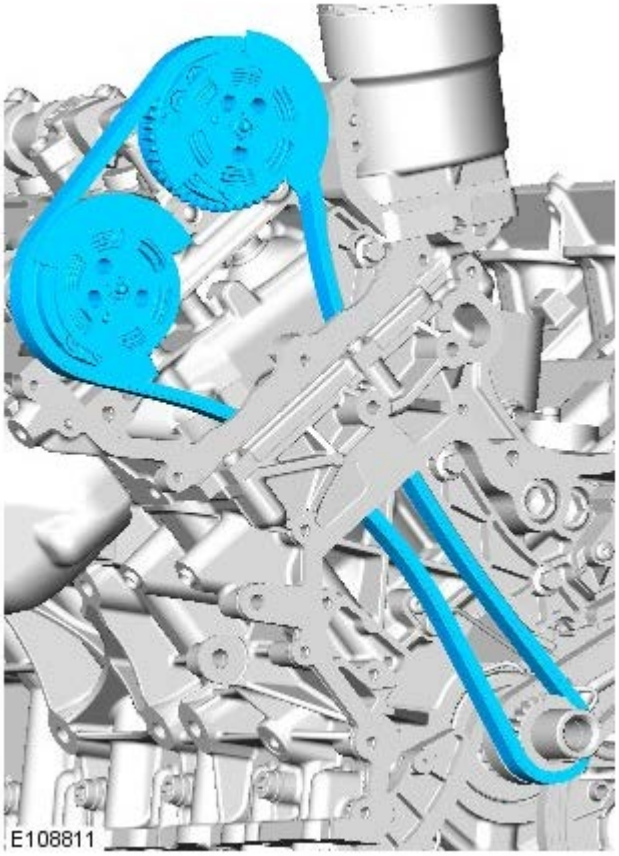


9.

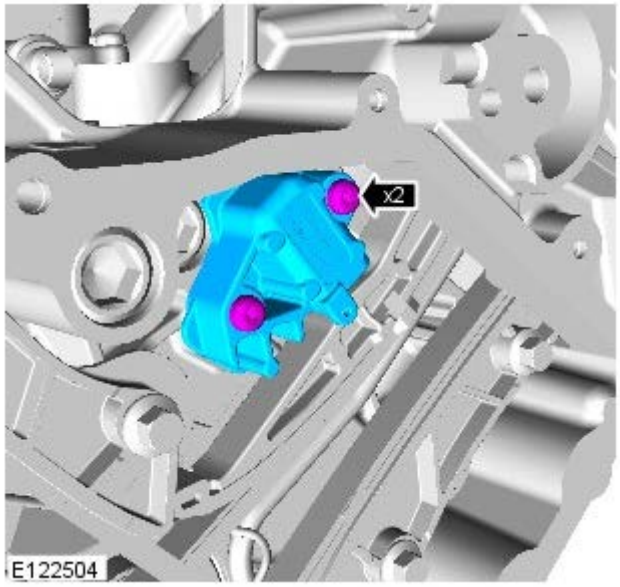


10. CAUTION: If the variable valve timing (VVT) units are knocked or dropped then the VVT must be replaced.

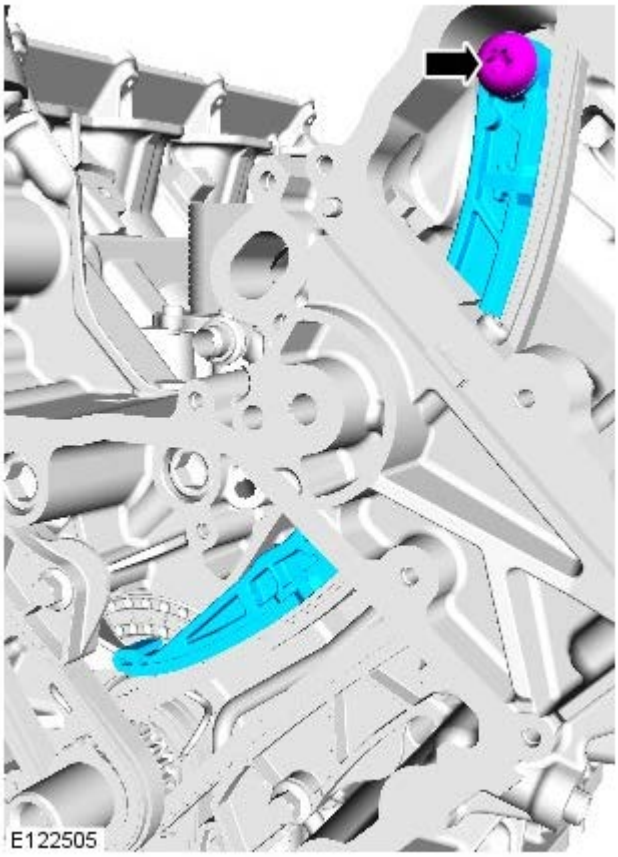
Remove the timing chain with the VVT units.



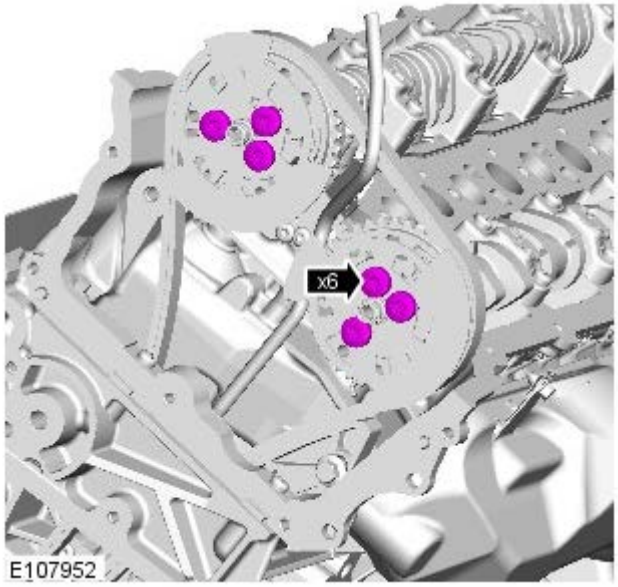
11.



12.

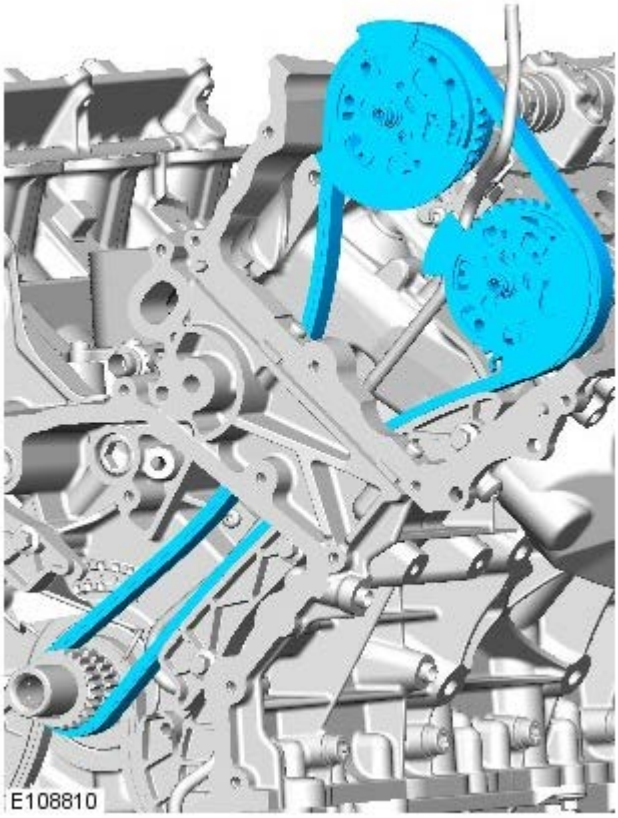


13.

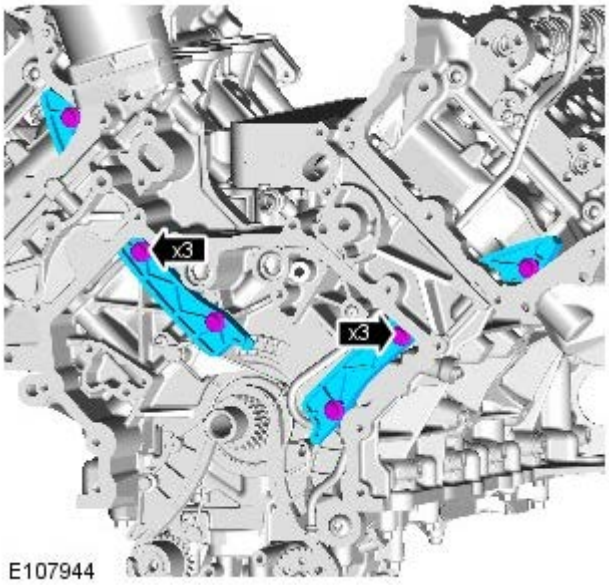


14. CAUTION: If the VVT is knocked or dropped then the VVT must be replaced.

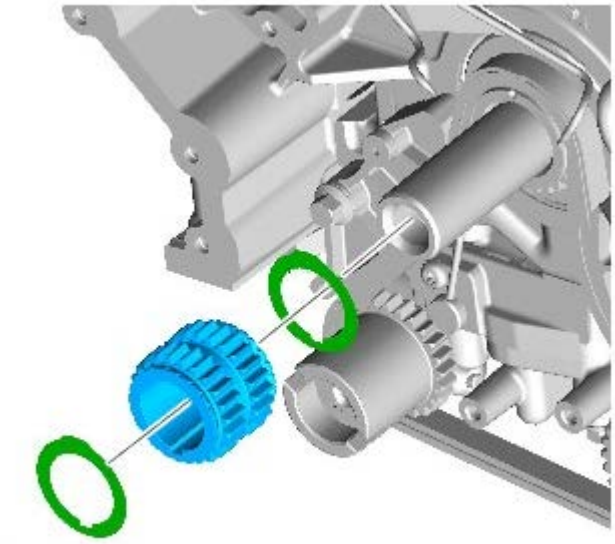
Remove the timing chain with the VVT units.



15.

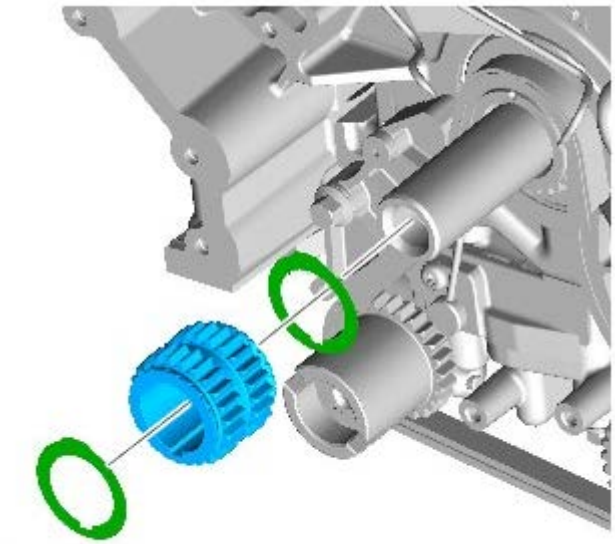


16. CAUTION: Discard the friction washer.



E107945

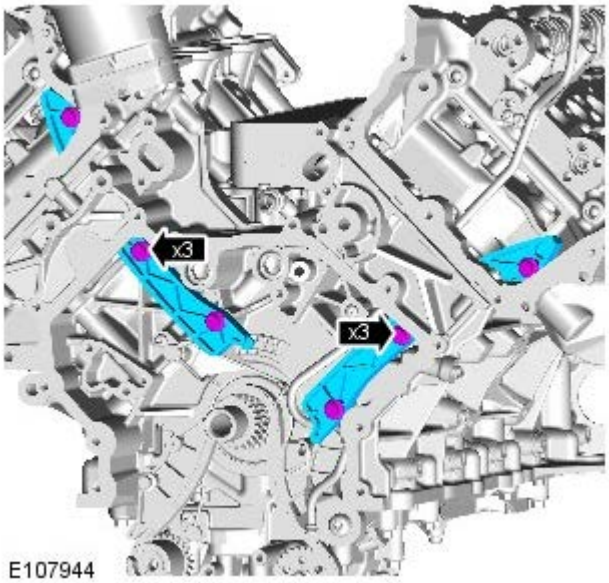
Installation



E107945

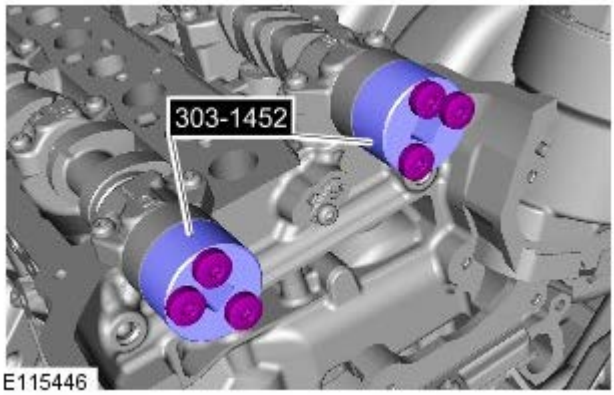
1. CAUTION: Install a new friction washer.

2. *Torque:* 12 Nm



E107944

3.
   - Install the special tool to each Camshaft.
   - *Special Tool(s):* 303-1452
   - *Torque:* 10 Nm



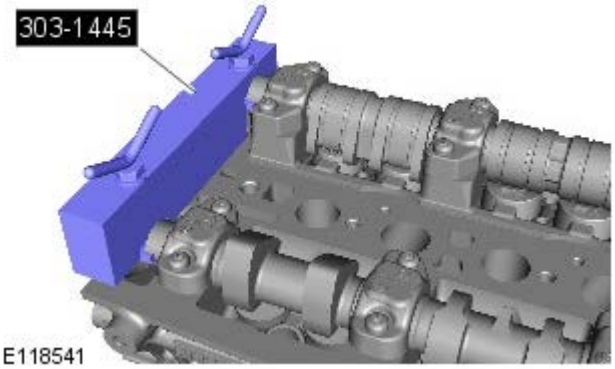
4.

- 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.

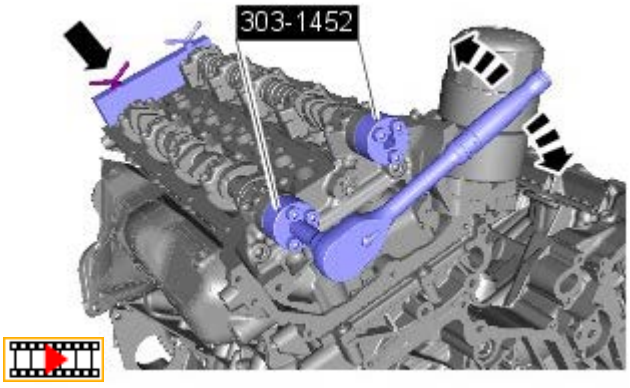


6. CAUTIONS:

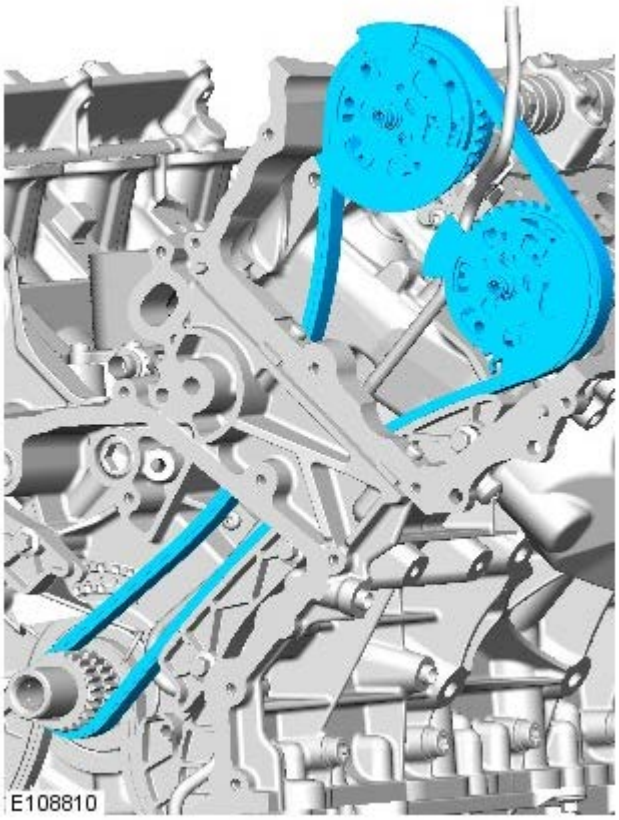
Do not overturn the camshafts.

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.

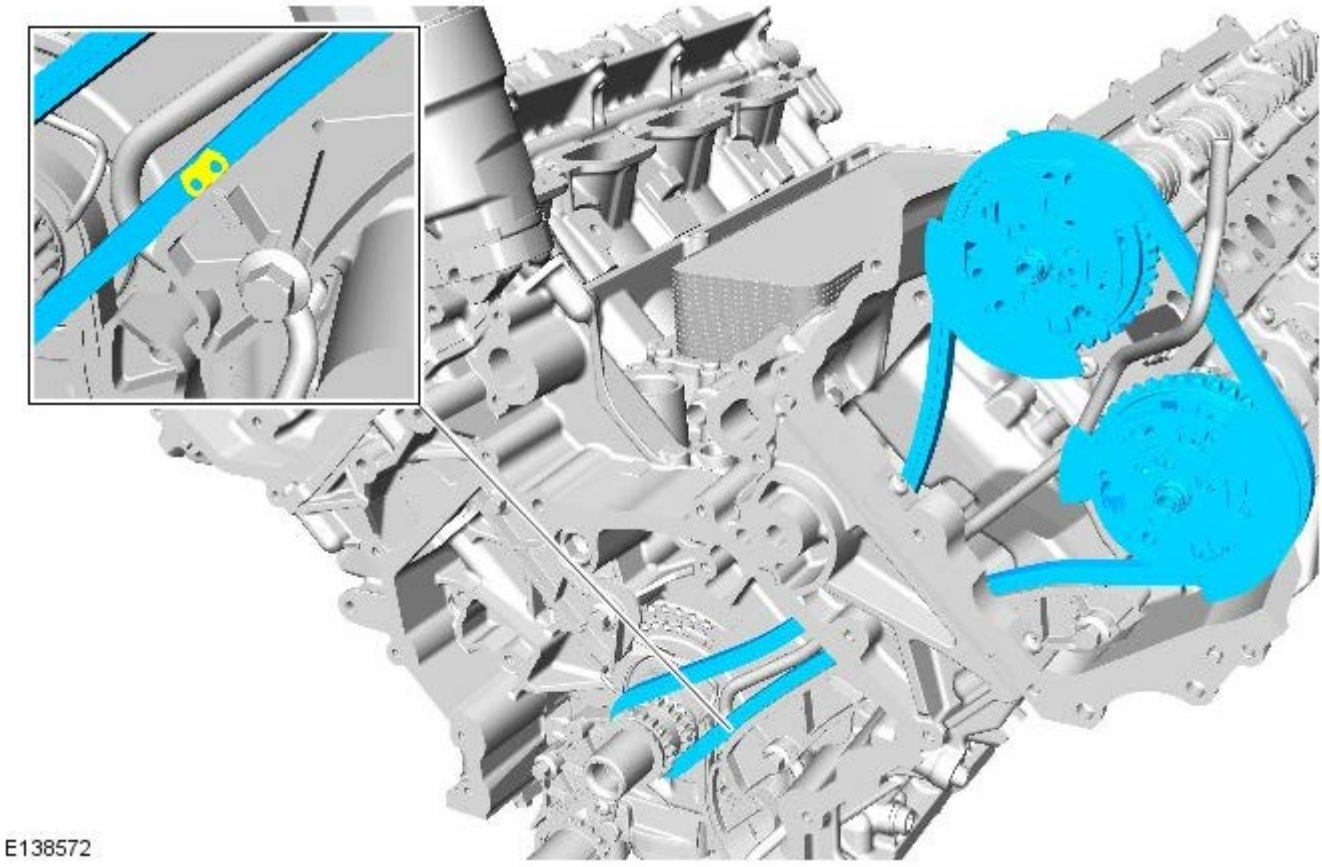
If the VVT is knocked or dropped then the VVT must be replaced.

NOTE: Do not tighten at this stage.

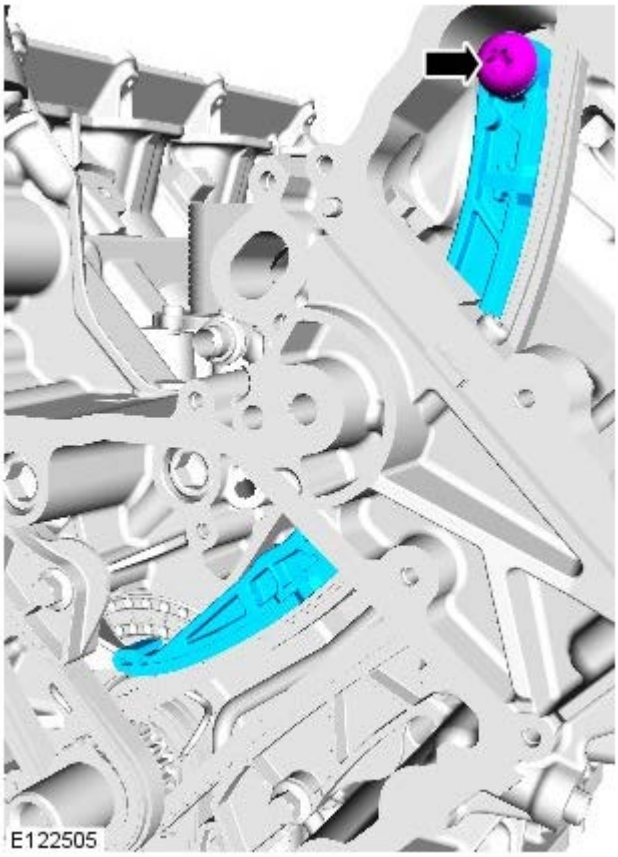
- Install the timing chain with the variable valve timing (VVT) units.

8.

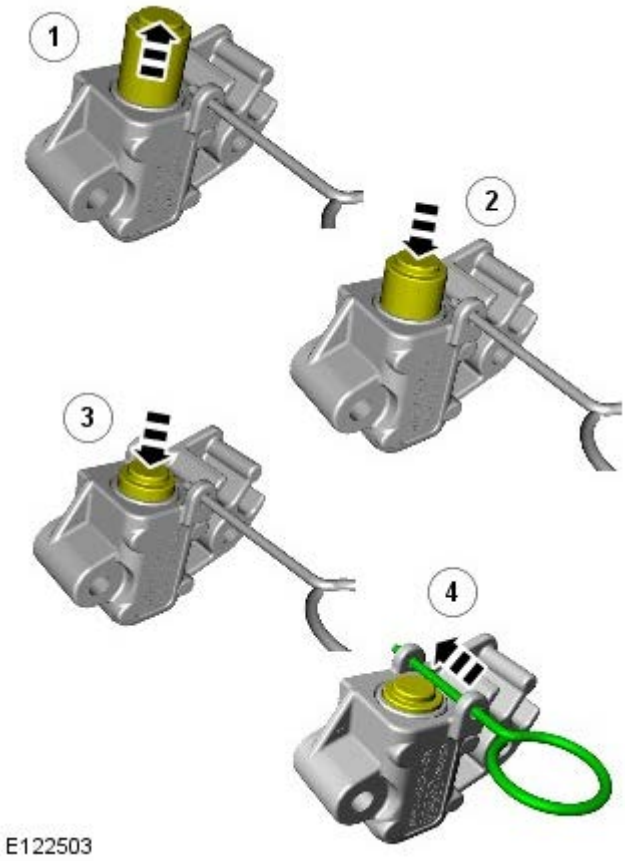
- Make sure that all the timing chain alignment marks are in the positions shown.



9. *Torque:* 25 Nm

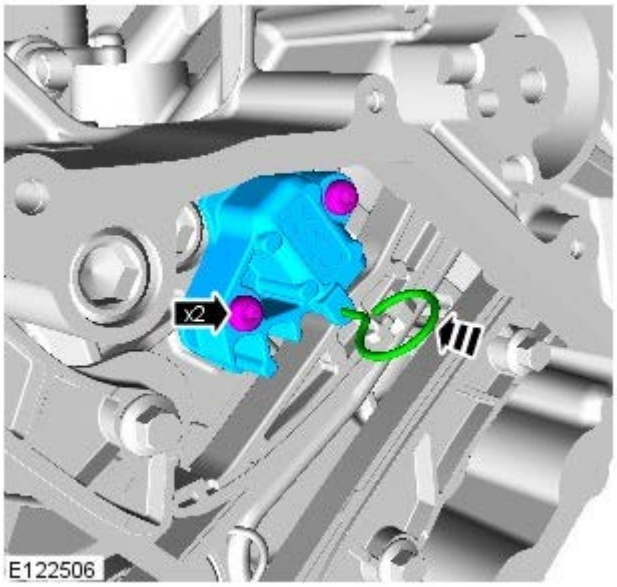


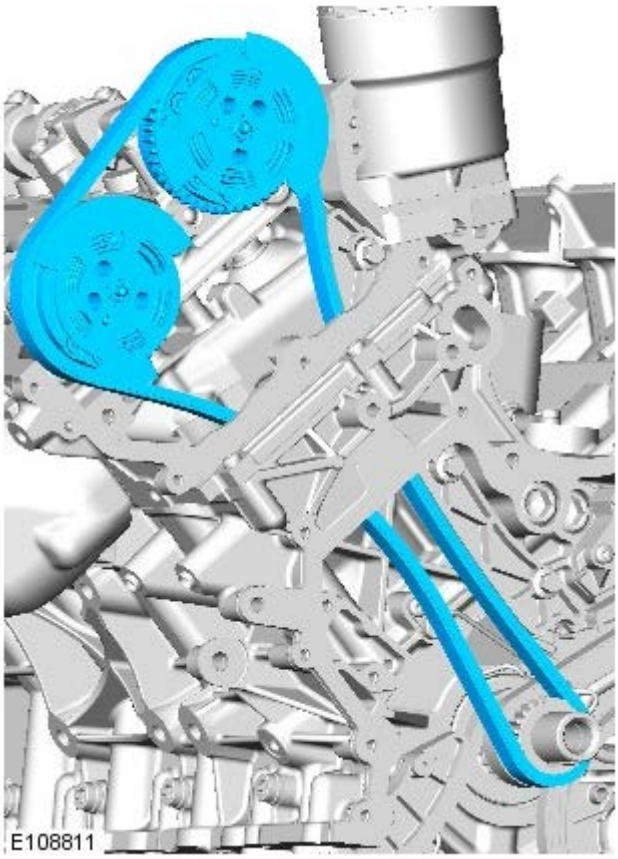
10. Make sure the tensioner piston is fully extended. Then fully depress and lock the tensioner piston with the grenade pin before installation, failure to do this may result in damage to the engine.



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.

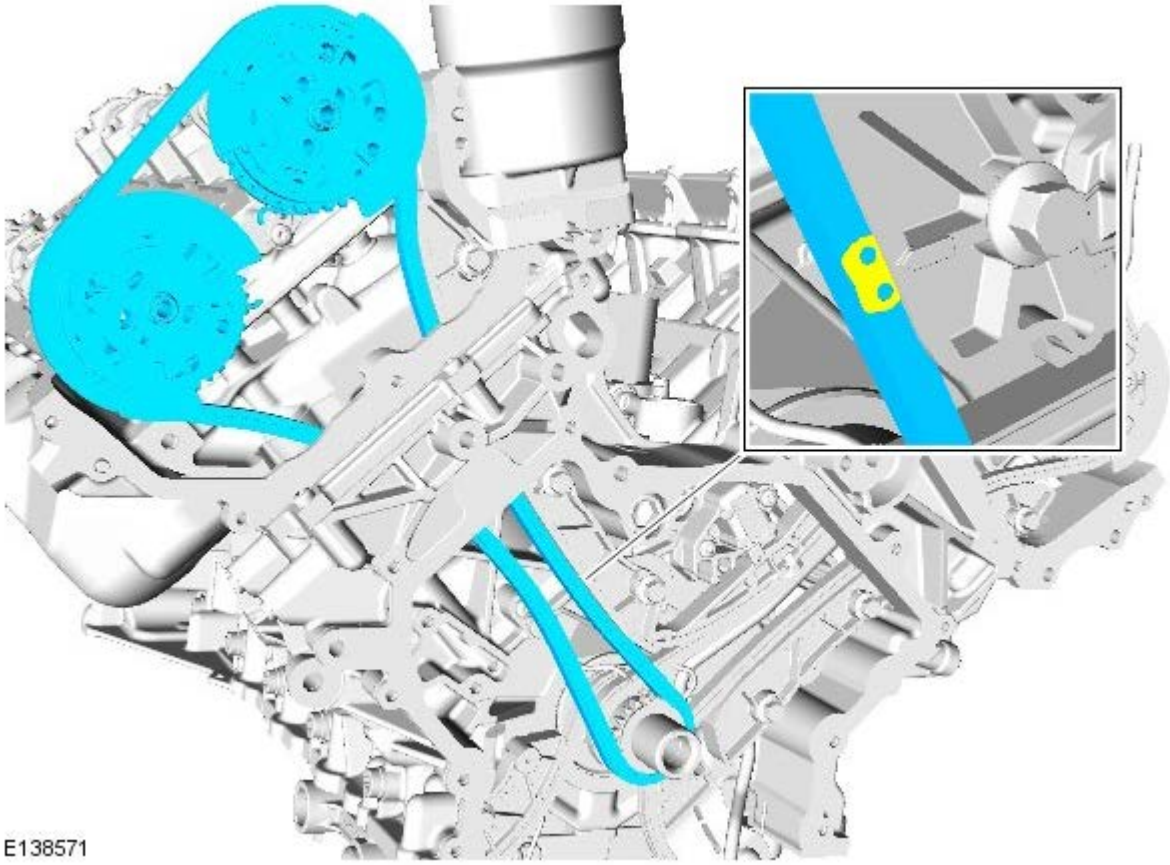
If the VVT is knocked or dropped then the VVT must be replaced.

NOTE: Do not tighten at this stage.

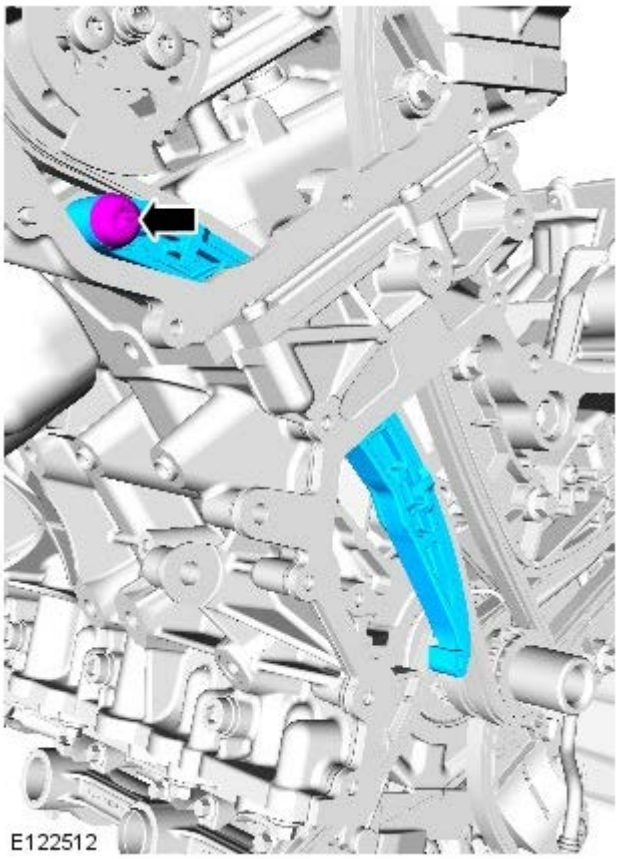
- Install the timing chain with the VVT units.

13.

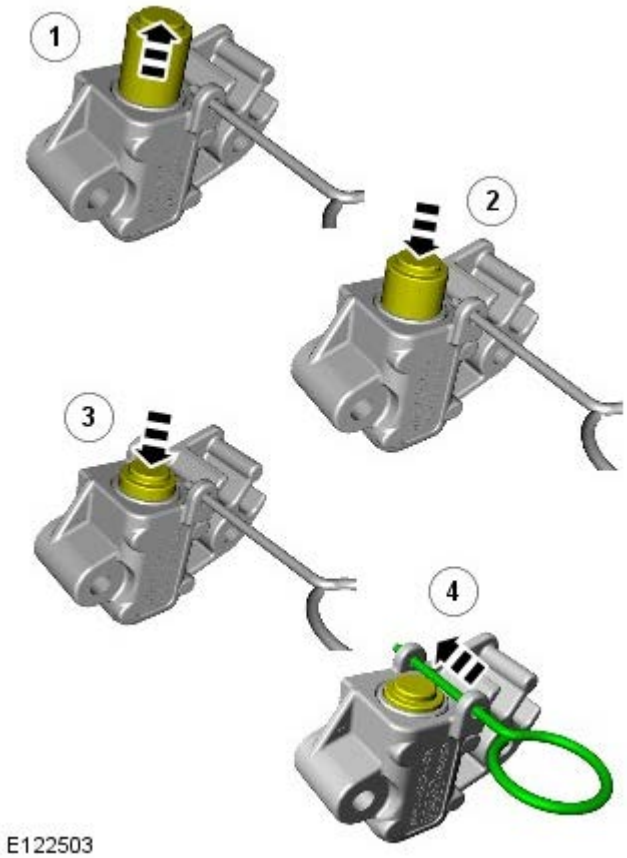
- Make sure that all the timing chain alignment marks are in the positions shown.



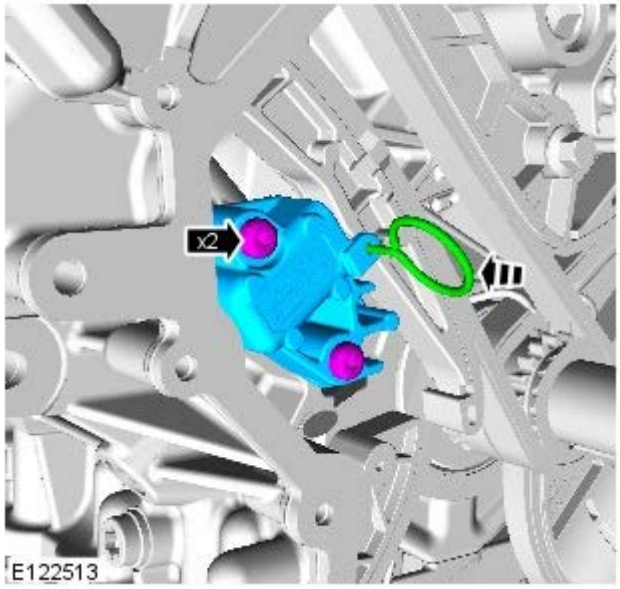
14. *Torque:* 25 Nm



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.



E122503

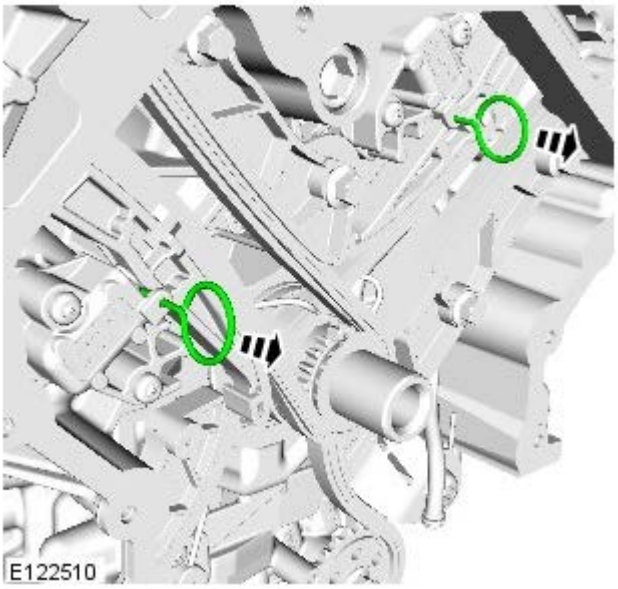


E122513

16. CAUTION: Do not release the timing chain tensioner locking pin at this stage.

Torque: 10 Nm

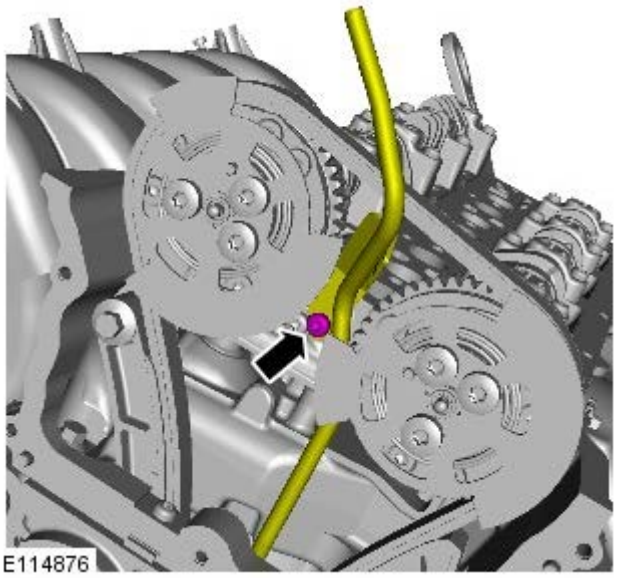
17.



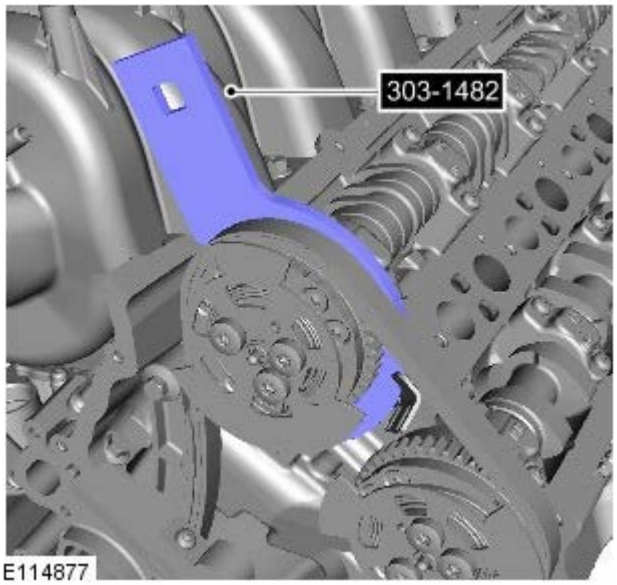
18. CAUTION: Do not use mechanical force.

    Make sure that the tensioners are fully deployed.

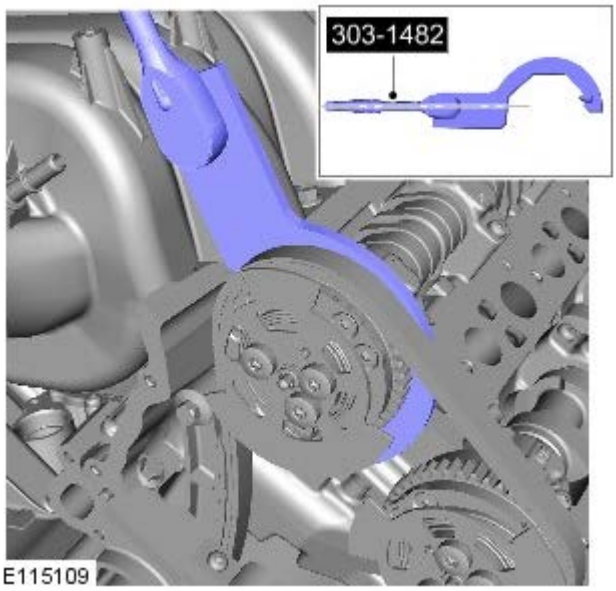
19.
    - Release and reposition the oil suction tube to one side.



20.
    - Install the special tool.
    - *Special Tool(s):* 303-1482



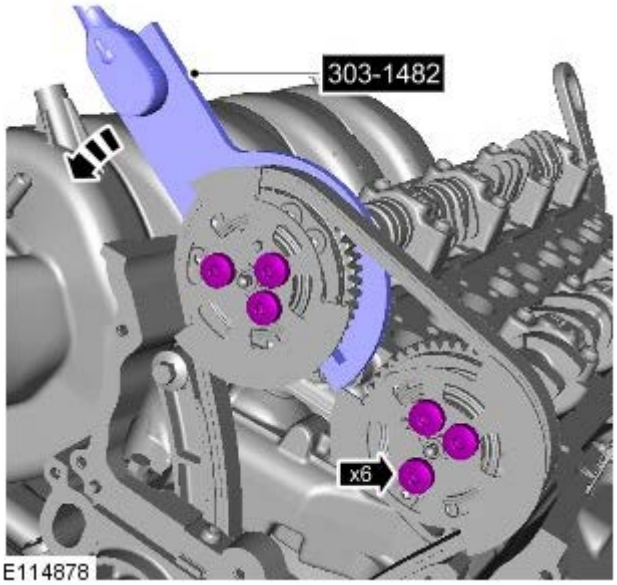
21. CAUTIONS:



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.

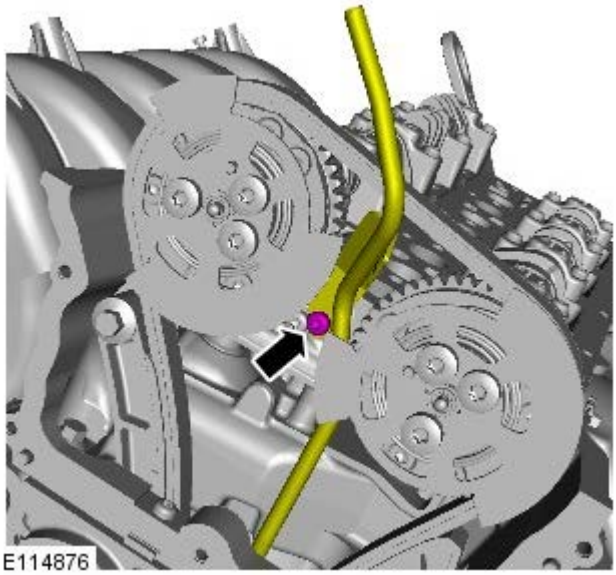
- Install the torque wrench to the special tool.
- *Torque:* 35 Nm



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

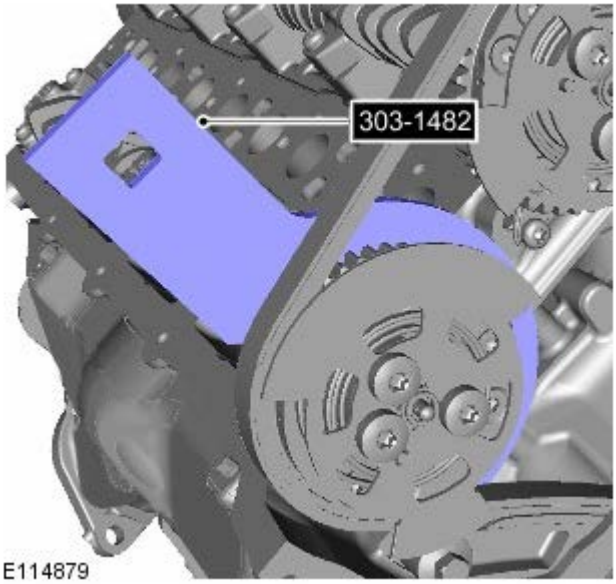


23.

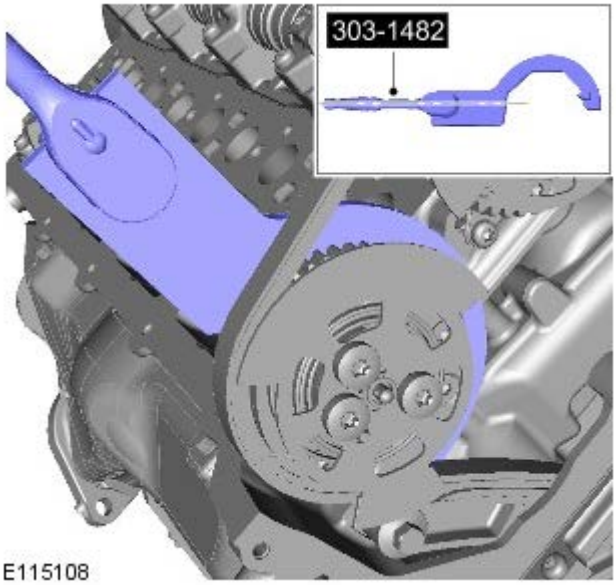
- Install the oil suction tube.
- *Torque:* 10 Nm

24.

- Install the special tool.
- *Special Tool(s):* 303-1482



E114879



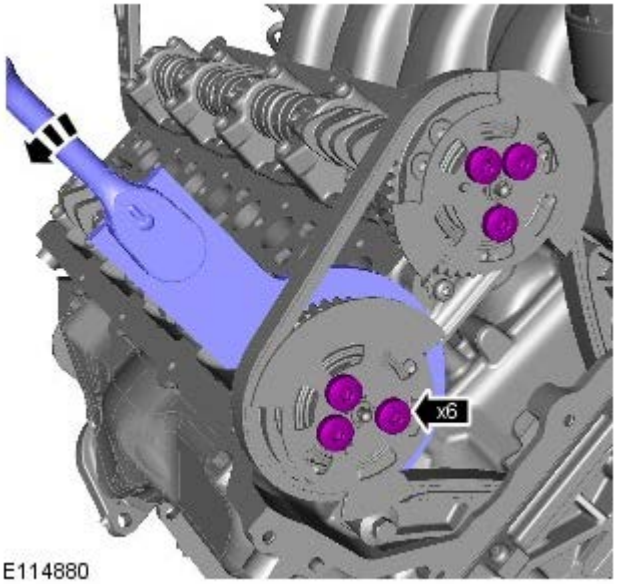
E115108

25. 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



E114880

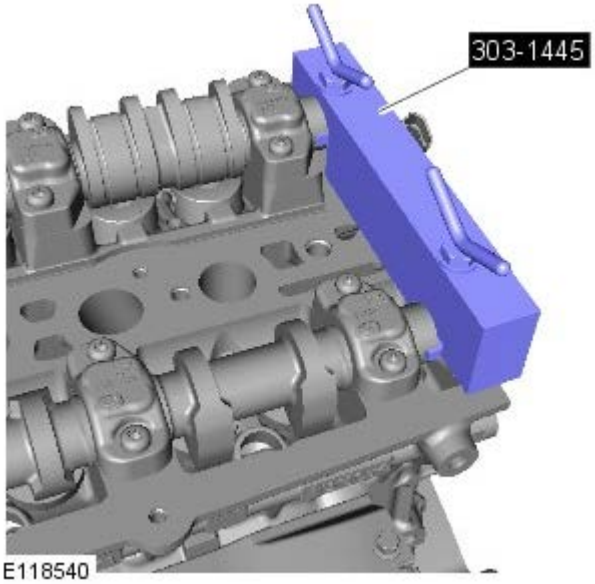
26. ⚠ CAUTION: Make sure that the torque wrench does not move whilst tightening the VVT bolts.

NOTE: Make sure to tighten the inlet VVT unit bolts first.

Torque: 32 Nm

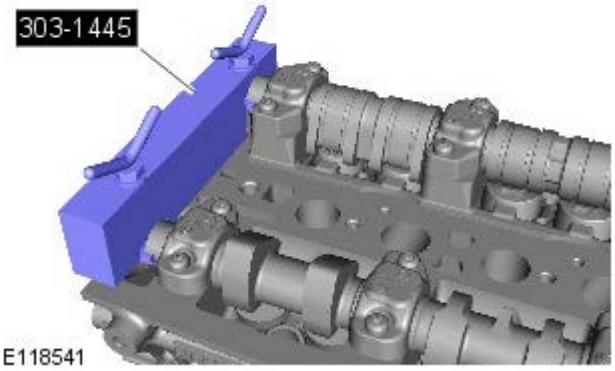
27.

- Remove the special tool.



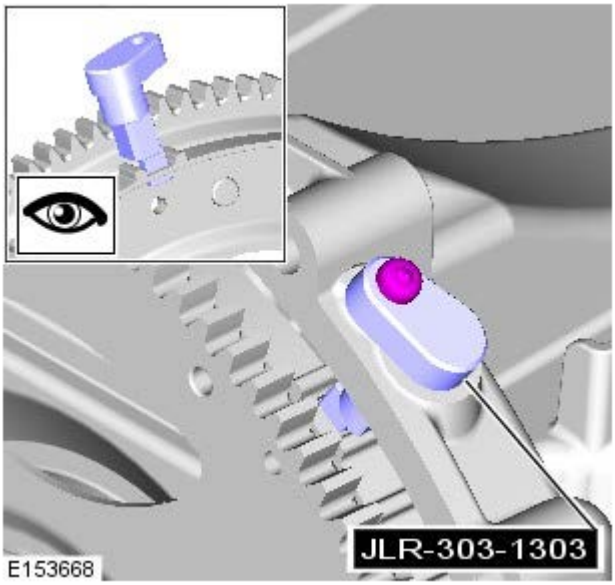
28.

- Remove the special tool.



29.

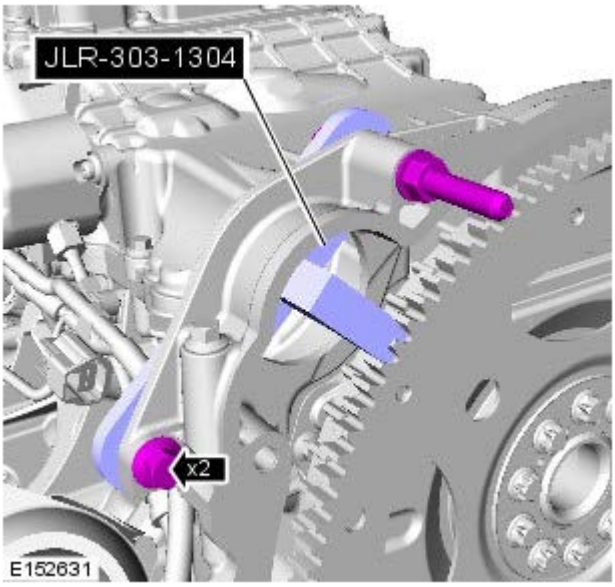
- Remove the special tool.
- *Special Tool(s):* JLR-303-1303

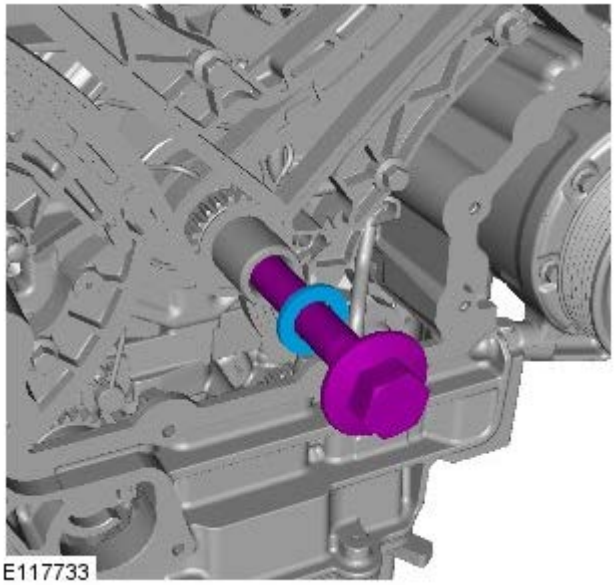


30.

- Install the special tool.

  Special Tool(s): JLR-303-1304





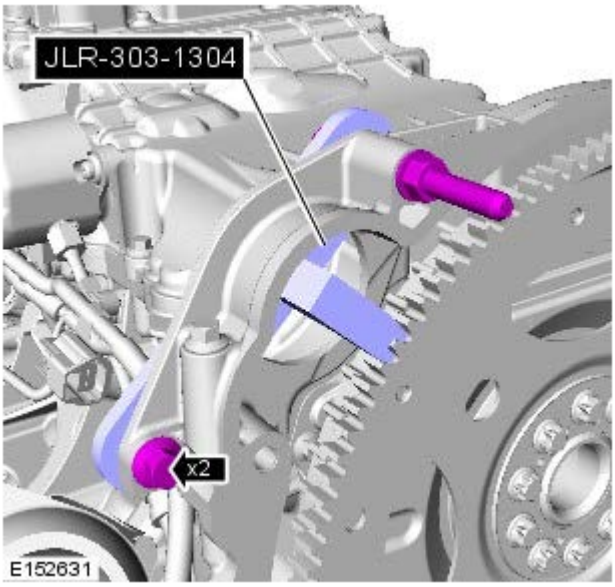
31. CAUTION: Install the crankshaft pulley bolt with an M16 washer to prevent damage to the crankshaft on installation.

Torque: 50 Nm

32.

- Remove the special tool.

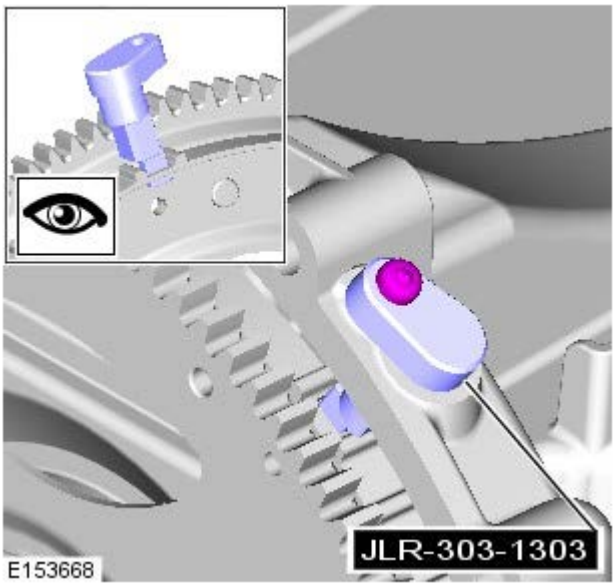
Special Tool(s): JLR-303-1304



33. Rotate the engine two complete turns clockwise.

34. CAUTION: Only rotate the crankshaft clockwise.

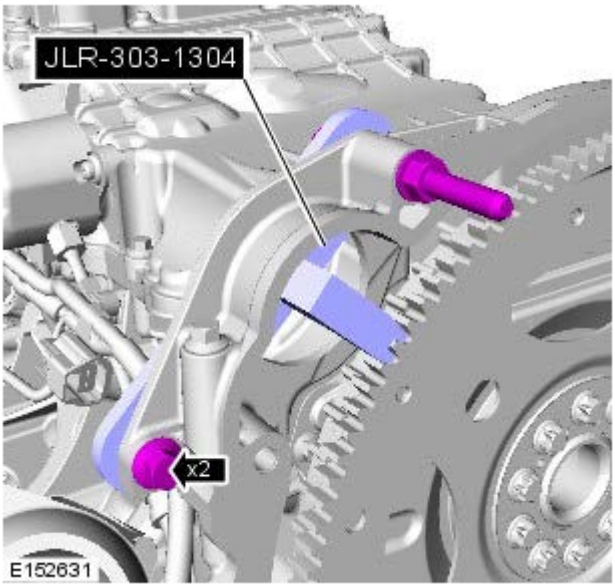
- Install the special tool.



Special Tool(s): JLR-303-1303

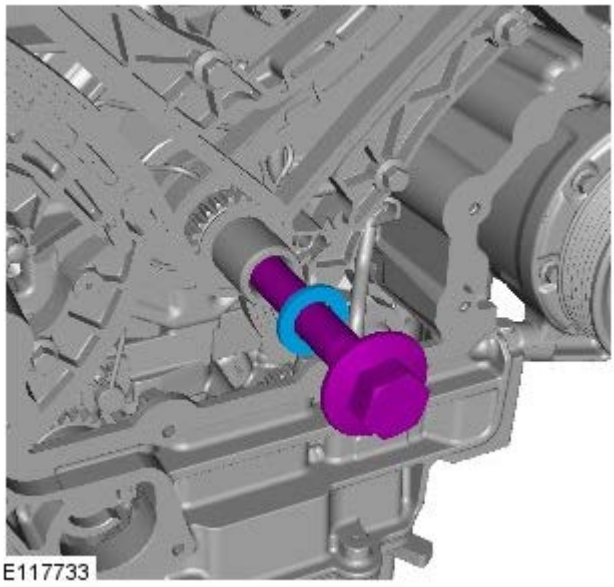
35.

- Install the special tool.



Special Tool(s): JLR-303-1304

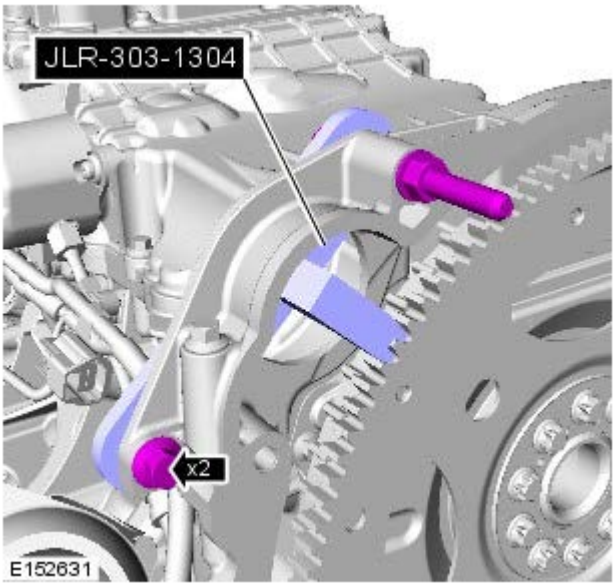
36.

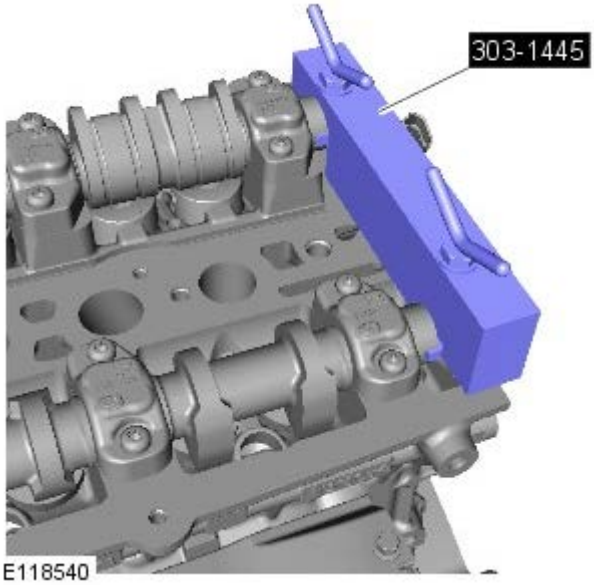


37.

- Remove the special tool.

Special Tool(s): JLR-303-1304





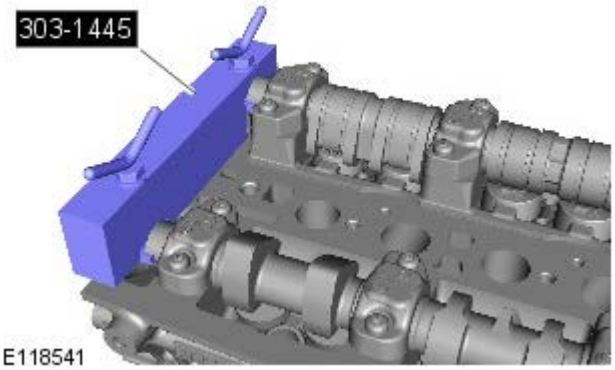
38. CAUTIONS:

    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.

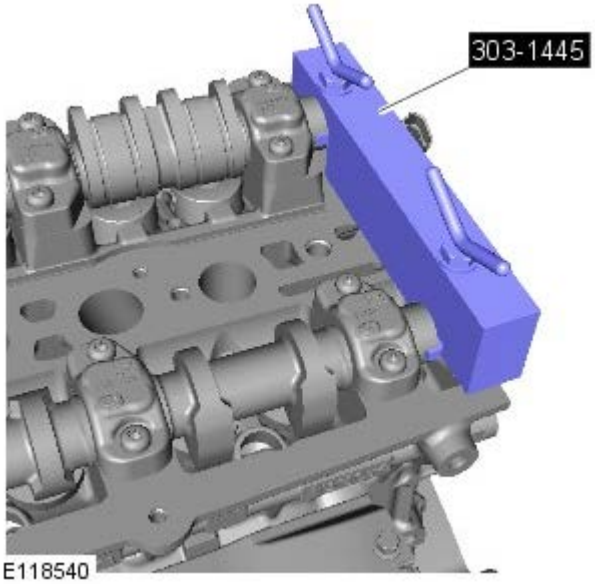
    Special Tool(s): 303-1445



39. CAUTION: If the special tool cannot be installed, the timing chain installation steps must be repeated.

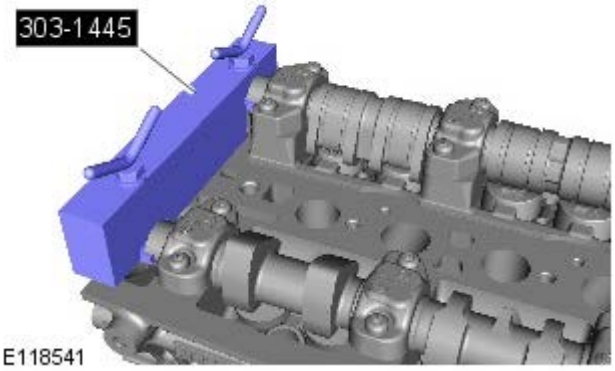
    Install the special tool.

40.
    - Remove the special tool.



41.

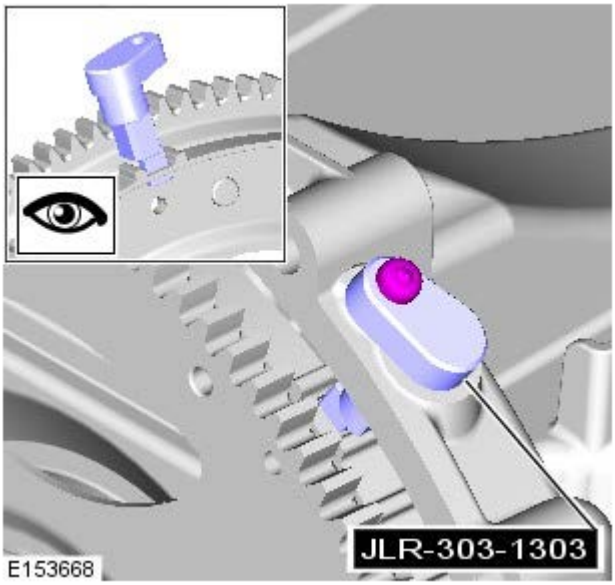
- Remove the special tool.



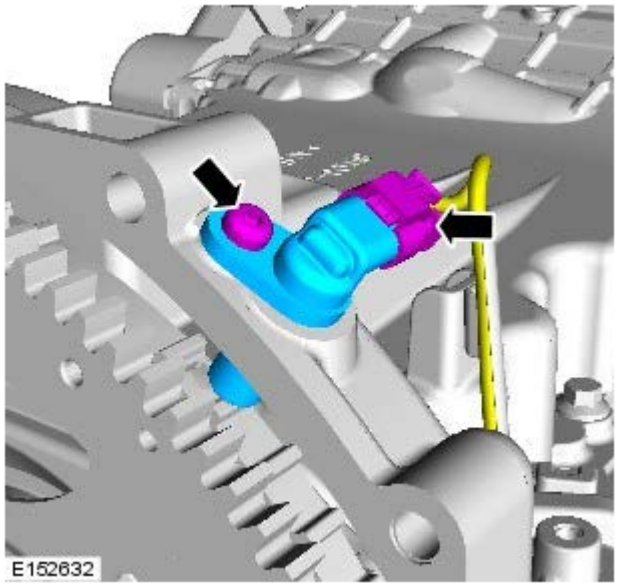
42.

- Remove the special tool.

  Special Tool(s): JLR-303-1303



43. *Torque:* 10 Nm



44. Refer to: Timing Cover (303-01C Engine - V8 S/C 5.0L Petrol, Removal and Installation).

45. Connect the battery ground cable.

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

Published: 10-Sep-2012

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.

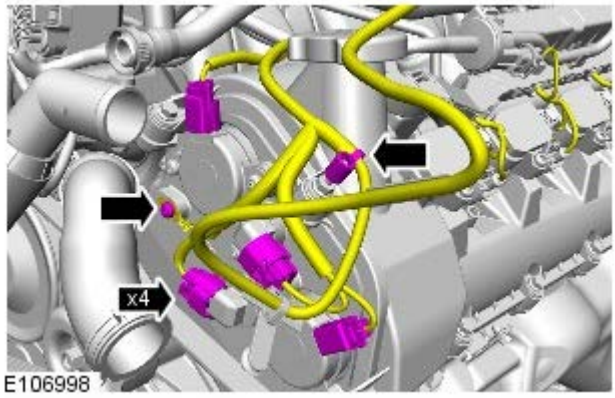
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

2. Refer to: Supercharger (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).

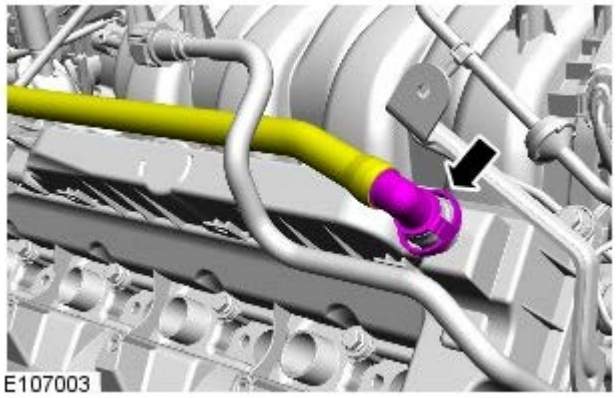
3. Refer to: Air Cleaner Outlet Pipe LH (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).

4. Refer to: Fuel Rail LH (303-04 Fuel Charging and Controls - V8 S/C 5.0L Petrol, Removal and Installation).

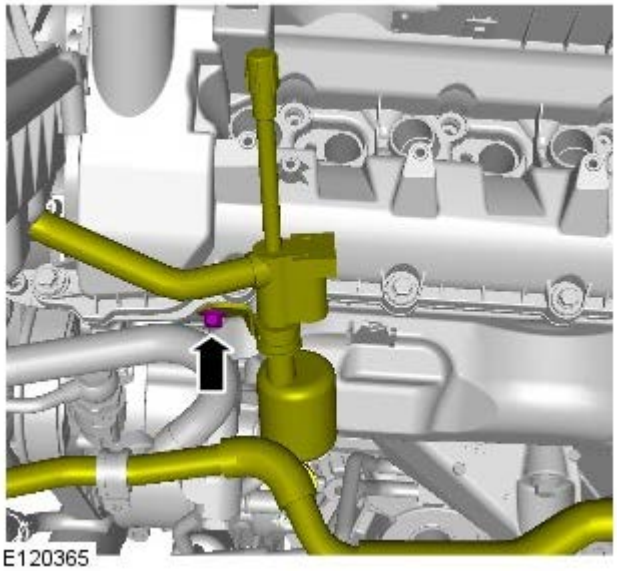
5. *Torque:* 10 Nm



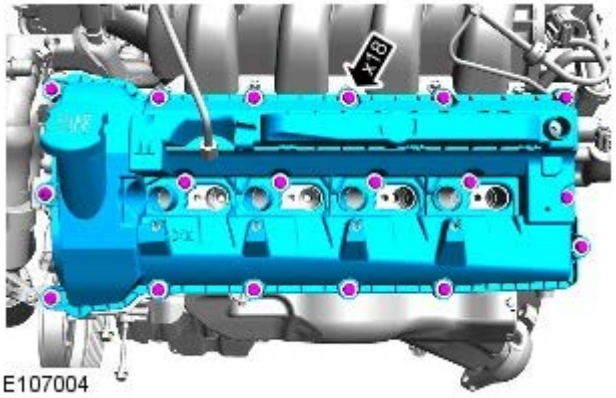
6.



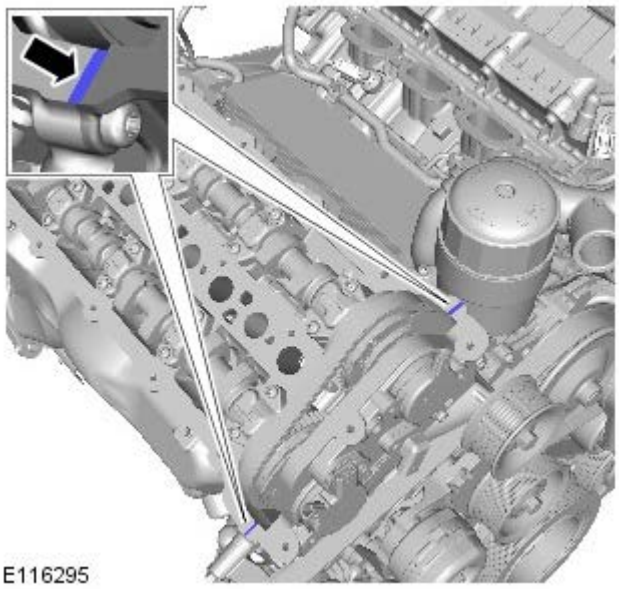
7. *Torque:* 25 Nm



8.



Installation



1. CAUTIONS:

   Use only a plastic scraper when removing the sealing material.

   Use lint free cloth.

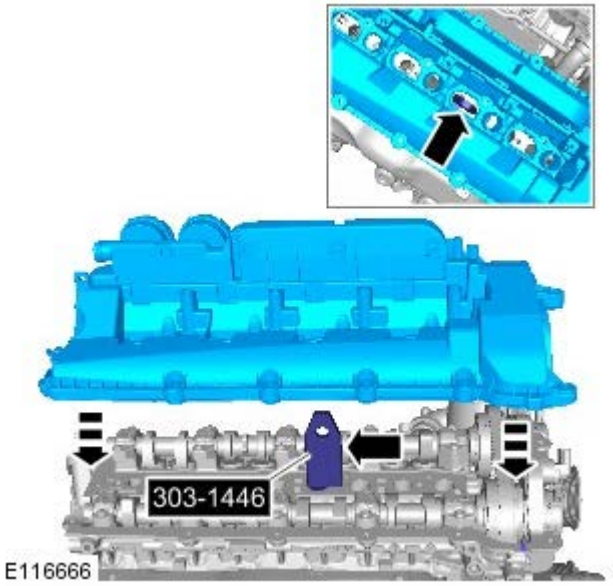
   Make sure that the mating faces are clean and free of corrosion and foreign material.

   Installation of the valve cover and tightening must be carried out within 7 minutes of applying the sealant.

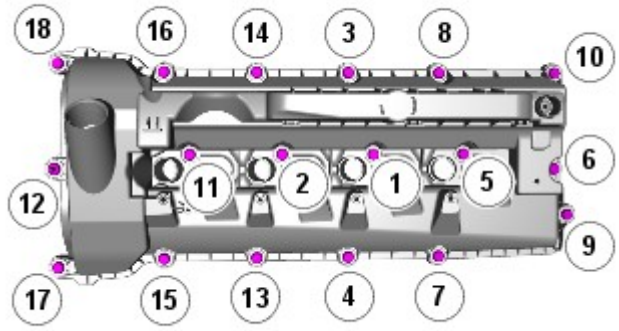
   NOTE: Apply two beads of silcone gasket sealant (Loctite 5901) as shown on the illustration. The application of the sealant must be 1.5mm diameter 12mm long. Install the valve cover immediately after applying the sealant. The cover should be fitted directly to the head without smearing the sealant or the seals.

   To install, reverse the removal procedure.

2. *Special Tool(s):* 303-1446



E116666



E107006

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

Torque: 13 Nm

Published: 10-Sep-2012

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.

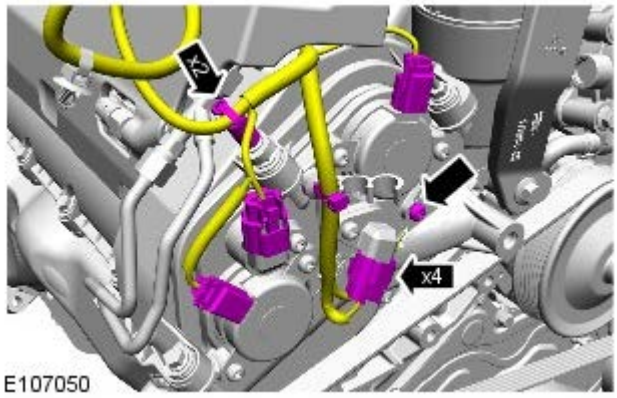
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

2. Refer to: Supercharger (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).

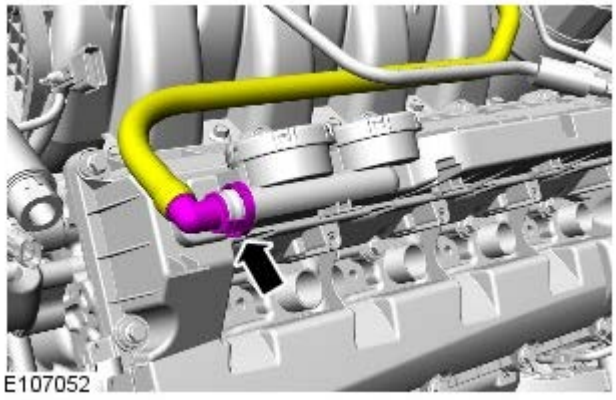
3. Refer to: Air Cleaner Outlet Pipe RH (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).

4. Refer to: Fuel Rail RH (303-04 Fuel Charging and Controls - V8 S/C 5.0L Petrol, Removal and Installation).

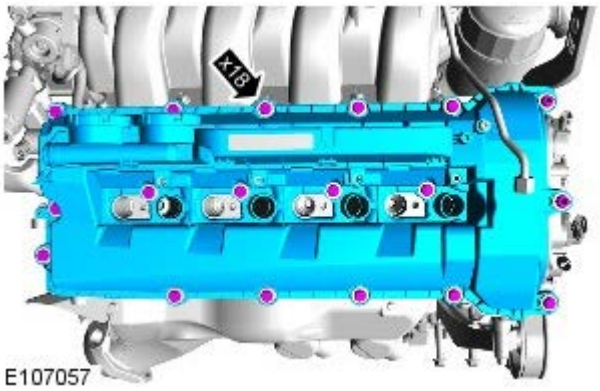
5.



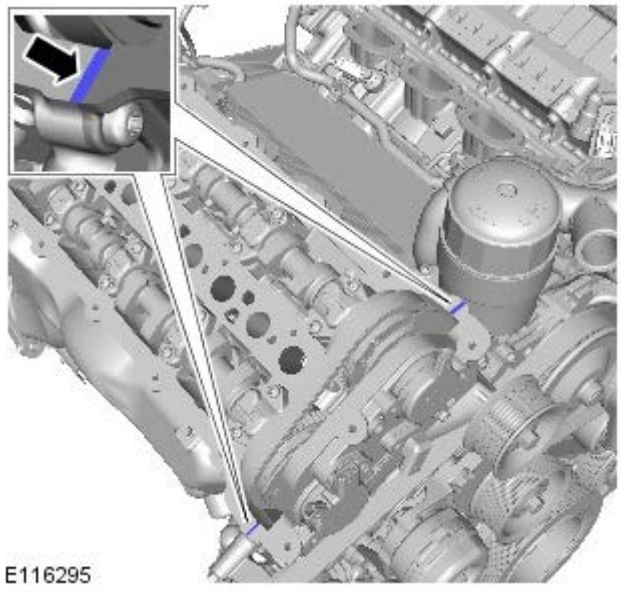
6.



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.

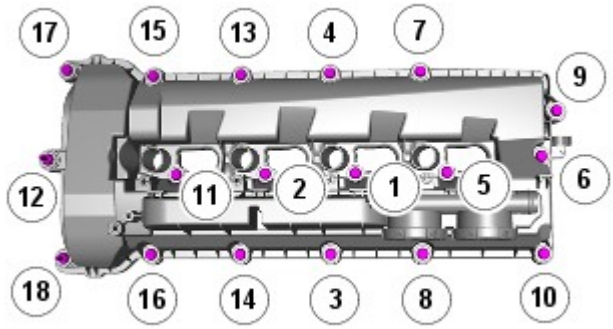
   To install, reverse the removal procedure.

2. *Special Tool(s):* 303-1446



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

   Torque: 13 Nm



E107058

Published: 10-Sep-2012

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 ground cable.

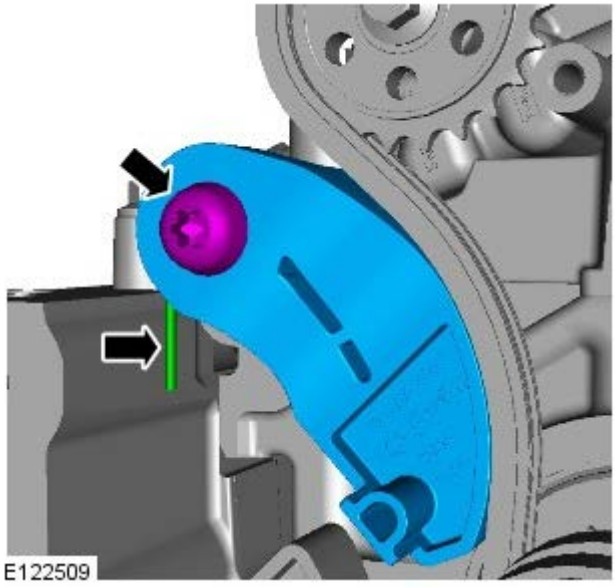
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

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

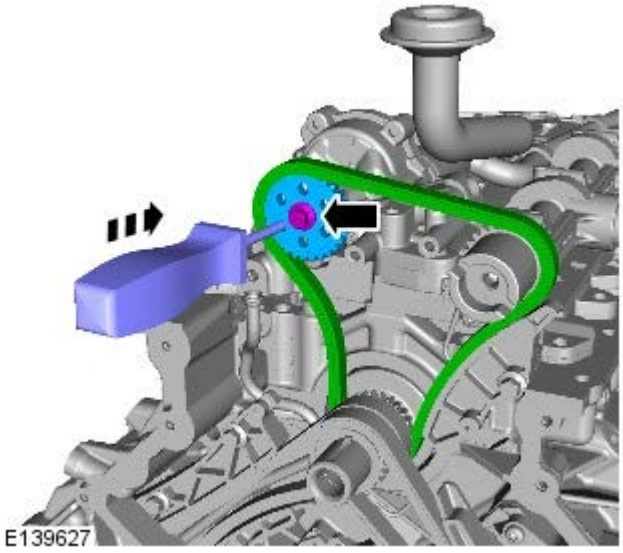
   Raise and support the vehicle.

3. Refer to: Oil Pan Extension (303-01C Engine - V8 S/C 5.0L Petrol, Removal and Installation).

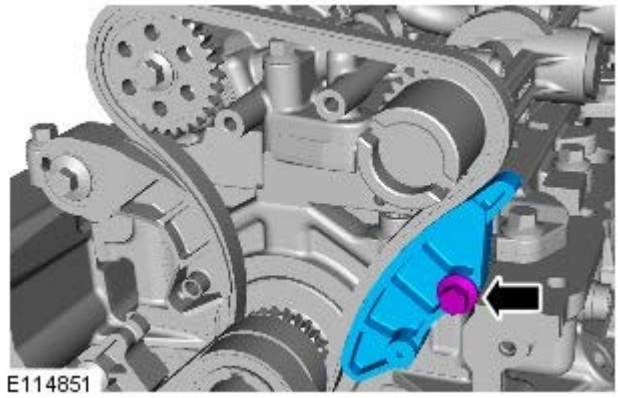
4.

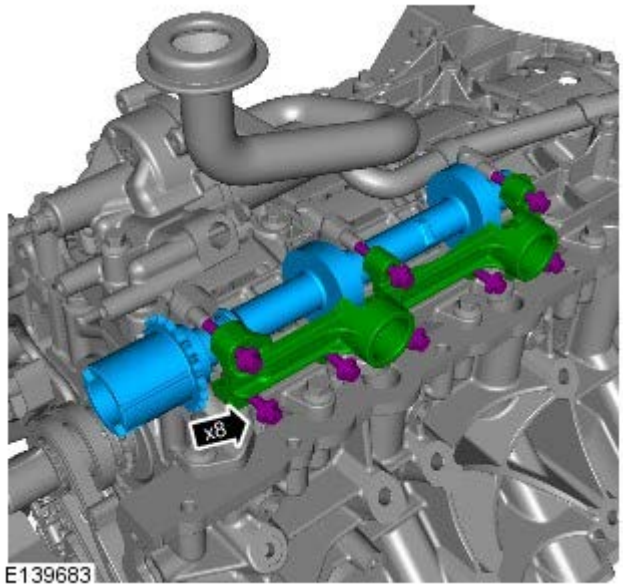


5.



6.

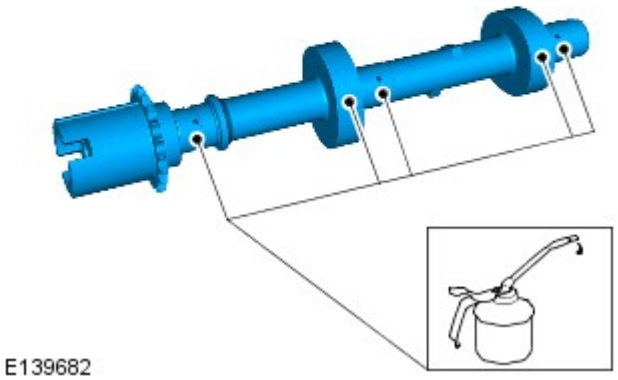




7. CAUTION: Take extra care when removing the component, prevent damage to the mating faces.

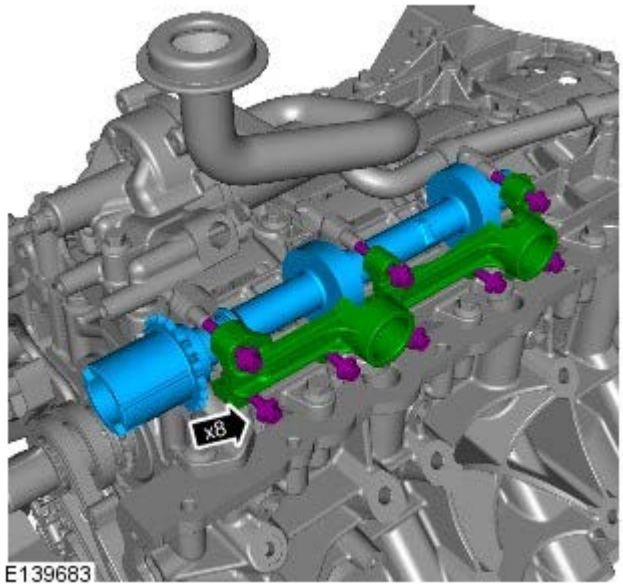
Installation

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

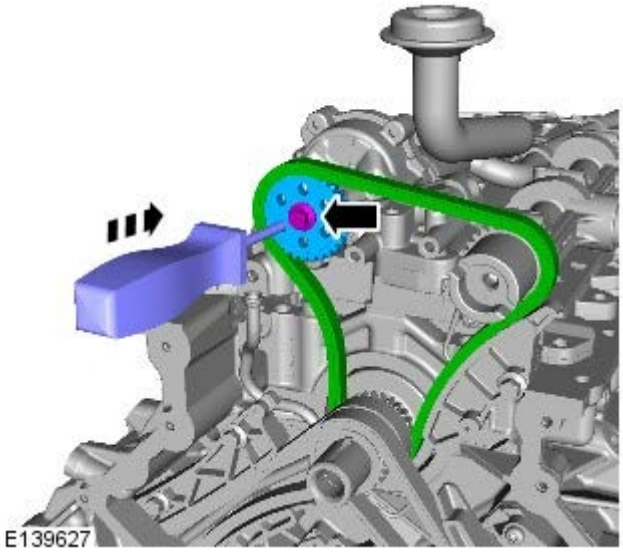


2. CAUTION: Take extra care not to damage the mating faces.

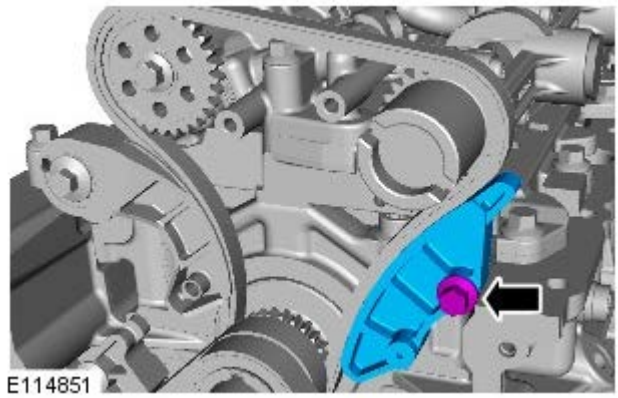
   Torque: 12 Nm



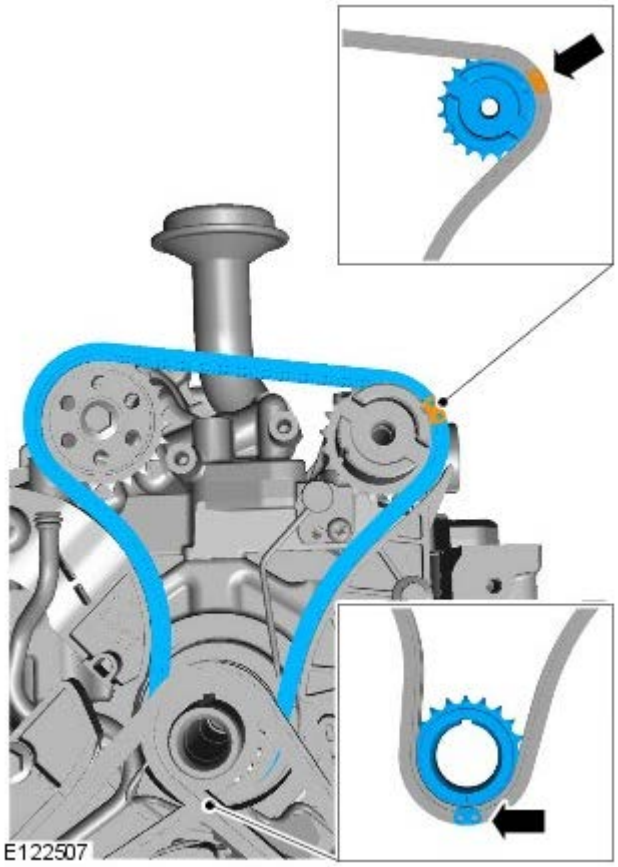
3. *Torque:* 21 Nm

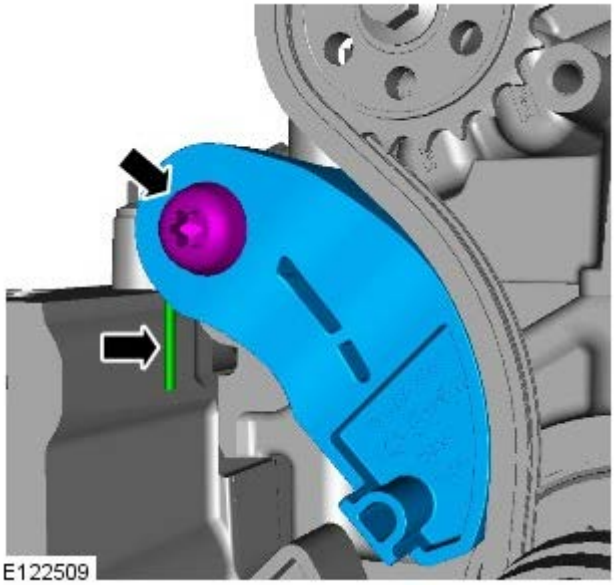


4. *Torque:* 12 Nm



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 Engine - V8 S/C 5.0L Petrol, Removal and Installation).

8. Connect the battery ground cable.

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

Published: 14-Sep-2012

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

NOTES:

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

Engine shown removed for clarity.

1. Disconnect the battery ground cable.

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

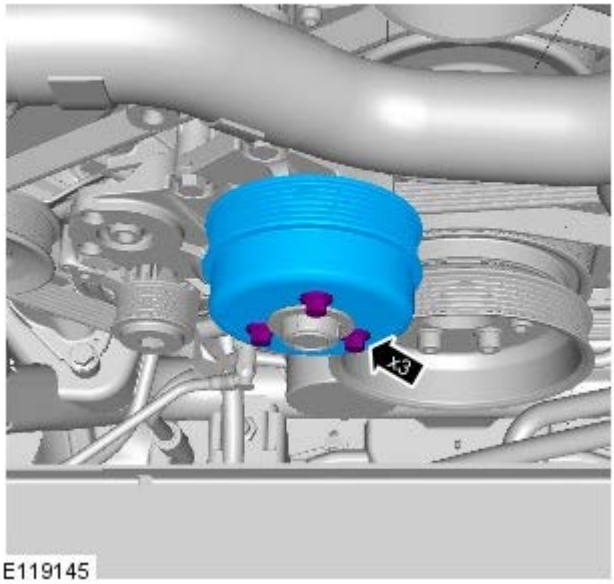
2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Refer to: Crankshaft Pulley (303-01C Engine - V8 S/C 5.0L Petrol, Removal and Installation).

4. Refer to: Brake Vacuum Pump - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (206-07 Power Brake Actuation, Removal and Installation).

5.

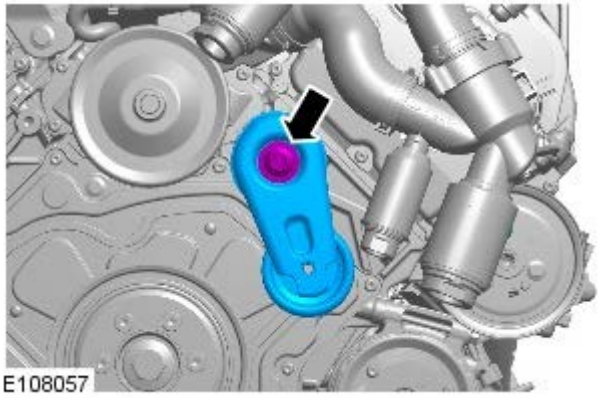


E119145

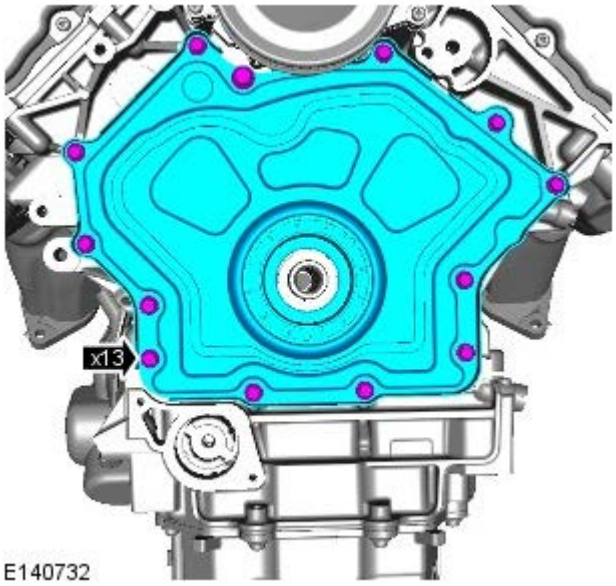
6.



7.

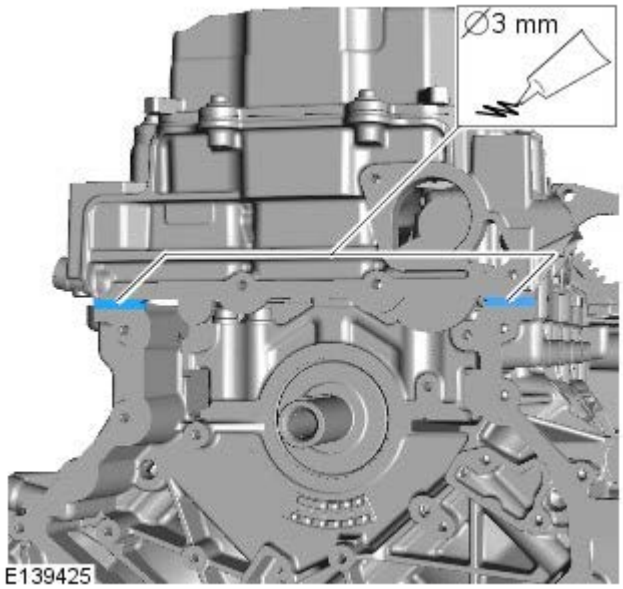


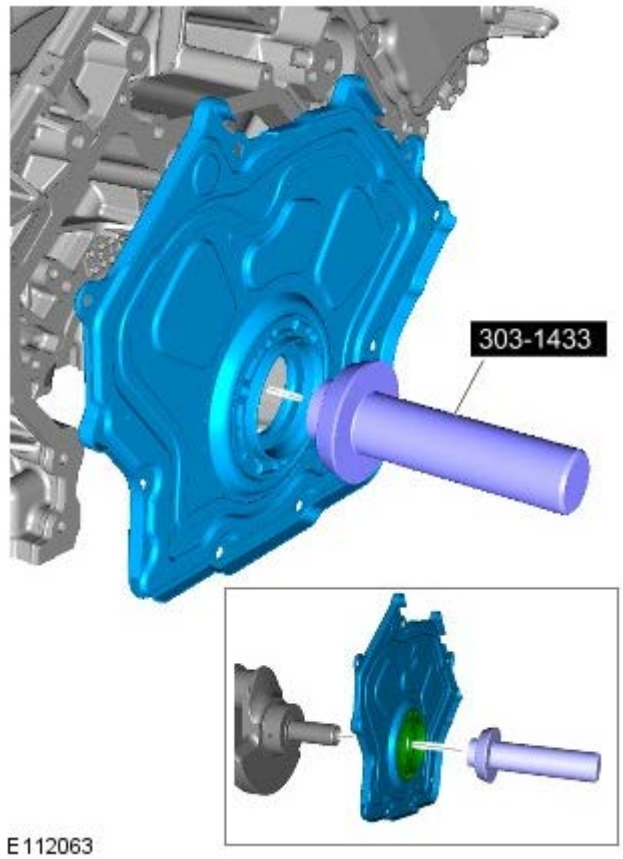
8.



Installation

1. Apply RTV sealant WSE-M4G323-A6 (Loctite 5901G) to the areas shown, and tighten the bolts within 7 minutes.

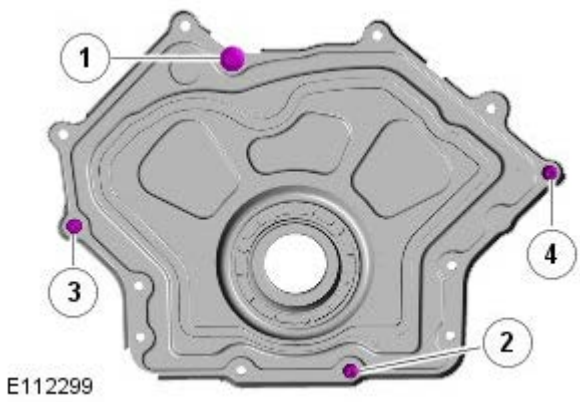




2. CAUTION: Make sure that the mating faces are clean and free of foreign material.

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

   Special Tool(s): 303-1433



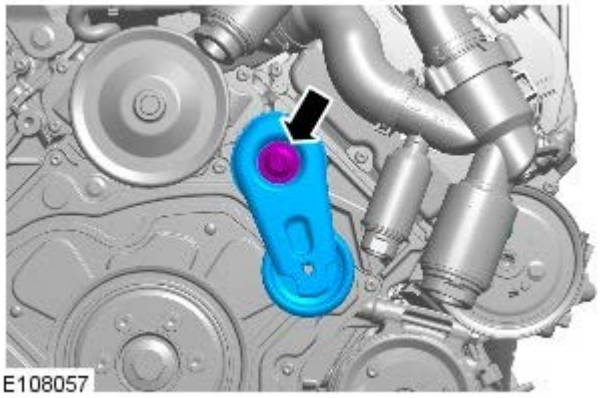
3. *Torque:*
   M6 12 Nm
   M8 20 Nm

4. *Torque:* 12 Nm



E112300

5. *Torque:* 40 Nm

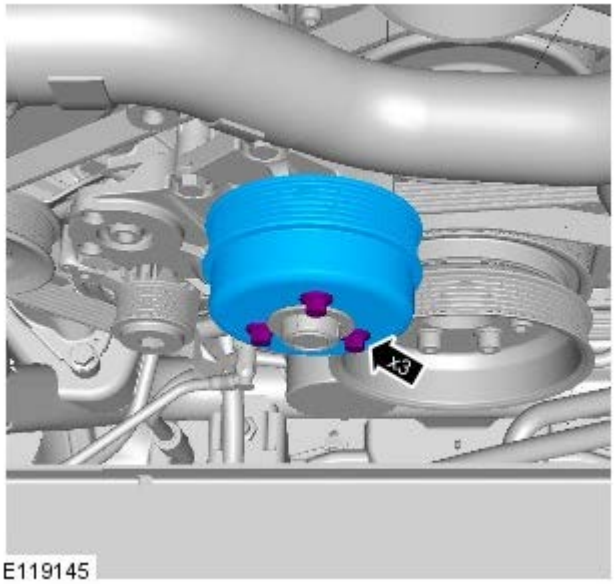

E108057

6. *Torque:* 25 Nm



E119365

7. *Torque:* 25 Nm



8. Refer to: Brake Vacuum Pump - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (206-07 Power Brake Actuation, Removal and Installation).

9. Refer to: Crankshaft Pulley (303-01C Engine - V8 S/C 5.0L Petrol, Removal and Installation).

10. Connect the battery ground cable.

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

11. 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 12 to 20), before starting the engine.

    - Fill the engine with oil - for filling values on vehicles without supercharger:
    - Refer to: Specifications (303-01C, Specifications).

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

    - 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.

    - Set the ignition to the ON position.

14.
    - Press the left-hand OK button to access the Instrument Cluster (IC) Main Menu.



15.

- Press the left hand directional button and select Service Menu.



16.

- Press the left hand OK button.


E147184

17.

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



E147185

18.

- Press the left hand OK button to access the Oil Level display.




E147181

19. CAUTION: Make sure that the hood is open.

- Press the speed control cancel button twice within 2 seconds while being on the oil level display.

20.

- The message center displays the actual oil level in service mode.
- 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.



21. Set the ignition to the OFF position.
22. Allow 10 minutes for the engine oil level to stabilize if there has been additional oil top up.
23. NOTE: The following steps are to update the average oil level value.
24. Repeat steps 13 to 19 to access the oil level display in service mode.



25. NOTE: The actual volume displayed on the bar graph will be written into the electronic control unit as a new value.
    - Press and hold the speed control cancel button for more than 5 seconds.
    - The message center displays the current oil level.
26. Set the ignition to the OFF position.
27. Set the ignition to the ON position.
28.
    - Press the left hand OK button to access the Instrument Cluster (IC) Main Menu.



29.

- Press the left-hand directional button and select Service Menu.



30.

- Press the left hand OK button.


E147184

31.

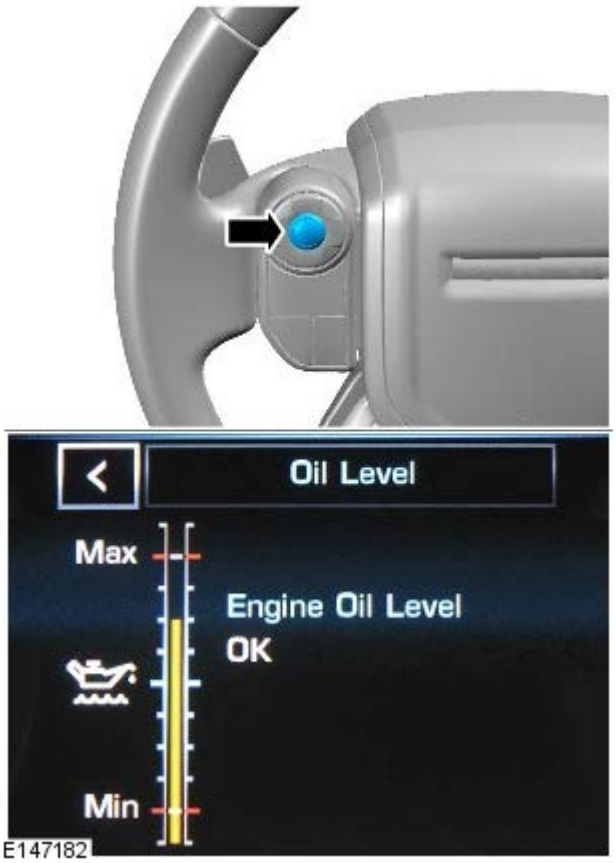
- Press the left-hand directional button and select the Oil Level display.



E147185

32.

- Press the left-hand OK button and follow the instructions.
- NOTE: If the message shows "Not available" wait for further 10 minutes to allow the oil level to stabilize.
- Make sure that the average oil level value has now been updated.


Oil Level
Max
Engine Oil Level
OK
Min
E147182

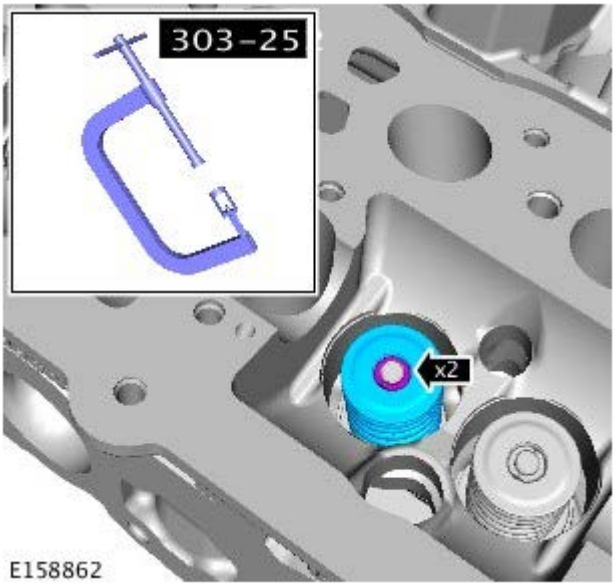
Published: 10-Jul-2013

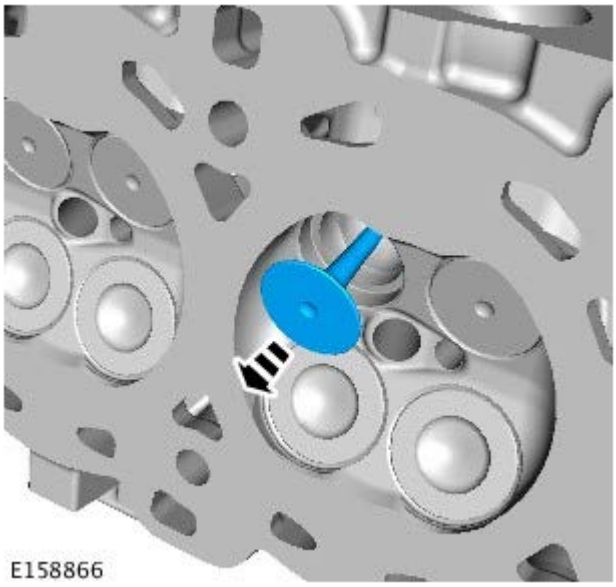
Engine - V8 S/C 5.0L Petrol - Valves

Removal and Installation

Removal

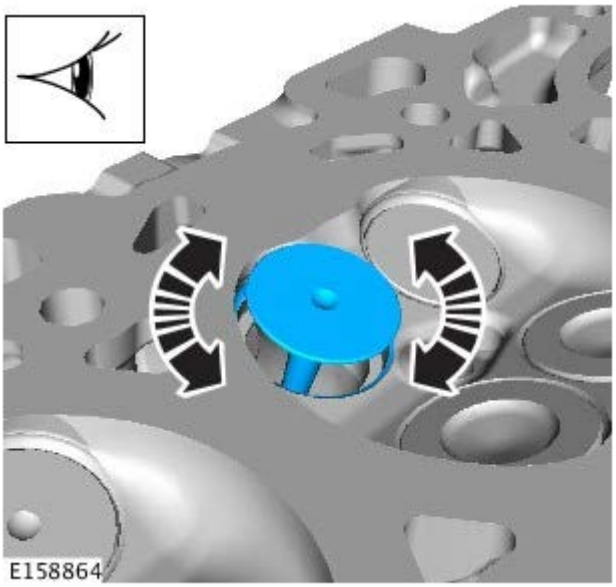
1. Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).
2. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.
3. Refer to: Cylinder Head LH (303-01C, Removal and Installation).
4. Refer to: Cylinder Head RH (303-01C, Removal and Installation).
5. 

6. 

7.





8. CAUTIONS:

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

   Make sure the working surfaces are thoroughly clean to avoid contamination of the sensitive components.

   Make sure that the valve grinding paste is kept away from the valve stem.

   - Place a small amount of fine valve grinding paste evenly around the contact face of the valve.
   - Place the valve in position and, using a suitable valve grinding tool, rotate the valve back and forth a few degrees on its seat, using light pressure.
   - Raise the valve frequently during lapping and turn it into a new position after a few laps or rotations.
   - Lap only until a continuous but narrow lapping mark is visible on both the valve seat and valve face.
   - Thoroughly clean all surfaces to remove traces of valve grinding paste from the cylinder head, valve seat and valve face.

Installation

1. CAUTION: Make sure the working surfaces are thoroughly clean to avoid contamination of the sensitive components.

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

   To install reverse the removal procedure.

Published: 09-Apr-2013

Engine - V8 S/C 5.0L Petrol - Engine

Removal

NOTES:

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

Some components shown removed for clarity.

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: Secondary Bulkhead Center Panel - V8 S/C 5.0L Petrol (501-02 Front End Body Panels, Removal and Installation).

4. Refer to: Hood (501-02 Front End Body Panels, Removal and Installation).

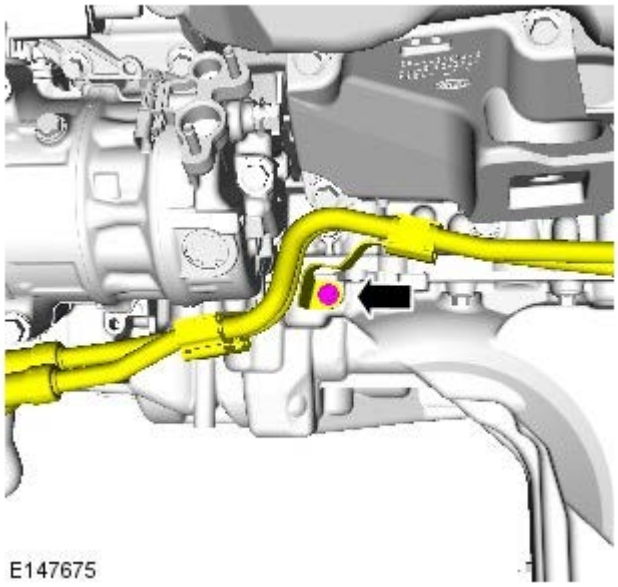
5. Refer to: Radiator (303-03C Engine Cooling - V8 S/C 5.0L Petrol, Removal and Installation).

6. Refer to: Accessory Drive Belt (303-05C Accessory Drive - V8 S/C 5.0L Petrol, Removal and Installation).

7. Refer to: Engine Oil Draining and Filling (303-01C Engine - V8 S/C 5.0L Petrol, General Procedures).

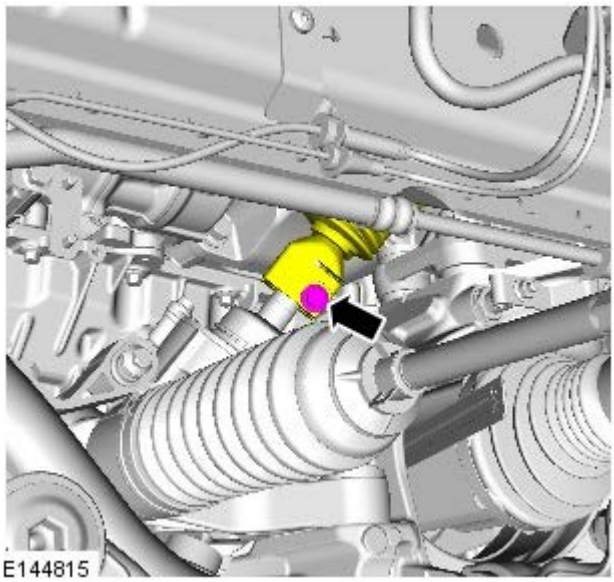
8. Refer to: Transmission - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, Removal).

9.

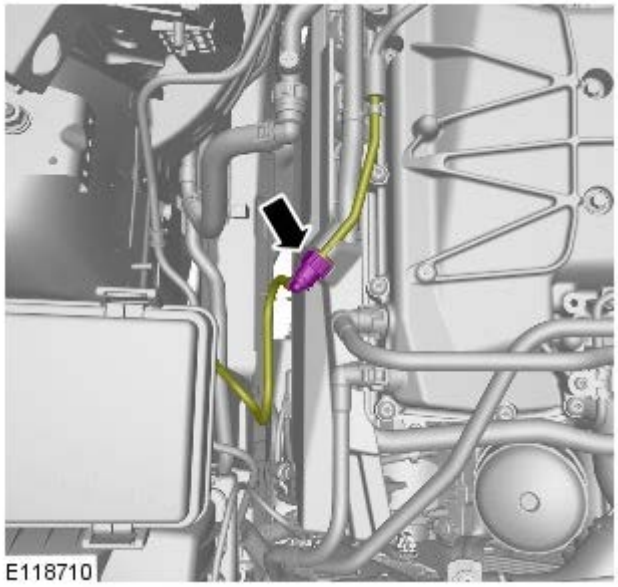


10. NOTE: Left hand drive only.

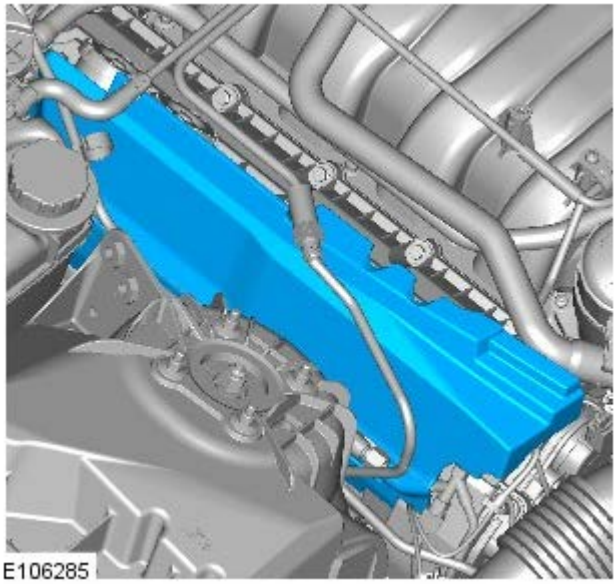
    Discard the bolt.



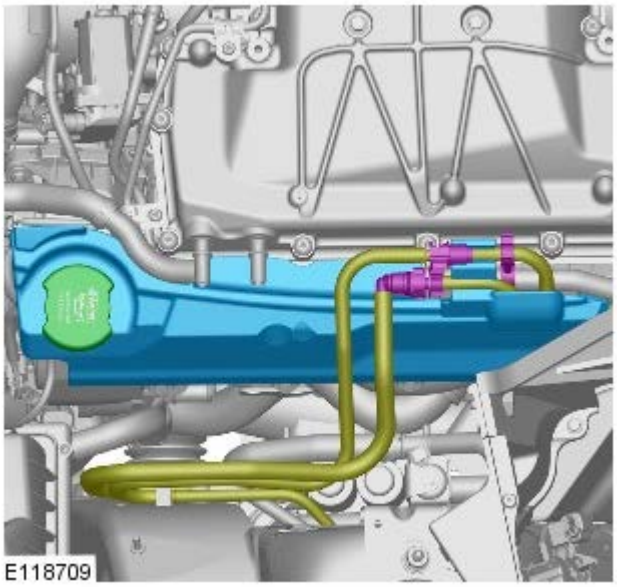
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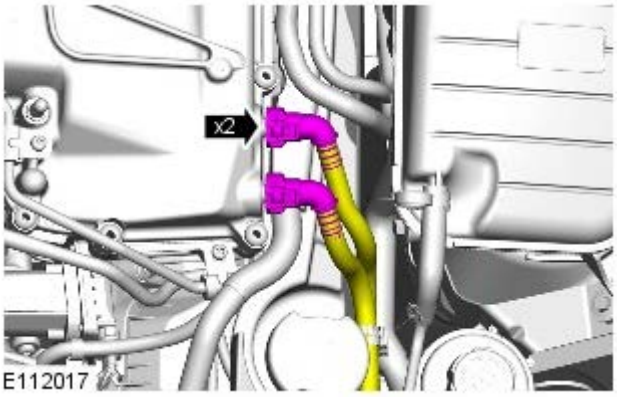
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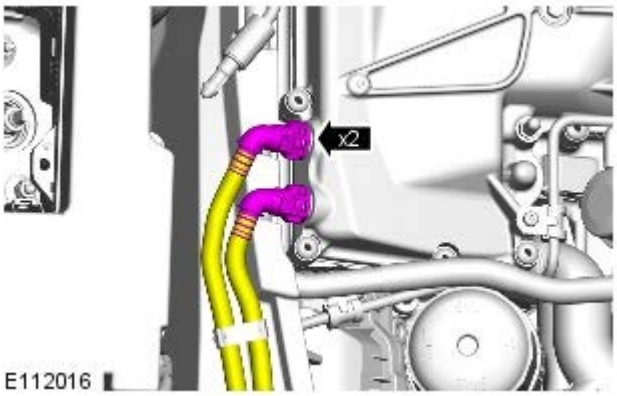
13. WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.



CAUTION: Be prepared to collect escaping fuel.

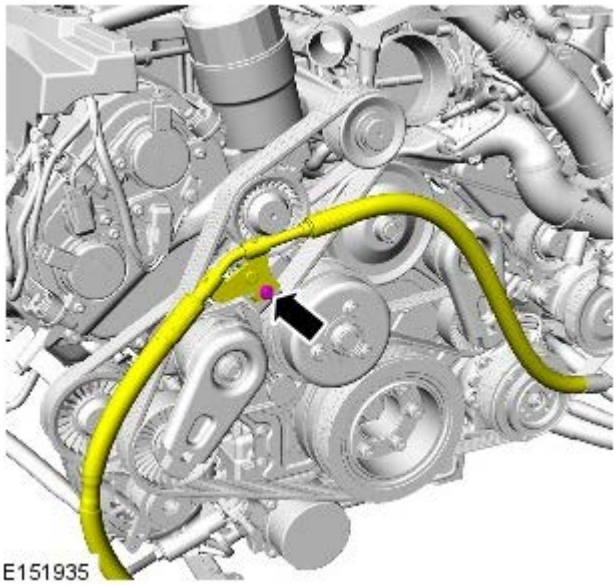


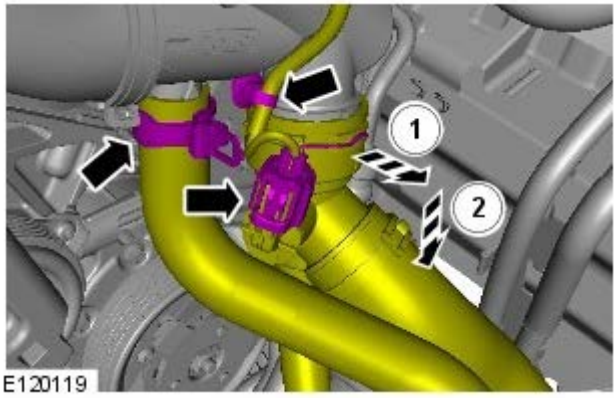
14. WARNING: Be prepared to collect escaping fluids.



15. WARNING: Be prepared to collect escaping fluids.

16.

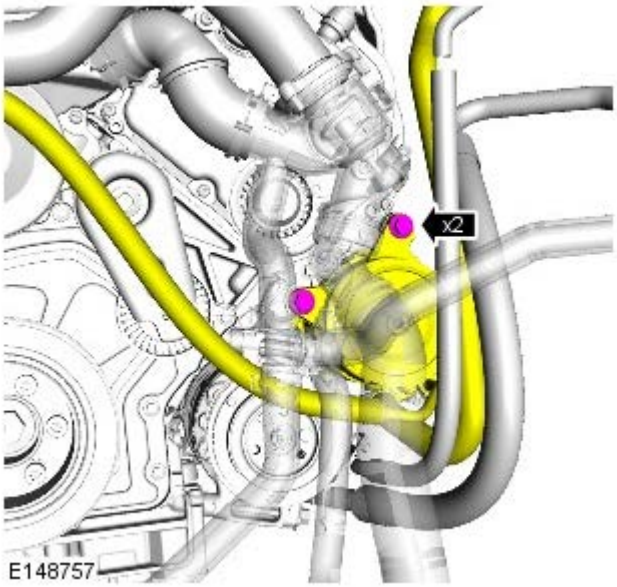

E151935



E120119

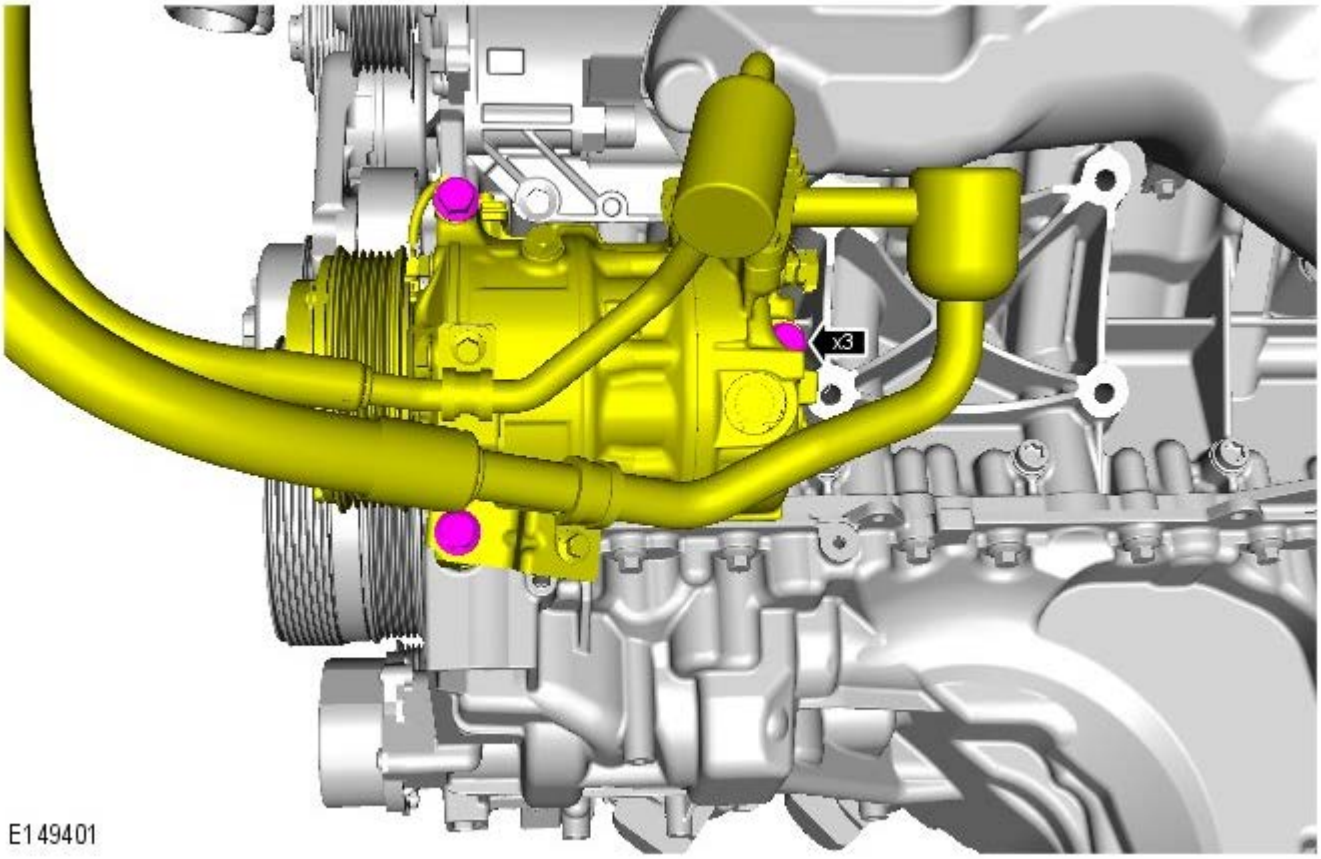
17. CAUTION: Be prepared to collect escaping coolant.

18.

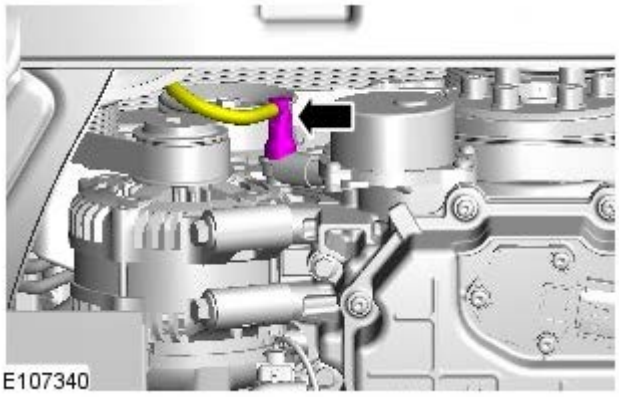


E148757

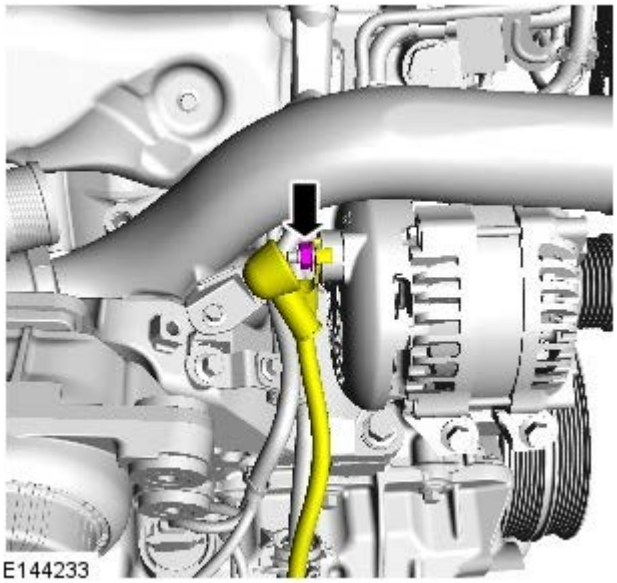
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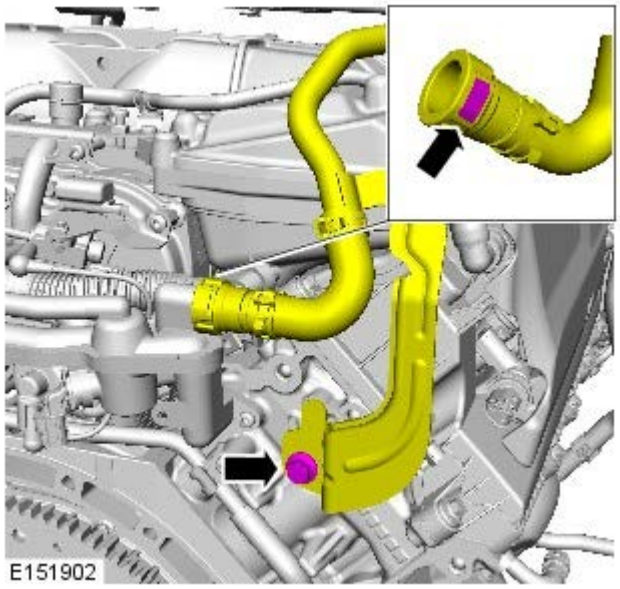
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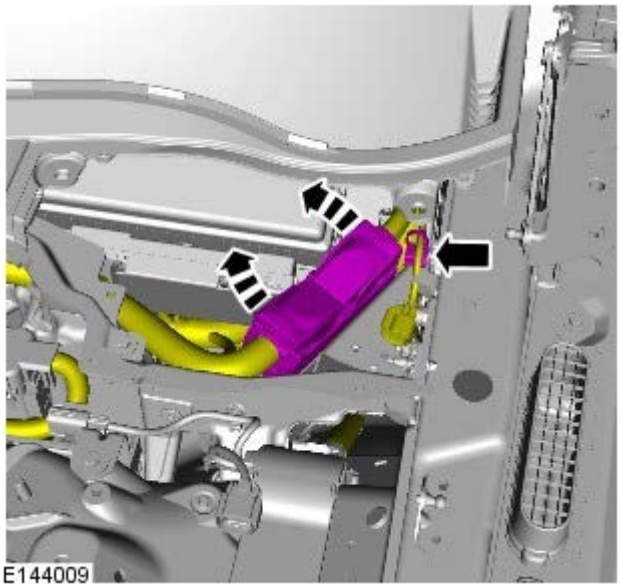
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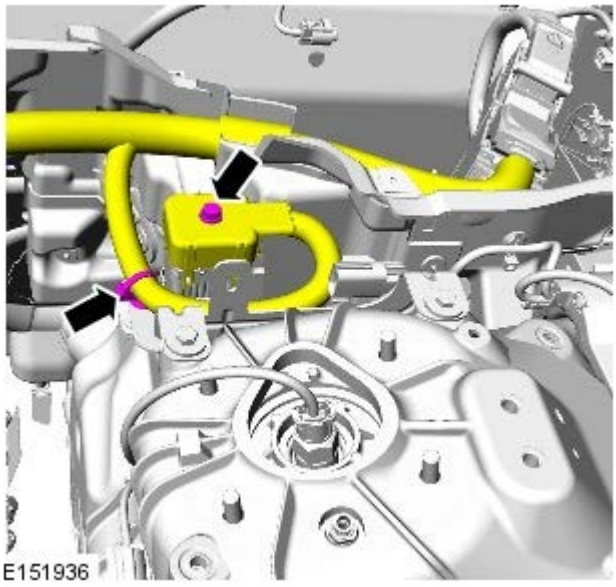
22. CAUTION: Be prepared to collect escaping coolant.



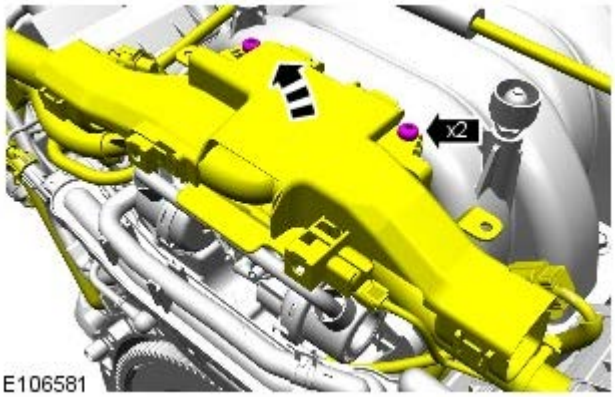
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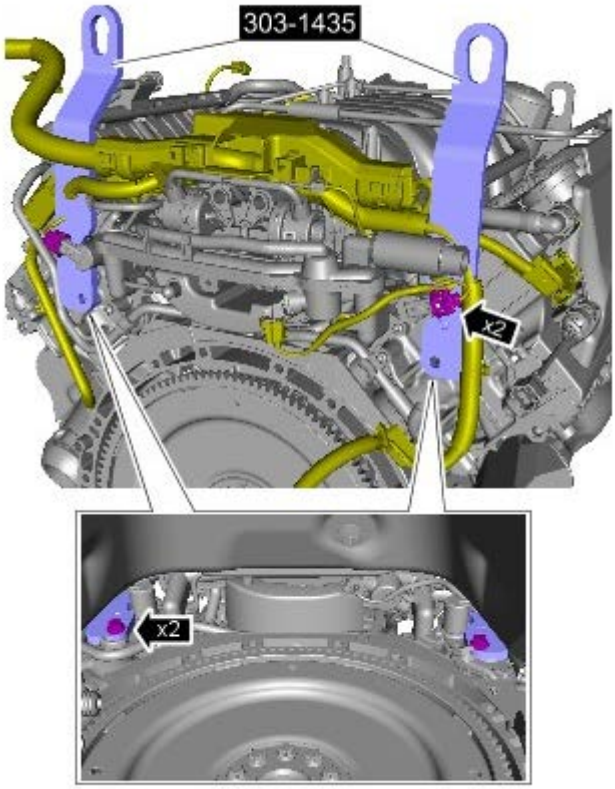


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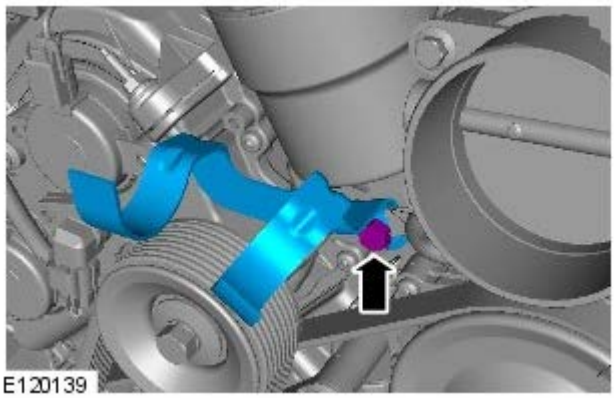
E106581

26. *Torque:* 25 Nm

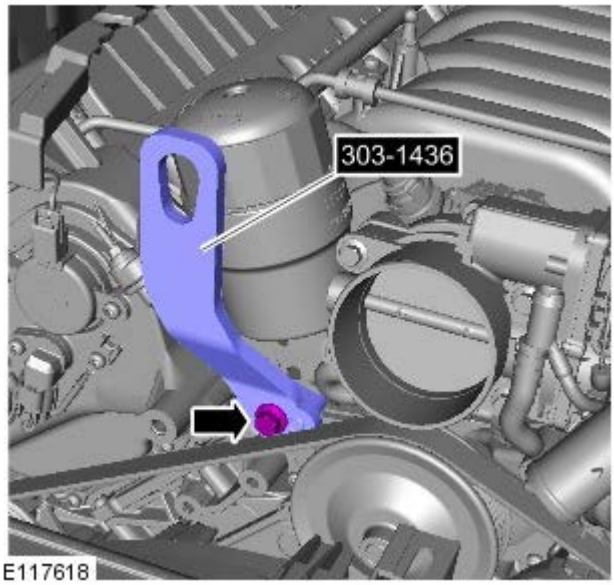


E117619

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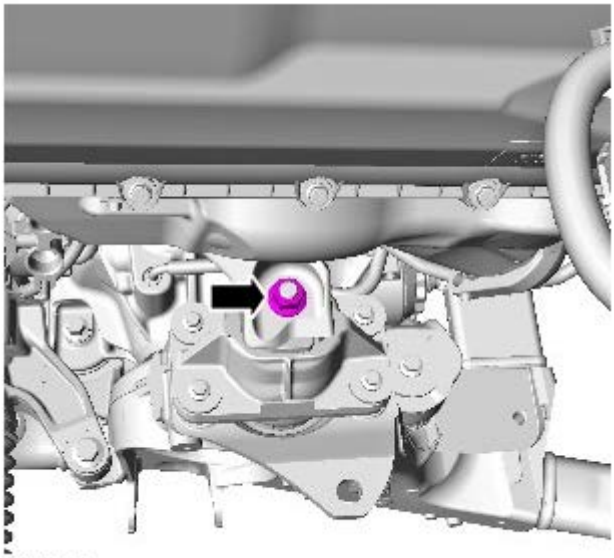

E120139

28. *Torque:* 25 Nm

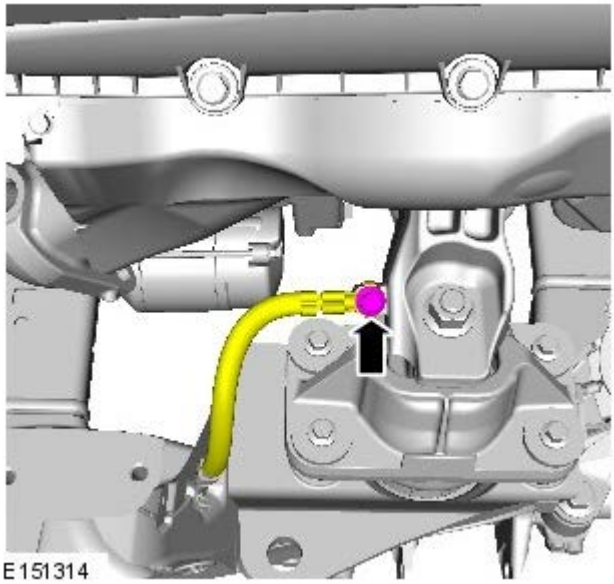


E117618

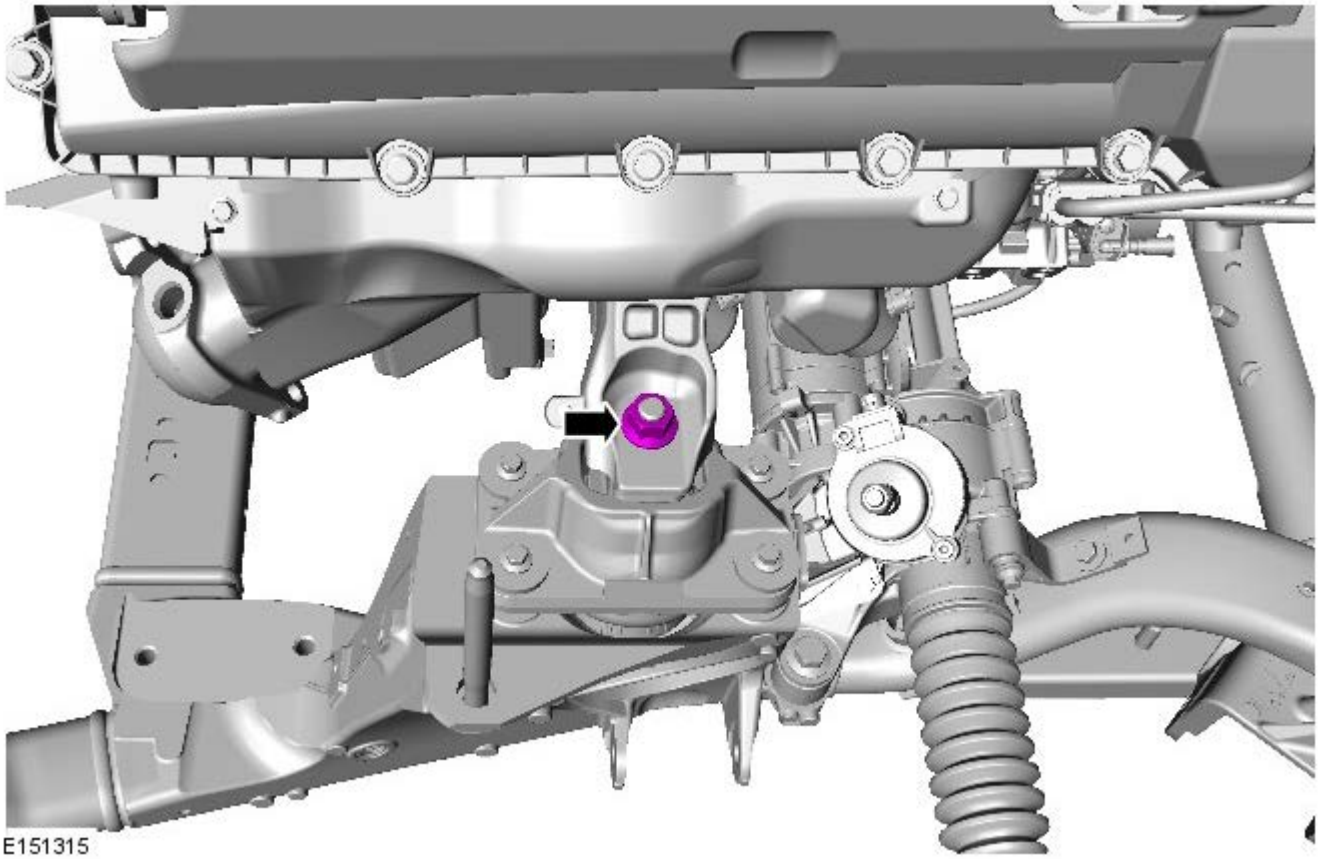
29.


E151309

30.


E151314

31.



E151315



E149361

32. NOTE: This step requires the aid of another technician.

Published: 09-Apr-2013

Engine - V8 S/C 5.0L Petrol - Engine

Installation

NOTES:

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

Some components shown removed for clarity.

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

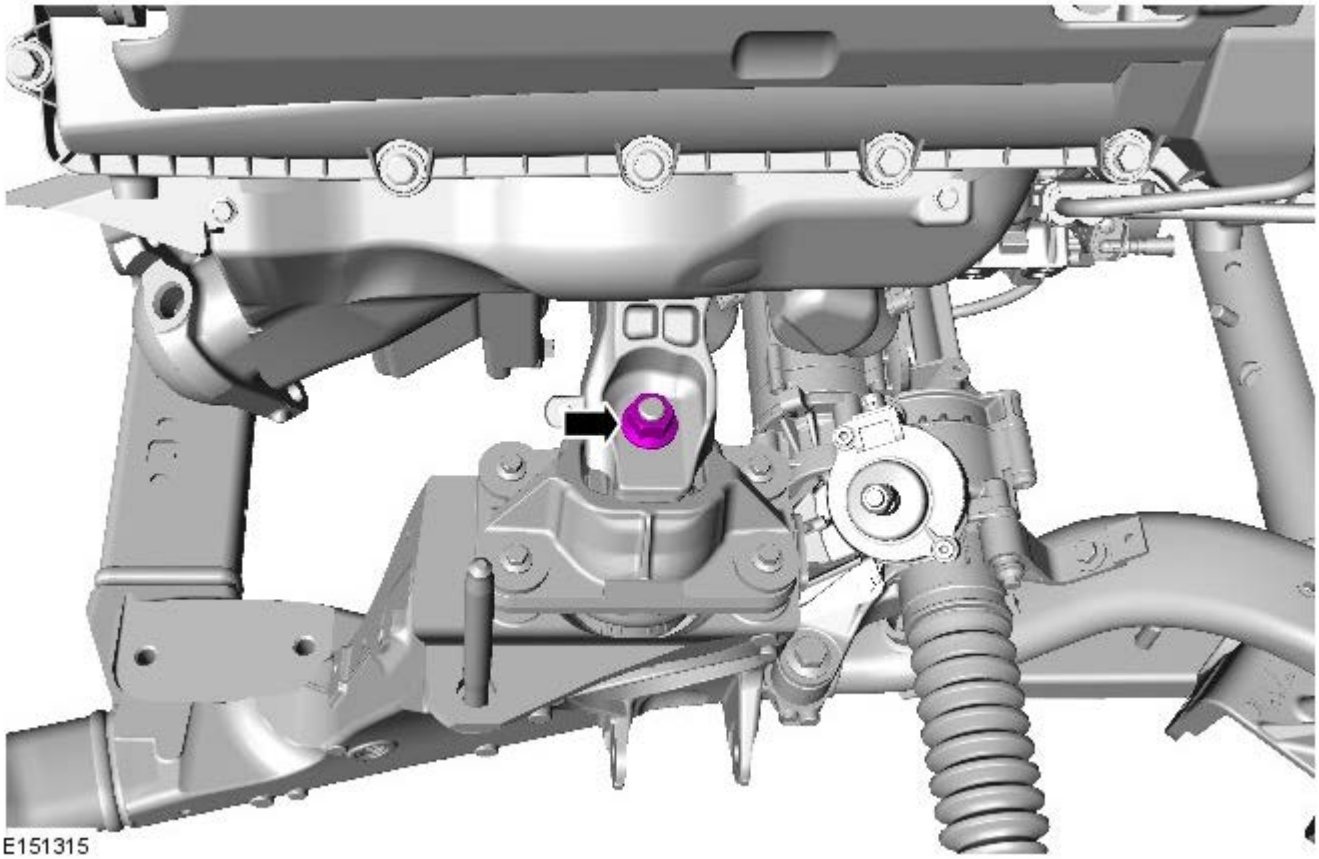
   Raise and support the vehicle.

2. NOTE: This step requires the aid of another technician.



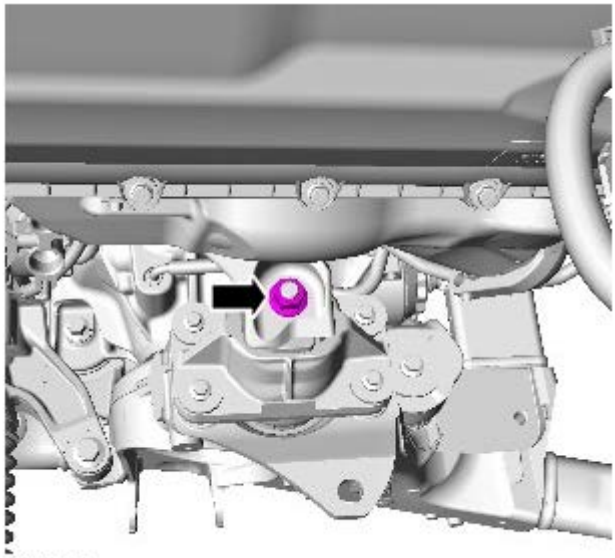
E149361

3. *Torque:* 110 Nm



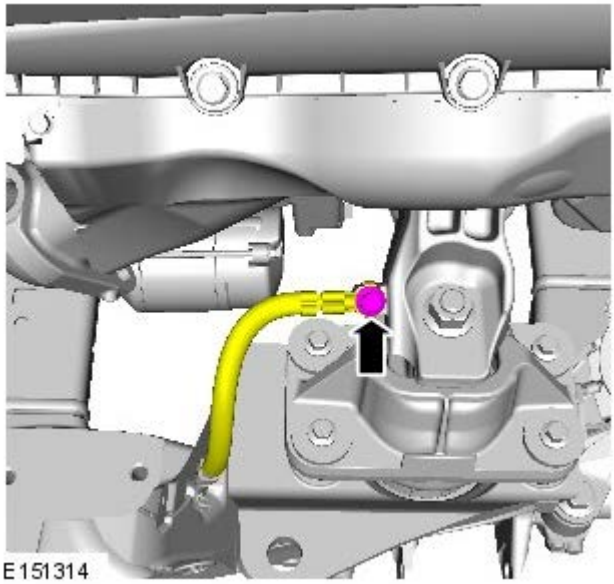
E151315

4. *Torque:* 110 Nm

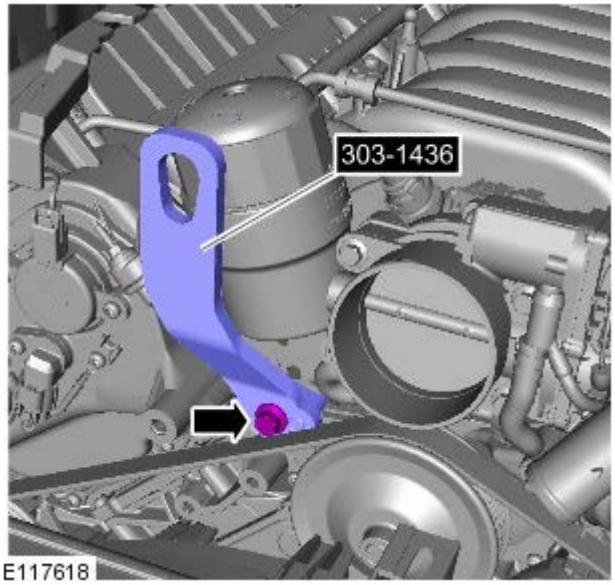


E151309

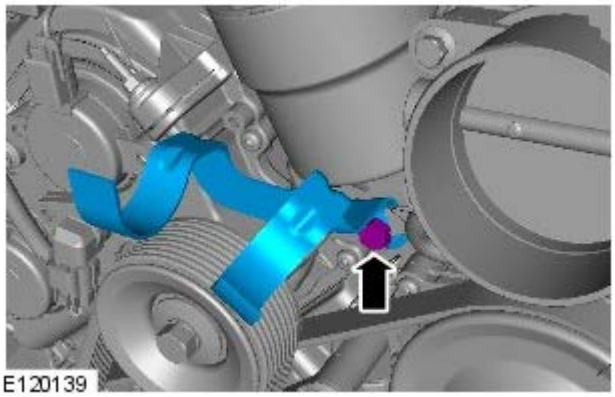
5. *Torque:* 9 Nm



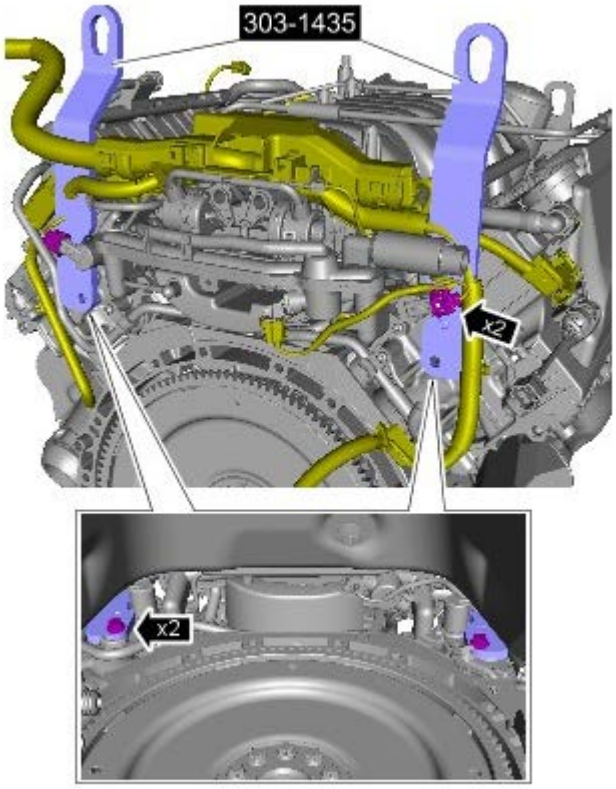
6.



7. *Torque:* 25 Nm

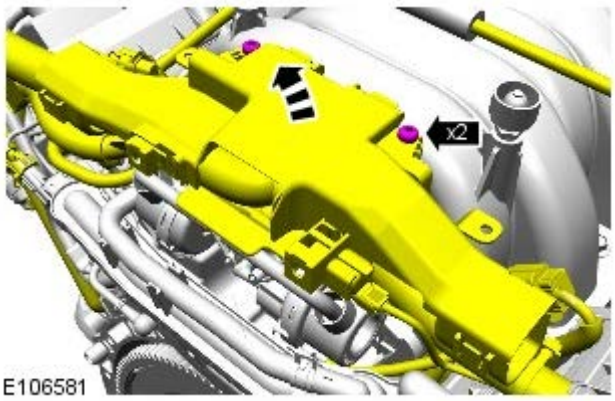


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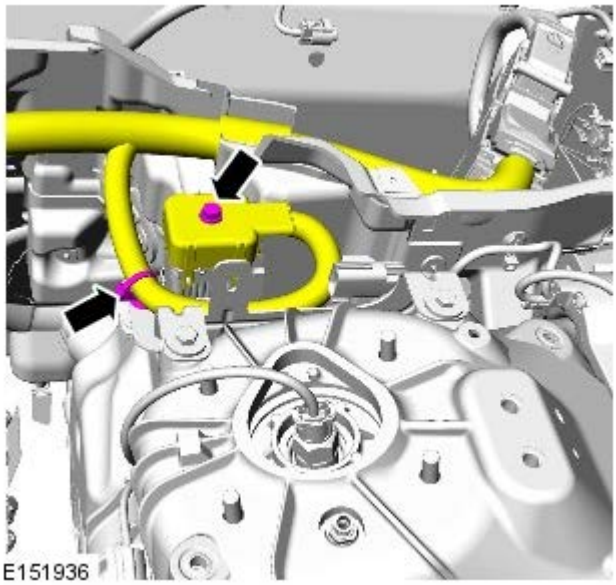
E117619

9. *Torque:* 10 Nm

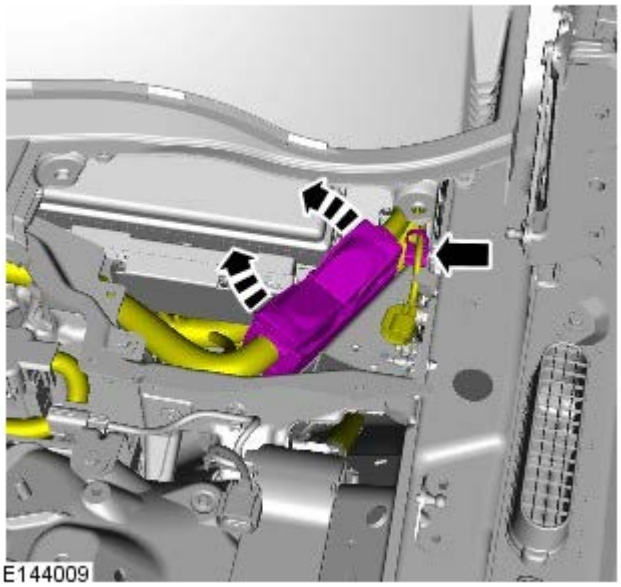


E106581

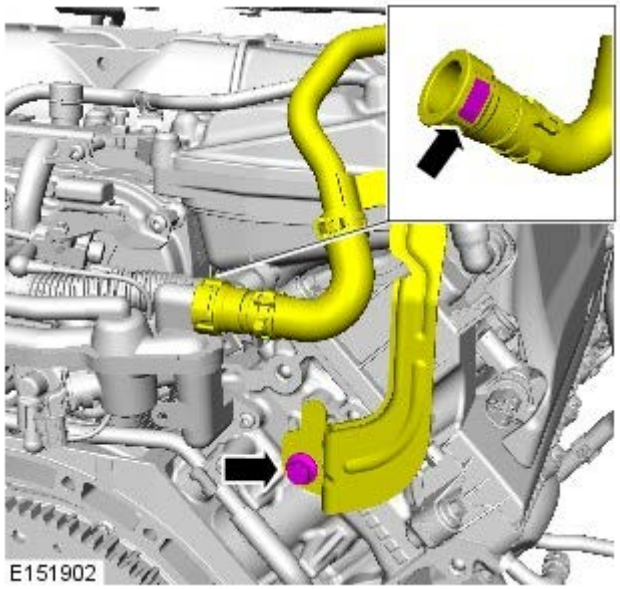
10. *Torque:* 7 Nm


E151936

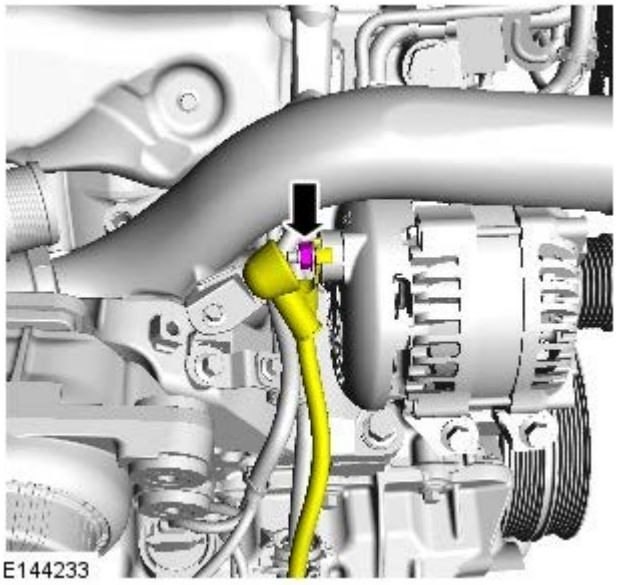
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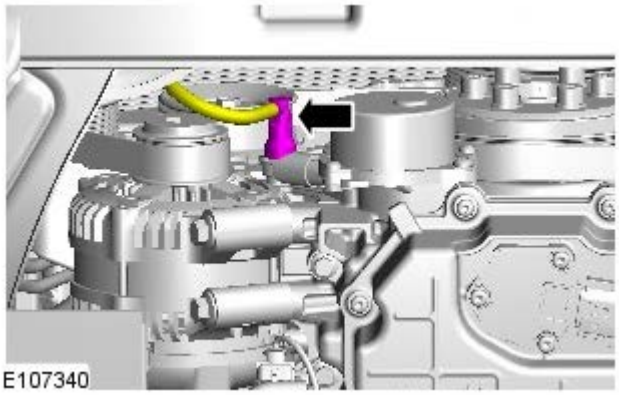
12. *Torque:* 25 Nm



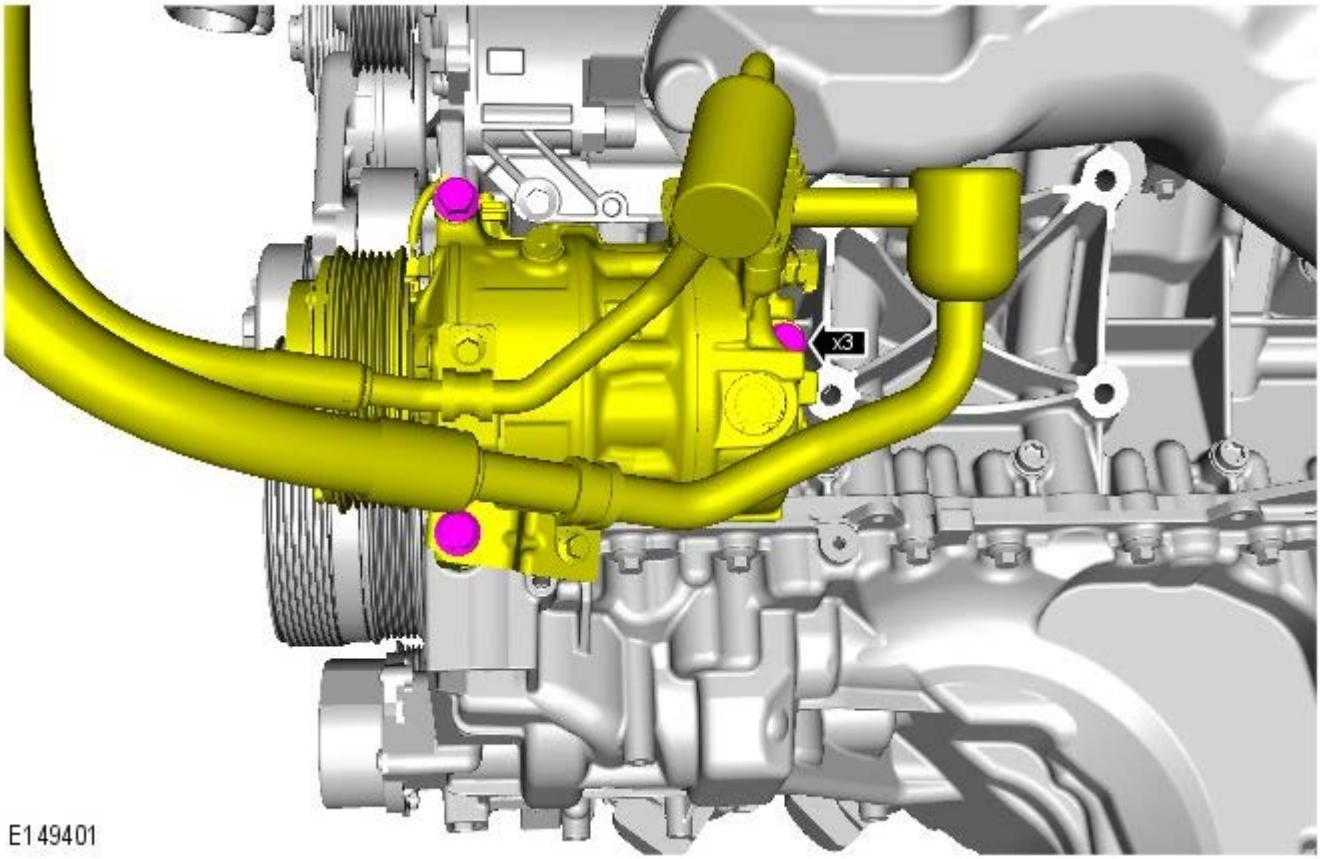
13. *Torque:* 12 Nm



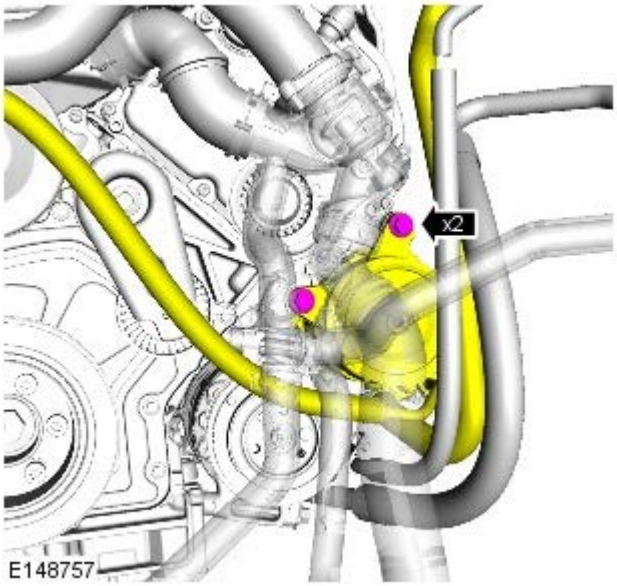
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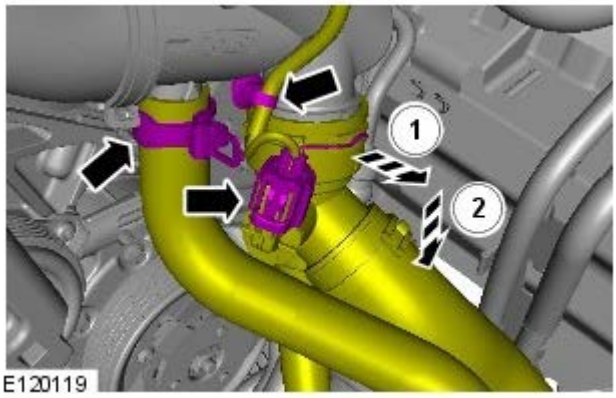
15. *Torque:* 25 Nm



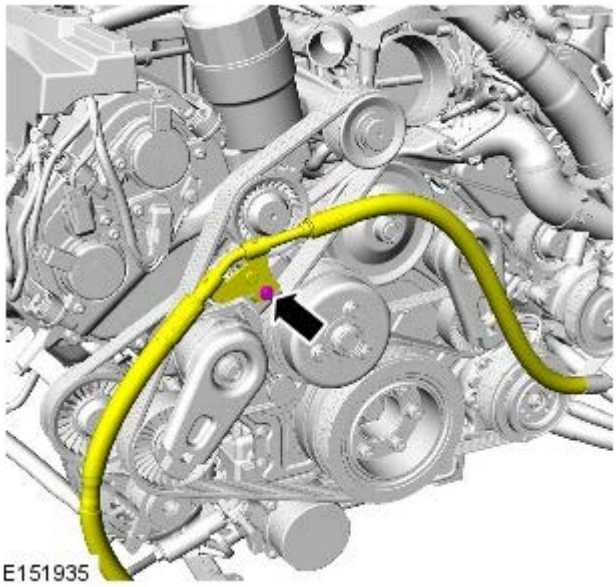
16. *Torque:* 22 Nm



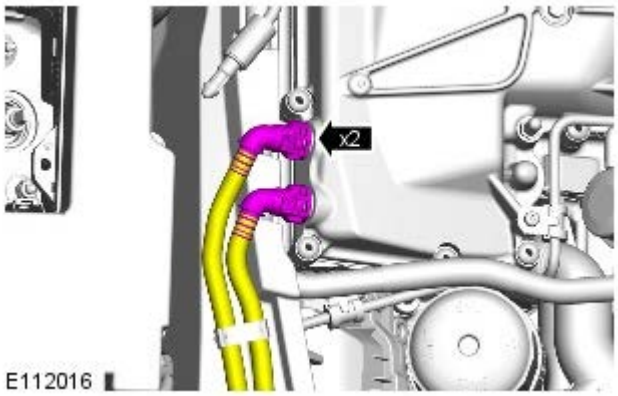
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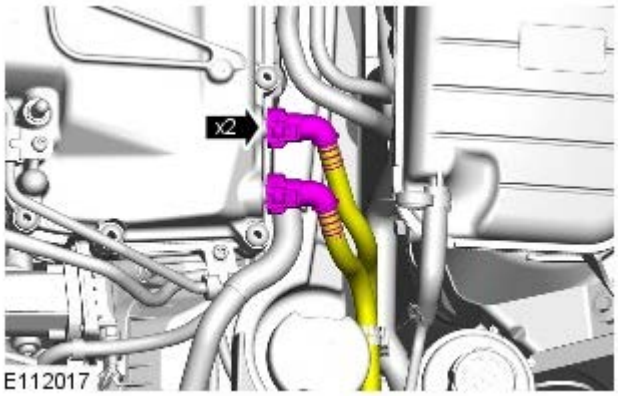
18. *Torque:* 10 Nm



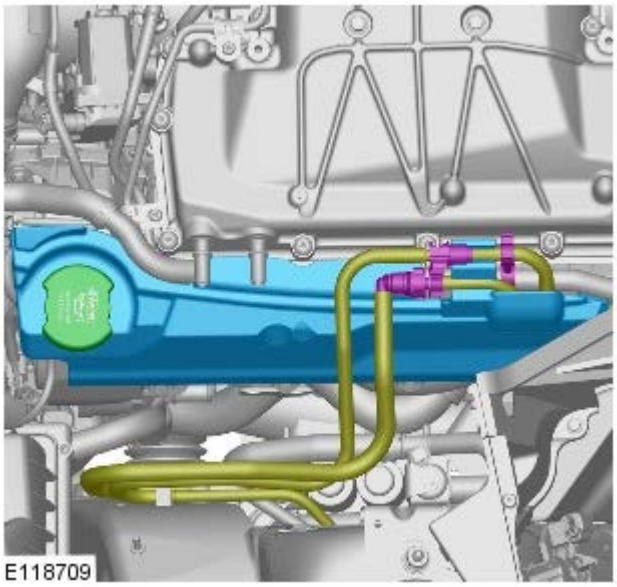
19.



20.



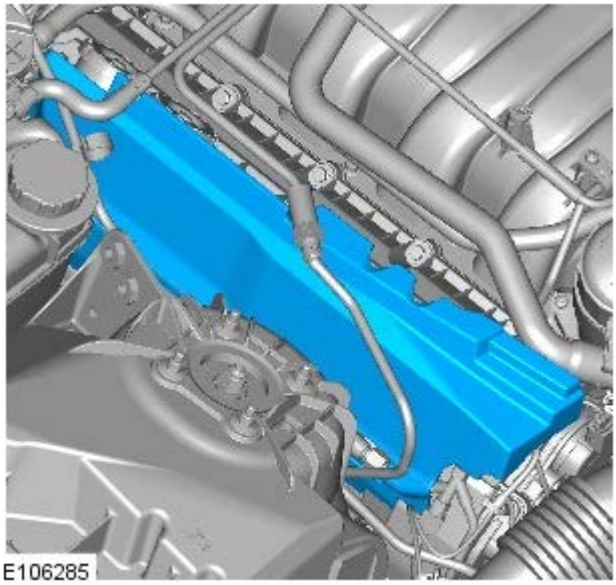
21. WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors



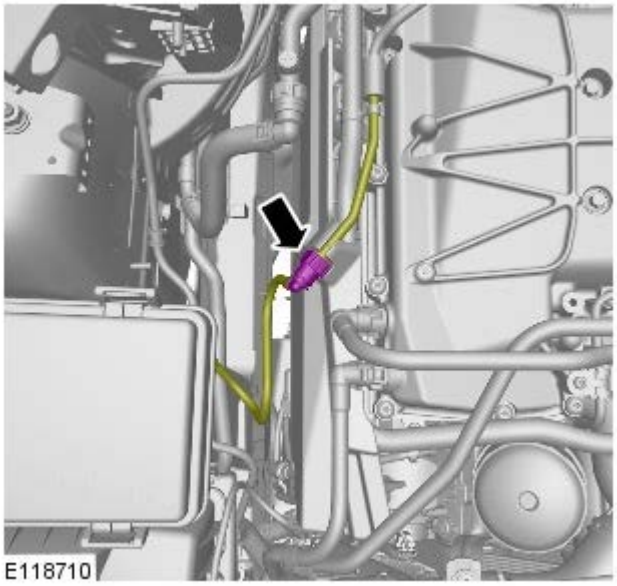
are always present and may ignite. Failure to follow these instructions may result in personal injury.

CAUTION: Be prepared to collect escaping fuel.

22.



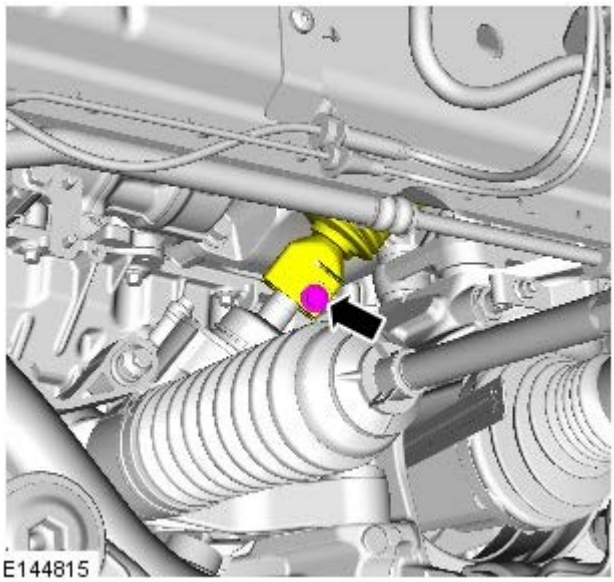
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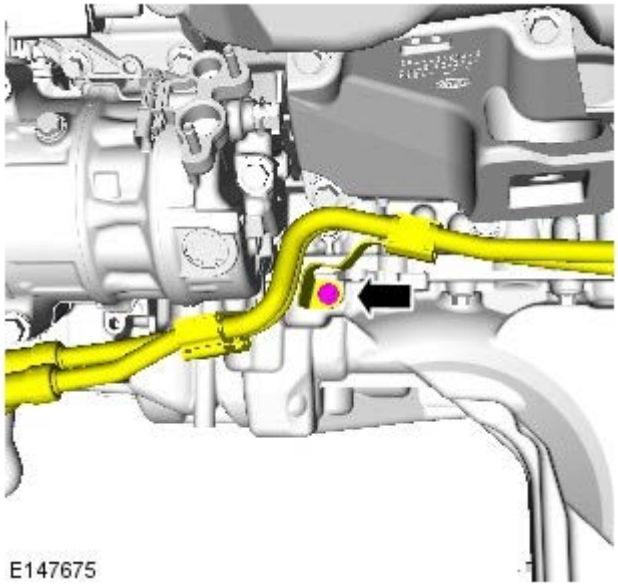
24. NOTE: Left hand drive only.

Install a new bolt.

Torque: 30 Nm


E144815

25. *Torque:* 9 Nm


E147675

26. Refer to: Transmission - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, Removal).

27. Refer to: Accessory Drive Belt (303-05C Accessory Drive - V8 S/C 5.0L Petrol, Removal and Installation).

28. Refer to: Radiator (303-03C Engine Cooling - V8 S/C 5.0L Petrol, Removal and Installation).

29. Refer to: Hood (501-02 Front End Body Panels, Removal and Installation).

30. Refer to: Secondary Bulkhead Center Panel - V8 S/C 5.0L Petrol (501-02 Front End Body Panels, Removal and Installation).

31. Reconnect the battery ground cable.

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

32. Refer to: Engine Oil Draining and Filling (303-01C Engine - V8 S/C 5.0L Petrol, General Procedures).

Published: 24-Jul-2013

Engine - TDV8 4.4L Diesel -

Lubricants

Description	Specification
Engine Oil - vehicles with diesel particulate filter (DPF)	SAE 5W-30 oils confirming to WSS-M2C-934B
Engine Oil - vehicles without DPF	SAE 5W-30 oils conforming to WSS-M2C-913C

Sealers

Description	Specification
Camshaft caps	Loctite 518 ESK- M2G348-A5
'T' joints - ladder frame to engine block	Loctite 5901 WSE – M4G323 – A4T
Coolant plug - threaded	Loctite 572 Specification SJM4G – 9102l

Capacities

Engine Oil Capacity	Specification
Dry fill including filter	11.0 liters (23.24 US pints) (11.62 US quarts)
Oil and filter change	9.4 liters (20.07 US pints) (10.03 US quarts)
Amount of oil required to bring level from 'MIN' to 'MAX' mark on oil level indicator	2.0 liters (4.22 US pints) (2.11 US quarts)

General Specifications

Item	Specification
Type	4.4L, 90 degree 'V', common rail direct injection, twin turbocharged and intercooled diesel, twin overhead camshafts, 4 valves per cylinder
Cylinder arrangement	V8, numbers 1 and 5 cylinders at front of engine when engine is viewed from the rear of the cylinder block
Cylinder numbering	NOTE: Viewed from the rear of the cylinder block • RH bank: Front cylinder number 1 through to cylinder number 4 • LH bank: Front cylinder number 5 through to cylinder number 8
Bore - nominal	84.00 mm (3.307 inches)
Stroke	98.5 mm (3.858 inches)
Capacity	4367 cc (266.49 cu.in)
Firing order	1 - 5 - 4 - 2 - 6 - 3 - 7 - 8
Compression ratio	16.1:1
Direction of rotation	Anti-clockwise viewed from rear of engine
Maximum power	250 kW (339 PS) (335 bhp) at 3500 rev/min
Maximum torque	700 Nm (516 lb/ft) at 1750 - 3000 rev/min

Torque Specifications

Description	Nm	lb-ft
Accessory drive belt idler pulley bolt (65mm)	48	35
Accessory drive belt idler pulley bolt (80mm)	80	59
Accessory drive belt tensioner bolts	25	18
Air conditioning (A/C) compressor bolts	25	17
A/C compressor mounting bracket bolts	25	17
A/C compressor low pressure refrigerant line bolt	18	17
A/C compressor high pressure refrigerant line bolt	18	17
Dynamic response hydraulic pump M10 bolts	48	35
Dynamic response hydraulic pump M8 bolts	25	18
Battery positive cable nut	22	16
Camshaft position sensor bolt	10	7
*** Camshaft bearing cap bolts**	-	-
Stage 1	1	1
Stage 2	5	4
Stage 3	10	7
*** Vacuum pump fixings**	-	-
Studs	13	10
Nut	23	17
Bolts	23	17
Vacuum pump cap bolts	10	77
***+ LH camshaft sprocket and gear bolts**	-	-
Stage 1: Tighten the exhaust camshaft gear bolt	80	59
Stage 2: Tighten the exhaust camshaft gear bolt	Further 80°	
Stage 3: Tighten the intake camshaft sprocket and gear bolt	80	59

Stage 4: Tighten the intake camshaft sprocket and gear bolt	Further 80°	
***+ RH camshaft sprocket and gear bolts**	-	-
Stage 1: Tighten the exhaust camshaft gear bolt	80	59
Stage 2: Tighten the exhaust camshaft gear bolt	Further 80°	
Stage 3: Tighten the intake camshaft sprocket and gear bolt	80	59
Stage 4: Tighten the intake camshaft sprocket and gear bolt	Further 80°	
Coolant pump bolts	23	17
Coolant pump pulley bolts	23	17
Camshaft phase sensor bolt	10	7
***+² Crankshaft pulley bolt**	-	-
Stage 1	100	74
Stage 2	103°	
Stage 3	35°	
Crankshaft position sensor bolt	5	4
Crankshaft rear seal plate bolts	10	7
Cylinder block coolant elbow bolts	10	7
***+² Cylinder head bolts**	-	-
Stage 1: Tighten the M13 bolts	20	15
Stage 2: Tighten the M13 bolts	40	30
Stage 3: Tighten the M13 bolts	80	59
Stage 4: Tighten the M13 bolts	Further 180°	
Stage 5: Tighten the M8 bolts	20	15
EGR valve inlet tube bolts	10	7
EGR valve and cooler assembly bolts	10	7
Engine breather line bolts	23	17
Engine mount bracket bolts	115	85
Engine mount bolt	130	96
Engine mount nut	130	96
* Engine mount to subfame bolts	40	30
Exhaust manifold heat shield bolts	10	7
* Exhaust manifold nuts	23	17
+ Exhaust manifold studs	13	10
Front driveshaft joint shield bolts	3	2
Front driveshaft joint shield nut	10	7
Fuel injection pump bolts	23	17
+ Fuel injector bolts	10	7
Fuel rail bolts	23	17
++ Fuel injection high-pressure fuel supply line, fuel rail and injector unions	-	-
Stage 1	Finger tight	Finger tight
Stage 2	10	7
Stage 3	73°	73°
++ Fuel injection high-pressure fuel supply line, fuel pump unions.	-	-
Stage 1	Finger tight	Finger tight
Stage 2	10	7
Stage 3	80°	80°
Generator bolts	47	35
Generator battery positive cable nut	15	11
Glow plugs	10	7
Knock sensor bolts	20	15
Oil pan bolts	-	-
M6 bolts	10	7
M8 bolts	23	17
*** Oil pump bolts**	-	-
Stage 1	4	3
Stage 2	10	7
Oil level indicator tube nut	23	17
Oil pan drain plugs	23	17
Oil baffle plate bolts	23	17
Oil pressure sensor	14	10
Oil filter cover	35	26
Power steering gear bolts	100	74
Power steering pump bolts	23	17
Throttle body bolts	12	
Power steering pump to steering gear pressure line bolt	25	18
Starter motor bolts	45	33
Timing chain tensioner bolts	10	7
Transmission fluid line bracket bolt	6	4
Flexplate bolts	-	-
Stage 1	15	11
Stage 2	50°	50°

Transmission bolts	45	33
Turbocharger heat shield bolts	10	7
Turbocharger support bracket bolts	24	18
+ Turbocharger to exhaust manifold	-	-
M8 studs	13	10
Nuts	23	17
+ Turbocharger coolant feed pipe	10	7
Secondary turbo down pipe	33	33
Turbo oil drain pipe	10	7
+ Exhaust cross over pipe	-	-
Stud	13	10
Bolts	23	17
Nut	28	20
Exhaust cross over pipe to support bracket	23	17
Exhaust cross over support bracket to EGR	23	17
+ Oil feed to turbo stub pipe	-	-
M8 bolts	8	5
Banjo bolt	23	17
*Valve cover bolts	10	7
Vacuum pump bolts	23	17
Vacuum pump nut	23	17
Vacuum pump stud	10	7

*** Bolts must be tightened in sequence**

+ New bolts must be installed

++ New pipes must be installed

¹ Lightly oil bolt threads

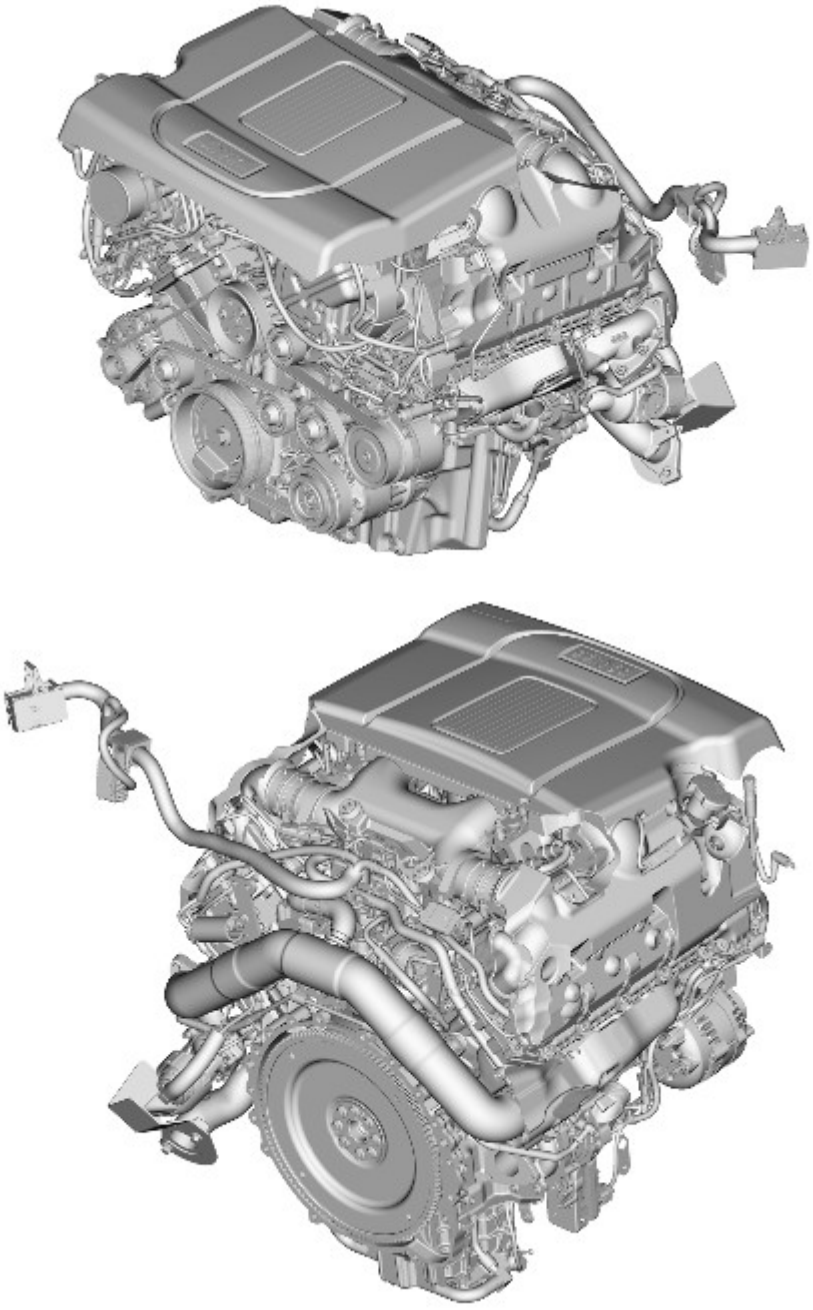
² Do not apply lubricant to bolt threads

Published: 02-Dec-2013

Engine - TDV8 4.4L Diesel - Engine

Description and Operation

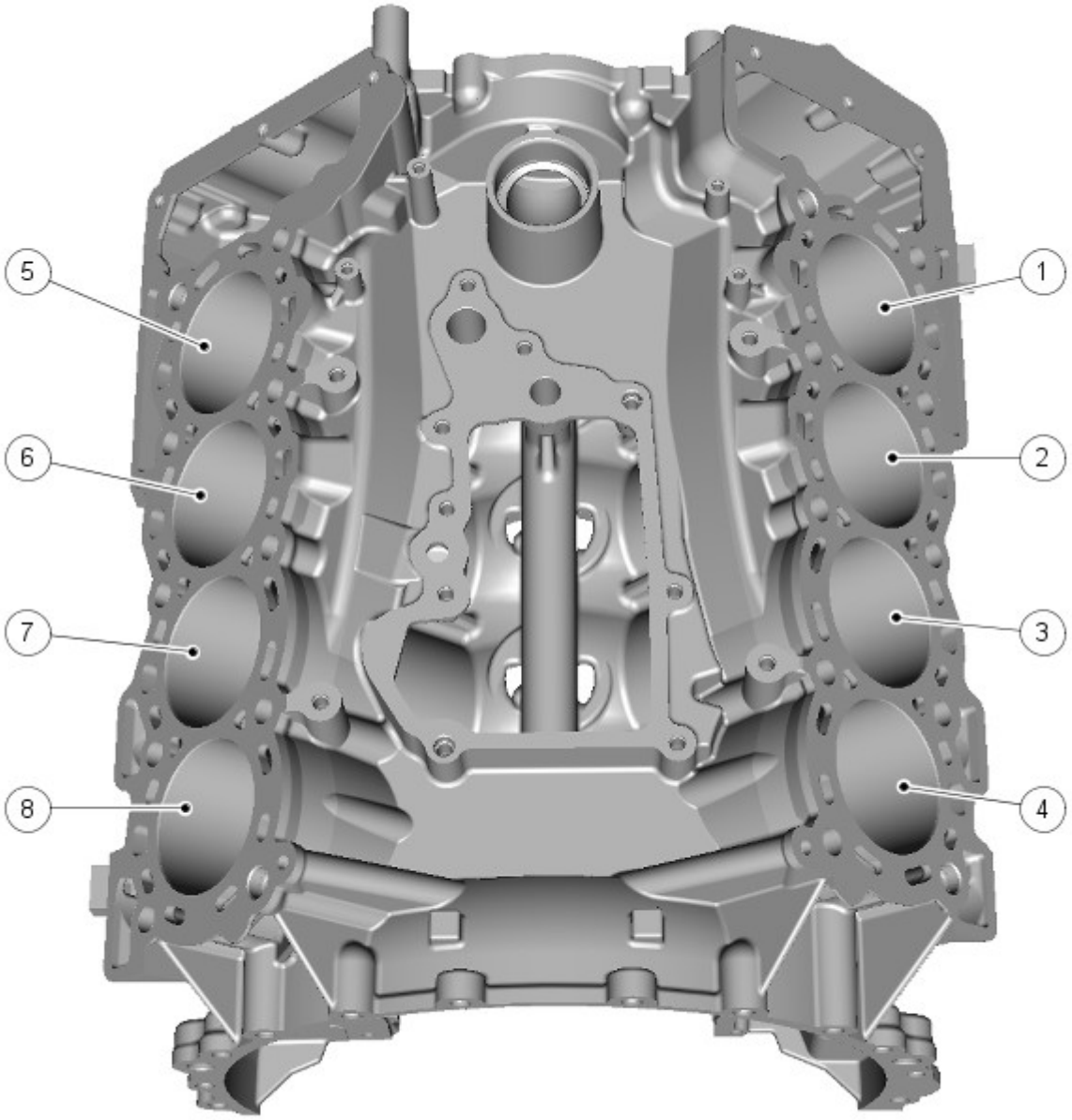
EXTERNAL VIEWS



E142945

OVERVIEW

The TDV8 4.4L diesel is a DI (Direct Injection), 8-cylinder engine with 2 banks of 4 cylinders, arranged at 90 degrees to each other. The cylinders are numbered as shown below, with cylinders 1 and 5 being at the front of the engine.



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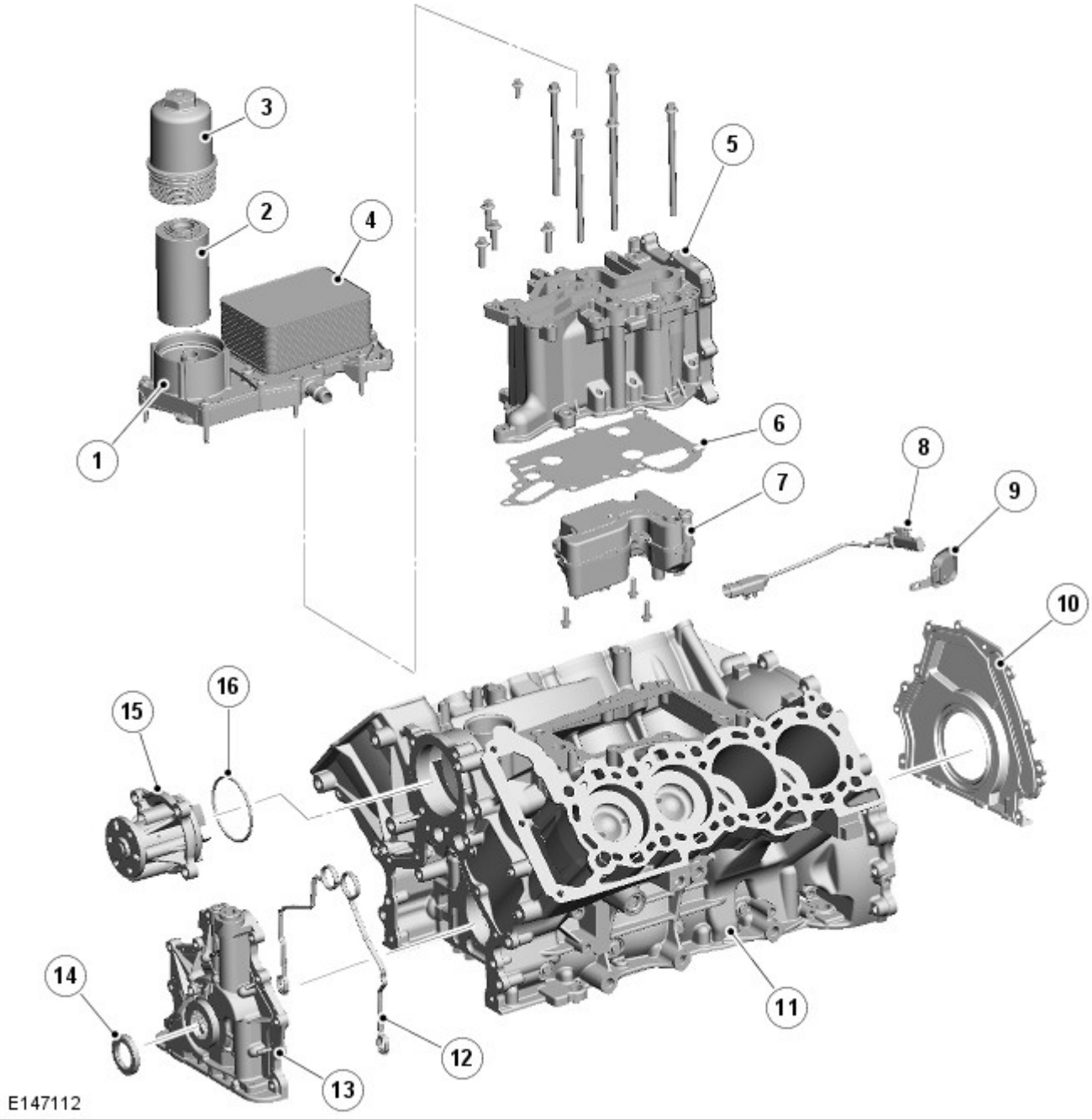
There are 4 valves per cylinder, which are operated by 2 overhead camshafts per cylinder.

The engine is liquid cooled and turbo-charged. The fuel injection system features common rail technology.

The cylinder block is coupled with a separate oil pan to provide a lightweight, compact and very stiff bottom end. The cylinder heads are fitted with integrated intake manifold and camshaft covers. The exhaust manifolds are unique for each cylinder head. Acoustic injector covers and an acoustic top cover are fitted over the upper engine to absorb engine-generated noise.

DESCRIPTION

Cylinder Block Components



Item	Part Number	Description
1	-	Oil filter housing
2	-	Oil filter element
3	-	Oil filter cap
4	-	Oil cooler assembly
5	-	Exhaust Gas Recirculation (EGR) cooler
6	-	EGR cooler gasket
7	-	Crankcase ventilation oil separator assembly
8	-	Crankshaft Position (CKP) sensor
9	-	Cylinder block aperture cover
10	-	Crankshaft rear oil seal
11	-	Cylinder block
12	-	Oil pump gasket
13	-	Oil pump
14	-	Crankshaft front oil seal
15	-	Coolant pump
16	-	Coolant pump seal

CYLINDER BLOCK

The cylinders and crankcase are contained in the closed-deck cylinder block, which has a hollow beam structure and features fully cross-bolted main bearing journals. With this type of construction less material is required than for a conventional cylinder block, therefore reducing engine weight and length.

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

A single connection at the right rear of the oil cooler and oil filter assembly connects a pipe to each of the turbochargers via a T-piece connector. Oil is supplied under pressure via this connection, from the oil pump, to provide lubrication for the bearings of the turbochargers.

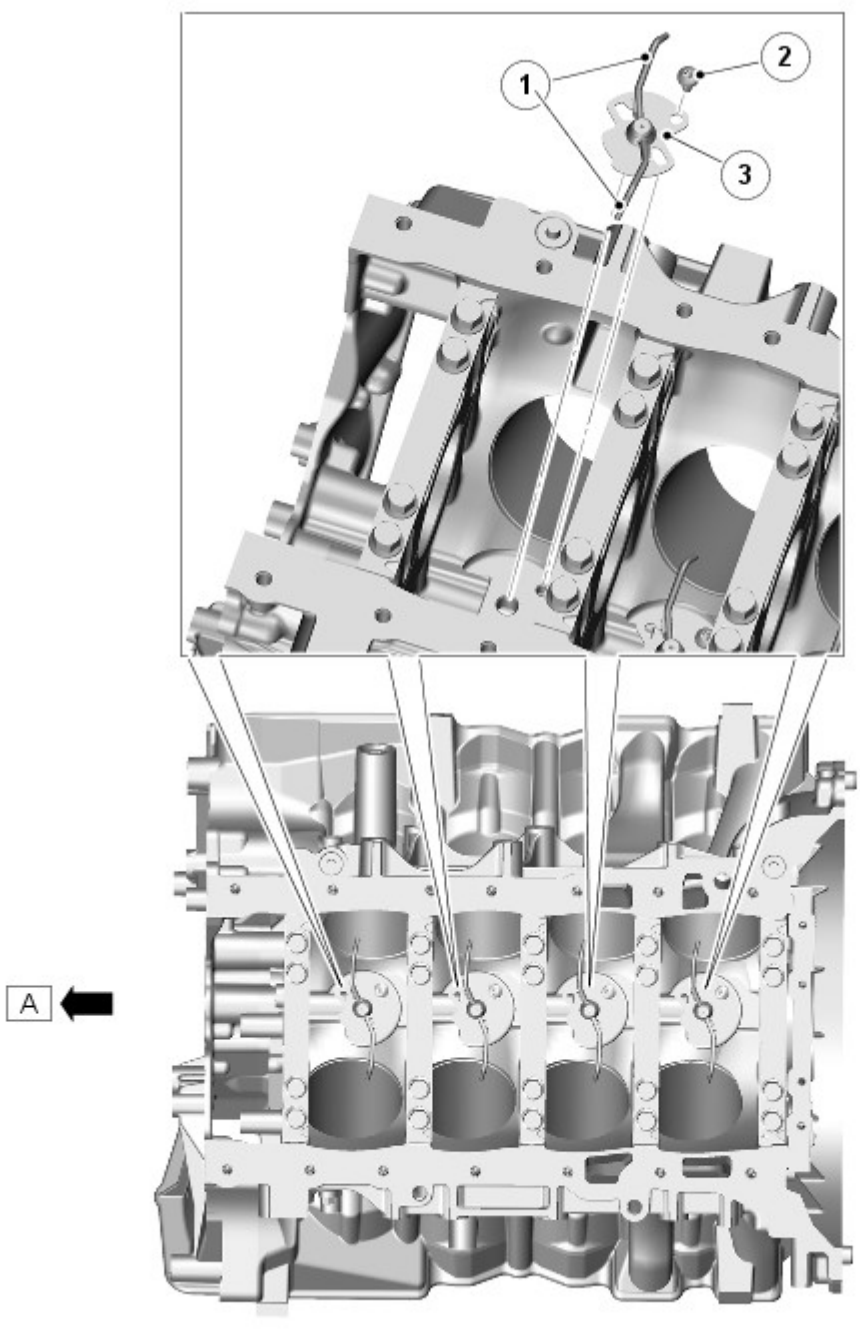
Cylinder cooling is achieved by coolant circulating through chambers in the cylinder block casting.

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

A port is included at the rear right and left sides of the oil pan, below the turbochargers, to connect the turbocharger oil return pipes to a dedicated reservoir (see TURBOCHARGER OIL RETURN section for more information).

Threaded plugs sealing the lubrication cross-drilling galleries are located at the front left and right sides of the cylinder block. Plugs for the main lubrication gallery are included at the front and rear of the cylinder block.

PISTON COOLING JETS



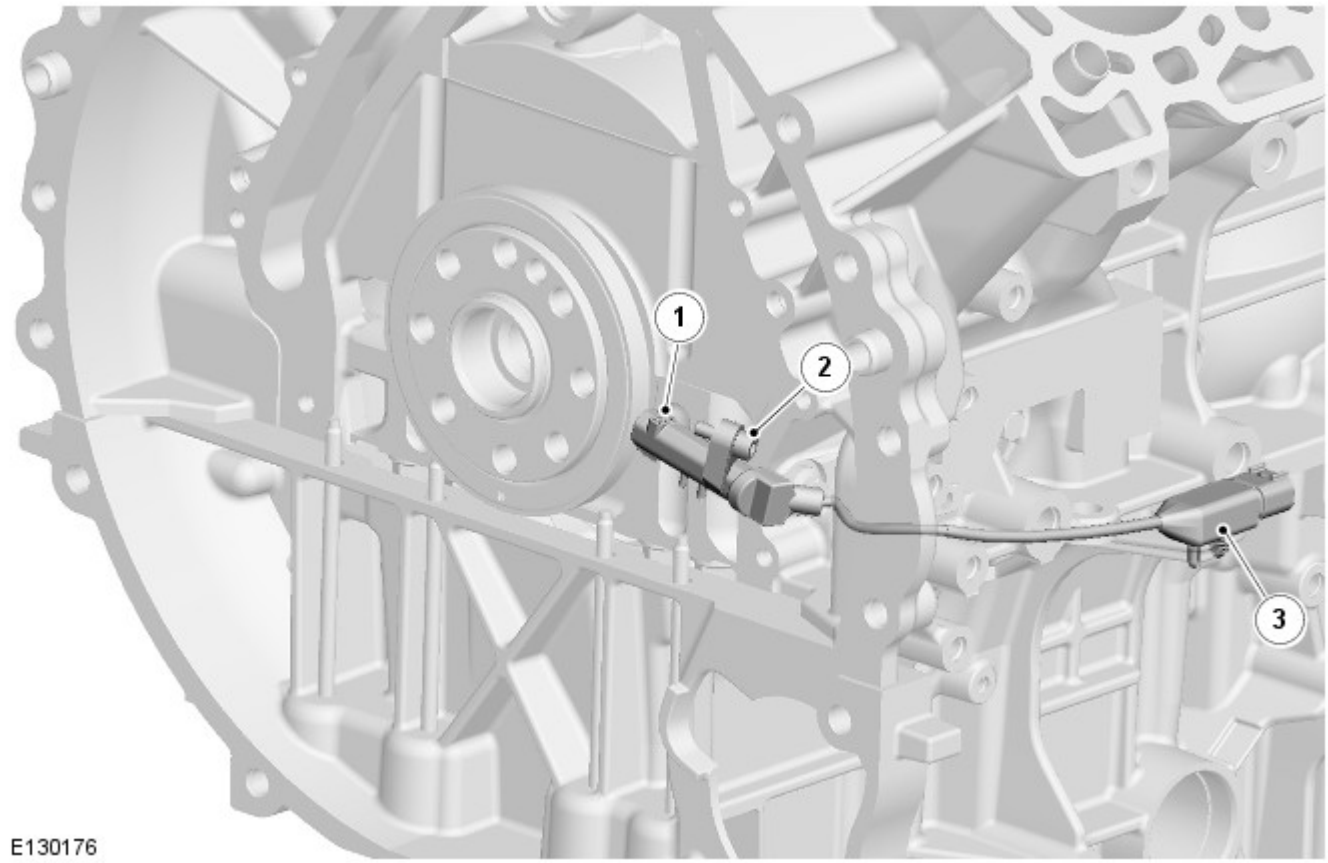
E130175

Item	Part Number	Description
A	-	Front of engine
1	-	Piston cooling jets
2	-	Screw
3	-	Plate

Jets located in the cylinder block provide piston and gudgeon pin lubrication and cooling.

These jets spray oil onto the inside of the piston. The oil then flows through 2 internal wave shaped channels to help cool each piston crown.

CRANKSHAFT POSITION SENSOR



Item	Part Number	Description
1	-	Crankshaft Position (CKP) sensor
2	-	Bolt
3	-	Electrical connector

The CKP (Crankshaft Position) sensor is located at the rear of the crankshaft, behind the drive plate in the right side of the rear oil seal retainer. The sensor bolts into the rear oil seal retainer.

The CKP sensor provides an input of engine crankshaft speed and position. The sensor works on the Hall effect principle and scans a reluctor ring on the crankshaft. An air gap of 0.4 to 1.5 mm, between the reluctor ring and the sensor, is achieved by the positional mounting of the sensor. The air gap is not adjustable.
For additional information, refer to: Electronic Engine Controls (303-14D Electronic Engine Controls - TDV8 4.4L Diesel, Description and Operation).

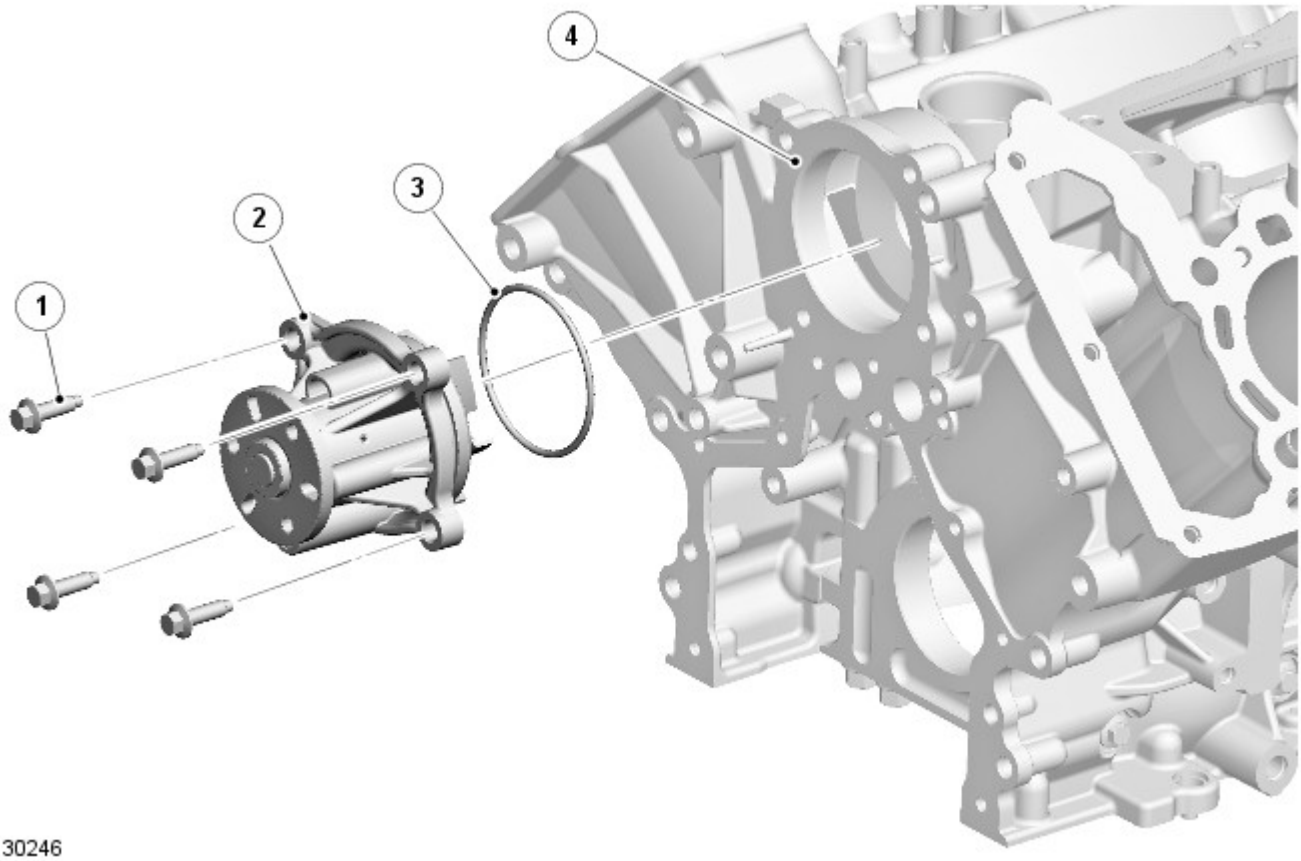
STARTER MOTOR

The engine starter motor is installed at the rear right side of the oil pan, at the cylinder block to oil pan split line.
For additional information, refer to: Starting System (303-06D Starting System - TDV8 4.4L Diesel, Description and Operation).

COOLANT DRAIN PLUG

A coolant drain plug is installed in the cylinder block on the left side below cylinder number 5.

COOLANT PUMP



E130246

Item	Part Number	Description
1	-	Bolt (4 off)
2	-	Coolant pump
3	-	O-ring seal
4	-	Cylinder block

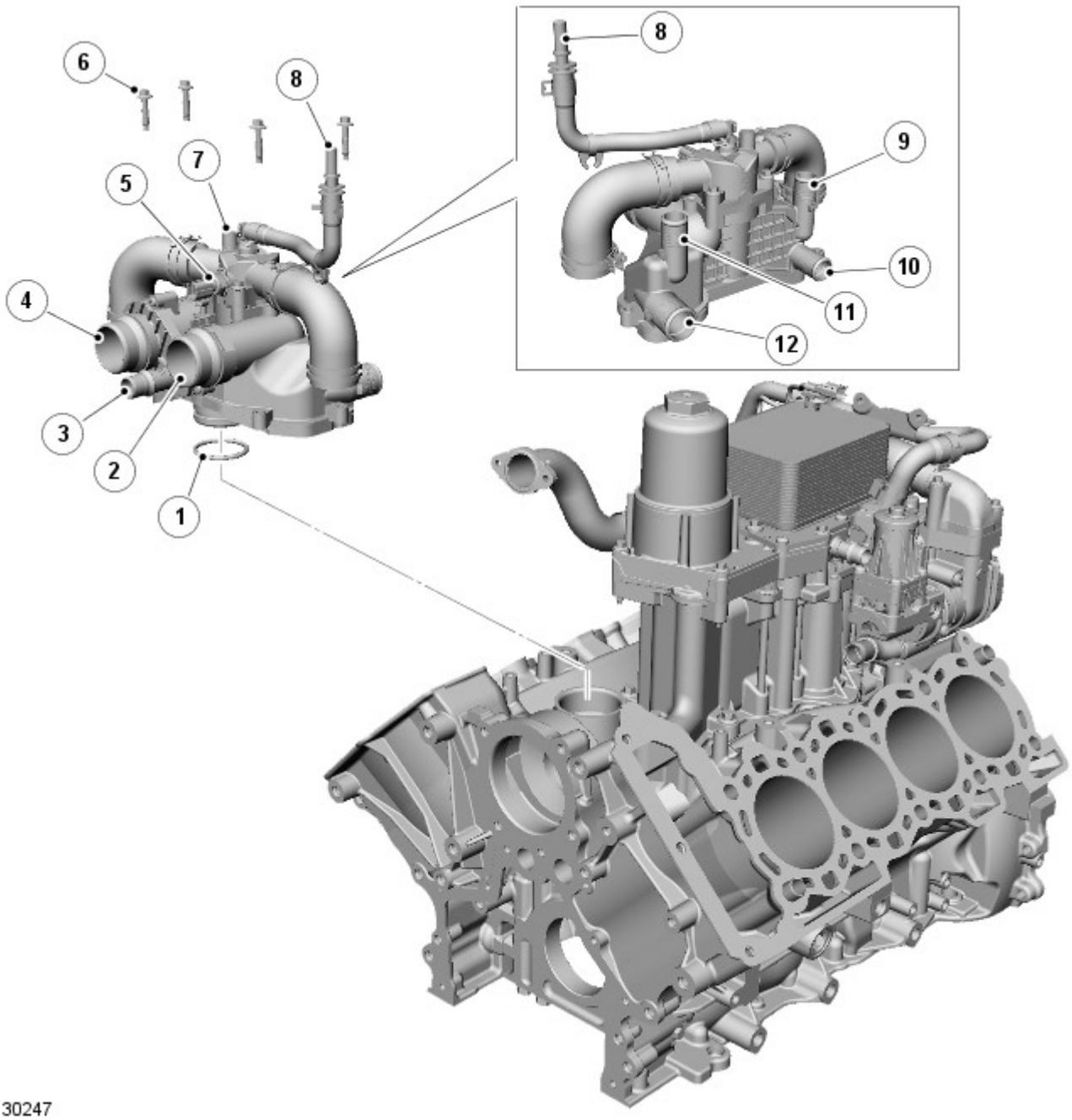
The coolant pump is installed on the center of the cylinder block front face and is secured and sealed using 4 bolts and an O-ring. The accessory drive belt drives the coolant pump.

OIL FILTER AND COOLANT ASSEMBLY

The oil filter and oil cooler assembly is located on top of the EGR (Exhaust Gas Recirculation) cooler, which is located in the center of the 'vee' of the cylinder block.

The oil filter is a replaceable cartridge installed on an adapter.

THERMOSTAT ASSEMBLY



E130247

Item	Part Number	Description
1	-	Seal
2	-	Connection from radiator upper hose
3	-	Connection to expansion tank
4	-	Connection from radiator bottom hose
5	-	Engine Coolant Temperature (ECT) sensor
6	-	Bolt (4 off)
7	-	Housing
8	-	Coolant bleed to radiator upper hose
9	-	Coolant supply to heater core
10	-	EGR cooler inlet
11	-	Coolant return from heater core
12	-	EGR cooler outlet

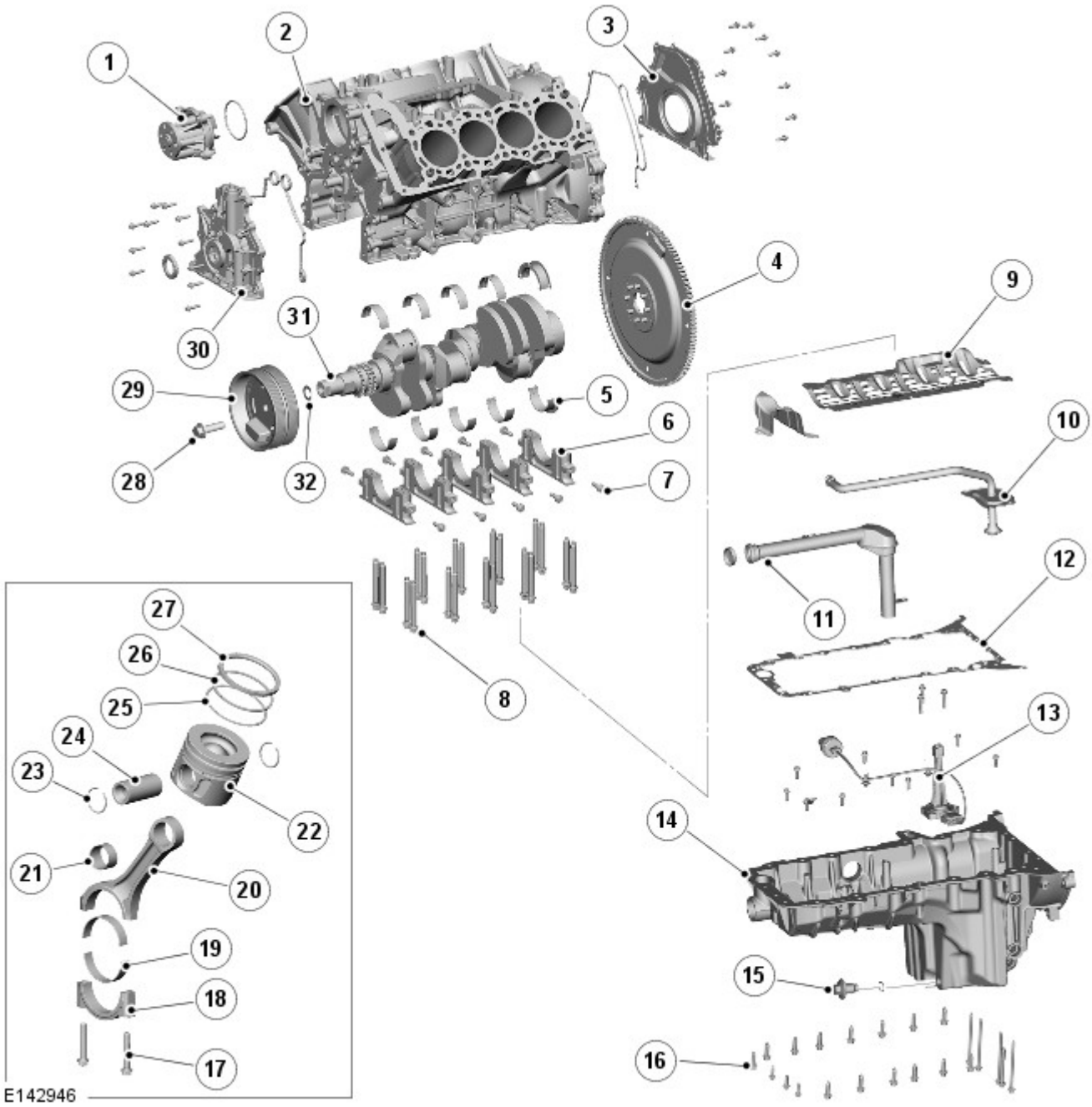
The thermostat assembly connects the cooling channels of the cylinder block to the cooling channels of the left and right cylinder heads and provides the coolant outlet for the EGR and coolant return.
For additional information, refer to: Engine Cooling (303-03F Engine Cooling - TDV8 4.4L Diesel, Description and Operation).

On the front of the thermostat assembly are three hose connections for the radiator upper hose, expansion tank and radiator lower hose. A connection from the top of the thermostat assembly connections to the radiator upper hose and four connections at the rear of the assembly provide for connections to the EGR cooler inlet, EGR cooler outlet, heater core supply and heater core return.

An ECT (Engine Coolant Temperature) sensor is located in a hole in the front of the thermostat assembly. The sensor is

sealed with an O-ring seal and secured with a spring clip. The ECT sensor is connected to the ECM (Engine Control Module) which uses the coolant temperature information for a number of functions.
For additional information, refer to: Electronic Engine Controls (303-14D Electronic Engine Controls - TDV8 4.4L Diesel, Description and Operation).

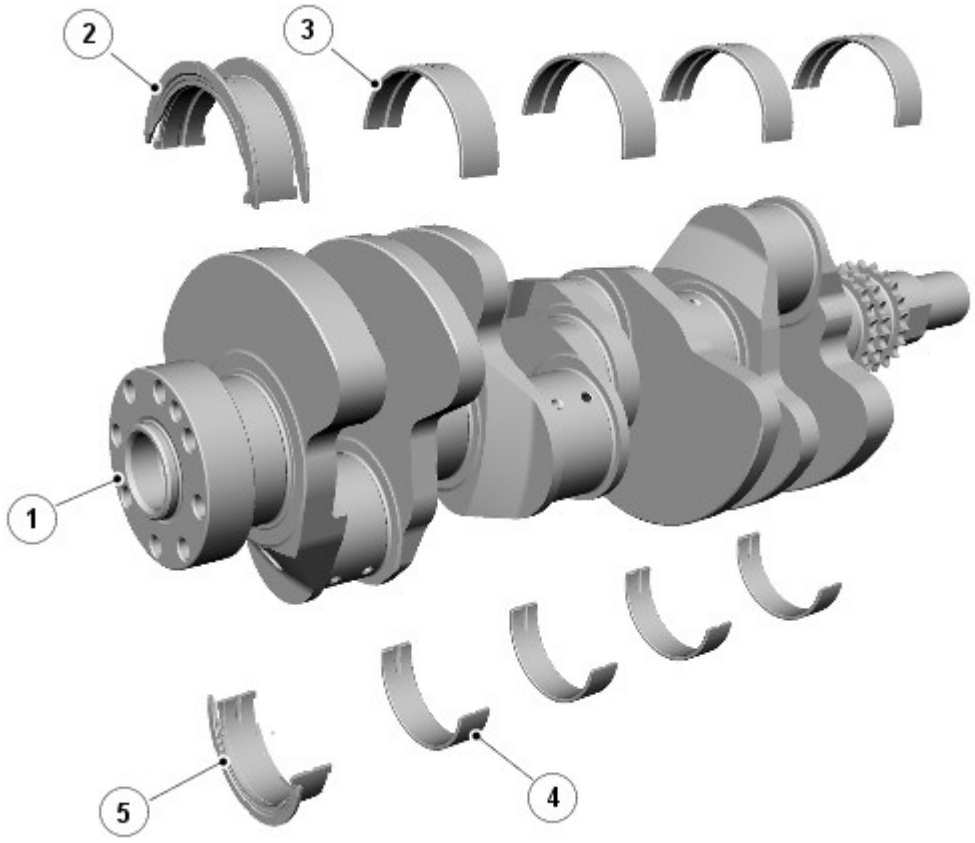
Crankshaft and Oil Pan Components



Item	Part Number	Description
1	-	Coolant pump
2	-	Cylinder block
3	-	Crankshaft rear oil seal
4	-	Drive plate
5	-	Main bearings (10 off, 5 upper and 5 lower. Number 5 bearings include thrust washers)
6	-	Main bearing caps (5 off)
7	-	Main bearing cap cross bolts (10 off)
8	-	Main bearing cap bolts (20 off)
9	-	Oil baffle plate
10	-	Oil scavenge pipe
11	-	Oil pick-up and strainer
12	-	Oil pan gasket
13	-	Oil level and temperature sensor
14	-	Oil pan
15	-	Oil drain plug

16	-	Oil pan bolt (22 off)
17	-	Bolt (16 off, 2 per piston)
18	-	Connecting rod cap
19	-	Connecting rod big end bearing (2 off per connecting rod)
20	-	Connecting rod
21	-	Connecting rod small end bearing
22	-	Piston
23	-	Piston pin retainer (16 off, 2 per piston)
24	-	Piston pin
25	-	Oil control ring
26	-	Lower compression ring
27	-	Upper compression ring
28	-	Bolt
29	-	Crankshaft damper pulley
30	-	Oil pump
31	-	Crankshaft
32	-	Diamond washer

CRANKSHAFT AND MAIN BEARINGS



E130356

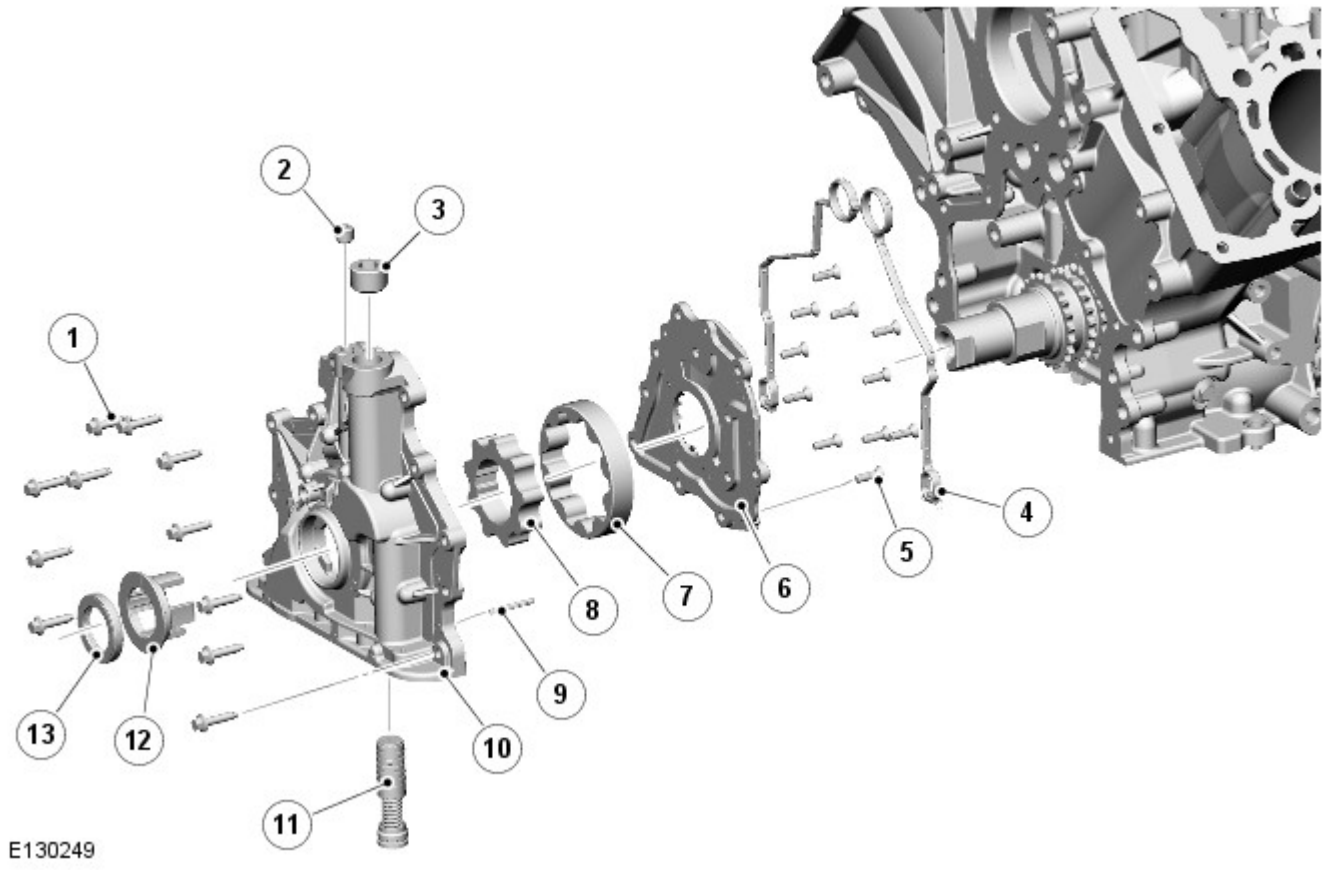
Item	Part Number	Description
1	-	Crankshaft
2	-	Rear main bearing shell - upper with thrust washer
3	-	Main bearing shell - upper (4 off)
4	-	Main bearing shell - lower (4 off)
5	-	Rear main bearing shell - lower with thrust washer

The crankshaft is installed in five main bearings. The main bearing caps are double and cross-bolted, which adds to the strength and rigidity of the engine block.

The crankshaft drive pulley is not keyed onto the crankshaft; the crankshaft and the pulley hub have a corresponding flat which provides positive location. The pulley is secured to the crankshaft with a bolt and diamond washer.

The main bearings are 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 5 contain integral thrust washers, which limits the crankshaft end float.

CRANKSHAFT FRONT OIL SEAL AND OIL PUMP



Item	Part Number	Description
1	-	Bolt (11 off)
2	-	Clean oil gallery plug
3	-	Outlet gallery plug
4	-	Gasket
5	-	Cover screw (11 off)
6	-	Backplate
7	-	Oil pump outer rotor
8	-	Oil pump inner rotor
9	-	Roll pin
10	-	Oil pump housing
11	-	Relief valve
12	-	Oil pump insert (fitting tool only - discarded after installation of oil pump)
13	-	Crankshaft front oil seal

The oil pump draws engine oil out via a strainer in the oil pan, through the oil filter, galleries, and to the engine bearings, pistons and turbochargers.

The oil pump is located at the front of the engine in an oil pump housing which is secured to the cylinder block with 11 bolts. The pump is an eccentric rotor type pump which is located in the rear of the housing and sealed with a backplate and screws.

The pump is driven by a direct drive off the crankshaft.

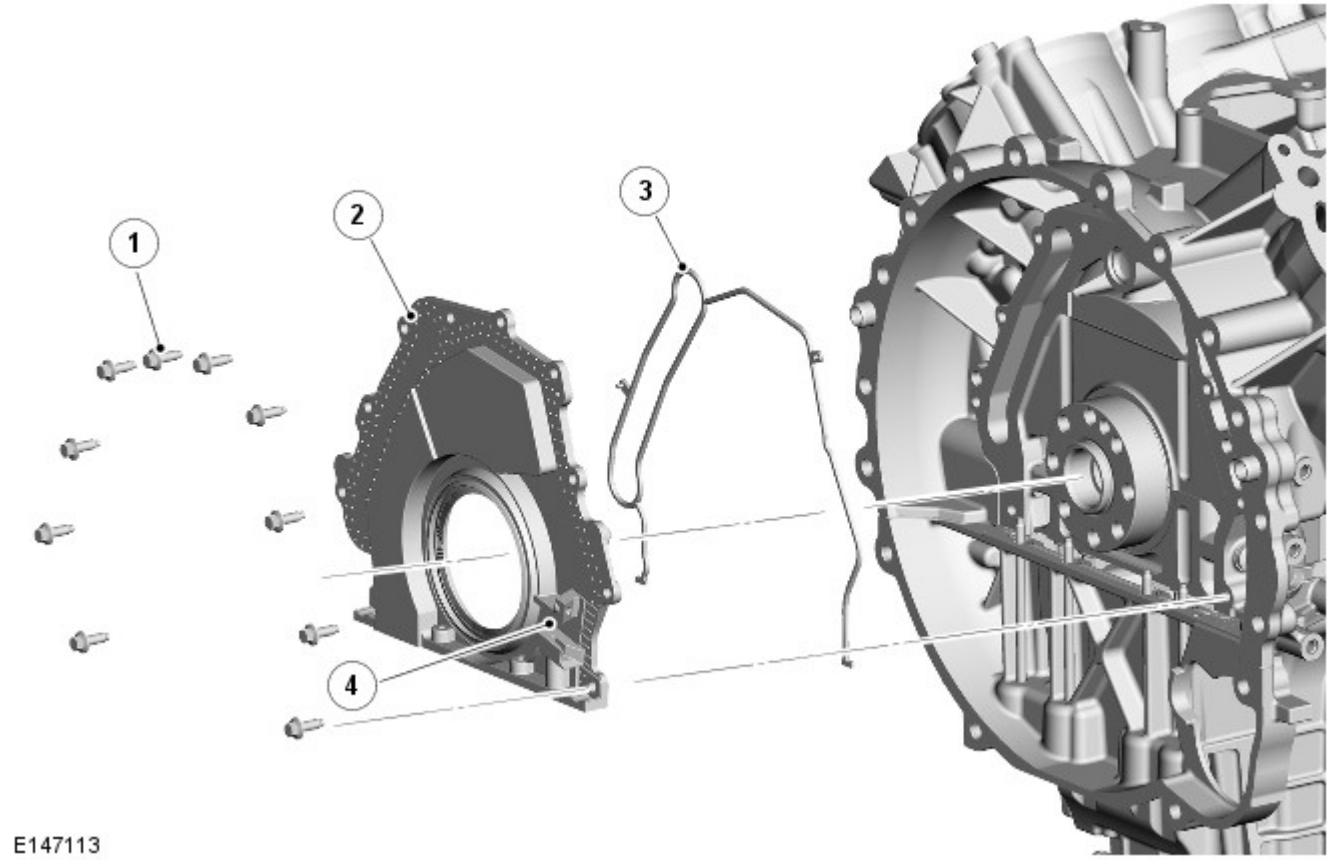
The oil pump housing also contains a relief valve assembly which is secured in the housing with a roll pin. The oil pump supplies a greater amount of oil than is normally required for adequate lubrication. The oil pressure relief valve is incorporated in the pump oil circuit to limit maximum oil pressure to 4.5 bar (65.25 lbf/in²).

The pressure relief valve is a spring-loaded bypass valve which comprises a small piston and spring located in a bore in the oil pump housing. Under normal pressure conditions, the spring holds the relief valve closed and all the oil from the oil pump flows into the oil galleries and to the bearings. Under abnormally high oil pressure conditions (when the oil is cold for example), the pressure relief valve opens. Oil pressure pushes the small piston back in its bore in the housing by overcoming spring tension. This allows some of the pressurized oil to bypass the main oil galleries and return back into the oil pan. Most of the oil still flows to the bearings and a preset oil pressure is maintained.

The crankshaft front oil seal is a press fit into the oil pump housing and requires a special tool for fitment.

NOTE: The seal must be inserted such that the front face is 1 mm underflush with the machined front face of the oil pump. It must not be pushed all the way into the bore, as this will block the seal drains.

CRANKSHAFT REAR OIL SEAL

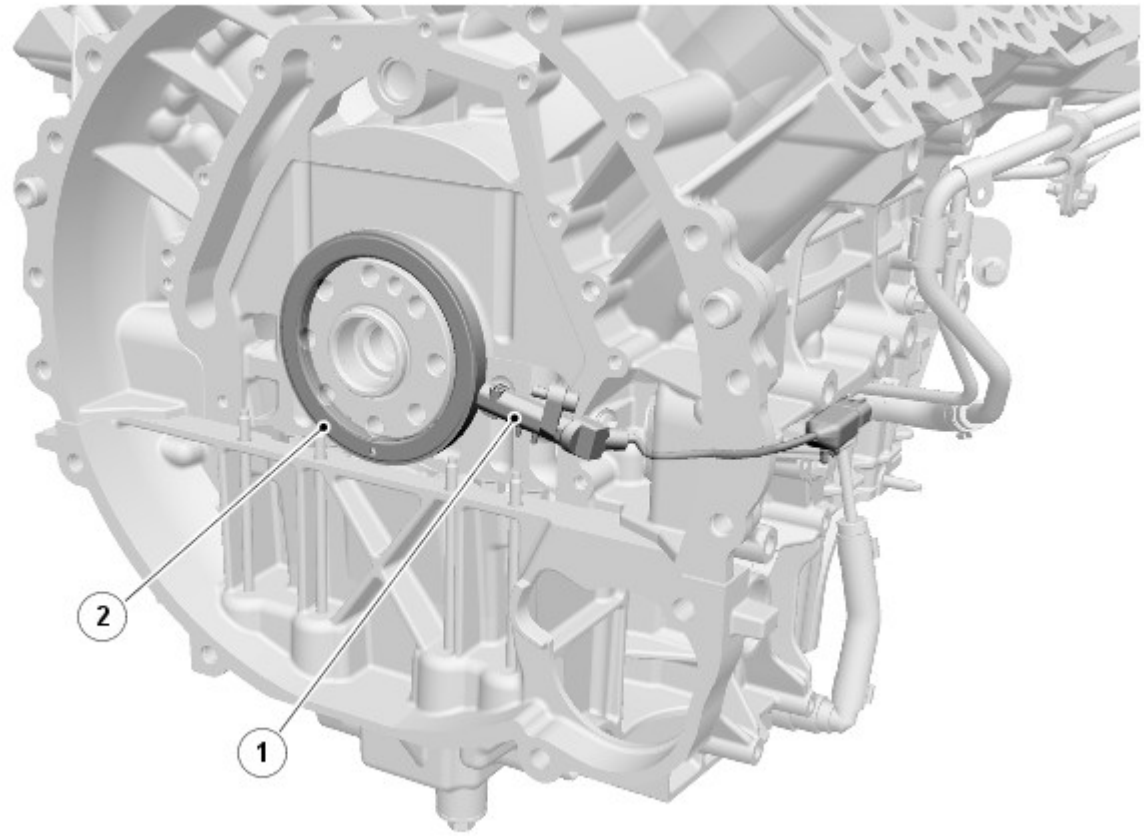


Item	Part Number	Description
1	-	Bolt (10 off)
2	-	Crankshaft rear oil seal
3	-	Gasket
4	-	Crankshaft Position (CKP) sensor location

The crankshaft rear oil seal consists of a lipped oil seal pressed into a retainer. The retainer is attached to the rear of the crankcase with 10 bolts.

The retainer also provides the location for the CKP sensor.

RELUCTOR RING



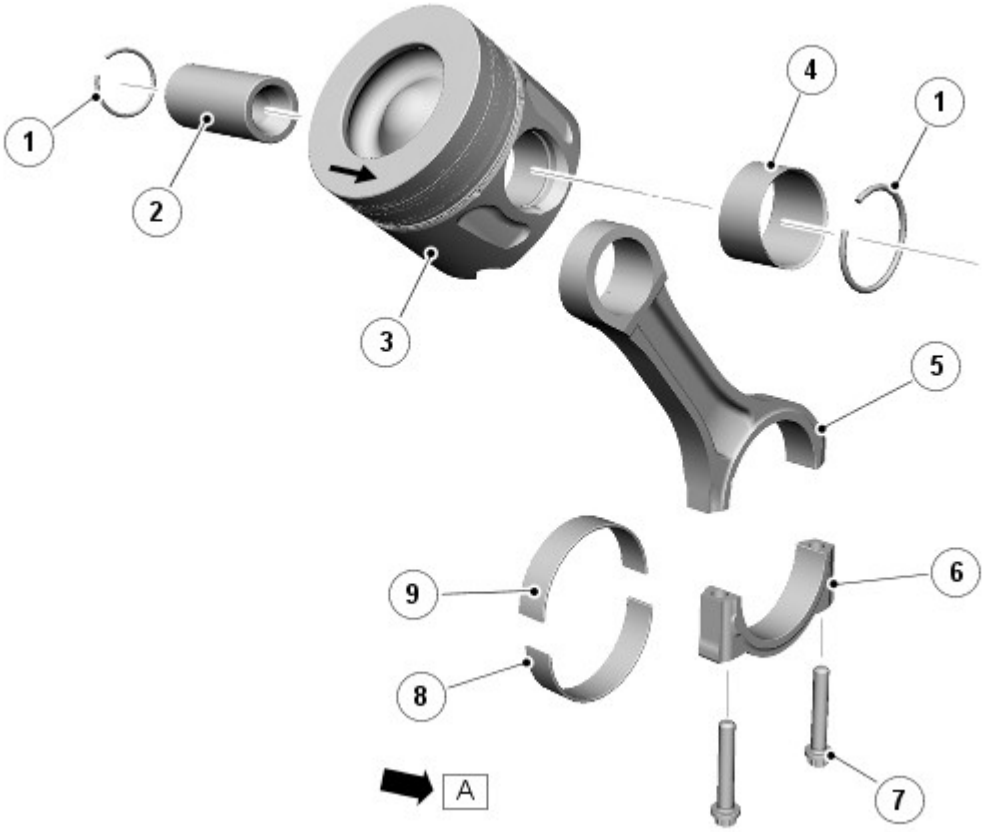
E130251

Item	Part Number	Description
1	-	Crankshaft Position (CKP) sensor
2	-	Reluctor ring

The reluctor ring is located on the rear of the crankshaft. It is pressed onto the crankshaft using a special tool, which precisely aligns the reluctor ring for crankshaft position and timing. The reluctor ring consists of 60 equally spaced points, 58 of which contain a magnet. The 2 missing spaces are used for ECM crankshaft position reference and synchronisation. The magnets cannot be seen on the trigger-wheel; therefore, it can only be positioned using the special tool.

NOTE: If the reluctor ring is removed for any reason, a new reluctor ring must be fitted. Do not reuse the old reluctor ring.

CONNECTING RODS AND PISTONS

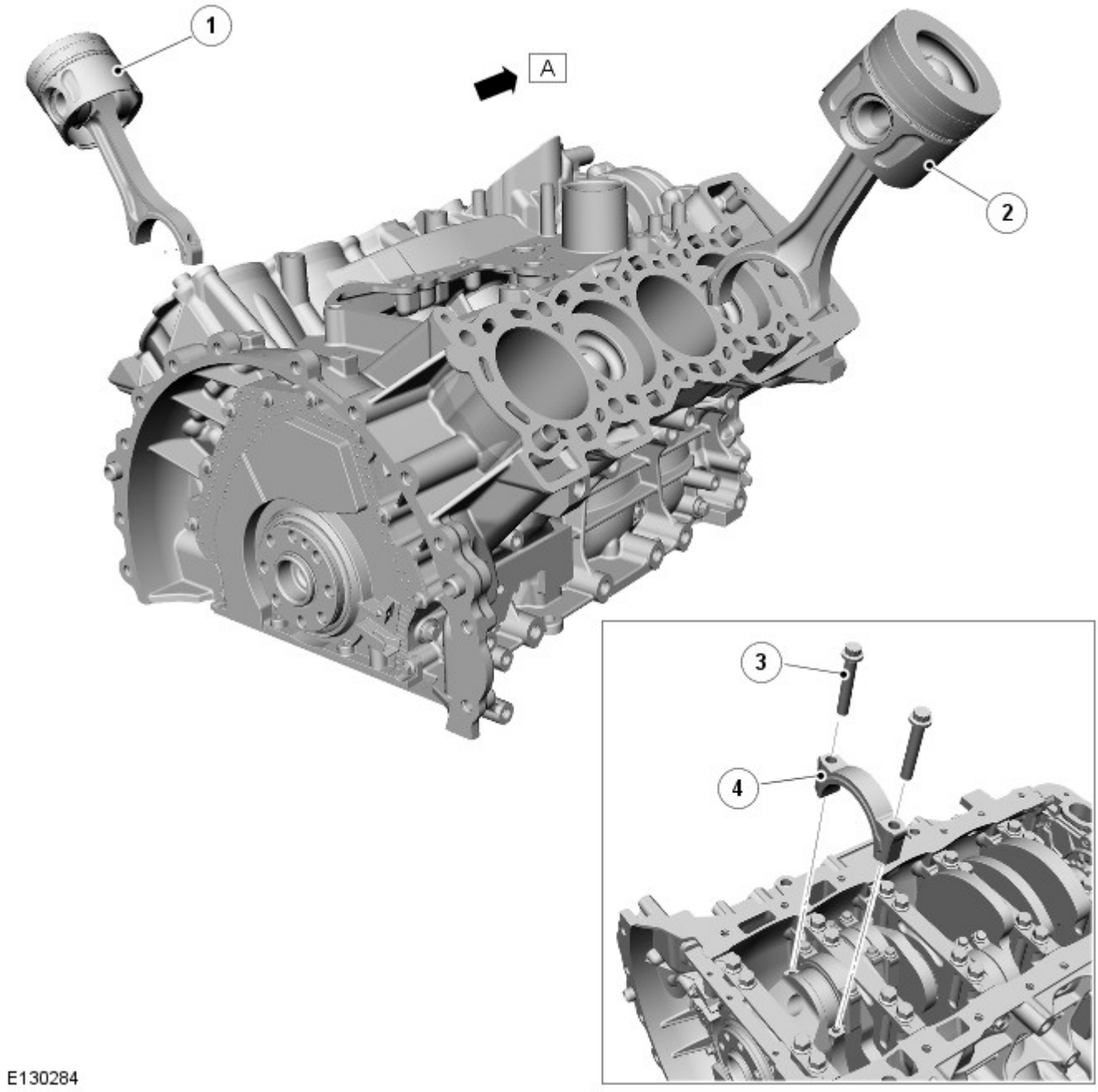


E130362

Item	Part Number	Description
A	-	Front of engine
1	-	Piston pin retainers
2	-	Piston pin
3	-	Piston
4	-	Connecting rod small end bearing
5	-	Connecting rod
6	-	Connecting rod bearing cap
7	-	Bolt (2 off)
8	-	Connecting rod bearing (lower)
9	-	Connecting rod bearing (upper)

The connecting rods have fracture-split bearing caps. Fracturing the opposing sides of the connecting rod at the bearing horizontal centerline, produces the bearing caps. 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 split plain bearings.

NOTE: The connecting rods are not selective.



E130284

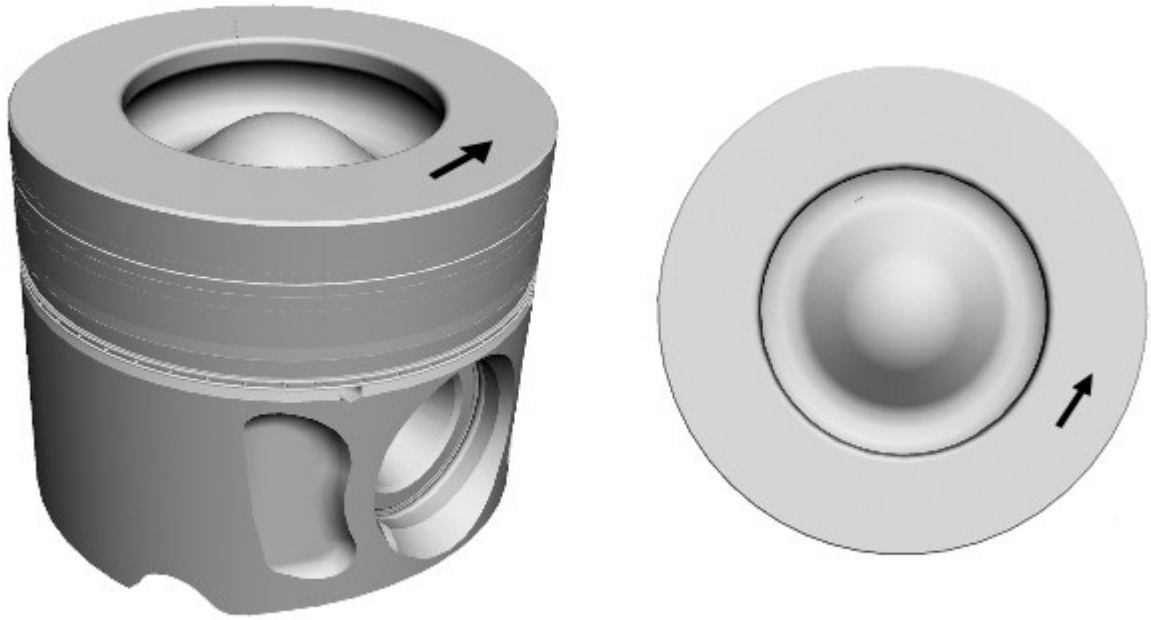
Item	Part Number	Description
A	-	Front of engine
1	-	Piston and connecting rod assembly, cylinders 5-8
2	-	Piston and connecting rod assembly, cylinders 1-4
3	-	Bolt (16 off)
4	-	Connecting rod bearing cap (8 off)

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

The pistons are fitted with 2 compression rings and an oil control ring. 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 underside of 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, which is located in a bushing in the connecting rod.



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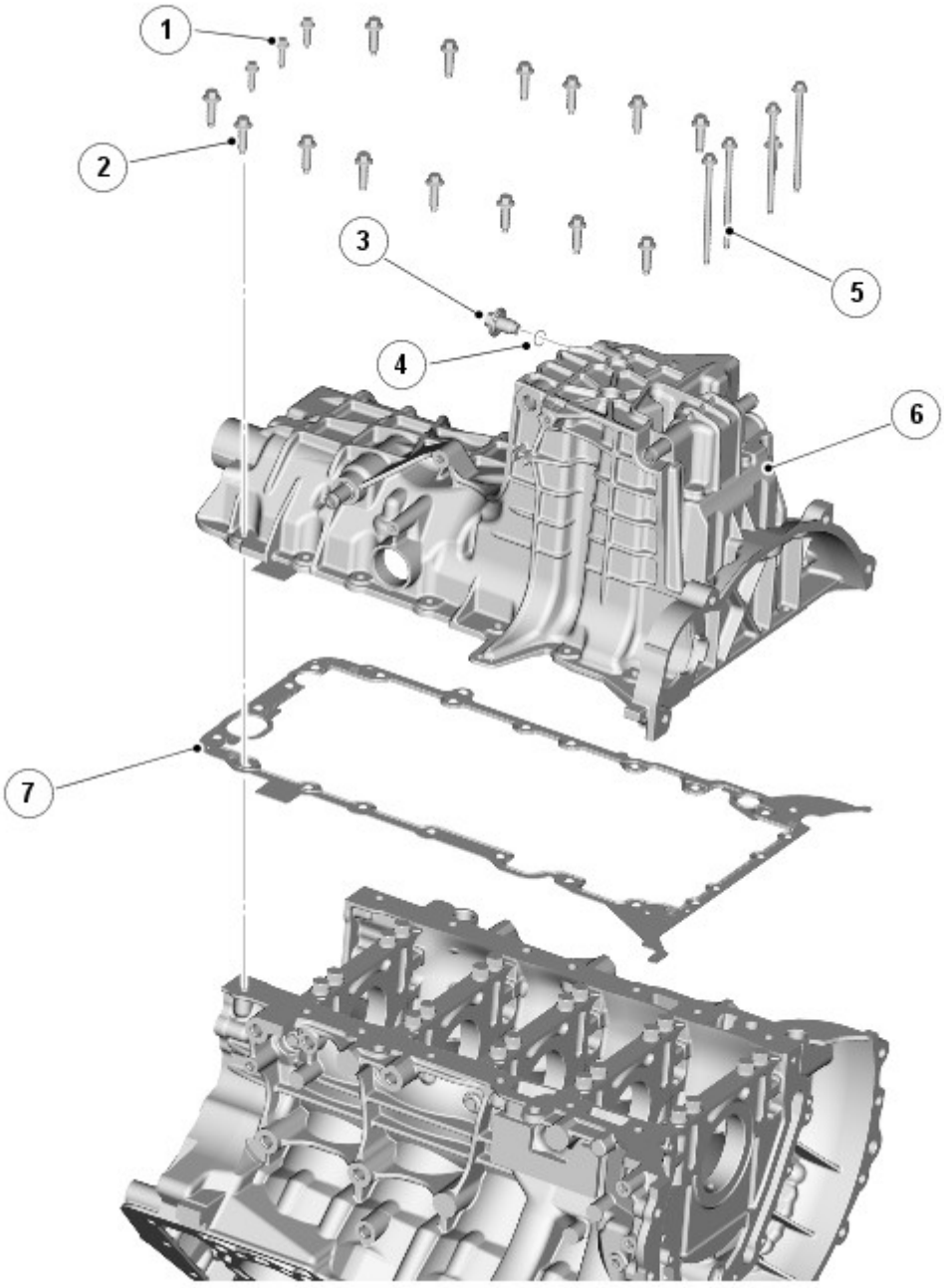
When installing pistons ensure the arrows on the piston crowns all point to the front of the engine.

NOTE: All pistons are common single grade/single part number.

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, with the ring gaps at 120° to each other. The circumference gap of the double beveled oil control ring must be opposite the spiral control joint.

The upper and lower compression rings and the oil control ring are identified by a paint code on each ring. The upper compression ring has a red paint mark, the lower compression ring has a yellow paint mark and the oil control ring has a light blue paint mark.

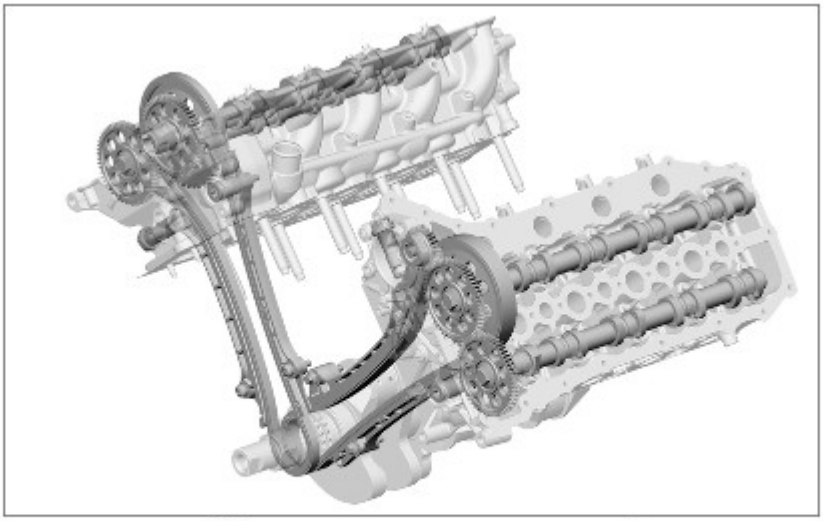
OIL PAN

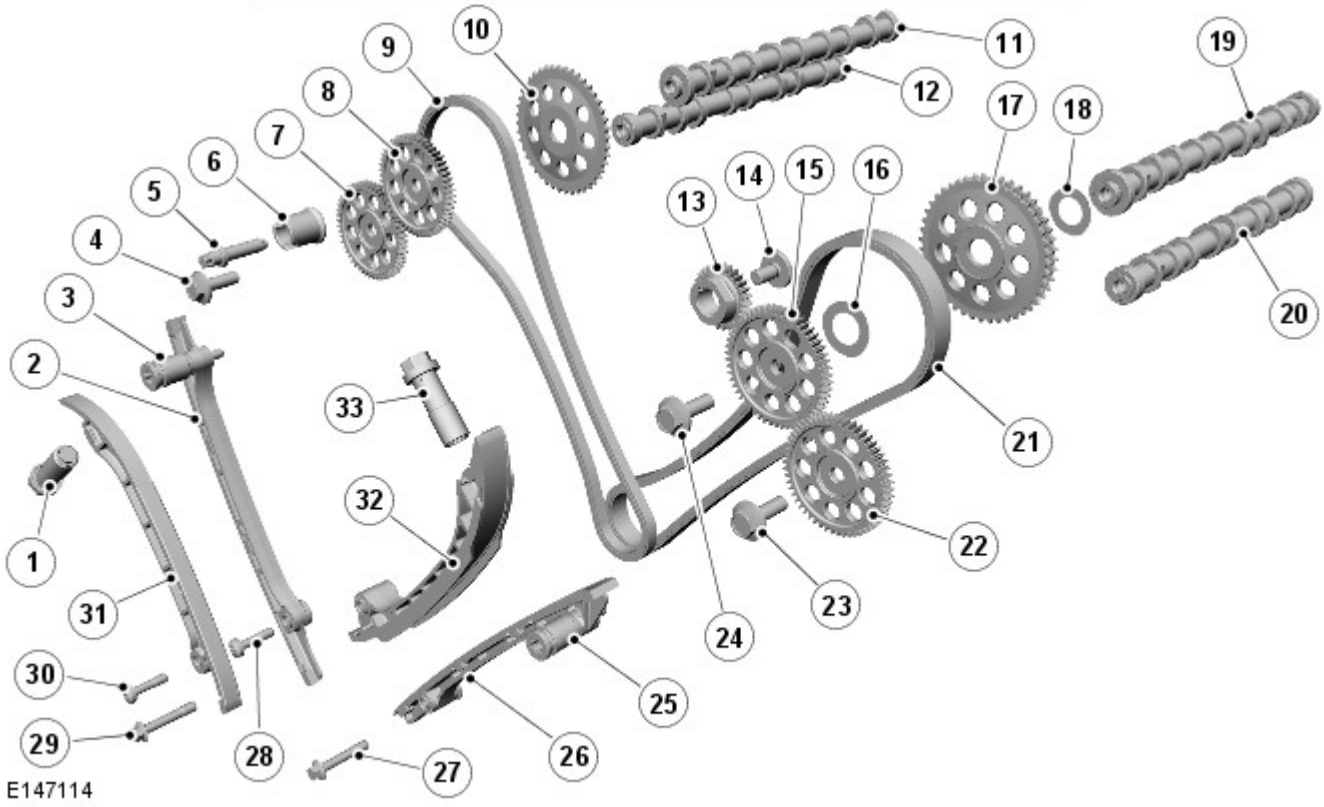


Item	Part Number	Description
1	-	Bolt (3 off)
2	-	Bolt (14 off)
3	-	Oil drain plug
4	-	Seal
5	-	Bolt (4 off)
6	-	Oil pan
7	-	Oil pan gasket

The oil pan is heavily ribbed for strength and stiffness. An oil drain plug is located on the underside of the oil pan. A gasket seals the joint between the oil pan and the cylinder block.

Camshaft Timing Components





Item	Part Number	Description
1	-	Right camshaft chain tensioner
2	-	Right camshaft chain guide
3	-	Bolt
4	-	Bolt
5	-	Bolt - camshaft drive gear adaptor
6	-	Vacuum and oil scavenge pump drive
7	-	Right exhaust camshaft gear
8	-	Right intake camshaft gear
9	-	Timing chain
10	-	Right intake camshaft sprocket
11	-	Right intake camshaft
12	-	Right exhaust camshaft
13	-	High pressure fuel pump drive gear
14	-	Bolt
15	-	Left intake camshaft gear
16	-	Diamond washer
17	-	Left intake camshaft sprocket
18	-	Diamond washer
19	-	Left intake camshaft
20	-	Left exhaust camshaft

21	-	Timing chain
22	-	Left exhaust camshaft gear
23	-	Bolt
24	-	Bolt
25	-	Bolt
26	-	Left camshaft chain guide
27	-	Bolt
28	-	Bolt
29	-	Bolt
30	-	Bolt
31	-	Right camshaft chain tensioner arm
32	-	Left camshaft chain tensioner arm
33	-	Left camshaft chain tensioner

Drive is provided by a simplex bush timing chain for the right camshafts and a duplex bush timing chain for the left camshafts. The two timing chains are driven from the crankshaft to the intake camshaft sprocket of each cylinder head. Each exhaust camshaft is driven by a gear arrangement from the intake camshaft.

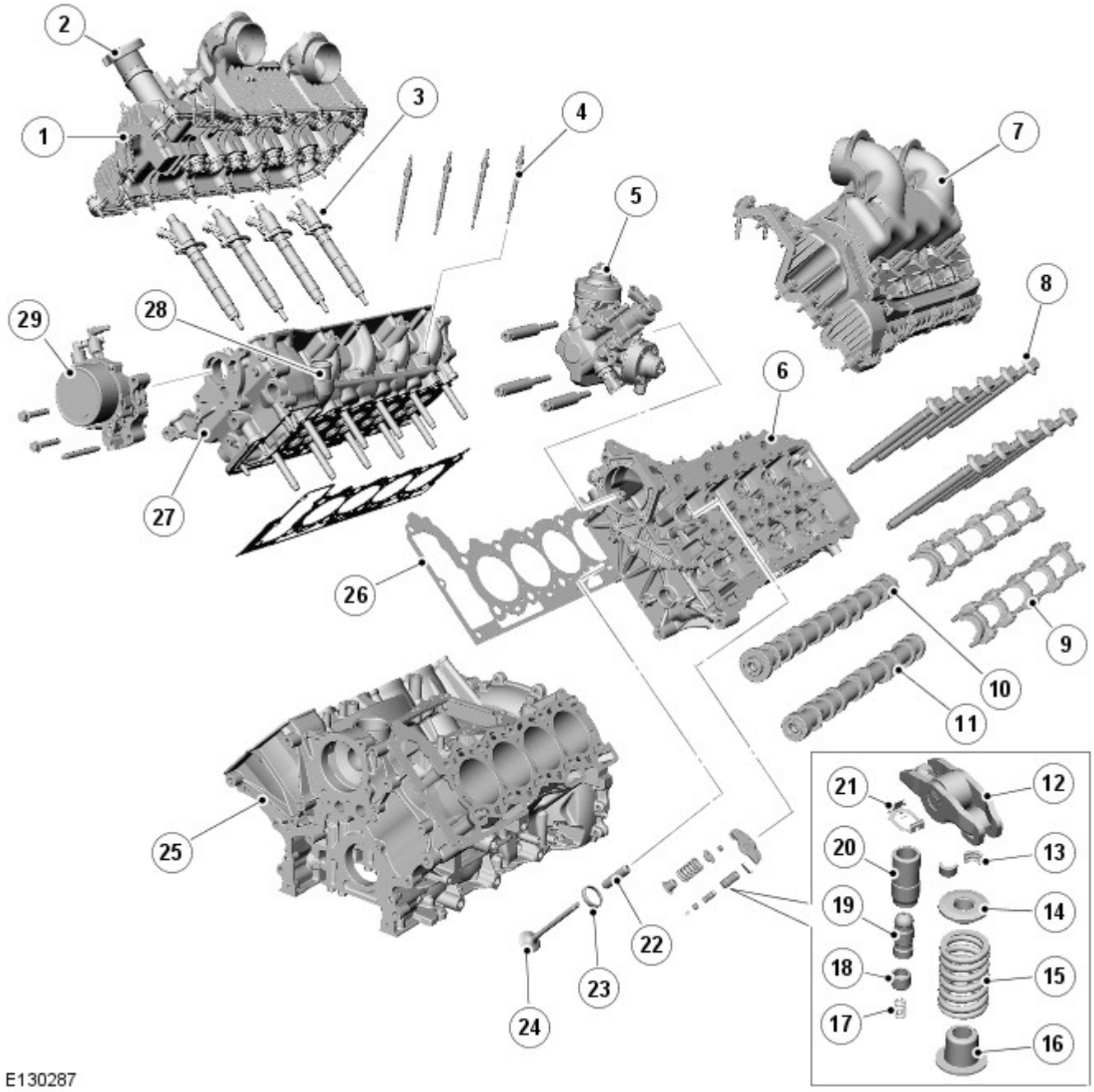
On the left cylinder head, the gear arrangement also drives the high pressure fuel pump. To ensure there is no slippage in the drive from the intake camshaft sprocket, due to the load of the fuel pump, diamond washers are installed each side of the sprocket. The diamond washers increase the friction between the sprocket and the adjacent components.

 NOTE: The diamond washers can become embedded in the sprocket, and difficult to separate when the timing gear is disassembled.

The non-driven side of each timing chain is contained between fixed and moveable camshaft chain guides. The moveable guides are attached to the front of the cylinder block using pivot bolts. Hydraulic tensioners keep the moveable guides in contact with the timing chains, to control timing chain flutter.

The timing chains are oil splash lubricated. Oil spray is directed onto the chains from several oil supply ports in the front of the cylinder block and cylinder heads.

Cylinder Head Components

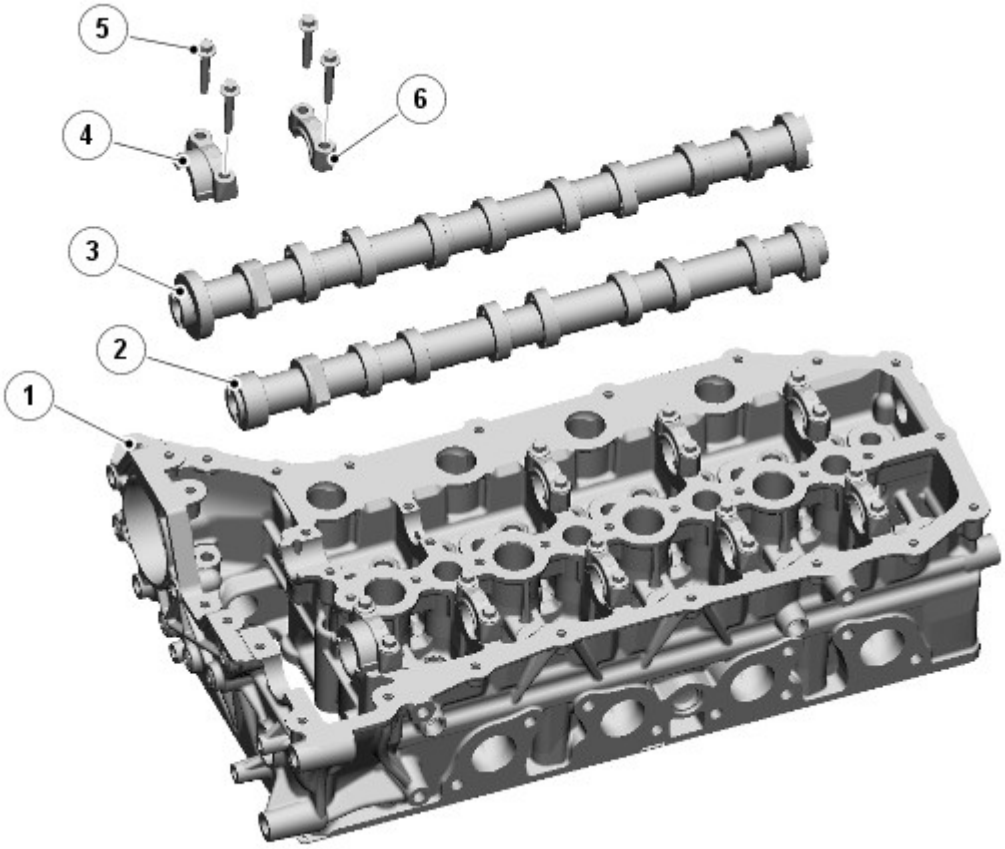


E130287

Item	Part Number	Description
1	-	Right camshaft cover
2	-	Oil filler cap
3	-	Fuel injectors (4 off per cylinder head)
4	-	Glow plugs (4 off per cylinder head)
5	-	High pressure fuel pump
6	-	Left cylinder head
7	-	Left camshaft cover
8	-	Cylinder head bolts (10 off per cylinder head)
9	-	Cam caps and bolts assemblies (10 off per cylinder head)
10	-	Left intake camshaft
11	-	Left exhaust camshaft
12	-	Rocker arm (16 off per cylinder head)
13	-	Valve spring retaining collet (32 off per cylinder head)
14	-	Valve spring retainer (16 off per cylinder head)
15	-	Valve spring (16 off per cylinder head)
16	-	Valve spring seat and stem seal (16 off per cylinder head)
17	-	Rocker arm - Return spring (16 off per cylinder head)
18	-	Rocker arm - Lower piston (16 off per cylinder head)
19	-	Rocker arm - Upper piston (16 off per cylinder head)
20	-	Rocker arm - housing (16 off per cylinder head)

21	-	Clip (16 off per cylinder head)
22	-	Valve guide (16 off per cylinder head)
23	-	Valve seat (16 off per cylinder head)
24	-	Valve (8 off exhaust, 8 off intake per cylinder head)
25	-	Cylinder block
26	-	Cylinder head gasket (1 off per cylinder head)
27	-	Right cylinder head
28	-	Engine coolant supply connection
29	-	Vacuum and oil scavenge pump

CYLINDER HEADS



E130288

Item	Part Number	Description
1	-	Cylinder head (left shown, right similar)
2	-	Exhaust camshaft
3	-	Intake camshaft
4	-	Camshaft bearing cap front (1 off per camshaft)
5	-	Camshaft bearing cap bolts (10 off per camshaft)
6	-	Camshaft bearing cap (4 off per camshaft)

The cylinder heads are unique to each cylinder. Ten deep-seated bolts help reduce distortion and secure each cylinder head to the cylinder block. The cylinder head bolts are located beneath the camshafts, 5 under the intake camshaft and 5 under the exhaust camshaft. Two hollow dowels align each cylinder head with the cylinder block.

NOTES:

The cylinder head bolts are not accessible with the camshafts fitted.

The cylinder head cannot be reworked.

Each 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.

Each cylinder head houses a manual chain tensioner that operates on the adjustable guide at the slack side of each of the timing chains. Pressurized oil for the adjuster is supplied through the back of the unit from an oil supply port in each cylinder head.

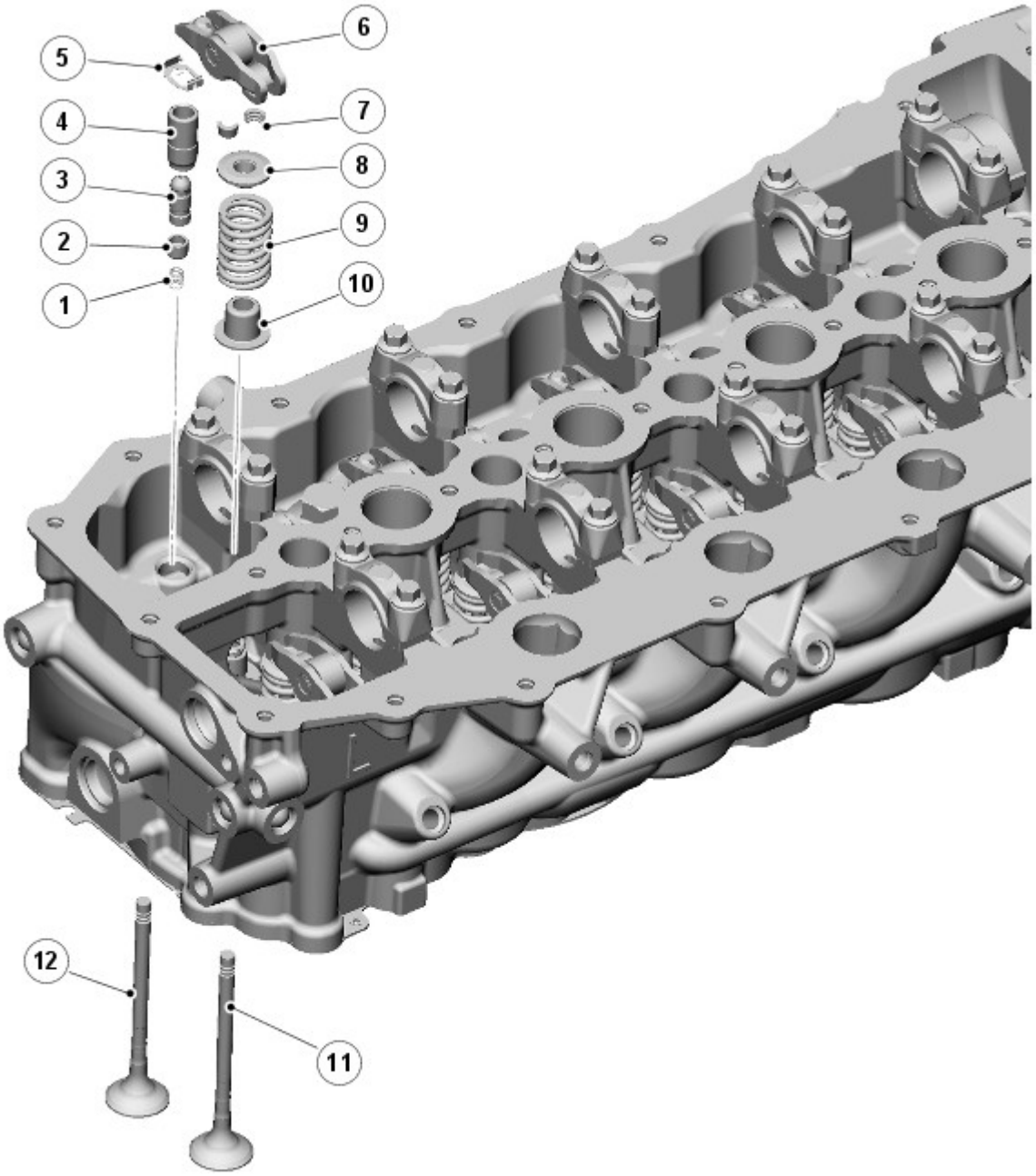
CAMSHAFTS

There is 1 exhaust camshaft and 1 intake camshaft per cylinder head. Each of the overhead camshafts are located in 5 bearings and maintained in position by 5 bearing caps. Each of the bearing caps are fixed to the cylinder head by 2 bolts.

Location letters and numbers are etched on the caps for each cylinder head, A to L for the left head and 0 to 9 for the right head. The camshafts are of a hollow tube construction, with pressed on lobes. The camshafts are driven from the crankshaft via a gear arrangement and a simplex chain for the right cylinder head camshaft and a duplex chain for the left cylinder head camshafts.

Each camshaft has 8 machined lobes for operating the intake and exhaust valves through hydraulic lash adjusters and roller-type finger levers. The front of the right cylinder head intake camshaft provides a drive connection for the vacuum and oil scavenge pump, via a drive gear. The front of the left cylinder head intake camshaft provides a drive connection for the high-pressure fuel pump, also via a drive gear.

VALVES AND LASH ADJUSTERS



E130289

Item	Part Number	Description
1	-	Return spring (16 off per cylinder head)
2	-	Lower piston (16 off per cylinder head)
3	-	Upper piston (16 off per cylinder head)
4	-	Housing (16 off per cylinder head)
5	-	Clip (16 off per cylinder head)
6	-	Rocker arm assembly (16 off per cylinder head)
7	-	Valve spring collet (32 off per cylinder head)
8	-	Valve spring retainer (16 off per cylinder head)
9	-	Valve spring (16 off per cylinder head)
10	-	Valve stem seal (16 off per cylinder head)
11	-	Intake valve (8 off per cylinder head)

12	-	Exhaust valve (8 off per cylinder head)

Two 27.5 mm intake valves and two 25.0 mm exhaust valves serve each cylinder. Each valve is of a ground, solid one-piece cylinder head construction.

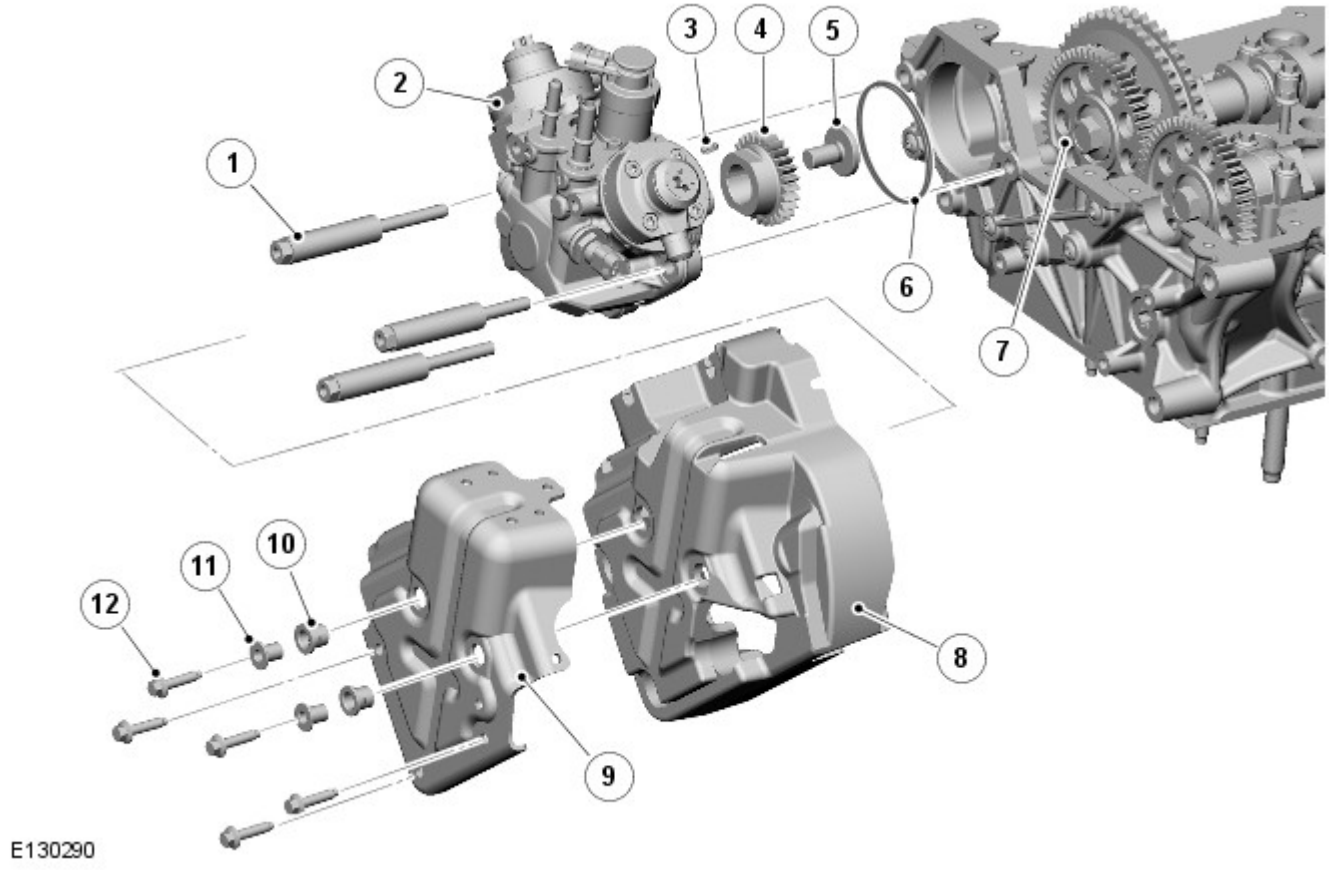
The valve springs are of the parallel single-coil type. The bottom end of each spring rests on the flange of a spring retainer, which has an integral valve stem seal. The top end of the spring is held in place by a spring retainer, which is held in position at the top end of the valve stem by split taper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

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

Valve	Position
Intake valve opens	8.5 degrees Before Top Dead Center
Intake valve closes	35.5 degrees After Bottom Dead Center
Exhaust valve opens	64 degrees Before Bottom Dead Center
Exhaust valve closes	12 degrees After Top Dead Center

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

HIGH PRESSURE FUEL PUMP



Item	Part Number	Description
1	-	Bolt (3 off)
2	-	High-pressure fuel pump
3	-	Woodruff key
4	-	Fuel pump drive gear
5	-	Fuel pump gear flange bolt
6	-	O-ring seal
7	-	Intake camshaft drive gear
8	-	Sound absorbing cover
9	-	Shield
10	-	Mounting sleeve (2 off)
11	-	Sleeve (2 off)
12	-	Bolt (5 off)

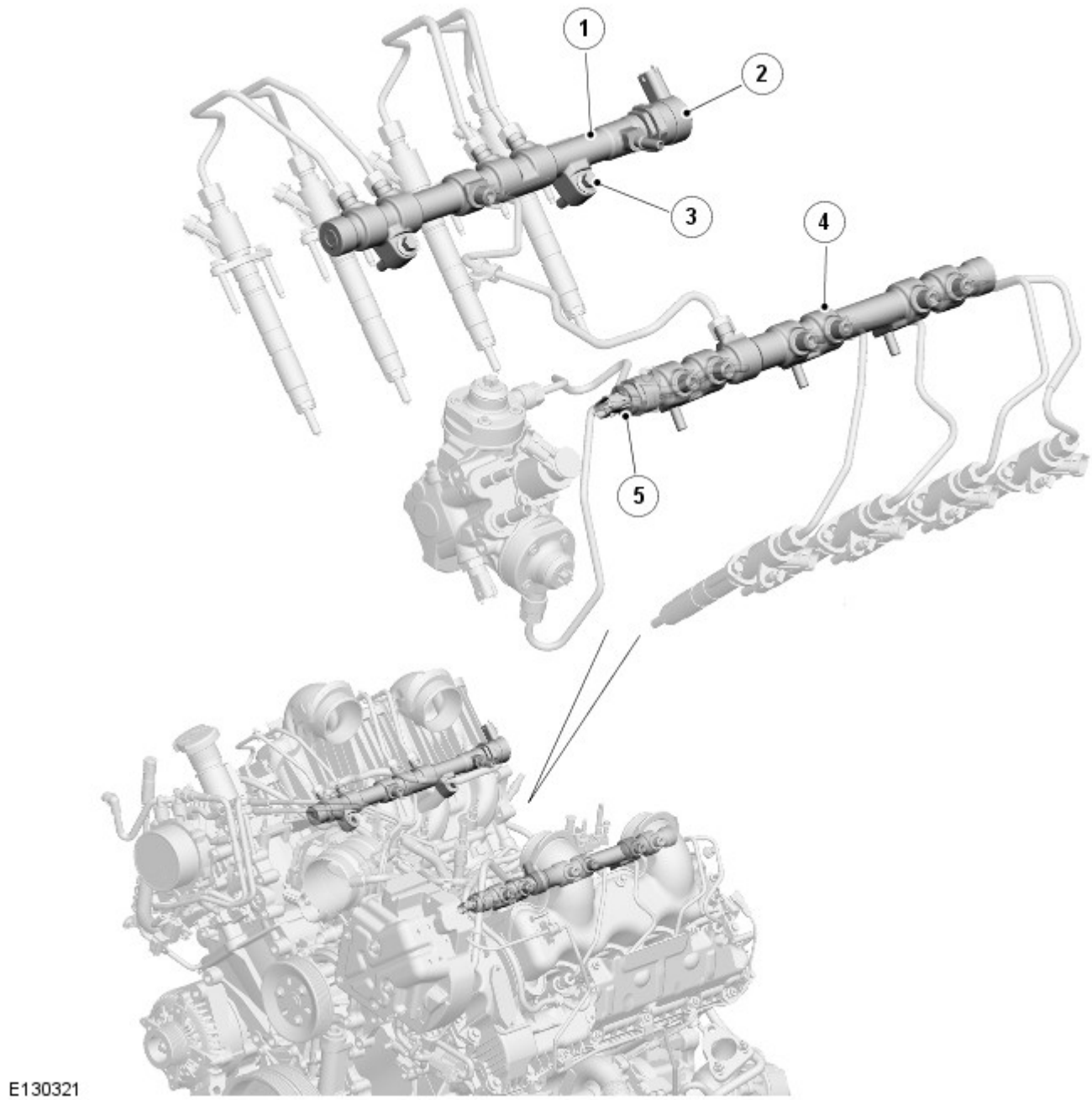
The high-pressure fuel pump supplies the common rails with fuel and is fixed to the front of the left cylinder head with 3 special bolts.

The pump is a 2-radial piston type and is driven by the intake camshaft drive gear of the left cylinder head via the fuel pump drive gear. The fuel pump drive gear is located on the pump input shaft with a woodruff key and the gear is

secured using a flanged bolt.

An O-ring seal is used to seal the pump body to the fuel pump mounting bracket which is attached to the front of the left cylinder head. A sound absorbing cover is attached to the front of the pump body and is secured with a shield retained with 5 bolts.
For additional information, refer to: Fuel Charging and Controls (303-04E Fuel Charging and Controls - TDV8 4.4L Diesel, Description and Operation).

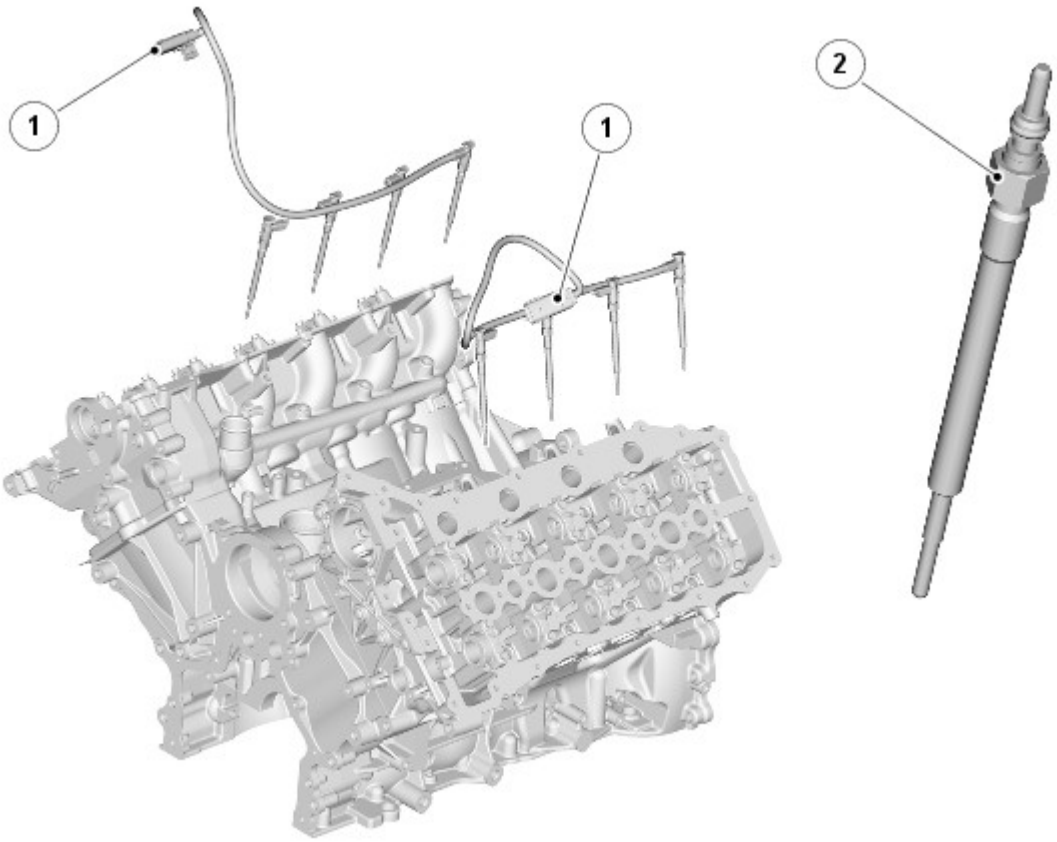
HIGH PRESSURE FUEL RAILS



Item	Part Number	Description
1	-	Right high pressure fuel rail
2	-	Fuel pressure control valve
3	-	Bolt (4 off, 2 per rail)
4	-	Left high pressure fuel rail
5	-	Fuel Rail Pressure (FRP) sensor

The fuel rails store the fuel at high pressure and prevent pressure fluctuations in the high-pressure system. A fuel rail pressure sensor is fitted into a threaded bore in the forward end of the left fuel rail. A fuel pressure control valve is located in the rearward facing end of the right fuel rail.
For additional information, refer to: Fuel Charging and Controls (303-04E Fuel Charging and Controls - TDV8 4.4L Diesel, Description and Operation).

GLOW PLUGS



E142948

Item	Part Number	Description
1	-	Glow plug harness connector
2	-	Glow plug (4 off per cylinder head)

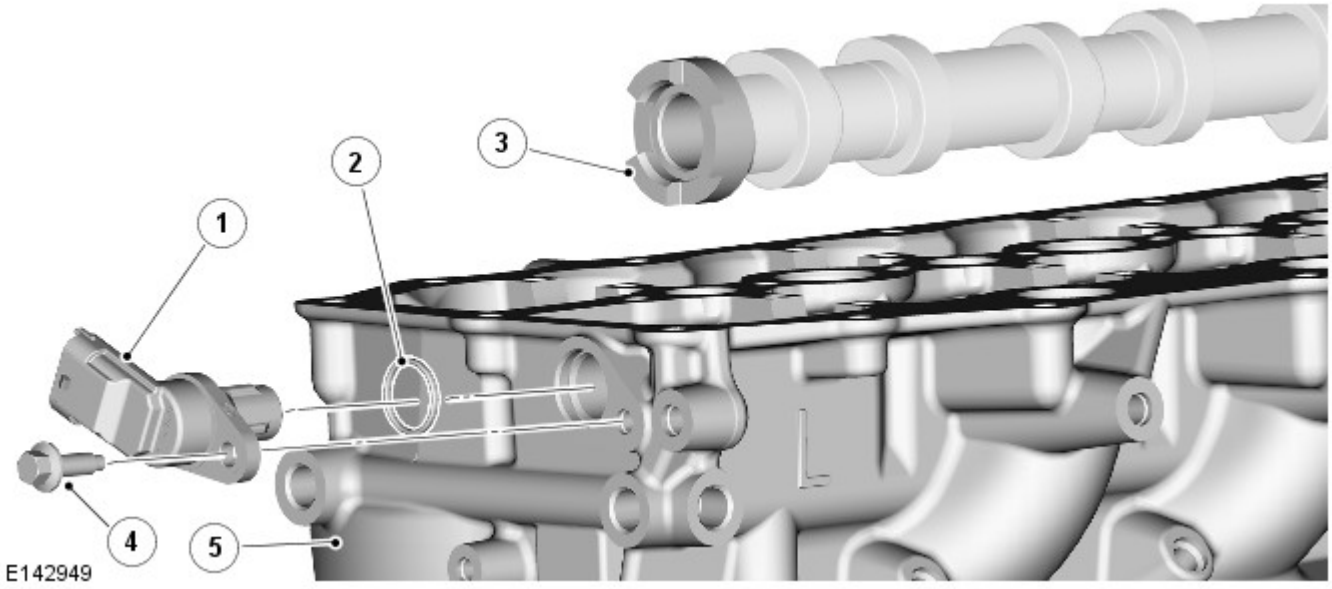
The glow plugs are arranged centrally on the intake side of the cylinder head, between the 2 intake ports of each cylinder.
For additional information, refer to: Glow Plug System (303-07D Glow Plug System - TDV8 4.4L Diesel, Description and Operation).

CAUTION: The glow plugs are sensitive to damage due to the material properties of the ceramic heater pin. The ceramic glow plugs are sensitive to shock and bending and for this reason a dropped glow plug MUST NOT be used, even if there is no visible damage.

CYLINDER HEAD GASKETS

The cylinder head gasket is a multi-layer type. Only one thickness of gasket is available.

CAMSHAFT POSITION SENSOR



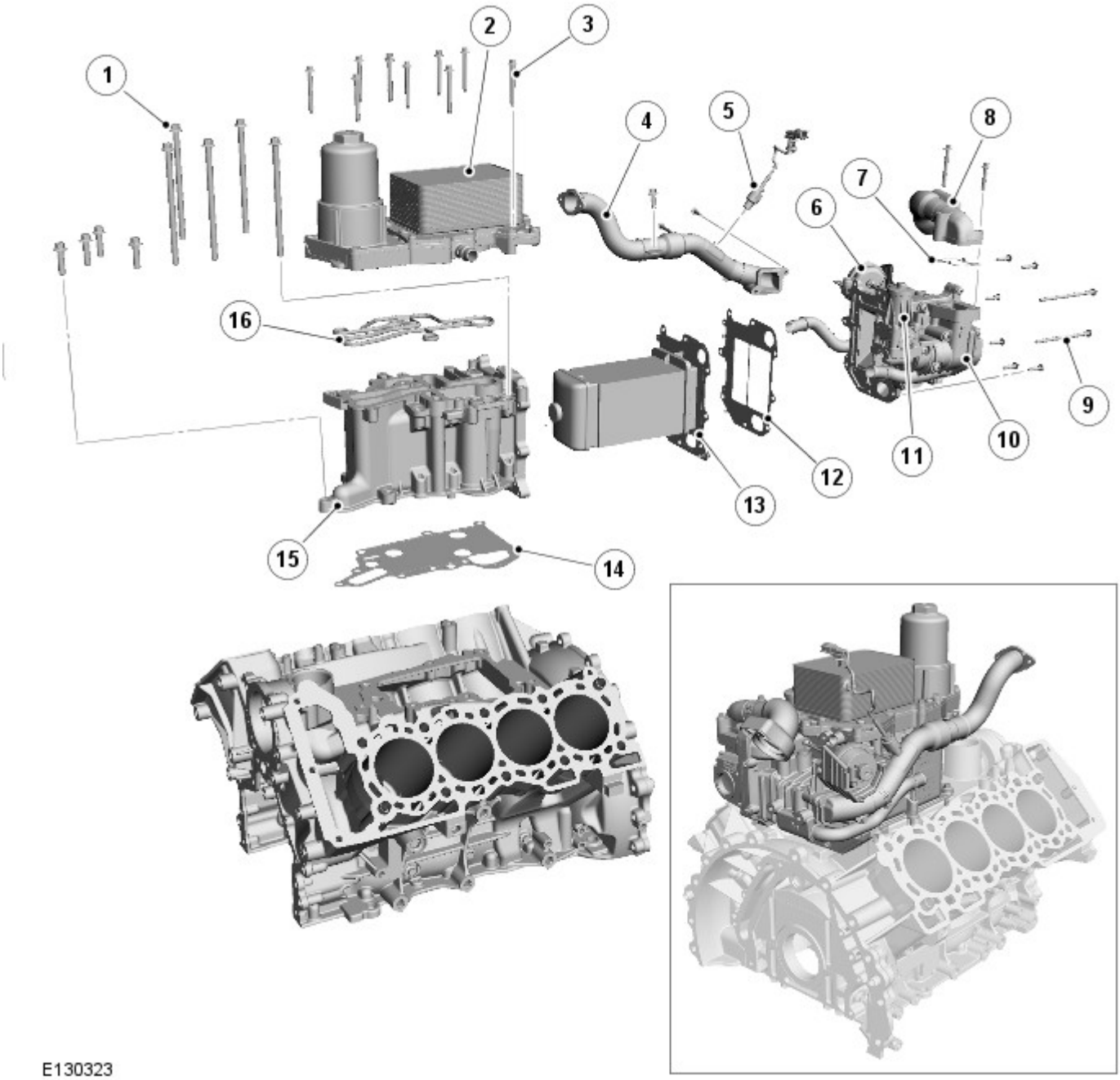
E142949

Item	Part Number	Description

1	-	Camshaft Position (CMP) sensor
2	-	O-ring seal
3	-	Intake camshaft
4	-	Bolt (1 off)
5	-	Left cylinder head

The CMP (Camshaft Position) sensor locates through a hole in a flange on the rear right side of the left cylinder head. The rear of the intake camshaft incorporates a reluctor ring, which is used in conjunction with the sensor to measure engine position.
For additional information, refer to: Electronic Engine Controls (303-14D Electronic Engine Controls - TDV8 4.4L Diesel, Description and Operation).

EXHAUST GAS RECIRCULATION VALVE AND COOLER ASSEMBLY



Item	Part Number	Description
1	-	Bolt (9 off)
2	-	Engine oil cooler and filter assembly (reference only)
3	-	Bolt (10 off) (reference only)
4	-	Exhaust Gas Recirculation (EGR) outlet pipe
5	-	EGR temperature sensor
6	-	Bypass valve vacuum actuator
7	-	Gasket
8	-	EGR inlet pipe from exhaust manifold
9	-	Bolt (4 off)

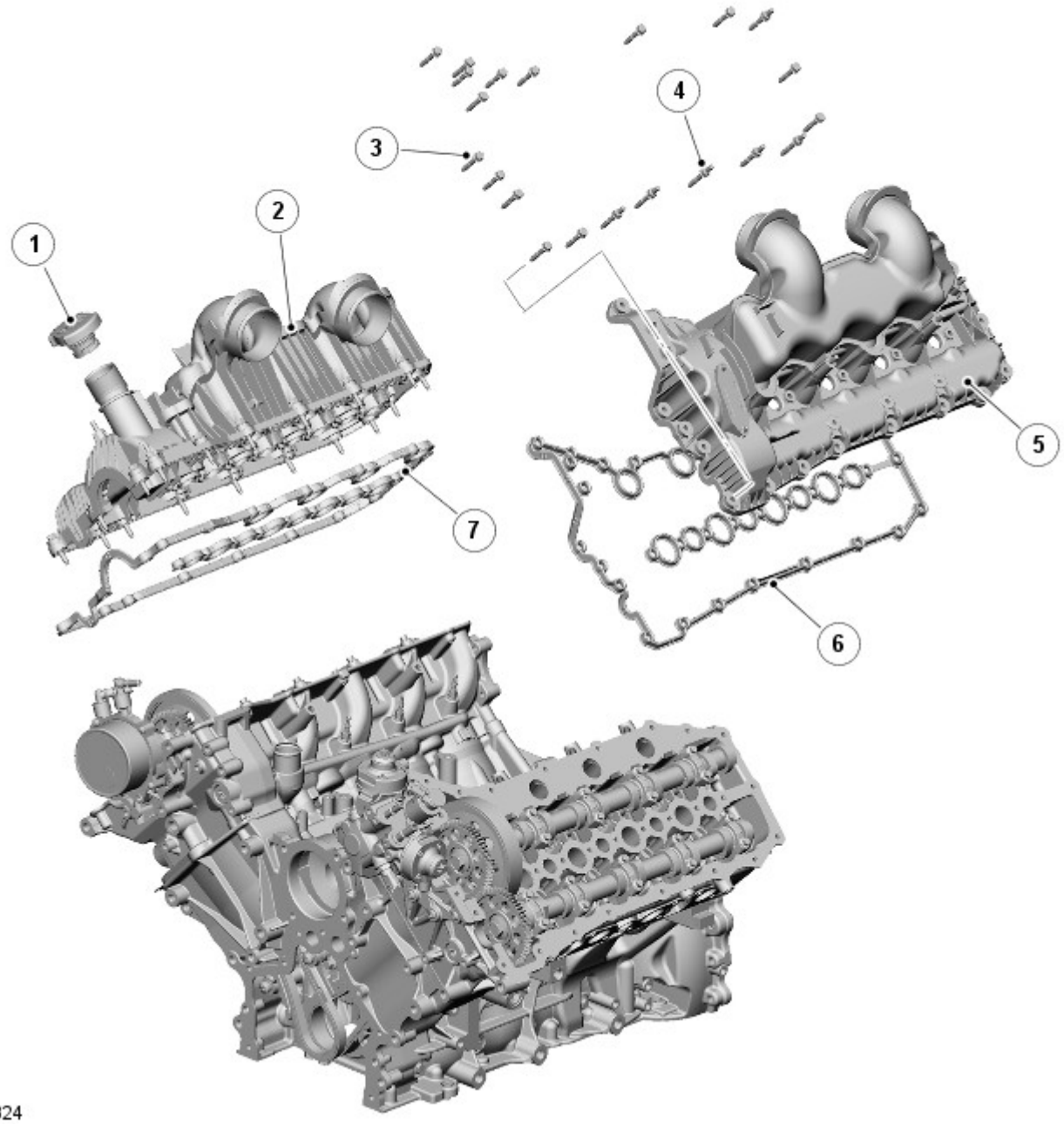
10	-	EGR valve and bypass assembly
11	-	EGR valve motor
12	-	Gasket
13	-	EGR cooler tube
14	-	EGR cooler gasket
15	-	EGR cooler end tank housing
16	-	Gasket - Engine oil cooler to exhaust gas recirculation cooler

The EGR valve and bypass assembly and the EGR cooler are a combined unit located on the top of the engine crankcase, in the vee between the cylinder heads.

The unit comprises a cooler assembly which uses a cooler housing to circulate engine coolant around an EGR cooler tube which is located within the housing. The tube is sealed to the housing with a gasket and secured with bolts.

The EGR valve and bypass assembly is located on the end of the cooler tube and is sealed with a gasket. The assembly comprises the valve housing to which is attached a vacuum operated bypass valve actuator and the EGR valve motor. For additional information, refer to: Engine Emission Control (303-08D Engine Emission Control - TDV8 4.4L Diesel, Description and Operation).

CAMSHAFT COVERS



E130324

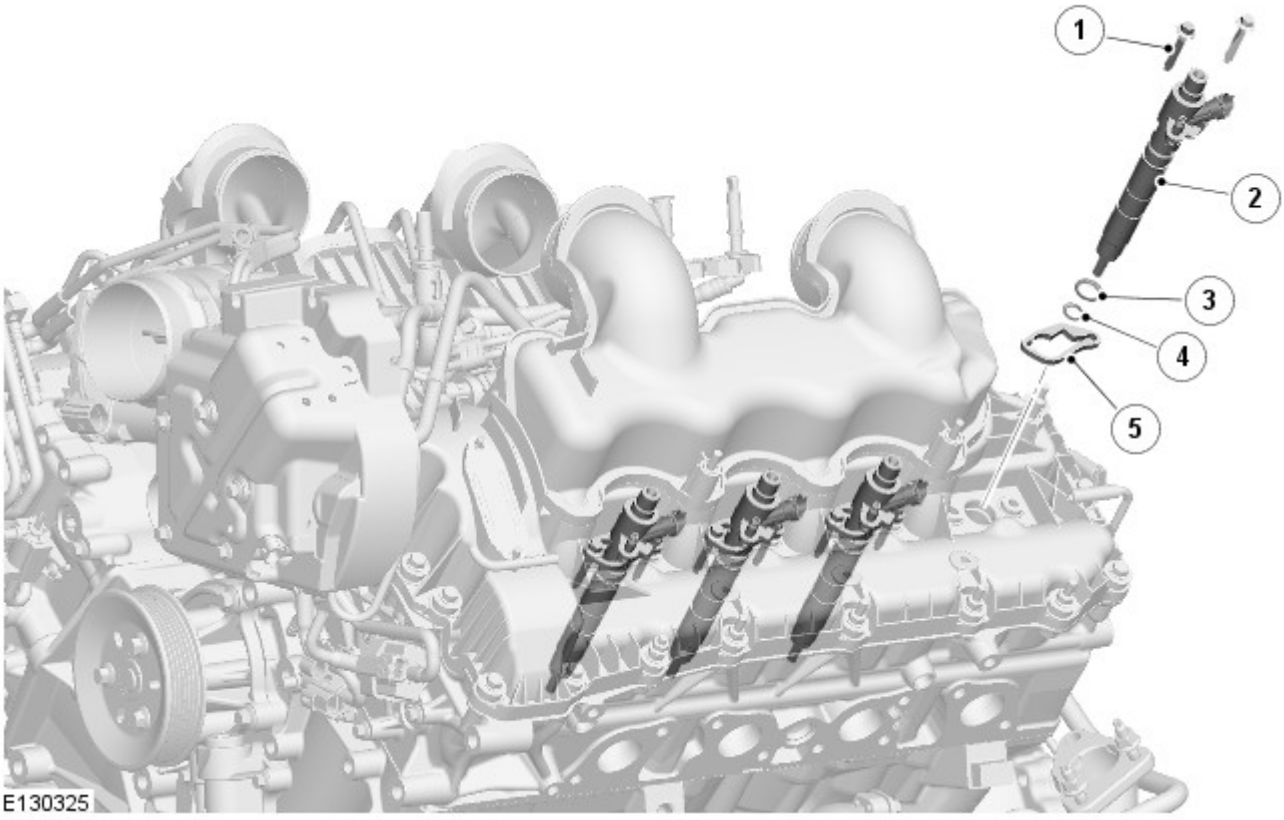
Item	Part Number	Description
1	-	Oil filler cap (right camshaft cover)
2	-	Camshaft cover - right
3	-	Bolt (16 off left camshaft cover - 10 off right camshaft cover)
4	-	Stud and nut (7 off left camshaft cover - 8 off right camshaft cover)

5	-	Camshaft cover - left
6	-	Manifold gasket - left
7	-	Manifold gasket - right

The intake manifolds are integrated with the camshaft covers. The right camshaft cover incorporates the oil filler cap assembly.

FUEL INJECTORS

NOTE: Left cylinder head and camshaft cover shown, right similar.



Item	Part Number	Description
1	-	Bolt (2 off per injector)
2	-	Injector (8 off, 4 per cylinder head)
3	-	O-ring seal
4	-	Sealing washer
5	-	Retaining clamp

The 8, top fed, piezo electrically controlled fuel injectors are mounted in the camshaft covers, which locates them centrally in each cylinder head. A washer and an O-ring seals each injector to the manifold interface. Each injector is retained in position with a retaining clamp which is secured to the base part of the manifold with 2 bolts.

The injectors are protected by sound absorbing covers.

The start of fuel injection and the quantity of fuel injected is controlled directly by the ECM (Engine Control Module). For additional information, refer to: Electronic Engine Controls (303-14D Electronic Engine Controls - TDV8 4.4L Diesel, Description and Operation).

Lubrication System

The lubrication system is a wet oil pan, pressure fed type. It lubricates the engine sliding surfaces, dissipates heat, absorbs fuel combustion residue and seals off the gap between the cylinder and piston.

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

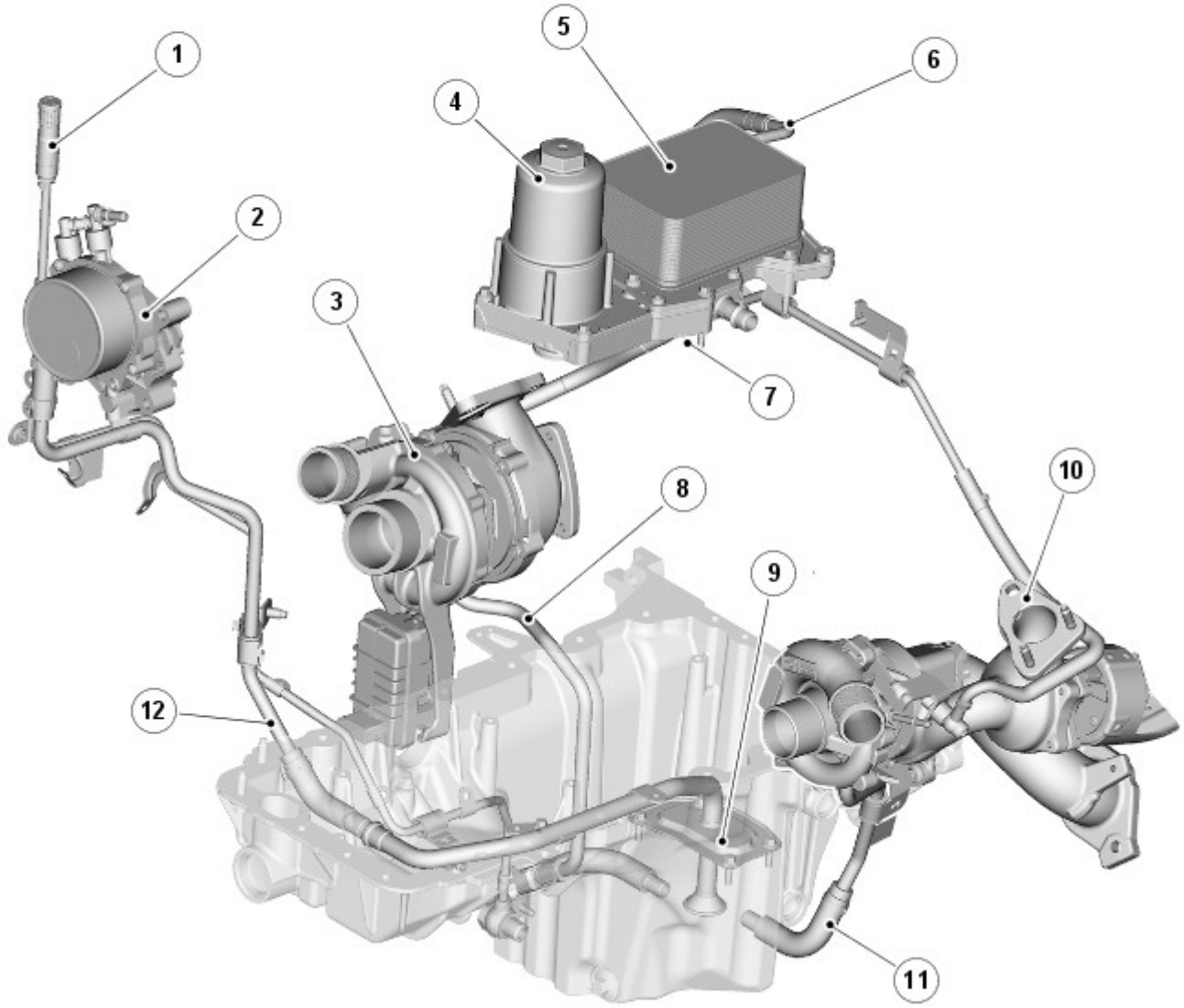
All moving parts are lubricated by pressure or splash oil. Pressurized oil is also provided for operation of the hydraulic lash adjusters and the timing gear chain tensioners.

The engine is lubricated by a force-fed 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.

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 right camshaft cover.

TURBOCHARGER OIL RETURN



E142950

Item	Part Number	Description
1	-	Oil extraction tube
2	-	Vacuum and oil scavenge pump
3	-	Variable geometry turbocharger
4	-	Engine oil filter (ref)
5	-	Engine oil cooler
6	-	Oil feed pipe to turbochargers
7	-	Cooler and filter housing assembly
8	-	Oil return pipe
9	-	Secondary reservoir cover
10	-	Fixed vane turbocharger
11	-	Oil return pipe
12	-	Oil scavenge pipe

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. At extreme angles there is a risk the turbochargers may be below the oil level in the oil pan, restricting oil return flow. To overcome this, the engine uses:

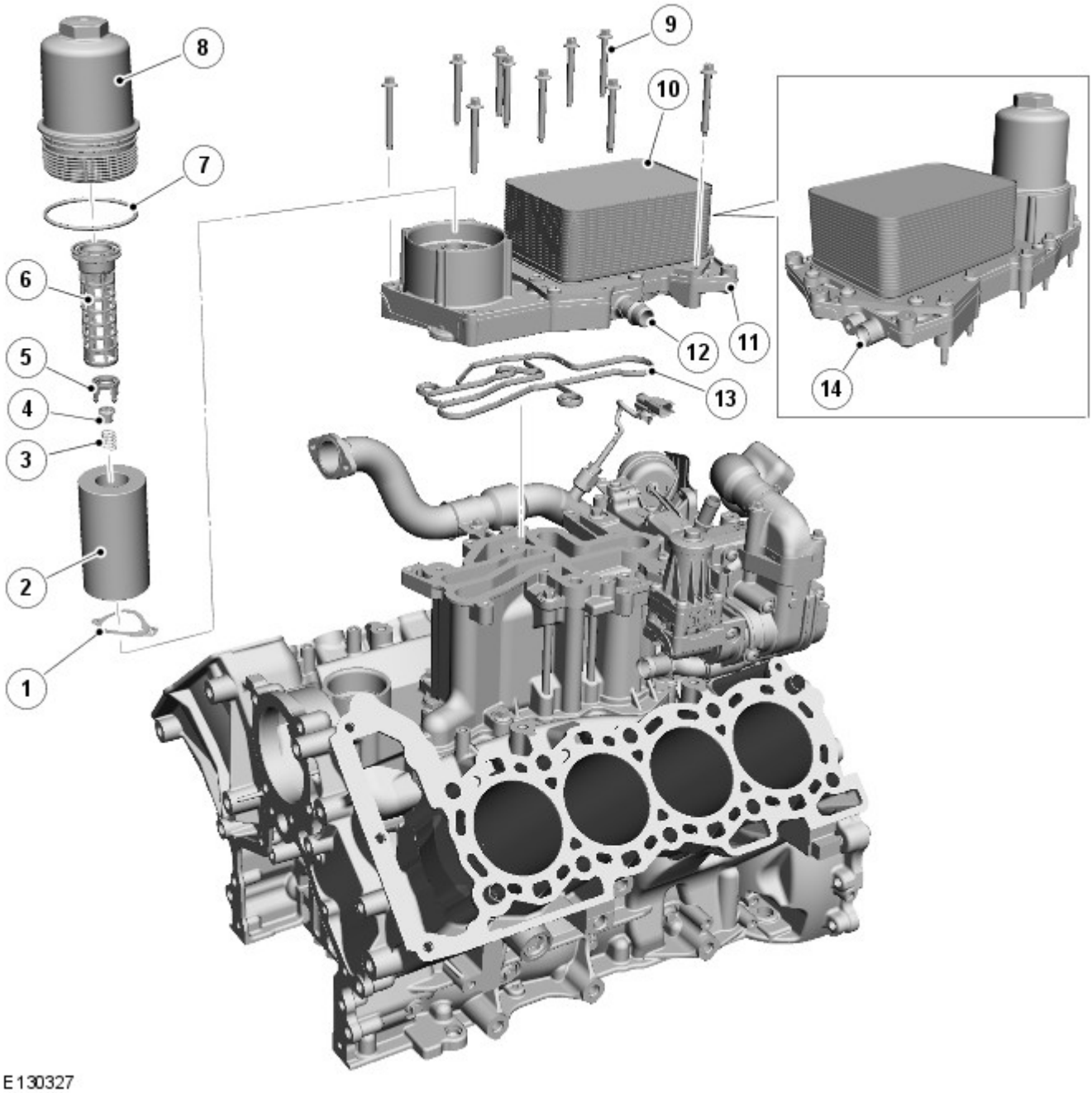
- The oil pump to supply oil to the turbocharger bearings from the main reservoir of the oil pan

A secondary reservoir in the oil pan, sealed off from the main reservoir, to receive oil draining from the turbocharger bearings
- A scavenge pump, integrated into the vacuum pump, to assist the flow of oil draining from the turbocharger bearings by scavenging oil from the secondary reservoir into the right camshaft cover.

OIL PICK-UP

An oil pick-up assembly is immersed in the bottom of the oil pan to provide a supply to the oil pump during all normal vehicle attitudes. The oil pick-up contains a mesh screen to filter the oil and prevent debris from entering the oil system.

OIL FILTER AND OIL COOLER ASSEMBLY



E130327

Item	Part Number	Description
1	-	Leaf spring
2	-	Filter element
3	-	Compression spring
4	-	Valve cone
5	-	Valve seat
6	-	Center pipe
7	-	O-ring seal
8	-	Filter cover
9	-	Bolt (10 off)
10	-	Oil cooler
11	-	Housing assembly
12	-	Connection to EGR cooler inlet

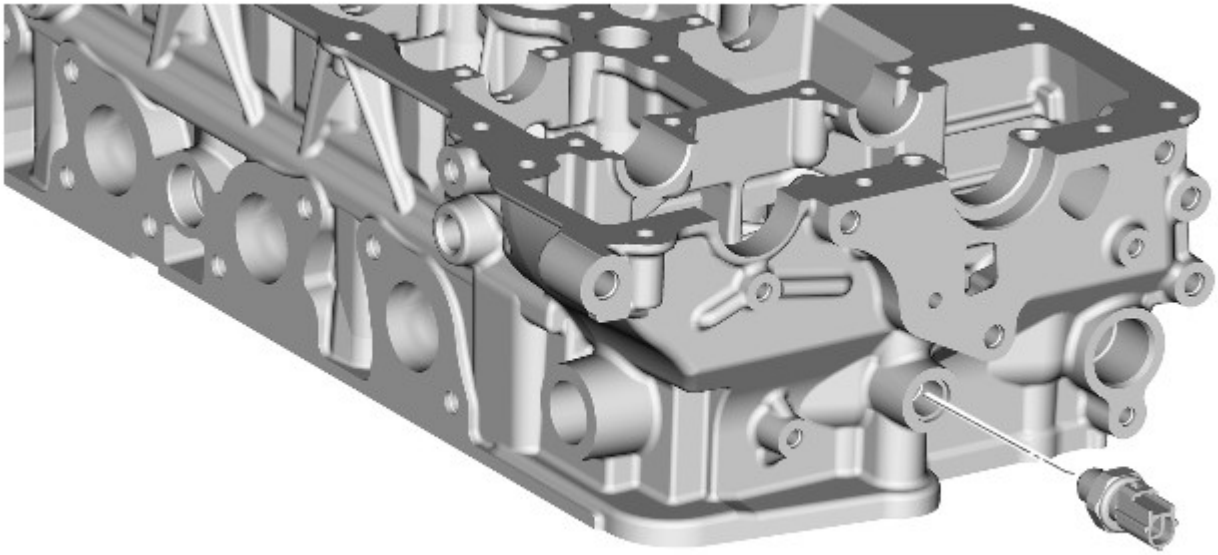
13	-	Gasket
14	-	Engine oil supply connection to turbochargers

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 oil filter is a replaceable cartridge installed on an adapter in the center of the 'vee'. An internal bypass valve permits full flow bypass if the filter becomes blocked.

NOTE: In service care must be taken when removing the oil filter to minimize oil drips and spillage into the engine 'vee' and camshaft covers.

OIL PRESSURE SWITCH

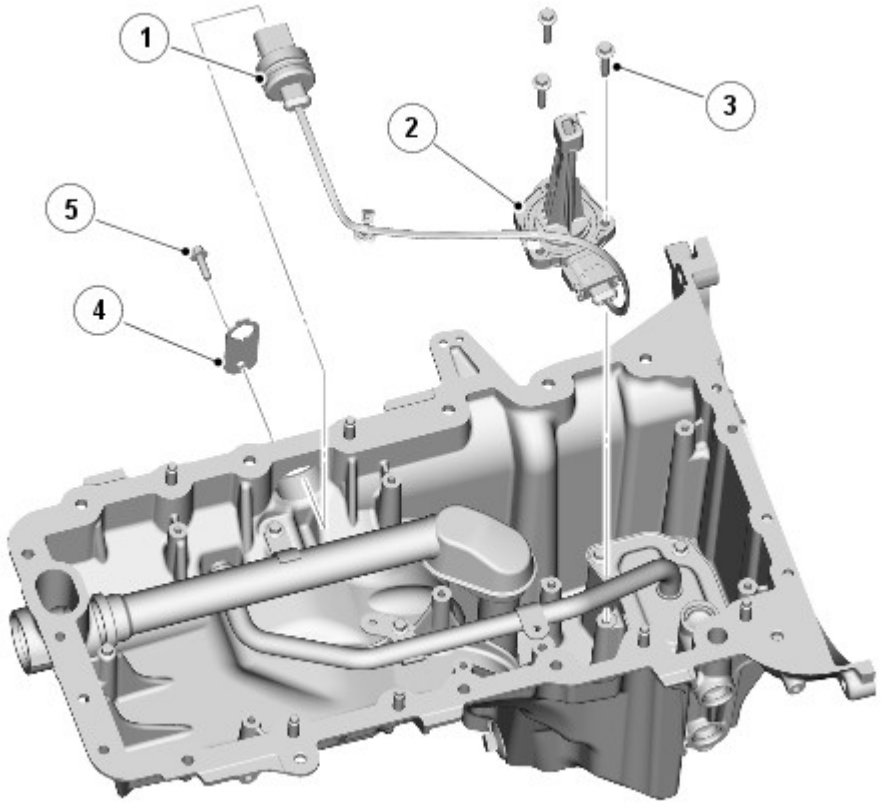


E142951

The oil pressure switch is located in the front of the right cylinder head. The switch connects a ground input to the CJB (Central Junction Box) when oil pressure is present.

The switch operates at a pressure of 0.15 to 0.41 bar (2.2 to 5.9 lbf/in²).
For additional information, refer to: Electronic Engine Controls (303-14D Electronic Engine Controls - TDV8 4.4L Diesel, Description and Operation).

OIL LEVEL AND TEMPERATURE SENSOR



E142952

Item	Part Number	Description
1	-	Sensor link harness
2	-	Oil level and temperature sensor
3	-	Screw (3 off)
4	-	Connector bracket
5	-	Screw

The oil level and temperature sensor is installed in the bottom of the oil pan and secured with three screws. A link lead connects the sensor to the engine harness at the right side of the oil pan.

The sensor has three connections for a power supply from the ECM relay in the EJB (Engine Junction Box), and signal lines to the ECM for level and temperature information.

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

OIL LEVEL CHECK

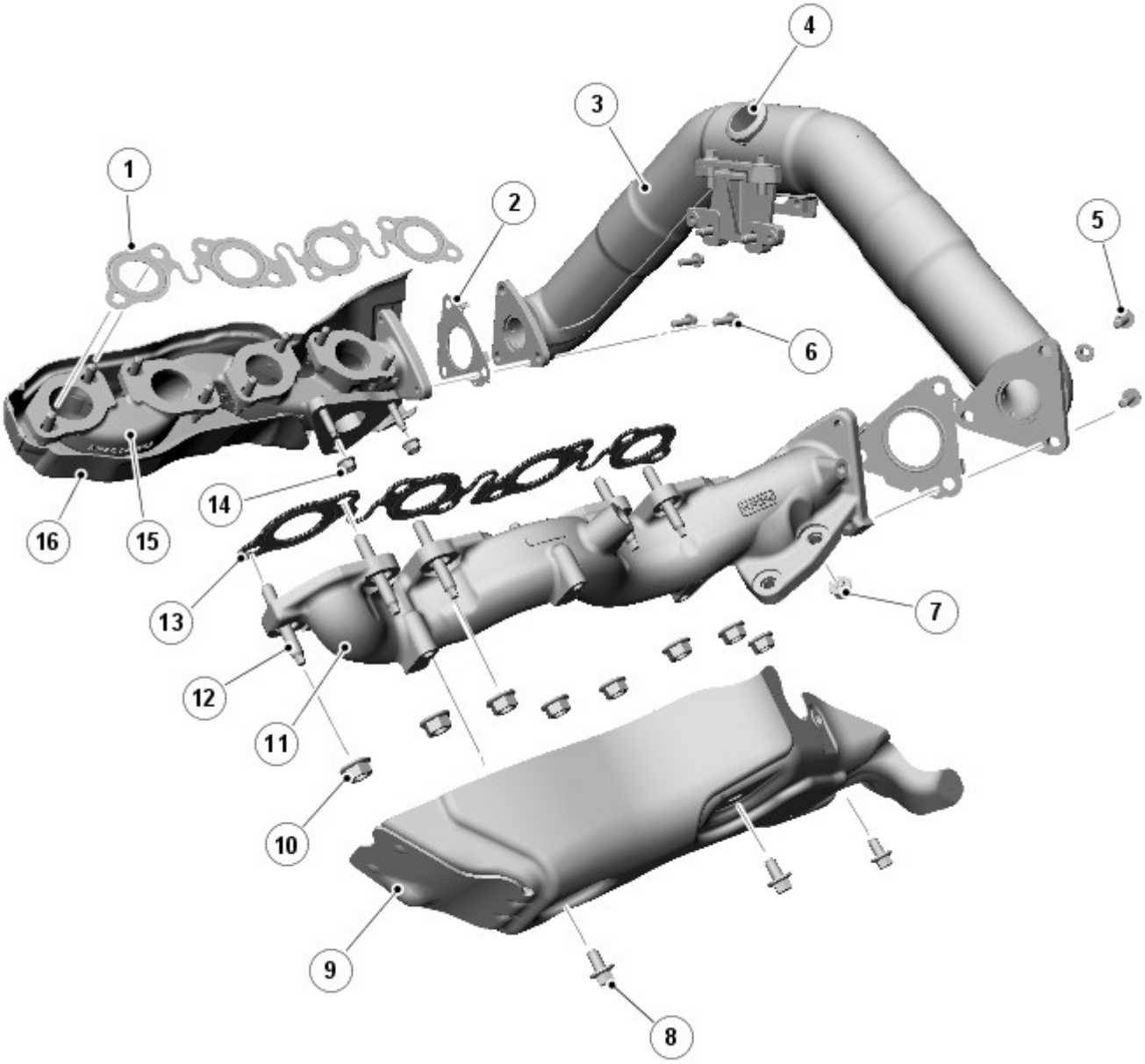
The engine oil level can be displayed in the message center on the instrument cluster.

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.

The method of checking the oil level can be found in the oil draining and filling procedures. For additional information, refer to: (303-01D Engine - TDV8 4.4L Diesel)

Engine Oil Draining and Filling (General Procedures),
Engine Oil Vacuum Draining and Filling (General Procedures).

Exhaust Manifolds



E130329

Item	Part Number	Description
1	-	Right exhaust manifold gasket
2	-	Gasket - exhaust manifold to crossover pipe
3	-	Crossover pipe
4	-	Crossover pipe EGR connection to EGR valve and bypass assembly
5	-	Bolt and nut - crossover pipe to left exhaust manifold (2 off bolt, 1 off nut)
6	-	Bolt - crossover pipe to right exhaust manifold (3 off)
7	-	Nut - exhaust manifold to turbocharger flange (3 off)
8	-	Bolt - left exhaust manifold heat shield (3 off)
9	-	Left exhaust manifold heat shield
10	-	Nut - exhaust manifold to cylinder head stud (8 off)
11	-	Left exhaust manifold
12	-	Stud (8 off)
13	-	Left exhaust manifold gasket
14	-	Nut - right exhaust manifold to turbocharger (3 off)
15	-	Right exhaust manifold
16	-	Right exhaust manifold heat shield

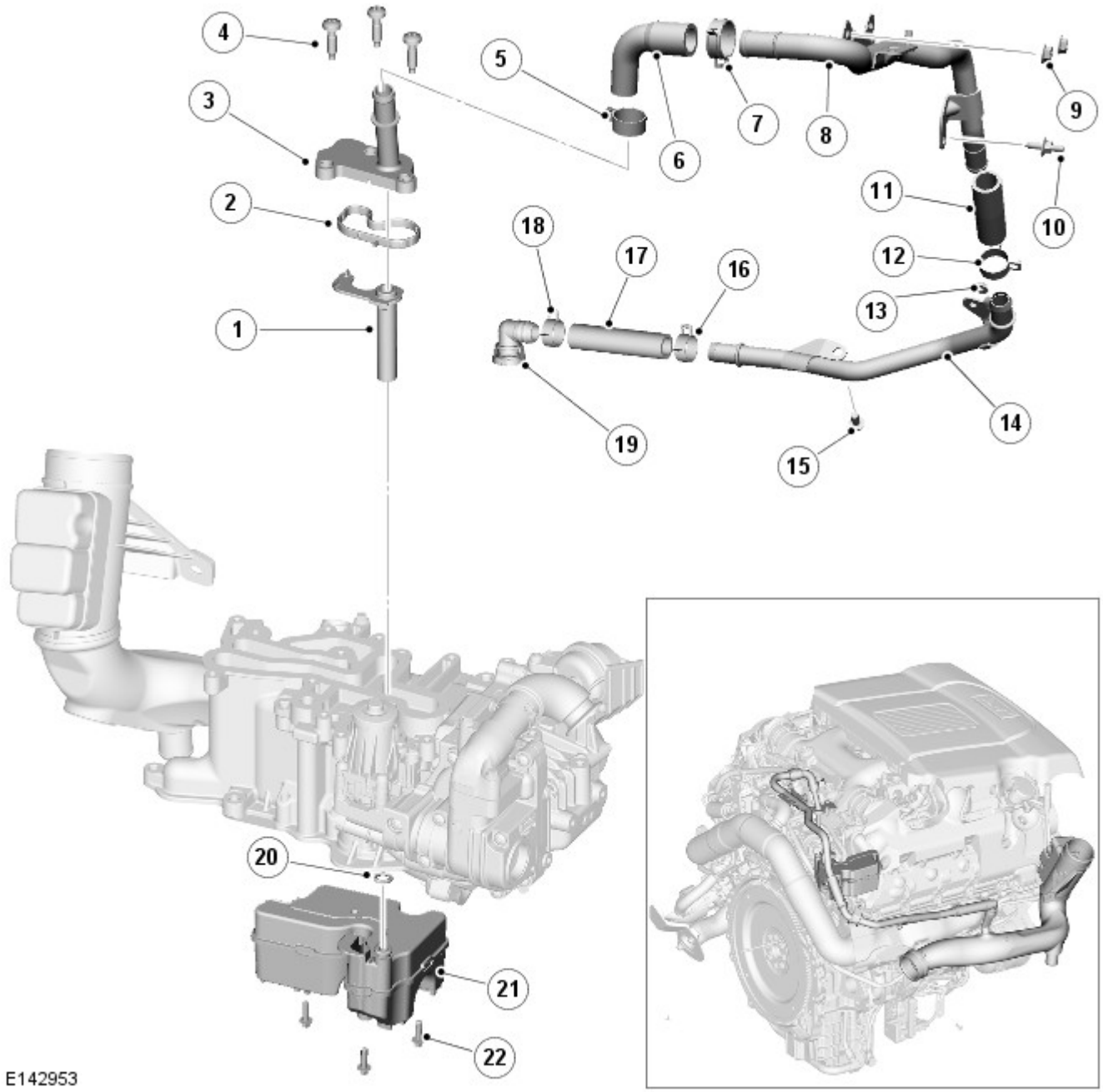
The exhaust manifolds are handed for each cylinder bank. Each manifold is secured to its respective cylinder head with 8 studs and 8 flanged nuts. A gasket seals the manifold to the cylinder head.

Each exhaust manifold has 2 flanges. One flange at the rear of the manifold provides the mounting for the crossover pipe which is sealed with a gasket and secured with 2 bolts and 1 stud and a flanged nut on the left manifold and 3 bolts on

the right manifold. The second flange faces downwards and provides the attachment for the turbochargers. Each turbocharger is secured to its manifold with 3 studs and 3 flanged nuts.

Each manifold is fitted with a heat shield. The heat shield is secured to the manifold with 3 bolts which screw into threaded holes in the manifold.

Crankcase Ventilation



Item	Part Number	Description
1	-	Baffle
2	-	Gasket
3	-	Crankcase vent cap
4	-	Screw (3 off)
5	-	Hose clip
6	-	Hose
7	-	Hose clip
8	-	Vent tube
9	-	Nut (2 off)
10	-	Stud and nut
11	-	Short hose
12	-	Hose clip
13	-	Nut
14	-	Tube

15	-	Bolt
16	-	Hose clip
17	-	Long hose
18	-	Hose clip
19	-	Quick fit connector
20	-	O-ring seal
21	-	Crankcase oil separator assembly
22	-	Bolt (3 off)

The crankcase ventilation system ensures that all gasses emitted from the crankcase during engine running are separated from any oil particles and recirculated via the clean air induction system.

Crankcase gasses are drawn into the oil separator unit from the crankcase 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. A series of pipes and hoses route the gasses from the separator to the inlet pipe of the primary turbocharger. The collected oil is drained down from 2 umbrella valves in the base of the separator to the sump.
For additional information, refer to: Engine Emission Control (303-08D Engine Emission Control - TDV8 4.4L Diesel, Description and Operation).

OPERATION

Operation of the engine is controlled by the ECM.
For additional information, refer to: Electronic Engine Controls (303-14D Electronic Engine Controls - TDV8 4.4L Diesel, Description and Operation).

Published: 31-Jul-2012

Engine - TDV8 4.4L Diesel - Engine

Diagnosis and Testing

For additional information, refer to Diagnosis and Testing, Engine - 4.4L Diesel.
REFER to: Engine (303-01B, Diagnosis and Testing).

Published: 22-Oct-2013

Engine - TDV8 4.4L Diesel - Engine Oil Draining and Filling

General Procedures

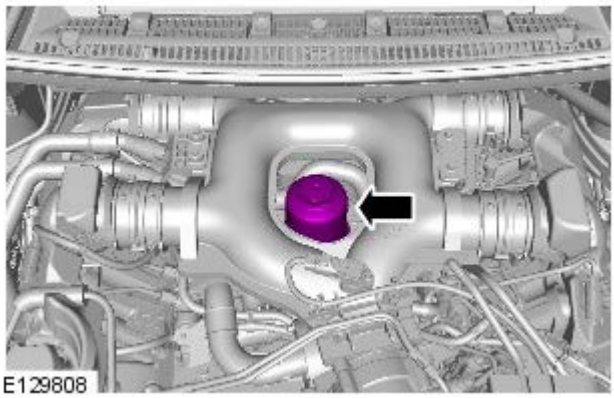
Draining

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

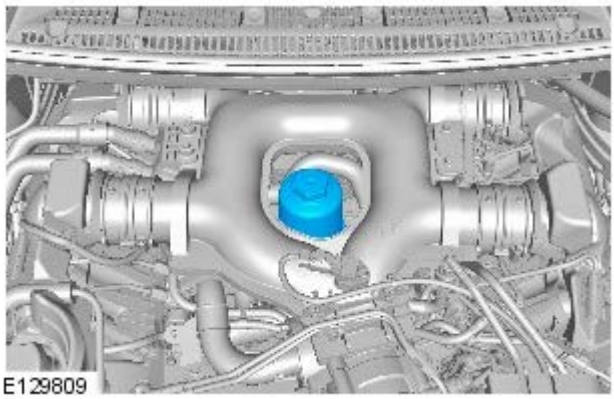
CAUTION: Correct installation of the oil filler cap can be obtained by tightening the cap until hard stop.

NOTE: Clean the components general area prior to dismantling.

1. Refer to: Engine Cover - 4.4L V8 - TdV8 (501-05 Interior Trim and Ornamentation, Removal and Installation).

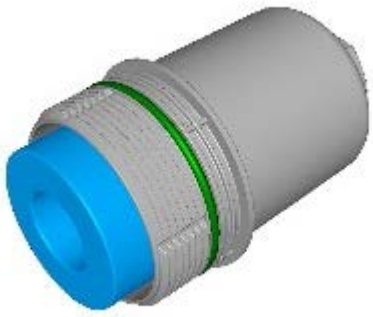

E129808

2.
   - Loosen the oil filter cover 3 turns and allow the engine oil to drain.


E129809

3. NOTE: Position cloth to collect fluid spillage.

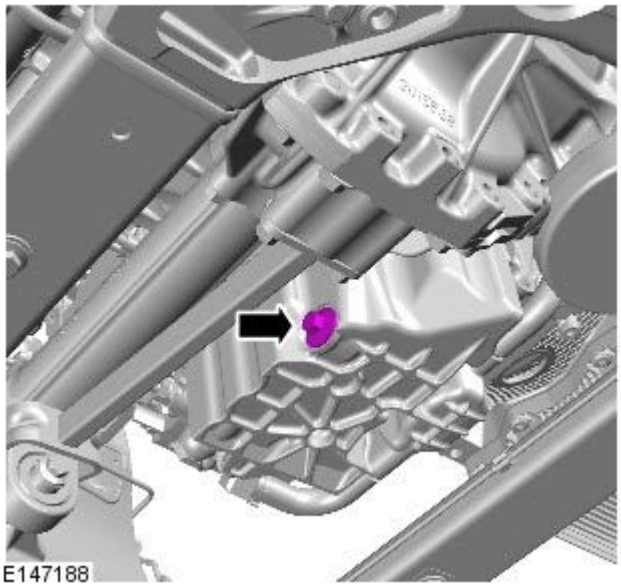
4.
   - Remove and discard the oil filter element.
   - Remove and discard the oil filter cover O-ring seal.


E129862

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

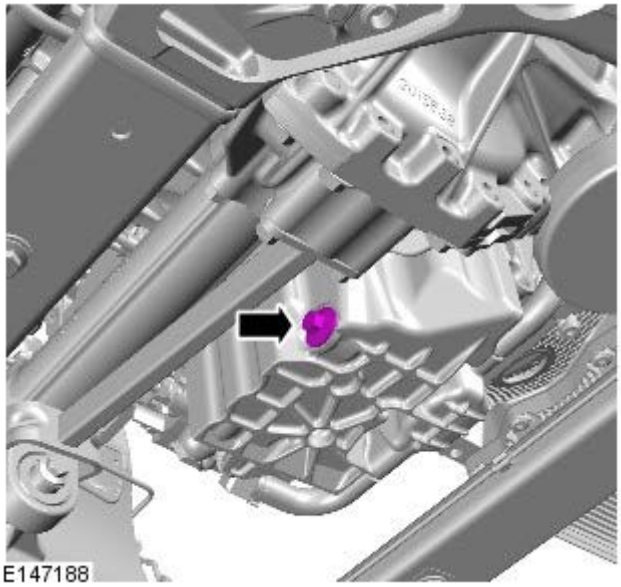
   Raise and support the vehicle.

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


E147188

7.
- Position a container to collect the engine oil.

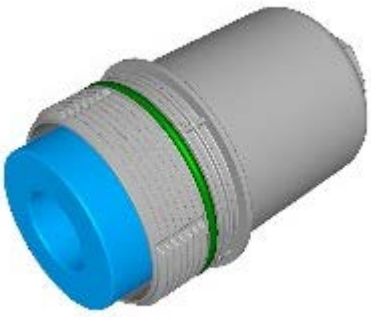
Filling


E147188

1.
- Remove the container.

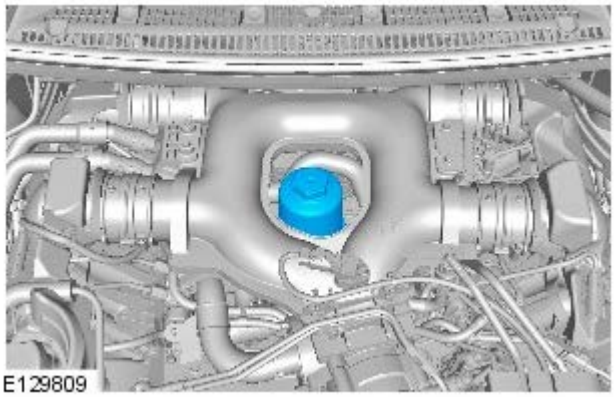
Torque: 23 Nm

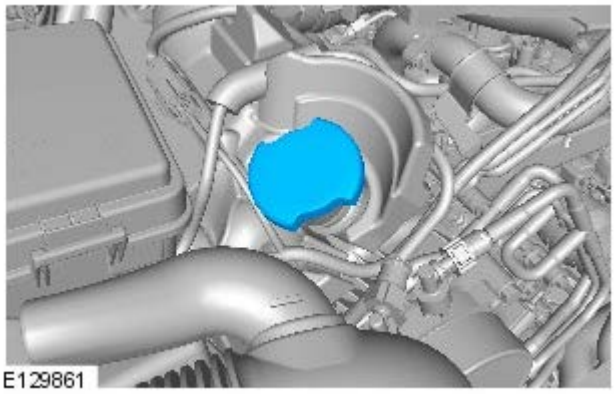
2. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).


E129862

3.
- Clean the components.
- Install a new oil filter element to the oil filter cover.
- Install a new oil filter cover O-ring seal.
- Lubricate the O-ring seal with clean engine oil.

4. *Torque:* 27 Nm


E129809


E129861

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

6. Install the engine cover.

   Refer to: Engine Cover - 4.4L V8 - TdV8 (501-05 Interior Trim and Ornamentation, Removal and Installation).

7. CAUTION: Make sure that the vehicle has been left for 5 minutes from filling with oil.
   - Start the engine and allow to run for 10 minutes, stop the engine.
   - Check for leaks.

8. CAUTIONS:

   Make sure that the selector lever is in the park (P) position.

   Make sure that the hood is open.
   - Set the ignition to the ON position.

9.
- Press the left-hand OK button to access the Instrument Cluster (IC) Main Menu.



10.

- Press the left-hand directional button and select Service Menu.



11.

- Press the left-hand OK button.



E147184

12.

- Press the left-hand directional button and select the Oil Level display.



E147185

13.

- Press the left-hand OK button to access the Oil Level display.




E147181

14. CAUTION: Make sure that the hood is open.

- Press the speed control cancel button twice within 2 seconds while being on the oil level display.

15.

- The message center displays the actual oil level in service mode.
- Only after having started and run the engine for 10 minutes (as indicated in Step 7), 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.



16. Set the ignition to the OFF position.
17. Allow 10 minutes for the engine oil level to stabilize if there has been additional oil top up.

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

18. Repeat step 8 to 14 to access the oil level display in service mode.



19. NOTE: The actual volume displayed on the bar graph will be written into the electronic control unit as a new value.
    - Press and hold the speed control cancel button for more than 5 seconds.
    - The message center display the current oil level.

NOTE: Close the hood.

20. Set the ignition to the OFF position.
21. Set the ignition to the ON position.
22. NOTE: The following steps are to check the



current oil level in a customer mode.

- Press the left-hand OK button to access the Instrument Cluster (IC) Main Menu.

23.



- Press the left-hand directional button and select Service Menu.

24.

- Press the left-hand OK button.



E147184

25.

- Press the left-hand directional button and select the Oil Level display.

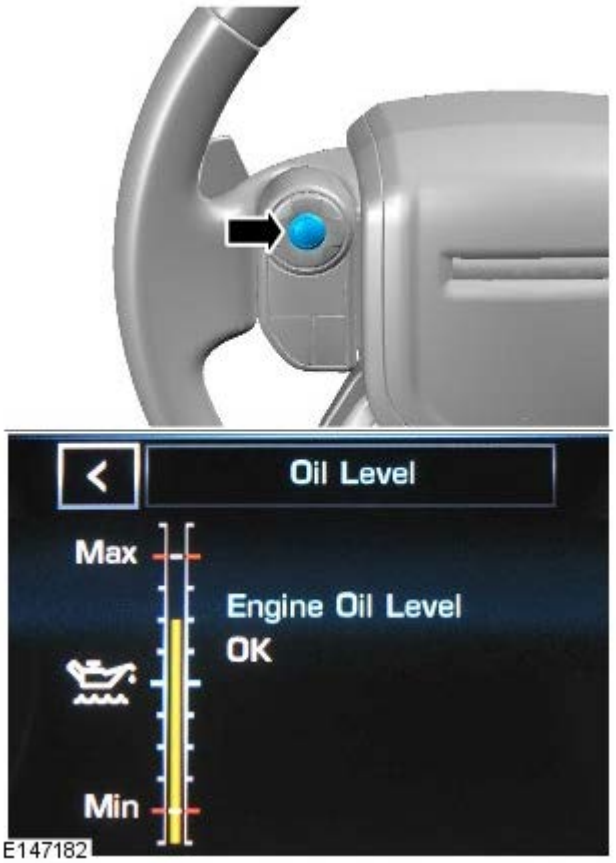


E147185

26.

- Press the left-hand OK button and follow the instructions.
- NOTE: If the message shows "Not available" wait for further 10 mins to allow the oil level to stabilize.

  Make sure that the average oil level value has now been updated.


Oil Level
Max
Engine Oil Level
OK
Min
E147182

Published: 22-Oct-2013

Engine - TDV8 4.4L 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.

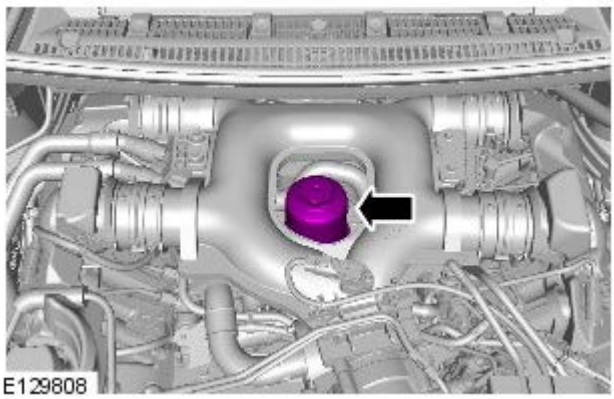
CAUTIONS:

Make sure the engine is warm.

Make sure that the vehicle is parked on level ground.

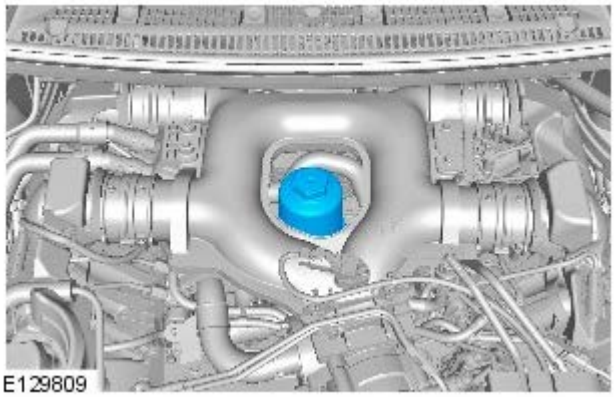
1.
- Start the engine and allow to run for 10 minutes, stop the engine.

2. Refer to: Engine Cover - 4.4L V8 - TdV8 (501-05 Interior Trim and Ornamentation, Removal and Installation).

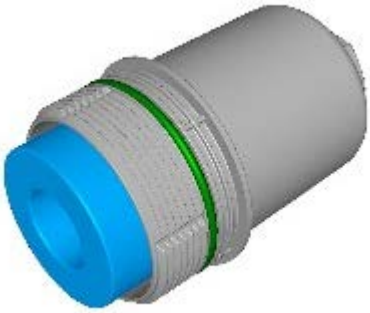

E129808

3.
- Loosen the oil filter cover 3 turns and allow the engine oil to drain.

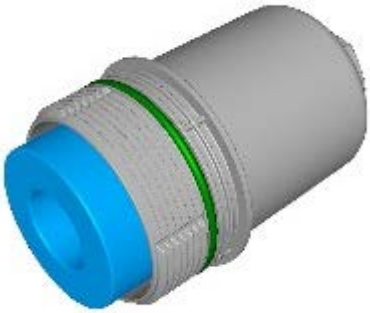
4. NOTE: Position cloth to collect fluid spillage.


E129809

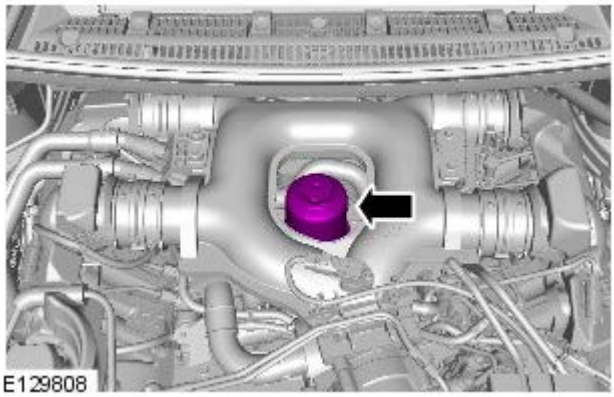
5.
- Remove and discard the oil filter element.
- Remove and discard the oil filter cover O-ring seal.


E129862

6.
- Clean the components.
- Install a new oil filter element to the oil filter cover.
- Install a new oil filter cover O-ring seal.
- Lubricate the O-ring seal with clean engine oil.


E129862

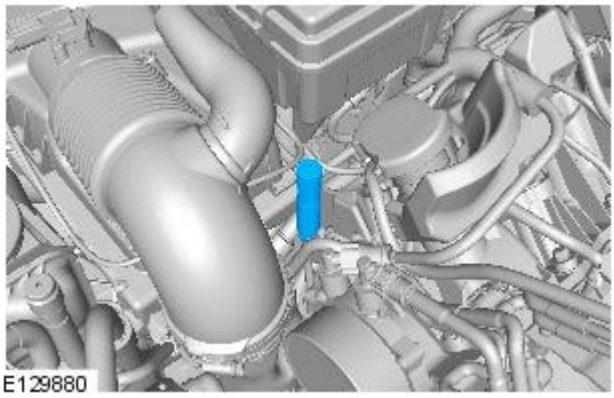
7. *Torque:* 27 Nm

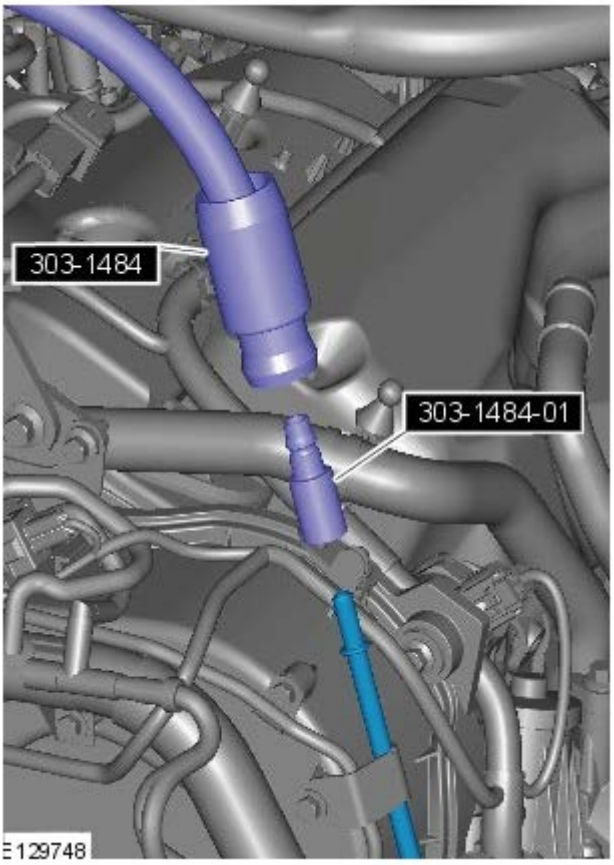

E129808

8. CAUTIONS:

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

Position absorbent cloth around the filler neck to prevent any oil from coming into contact with the Generator.





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

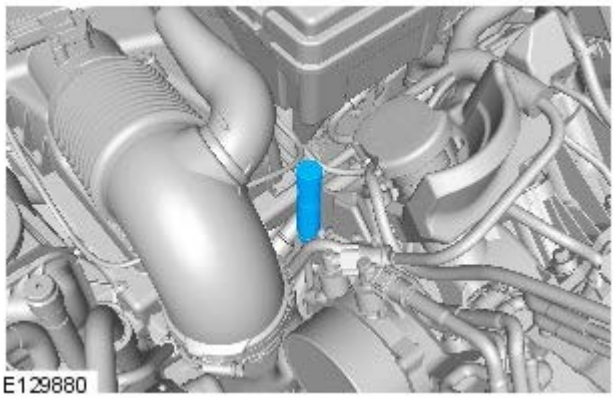
   Using the oil vacuum pump drain the oil out through the oil extraction tube.

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

10.

- Remove the oil vacuum pump.

Filling

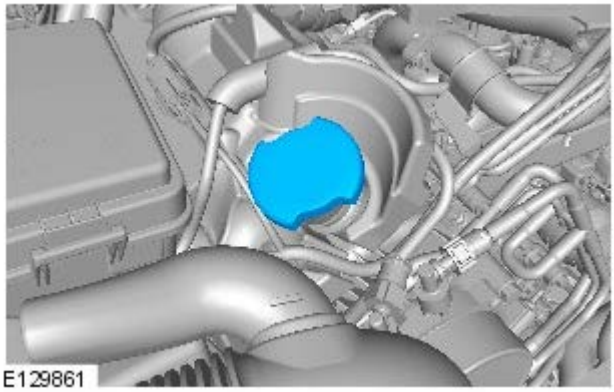


1.

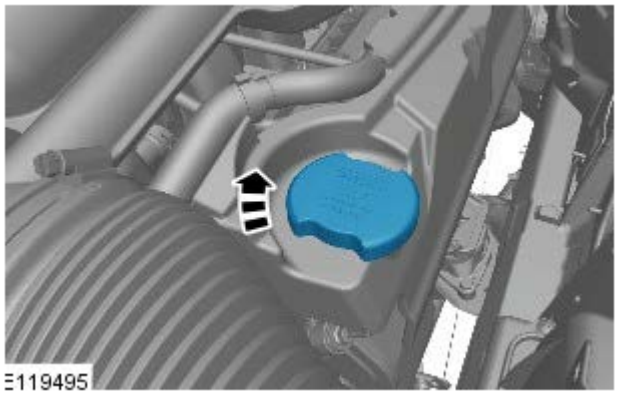
- Clean the component mating faces.

2.

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



3.



4. CAUTION: Make sure that the vehicle has been left for 5 minutes from filling with oil.
   - Start the engine and allow to run for 10 minutes, stop the engine.
   - Check for leaks.

5. CAUTIONS:

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

   Make sure that the hood is open.

   - Set the ignition to the ON position.

6.
   - Press the left-hand OK button to access the Instrument Cluster (IC) Main Menu.



7.

- Press the left-hand directional button and select Service Menu.



8.

- Press the left-hand OK button.



E147184

9.

- Press the left-hand directional button and select the Oil Level display.



E147185

10.

- Press the left-hand OK button to access the Oil Level display.




E147181

11. CAUTION: Make sure that the hood is open.

- Press the speed control cancel button twice within 2 seconds while being on the oil level display.

12.

- The message center displays the actual oil level in service mode.
- Only after having started and run the engine for 10 minutes (as indicated in Step 4), 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.



13. Set the ignition to the OFF position.
14. Allow 10 minutes for the engine oil level to stabilize if there has been additional oil top up.

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

15. Repeat step 5 to 11 to access the oil level display in service mode.



16. NOTE: The actual volume displayed on the bar graph will be written into the electronic control unit as a new value.
    - Press and hold the speed control cancel button for more than 5 seconds.
    - The message center display the current oil level.

NOTE: Close the hood.

17. Set the ignition to the OFF position.
18. Set the ignition to the ON position.
19. NOTE: The following steps are to check the



current oil level in a customer mode.

- Press the left-hand OK button to access the Instrument Cluster (IC) Main Menu.

20.



- Press the left-hand directional button and select Service Menu.

21.

- Press the left-hand OK button.


E147184

22.

- Press the left-hand directional button and select the Oil Level display.

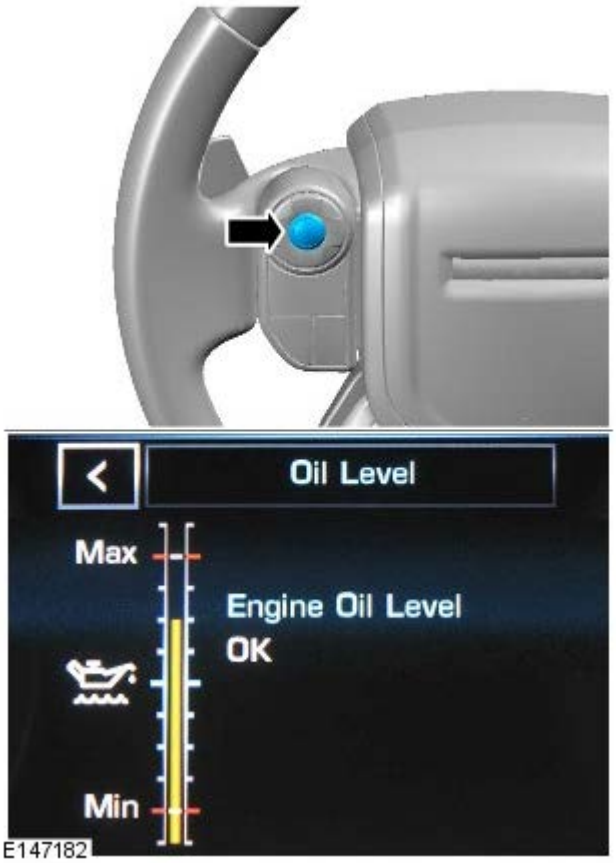


E147185

23.

- Press the left-hand OK button and follow the instructions.
- NOTE: If the message shows "Not available" wait for further 10 minutes to allow the oil level to stabilize.

  Make sure that the average oil level value has now been updated.

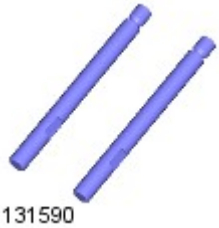

Oil Level
Max
Engine Oil Level
OK
Min
E147182

Published: 30-Oct-2013

Engine - TDV8 4.4L Diesel - Camshaft LH

Removal and Installation

Special Tool(s)

 E81374	303-1239 Adjustment Tool, Camshaft
 E131271	JLR-303-1568 Locking Tool, Camshaft
 E148198	JLR-303-1620 Timing Pin
 E131589	JLR-310-246 Locking Tool, Fuel Injection Pump
 E131588	JLR-310-247 Locking Tool, Camshaft
 E131590	JLR-310-248 Aligner, Fuel Pump

Removal

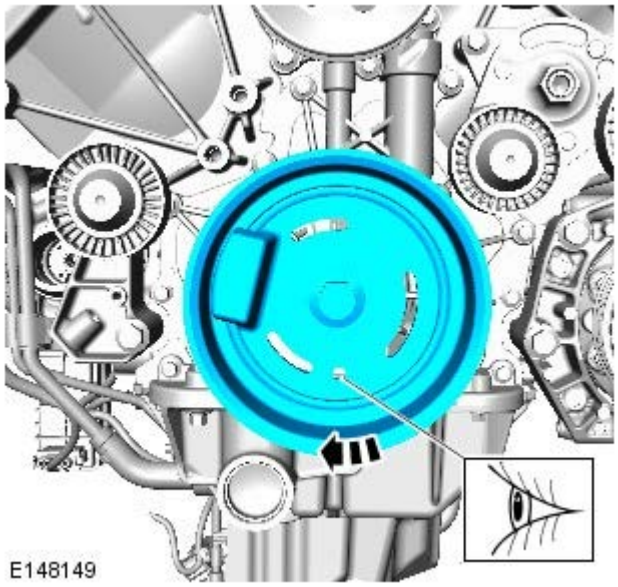
1. Refer to: Diesel Fuel System Health and Safety Precautions (100-00 General Information, Description and Operation).
2. Disconnect the battery ground cable.

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

3. Refer to: Cooling Fan (303-03F Engine Cooling - TDV8 4.4L Diesel, Removal and Installation).

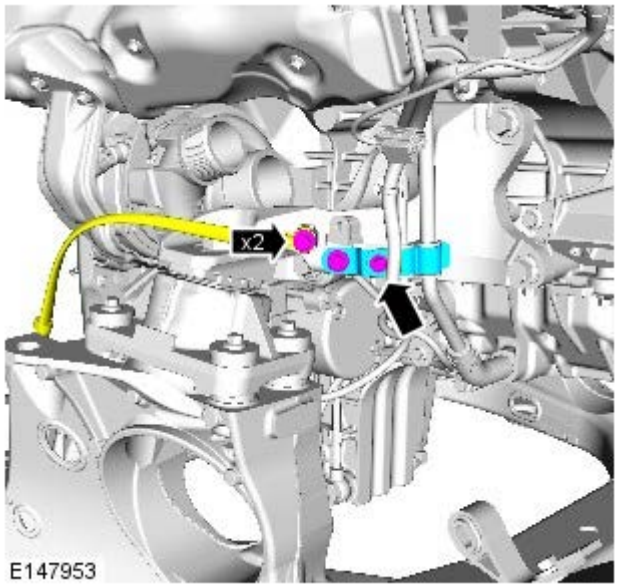
4. Refer to: Valve Cover LH (303-01D Engine - TDV8 4.4L Diesel, Removal and Installation).

5. Refer to: Generator (414-02D Generator and Regulator - TDV8 4.4L Diesel, Removal and Installation).

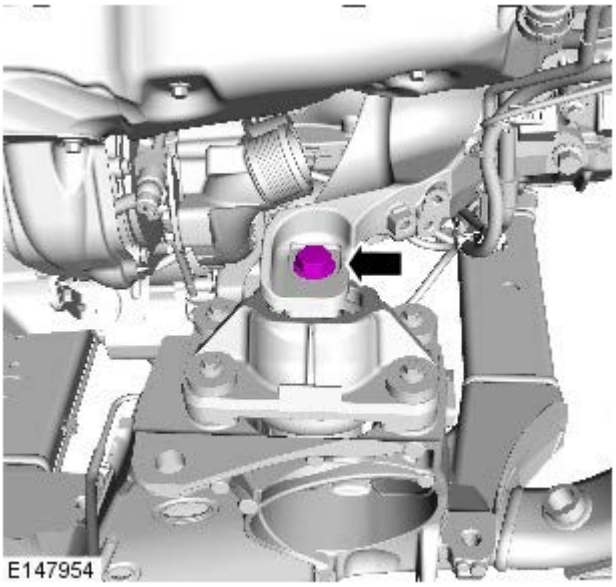


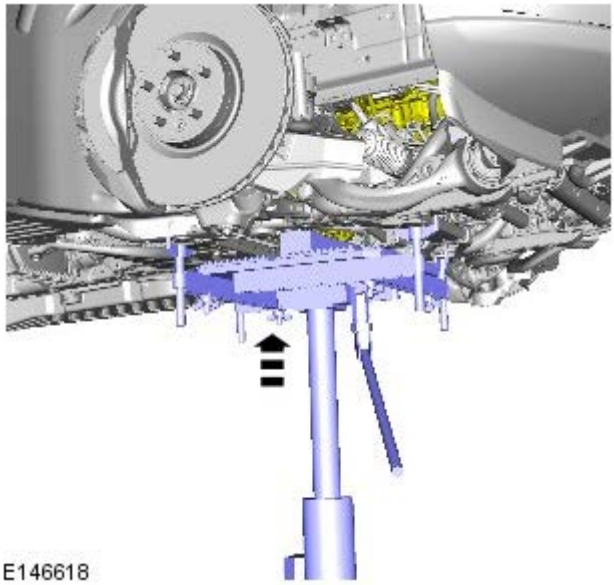
6. CAUTION: Only rotate the crankshaft clockwise.

7.



8.

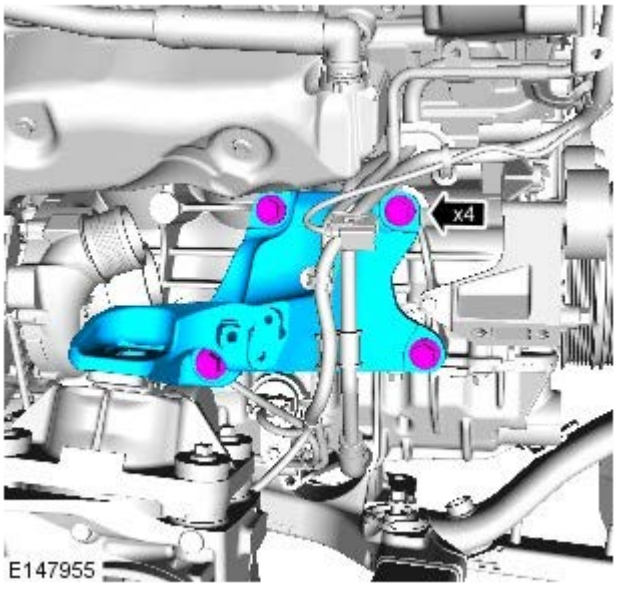




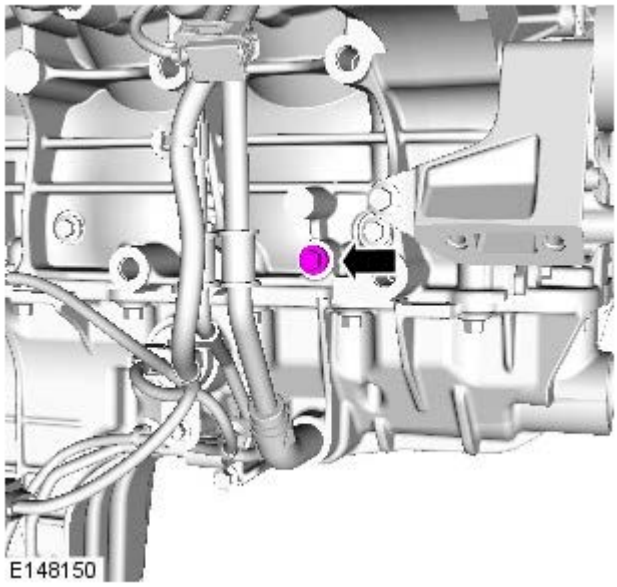
9. CAUTION: Use a wooden block to protect the oil pan when supporting the engine.

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

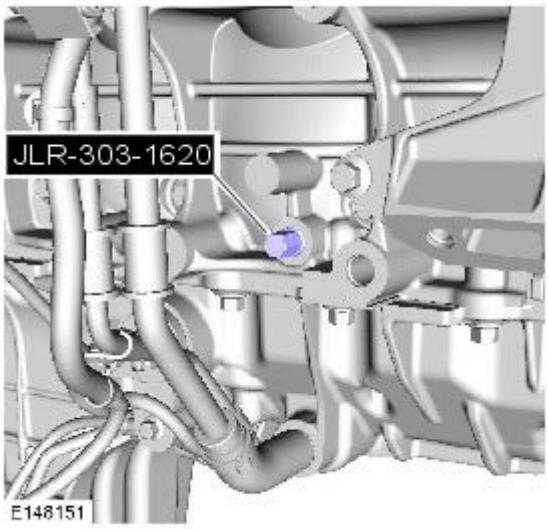
10.



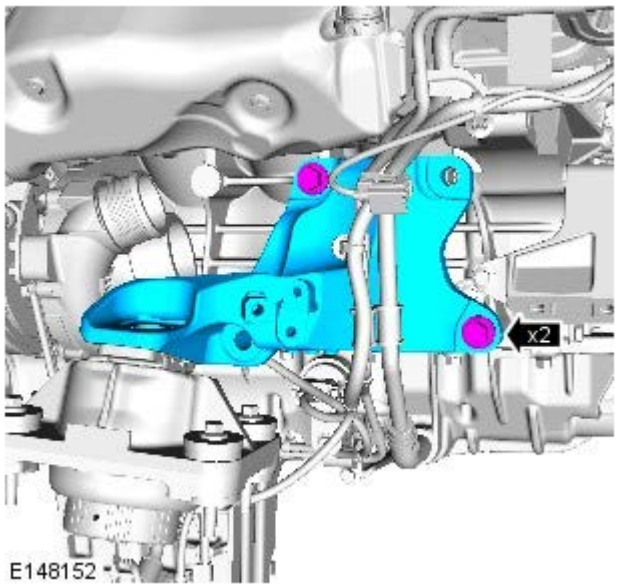
11.



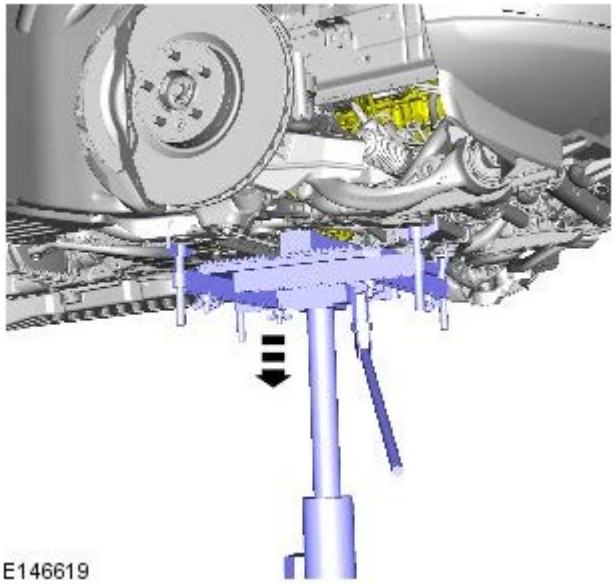
12. *Special Tool(s):* JLR-303-1620



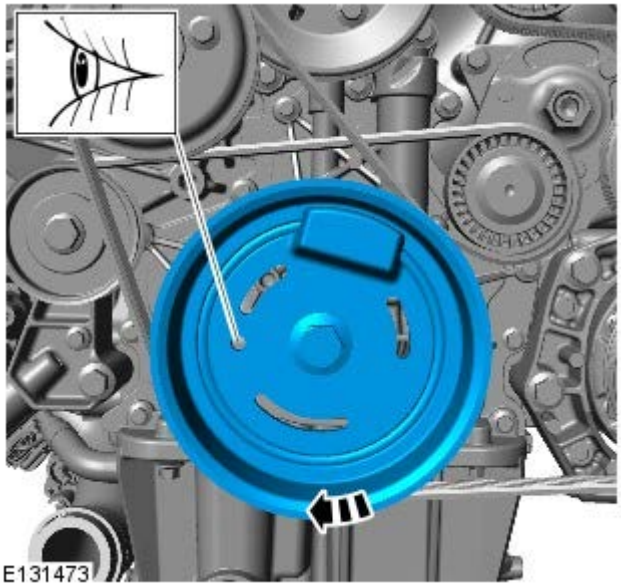
13.



14.

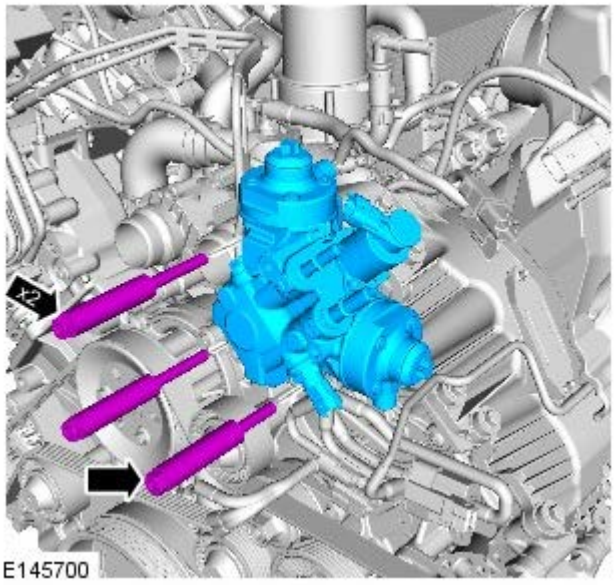

E146619

15. Rotate the engine clockwise until the crankshaft contacts the timing pin. Do not attempt to rotate the engine counter clockwise.


E131473

16. CAUTION: Discard the bolts.

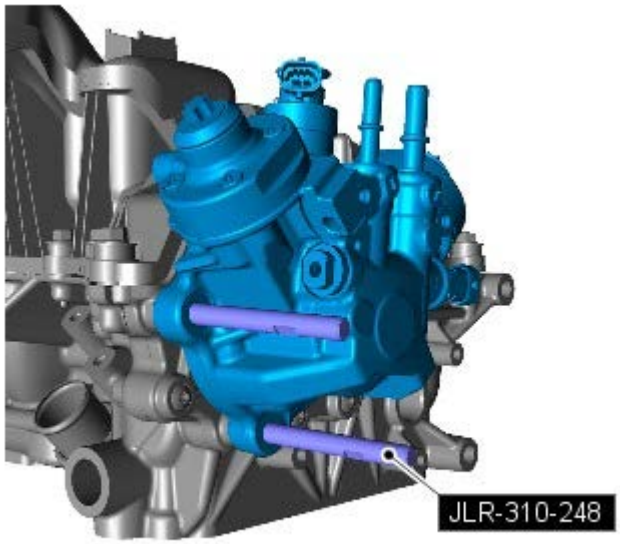
NOTE: Note the different lengths of the bolts.



E145700

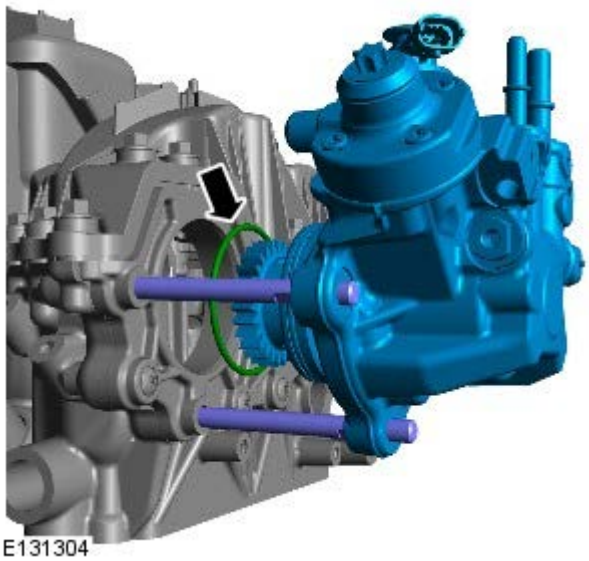
17. Install 2 guide pins in the original location of the 2 bolts.

Special Tool(s): JLR-310-248



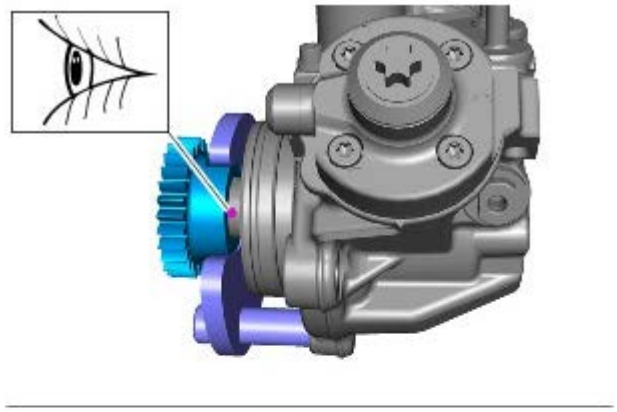
E131307

18.



E131304

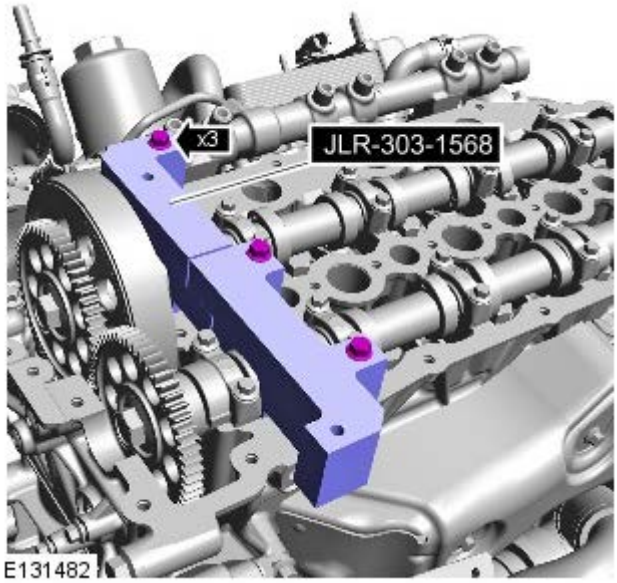
19. *Special Tool(s):* JLR-310-246





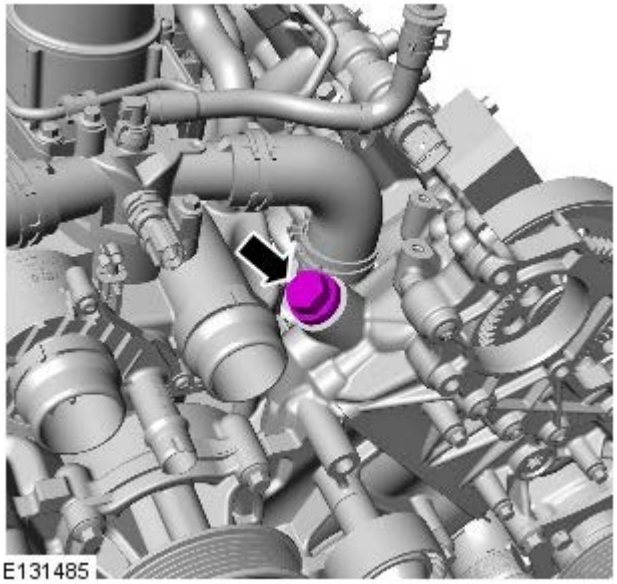
E131472

20. *Special Tool(s):* JLR-303-1568

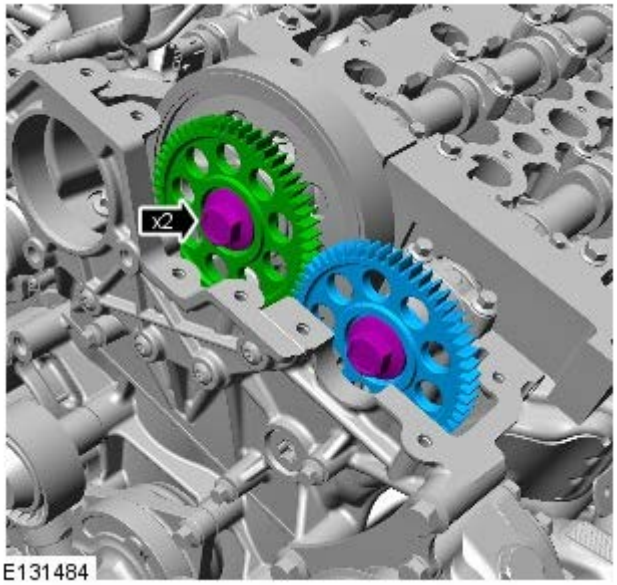


E131482

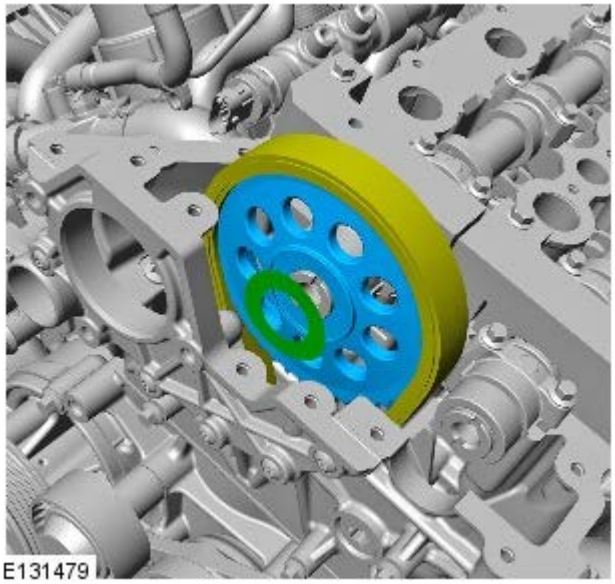
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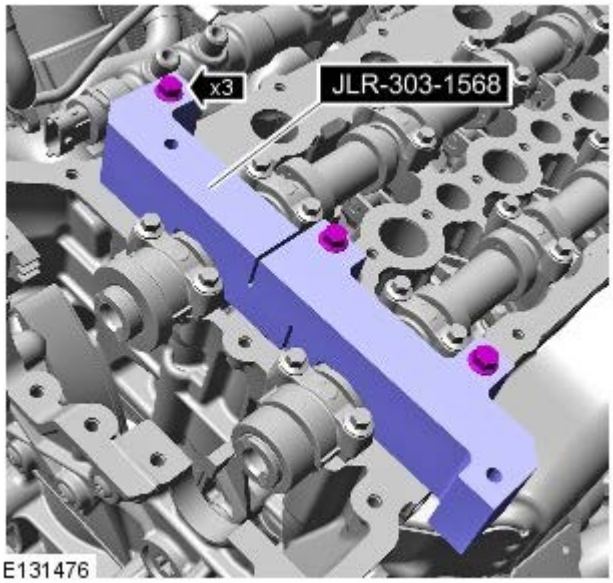
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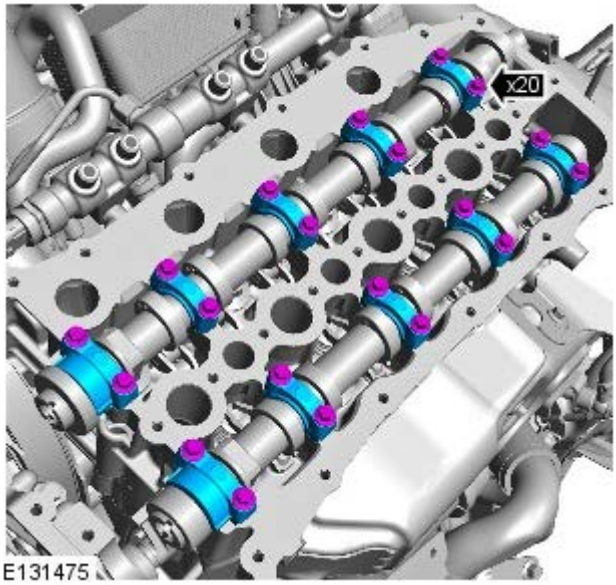
23.



24. Remove the special tool.



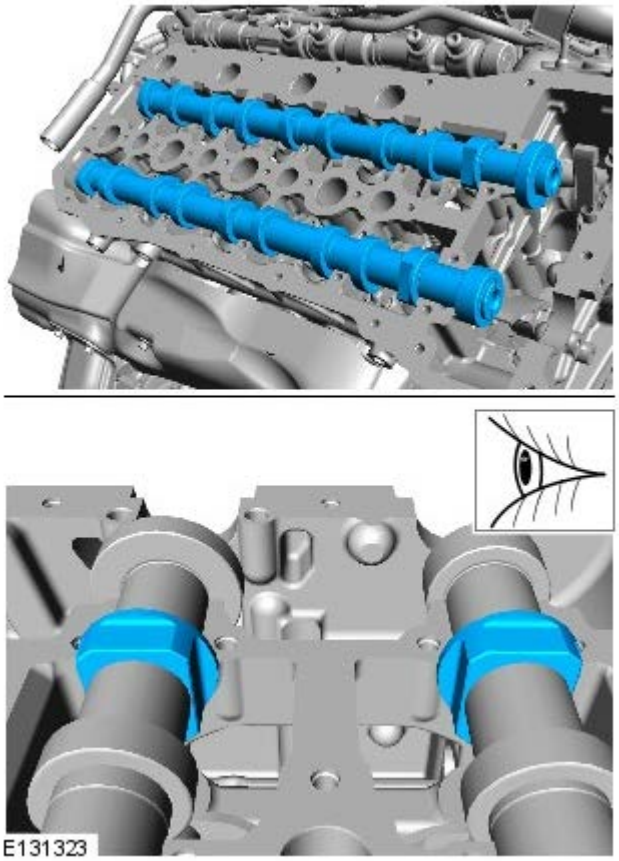
E131476



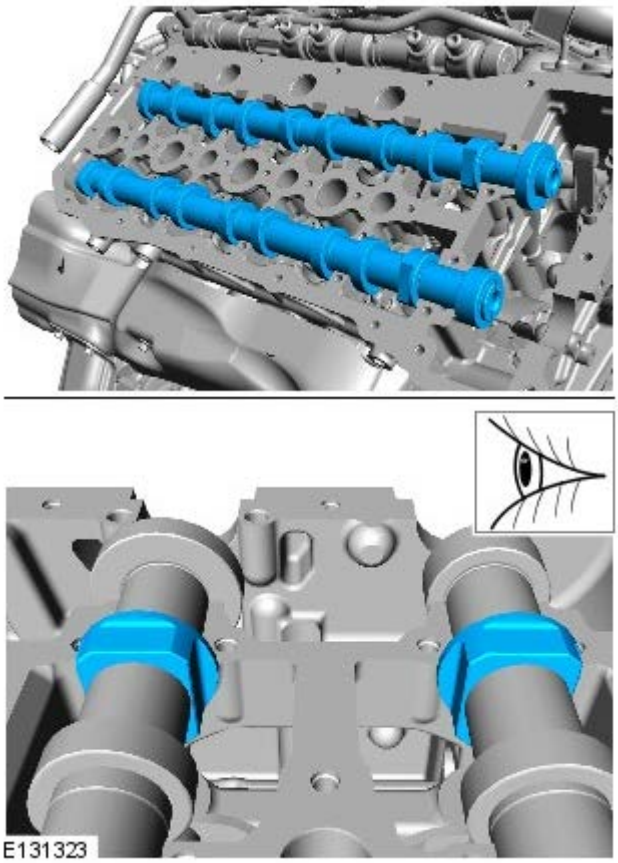
E131475

25. CAUTION: Note the fitted position of the component prior to removal.

26. NOTE: Right-hand shown, left-hand similar.



Installation



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

   NOTES:

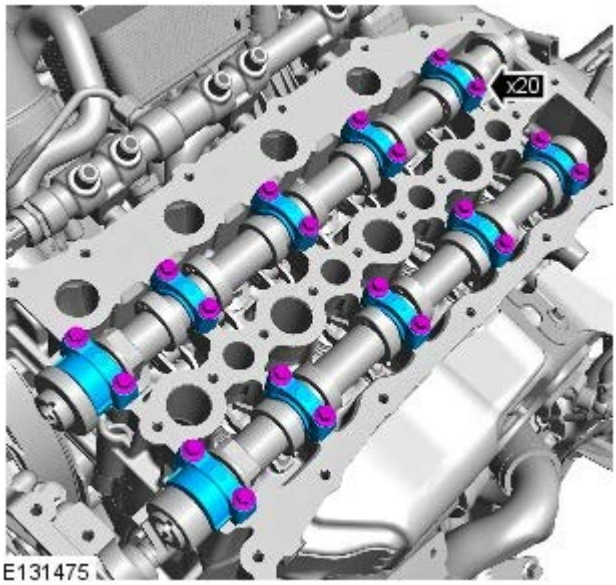
   Lubricate the camshafts and the camshaft bearing caps with oil meeting Land Rover specification prior to installation.

   Align to the orientation noted on removal.

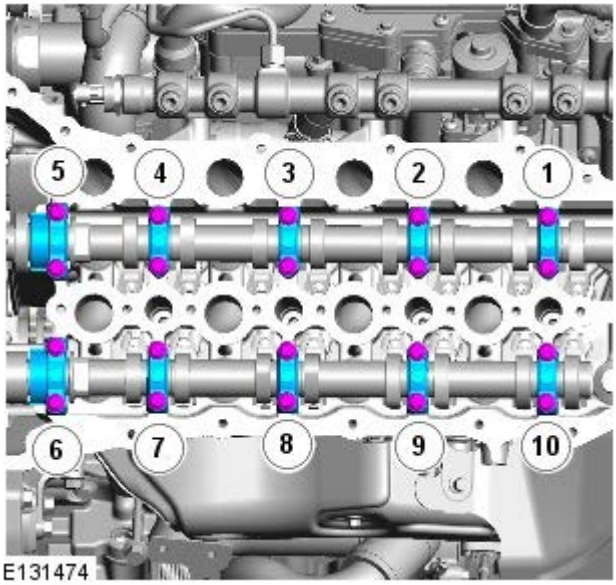
   Right-hand shown, left-hand similar.

2. CAUTIONS:

   Make sure that these components are installed to the noted removal position.



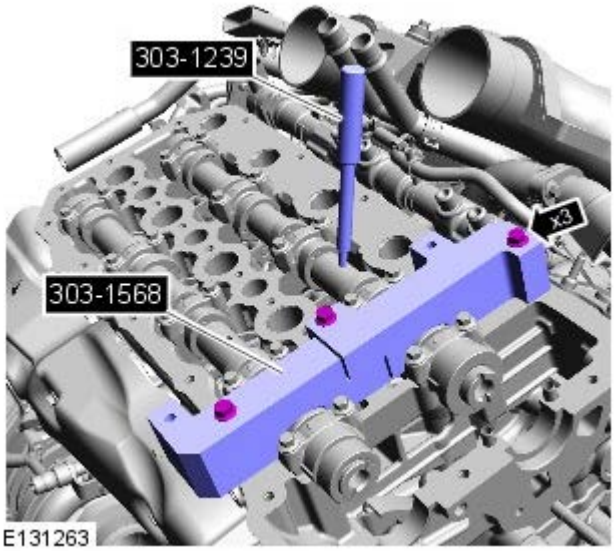
Only tighten the bolts finger-tight at this stage.



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

Torque:

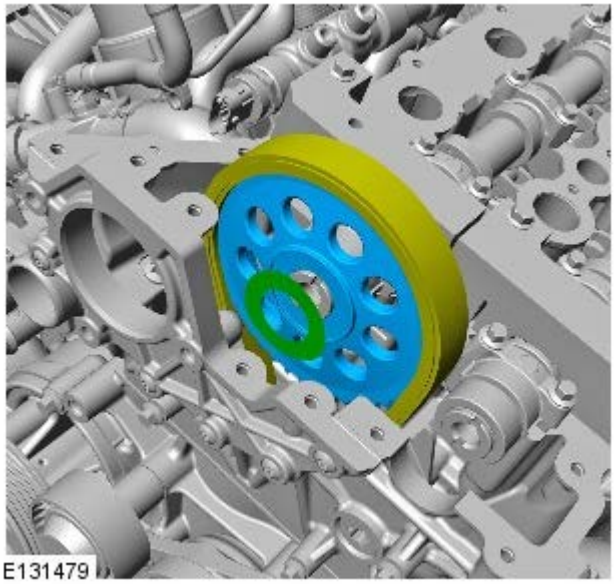
Stage 1: Bolts 3,4,2,5,1 5 Nm
Stage 2: Bolts 8,7,9,6,10 5 Nm
Stage 3: Bolts 5,4,3,2,1 10 Nm
Stage 4: Bolts 10,9,8,7,6 10 Nm

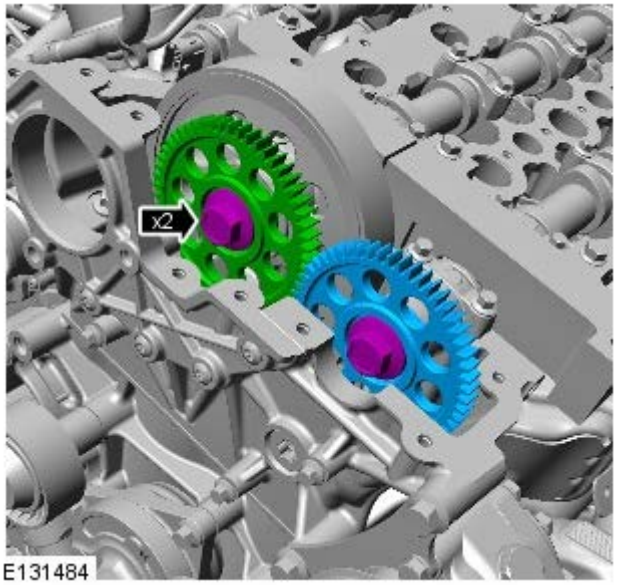


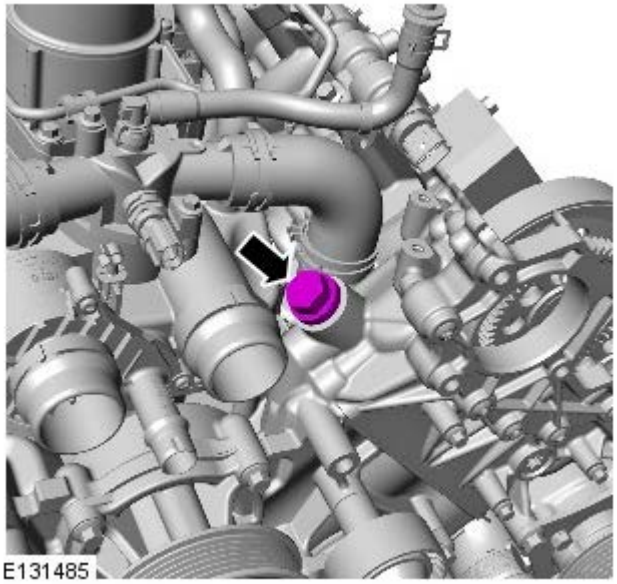
4. NOTE: Right-hand shown, left-hand similar.

- *Special Tool(s):* JLR-303-1568
- *Special Tool(s):* 303-1239

5.







6. CAUTIONS:

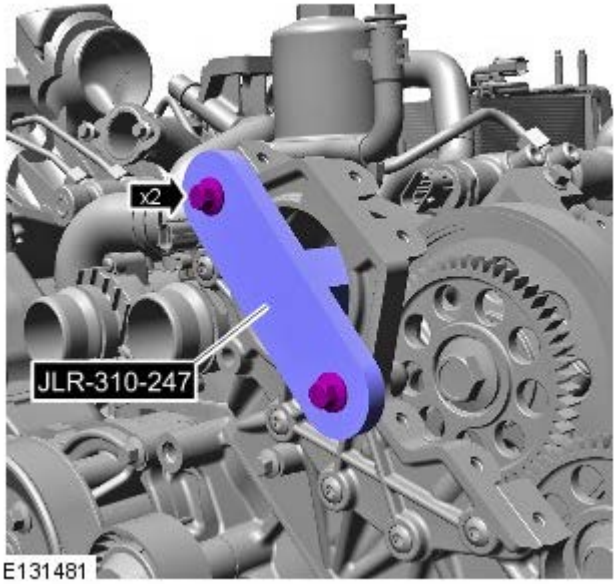
   Make sure that new bolts are installed.

   Only tighten the bolts finger-tight at this stage.

7. CAUTION: Make sure that a new component is installed.

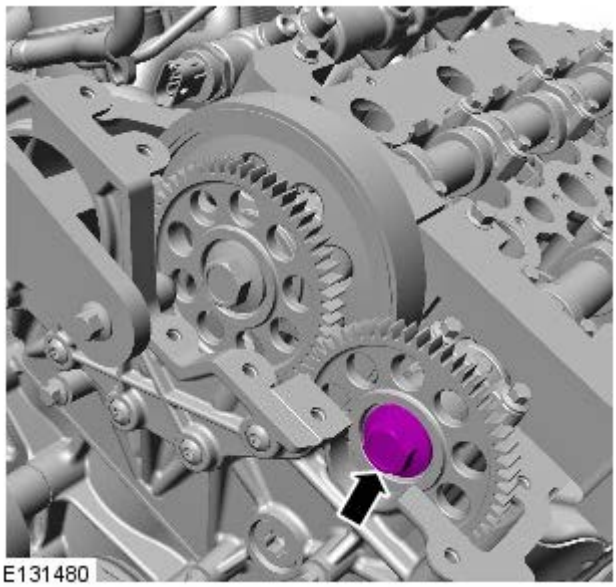
   Torque: 65 Nm

8. *Special Tool(s):* JLR-310-247

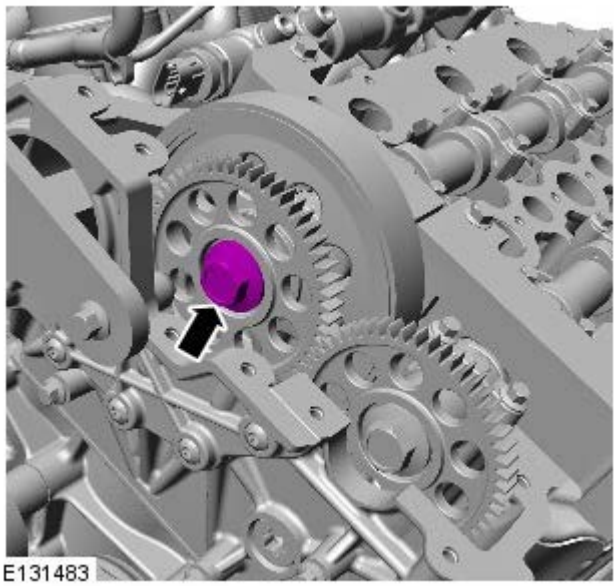


E131481

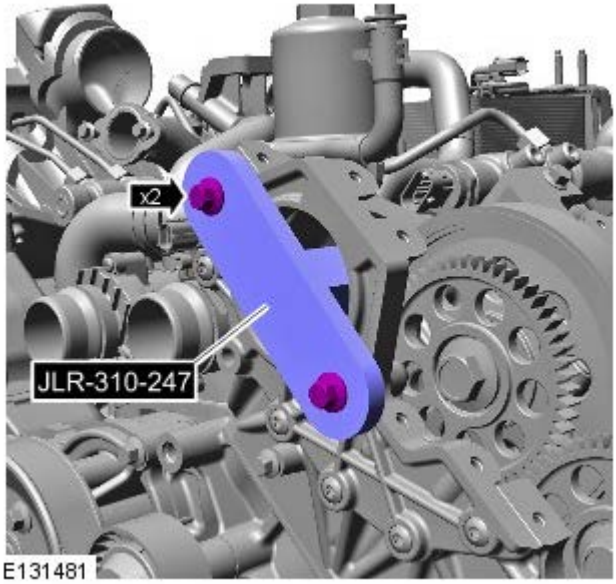
9. *Torque:*
   Stage 1:80 Nm
   Stage 2:80°


E131480

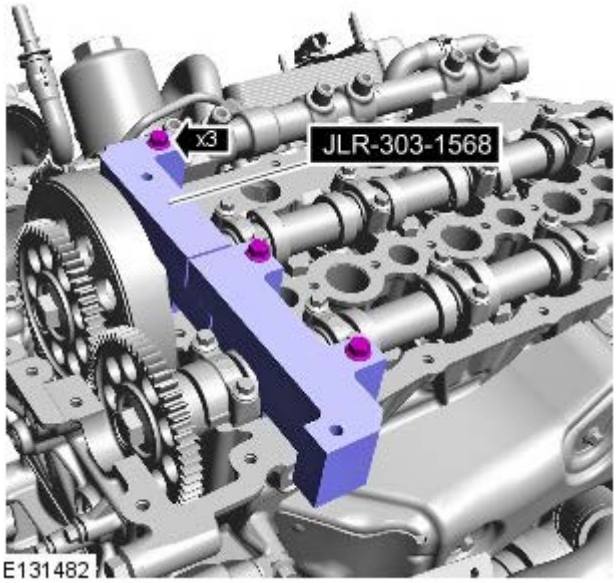
10. *Torque:*
    Stage 1:80 Nm
    Stage 2:80°


E131483

11. Remove the special tool.

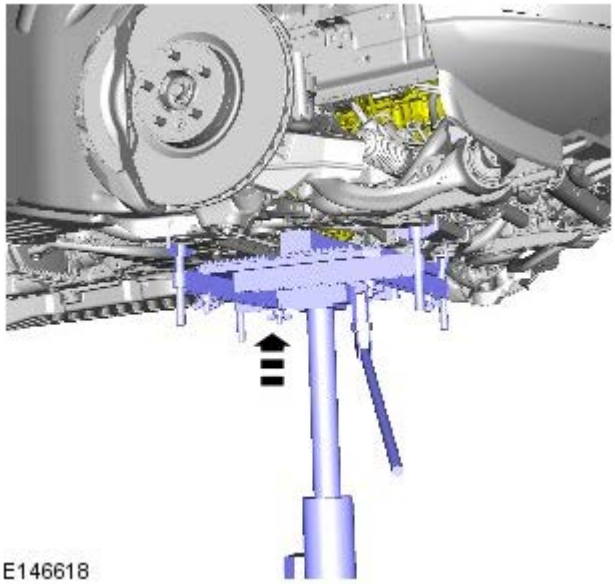


12. Remove the special tool.

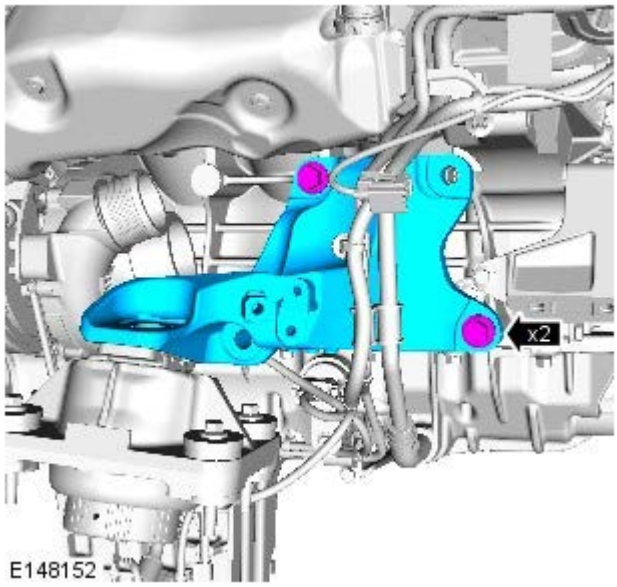


13. CAUTION: Use a wooden block to protect the oil pan when supporting the engine.

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

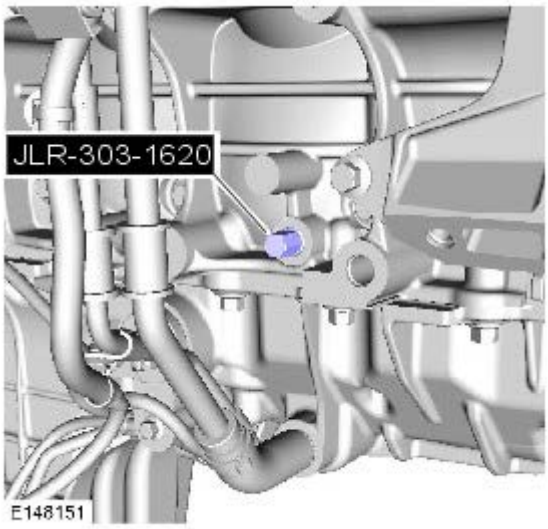


14.

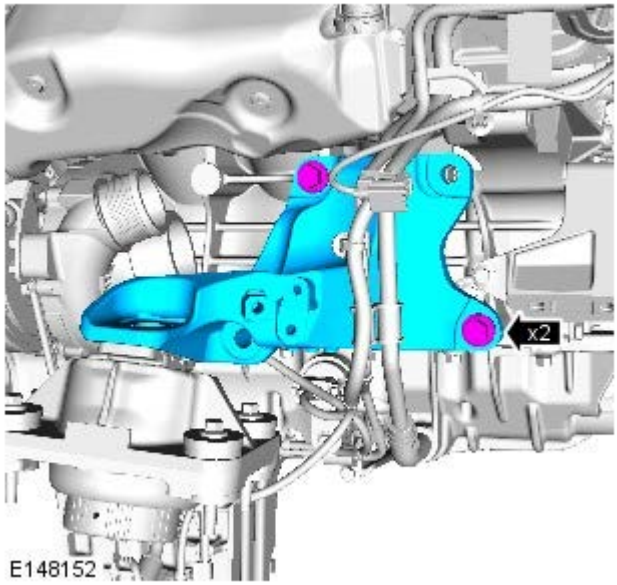


15. NOTE: Remove the special tool.

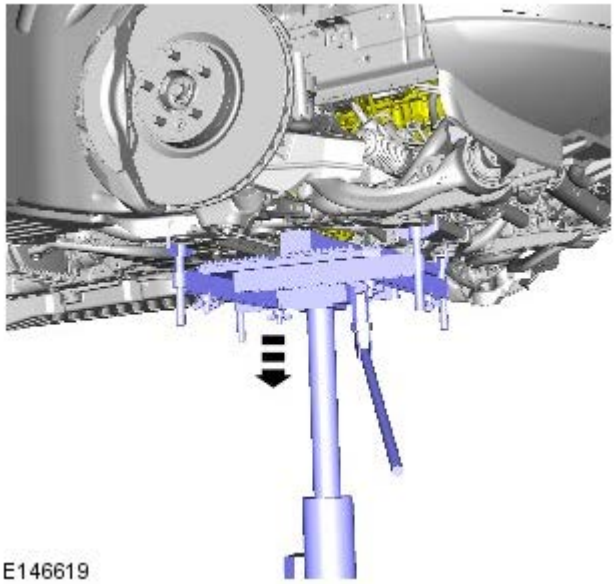
Special Tool(s): JLR-303-1620



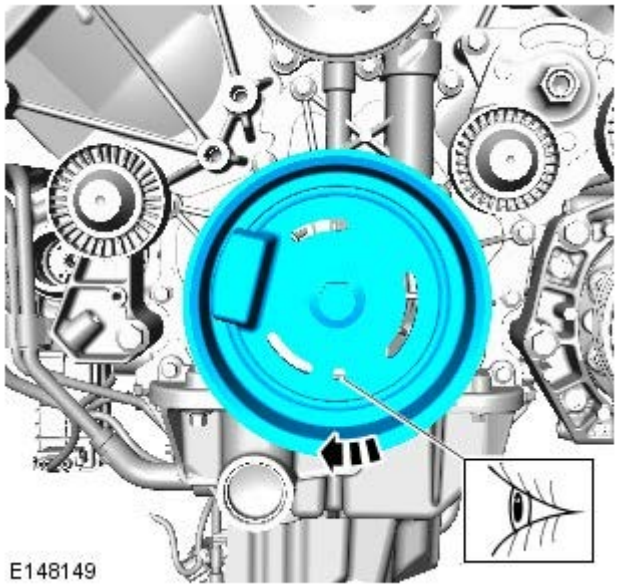
16.



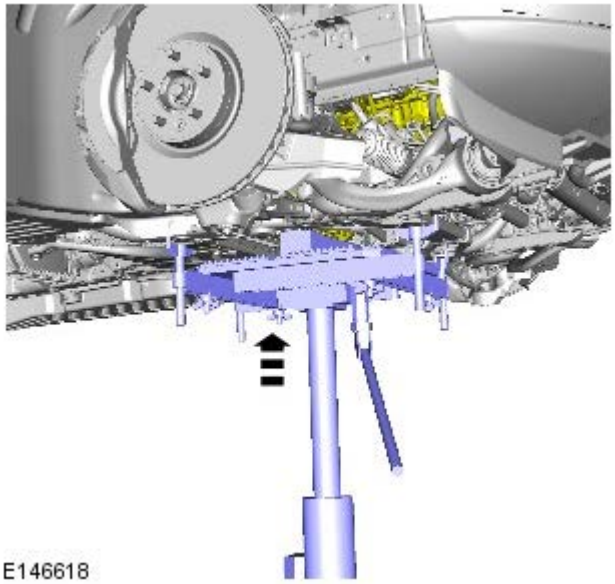
17.



18. Rotate the engine two complete turns clockwise.



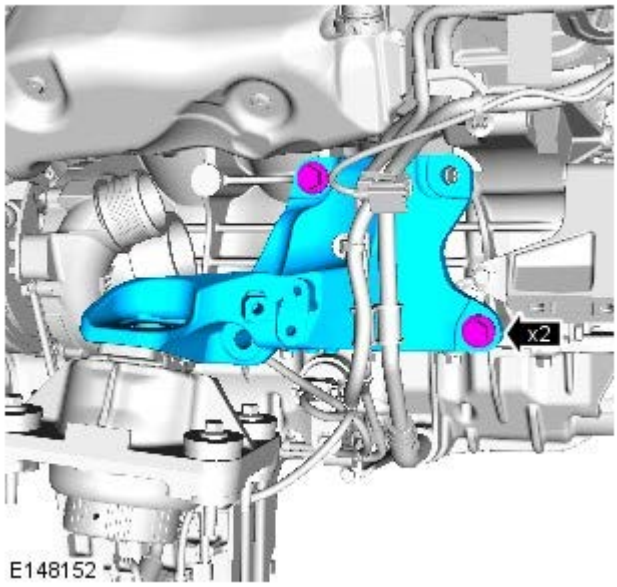
19. CAUTION: Only rotate the crankshaft clockwise.



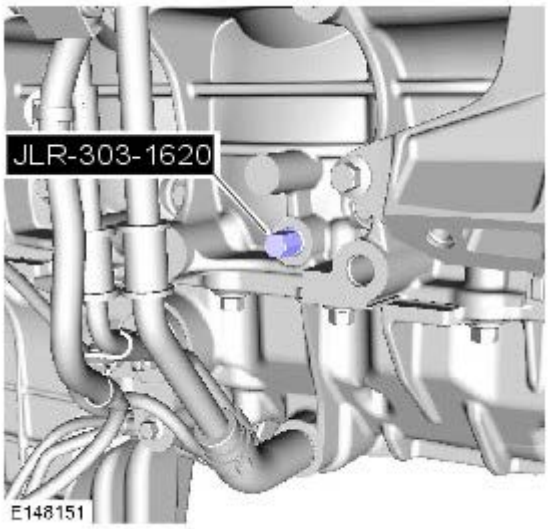
20. CAUTION: Use a wooden block to protect the oil pan when supporting the engine.

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

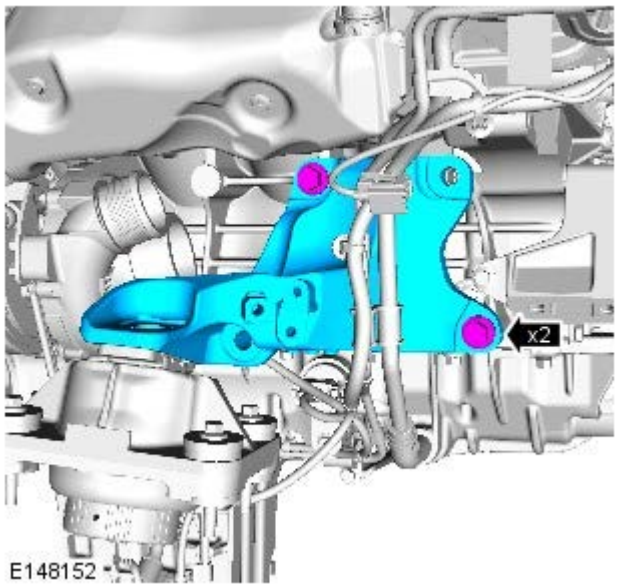
21.



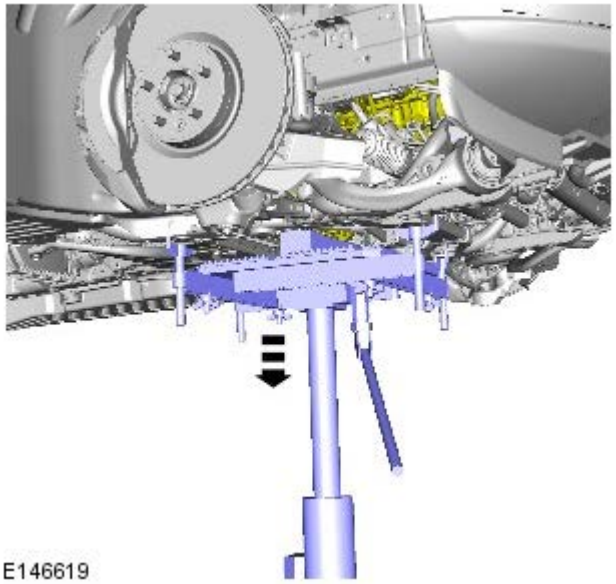
22. *Special Tool(s):* JLR-303-1620



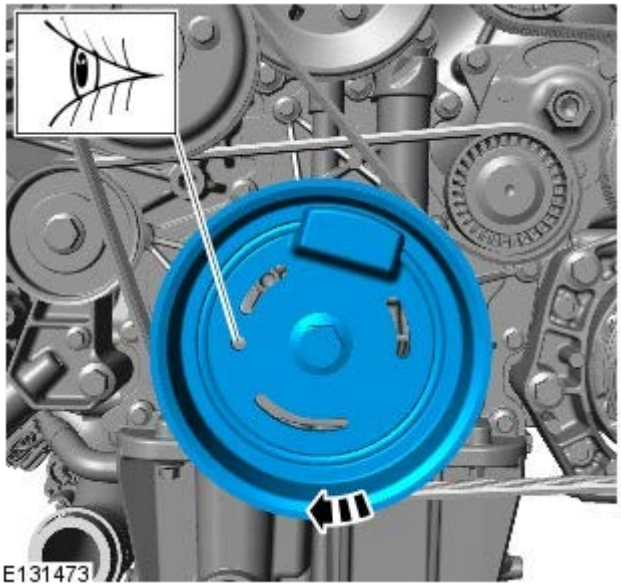
23.



24.

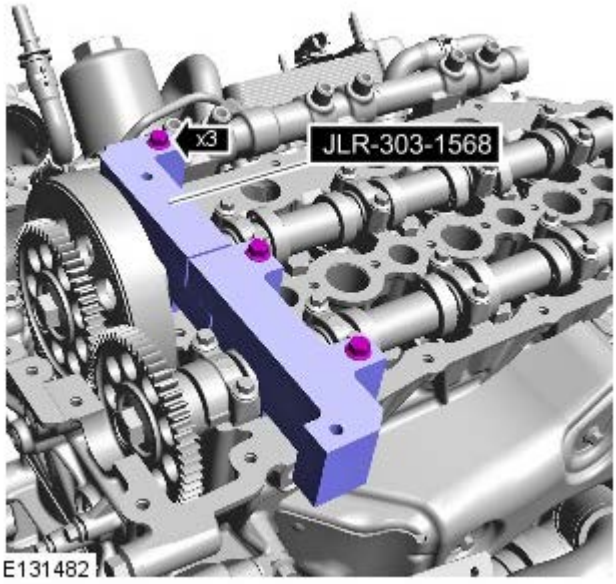

E146619

25. Rotate the engine clockwise until the crankshaft contacts the timing pin. Do not attempt to rotate the engine counter clockwise.


E131473

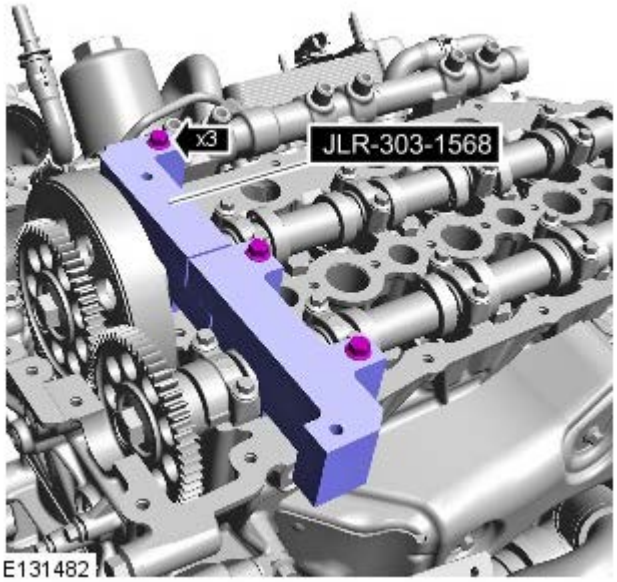
26. CAUTION: If the special tool cannot be installed, the timing chain installation steps must be repeated.

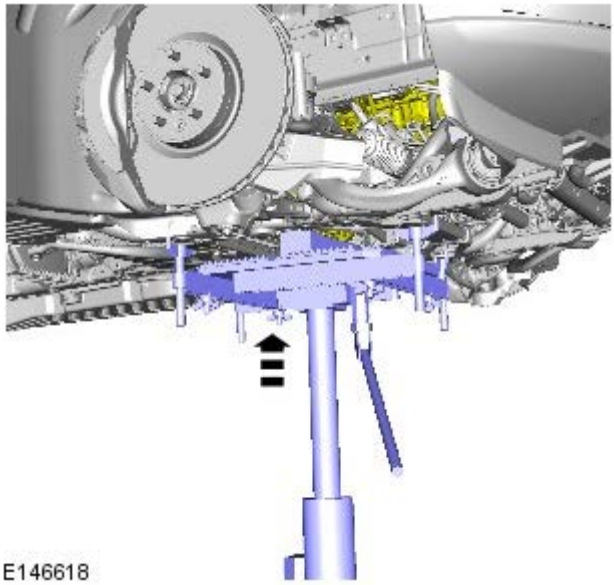
Special Tool(s): JLR-303-1568



E131482

27. Remove the special tool.

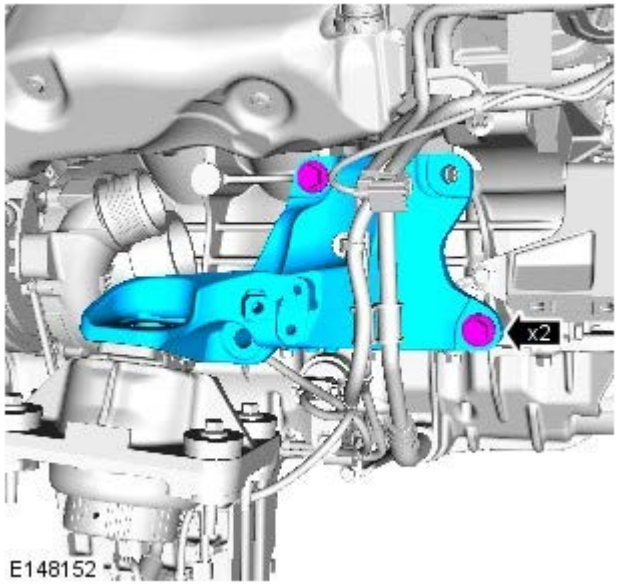




28. CAUTION: Use a wooden block to protect the oil pan when supporting the engine.

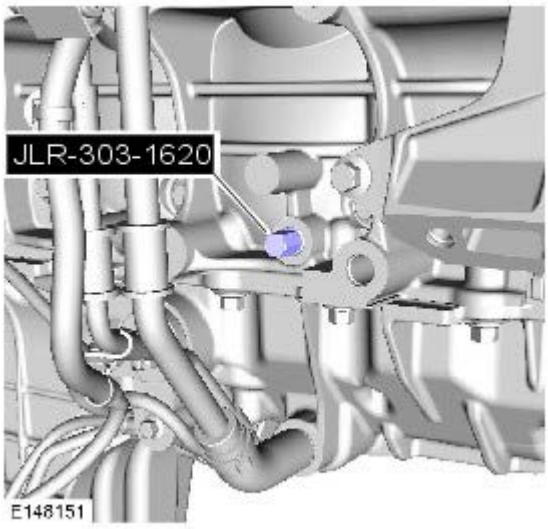
Using a suitable hydraulic jack, raise and support the engine.

29.

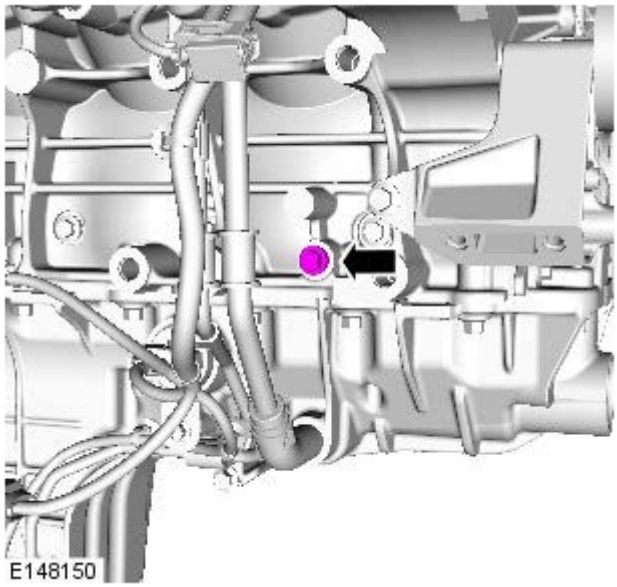


30. NOTE: Remove the special tool.

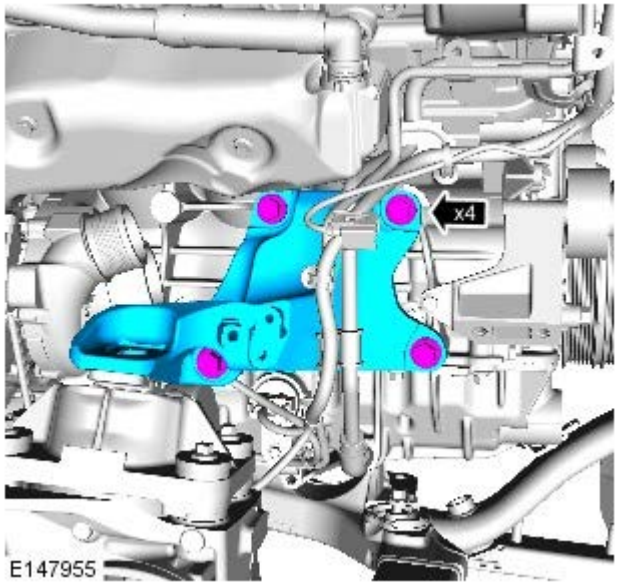
Special Tool(s): JLR-303-1620



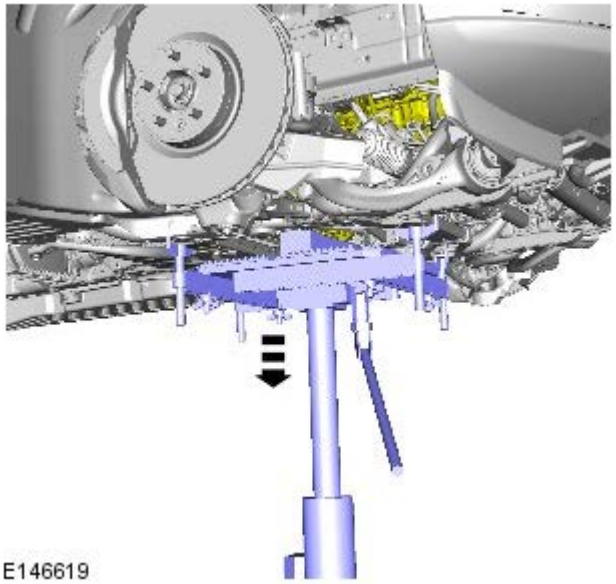
31. *Torque:* 23 Nm



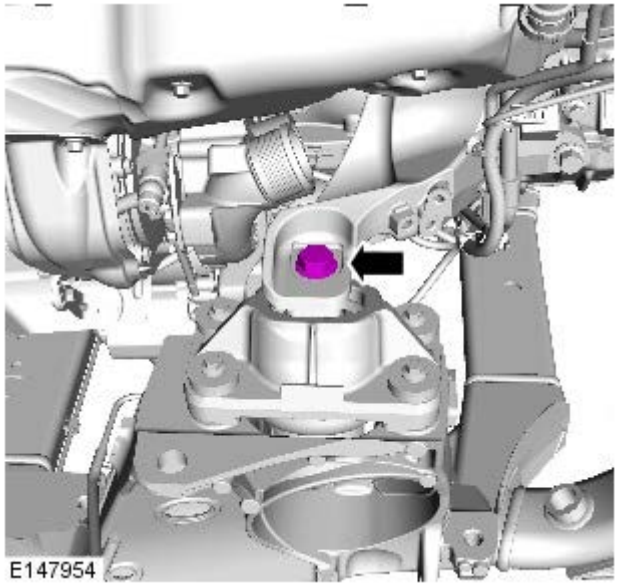
32. *Torque:* 119 Nm



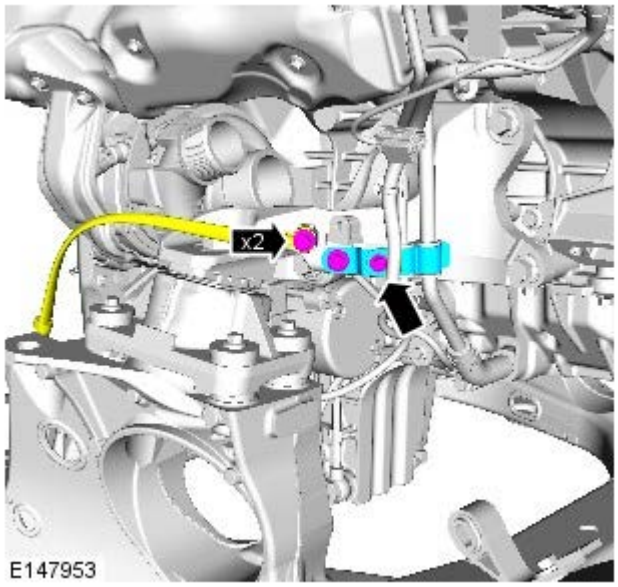
33.



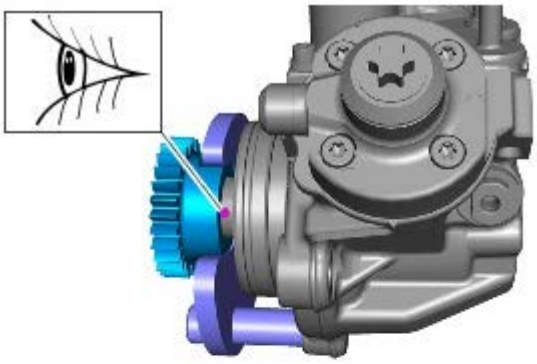
34. *Torque:* 110 Nm



35. *Torque:*
M8 25 Nm
M6 10 Nm



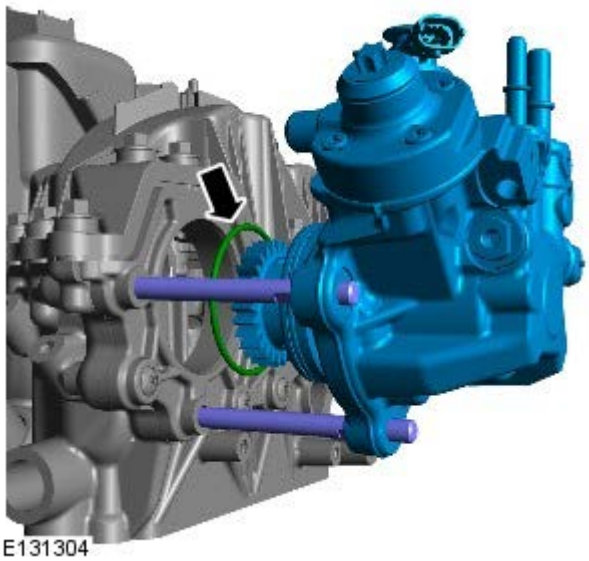
36. *Special Tool(s):* JLR-310-246





E131472

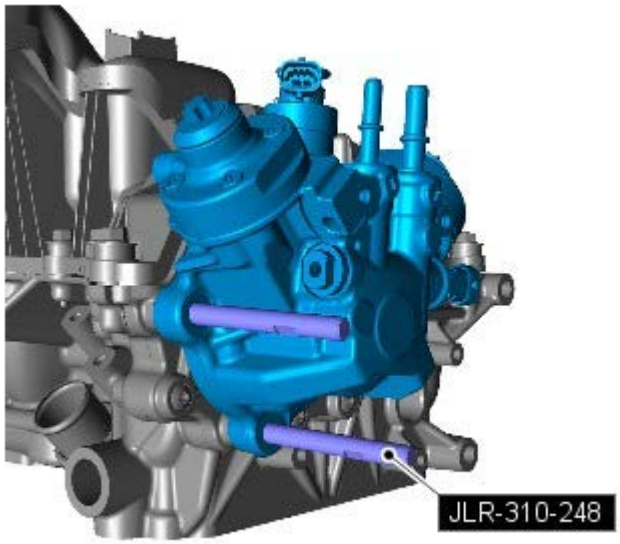
37. NOTE: Lubricate the O-ring seal with clean engine oil.



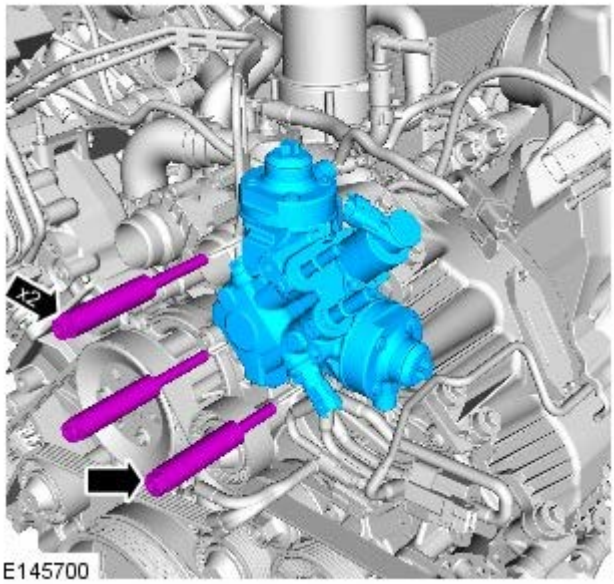
E131304

38. Remove the guide pins.

    Special Tool(s): JLR-310-248



E131307



E145700

39. CAUTIONS:

    Make sure that new bolts are installed.

    Install the bolts in the noted position.

    Torque: 24 Nm

40. Refer to: Generator (414-02D Generator and Regulator - TDV8 4.4L Diesel, Removal and Installation).

41. Refer to: Valve Cover LH (303-01D Engine - TDV8 4.4L Diesel, Removal and Installation).

42. Refer to: Cooling Fan (303-03F Engine Cooling - TDV8 4.4L Diesel, Removal and Installation).

43. Connect the battery ground cable.

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

Published: 08-Nov-2013

Engine - TDV8 4.4L Diesel - Camshaft RH

Removal and Installation

Special Tool(s)

	303-1239 Adjustment Tool, Camshaft
	JLR-303-1568 Locking Tool, Camshaft
	JLR-303-1620 Timing Pin

Removal

NOTES:

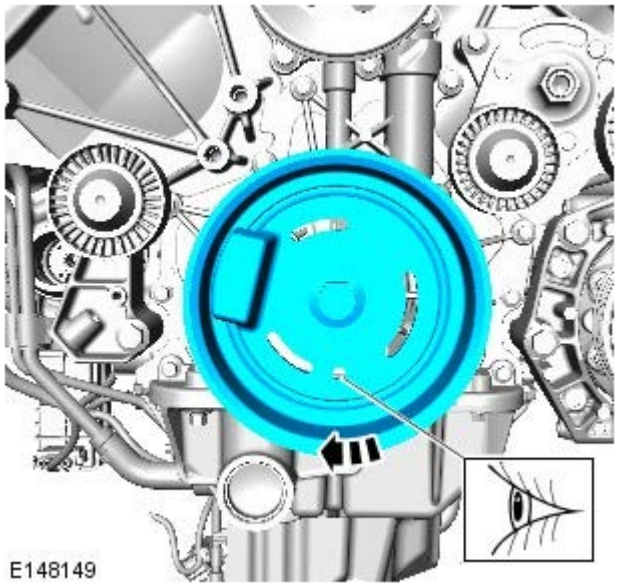
Some variation in the illustrations may occur, but the essential information is always correct.

Removal steps in this procedure may contain installation details.

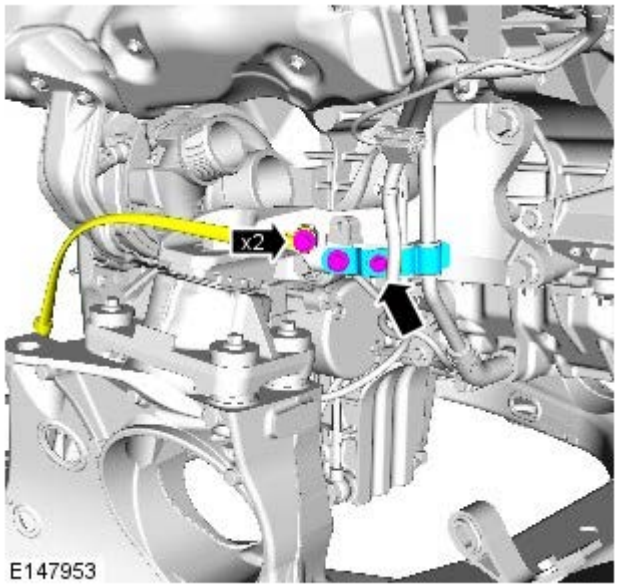
Engine shown removed for clarity.

1. Refer to: Diesel Fuel System Health and Safety Precautions (100-00 General Information, Description and Operation).
2. Disconnect the battery ground cable.

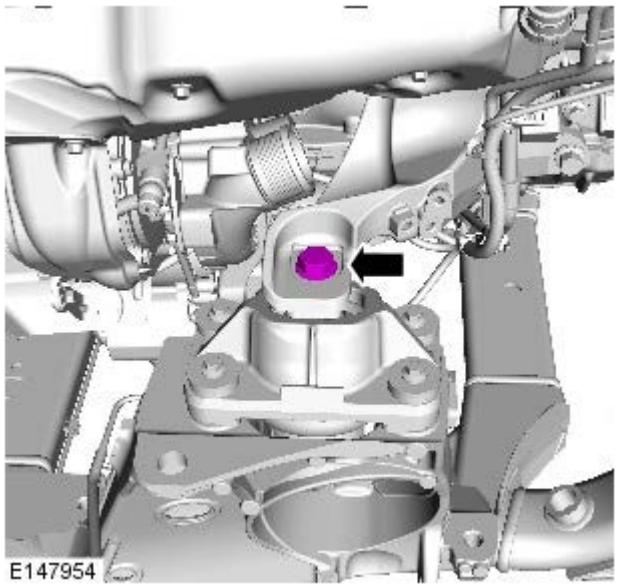
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).
3. Refer to: Cooling Fan (303-03F Engine Cooling - TDV8 4.4L Diesel, Removal and Installation).
4. Refer to: Valve Cover RH (303-01D Engine - TDV8 4.4L Diesel, Removal and Installation).
5. Refer to: Generator (414-02D Generator and Regulator - TDV8 4.4L Diesel, Removal and Installation).
6. Refer to: Brake Vacuum Pump - 4.4L V8 - TdV8 (206-07 Power Brake Actuation, Removal and Installation).
7. CAUTION: Only rotate the crankshaft clockwise.



8.

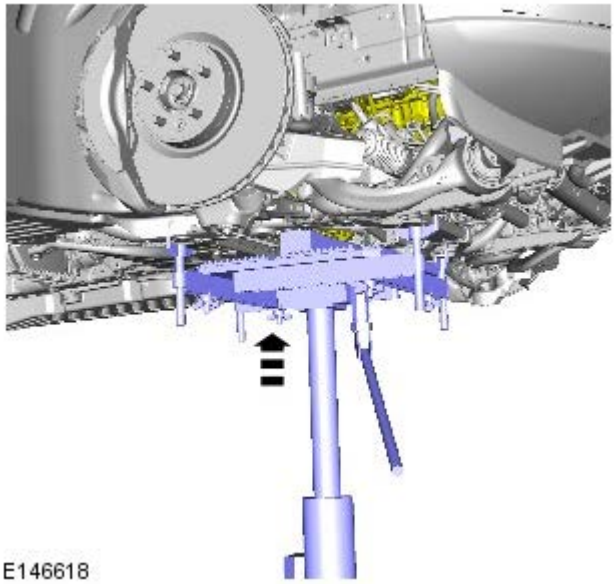


9.

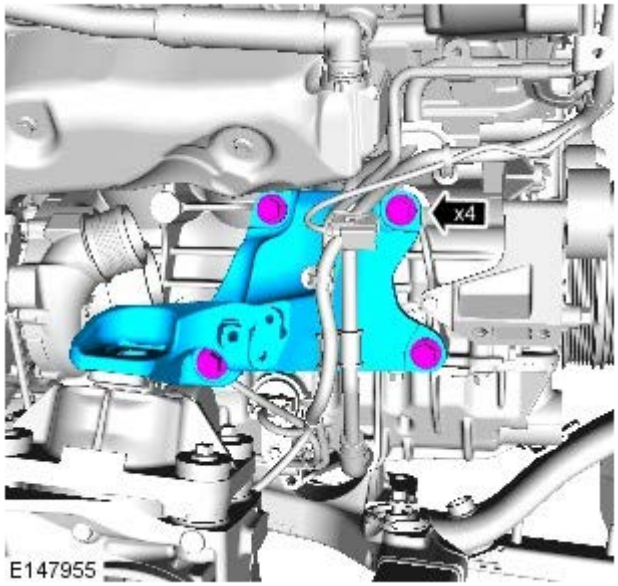


10. CAUTION: Use a wooden block to protect the oil pan when supporting the engine.

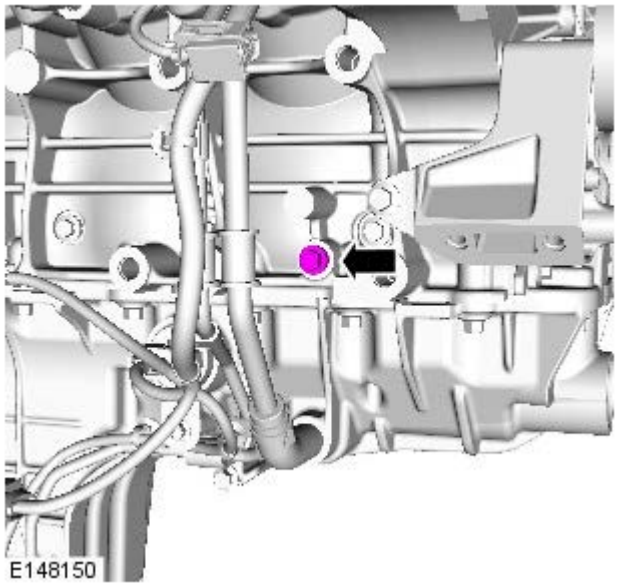
Using a suitable hydraulic jack, raise and support the engine.



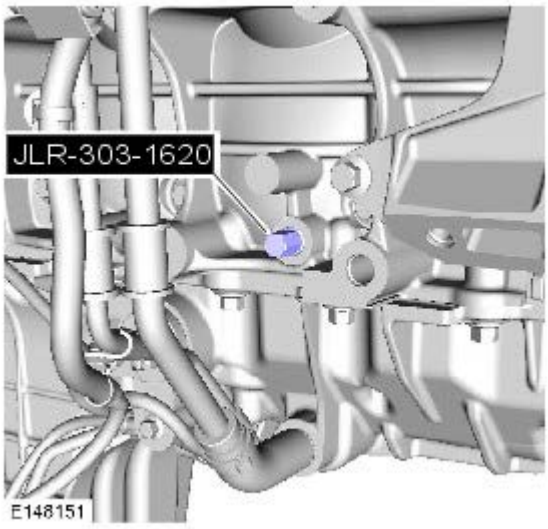
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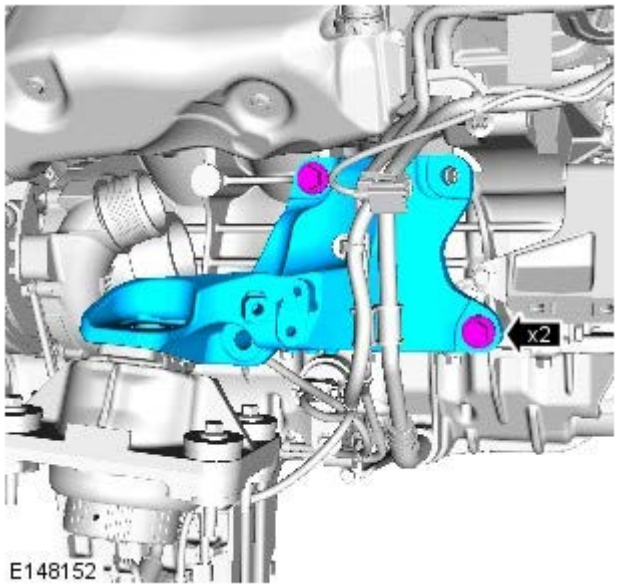
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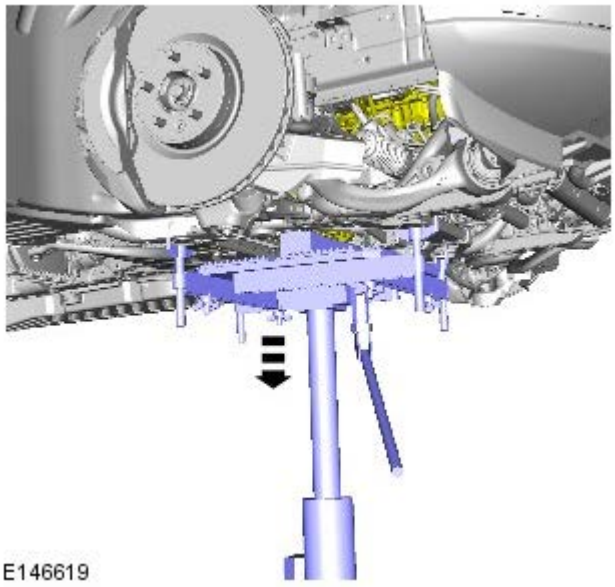
13. *Special Tool(s):* JLR-303-1620



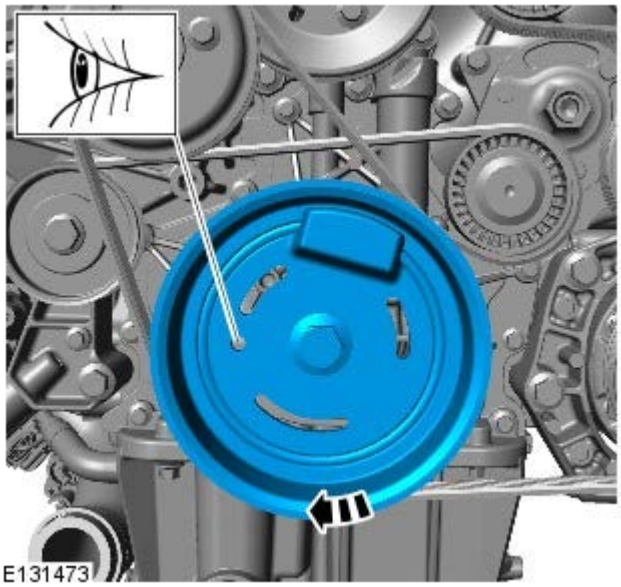
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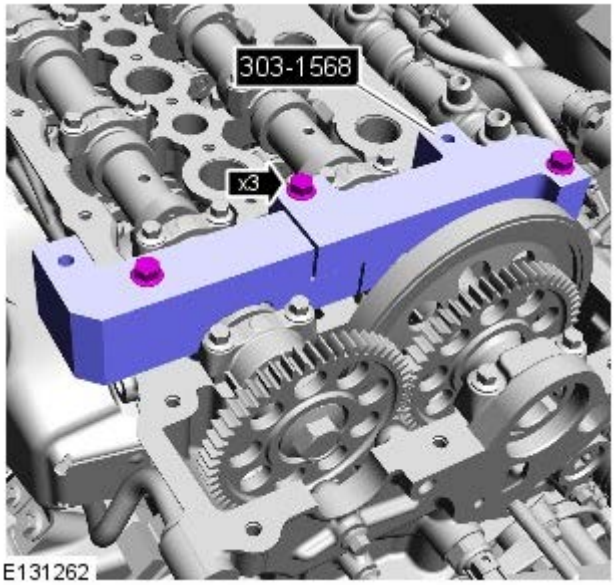
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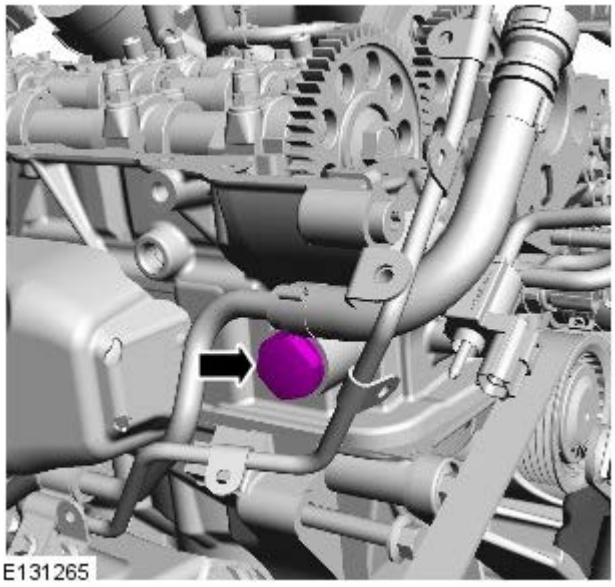
16. Rotate the engine clockwise until the crankshaft contacts the timing pin. Do not attempt to rotate the engine counter clockwise.



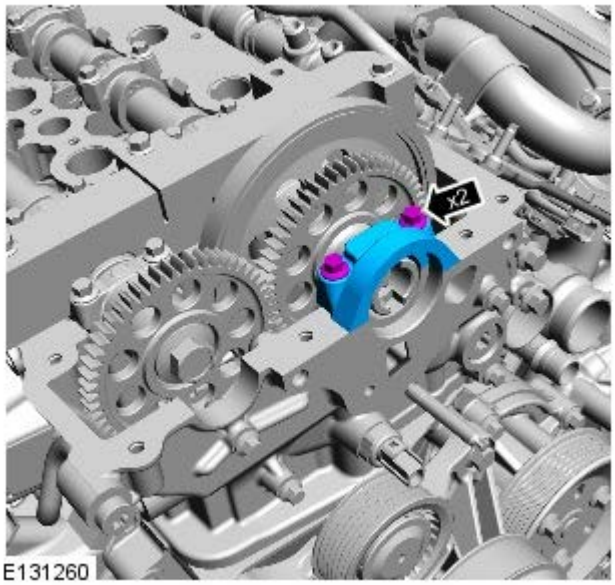
17. *Special Tool(s):* JLR-303-1568



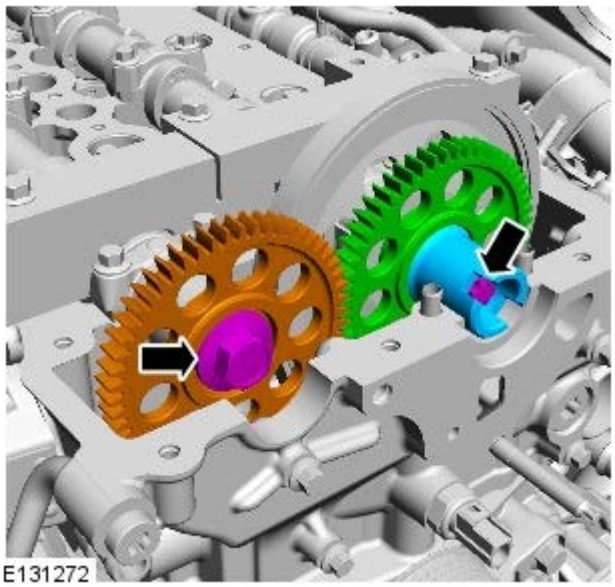
18. CAUTION: Discard the component.



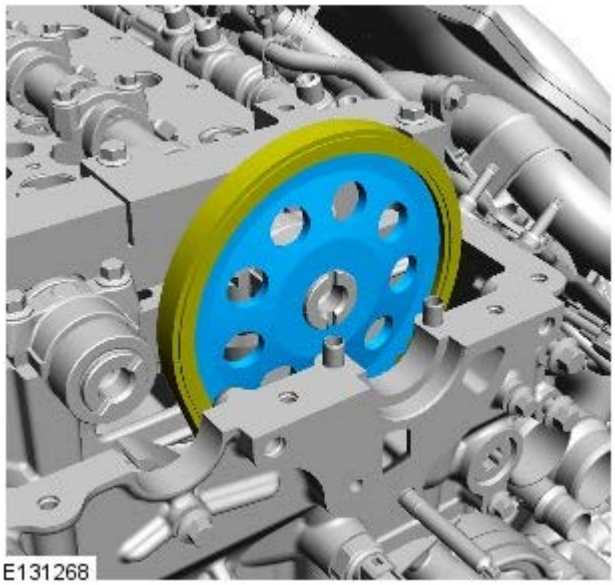
19.



20.

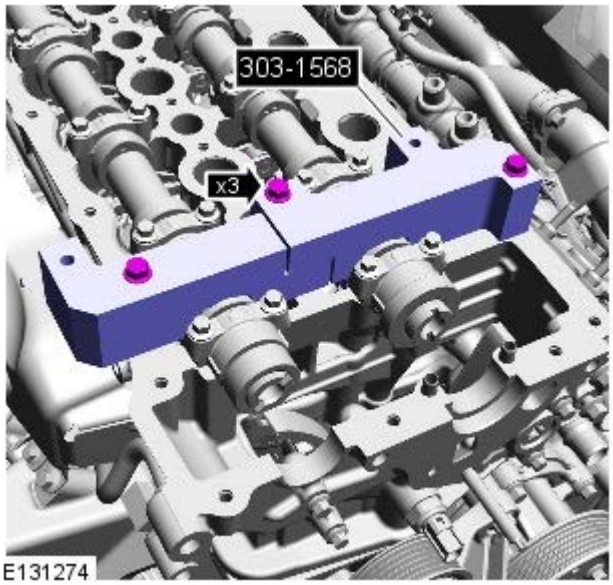


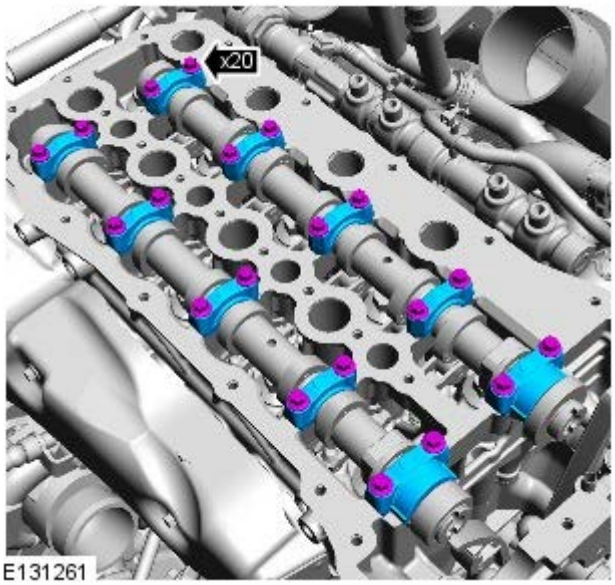
21.



22. Remove the special tool.

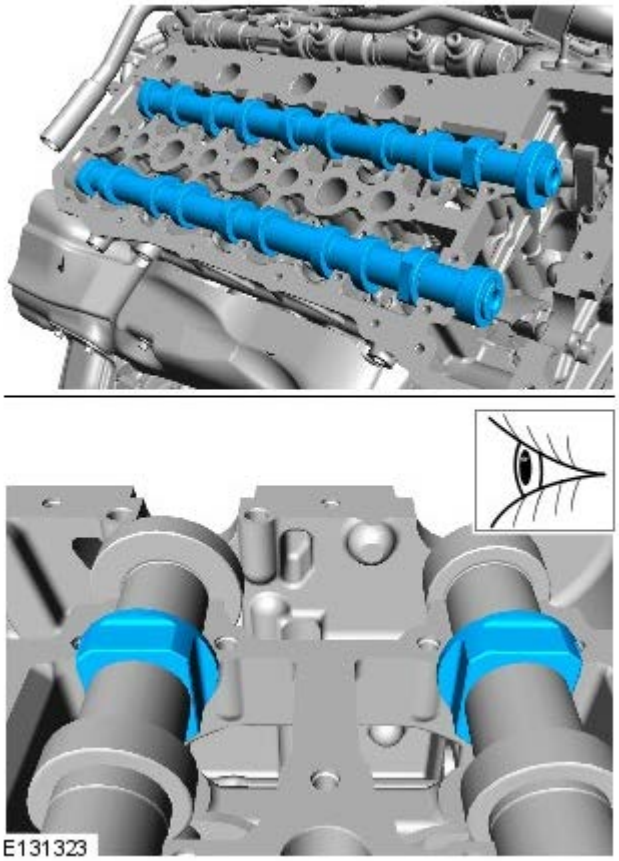
Special Tool(s): JLR-303-1568



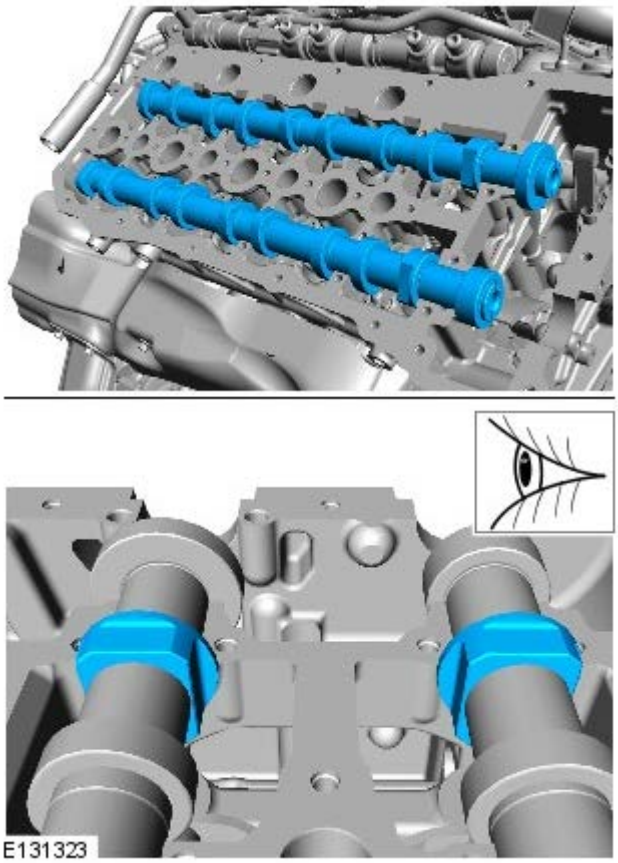


23. CAUTION: Note the fitted position of the component prior to removal.

24.



Installation



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

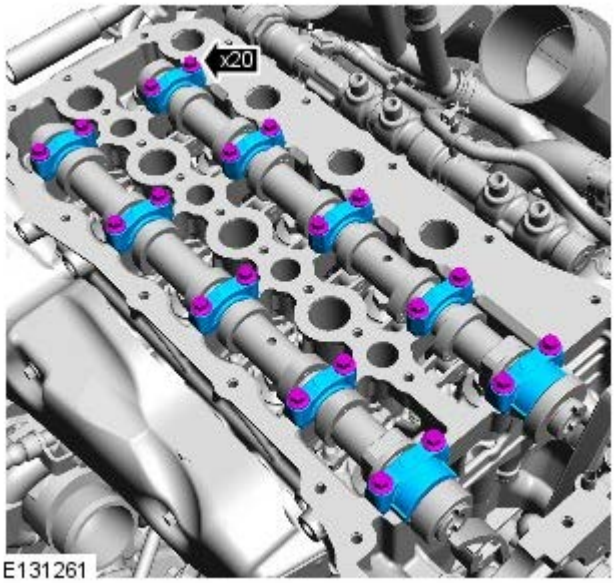
   NOTES:

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

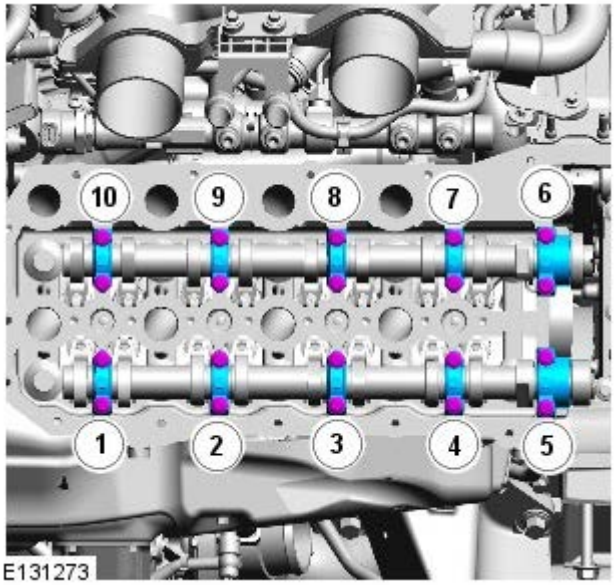
   Align to the orientation noted on removal.

2. CAUTIONS:

   Make sure that these components are installed to the noted removal position.



Only tighten the bolts finger-tight at this stage.



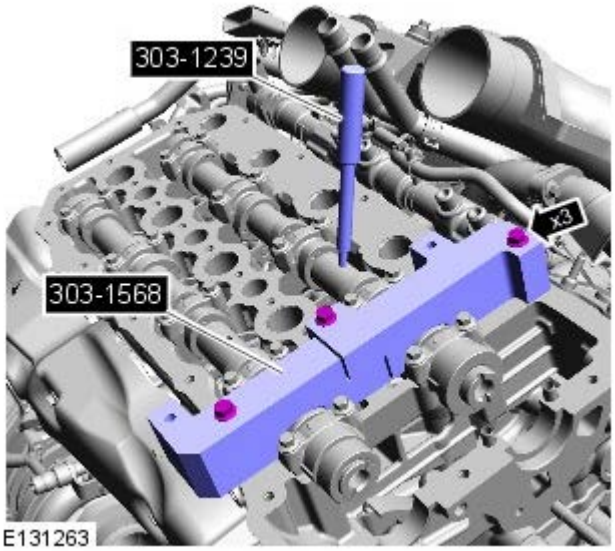
3. CAUTION: Tighten the bolts in the sequence shown.

Torque:

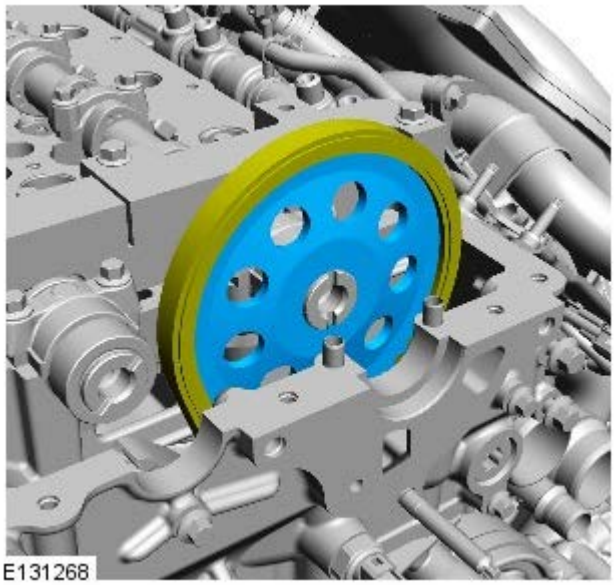
Stage 1: Bolts 8,7,9,6,10 5 Nm
Stage 2: Bolts 3,4,2,5,1 5 Nm
Stage 3: Bolts 6,7,8,9,10 10 Nm
Stage 4: Bolts 1,2,3,4,5 10 Nm

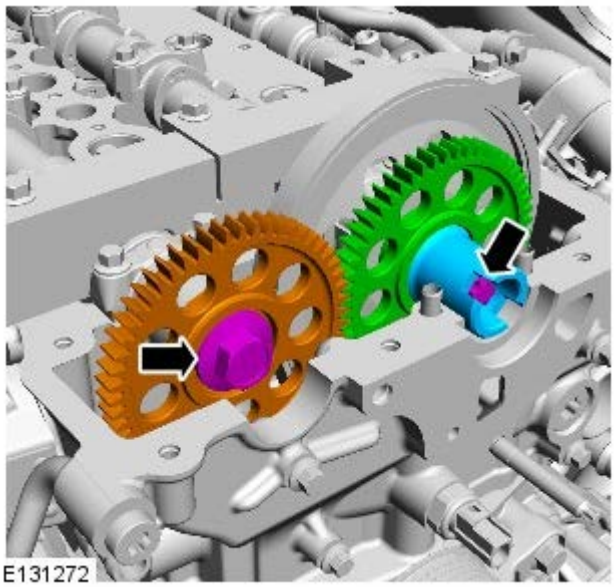
4.

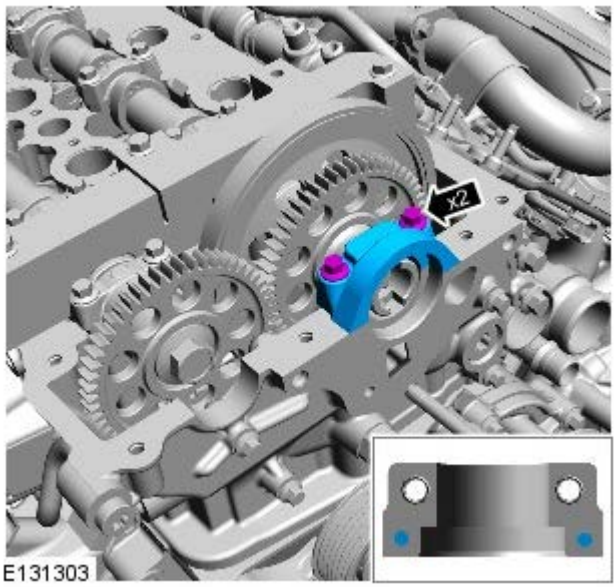
- *Special Tool(s):* JLR-303-1568
- *Special Tool(s):* 303-1239



5.







6. CAUTIONS:

   Make sure that new bolts are installed.

   Only tighten the bolts finger-tight at this stage.

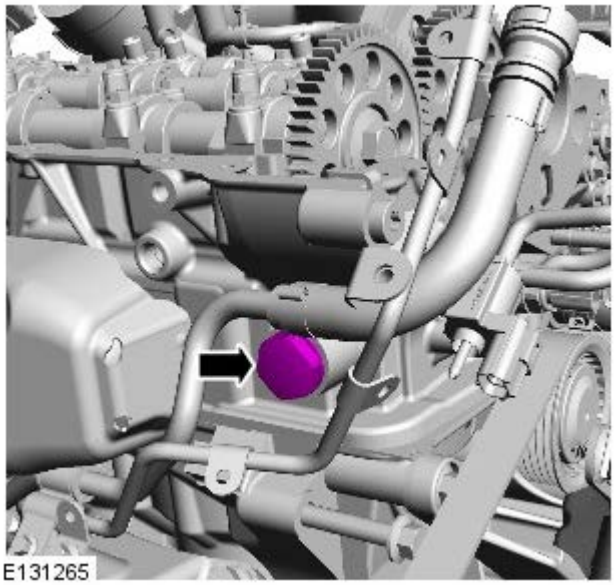
7. CAUTION: Make sure that the mating faces are clean and free of foreign material.

   Apply a 3.5 mm - 4 mm circle of loctite 518 sealant in the two areas shown.

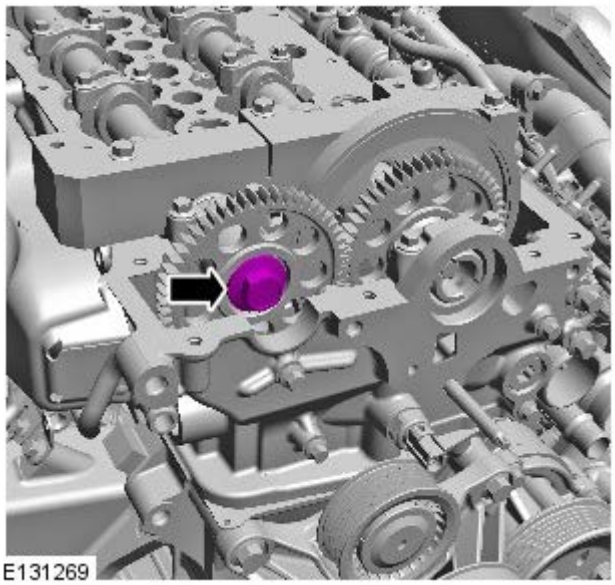
   Torque:
   Stage 1: 5 Nm
   Stage 2: 10 Nm

8. CAUTION: Make sure that a new component is installed.

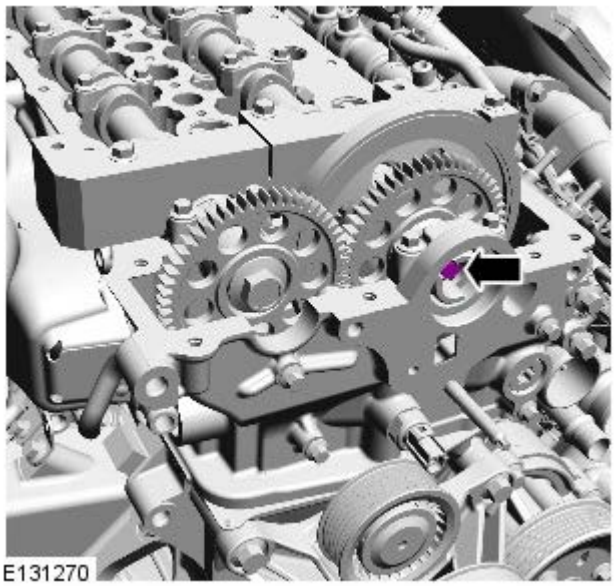
   Torque: 65 Nm



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

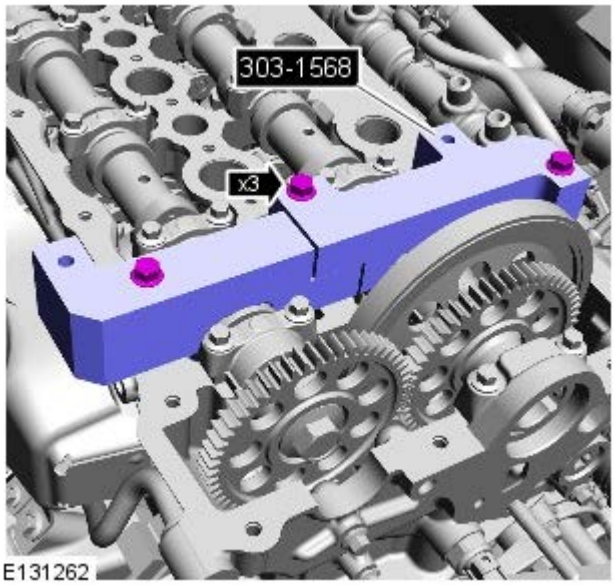


10. *Torque:*
    Stage 1:80 Nm
    Stage 2:80°

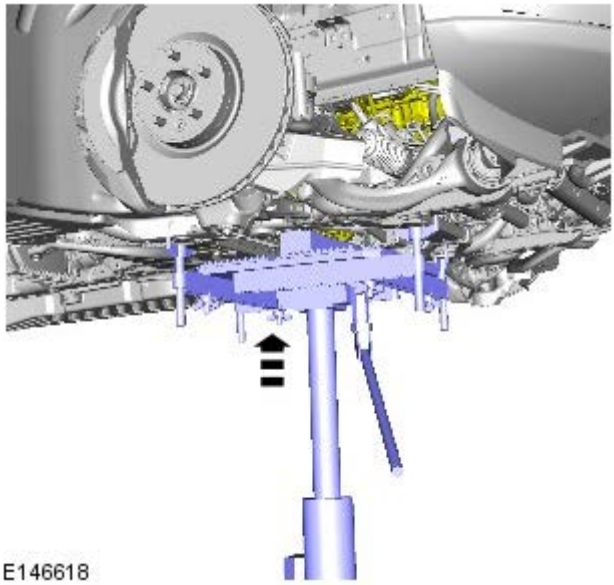


11. Remove the special tool.

    Special Tool(s): JLR-303-1568



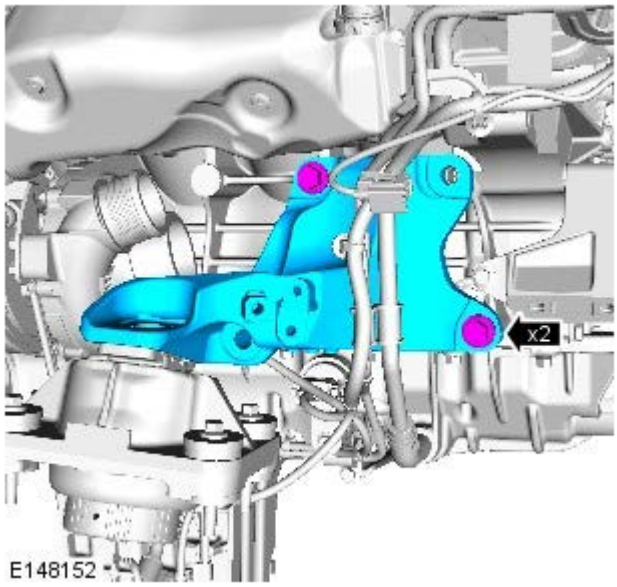
E131262


E146618

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.

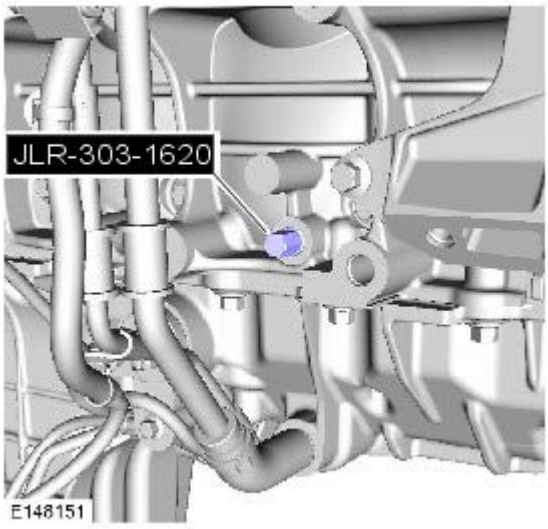
13.



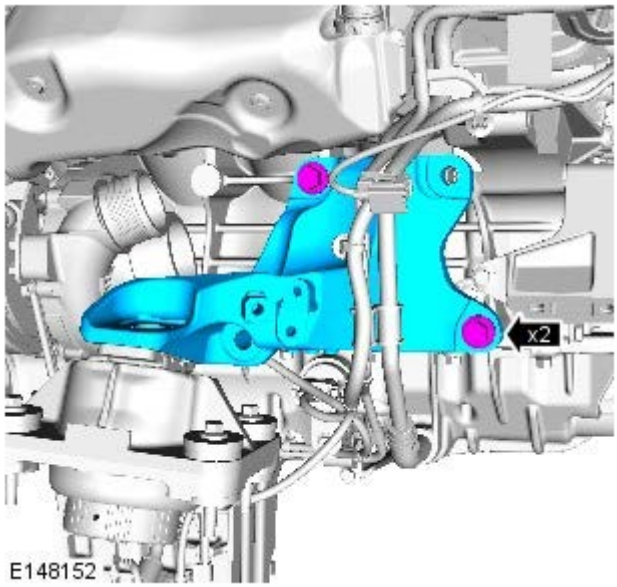
E148152

14. Remove the special tool.

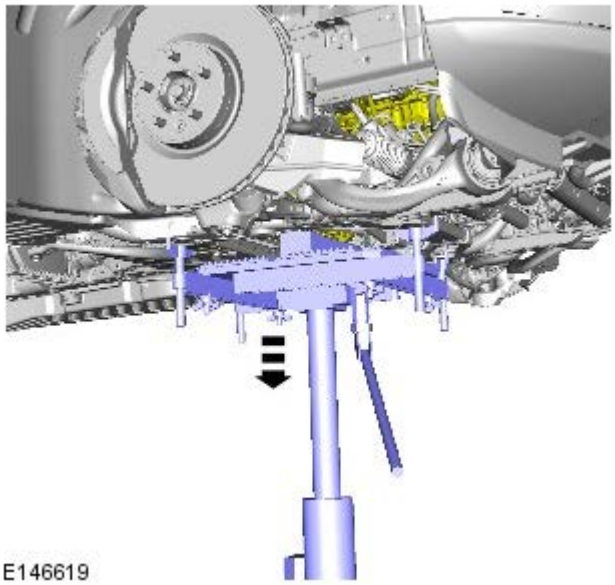
    Special Tool(s): JLR-303-1620



15.

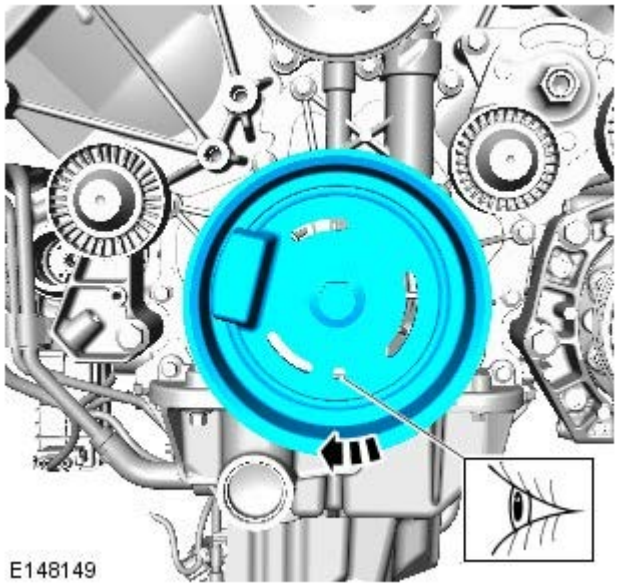


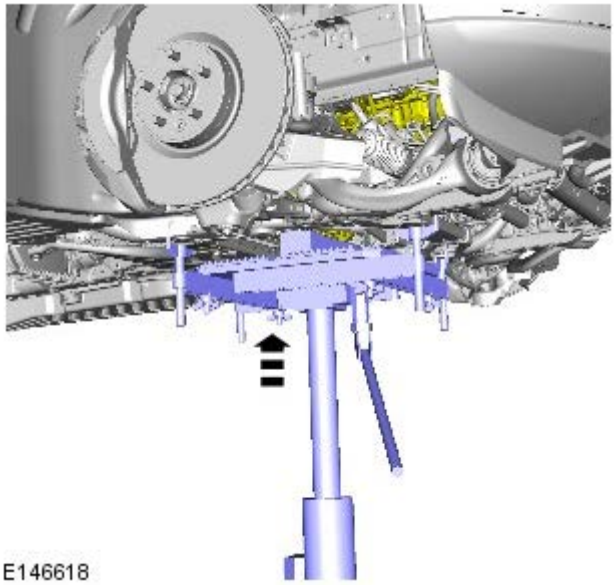
16.



17. Rotate the engine two complete turns clockwise.

18. CAUTION: Only rotate the crankshaft clockwise.

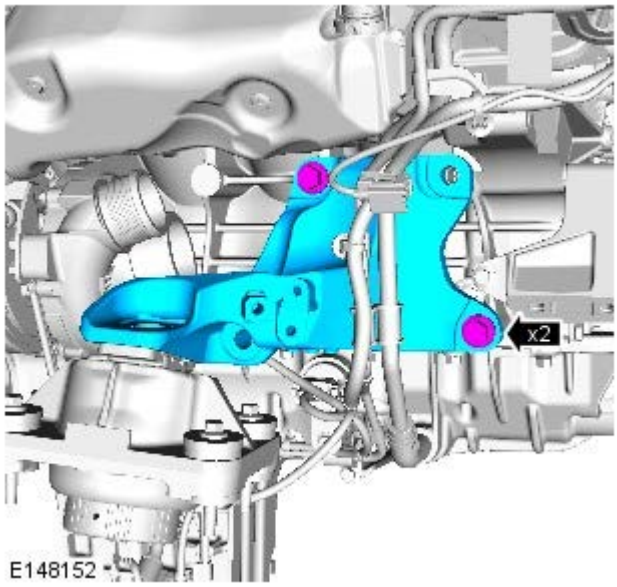




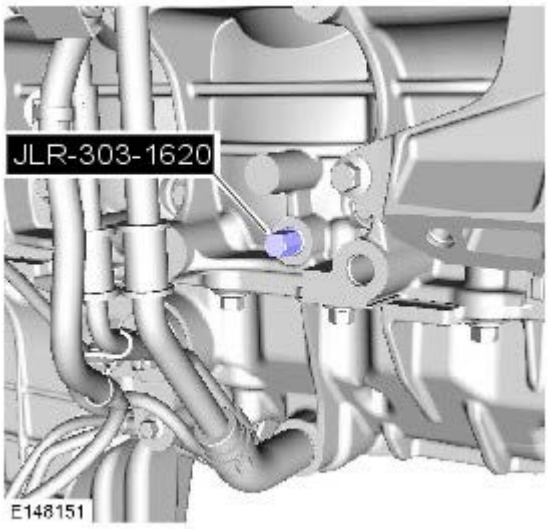
19. CAUTION: Use a wooden block to protect the oil pan when supporting the engine.

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

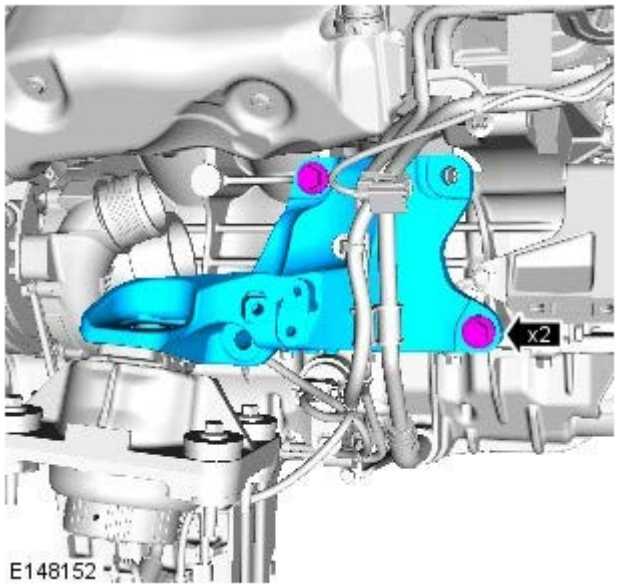
20.



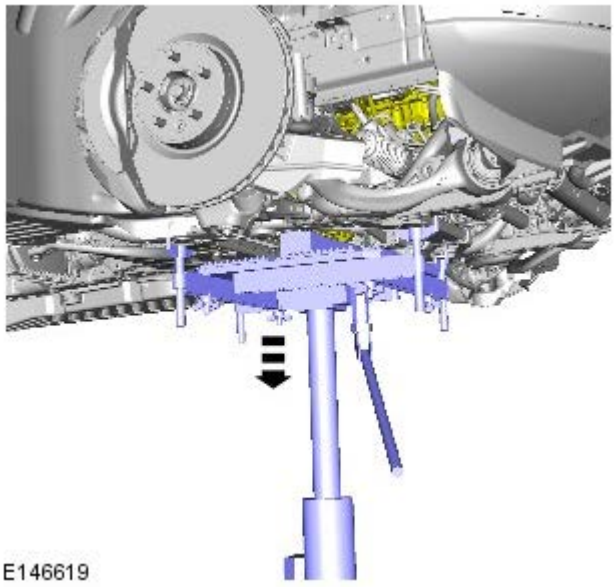
21. *Special Tool(s):* JLR-303-1620



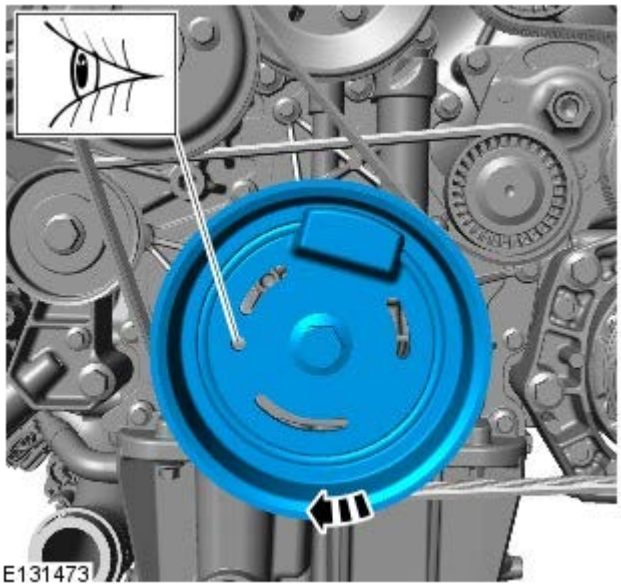
22.



23.

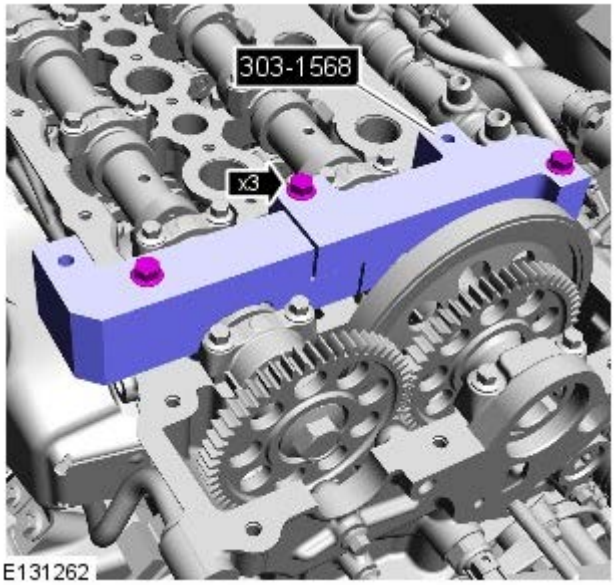


24. Rotate the engine clockwise until the crankshaft contacts the timing pin. Do not attempt to rotate the engine counter clockwise.


E131473

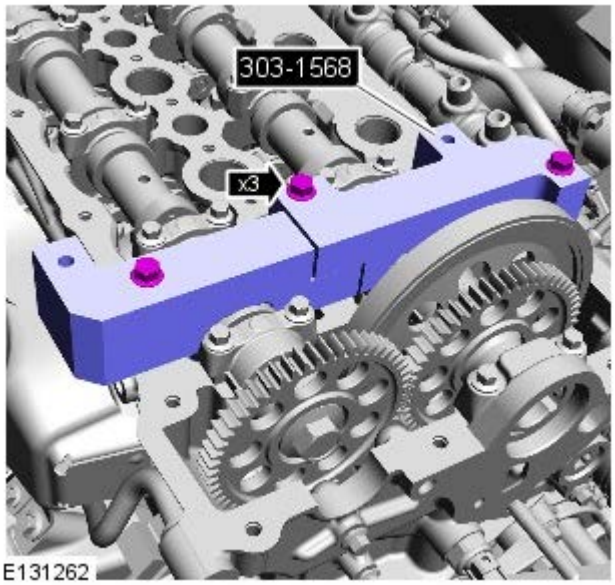
25. CAUTION: If the special tool cannot be installed, the timing chain installation steps must be repeated.

Special Tool(s): JLR-303-1568



E131262

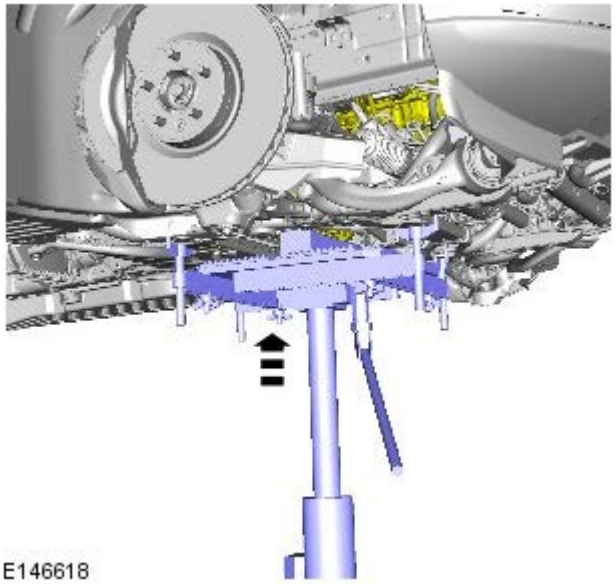
26. Remove the special tool.



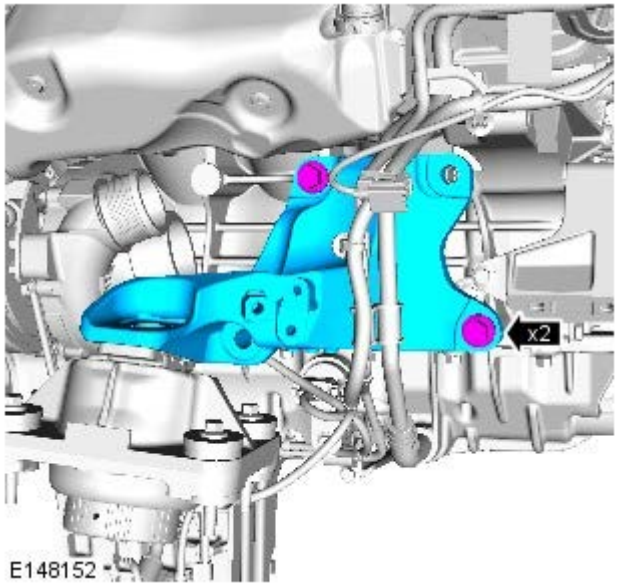
E131262

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

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

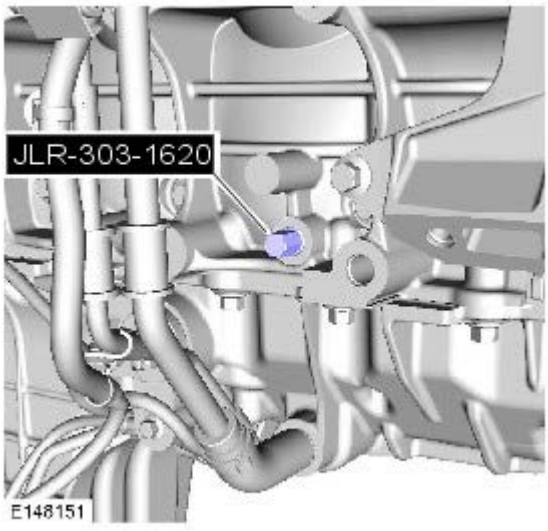


28.

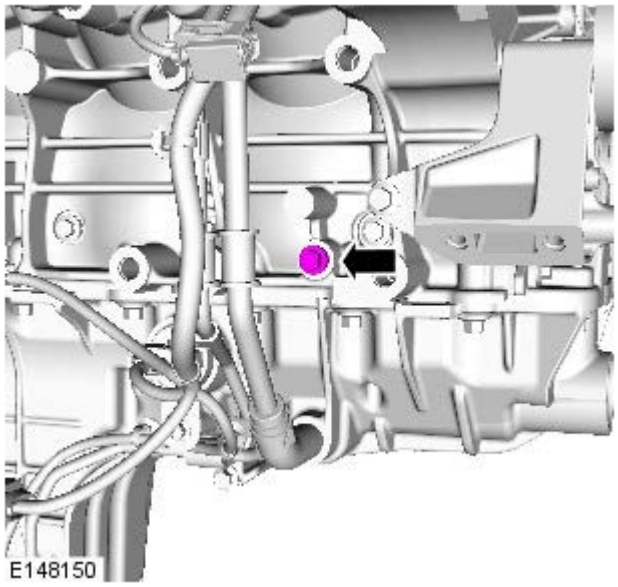


29. Remove the special tool.

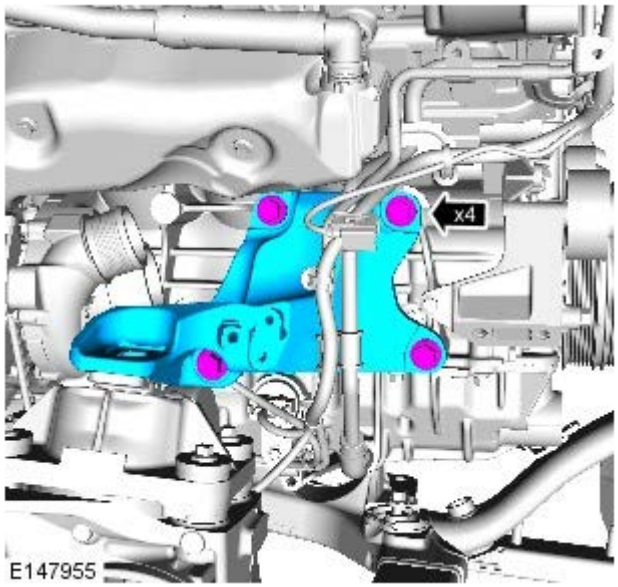
Special Tool(s): JLR-303-1620



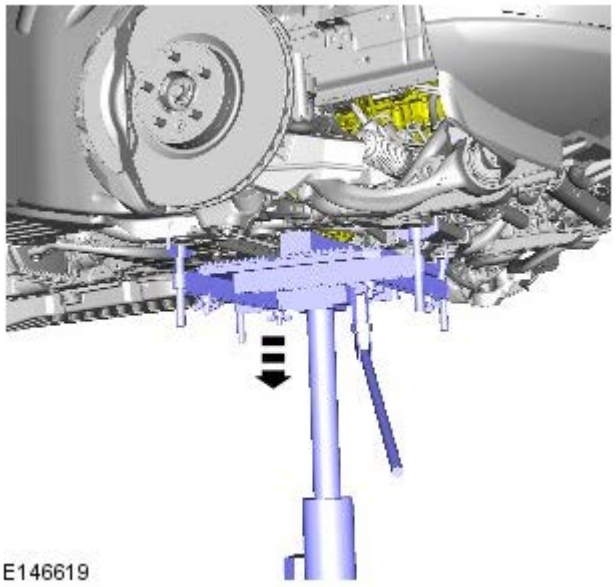
30. *Torque:* 23 Nm



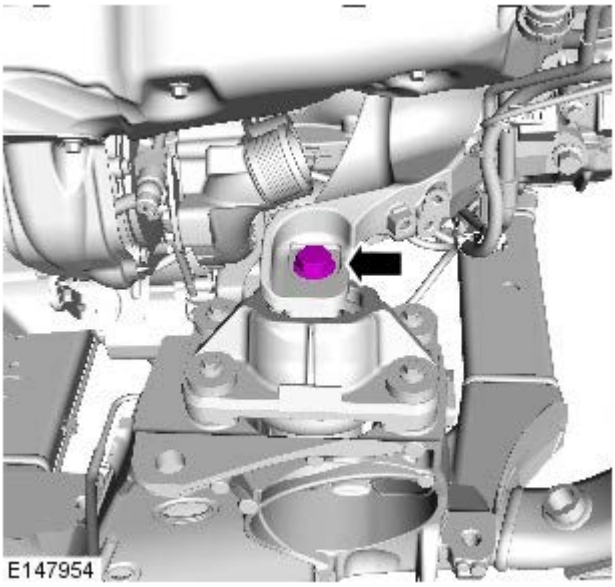
31. *Torque:* 119 Nm



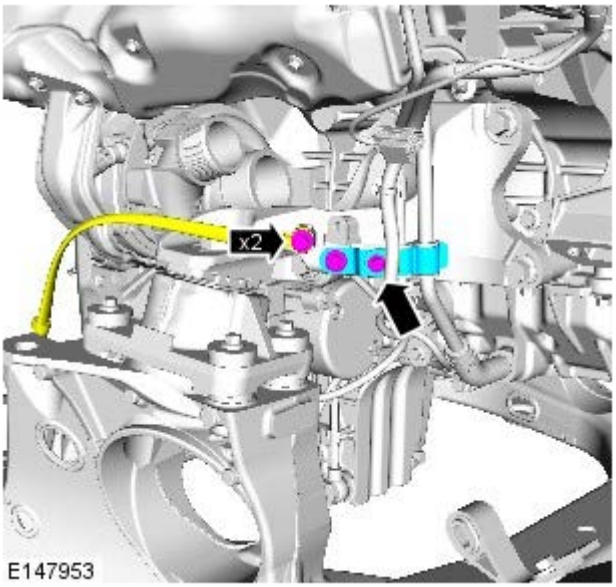
32.



33. *Torque:* 110 Nm



34. *Torque:*
    M8 25 Nm
    M6 10 Nm



35. Refer to: Brake Vacuum Pump - 4.4L V8 - TdV8 (206-07 Power Brake Actuation, Removal and Installation).

36. Refer to: Generator (414-02D Generator and Regulator - TDV8 4.4L Diesel, Removal and Installation).

37. Refer to: Valve Cover RH (303-01D Engine - TDV8 4.4L Diesel, Removal and Installation).

38. Refer to: Cooling Fan (303-03F Engine Cooling - TDV8 4.4L Diesel, Removal and Installation).

39. Connect the battery ground cable.

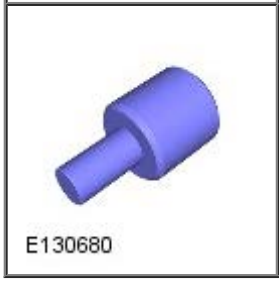
    Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 30-Oct-2013

Engine - TDV8 4.4L 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
	JLR-303-1120-01 Adapter, Crankshaft Front Seal

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.

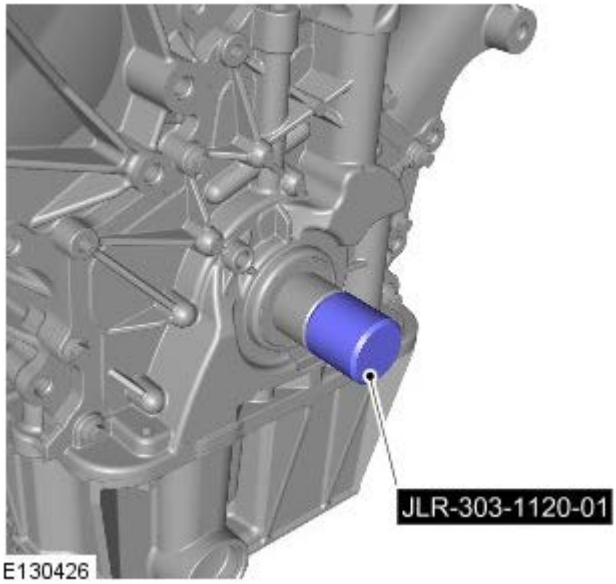
Engine shown removed for clarity.

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.

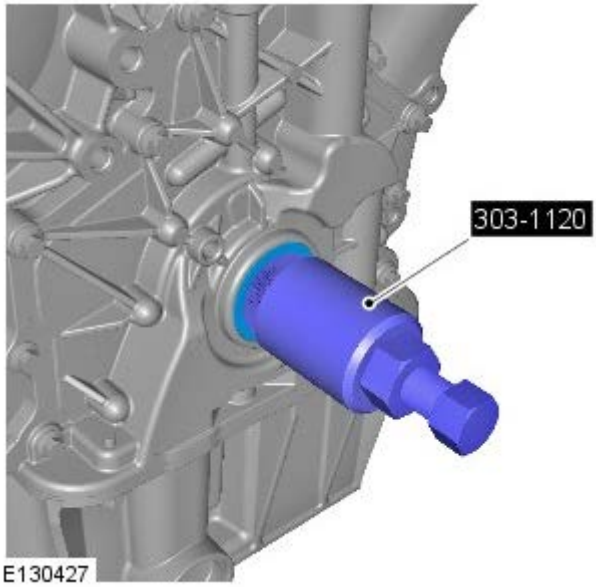
2. Refer to: Crankshaft Pulley (303-01D Engine - TDV8 4.4L Diesel, Removal and Installation).

3. *Special Tool(s):* JLR-303-1120-01

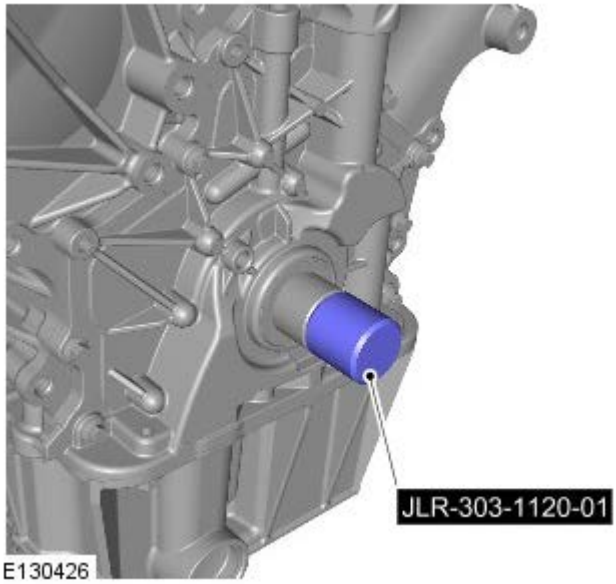


4. CAUTION: Be prepared to collect escaping oil.

   Special Tool(s): 303-1120

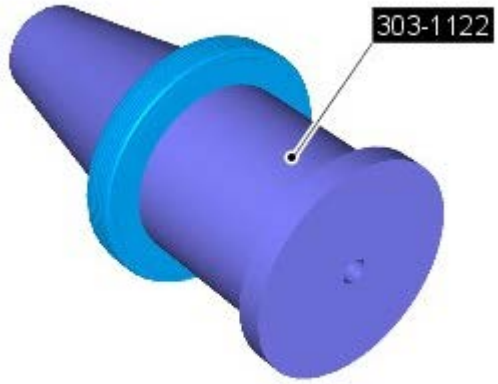


5. Remove the special tool.

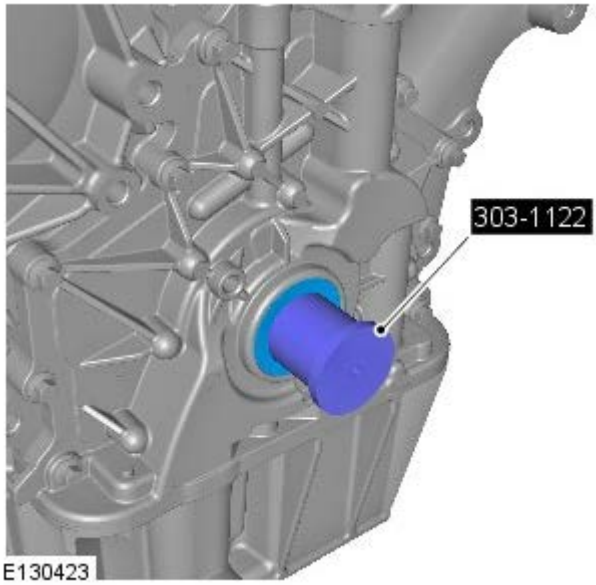


Installation

1. *Special Tool(s):* 303-1122



E130425



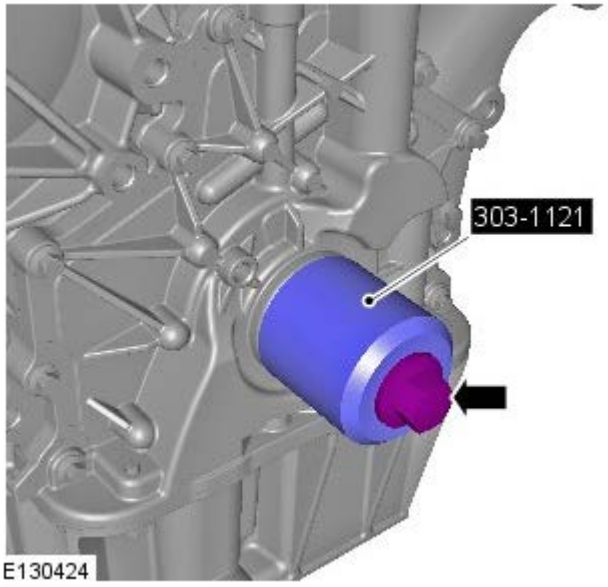
E130423

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

   NOTE: Make sure that the transit sleeve is correctly in place and install the new seal over the crankshaft. Do not use any lubricant on the seal, the transit sleeve or the crankshaft.

3. Remove the special tool.

4. *Special Tool(s):* 303-1121



E130424

5. Remove the special tool.

6. Install the crankshaft pulley.

Refer to: Crankshaft Pulley (303-01D Engine - TDV8 4.4L Diesel, Removal and Installation).

Published: 30-Oct-2013

Engine - TDV8 4.4L Diesel - Crankshaft Pulley

Removal and Installation

Special Tool(s)

	303-1243 Locking Tool, Flexplate

Removal

1. Disconnect the battery ground cable.

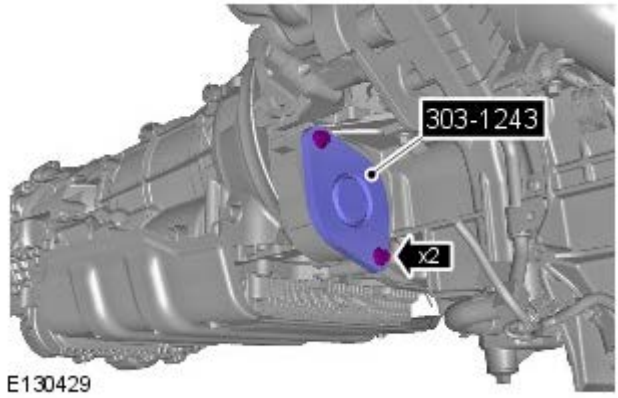
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

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.

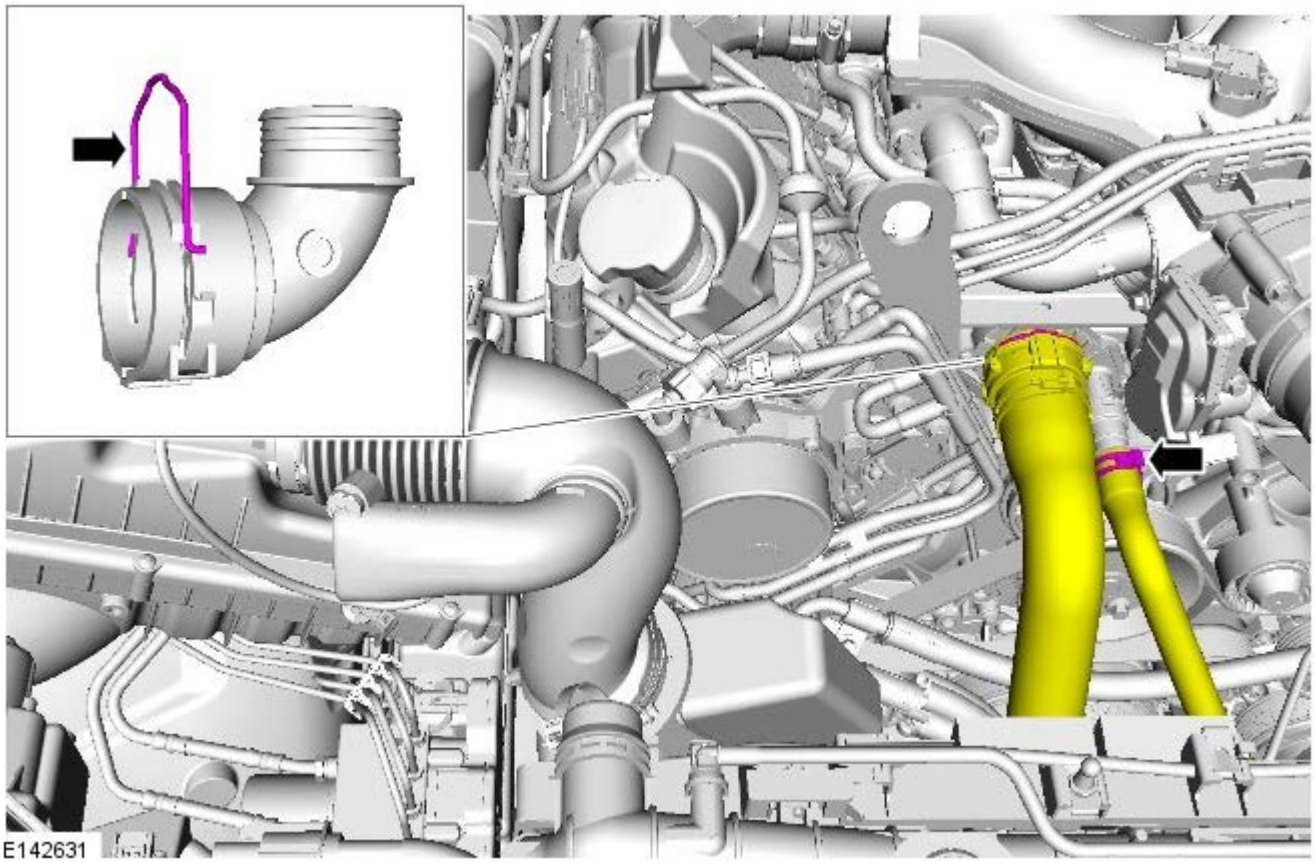
3. Refer to: Starter Motor (303-06D Starting System - TDV8 4.4L Diesel, Removal and Installation).

4. *Special Tool(s):* 303-1243

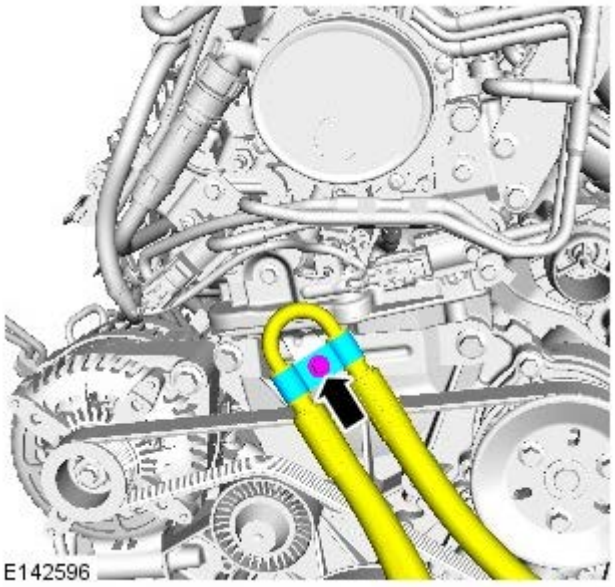


5. Refer to: Cooling Fan (303-03F Engine Cooling - TDV8 4.4L Diesel, Removal and Installation).

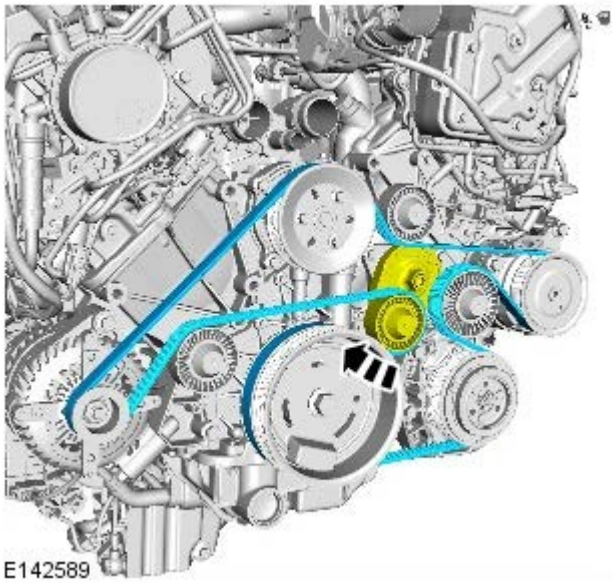
6.



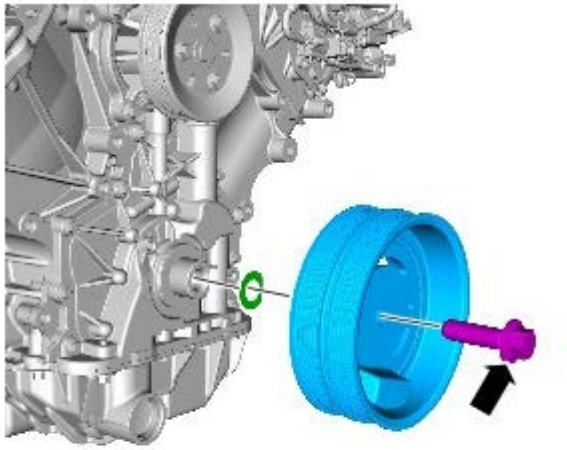
7.



8.



E142589

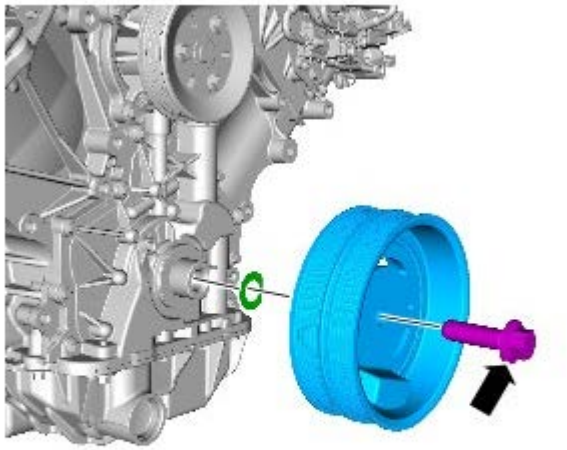


E144269

9. CAUTION: Discard the bolt.

   NOTE: The crankshaft pulley bolt will be very tight.

Installation



E144269

1. CAUTIONS:

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

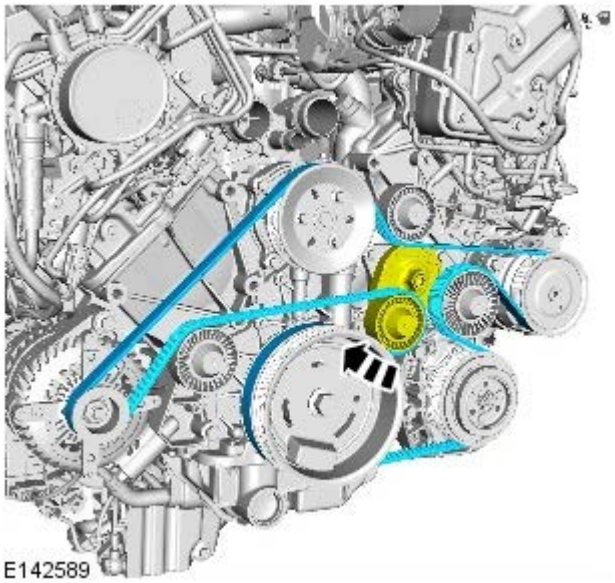
   Make sure that the washer is installed between the nose of the crankshaft and the crankshaft pulley.

   Make sure that a new crankshaft pulley bolt is installed.

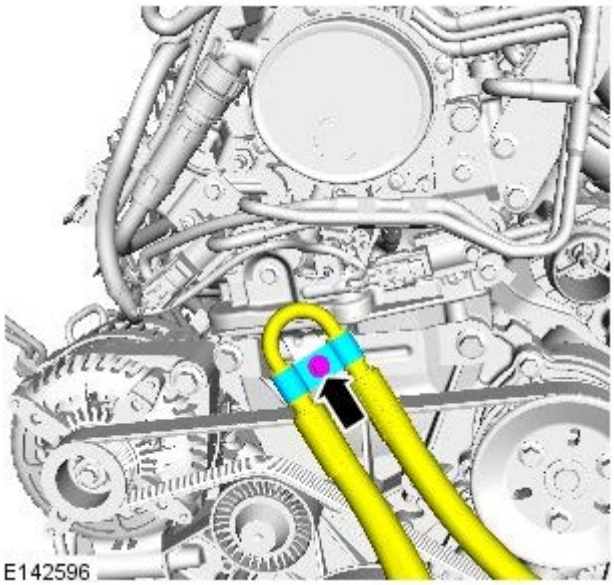
   NOTE: The use of a torque multiplier capable of 600Nm will be required.

   Torque:
   Stage 1: 100 Nm
   Stage 2: 103°
   Stage 3: 35°

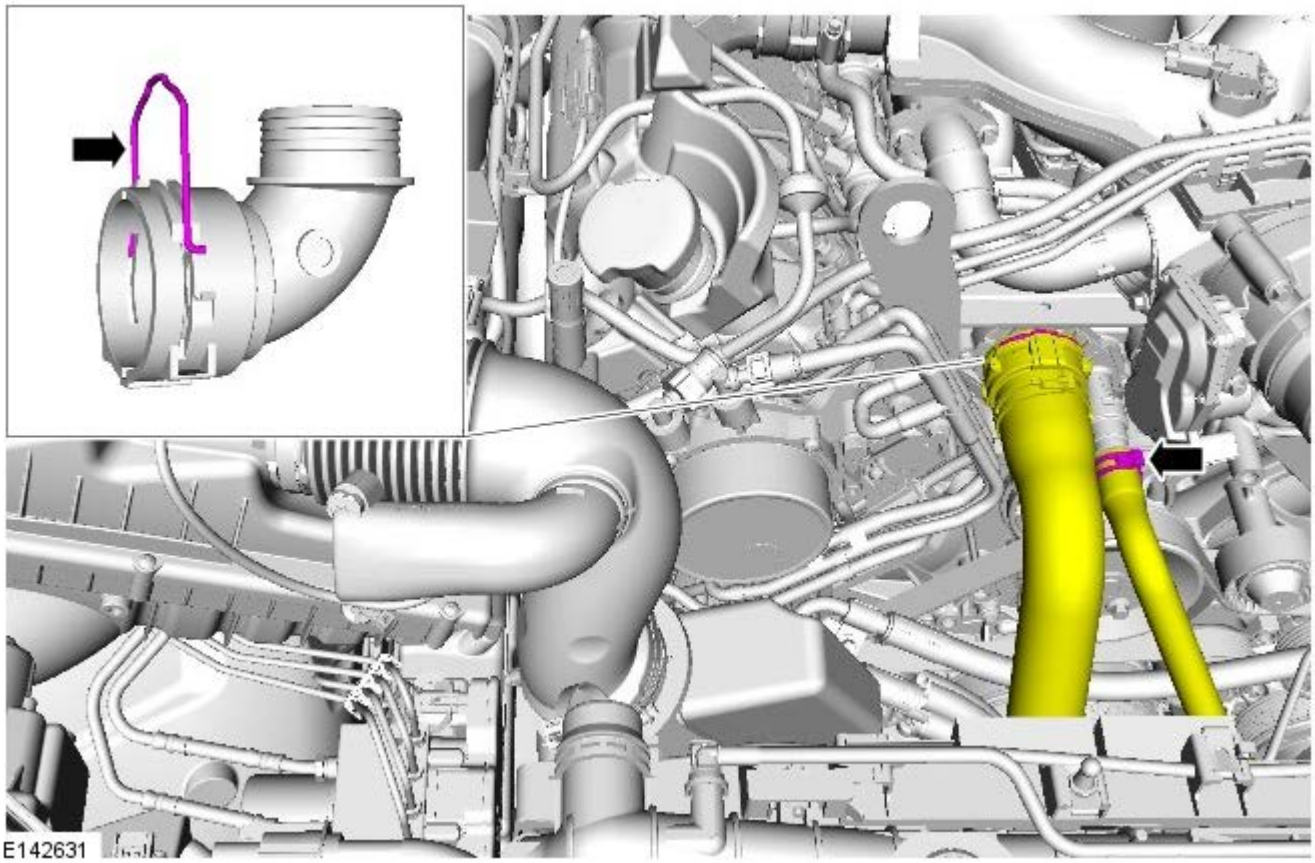
2.



3. *Torque:* 10 Nm

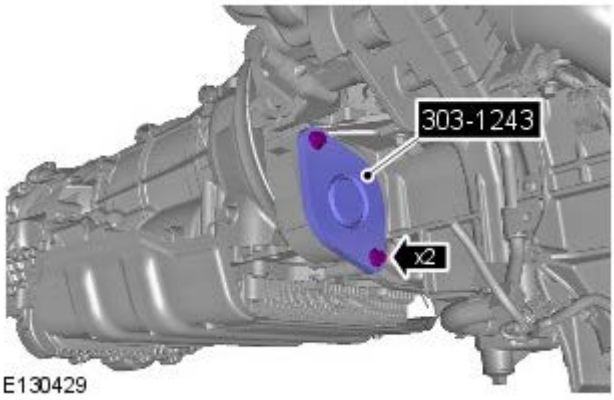


4.



5. Refer to: Cooling Fan (303-03F Engine Cooling - TDV8 4.4L Diesel, Removal and Installation).

6. *Special Tool(s):* 303-1243



7. Refer to: Starter Motor (303-06D Starting System - TDV8 4.4L Diesel, Removal and Installation).

8. Connect the battery ground cable.

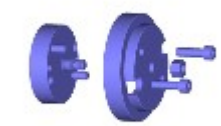
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 31-Oct-2013

Engine - TDV8 4.4L Diesel - Crankshaft Rear Seal

Removal and Installation

Special Tool(s)

 E130668	303-1237 Installer, Crankshaft Position Sensor Ring
 E81375	303-1243 Locking Tool, Flexplate

Removal

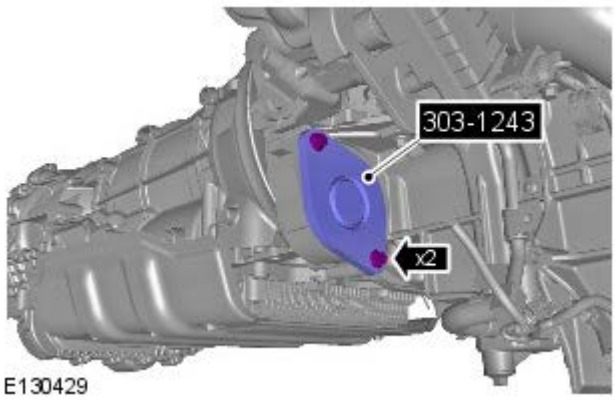
NOTES:

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

Removal steps in this procedure may contain installation details.

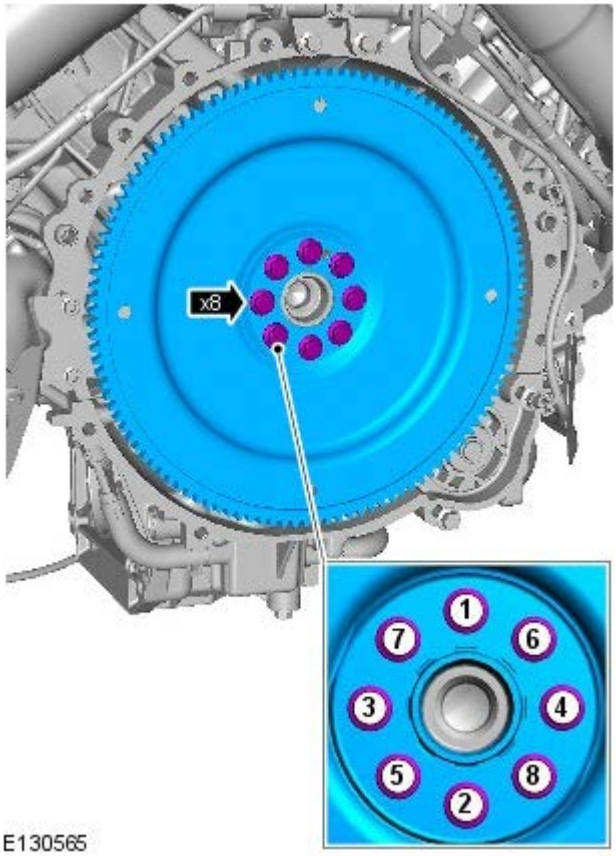
Some components shown removed for clarity.

1. Refer to: Engine Oil Draining and Filling (303-01D Engine - TDV8 4.4L Diesel, General Procedures).
2. Refer to: Transmission - TDV8 4.4L Diesel (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, Removal).
3. Refer to: Differential Case (205-03 Front Drive Axle/Differential, Removal and Installation).
4. *Special Tool(s):* 303-1243



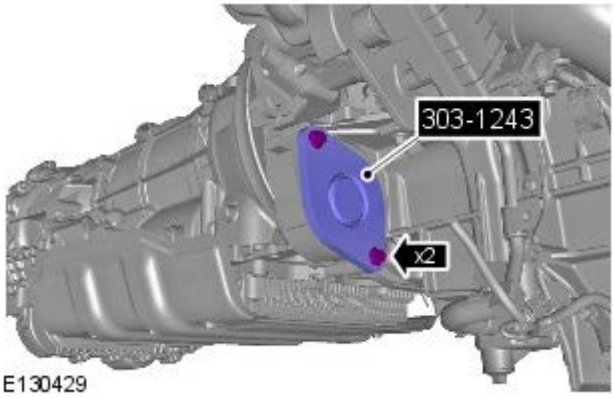
E130429

5. CAUTION: Discard the bolts.



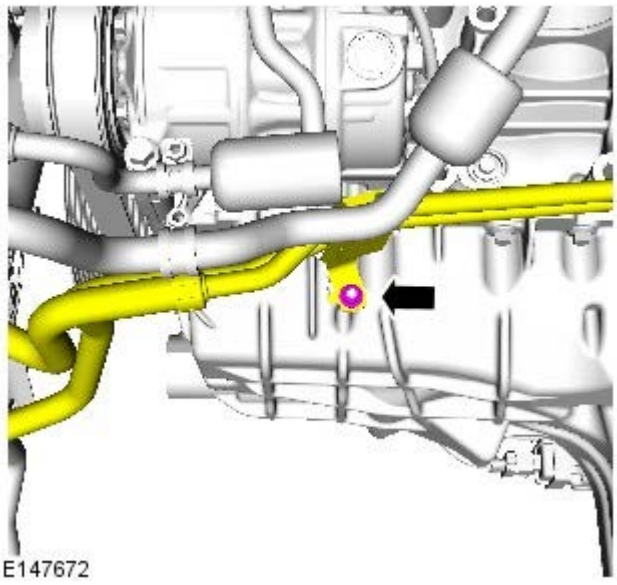
E130565

6. *Special Tool(s):* 303-1243

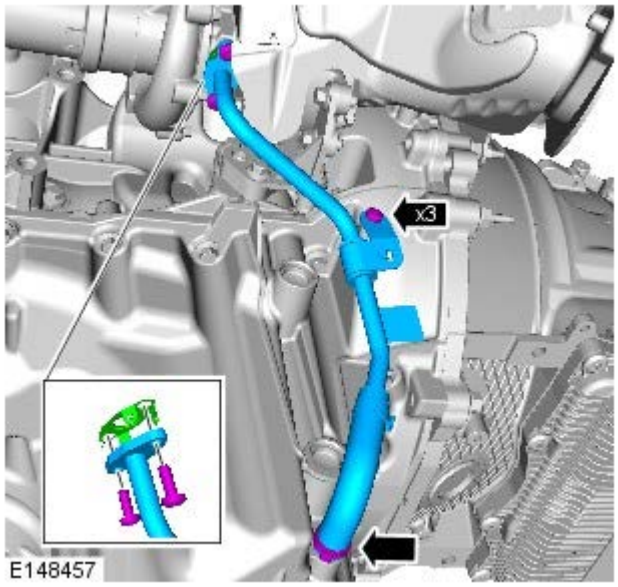


E130429

7.


E147672

8. CAUTIONS:



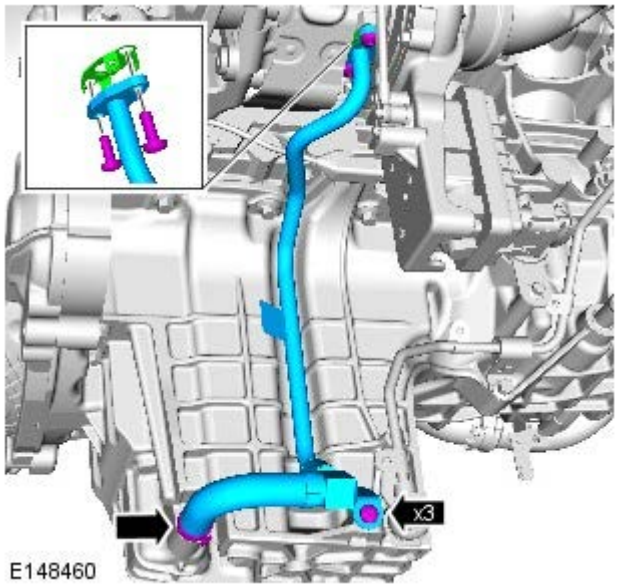
Be prepared to collect escaping oil.

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

NOTES:

Remove and discard the gasket.

Discard the retaining clip.



9. CAUTIONS:

Be prepared to collect escaping oil.

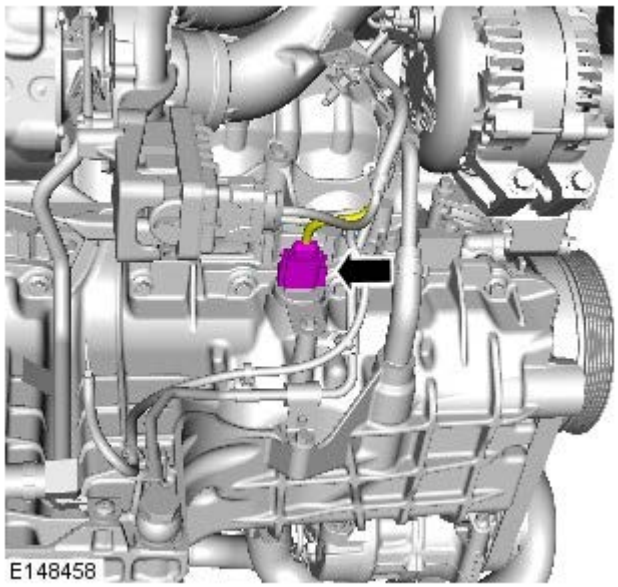
Make sure that all openings are sealed. Use new blanking caps.

NOTES:

Remove and discard the gasket.

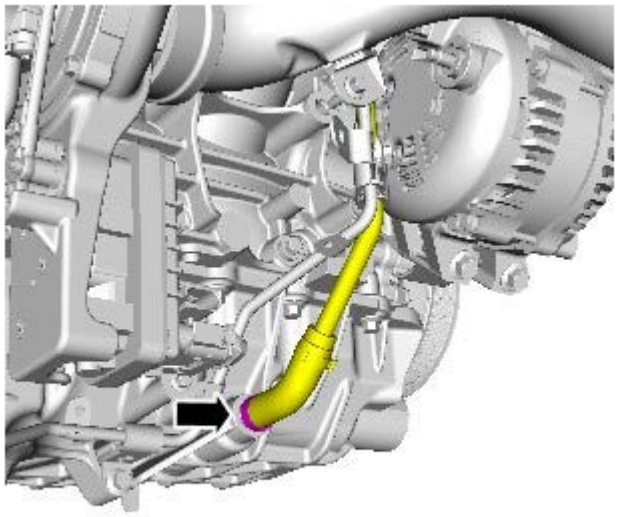
Discard the retaining clip.

10.

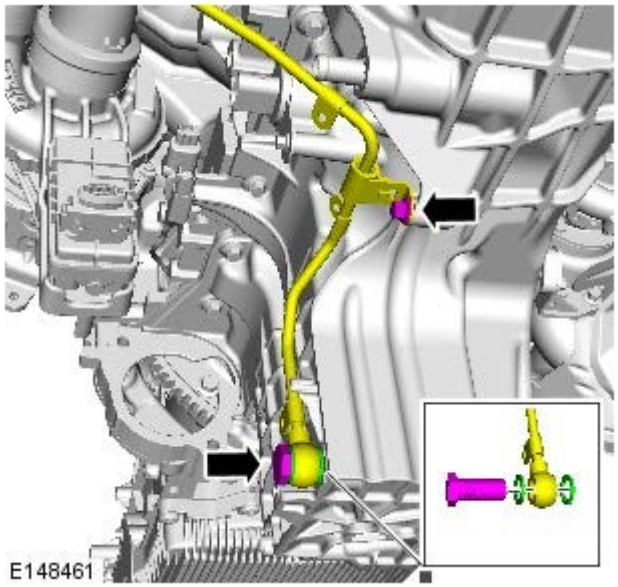


11. CAUTION: Be prepared to collect escaping oil.

NOTE: Discard the retaining clip.



E148459



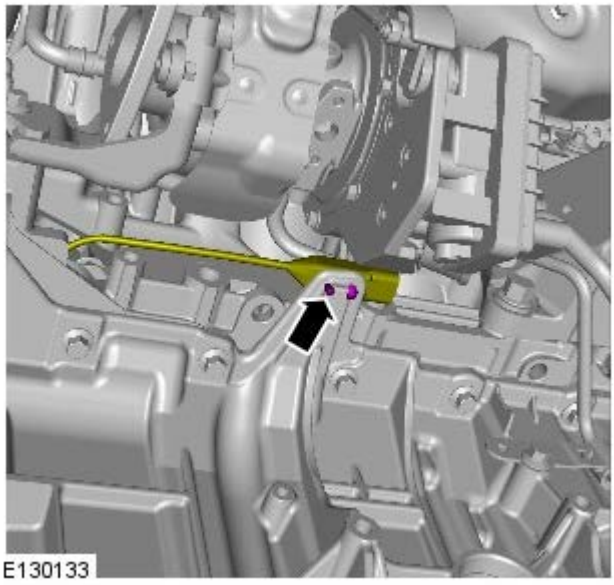
E148461

12. CAUTIONS:

Be prepared to collect escaping oil.

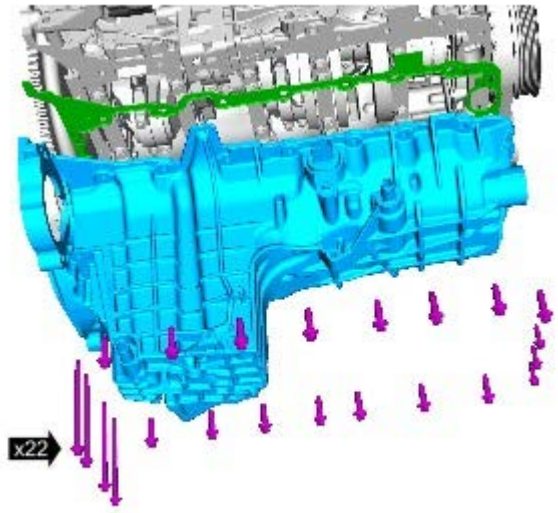
Inspect the seals, replace if damaged.

13.

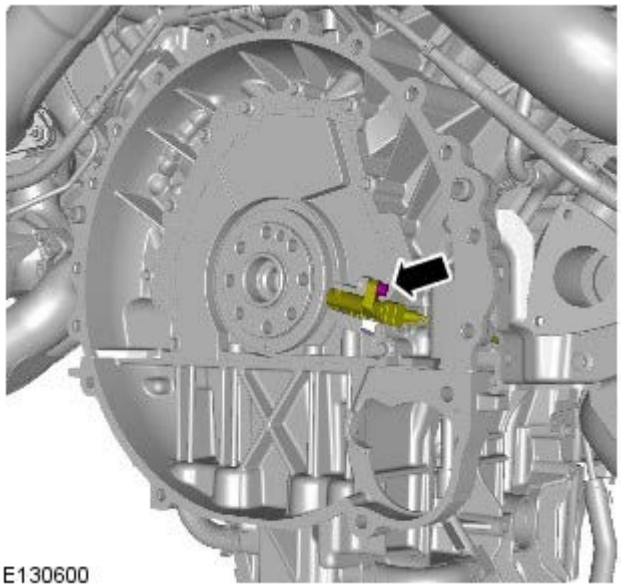


E130133

14. NOTE: Remove and discard the gasket.

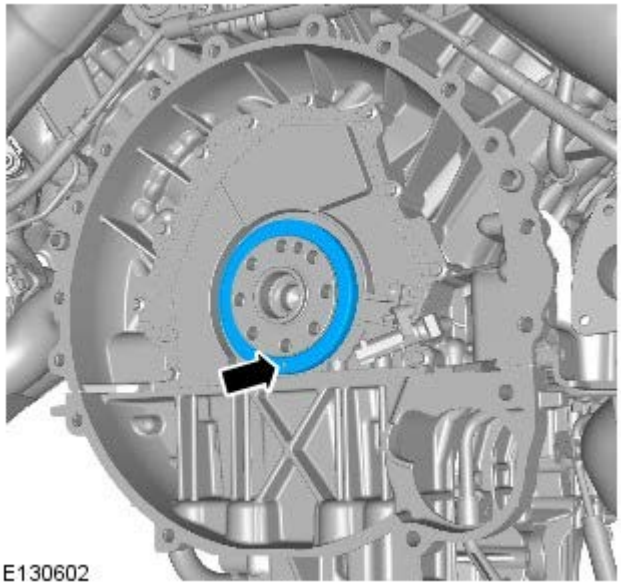


E148681



E130600

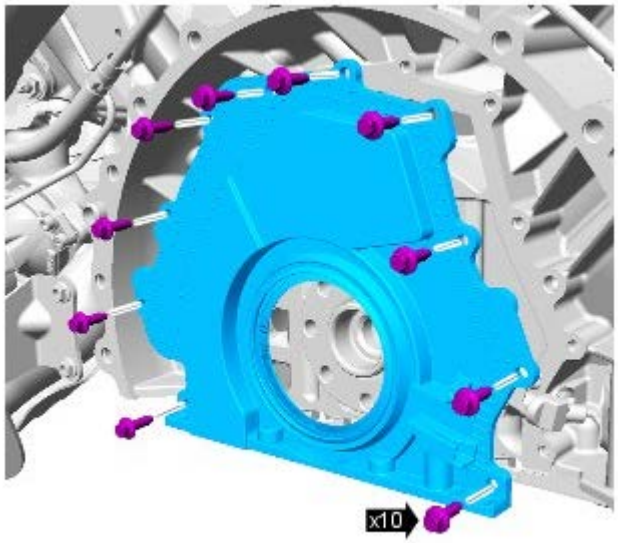
15. CAUTION: The CKP sensor bolt should not be removed from the CKP sensor.



E130602

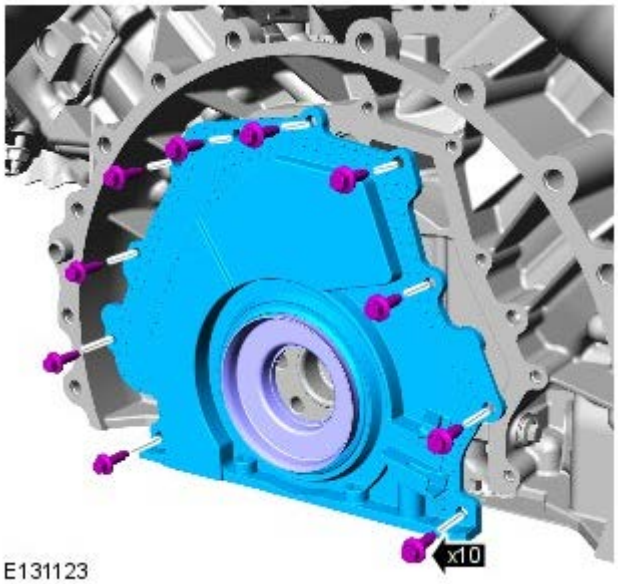
16. CAUTION: Discard the component.

17.



E131065

Installation



E131123

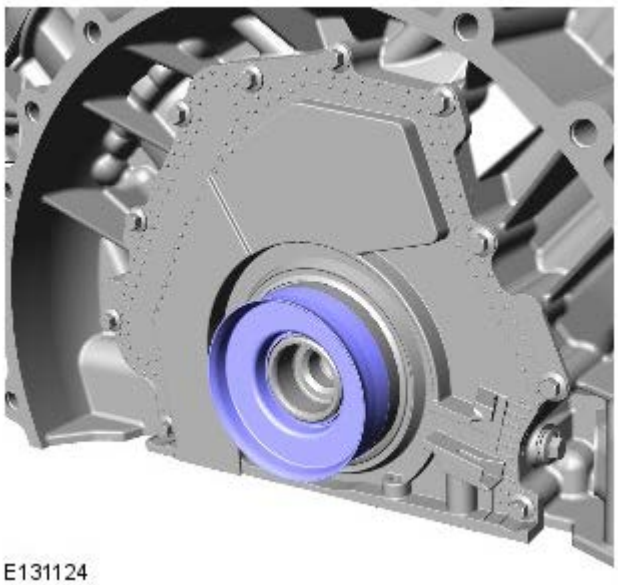
1. CAUTIONS:

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

   A new crankshaft rear seal is supplied with a transit sleeve that must not be removed until the crankshaft rear seal is fully installed.

   Install all the bolts finger tight before final tightening.

   Torque: 10 Nm



E131124

2. Remove and discard the transit sleeve.

3. CAUTIONS:



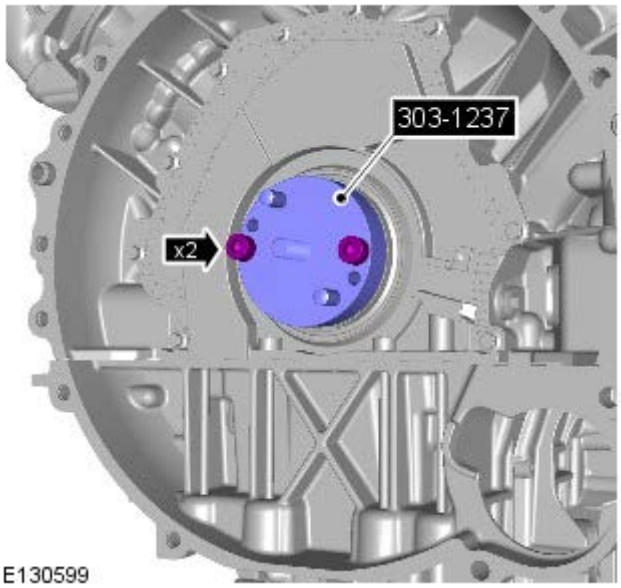
E130601

Make sure that a new component is installed.

Make sure that the CKP sensor ring is aligned correctly with the special tool pip and that both mating surfaces are fully seated.

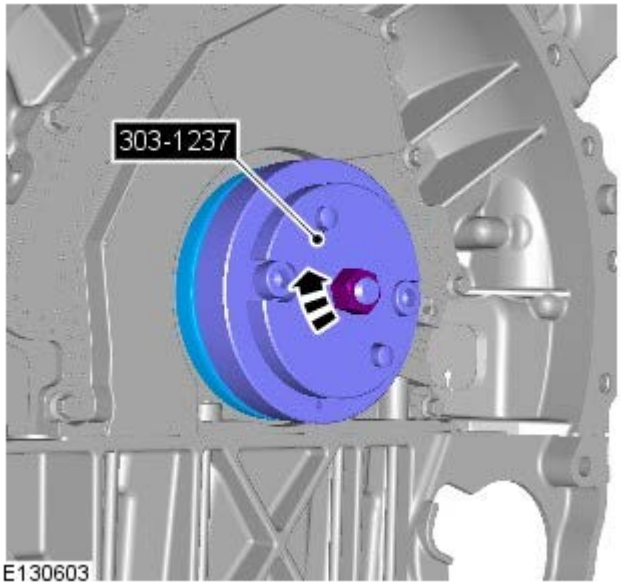
Special Tool(s): 303-1237

4. Install the special tool.



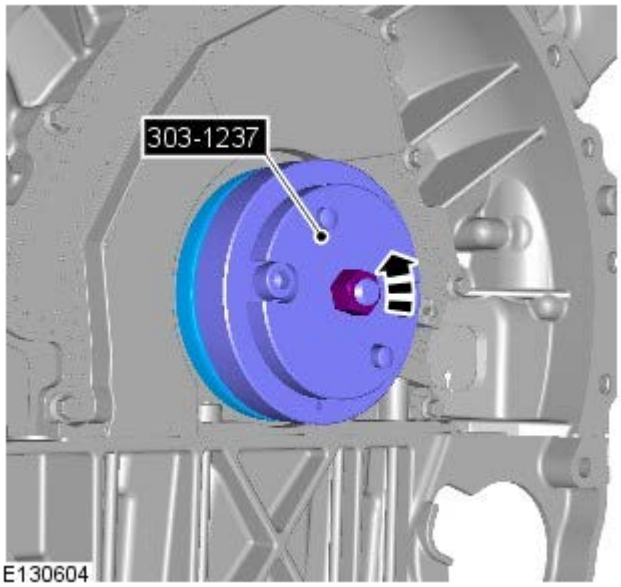
E130599

5.



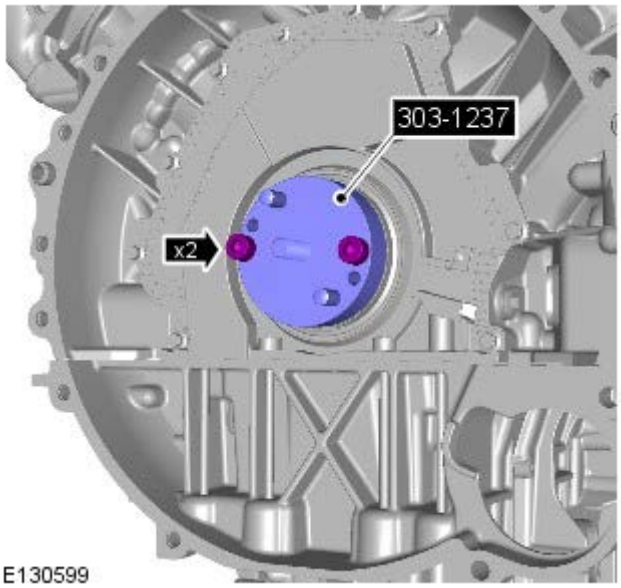
E130603

6.

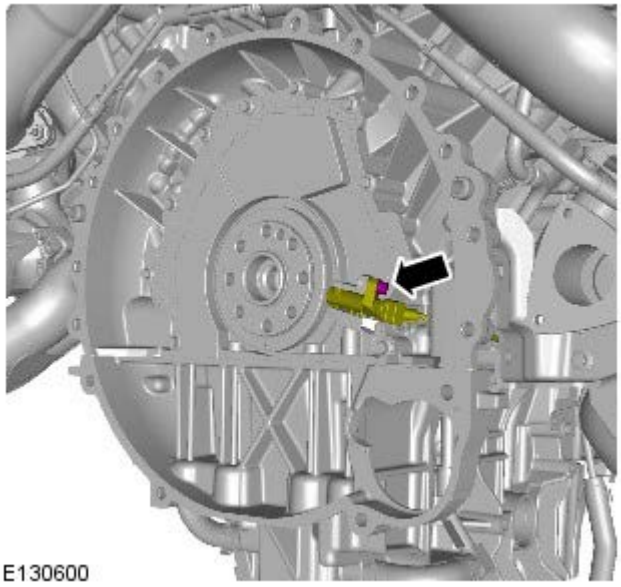


E130604

7. Remove the special tool.



E130599

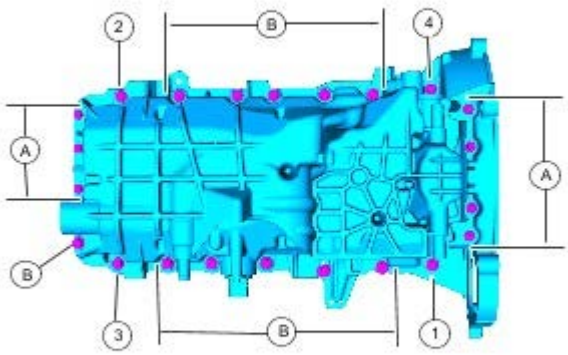

E130600

8. CAUTION: Install the CKP sensor correctly into the housing. Failure to follow this instruction may result in damage to the CKP sensor.

   Torque: 5 Nm

9. CAUTIONS:

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



E148682

Install all the bolts finger tight before final tightening.

NOTES:

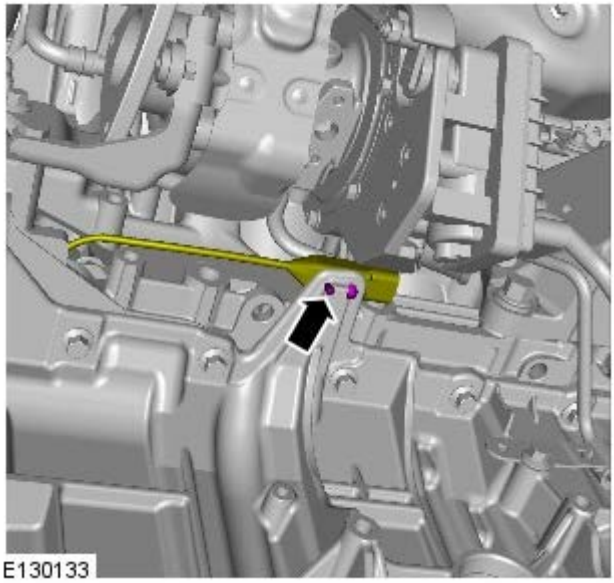
Install a new gasket.

Tighten the bolts in the indicated sequence.

Torque:

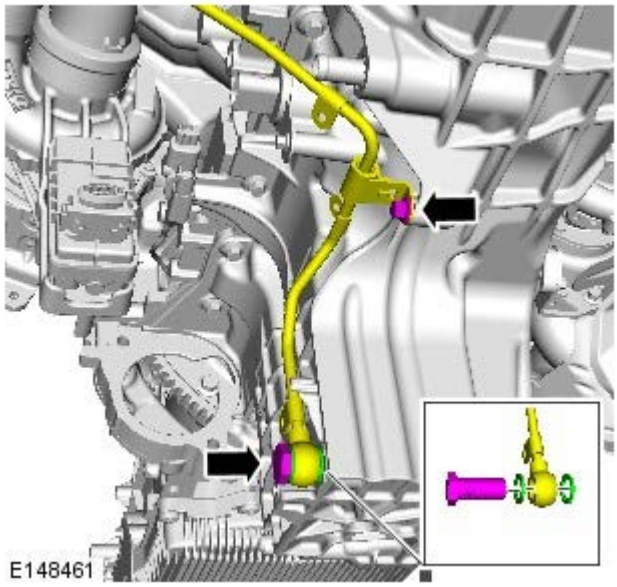
1-4 23 Nm
B 23 Nm
A 10 Nm

10.



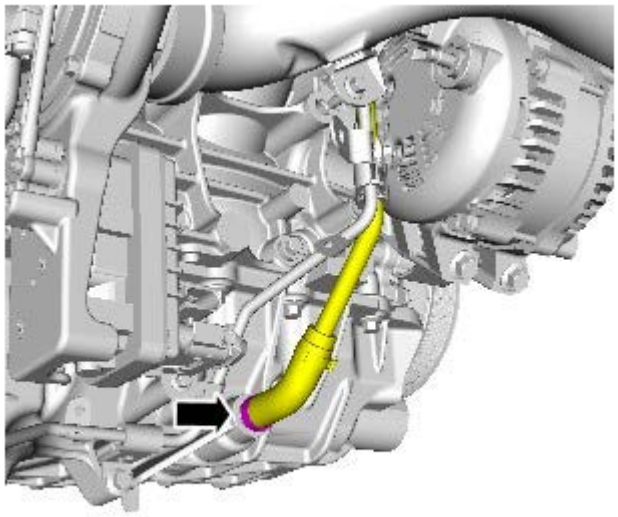
E130133

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



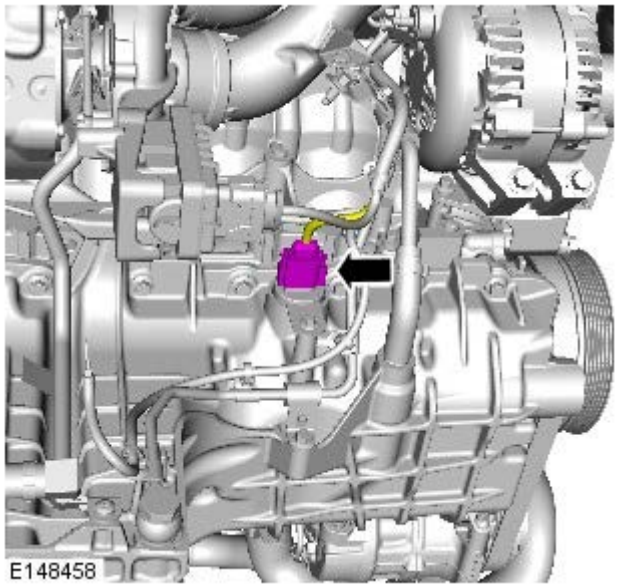
E148461

12. NOTE: Install a new retaining clip.



E148459

13.



E148458

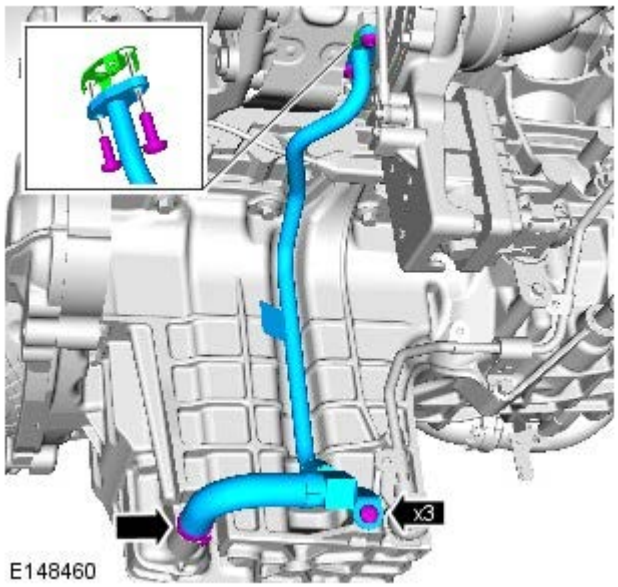
14. NOTES:

Remove and discard the blanking caps.

Install a new gasket.

Install a new retaining clip.

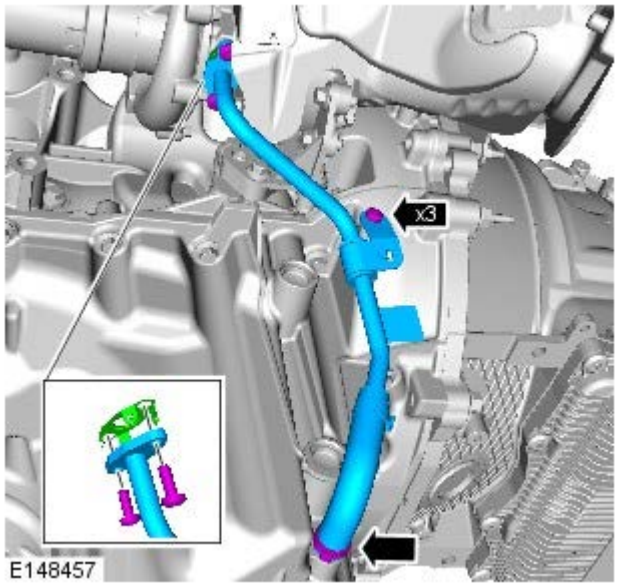
Torque: 10 Nm



E148460

15. NOTES:

Remove and discard the blanking caps.

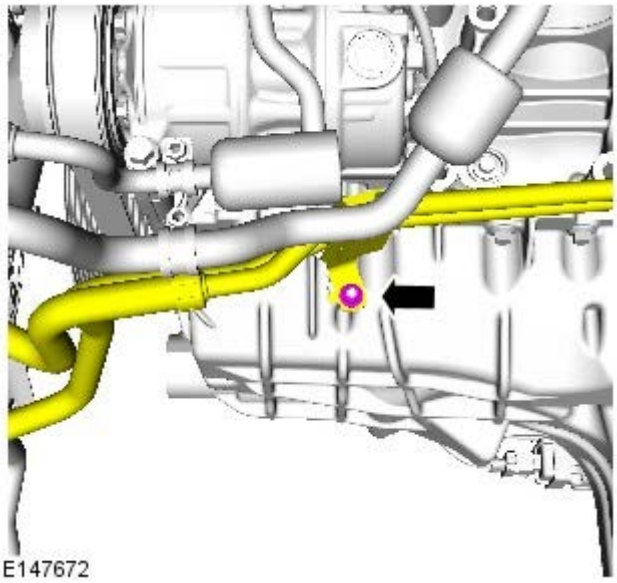


Install a new gasket.

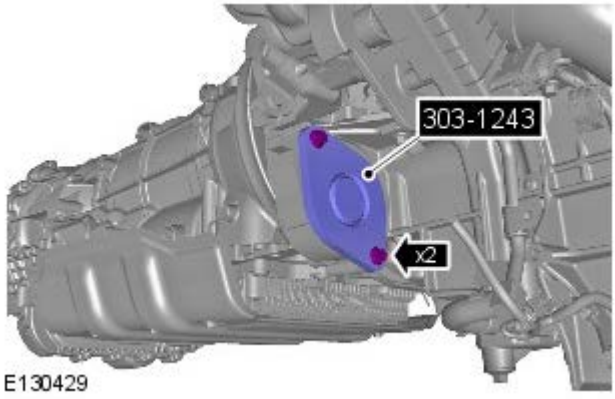
Install a new retaining clip.

Torque: 10 Nm

16. *Torque:* 9 Nm

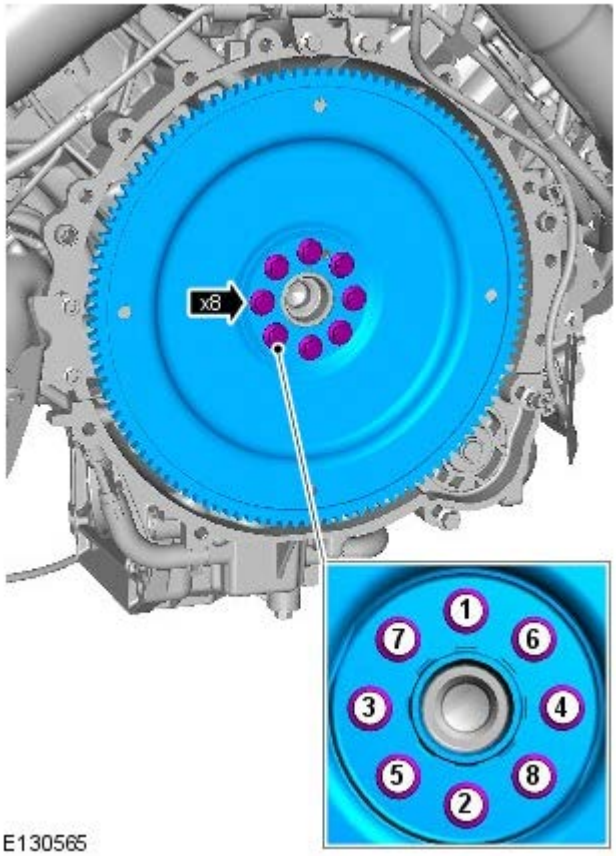


17. *Special Tool(s):* 303-1243



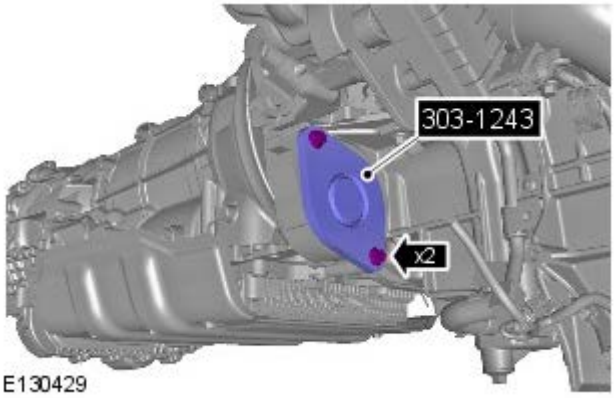
18. CAUTION: Make sure that new bolts are installed.

Torque:
Stage 1 15 Nm
Stage 2 35°
Stage 3 15°



E130565

19. *Special Tool(s):* 303-1243



E130429

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

21. Refer to: Transmission - TDV8 4.4L Diesel (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, Removal).

22. Connect the battery ground cable.

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

Published: 11-Nov-2013

Engine - TDV8 4.4L Diesel - Cylinder Head 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.

Engine shown removed for clarity.

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

   Raise and support the vehicle.

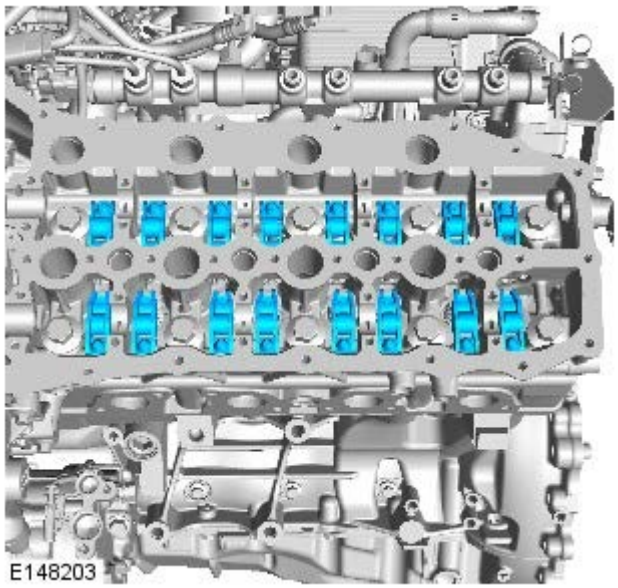
2. Disconnect the battery ground cable.

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

3. Refer to: Exhaust Manifold LH (303-01D Engine - TDV8 4.4L Diesel, Removal and Installation).

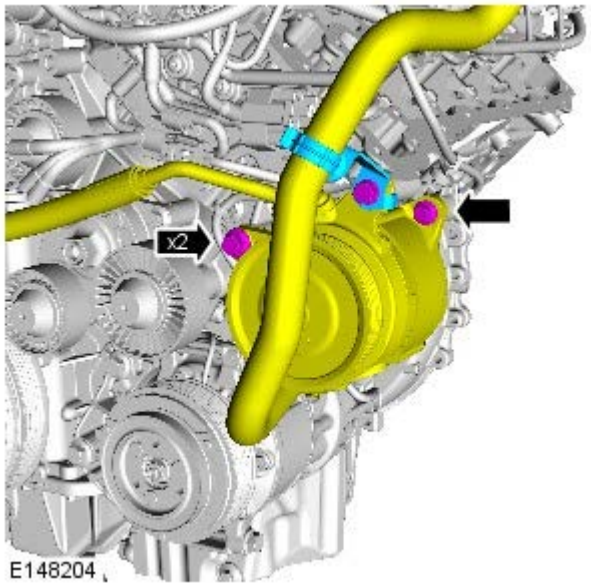
4. Refer to: Generator (414-02D Generator and Regulator - TDV8 4.4L Diesel, Removal and Installation).

5. Refer to: Camshaft LH (303-01D Engine - TDV8 4.4L Diesel, Removal and Installation).

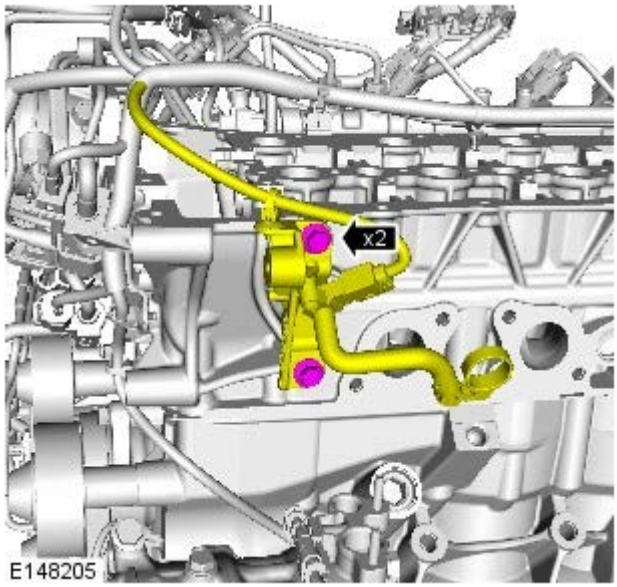


6. NOTE: Note the position of the components prior to removal.

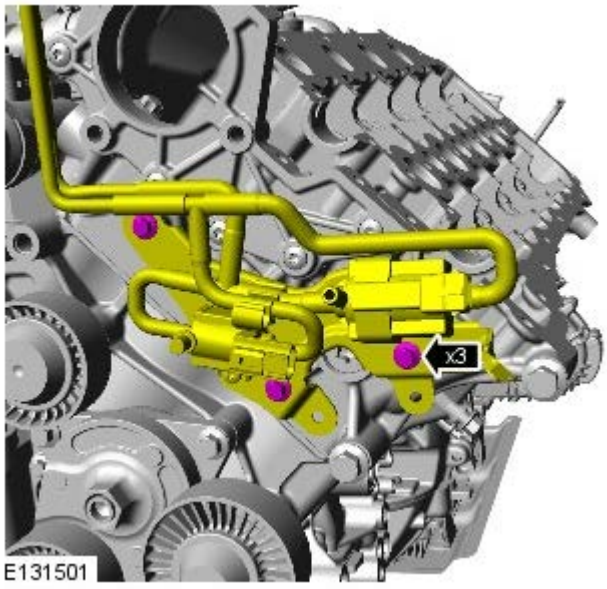
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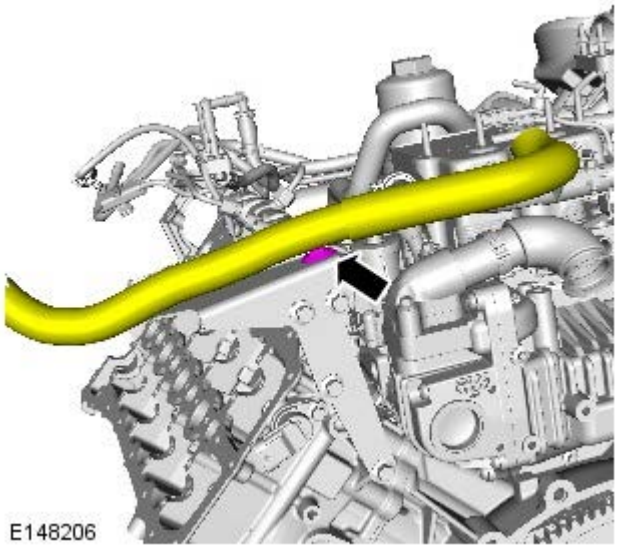
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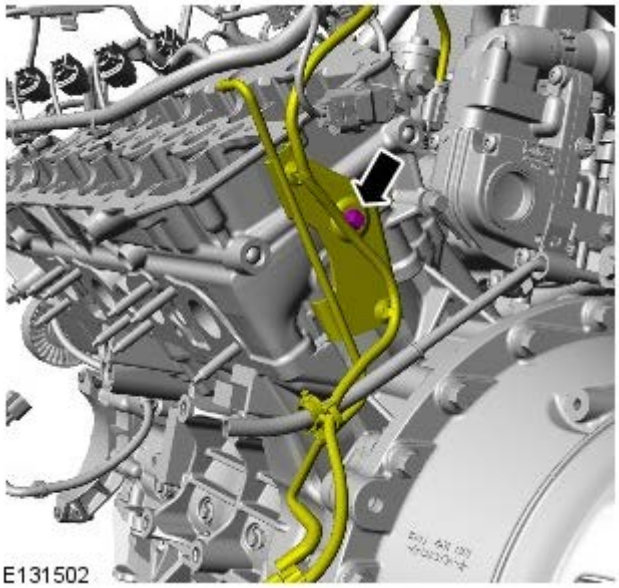
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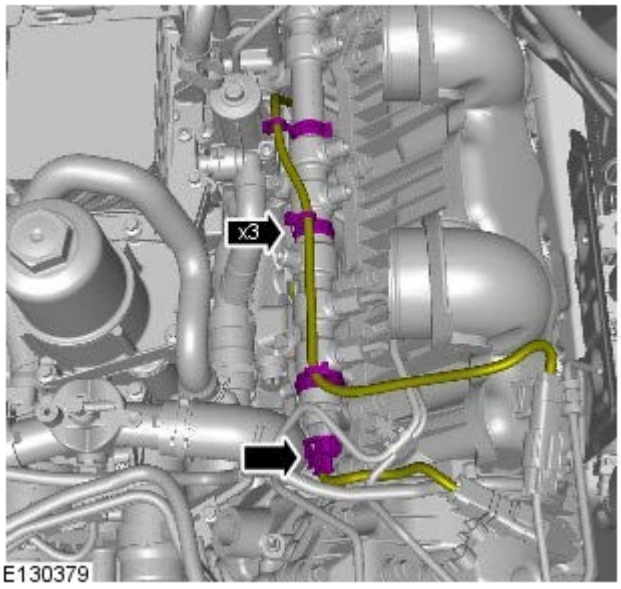
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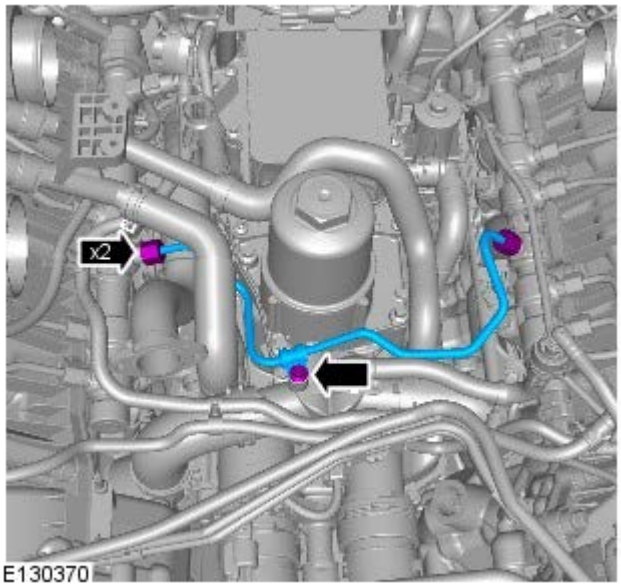
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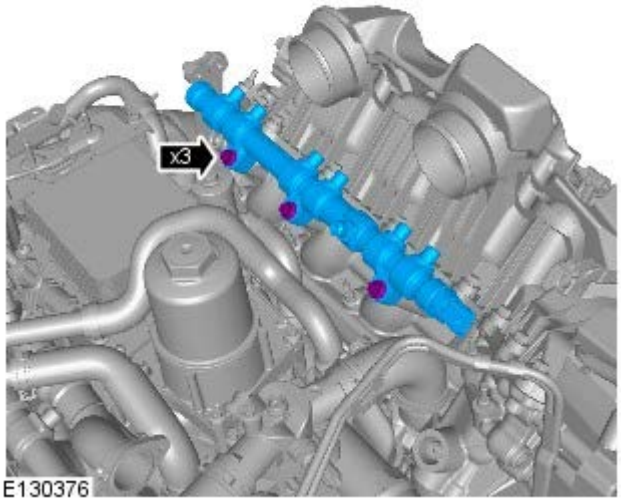
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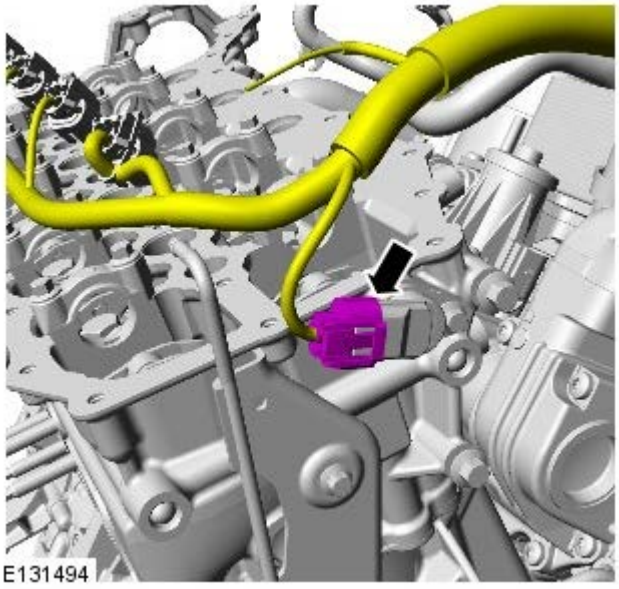
13. CAUTION: Discard the fuel pipes.



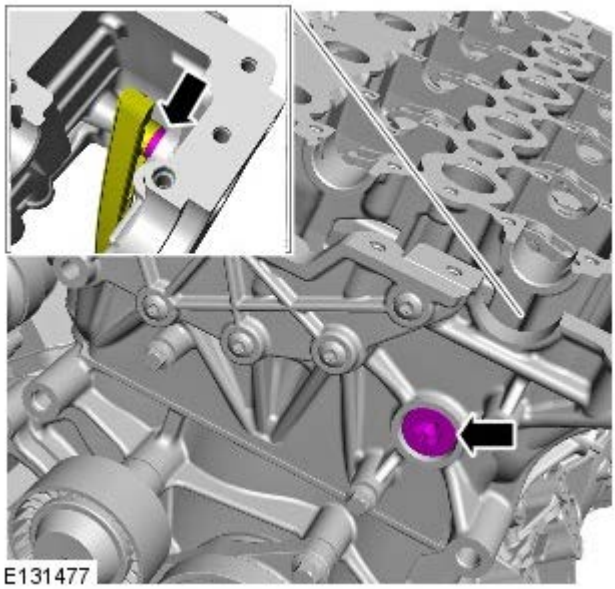
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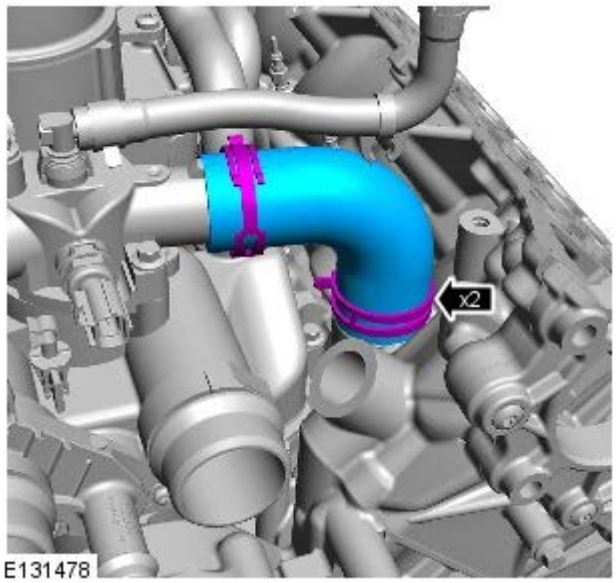
15.



16.


E131477

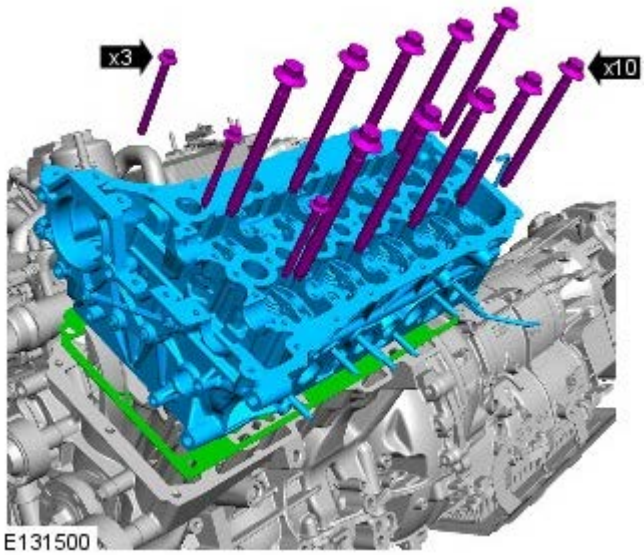
17.



E131478

18. CAUTION: Discard the bolts.

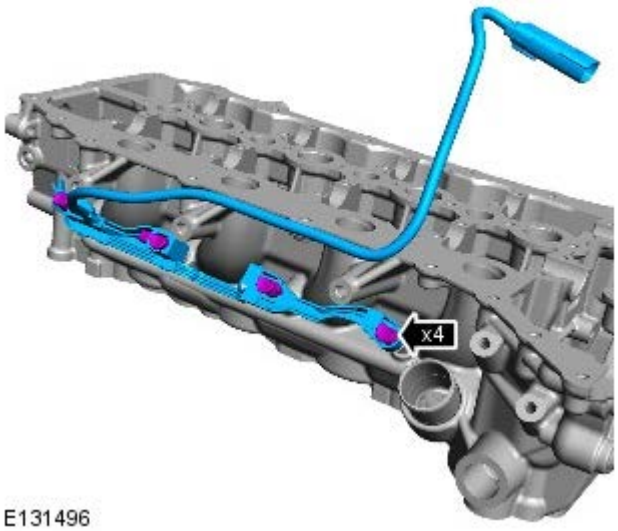
NOTE: Discard the gasket.



E131500

19. CAUTION: Take extra care not to damage the component.

Do not disassemble further if removed for access only.

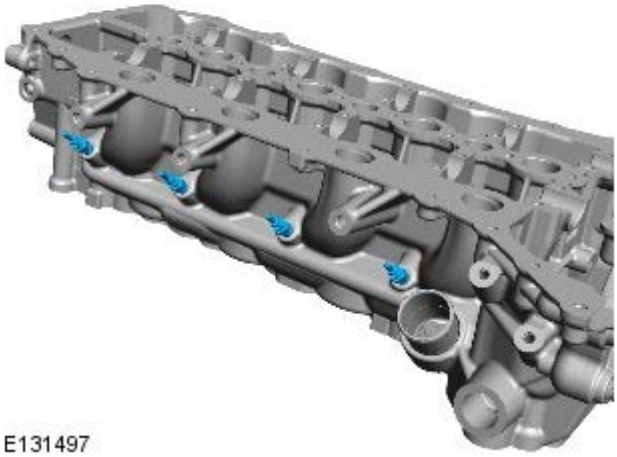


E131496

20. CAUTIONS:

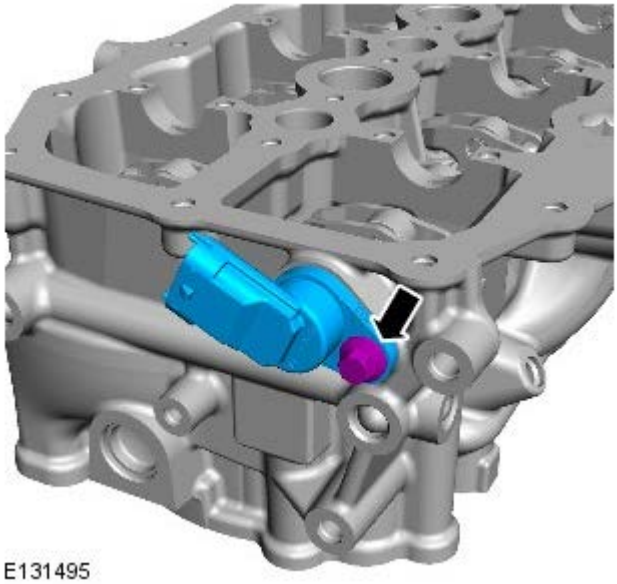
    Take extra care not to damage the component.

    If accidentally dropped or knocked install a new glow plug.



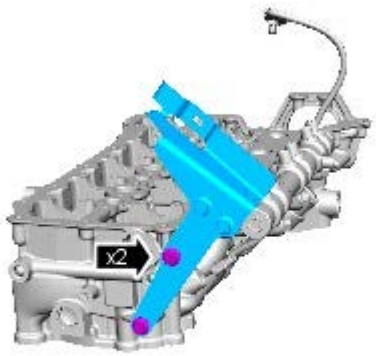
E131497

21.



E131495

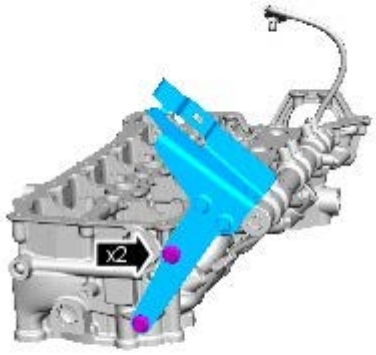
22.



E148207

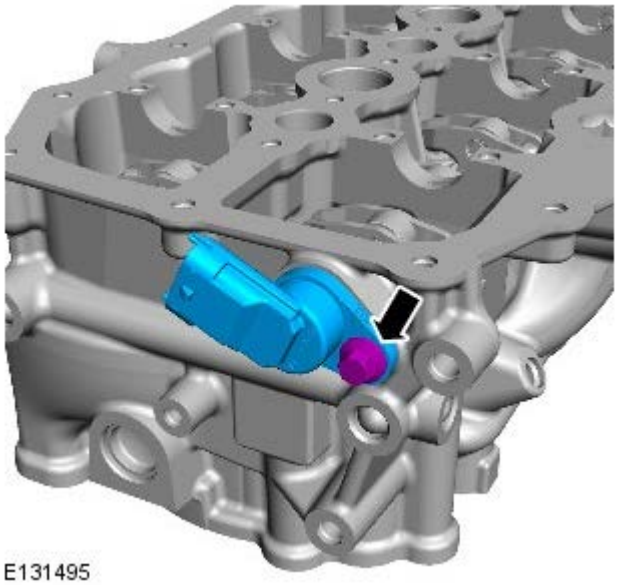
Installation

1. *Torque:* 25 Nm



E148207

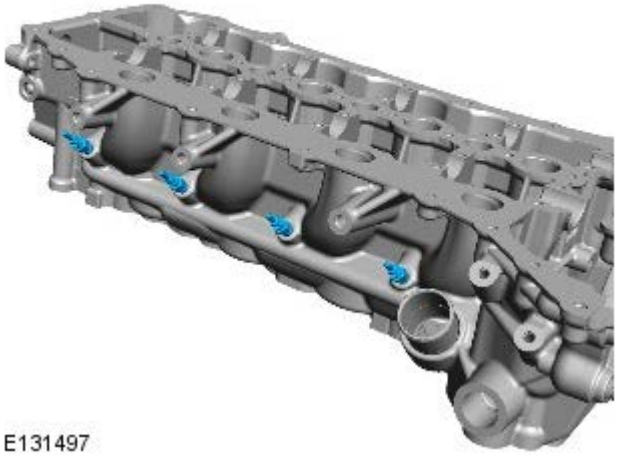
2. *Torque:* 13 Nm



E131495

3. CAUTIONS:

Take extra care not to damage the component.

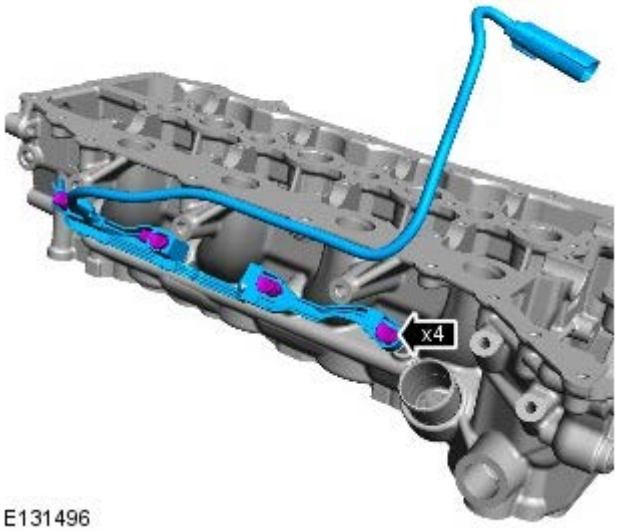


E131497

If accidentally dropped or knocked install a new glow plug.

Torque: 10 Nm

4. CAUTION: Take extra care not to damage the component.



E131496

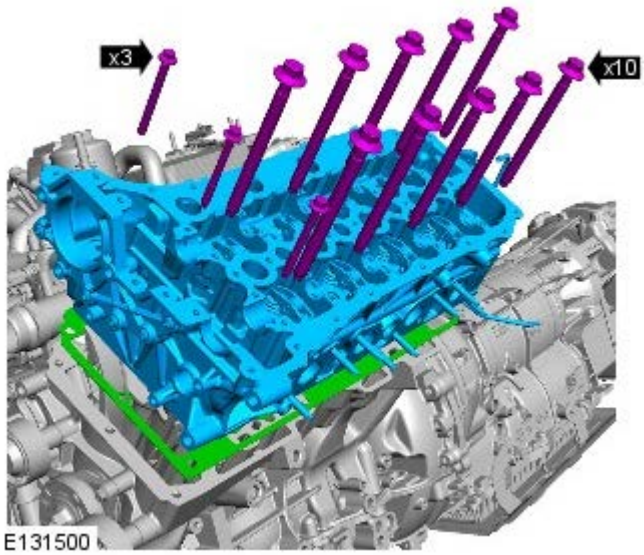
5. CAUTIONS:

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

Make sure that new cylinder head bolts are installed.

Only tighten the bolts finger-tight at this stage.

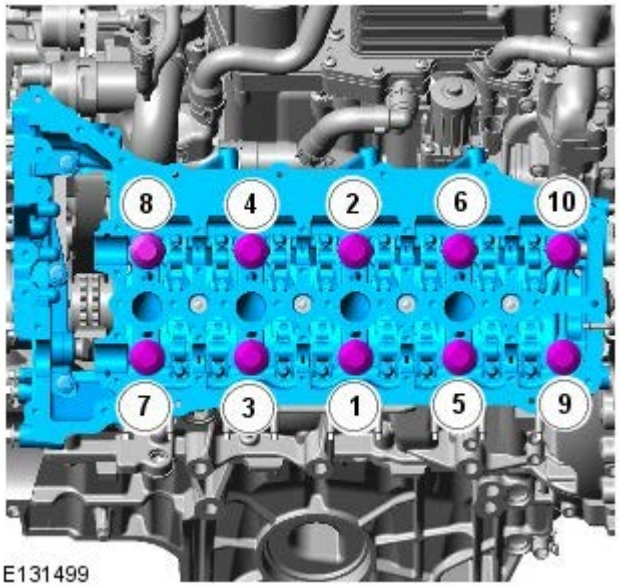
NOTE: Install a new cylinder head gasket.



E131500

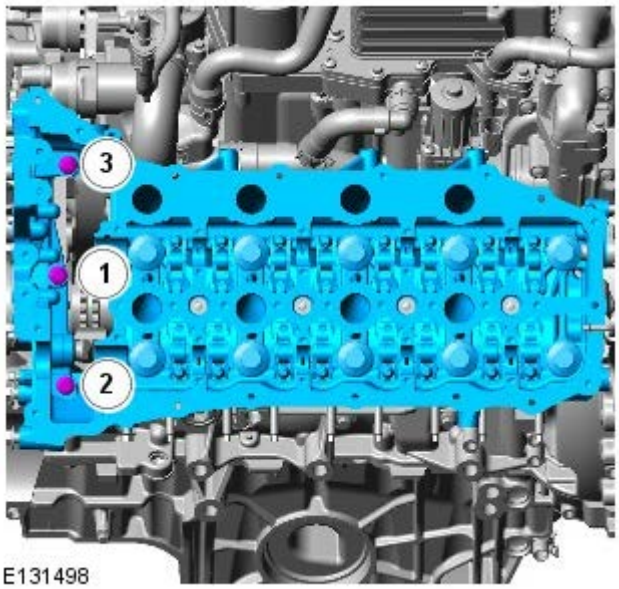
6. CAUTION: Tighten the bolts in the sequence shown.

Torque:
Stage 1: 20 Nm
Stage 2: 40 Nm



E131499

Stage 3:80 Nm
Stage 4:180°

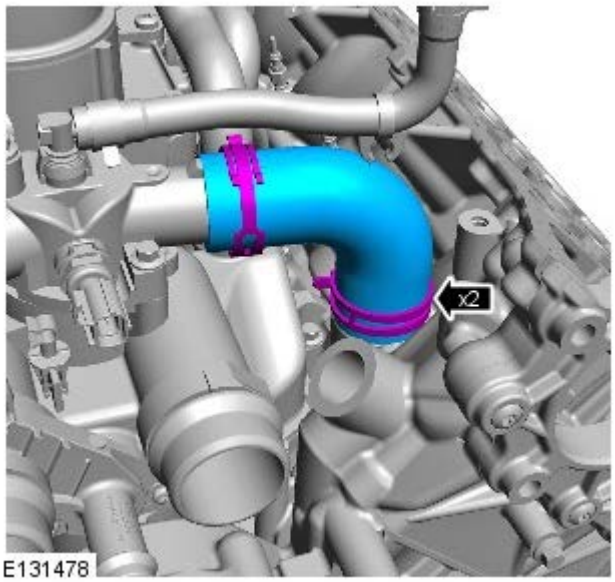


E131498

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

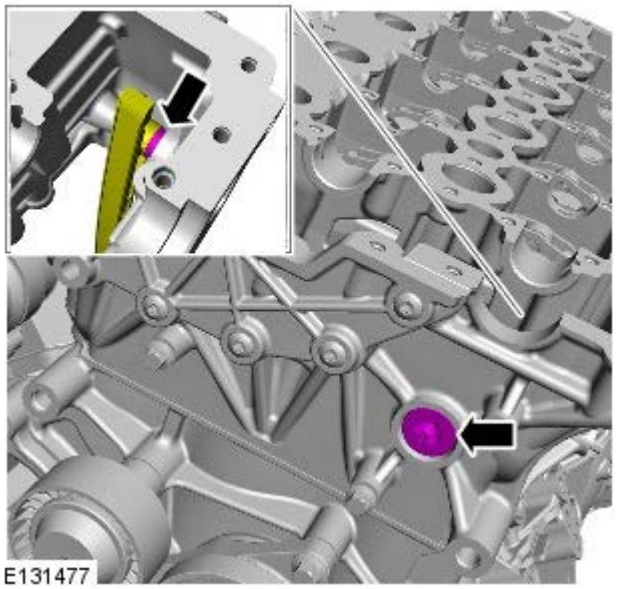
Torque: 20 Nm

8.

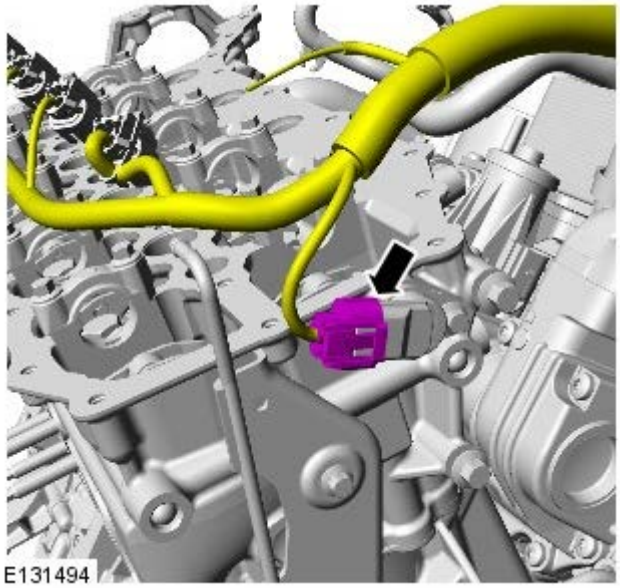


E131478

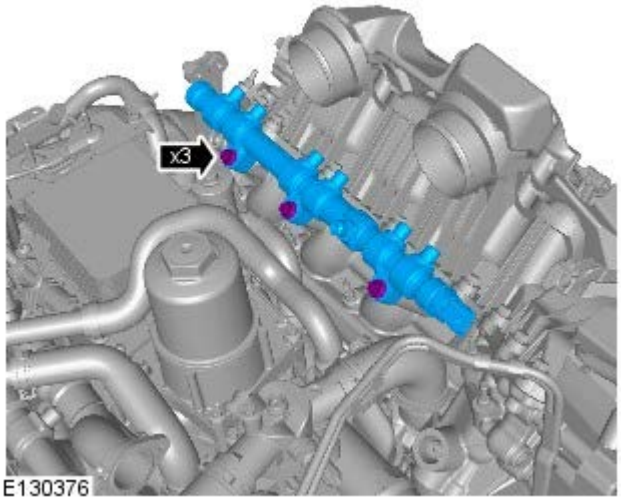
9. *Torque:* 27 Nm



10.

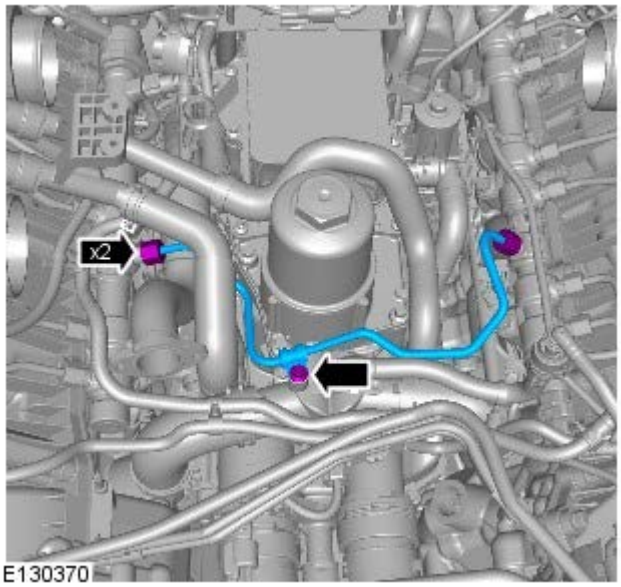


11. *Torque:* 23 Nm



12. CAUTIONS:

Install a new fuel pipe.

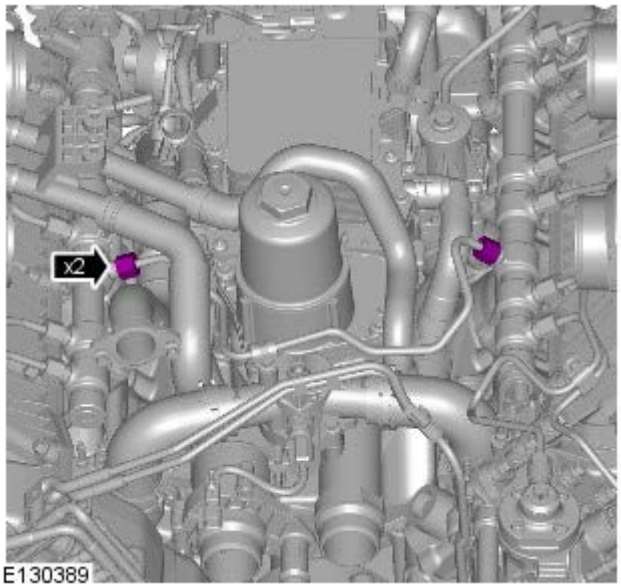


E130370

⚠ Only tighten the unions finger-tight at this stage.

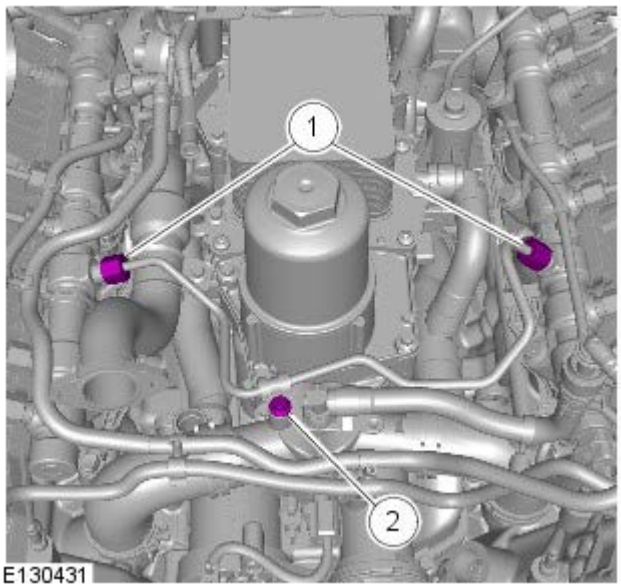
⚠ Only tighten the bolts finger-tight at this stage.

13. *Torque:* 10 Nm



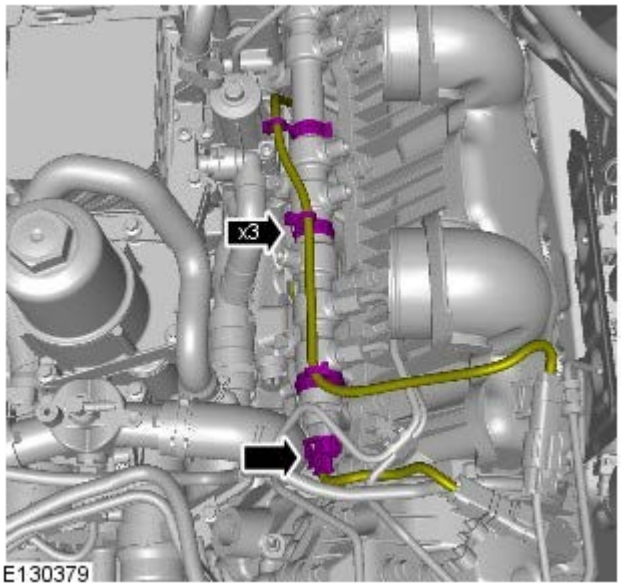
E130389

14. *Torque:*
Unions 73°
M6 10 Nm

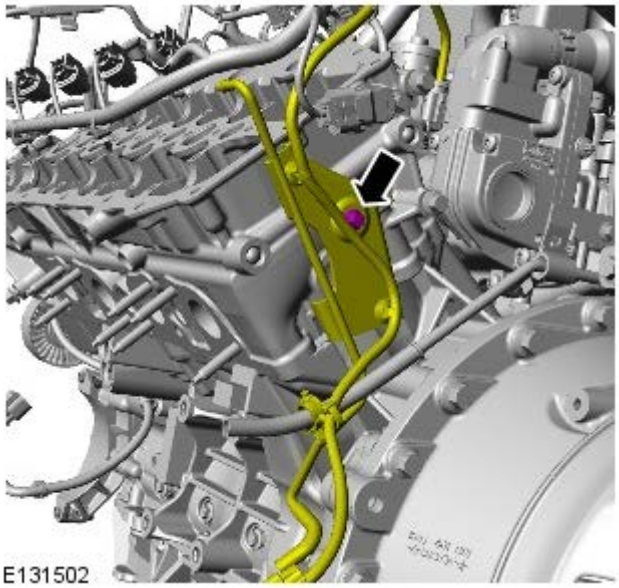


E130431

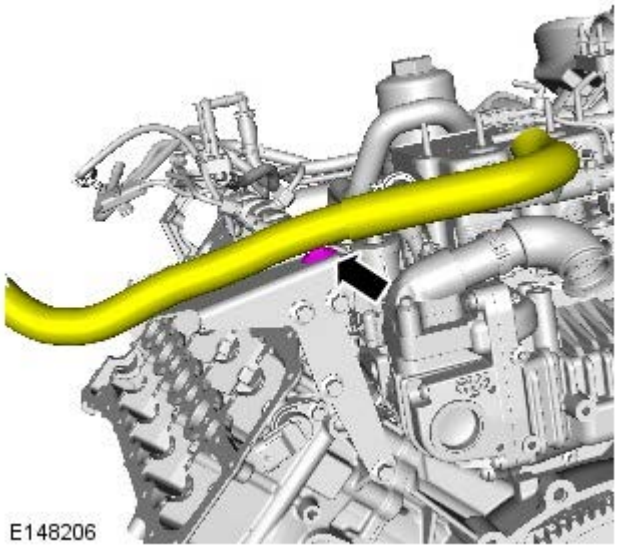
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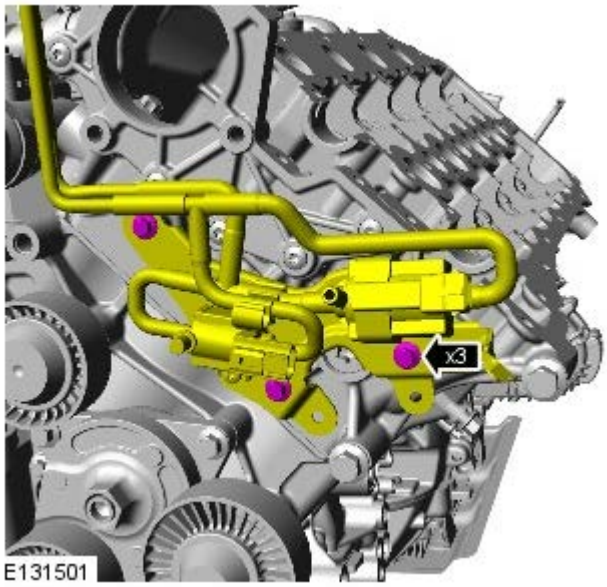
16. *Torque:* 10 Nm



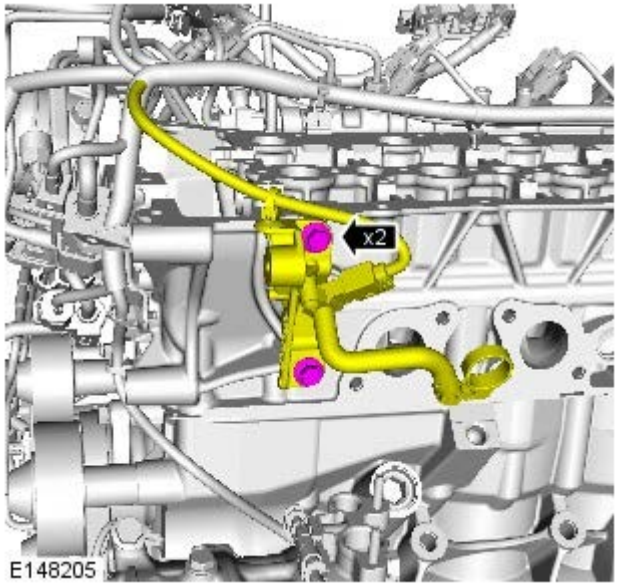
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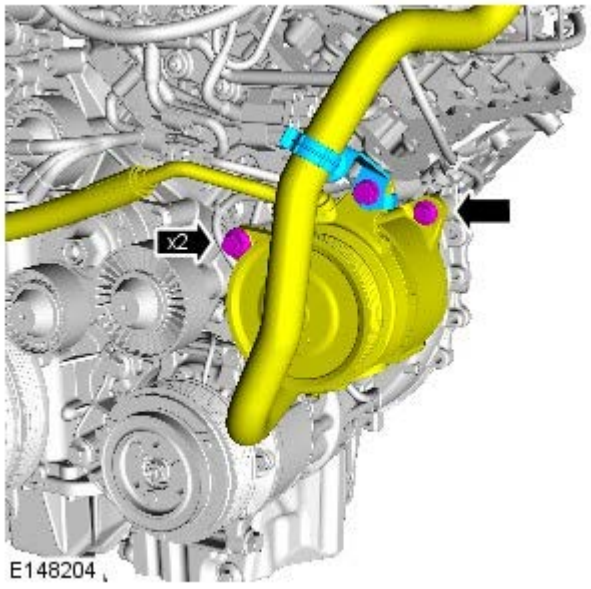
18. *Torque:* 10 Nm



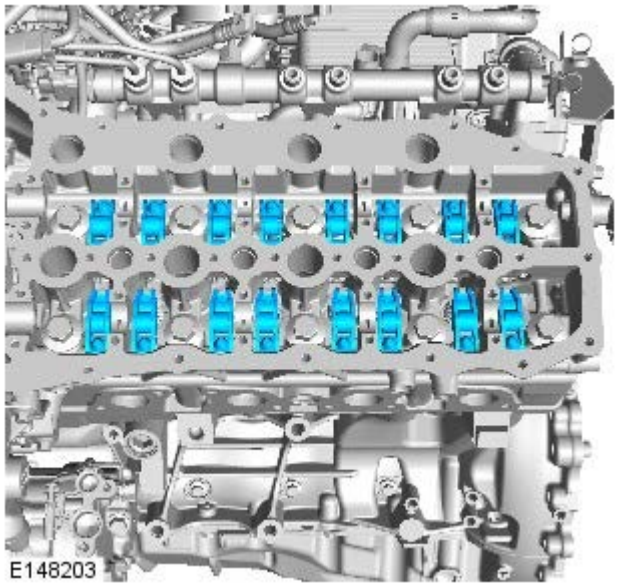
19. *Torque:* 25 Nm



20. *Torque:*
    M8 25 Nm
    M10 45 Nm



21. CAUTION: Make sure that the components are installed to the noted position in the removal steps.



22. Refer to: Camshaft LH (303-01D Engine - TDV8 4.4L Diesel, Removal and Installation).

23. Refer to: Generator (414-02D Generator and Regulator - TDV8 4.4L Diesel, Removal and Installation).

24. Refer to: Exhaust Manifold LH (303-01D Engine - TDV8 4.4L Diesel, Removal and Installation).

25. Connect the battery ground cable.

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

Published: 11-Nov-2013

Engine - TDV8 4.4L Diesel - Cylinder Head 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.

Engine shown removed for clarity.

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

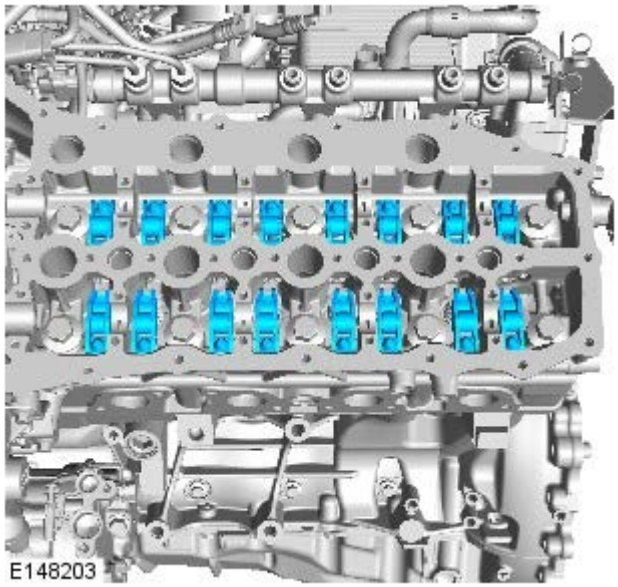
   Raise and support the vehicle.

2. Disconnect the battery ground cable.

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

3. Refer to: Exhaust Manifold RH (303-01D Engine - TDV8 4.4L Diesel, Removal and Installation).

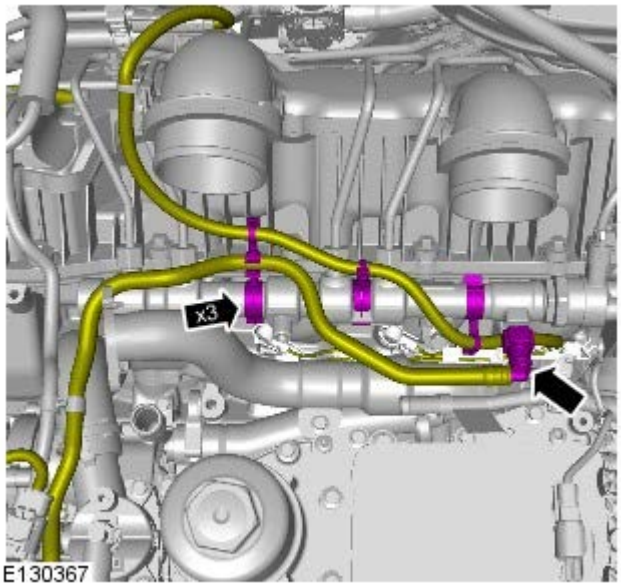
4. Refer to: Camshaft RH (303-01D Engine - TDV8 4.4L Diesel, Removal and Installation).



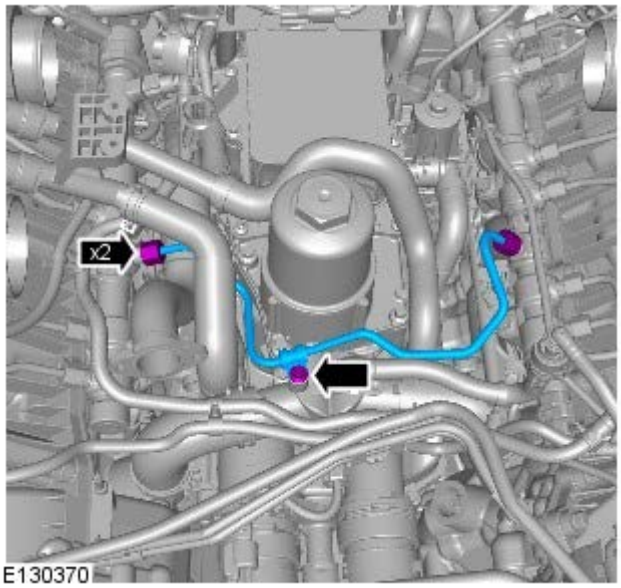
5. CAUTION: LH illustration shown, RH is similar.

   NOTE: Note the position of the components prior to removal.

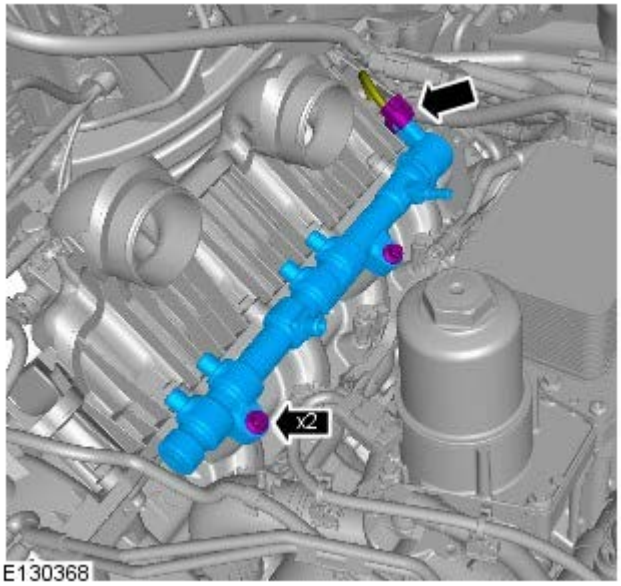
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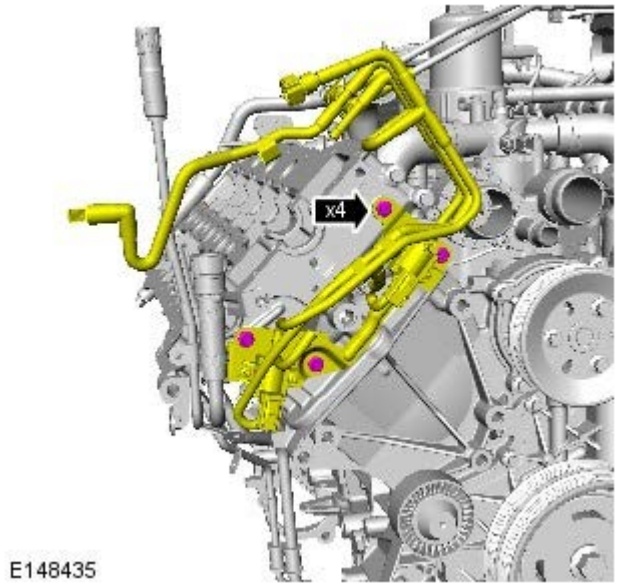
7. CAUTION: Discard the fuel pipes.



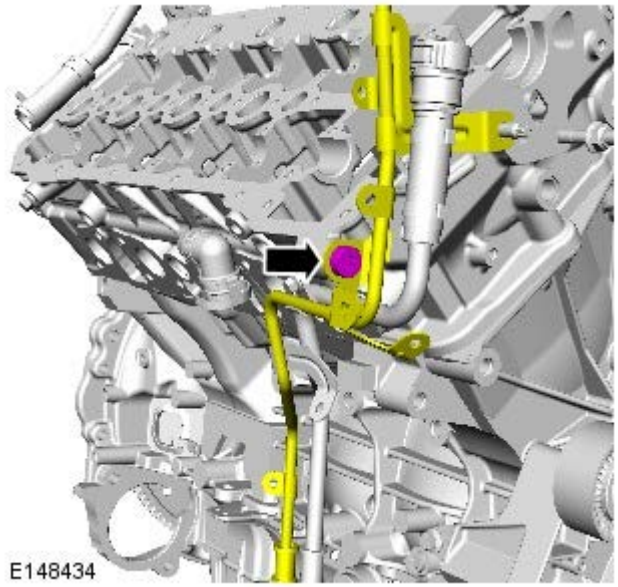
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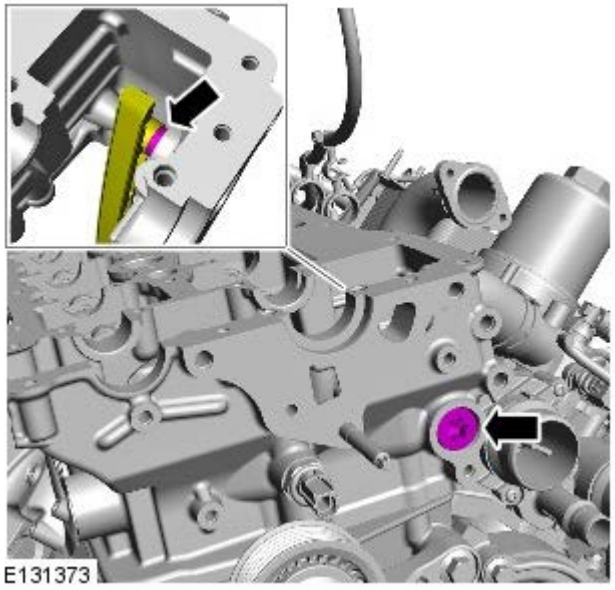
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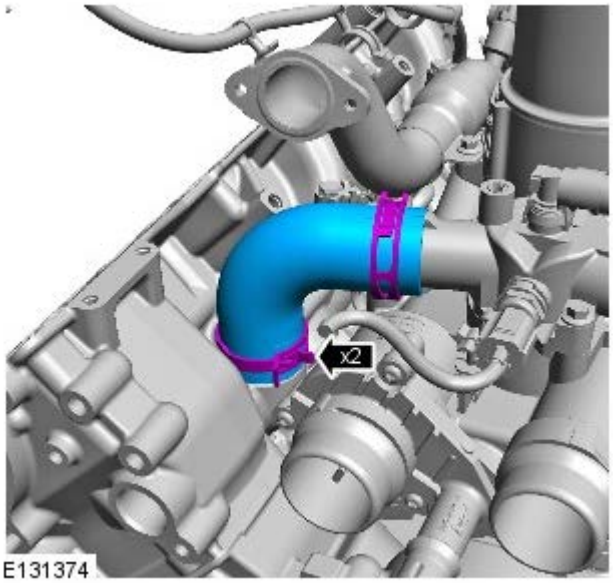
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11.



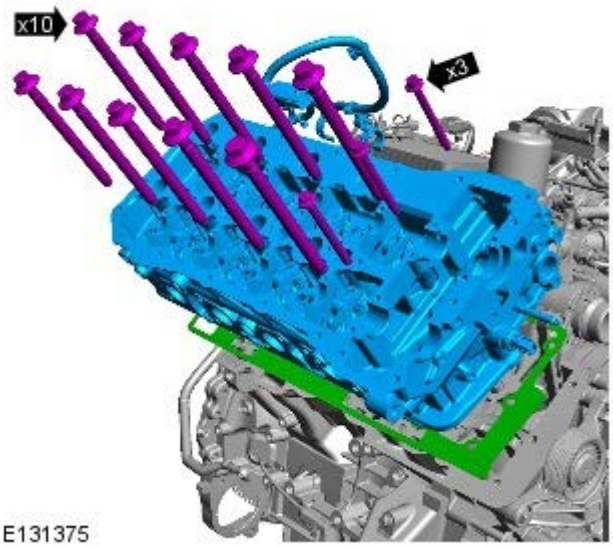
12.



E131374

13. CAUTION: Discard the bolts.

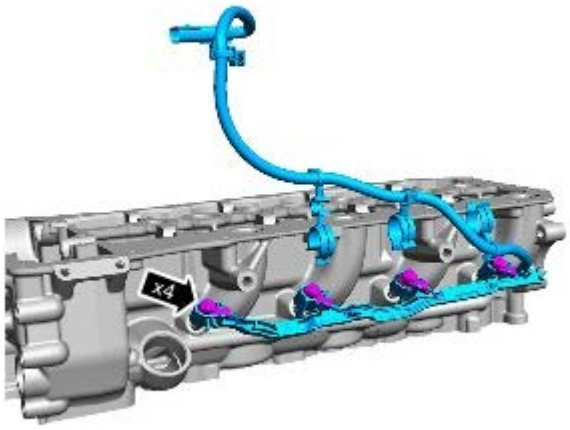
NOTE: Discard the gasket.



E131375

14. CAUTION: Take extra care not to damage the component.

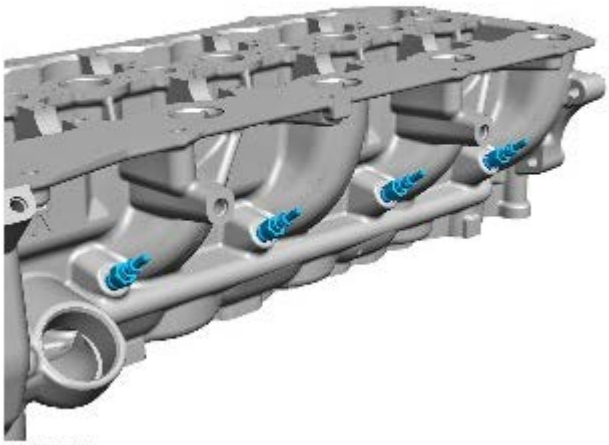
Do not disassemble further if removed for access only



E131376

15. CAUTIONS:

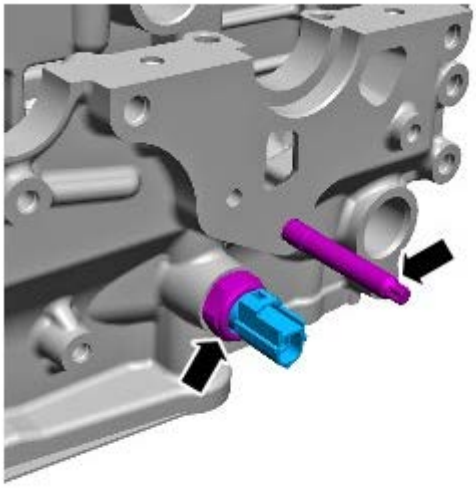
Take extra care not to damage the component.



E131377

If accidentally dropped or knocked install a new glow plug.

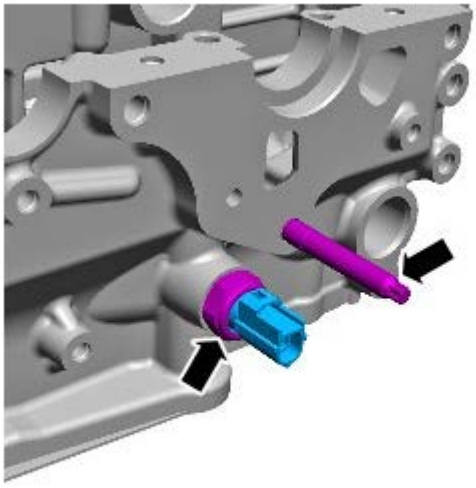
16.



E131378

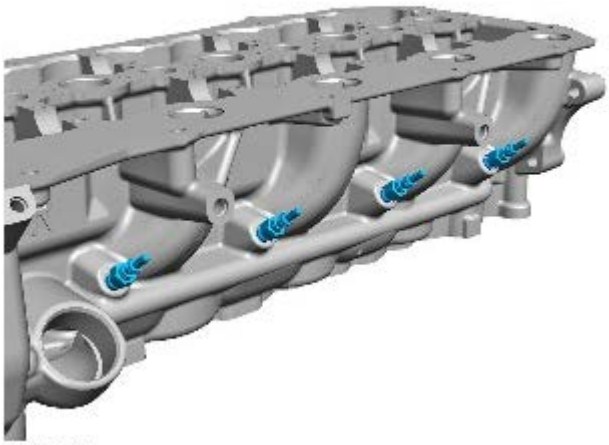
Installation

1. *Torque:* 13 Nm



E131378

2. CAUTIONS:



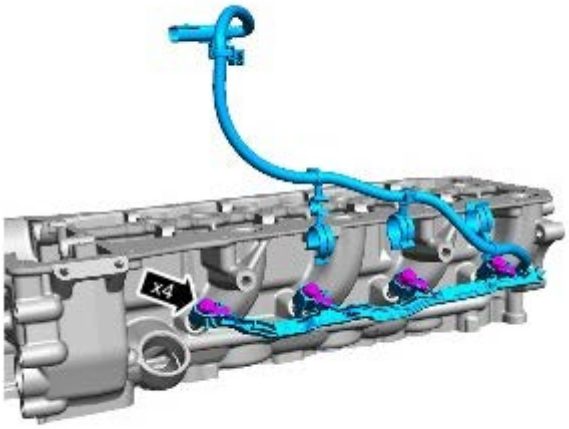
E131377

Take extra care not to damage the component.

If accidentally dropped or knocked install a new glow plug.

Torque: 10 Nm

3. CAUTION: Take extra care not to damage the component.



E131376

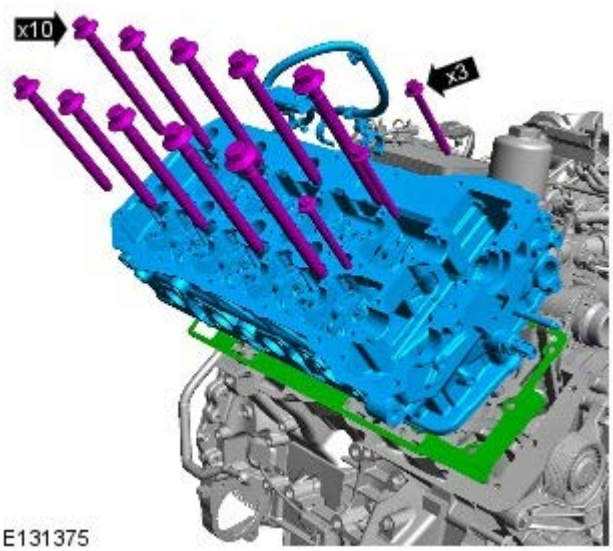
4. CAUTIONS:

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

Make sure that new cylinder head bolts are installed.

Only tighten the bolts finger-tight at this stage.

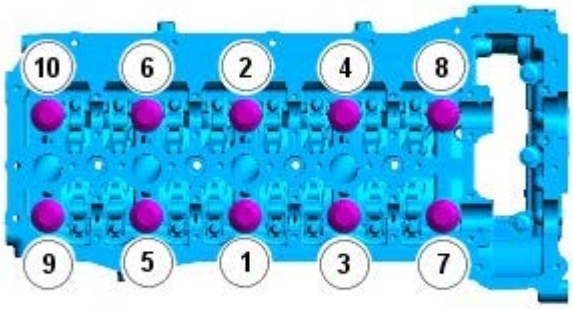
NOTE: Install a new cylinder head gasket.



E131375

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

Torque:
Stage 1:20 Nm
Stage 2:40 Nm



E131380

Stage 3:80 Nm
Stage 4:180°

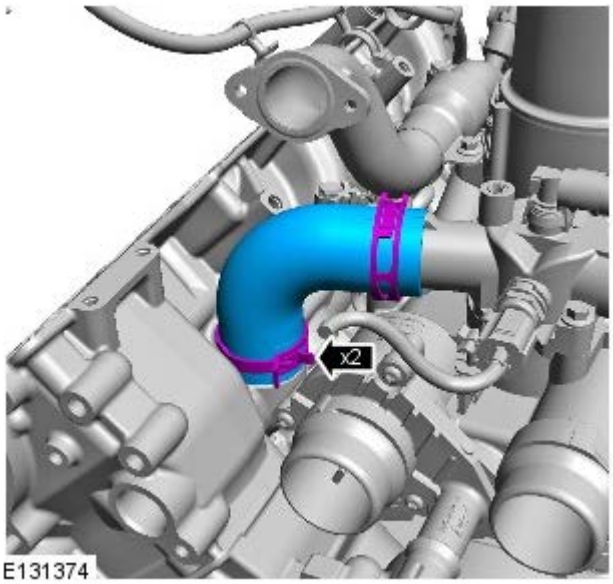
6. CAUTION: Tighten the bolts in the sequence shown.

Torque: 12 Nm



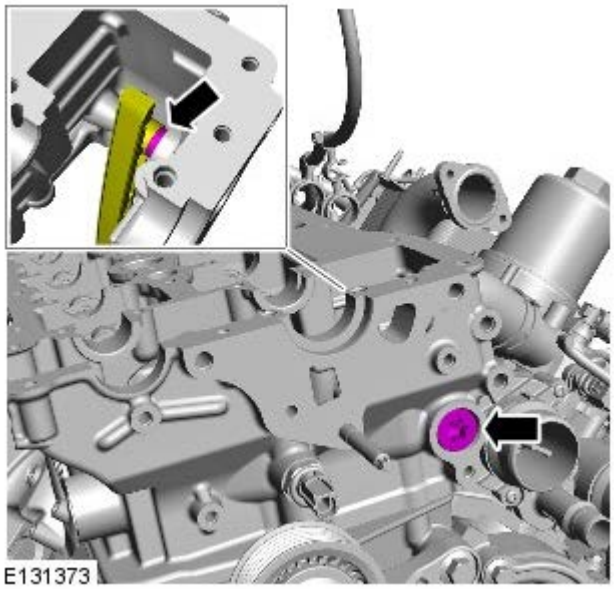
E131379

7.

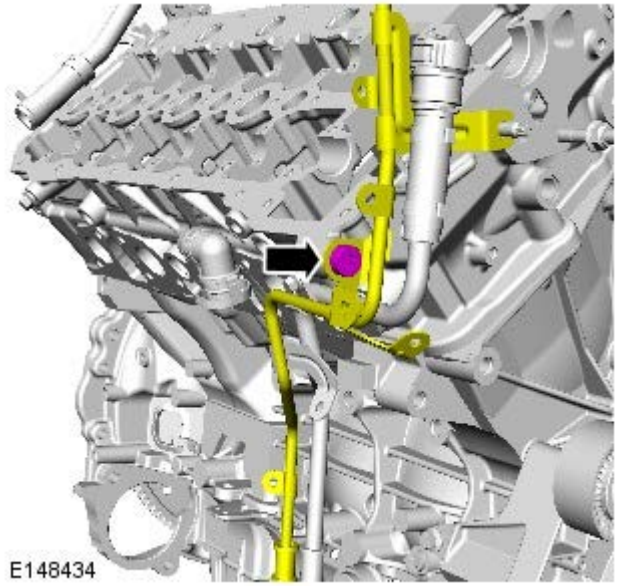


E131374

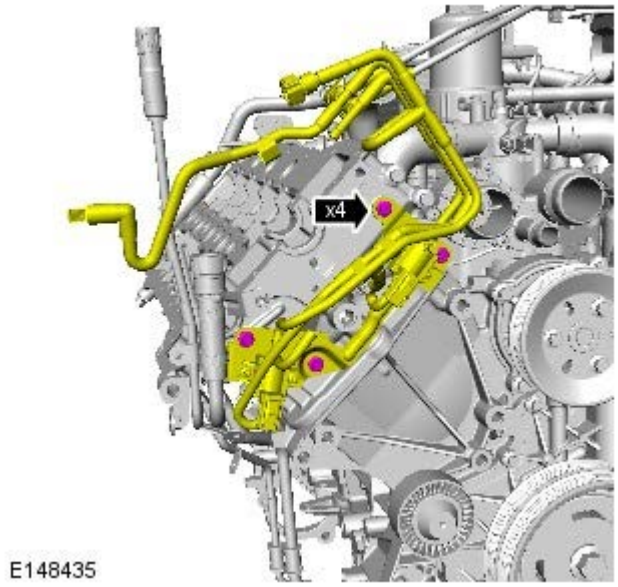
8. *Torque:* 27 Nm



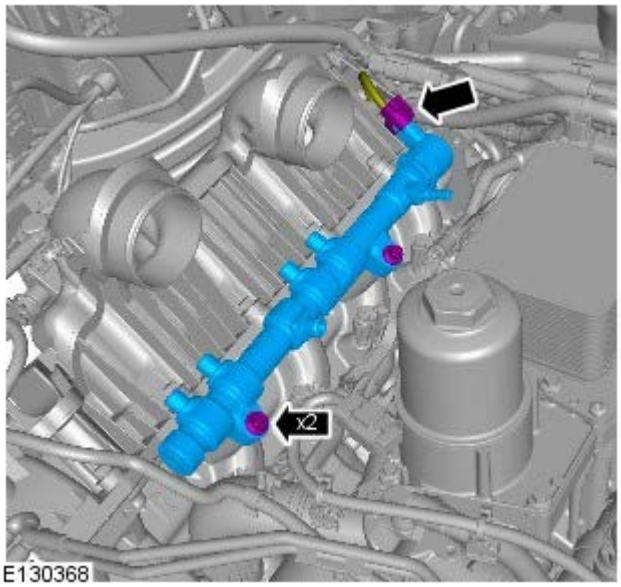
9. *Torque:* 23 Nm



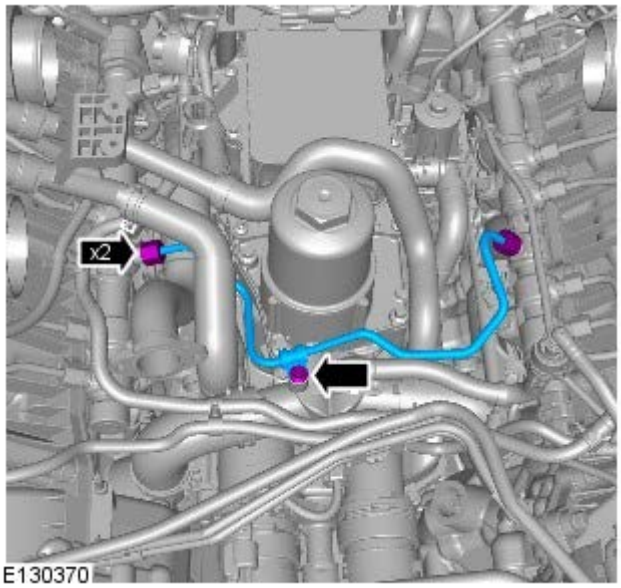
10. *Torque:* 10 Nm



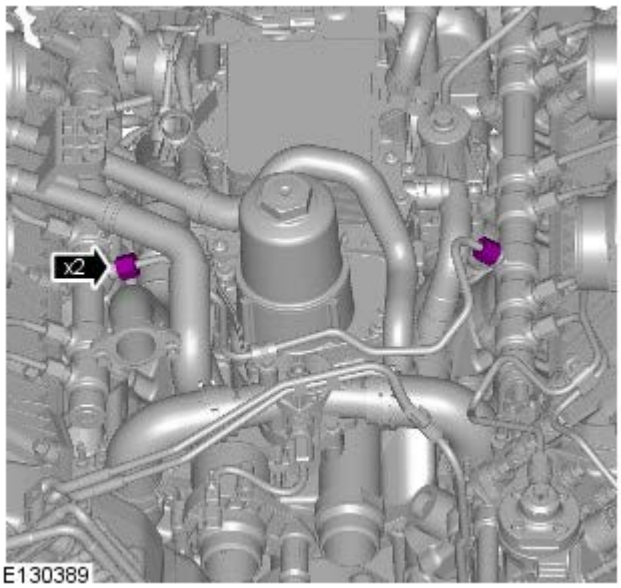
11.



E130368



E130370



E130389

12. CAUTIONS:

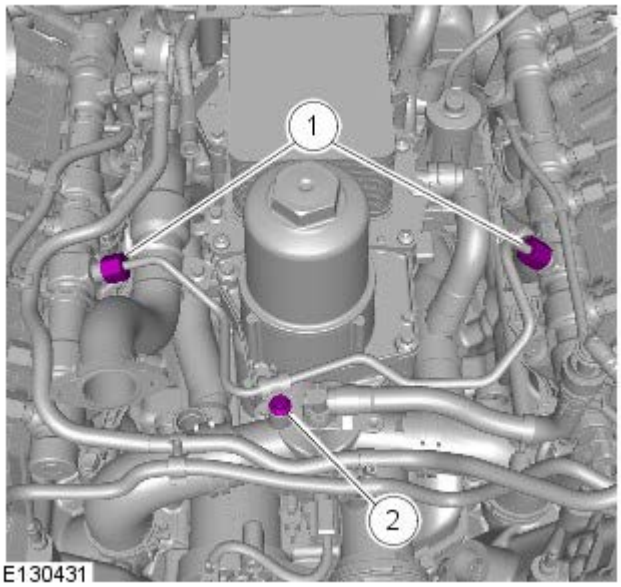
⚠ Install a new fuel pipe.

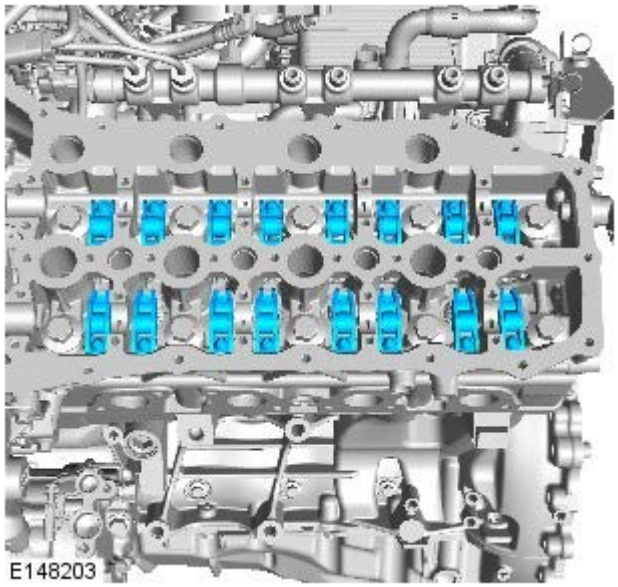
⚠ Only tighten the unions finger-tight at this stage.

⚠ Only tighten the bolt finger-tight at this stage.

13. *Torque:* 10 Nm

14. *Torque:*
    Unions 73°
    M6 10 Nm





15. CAUTIONS:

    LH illustration shown, RH is similar.

    Make sure that the components are installed to the noted position in the removal steps.

16. Refer to: Camshaft RH (303-01D Engine - TDV8 4.4L Diesel, Removal and Installation).

17. Refer to: Exhaust Manifold RH (303-01D Engine - TDV8 4.4L Diesel, Removal and Installation).

18. Connect the battery ground cable.

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

Published: 05-Nov-2013

Engine - TDV8 4.4L Diesel - Engine Mount LH

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.

Engine shown removed for clarity.

1. Disconnect the battery ground cable.

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

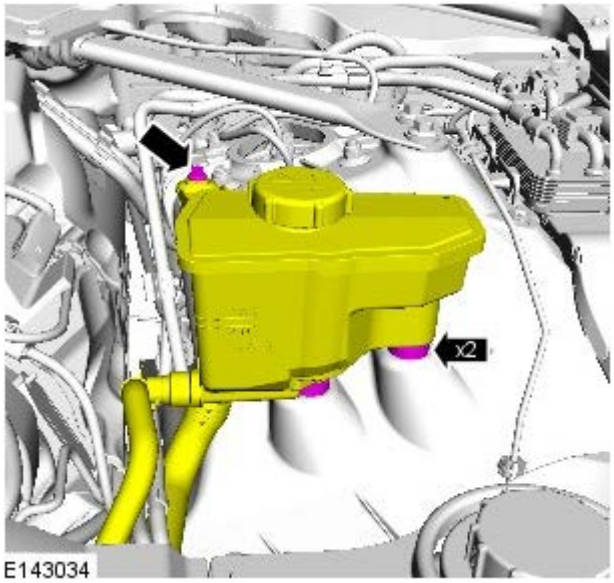
2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

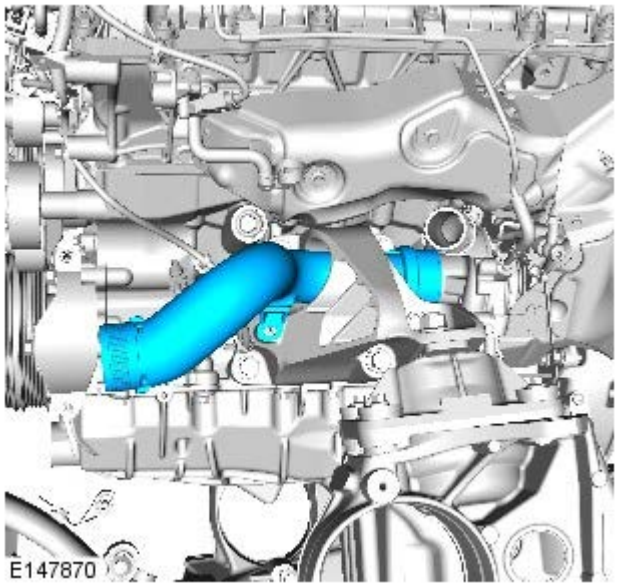
3. Refer to: Fender Splash Shield (501-02 Front End Body Panels, Removal and Installation).

4. Refer to: Air Conditioning (A/C) Compressor - TDV8 4.4L Diesel (412-01A Climate Control, Removal and Installation).

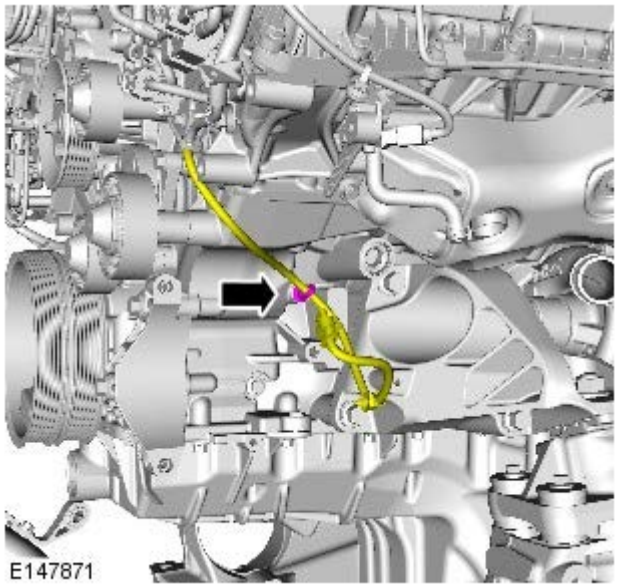
5.



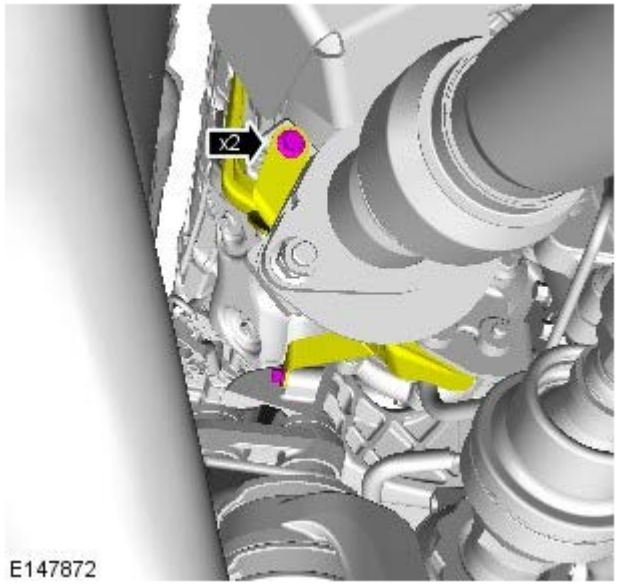
6.



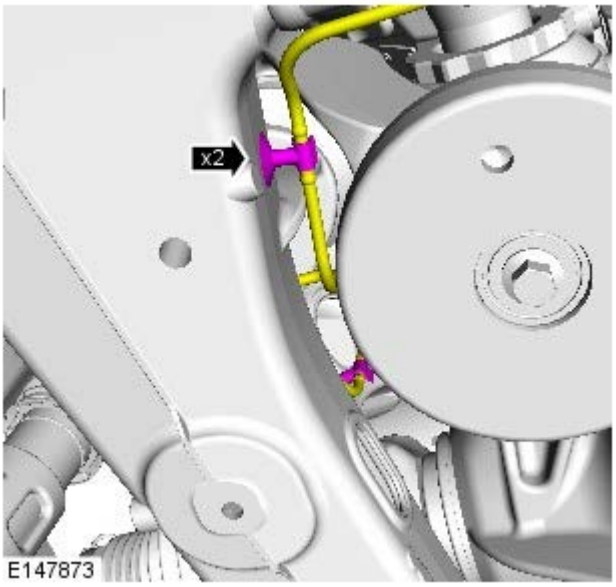
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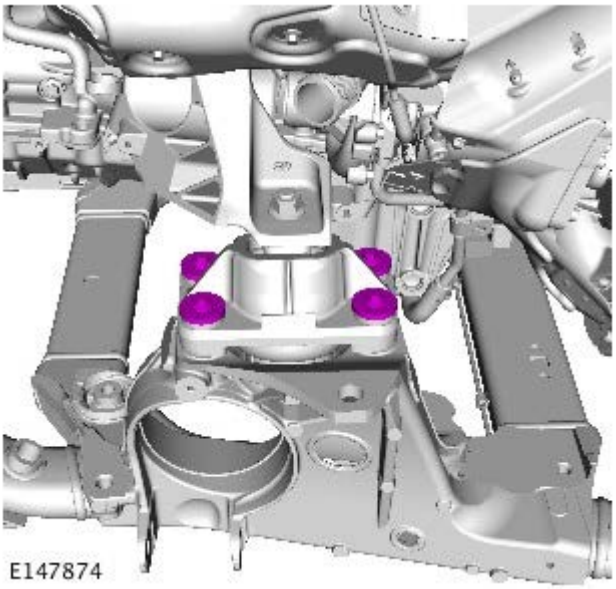


8.

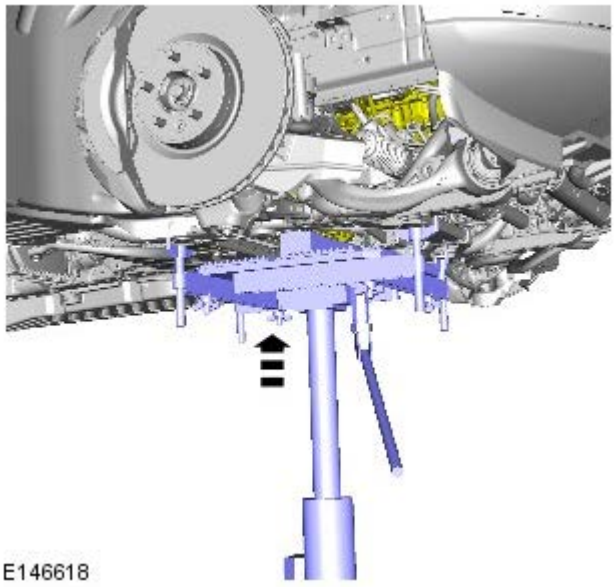


9.





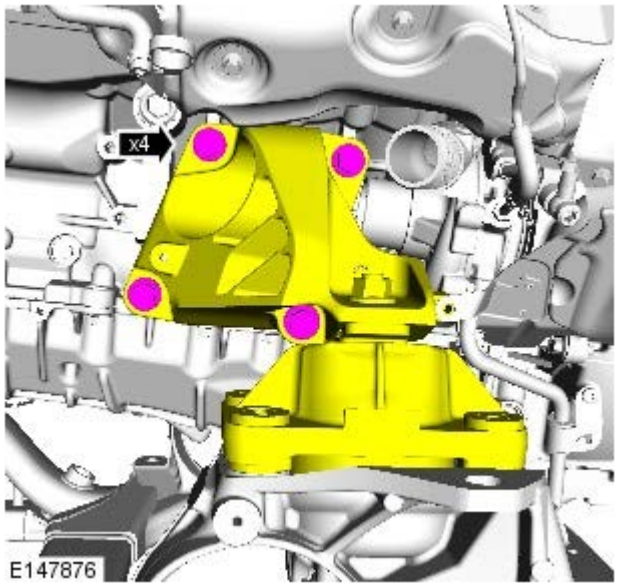
10. CAUTION: Discard the bolts.



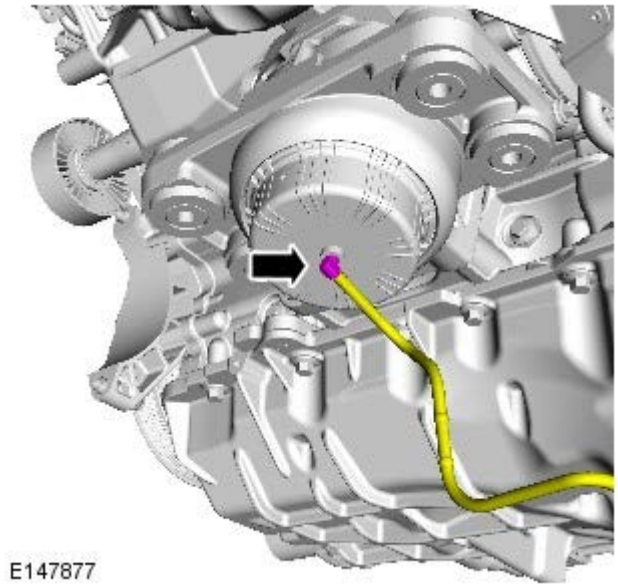
11. CAUTION: Use a wooden block to protect the oil pan when supporting the engine.

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

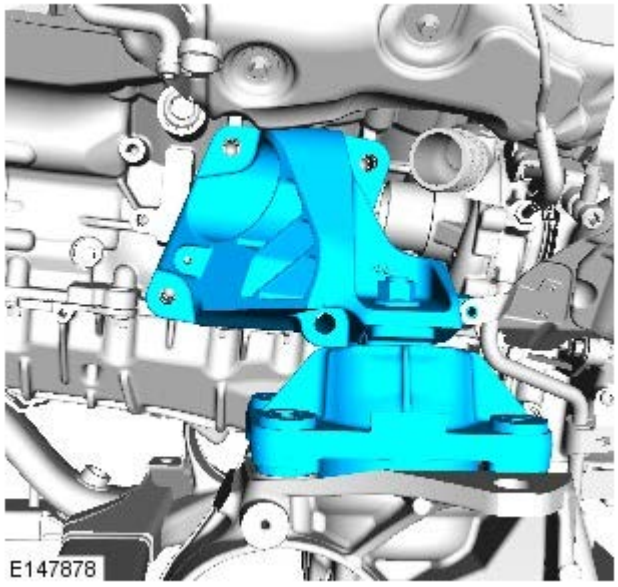
12.



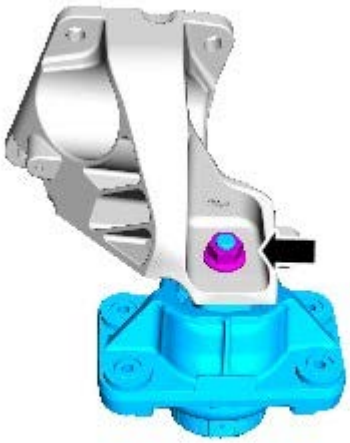
13.



14.

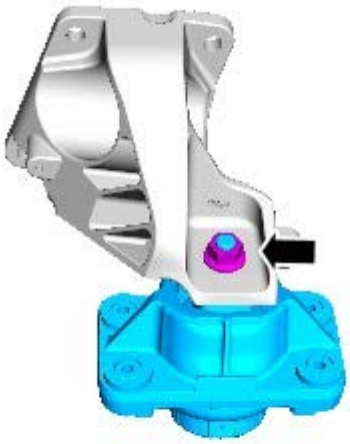


15.



E147879

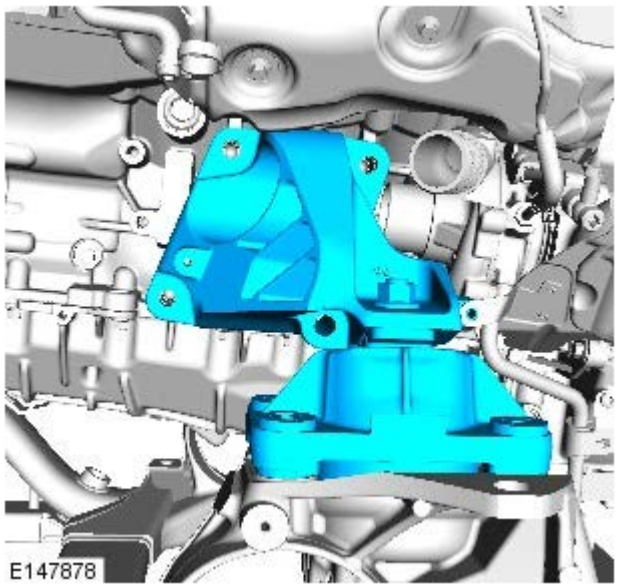
Installation



E147879

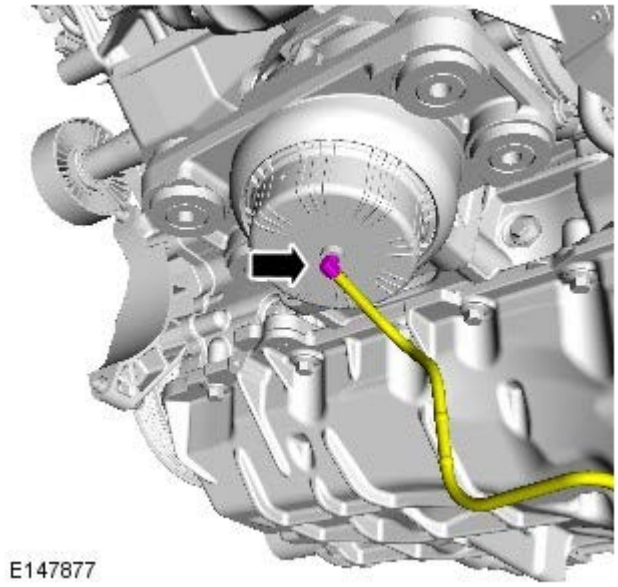
1. CAUTION: Only tighten the nut finger tight at this stage.

2.

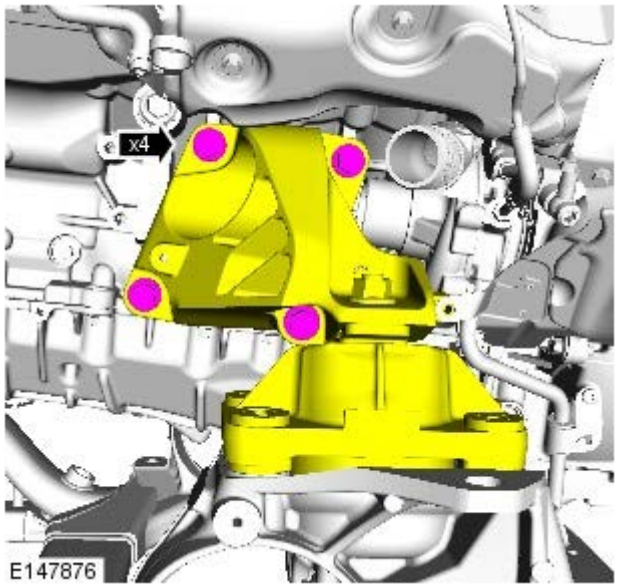


E147878

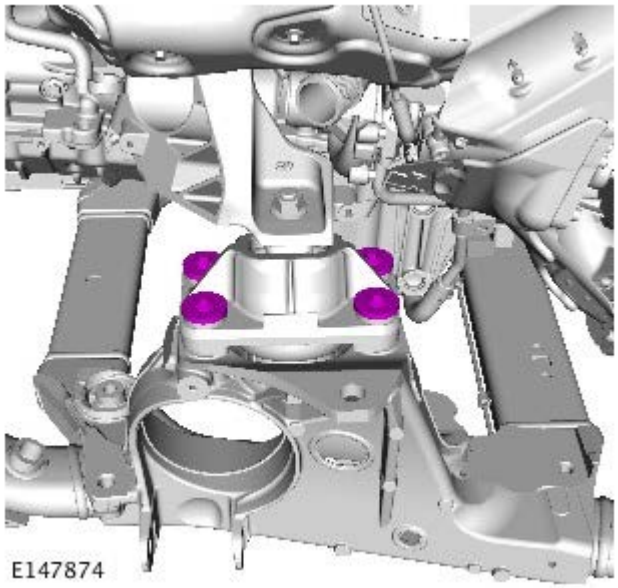
3.



4. *Torque:* 115 Nm



5. Lower the engine onto the mount.



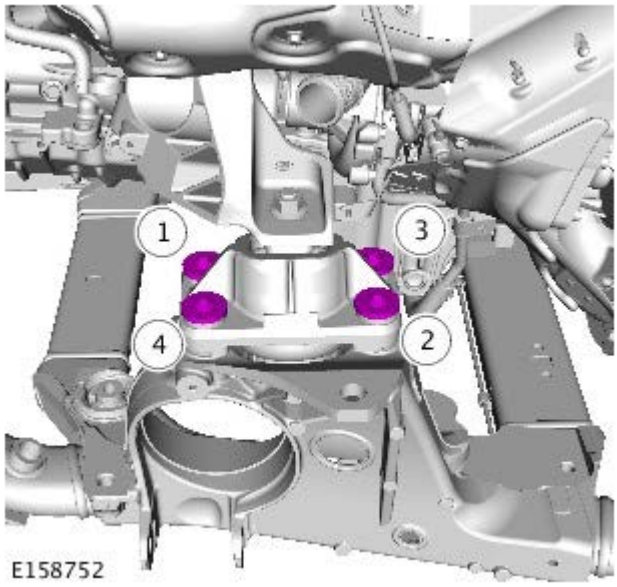
6. CAUTIONS:

   Make sure new bolts are installed.

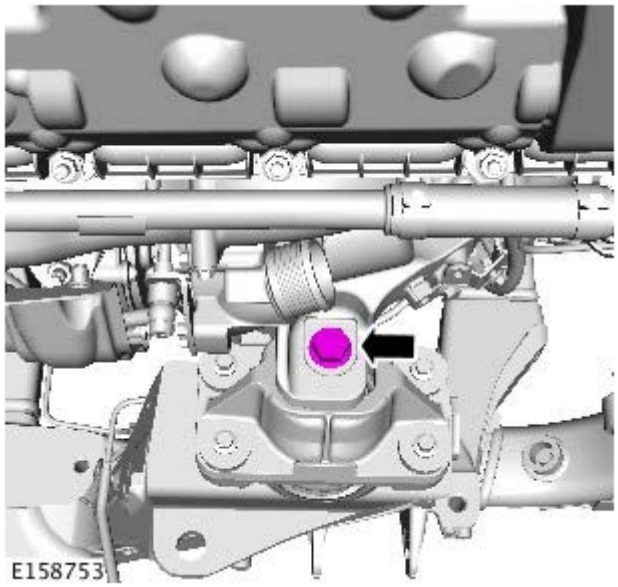
   Only tighten the bolts finger tight at this stage.

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

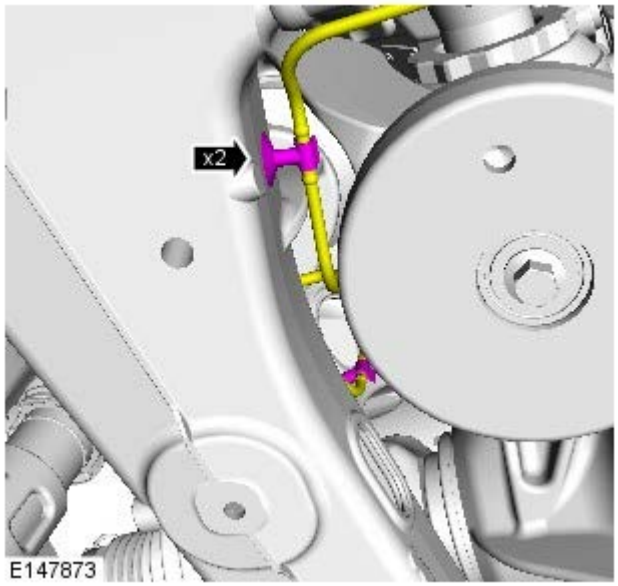
   Torque: 40 Nm



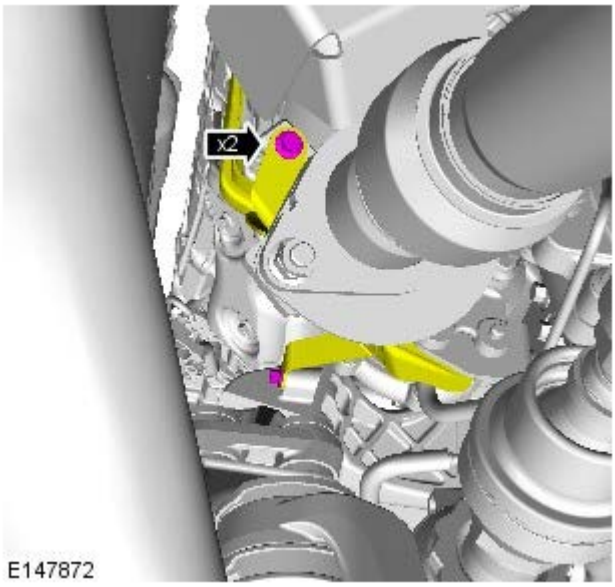
8. *Torque:* 130 Nm



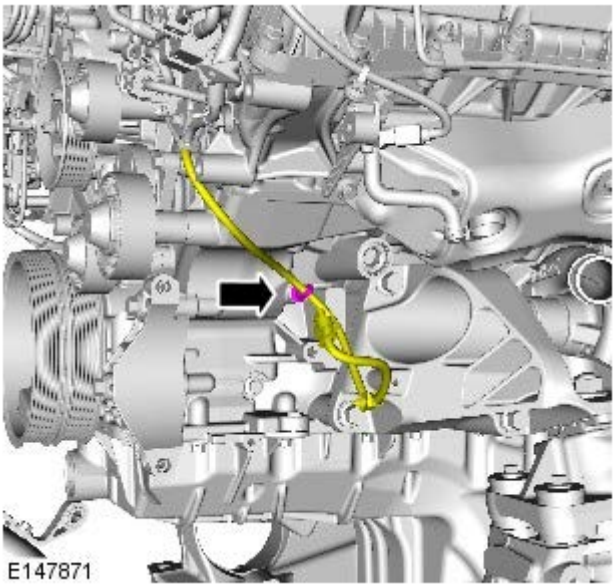
9.



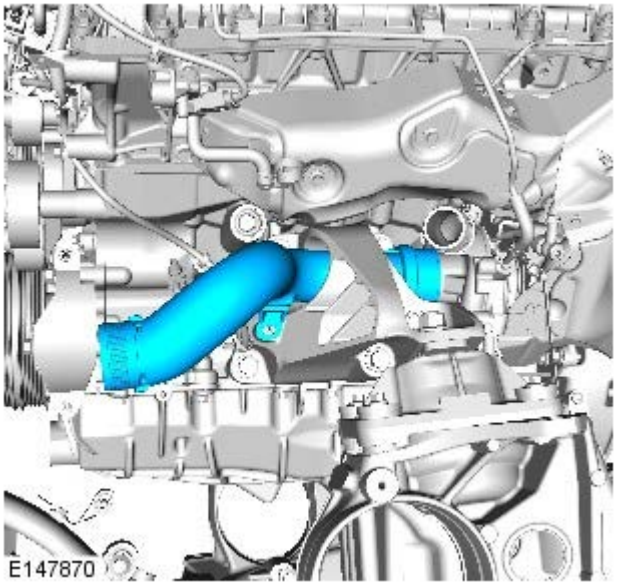
10. *Torque:* 9 Nm



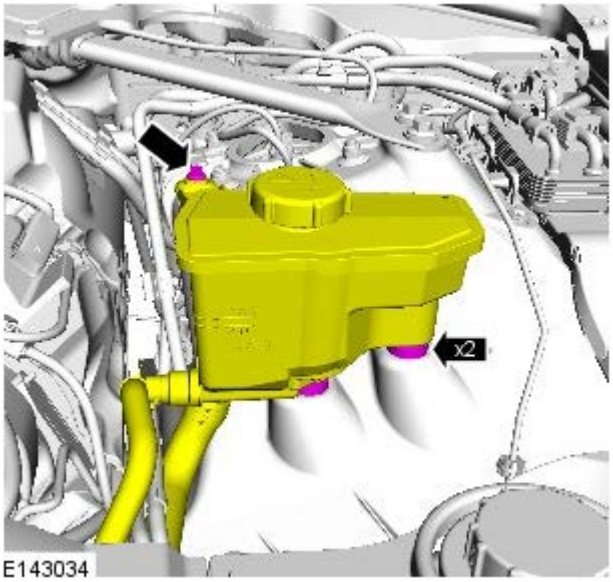
11.



12.



13. *Torque:* 9 Nm



14. Refer to: Air Conditioning (A/C) Compressor - TDV8 4.4L Diesel (412-01A Climate Control, Removal and Installation).

15. Refer to: Fender Splash Shield (501-02 Front End Body Panels, Removal and Installation).

16. Connect the battery ground cable.

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

Published: 14-Nov-2013

Engine - TDV8 4.4L 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.

Engine shown removed for clarity.

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

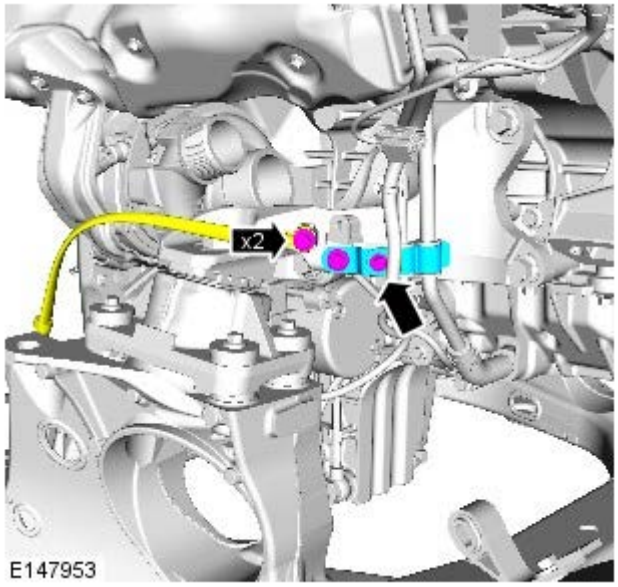
   Raise and support the vehicle.

2. Disconnect the battery ground cable.

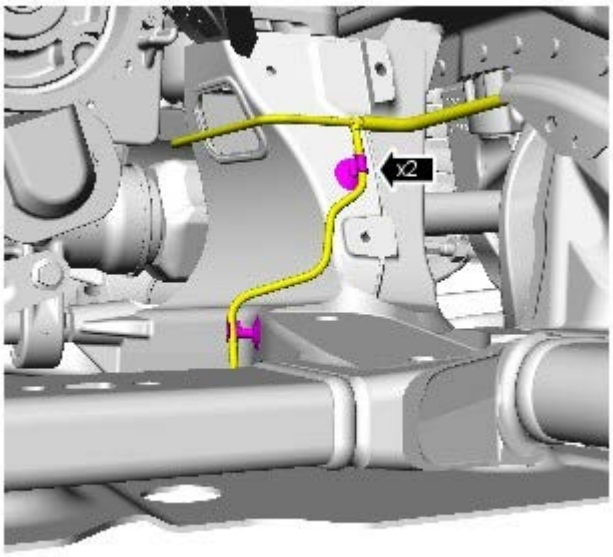
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

3. Refer to: Generator (414-02D Generator and Regulator - TDV8 4.4L Diesel, Removal and Installation).

4.

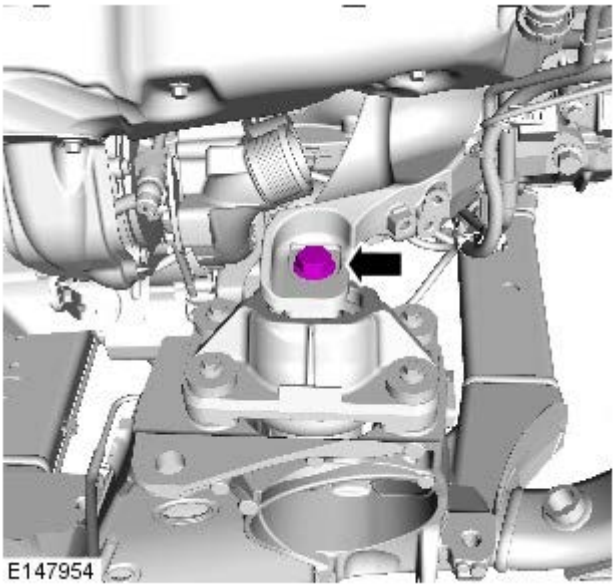


5.



E147958

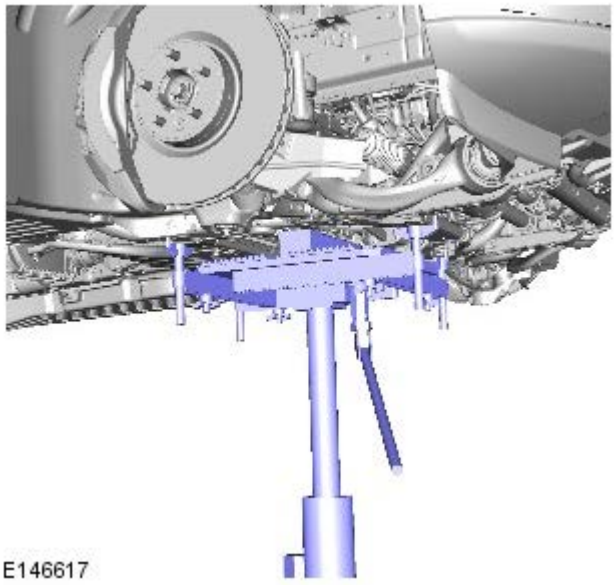
6.



E147954

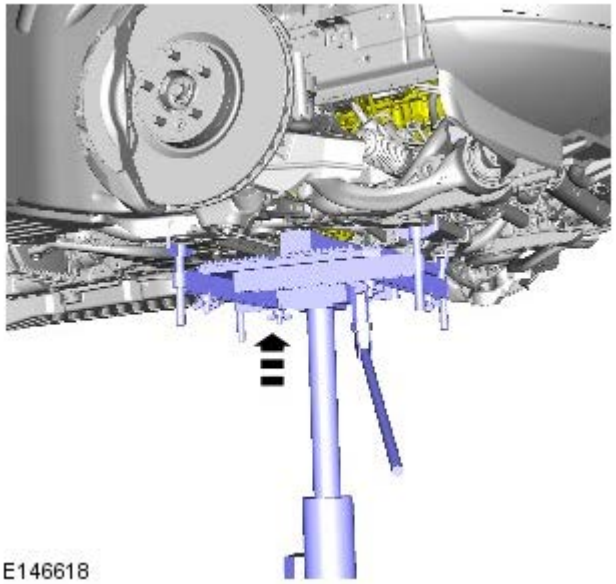
7. CAUTION: Use a wooden block to protect the oil pan when supporting the engine.

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

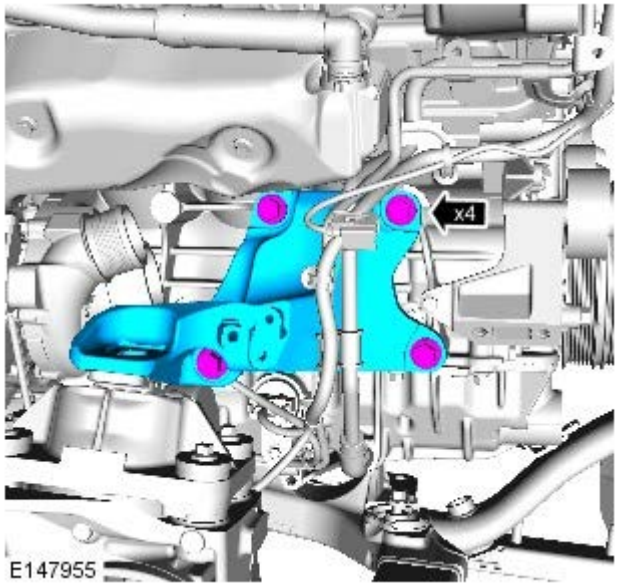


E146617

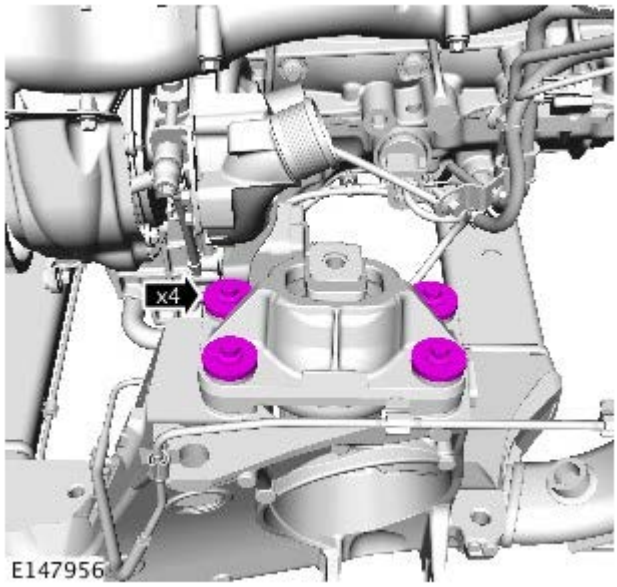
8.



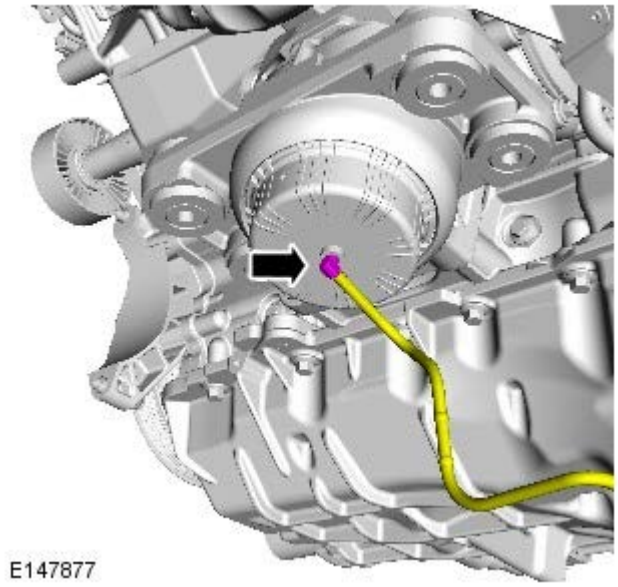
9.



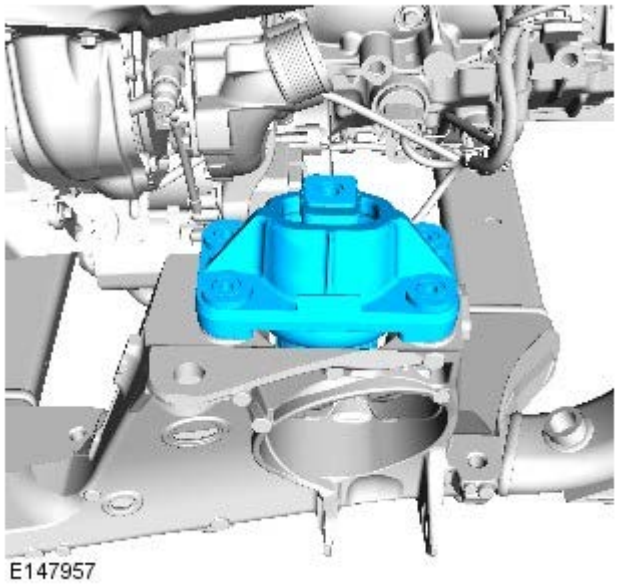
10. CAUTION: Remove and discard the bolts.



11. CAUTION: LH illustration shown, RH is similar.

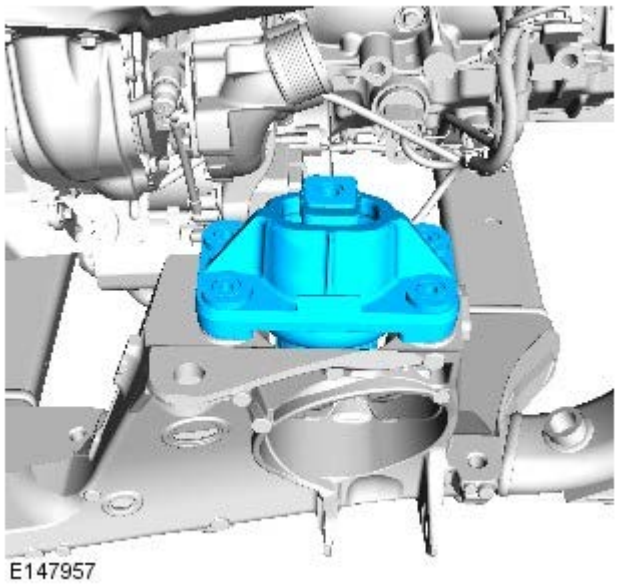

E147877

12.

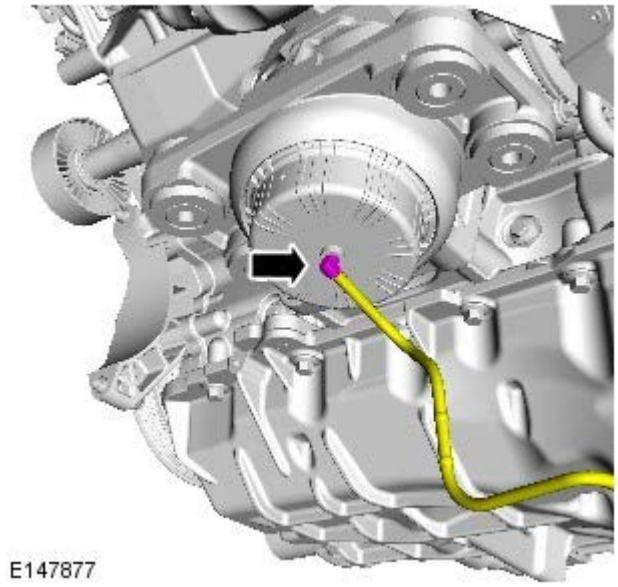

E147957

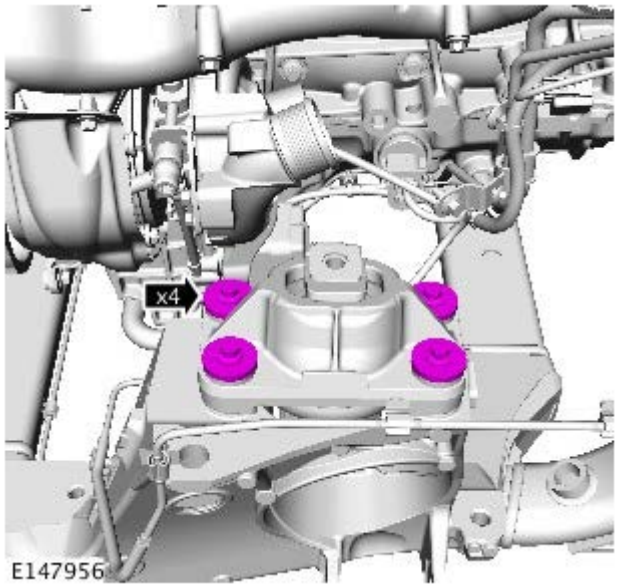
Installation

1.


E147957

2. CAUTION: LH illustration shown, RH is similar.


E147877



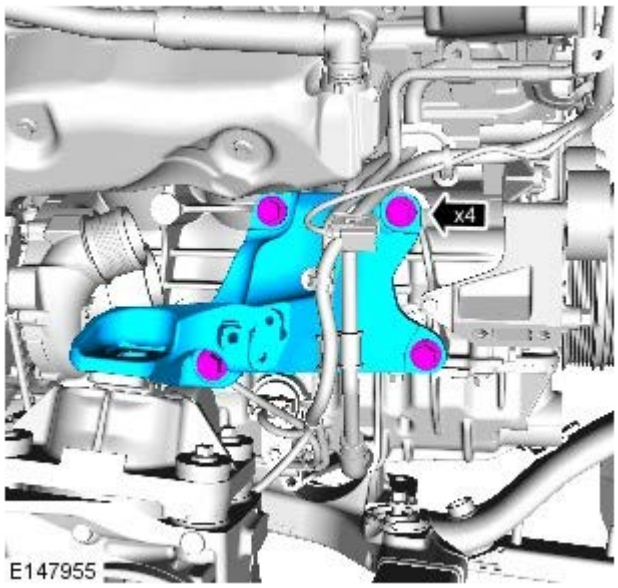
E147956

3. CAUTIONS:

   Make sure that new bolts are installed.

   Only tighten the bolts finger-tight at this stage.

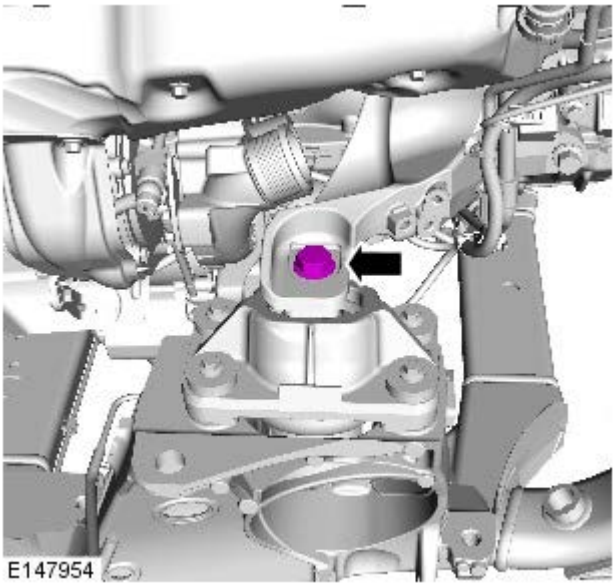
4. *Torque:* 115 Nm

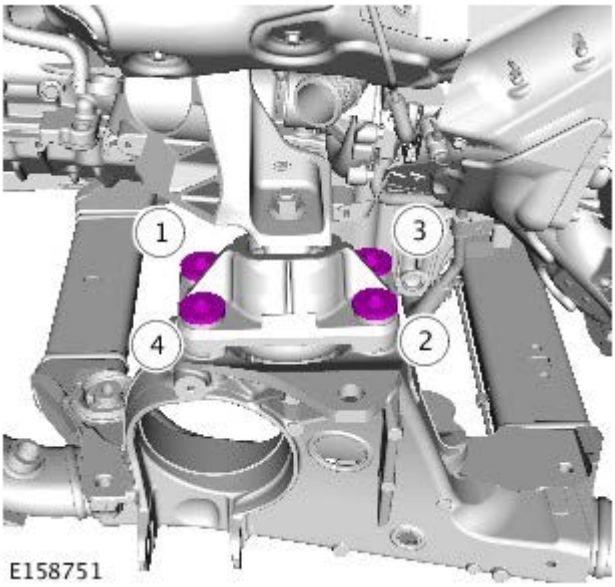


E147955

5. Lower the engine onto the mount.

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

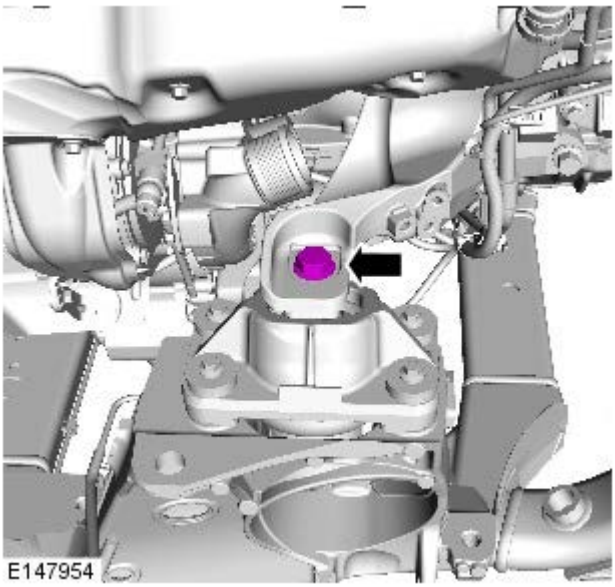




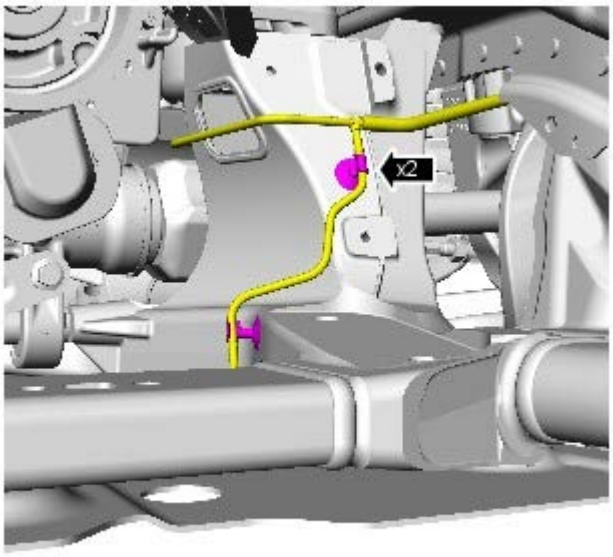
7. CAUTION: Tighten the bolts in the sequence shown.

   Torque: 40 Nm

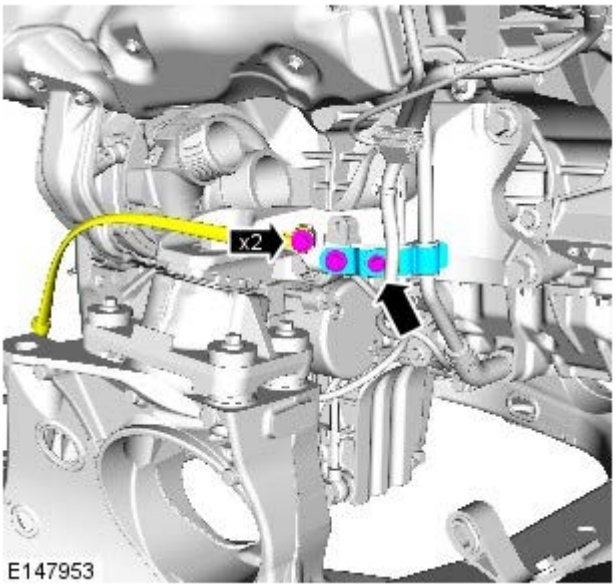
8. *Torque:* 130 Nm



9.



E147958



E147953

10. *Torque:*
    M8 25 Nm
    M6 10 Nm

11. Refer to: Generator (414-02D Generator and Regulator - TDV8 4.4L Diesel, Removal and Installation).

12. Connect the battery ground cable.

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

Published: 22-Oct-2013

Engine - TDV8 4.4L Diesel - Exhaust Manifold Crossover Pipe

Removal and Installation

Removal

1. Disconnect the battery ground cable.

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

2. Refer to: Engine Cover - 4.4L V8 - TdV8 (501-05 Interior Trim and Ornamentation, Removal and Installation).

3. Refer to: Intake Manifold Plenum Chamber (303-01D Engine - TDV8 4.4L Diesel, Removal and Installation).

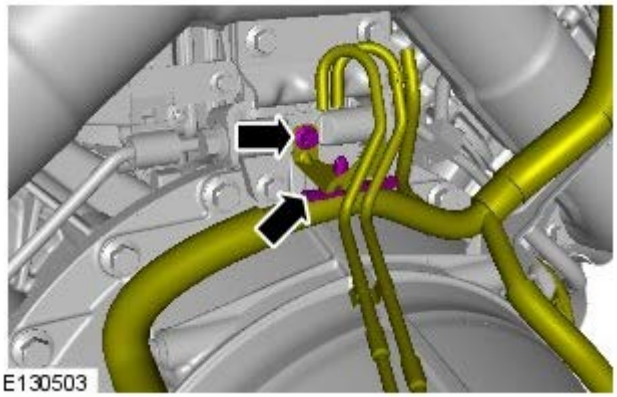
4. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

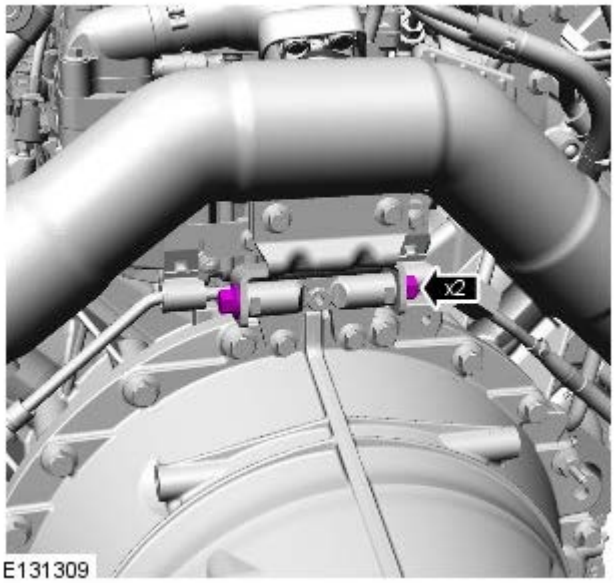
5. Refer to: Exhaust System - Vehicles With: Diesel Particulate Filter (DPF) (309-00D Exhaust System - TDV8 4.4L Diesel, Removal and Installation).

6. Refer to: Exhaust System - Vehicles Without: Diesel Particulate Filter (DPF) (309-00D Exhaust System - TDV8 4.4L Diesel, Removal and Installation).

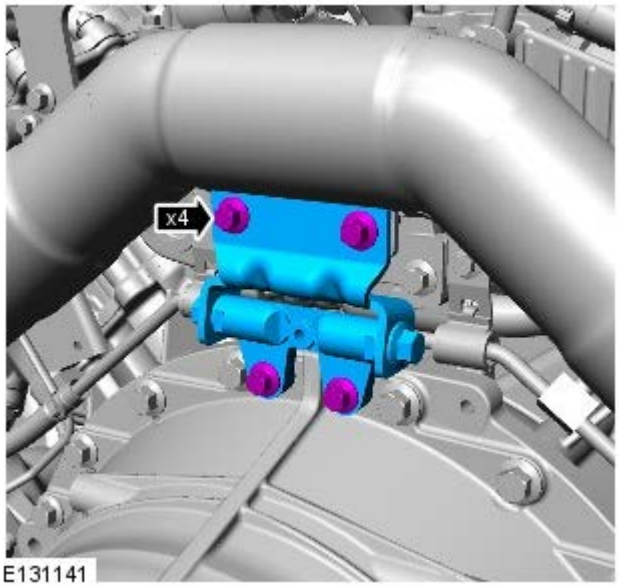
7.



8. NOTE: Loosen the bolt, but do not fully remove.

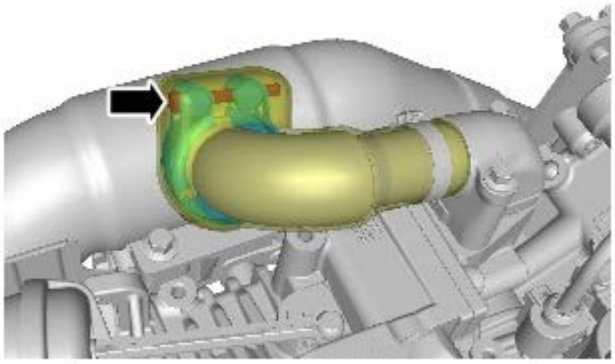


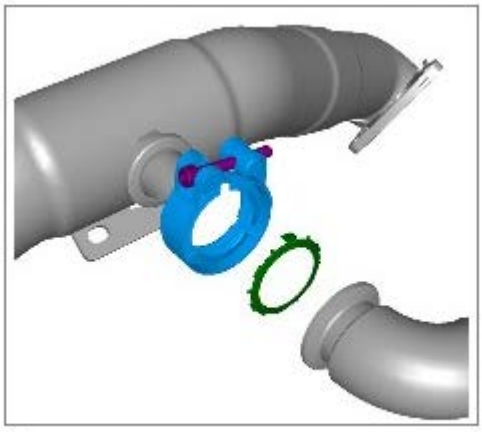
9.



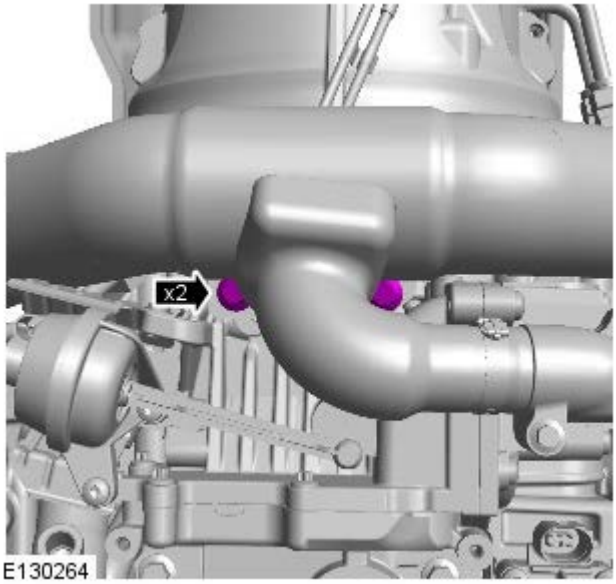
E131141

10.

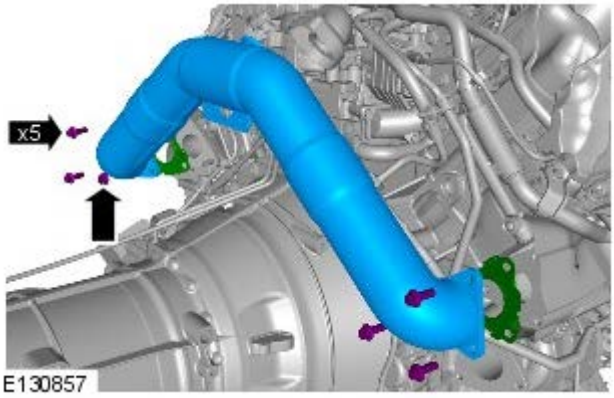



E130116

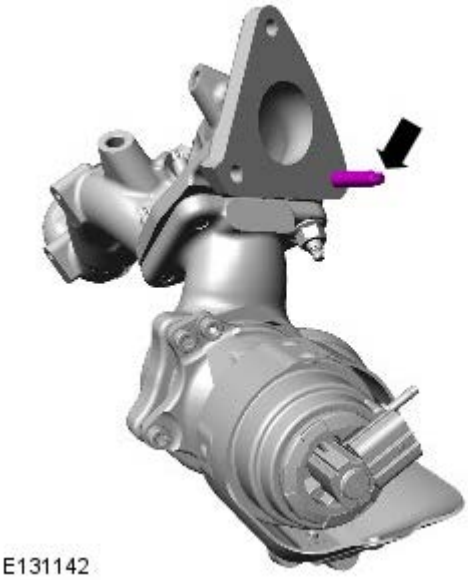
11.



12.



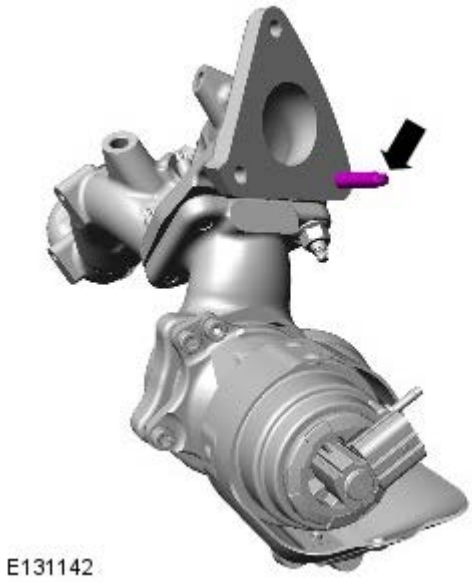
13. Remove and discard the stud.



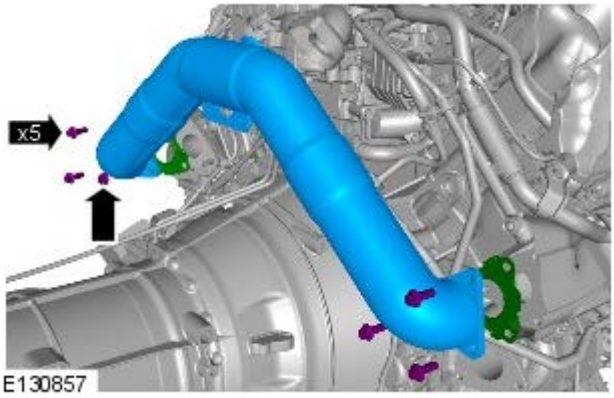
Installation

1. CAUTION: Make sure a new stud is installed

   Torque: 13 Nm



E131142



E130857

2. CAUTIONS:

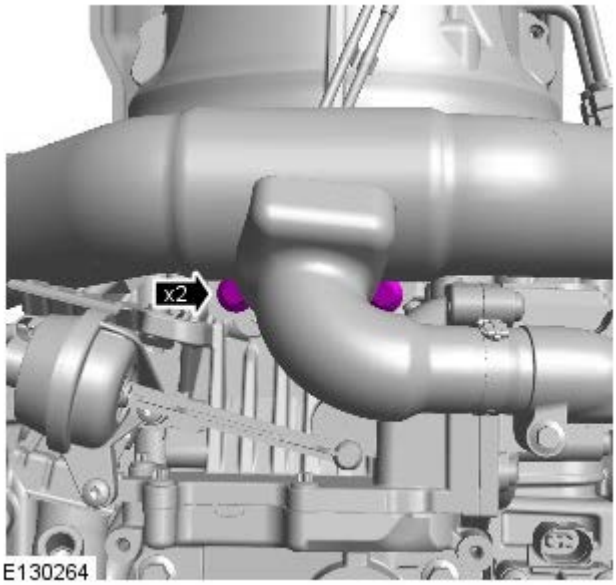
   Make sure that the mating faces are clean and free of foreign material.

   The bolts and nut must be re-torqued after 20 minutes.

   Install the nut and bolts finger tight before final tightening.

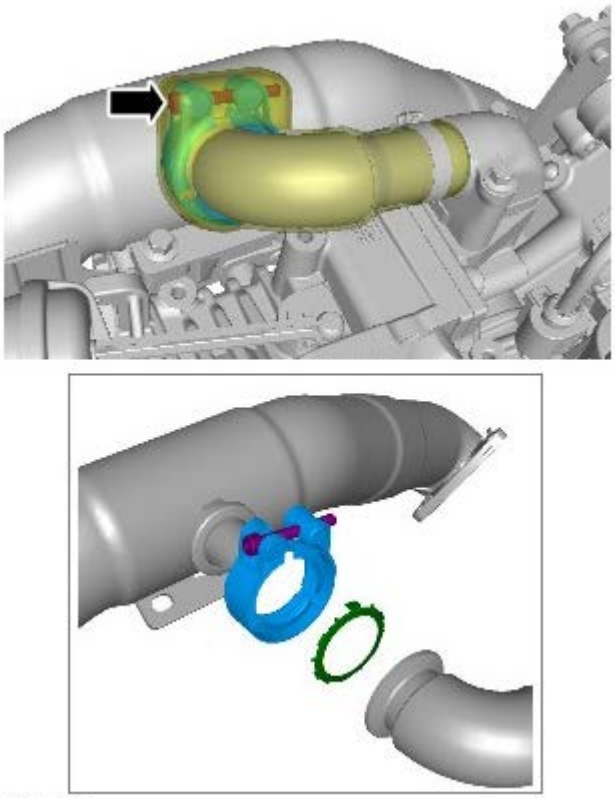
   Torque:
   Bolts 23 Nm
   nut 28 Nm

3. *Torque:* 23 Nm



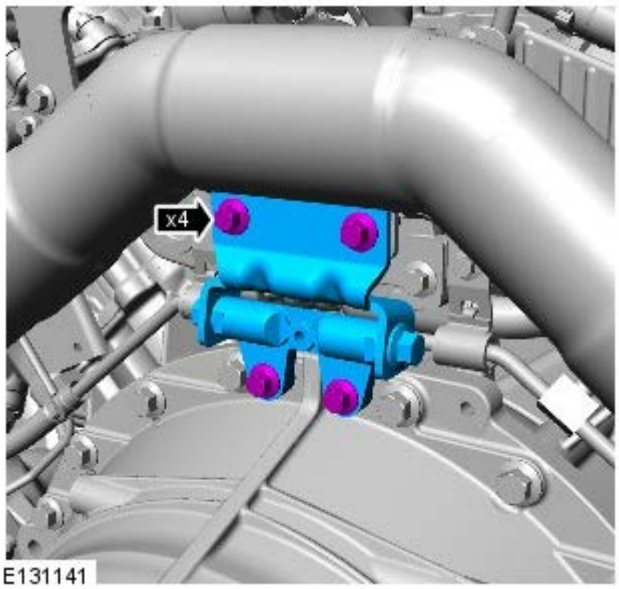
E130264

4. *Torque:* 7 Nm



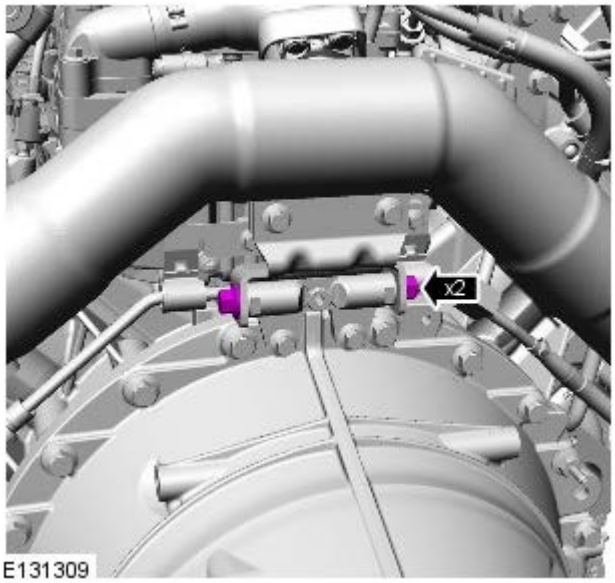
E130116

5. *Torque:* 23 Nm

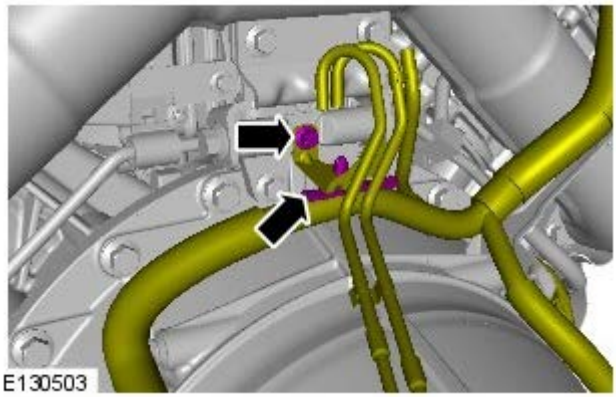


E131141

6. *Torque:* 23 Nm



7. *Torque:* 10 Nm



8. Refer to: Exhaust System - Vehicles Without: Diesel Particulate Filter (DPF) (309-00D Exhaust System - TDV8 4.4L Diesel, Removal and Installation).

9. Refer to: Exhaust System - Vehicles With: Diesel Particulate Filter (DPF) (309-00D Exhaust System - TDV8 4.4L Diesel, Removal and Installation).

10. Refer to: Intake Manifold Plenum Chamber (303-01D Engine - TDV8 4.4L Diesel, Removal and Installation).

11. Refer to: Engine Cover - 4.4L V8 - TdV8 (501-05 Interior Trim and Ornamentation, Removal and Installation).

12. Connect the battery ground cable.

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

Published: 28-Oct-2013

Engine - TDV8 4.4L Diesel - Exhaust Manifold LH

Removal and Installation

Removal

NOTES:

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

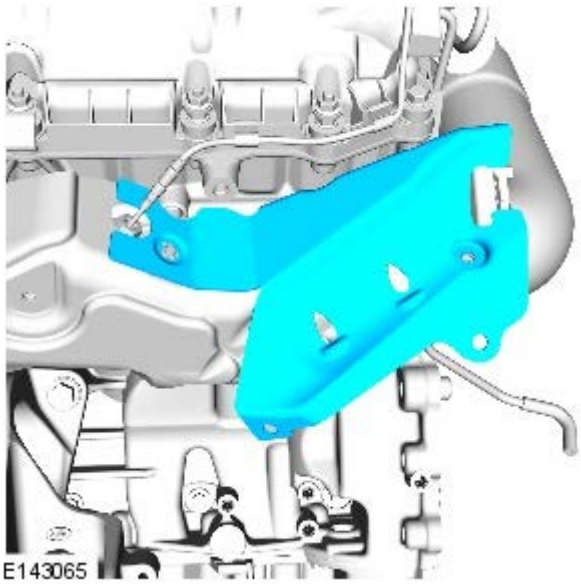
Engine shown removed for clarity.

1. Disconnect the battery ground cable.

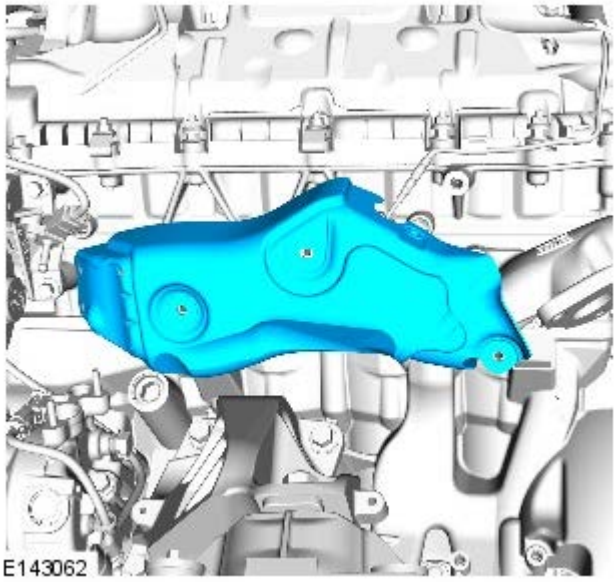
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

2. Refer to: Turbocharger LH (303-04F Fuel Charging and Controls - Turbocharger - TDV8 4.4L Diesel, Removal and Installation).

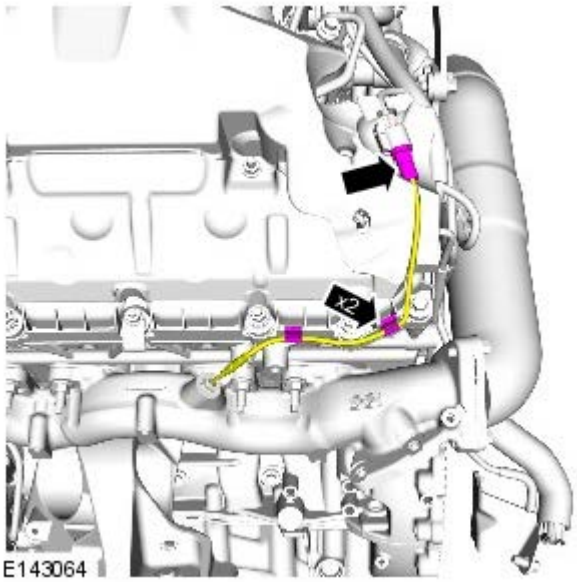
3.



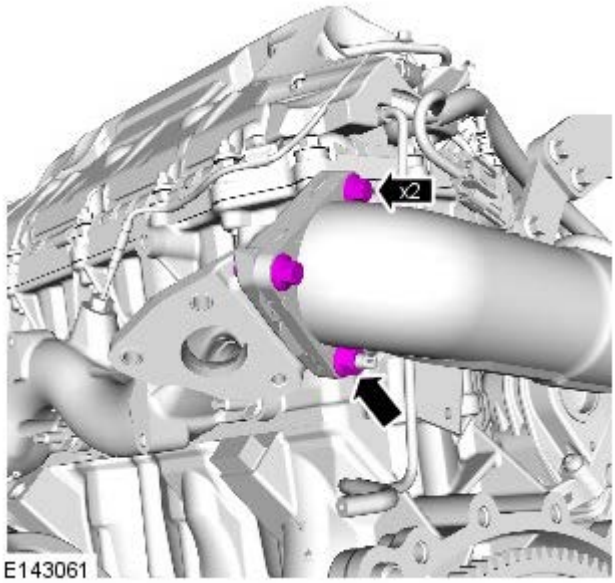
4.



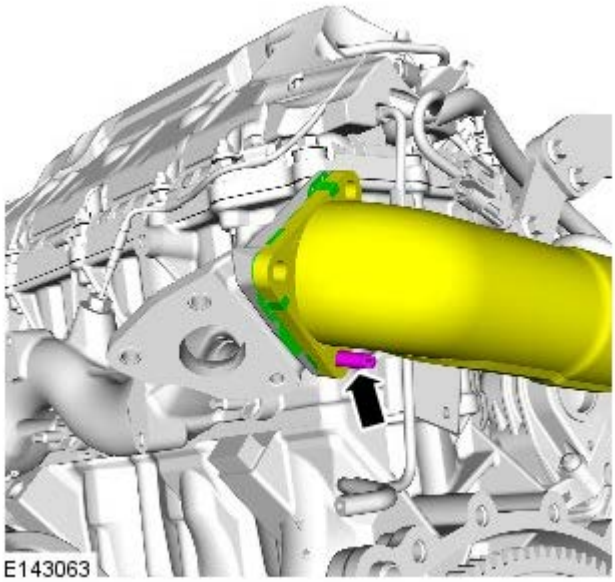
5.



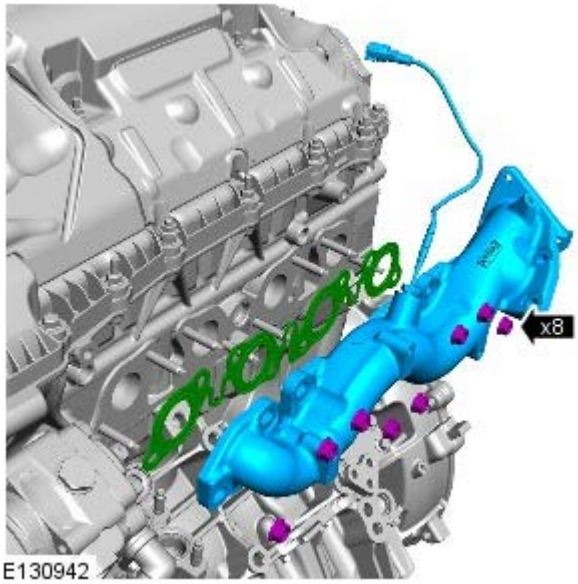
6.



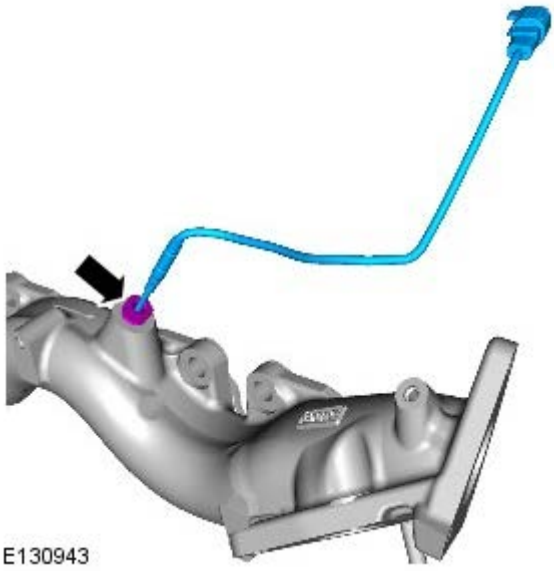
7.



8.

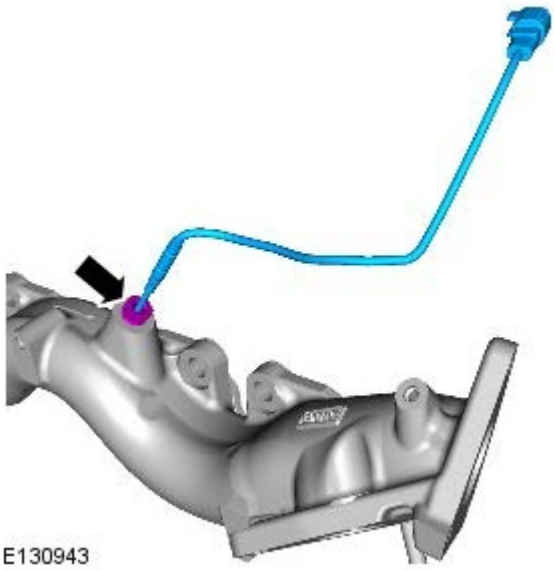


9. NOTE: Do not disassemble further if the component is removed for access only.



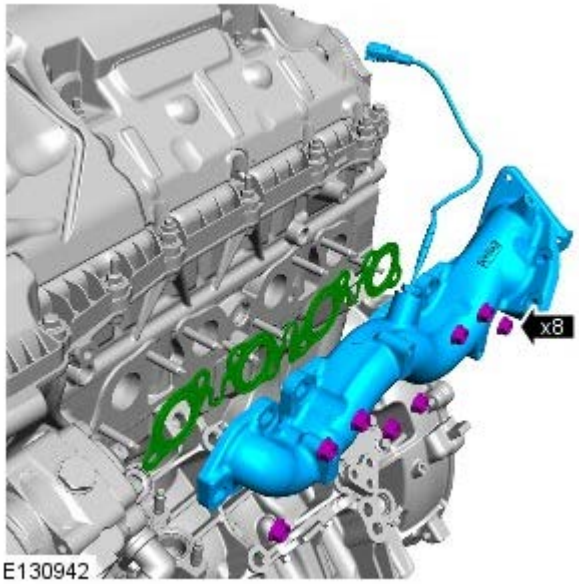
Installation

1. *Torque:* 32 Nm



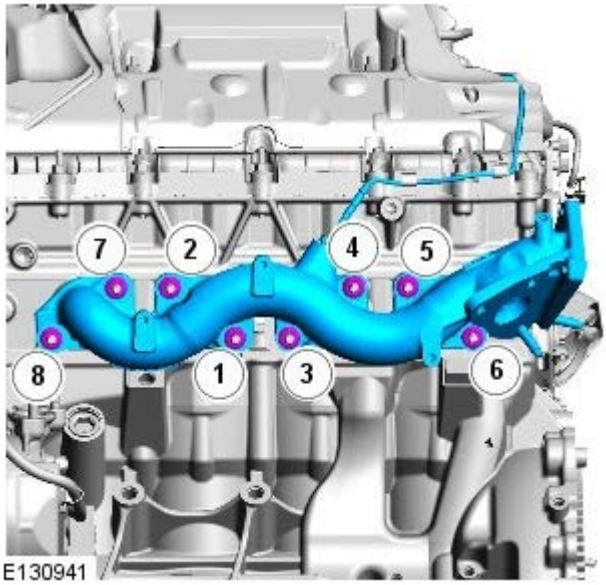
2. WARNING: Make sure that new nuts are installed.

CAUTIONS:



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

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

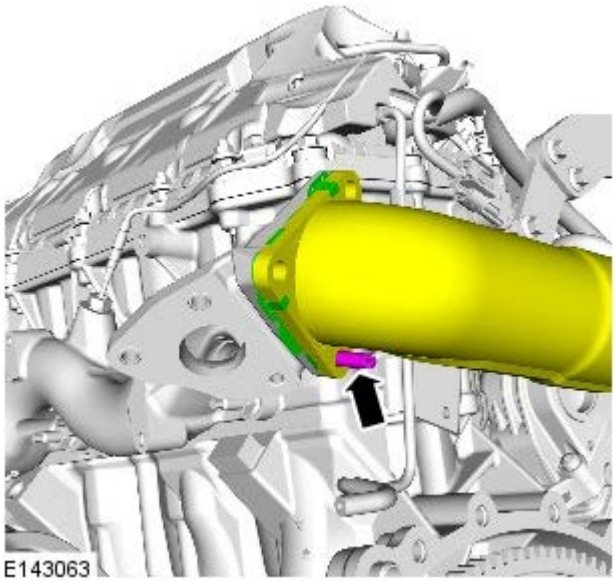


3. CAUTION: Repeat this step 3 times, waiting 2 minutes between each repetition.

NOTE: Tighten the nuts in the sequence shown.

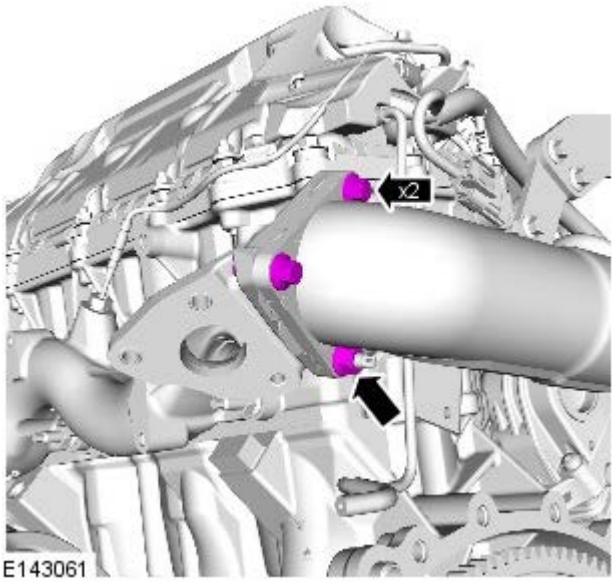
Torque: 20 Nm

4. *Torque:* 13 Nm

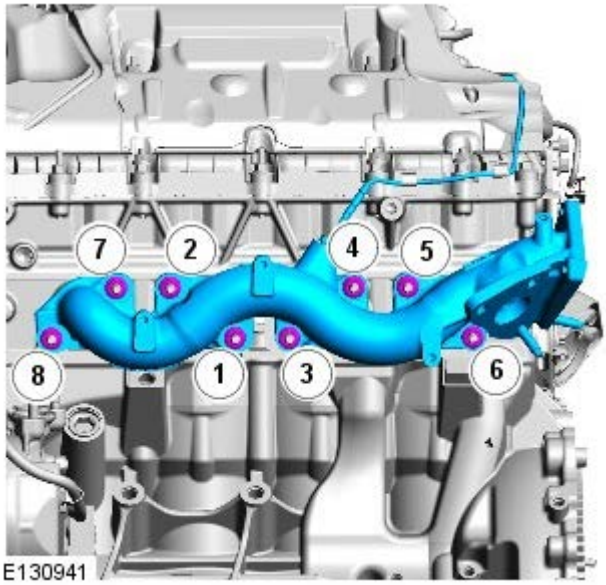


5. CAUTIONS:

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



Only tighten the nut and bolts finger tight at this stage.

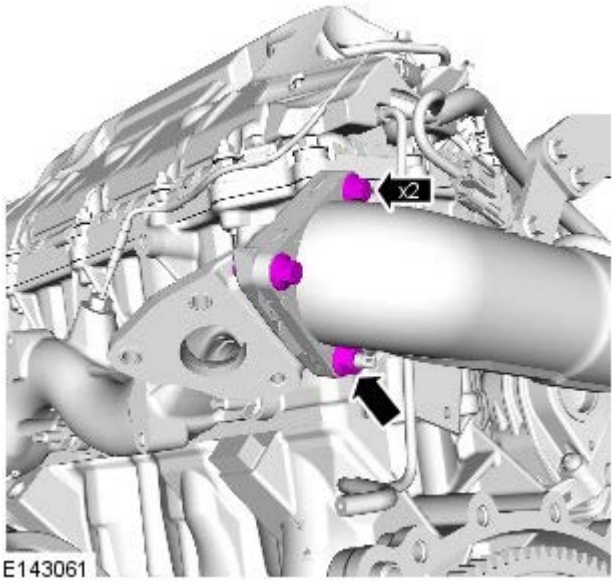


6. CAUTION: Repeat this step 3 times, waiting 2 minutes between each repetition.

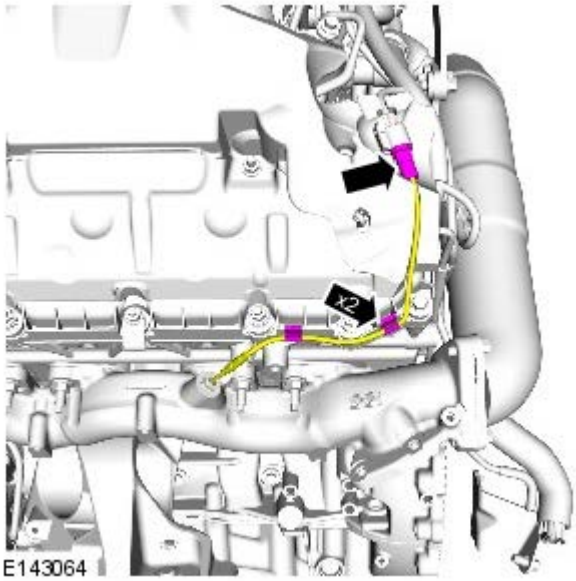
NOTE: Tighten the nuts in the sequence shown.

Torque: 20 Nm

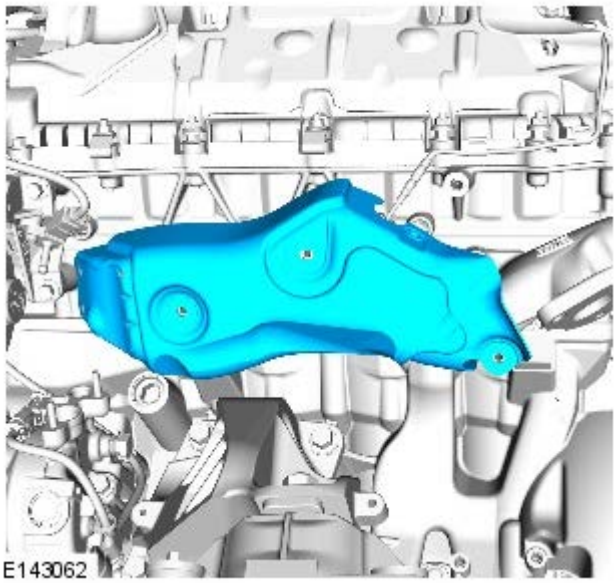
7. *Torque:* 35 Nm



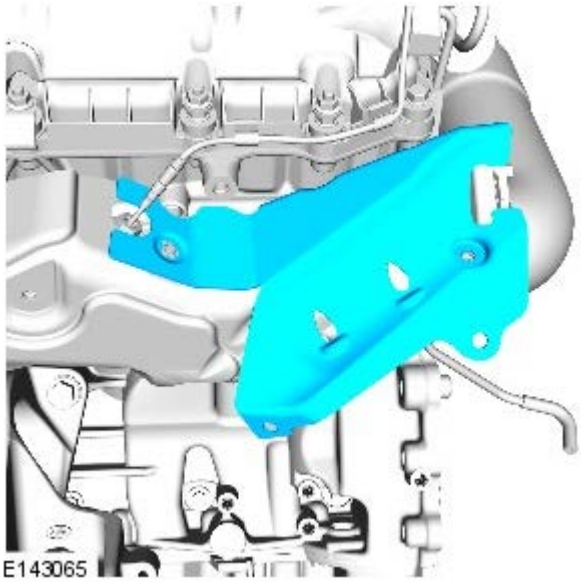
8.



9.



10.



11. Refer to: Turbocharger LH (303-04F Fuel Charging and Controls - Turbocharger - TDV8 4.4L Diesel, Removal and Installation).

12. Connect the battery ground cable.

    Refer to: Specifications (414-00 Battery and Charging System -

General Information, Specifications).

Published: 28-Oct-2013

Engine - TDV8 4.4L Diesel - Exhaust Manifold RH

Removal and Installation

Removal

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

NOTES:

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

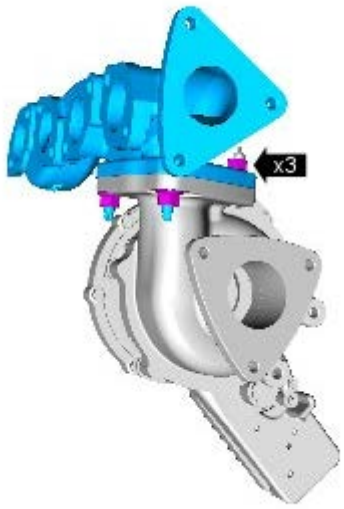
Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

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

2. Refer to: Turbocharger RH (303-04F Fuel Charging and Controls - Turbocharger - TDV8 4.4L Diesel, Removal and Installation).

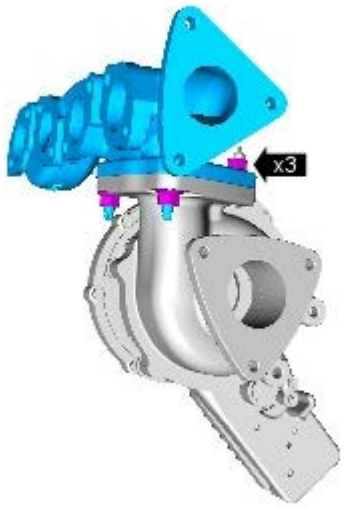
3.



E146614

Installation

1. *Torque:* 23 Nm



E146614

2. Refer to: Turbocharger RH (303-04F Fuel Charging and Controls -

Turbocharger - TDV8 4.4L Diesel, Removal and Installation).

3. Connect the battery ground cable.

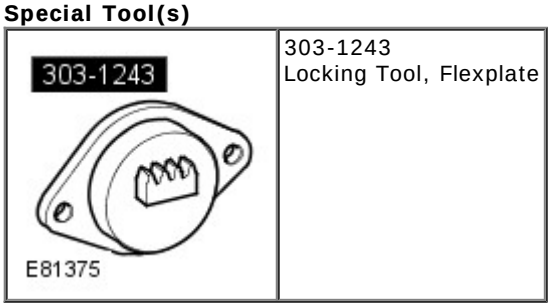
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 28-Oct-2013

Engine - TDV8 4.4L Diesel - Flexplate

Removal and Installation

Special Tool(s)

	303-1243 Locking Tool, Flexplate

Removal

NOTES:

Removal steps in this procedure may contain installation details.

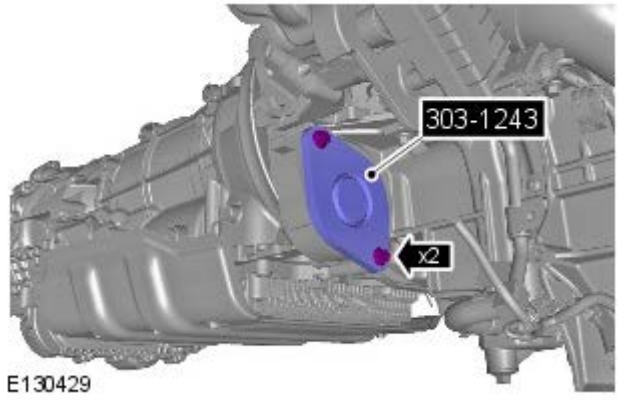
Some variation in the illustrations may occur, but the essential information is always correct.

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

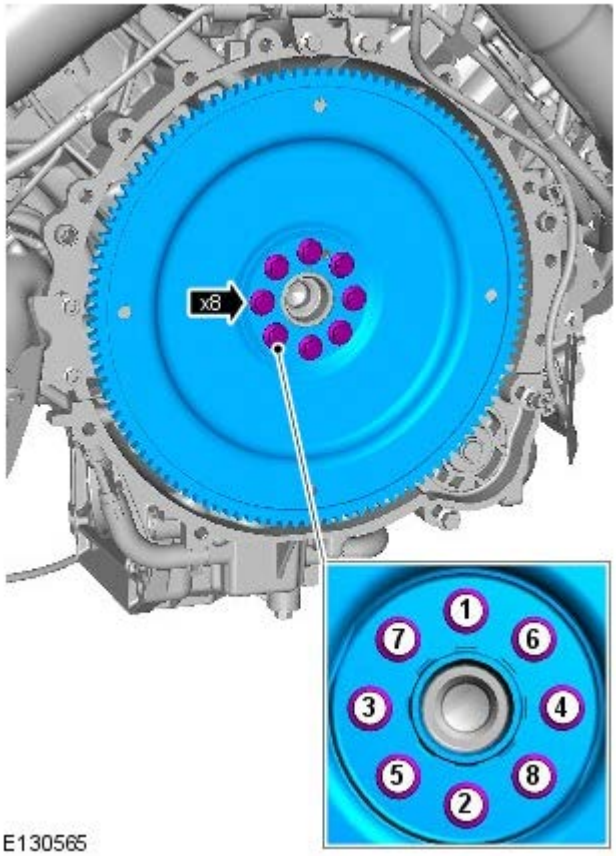
   Raise and support the vehicle.

2. Refer to: Transmission - TDV8 4.4L Diesel (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, Removal).

3. *Special Tool(s):* 303-1243

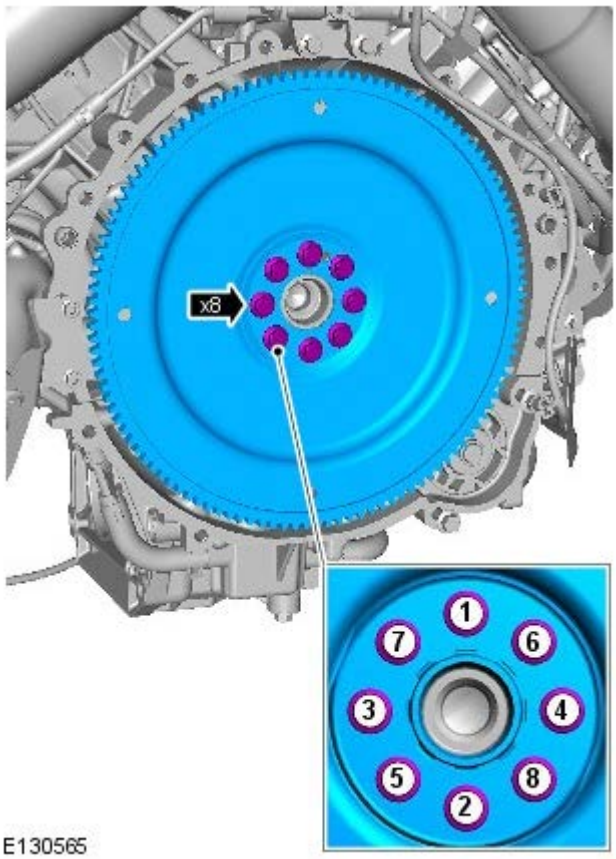


4.
   - Discard the bolts.



E130565

Installation



E130565

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

   To install, reverse the removal procedure.

   Torque:
   Stage 1:15 Nm
   Stage 2:35°
   Stage 3:15°

Published: 22-Oct-2013

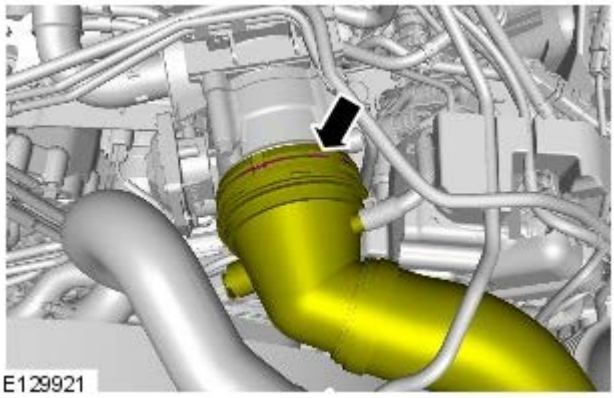
Engine - TDV8 4.4L Diesel - Intake Manifold Plenum Chamber

Removal and Installation

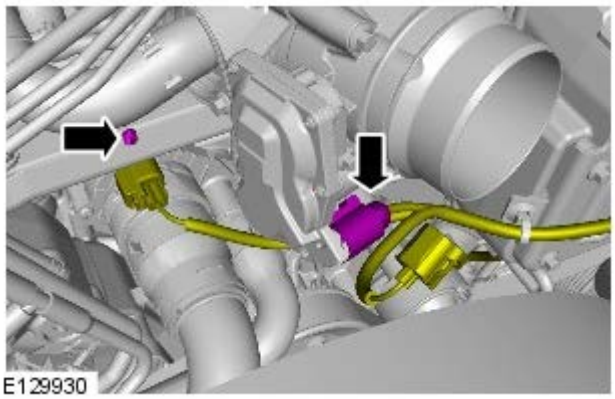
Removal

1. Refer to: Engine Cover - 4.4L V8 - TdV8 (501-05 Interior Trim and Ornamentation, Removal and Installation).

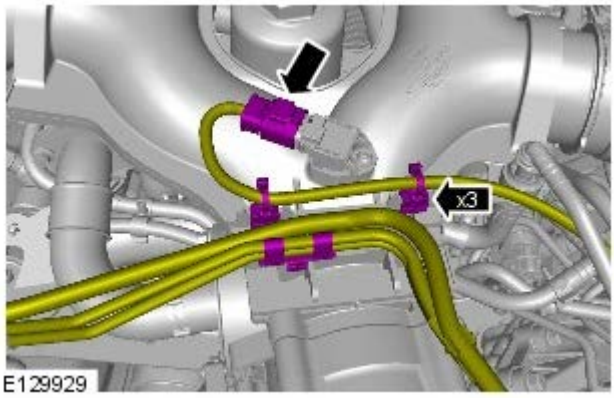
2. Refer to: Secondary Bulkhead Center Panel - TDV8 4.4L Diesel (501-02, Removal and Installation).



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



4.



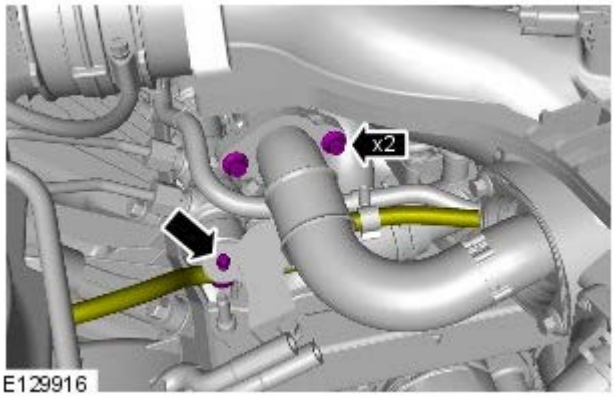
5.

6. NOTES:

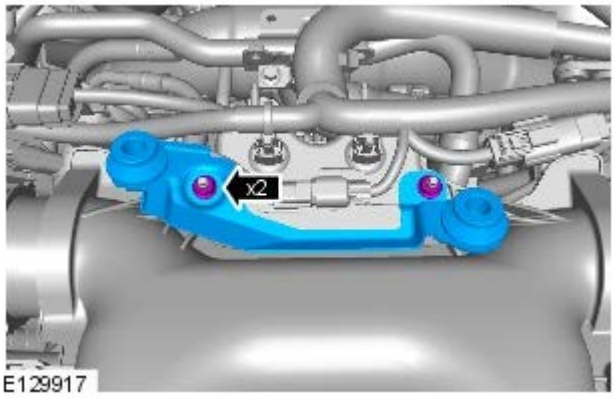
   Remove and discard the gasket.

   Install a new gasket.

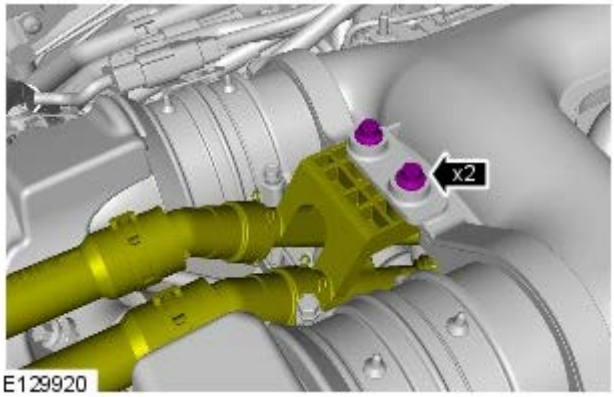
   Torque: 10 Nm



7. *Torque:* 10 Nm

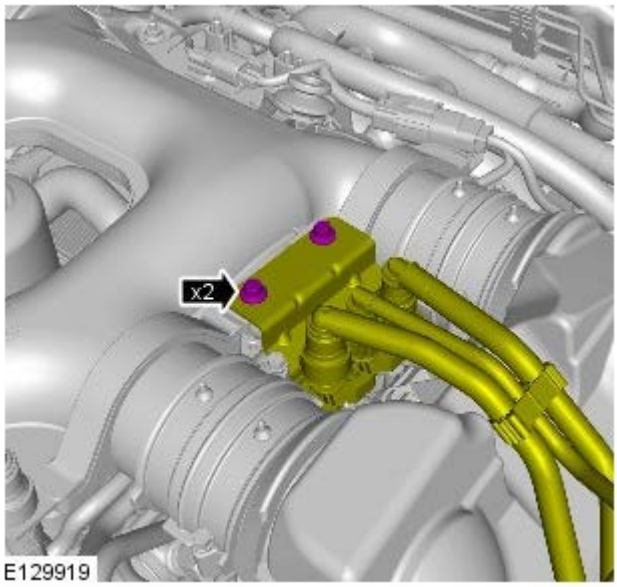


8. *Torque:* 10 Nm

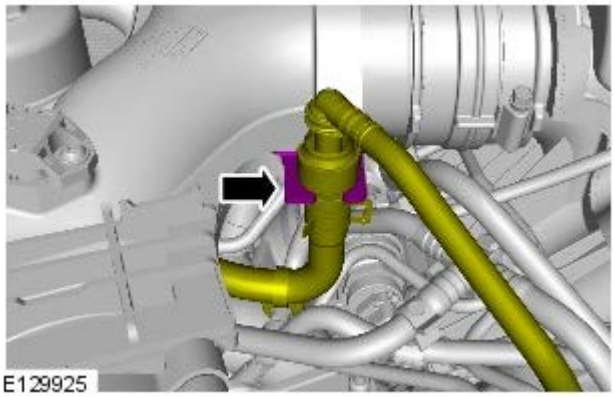


9. CAUTION: Take extra care not to damage the component.

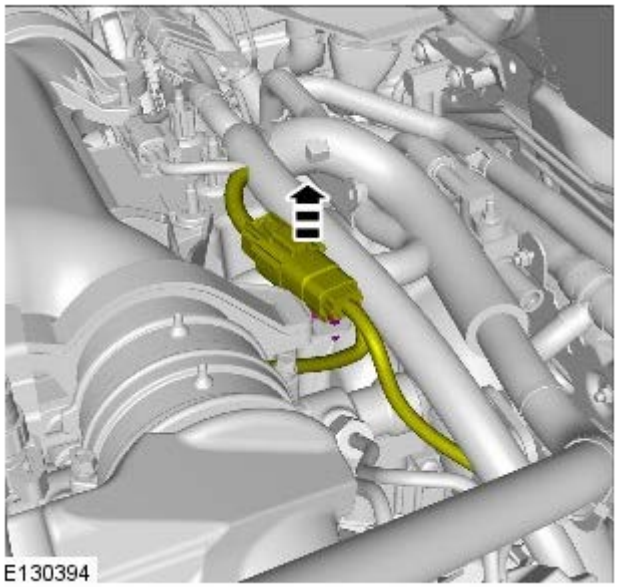
   Torque: 10 Nm



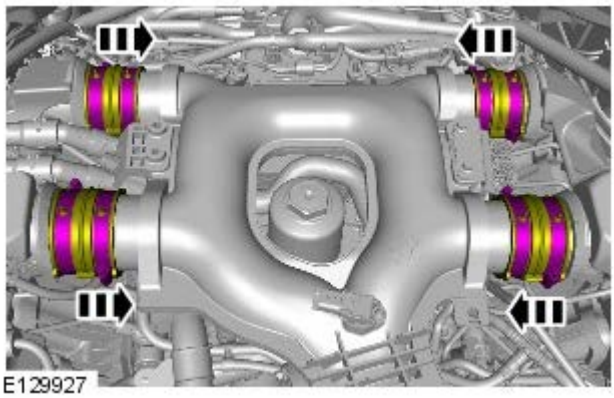
10.



11.

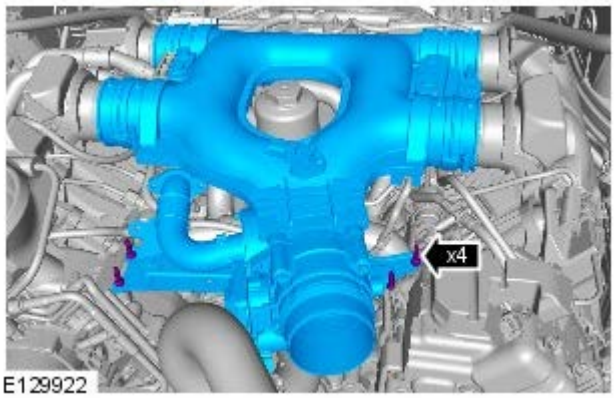


12. *Torque:* 5 Nm

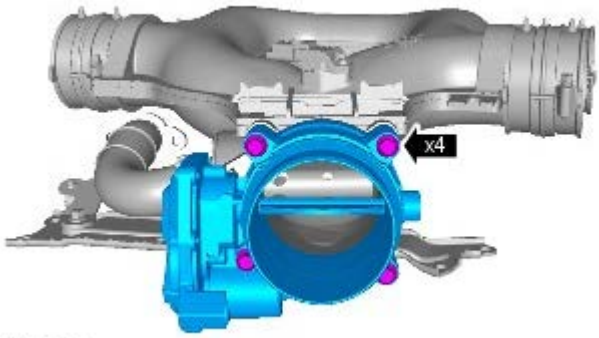


13. CAUTION: Make sure that all openings are sealed. Use new blanking caps.

Torque: 10 Nm



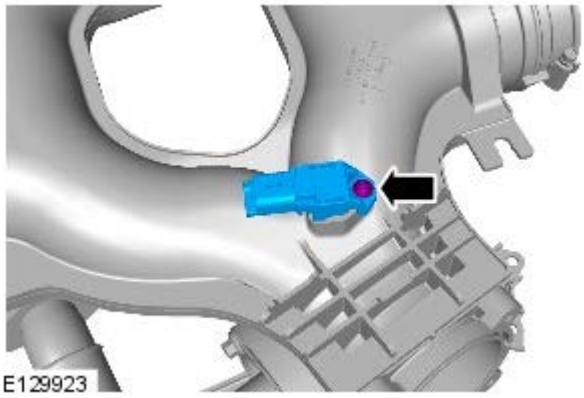
14. CAUTION: Make sure that all openings are sealed. Use new blanking caps.



E129928

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

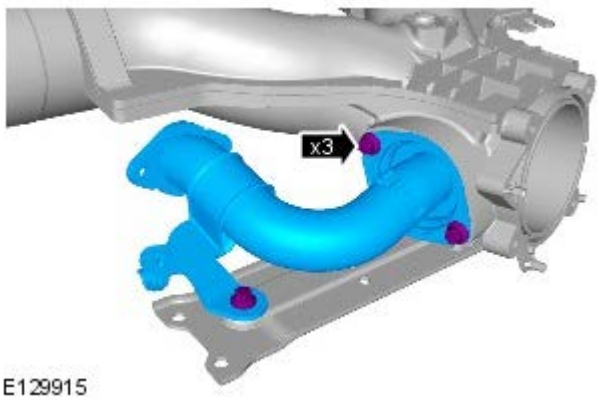
Torque: 12 Nm


E129923

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

16.


E129926



E129915

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

Torque: 10 Nm

18. *Torque:* 10 Nm



Installation

1. To install, reverse the removal procedure.

Published: 22-Oct-2013

Engine - TDV8 4.4L Diesel - Oil Cooler

Removal and Installation

Removal

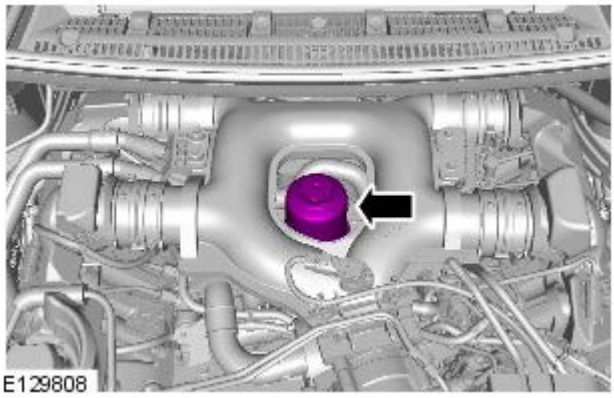
NOTES:

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

Removal steps in this procedure may contain installation details.

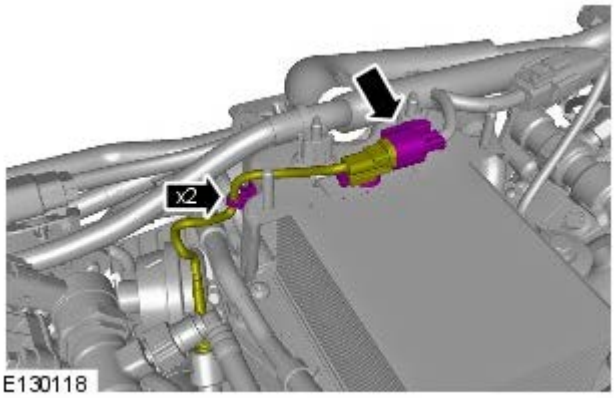
1. Disconnect the battery ground cable.

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



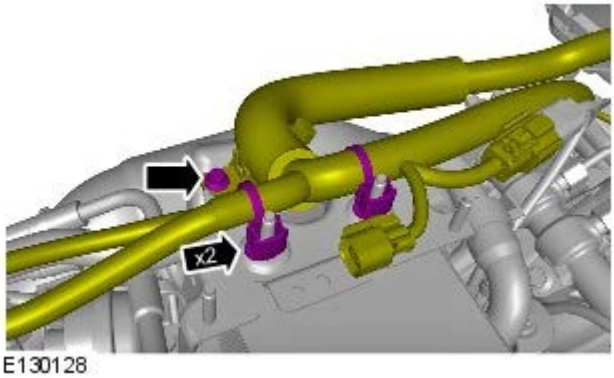
2.
   - Loosen the oil filter cover 3 turns and allow the engine oil to drain.

3. Refer to: Intake Manifold Plenum Chamber (303-01D Engine - TDV8 4.4L Diesel, Removal and Installation).

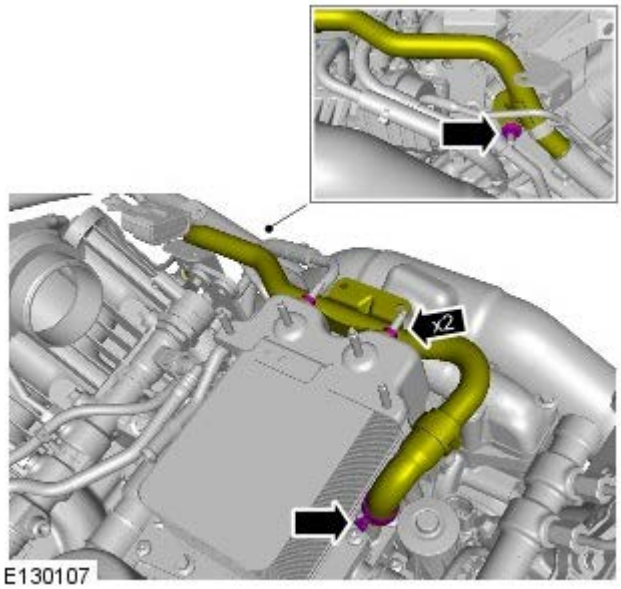


4.

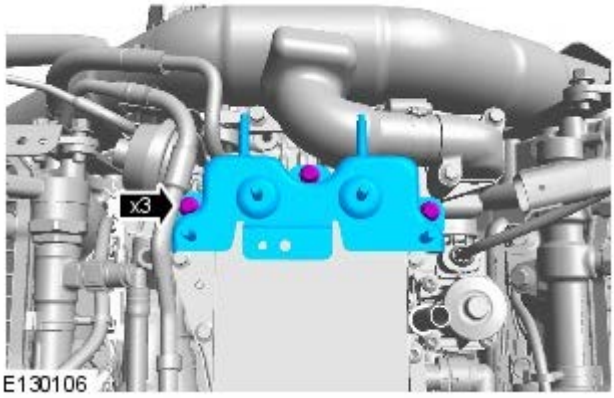
5. *Torque:* 10 Nm



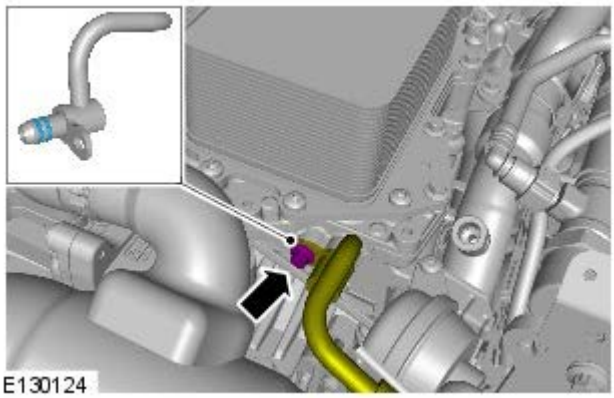
6. CAUTION: Make sure that all openings are sealed. Use new blanking caps.



Torque: 10 Nm



7. *Torque:* 10 Nm



8. CAUTIONS:

⚠ Be prepared to collect escaping oil.

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

Torque: 10 Nm

9. CAUTIONS:

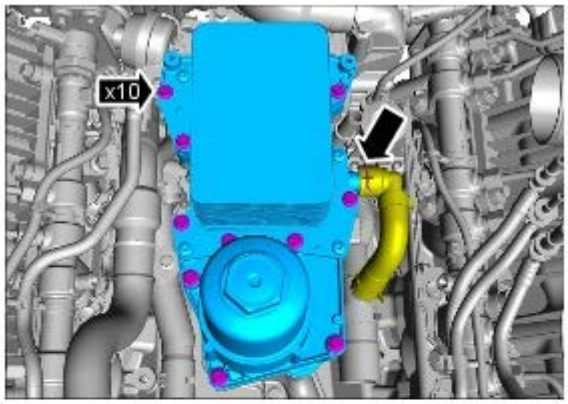
⚠ Be prepared to collect escaping oil.

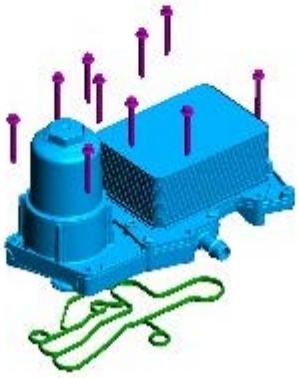
⚠ Be prepared to collect escaping coolant.

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

⚠ Make sure the seal is installed correctly.

Torque: 13 Nm





E130123

Installation

1. To install, reverse the removal procedure.

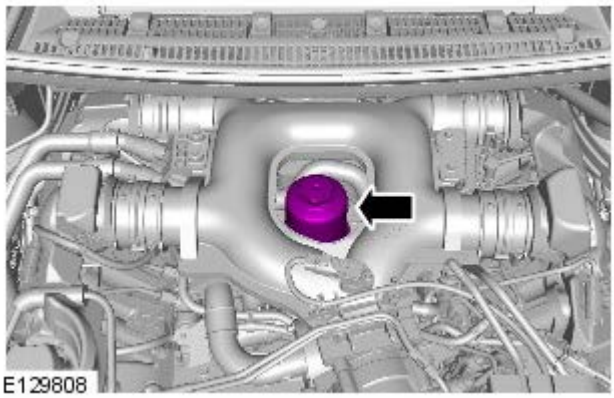
Published: 22-Oct-2013

Engine - TDV8 4.4L Diesel - Oil Filter Element

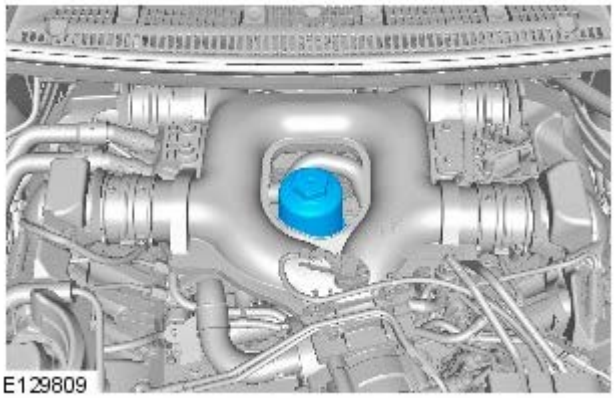
Removal and Installation

Removal

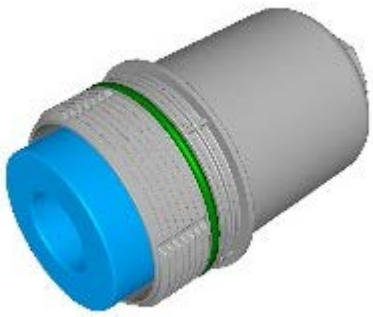
1. Refer to: Engine Cover - 4.4L V8 - TdV8 (501-05 Interior Trim and Ornamentation, Removal and Installation).


E129808

2.
- Loosen the oil filter cover 3 turns and allow the engine oil to drain.


E129809

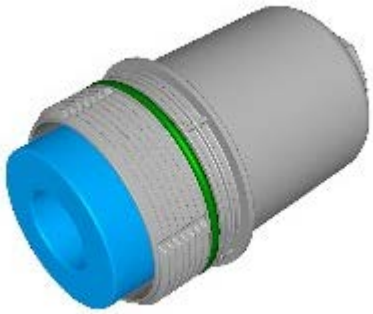
3. NOTE: Position cloth to collect fluid spillage.


E129862

4.
- Remove and discard the oil filter element.
- Remove and discard the oil filter cover O-ring seal.

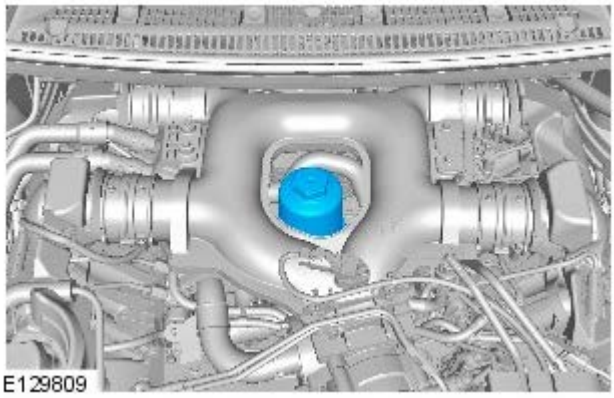
Installation

1.
- Clean the components.
- Install a new oil filter element to the oil filter cover.
- Lubricate the oil filter element O-ring seal with clean engine oil.
- Install a new oil filter cover O-ring seal.
- Lubricate the O-ring seal with clean engine oil.



E129862

2. *Torque:* 35 Nm



E129809

3. Check and top-up the engine oil.

4. Refer to: Engine Cover - 4.4L V8 - TdV8 (501-05 Interior Trim and Ornamentation, Removal and Installation).

Published: 31-Oct-2013

Engine - TDV8 4.4L Diesel - Oil Pan

Removal and Installation

Removal

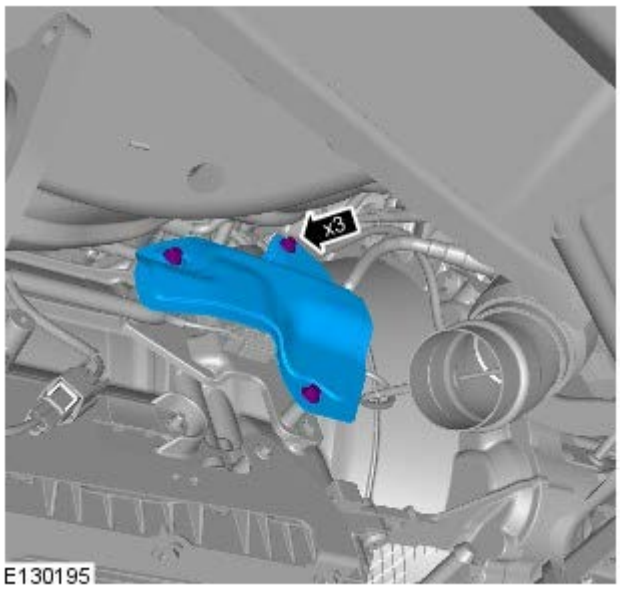
NOTES:

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

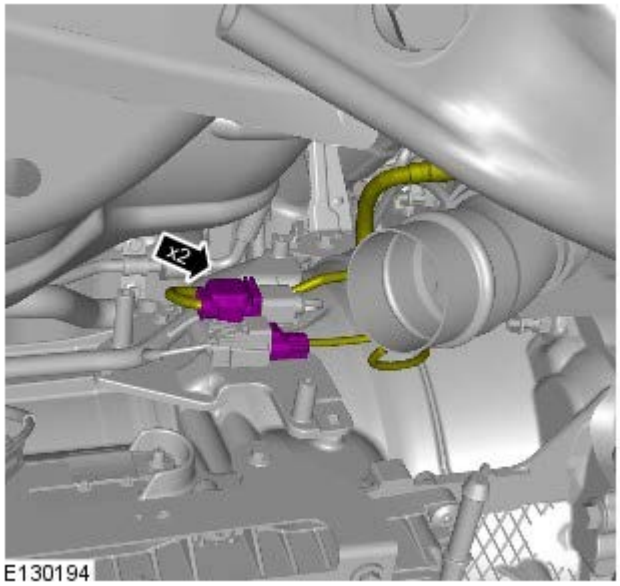
Removal steps in this procedure may contain installation details.

Engine shown removed for clarity.

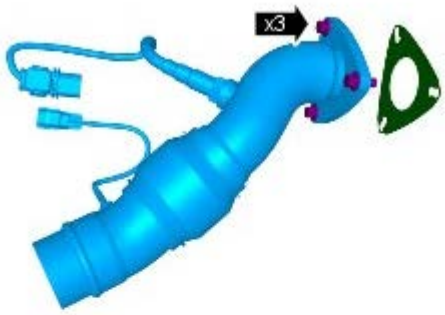
1. Refer to: Engine Oil Vacuum Draining and Filling (303-01D Engine - TDV8 4.4L Diesel, General Procedures).
2. Refer to: Differential Case (205-03 Front Drive Axle/Differential, Removal and Installation).
3.

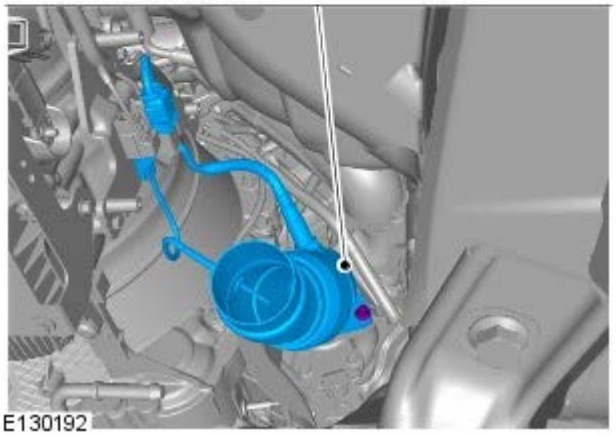


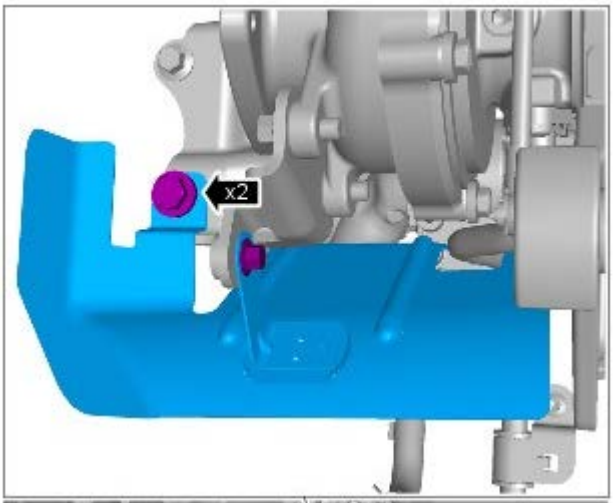
4.

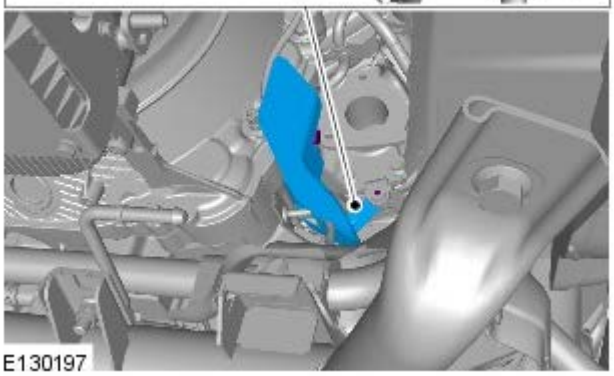


5. NOTE: Remove and discard the gasket.



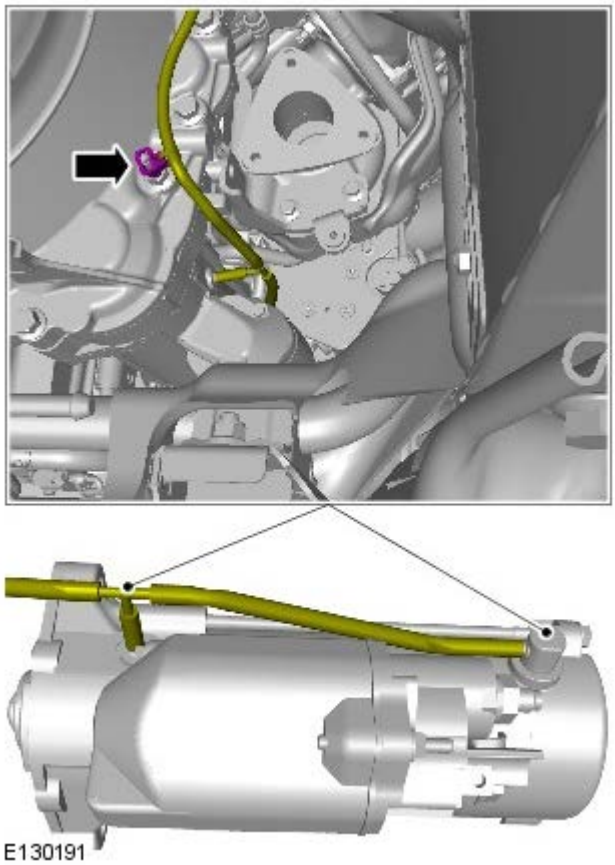

E130192



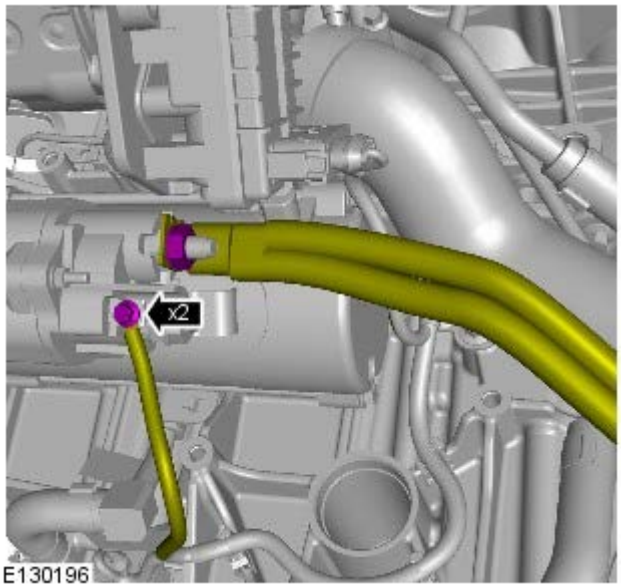

E130197

6. NOTE: Note the position of the wiring harnesses to aid installation.

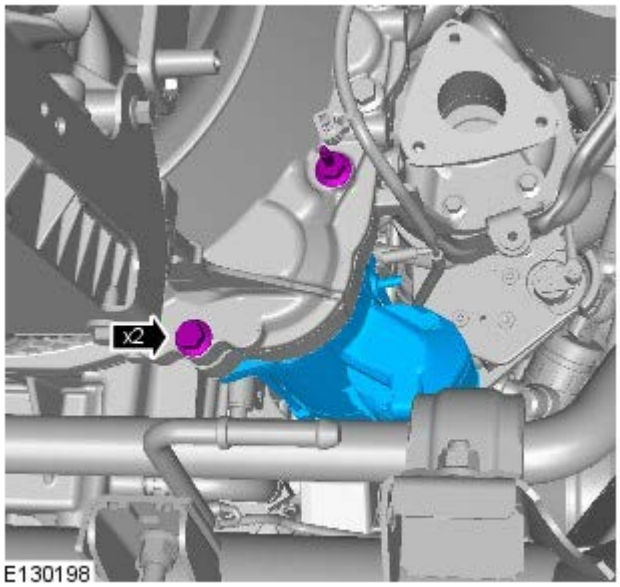
7.



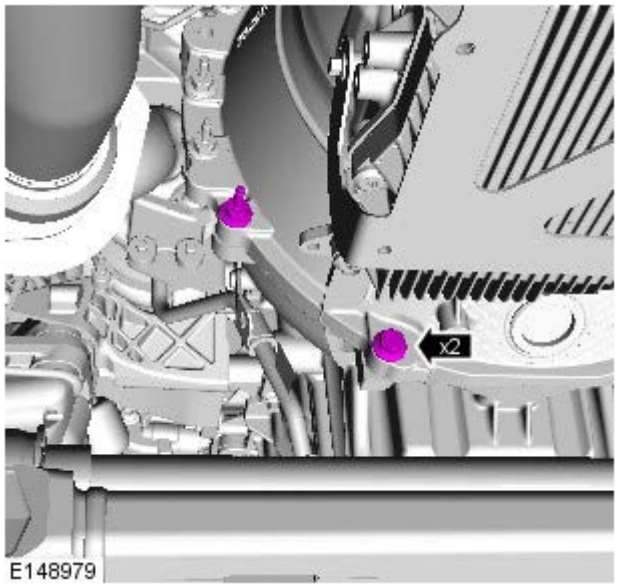
8.



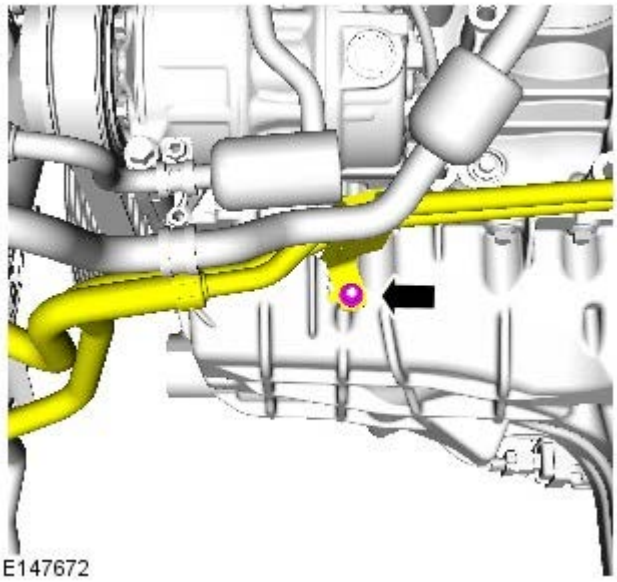
9.



10.

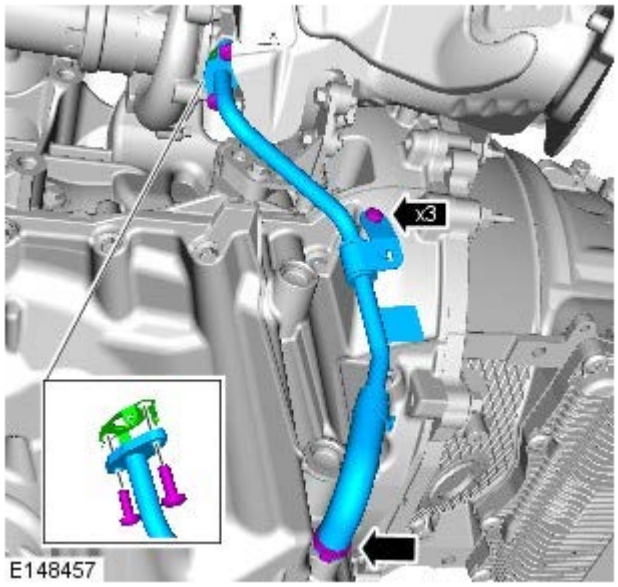


11.



12. CAUTIONS:

Be prepared to collect escaping oil.

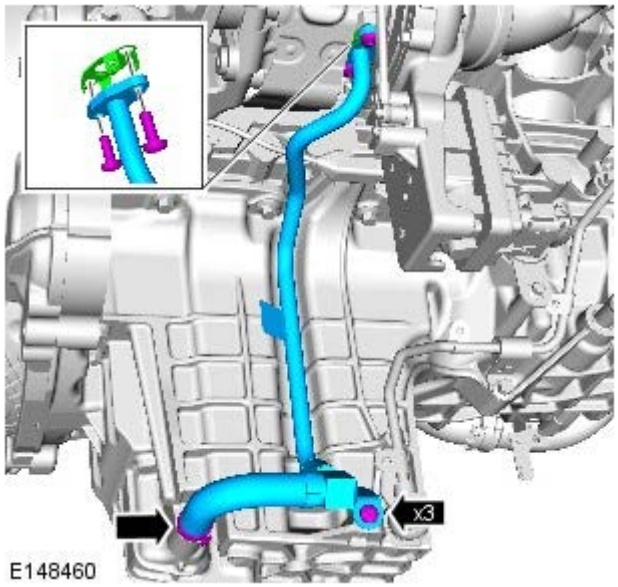


Make sure that all openings are sealed. Use new blanking caps.

NOTES:

Remove and discard the gasket.

Discard the retaining clip.



13. CAUTIONS:

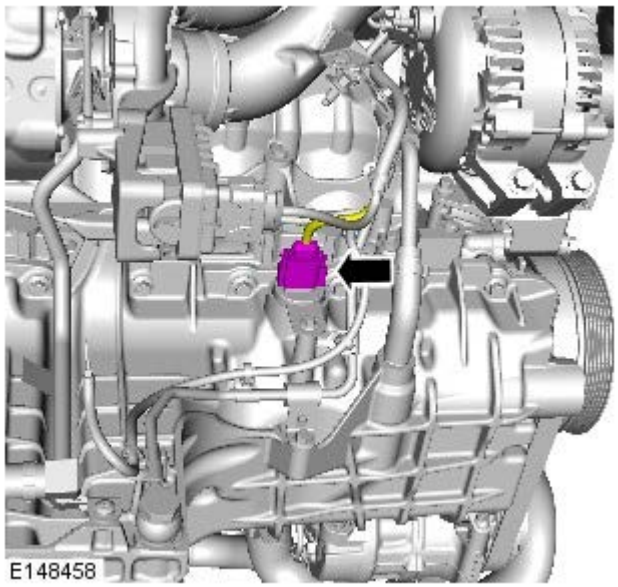
Be prepared to collect escaping oil.

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

NOTES:

Remove and discard the gasket.

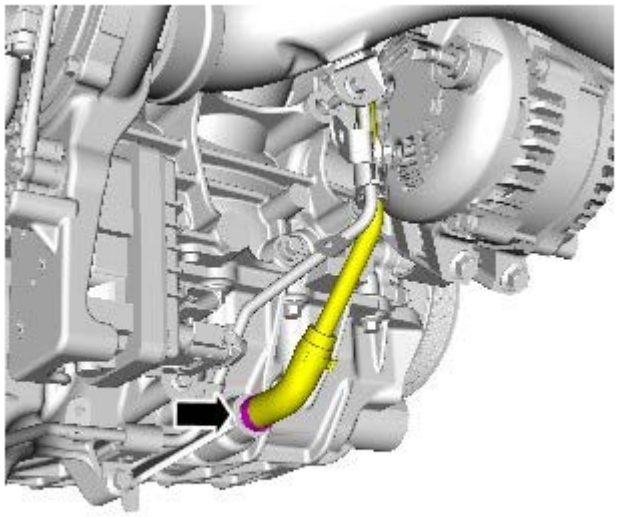
Discard the retaining clip.



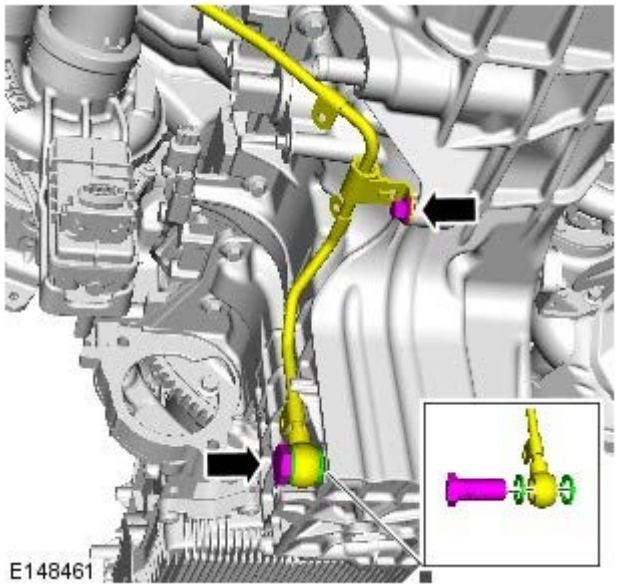
14.

15. CAUTION: Be prepared to collect escaping oil.

NOTE: Discard the retaining clip.



E148459



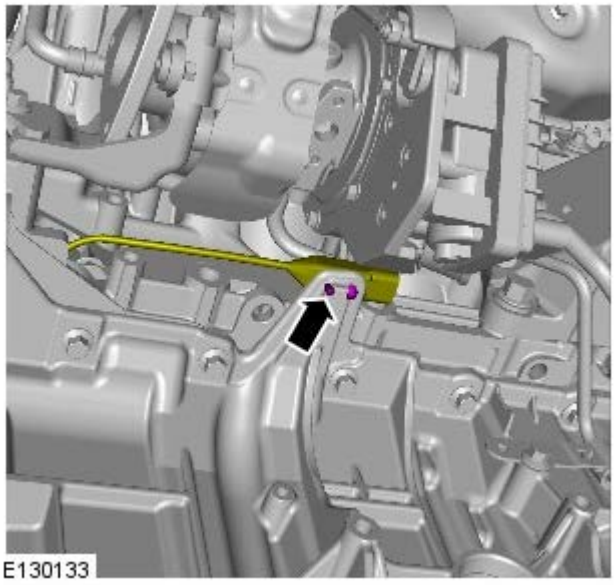
E148461

16. CAUTIONS:

Be prepared to collect escaping oil.

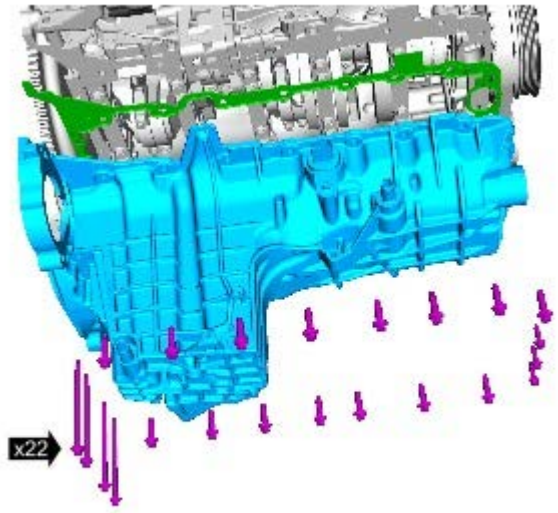
Inspect the seals, replace if damaged.

17.



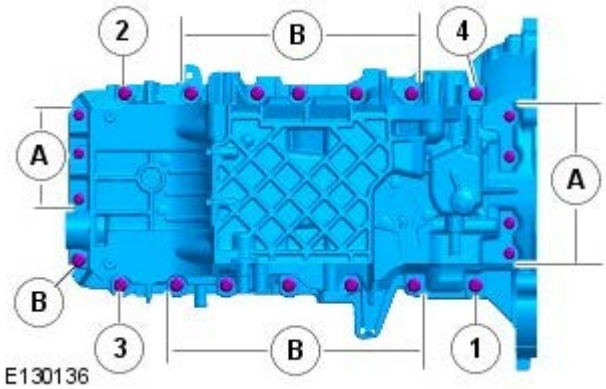
E130133

18. NOTE: Remove and discard the gasket.



E148681

Installation



E130136

1. CAUTIONS:

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

   Install all the bolts finger tight before final tightening.

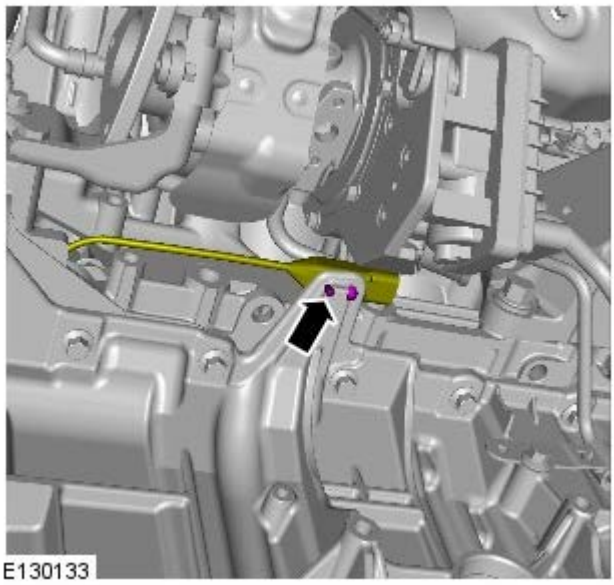
   NOTES:

   Install a new gasket.

   Tighten the bolts in the indicated sequence.

   Torque:
   1-4 23 Nm
   B 23 Nm
   A 10 Nm

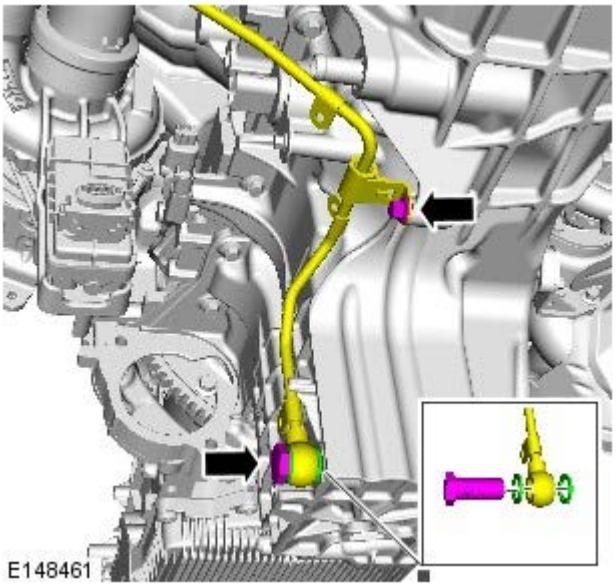
2.



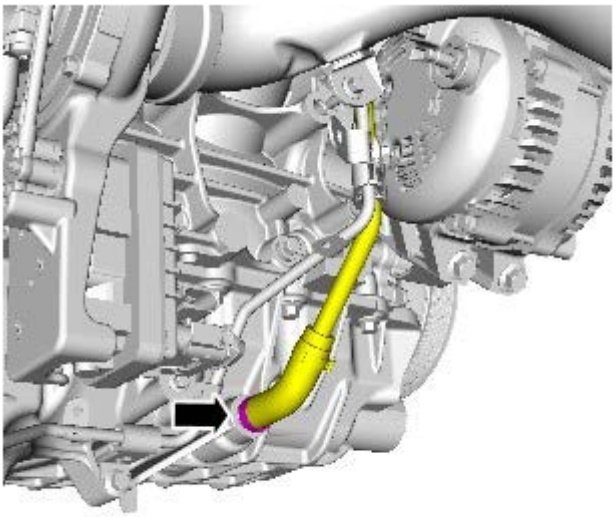
E130133

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

   Torque:

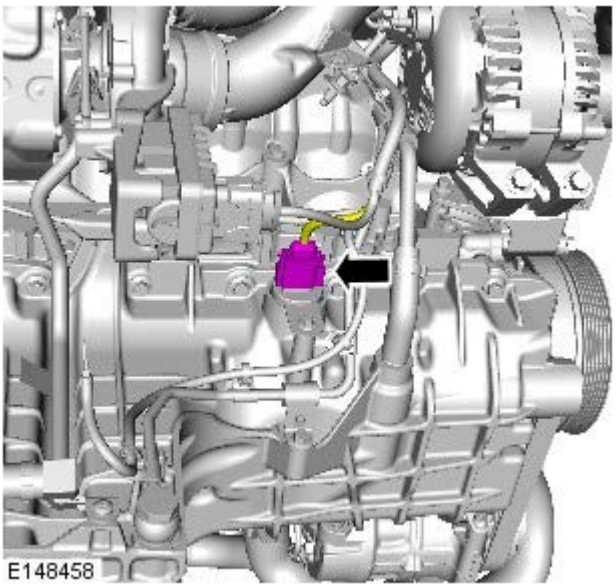


M8 25 Nm
Banjo bolt 45 Nm



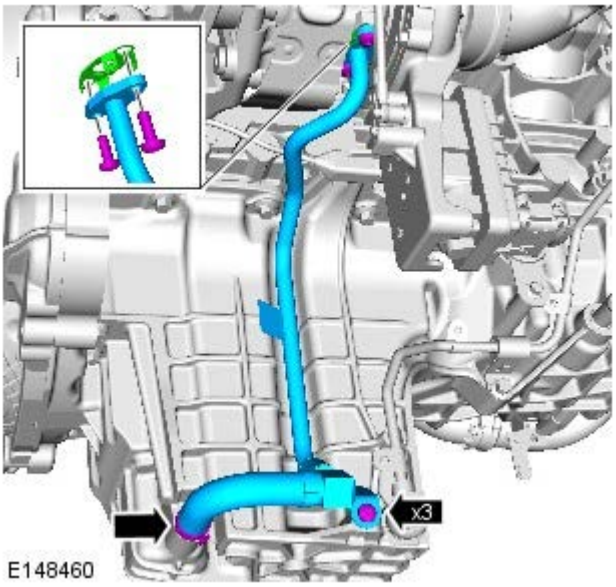
4. NOTE: Install a new retaining clip.

5.



6. NOTES:

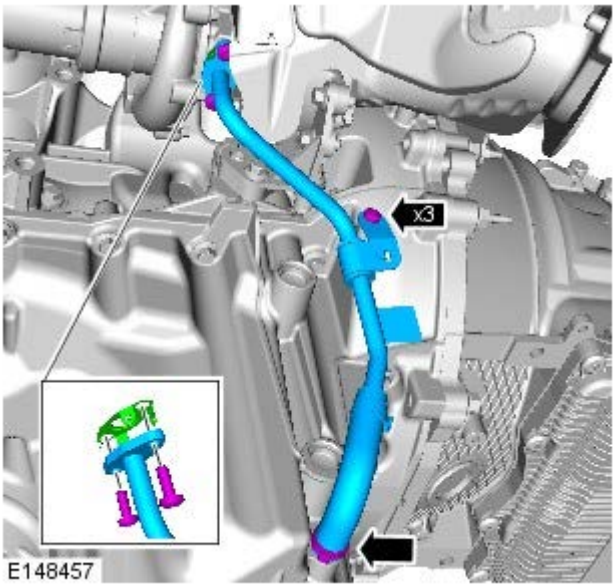
Remove and discard the blanking caps.



Install a new gasket.

Install a new retaining clip.

Torque: 10 Nm



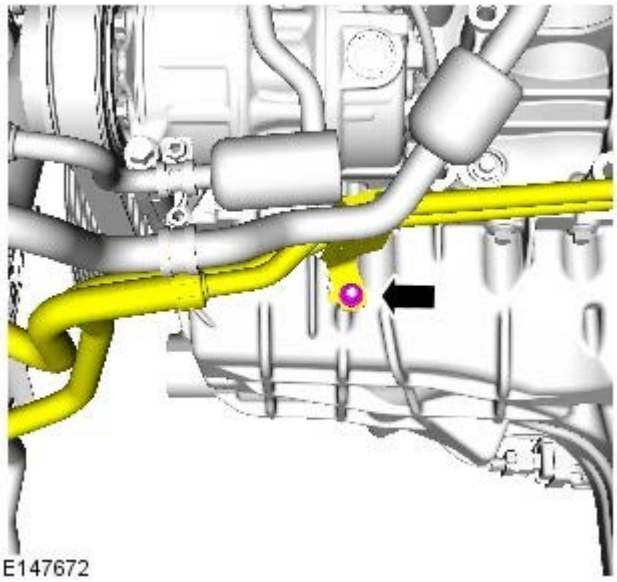
7. NOTES:

Remove and discard the blanking caps.

Install a new gasket.

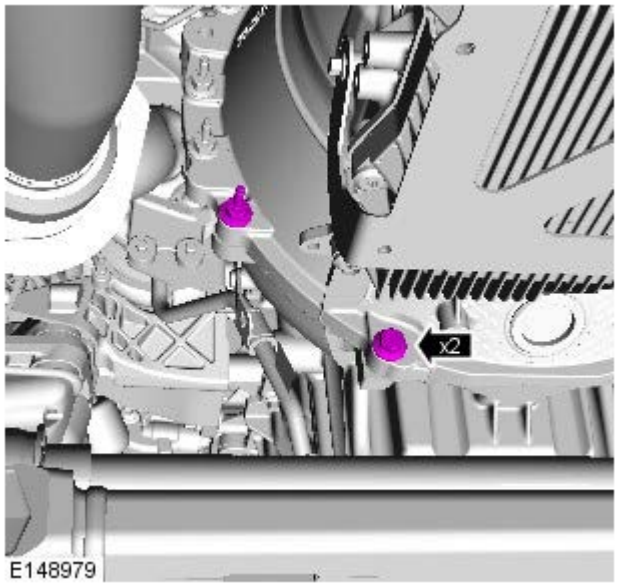
Install a new retaining clip.

Torque: 10 Nm

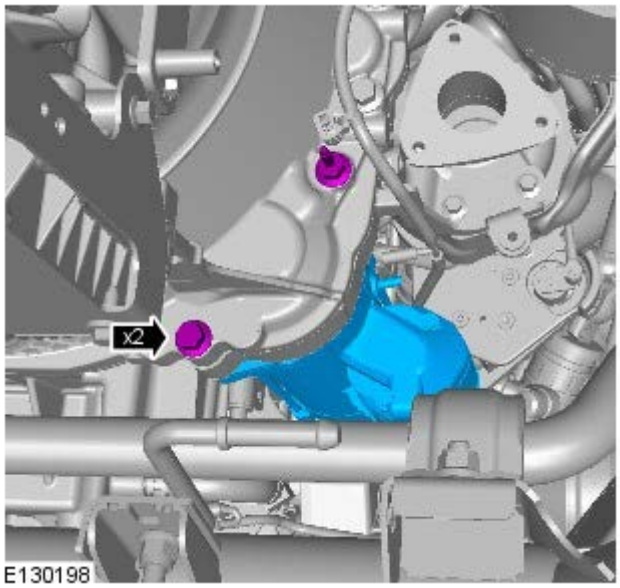


8. *Torque:* 9 Nm

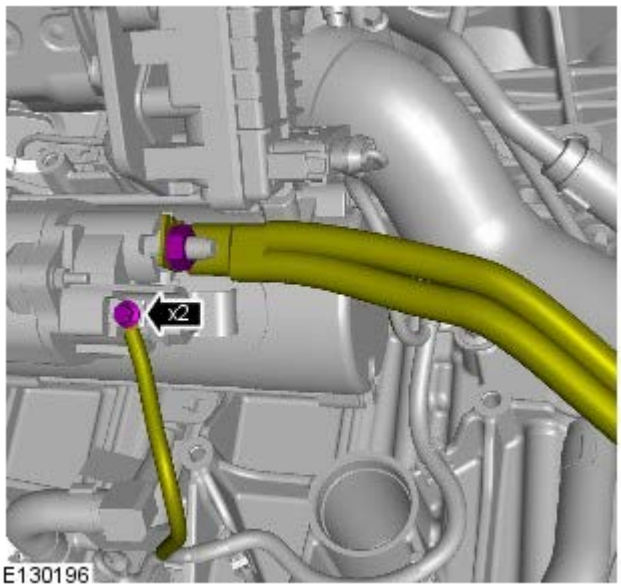
9. *Torque:* 40 Nm



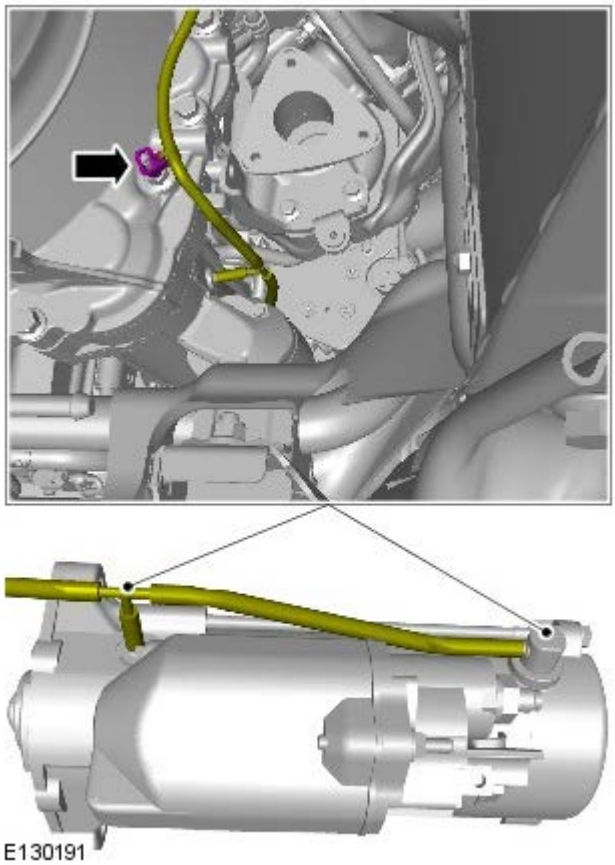
10. *Torque:* 45 Nm



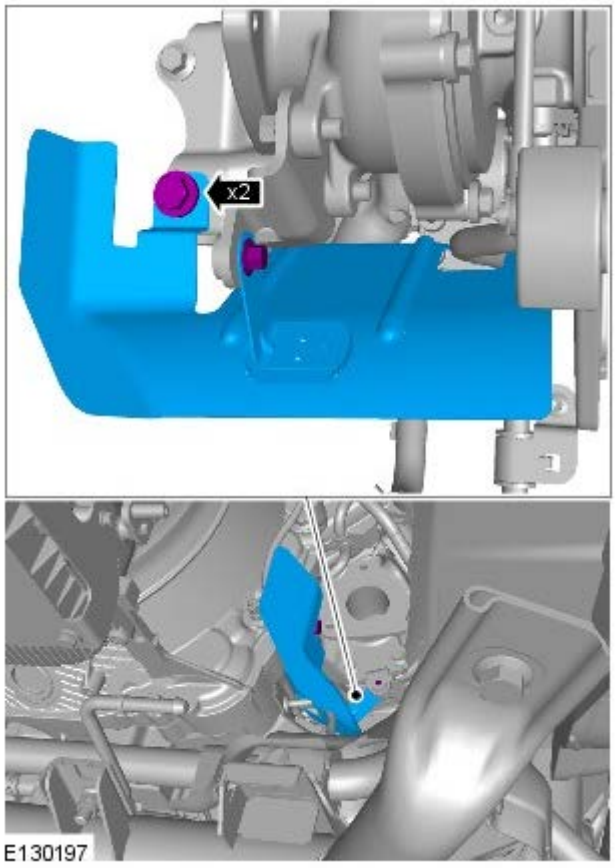
11. *Torque:*
M8 nut 22 Nm
M6 bolt 4 Nm



12.

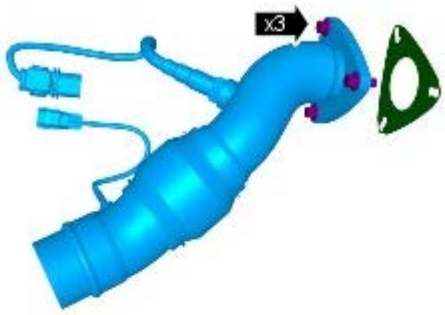


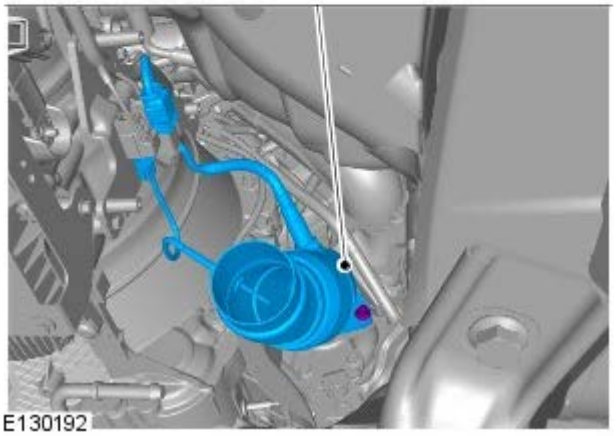
13. *Torque:* 10 Nm



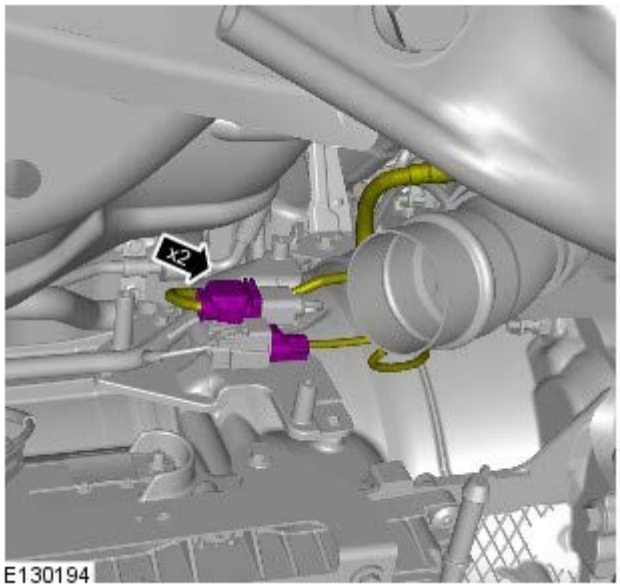
14. NOTE: Install a new gasket.

Torque: 21 Nm

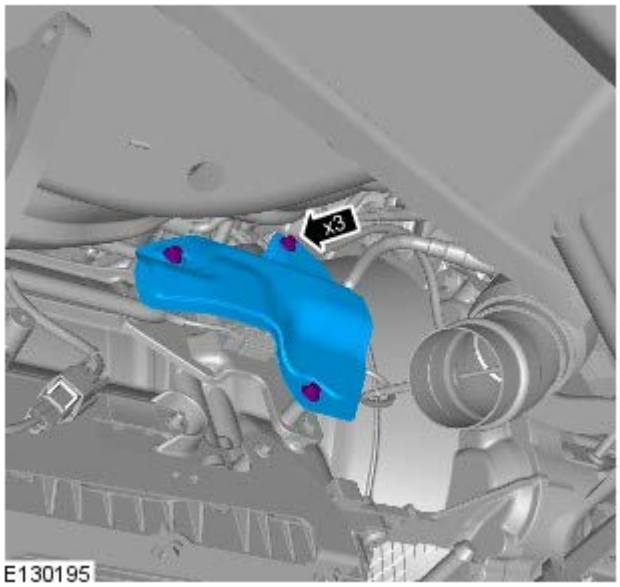




15.



16. *Torque:* 10 Nm



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

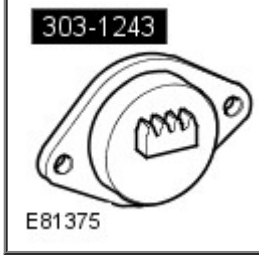
18. Refer to: Engine Oil Vacuum Draining and Filling (303-01D Engine - TDV8 4.4L Diesel, General Procedures).

Published: 18-Nov-2013

Engine - TDV8 4.4L Diesel - Oil Pump

Removal and Installation

Special Tool(s)

 E52717	303-1121 Installer, Crankshaft Seal
 E54545	303-1122 Installer, Crankshaft Front Seal
 E81375	303-1243 Locking Tool, Flexplate

Removal

NOTES:

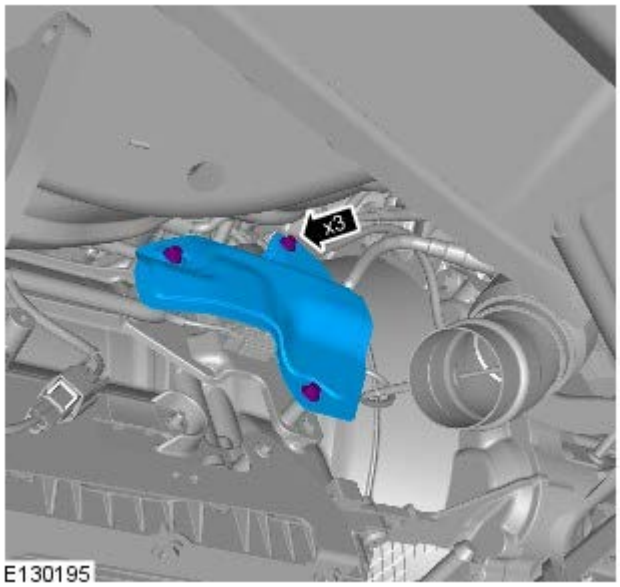
Some variation in the illustrations may occur, but the essential information is always correct.

Removal steps in this procedure may contain installation details.

Some components shown removed for clarity.

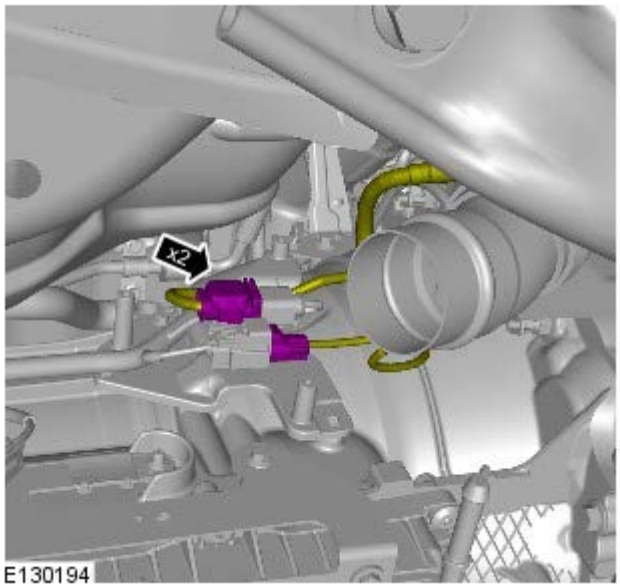
1. Refer to: Engine Oil Vacuum Draining and Filling (303-01D Engine - TDV8 4.4L Diesel, General Procedures).
2. Refer to: Radiator (303-03F Engine Cooling - TDV8 4.4L Diesel, Removal and Installation).
3. Refer to: Axle Assembly (205-03, Removal and Installation).

4.



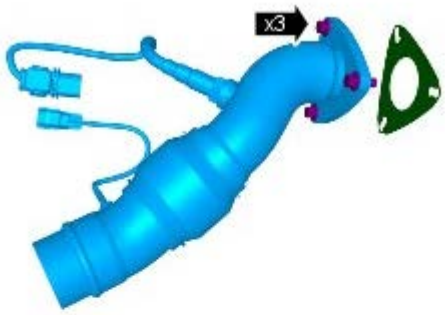
E130195

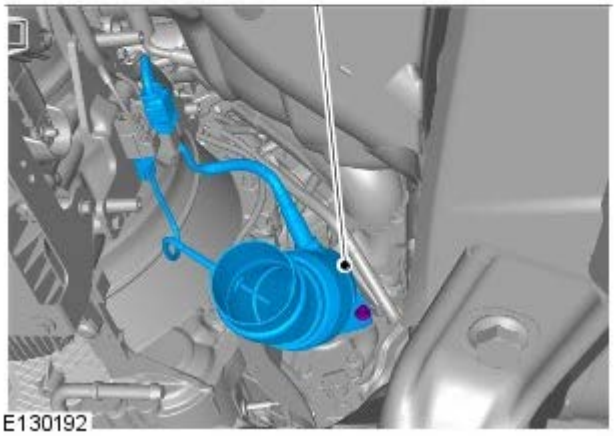
5.



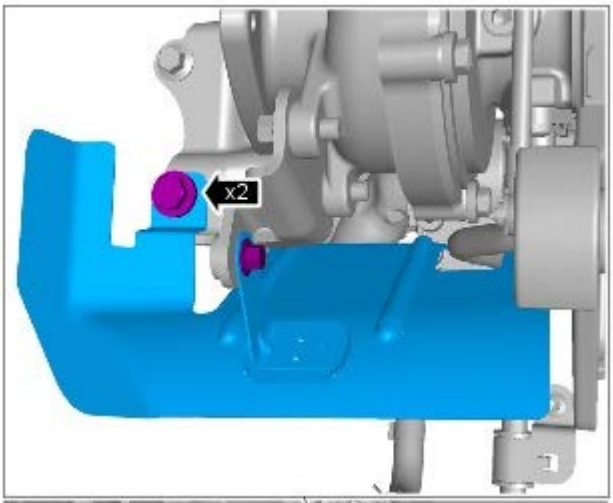
E130194

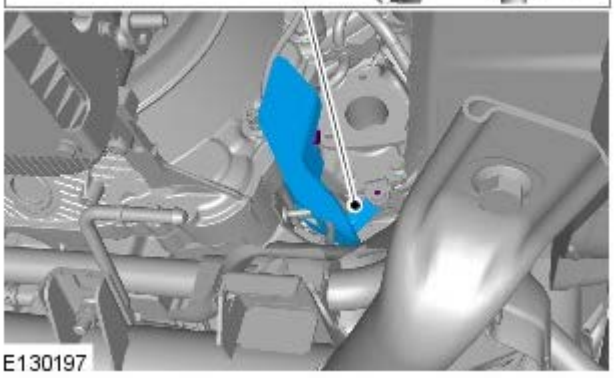
6. NOTE: Discard the gasket.



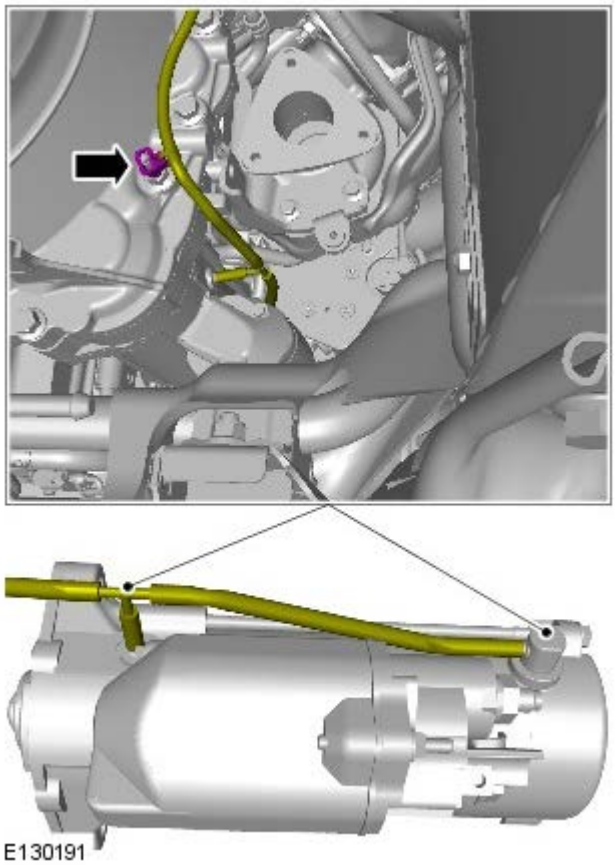


7.

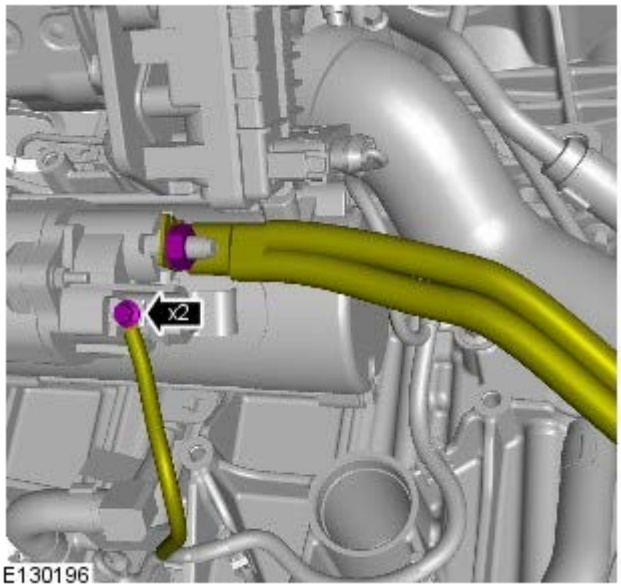




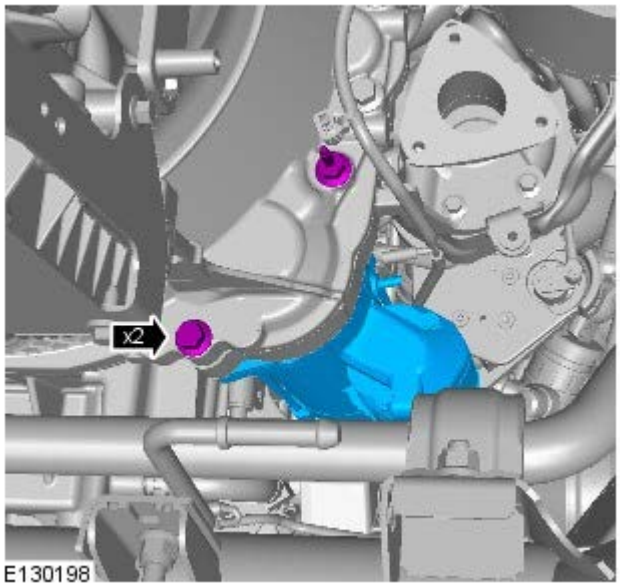
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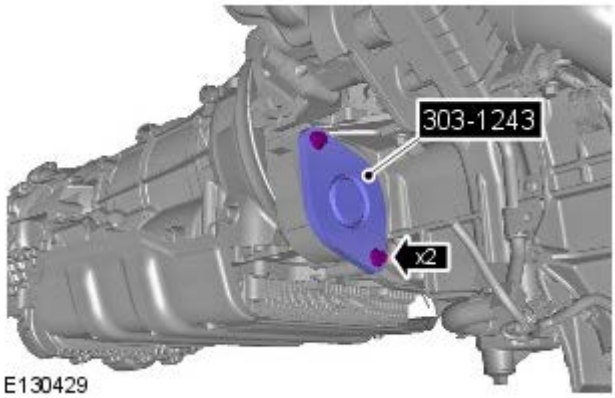
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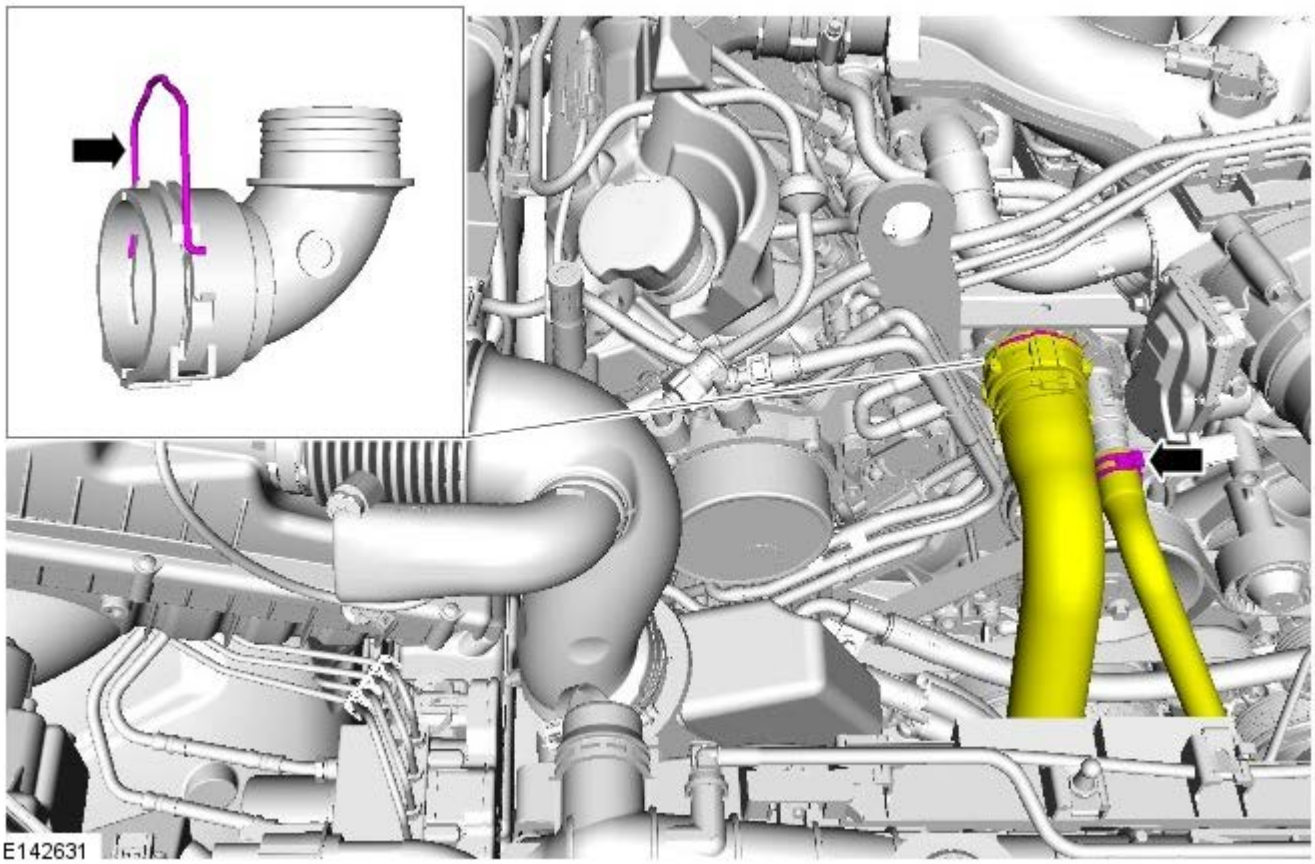
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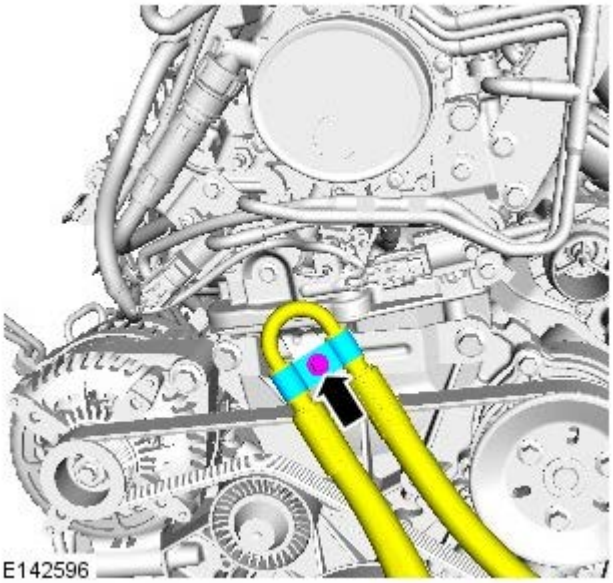
11. *Special Tool(s):* 303-1243



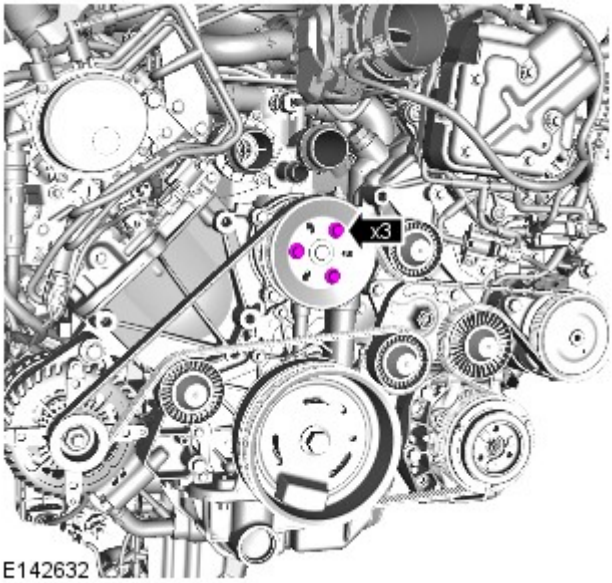
12.



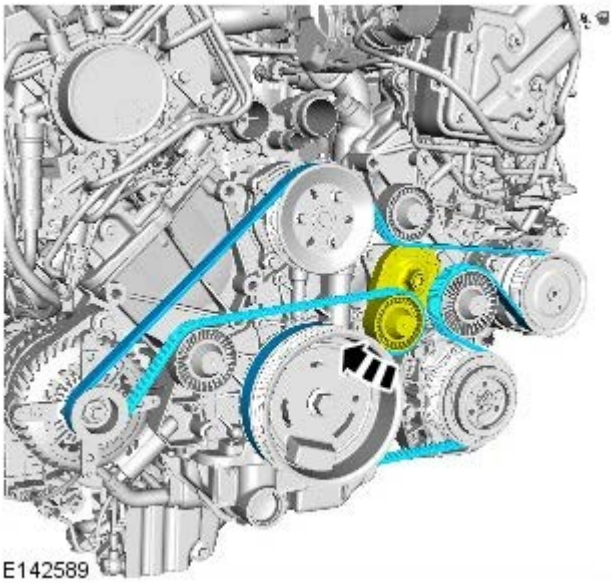
13.



14.

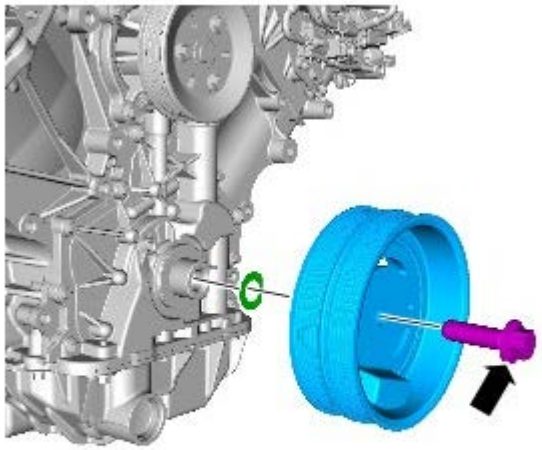


15.



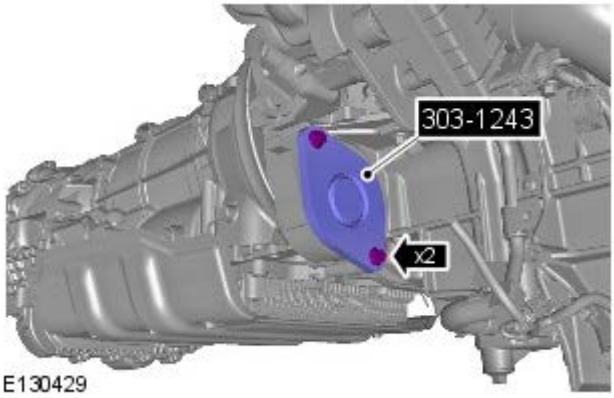
16. CAUTION: Discard the bolt.

NOTE: The crankshaft pulley will be very tight.



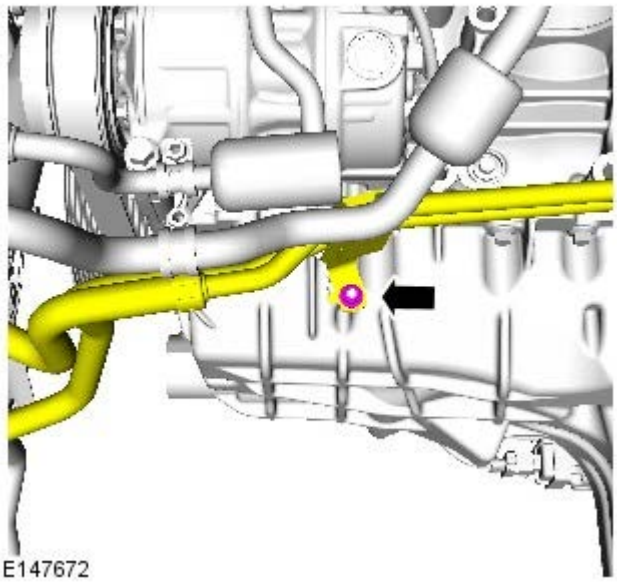
E144269

17. *Special Tool(s):* 303-1243



E130429

18.



E147672

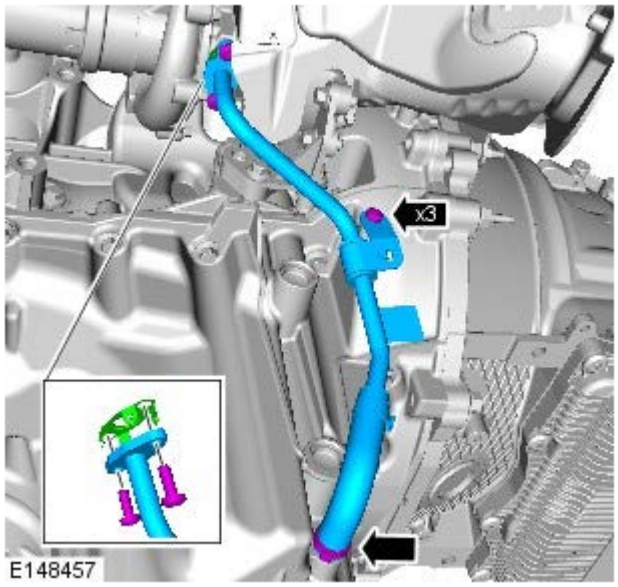
19. CAUTIONS:

Be prepared to collect escaping oil.

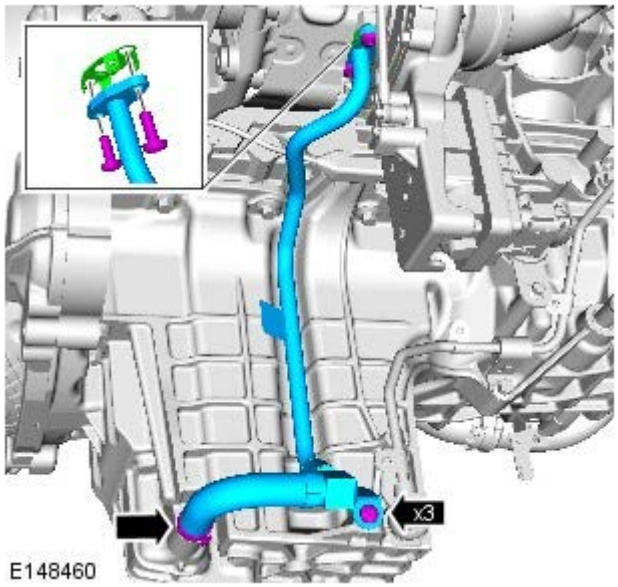
Make sure that all openings are sealed. Use new blanking caps.

NOTES:

Remove and discard the gasket.



Discard the retaining clip.



20. CAUTIONS:

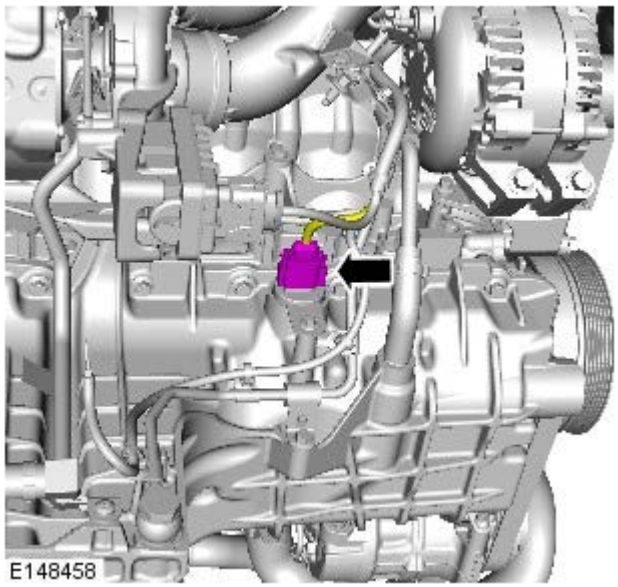
Be prepared to collect escaping oil.

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

NOTES:

Remove and discard the gasket.

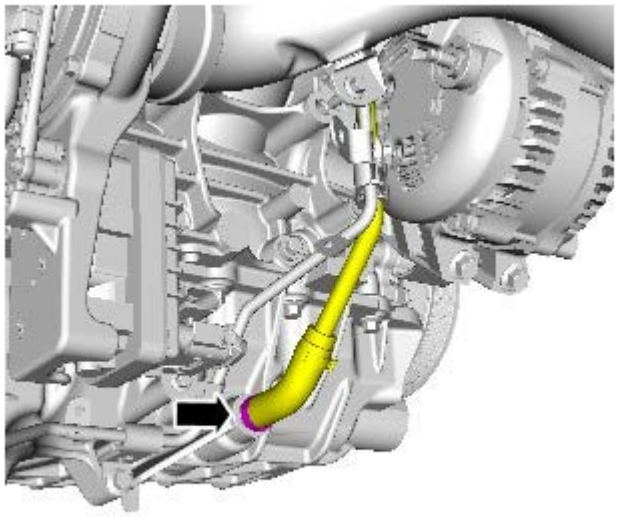
Discard the retaining clip.



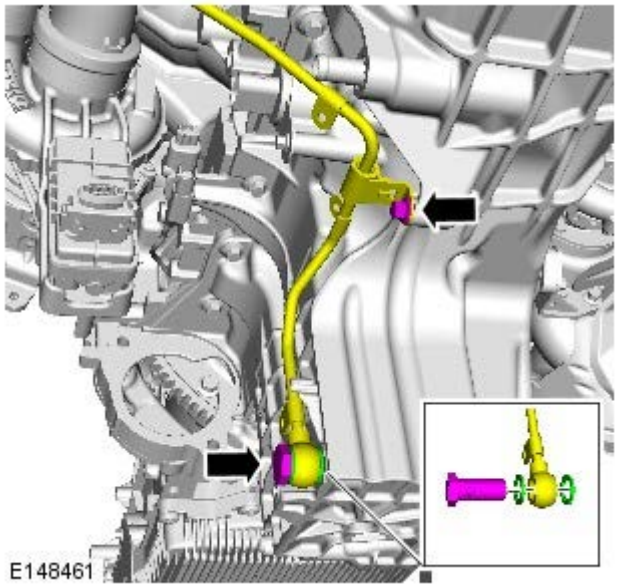
21.

22. CAUTION: Be prepared to collect escaping oil.

NOTE: Discard the retaining clip.



E148459



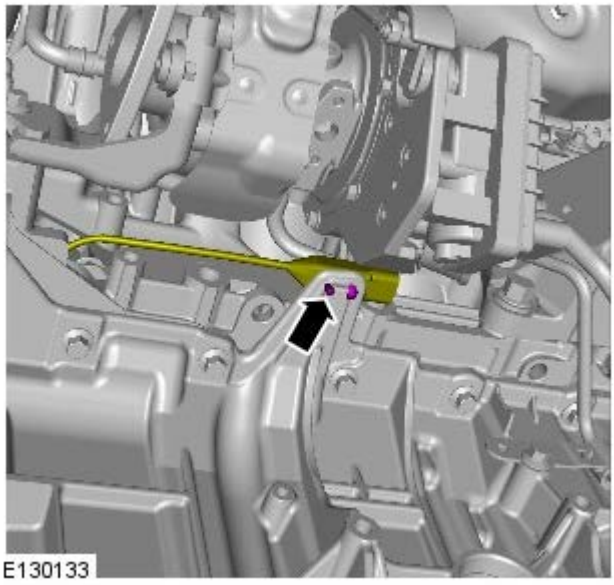
E148461

23. CAUTIONS:

Be prepared to collect escaping oil.

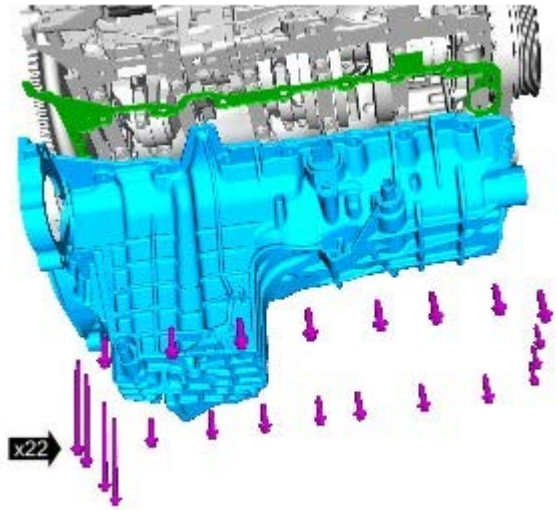
Inspect the seals, replace if damaged.

24.



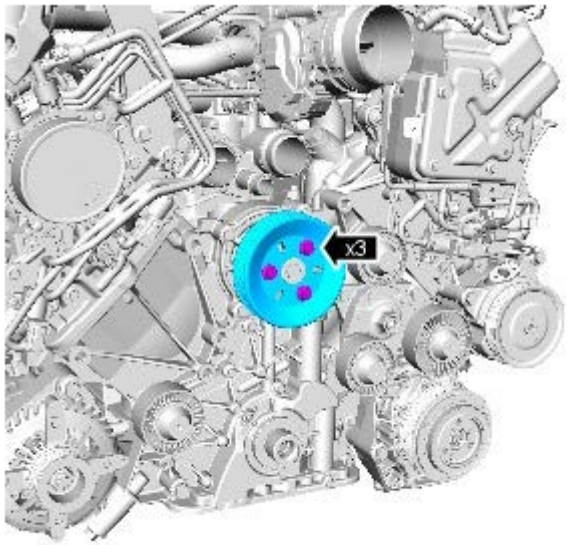
E130133

25. NOTE: Remove and discard the gasket.



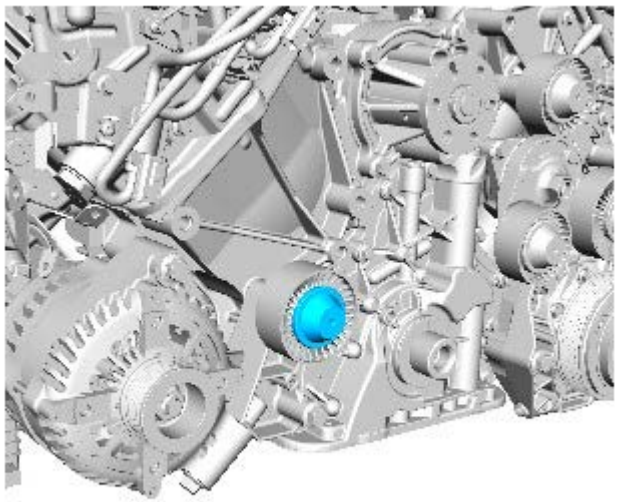
E148681

26.



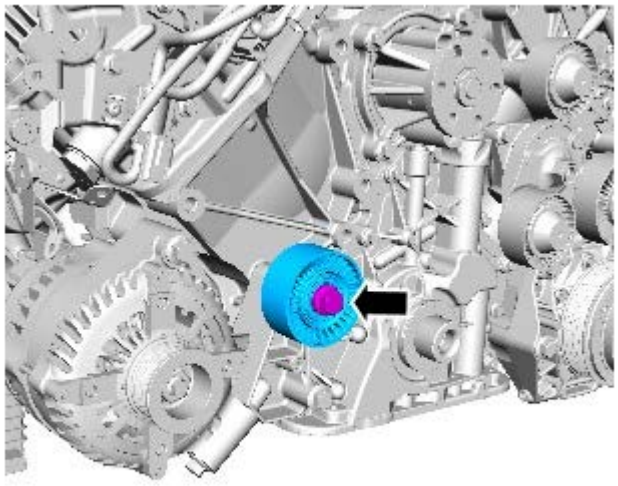
E148579

27.



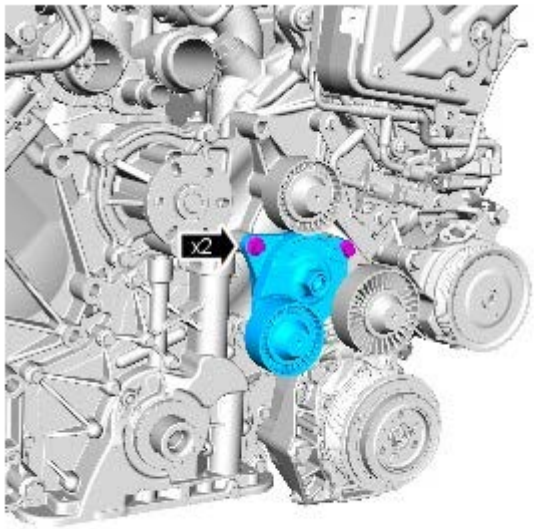
E148580

28.



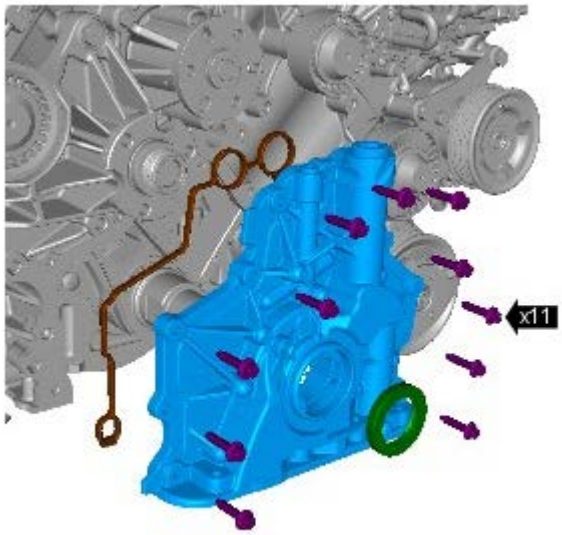
E148581

29.



E148582

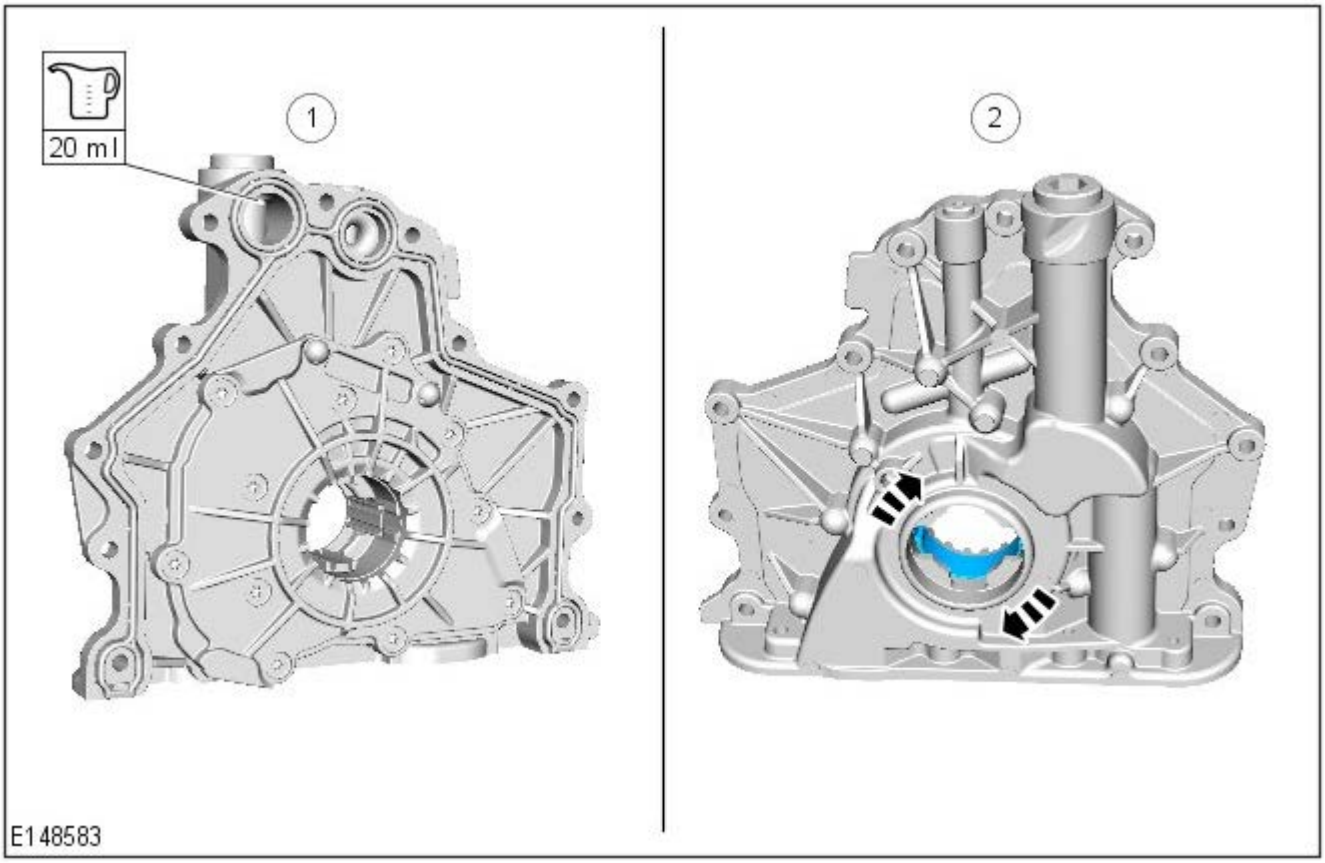
30.



E130736

Installation

1. Prime the oil pump with 20ml of engine oil in the orifice shown. Rotate the oil pump 2 complete turns.



2. CAUTIONS:

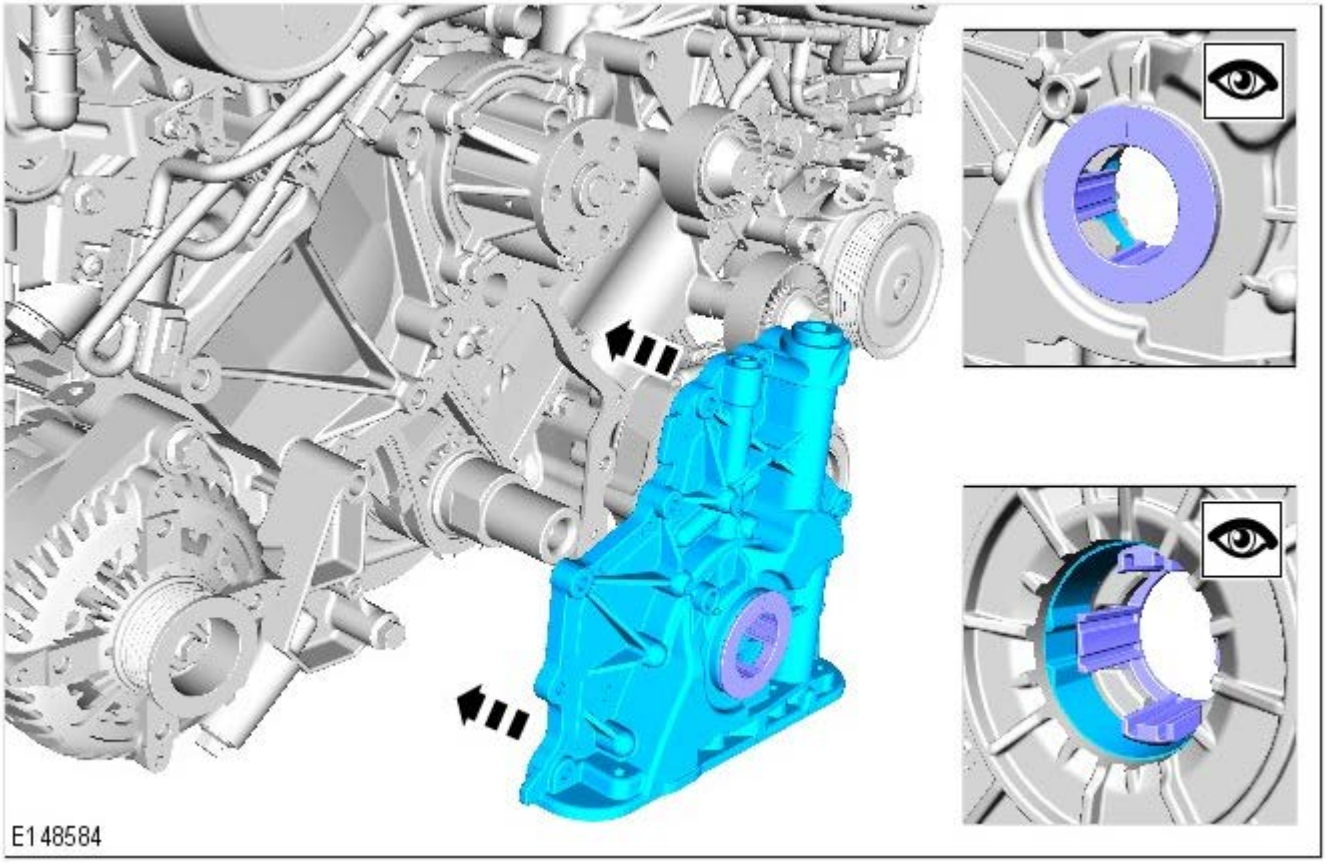
   Make sure that the mating faces are clean and free of corrosion and foreign material.

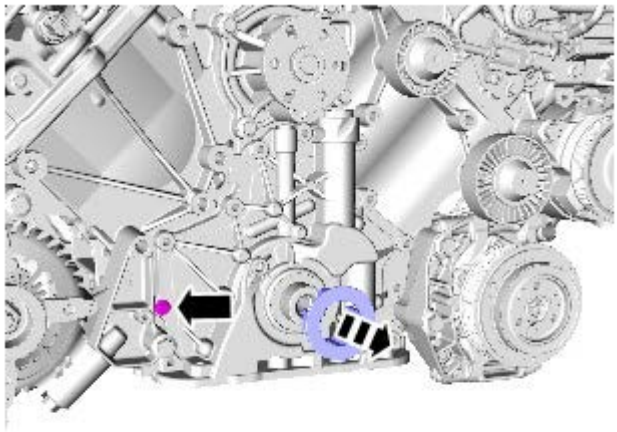
   Make sure the gasket is installed correctly.

   Make sure that the oil pump remains aligned to the crankshaft during installation.

   Install the oil pump.

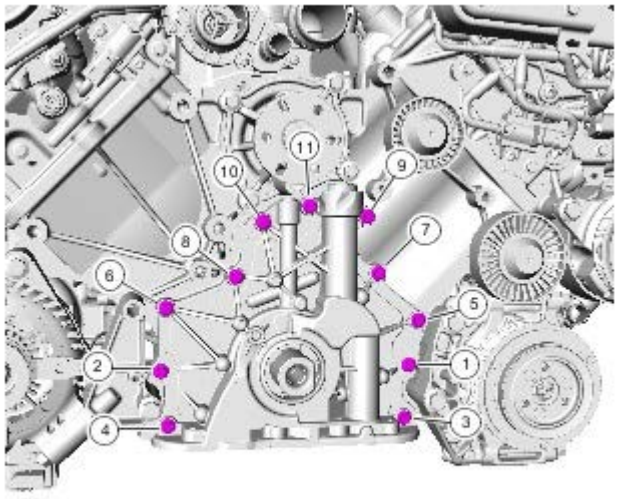
   Torque: 10 Nm





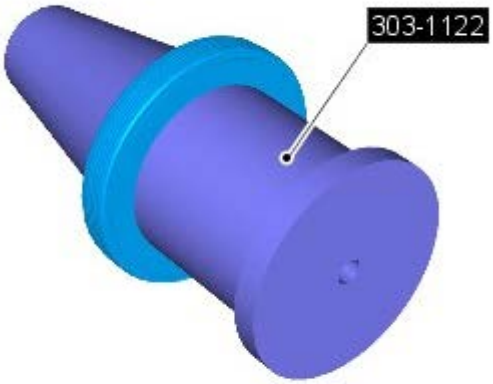
3. CAUTION: Install the bolt finger tight.

4. *Torque:* 10 Nm

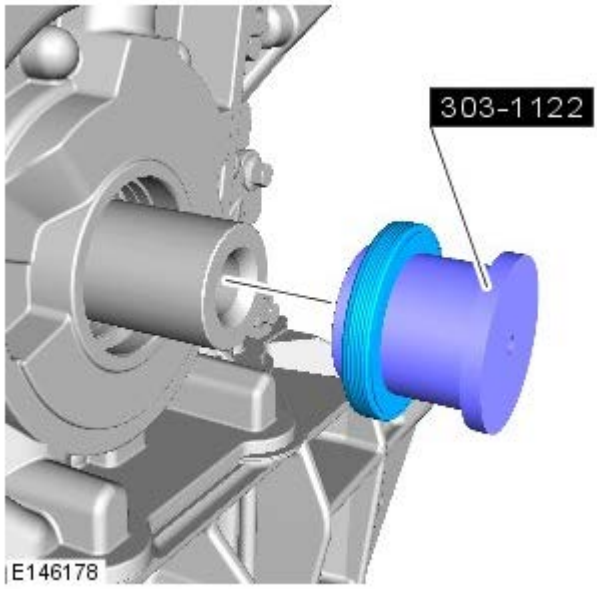


E148586

5. *Special Tool(s):* 303-1122



E130425



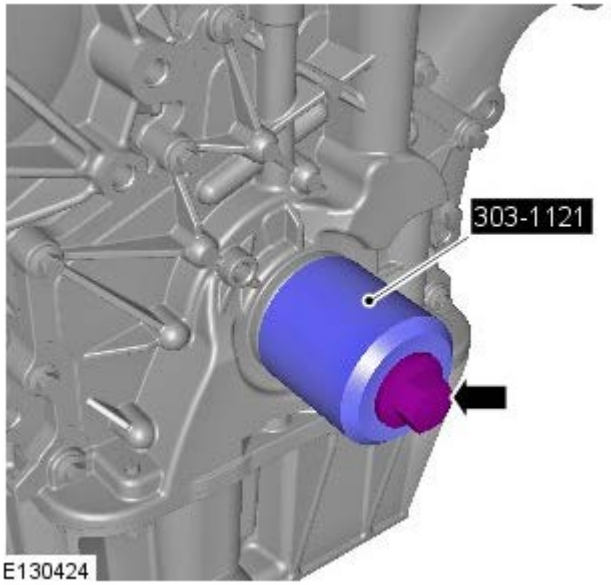
E146178

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

NOTE: Make sure that the transit sleeve is correctly in place and install the new seal over the crankshaft. Do not use any lubricant on the seal, the transit sleeve or the crankshaft.

7. Remove the special tool.

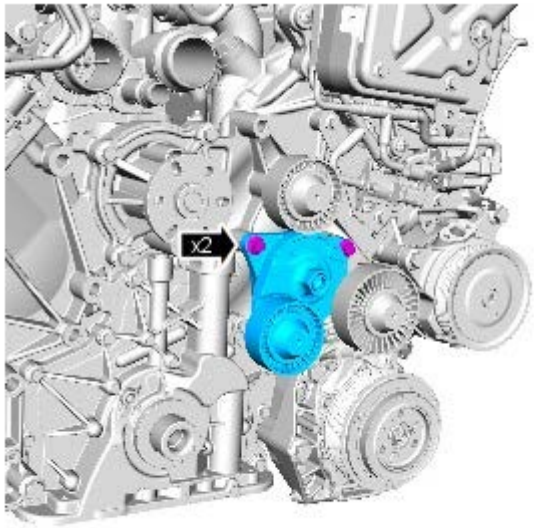
8. *Special Tool(s):* 303-1121



E130424

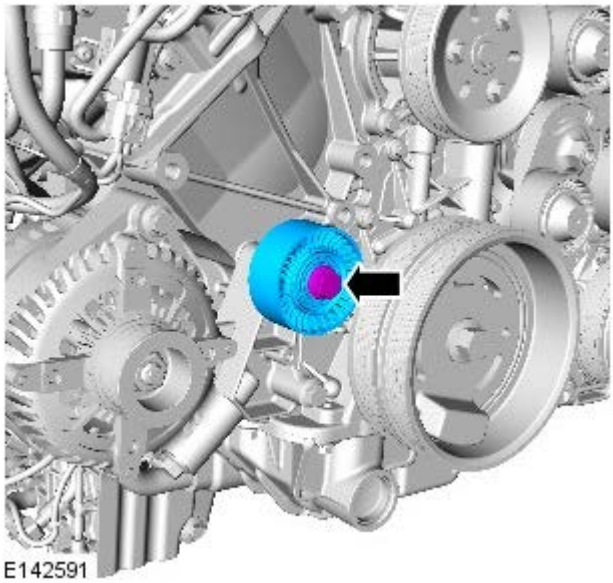
9. Remove the special tool.

10. *Torque:* 25 Nm

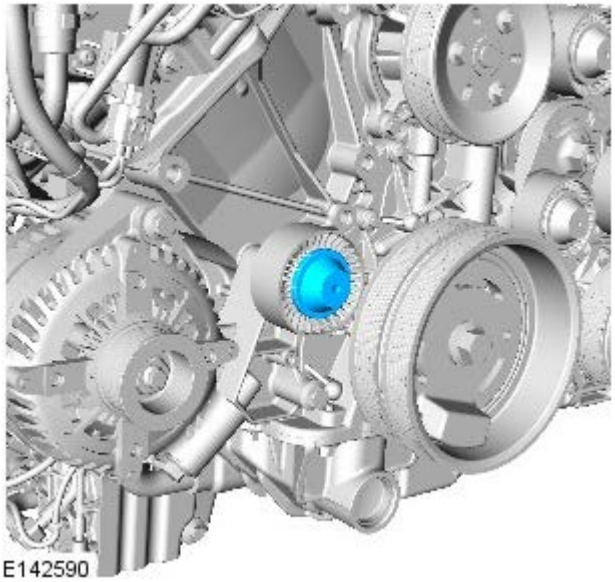


E148582

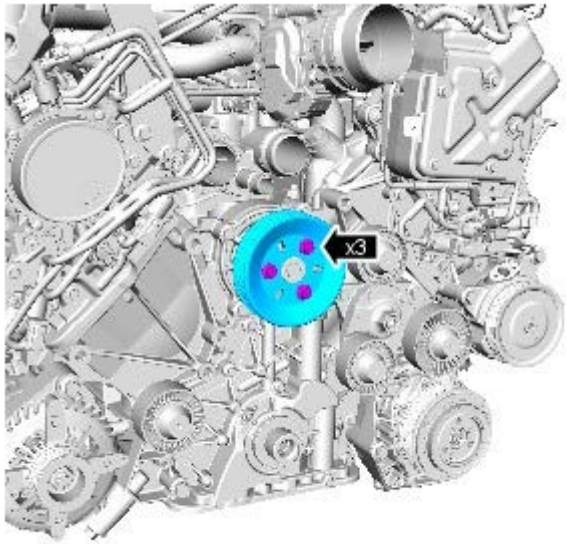
11. *Torque:* 62 Nm


E142591

12.



E142590



E148579

13. CAUTION: Install all the bolts finger tight before final tightening.

14. CAUTIONS:

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

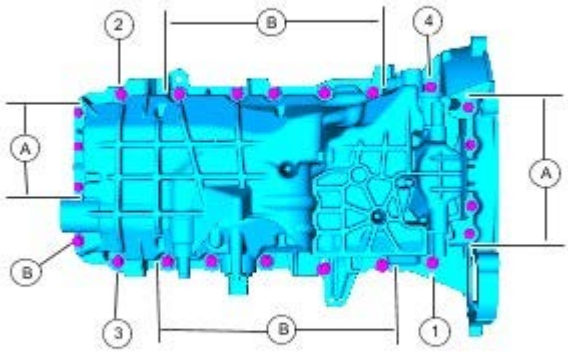
Install all the bolts finger tight before final tightening.

NOTES:

Install a new gasket.

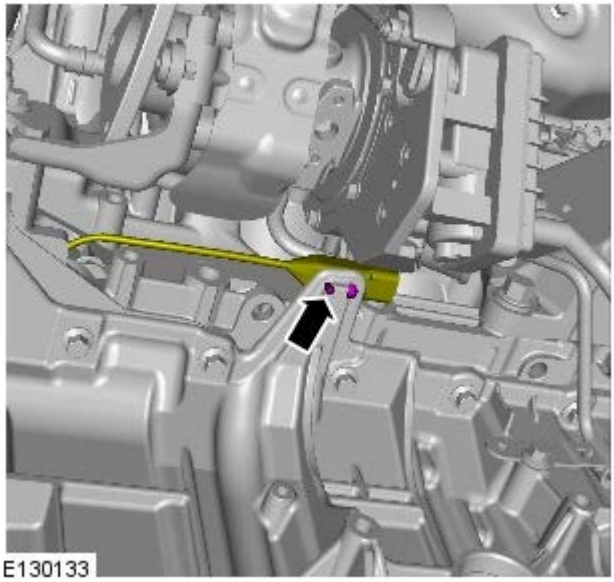
Tighten the bolts in the indicated sequence.

Torque:
1-4 23 Nm
B 23 Nm
A 10 Nm

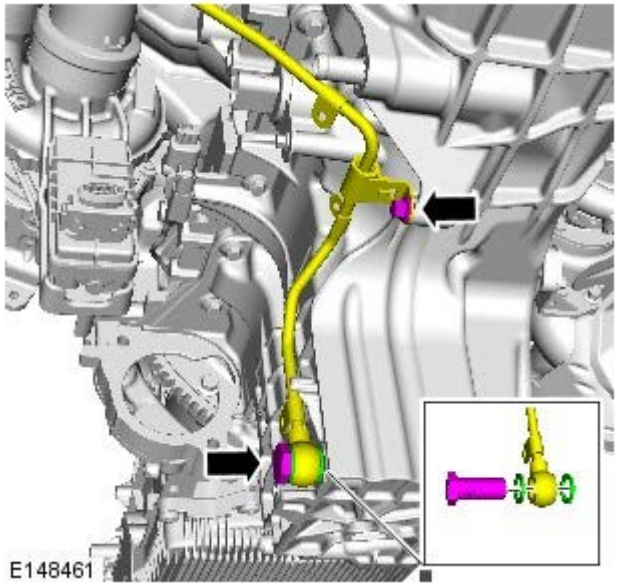


E148682

15.

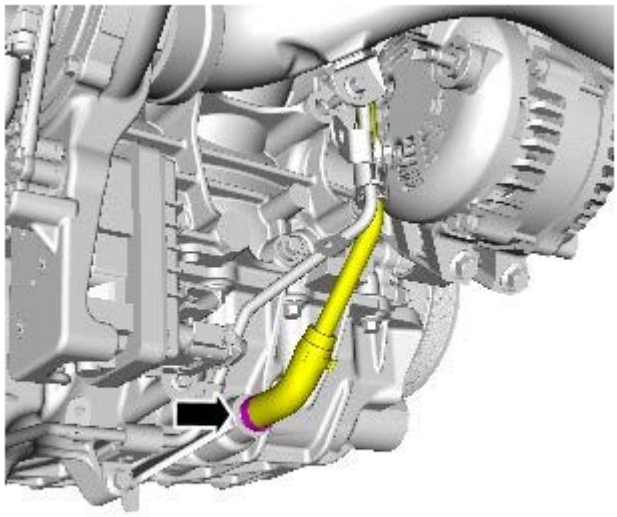


E130133



E148461

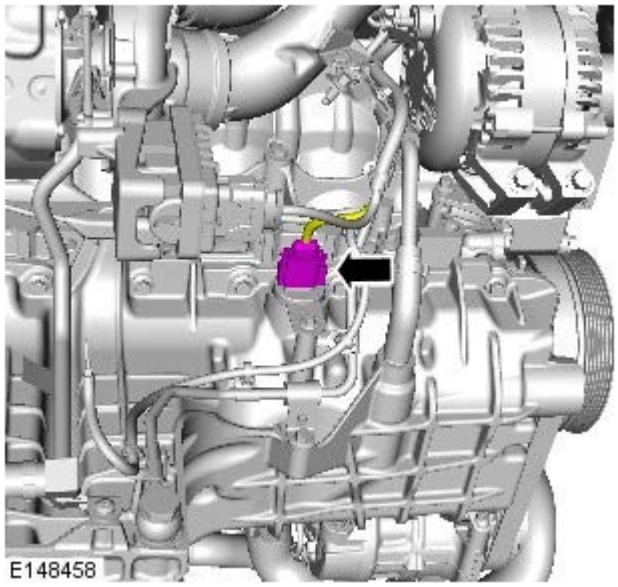
16. CAUTION: Make sure that the mating faces are clean and free of corrosion and foreign material.

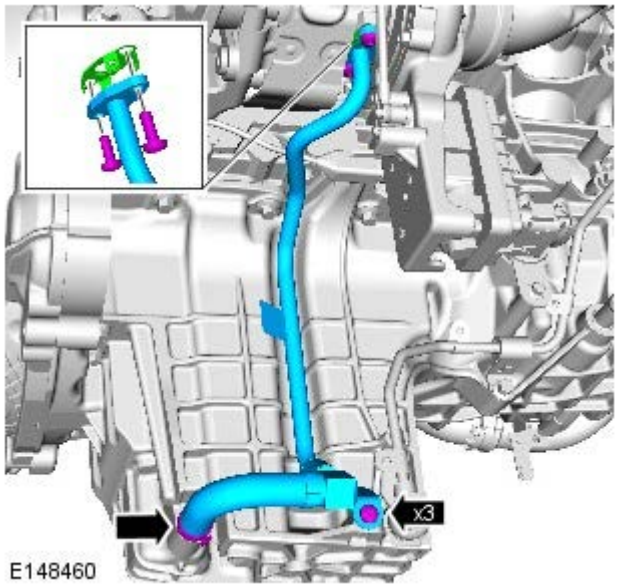


E148459

17. NOTE: Install a new retaining clip.

18.





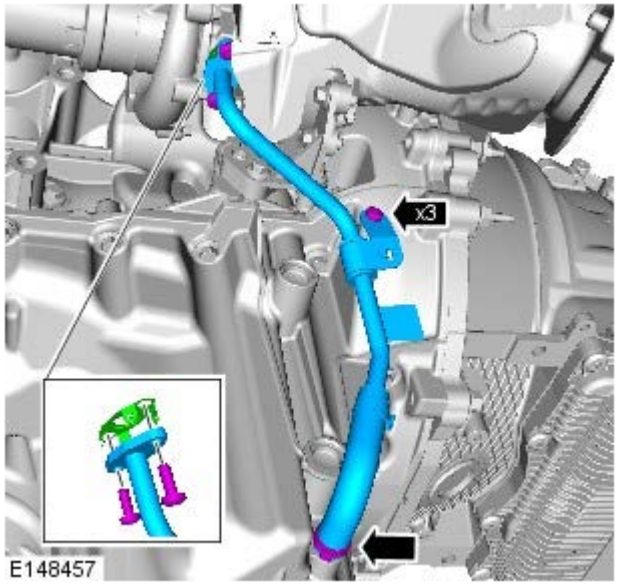
19. NOTES:

Remove and discard the blanking caps.

Install a new retaining clip.

Install a new gasket.

Torque: 10 Nm



20. NOTES:

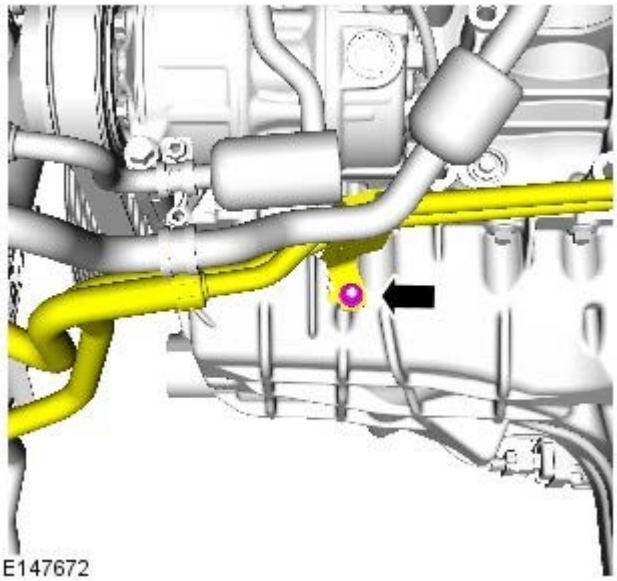
Remove and discard the blanking caps.

Install a new retaining clip.

Install a new gasket.

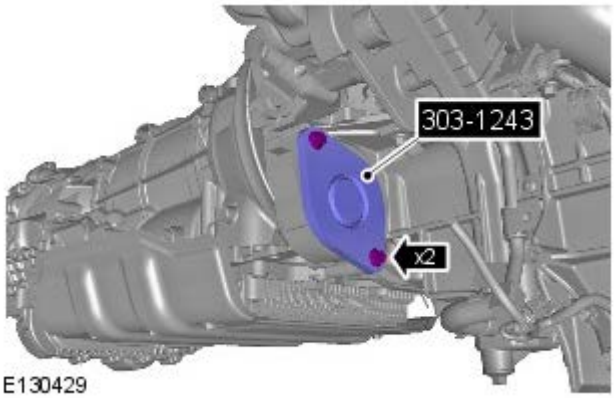
Torque: 10 Nm

21. *Torque:* 9 Nm

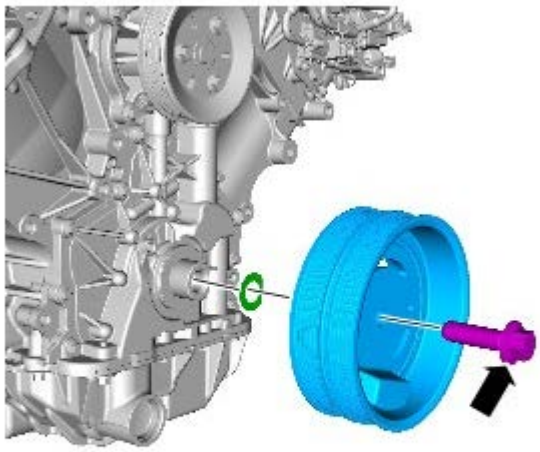


E147672

22. *Special Tool(s):* 303-1243



E130429



E144269

23. CAUTIONS:

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

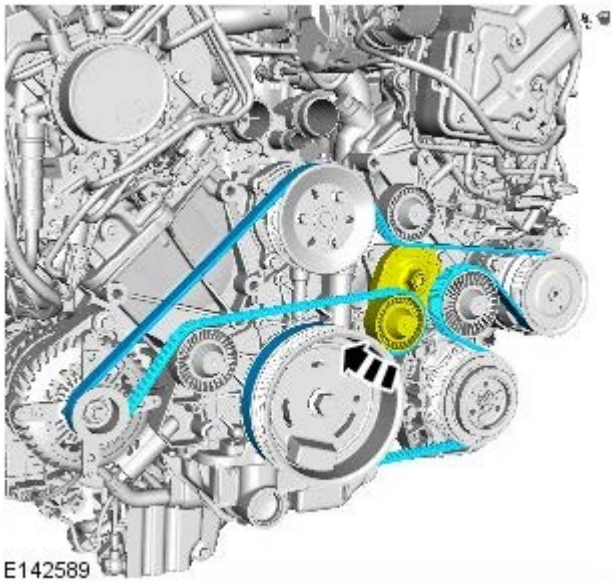
Make sure that the washer is installed between the nose of the crankshaft and the crankshaft pulley.

Make sure that a new crankshaft pulley bolt is installed.

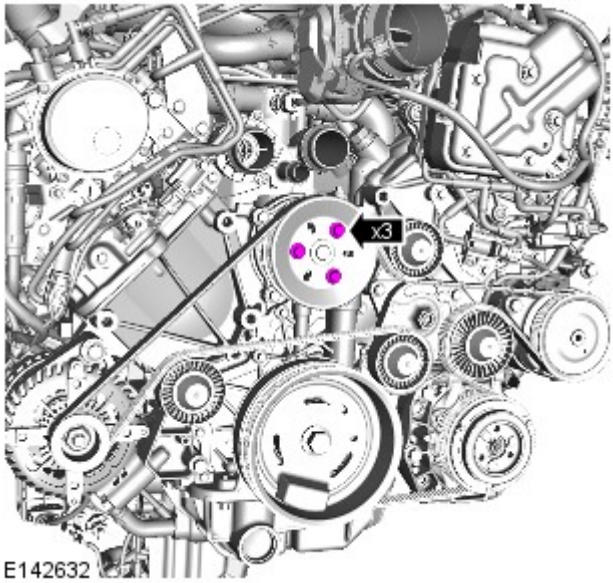
NOTE: The use of a torque multiplier capable of 600Nm will be required.

Torque:
Stage 1 100 Nm
Stage 2 103°
Stage 3 35°

24.

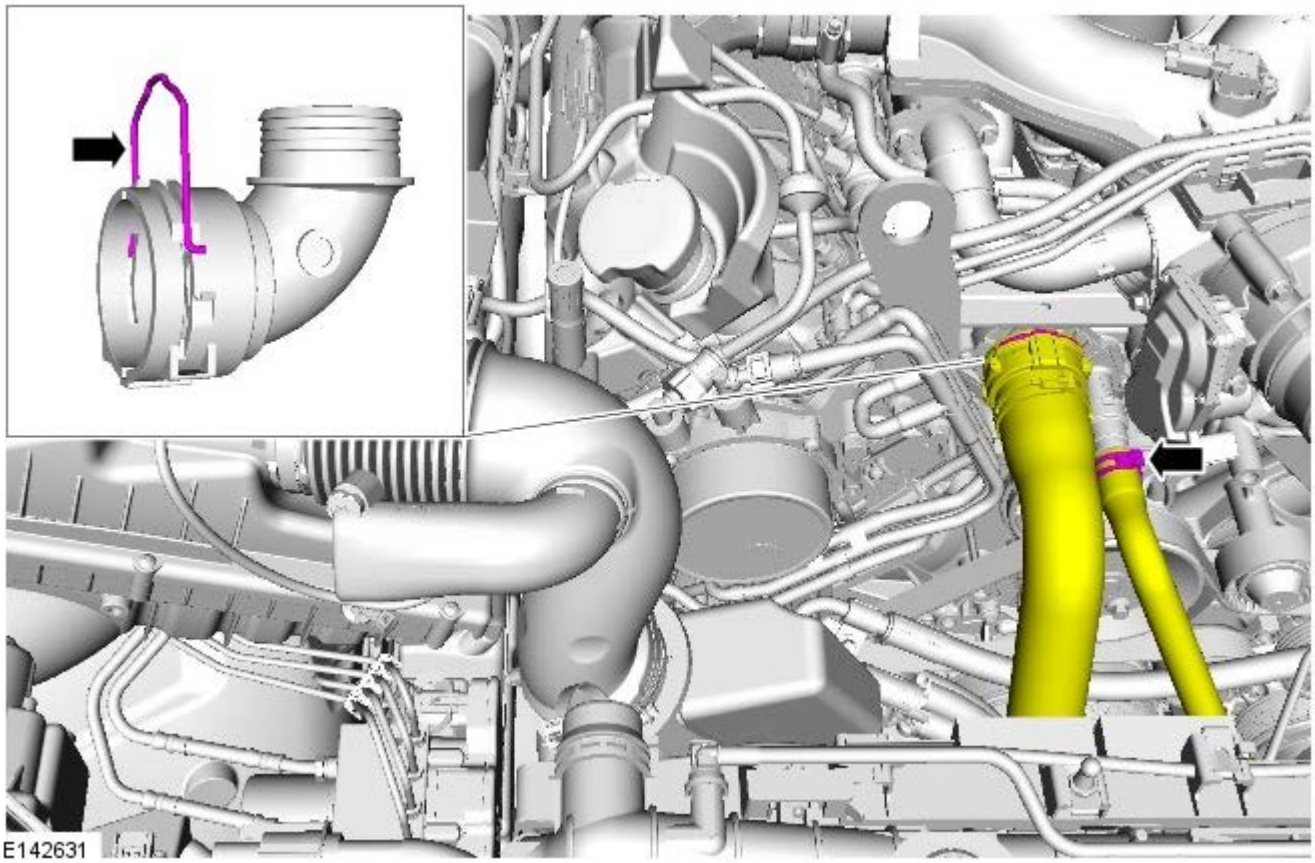

E142589

25. *Torque:* 23 Nm

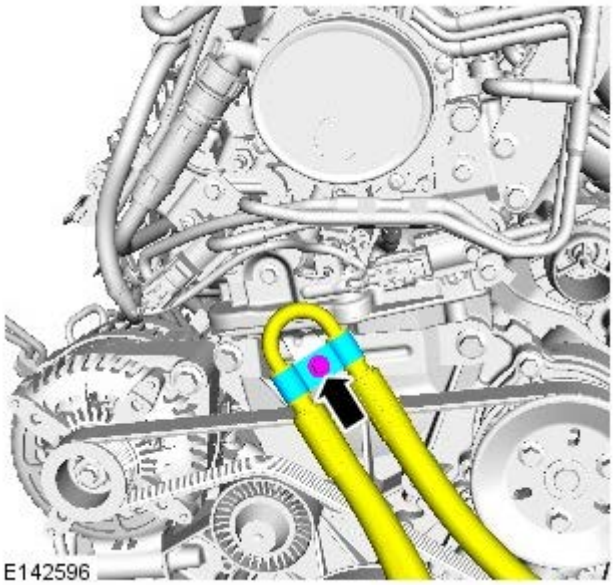


E142632

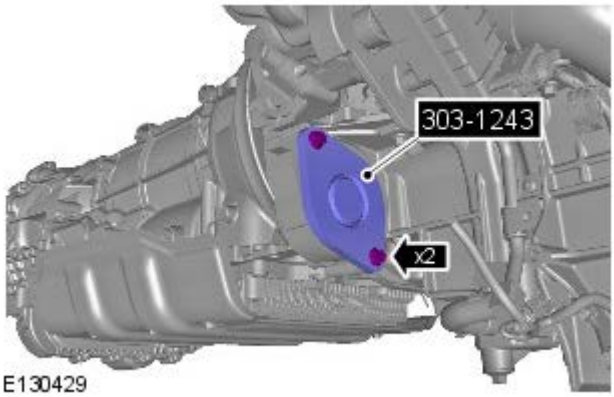
26.



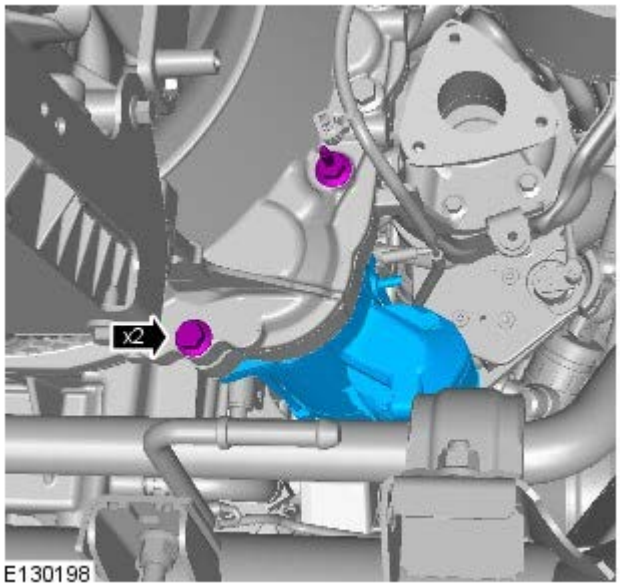
27. *Torque:* 25 Nm



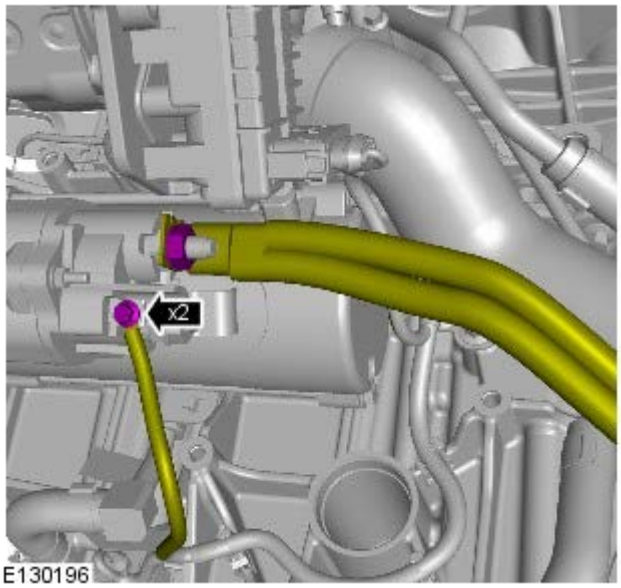
28. *Special Tool(s):* 303-1243



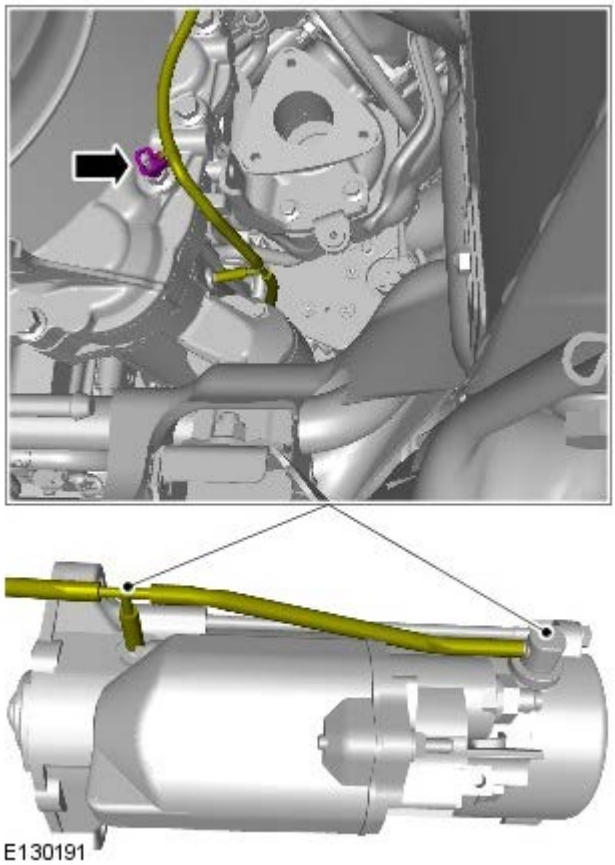
29. *Torque:* 45 Nm



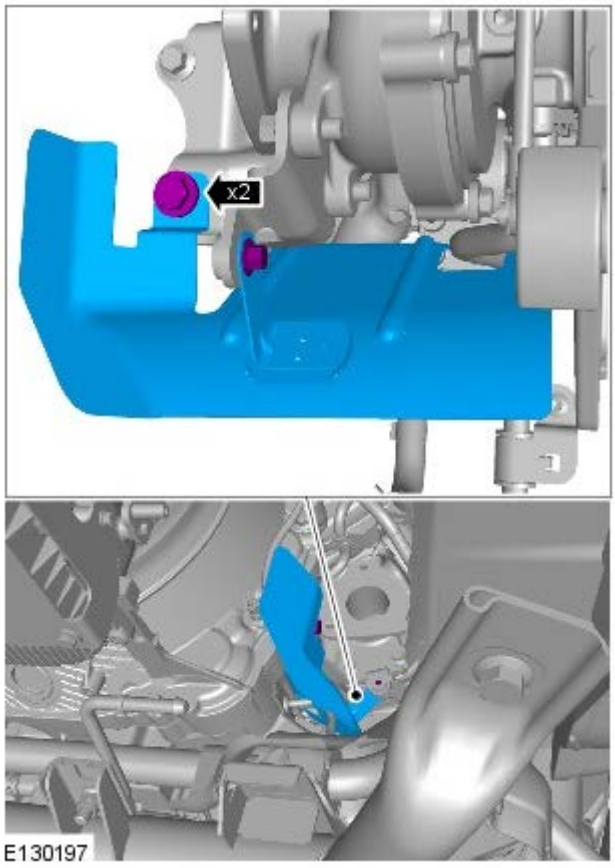
30. *Torque:*
    M8 nut 22 Nm
    M6 bolt 4 Nm



31.

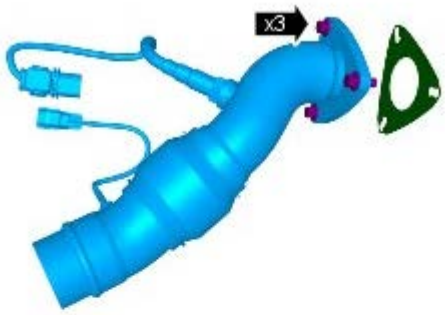


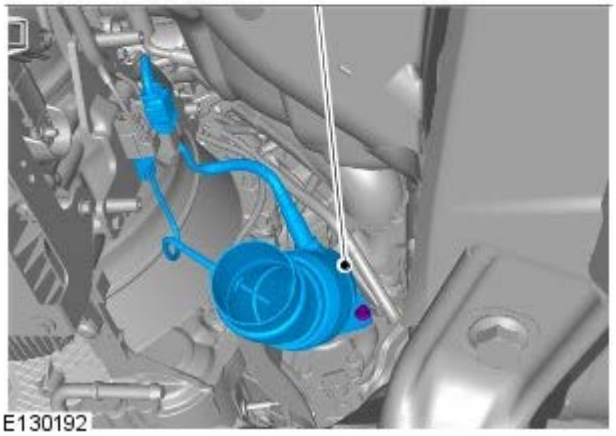
32. *Torque:* 10 Nm



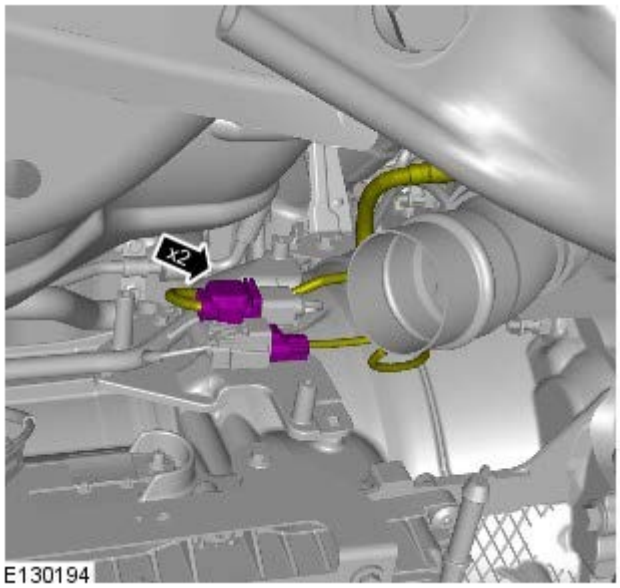
33. NOTE: Install a new gasket.

Torque: 21 Nm

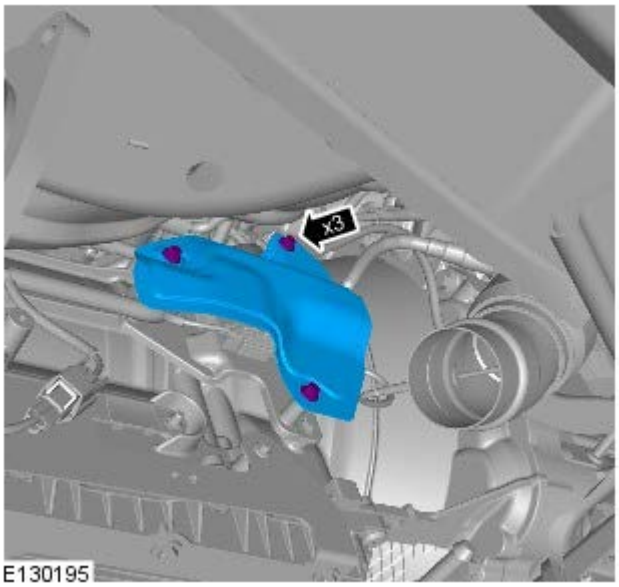




34.



35. *Torque:* 10 Nm



36. Refer to: Axle Assembly (205-03, Removal and Installation).

37. Refer to: Radiator (303-03F Engine Cooling - TDV8 4.4L Diesel, Removal and Installation).

38. Refer to: Engine Oil Vacuum Draining and Filling (303-01D Engine - TDV8 4.4L Diesel, General Procedures).

Published: 14-Nov-2013

Engine - TDV8 4.4L Diesel - Timing Drive Components

Removal and Installation

Special Tool(s)

 E131271	JLR-303-1568 Locking Tool, Camshaft
 E148198	JLR-303-1620 Timing Pin
 E131589	JLR-310-246 Locking Tool, Fuel Injection Pump
 E131588	JLR-310-247 Locking Tool, Camshaft
 E131590	JLR-310-248 Aligner, Fuel Pump

Removal

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

NOTES:

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

Removal steps in this procedure may contain installation details.

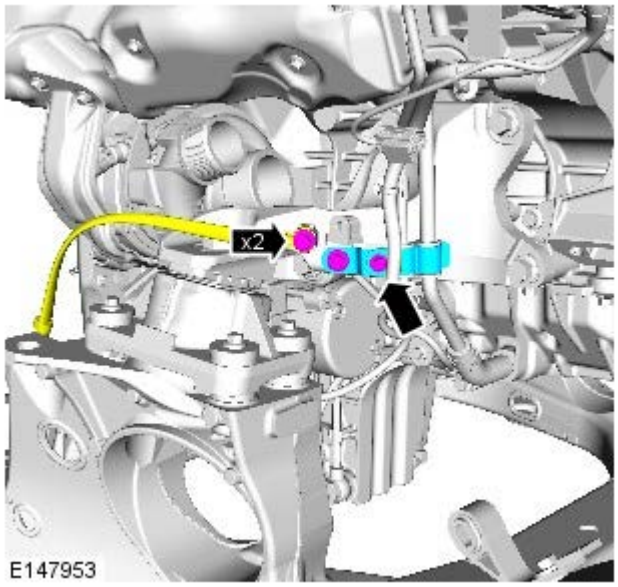
Engine shown removed for clarity.

1. Disconnect the battery ground cable.

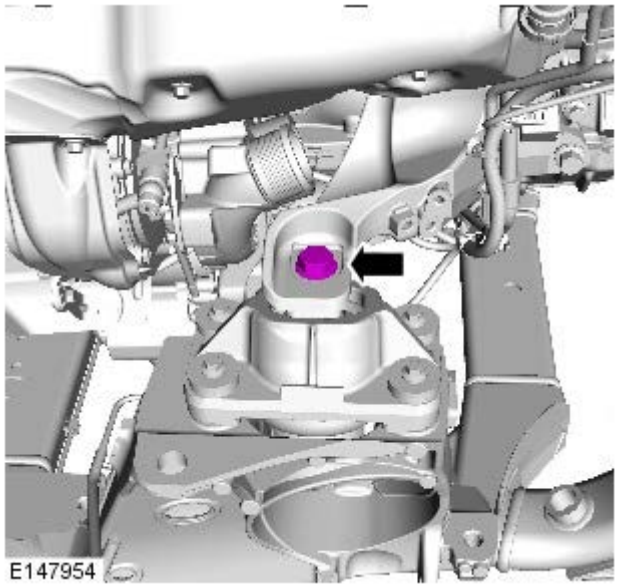
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

2. Refer to: Valve Cover RH (303-01D Engine - TDV8 4.4L Diesel, Removal and Installation).
3. Refer to: Valve Cover LH (303-01D Engine - TDV8 4.4L Diesel, Removal and Installation).
4. Refer to: Generator (414-02D Generator and Regulator - TDV8 4.4L Diesel, Removal and Installation).
5. Refer to: Brake Vacuum Pump - 4.4L V8 - TdV8 (206-07 Power Brake Actuation, Removal and Installation).

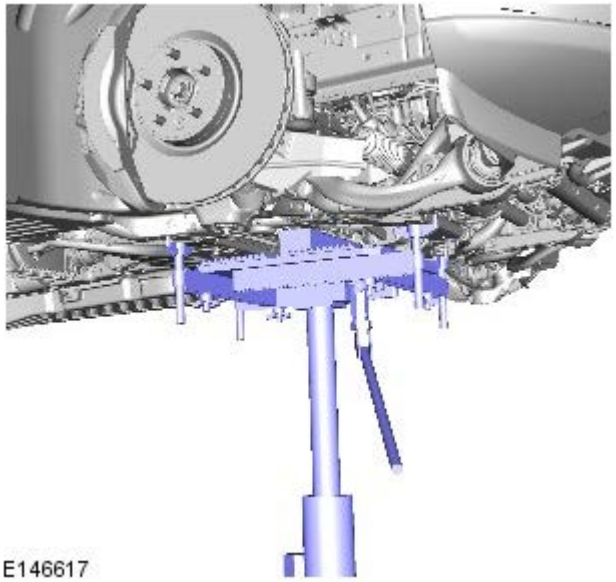
6.



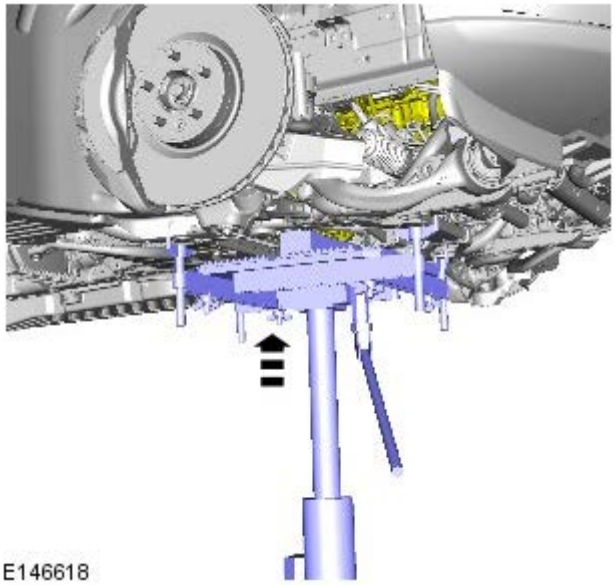
7.



8.



E146617

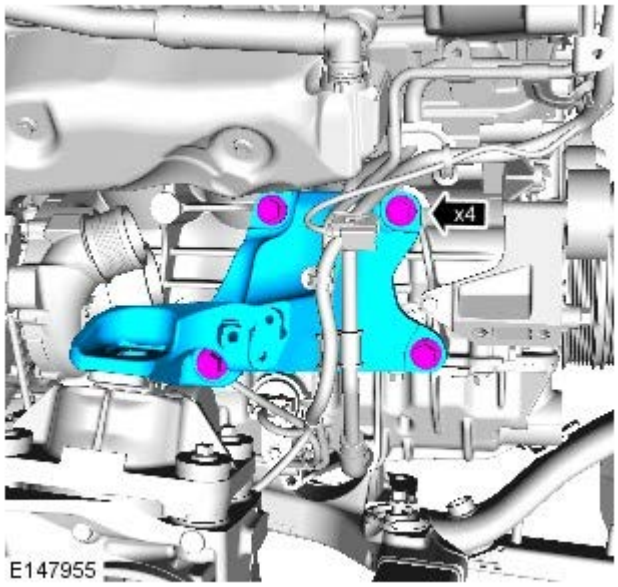


E146618

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

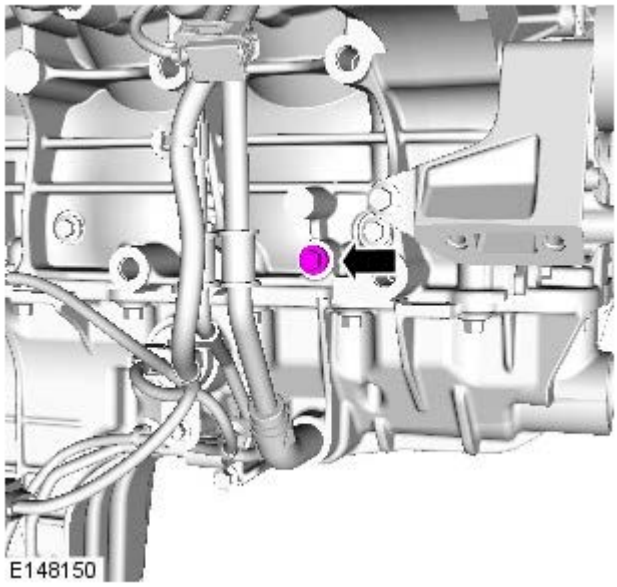
   Using a suitable hydraulic jack, raise and support the engine.

10.

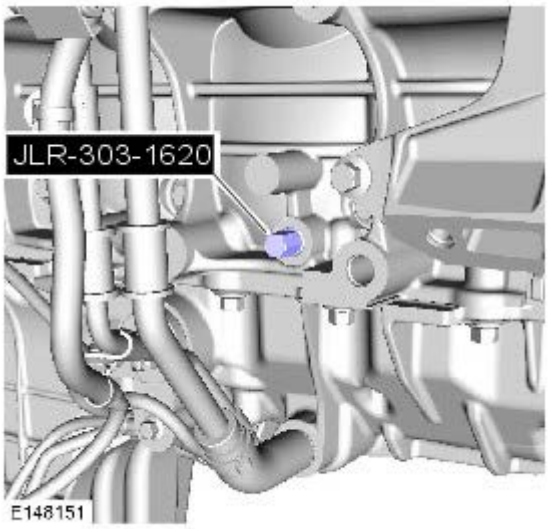


E147955

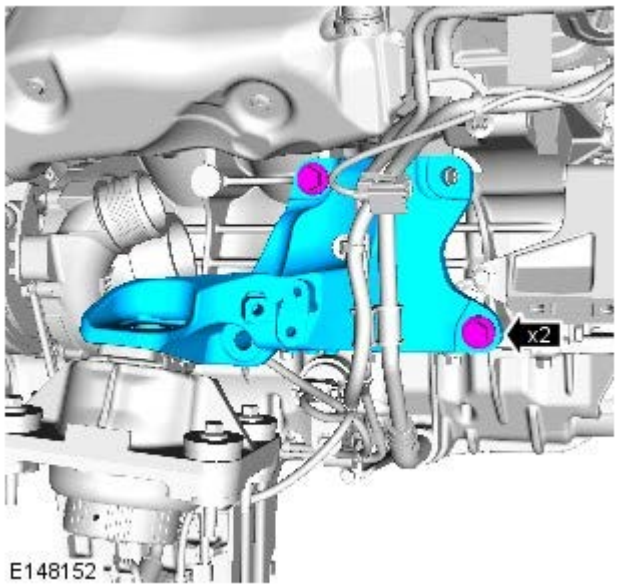
11.



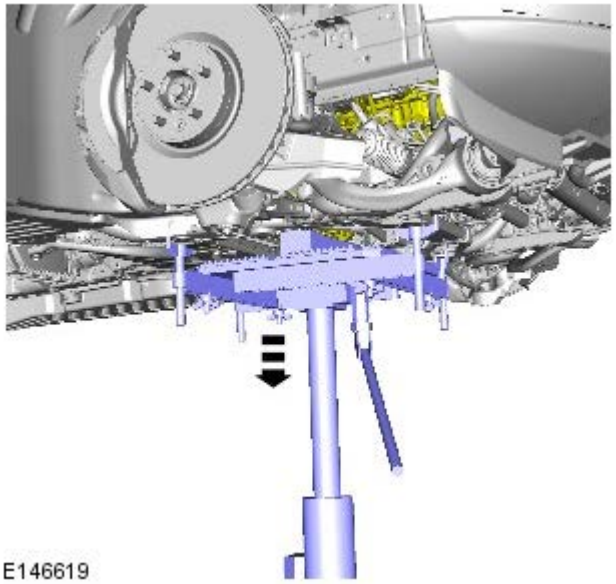
12. *Special Tool(s):* JLR-303-1620



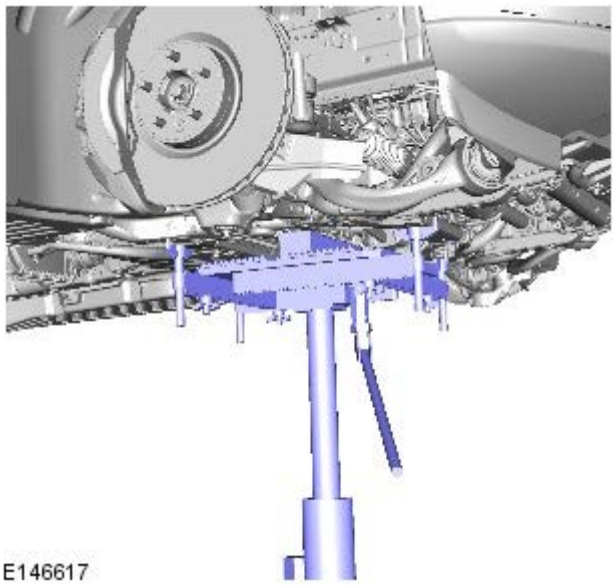
13.



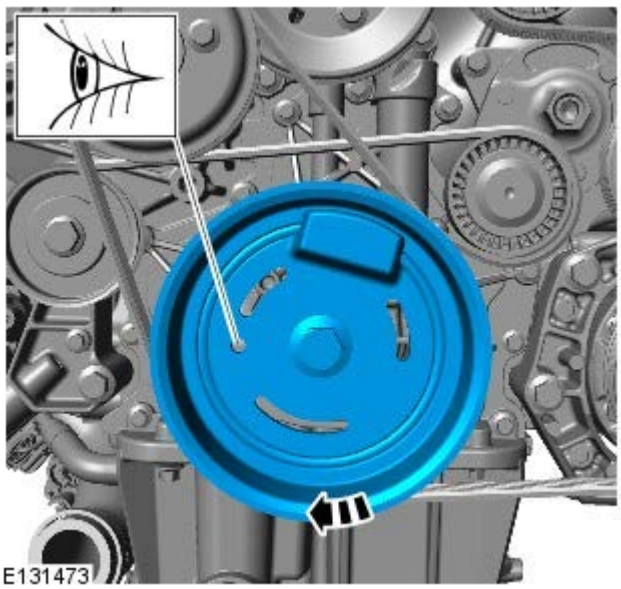
14.



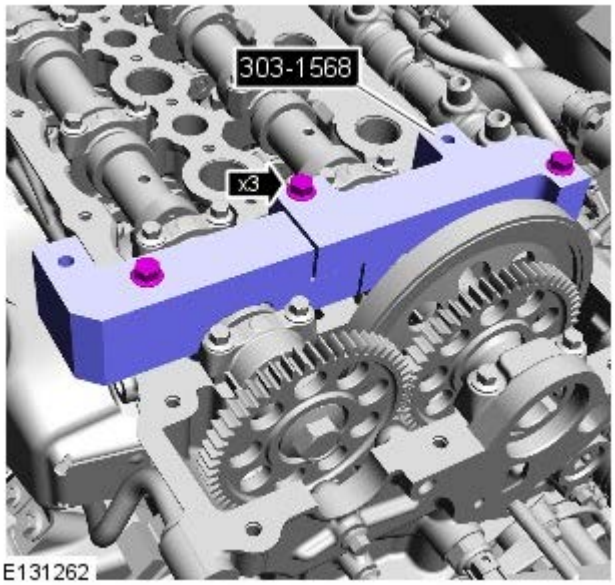
15.



16. Rotate the engine clockwise until the crankshaft contacts the timing pin. Do not attempt to rotate the engine counter clockwise.

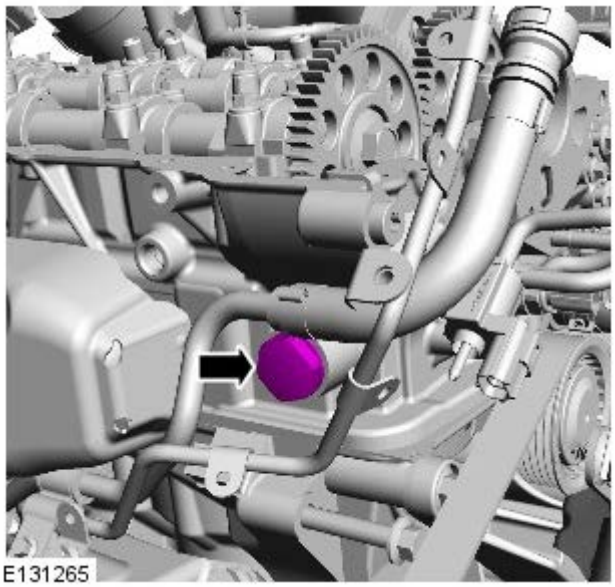


17. *Special Tool(s):* JLR-303-1568

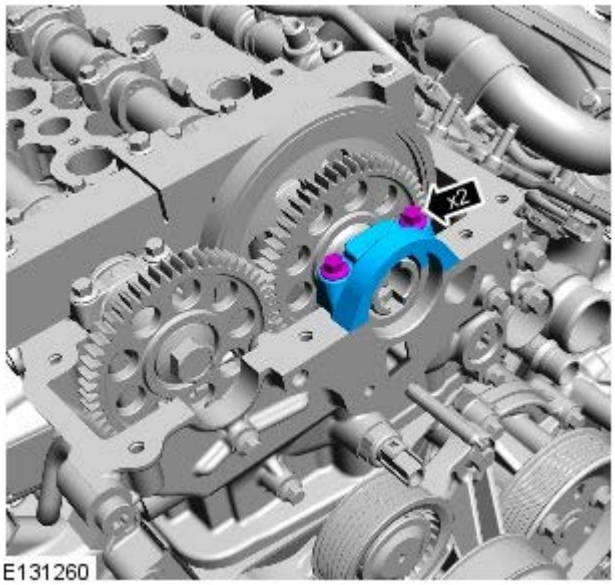


E131262

18. CAUTION: Discard the component.

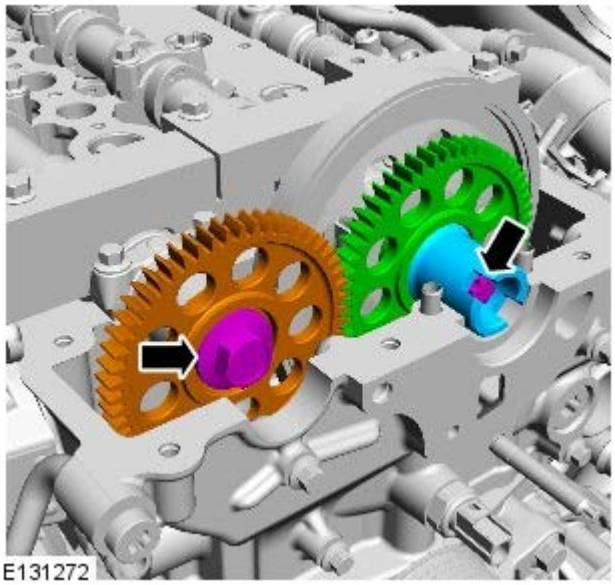

E131265

19.

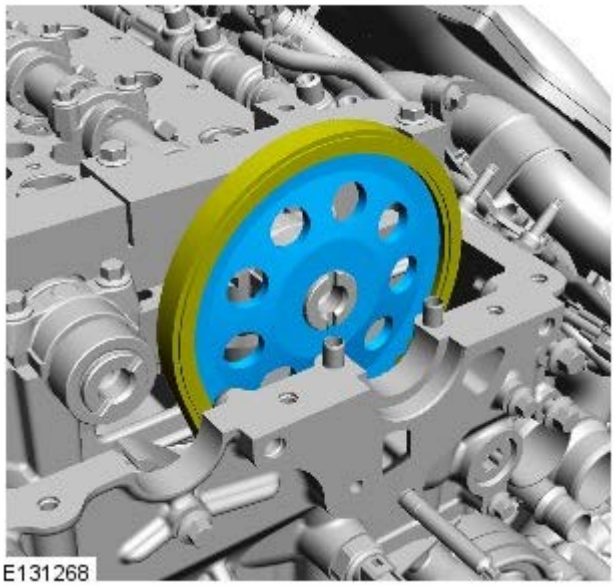


E131260

20.

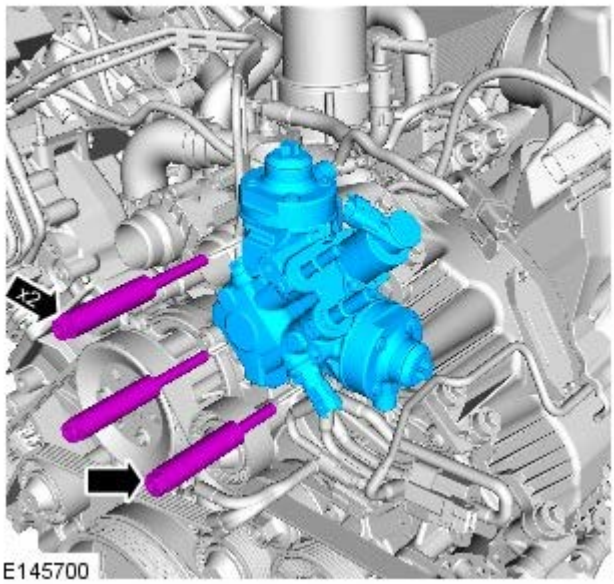

E131272

21.


E131268

22. CAUTION: Discard the bolts.

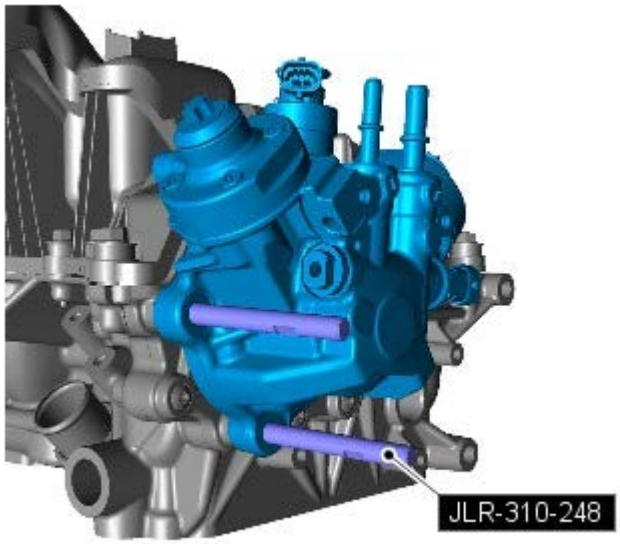
NOTE: Note the different lengths of the bolts.



E145700

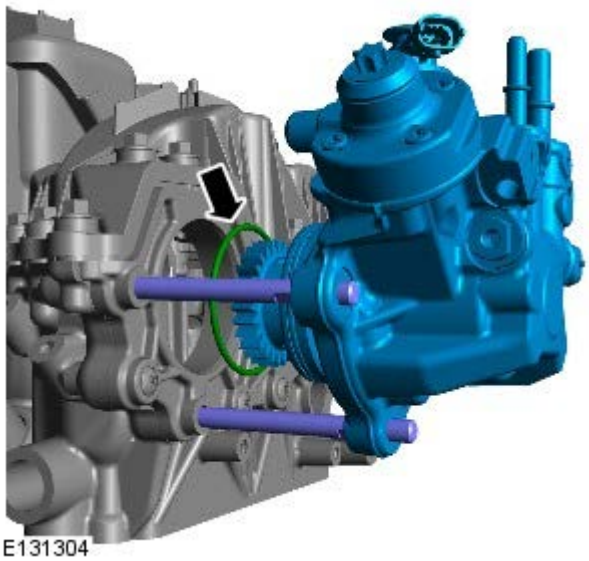
23. Install 2 guide pins in the original location of the 2 bolts.

Special Tool(s): JLR-310-248



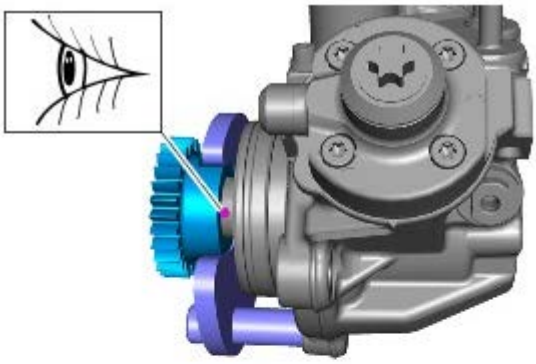
E131307

24.



E131304

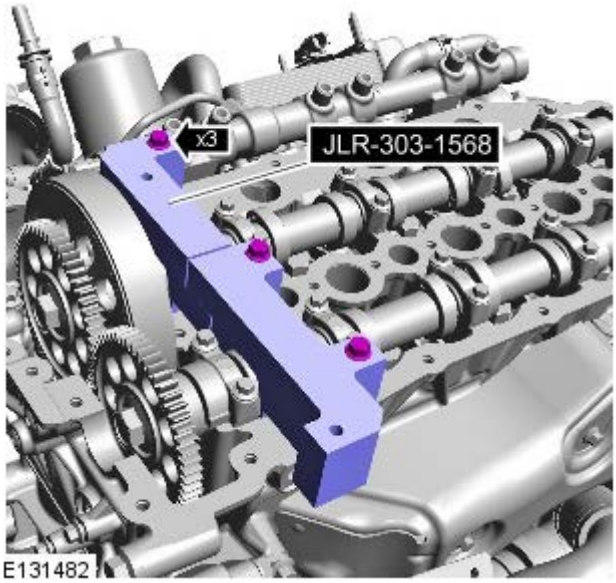
25. *Special Tool(s):* JLR-310-246





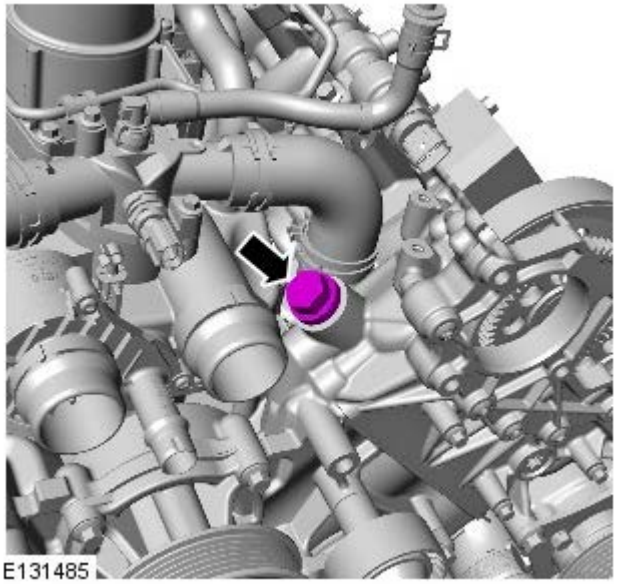
E131472

26. *Special Tool(s):* JLR-303-1568

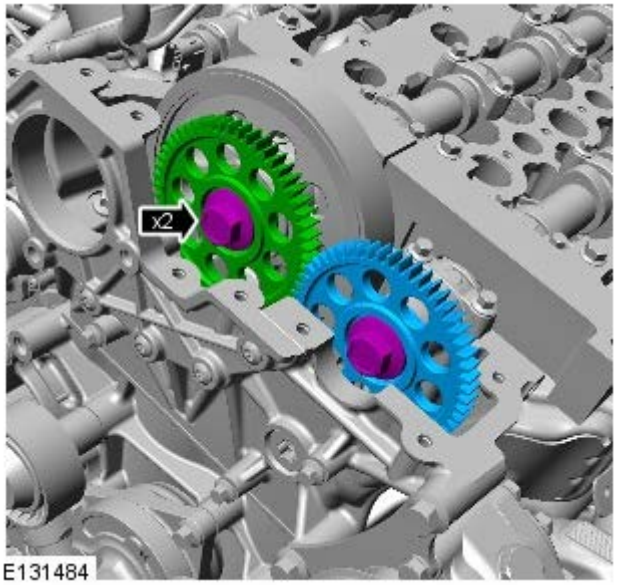


E131482

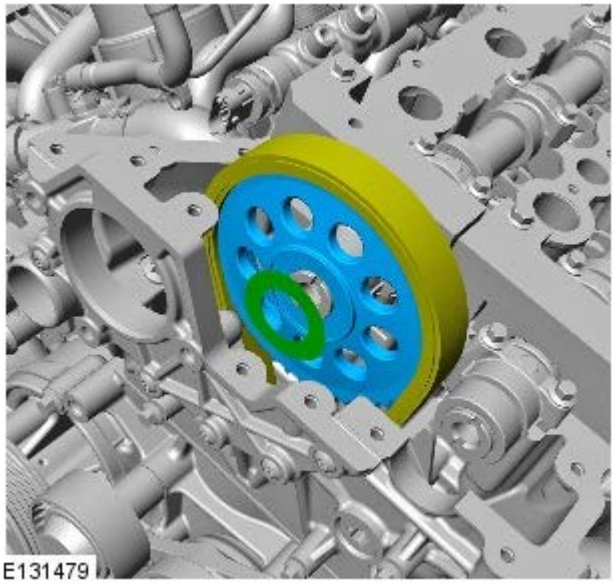
27. CAUTION: Discard the component.



28.

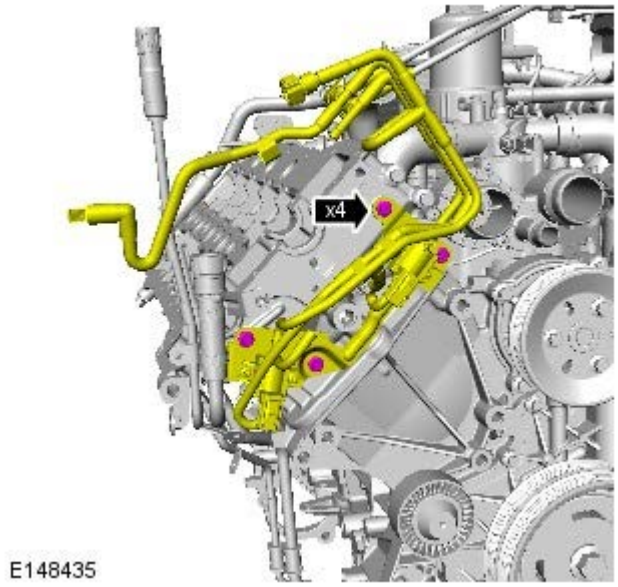


29.

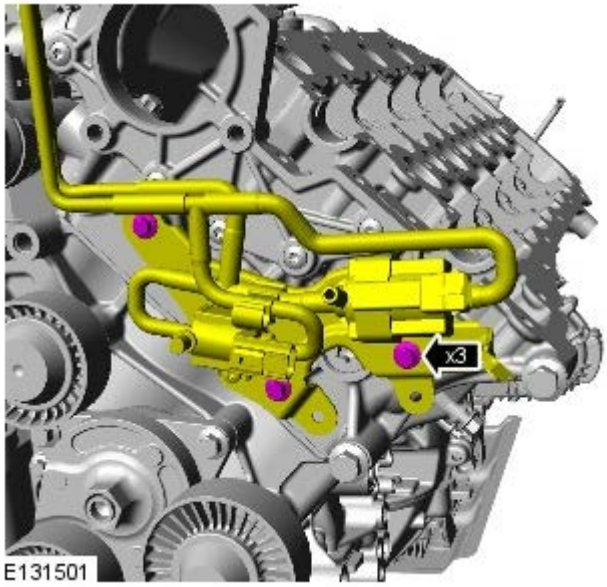


30. Refer to: Oil Pump (303-01D Engine - TDV8 4.4L Diesel, Removal and Installation).

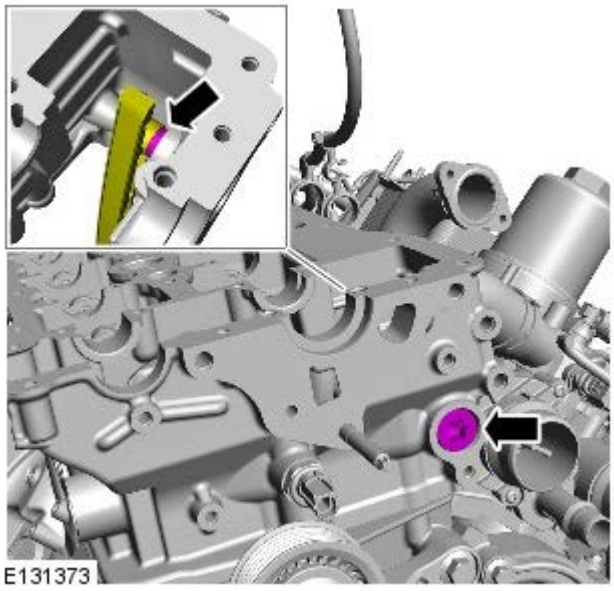
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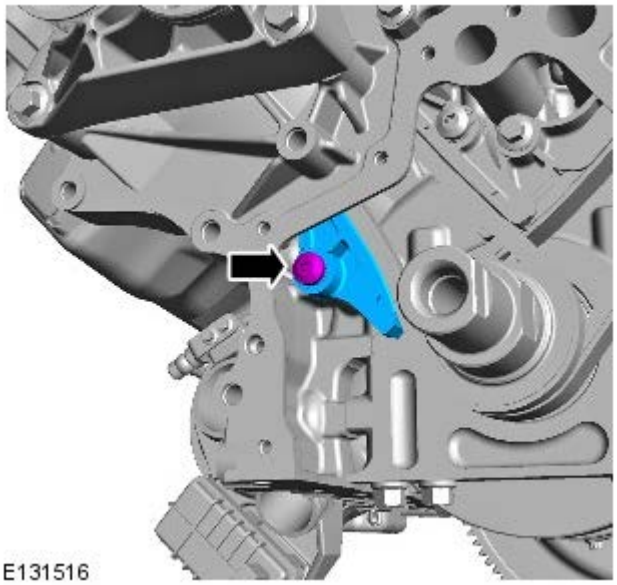
32.



33.

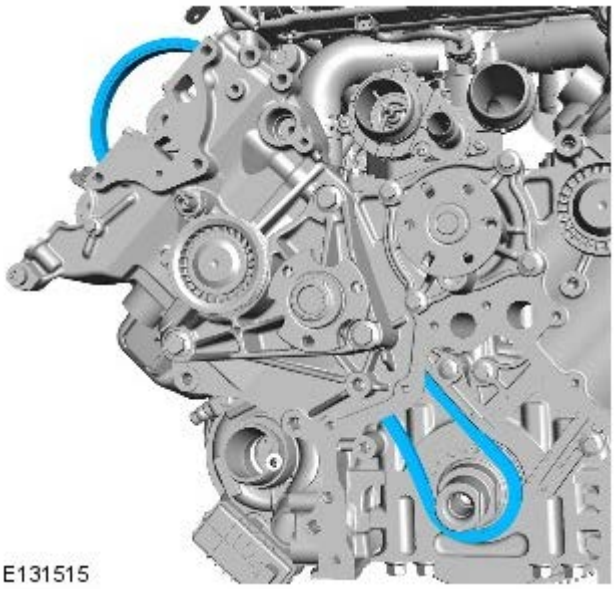


34.



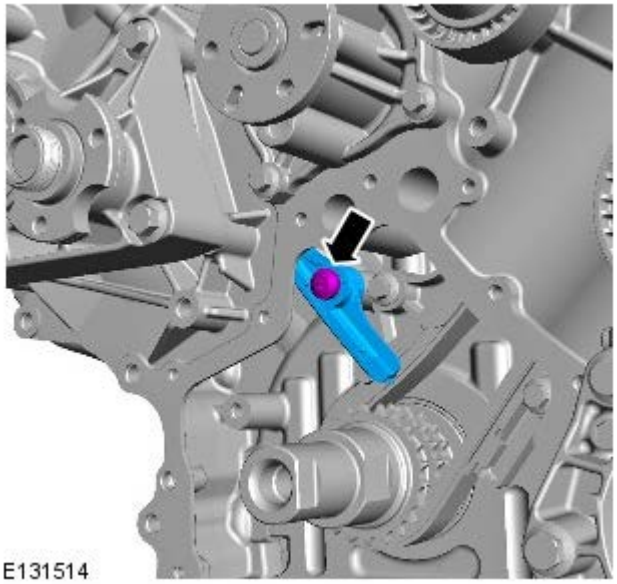
E131516

35.



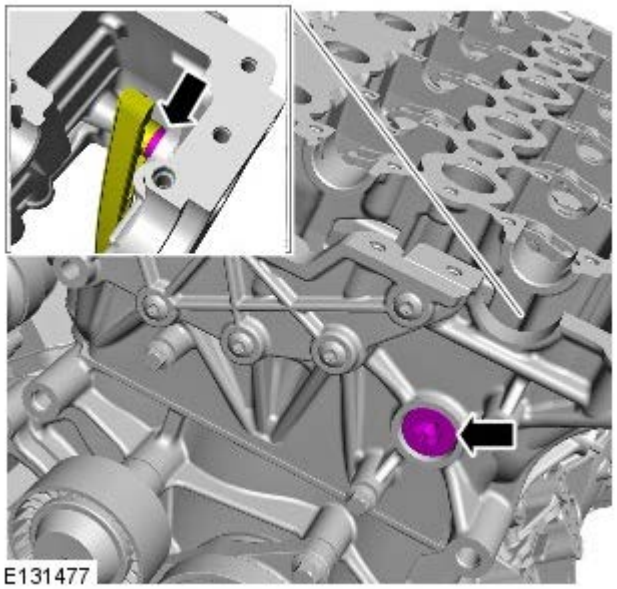
E131515

36.



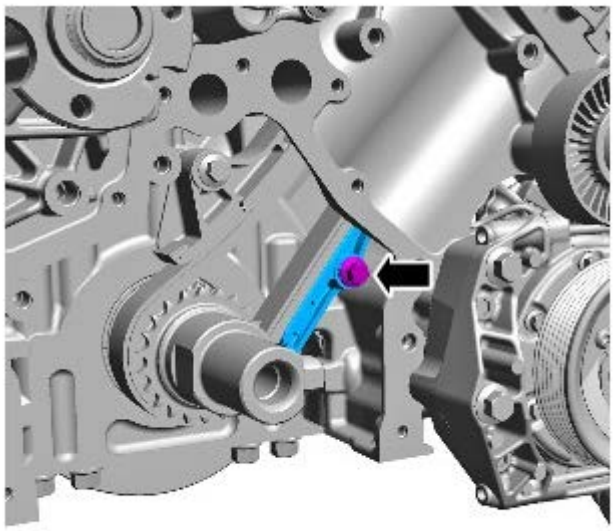
E131514

37.



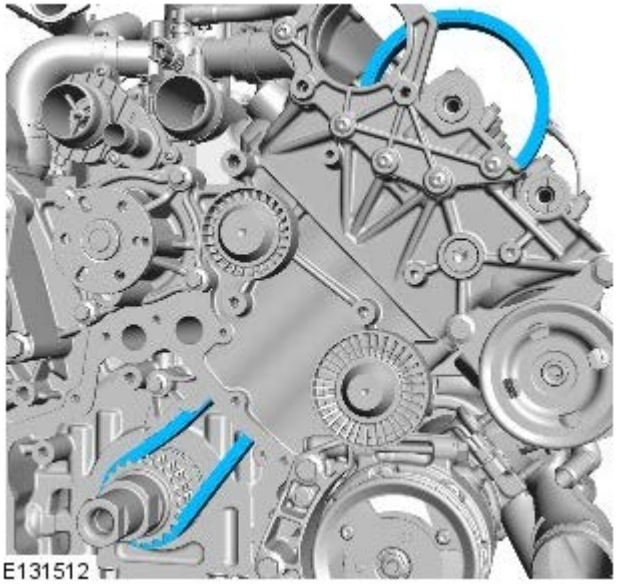
E131477

38.



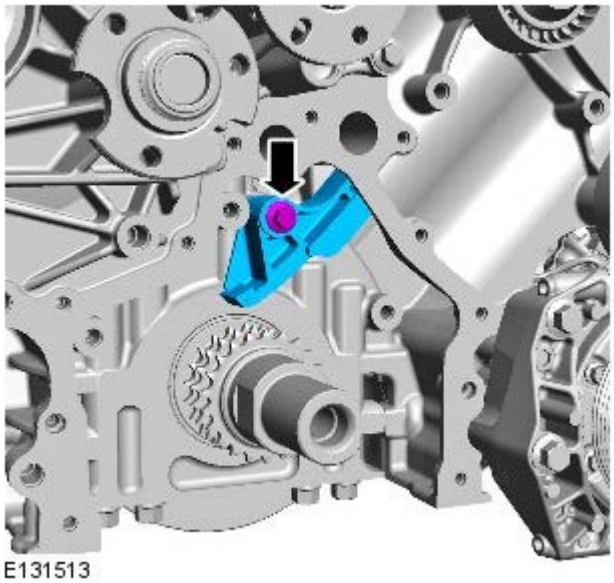
E131511

39.



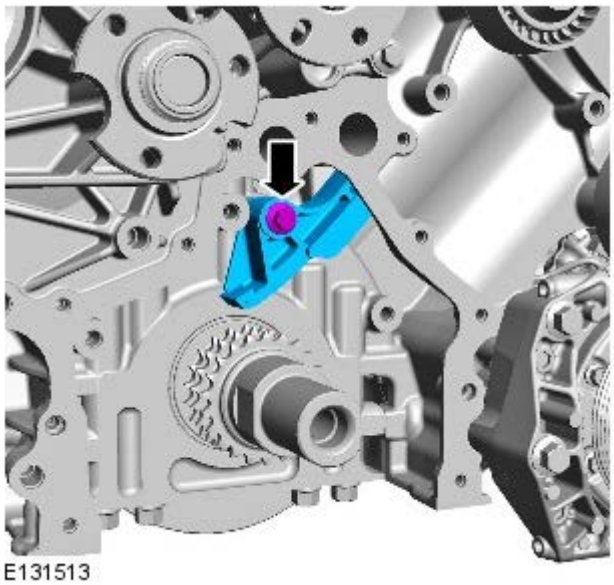
E131512

40.

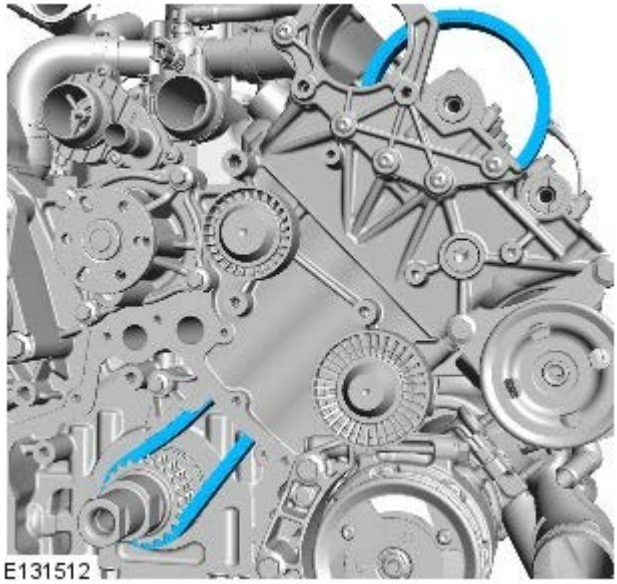

E131513

Installation

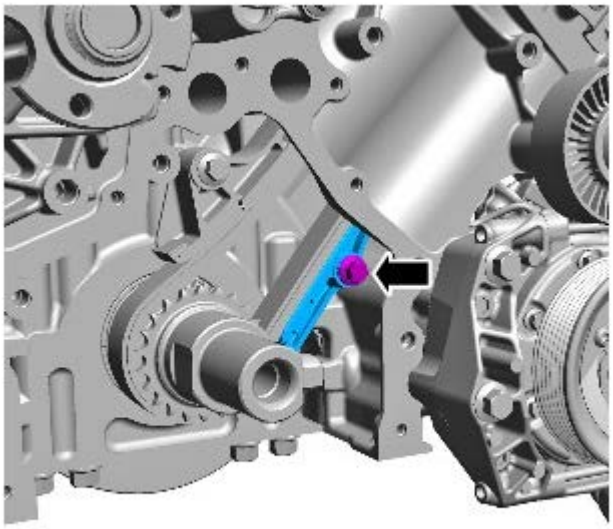
1. *Torque:* 20 Nm


E131513

2.

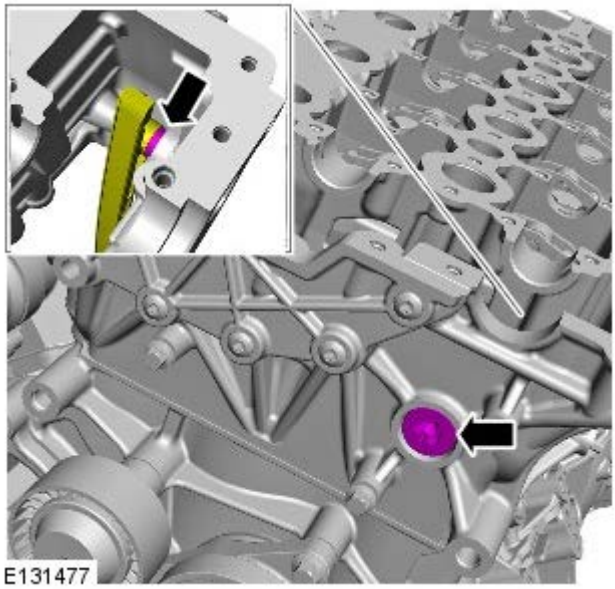

E131512

3. *Torque:* 20 Nm



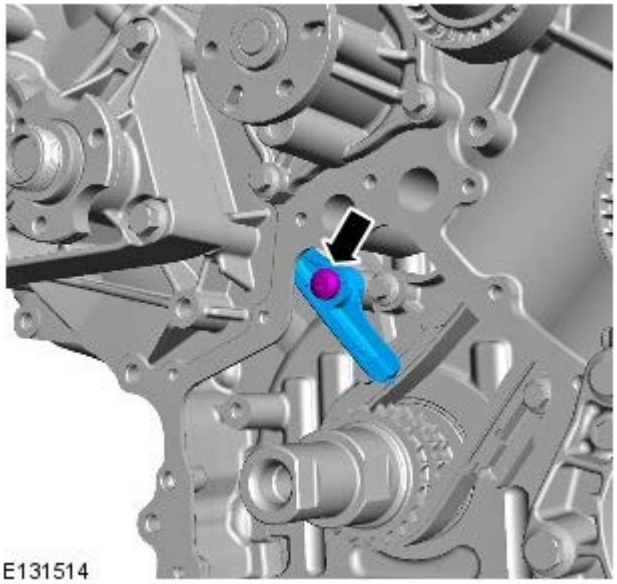
E131511

4. *Torque:* 27 Nm



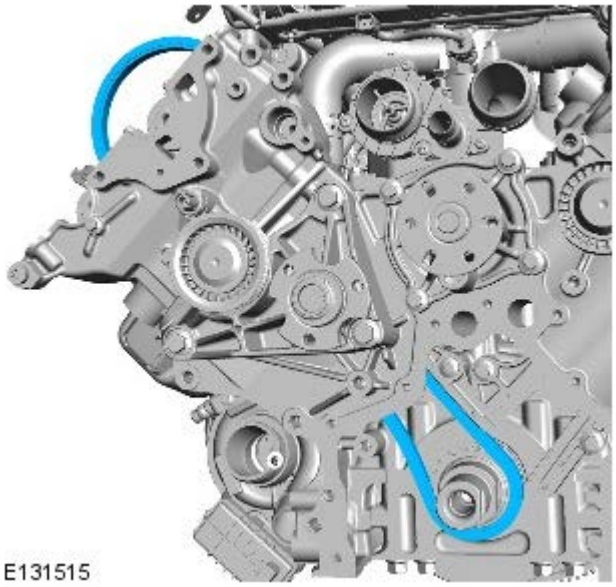
E131477

5. *Torque:* 20 Nm

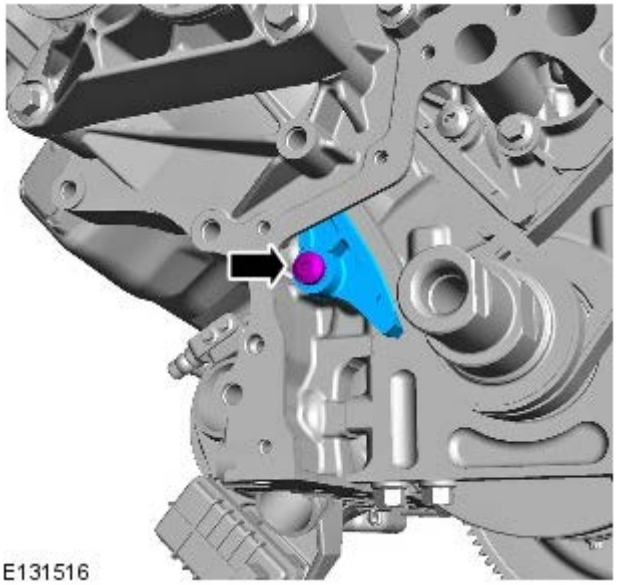


E131514

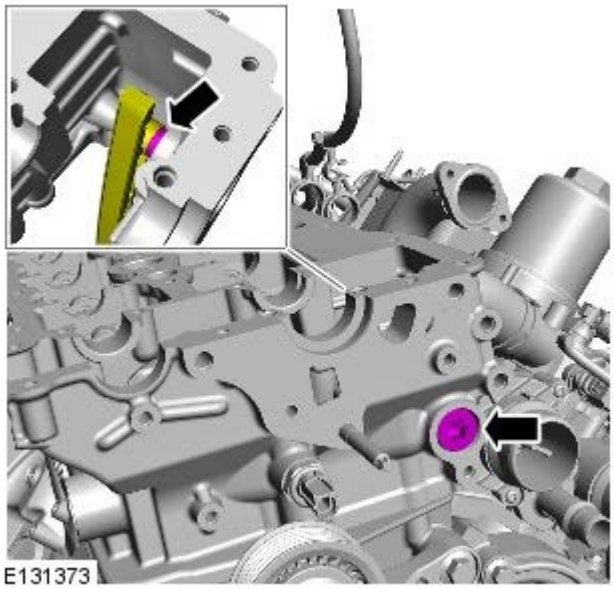
6.



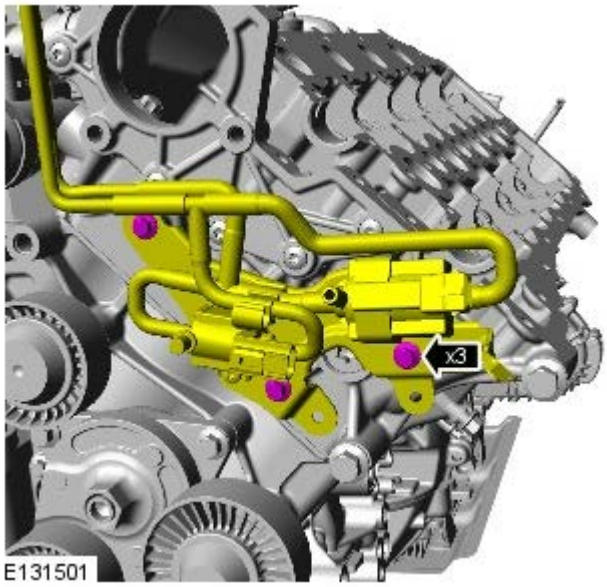
7. *Torque:* 20 Nm



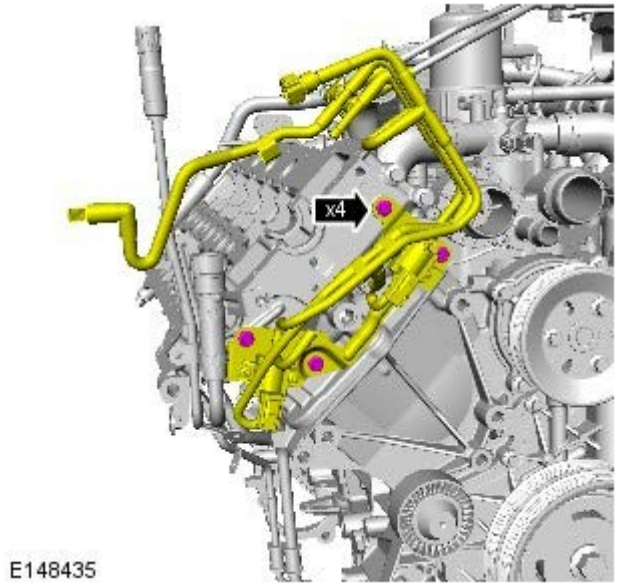
8. *Torque:* 27 Nm



9. *Torque:* 10 Nm

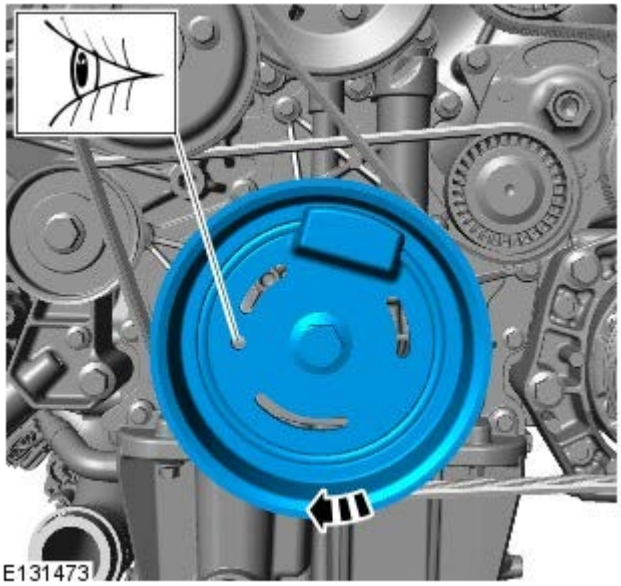


10. *Torque:* 10 Nm

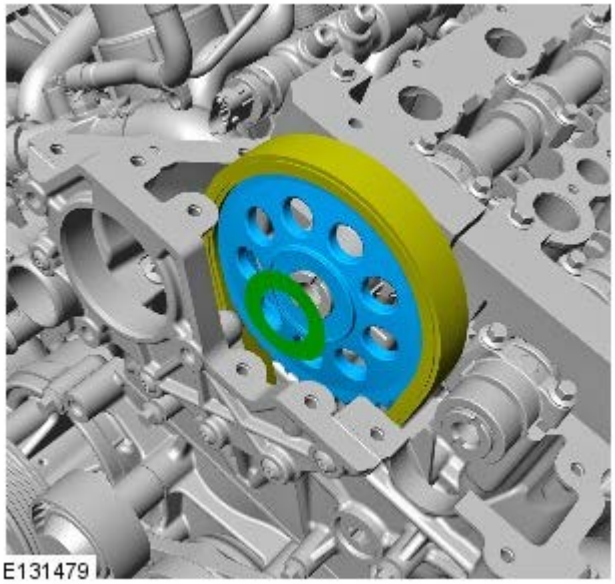


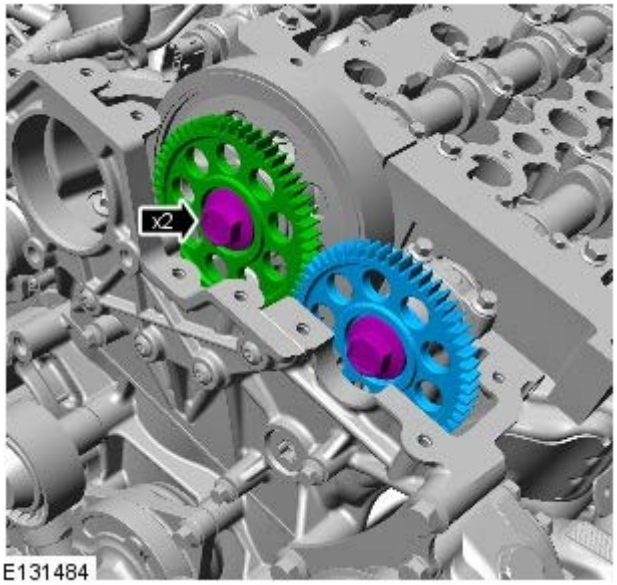
11. Refer to: Oil Pump (303-01D Engine - TDV8 4.4L Diesel, Removal and Installation).

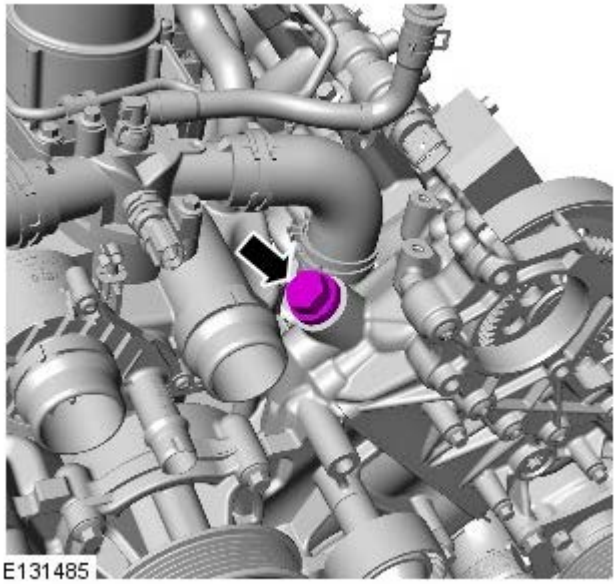
12. Rotate the engine clockwise until the crankshaft contacts the timing pin. Do not attempt to rotate the engine counter clockwise.



13.







14. CAUTIONS:

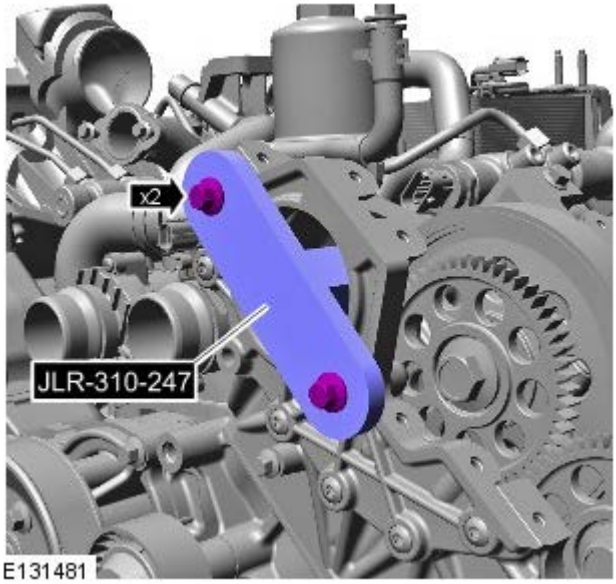
    Make sure that new bolts are installed.

    Only tighten the bolts finger-tight at this stage.

15. CAUTION: Make sure that a new component is installed.

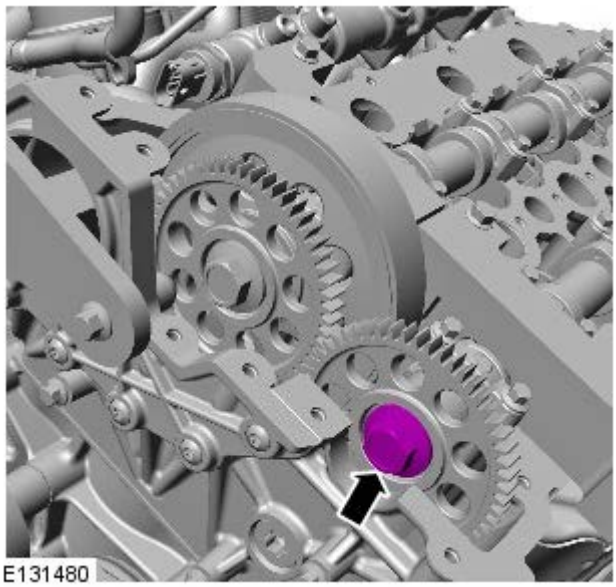
    Torque: 65 Nm

16. *Special Tool(s):* JLR-310-247
    Torque: 10 Nm

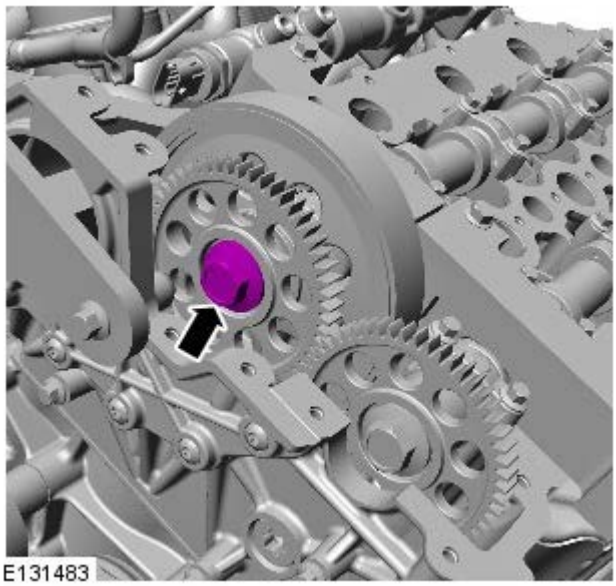


E131481

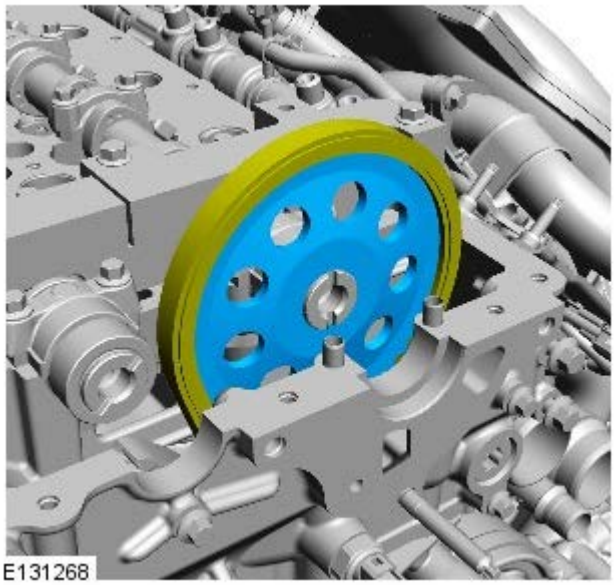
17. *Torque:*
    Stage 1:80 Nm
    Stage 2:80°

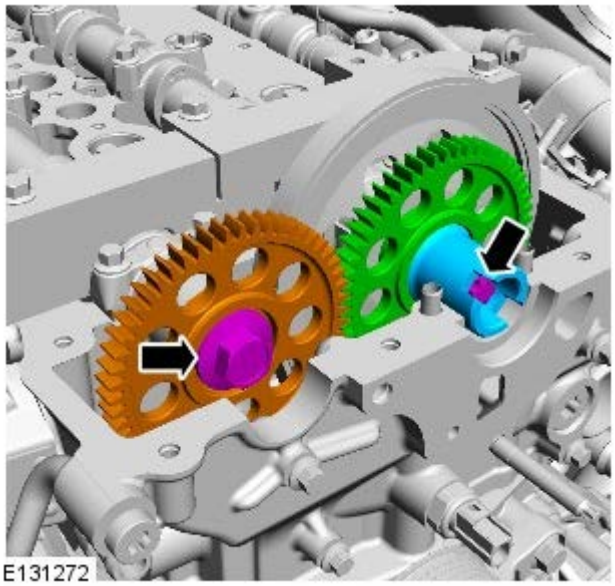

E131480

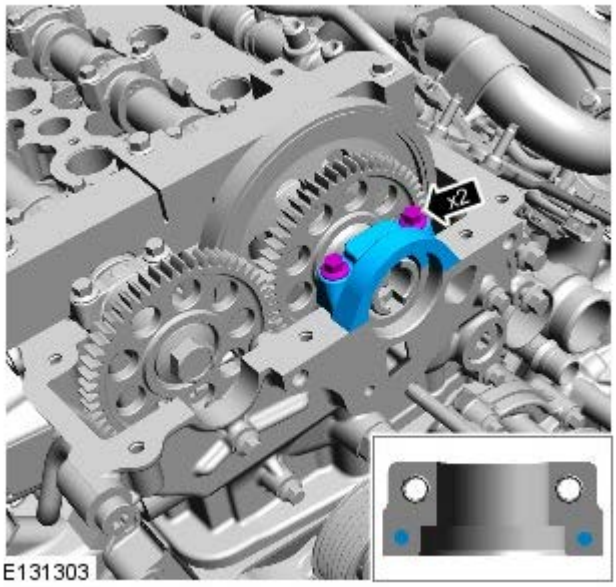
18. *Torque:*
    Stage 1:80 Nm
    Stage 2:80°


E131483

19.







20. CAUTIONS:

    Make sure that new bolts are installed.

    Only tighten the bolts finger-tight at this stage.

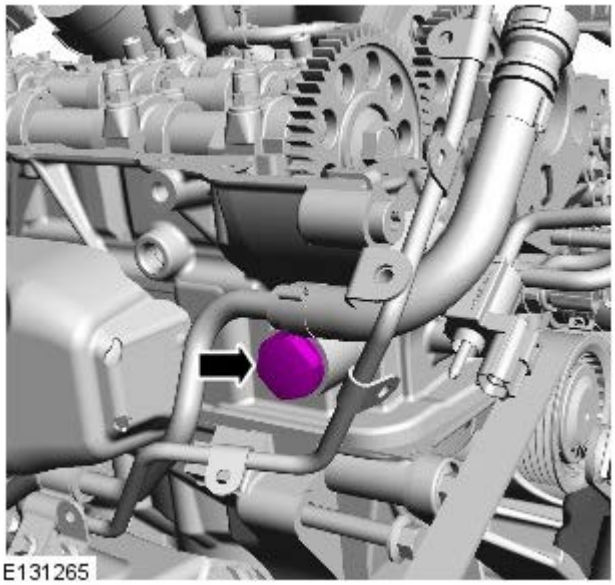
21. CAUTION: Make sure that the mating faces are clean and free of foreign material.

    Apply a 3.5 mm - 4 mm circle of loctite 518 sealant in the two areas shown.

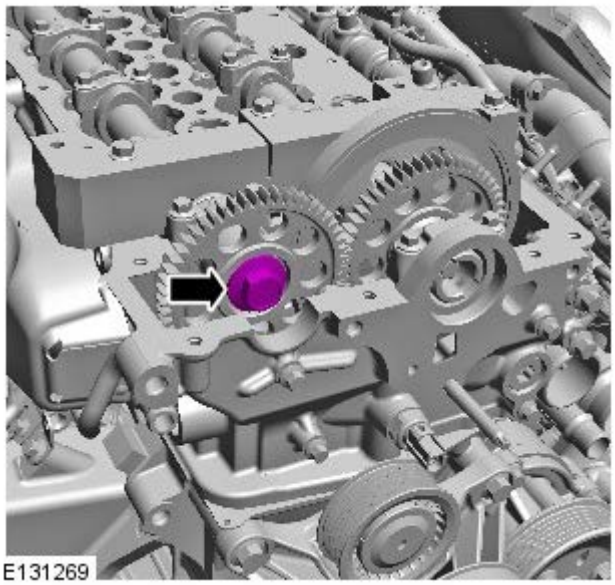
    Torque:
    Stage 1: 5 Nm
    Stage 2: 10 Nm

22. CAUTION: Make sure that a new component is installed.

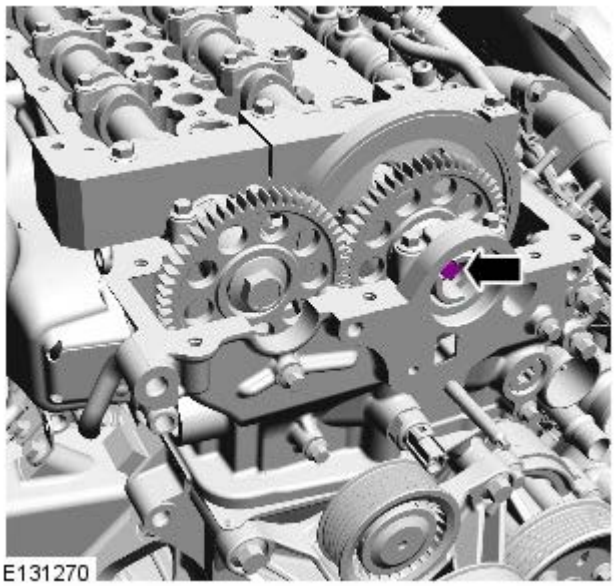
    Torque: 65 Nm



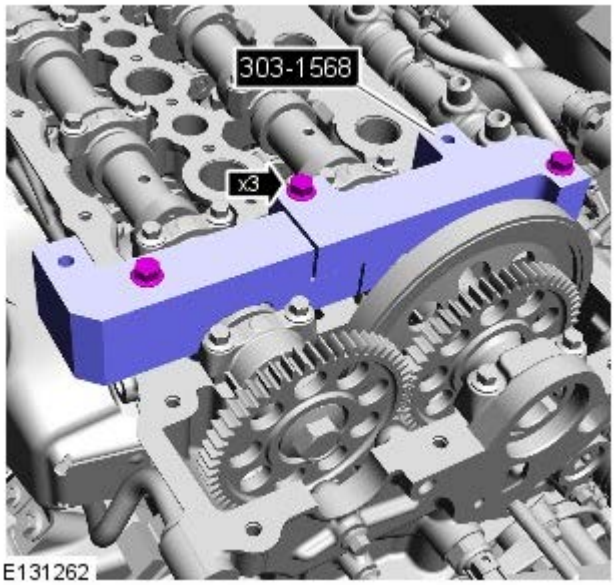
23. *Torque:*
    Stage 1:80 Nm
    Stage 2:80°



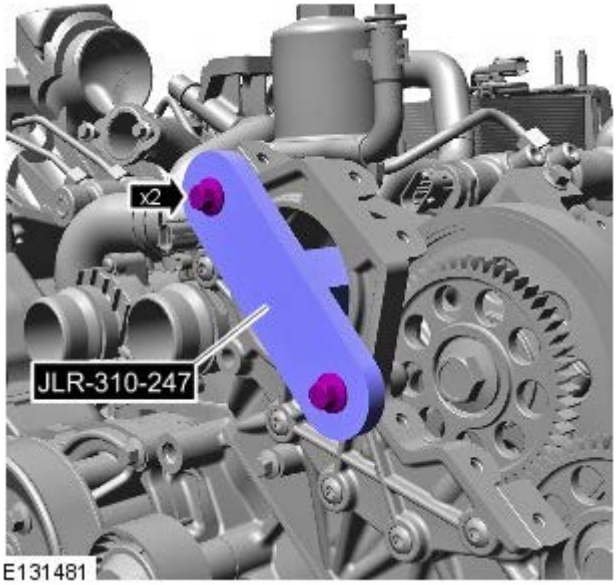
24. *Torque:*
    Stage 1:80 Nm
    Stage 2:80°



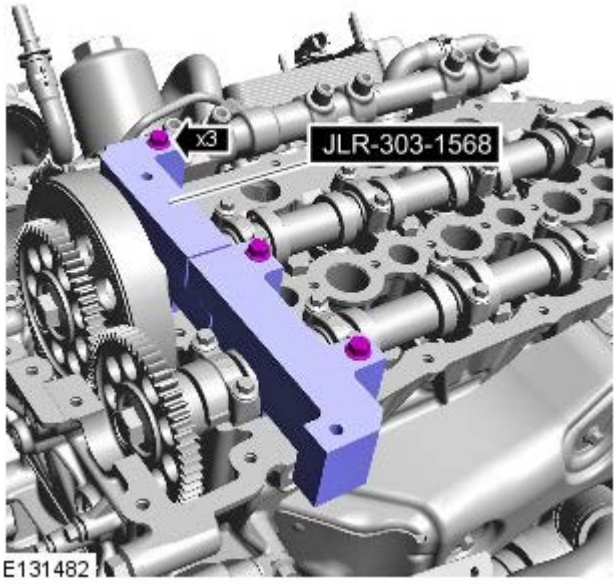
25. Remove the special tool.



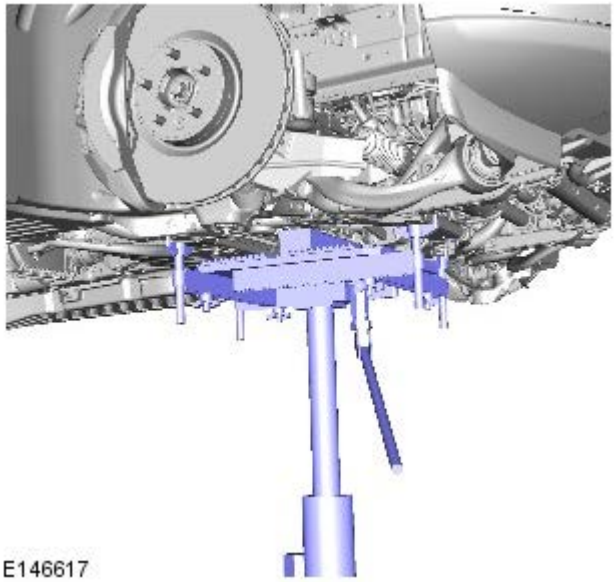
26. Remove the special tool.



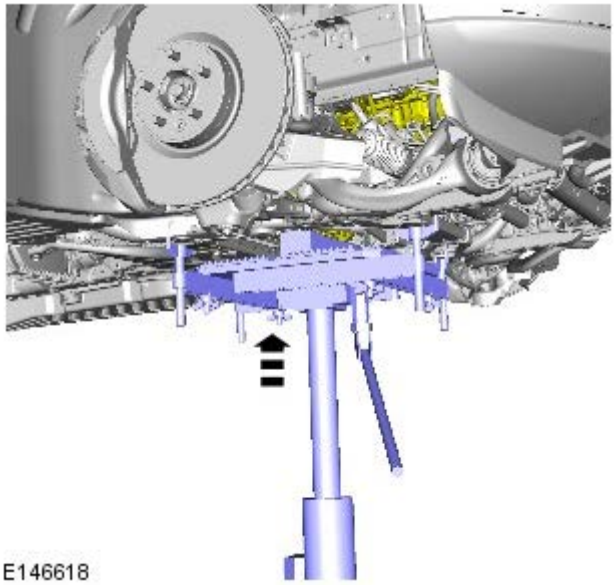
27. Remove the special tool.



28.



E146617

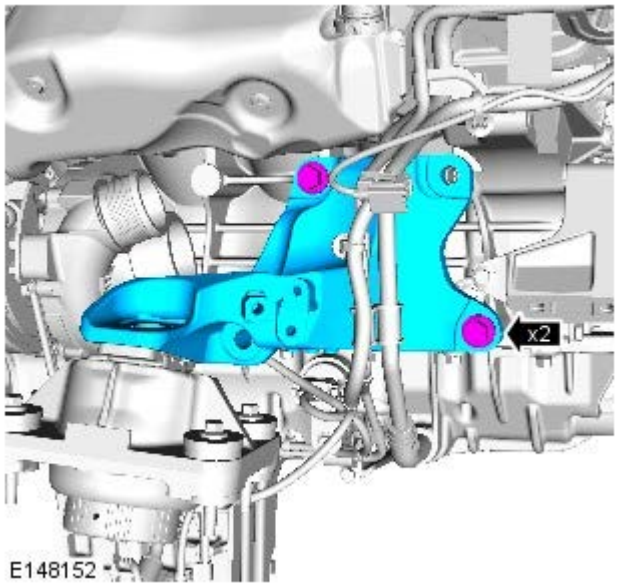


E146618

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

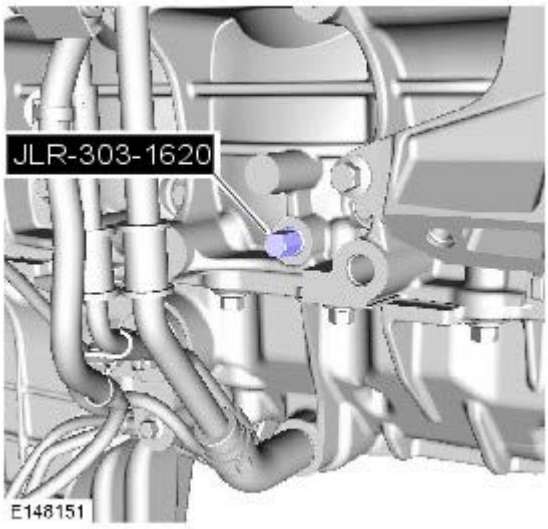
    Using a suitable hydraulic jack, raise and support the engine.

30.

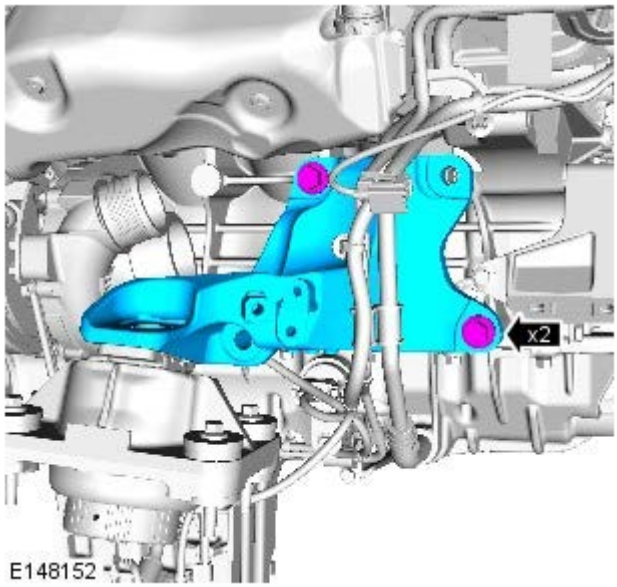


E148152

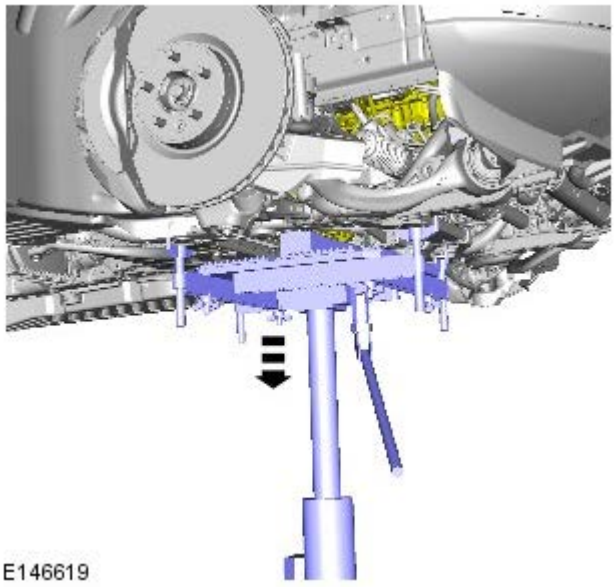
31. *Special Tool(s):* JLR-303-1620



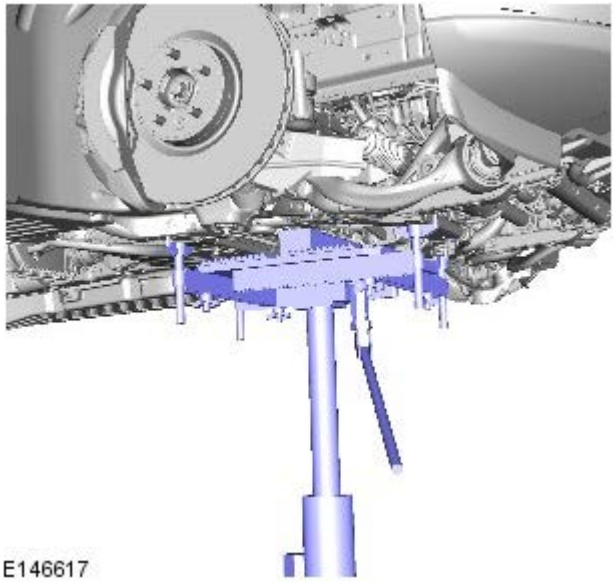
32.



33.

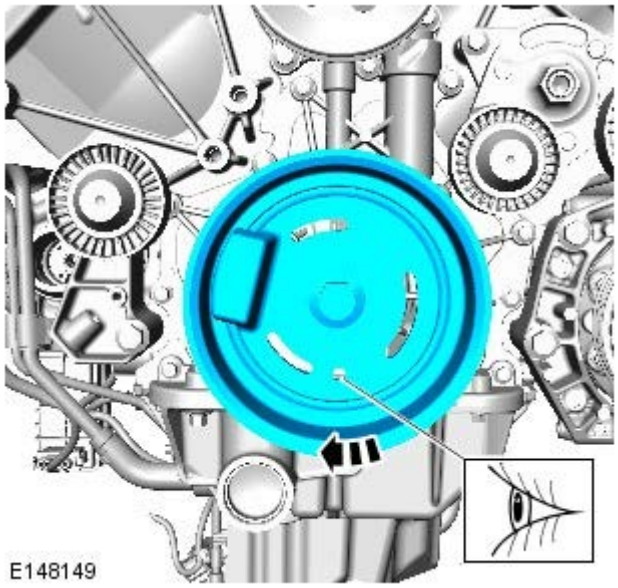


34.



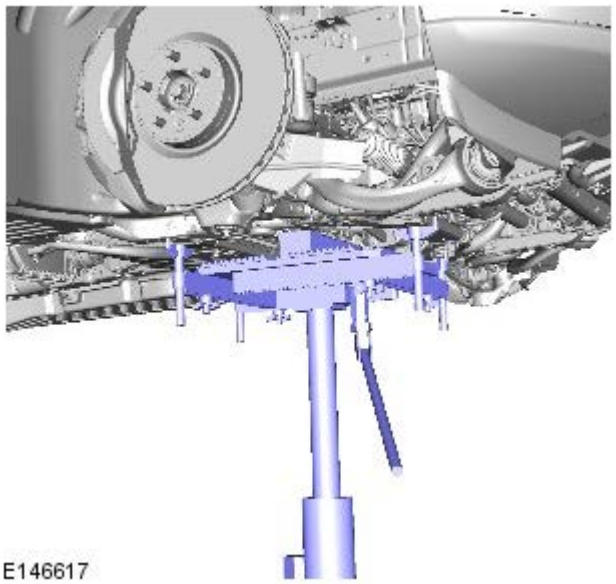
35. Rotate the engine two complete turns clockwise.

36.

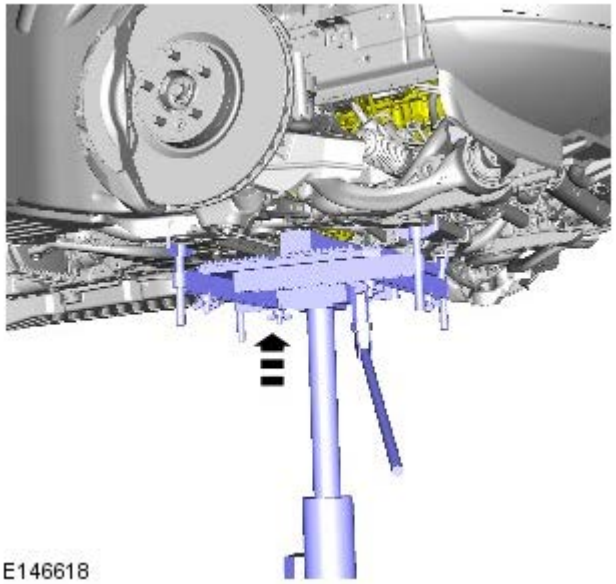


37. CAUTION: Use a wooden block to protect the oil pan when supporting the engine.

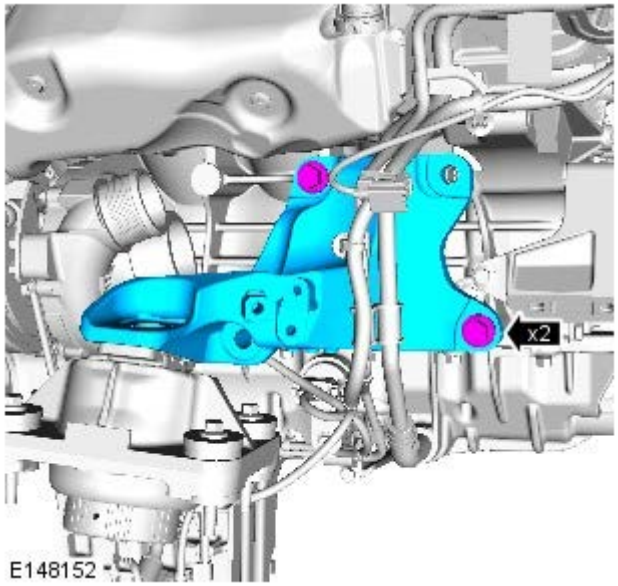
Using a suitable hydraulic jack, raise and support the engine.



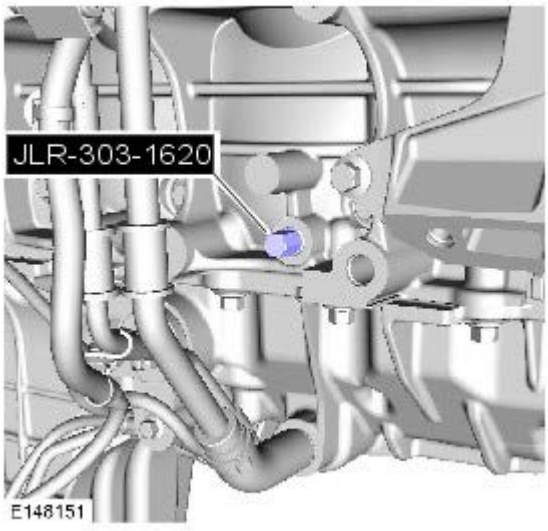
38.



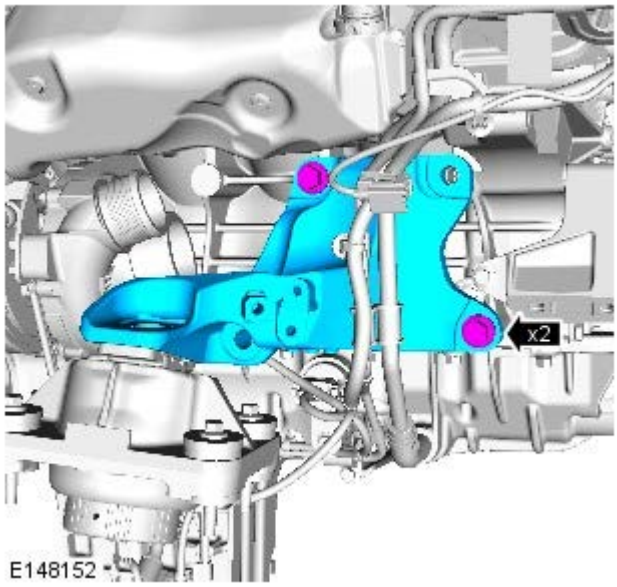
39.



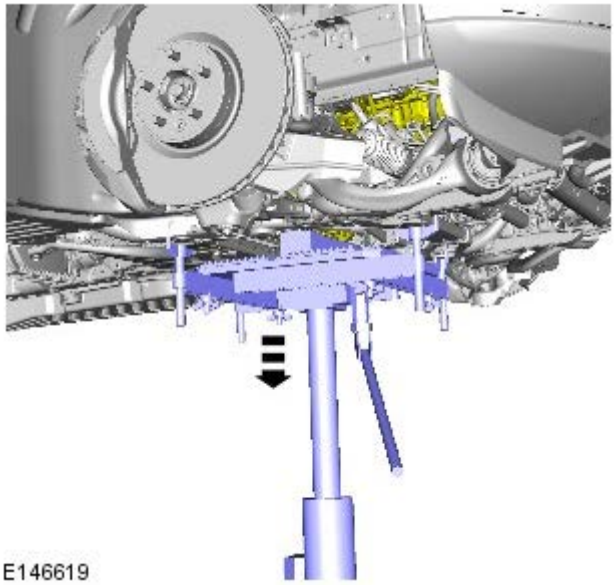
40. *Special Tool(s):* JLR-303-1620



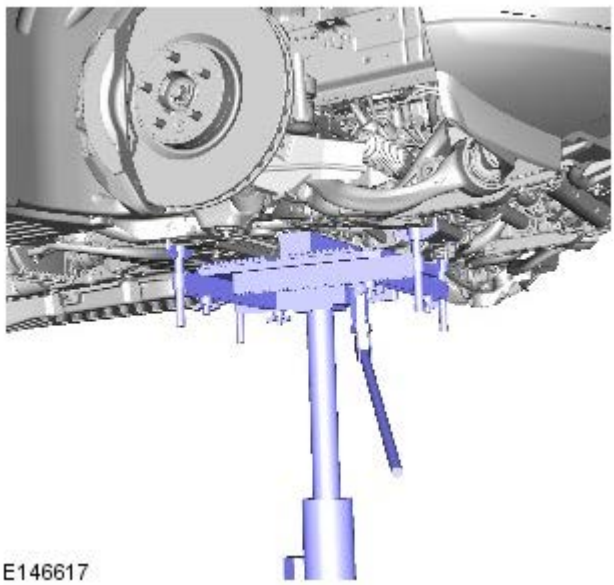
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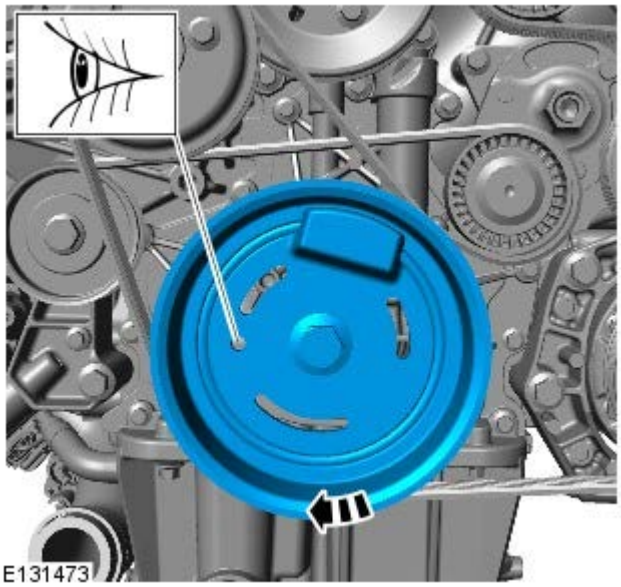
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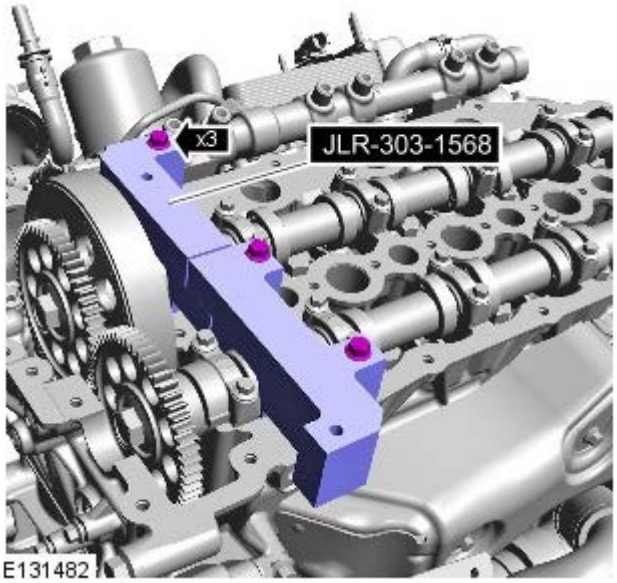


43.



44. Rotate the engine clockwise until the crankshaft contacts the timing pin. Do not attempt to rotate the engine counter clockwise.


E131473

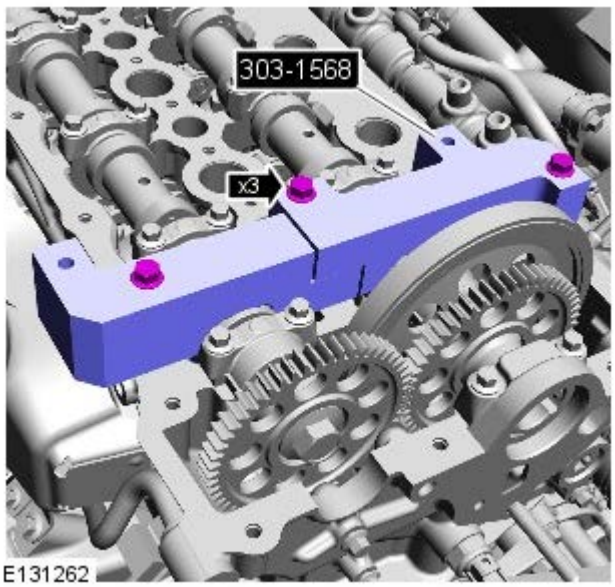


E131482

45. CAUTION: If the special tool cannot be installed, the timing chain installation steps must be repeated.

Install the special tool.

Special Tool(s): JLR-303-1568
Torque: 10 Nm



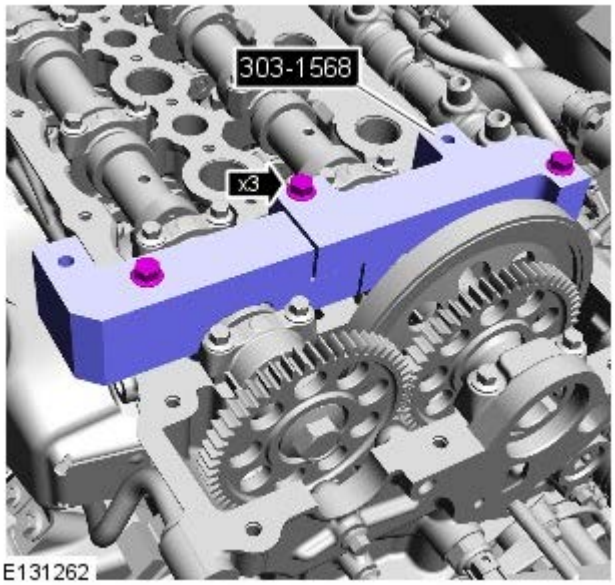
E131262

46. CAUTION: If the special tool cannot be installed, the timing chain installation steps must be repeated.

Install the special tool.

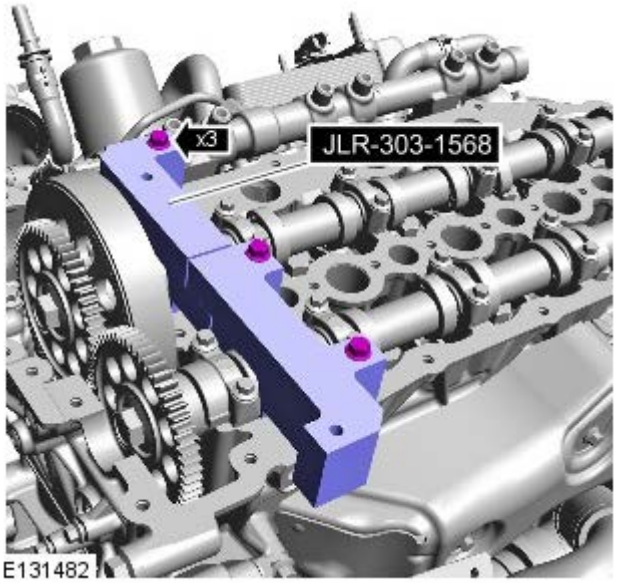
Special Tool(s): JLR-303-1568
Torque: 10 Nm

47. Remove the special tool.



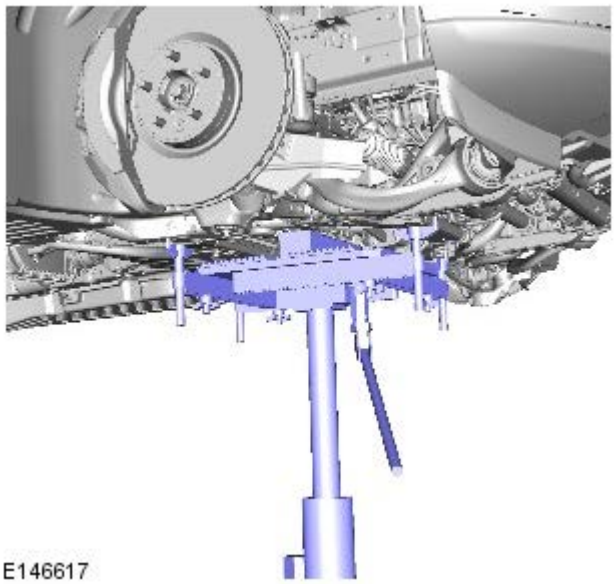
E131262

48. Remove the special tool.

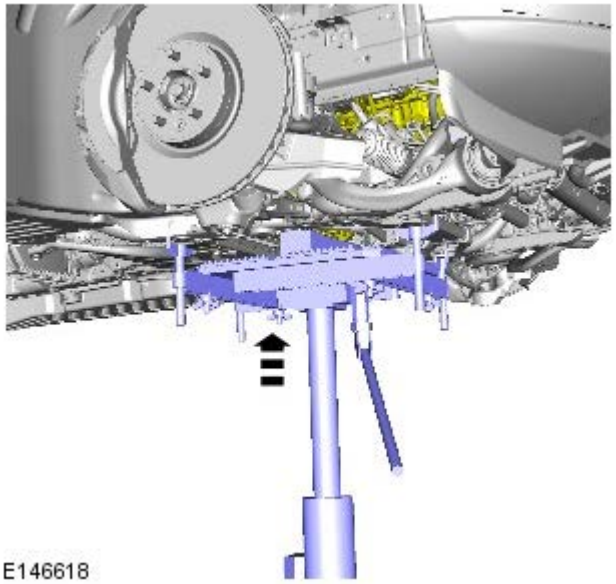


E131482

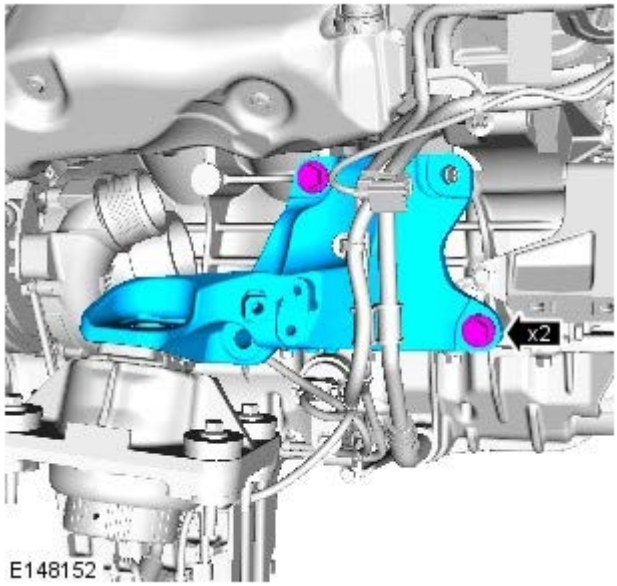
49.


E146617

50.

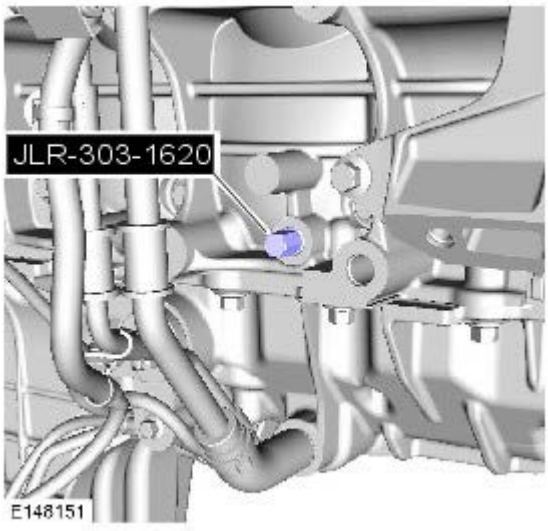


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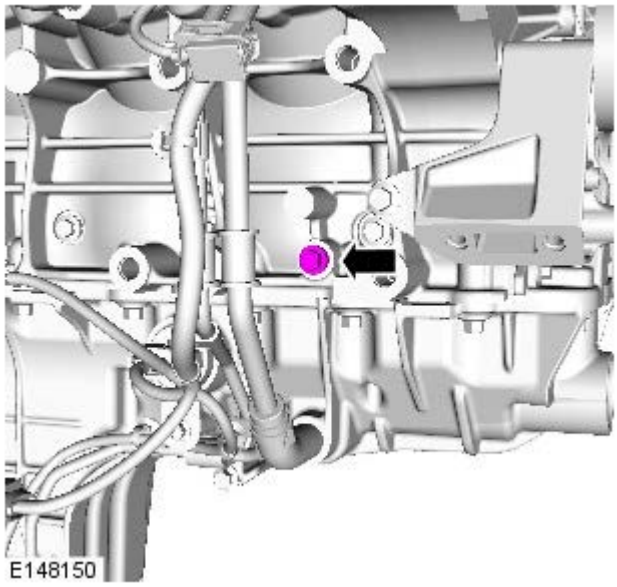


52. NOTE: Remove the special tool.

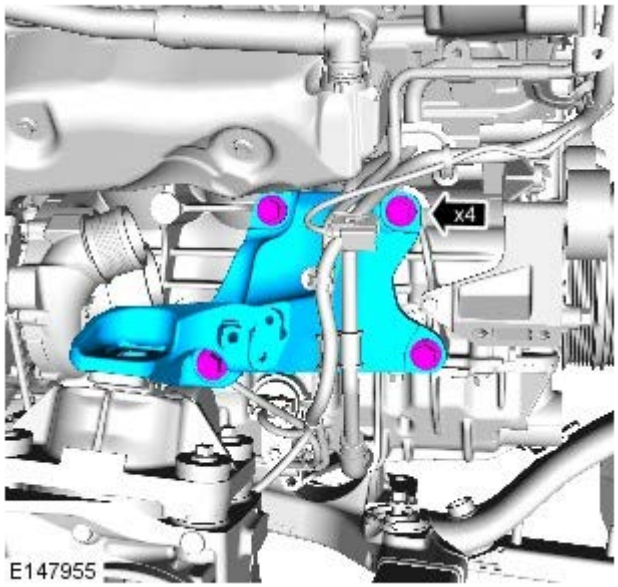
Special Tool(s): JLR-303-1620



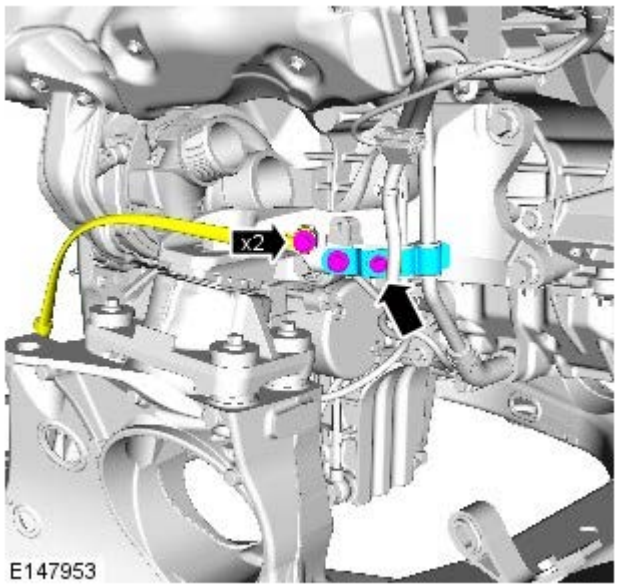
53. *Torque:* 23 Nm



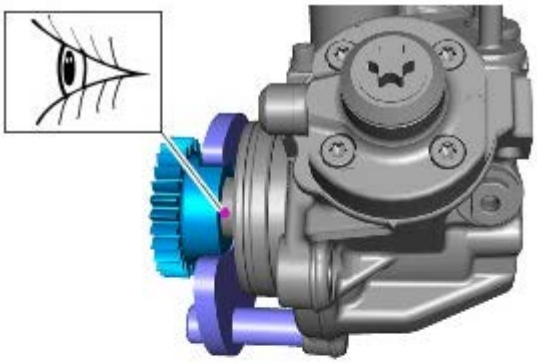
54. *Torque:* 119 Nm



55. *Torque:*
M8 25 Nm
M6 10 Nm



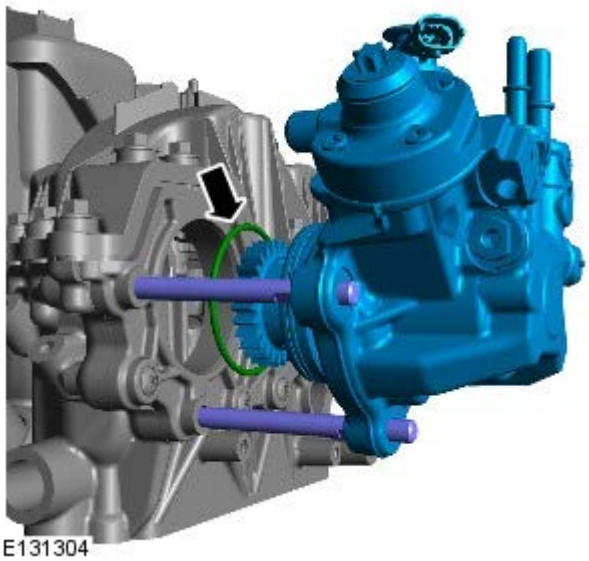
56. *Special Tool(s):* JLR-310-246





E131472

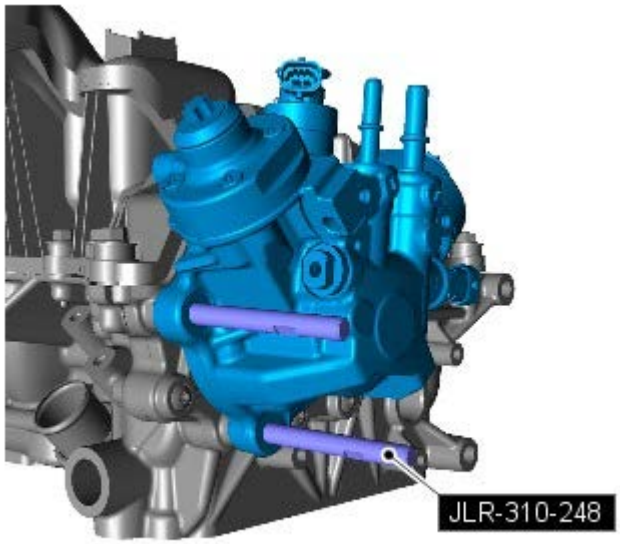
57. NOTE: Lubricate the O-ring seal with clean engine oil.



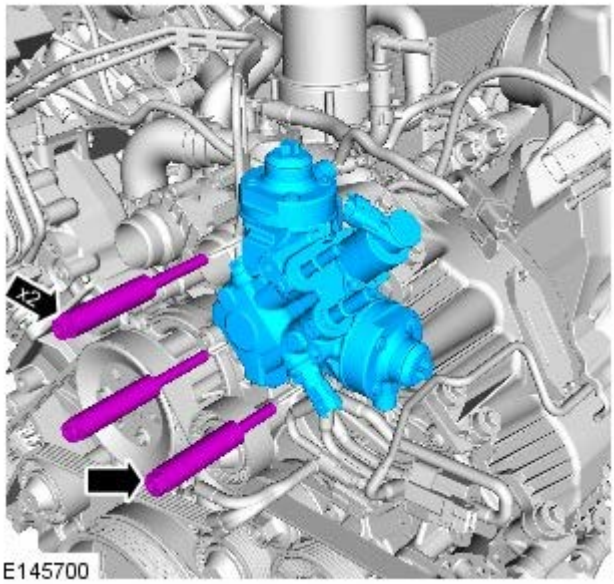
E131304

58. Remove the guide pins.

Special Tool(s): JLR-310-248



E131307



E145700

59. CAUTIONS:

    Make sure that new bolts are installed.

    Install the bolts in the noted position.

    Torque: 24 Nm

60. Refer to: Brake Vacuum Pump - 4.4L V8 - TdV8 (206-07 Power Brake Actuation, Removal and Installation).

61. Refer to: Generator (414-02D Generator and Regulator - TDV8 4.4L Diesel, Removal and Installation).

62. Refer to: Valve Cover LH (303-01D Engine - TDV8 4.4L Diesel, Removal and Installation).

63. Refer to: Valve Cover RH (303-01D Engine - TDV8 4.4L Diesel, Removal and Installation).

64. Connect the battery ground cable.

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

Published: 29-Oct-2013

Engine - TDV8 4.4L Diesel - Valve Cover LH

Removal and Installation

Special Tool(s)

	303-1244 Alignment Tool, Valve Cover

Removal

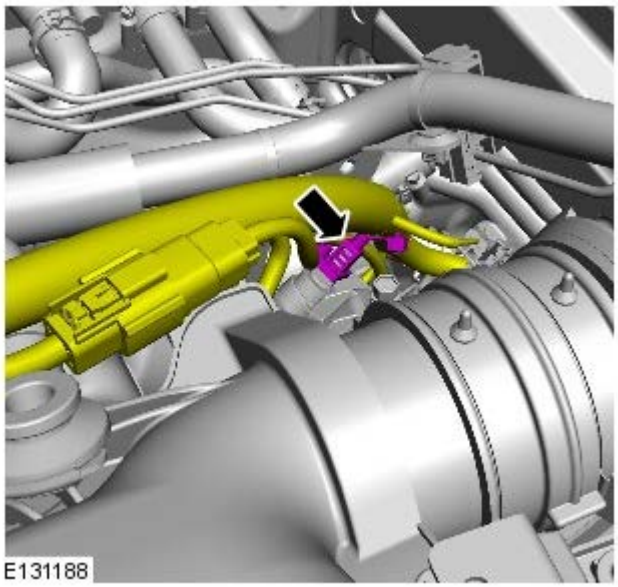
CAUTION: The use of an electronic torque and angle gauge is recommended during the high pressure fuel pipe tightening procedure.

NOTES:

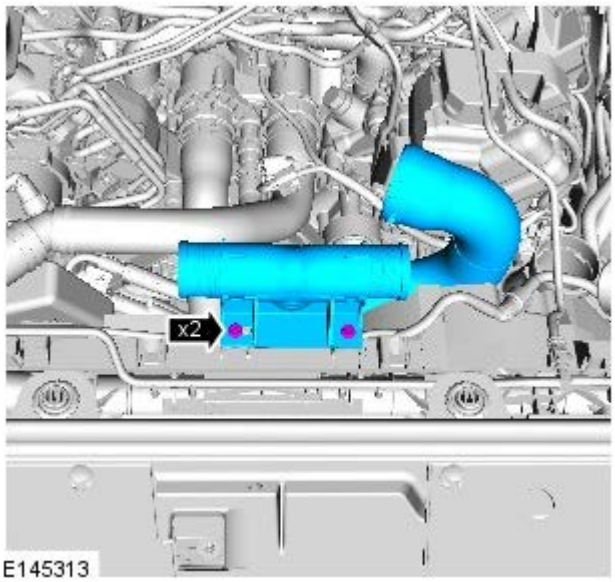
Some variation in the illustrations may occur, but the essential information is always correct.

Engine shown removed for clarity.

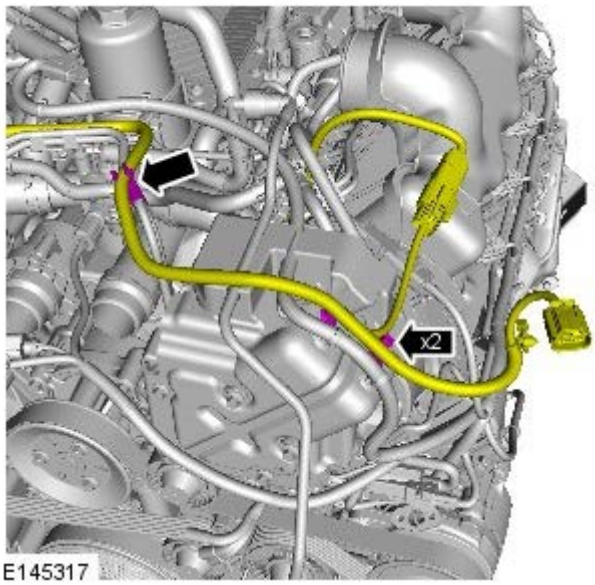
1. Refer to: Diesel Fuel System Health and Safety Precautions (100-00 General Information, Description and Operation).
2. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).
3. Refer to: Intake Manifold Plenum Chamber (303-01D Engine - TDV8 4.4L Diesel, Removal and Installation).
4. Refer to: Fuel Injectors LH (303-04E Fuel Charging and Controls - TDV8 4.4L Diesel, Removal and Installation).
5. 

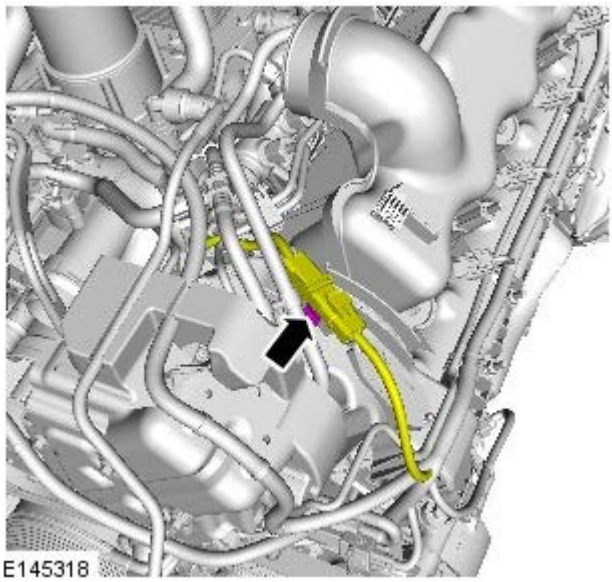
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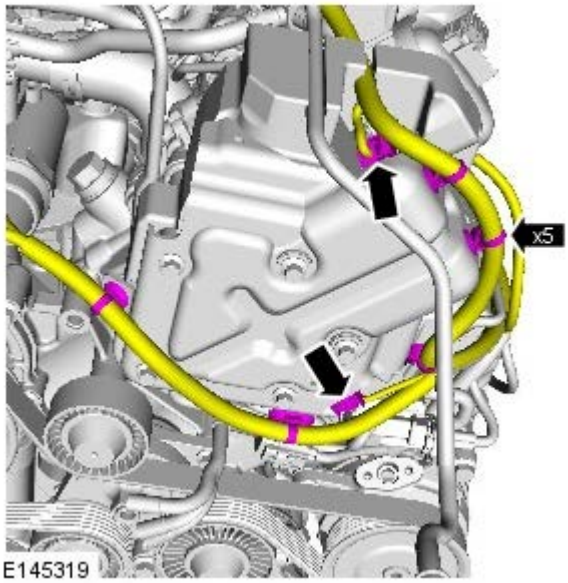
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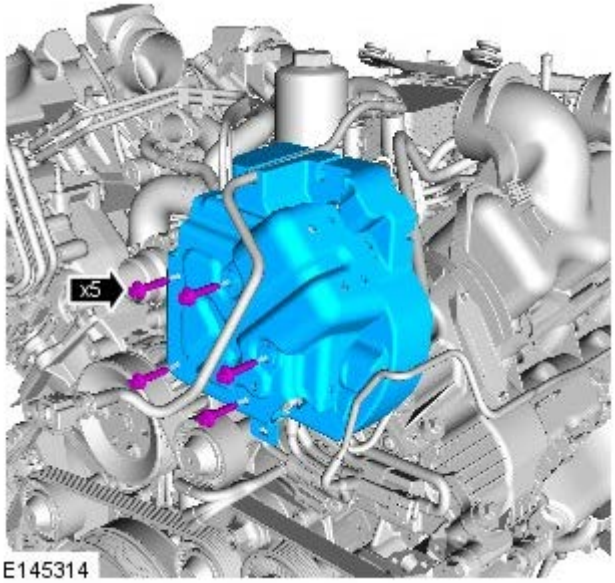
8.



9.

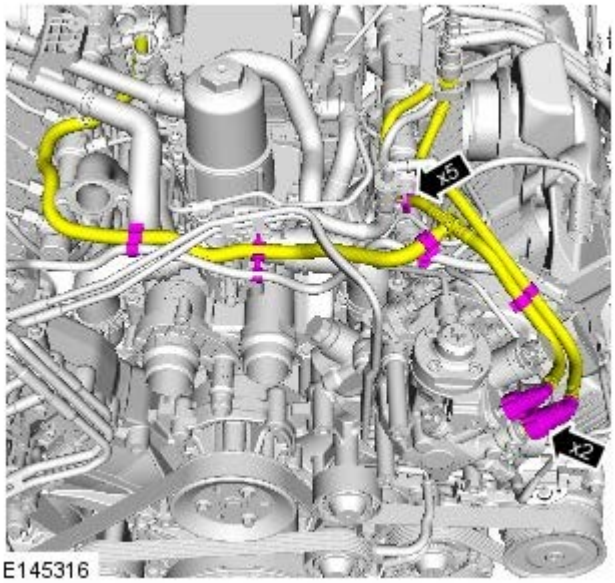


10.

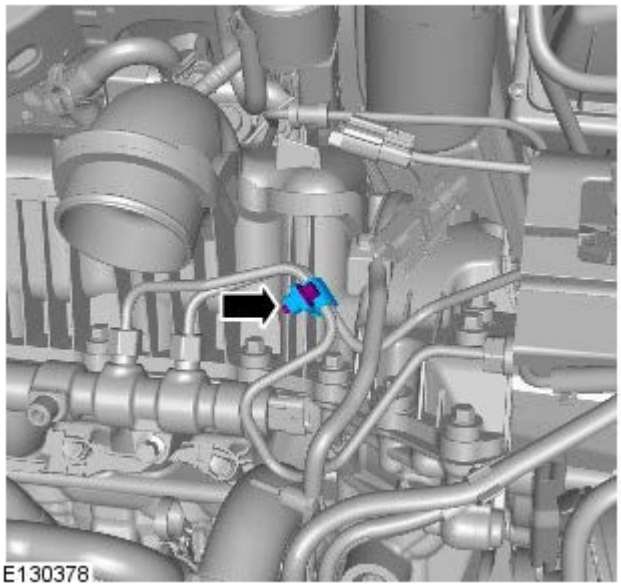


11. Refer to: Fuel Injection Component Cleaning (303-04A Fuel Charging and Controls - TDV6 3.0L Diesel, General Procedures).

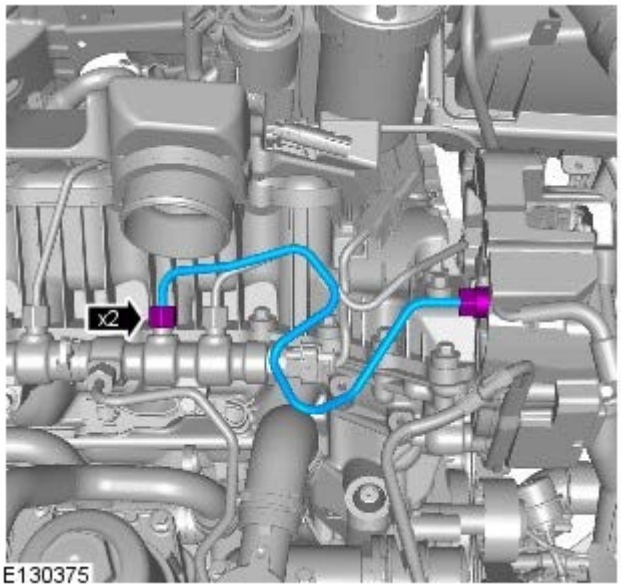
12.



13.

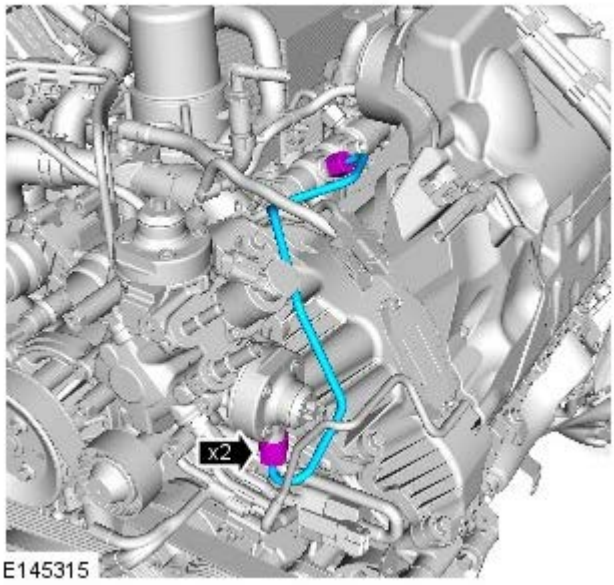

E130378

14. CAUTION: Discard the fuel pipes.



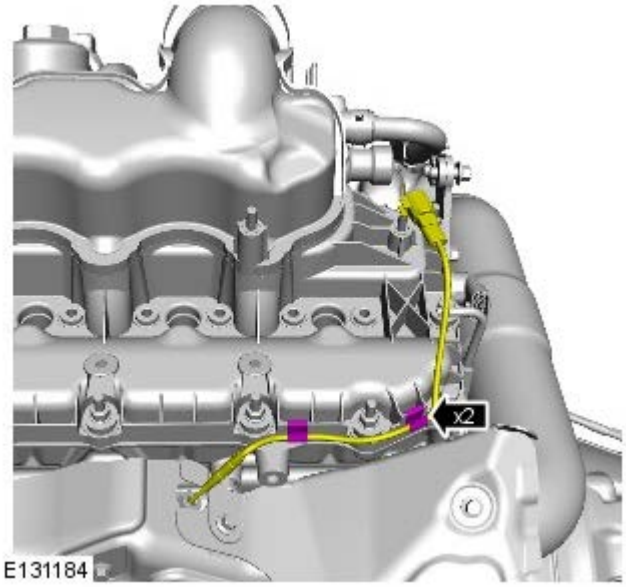
E130375

15. CAUTION: Discard the fuel pipes.

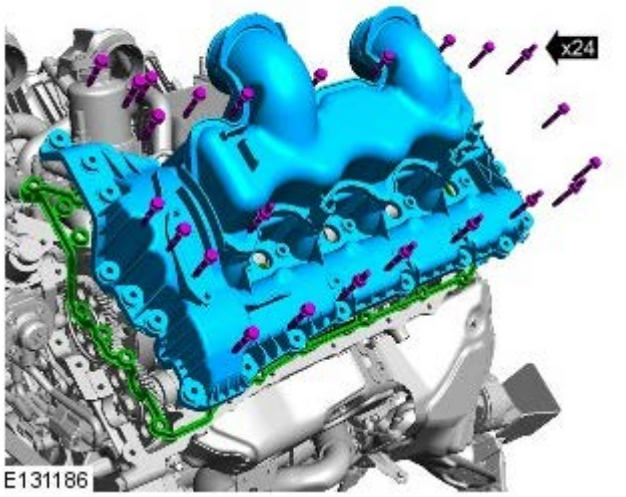


E145315

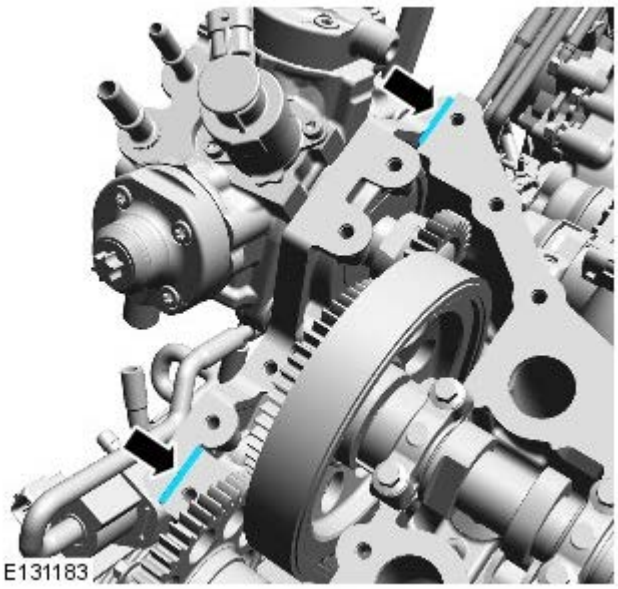
16.



17. NOTE: Make sure that all traces of the old sealant are removed from the mating faces.



Installation



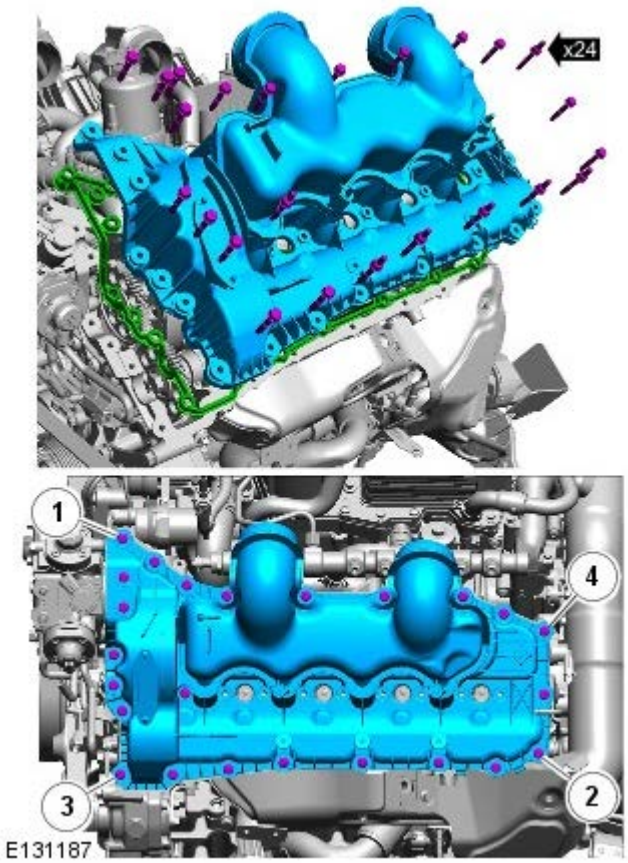
1. CAUTIONS:

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

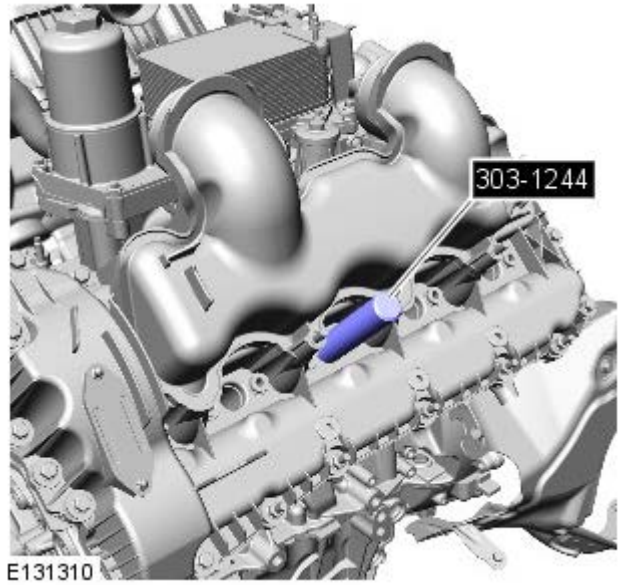
   The component must be installed within 5 minutes and the bolts torqued within 10 minutes of the sealant application.

   Apply RTV sealant in the position shown.

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

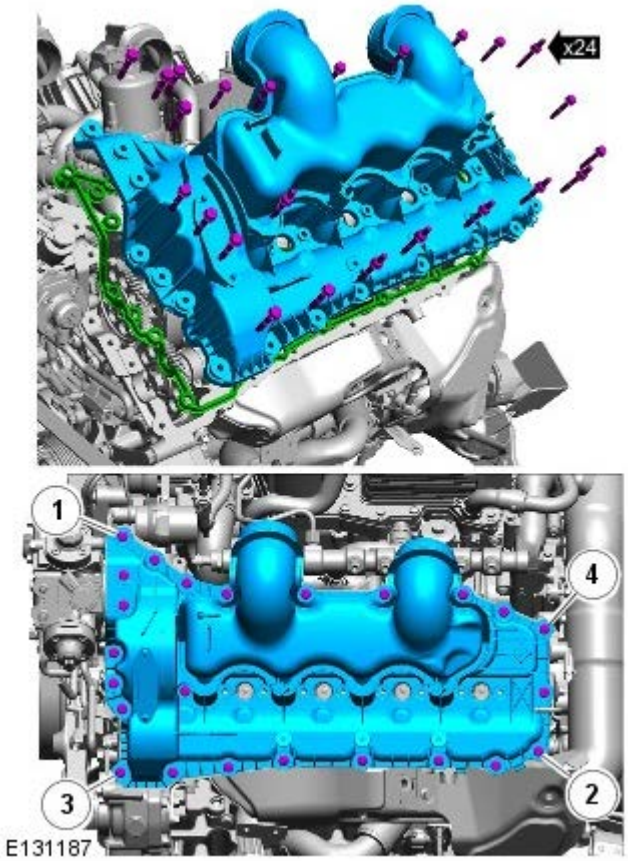


3. *Special Tool(s):* 303-1244



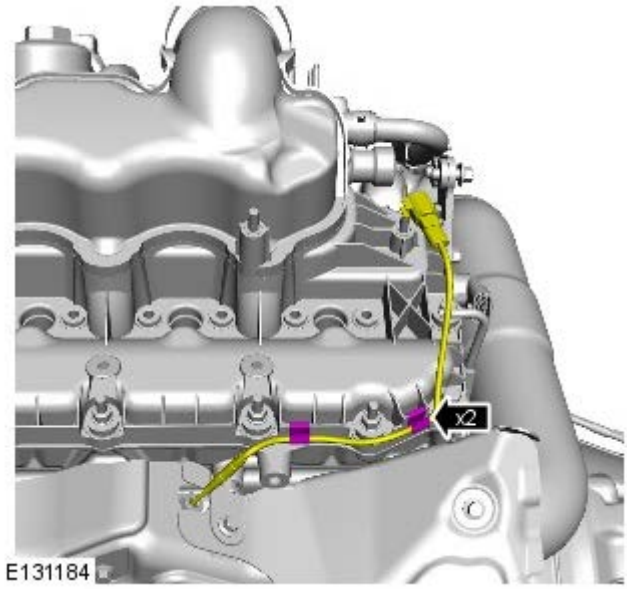
4. CAUTION: Tighten the bolts in the sequence shown.

Torque:
Stage 1: Bolts 1-4 10 Nm
Stage 2: Remaining Bolts 10 Nm



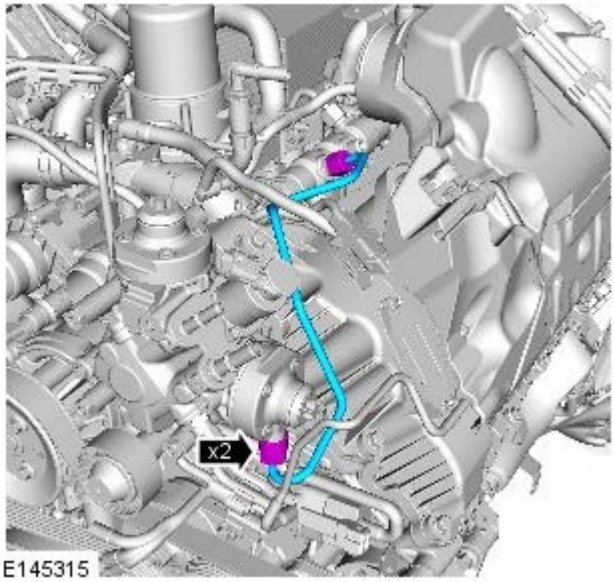
5. Remove the special tools.

6.

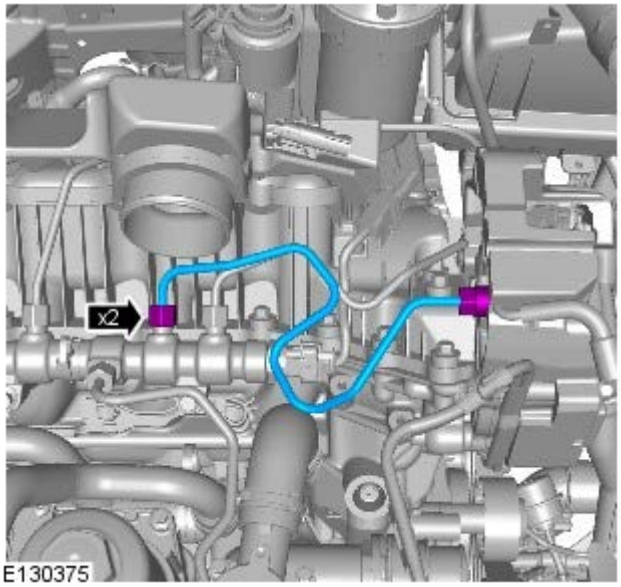


7. CAUTION: Install new fuel pipes.

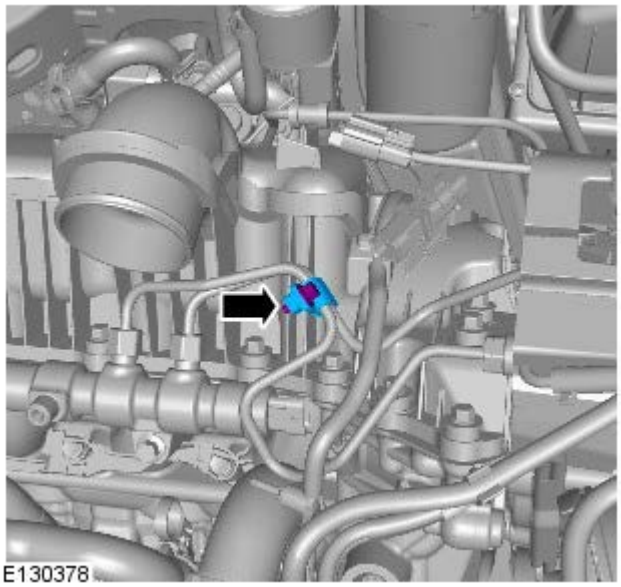
NOTE: Do not tighten at this stage.



E145315



E130375


E130378

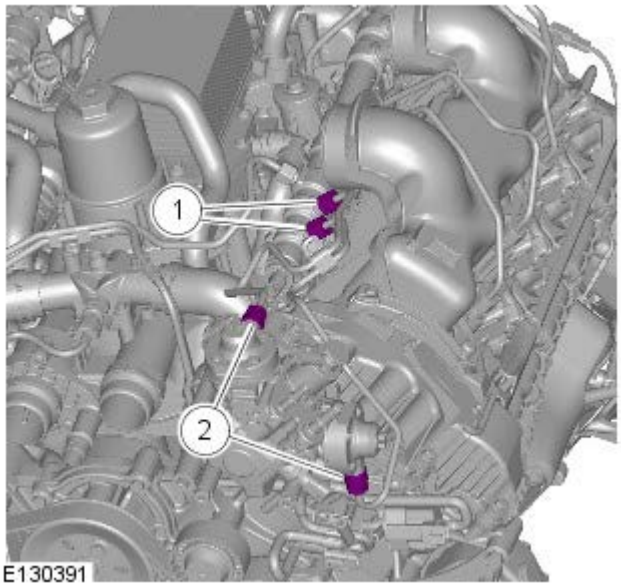
8. CAUTION: Install new fuel pipes.

   NOTE: Do not tighten at this stage.

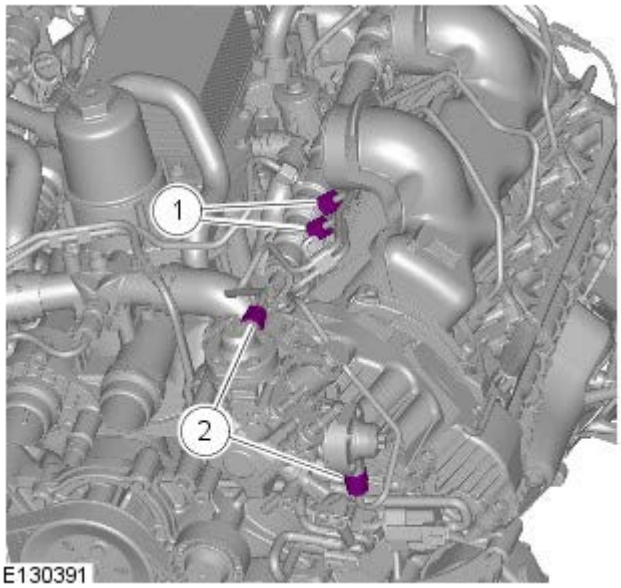
9. NOTE: Do not tighten at this stage.

10. Tighten all.

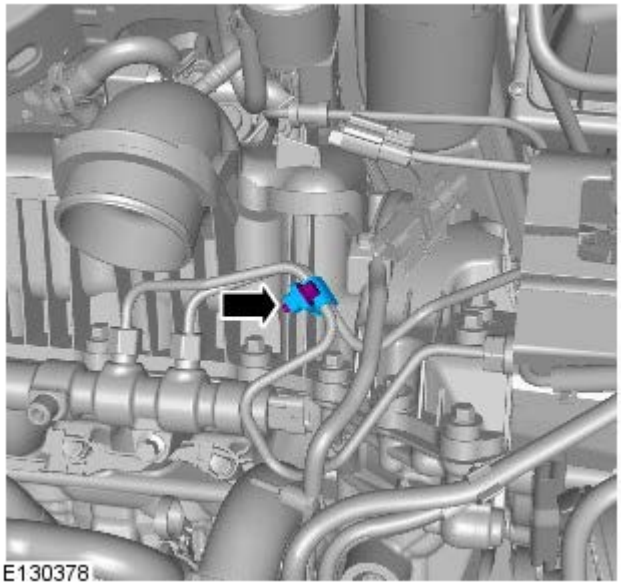
    Torque: 10 Nm



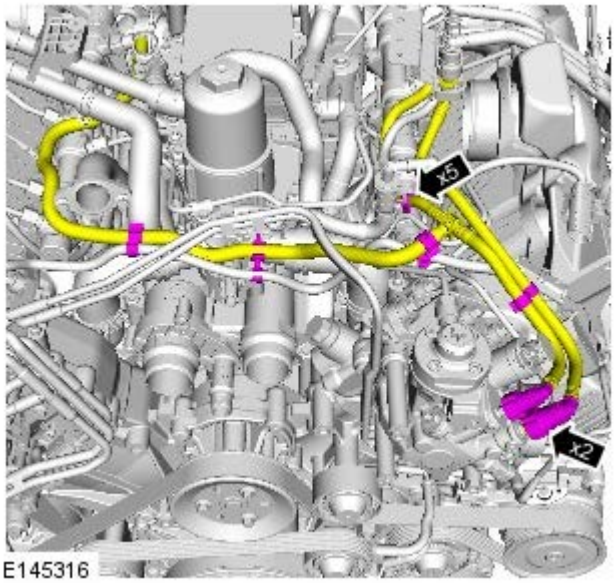
11. *Torque:*
    Stage 1:73°
    Stage 2:80°



12. *Torque:* 10 Nm

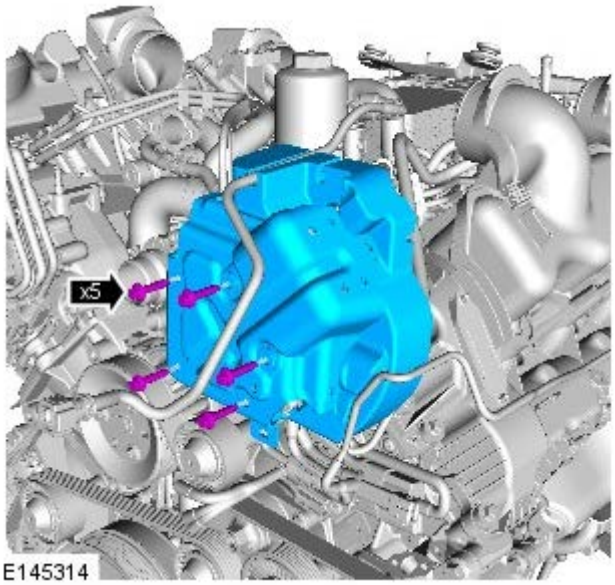


13.



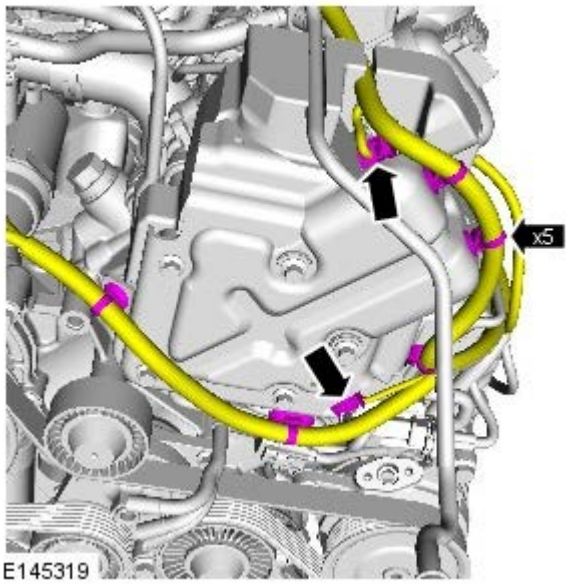
E145316

14. *Torque:* 10 Nm



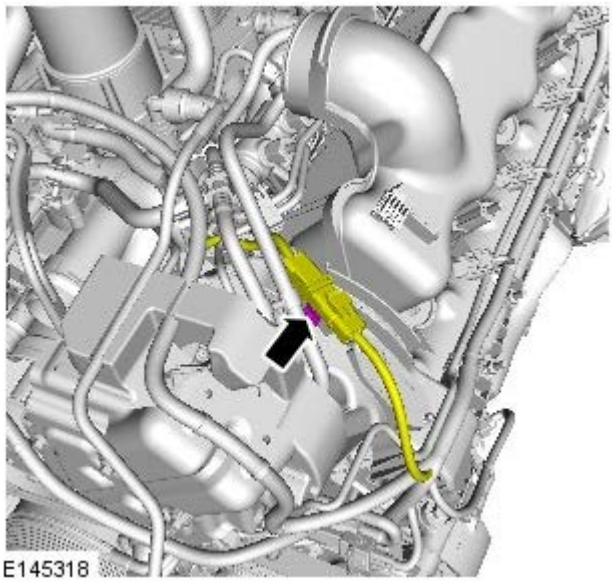
E145314

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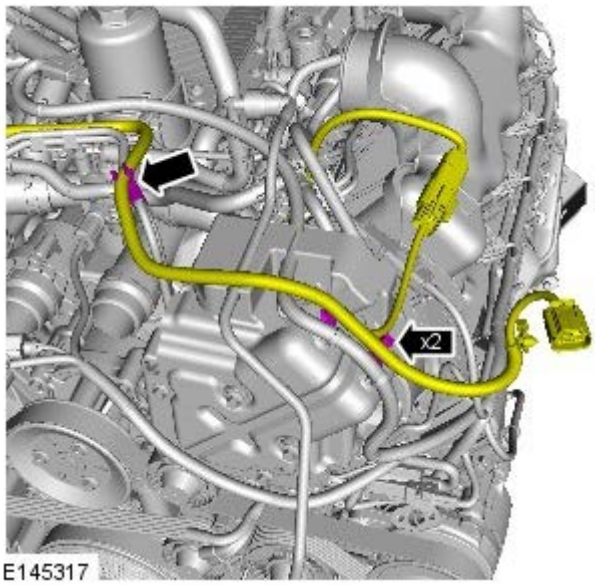


E145319

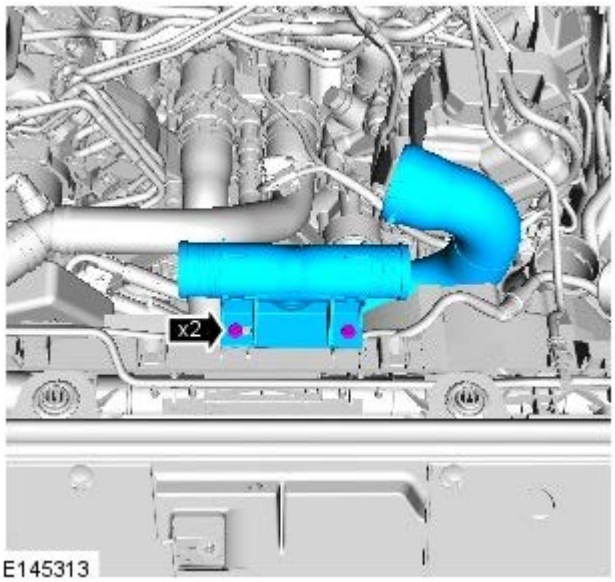
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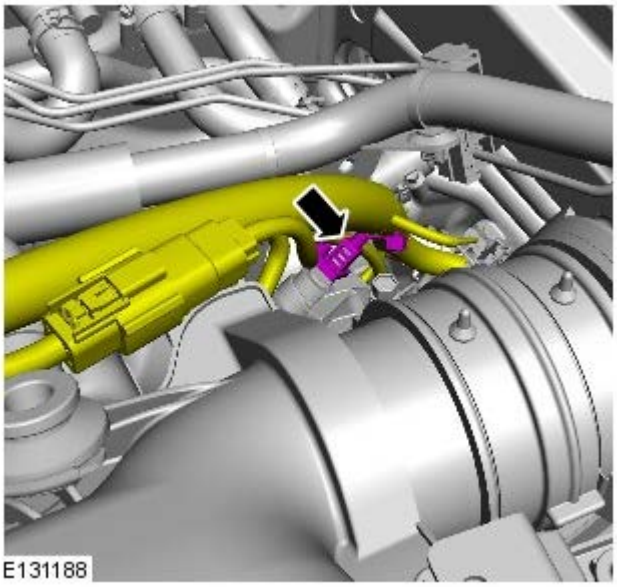
17.



18.



19.



20. Refer to: Fuel Injectors LH (303-04E Fuel Charging and Controls - TDV8 4.4L Diesel, Removal and Installation).

21. Refer to: Intake Manifold Plenum Chamber (303-01D Engine - TDV8 4.4L Diesel, Removal and Installation).

22. Connect the battery ground cable.

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

Published: 29-Oct-2013

Engine - TDV8 4.4L Diesel - Valve Cover RH

Removal and Installation

Special Tool(s)

	303-1244 Alignment Tool, Valve Cover

Removal

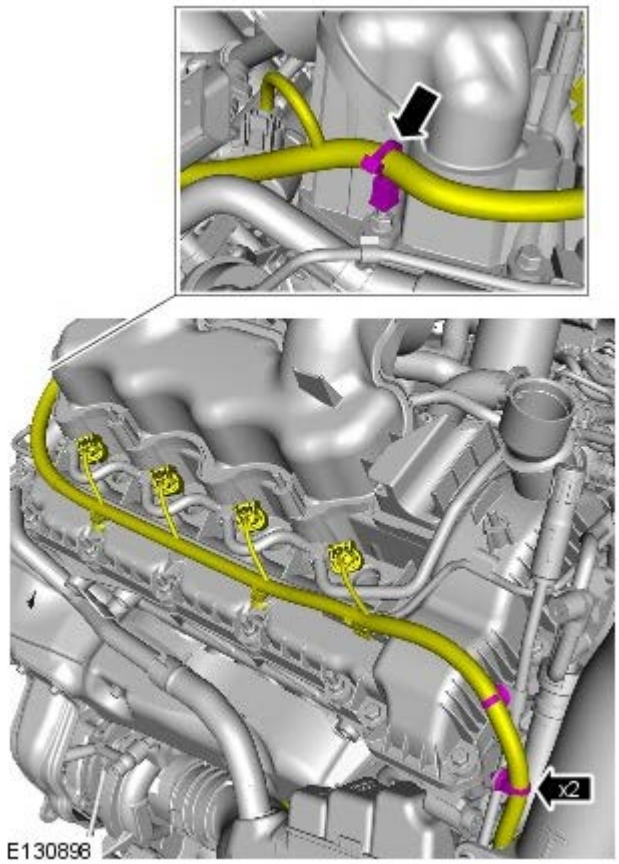
NOTES:

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

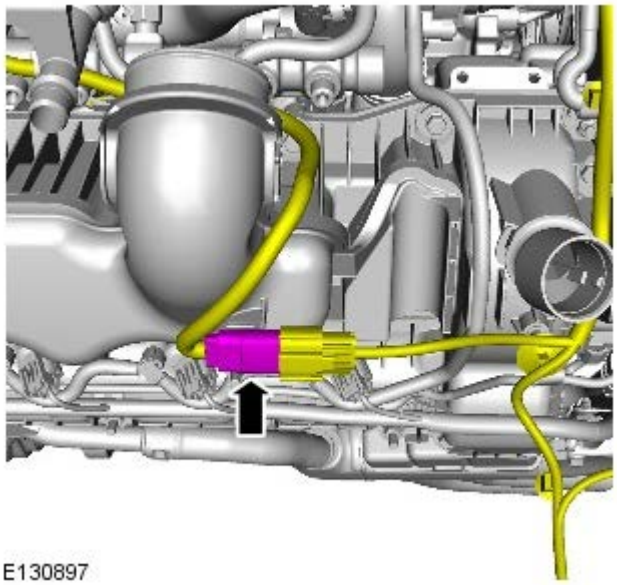
Removal steps in this procedure may contain installation details.

Engine shown removed for clarity.

1. Refer to: Diesel Fuel System Health and Safety Precautions (100-00 General Information, Description and Operation).
2. Disconnect the battery ground cable.

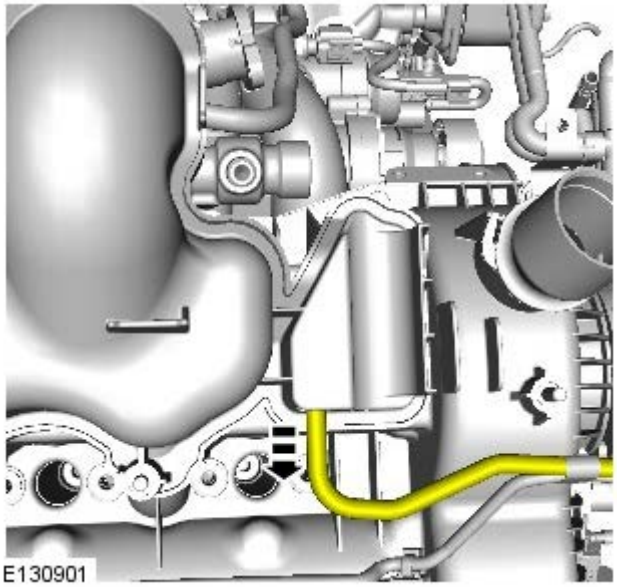
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).
3. Refer to: Fuel Injectors RH (303-04E Fuel Charging and Controls - TDV8 4.4L Diesel, Removal and Installation).
4. 

5.



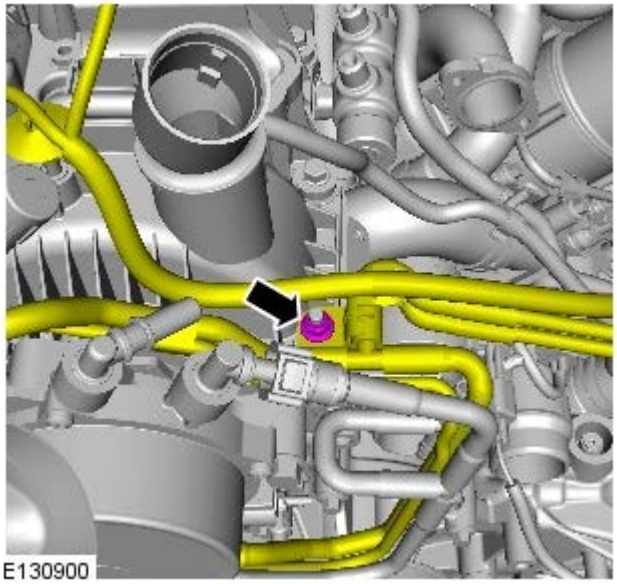
E130897

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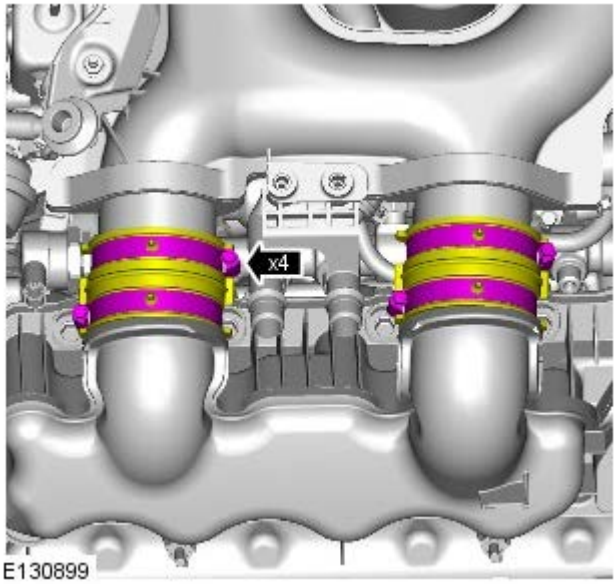
E130901

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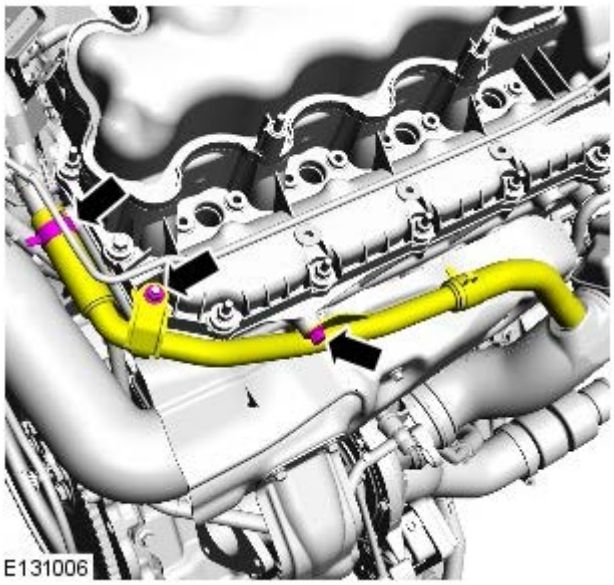


E130900

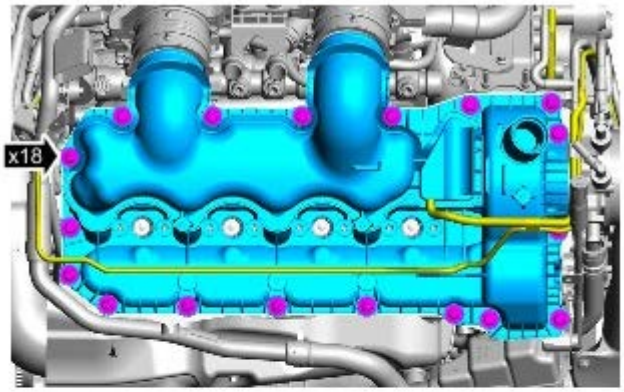
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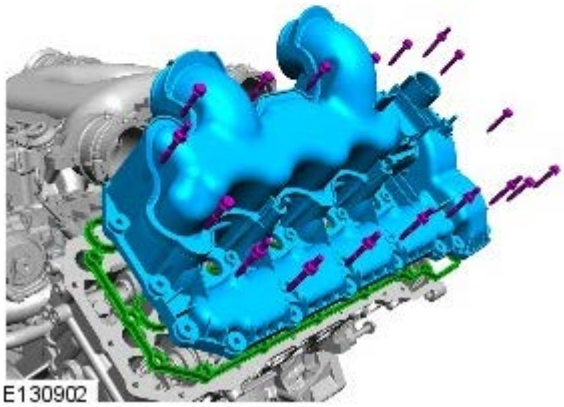


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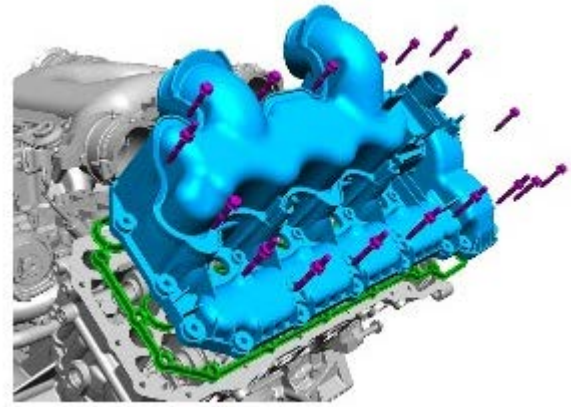


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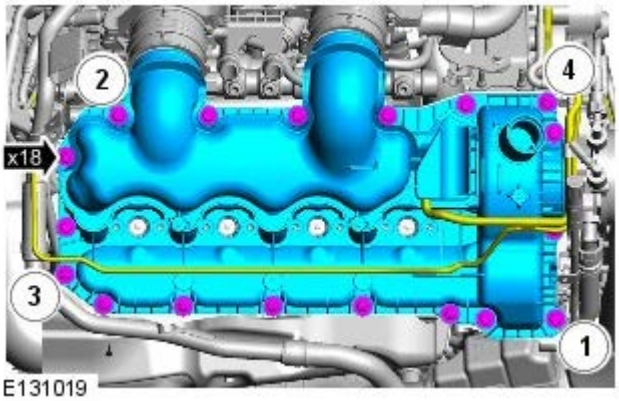




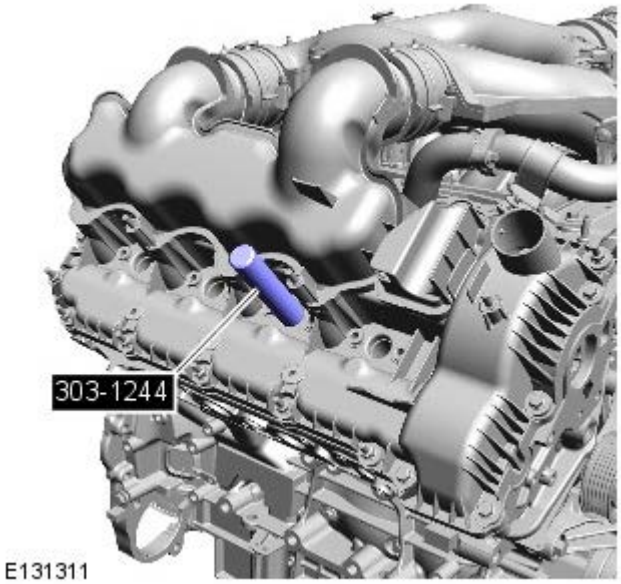
Installation

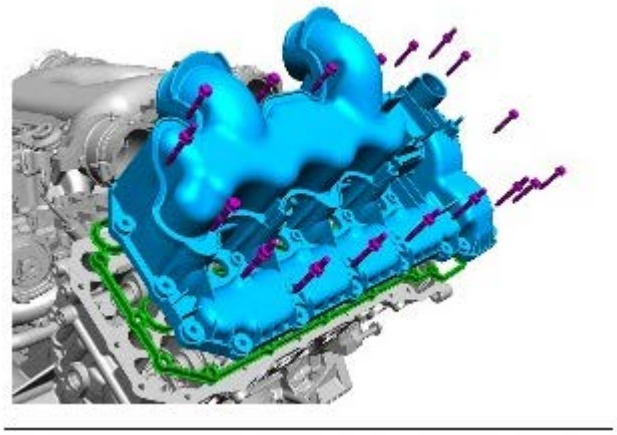


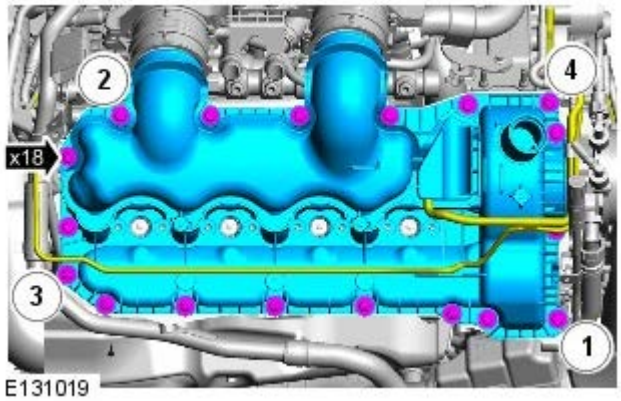
1. CAUTION: Only tighten the bolts finger-tight at this stage.



2. *Special Tool(s):* 303-1244







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

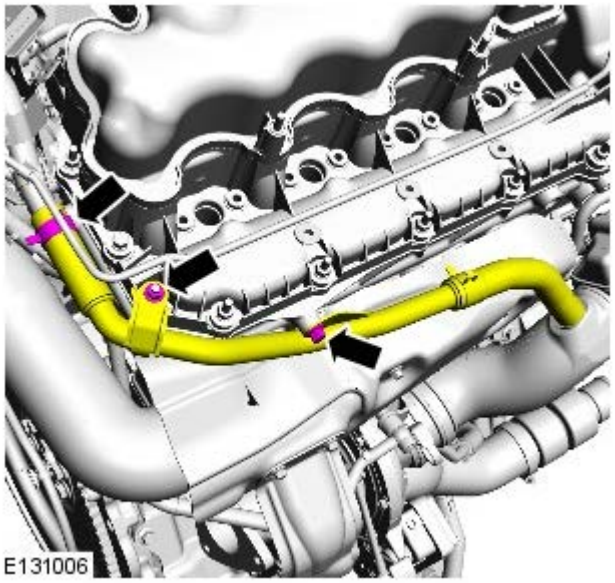
Torque:

Stage 1: Bolts 1-4 10 Nm

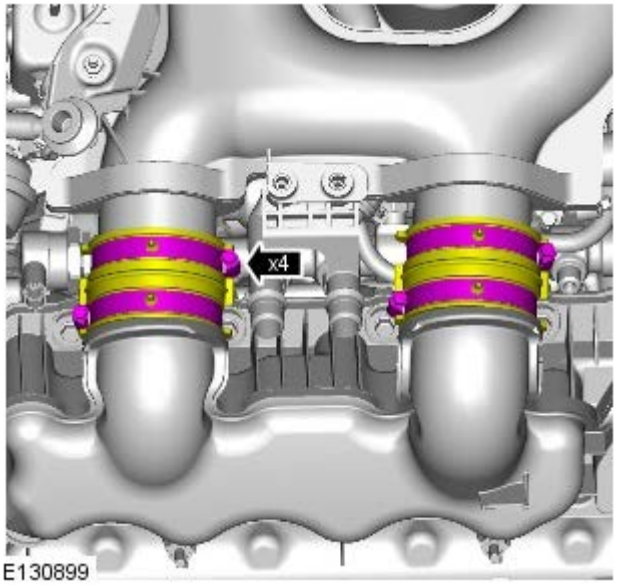
Stage 2: Remaining Bolts 10 Nm

4. Remove the special tool.

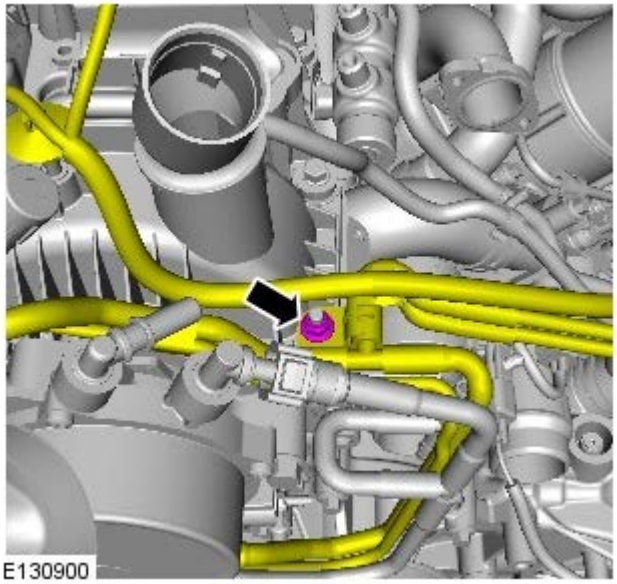
5. *Torque:* 10 Nm



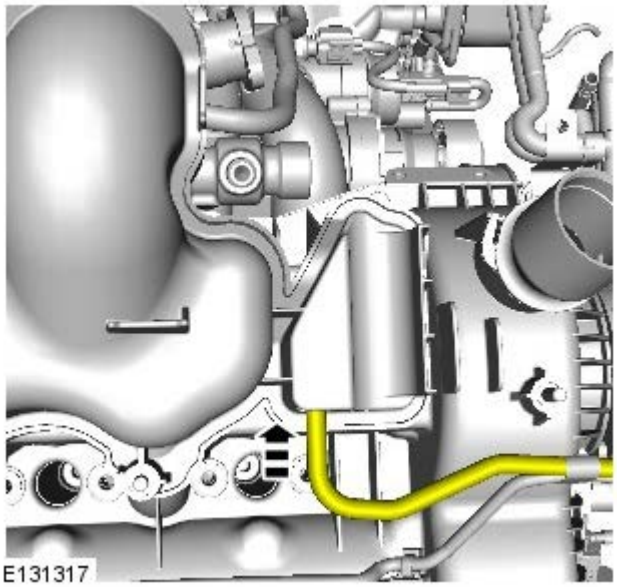
6. *Torque:* 7 Nm



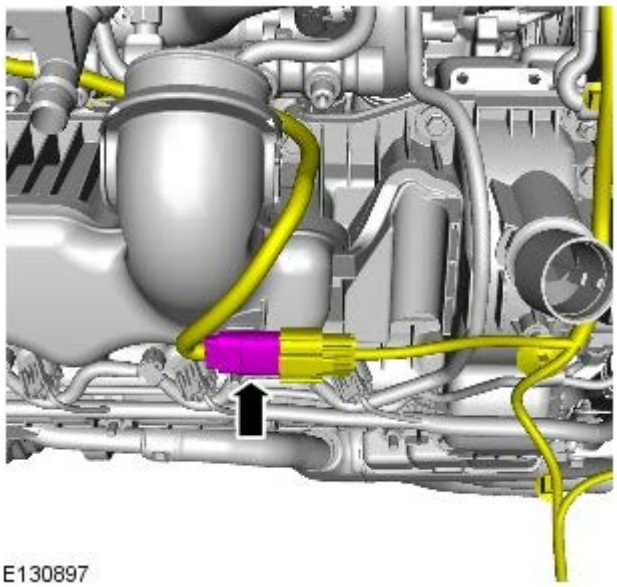
7. *Torque:* 10 Nm



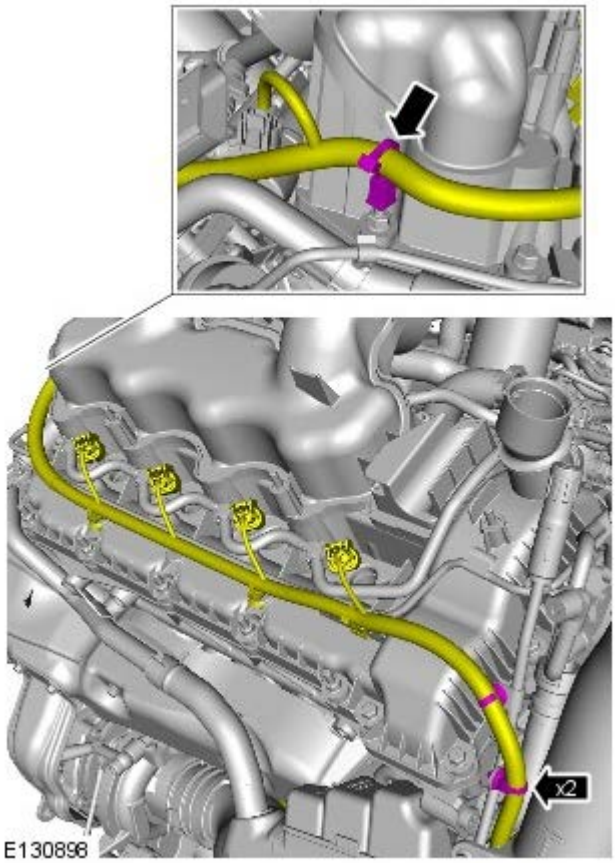
8.



9.



10.



11. Refer to: Fuel Injectors RH (303-04E Fuel Charging and Controls - TDV8 4.4L Diesel, Removal and Installation).

12. Connect the battery ground cable.

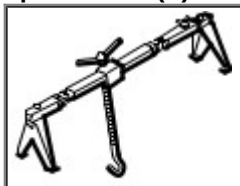
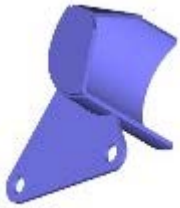
    Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 12-Nov-2013

Engine - TDV8 4.4L Diesel - Engine

Removal

Special Tool(s)

 303-021	303-021 Engine support bracket
 E131596	JLR-303-1569 Lifting Bracket, Engine
 E131594	JLR-303-1570 Lifting Bracket, Engine
 E131595	JLR-303-1572 Lifting Bracket, Engine
 E131593	JLR-303-1574 Protector, Turbocharger Actuator

NOTES:

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

Removal steps in this procedure may contain installation details.

Some components shown removed for clarity.

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.

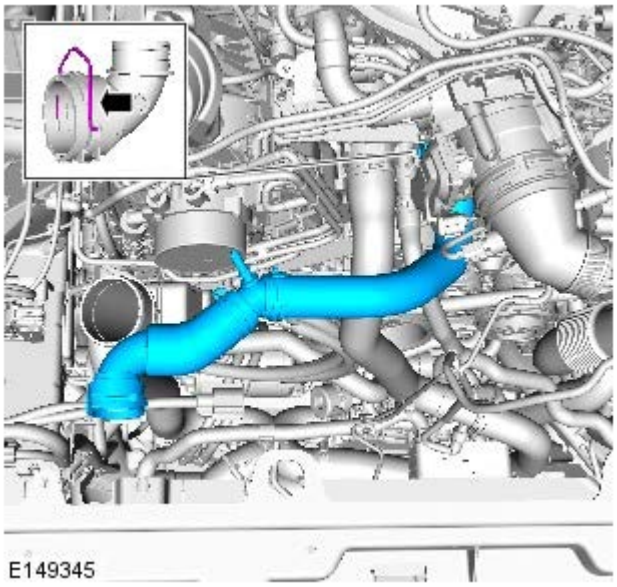
   Raise and support the vehicle.

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

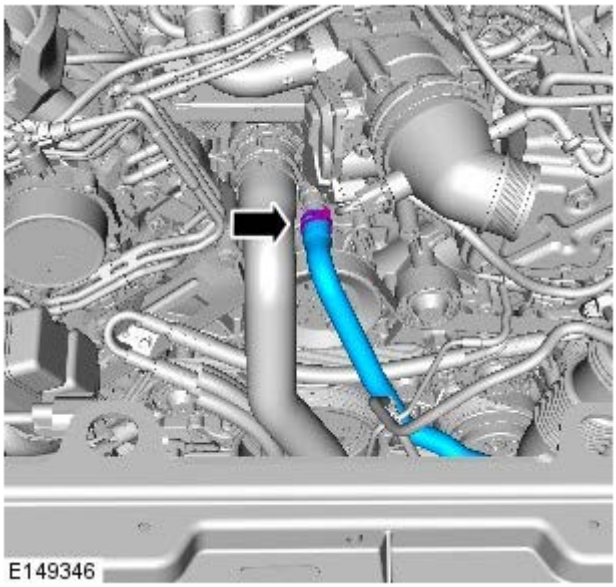
4. Refer to: Secondary Bulkhead Center Panel - TDV8 4.4L Diesel (501-02, Removal and Installation).

5. Refer to: Radiator (303-03F Engine Cooling - TDV8 4.4L Diesel, Removal and Installation).

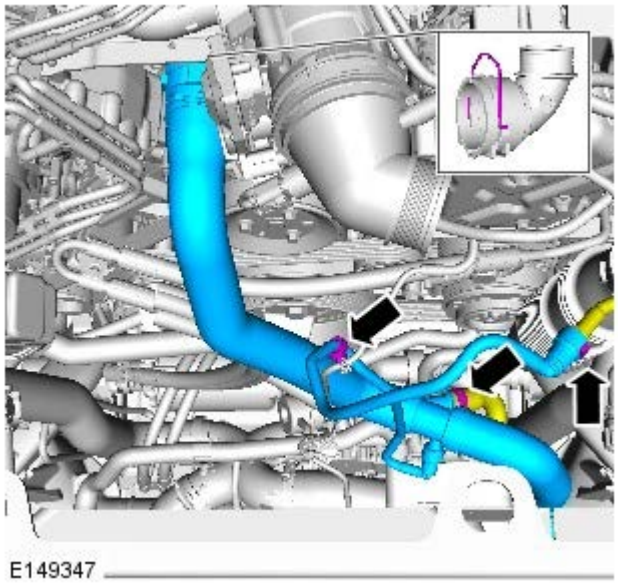
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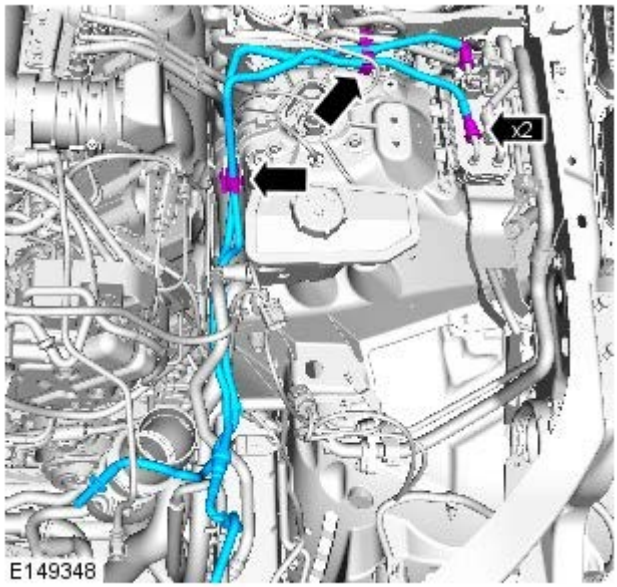
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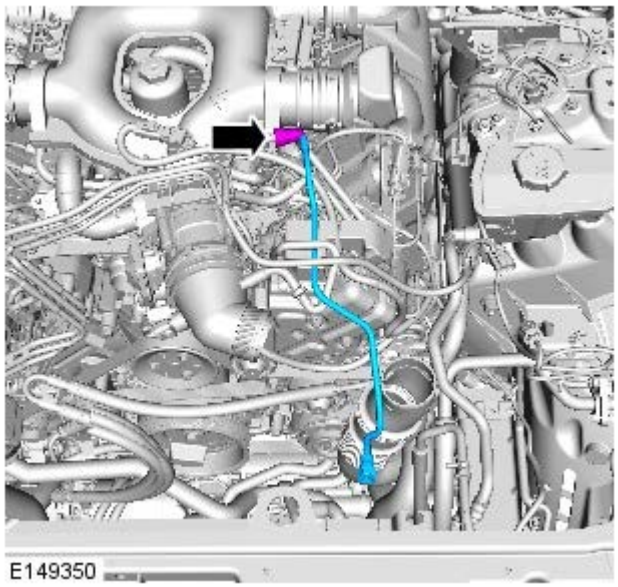
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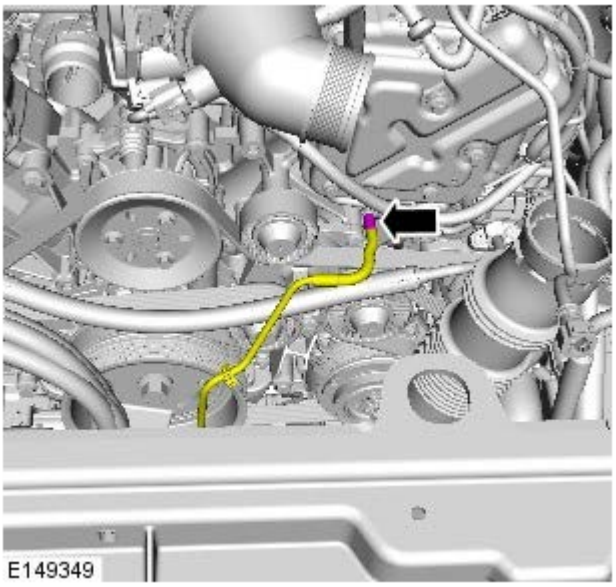
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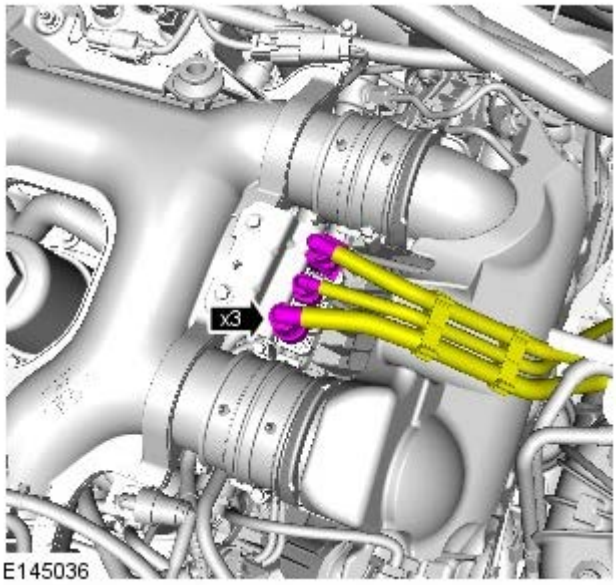


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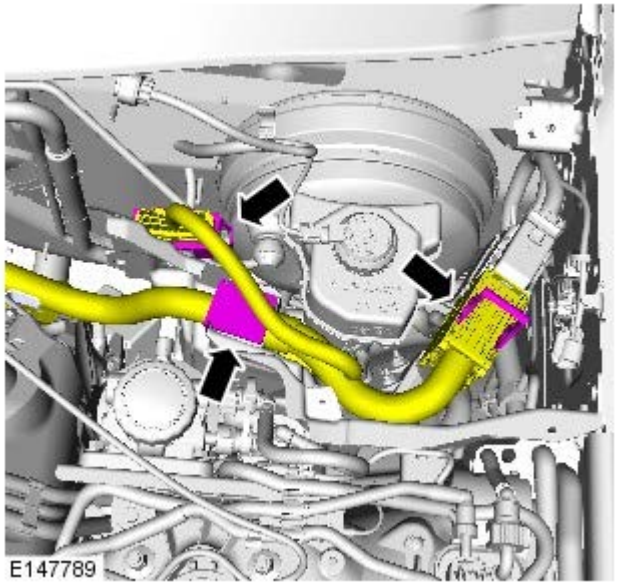


12. Refer to: Diesel Fuel System Health and Safety Precautions (100-00 General Information, Description and Operation).

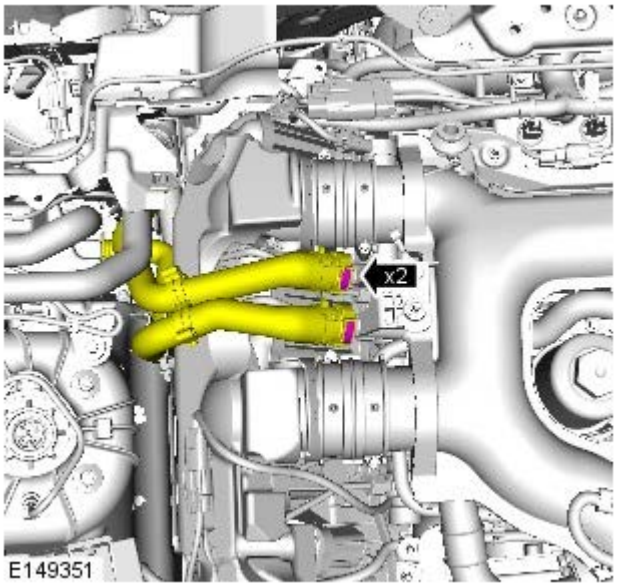
13.



14. NOTE: LHD illustration shown, RHD is similar.



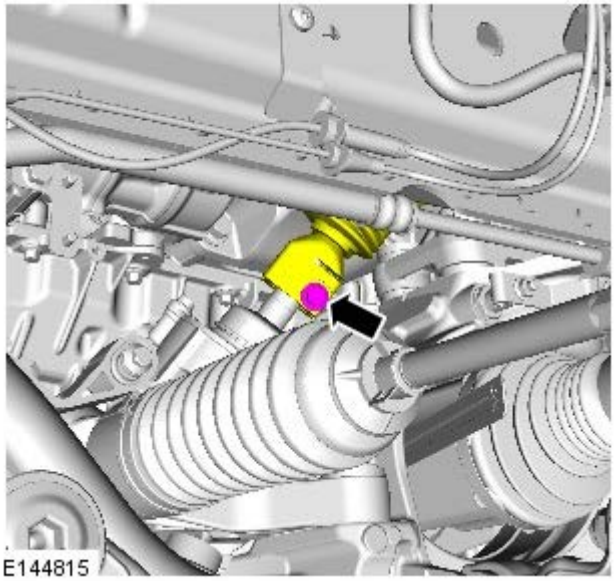
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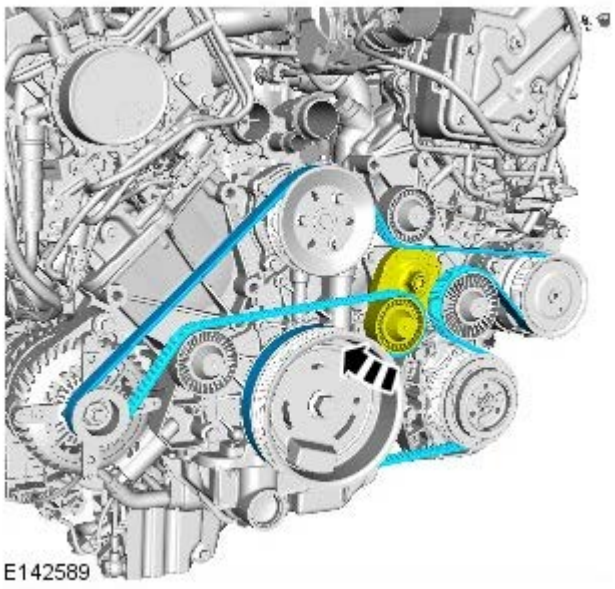
16. CAUTION: Discard the bolt.

NOTE: LHD illustration shown, RHD is similar.

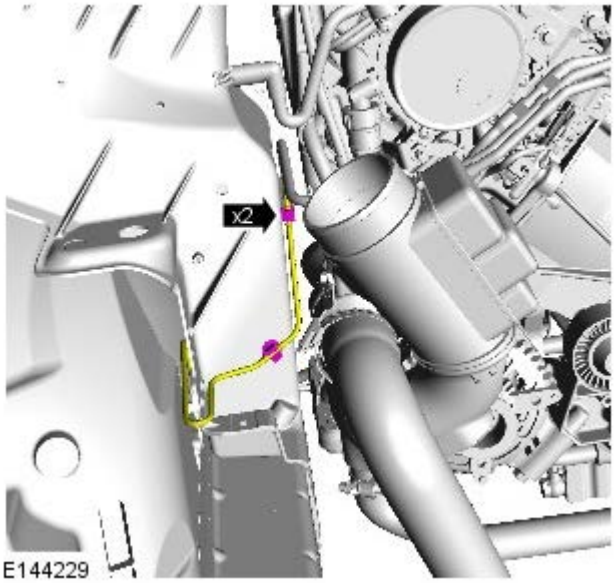
Align the steering wheel to straight ahead.



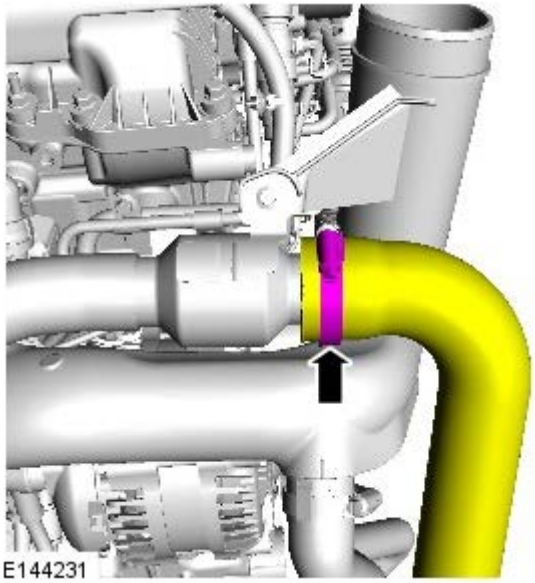
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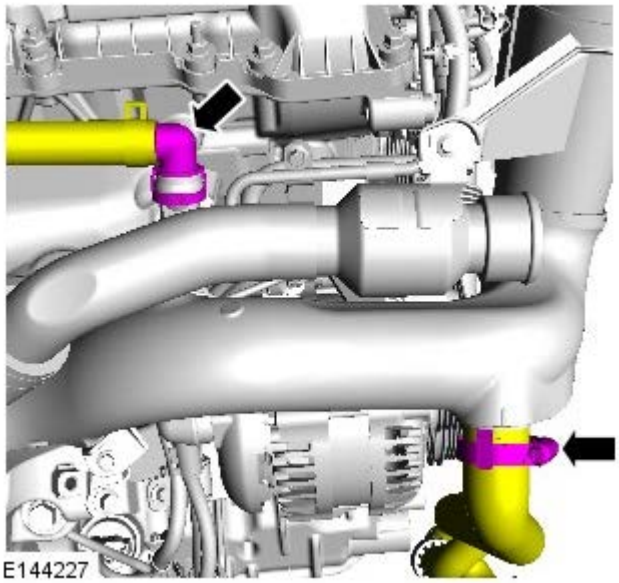
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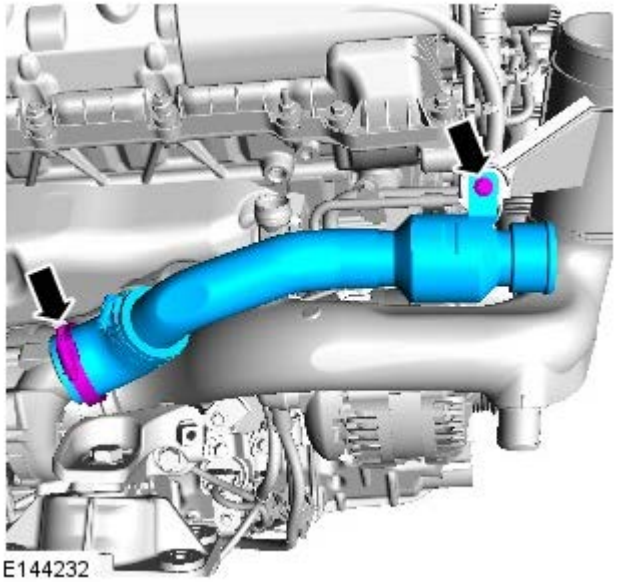
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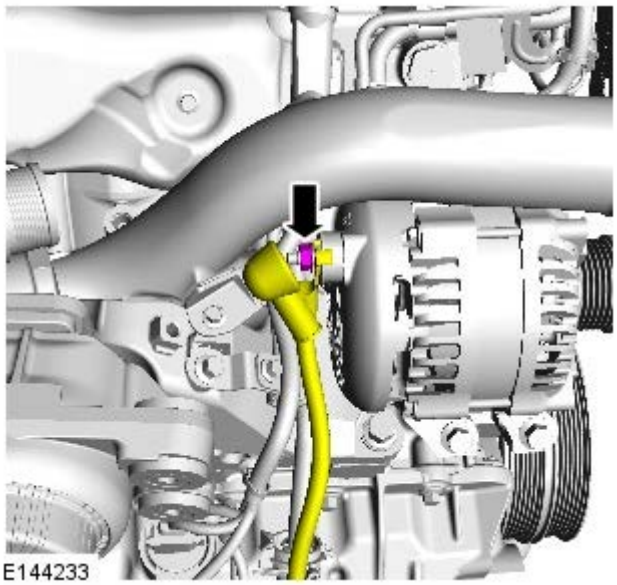
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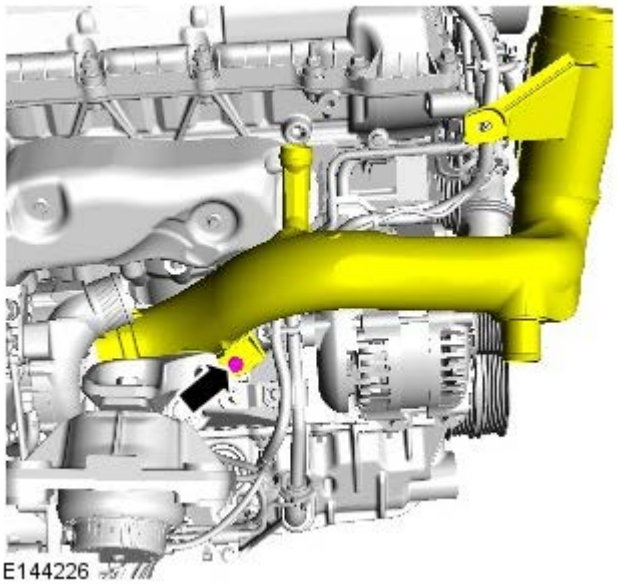
21.


E144232

22. CAUTION: Take extra care when removing the battery cable from the generator.


E144233

23. NOTE: The component cannot be removed at this stage.


E144226

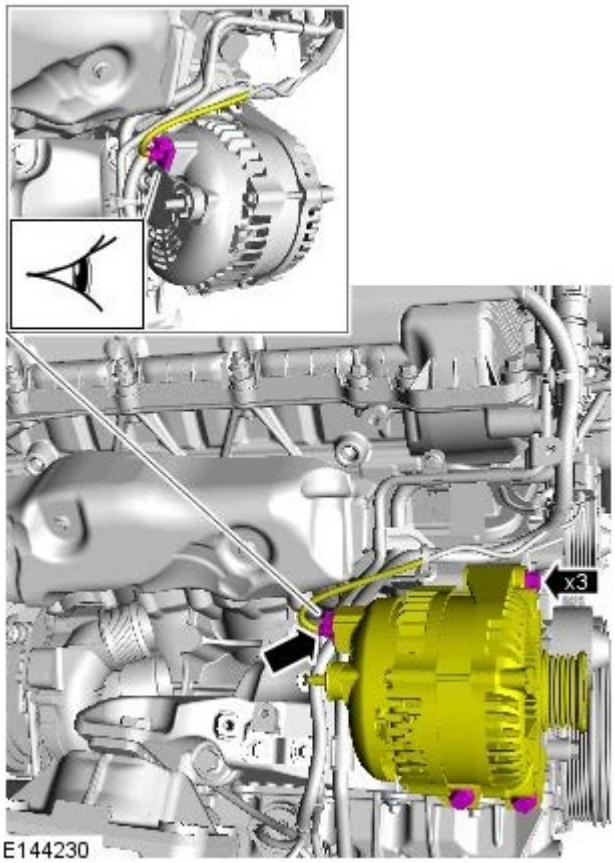
24. CAUTIONS:

Take extra care not to damage the battery cable terminal when removing the wiring harness or generator. Make sure that the terminal is not bent or

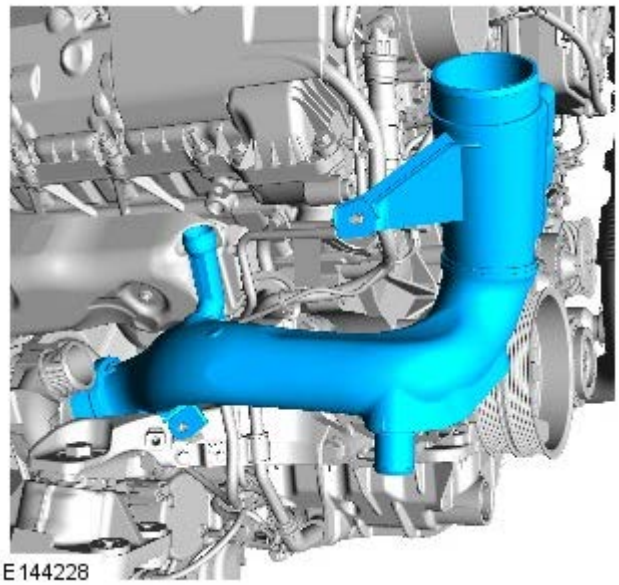
split.

Support the generator prior to disconencting the electrical connectors.

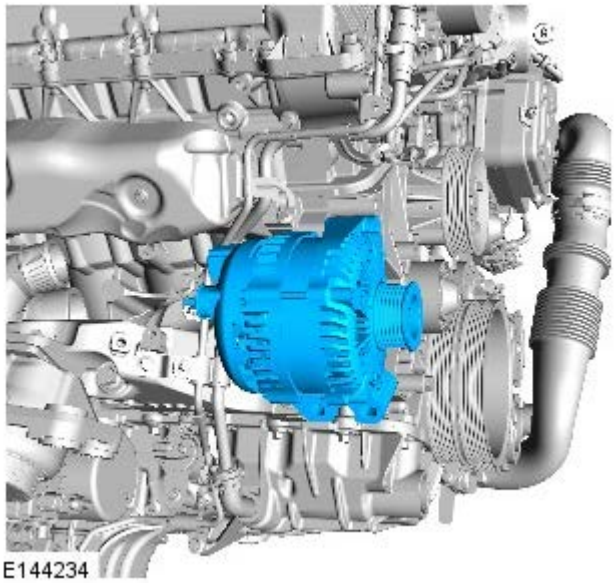
NOTE: The component cannot be removed at this stage.



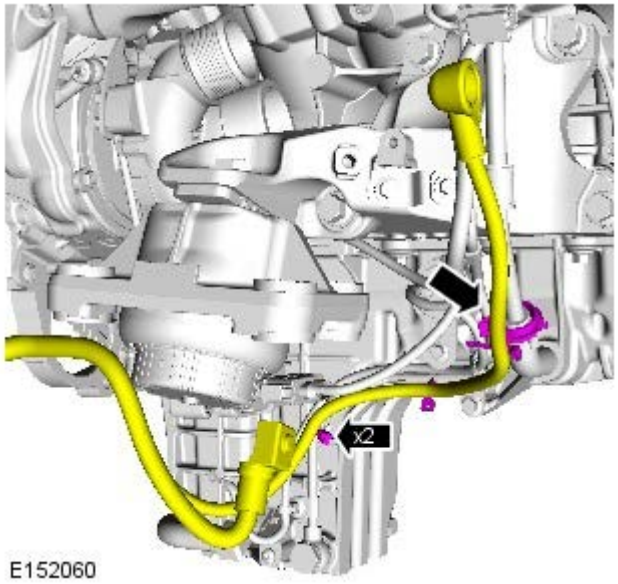
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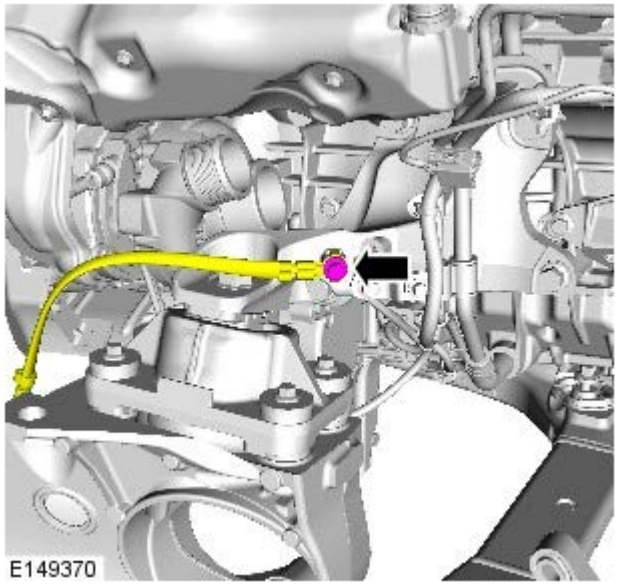

E144234

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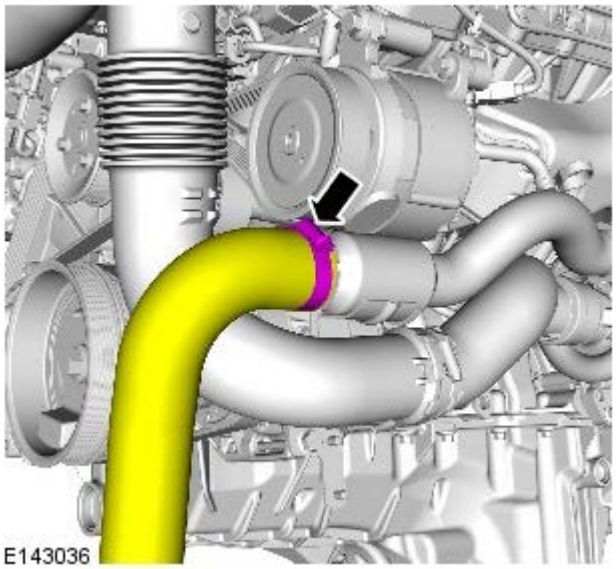


E152060

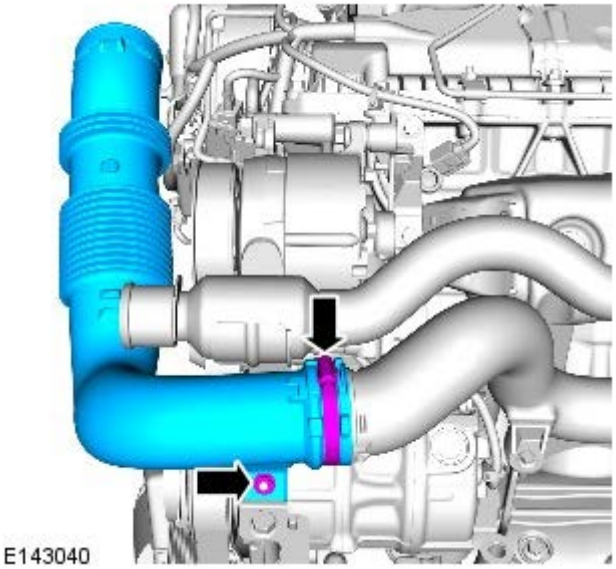
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E149370

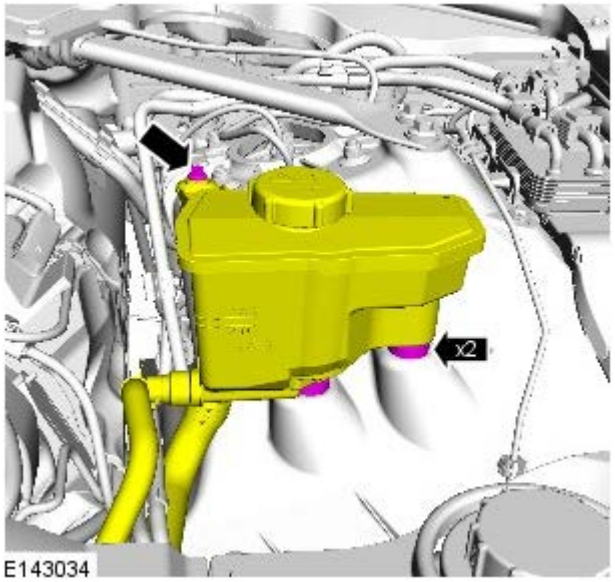
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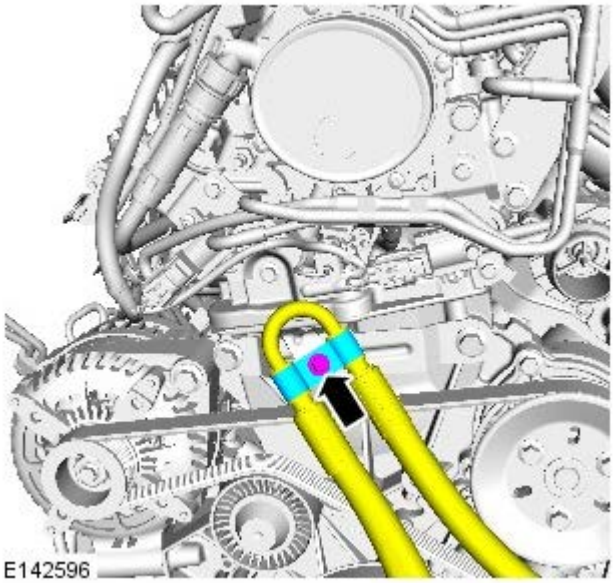
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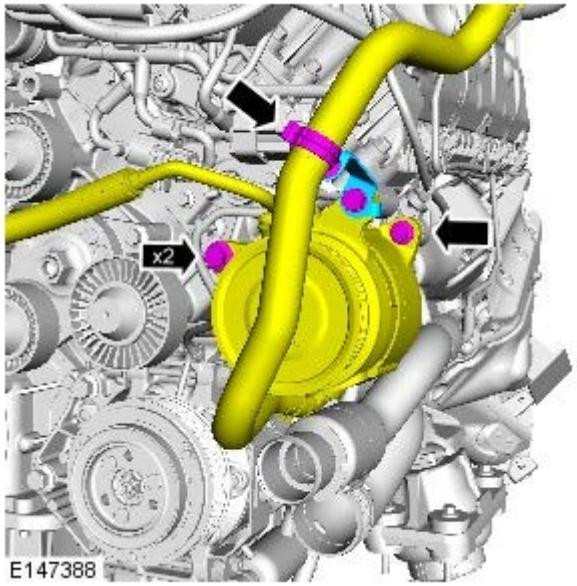
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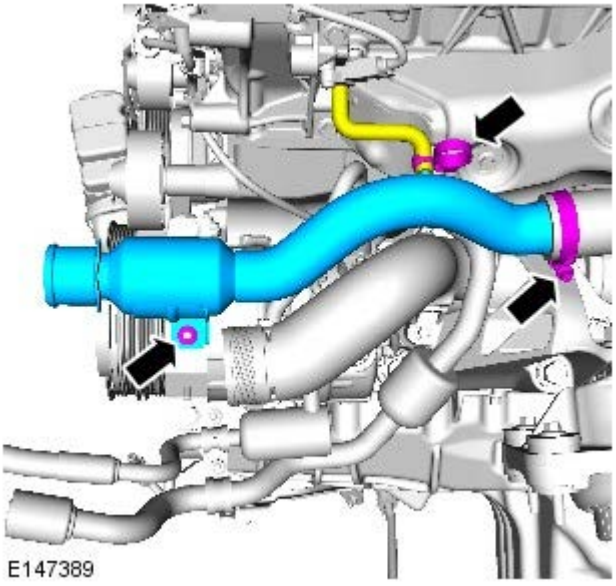
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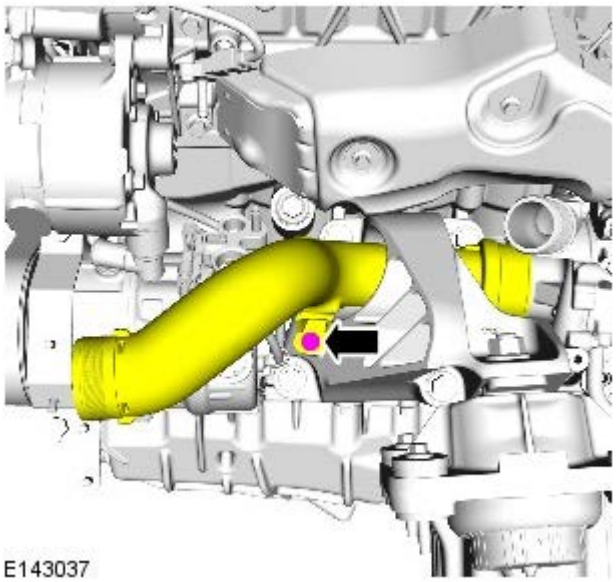
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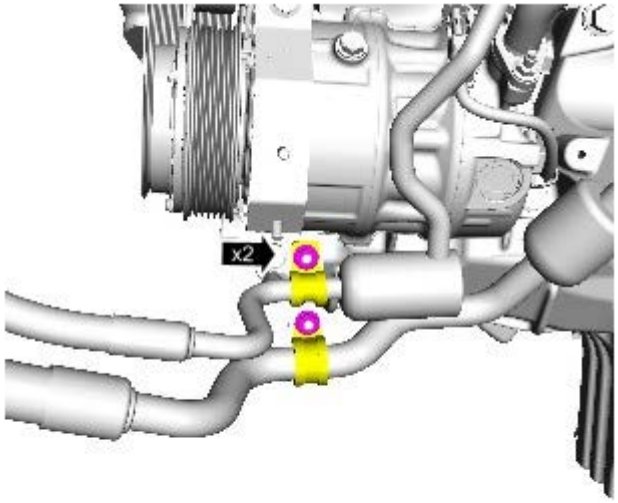


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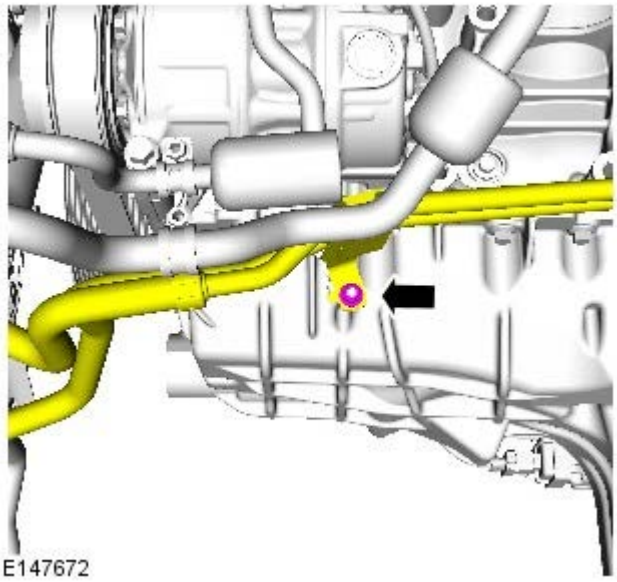
E143037

36.



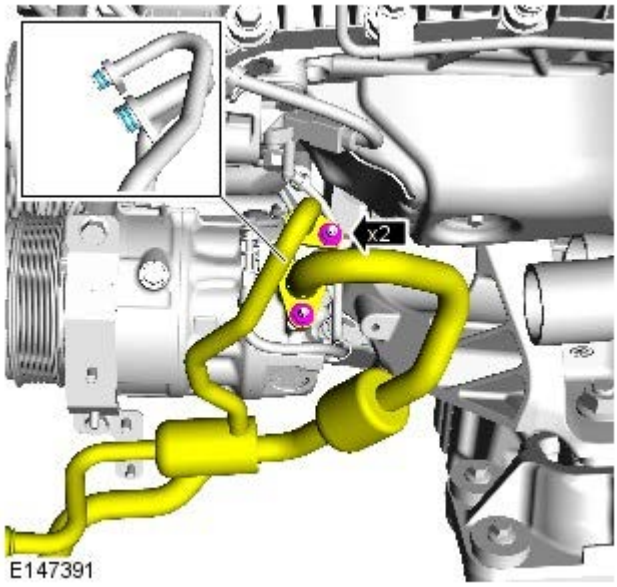
E147390

37.



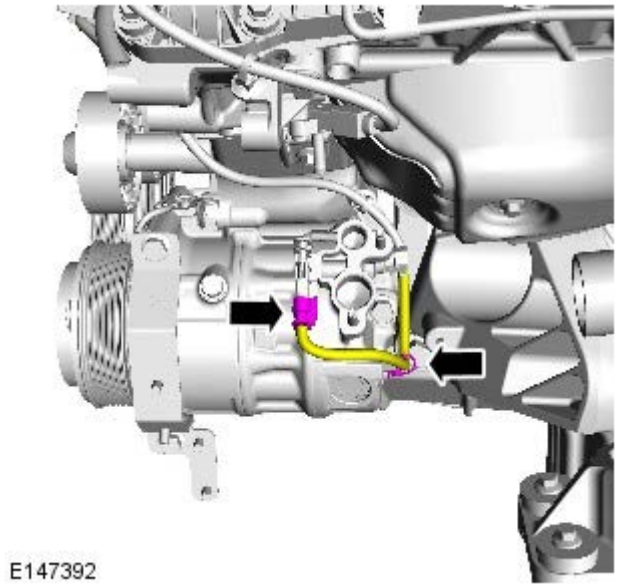
E147672

38. CAUTION: Remove and discard the O-ring seals.

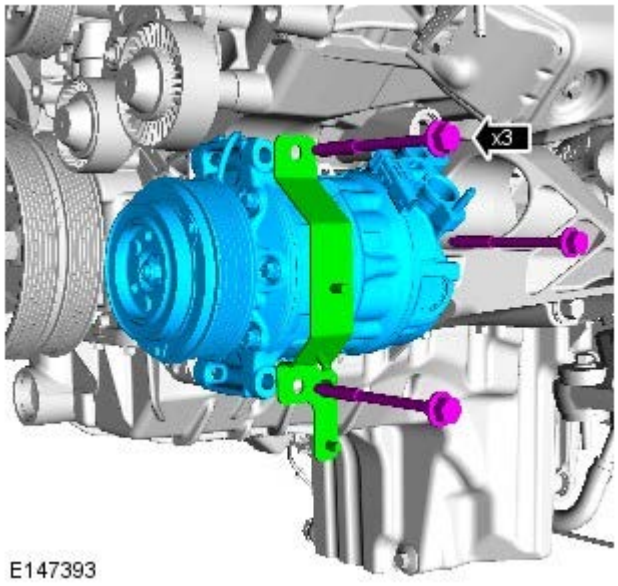


E147391

39.

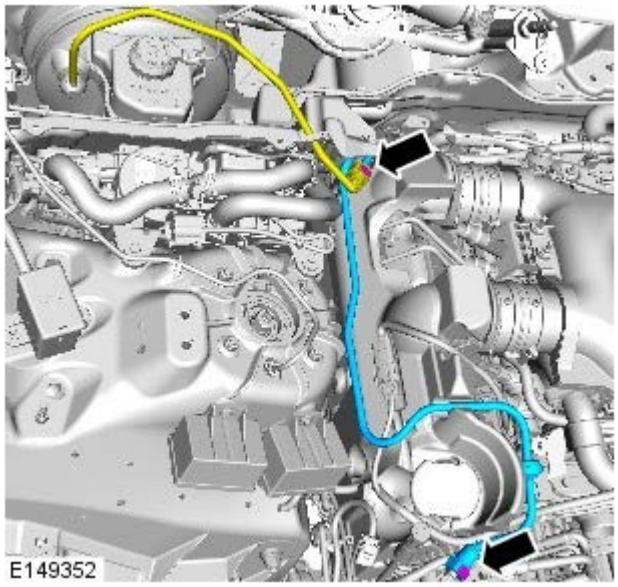

E147392

40.

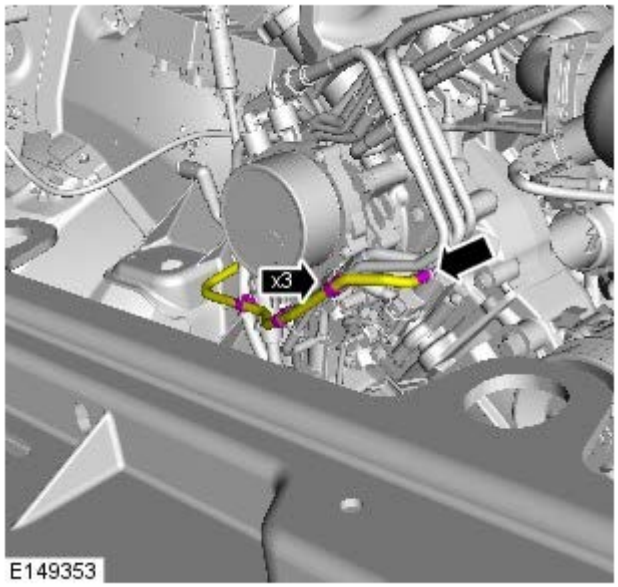


E147393

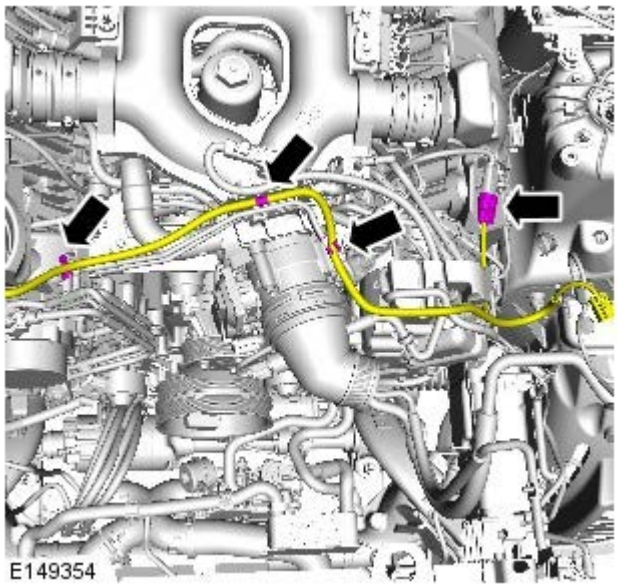
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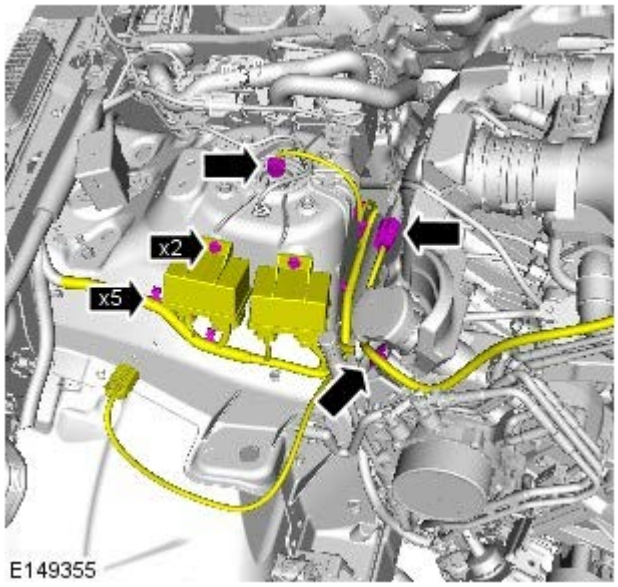
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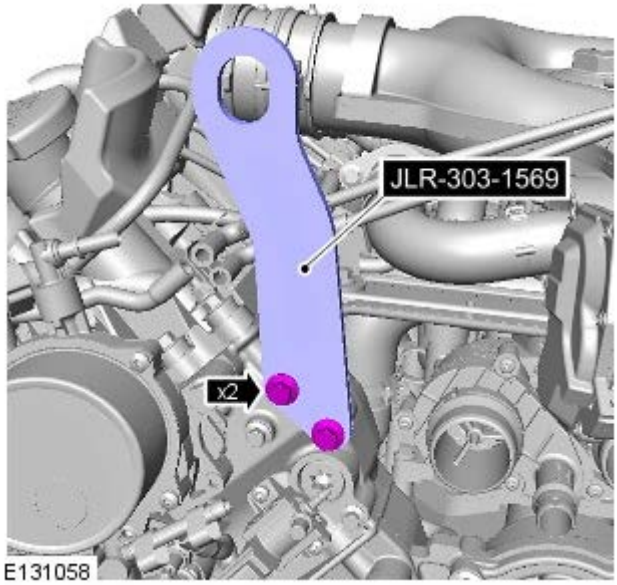
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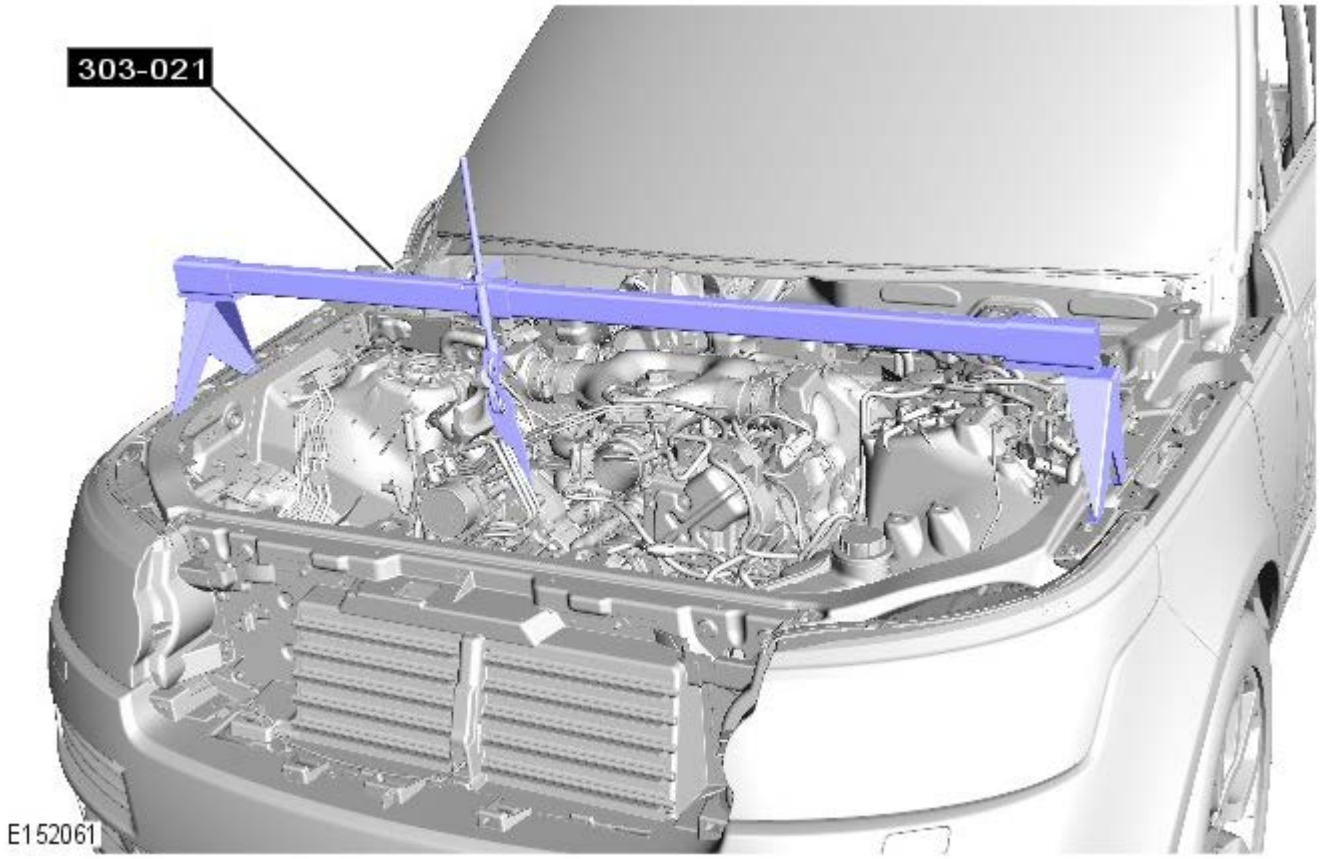
44.



45. *Special Tool(s):* JLR-303-1569
Torque: 40 Nm



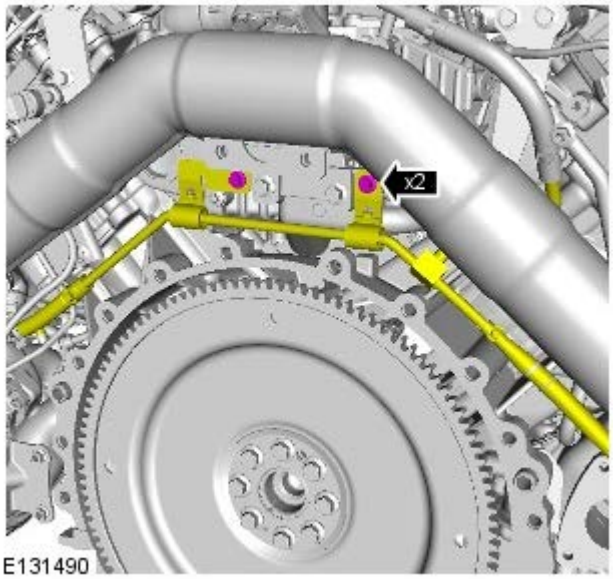
46. *Special Tool(s):* 303-021



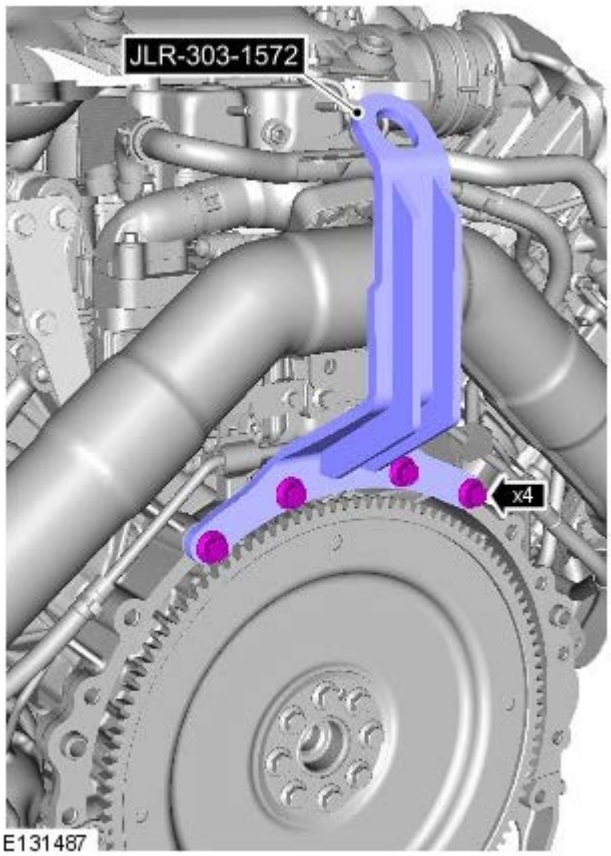
47. Refer to: Differential Case (205-03 Front Drive Axle/Differential, Removal and Installation).

48. Refer to: Transmission - TDV8 4.4L Diesel (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, Removal).

49.

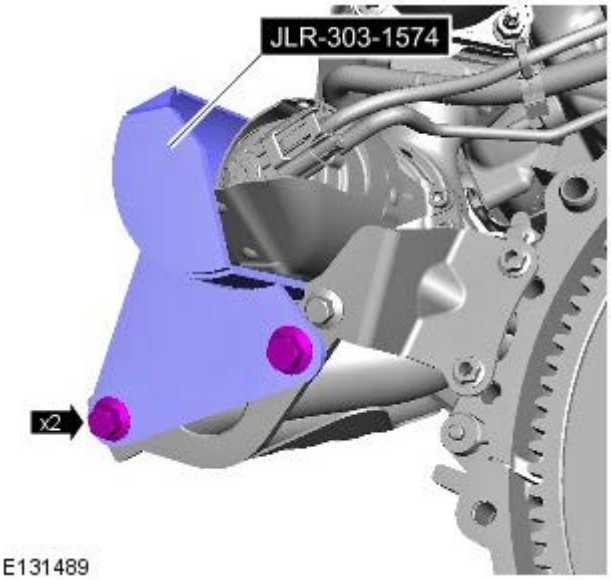


50. *Special Tool(s):* JLR-303-1572
Torque: 40 Nm



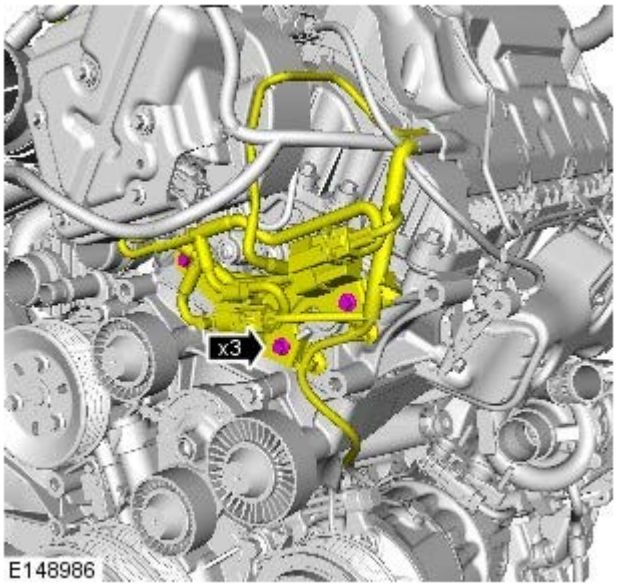
E131487

51. *Special Tool(s):* JLR-303-1574
Torque: 20 Nm

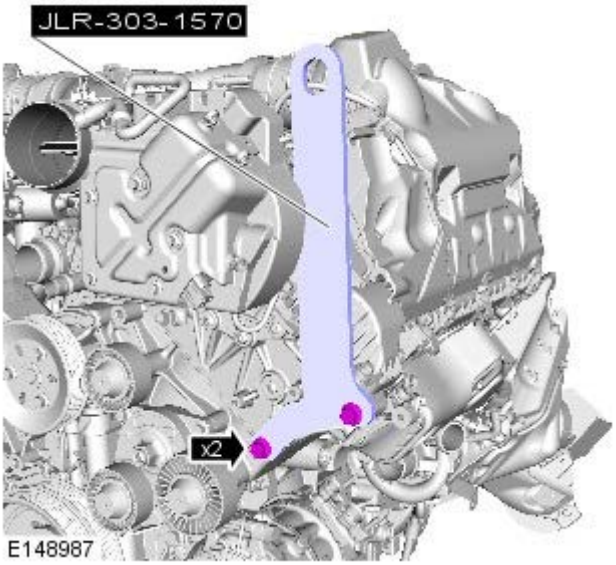


E131489

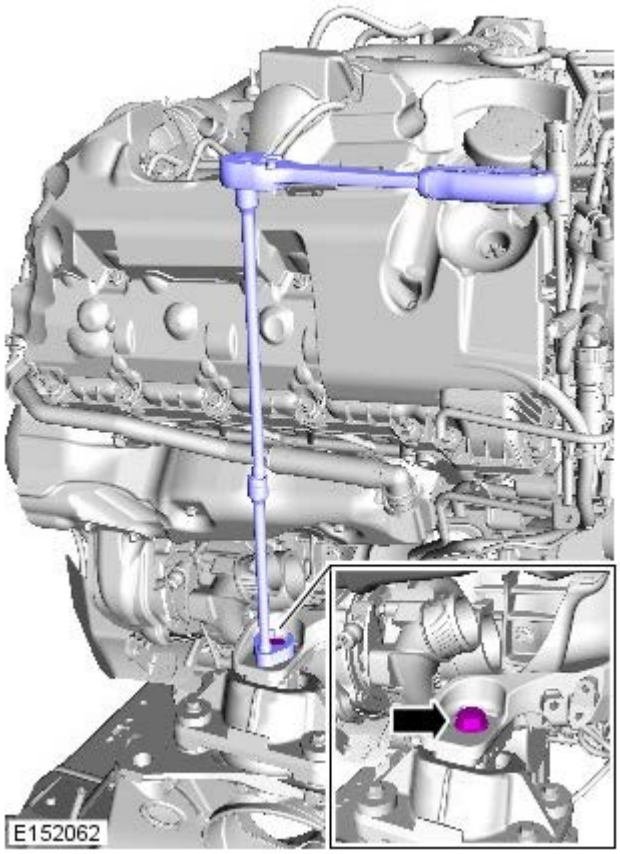
52.



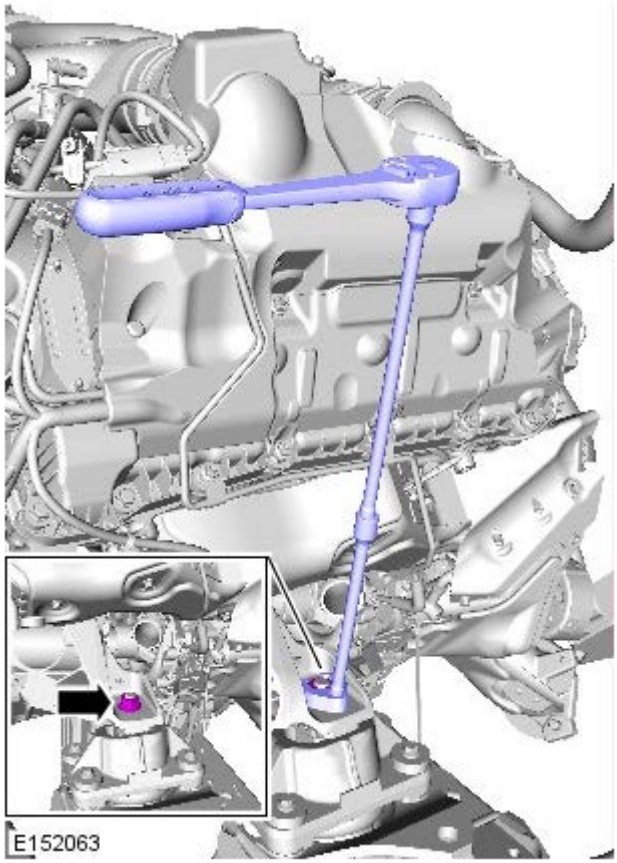
53. *Special Tool(s):* JLR-303-1570
Torque: 40 Nm



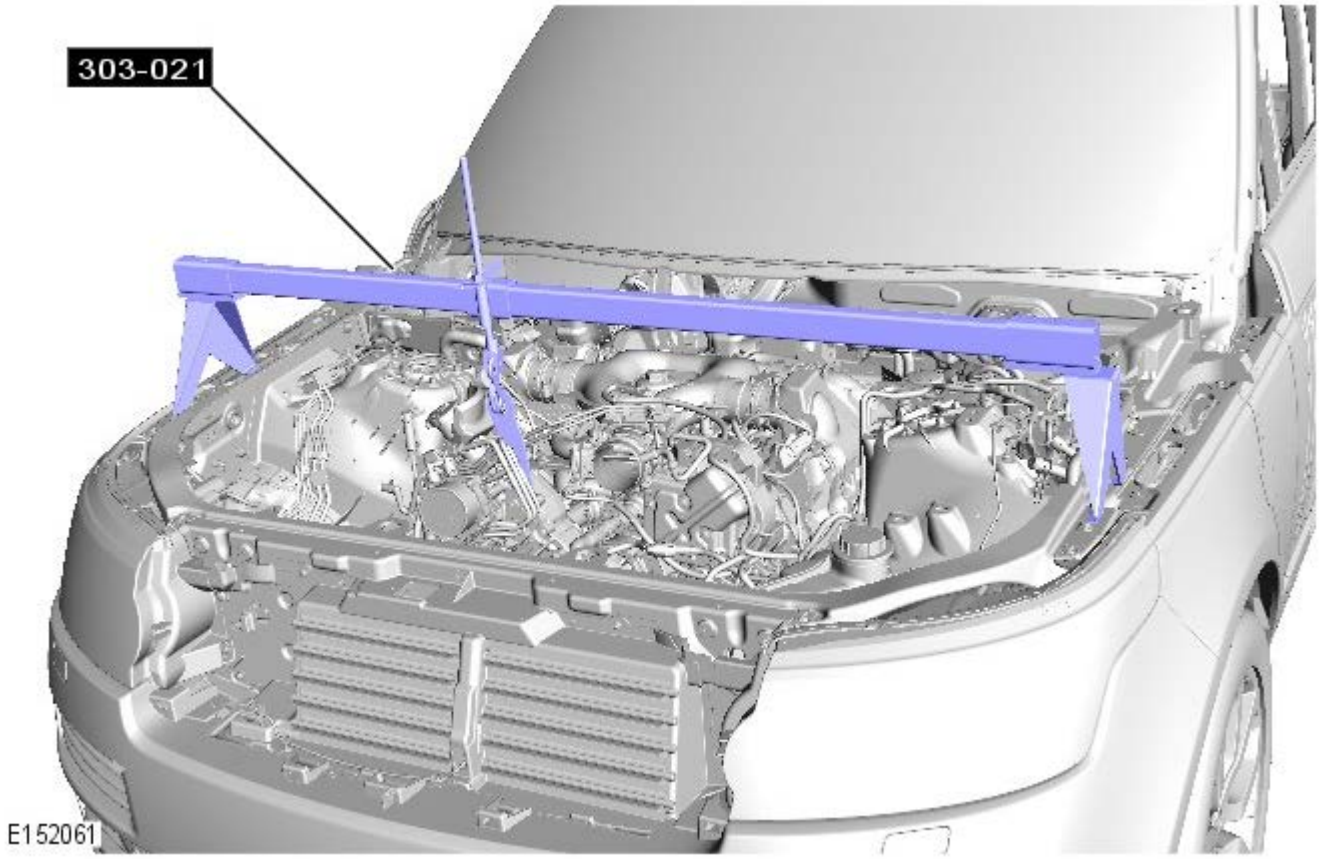
54.



55.



56. *Special Tool(s):* 303-021



57. NOTE: This step requires the aid of another technician.

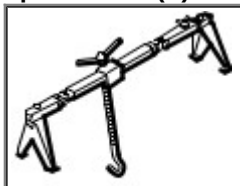
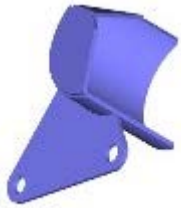

E149361

Published: 13-Nov-2013

Engine - TDV8 4.4L Diesel - Engine

Installation

Special Tool(s)

 303-021	303-021 Engine support bracket
 E131596	JLR-303-1569 Lifting Bracket, Engine
 E131594	JLR-303-1570 Lifting Bracket, Engine
 E131595	JLR-303-1572 Lifting Bracket, Engine
 E131593	JLR-303-1574 Protector, Turbocharger Actuator

NOTES:

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

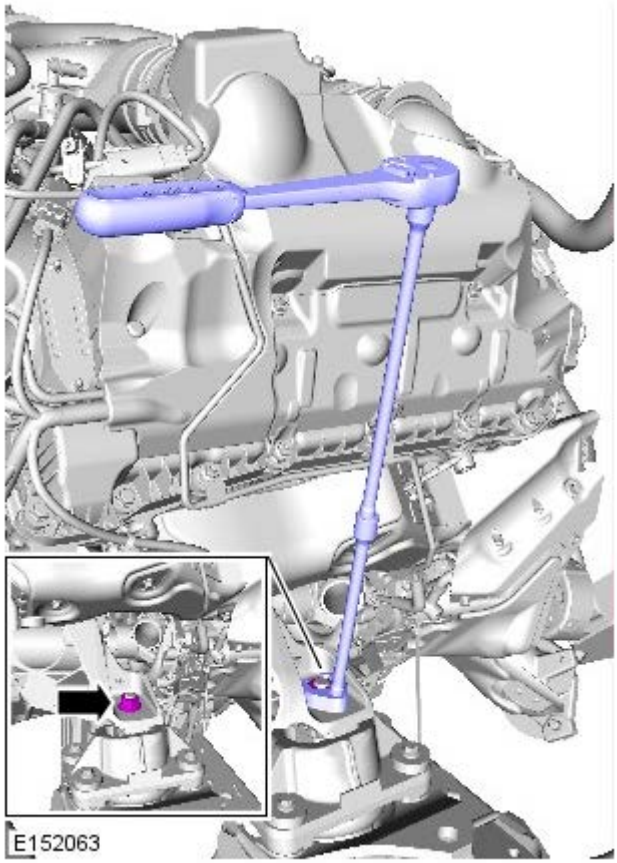
Some components shown removed for clarity.

1. NOTE: This step requires the aid of another technician.



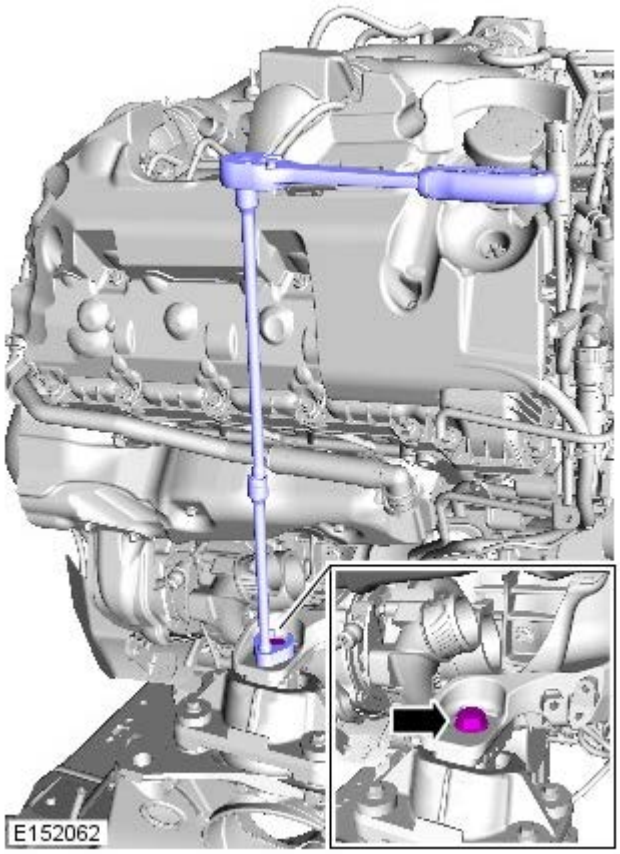
E149361

2. *Torque:* 110 Nm

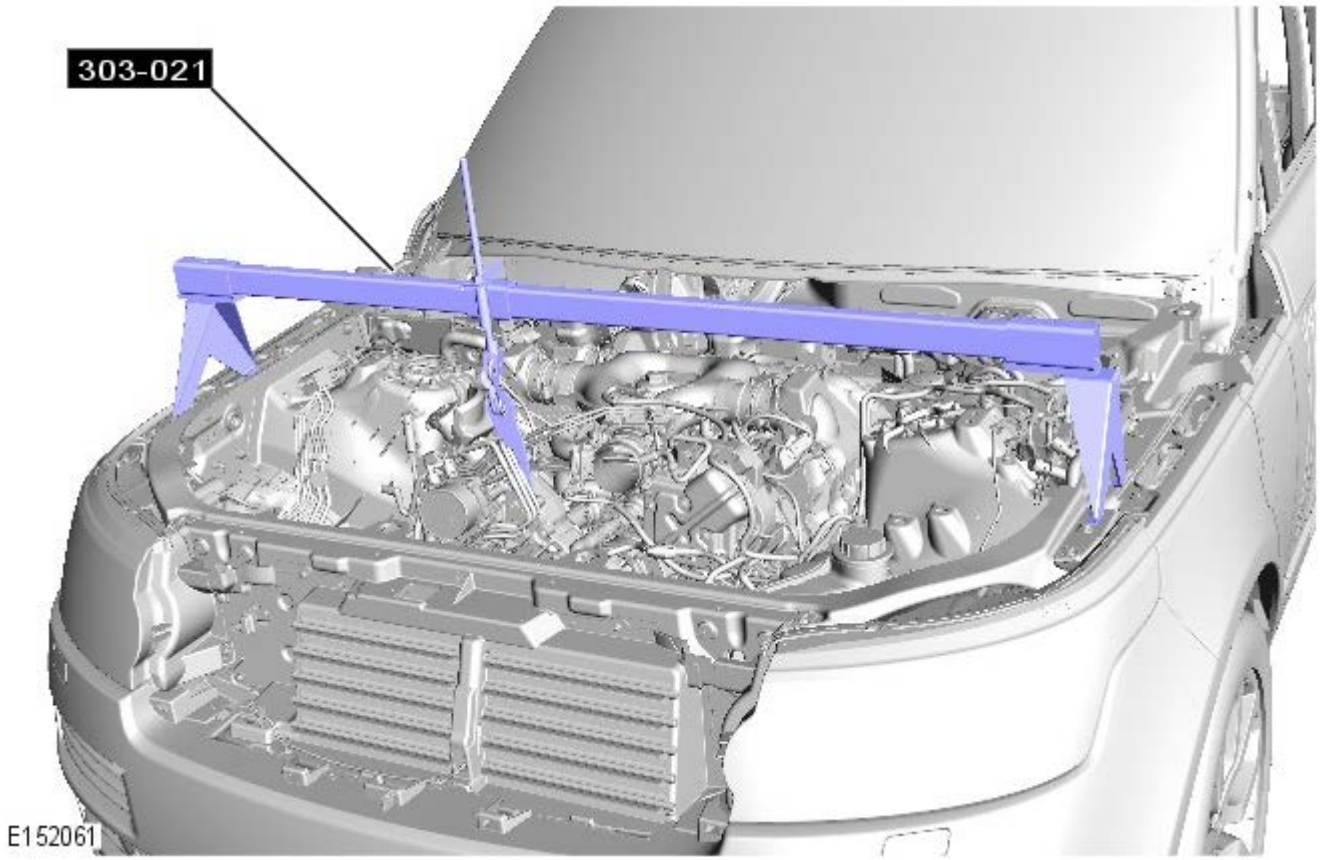


E152063

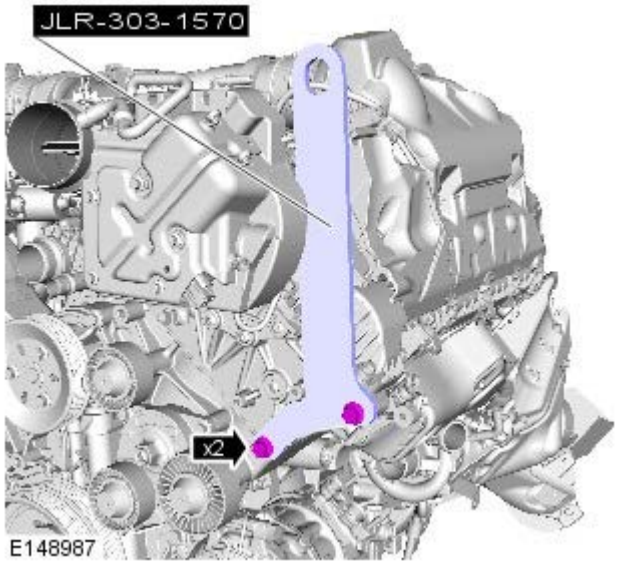
3. *Torque:* 110 Nm



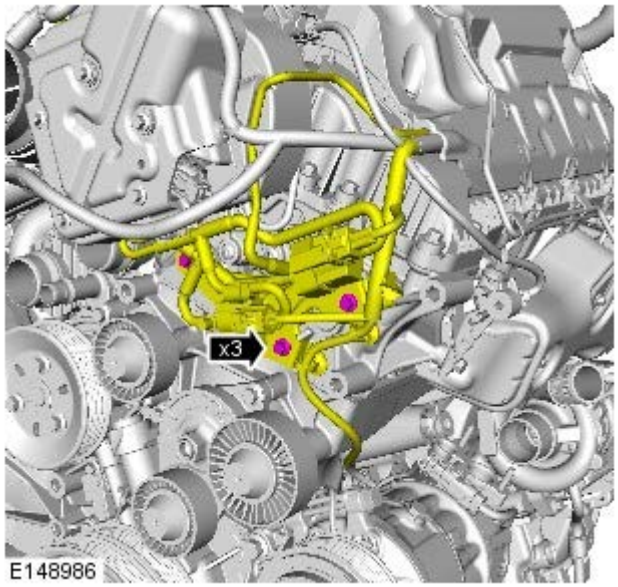
4. *Special Tool(s):* 303-021



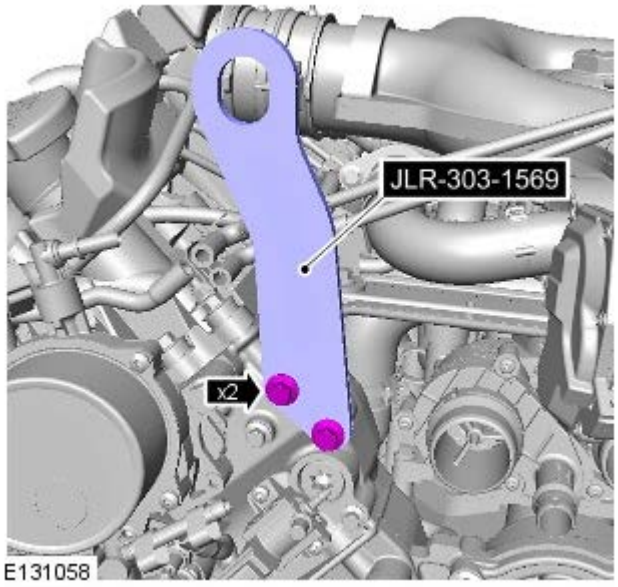
5. *Special Tool(s):* JLR-303-1570



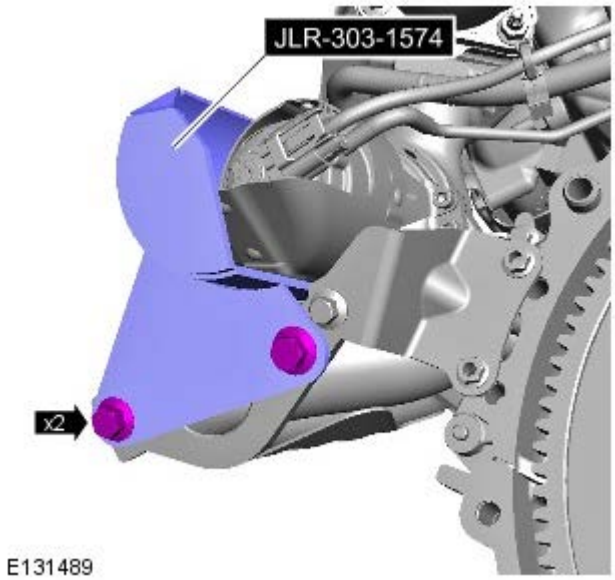
6. *Torque:* 10 Nm



7. *Special Tool(s):* JLR-303-1569

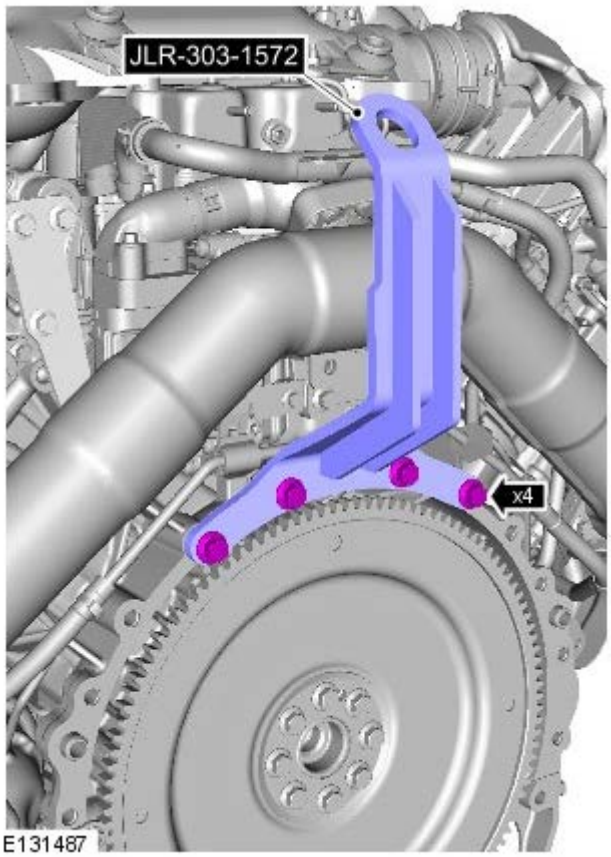


8. *Special Tool(s):* JLR-303-1574



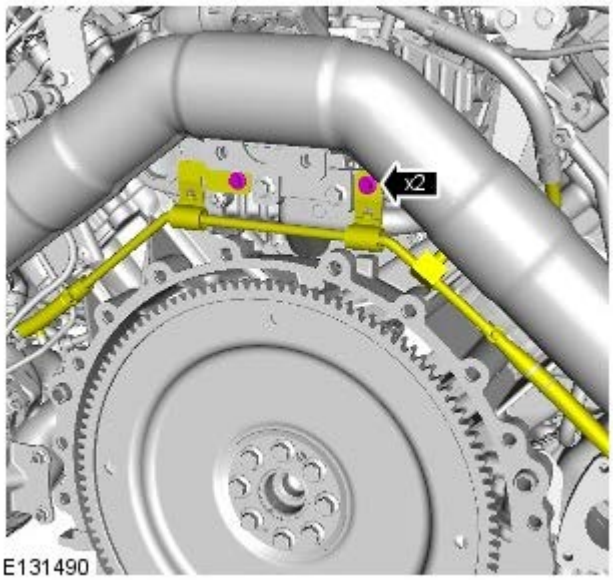
E131489

9. *Special Tool(s):* JLR-303-1572



E131487

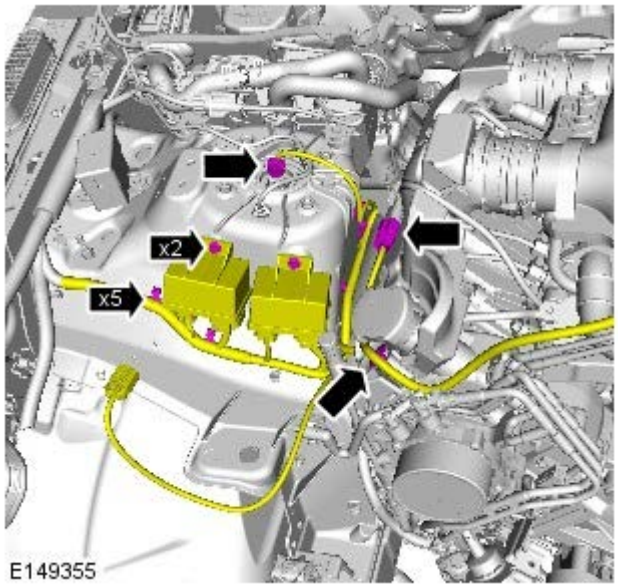
10. *Torque:* 12 Nm



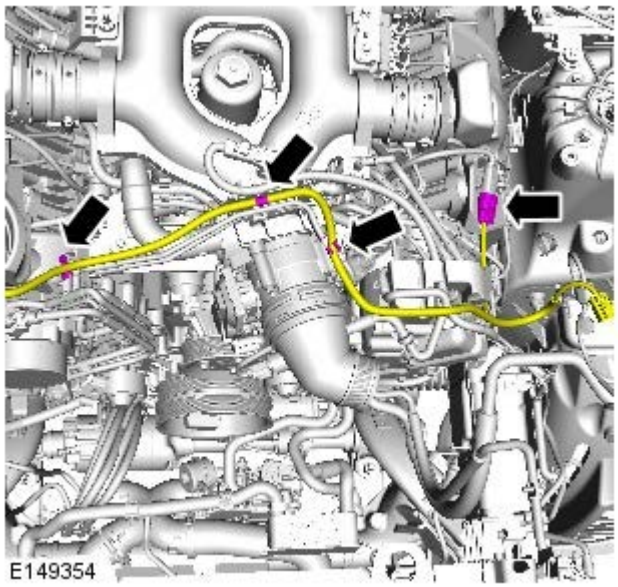
11. Refer to: Transmission - TDV8 4.4L Diesel (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, Removal).

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

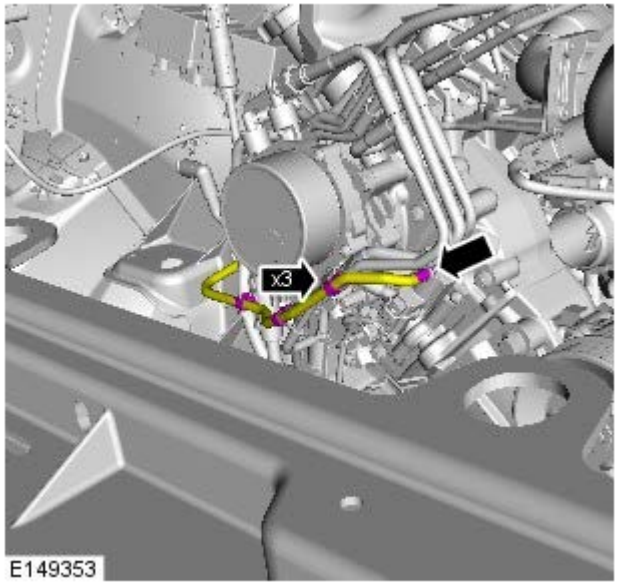
13. *Torque:* 10 Nm



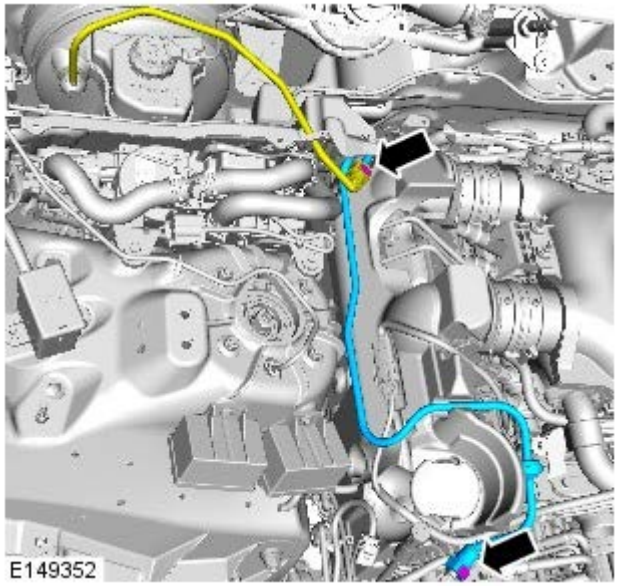
14.



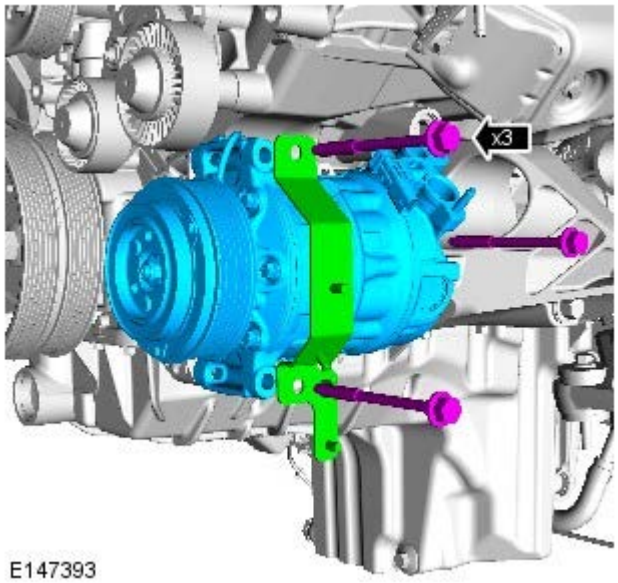
15.



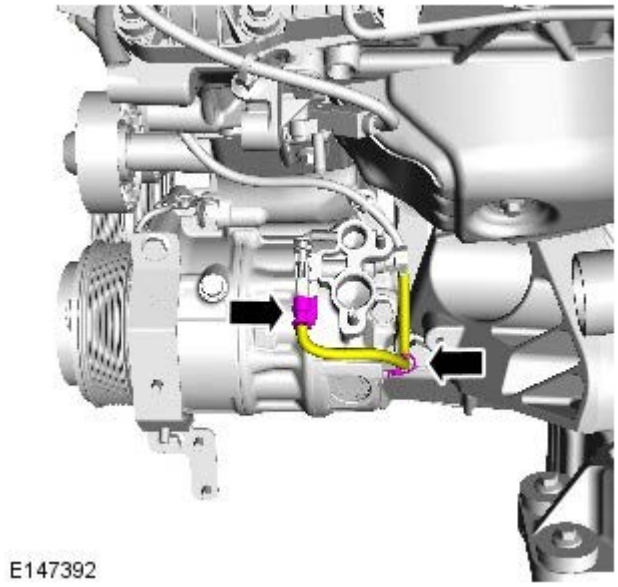
16.



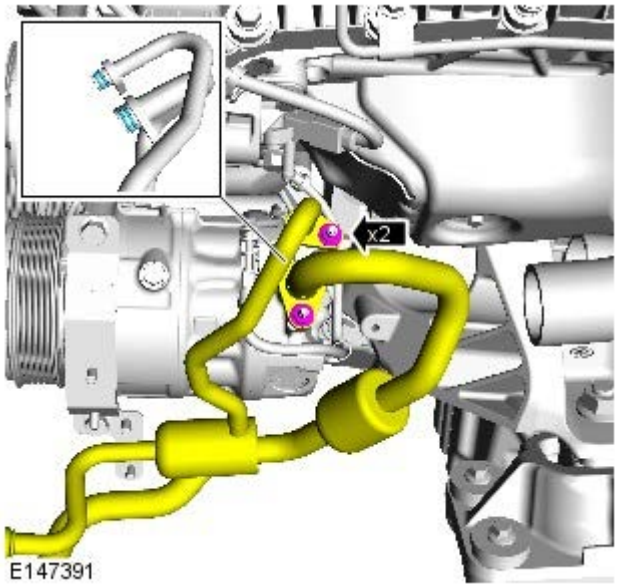
17. *Torque:* 25 Nm



18.



E147392

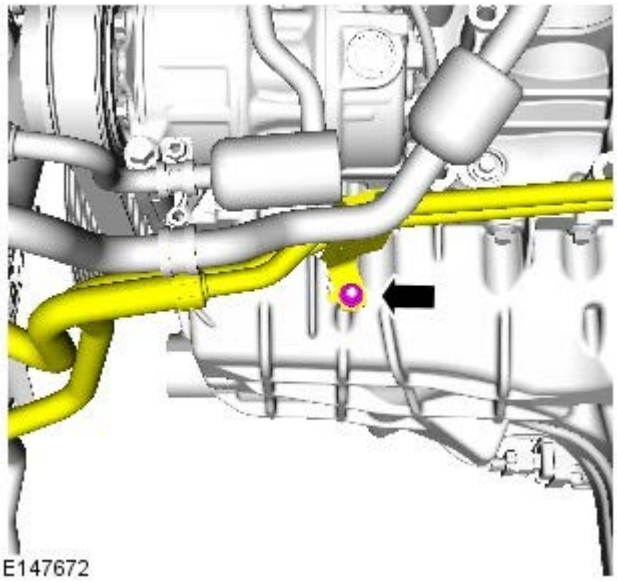


E147391

19. CAUTION: Install new o-ring seals

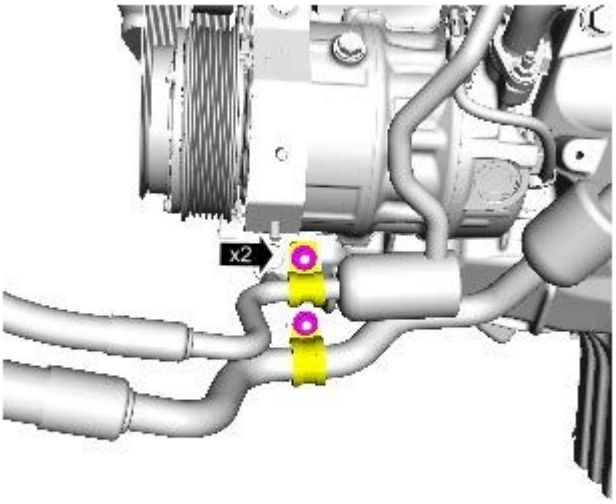
    Torque: 9 Nm

20. *Torque:* 9 Nm



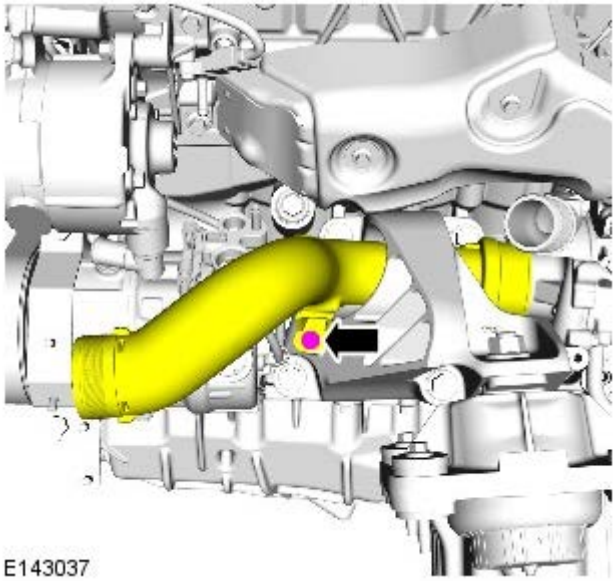
E147672

21. *Torque:* 9 Nm



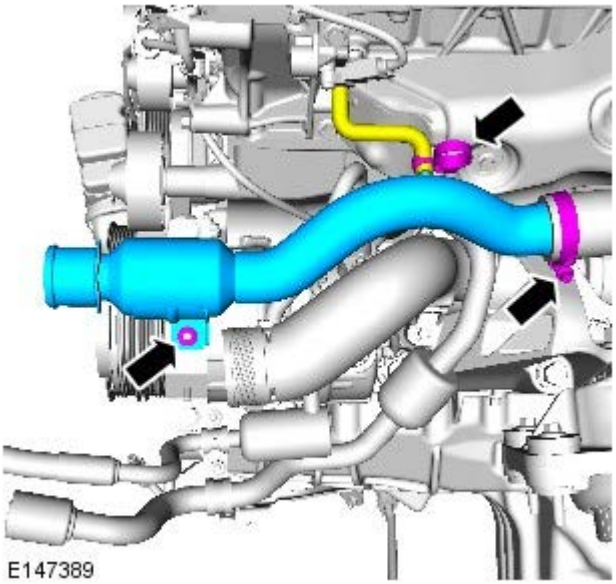
E147390

22. *Torque:* 12 Nm



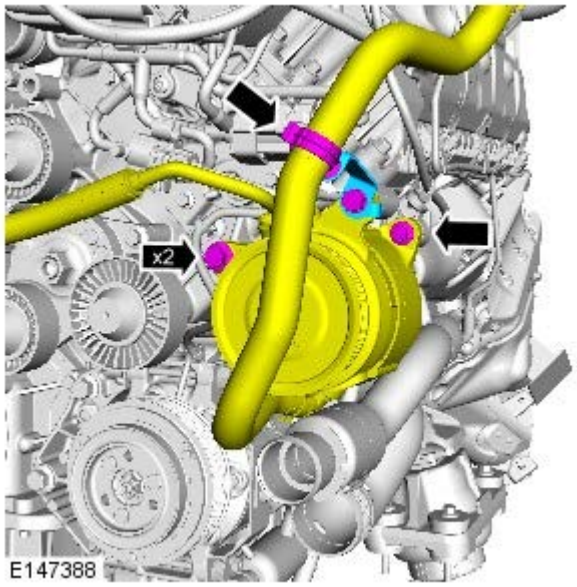
E143037

23. *Torque:*
    M6 10 Nm
    Clamp 3.5 Nm

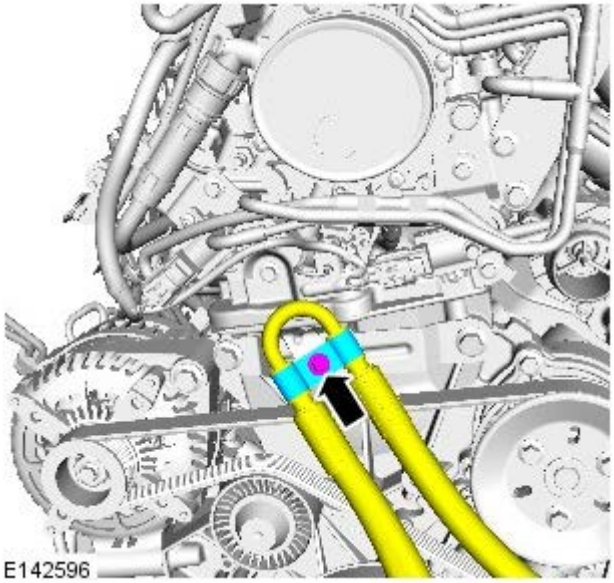


E147389

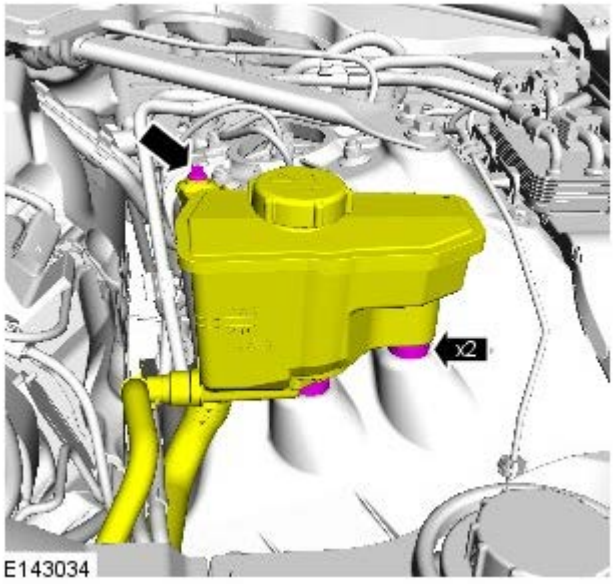
24. *Torque:*
    M8 25 Nm
    M10 45 Nm



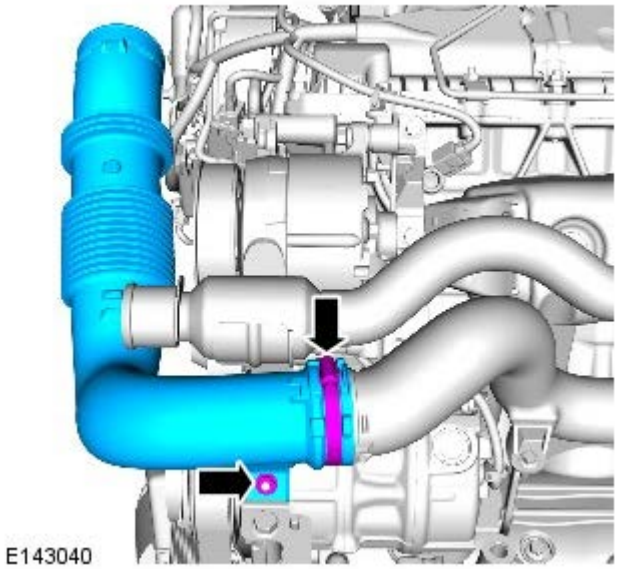
25. *Torque:* 10 Nm



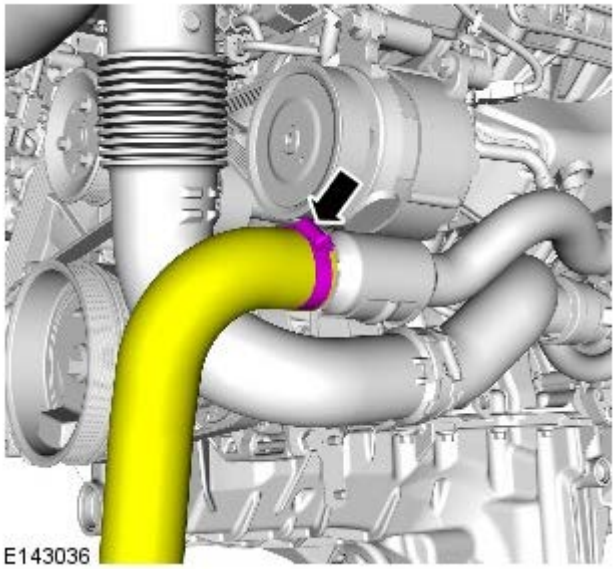
26. *Torque:* 9 Nm



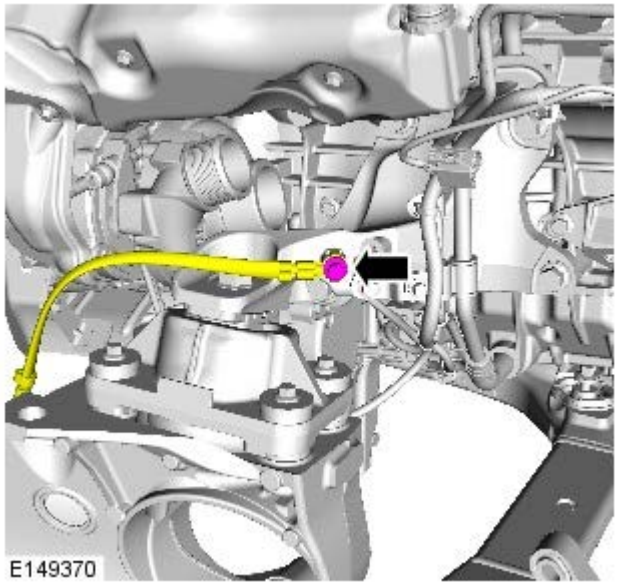
27. *Torque:*
    M6 12 Nm
    Clamp 3.5 Nm



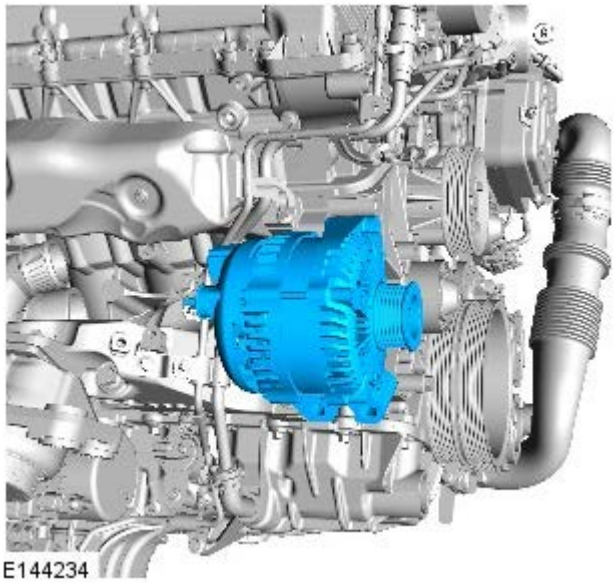
28. *Torque:* 3.5 Nm



29. *Torque:* 25 Nm

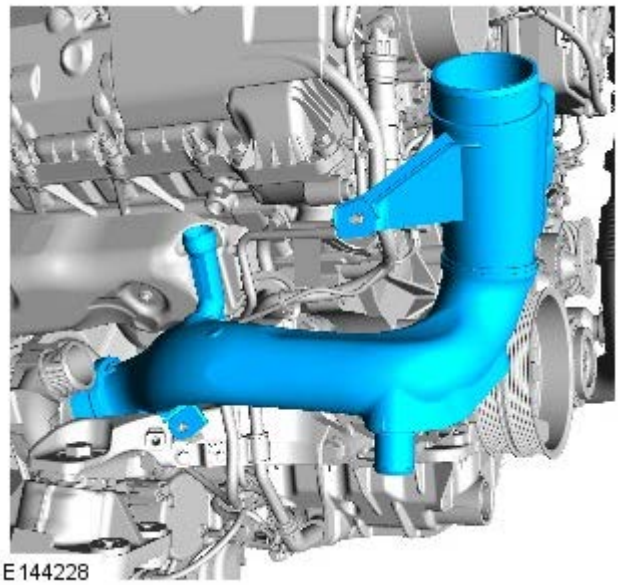


30.



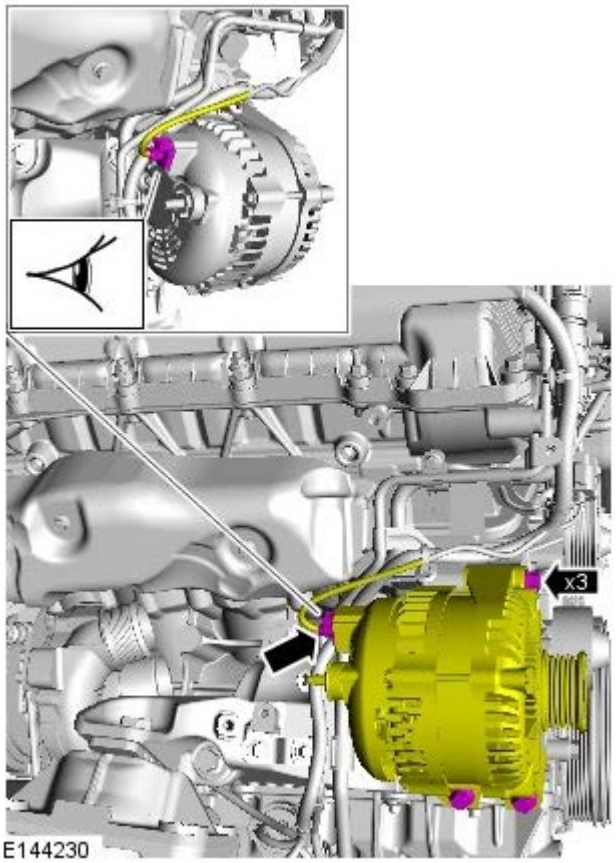
E144234

31.

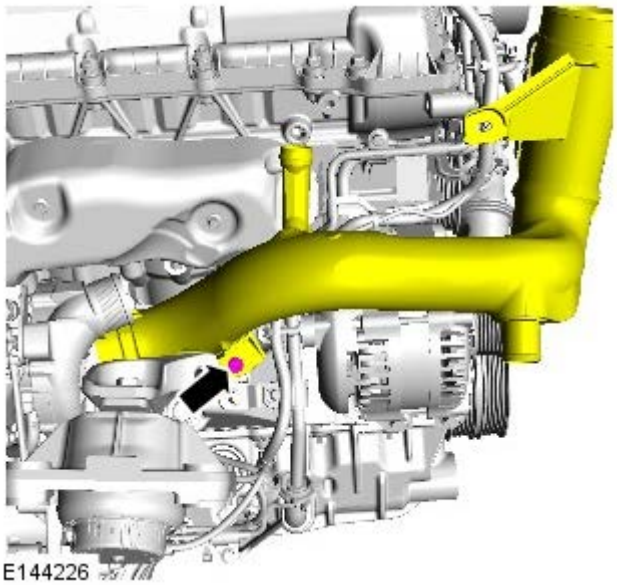


E144228

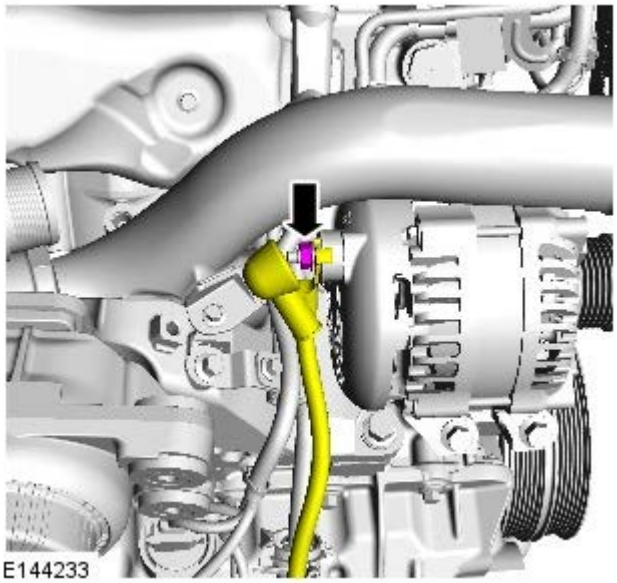
32. *Torque:* 47 Nm



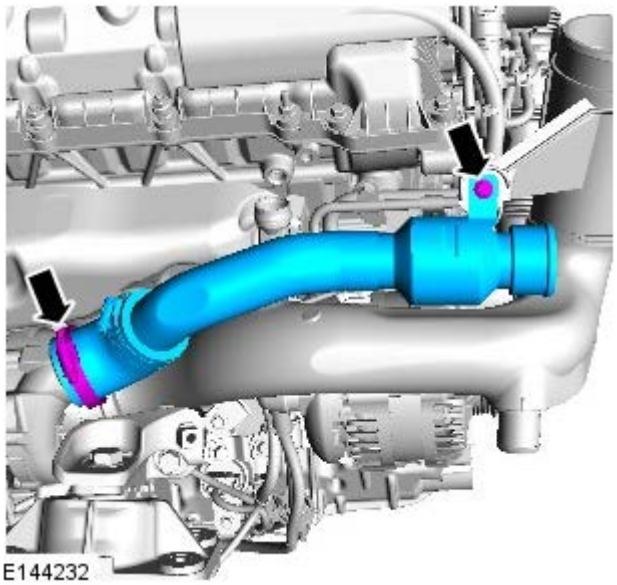
33. *Torque:* 8 Nm



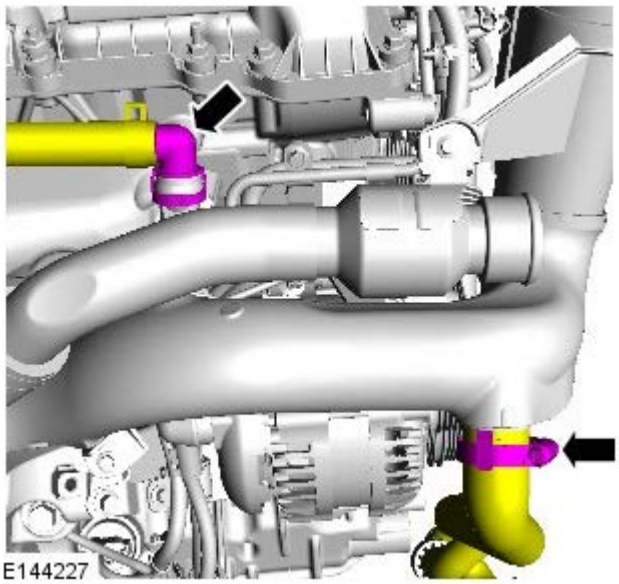
34. *Torque:* 12 Nm



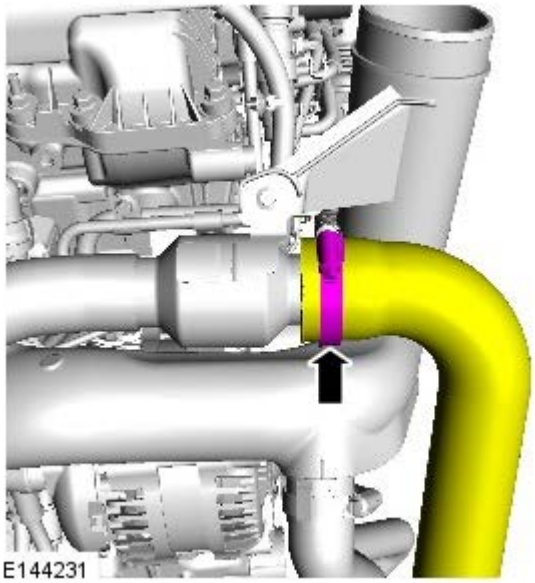
35. *Torque:*
    Clamp 3.5 Nm
    Bolt 8 Nm



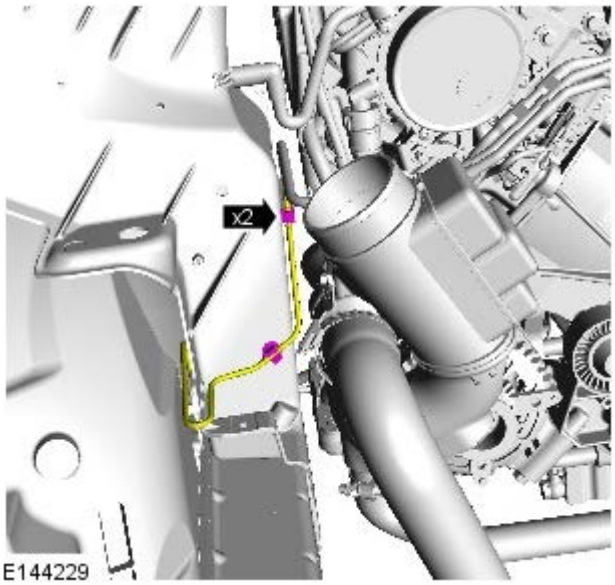
36. *Torque:* 3.5 Nm



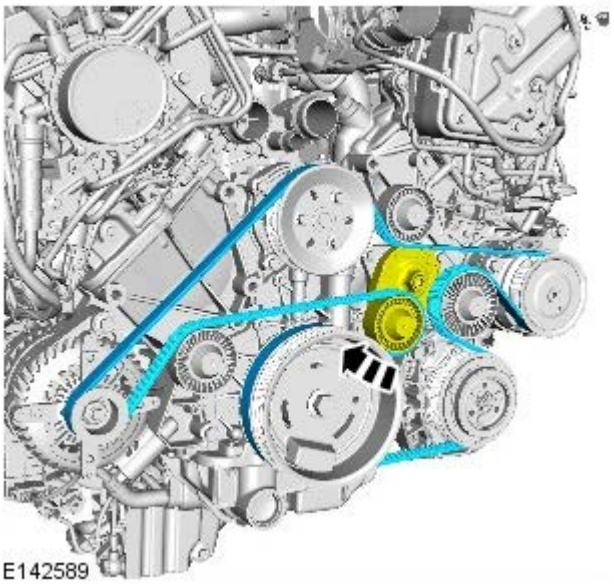
37. *Torque:* 3.5 Nm



38.



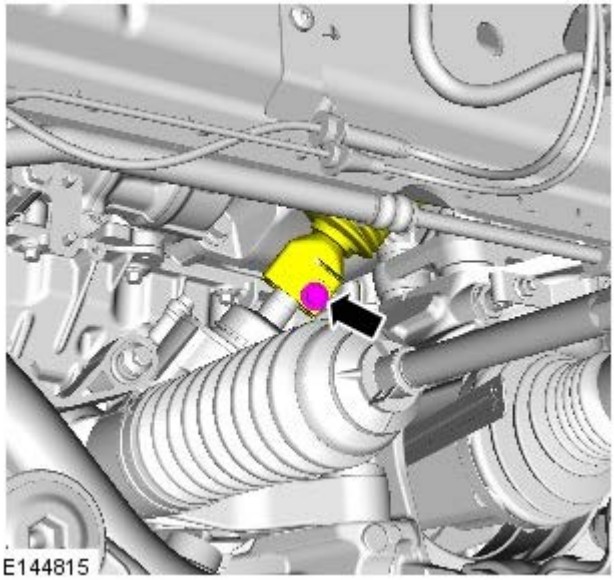
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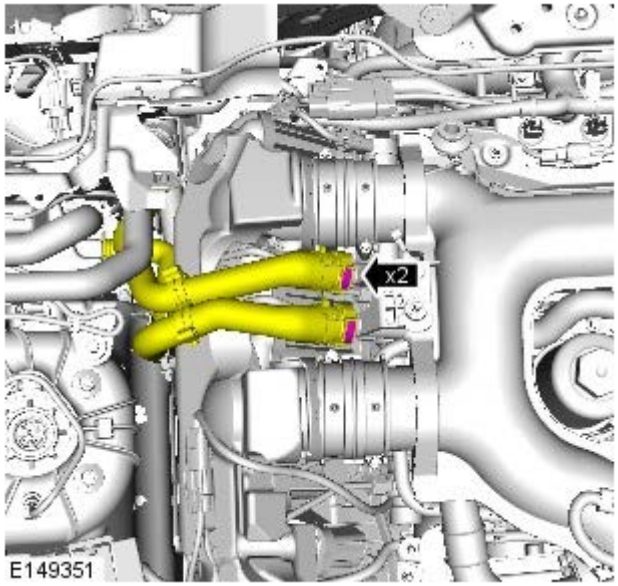
40. CAUTION: Make sure that a new bolt is installed.

NOTE: LHD illustration shown, RHD is similar.

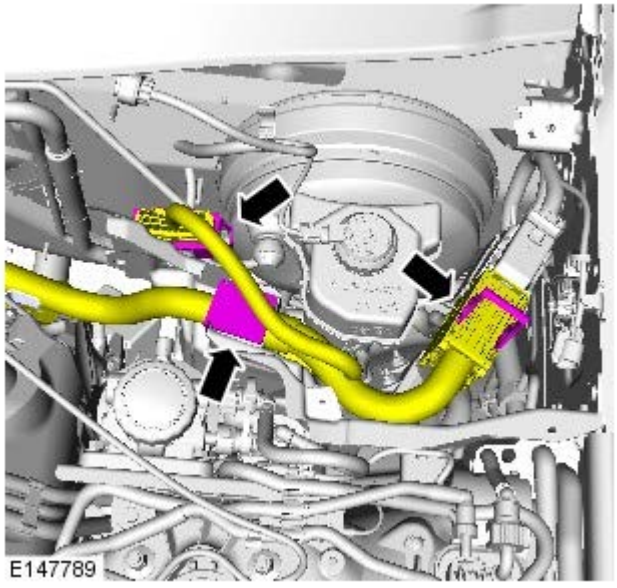
Using a suitable tool, clean out the threads.



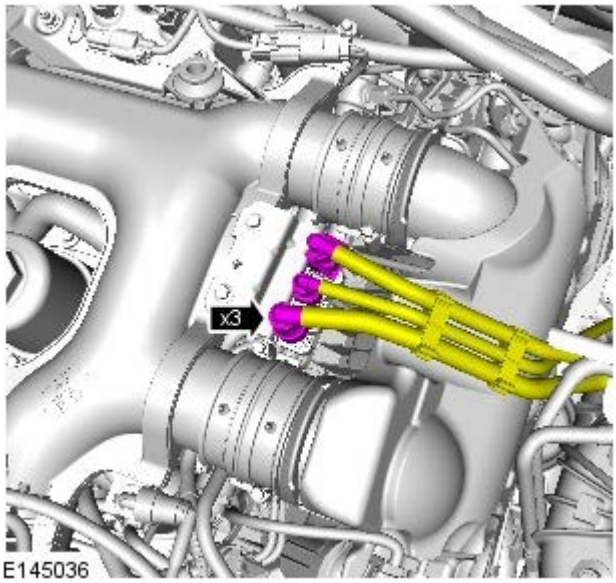
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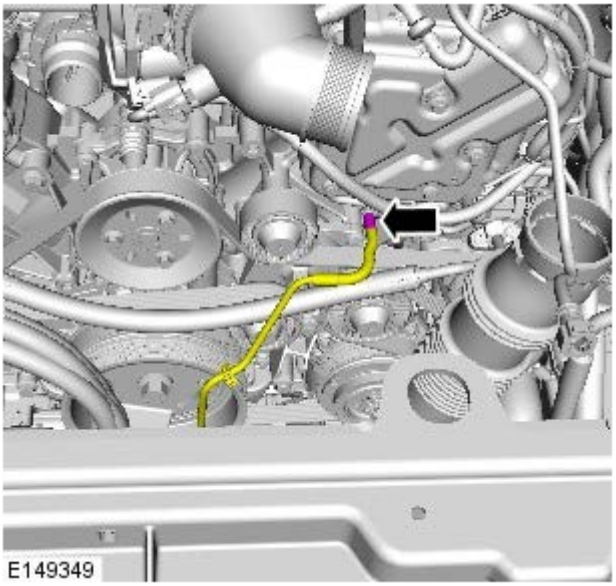
42. NOTE: LHD illustration shown, RHD is similar.



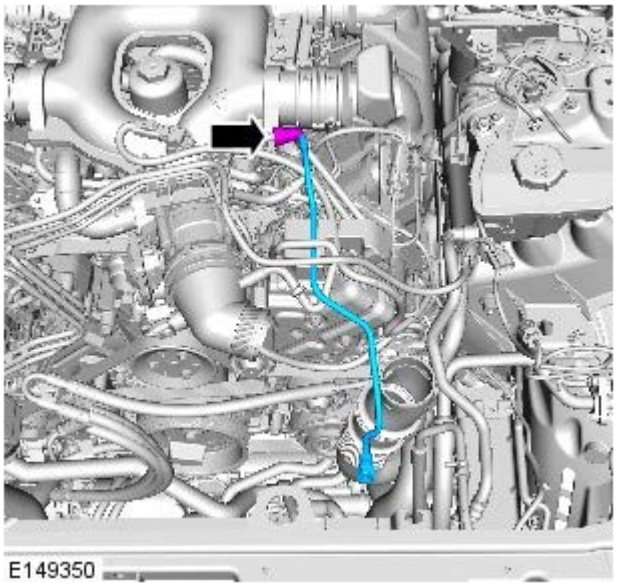
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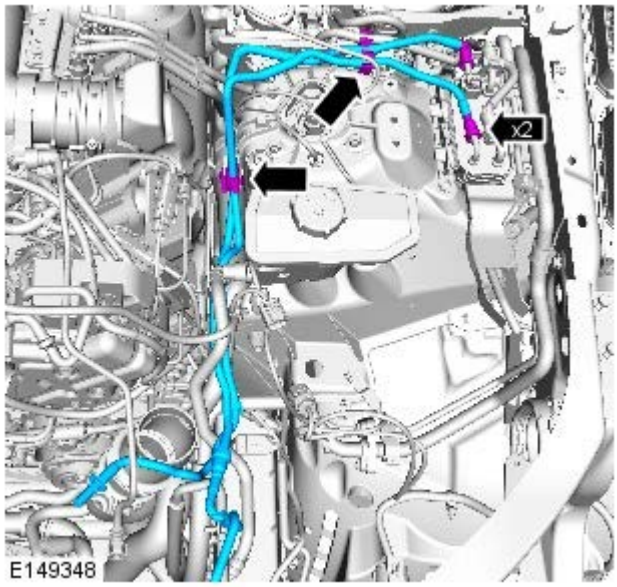
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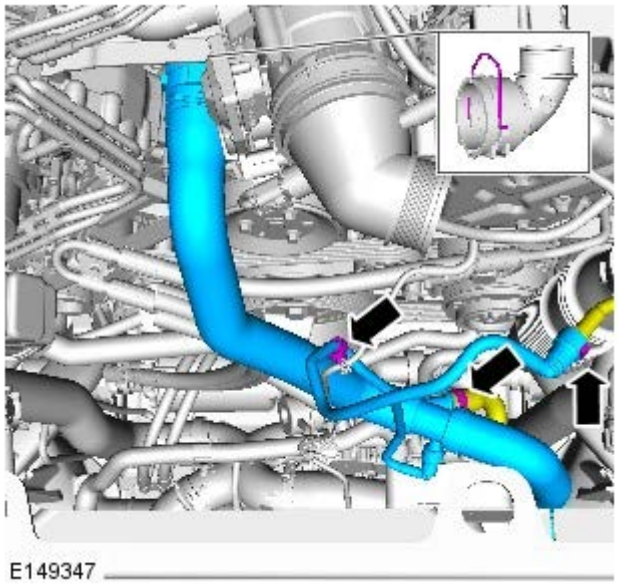
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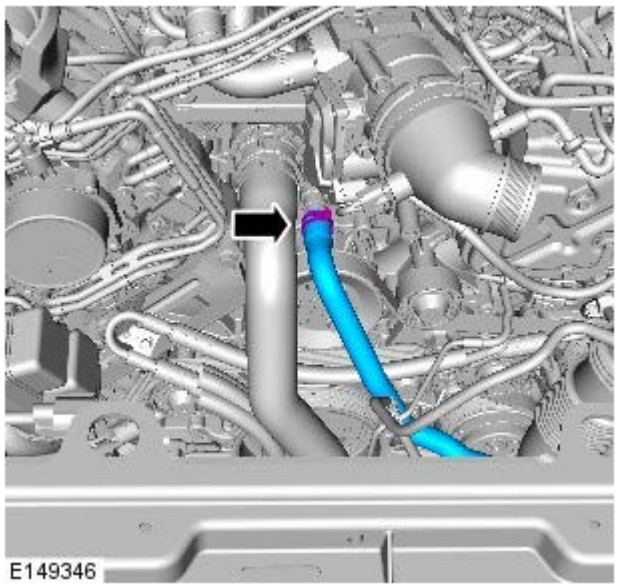
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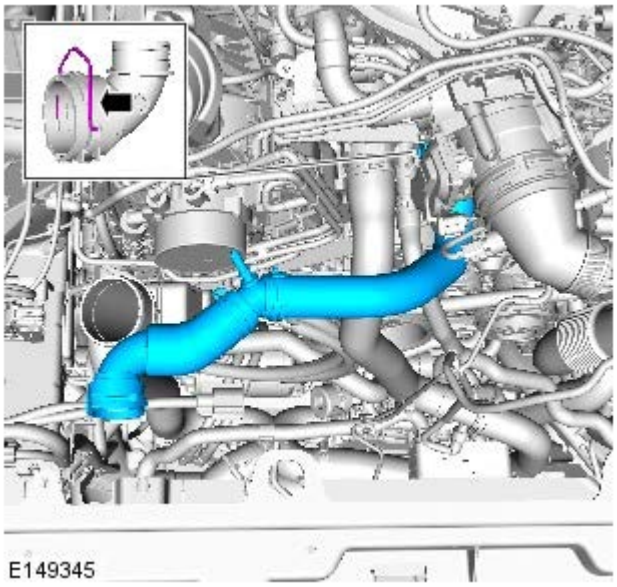
47.



48.



49.



50. Refer to: Radiator (303-03F Engine Cooling - TDV8 4.4L Diesel, Removal and Installation).

51. Refer to: Secondary Bulkhead Center Panel - TDV8 4.4L Diesel (501-02, Removal and Installation).

52. Connect the battery ground cable.

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

Published: 16-Dec-2013

Engine - SDV6 3.0L Diesel - Hybrid Electric Vehicle -

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	190 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 vehicles with Diesel Particulate Filter (DPF)	5W/30 – WSS–M2C934–B
Engine oil without (DPF)	5W/30 – WSS–M2C913–C
Sealant	WSE–M4G323–A5
Core plug and stub pipe retainer	WSK-M2G349-A7
Cooling system fluid	Havoline Extended Life Coolant (XLC)

Capacities

Description	Liters
Engine oil initial fill	6.66
Engine oil service fill with oil filter change	6.0

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
Cylinder head maximum permitted warp (mm) flatness specification	0.2mm (0.008 in)

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	-

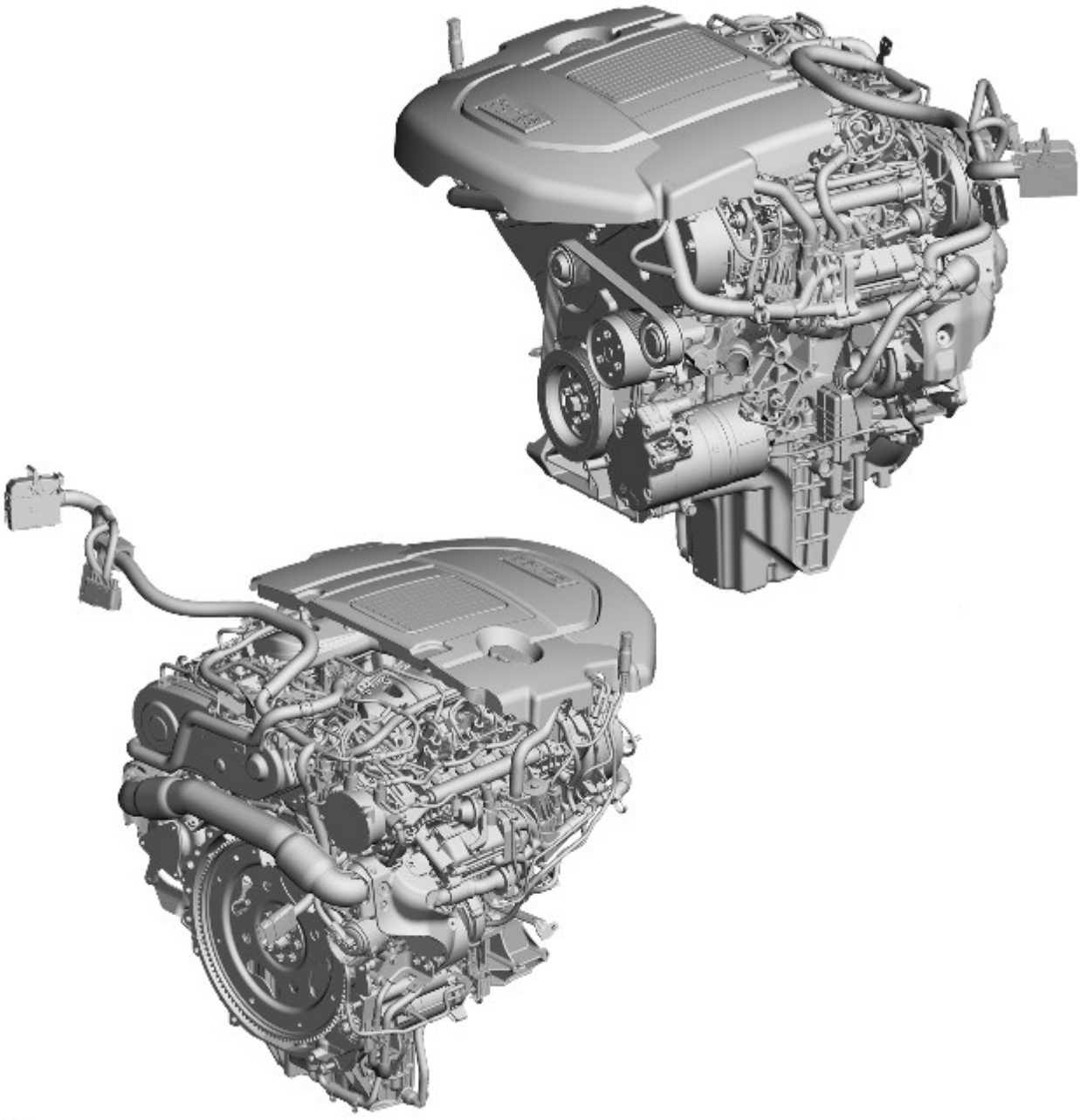
Fuel injection pump bracket to cradle retaining bolts	10	7	-
Fuel injection pump to bracket retaining bolts	10	7	-
Oil pump retaining bolts	10	7	-
Crankshaft rear oil seal housing retaining bolts	10	7	-
Oil pan retaining bolts M6	10	7	-
Oil pan retaining bolts M8	23	17	-
Oil pump pick up pipe retaining bolts	10	7	-
Engine oil level sensor retaining nuts	10	7	-
Crankshaft timing belt pulley retaining bolt	**A**	-	-
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	-
Engine mount bracket to engine mounting	130	96	-
Engine mounting to subframe bolts.	**A**	-	-
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	-
Generator retanining 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: 30-Jul-2013

Engine - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Engine

Description and Operation

EXTERNAL VIEWS



E158231

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.

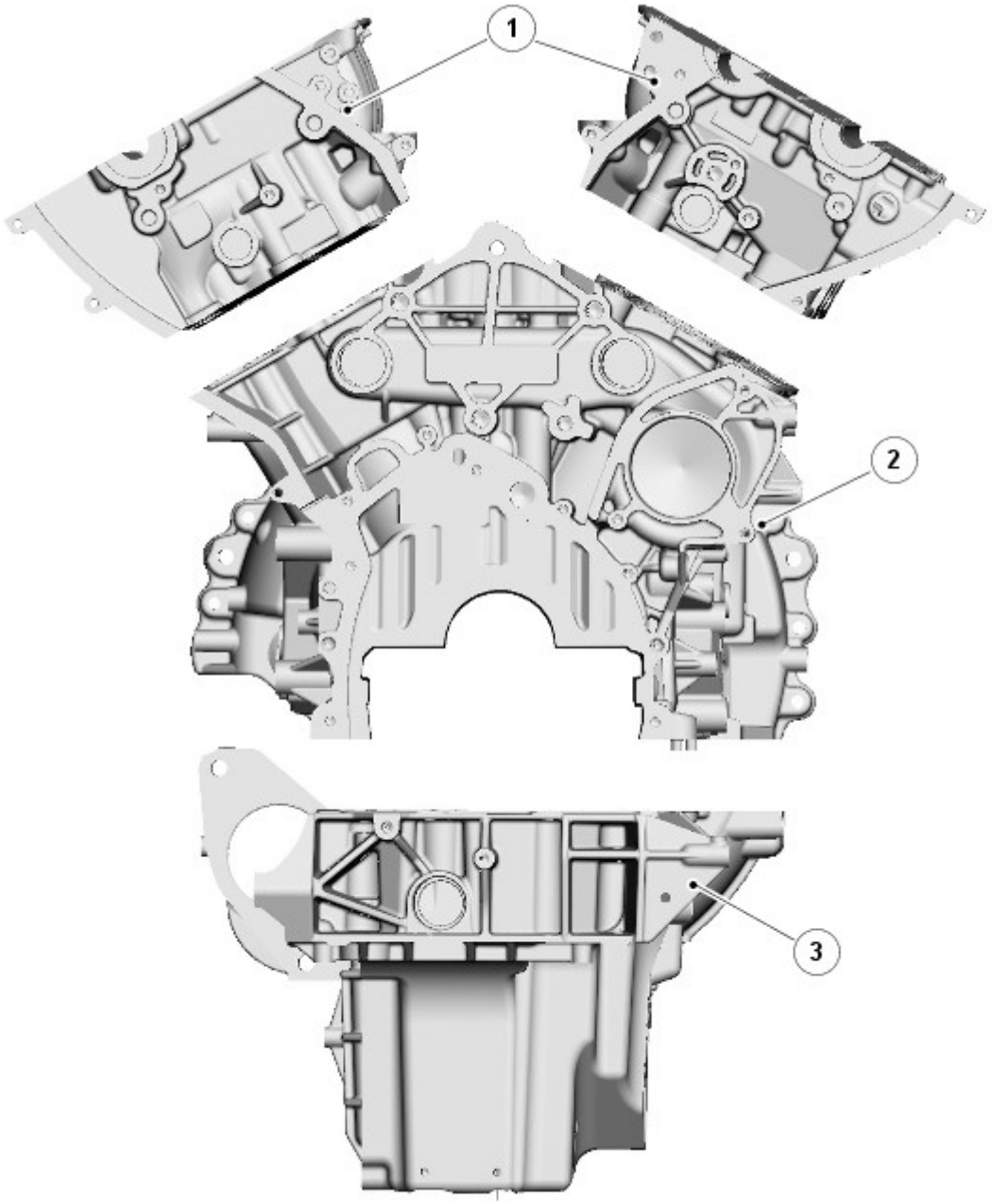
The cylinder block is coupled with a cast oil pan to provide a lightweight, compact and very stiff bottom end. The cylinder heads are fitted with integrated intake manifold and camshaft covers. The exhaust manifolds are unique for each cylinder head. An acoustic cover is fitted over the upper engine 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 (303-12A, Description and Operation).

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.

DESCRIPTION

Engine Structure



E120983

Item	Part Number	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. This type of construction provides outstanding strength and durability and reduces engine weight and length.

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.

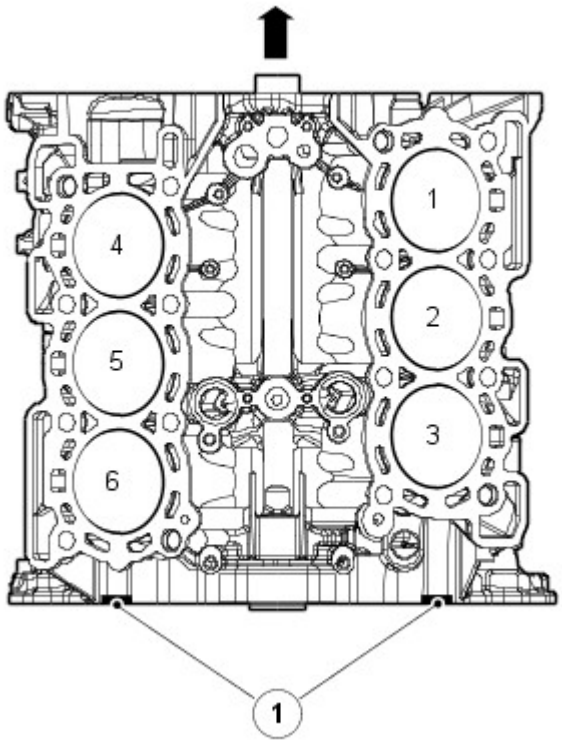
Cylinder cooling is achieved by coolant circulating through chambers in the cylinder block casting.

Two hollow 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 right and left 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 right side, and the other is fitted in the middle of the cylinder block on the left side.

ENGINE DATA

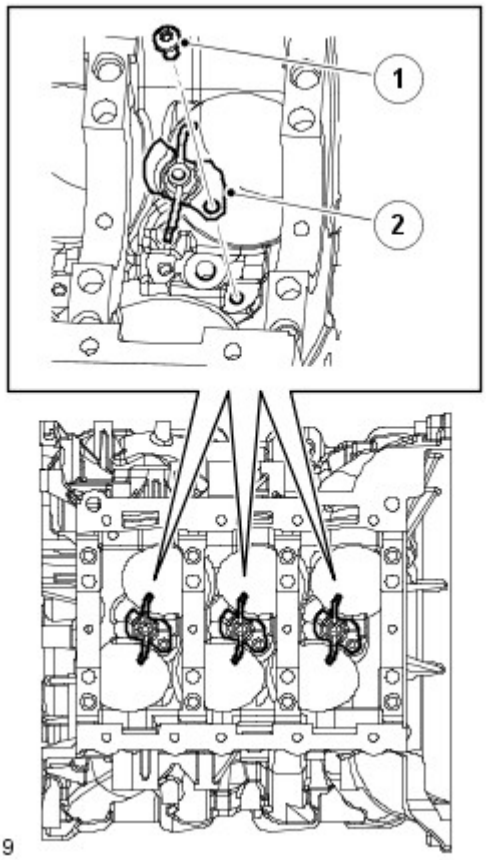


E44217

Item	Part Number	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.

PISTON COOLING JETS



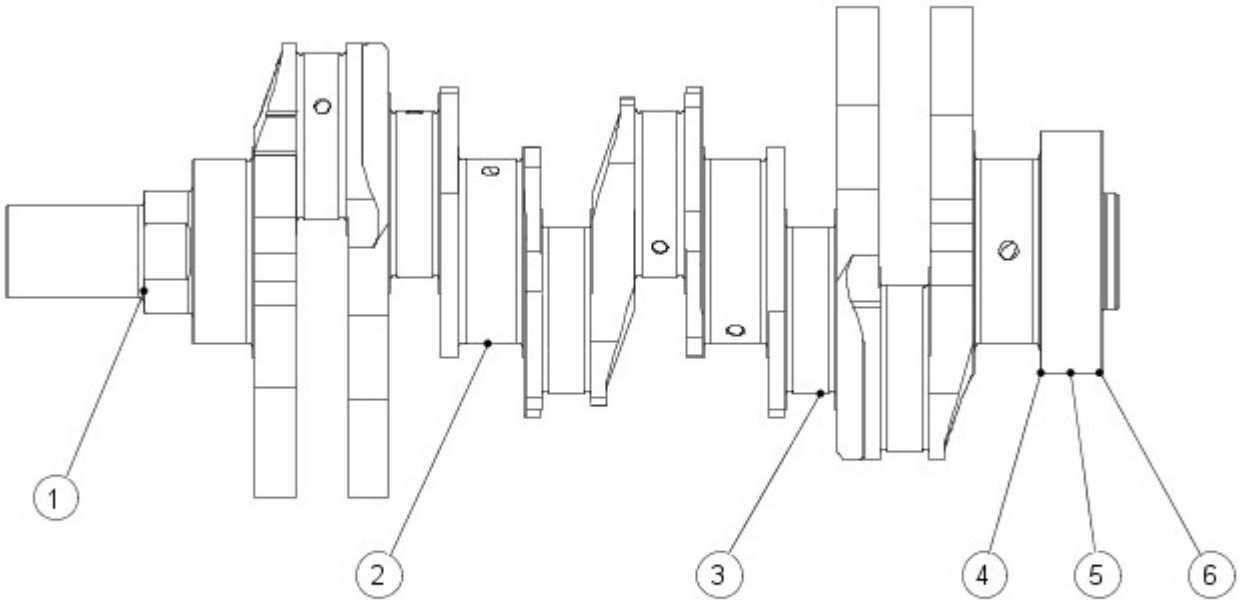
E44219

Item	Part Number	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



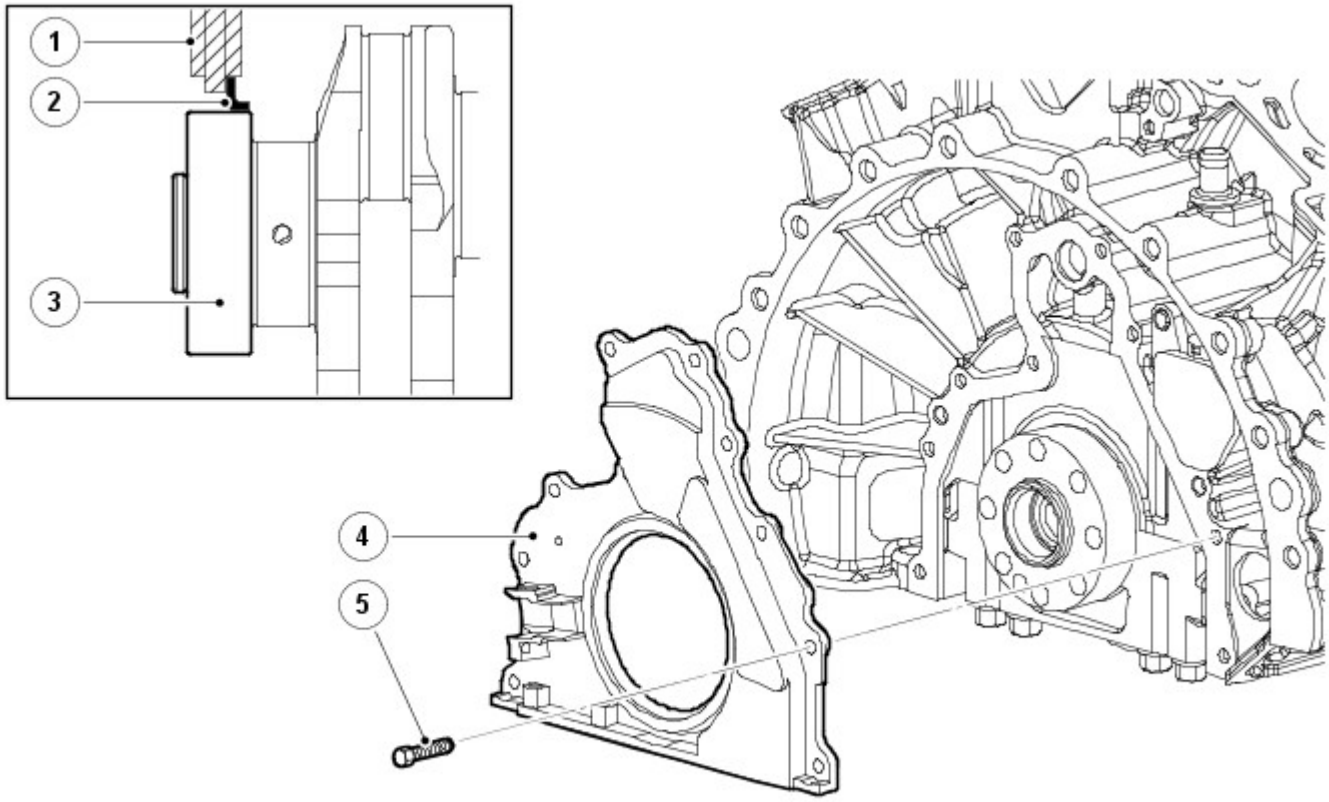
E52135

Item	Part Number	Description
1	-	Oil pump drive
2	-	Main bearing journal
3	-	Connecting rod bearing journal
4	-	Rear drive flange
5	-	Rear oil seal location
6	-	Reluctor ring location

The crankshaft runs 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 selective split plain bearings. An oil groove in the top half of each bearing transfers oil into the crankshaft for lubrication of the connecting rod bearings.

CRANKSHAFT REAR OIL SEAL

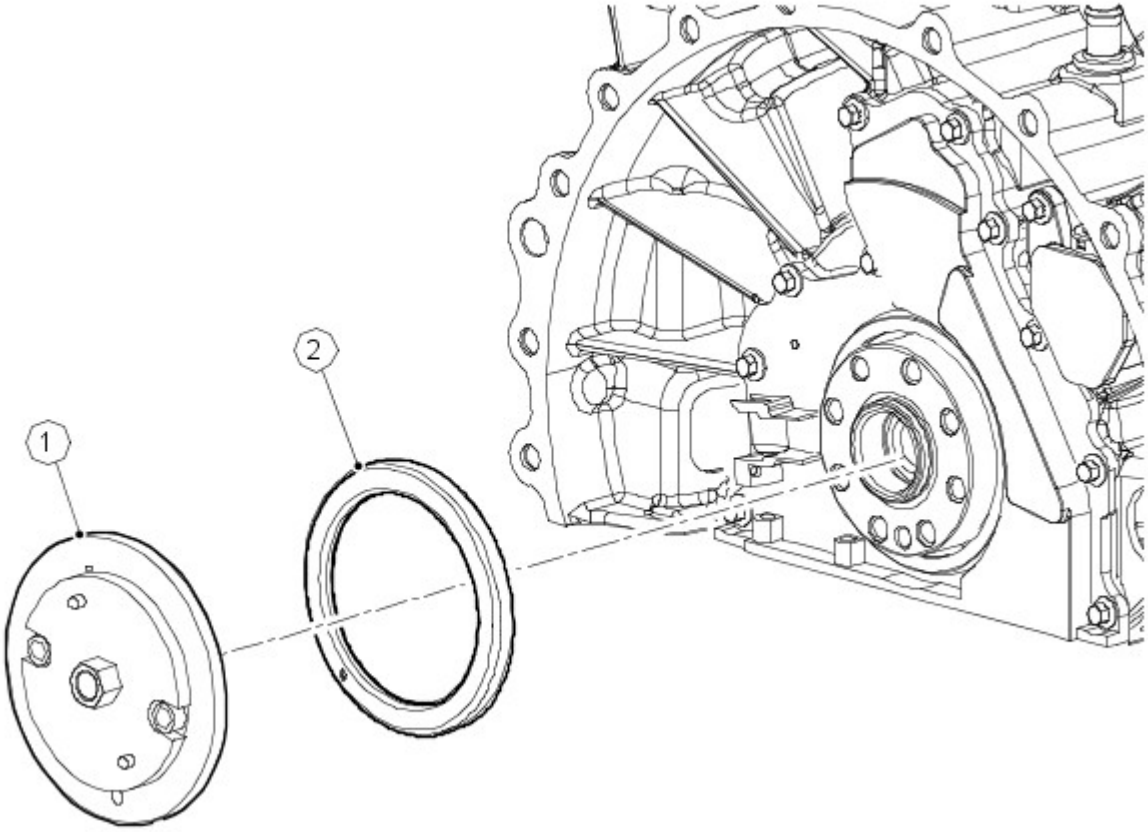


E44227

Item	Part Number	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 fitting sleeve. The seal and retainer have 2 locating dowels, 10 fixing bolts and a seal. In addition, the retainer has a location for the CKP (crankshaft position) sensor.
For additional information, refer to: Electronic Engine Controls (303-14F, Description and Operation).

CRANKSHAFT RELUCTOR RING



E52137

Item	Part Number	Description
1	-	Special tool
2	-	Reluctor ring

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

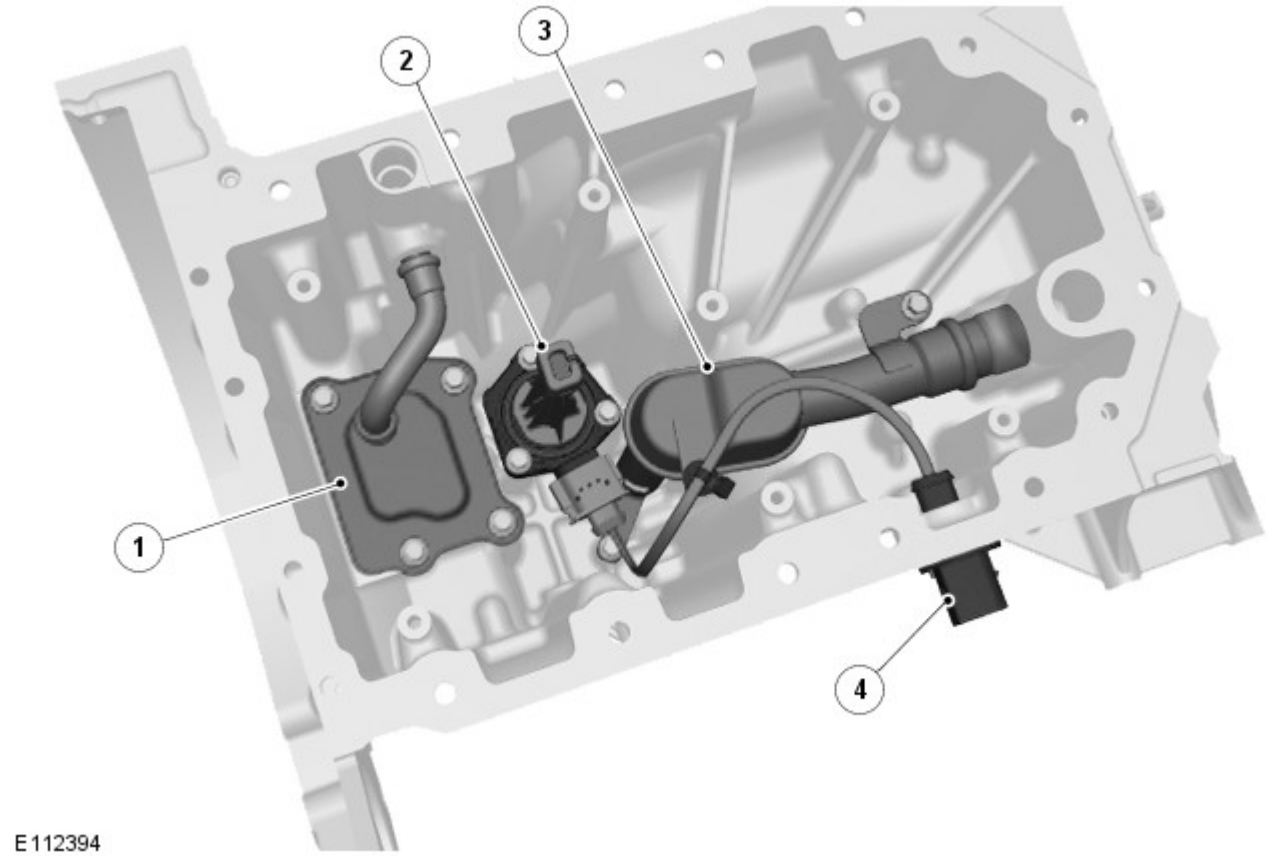
The reluctor ring consists of 60 magnets minus 2 for ECM (engine control module) crankshaft position reference and synchronization. The magnets cannot be seen on the reluctor ring, which therefore can only be positioned using the special tool.

If the reluctor ring is removed for any reason, then a new reluctor ring must be fitted.

CRANKSHAFT DAMPER PULLEY

The crankshaft damper pulley is bolted to the front of the crankshaft to provide the drive for the engine accessory components.
For additional information, refer to: Accessory Drive (303-05E, Description and Operation).

Oil Pan Components



Item	Part Number	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 fitted to the lower cylinder block to stiffen the base structure of the engine, helping to reduce NVH (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:

- M8 x 20 (9 off).
- M8 x 75 (1 off).
- M6 x 105 (8 off).

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.

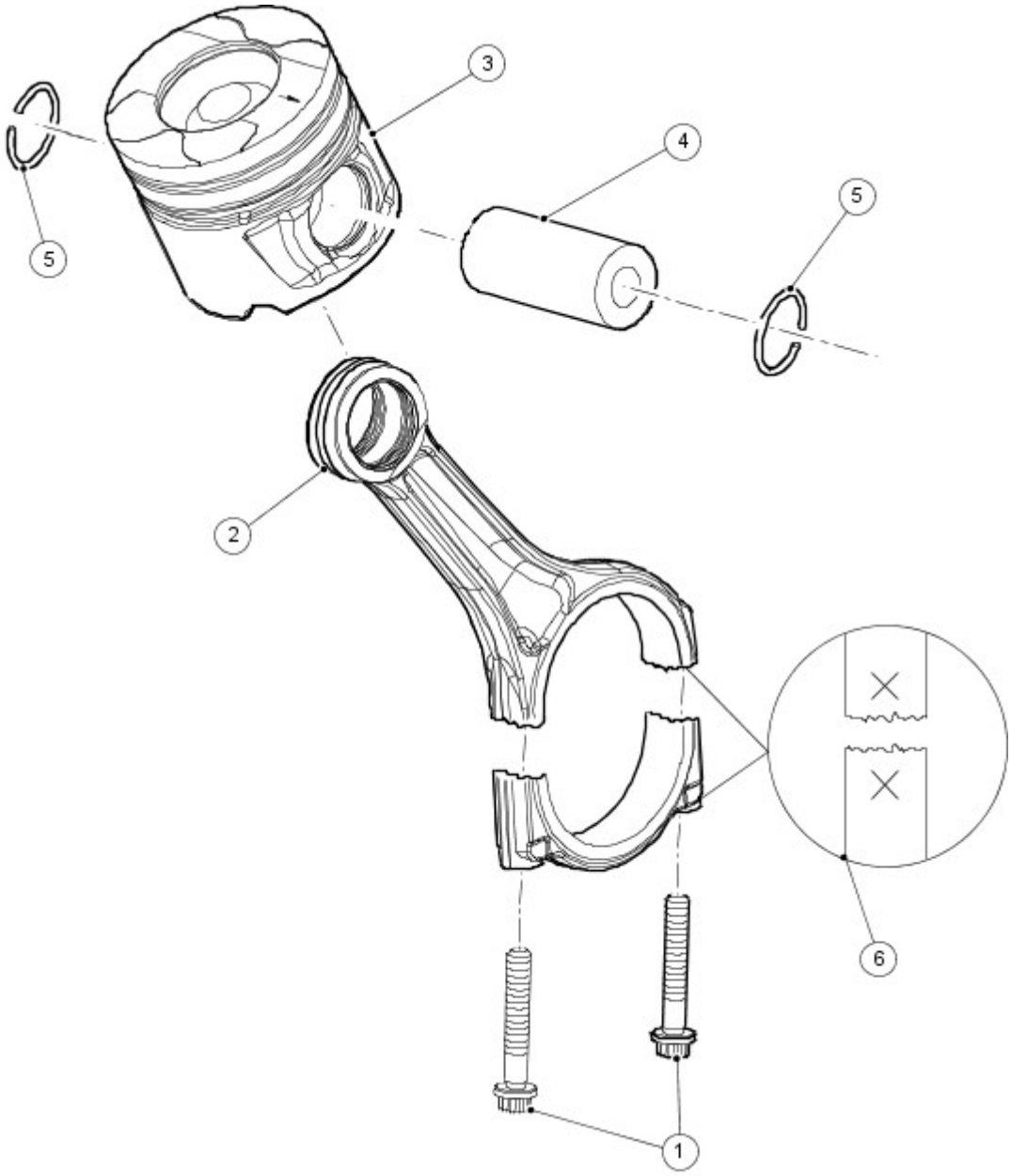
An oil level and temperature sensor provides an electronic indication of the oil level. This removes the requirement for the mechanical dipstick. An advantage in comparison with the static 'dipstick' method is that all marginal influences, for example vehicle being on a slope, lateral and longitudinal 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



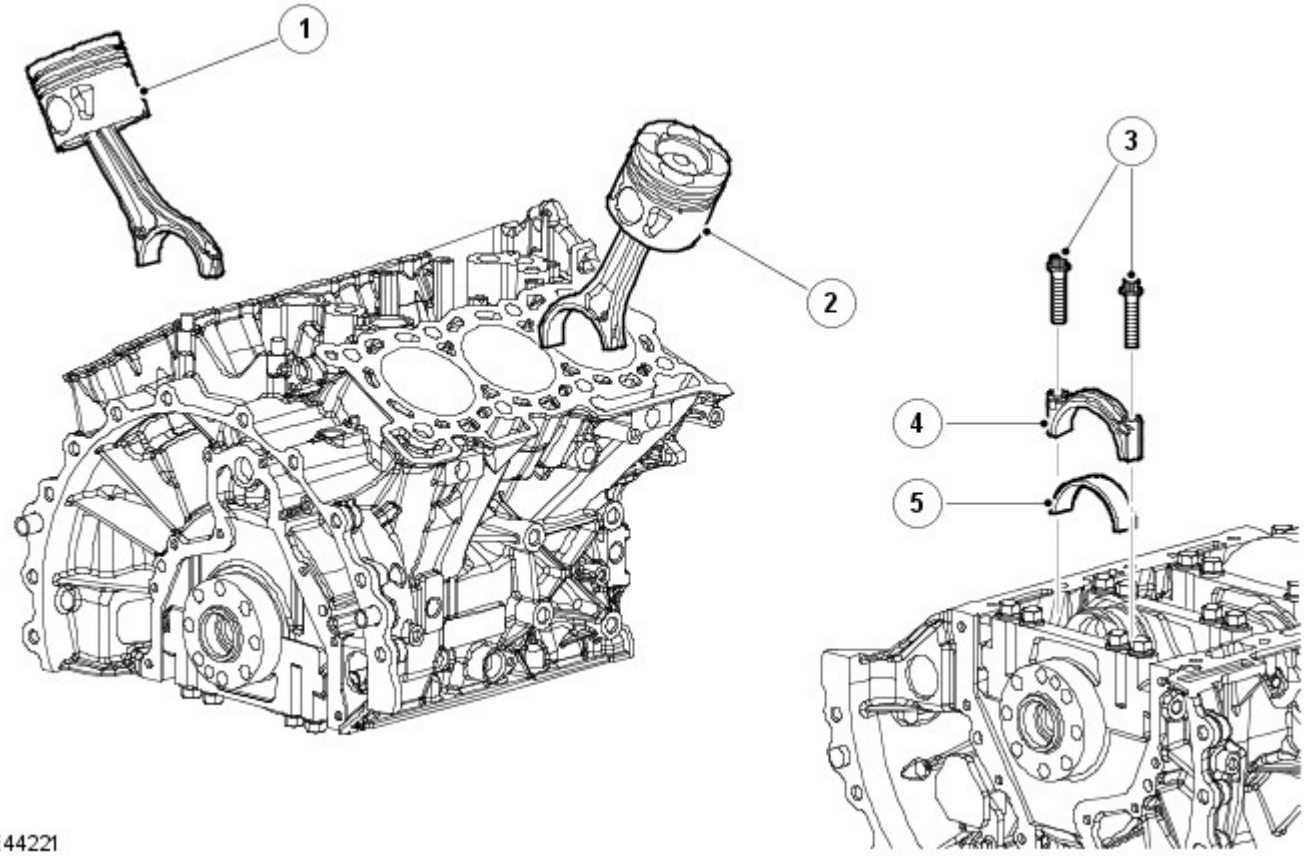
E52134

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

The connecting rods have fracture-split bearing caps. The bearing caps are produced by fracturing the opposing sides of the connecting rod at the bearing horizontal center-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 connecting rod bearings are selective 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



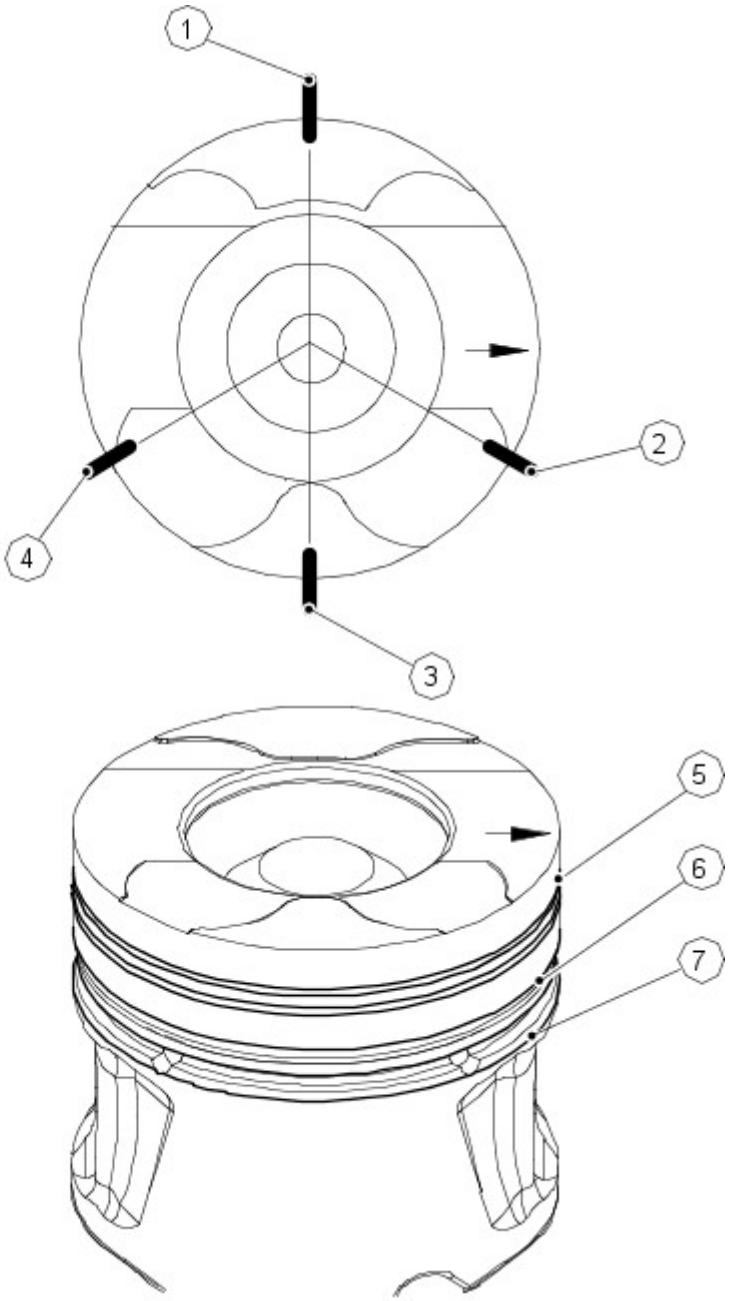
Item	Part Number	Description
1	-	Piston and connecting rod assembly, cylinders 4-6
2	-	Piston and connecting rod assembly, cylinders 1-3
3	-	Bolts (12 off)
4	-	Connecting rod bearing cap (6 off)
5	-	Connecting rod lower bearing (6 off)

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

The pistons are 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 bushing in the connecting rod.



E52133

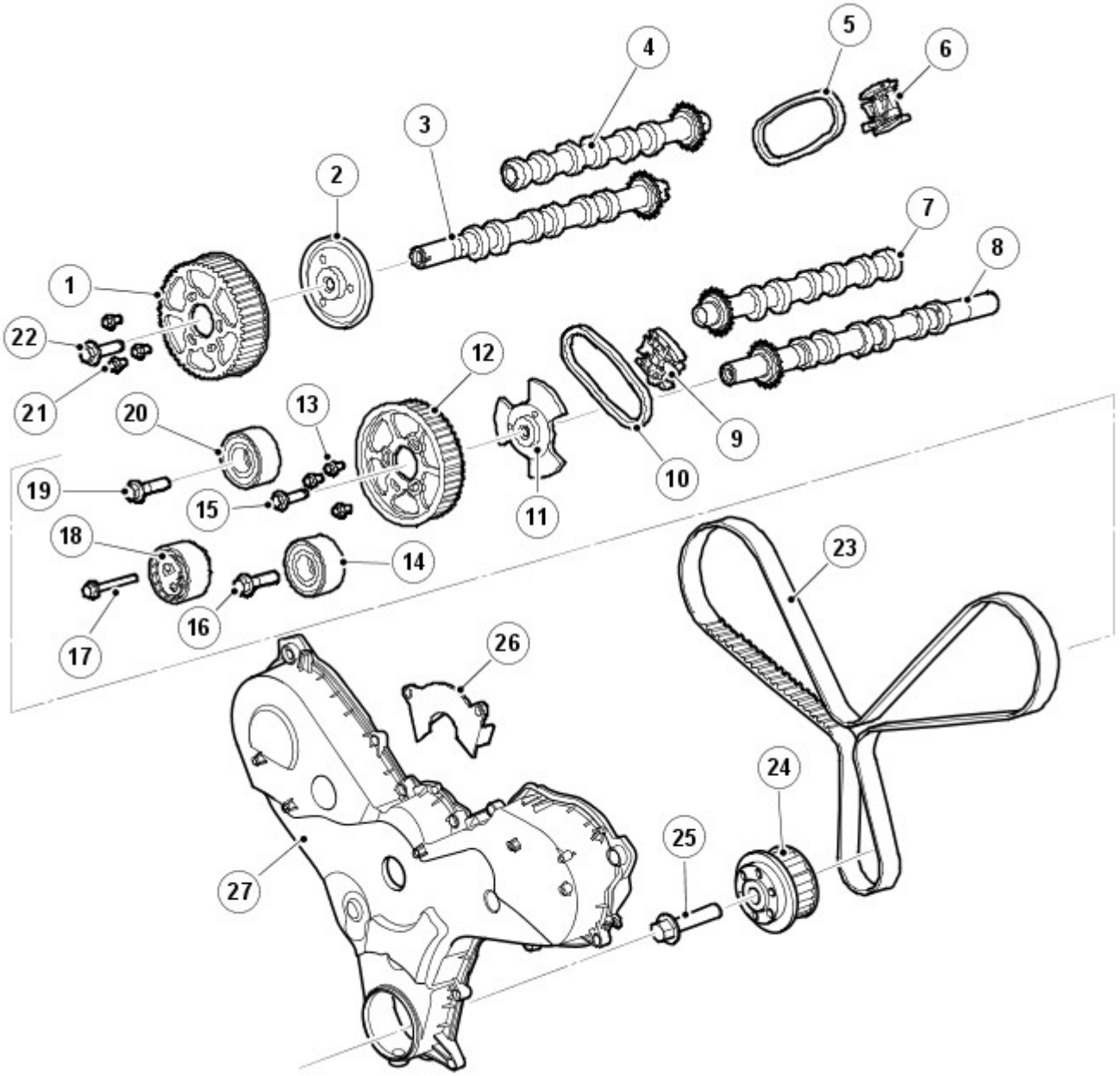
Item	Part Number	Description
1	-	Ring gap oil control
2	-	Ring gap upper compression
3	-	Spiral joint oil control
4	-	Ring gap lower compression
5	-	Upper compression ring
6	-	Lower compression ring
7	-	Oil control ring

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 beveled oil control ring must be opposite the spiral control joint.

Camshaft Timing Components

PRIMARY DRIVE



E142994

Item	Part Number	Description
1	-	Right camshaft timing pulley
2	-	Camshaft hub
3	-	Right exhaust camshaft
4	-	Right intake camshaft
5	-	Right crossover chain
6	-	Right chain tensioner
7	-	Left intake camshaft
8	-	Left exhaust camshaft
9	-	Left chain tensioner
10	-	Left crossover chain
11	-	Camshaft hub
12	-	Left camshaft timing pulley
13	-	Bolt (3 off)
14	-	Tensioner
15	-	Bolt
16	-	Bolt
17	-	Bolt
18	-	Idler
19	-	Bolt
20	-	Idler

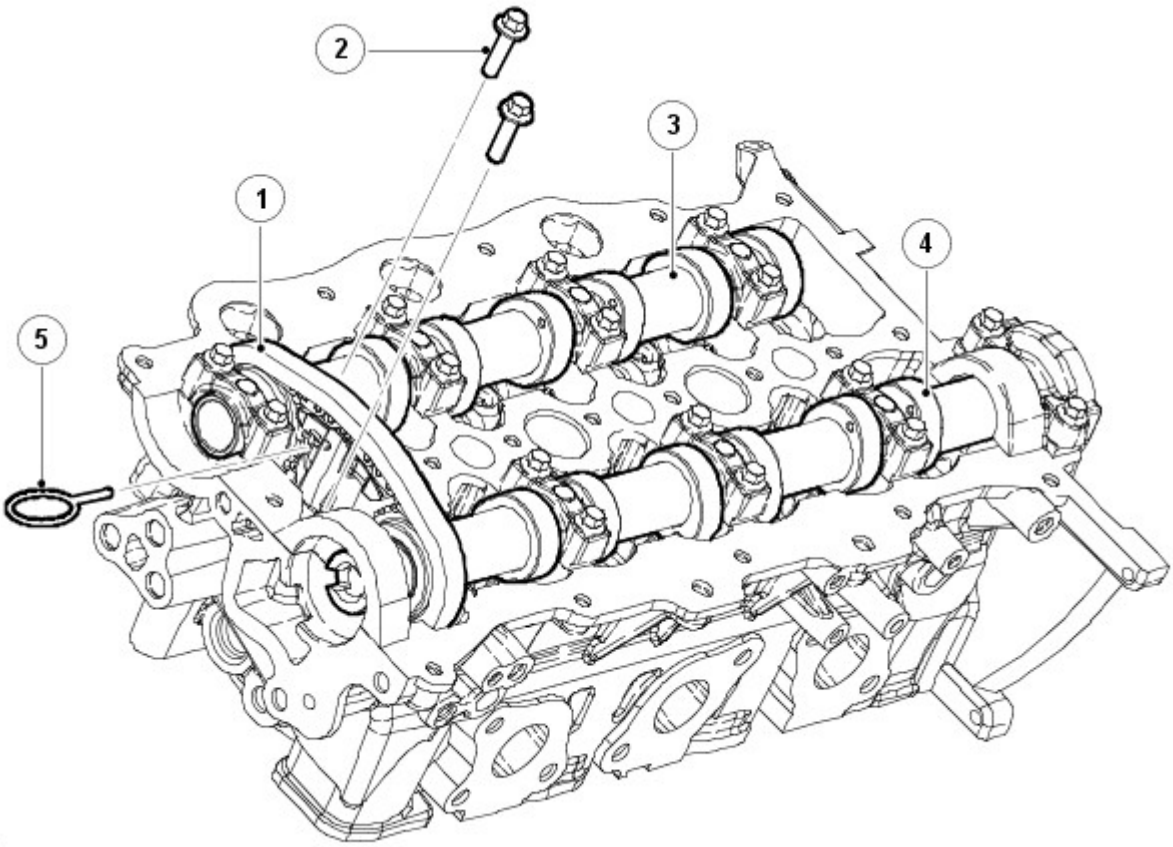
21	-	Bolt (3 off)
22	-	Bolt
23	-	Timing belt
24	-	Crankshaft sprocket
25	-	Bolt
26	-	Front cover bridge
27	-	Primary drive cover

Primary drive is provided by a toothed timing 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 the eccentric type tensioner mounted on the right front face of the cylinder block.

The primary drive cover is secured to the front of the cylinder block, cylinder heads, intake manifolds and oil pump housing. The cover is sealed with a gasket. A bridge piece closes the back of the cover in between the cylinder heads.

SECONDARY DRIVE



E44233

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

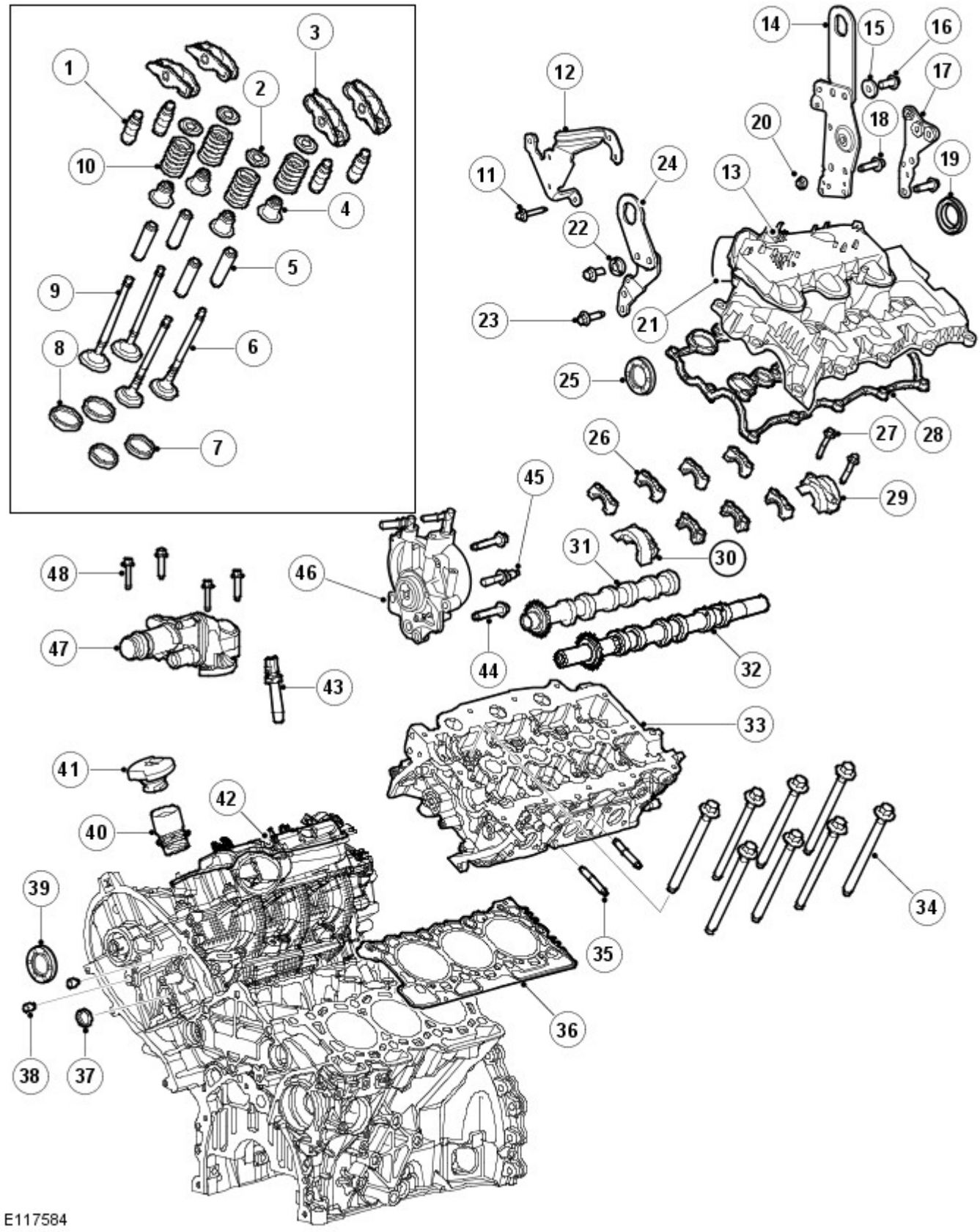
Secondary drive is provided by 2 short crossover chains, which transfer drive from the exhaust camshaft gears to the intake camshaft gears. The crossover drives are located at the rear of the right cylinder bank and the front of the left cylinder bank. This allows for a much shorter and simpler run for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

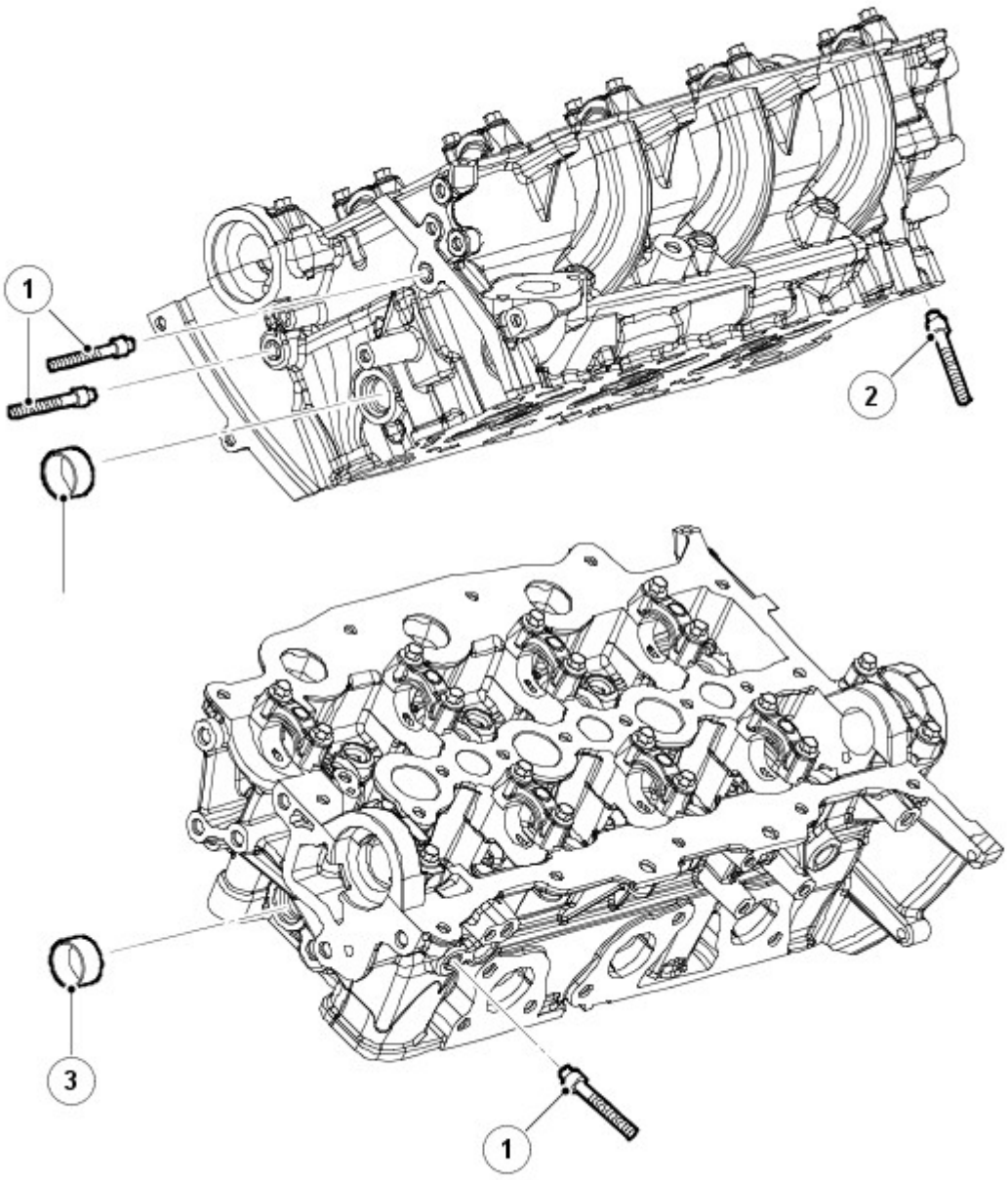
NOTE: Left cylinder head shown, right cylinder head similar.



Item	Part Number	Description
1	-	Hydraulic lash adjusters (12 off)
2	-	Valve spring retainers (12 off)
3	-	Rocker arms (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	-	Vacuum and oil scavenge pump
47	-	Water outlet assembly
48	-	Bolt (4 off)

CYLINDER HEADS



E44236

Item	Part Number	Description
1	-	Studs
2	-	Bolts
3	-	Blanking plug

The 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 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.
For additional information, refer to: Specifications (303-01F, 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 tube construction, with pressed on lobes. Each camshaft is retained by 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 left 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: Fuel Charging and Controls (303-04A, Description and Operation).

The exhaust camshaft gear of the left cylinder head also incorporates a reluctor ring, which is used in conjunction with the CMP (camshaft position) sensor to measure engine position.
For additional information, refer to: Electronic Engine Controls (303-14F, Description and Operation).

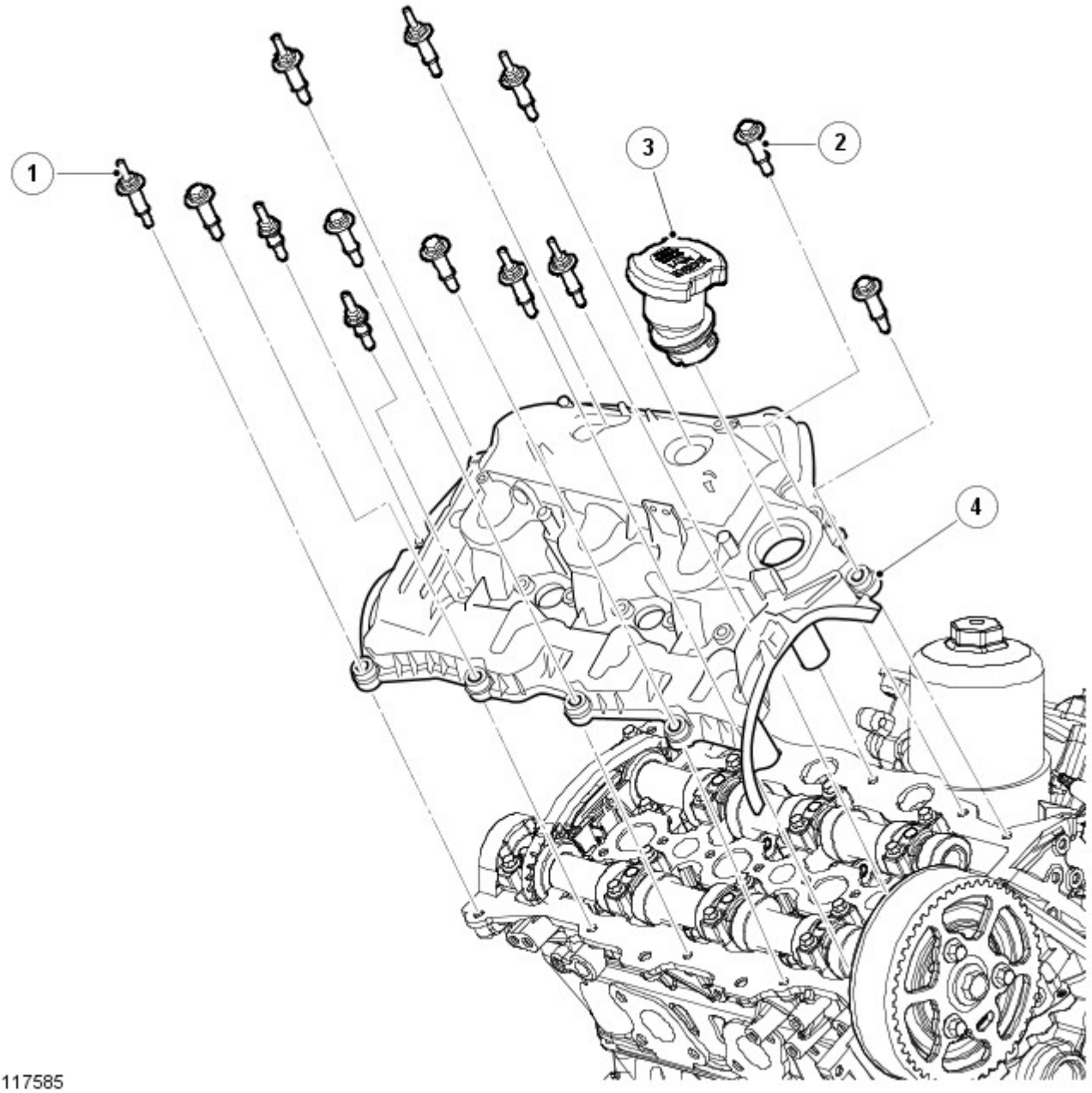
The right cylinder head exhaust camshaft is machined at the rear end to provide a drive connection for the vacuum and oil scavenge pump.

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

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: Glow Plug System (303-07C, Description and Operation).

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



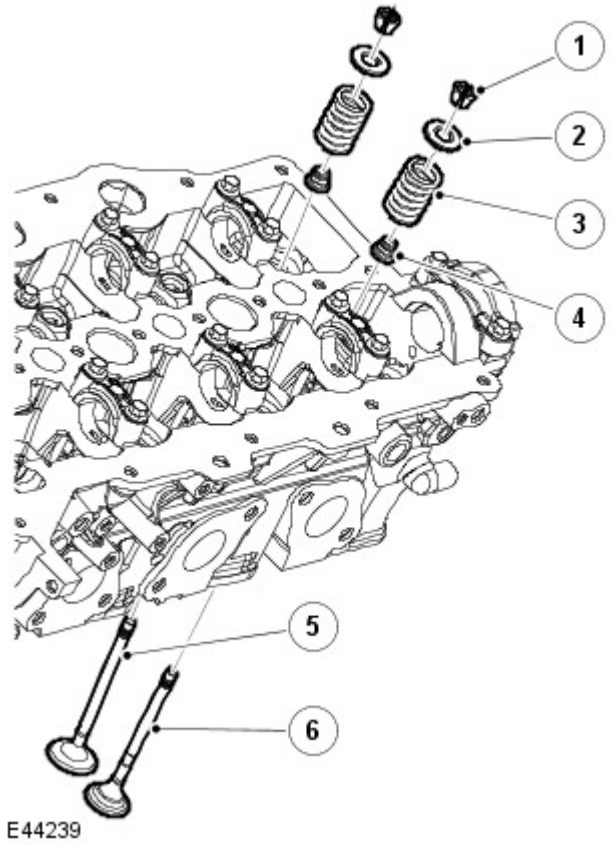
E117585

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

The right bank camshaft cover incorporates an outlet for the full load engine breather and the engine oil filler cap. The left bank camshaft cover incorporates an outlet for the part load engine breather.
For additional information, refer to: Engine Emission Control (303-08A, Description and Operation).

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.

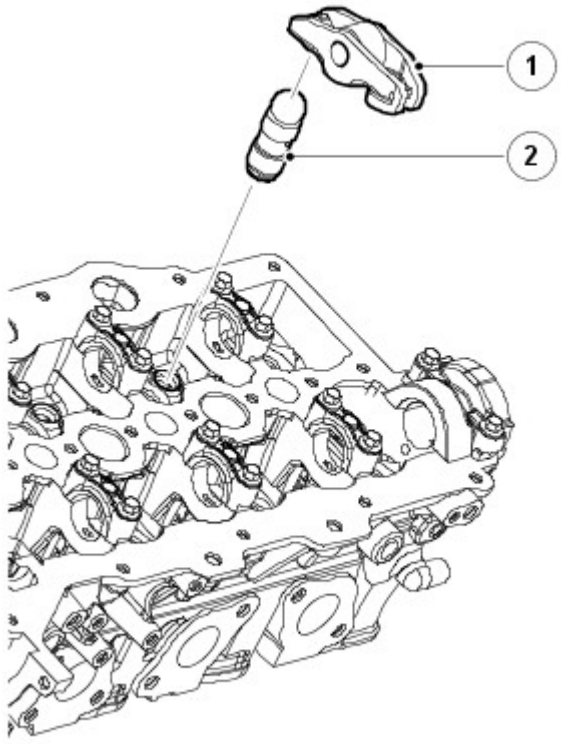
INTAKE AND EXHAUST VALVES



Item	Part Number	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 rocker arms with hydraulic lash adjusters.

ROCKER ARMS AND HYDRAULIC LASH ADJUSTERS

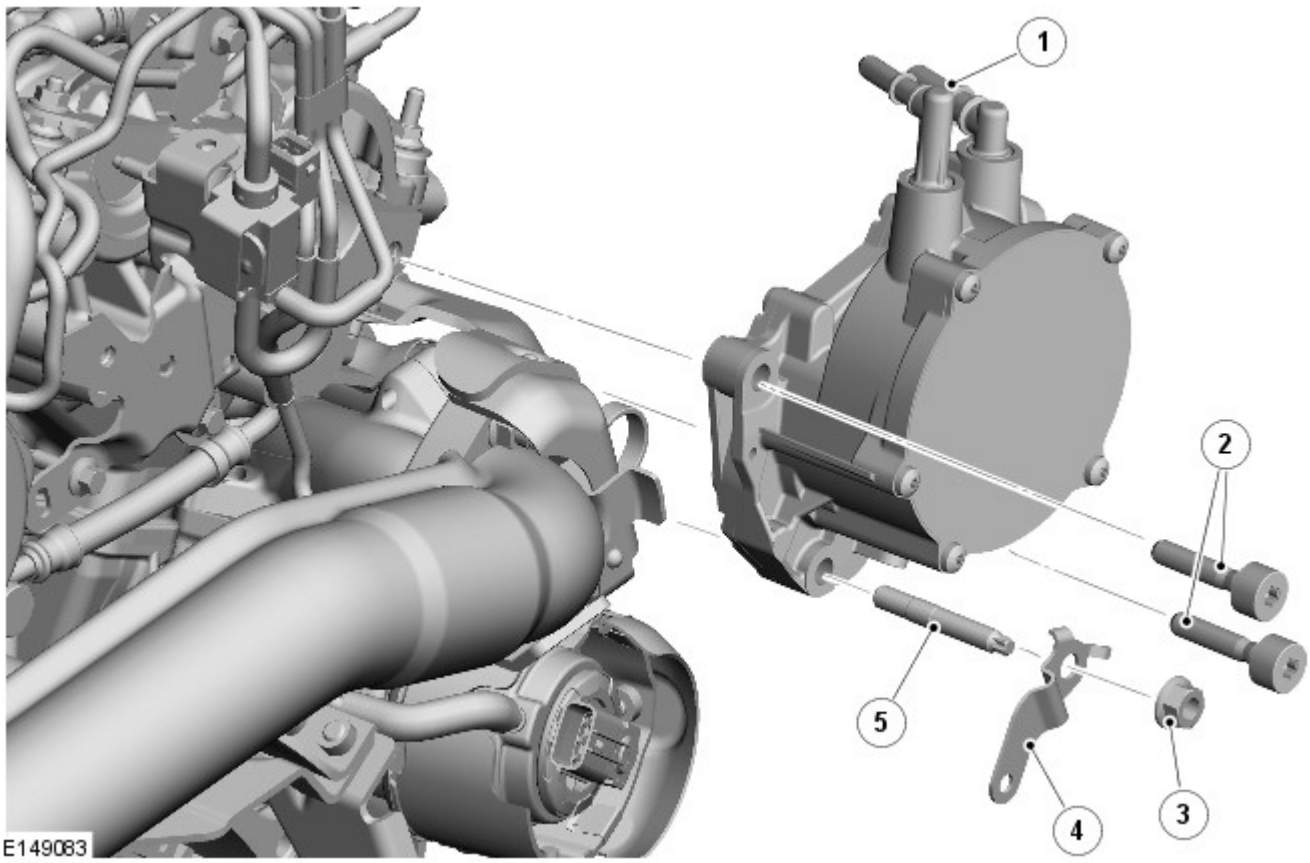


E44238

Item	Part Number	Description
1	-	Rocker arm (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 seats and guide inserts. Valve spring collets, collars seats locate single valve springs on both intake and exhaust valves. Valve stem seals are integrated into the valve spring seats.

VACUUM AND OIL SCAVENGE PUMP



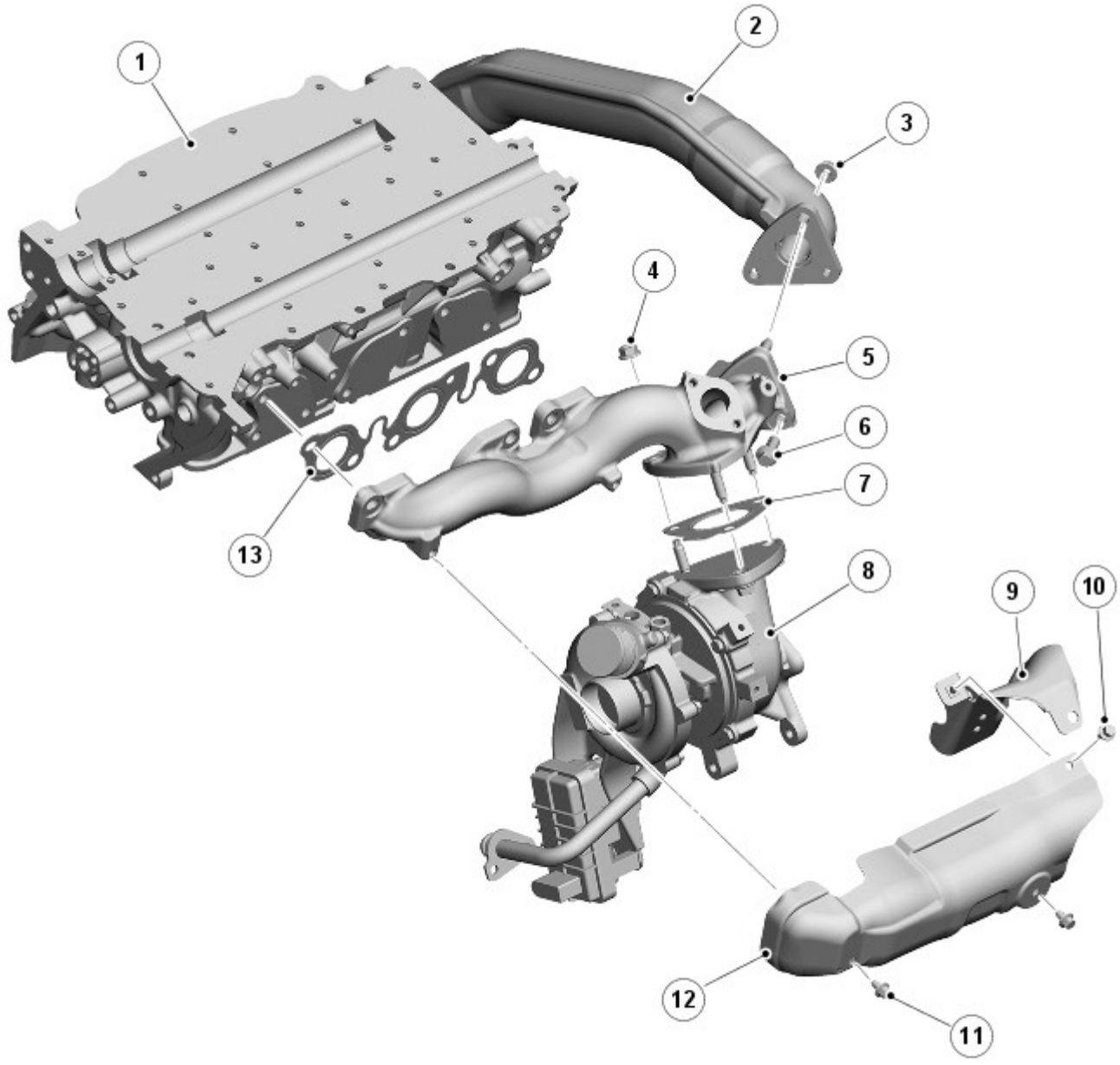
E149083

Item	Part Number	Description
1	-	Vacuum pipe connections
2	-	Torx bolt (2 off)
3	-	Nut
4	-	Bracket (emission hose)
5	-	Stud

The vacuum and oil scavenge pump is located at the rear of the right cylinder head and driven from the exhaust camshaft. The pump provides the vacuum used by the EGR (exhaust gas recirculation), turbocharger and brake booster systems, and scavenges oil from the turbochargers.

EXHAUST MANIFOLDS

NOTE: Left exhaust manifold shown, right exhaust manifold similar.



E115531

Item	Part Number	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)

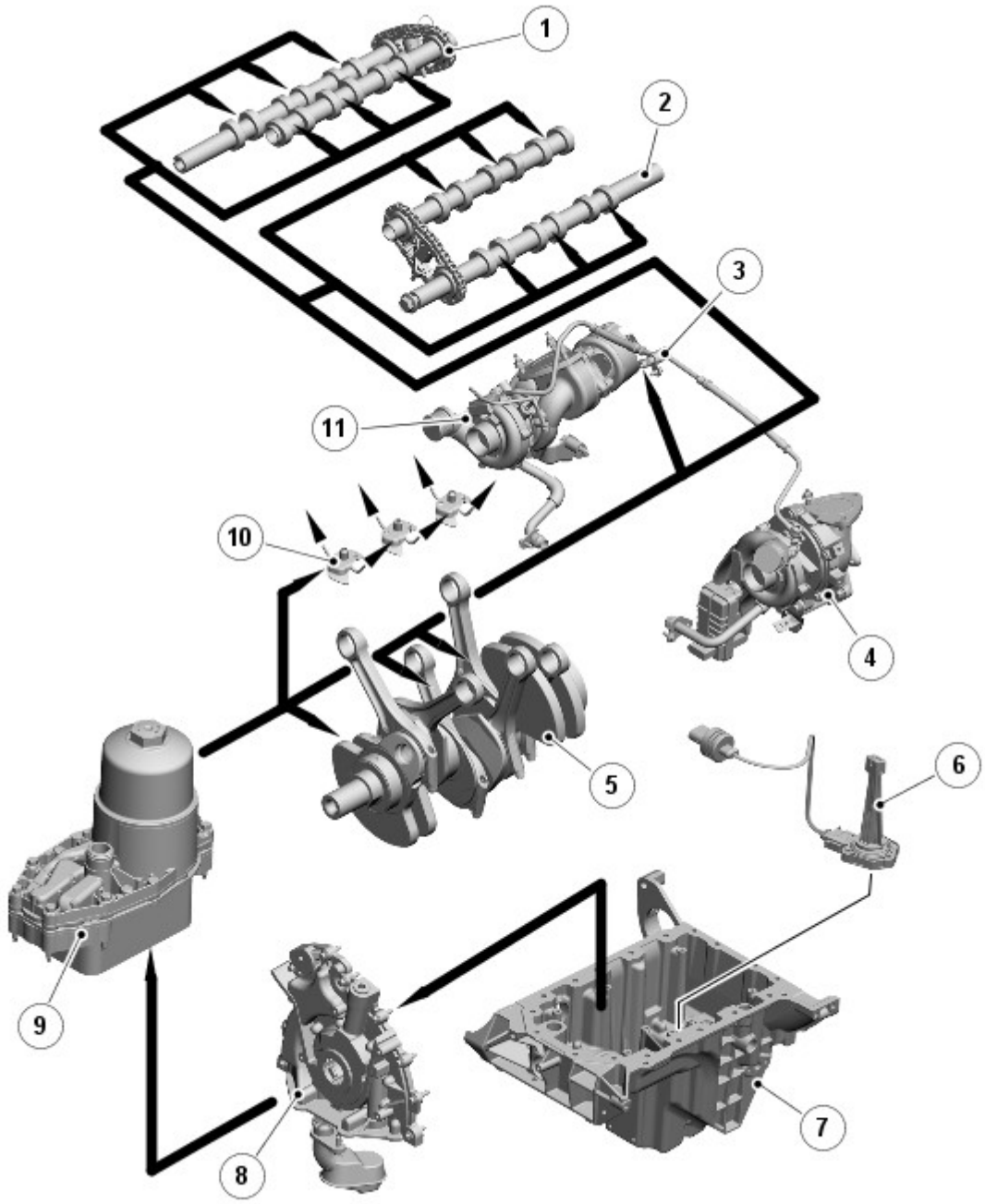
9	-	Manifold rear heat shield
10	-	Bolt
11	-	Bolt (2 off)
12	-	Manifold heat shield

The exhaust manifolds are sealed to the cylinder head by means of a gasket. Sacrificial 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 transfer pipe.

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

Lubrication System



E117573

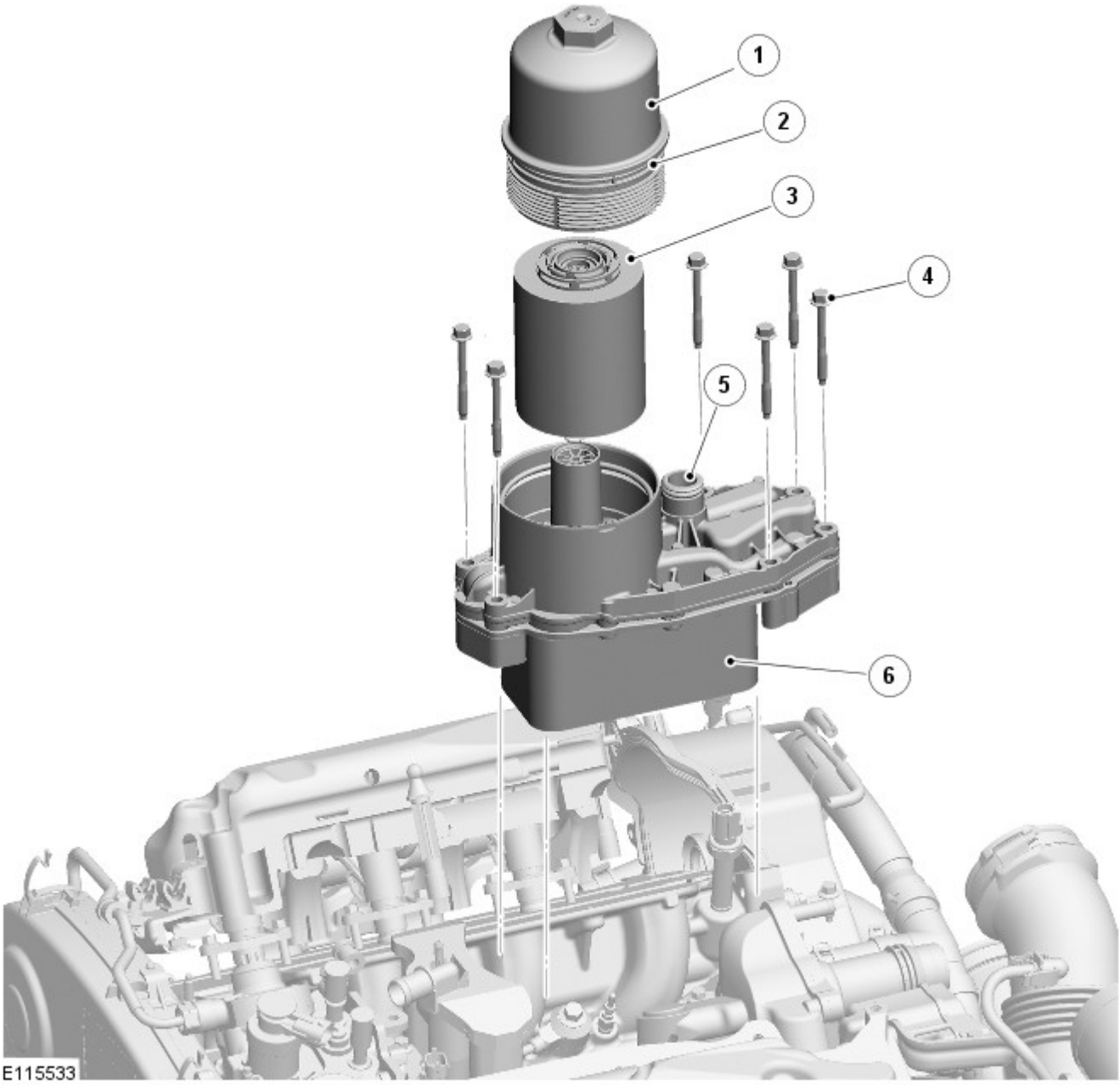
Item	Part Number	Description
1	-	Intake camshaft
2	-	Exhaust camshaft
3	-	Turbocharger oil supply
4	-	Primary turbocharger
5	-	Crankshaft and connecting rods
6	-	Oil level and temperature sensor
7	-	Oil pan
8	-	Oil pump

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 lash adjusters and the timing gear chain tensioners.

OIL COOLER AND FILTER ASSEMBLY



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

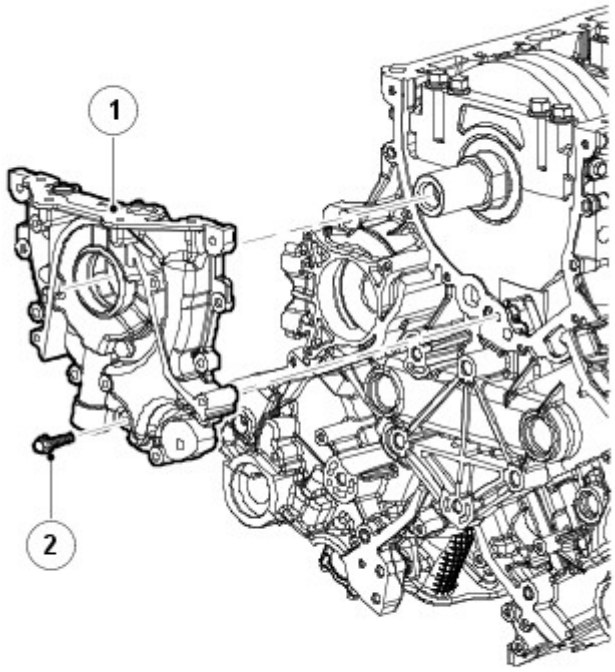
The engine is lubricated by a force-feed oil circulation system with a full flow oil filter. The oil cooler forms a unit with the oil filter, which is mounted centrally in the middle of the cylinder block between the 2 banks of cylinders. The engine oil is cooled using the engine cooling system.

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 right camshaft cover.

The 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 intake prevents debris from entering the oil system.

OIL PUMP



E44230

Item	Part Number	Description
1	-	Oil pump
2	-	Bolt (10 off)

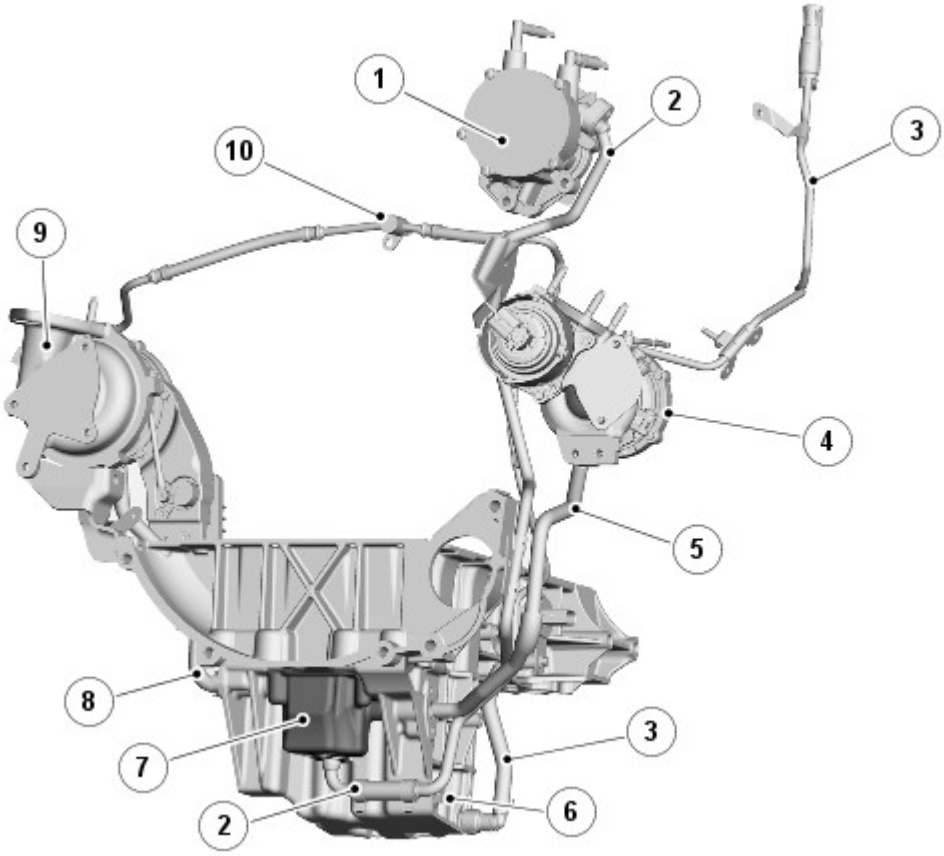
The oil pump is a gear type pump and is bolted and doweled to the front of the cylinder block. It is sealed by means of a gasket, which is recessed into the oil pump housing. The pump intake and outlet ports align with oil passages in the cylinder block.

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/in²).

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.

OIL PAN



E142995

Item	Part Number	Description
1	-	Vacuum and oil scavenge pump
2	-	Oil scavenge pipe
3	-	Oil extraction tube
4	-	Secondary turbocharger
5	-	Secondary turbocharger oil return tube
6	-	Drain plug
7	-	Secondary reservoir
8	-	Primary turbocharger oil return tube
9	-	Primary turbocharger
10	-	Turbocharger oil feed pipes

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. At extreme angles there is a risk the turbochargers may be below the oil level in 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 reservoir of the oil pan.
- A secondary reservoir in the oil pan, sealed off from the main reservoir, to receive oil from the turbocharger bearings.
- The vacuum and oil scavenge pump to assist the oil flow from the turbocharger bearings by scavenging oil from the secondary reservoir into the right camshaft cover.

For service, a drain plug and an oil extraction tube are installed to drain the main body of the oil pan.

OIL LEVEL CHECK

The engine oil level can be displayed in the message center on the instrument cluster.

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.

The method of checking the oil level can be found in the oil draining and filling procedures. For additional information, refer to: (303-01F)

Engine Oil Draining and Filling (General Procedures),
Engine Oil Vacuum Draining and Filling (General Procedures).

OPERATION

Operation of the engine is controlled by the ECM.
For additional information, refer to: Electronic Engine Controls (303-14F, Description and Operation).

Published: 13-Jan-2014

Engine - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Engine Oil Draining and Filling

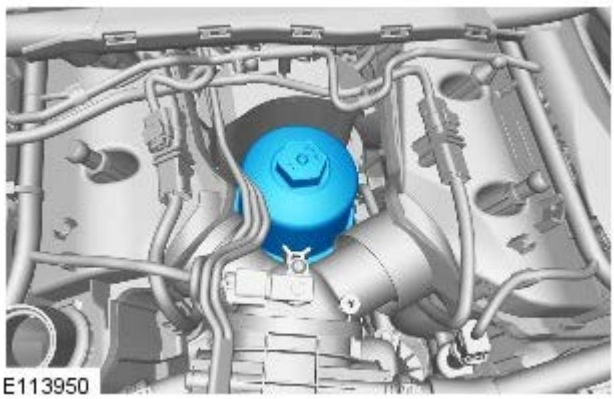
General Procedures

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: Engine Cover - TDV6 3.0L Diesel (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.

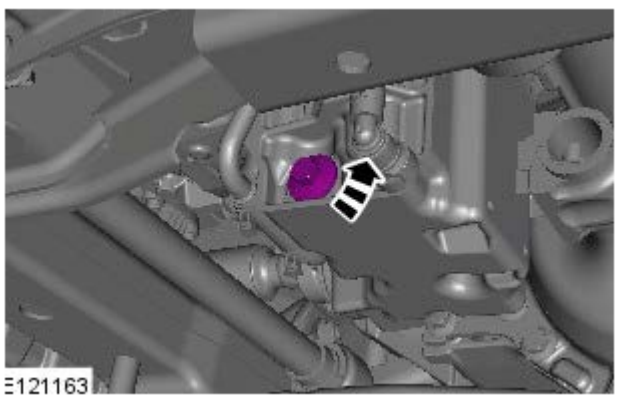

E113951

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

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

   Raise and support the vehicle.

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


E121163

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

   CAUTIONS:

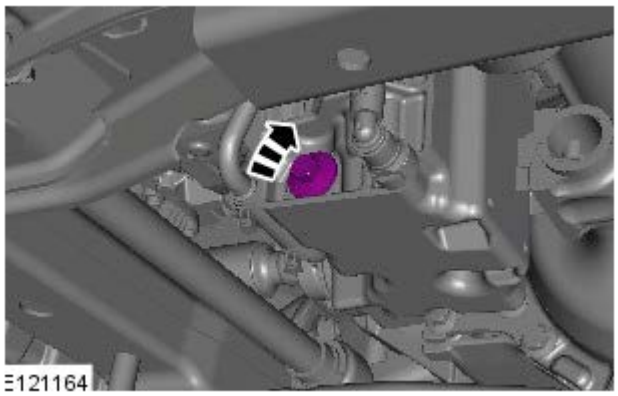
   Be prepared to collect escaping oil.

   Discard the bolt.

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

   Drain the engine oil.

Filling


E121164

1. CAUTIONS:

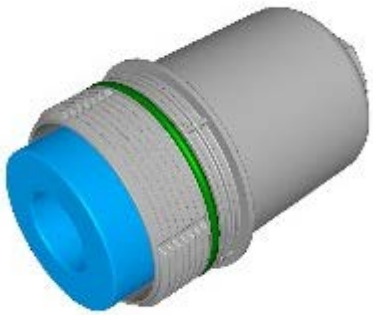
   Make sure that the component is clean, free of foreign material and lubricant.

   Make sure that a new bolt is installed.

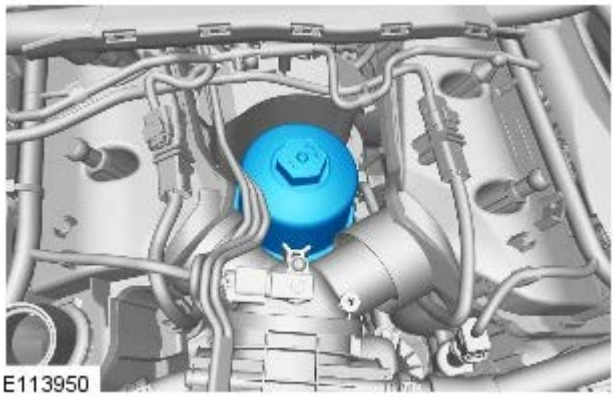
   Torque: 23 Nm

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

3. Lower the vehicle.


E129862

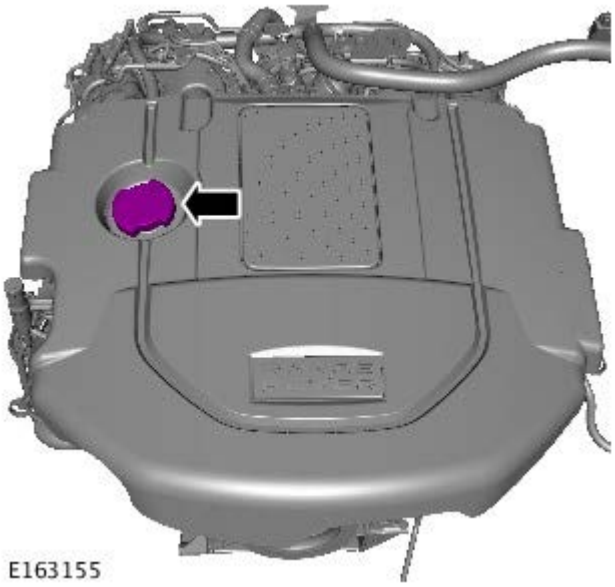
4.
   - Clean the components.
   - Install a new oil filter element to the oil filter cover.
   - Install a new oil filter cover O-ring seal.
   - Lubricate the O-ring seal with clean engine oil.


E113950

5. *Torque:* 28 Nm

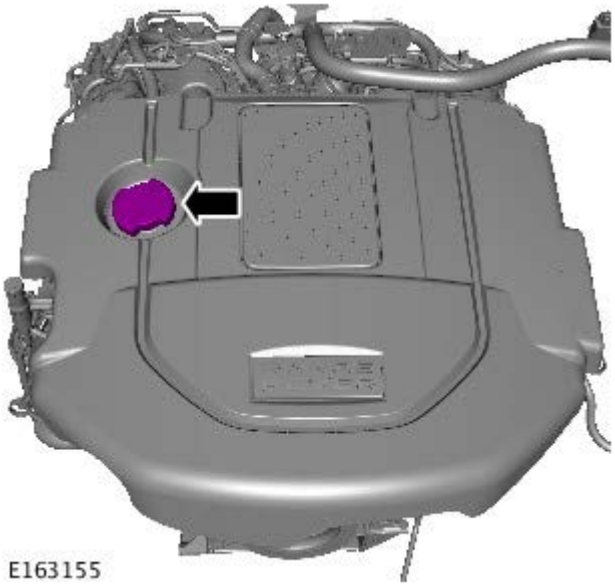
6. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05 Interior Trim and Ornamentation, Removal and Installation).

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



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

9.



10. CAUTION: Make sure that the vehicle has been left for 5 minutes from filling with oil.
    - Start the engine and allow to run for 10 minutes, stop the engine.
    - Check for leaks.

11. CAUTIONS:

    Make sure that the selector lever is in the park (P) position.

    Make sure that the hood is open.
    - Set the ignition to the ON position.

12.
    - Press the left-hand OK buton to access the Instrument Cluster (IC) Main Menu.



13.

- Press the left-hand directional button and select Service Menu.



14.

- Press the left-hand OK button.



E147184

15.

- Press the left-hand directional button and select the Oil Level display.



E147185

16.

- Press the left-hand OK button to access the Oil Level display.




E147181

17. CAUTION: Make sure that the hood is open.

- Press the speed control cancel button twice within 2 seconds while being on the oil level display.

18.

- The message center displays the actual oil level in service mode.
- 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.



19. Set the ignition to the OFF position.
20. Allow 10 minutes for the engine oil level to stabilize if there has been additional oil top up.

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

21. Repeat step 11 to 17 to access the oil level display in service mode.



22. NOTE: The actual volume displayed on the bar graph will be written into the electronic control unit as a new value.
    - Press and hold the speed control cancel button for more than 5 seconds.
    - The message center display the current oil level.

NOTE: Close the hood.

23. Set the ignition to the OFF position.
24. Set the ignition to the ON position.
25. NOTE: The following steps are to check the



current oil level in a customer mode.

- Press the left-hand OK button to access the Instrument Cluster (IC) Main Menu.

26.



- Press the left-hand directional button and select Service Menu.

27.

- Press the left-hand OK button.



E147184

28.

- Press the left-hand directional button and select the Oil Level display.

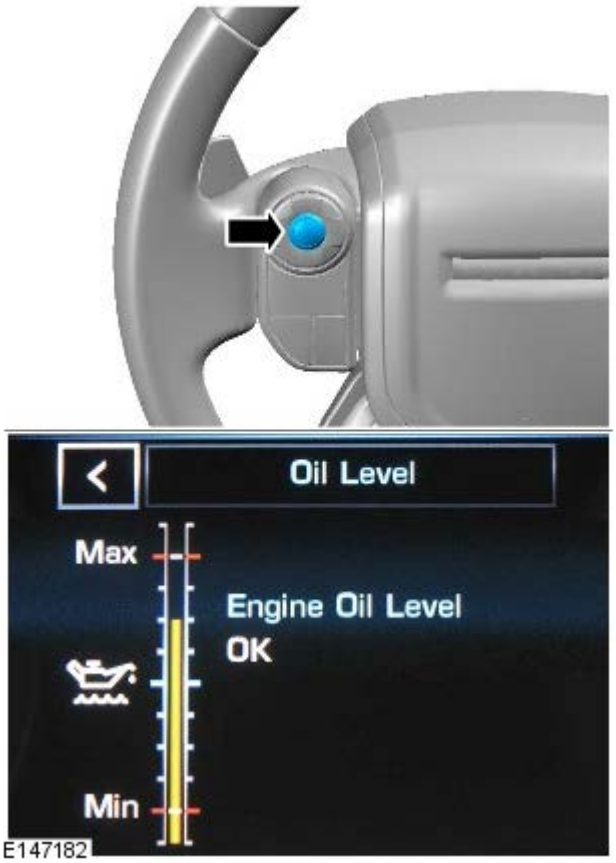


E147185

29.

- Press the left-hand OK button and follow the instructions.
- NOTE: If the message shows "Not available" wait for further 10 mins to allow the oil level to stabilize.

  Make sure that the average oil level value has now been updated.


Oil Level
Max
Engine Oil Level
OK
Min
E147182

Published: 13-Jan-2014

Engine - SDV6 3.0L Diesel - Hybrid Electric Vehicle - 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

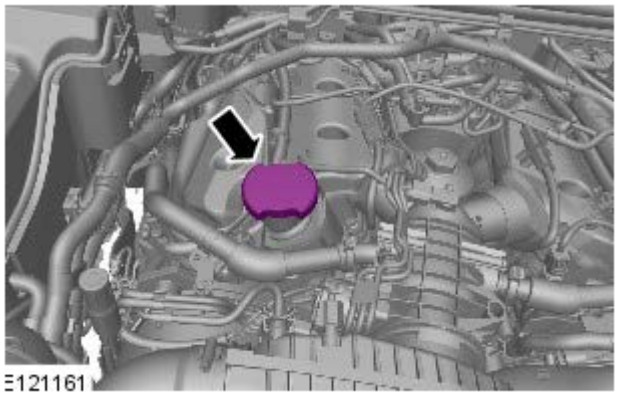
Draining

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

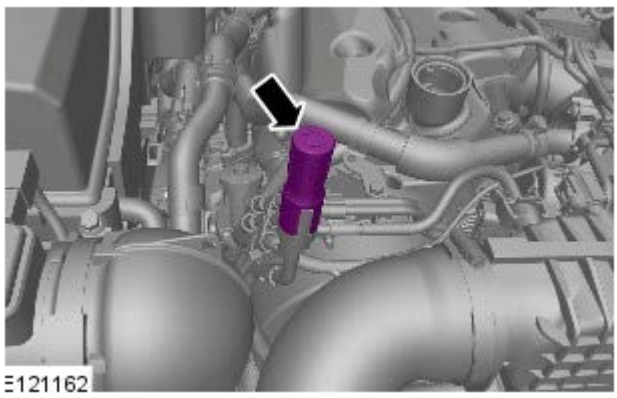
CAUTION: Make sure the engine is warm.

1. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05 Interior Trim and Ornamentation, Removal and Installation).

2.

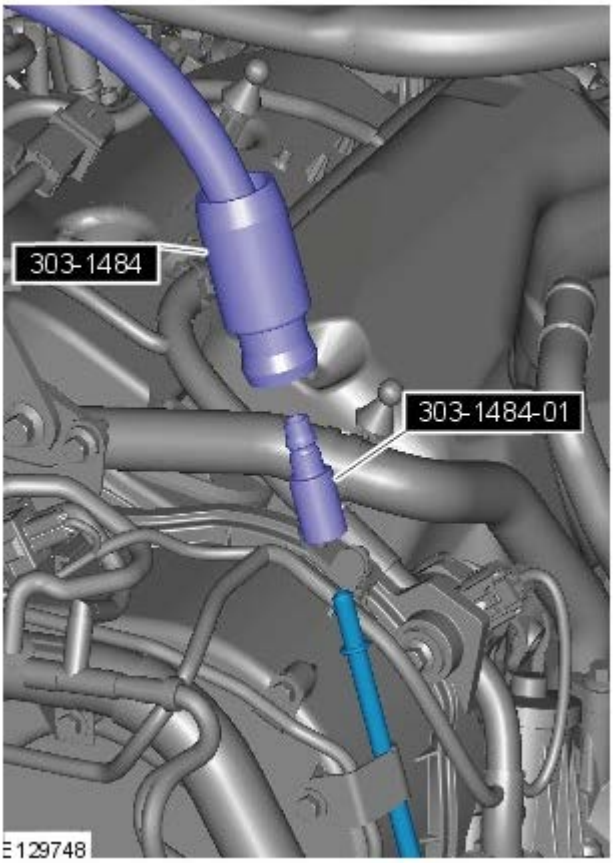

E121161

3.


E121162

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

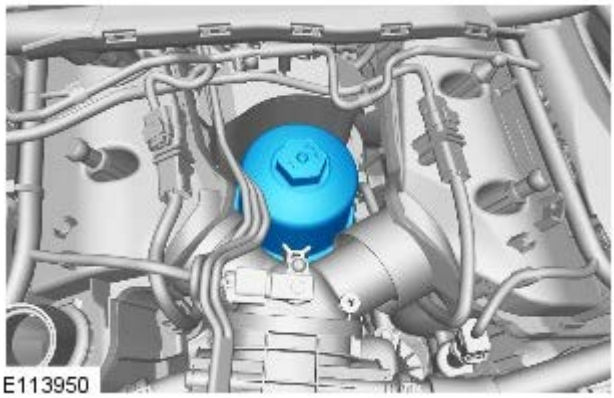
   Using the oil vacuum pump drain the oil out through the oil extraction tube.



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

5.

- Remove the oil vacuum pump.



6.

- 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.

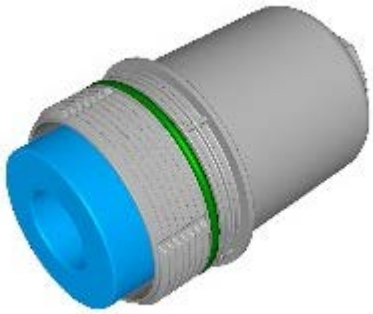


7. NOTE: Remove and discard the O-ring seal.

Filling

1.

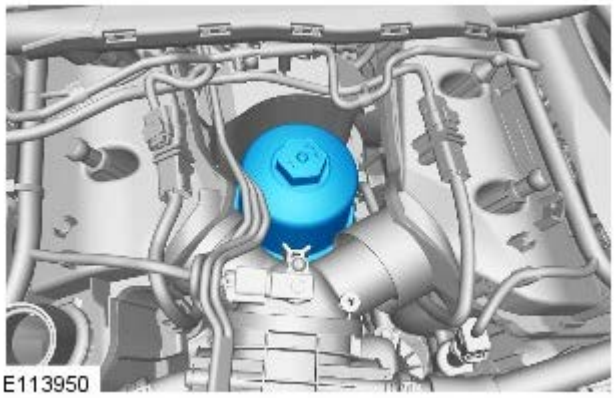
- Clean the components.
- Install a new oil filter element to the oil filter cover.
- Install a new oil filter cover O-ring seal.



E129862

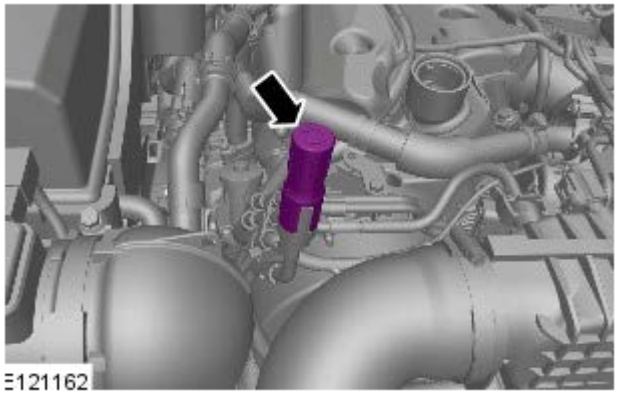
Lubricate the O-ring seal with clean engine oil.

2. *Torque:* 28 Nm



E113950

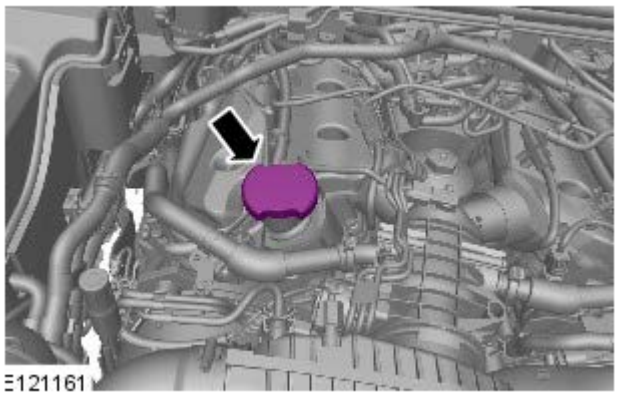
3.



E121162

4.

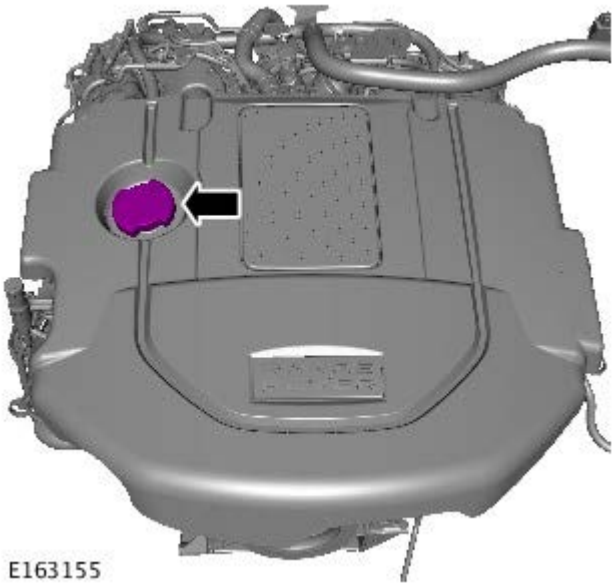
- Fill the engine with the recommended oil to the correct level.
- Clean any residual engine oil from the oil filler cap area.



E121161

5. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05 Interior Trim and Ornamentation, Removal and Installation).

6.



7. CAUTION: Make sure that the vehicle has been left for 5 minutes from filling with oil.
   - Start the engine and allow to run for 10 minutes, stop the engine.
   - Check for leaks.

8. CAUTIONS:

   Make sure that the selector lever is in the park (P) position.

   Make sure that the hood is open.
   - Set the ignition to the ON position.

9.
   - Press the left-hand OK button to access the Instrument Cluster (IC) Main Menu.



10.
   - Press the left-hand directional button and select

Service Menu.



11.

- Press the left-hand OK button.



12.

- Press the left-hand directional button and select the Oil Level display.



13.

- Press the left-hand OK button to access the Oil Level display.



14. CAUTION: Make sure that the hood is open.

- Press the speed control cancel button twice within 2 seconds while being on the oil level display.



E147181

15.

- The message center displays the actual oil level in service mode.
- Only after having started and run the engine for 10 minutes (as indicated in Step 7), 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.



E147272

16. Set the ignition to the OFF position.

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

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

18. Repeat step 8 to 14 to access the oil level display in service mode.

19. NOTE: The actual volume displayed on the bar graph will be written into the electronic control unit as a new value.

- Press and hold the speed control cancel button for more than 5 seconds.
- The message center display the current oil level.



NOTE: Close the hood.

20. Set the ignition to the OFF position.
21. Set the ignition to the ON position.
22. NOTE: The following steps are to check the current oil level in a customer mode.
    - Press the left-hand OK button to access the Instrument Cluster (IC) Main Menu.



23.
    - Press the left-hand directional button and select Service Menu.



24.

- Press the left-hand OK button.



25.

- Press the left-hand directional button and select the Oil Level display.



26.

- Press the left-hand OK button and follow the instructions.
- NOTE: If the message shows "Not available" wait for further 10 mins to allow the oil level to stabilize.

  Make sure that the average oil level value has now been updated.

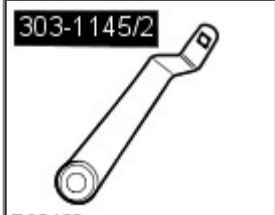
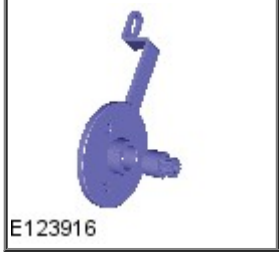


Published: 08-Aug-2012

Engine - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Camshaft LH

Removal and Installation

Special Tool(s)

	303-1124 Holding Tool, Camshaft Front Pulley
	303-1145/2 Remover, Camshaft Rear Pulley Bolt
	JLR-303-1523 Remover/Installer, Camshaft Rear Pulley

Removal

1. Refer to: Specifications (414-00, Specifications).
2. Refer to: Rear End Accessory Drive (READ) (303-05A Accessory Drive - TDV6 3.0L Diesel, Removal and Installation).
3. Refer to: Timing Belt (303-01A Engine - TDV6 3.0L Diesel, Removal and Installation).
4. Install the special tool.

   Special Tool(s): JLR-303-1523



5. Install the special tool.

   Special Tool(s): JLR-303-1523



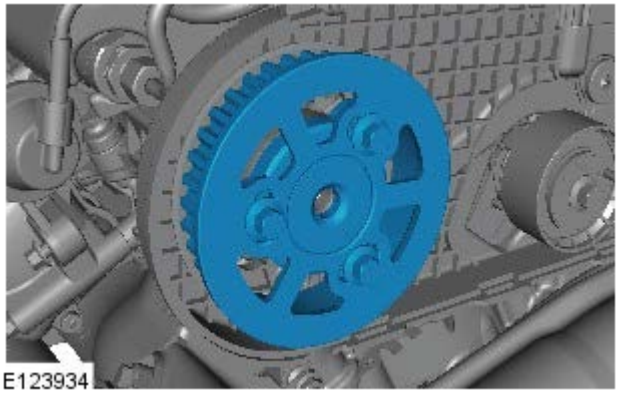
6. Using the special tool, remove the rear camshaft pulley retaining bolt.

   Special Tool(s): 303-1145/2

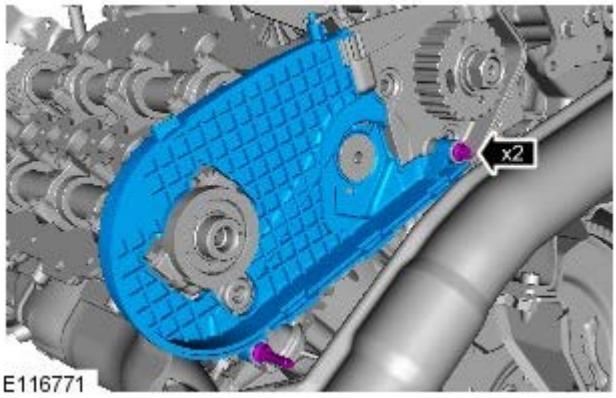


7. Remove the special tools.

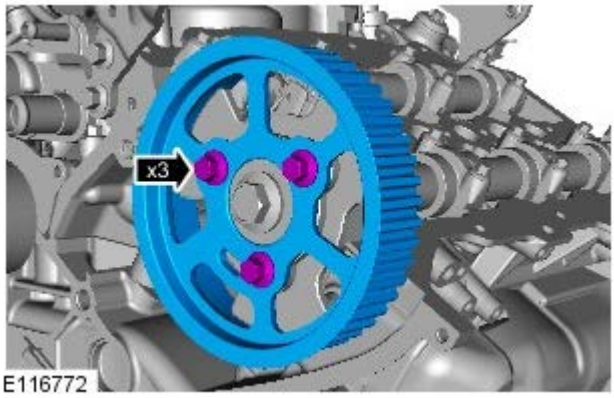
8.



9.

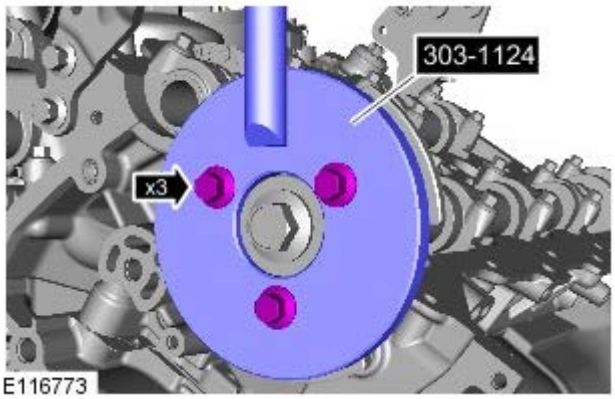


10.

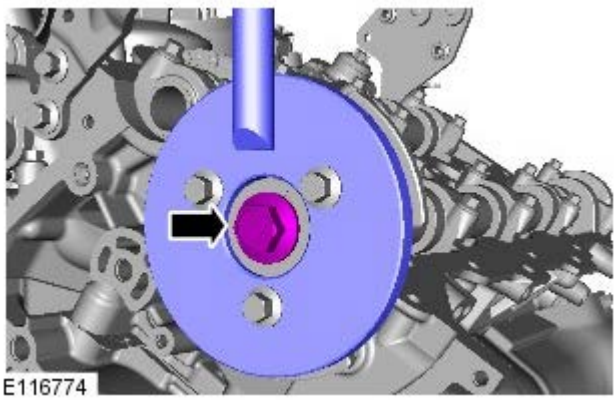


11. Install the special tool.

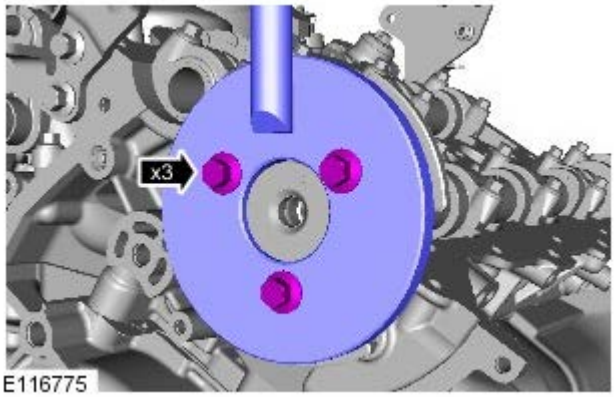
Special Tool(s): 303-1124



12.

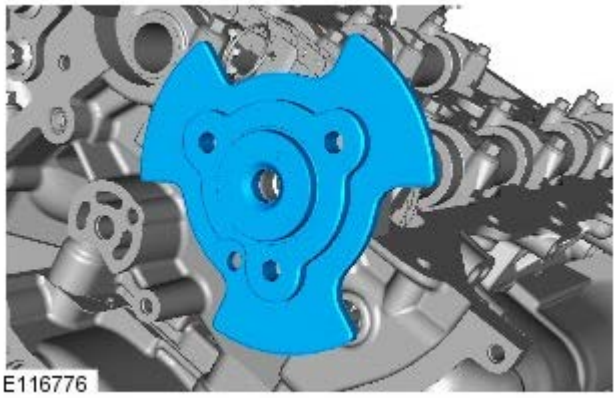


13. Remove the special tool.



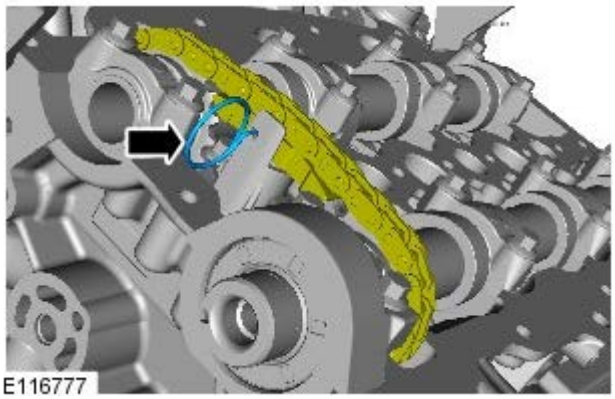
E116775

14.

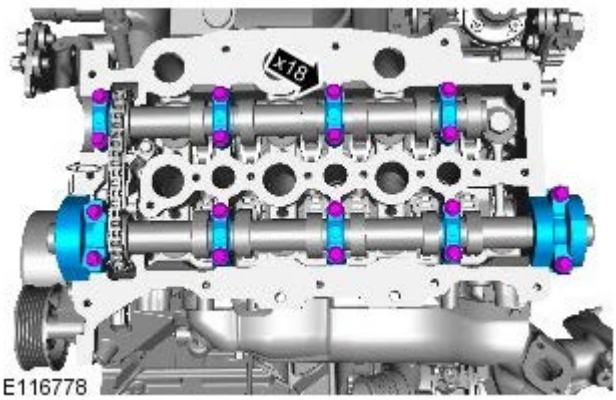

E116776

15.

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

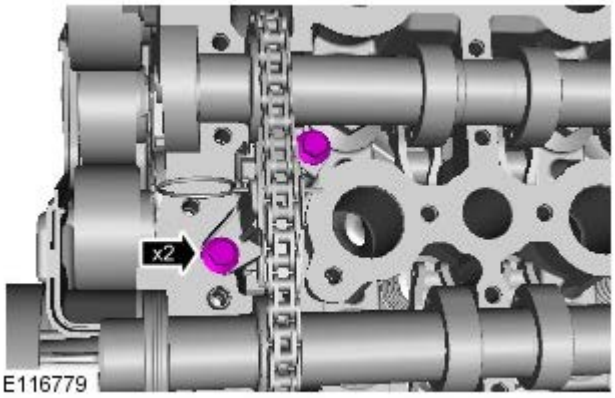

E116777

16. Remove the camshaft bearing caps evenly.

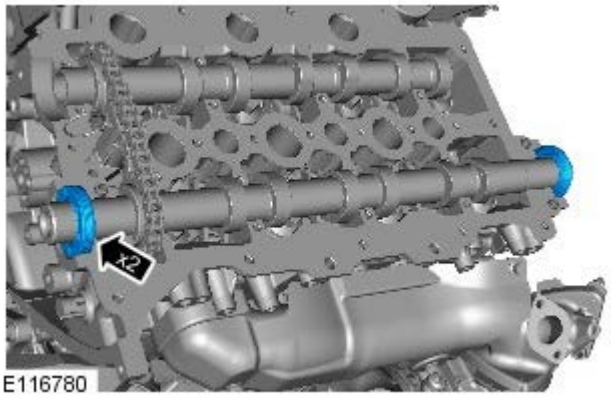


E116778

17.



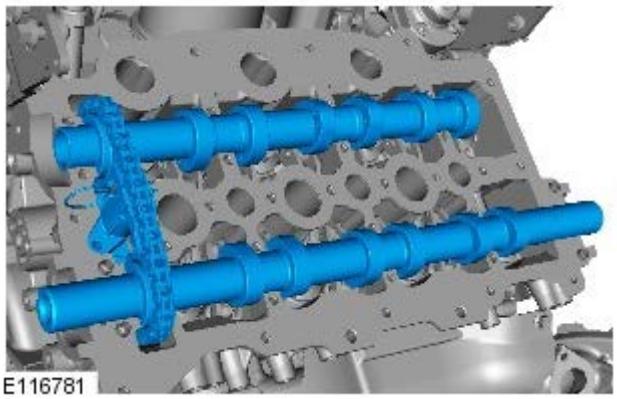
E116779



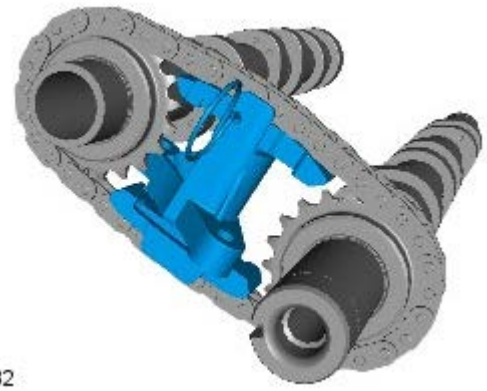
E116780

18. CAUTION: Discard the seals.

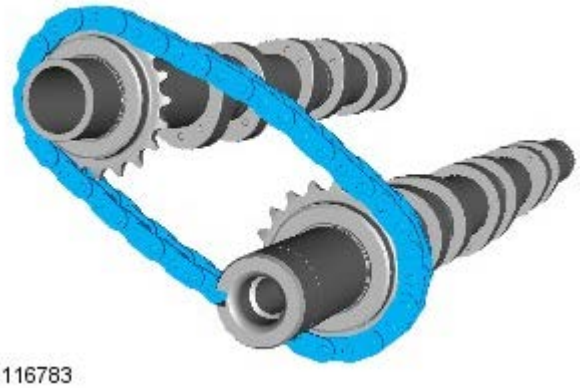
19.


E116781

20.


E116782

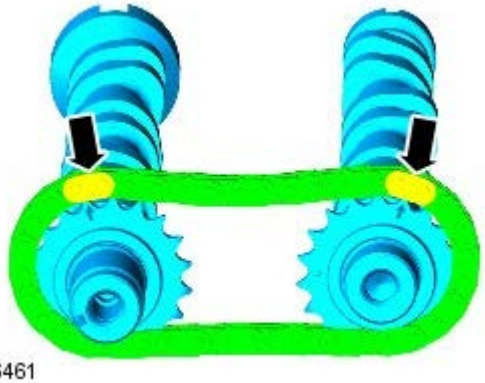
21. Remove the secondary timing chain from the camshafts.



E116783

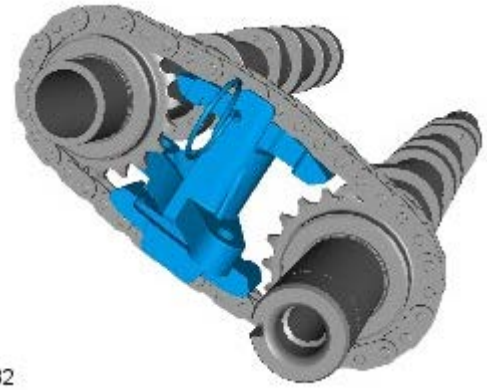
Installation

1. Install the secondary timing chain onto the camshafts.

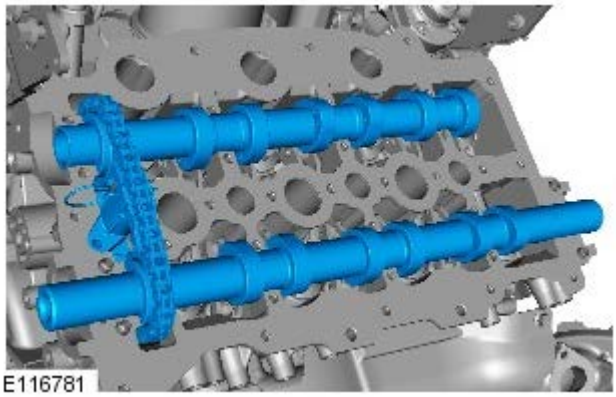


E86461

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.

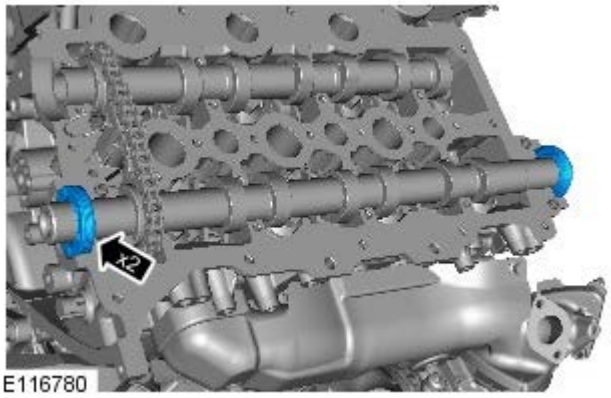
   NOTES:

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

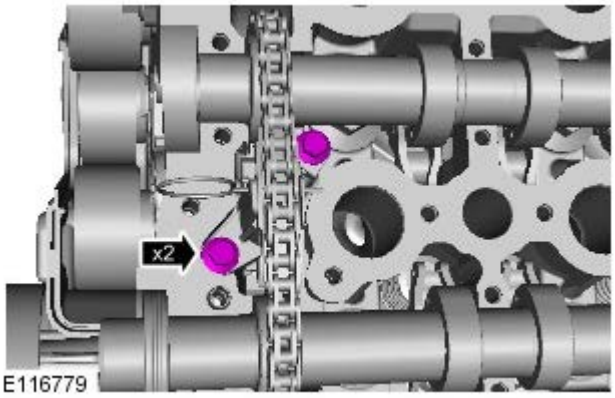
   Use hypoid oil to lubricate the camshafts.

   Install the camshafts.

4. NOTE: Install new seals.

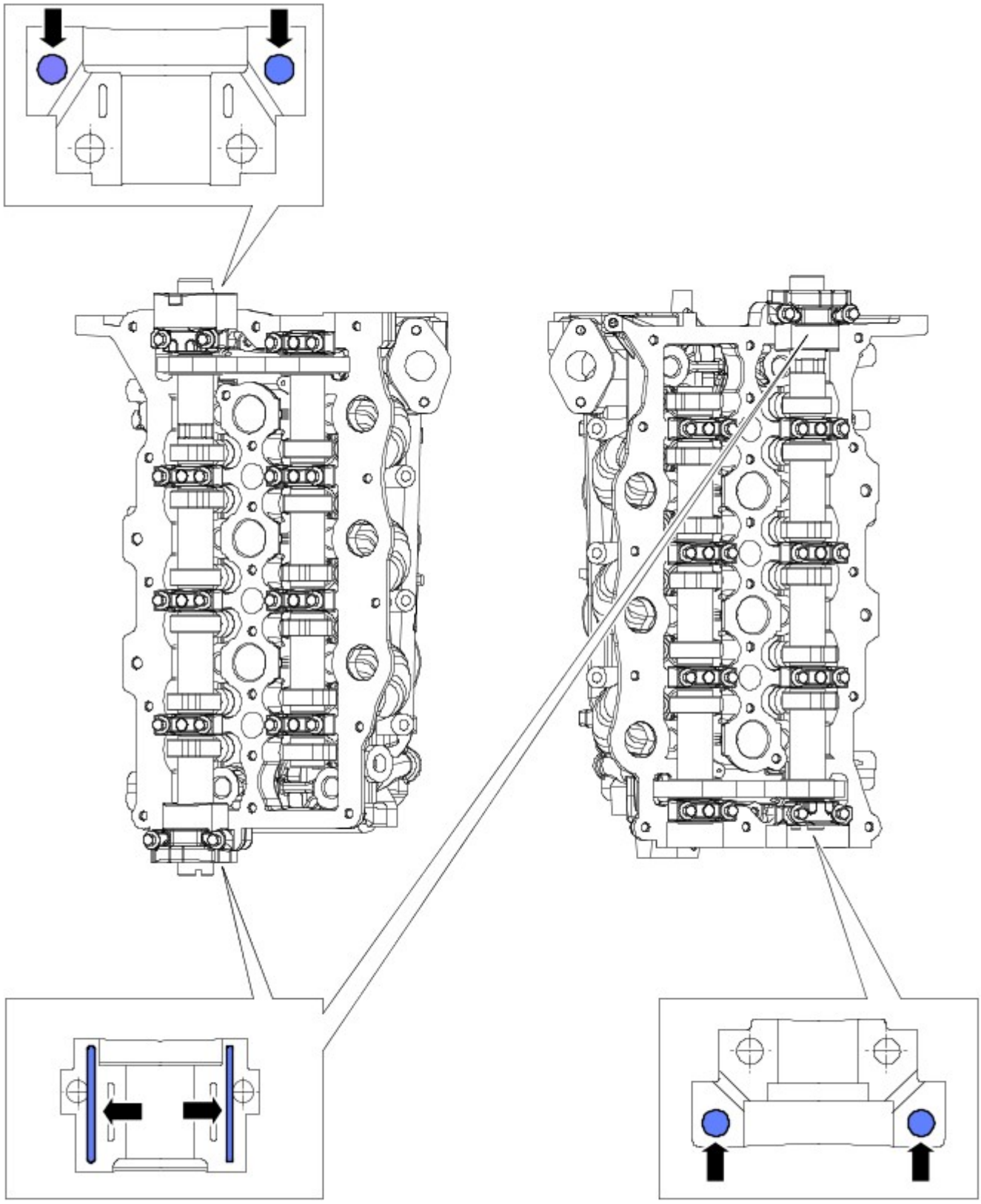


5. *Torque:* 10 Nm



6.

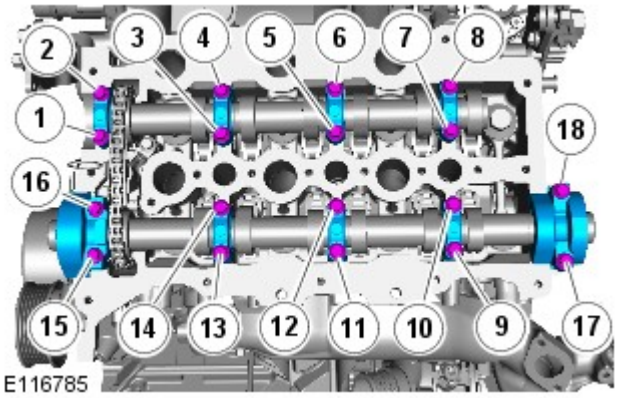
- Apply Loctite 518 sealant to the exhaust camshaft seal bearing caps.
- Apply Loctite 518 sealant, 2 mm wide, to the LH rear and RH front camshaft bearing caps.
- Apply Loctite 518 sealant, 7 mm diameter, to the LH front and RH rear camshaft bearing caps.



E116784

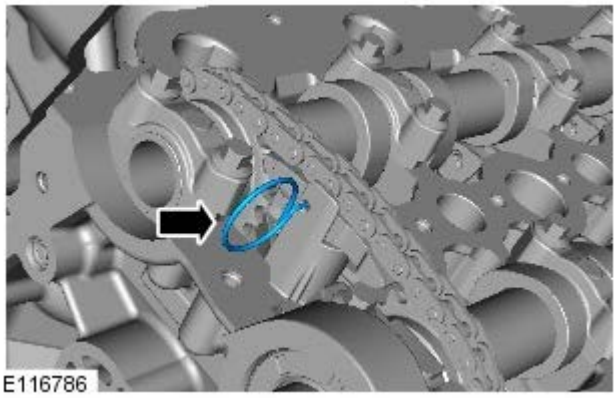
7. NOTE: Tighten the bolts in the indicated sequence.

- 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.

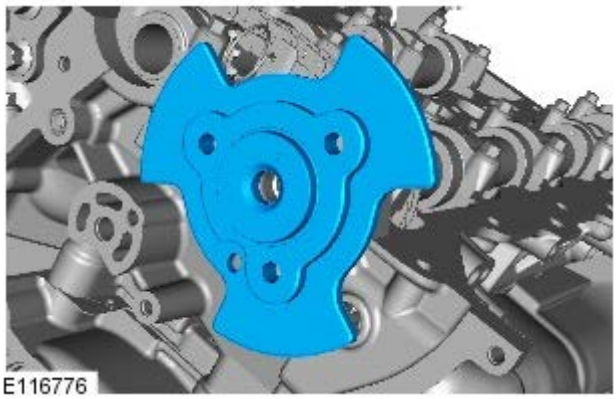


E116785

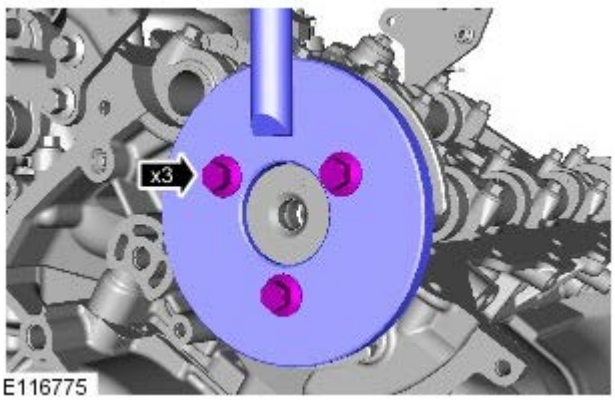
8. Remove the secondary timing chain tensioner retaining pin.


E116786

9.

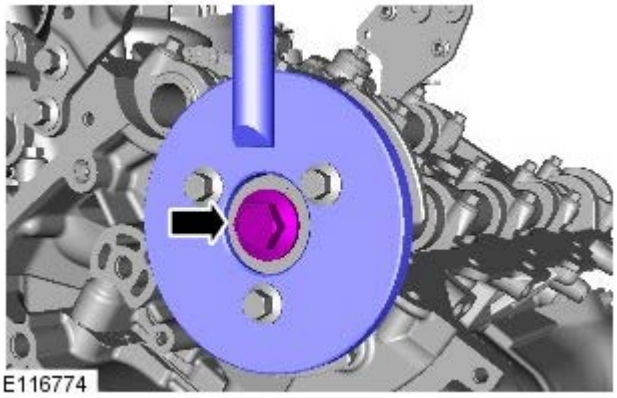

E116776

10. Install the special tool.

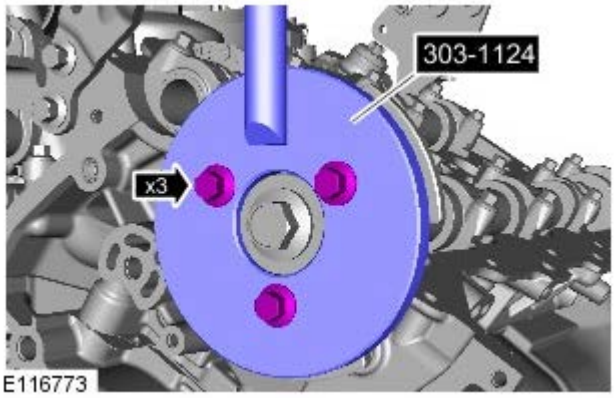


E116775

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

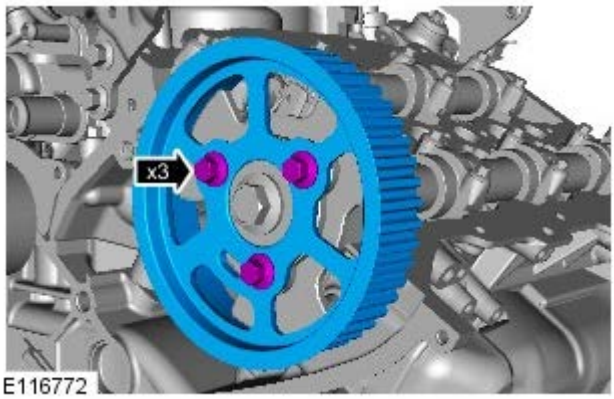

E116774

12. Remove the special tool.



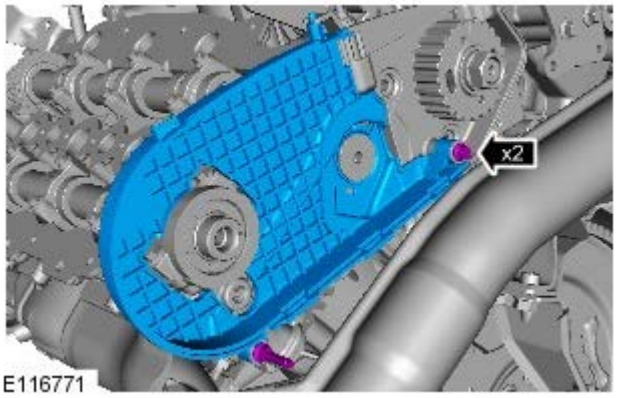
E116773

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



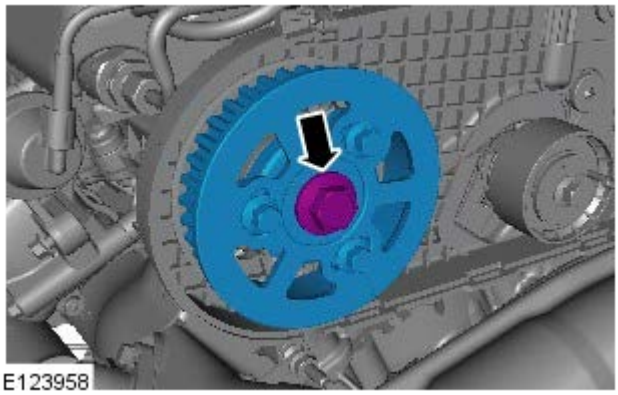
E116772

14. *Torque:* 10 Nm



E116771

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


E123958

16. Install the special tool.

    Special Tool(s): JLR-303-1523



E123893

17. Install the special tool.

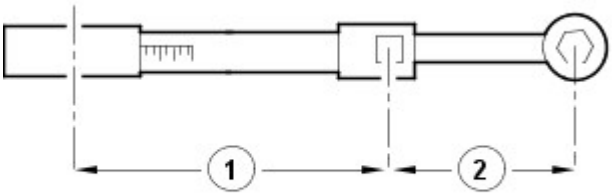
    Special Tool(s): JLR-303-1523



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

20. Remove the special tools.

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

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

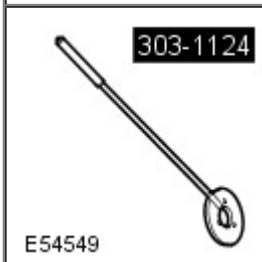
23. Refer to: Specifications (414-00, Specifications).

Published: 13-Dec-2013

Engine - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Camshaft RH

Removal and Installation

Special Tool(s)

	303-1117 Timing Peg, Automatic Transmission
	303-1124 Holding Tool, Camshaft Front Pulley
	303-1126 Timing Peg, Camshaft Pulley

Removal

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.

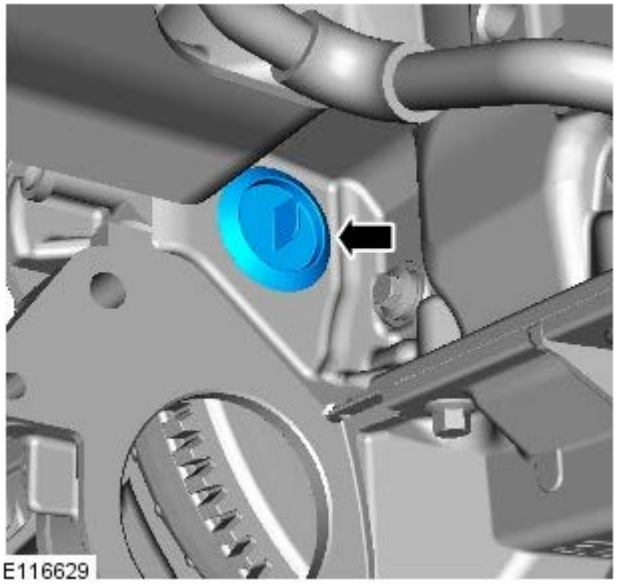
   Raise and support the vehicle.

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

4. Refer to: Brake Vacuum Pump - TDV6 3.0L Diesel (206-07, Removal and Installation).

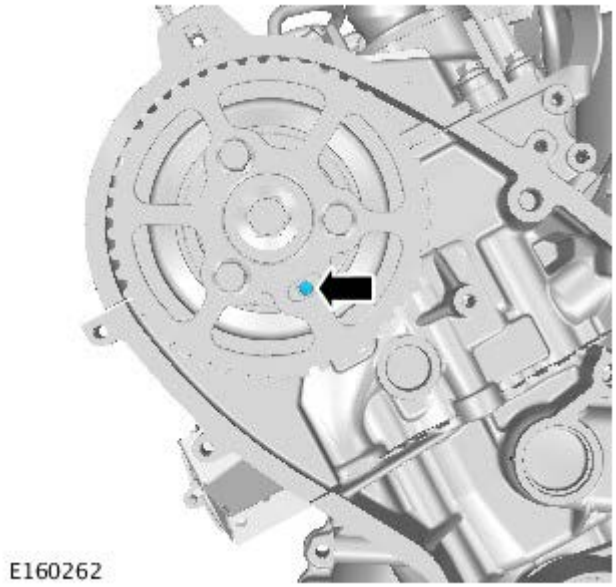
5. Refer to: Valve Cover RH (303-01A Engine - TDV6 3.0L Diesel, Removal and Installation).

6.



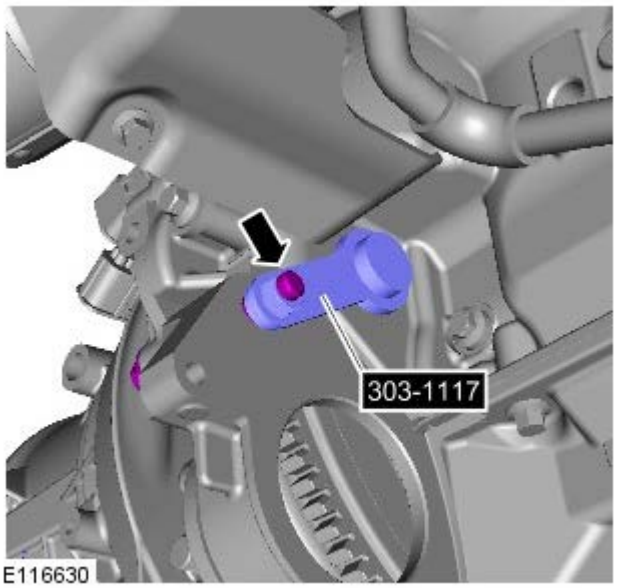
7. Rotate the crankshaft clockwise to align the crankshaft alignment hole in the flywheel or flexplate with the block aperture.

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

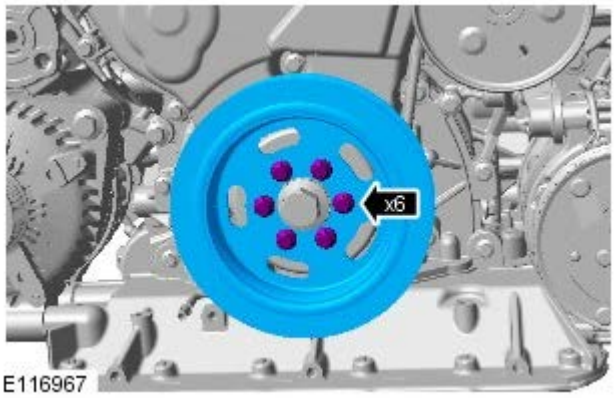


9. Install the special tool.

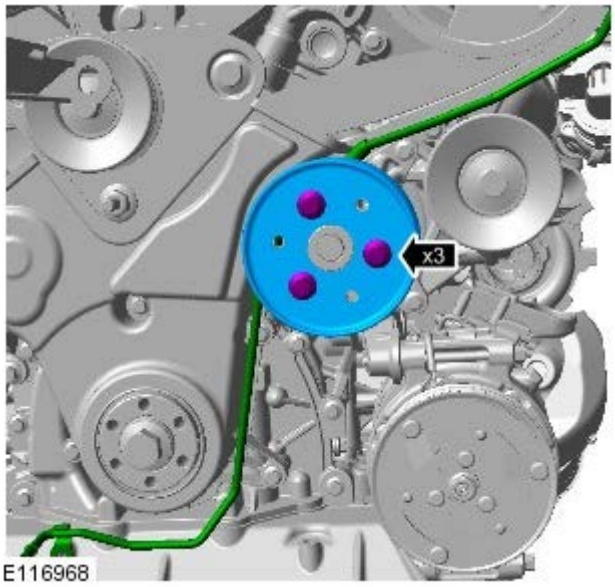
   Special Tool(s): 303-1117



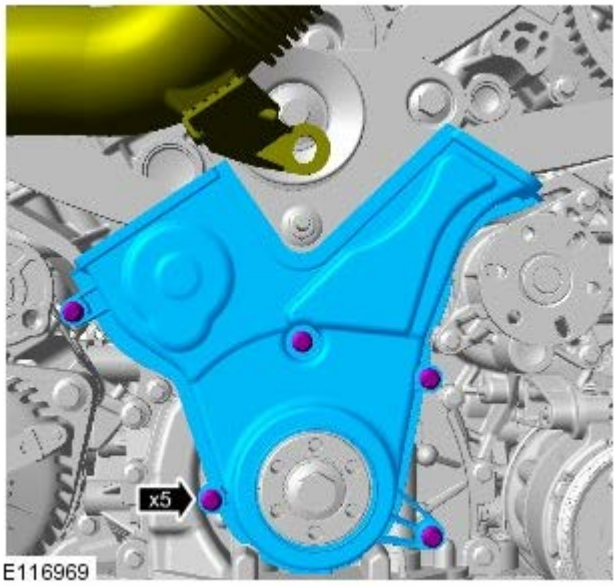
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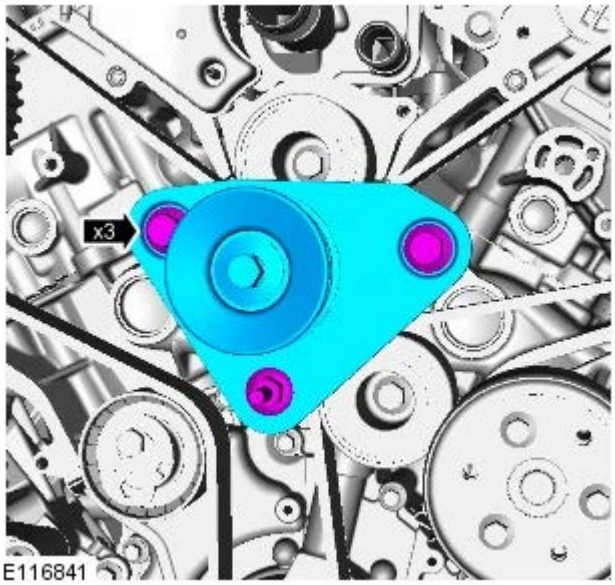
11. CAUTION: Discard the bolts.



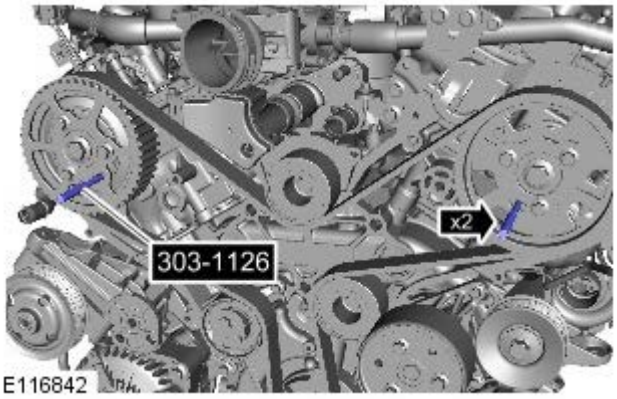
12. NOTE: Discard the gasket.



13.

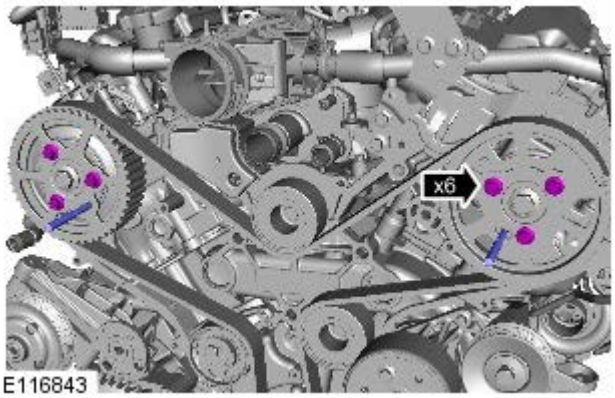


14. *Special Tool(s):* 303-1126



15. 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.

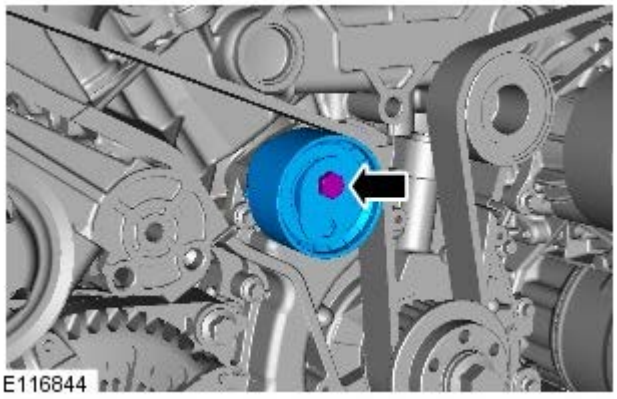
NOTE: Do not loosen the bolts more than 2 turns.



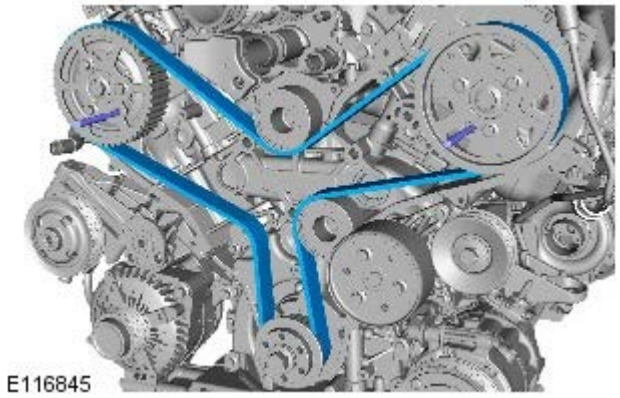
16. CAUTIONS:

Discard the component.

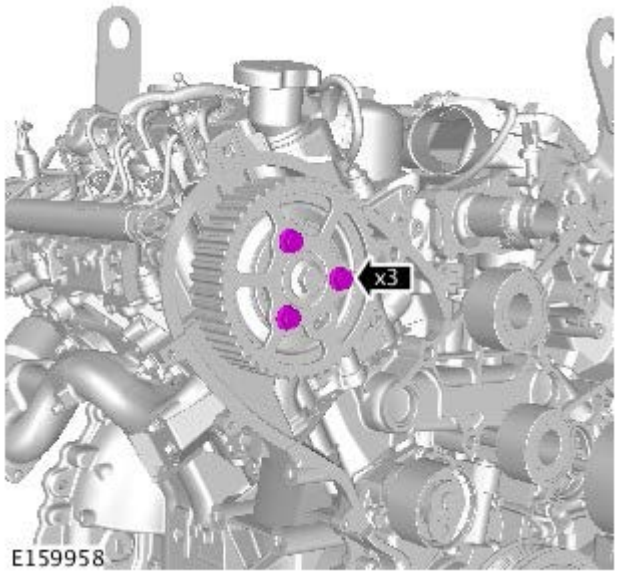
Discard the bolt.



17. CAUTION: Discard the component.

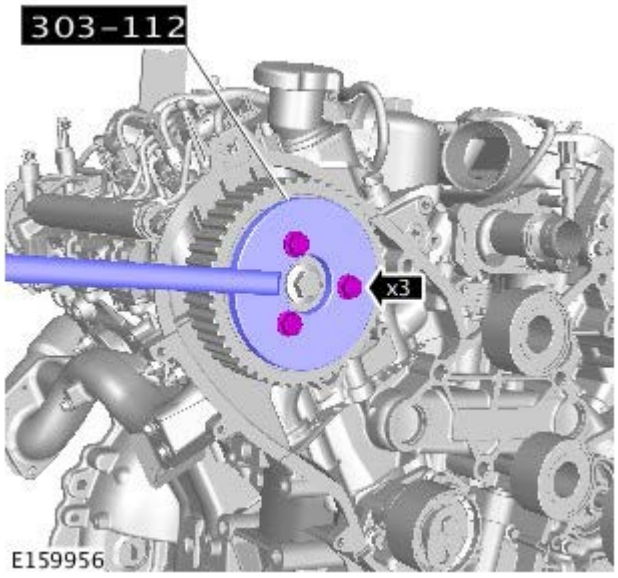


18.

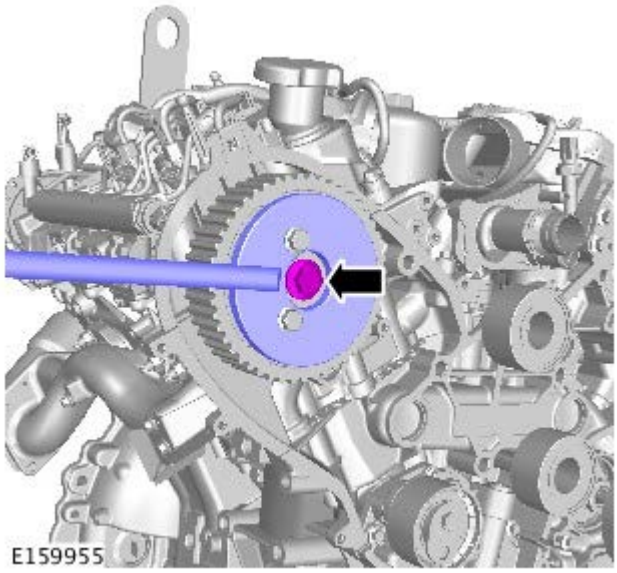


19. Install the special tool.

Special Tool(s): 303-1124

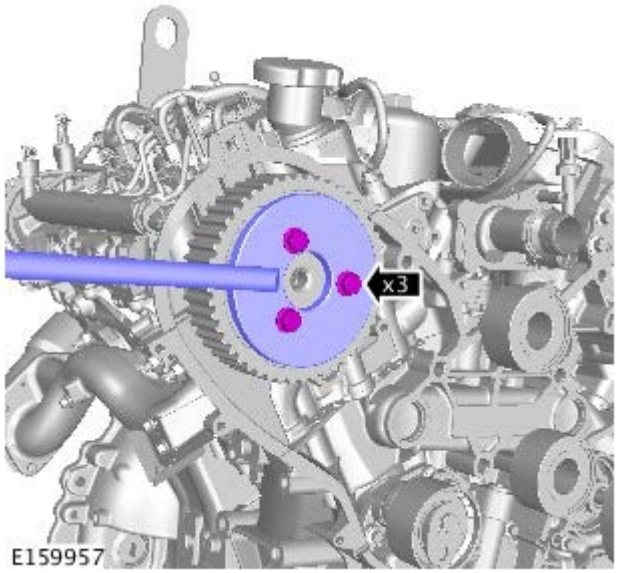


20.

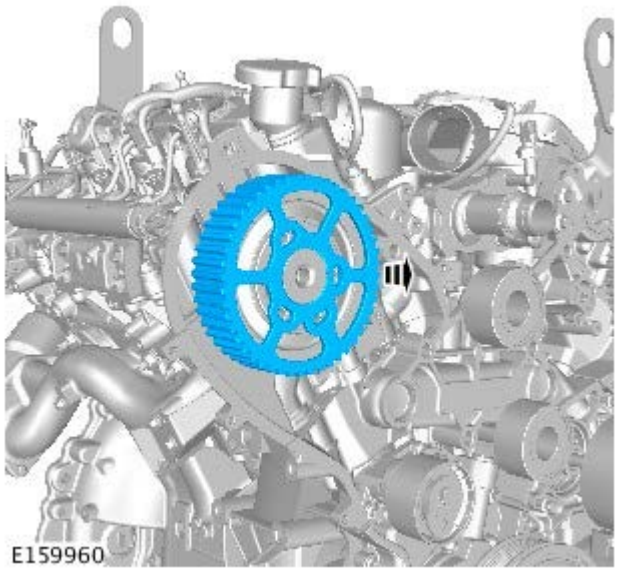


21. Remove the special tool.

    Special Tool(s): 303-1124

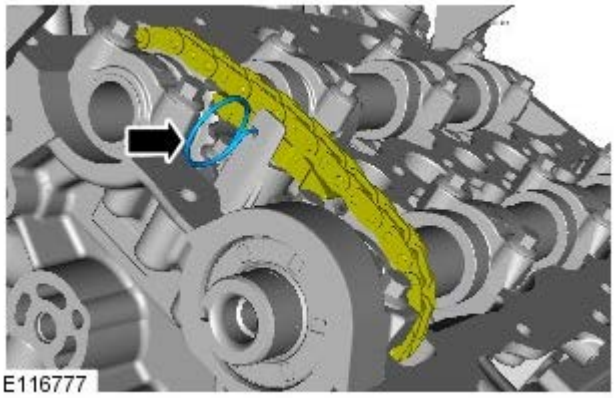


22.

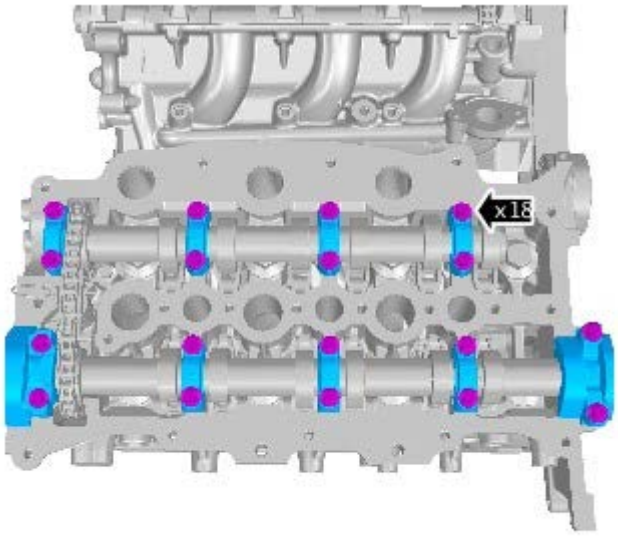


23.

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

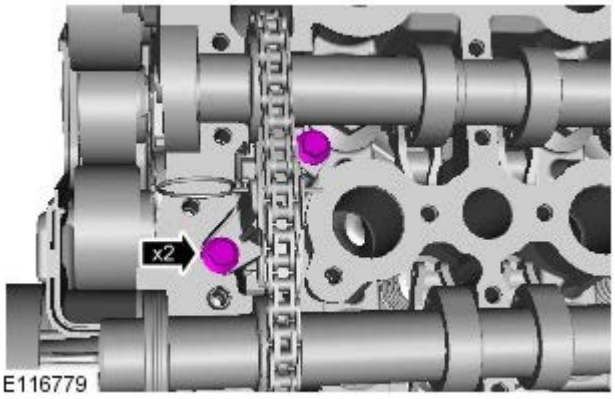

E116777

24. Remove the camshaft bearing caps evenly.



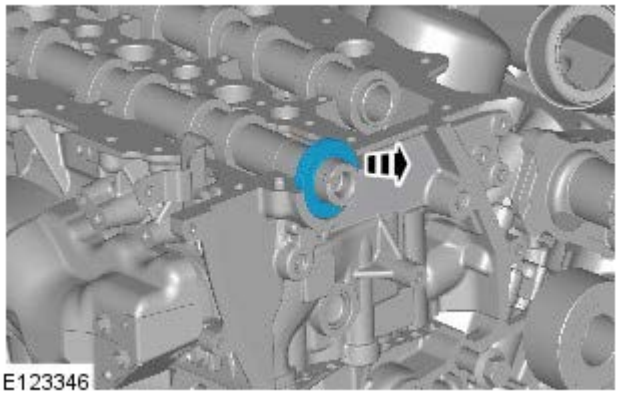
E159959

25.

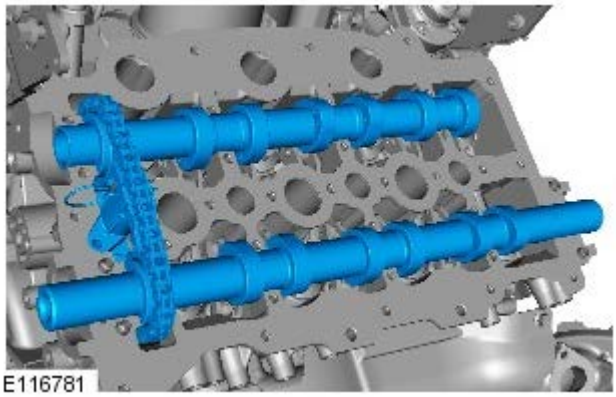


E116779

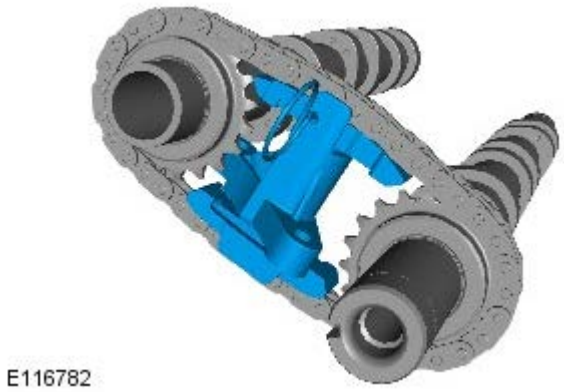
26. CAUTION: Discard the seal.


E123346

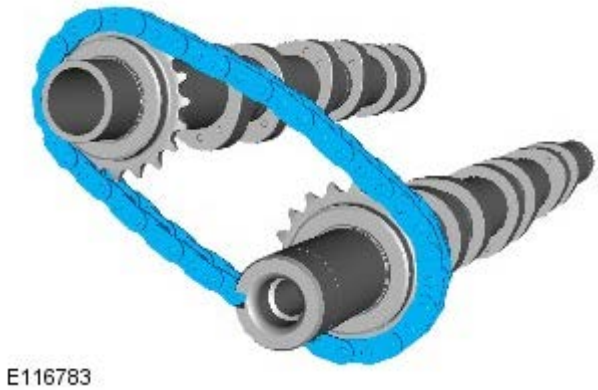
27. Remove the RH bank camshafts and secondary timing chain tensioner assembly.


E116781

28. Remove the secondary timing chain tensioner assembly.

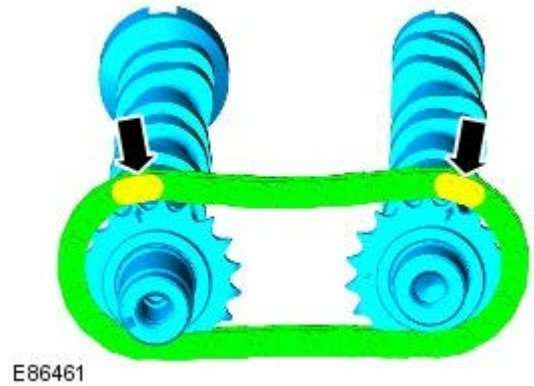

E116782

29. Remove the secondary timing chain from the camshafts.

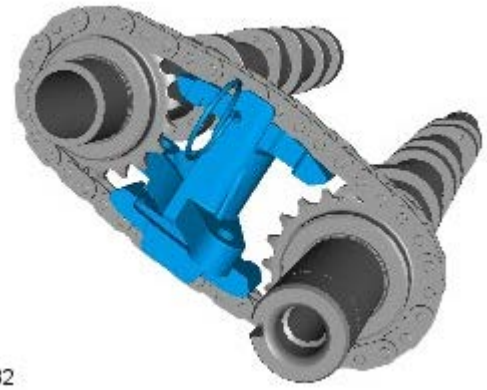

E116783

Installation

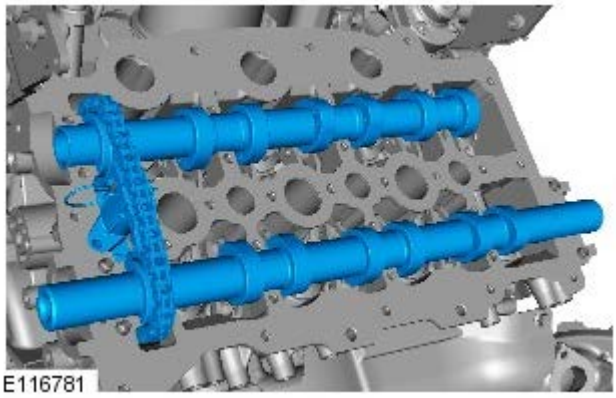
1. Install the secondary timing chain onto the camshafts.


E86461

2. Install the secondary timing chain tensioner assembly.



E116782



E116781

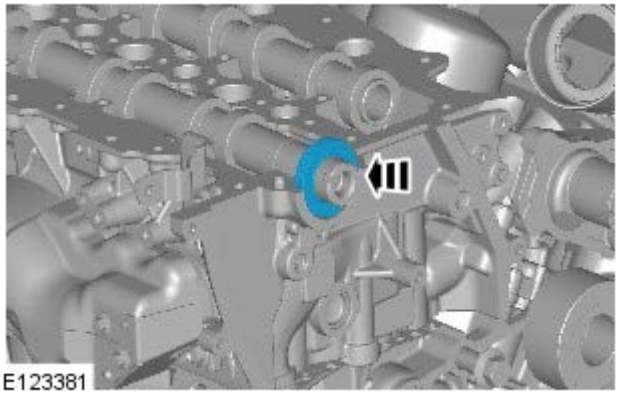
3. CAUTION: Make sure that the dots on the camshafts are aligned at the 12 o'clock position. Failure to follow this instruction may result in damage to the engine.

   NOTES:

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

   Use hypoid oil to lubricate the camshafts.

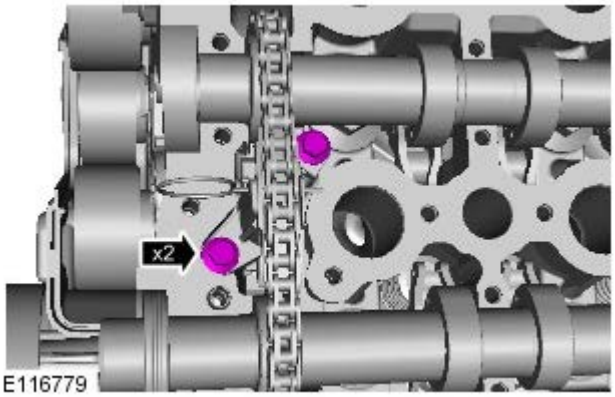
   Install the camshafts.



E123381

4. NOTE: Install a new seal.

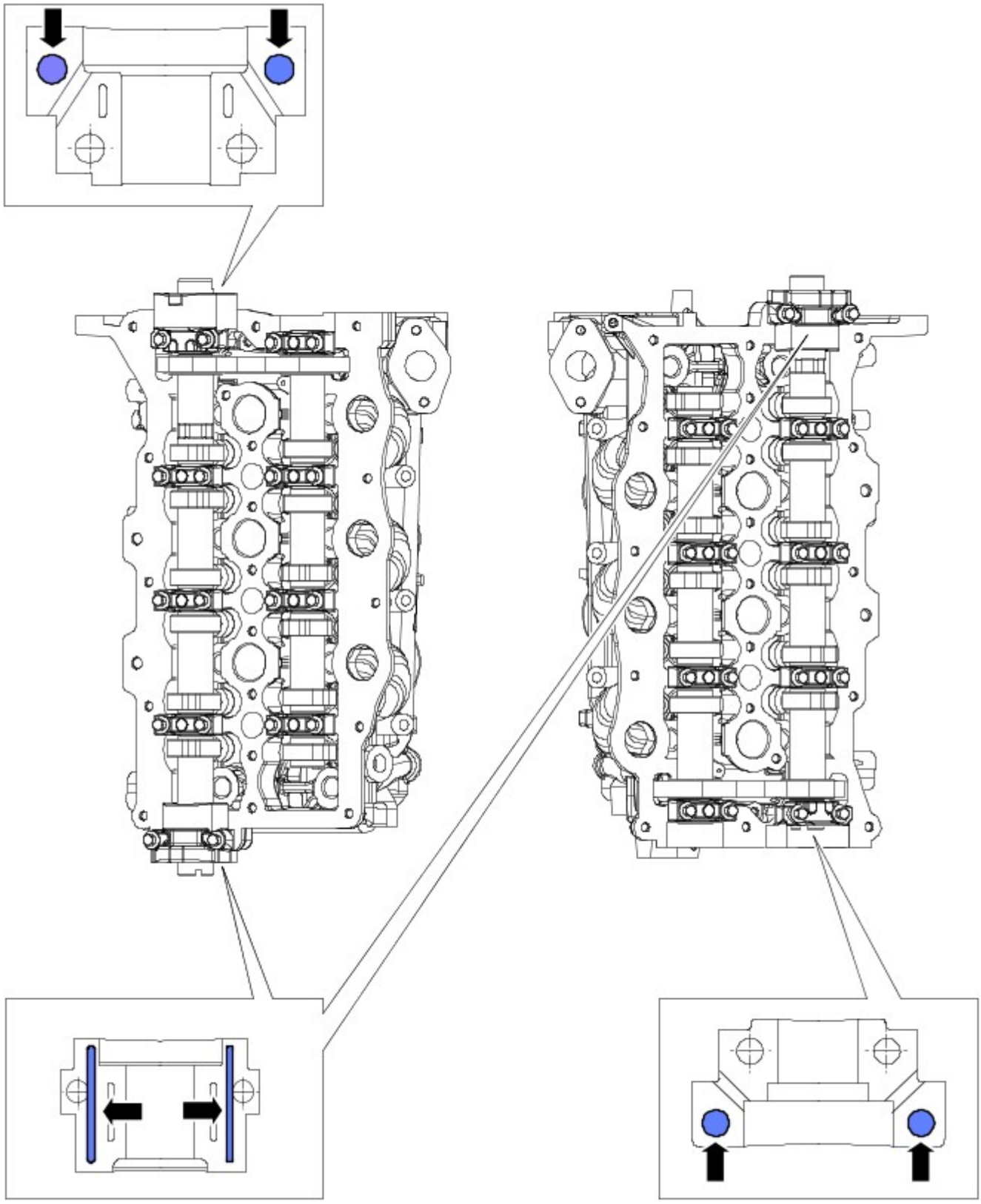
5. *Torque:* 10 Nm



E116779

6.

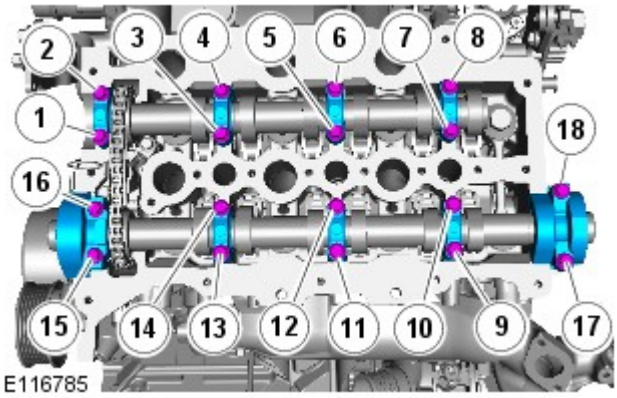
- Apply Loctite 518 sealant to the exhaust camshaft seal bearing caps.
- Apply Loctite 518 sealant, 2 mm wide, to the LH rear and RH front camshaft bearing caps.
- Apply Loctite 518 sealant, 7 mm diameter, to the LH front and RH rear camshaft bearing caps.



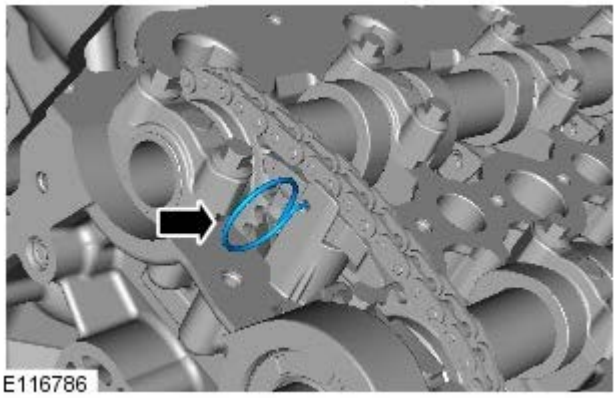
E116784

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

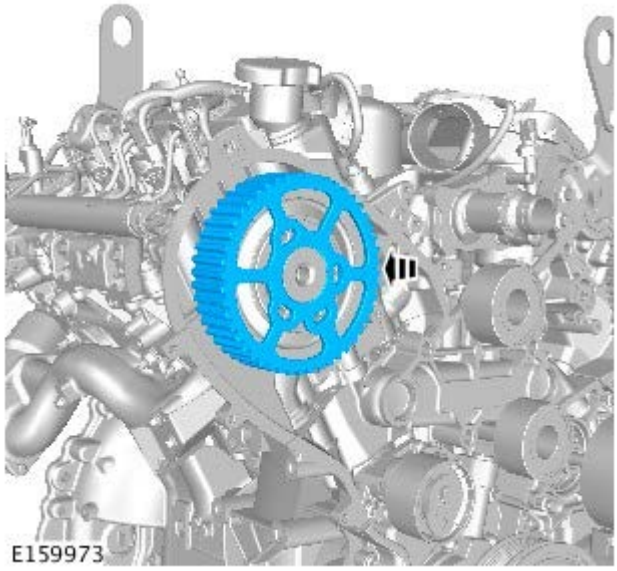
- Install the camshaft bearing caps in their original positions.
- Stage 1: Bolts 1 to 14, 1 Nm.
- Stage 2: Bolts 1 to 14, 5 Nm.
- Stage 3: Bolts 1 to 14, 10 Nm.
- Stage 4: Bolts 15 to 18, 1 Nm.
- Stage 5: Bolts 15 to 18, 5 Nm.
- Stage 6: Bolts 15 to 18, 10 Nm.



8. Remove the secondary timing chain tensioner retaining pin.

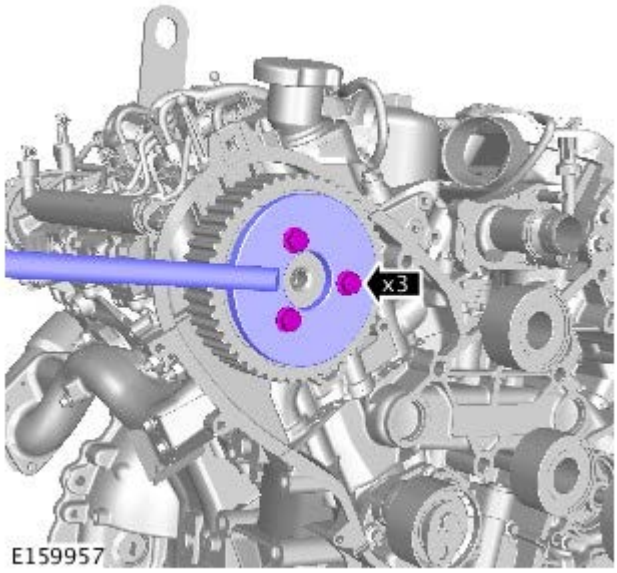


9.

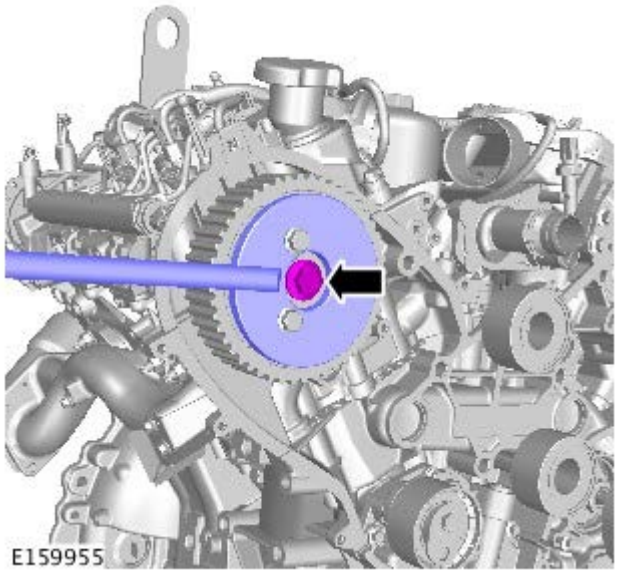


10. Install the special tool.

Special Tool(s): 303-1124

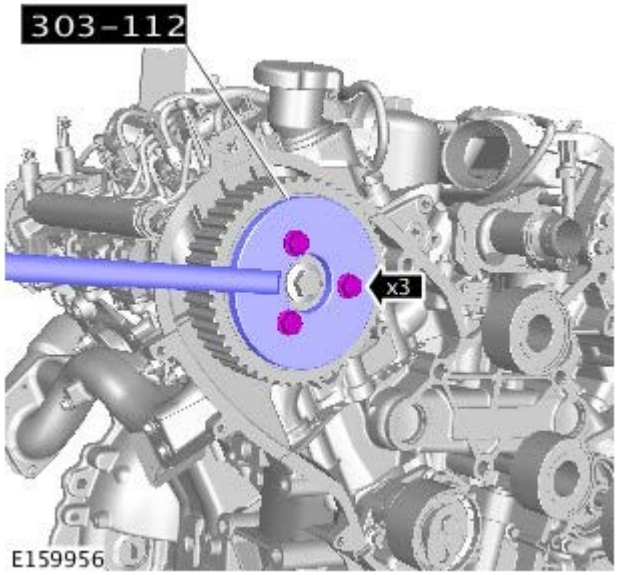


11. *Torque:*
    Stage 1:80 Nm
    Stage 2:80°

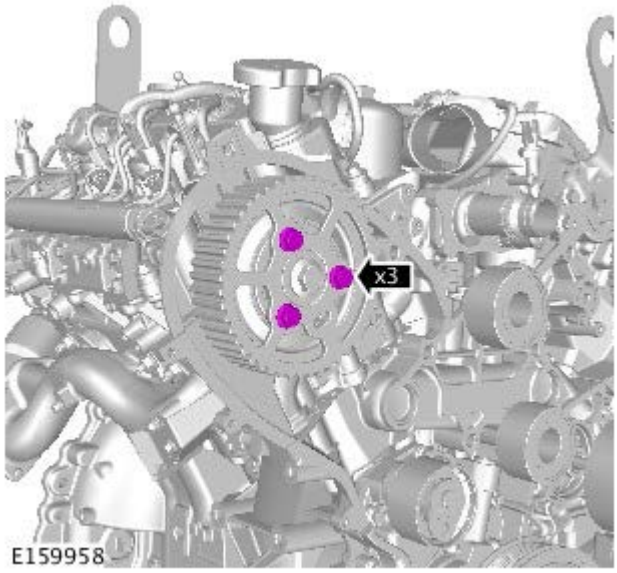


12. Remove the special tool.

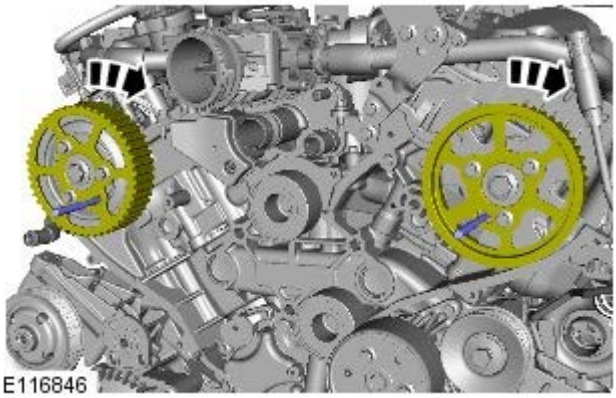
    Special Tool(s): 303-1124



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



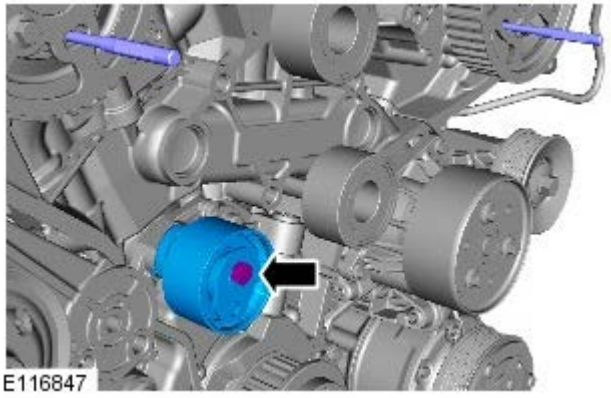
14.



15. CAUTIONS:

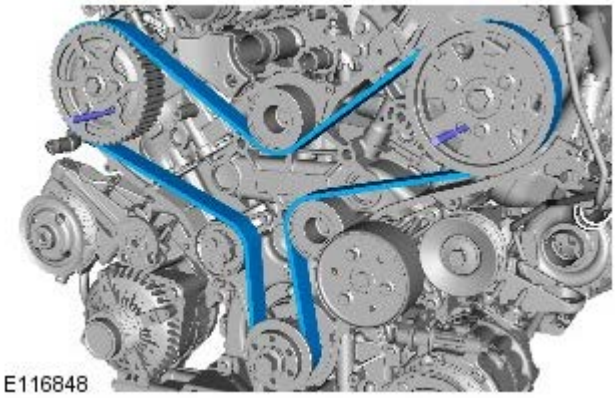
Make sure that a new bolt is installed.

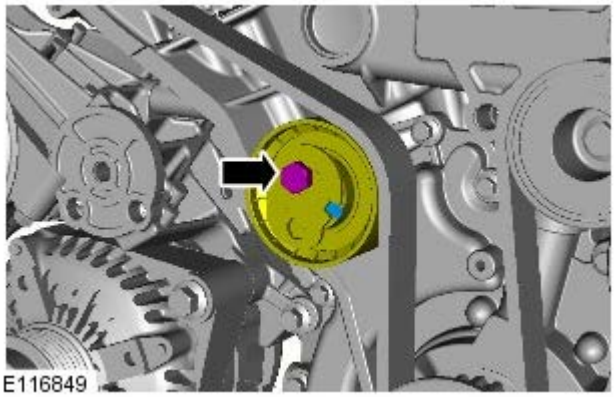
Only tighten the bolts finger-tight at this stage.



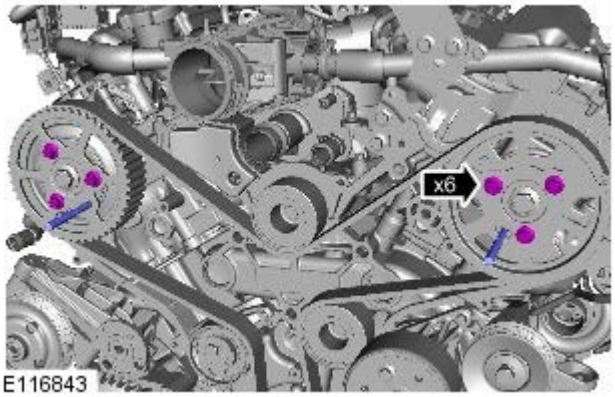
16. CAUTION: Make sure the camshaft pulleys remain in the clockwise position.

- 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.

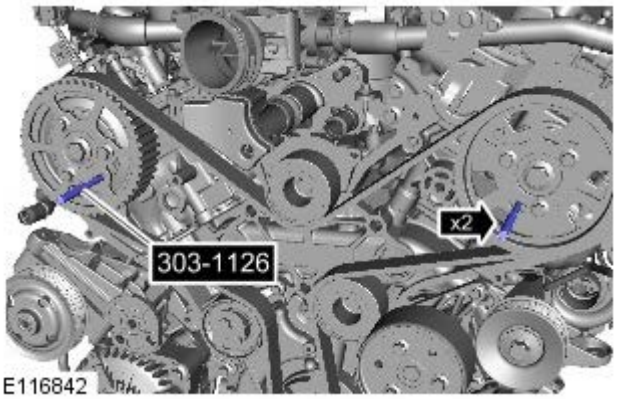




17. CAUTION: Make sure the timing belt tensioner window is aligned with the groove as illustrated.
    - Tension the timing belt.
    - Rotate the tensioner assembly counter-clockwise.
    - *Torque:* 26 Nm

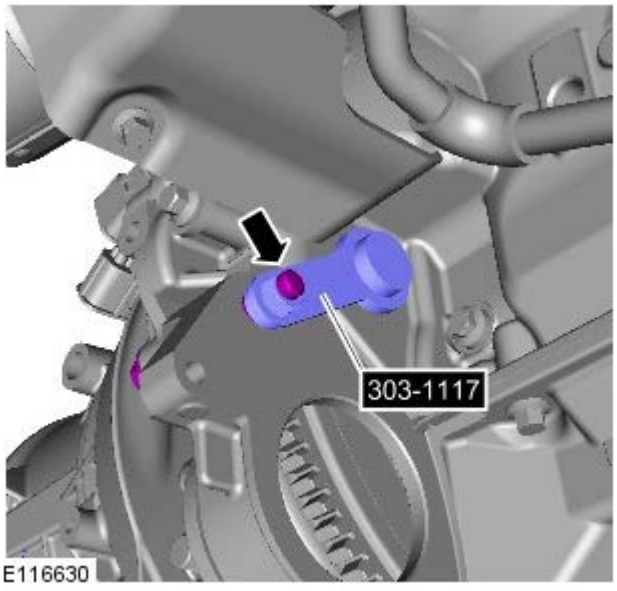


18. CAUTION: Do not use the special tools to lock the camshafts. Failure to follow this instruction may result in damage to the engine or the special tools.
    - Using a suitable tool, counterhold the camshaft pulley center retaining bolts.
    - *Torque:* 23 Nm



19. Remove the special tool.

    Special Tool(s): 303-1126



20. Remove the special tool.

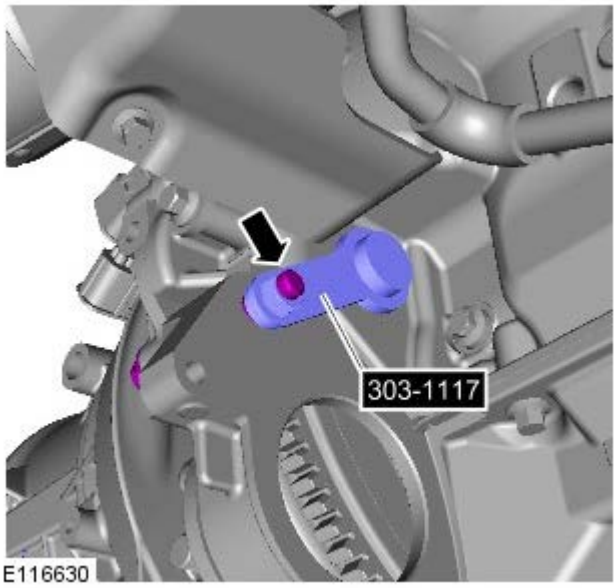
    Special Tool(s): 303-1117

21. CAUTION: Only rotate the crankshaft clockwise.

Rotate the engine two complete turns clockwise.

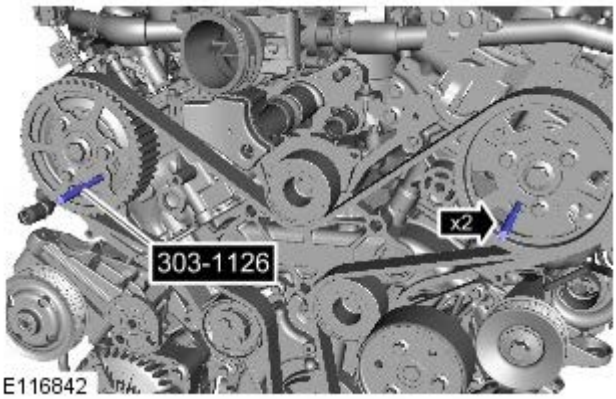
22. Install with the special tool.

    Special Tool(s): 303-1117

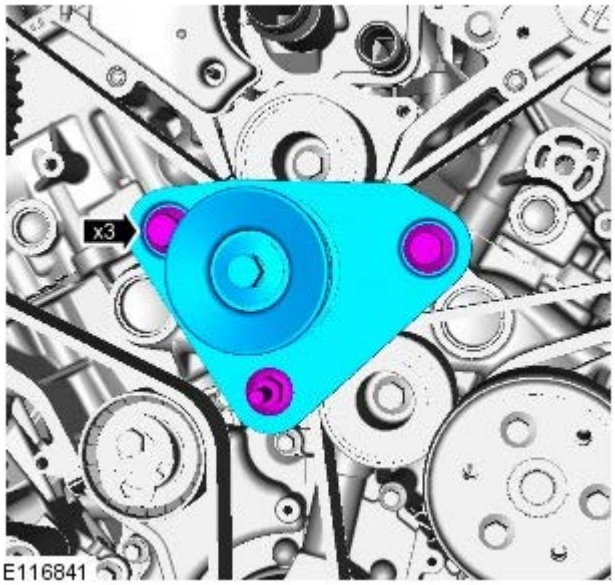


23.
- Install the special tools to the exhaust camshaft pulleys.

  Special Tool(s): 303-1126
- If the special tool does not fit correctly, repeat the timing belt installation procedure.
- Remove the special tools from the camshaft pulleys.

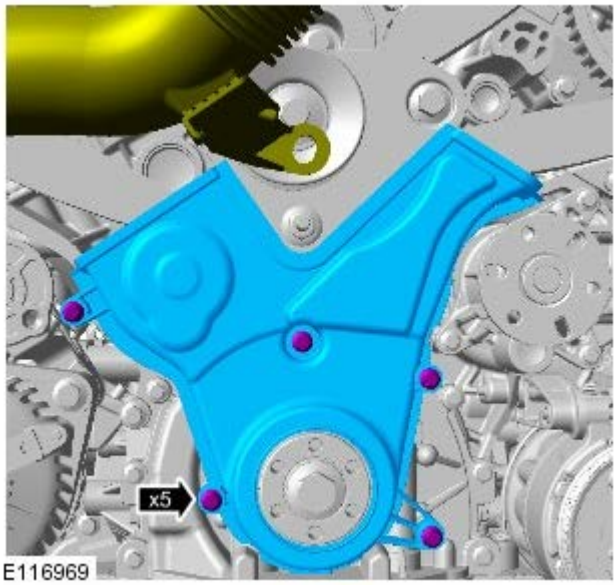


24. *Torque:* 80 Nm



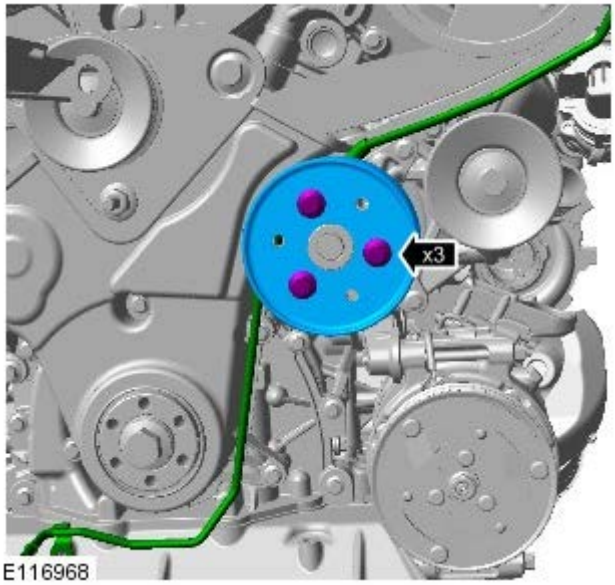
25. NOTE: Install a new gasket.

    Torque: 10 Nm

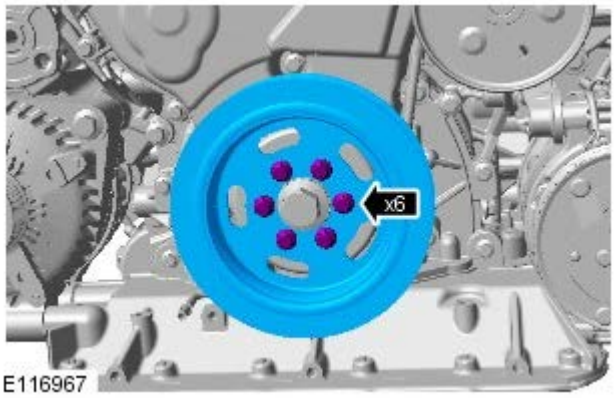


26. CAUTION: Make sure that new bolts are installed.

Torque: 24 Nm

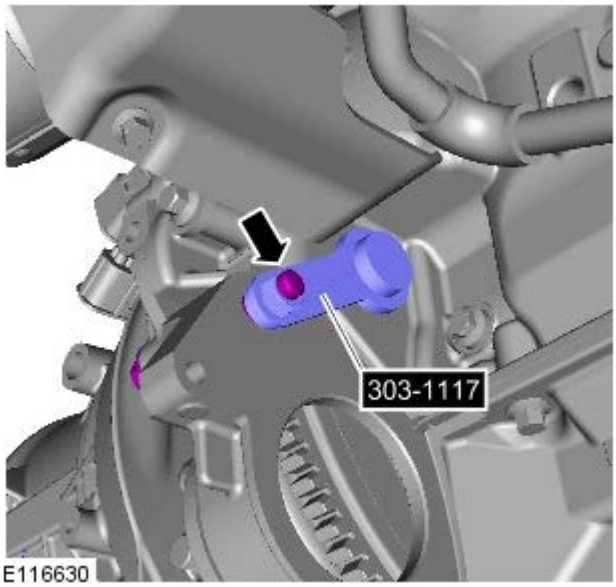


27. *Torque:* 25 Nm

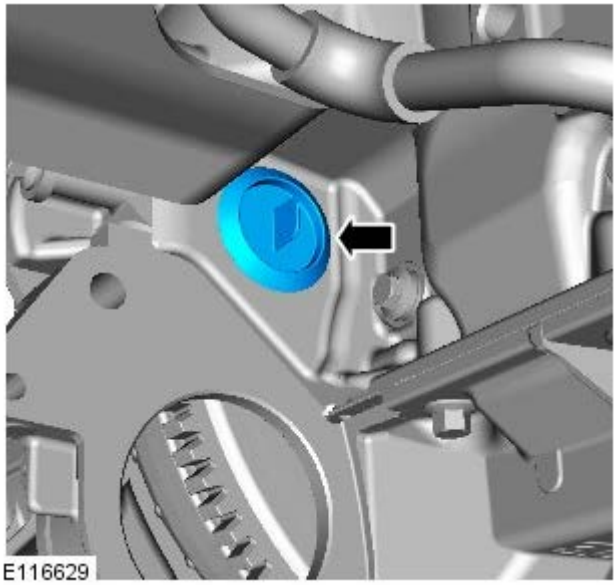


28. Remove the special tool.

Special Tool(s): 303-1117



29.



30. Refer to: Valve Cover RH (303-01A Engine - TDV6 3.0L Diesel, Removal and Installation).

31. Refer to: Brake Vacuum Pump - TDV6 3.0L Diesel (206-07, Removal and Installation).

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

33. Disconnect the battery ground cable.

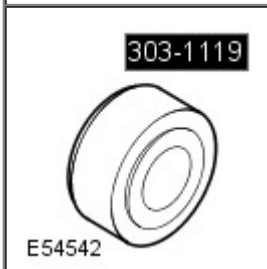
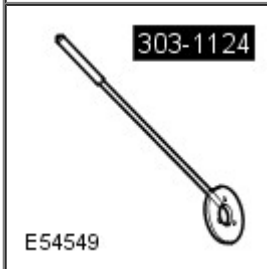
    Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 08-Aug-2012

Engine - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Camshaft Front Seal

Removal and Installation

Special Tool(s)

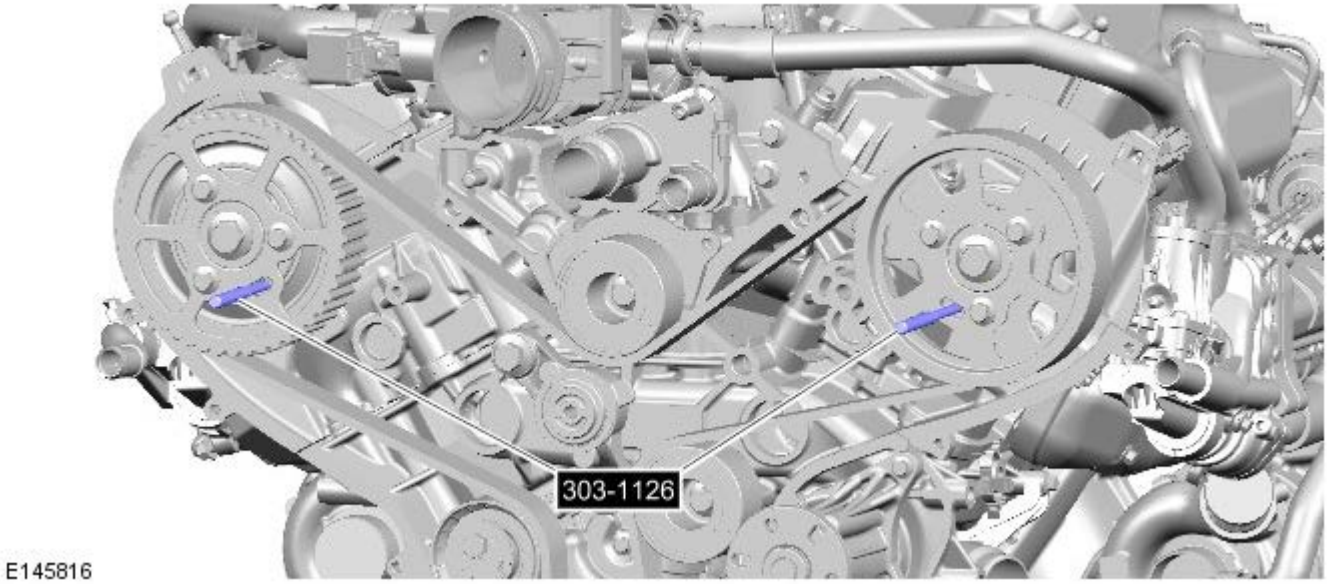
	303-1118 Remover, Camshaft Seal
	303-1119 Installer, Camshaft Seal
	303-1124 Holding Tool, Camshaft Front Pulley
	303-1126 Timing Peg, Camshaft Pulley

Removal

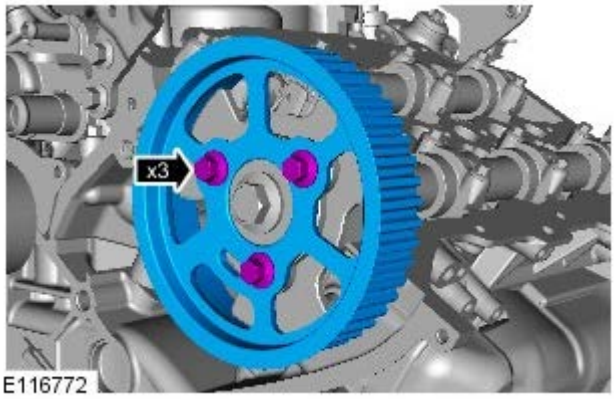
NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. Refer to: Specifications (414-00, Specifications).
2. Refer to: Timing Belt (303-01A Engine - TDV6 3.0L Diesel, 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.

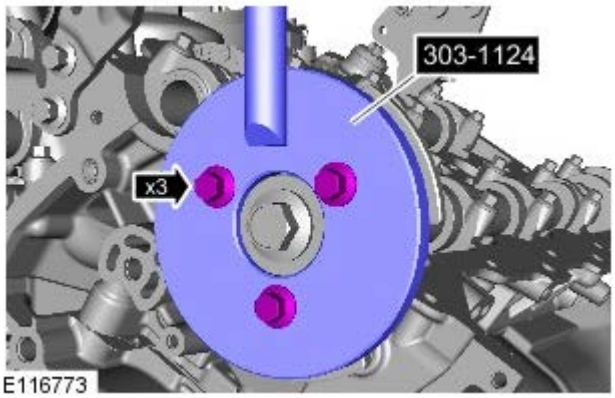
   Special Tool(s): 303-1126



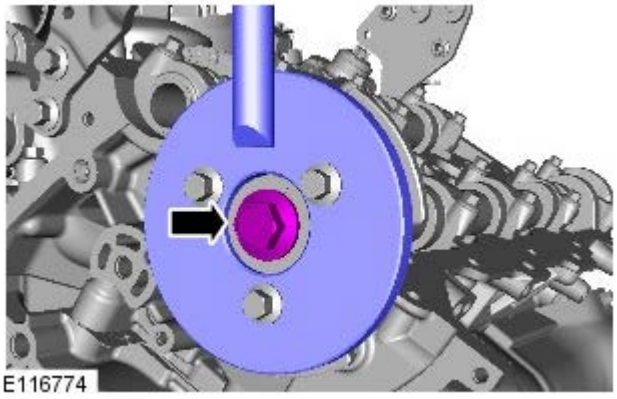
4.



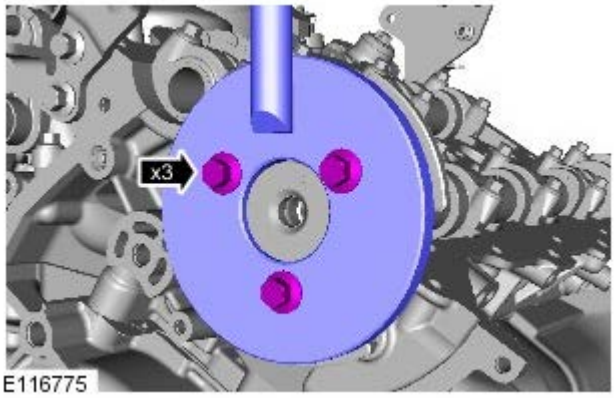
5. *Special Tool(s):* 303-1124



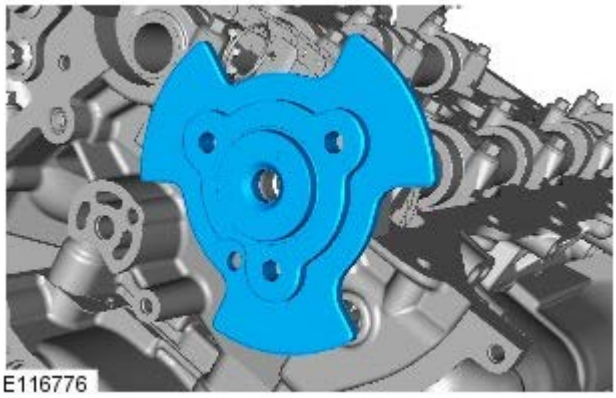
6.



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

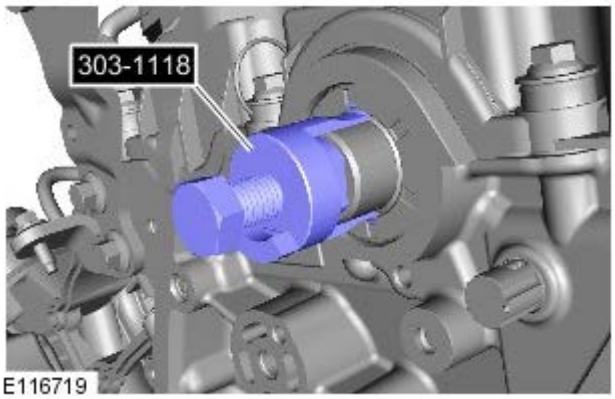


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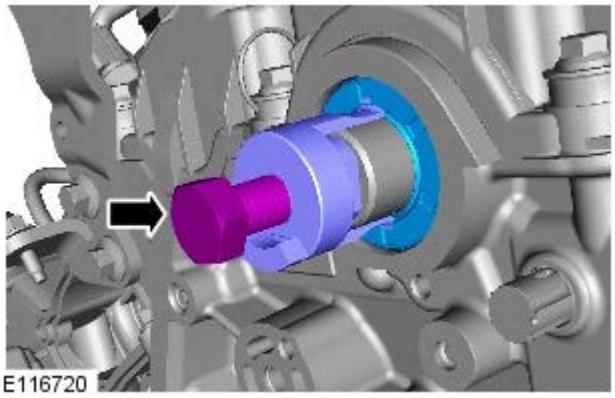


9. CAUTION: Make sure the special tool is correctly seated behind the camshaft seal. Failure to follow this instruction may result in damage to the special tool.

Special Tool(s): 303-1118

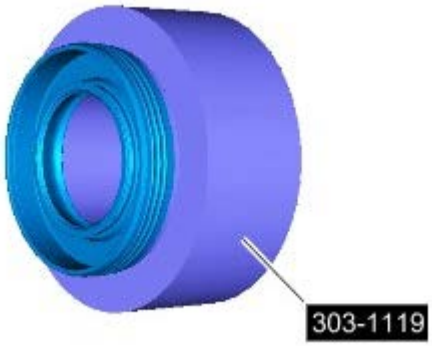


10.

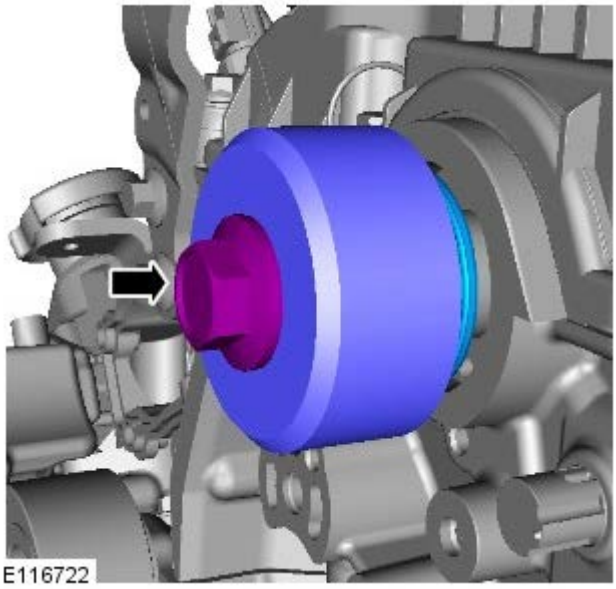


Installation

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



E116721


E116722

2. CAUTIONS:

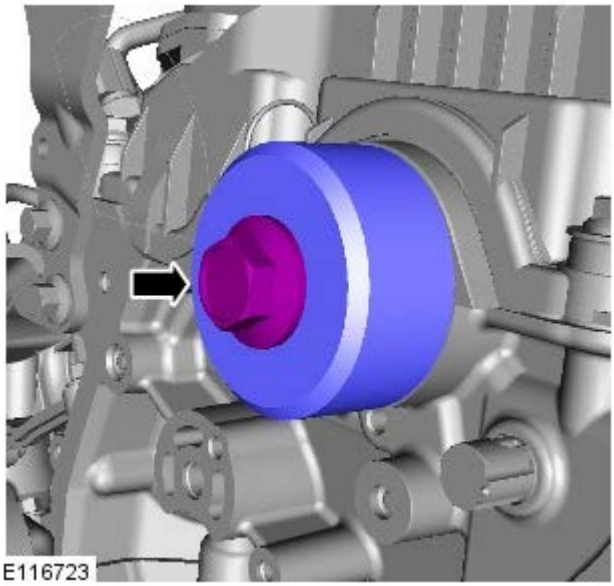
   Make sure the seal is installed correctly.

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

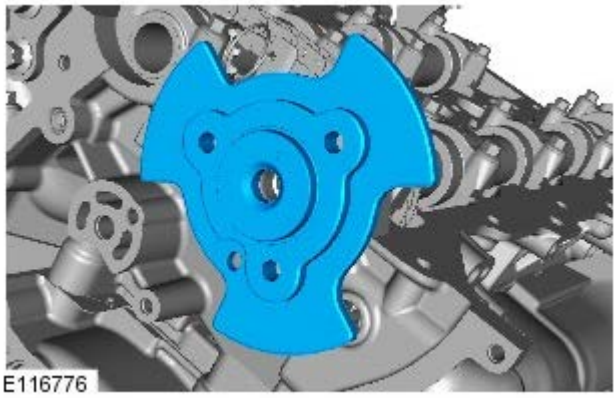
   Do not use any lubricant on the camshaft front seal or the camshaft. Failure to follow this instruction may result in damage to the vehicle.

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

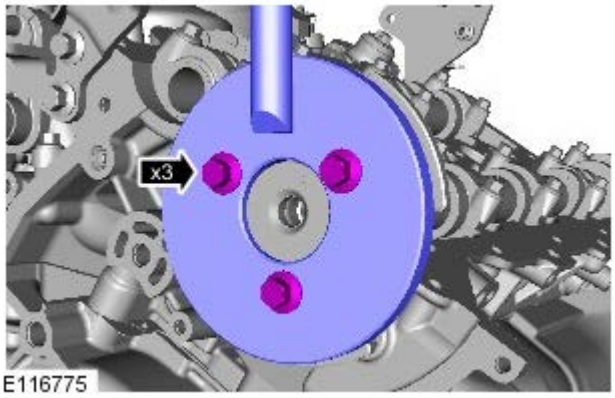
3. *Special Tool(s):* 303-1119


E116723

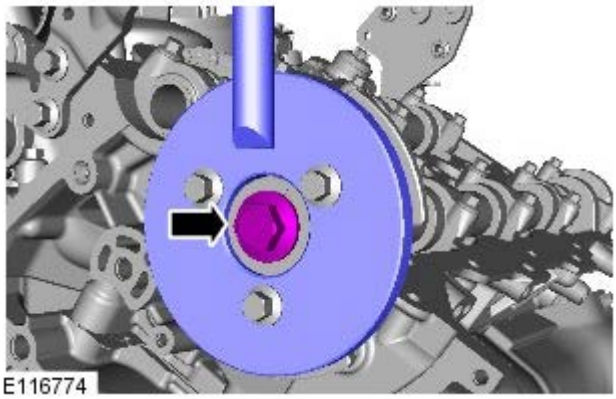
4.



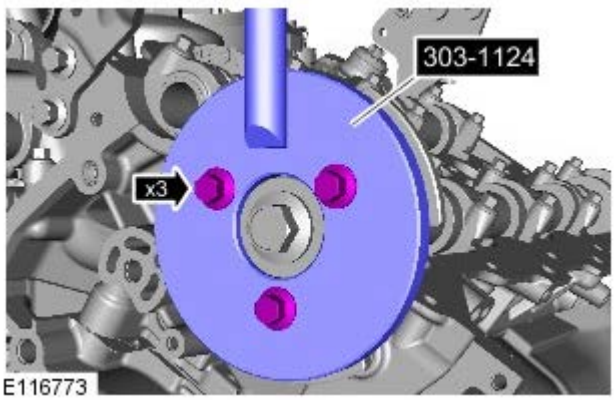
5. *Special Tool(s):* 303-1124



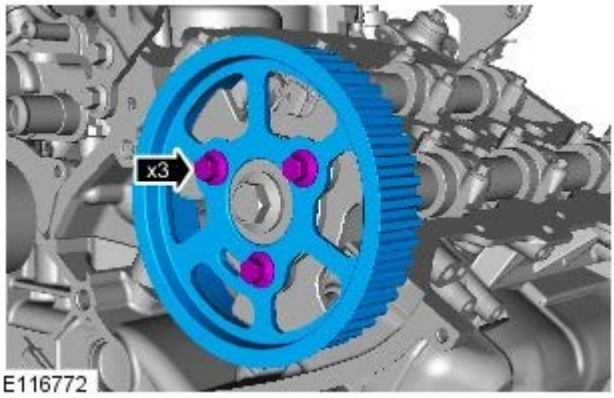
6. *Torque:*
   Stage 1: 80 Nm
   Stage 2: 80°



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

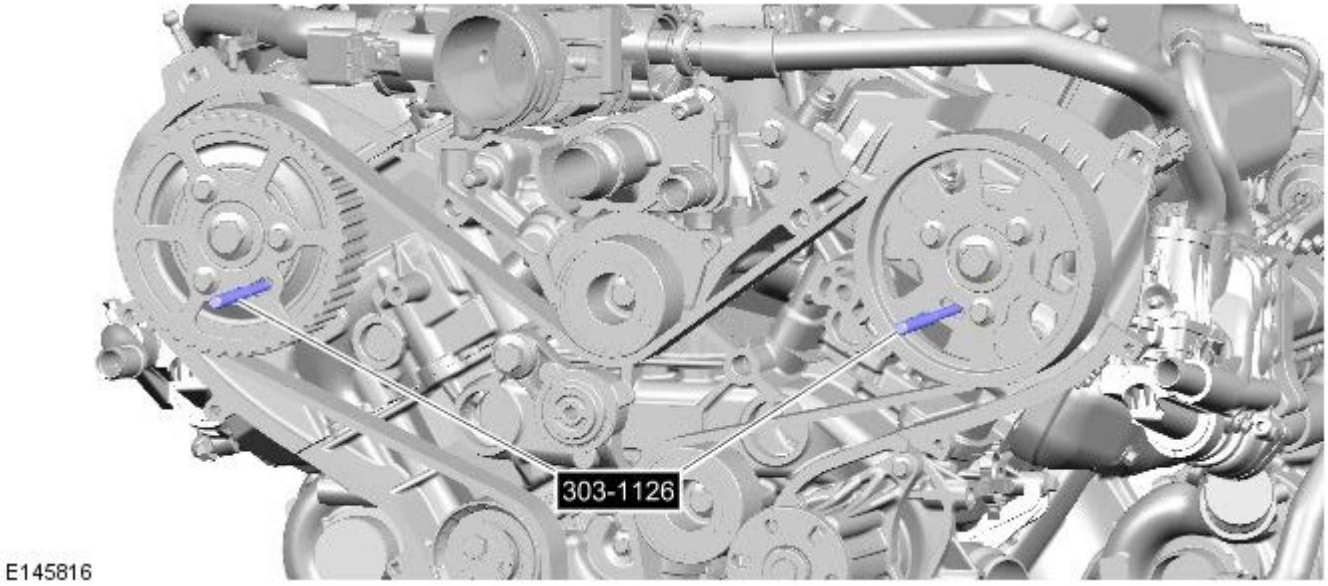


8. CAUTION: Only tighten the bolt finger-tight at this stage.



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 (303-01A Engine - TDV6 3.0L Diesel, Removal and Installation).

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

Published: 01-Aug-2012

Engine - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Camshaft Rear Seal

Removal and Installation

Removal

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

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.

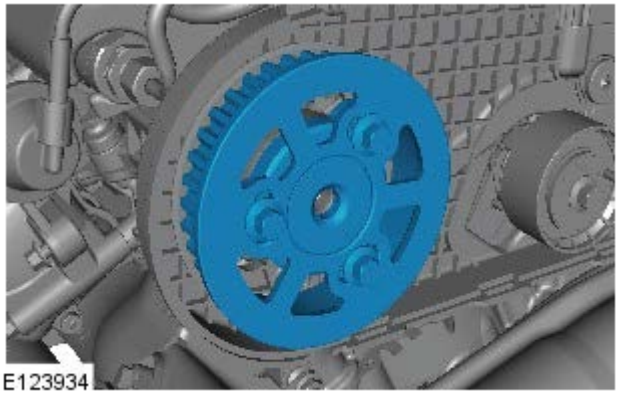


4. Using the special tool, remove the rear camshaft pulley retaining bolt.



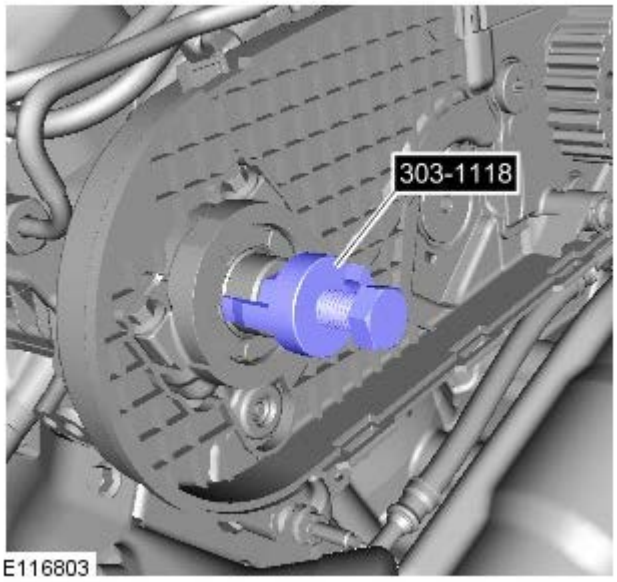
5. Remove the special tools.

6.

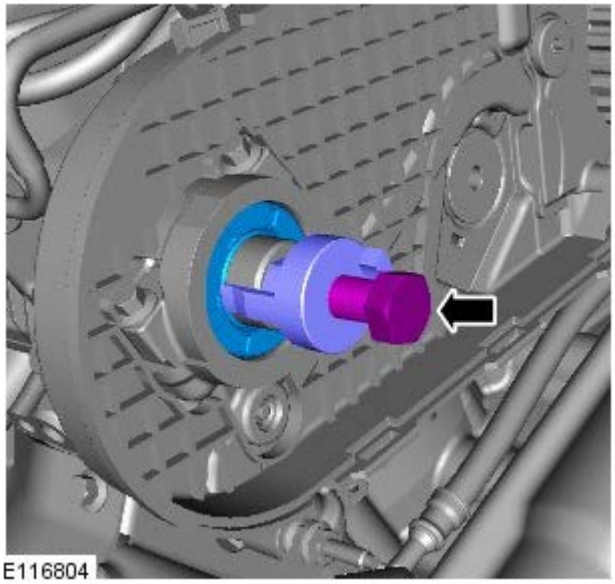


7. CAUTION: Make sure the special tool is correctly seated behind the camshaft seal. Failure to follow this instruction may result in damage to the special tool.

   Install the special tool.

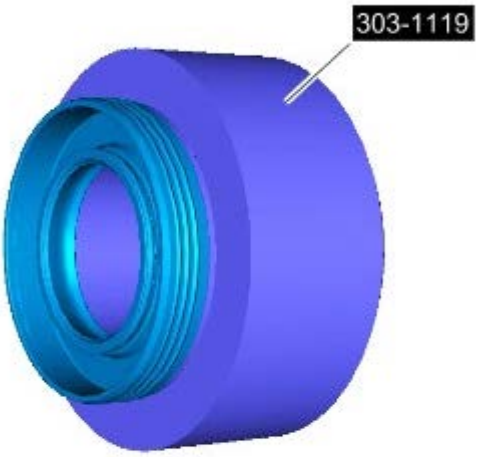


8.

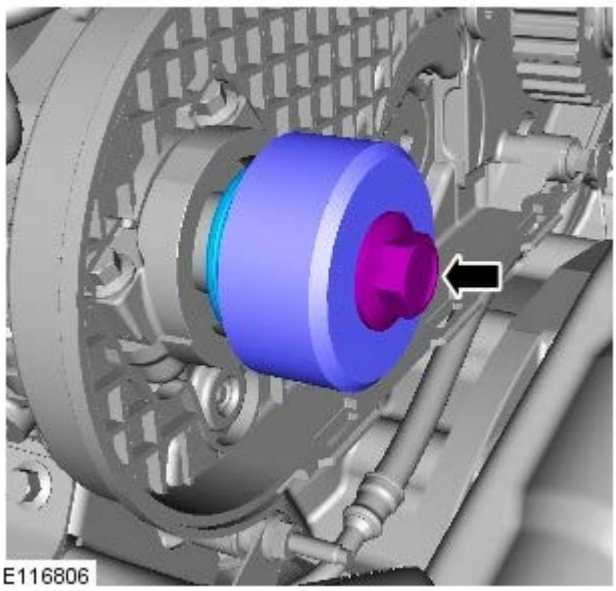

E116804

Installation

1. Install with the special tool.



E116805


E116806

2. CAUTIONS:

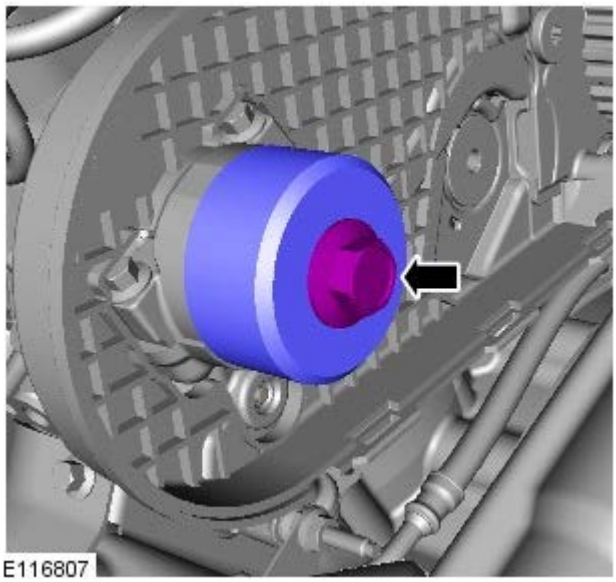
   Make sure the seal is installed correctly.

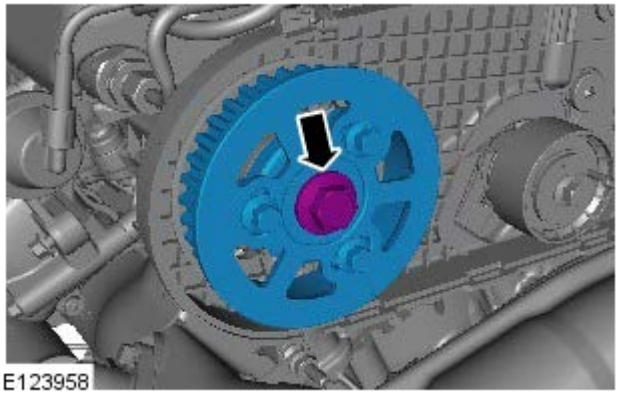
   Make sure that the mating faces are clean and free of corrosion and foreign material.

   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.



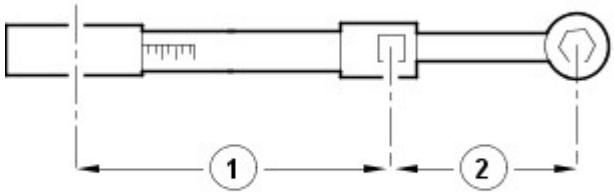
6. Install the special tool.



E123894

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.



E37107



E123895

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).

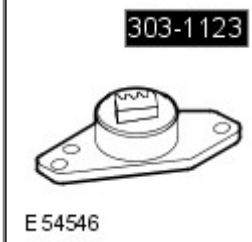
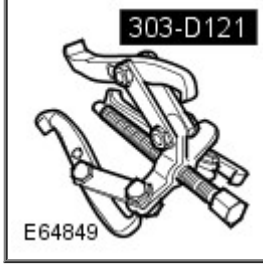
10. Remove the special tools.

Published: 17-Oct-2012

Engine - SDV6 3.0L Diesel - Hybrid Electric Vehicle - 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
	303-1123 Locking Tool, Flywheel
	303-D121 Puller, General Purpose

Removal

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

1. Disconnect the battery ground cable.

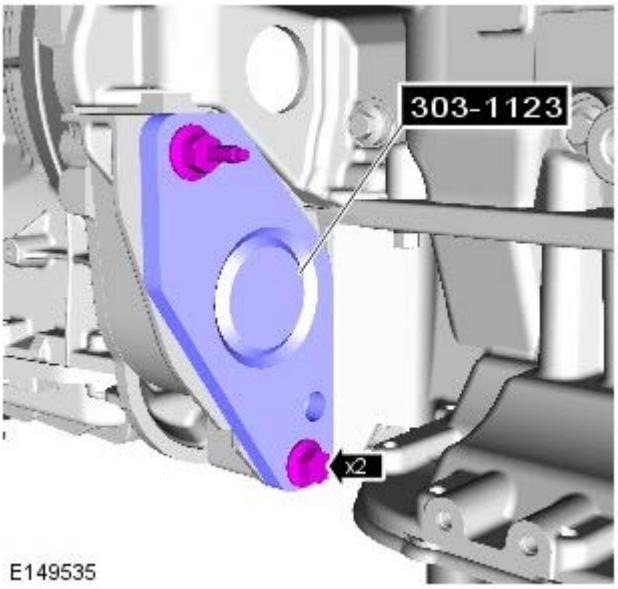
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

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

   Raise and support the vehicle.

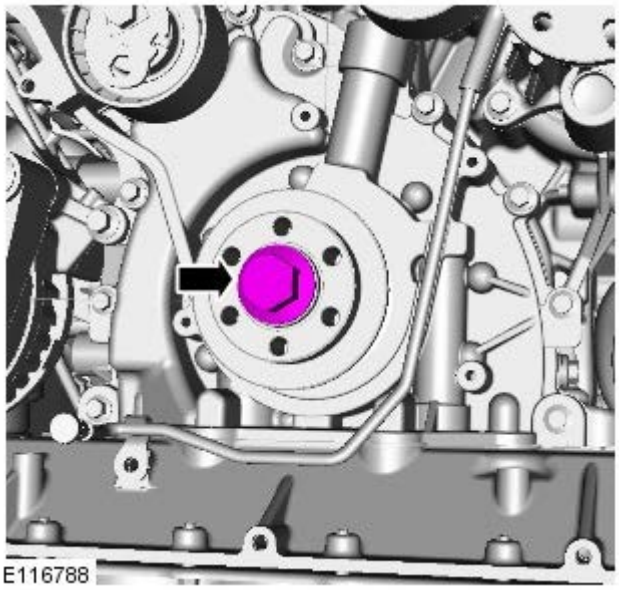
3. Refer to: Timing Belt (303-01A Engine - TDV6 3.0L Diesel, Removal and Installation).

4. Install the special tool.



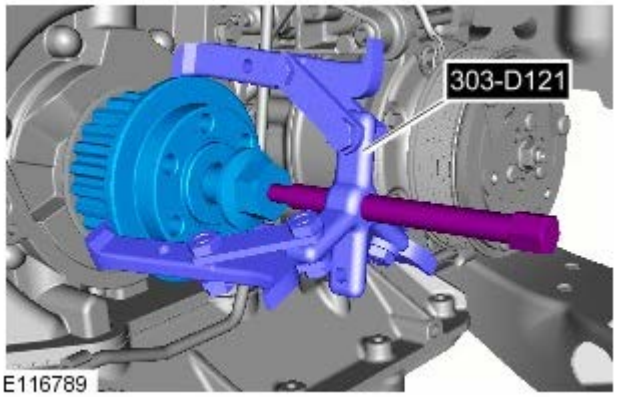
Special Tool(s): 303-1123

5.

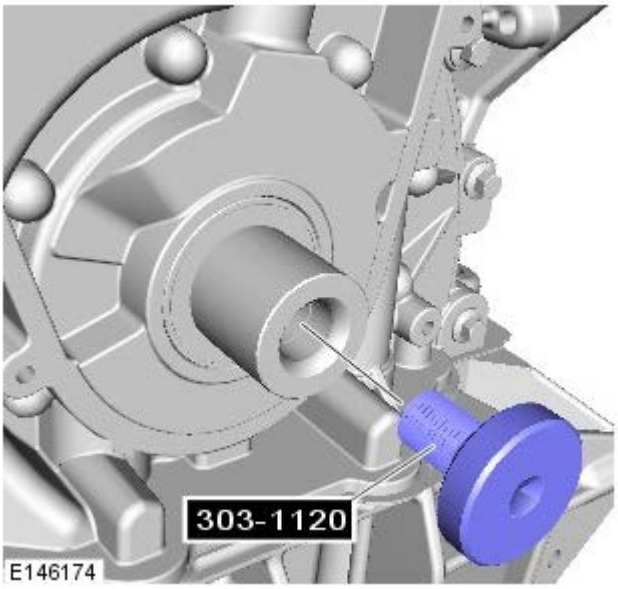


6. Install the special tool.

Special Tool(s): 303-D121

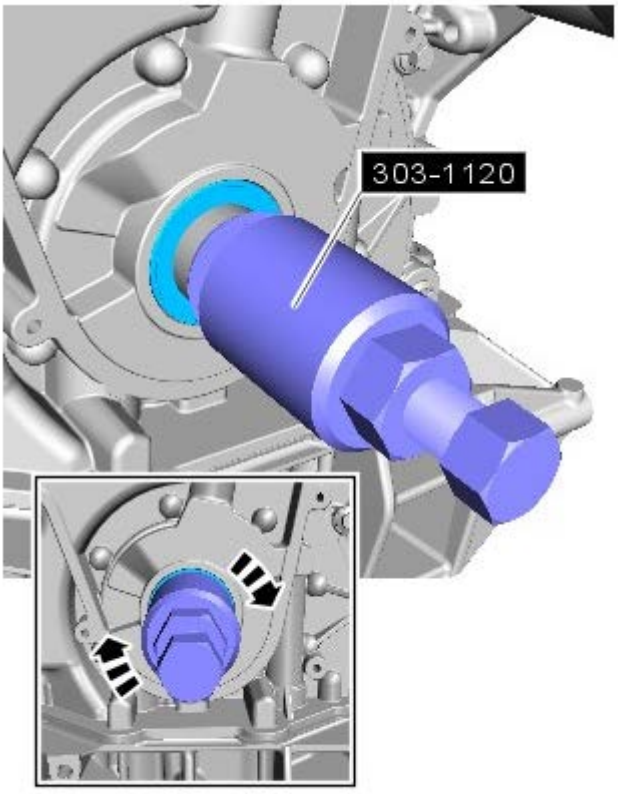


7. Install the special tool to the crankshaft.



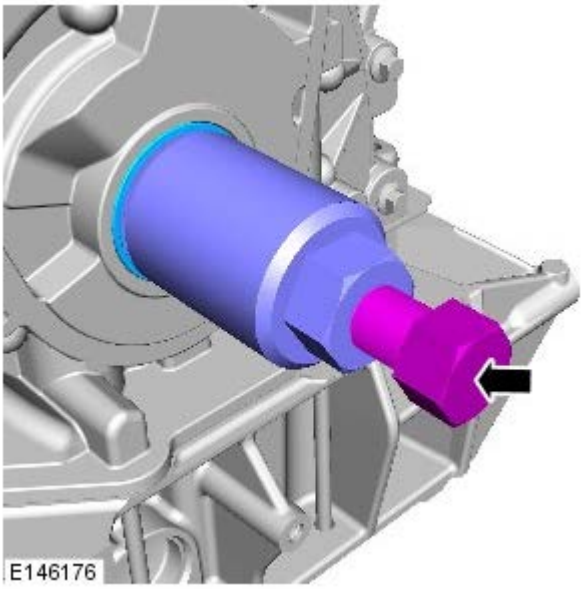
8. Install the special tool to the crankshaft, rotate the special tool to engage the crankshaft front oil seal as shown.

   Special Tool(s): 303-1120

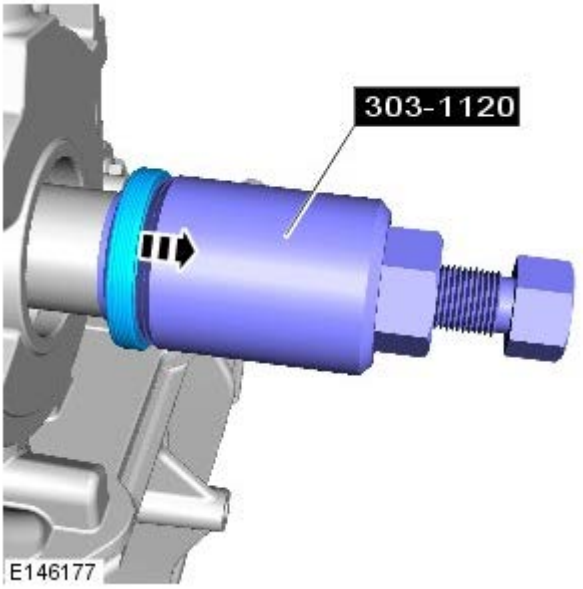


E146175

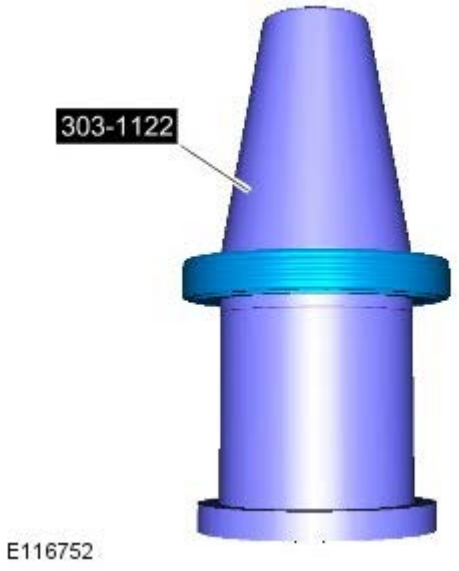
9. Rotate the special tool bolt.



10. Using the special tool, remove and discard the crankshaft front oil seal.



Installation



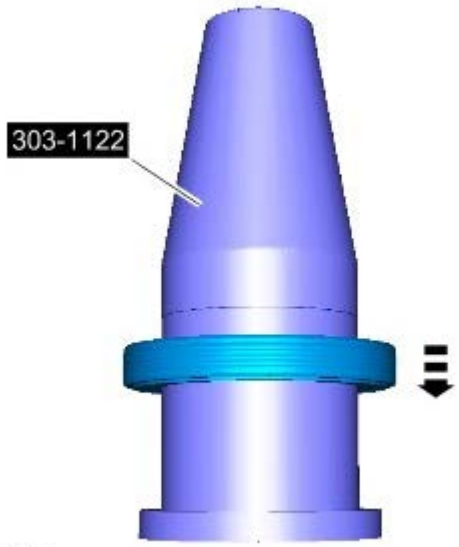
1. CAUTION: Do not use any lubricant on the crankshaft front seal, special tools or the crankshaft. Failure to follow this instruction may result in damage to the vehicle.

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

   Install a new crankshaft front seal to the special tool.

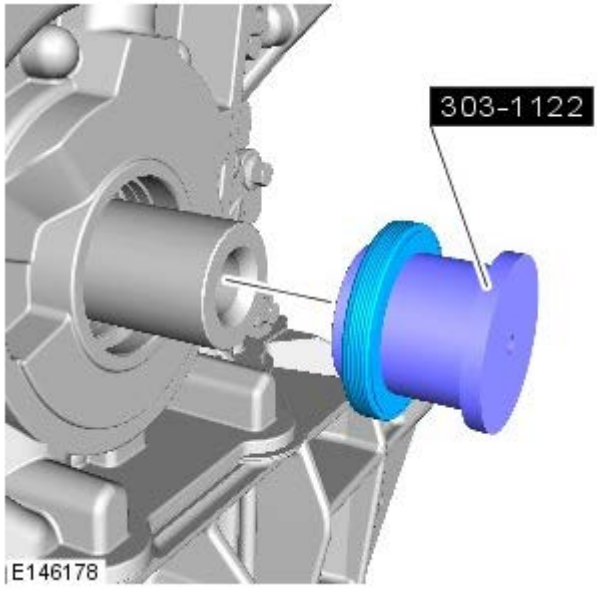
   Special Tool(s): 303-1122

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



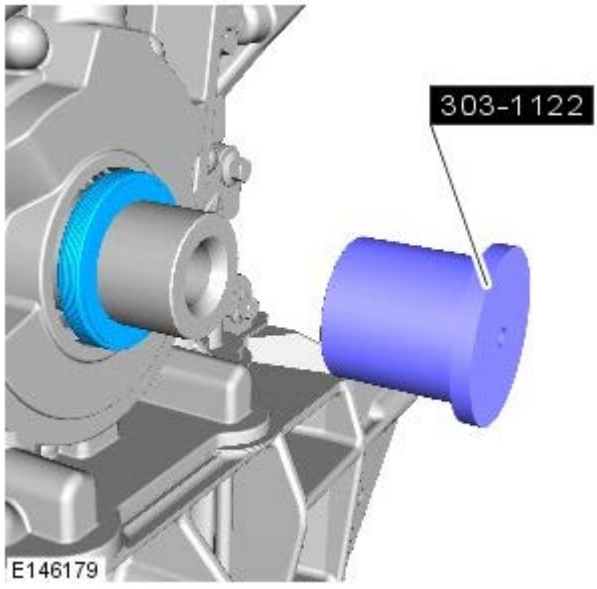
E116753

3. Install the special tool to the crankshaft.



E146178

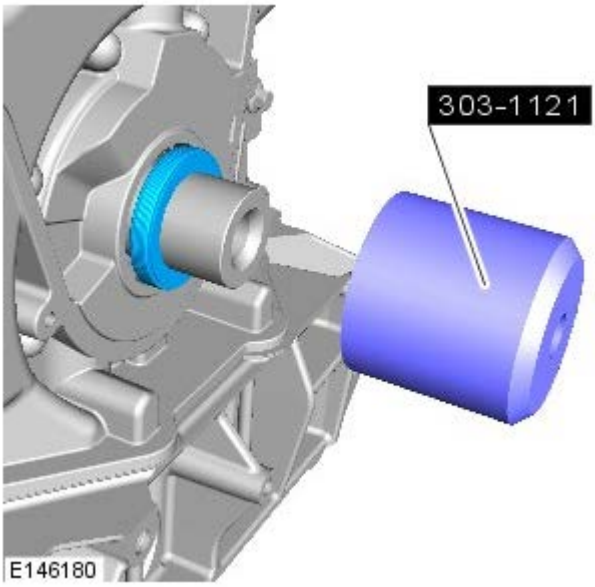
4. Install the special tool to the crankshaft.

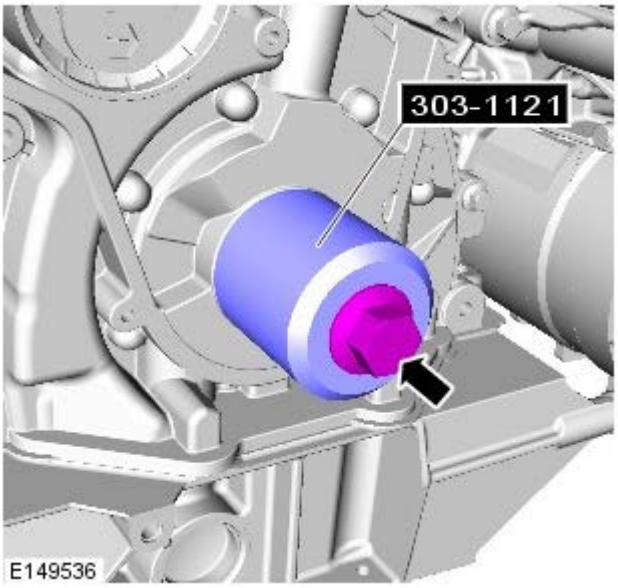


E146179

5. Install the special tool to the crankshaft.

Special Tool(s): 303-1121





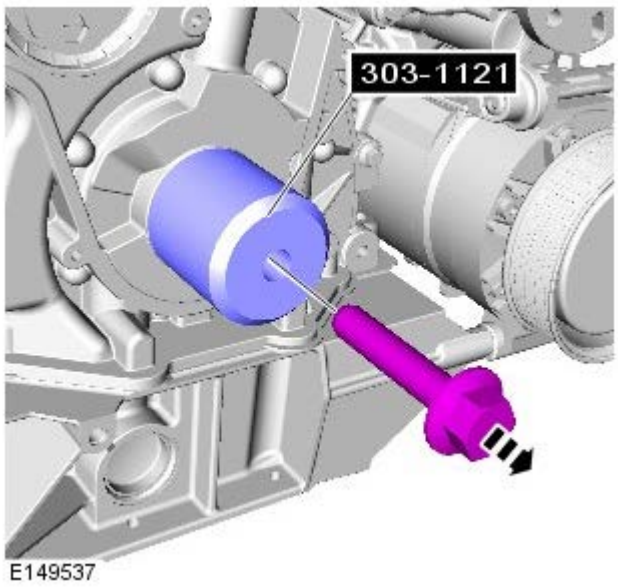
6. CAUTIONS:

   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.



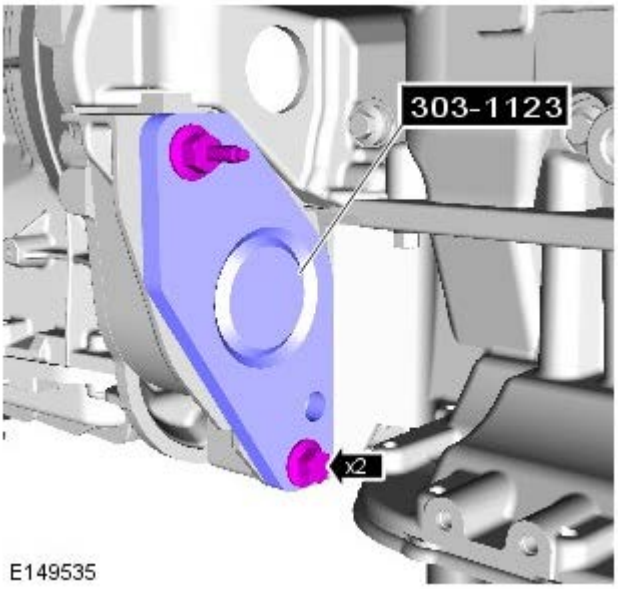
7. CAUTION: Make sure the seal is installed correctly.

   NOTE: Wait 10 seconds before removing the crankshaft seal installation tool.

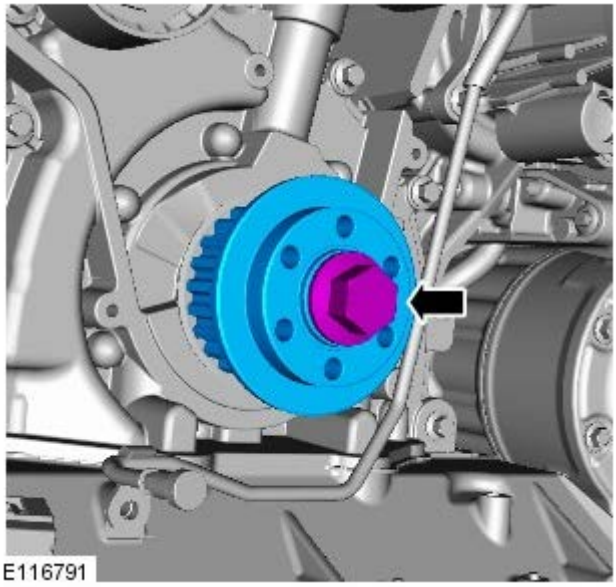
   Remove the special tool.

   Special Tool(s): 303-1121

8. Remove the special tool.



E149535


E116791

9. 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.

   Before installing the crankshaft pulley retaining bolt, note the thread size of the bolt (there are two different sized threads, M14 and M16). Failure to follow this instruction may result in damage to the engine.

   Install the crankshaft pulley.

   Torque:
   - M14 retaining bolt
     - Stage 1: 140 Nm
     - Stage 2: 90°
   - M16 retaining bolt
     - Stage 1: 100 Nm
     - Stage 2: 35°

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

11. Connect the battery ground cable.

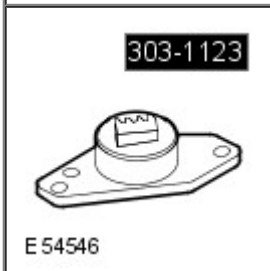
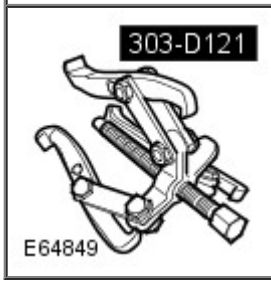
    Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 23-Jan-2014

Engine - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Crankshaft Pulley

Removal and Installation

Special Tool(s)

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

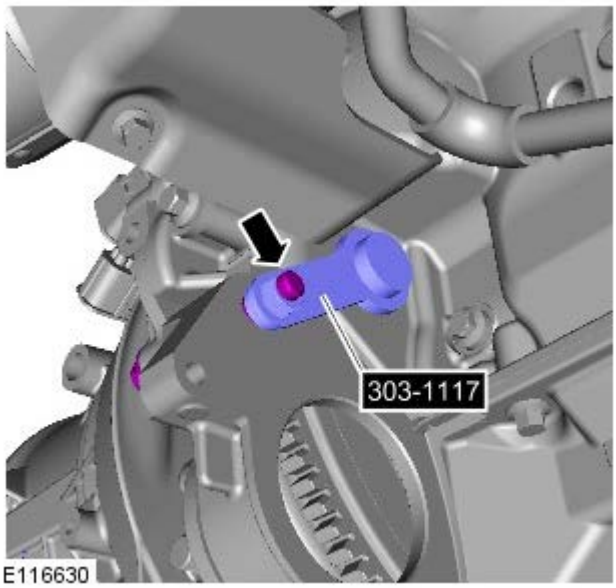
Removal

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

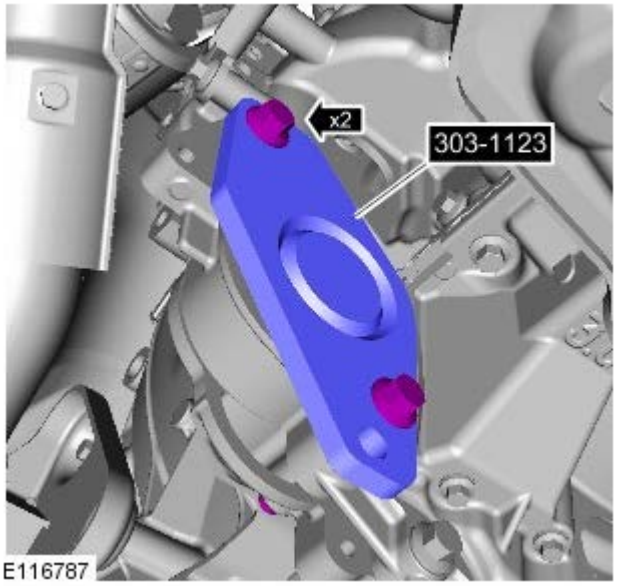
   Raise and support the vehicle.

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

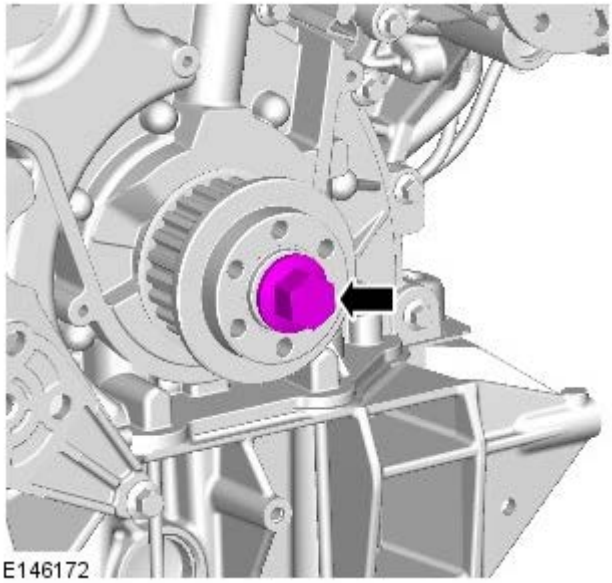
3.
   - Remove the special tool.
   - *Special Tool(s):* 303-1117



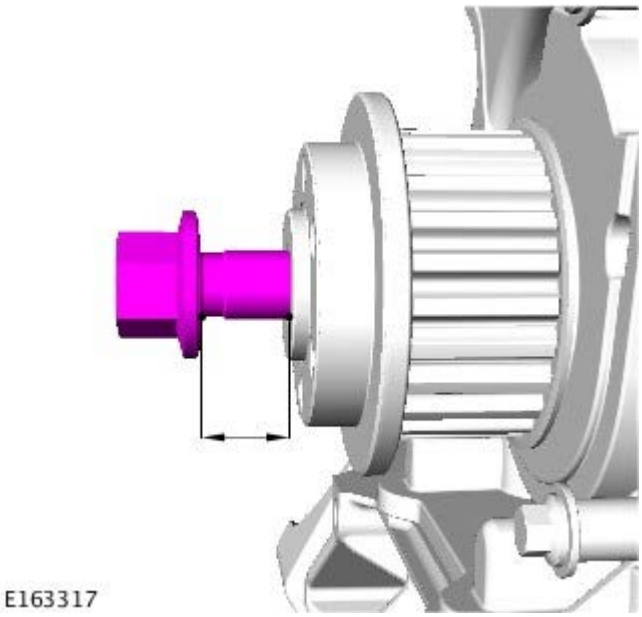
4.
   - Install the special tool.
   - *Special Tool(s):* 303-1123



5.

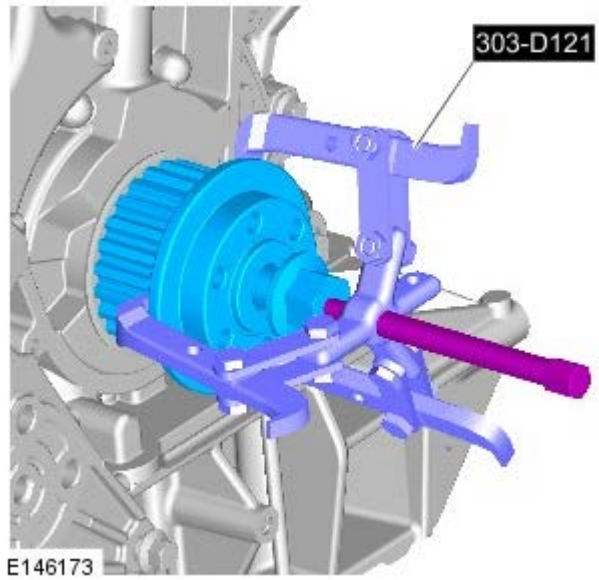


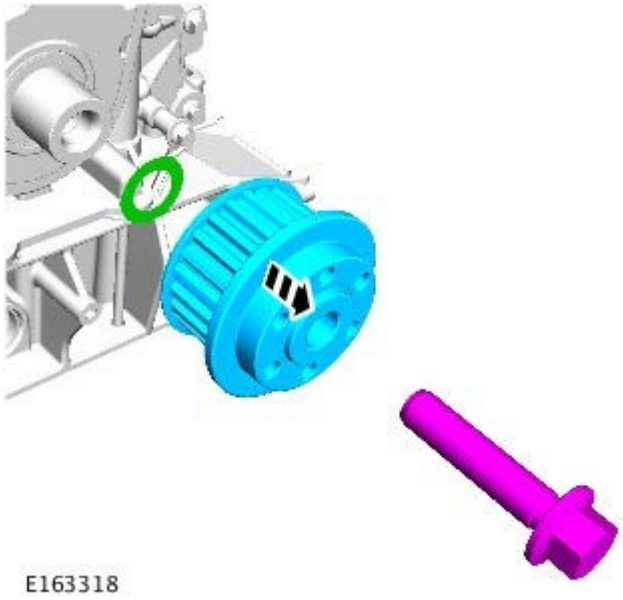
6. Loosen, but do not fully remove the bolt.



7.

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





8. CAUTIONS:

   Discard the bolt.

   Discard the friction washer.

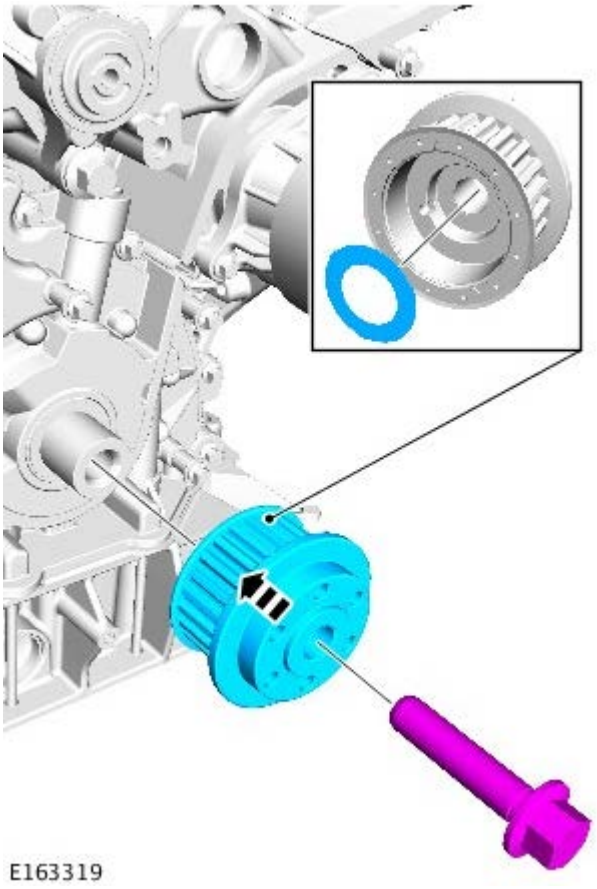
Installation

1. CAUTIONS:

   Install and new friction washer inside the pulley, make sure it is correctly seated before installing the pulley.

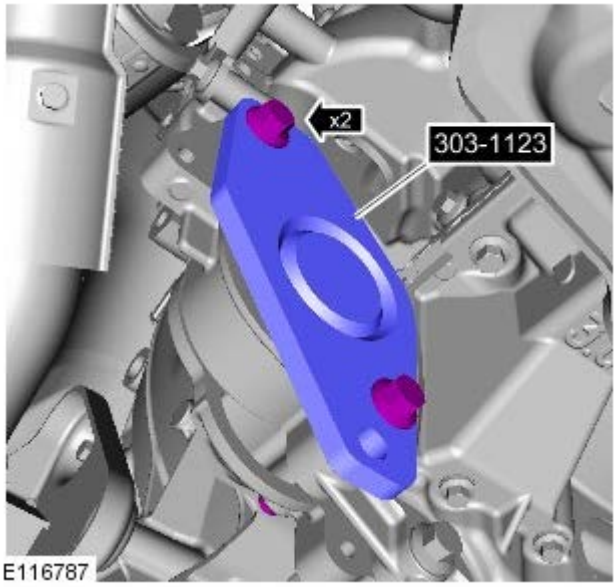
   Do not lubricate the components.

   Make sure that a new bolt is installed.



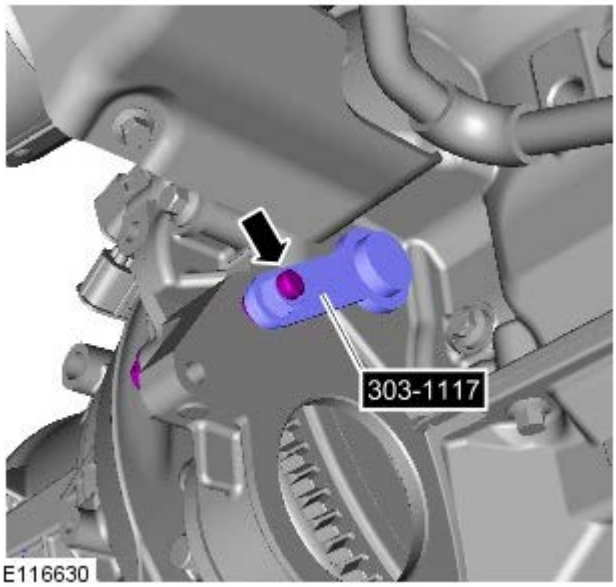
2.

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



3.

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



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

Published: 06-Sep-2013

Engine - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Crankshaft Rear Seal

Removal and Installation

Removal

WARNING: This procedure can only be carried out after the vehicle has been decommissioned, by an approved person.

NOTES:

Removal steps in this procedure may contain installation details.

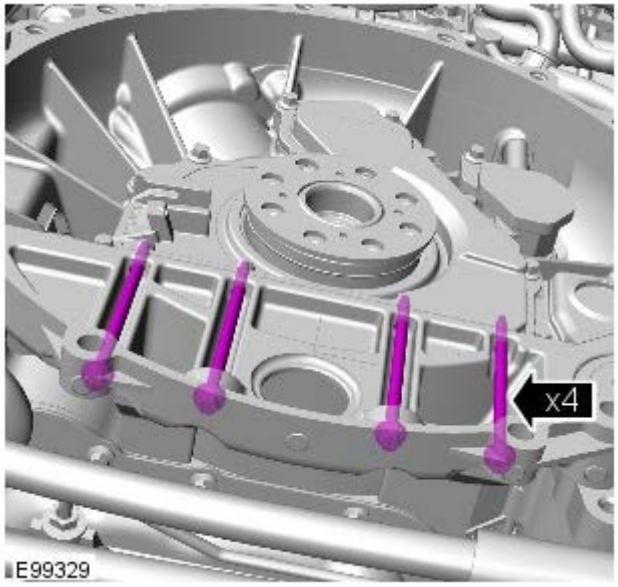
Some variation in the illustrations may occur, but the essential information is always correct.

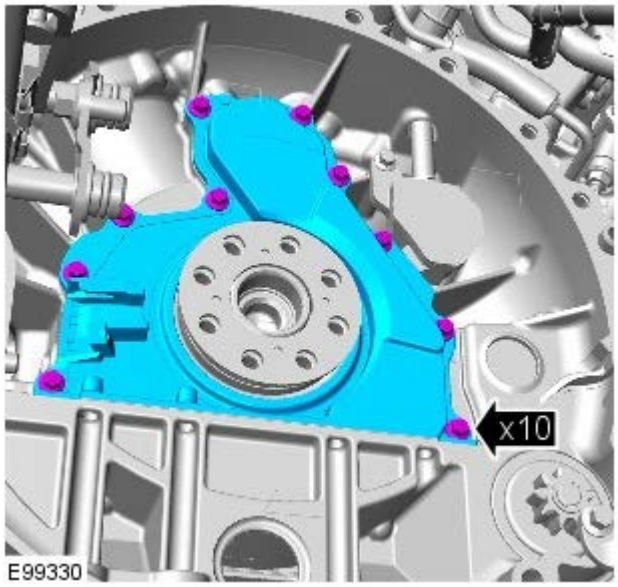
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Refer to: Crankshaft Position (CKP) Sensor Ring (303-14E Electronic Engine Controls - SDV6 3.0L Diesel - Hybrid Electric Vehicle, Removal and Installation).

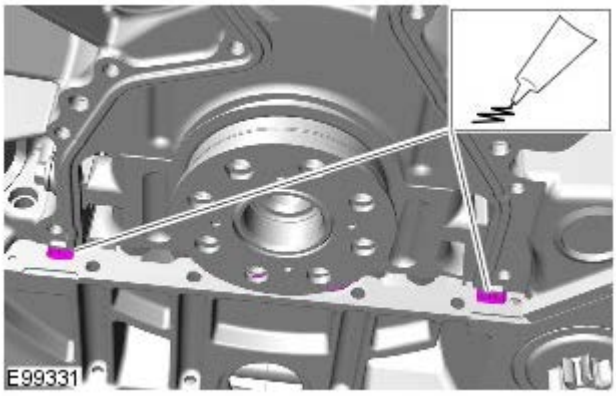
3.





4. CAUTION: Discard the seal.

Installation

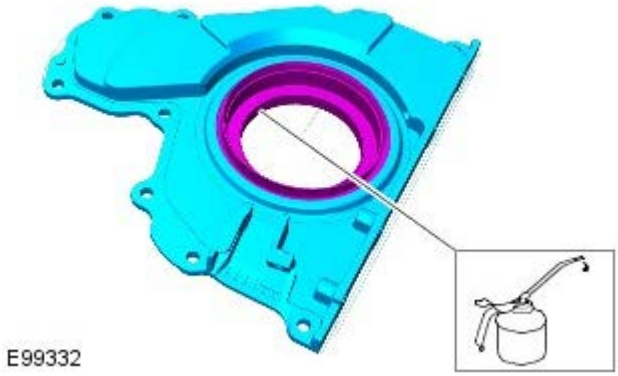


1. CAUTIONS:

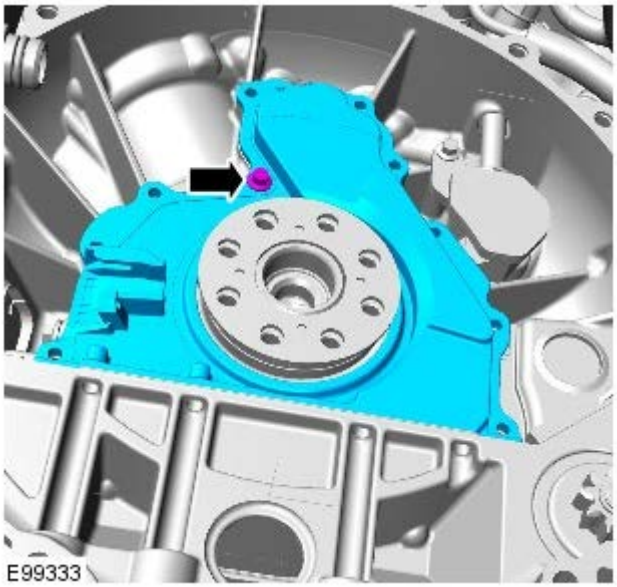
   Make sure that the crankshaft rear oil seal is correctly located.

   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.

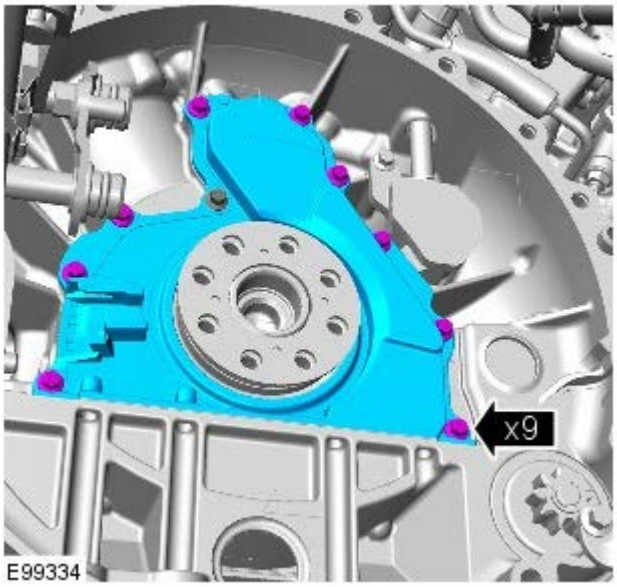


2.
   - Lubricate the oil seal.

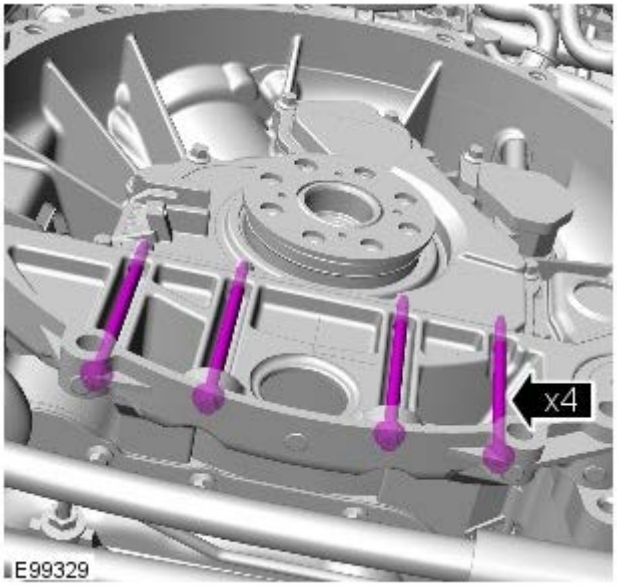


3. *Torque:* 10 Nm

4. *Torque:* 10 Nm



5. *Torque:* 10 Nm



6. Refer to: Crankshaft Position (CKP) Sensor Ring (303-14E Electronic Engine Controls - SDV6 3.0L Diesel - Hybrid Electric Vehicle, Removal and Installation).

Published: 09-Sep-2013

Engine - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Cylinder Head LH

Removal and Installation

Removal

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.

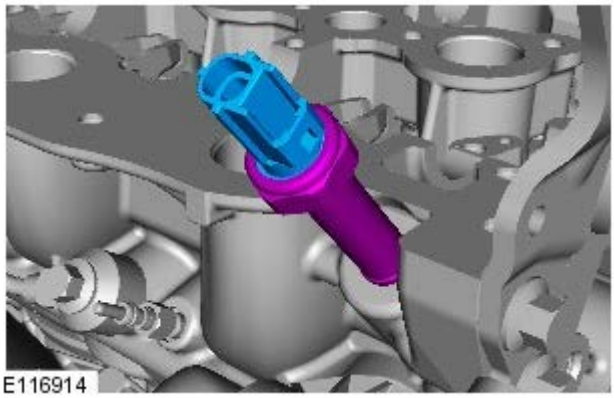
   Raise and support the vehicle.

3. Refer to: Camshaft LH (303-01A Engine - TDV6 3.0L Diesel, Removal and Installation).

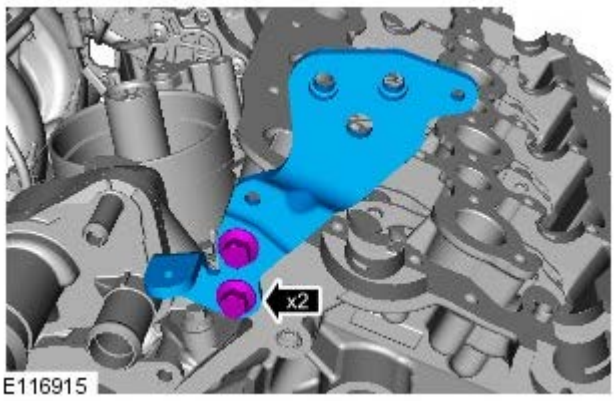
4. Refer to: Glow Plugs (303-07C Glow Plug System - TDV6 3.0L Diesel, Removal and Installation).

5. Refer to: Exhaust Manifold LH (303-01E Engine - SDV6 3.0L Diesel - Hybrid Electric Vehicle, Removal and Installation).

6.

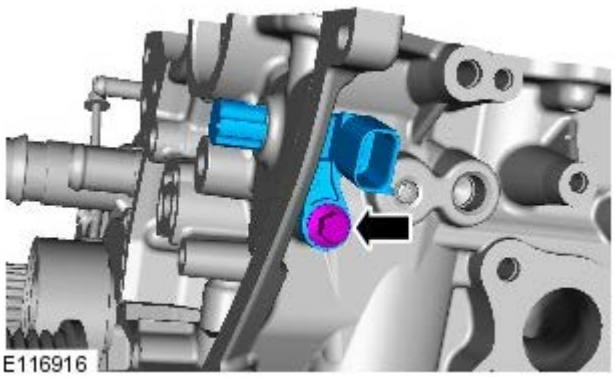

E116914

7.

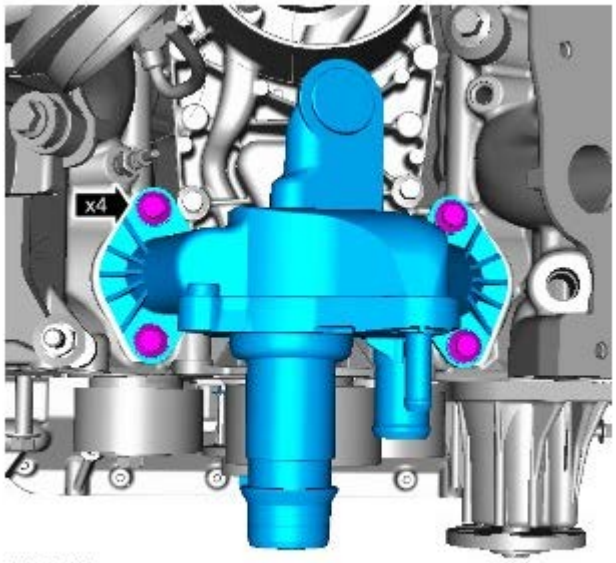


E116915

8.

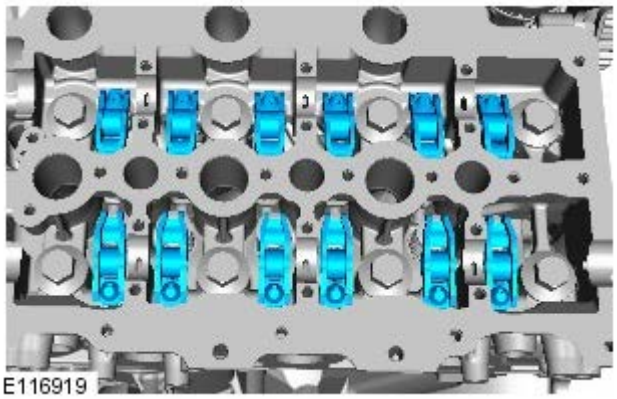

E116916

9.

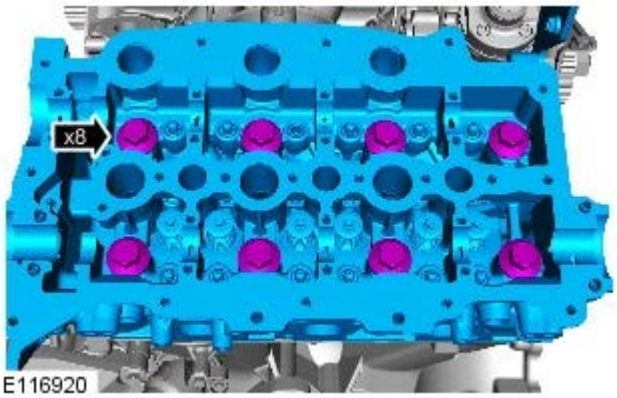


E116917

10.



E116919



E116920

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.

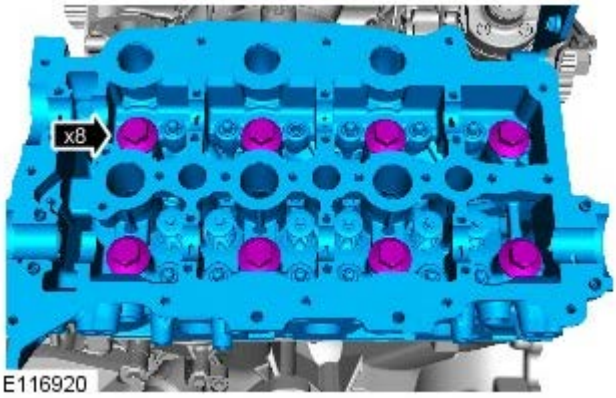
   Clean and inspect the cylinder head and cylinder block.

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



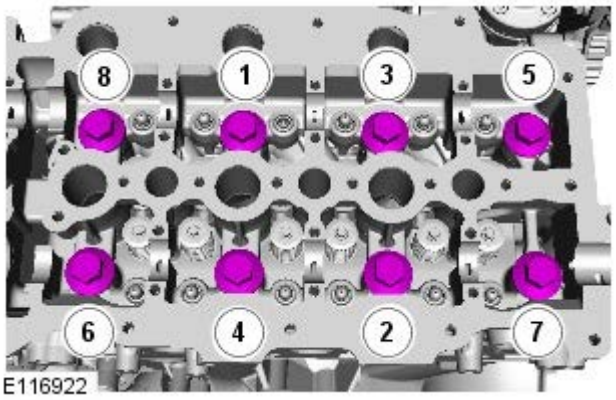
head gasket may result.

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

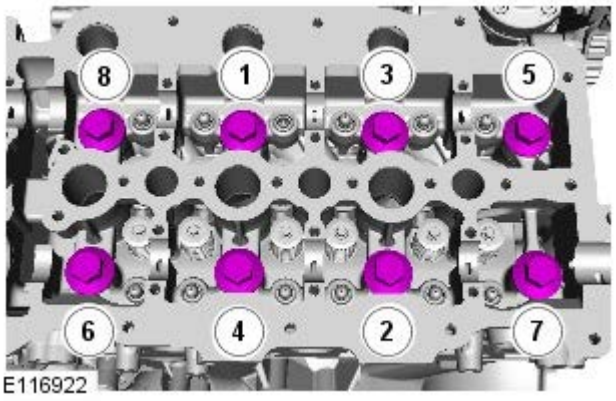
NOTES:

Install a new gasket.

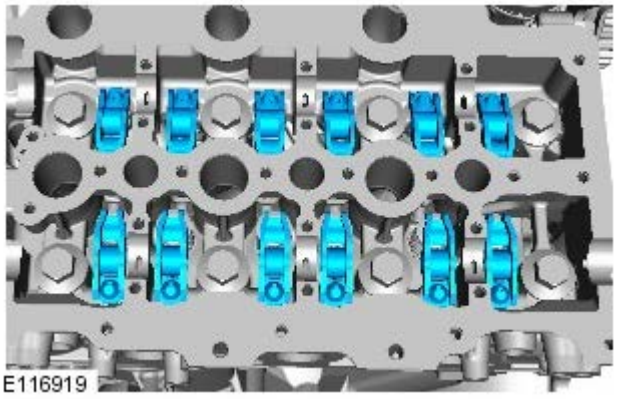
No additional lubrication to the cylinder head bolts is required.



3. NOTE: Tighten the bolts in the indicated sequence.
   - *Torque:* 80 Nm

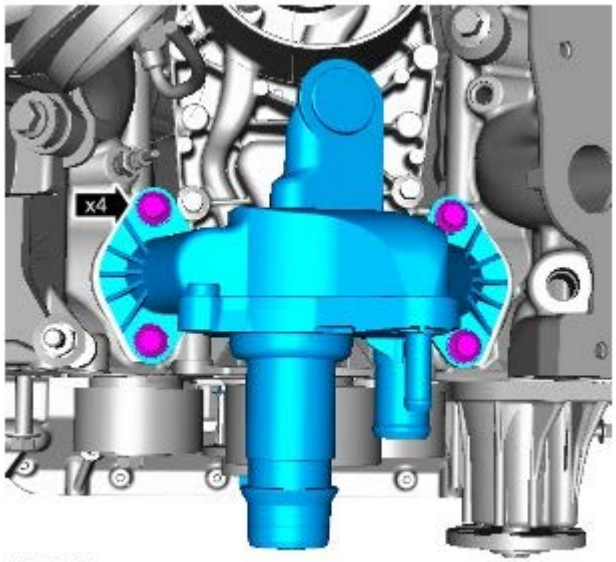


4. NOTE: Tighten the bolts in the indicated sequence.
   - *Torque:* 180°



5. .

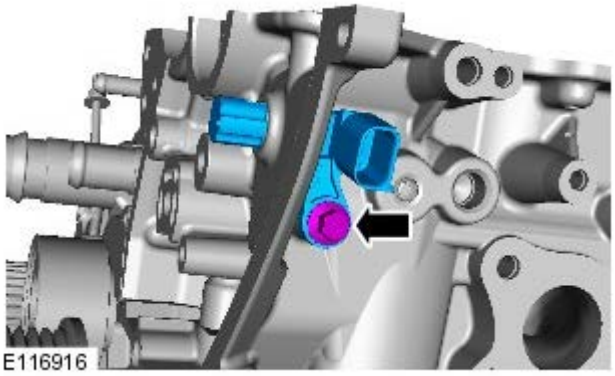
6. CAUTION: Install the new seals.



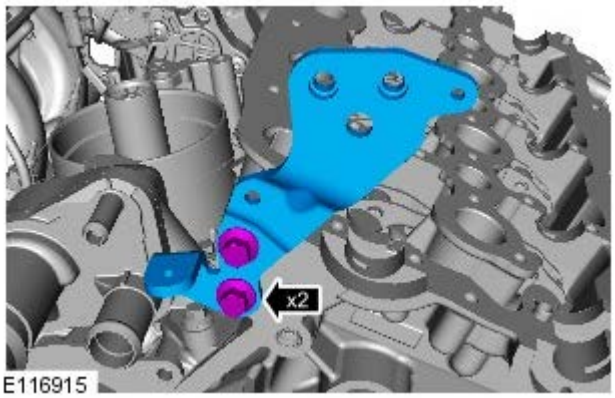
E116917

Torque: 10 Nm

7. *Torque:* 10 Nm

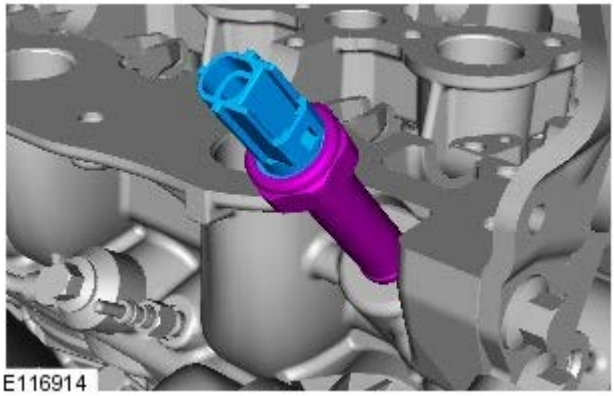

E116916

8. *Torque:* 24 Nm



E116915

9. *Torque:* 14 Nm


E116914

10. Refer to: Exhaust Manifold LH (303-01E Engine - SDV6 3.0L Diesel - Hybrid Electric Vehicle, Removal and Installation).

11. Refer to: Glow Plugs (303-07C Glow Plug System - TDV6 3.0L

Diesel, Removal and Installation).

12. Refer to: Camshaft LH (303-01A Engine - TDV6 3.0L Diesel, Removal and Installation).

13. Connect the battery ground cable.

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

Published: 17-Dec-2013

Engine - SDV6 3.0L Diesel - Hybrid Electric Vehicle - 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.

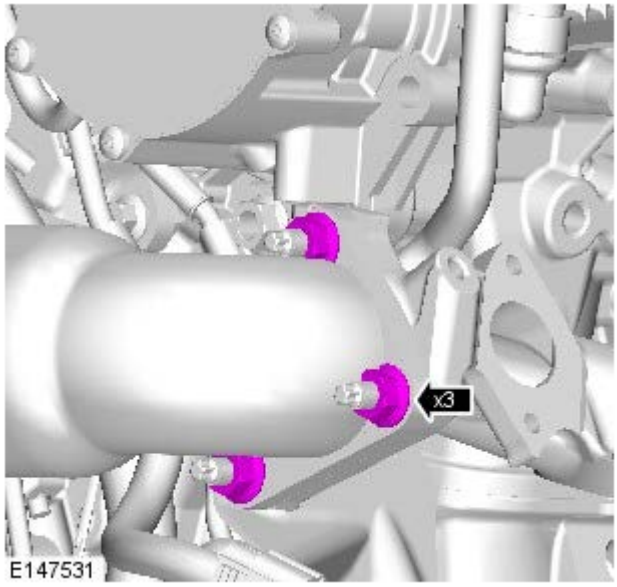
1. Disconnect the battery ground cable

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

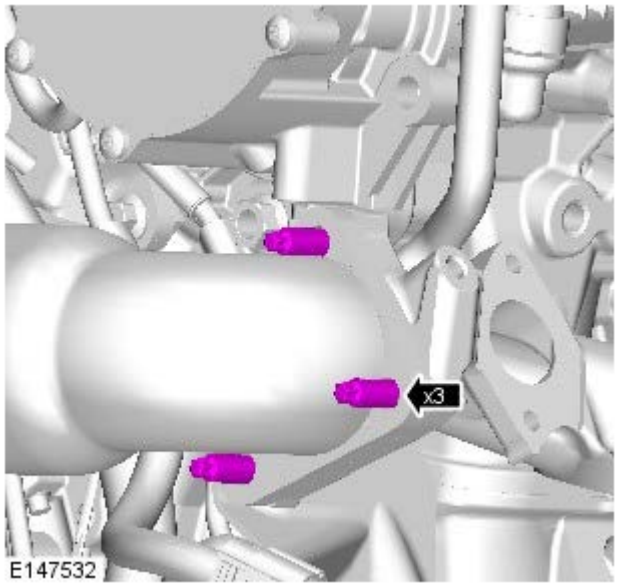
2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

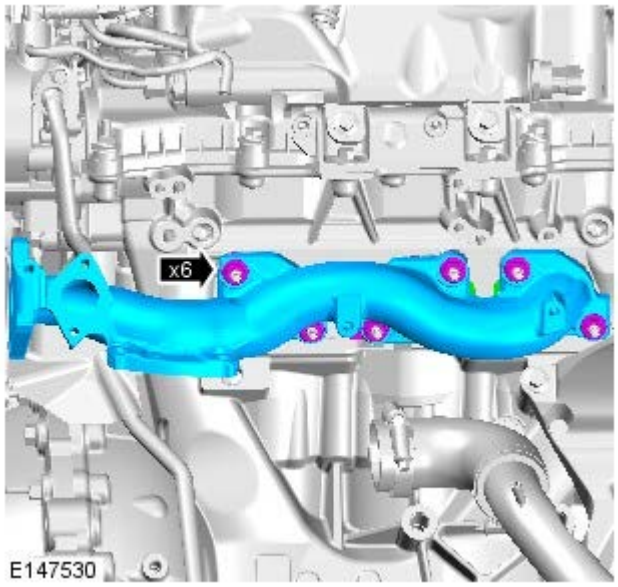
3. Refer to: Turbocharger RH (303-04B Fuel Charging and Controls - Turbocharger - SDV6 3.0L Diesel - Hybrid Electric Vehicle/TDV6 3.0L Diesel, Removal and Installation).



4. CAUTION: Discard the nuts.

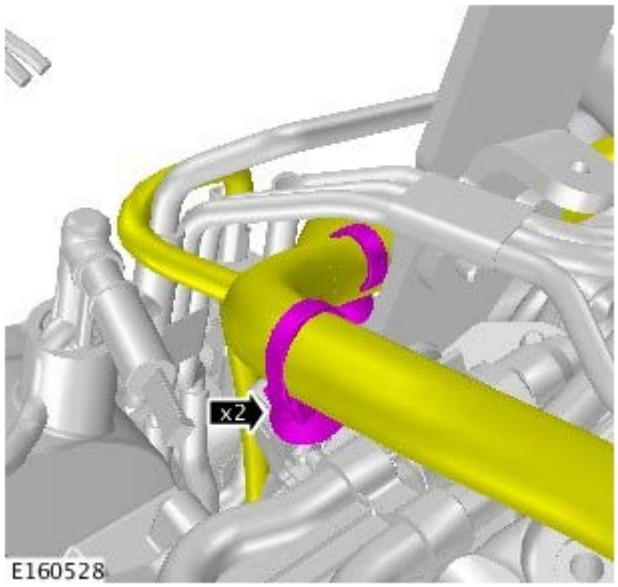


5. CAUTION: Discard the studs.

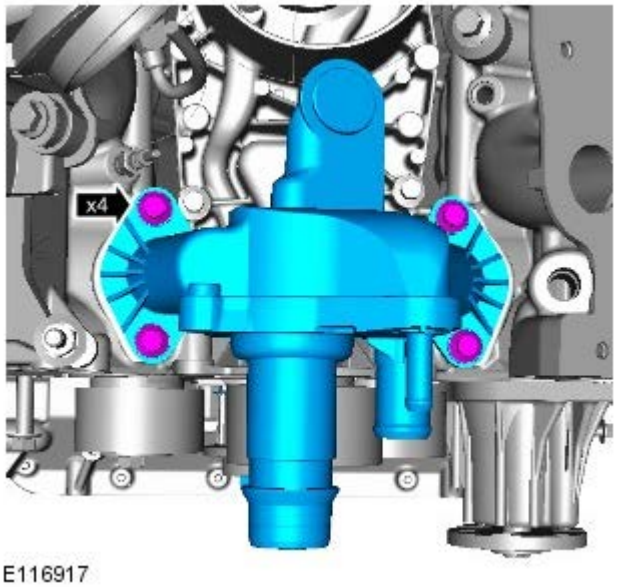


6. NOTE: Discard the gasket.

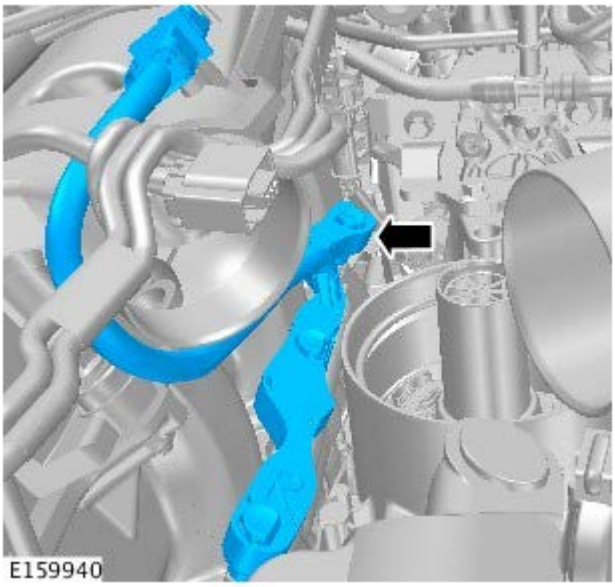
7.



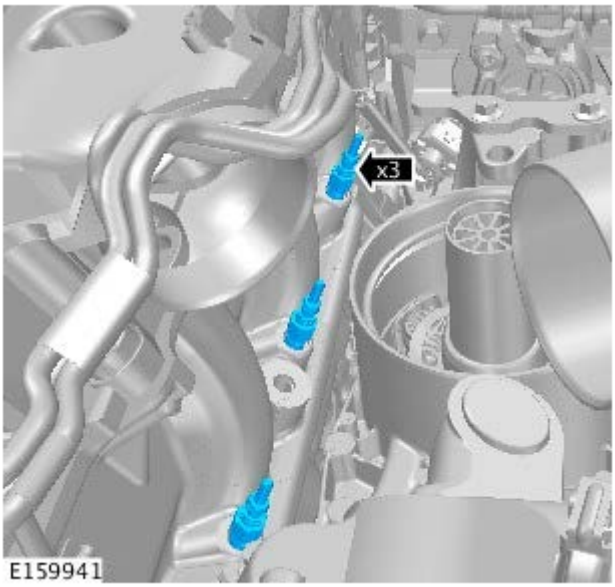
8.



9.

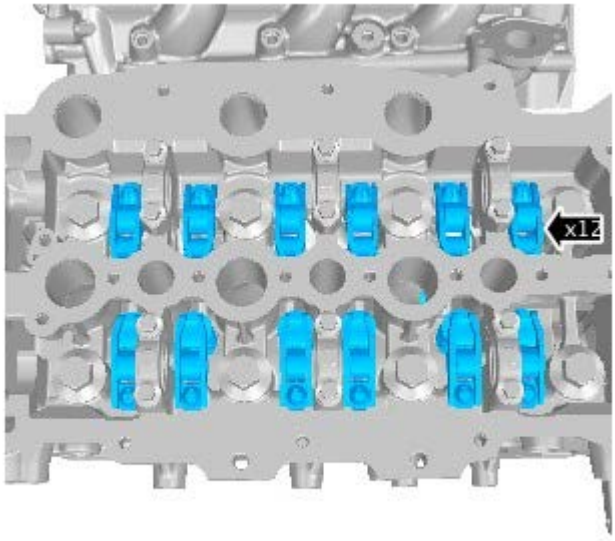


10.

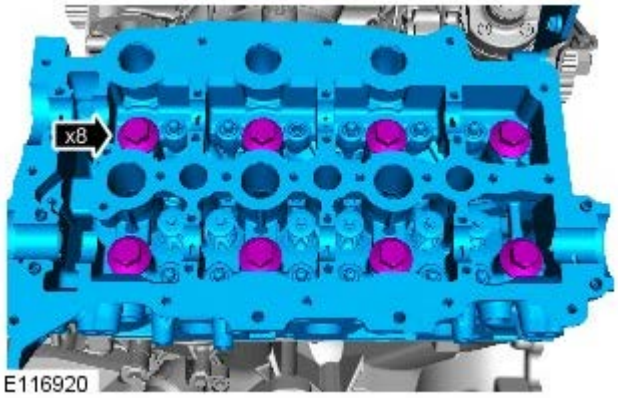


11. Refer to: Camshaft RH (303-01A Engine - TDV6 3.0L Diesel, Removal and Installation).

12.



13. CAUTION: Discard the bolts.



NOTE: Discard the gasket.

Installation

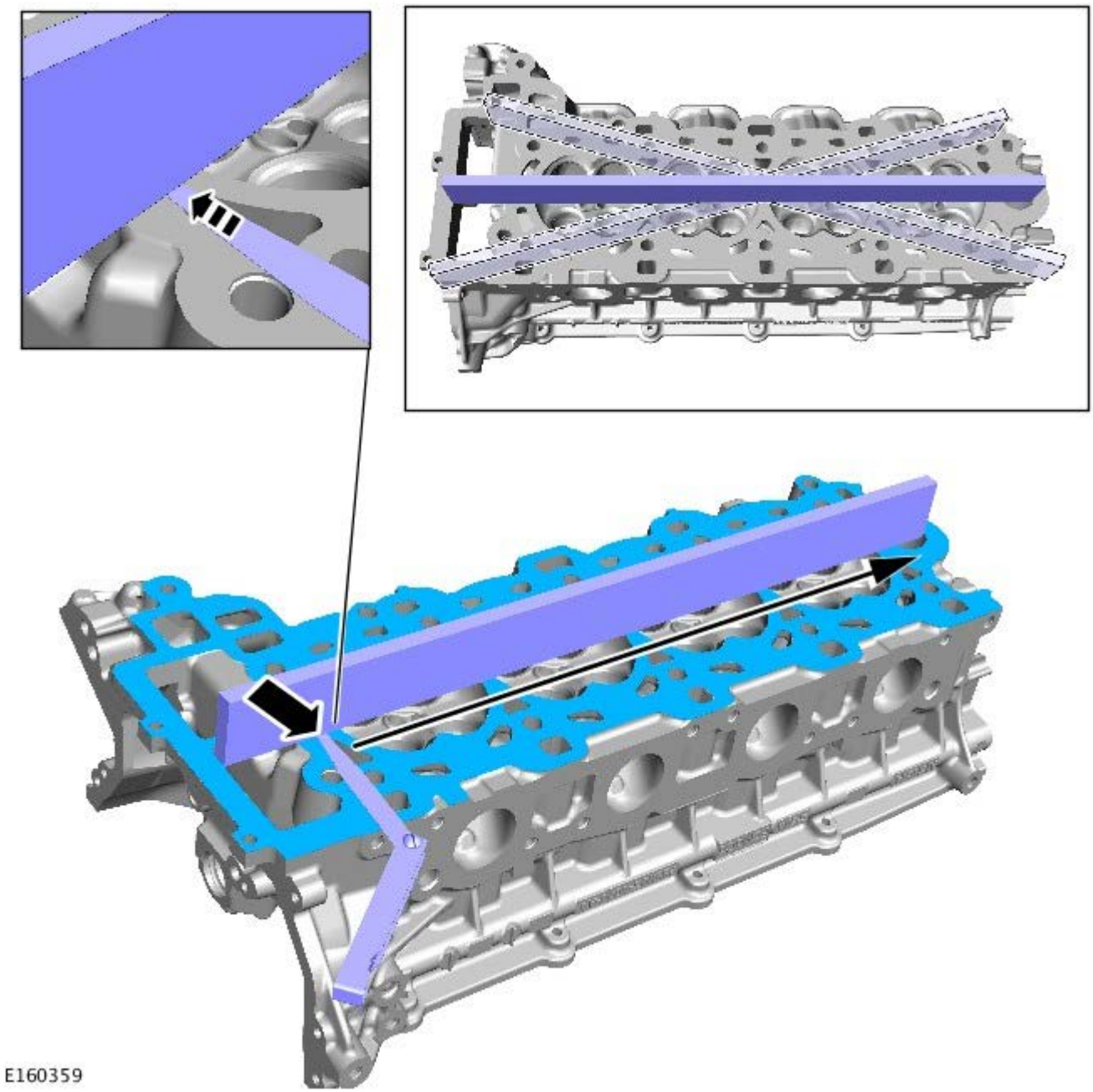
1. CAUTIONS:

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

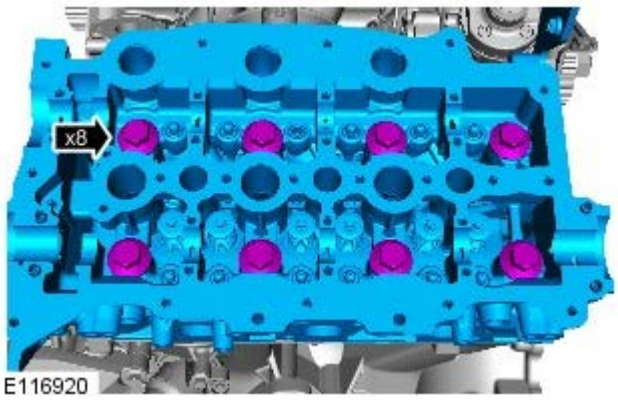
   An acceptable flatness of the cylinder head is 0.1mm.

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

   Clean and check the cylinder head face for distortion, across the center and from corner to corner.



E160359



E116920

2. CAUTIONS:

Only tighten the bolts finger-tight at this stage.

Make sure that new bolts are installed.

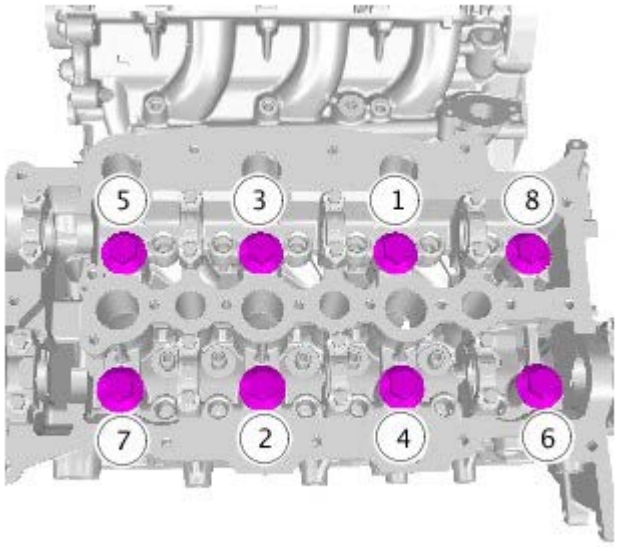
Use care when installing the cylinder head. Damage to the cylinder block, cylinder head or cylinder head gasket may result.

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

NOTES:

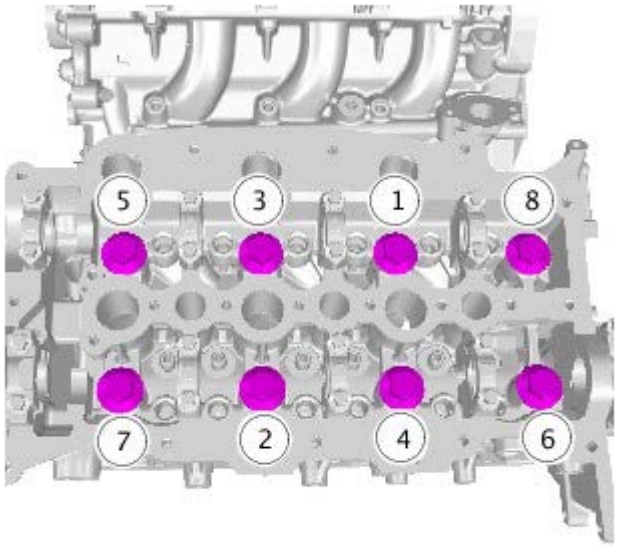
Install a new gasket.

No additional lubrication to the cylinder head bolts is required.



E159942

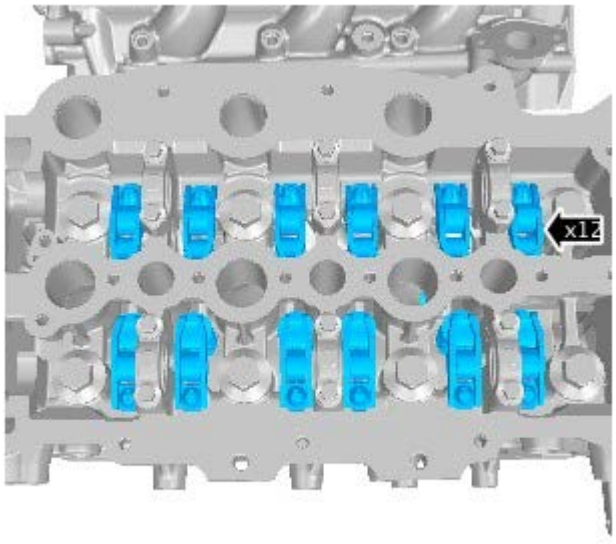
3. NOTE: Tighten the bolts in the indicated sequence.
   - *Torque:* 80 Nm



E159942

4. NOTE: Tighten the bolts in the indicated sequence.
   - *Torque:* 180°

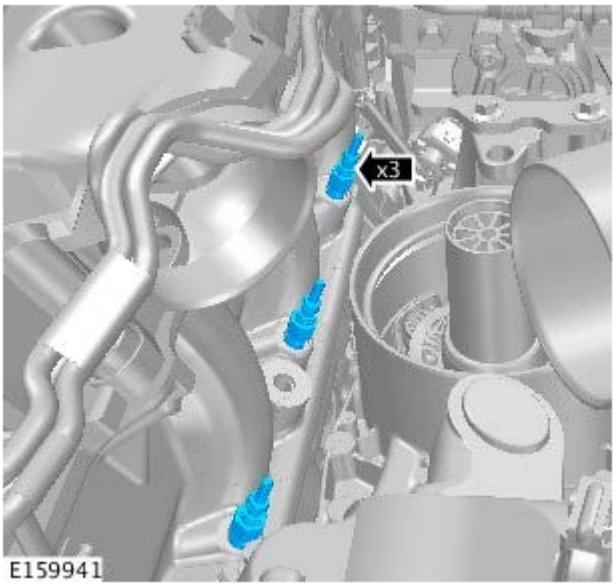
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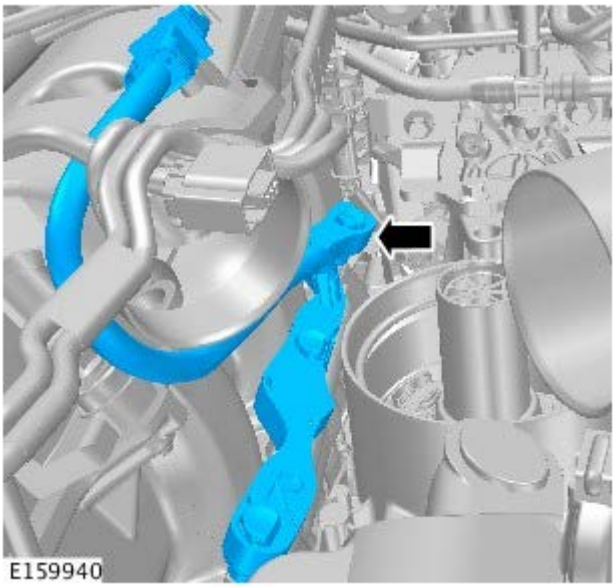
E159939

6. Refer to: Camshaft RH (303-01A Engine - TDV6 3.0L Diesel, Removal and Installation).

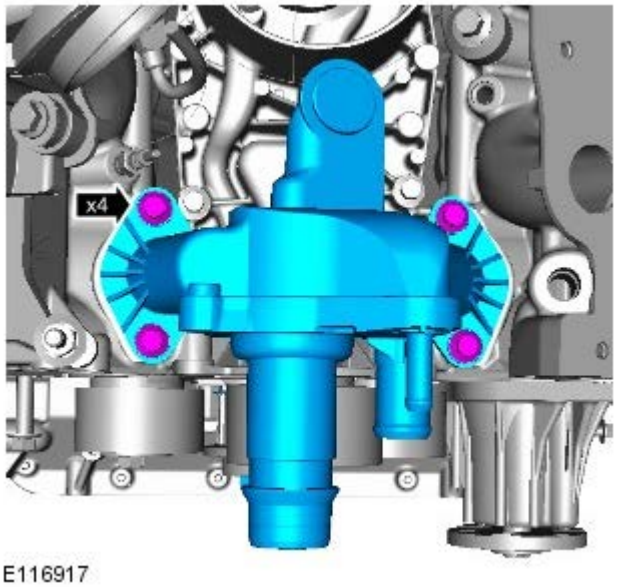
7. *Torque:* 10 Nm



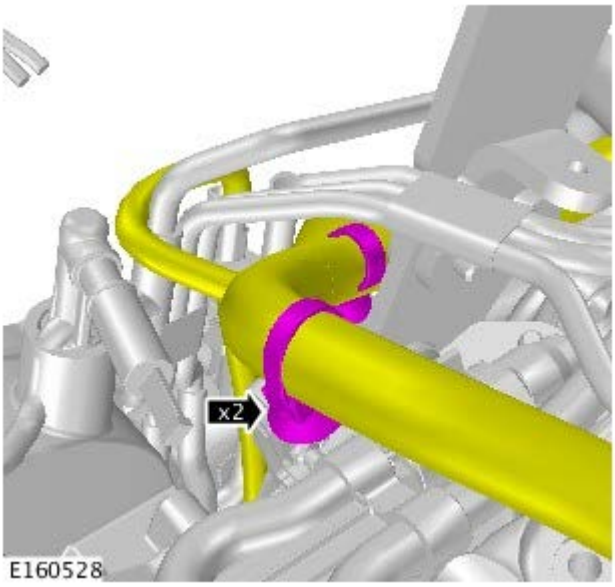
8.

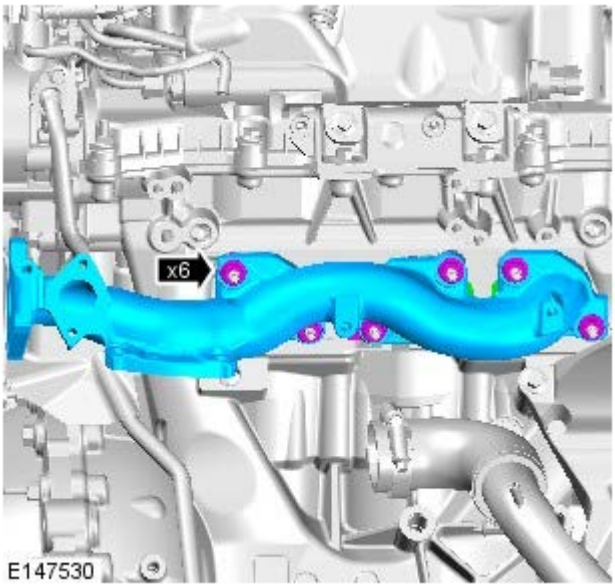


9. *Torque:* 10 Nm



10.

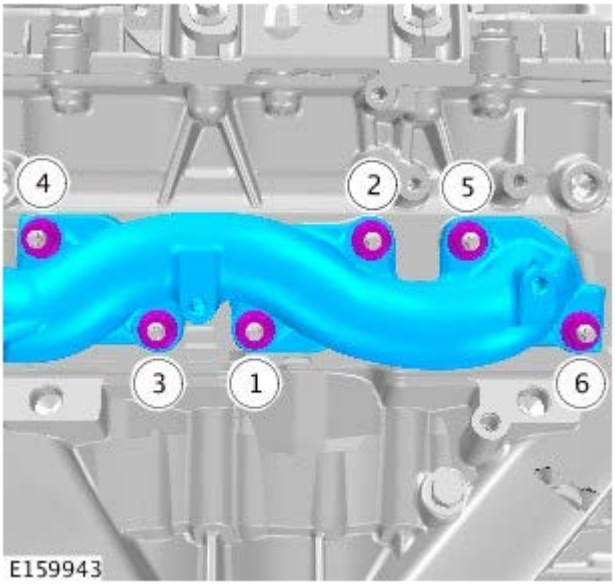




11. WARNING: Make sure that new nuts are installed.

CAUTION: Install the nuts finger tight before final tightening.

NOTE: Install a new gasket.

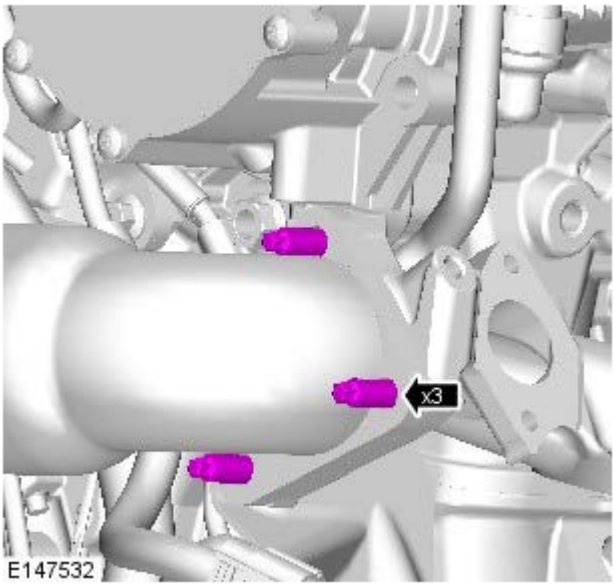


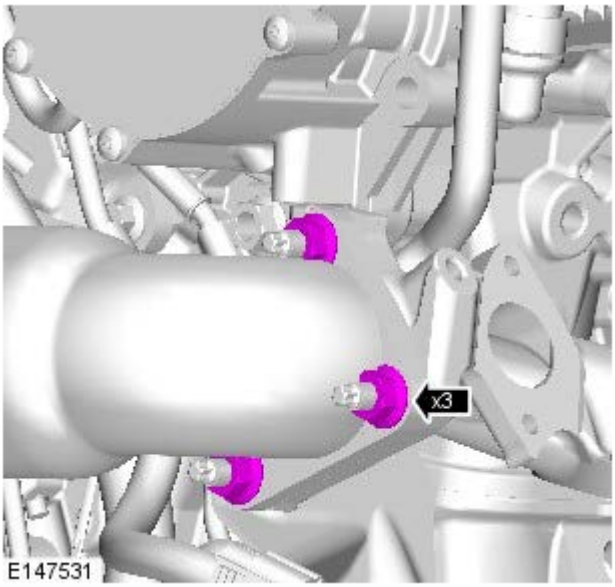
12. NOTE: Tighten the bolts in the indicated sequence.

Torque: 28 Nm

13. CAUTION: Install new studs.

Torque: 13 Nm





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

    Torque: 24 Nm

15. Refer to: Turbocharger RH (303-04B Fuel Charging and Controls - Turbocharger - SDV6 3.0L Diesel - Hybrid Electric Vehicle/TDV6 3.0L Diesel, Removal and Installation).

16. Connect the battery ground cable

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

Published: 06-Sep-2013

Engine - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Engine Mount LH

Removal and Installation

Removal

WARNING: This procedure can only be carried out after the vehicle has been decommissioned, by an approved person.

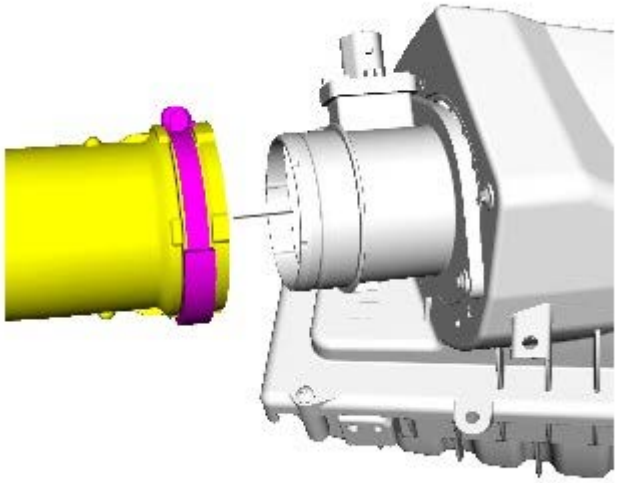
NOTES:

Some components shown removed for clarity.

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: Electric Air Conditioning (A/C) Compressor (412-01B, Removal and Installation).

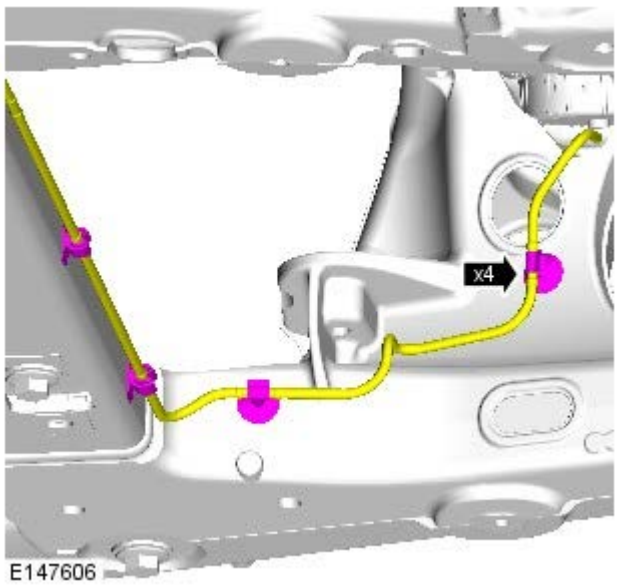


E157217

2. NOTE: Make sure the retaining clip is correctly installed and tightened.

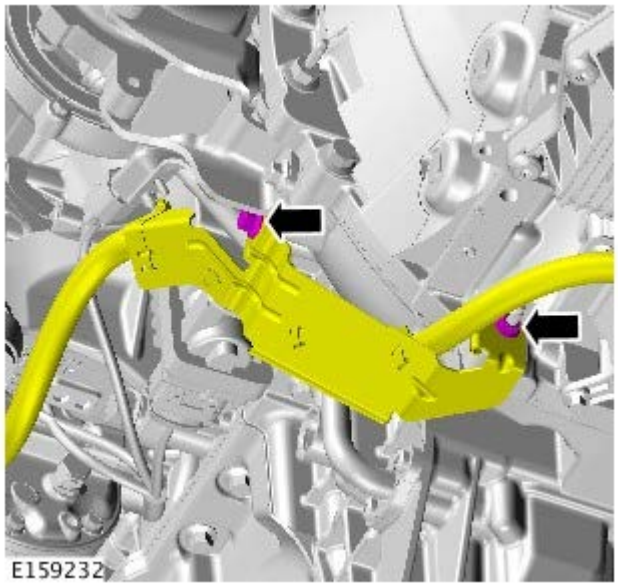
   Torque: 3 Nm

3.

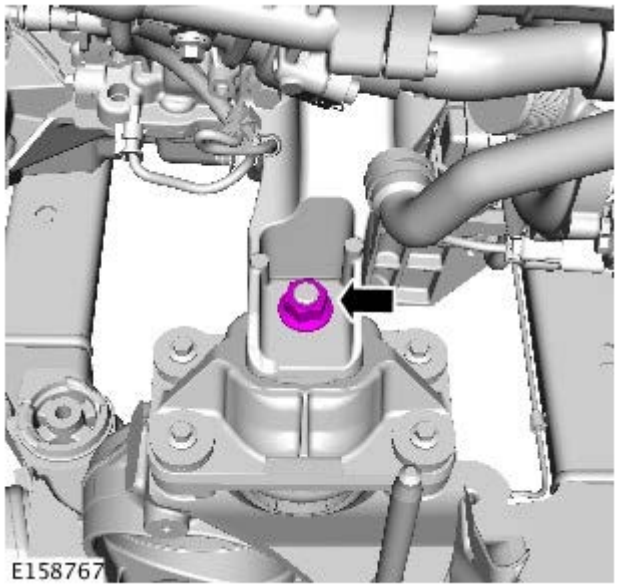


E147606

4.

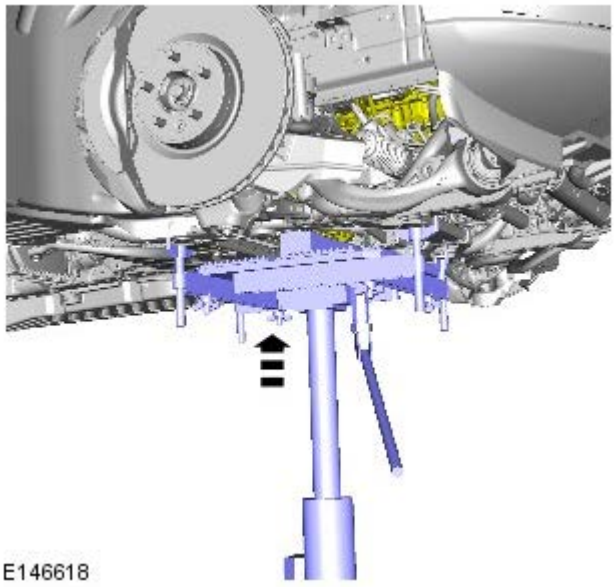


5.

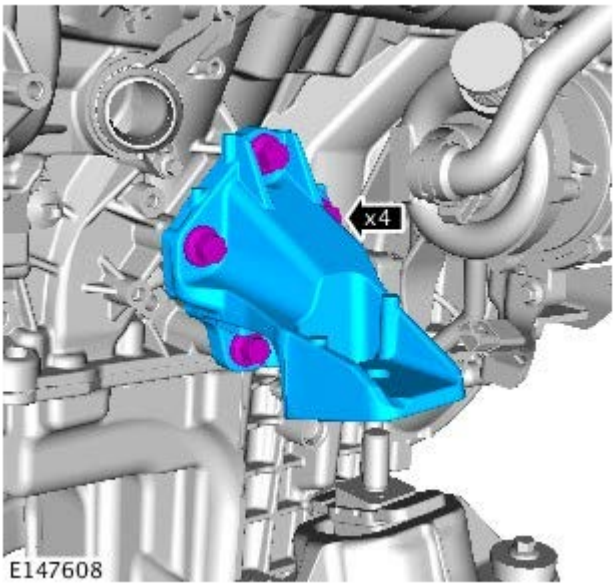


6. CAUTION: Use a wooden block to protect the oil pan when supporting the engine.

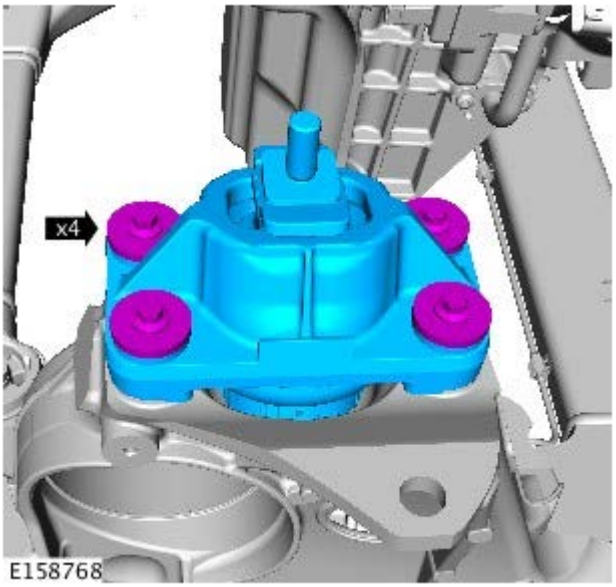
   Using a suitable hydraulic jack, raise and support the engine.



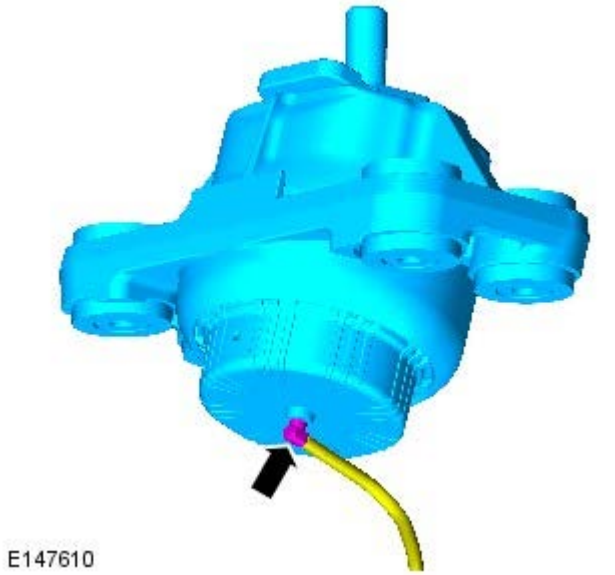
7.



8. CAUTION: Discard the bolts.

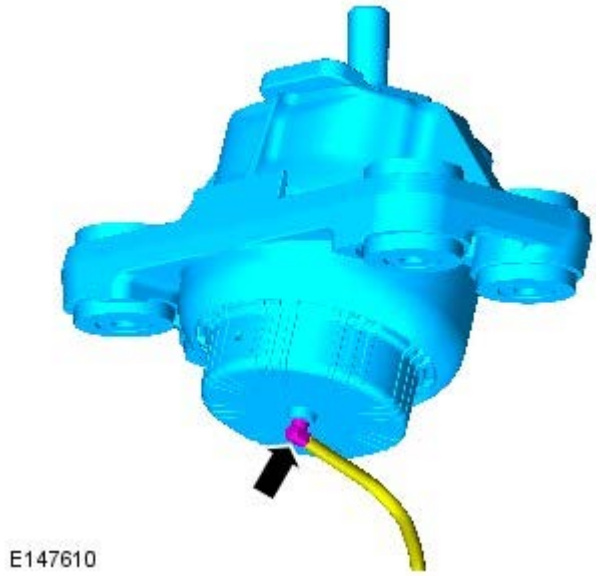


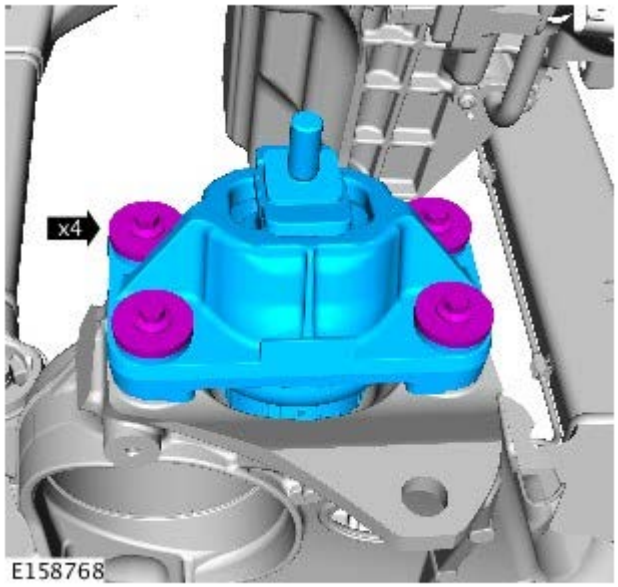
9.



Installation

1.

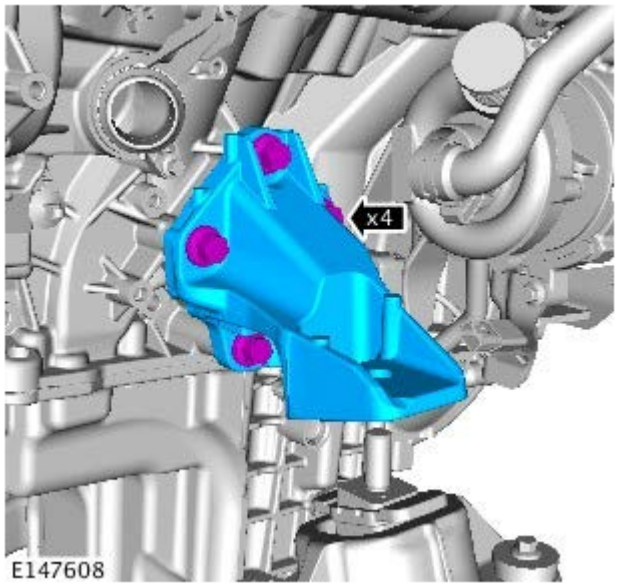




2. CAUTION: Only tighten the bolts finger tight at this stage.

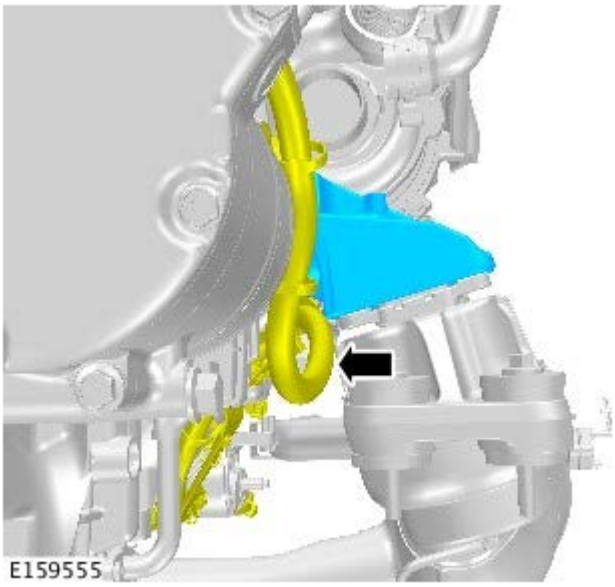
   NOTE: Make sure that new bolts are installed.

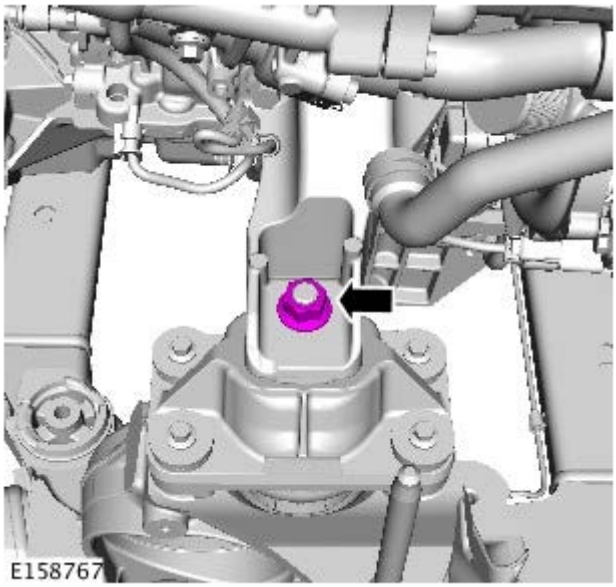
3. *Torque:* 115 Nm



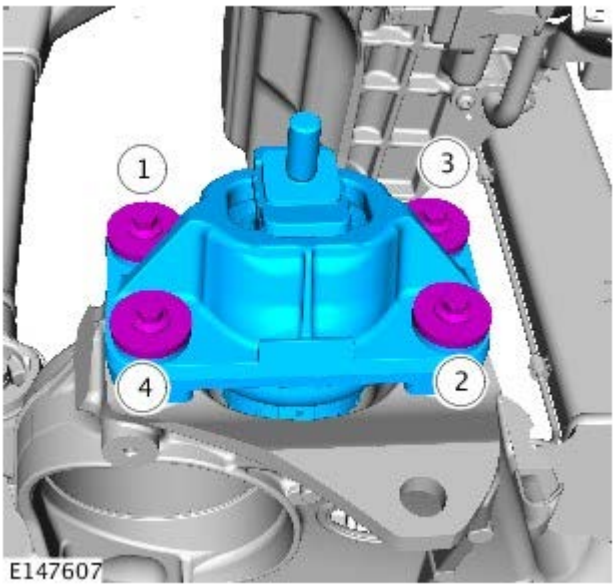
4. CAUTION: Make sure that the wiring harness does not catch.

   Lower the engine onto the mount.





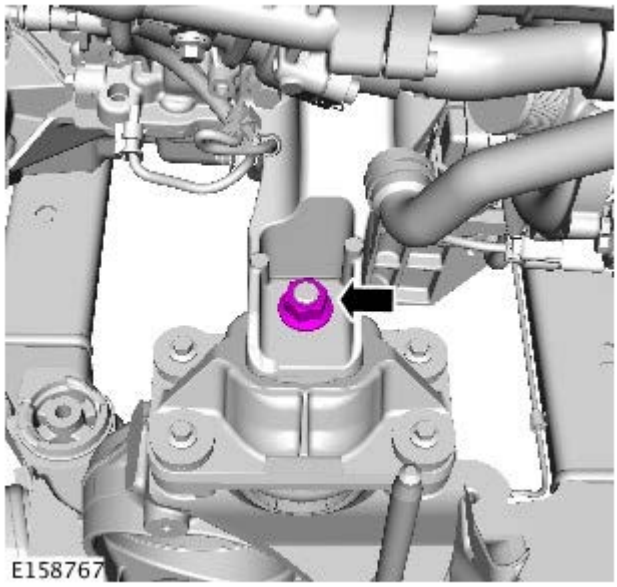
5. CAUTION: Only tighten the nut finger tight at this stage.



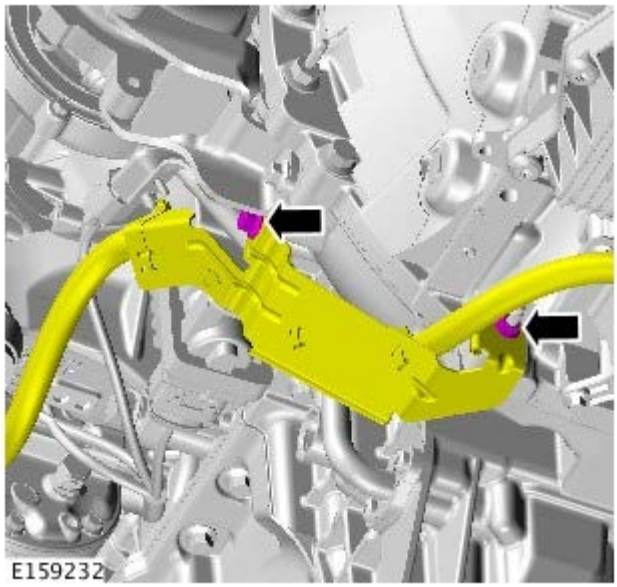
6. CAUTION: Tighten the bolts in the sequence shown.

   Torque: 40 Nm

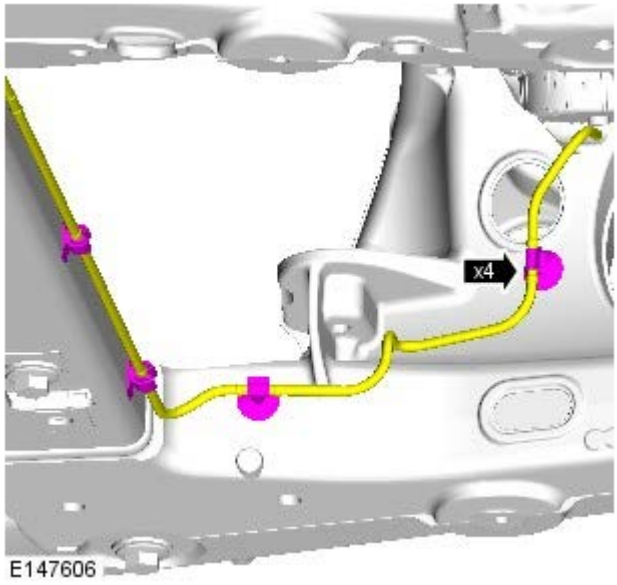
7. *Torque:* 130 Nm



8. *Torque:* 10 Nm

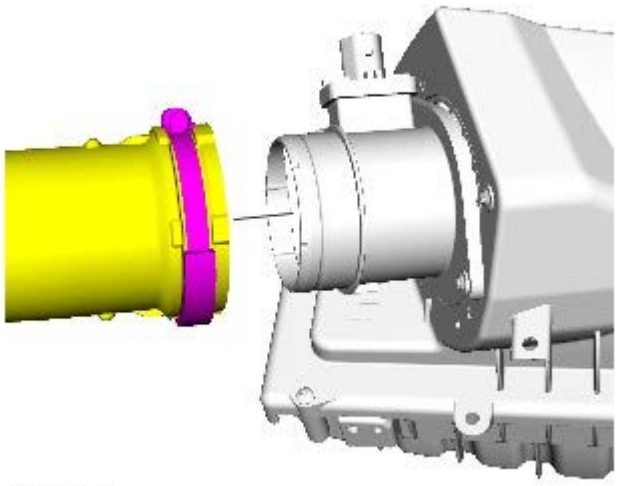


9.



10. NOTE: Make sure the retaining clip is correctly installed and tightened.

    Torque: 3 Nm



E157217

11. Refer to: Electric Air Conditioning (A/C) Compressor (412-01B, Removal and Installation).

Published: 06-Sep-2013

Engine - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Engine Mount RH

Removal and Installation

Removal

NOTES:

Some components shown removed for clarity.

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

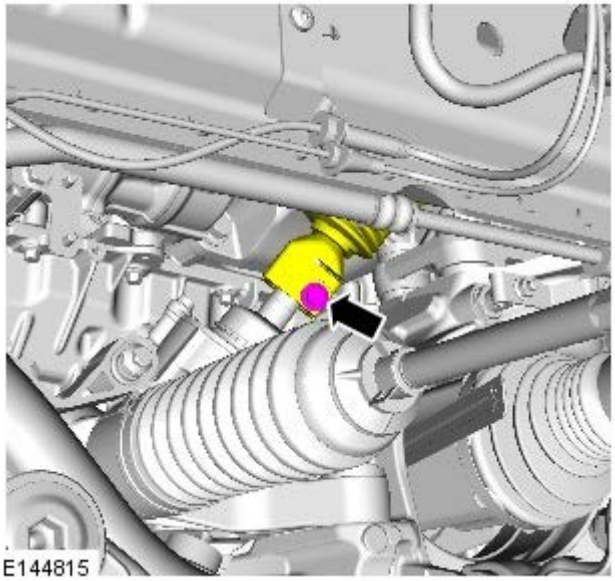
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

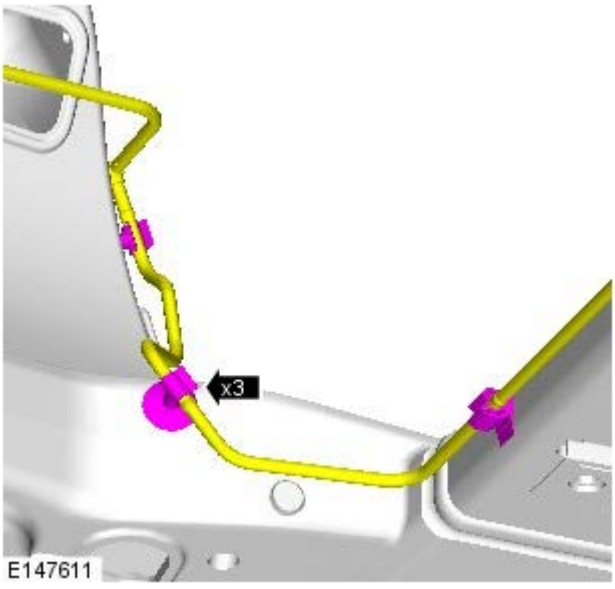
2. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

3. Refer to: Generator (414-02A Generator and Regulator - TDV6 3.0L Diesel, Removal and Installation).

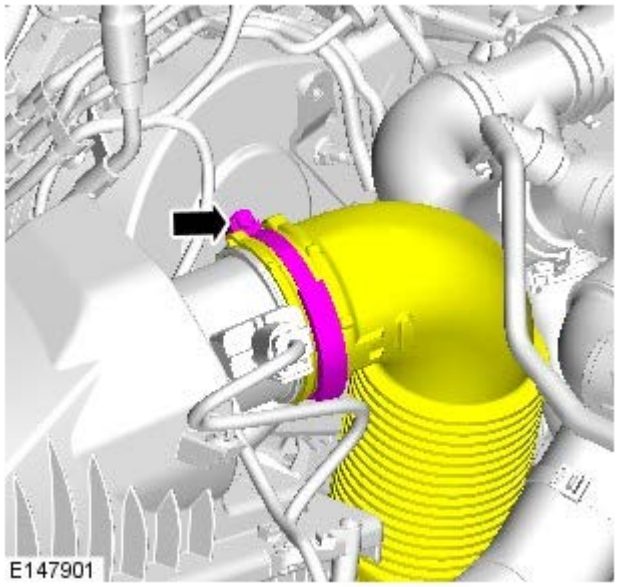
4. Align the steering wheel to straight ahead.



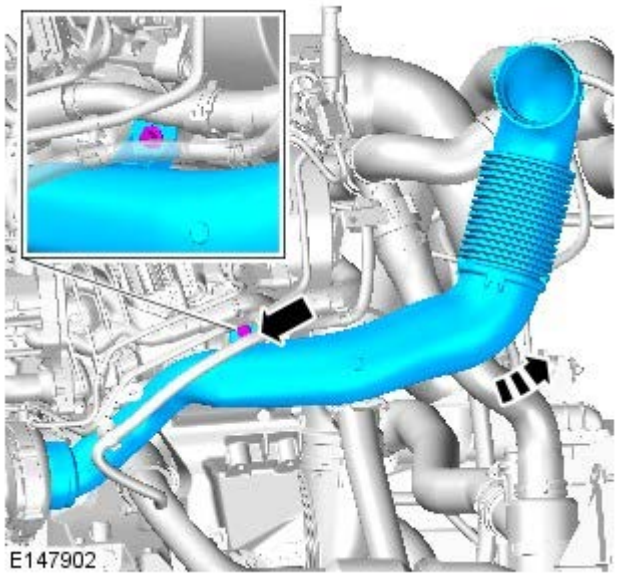
5.



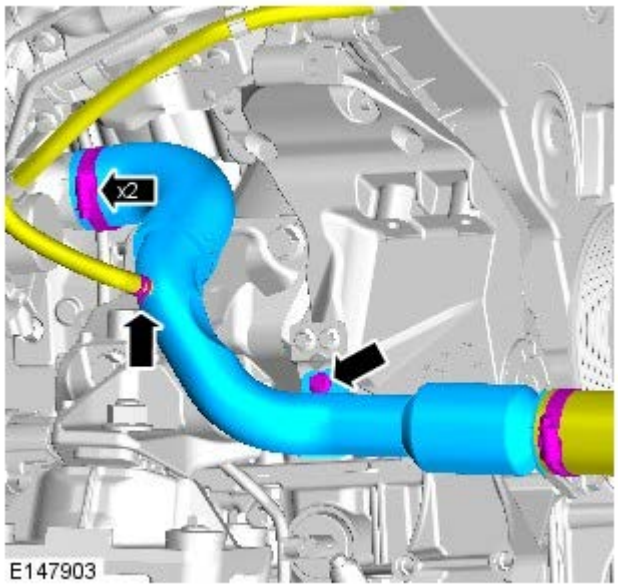
6.



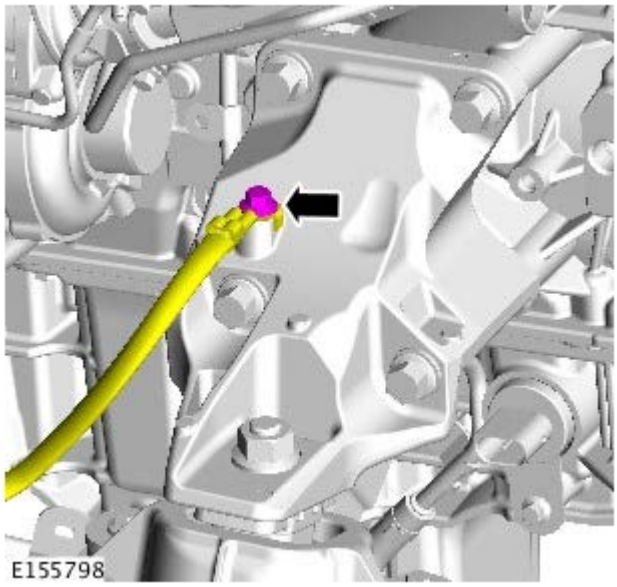
7.



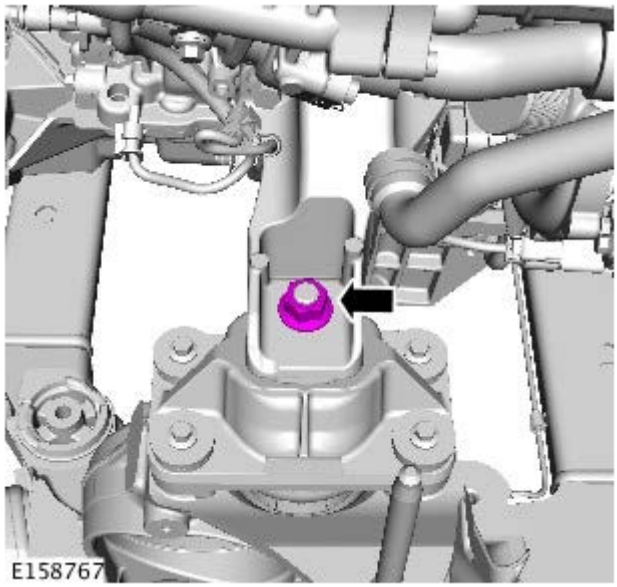
8.



9.

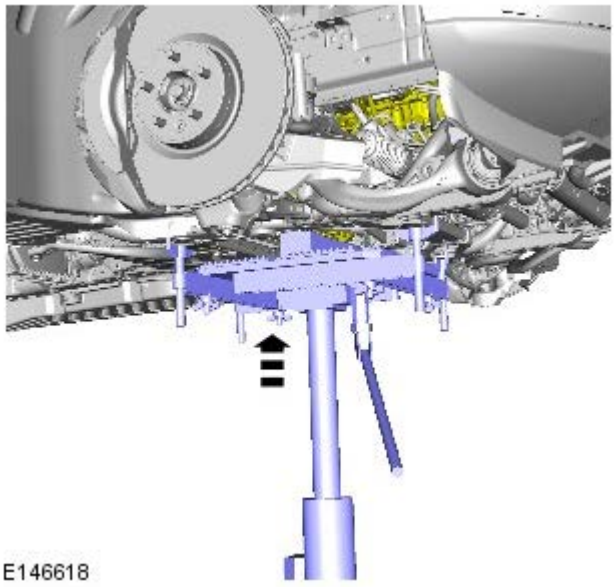


10.

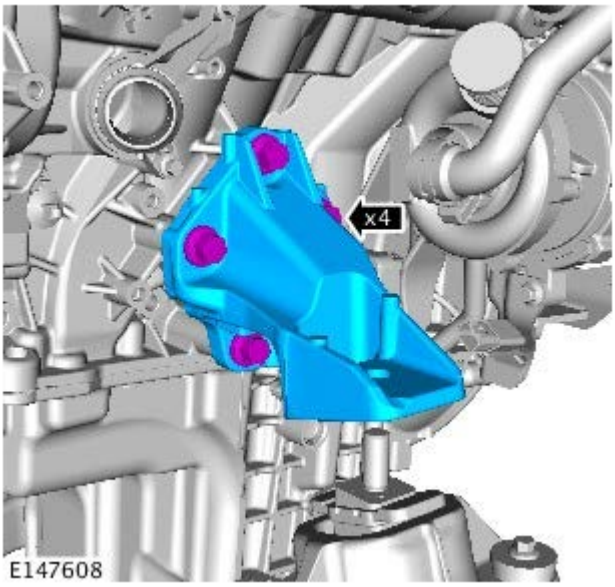


11. CAUTION: Use a wooden block to protect the oil pan when supporting the engine.

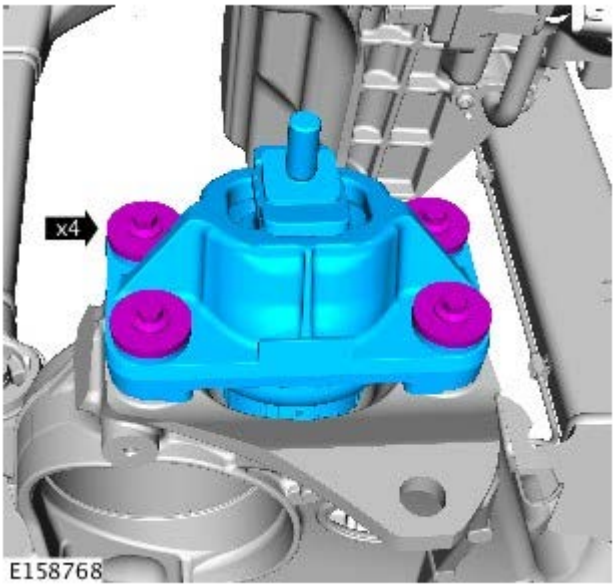
Using a suitable hydraulic jack, raise and support the engine.



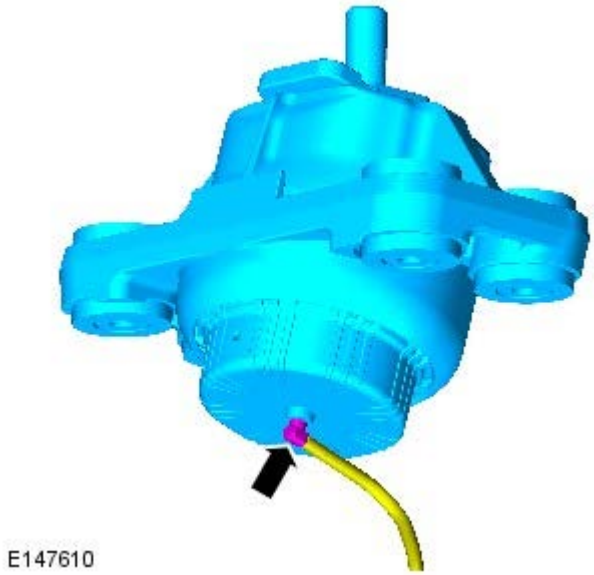
12.



13. CAUTION: Discard the bolts.

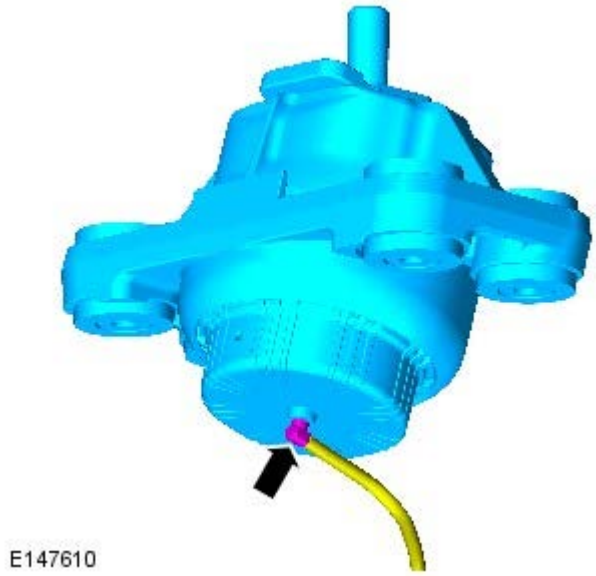


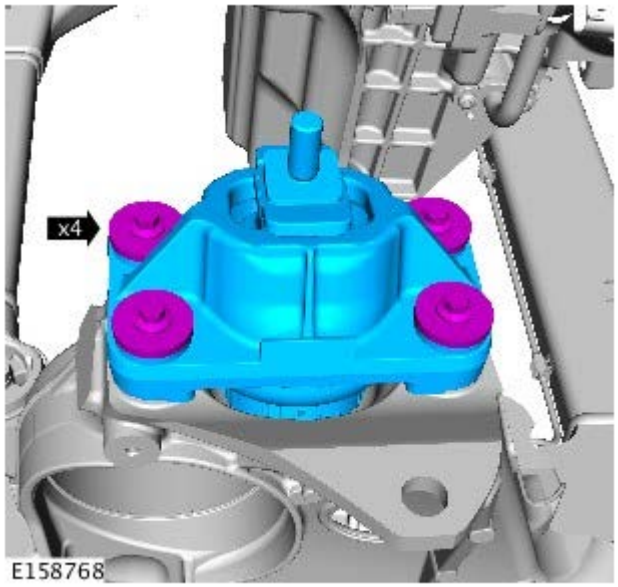
14.



Installation

1.

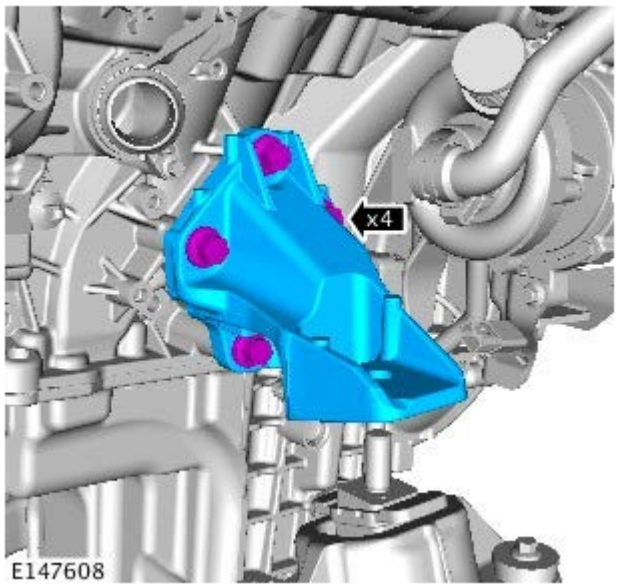




2. CAUTION: Only tighten the bolts finger tight at this stage.

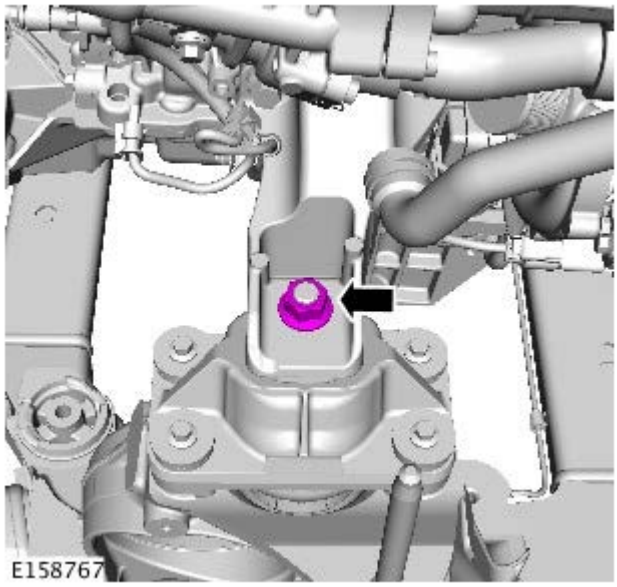
NOTE: Make sure that new bolts are installed.

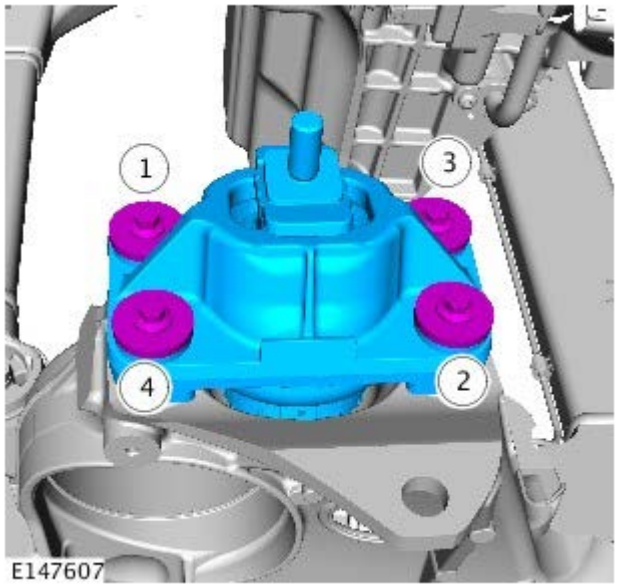
3. *Torque:* 115 Nm



4. Lower the engine onto the mount.

5. CAUTION: Only tighten the nut finger tight at this stage.

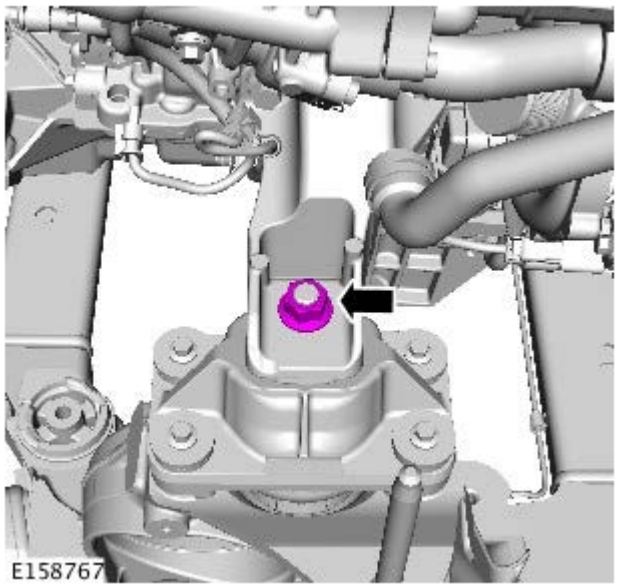




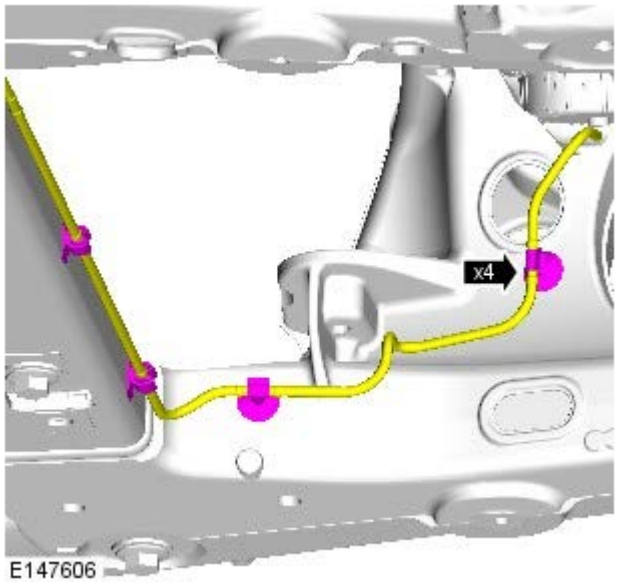
6. CAUTION: Tighten the bolts in the sequence shown.

   Torque: 40 Nm

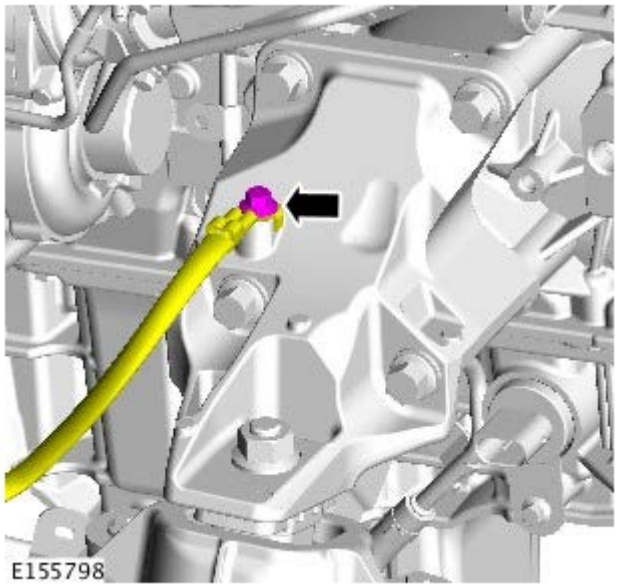
7. *Torque:* 130 Nm



8.



9. *Torque:* 25 Nm



10. CAUTION: Make sure a new bolt is installed.

NOTES:

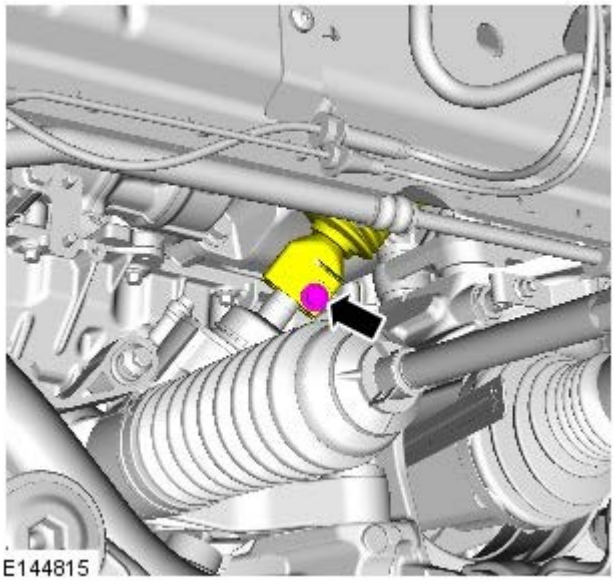
Make sure to clean the threads prior to installation.

Left-hand shown, right-hand similar.

Right hand drive only.

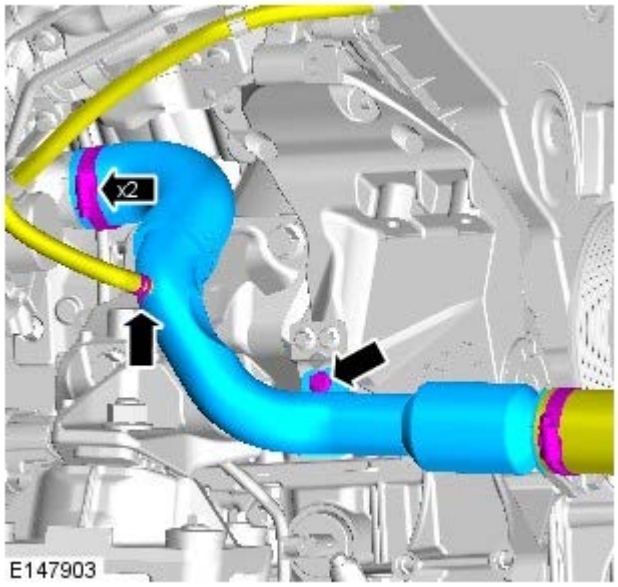
Align the steering wheel to straight ahead.

Torque: 30 Nm



11. NOTES:

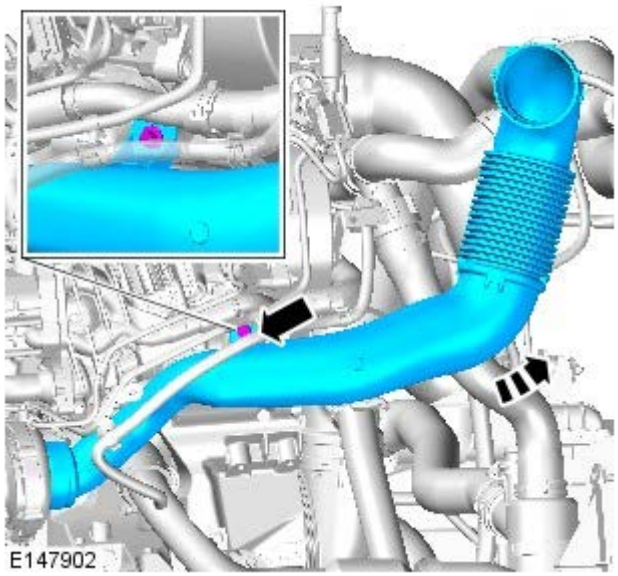
Make sure the retaining clips is correctly installed and tightened.

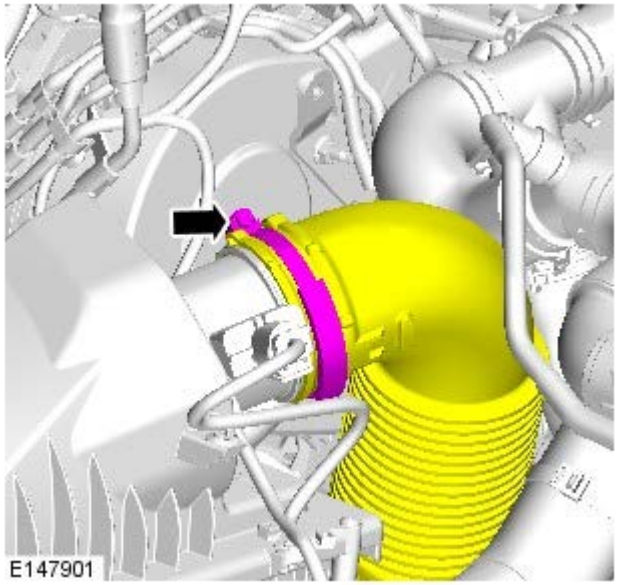


Left-hand shown, right-hand similar.

Torque: 10 Nm

12. *Torque:* 10 Nm





13. NOTE: Make sure the retaining clip is correctly installed and tightened.

14. Refer to: Generator (414-02A Generator and Regulator - TDV6 3.0L Diesel, Removal and Installation).

15. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

16. Refer to: Hybrid Electric Vehicle (HEV) System Bonding Test (414-

01, General Procedures).

17. Connect the battery ground cable.

    Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 09-Sep-2013

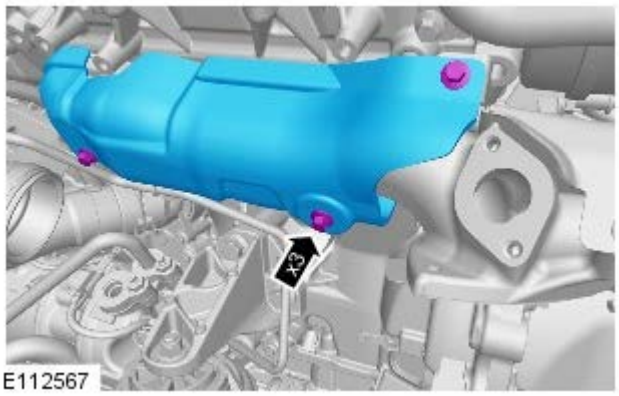
Engine - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Exhaust Manifold LH

Removal and Installation

Removal

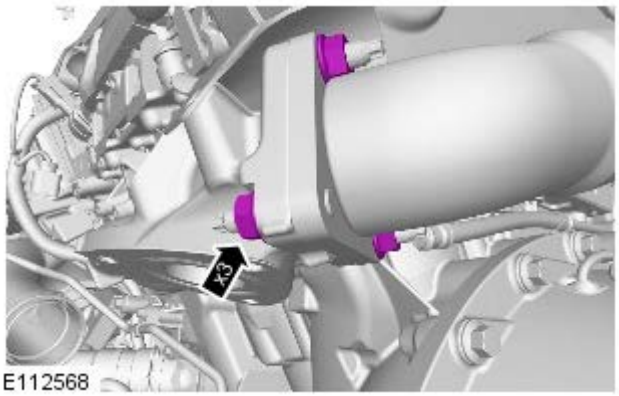
NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. Refer to: Turbocharger LH - SDV6 3.0L Diesel - Hybrid Electric Vehicle (303-04B Fuel Charging and Controls - Turbocharger - SDV6 3.0L Diesel - Hybrid Electric Vehicle/TDV6 3.0L Diesel, Removal and Installation).
2. Refer to: Exhaust Gas Recirculation (EGR) Valve LH (303-08A Engine Emission Control - TDV6 3.0L Diesel, Removal and Installation).
3.



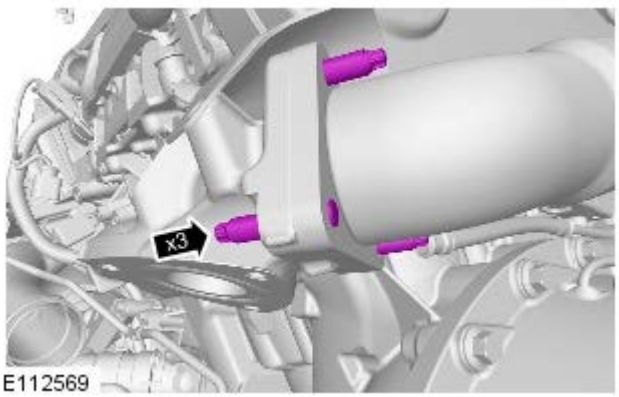
E112567

4. CAUTION: Discard the nuts.



E112568

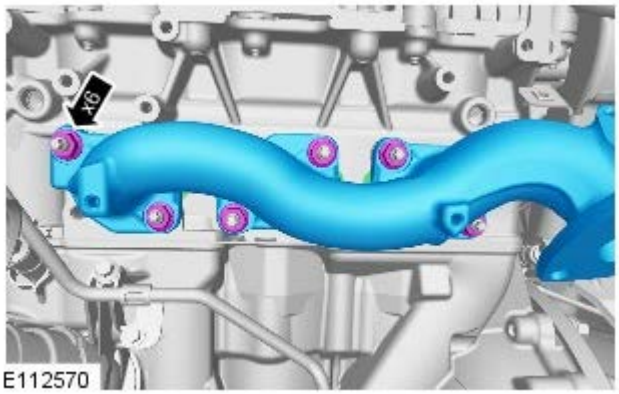
5. CAUTION: Discard the studs.



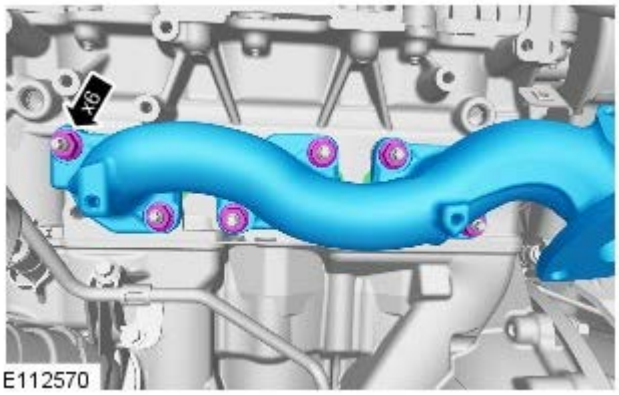
E112569

6. CAUTION: Discard the nuts.

NOTE: Discard the gasket.



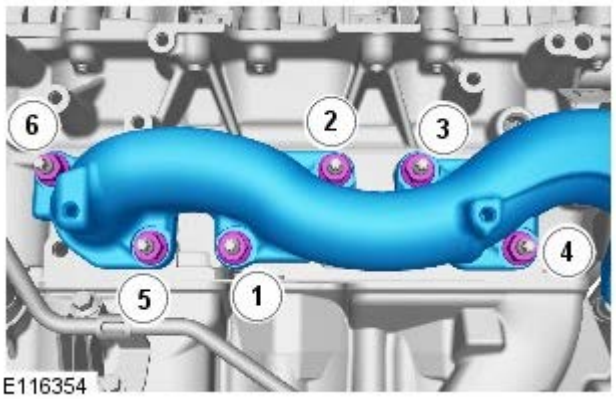
Installation



1. WARNING: Make sure that new nuts are installed.

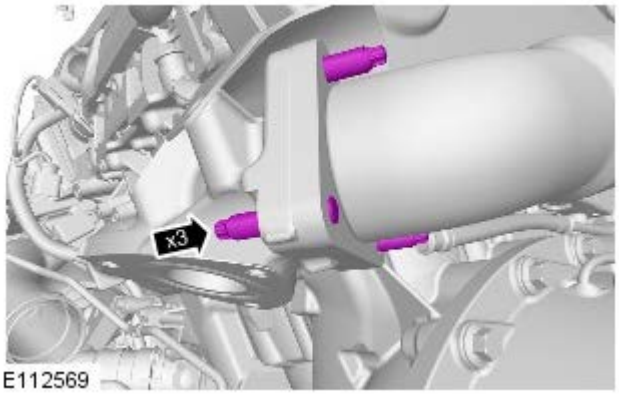
   CAUTION: Only tighten the bolt finger-tight at this stage.

   NOTE: Install a new gasket.



2. NOTE: Tighten the bolts in the indicated sequence.

   Torque: 28 Nm

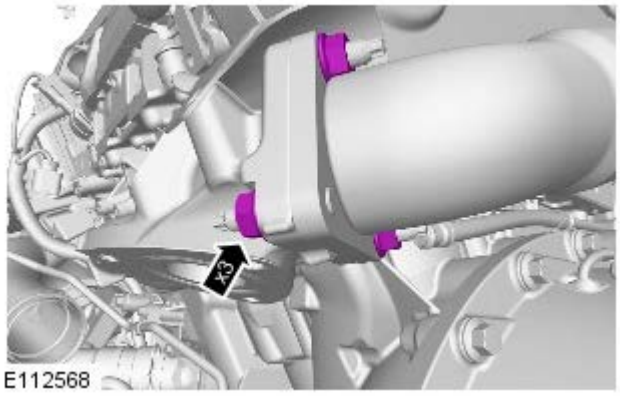


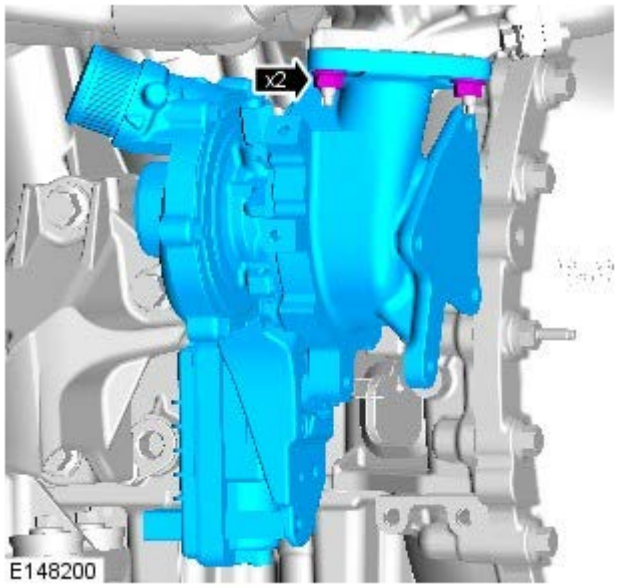
3. CAUTION: Install new studs.

   Torque: 13 Nm

4. WARNING: Make sure that new nuts are installed.

   Torque: 24 Nm





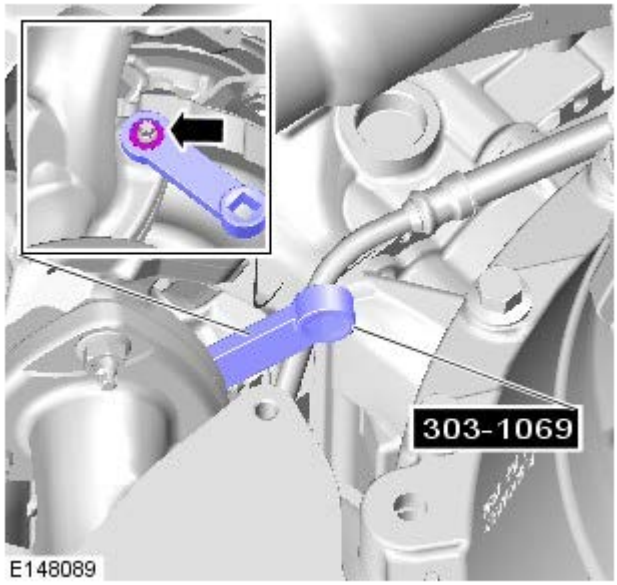
5. WARNING: Make sure that new nuts are installed.

   CAUTIONS:

   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.

   Torque: 24 Nm



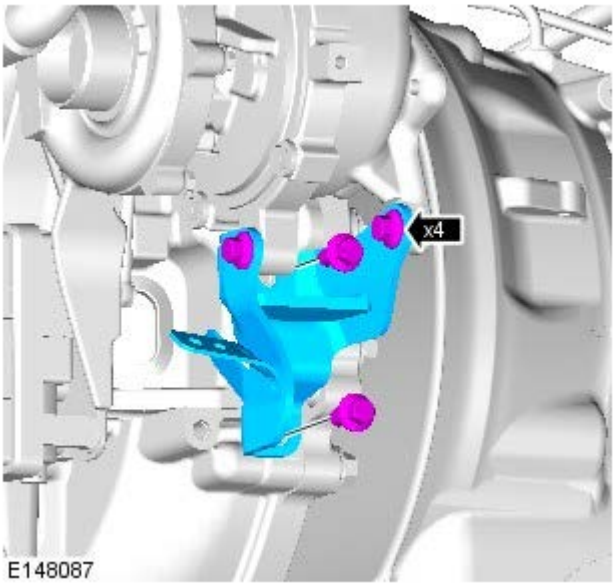
6. WARNING: Make sure that a new nut is installed.

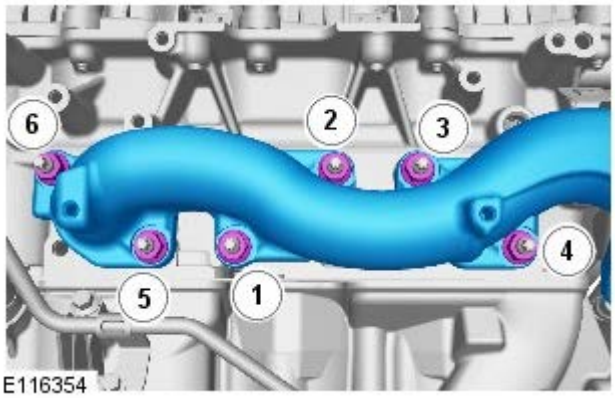
   Torque: 24 Nm

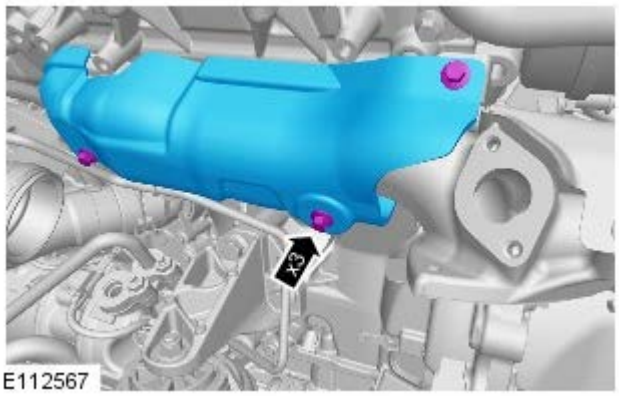
7. CAUTION: Apply Loctite 243 to the bolts.

   NOTE: Make sure to clean the threads prior to installation.

   Torque: 32 Nm







8. NOTES:

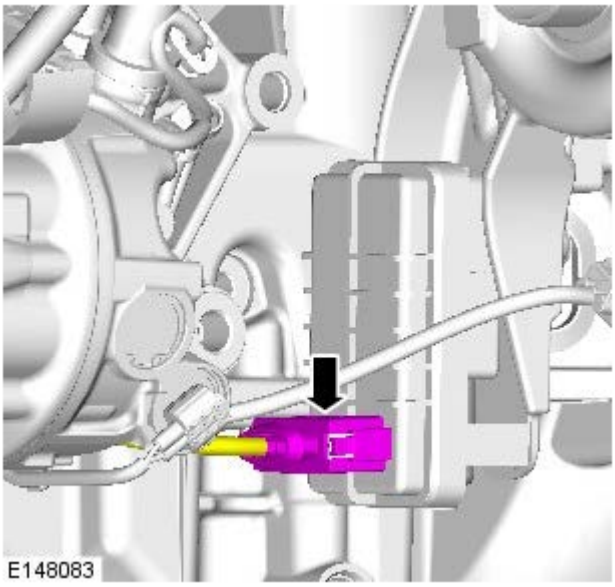
   Tighten the bolts in the indicated sequence.

   Some variation in the illustrations may occur, but the essential information is always correct.

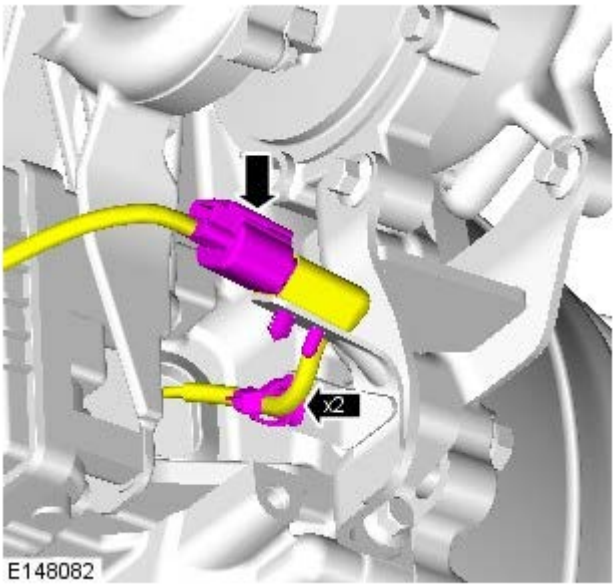
   Torque: 28 Nm

9. *Torque:* 10 Nm

10.



11.

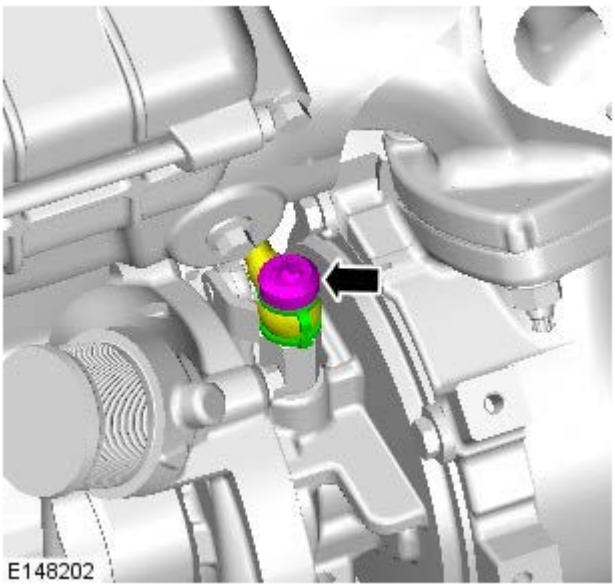


12. CAUTIONS:

Make sure that all openings are sealed. Use new blanking caps.

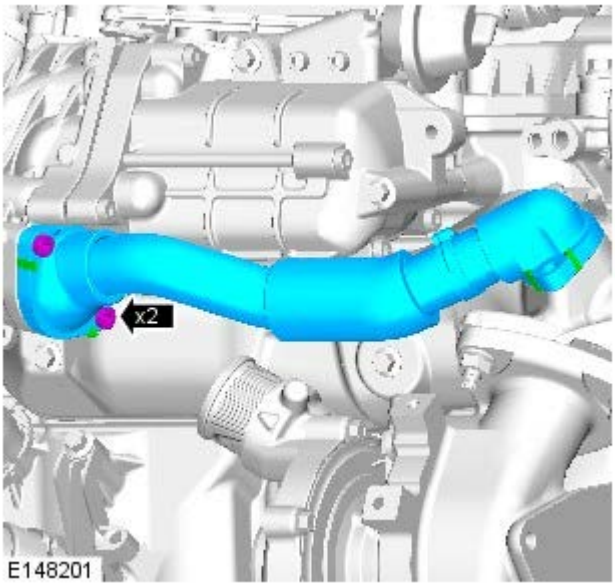
Make sure that new sealing washers are installed.

Torque: 30 Nm

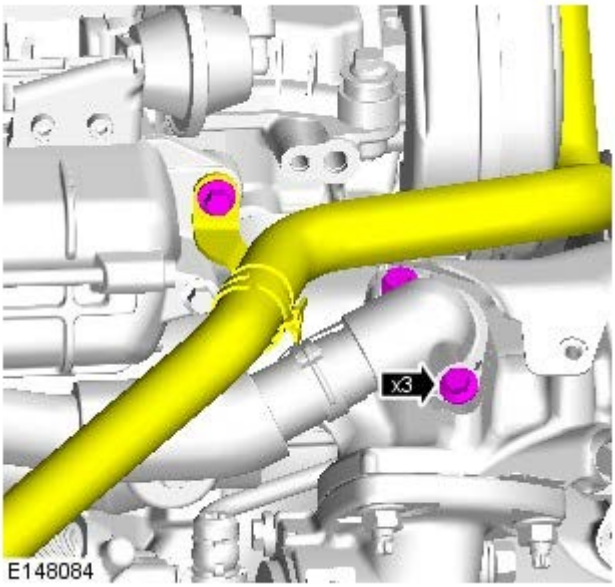


13. CAUTION: Install a new gasket.

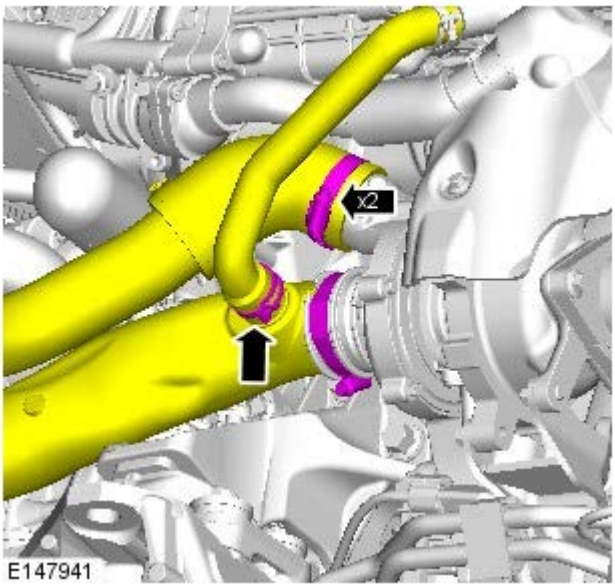
Torque: 6 Nm



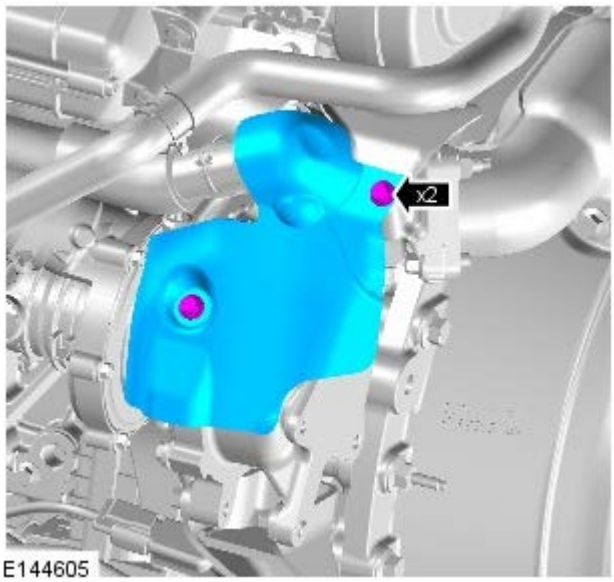
14. *Torque:* 10 Nm

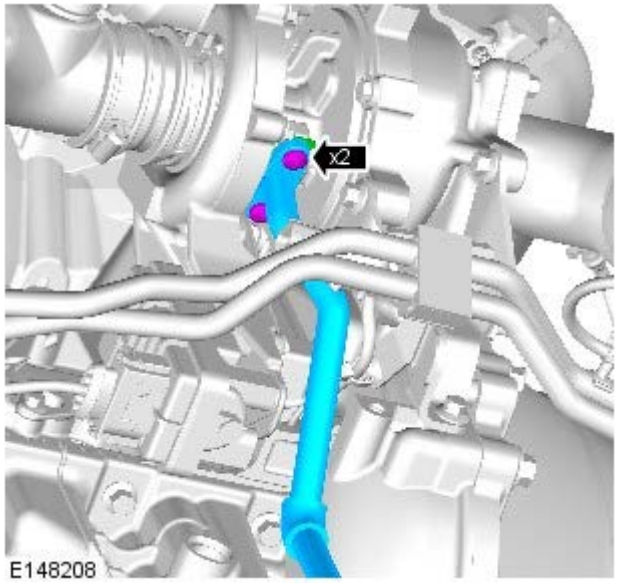


15.



16. *Torque:* 9 Nm

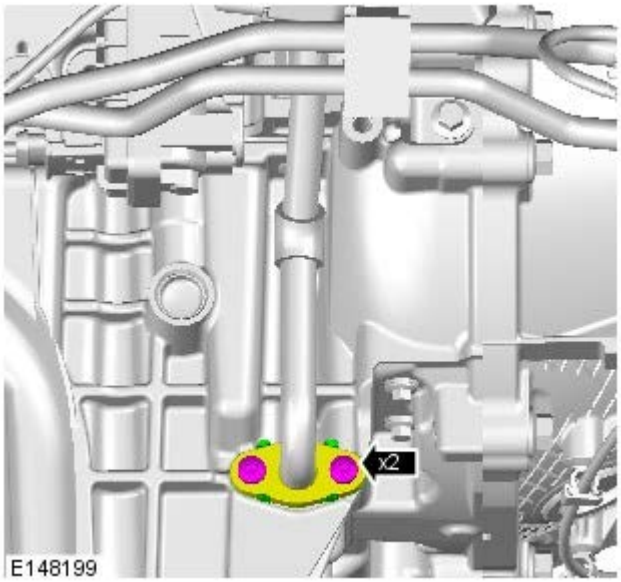




17. CAUTION: Make sure that the area around the component is clean and free of foreign material.

NOTE: Install new gaskets.

Torque: 9 Nm



18. CAUTION: Make sure that the area around the component is clean and free of foreign material.

NOTE: Install a new gasket.

Torque: 9 Nm

19. Refer to: Exhaust Gas Recirculation (EGR) Valve LH (303-08A Engine Emission Control - TDV6 3.0L Diesel, Removal and Installation).

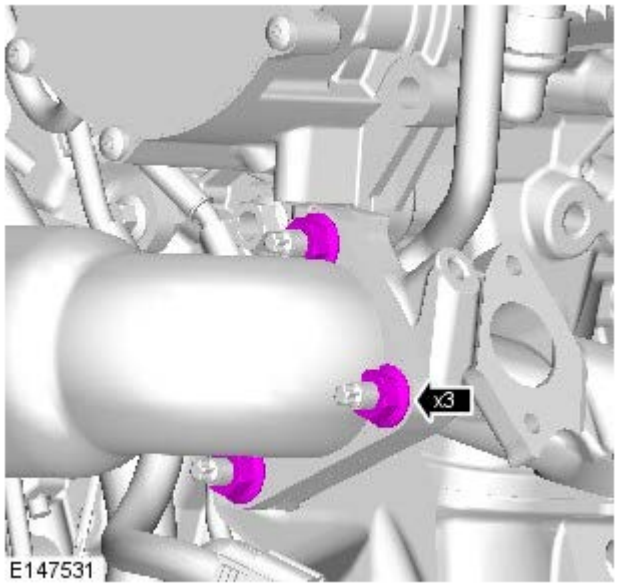
Published: 01-Aug-2012

Engine - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Exhaust Manifold RH

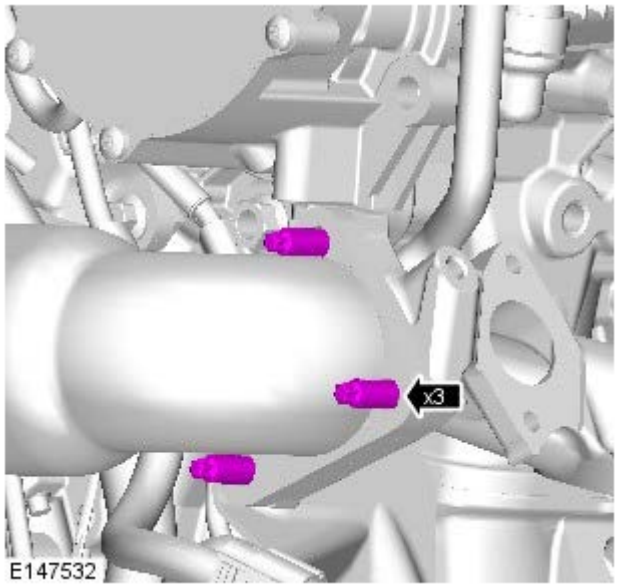
Removal and Installation

Removal

1. Refer to: Turbocharger RH (303-04, Removal and Installation).



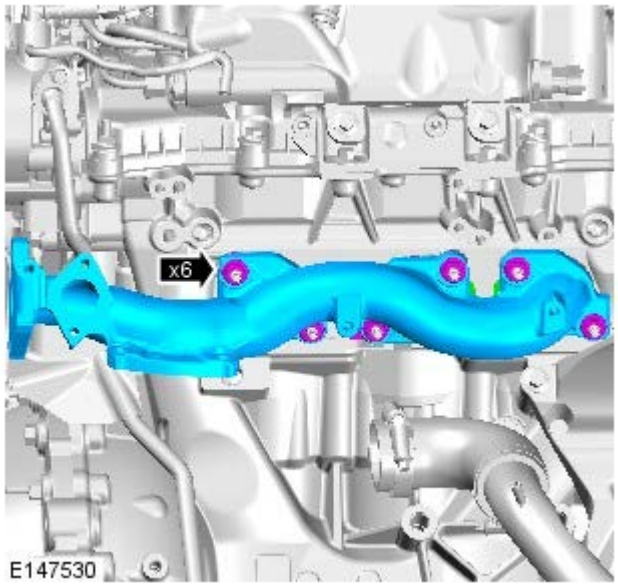
2. CAUTION: Discard the nuts.



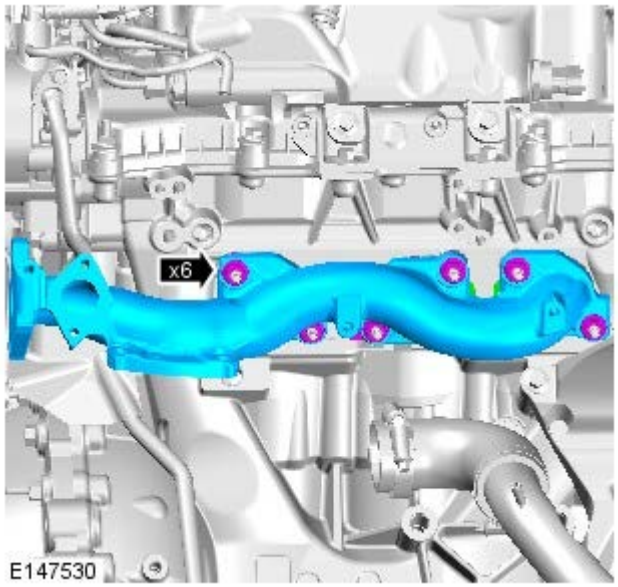
3. CAUTION: Discard the studs.

4. CAUTION: Discard the nuts.

NOTE: Remove and discard the gasket.



Installation

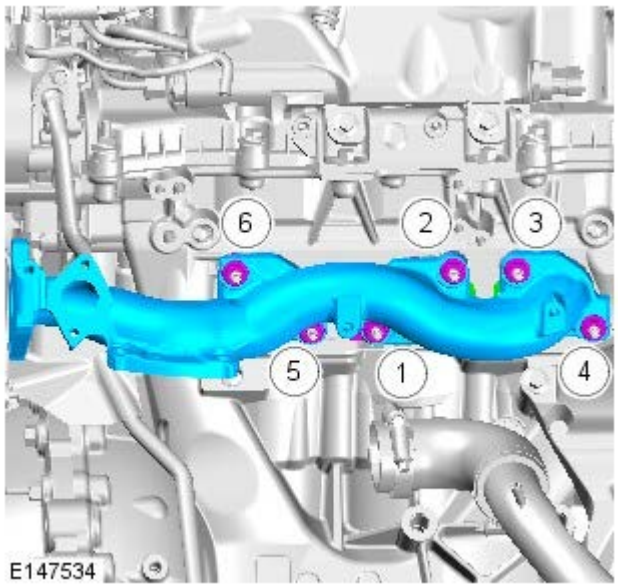


1. CAUTIONS:

   Make sure that new nuts are installed.

   Only tighten the bolts finger-tight at this stage.

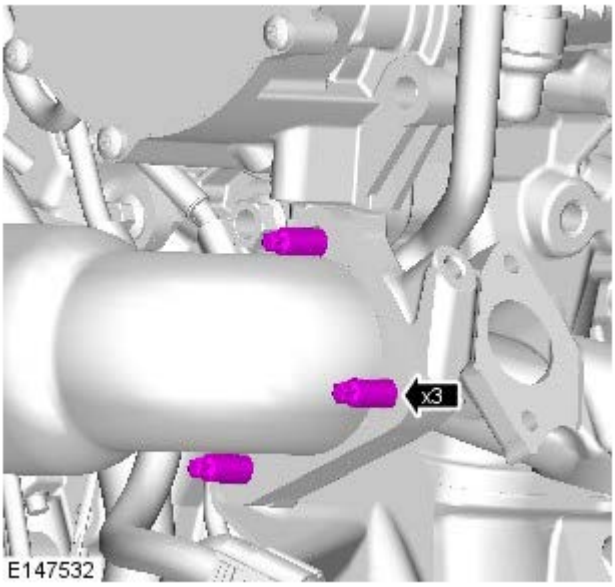
   NOTE: Install a new gasket.



2. NOTE: Tighten the bolts in the indicated sequence.

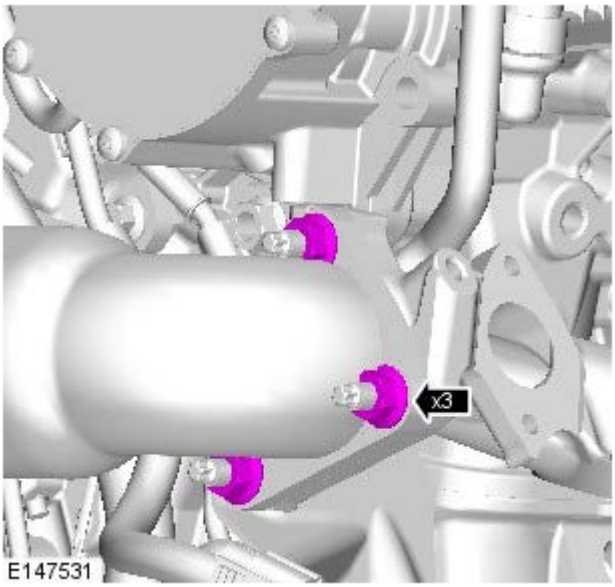
   Torque: 28 Nm

3. CAUTION: Install new studs.



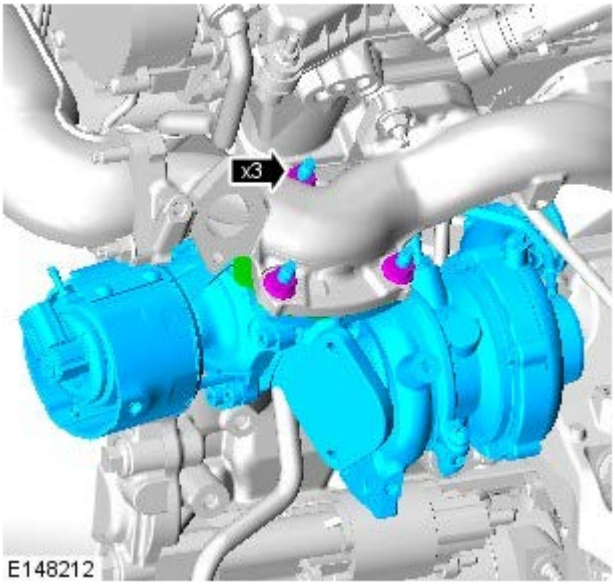
NOTE: Install a new gasket.

Torque: 13 Nm



4. CAUTION: Make sure that new nuts are installed.

Torque: 24 Nm



5. WARNING: Make sure that new nuts are installed.

CAUTIONS:

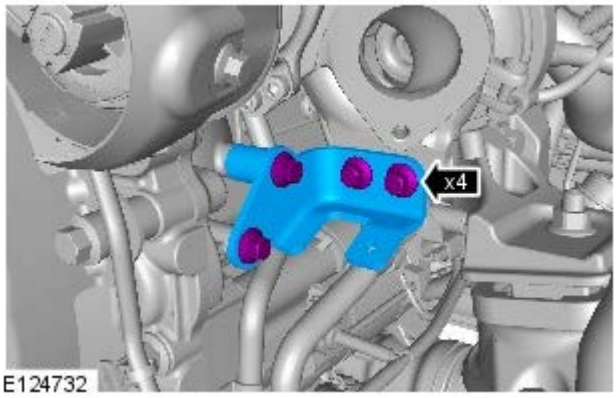
Make sure that the area around the component is clean and free of foreign material.

Install a new turbocharger to exhaust manifold gasket every time the turbocharger is removed.

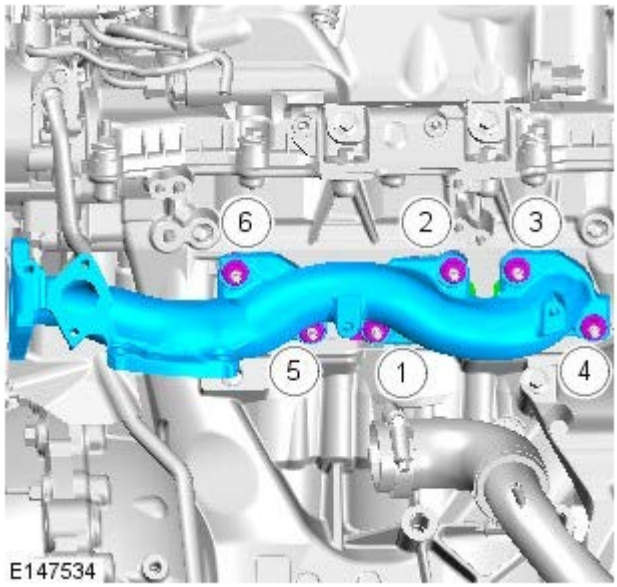
Torque: 24 Nm

6. CAUTION: Apply Loctite 243 to the bolts.

NOTE: Make sure to clean the threads prior to installation.



Torque: 32 Nm



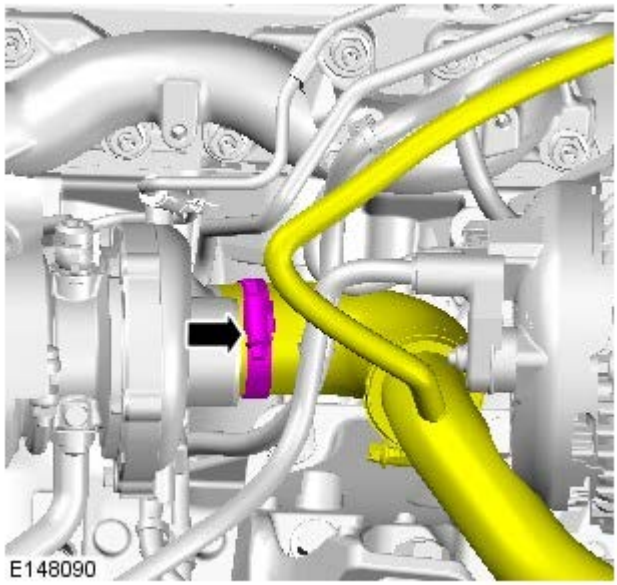
7. NOTES:

   Tighten the bolts in the indicated sequence.

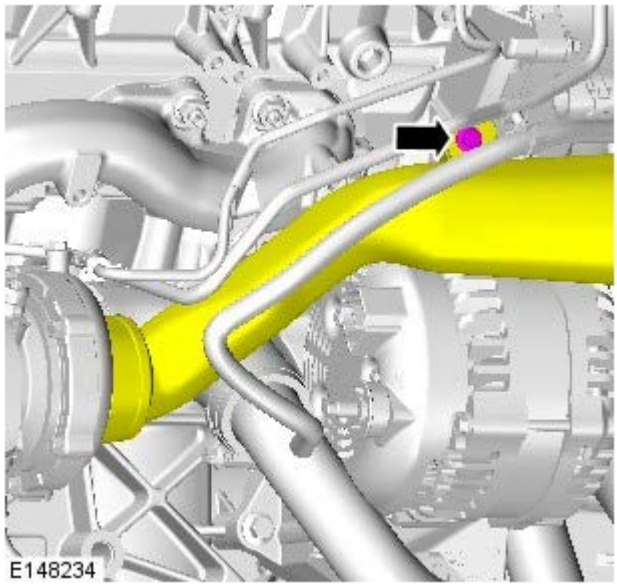
   Some variation in the illustrations may occur, but the essential information is always correct.

   Torque: 28 Nm

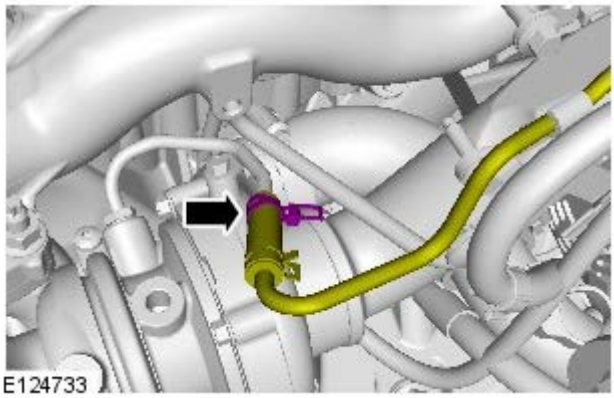
8.



9. *Torque:* 10 Nm



10.

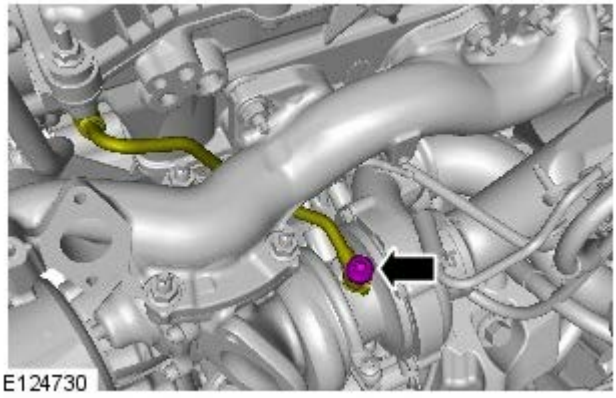


11. CAUTIONS:

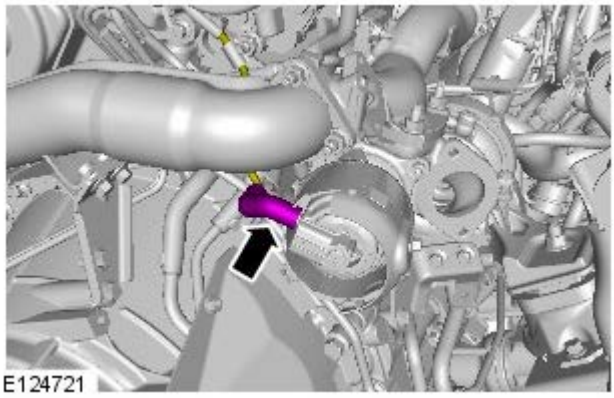
Make sure that new sealing washers are installed.

Make sure that a new bolt is installed.

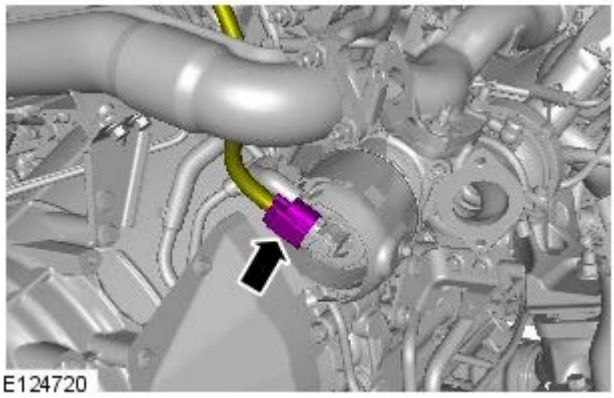
Torque: 30 Nm



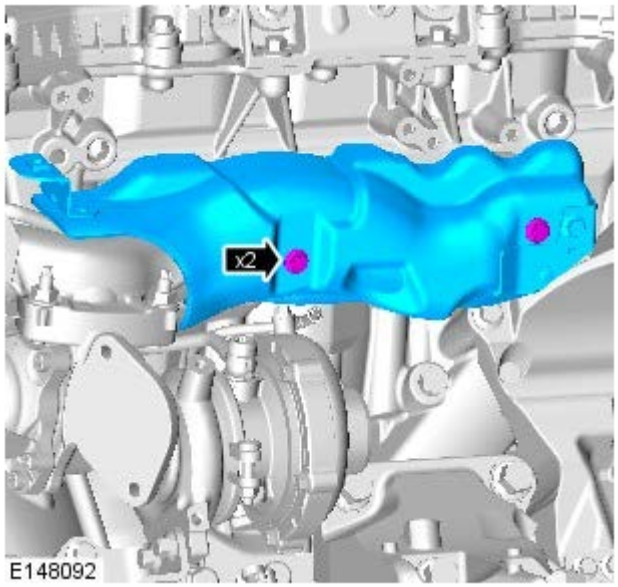
12.



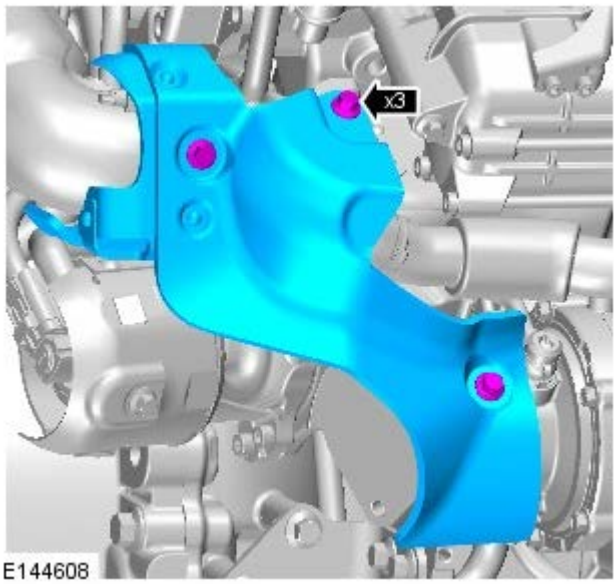
13.



14. *Torque:* 11 Nm

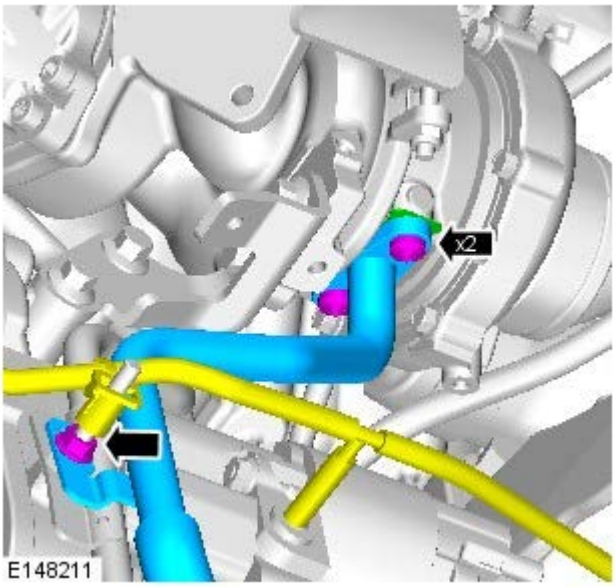


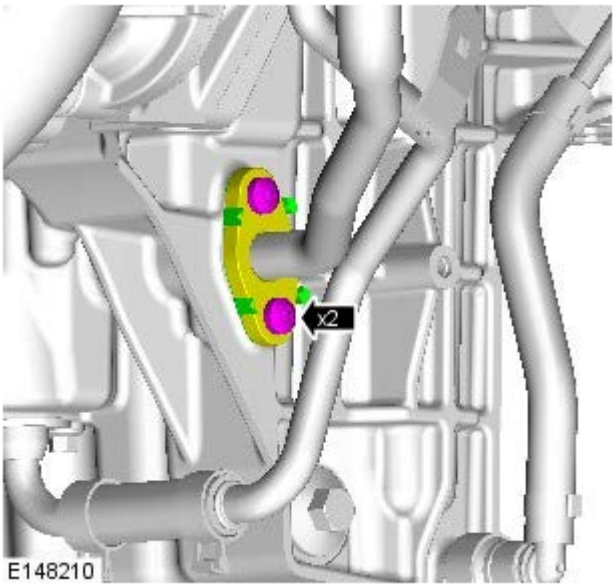
15. *Torque:* 9 Nm



16. NOTE: Install new gaskets.

Torque: 9 Nm





17. NOTE: Install a new gasket.

    Torque: 9 Nm

18. Refer to: Exhaust Gas Recirculation (EGR) Valve RH (303-08A Engine Emission Control - TDV6 3.0L Diesel, Removal and Installation).

19. Refer to: Engine Oil Draining and Filling (303-01A Engine - TDV6 3.0L Diesel, General Procedures).

Published: 08-Aug-2012

Engine - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Exhaust Manifold Crossover Pipe

Removal and Installation

General Equipment

Transmission jack

Removal

CAUTION: Take care when handling the cross-over pipe as damage to the insulating material may occur.

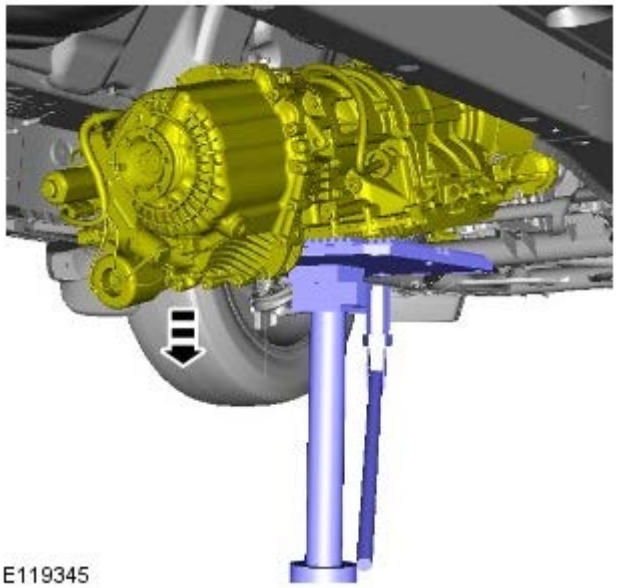
NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

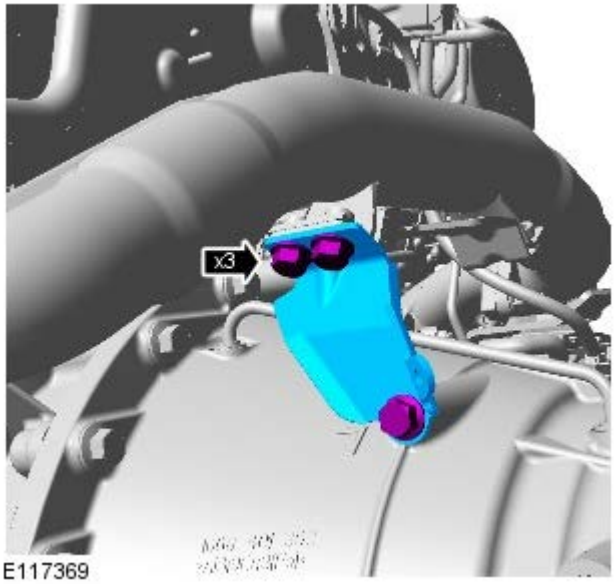
2. Refer to: Exhaust System - Vehicles With: Diesel Particulate Filter (DPF) (309-00A Exhaust System - TDV6 3.0L Diesel, Removal and Installation).
   Refer to: Exhaust System - Vehicles Without: Diesel Particulate Filter (DPF) (309-00A Exhaust System - TDV6 3.0L Diesel, Removal and Installation).

3. Refer to: Transmission Support Crossmember - TDV6 3.0L Diesel (502-02 Full Frame and Body Mounting, Removal and Installation).

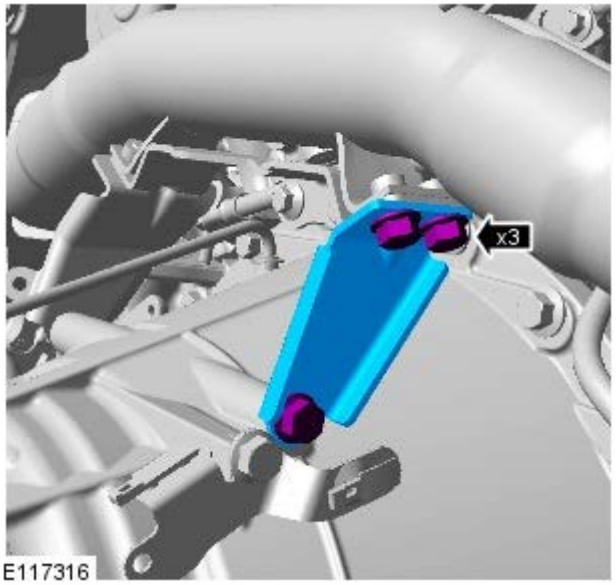

E119345

4. NOTE: The transmission is lowered for access.
   - *General Equipment:* Transmission jack

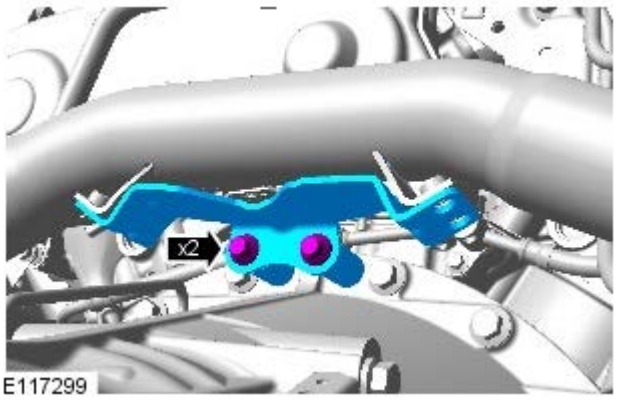
5.



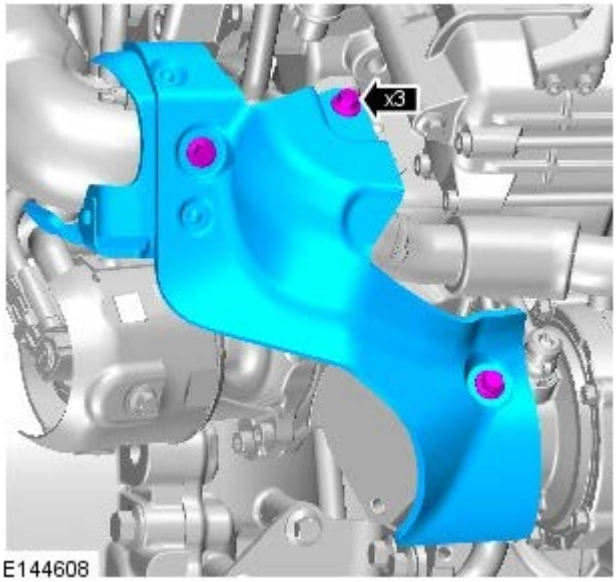
6.



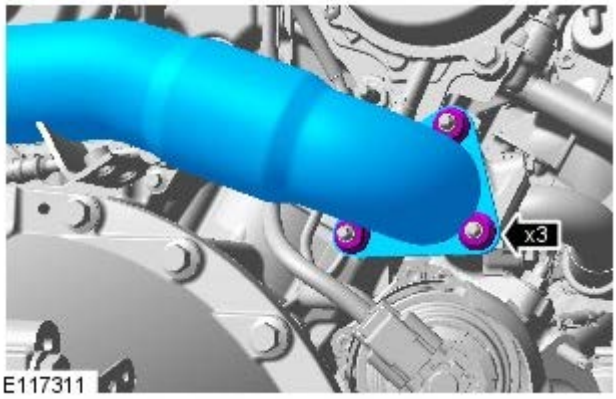
7.



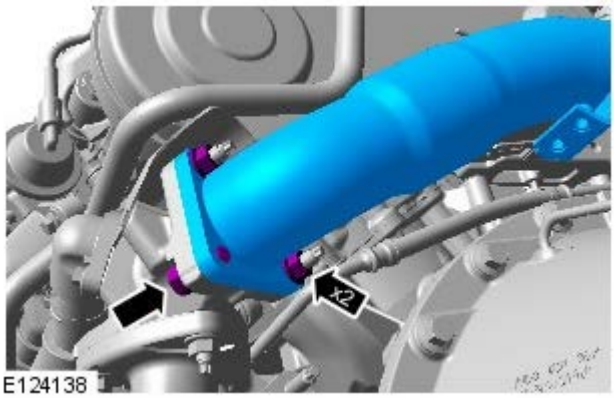
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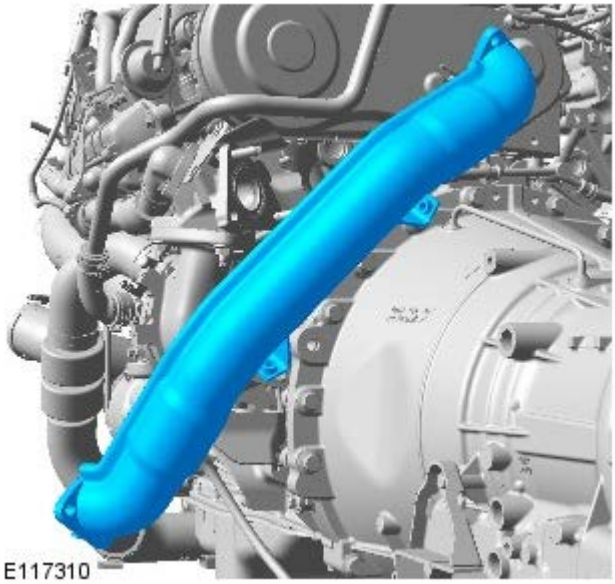
9. CAUTION: Discard the nuts.



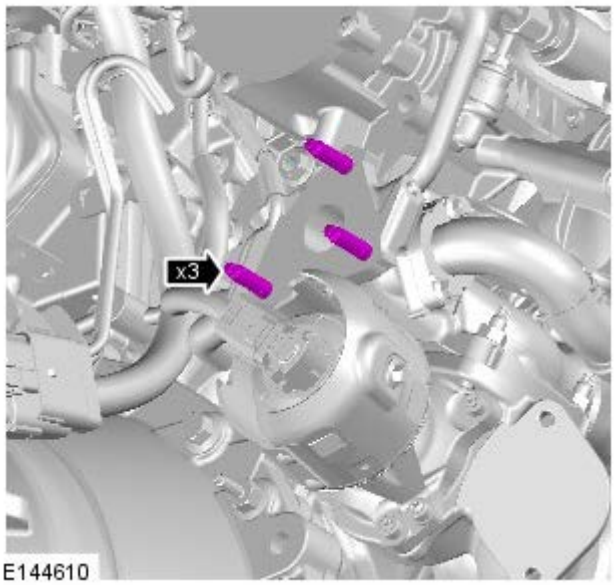
10. CAUTION: Discard the nuts and bolt.



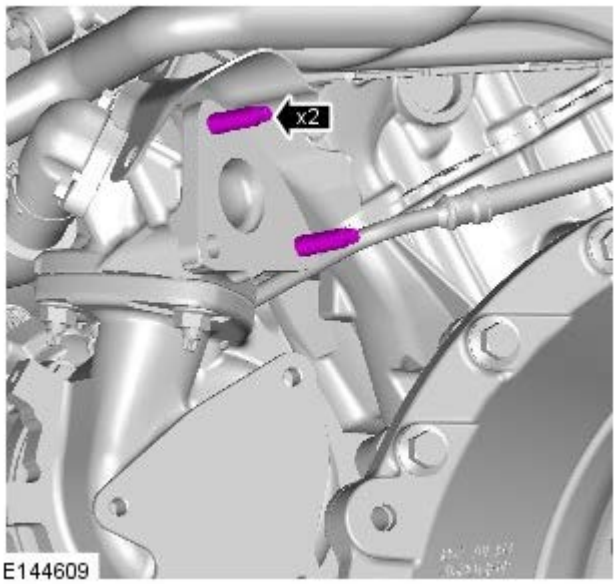
11.



12. CAUTION: Discard the studs.



13. CAUTION: Discard the studs.



14. NOTE: Discard the gasket.



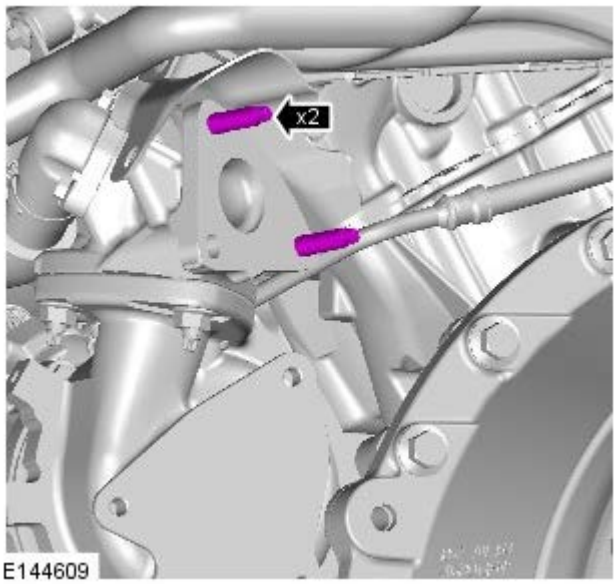
E124137

Installation



E124137

1. NOTE: Install new gaskets.

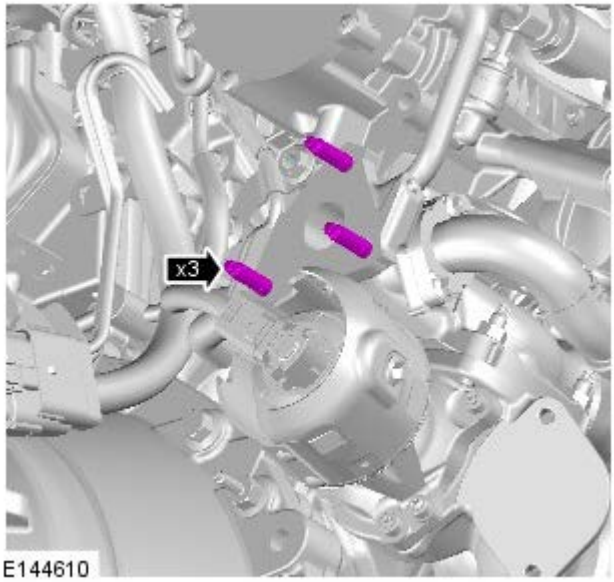


E144609

2. NOTE: New exhaust manifold retaining studs must be fitted if the old studs are removed.

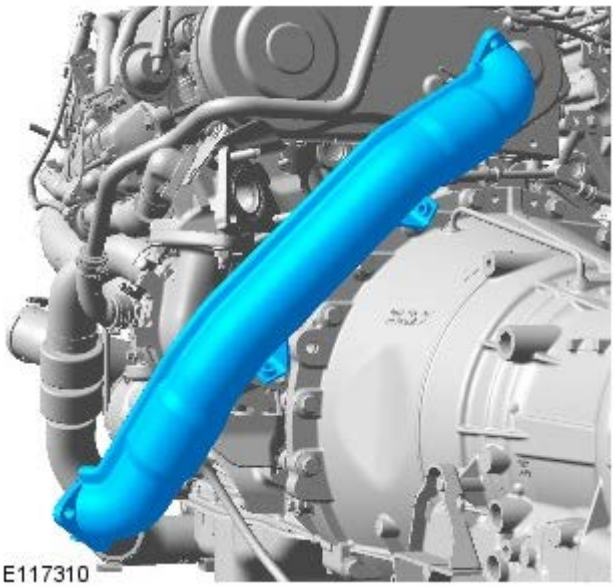
   Torque: 13 Nm

3. NOTE: New exhaust manifold retaining studs must be fitted if the old studs are removed.



Torque: 13 Nm

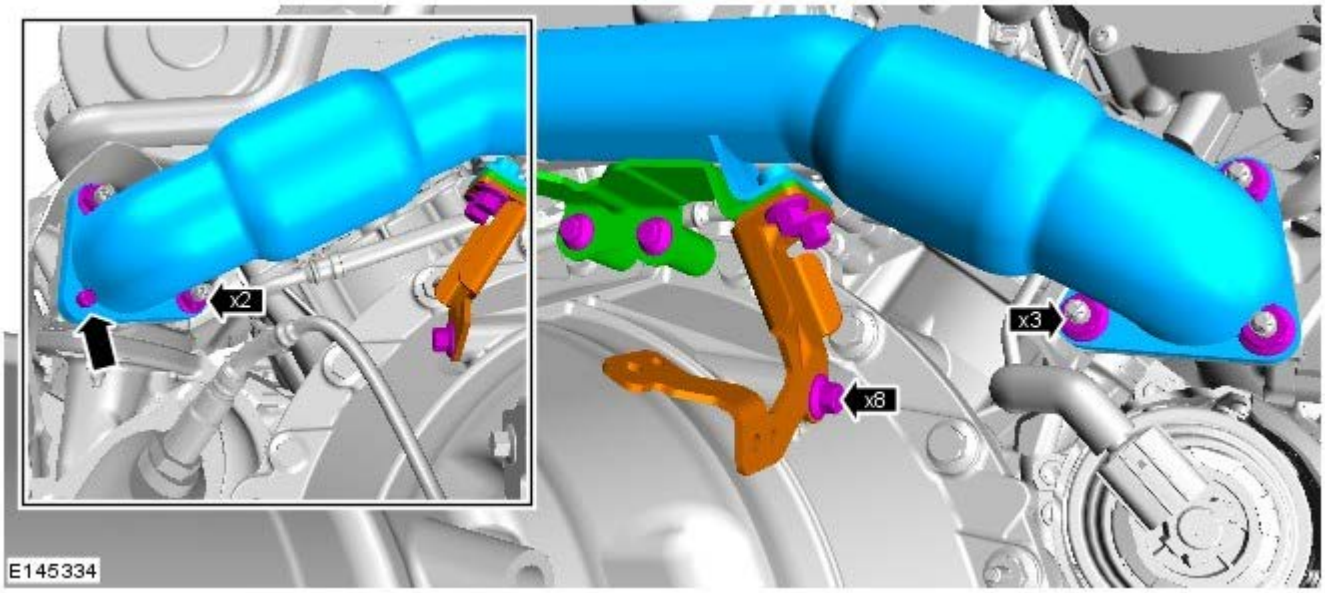
4.



5. CAUTIONS:

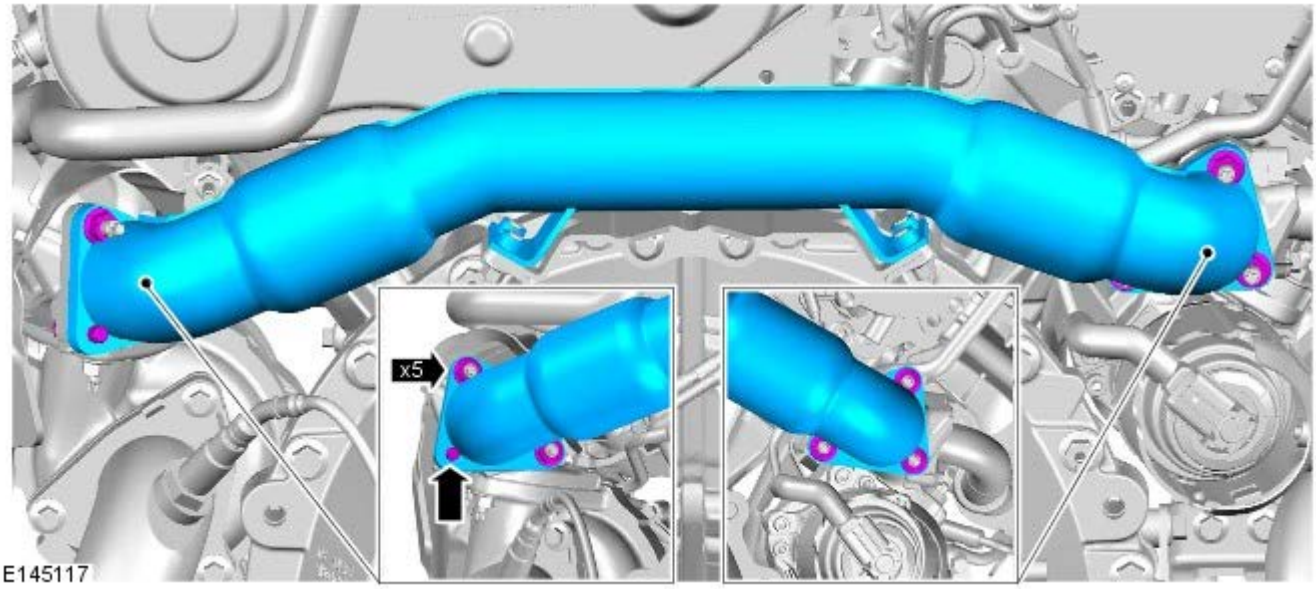
New exhaust manifold nuts and bolt must be fitted.

Only tighten the nuts finger-tight at this stage.



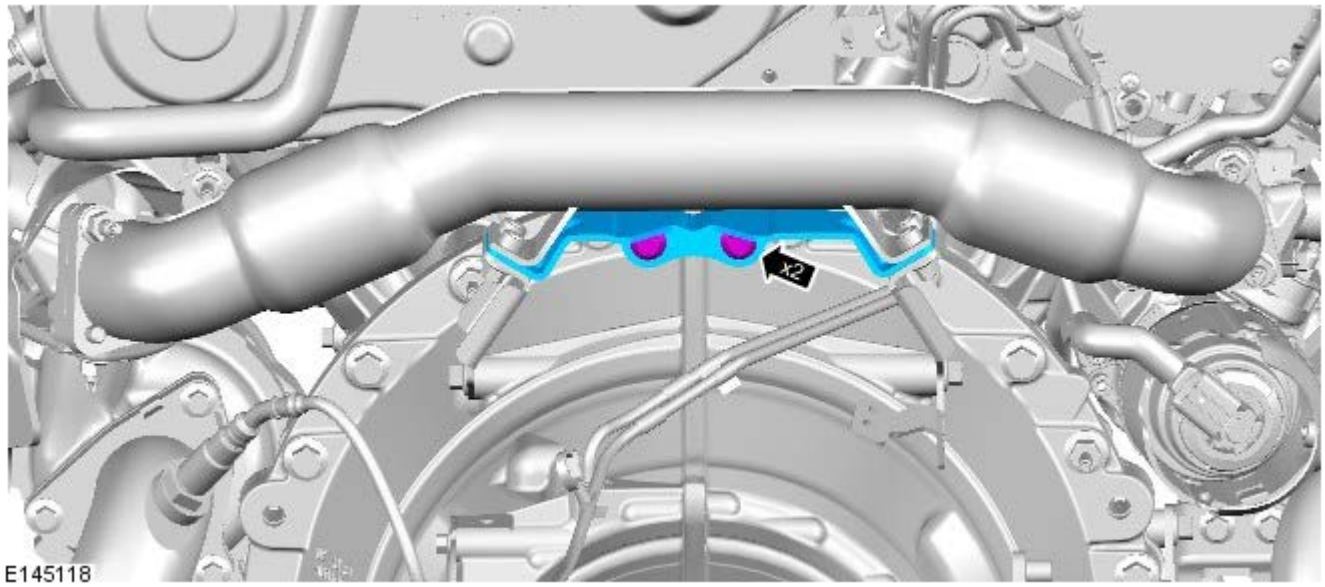
6. Check for correct alignment.

Torque: 23 Nm

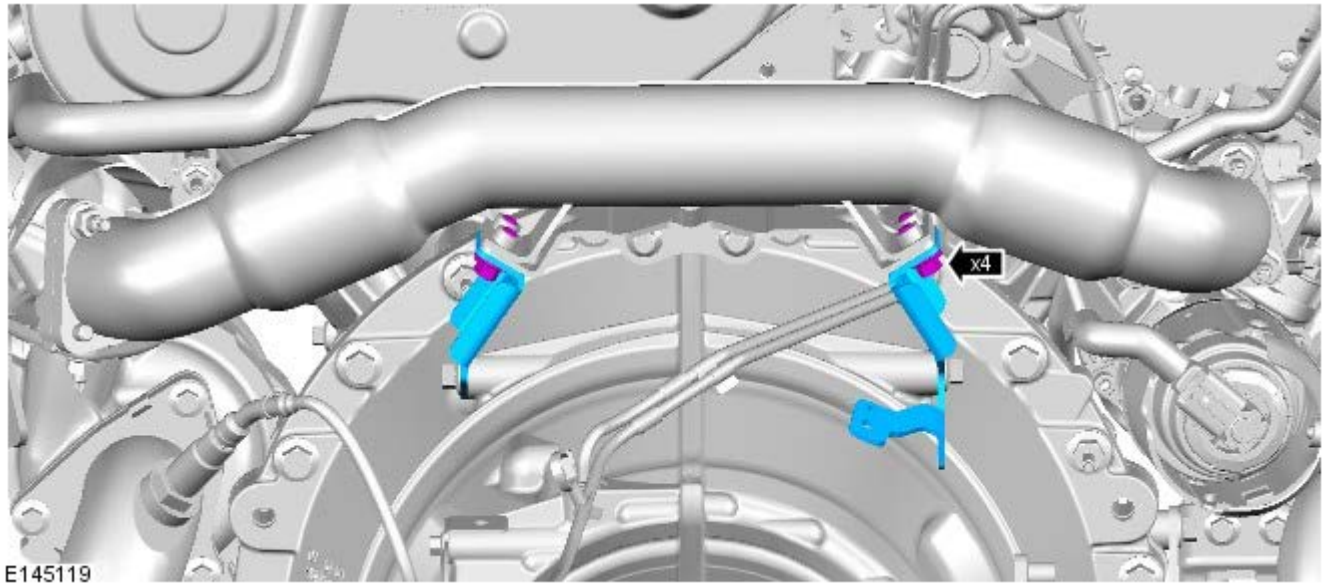


7. Check for correct alignment.

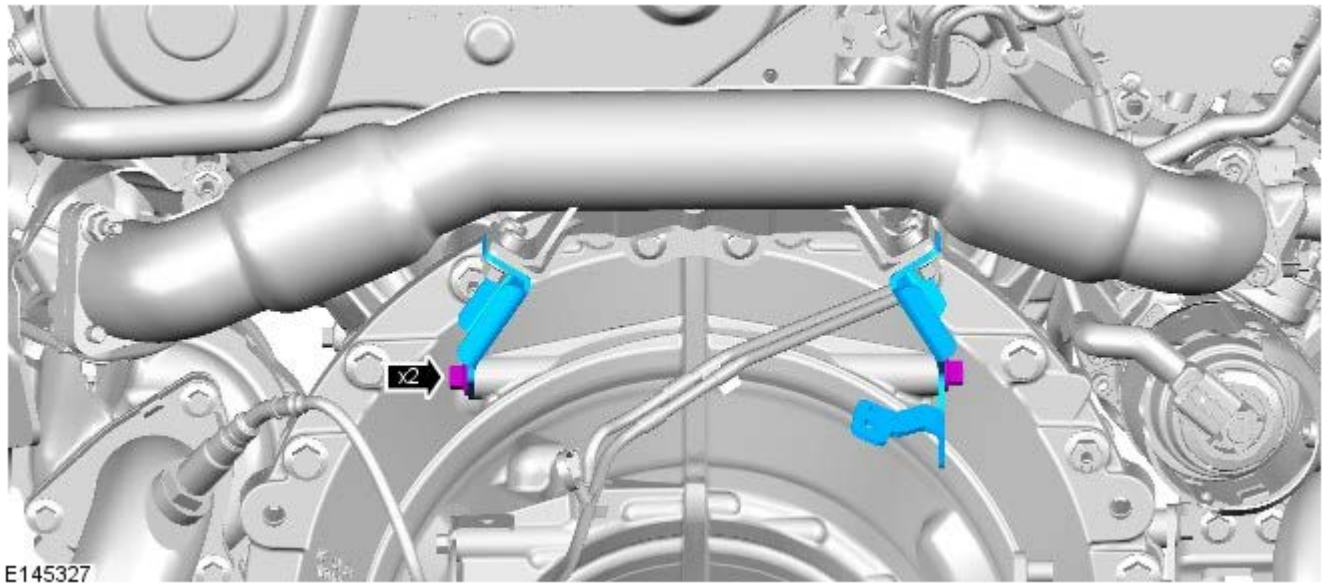
Torque: 23 Nm



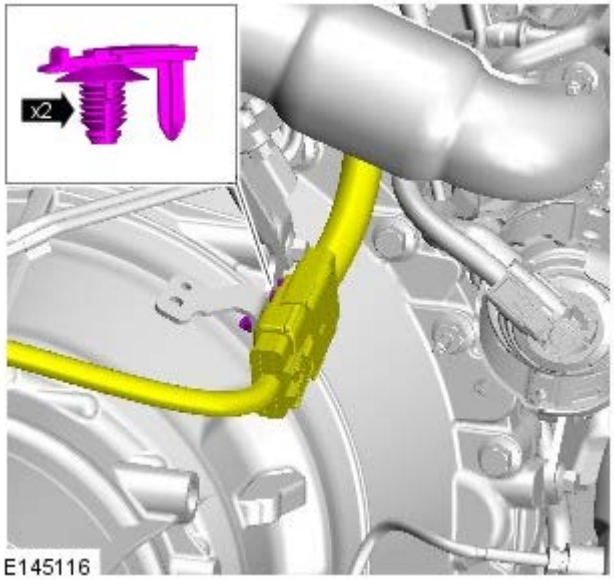
8. *Torque:* 23 Nm



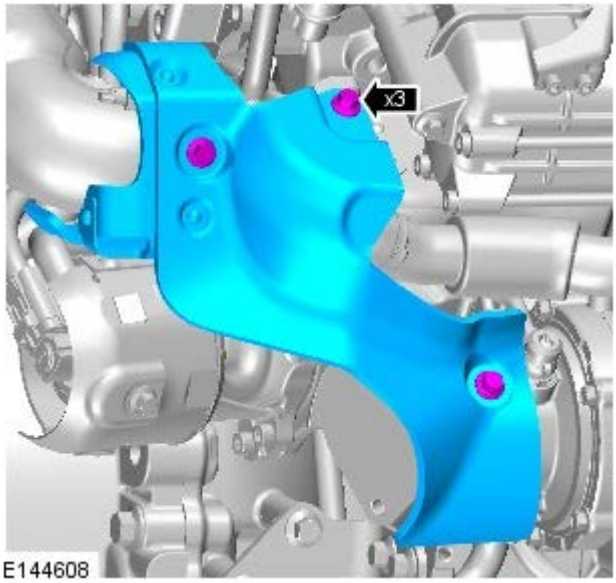
9. *Torque:* 23 Nm



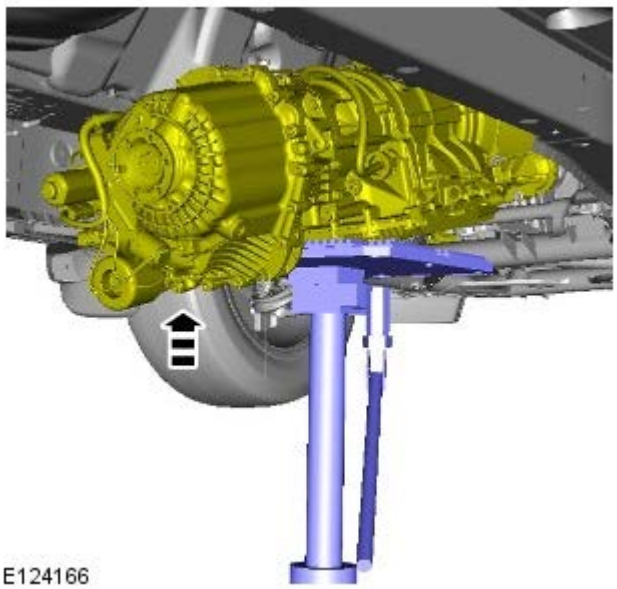
10.



11. *Torque:* 11 Nm



12. *General Equipment:* Transmission jack



13. Refer to: Transmission Support Crossmember - TDV6 3.0L Diesel (502-02 Full Frame and Body Mounting, Removal and Installation).

14. Refer to: Exhaust System - Vehicles With: Diesel Particulate Filter (DPF) (309-00A Exhaust System - TDV6 3.0L Diesel, Removal and Installation).

Refer to: Exhaust System - Vehicles Without: Diesel Particulate Filter (DPF) (309-00A Exhaust System - TDV6 3.0L Diesel, Removal and Installation).

Published: 06-Sep-2013

Engine - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Flexplate

Removal and Installation

Special Tool(s)

	303-1123 Locking Tool, Flywheel

Removal

WARNING: This procedure can only be carried out after the vehicle has been decommissioned, by an approved person.

NOTES:

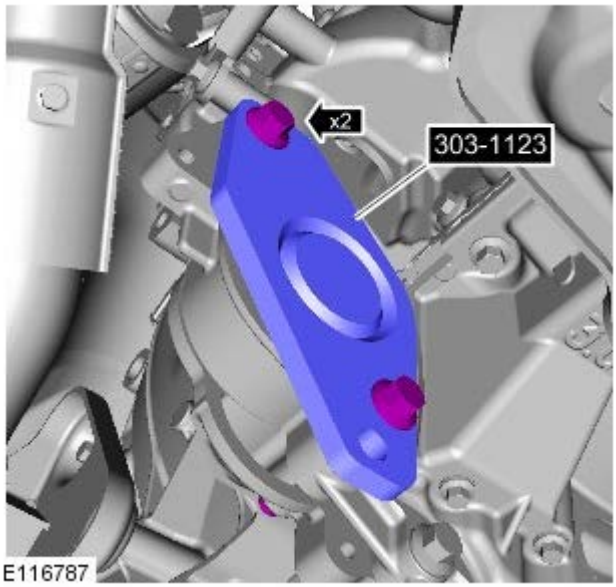
Some variation in the illustrations may occur, but the essential information is always correct.

Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Refer to: Transmission (307-01B, Removal).

3. 

   - Install the special tool.
   - *Special Tool(s):* 303-1123

4. CAUTION: Discard the bolts.

   NOTE: Prevent the flexplate from rotating.



Installation



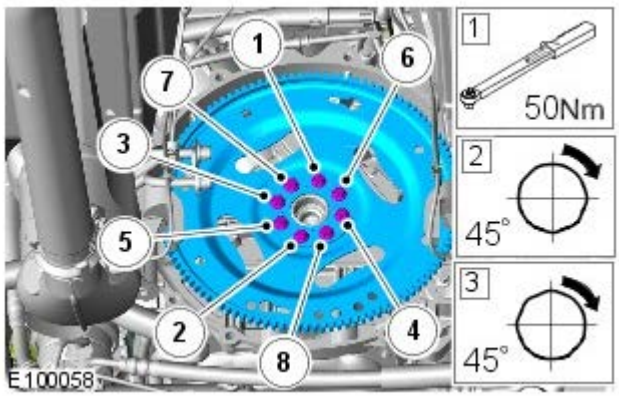
1. CAUTION: Make sure that new bolts are installed.

   NOTES:

   Make sure that all the component mating faces are clean.

   Loosely install all retaining bolts.

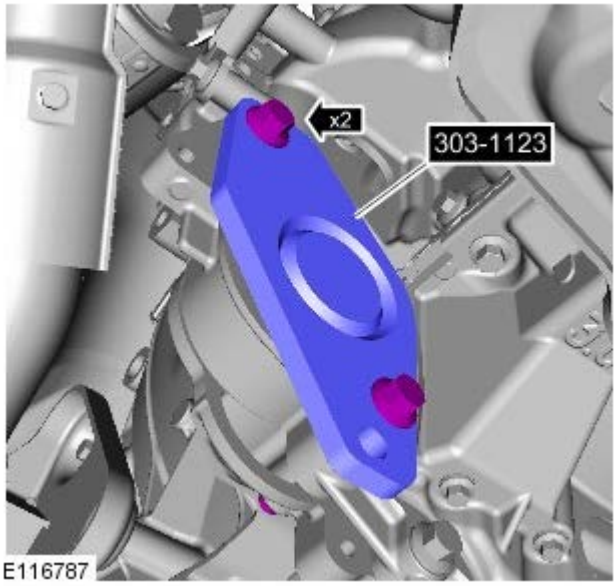
   - Prevent the flexplate from rotating.



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 (307-01B, Installation).

Published: 24-Aug-2012

Engine - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Oil Cooler

Removal and Installation

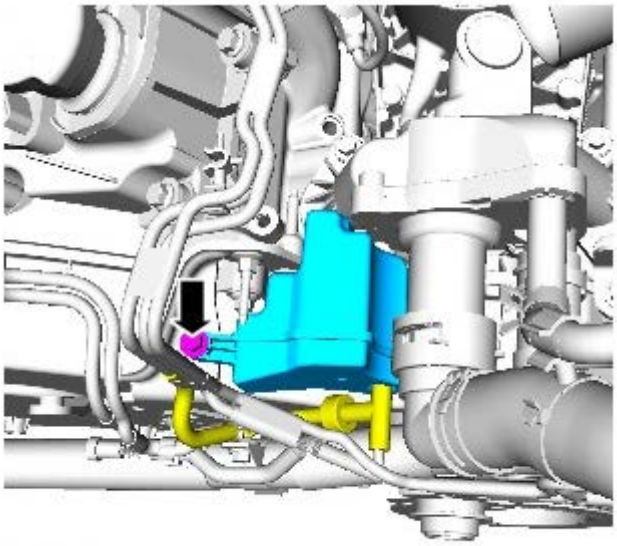
Removal

NOTES:

Some variation in the illustrations may occur, but the essential information is always correct.

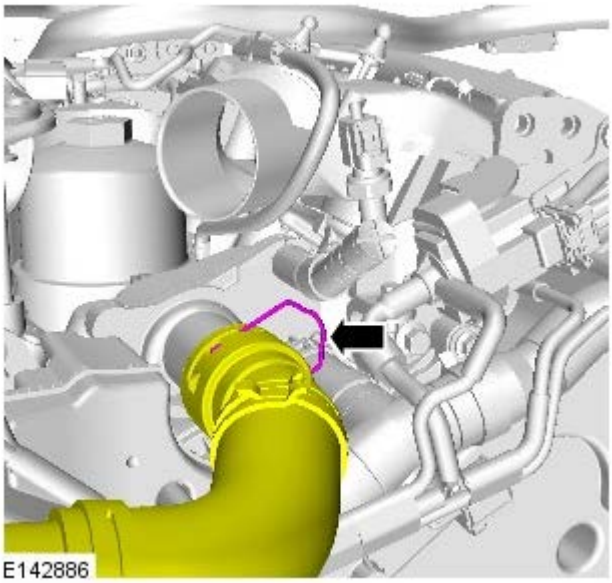
Some illustrations may show the engine removed for clarity.

1. Refer to: Cooling System Partial Draining, Filling and Bleeding (303-03A Engine Cooling - TDV6 3.0L Diesel, General Procedures).
2. Refer to: Intake Air Shutoff Throttle (303-04A Fuel Charging and Controls - TDV6 3.0L Diesel, Removal and Installation).
3. Refer to: Crankcase Vent Oil Separator (303-08A Engine Emission Control - TDV6 3.0L Diesel, Removal and Installation).
4. *Torque:* 10 Nm



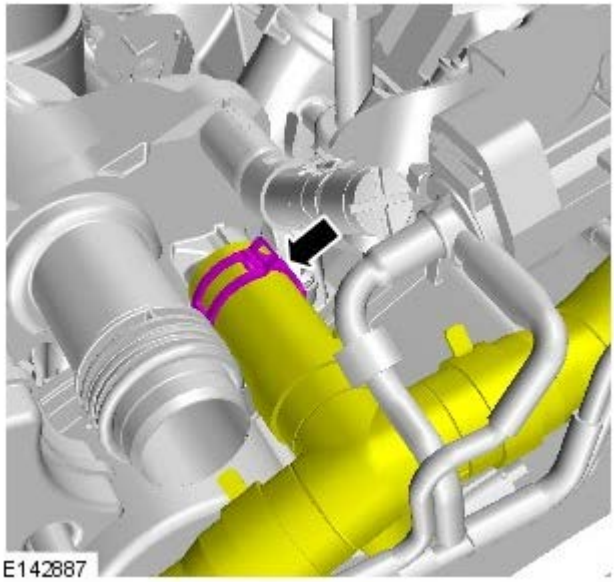
E141746

5.

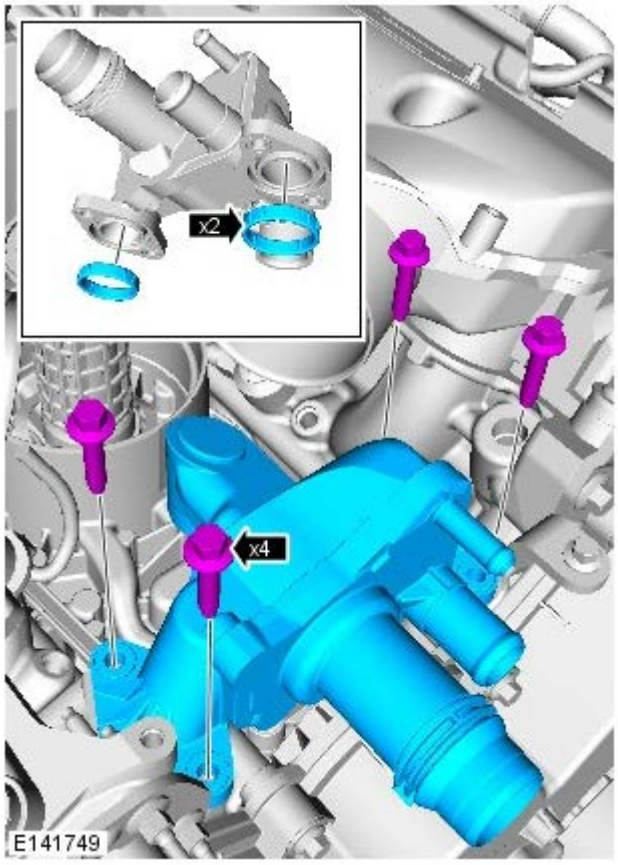


E142886

6.



7. Refer to: Oil Filter Element (303-01A Engine - TDV6 3.0L Diesel, Removal and Installation).



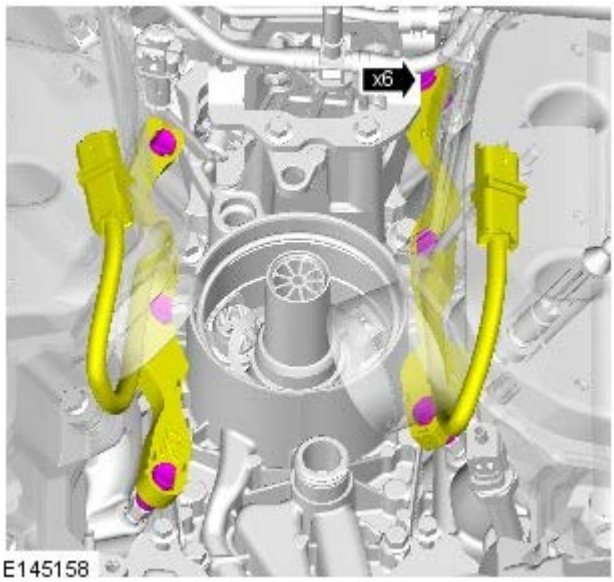
8. CAUTIONS:

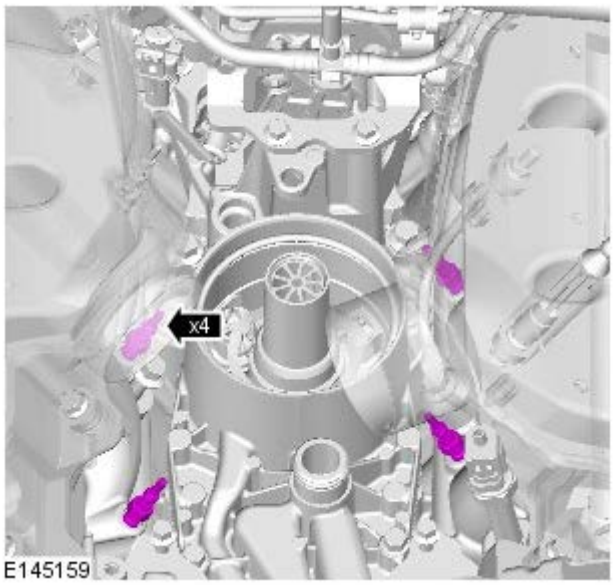
   Install new o-ring seals

   Make sure that the mating faces are clean and free of foreign material.

   Torque: 10 Nm

9. CAUTION: Take extra care not to damage the component.





10. CAUTIONS:

⚠ Make sure the engine is cold before this procedure is carried out. Failure to follow this instruction may result in damage to the vehicle.

⚠ If accidentally dropped or knocked install a new module.

⚠ Fixings must be started by hand to avoid damaging threads.

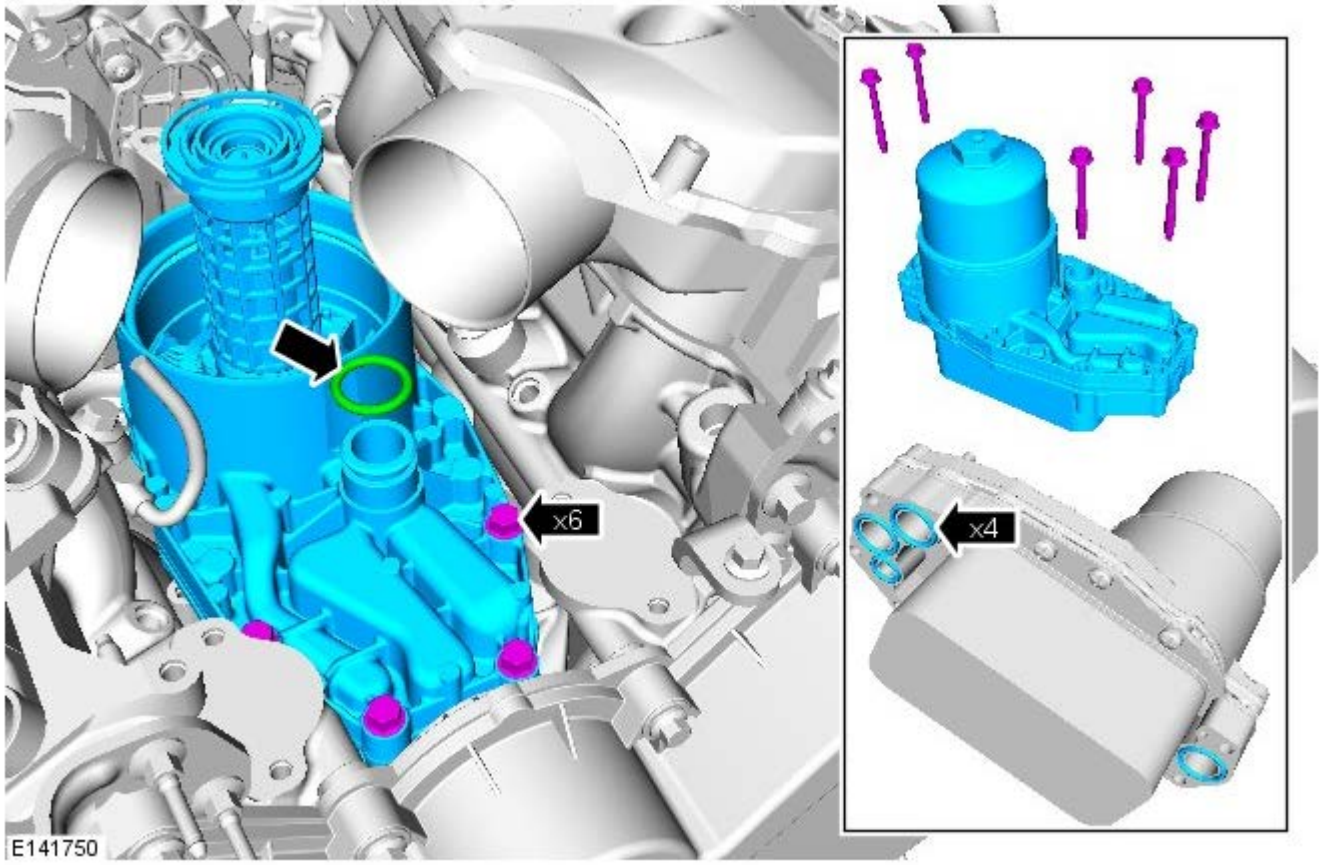
⚠ Take extra care not to damage the component.

11. CAUTIONS:

⚠ Install new o-ring seals

⚠ Make sure that the mating faces are clean and free of foreign material.

Torque: 10 Nm



Installation

1. To install, reverse the removal procedure.
2. Check and top-up the engine oil.

Published: 04-Aug-2012

Engine - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Oil Filter Element

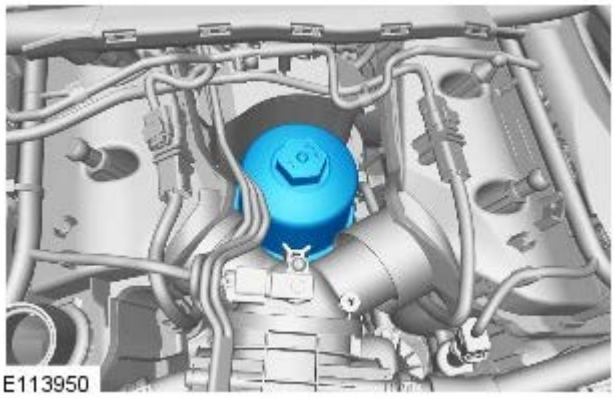
Removal and Installation

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 - TDV6 3.0L Diesel (501-05, Removal and Installation).

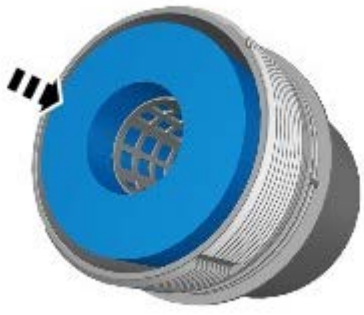

E113950

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.

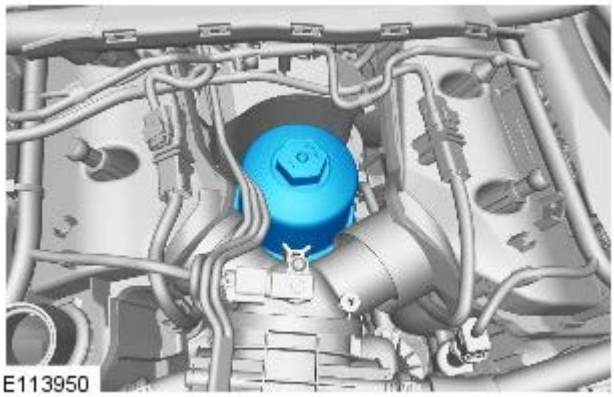
Installation


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 - TDV6 3.0L Diesel (501-05, Removal and Installation).

4. Start and run the engine.

5. Check and top-up the engine oil.

Published: 06-Sep-2013

Engine - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Oil Pan

Removal and Installation

Removal

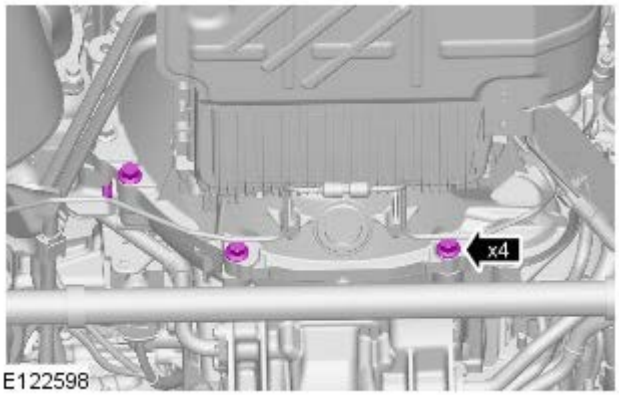
WARNING: This procedure can only be carried out after the vehicle has been decommissioned, by an approved person.

NOTES:

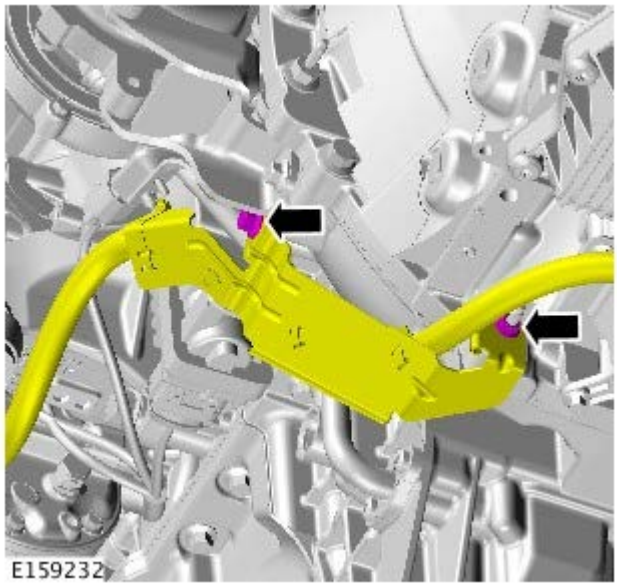
Removal steps in this procedure may contain installation details.

Some variation in the illustrations may occur, but the essential information is always correct.

1. Refer to: Hybrid Electric Vehicle (HEV) Decommission (414-01, General Procedures).
2. Refer to: Engine Oil Draining and Filling (303-01E Engine - SDV6 3.0L Diesel - Hybrid Electric Vehicle, General Procedures).
3. Refer to: Starter Motor (303-06A Starting System - TDV6 3.0L Diesel, Removal and Installation).
4. Refer to: Differential Case (205-03, Removal and Installation).
5. *Torque:*
   M10 40 Nm
   M8 24 Nm

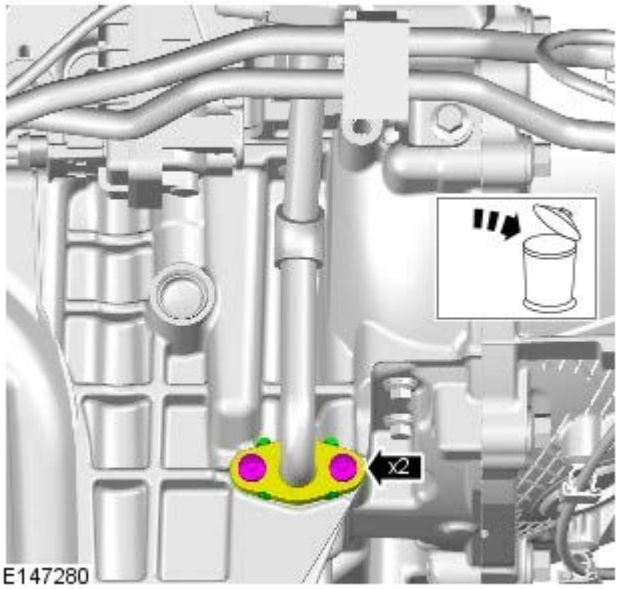


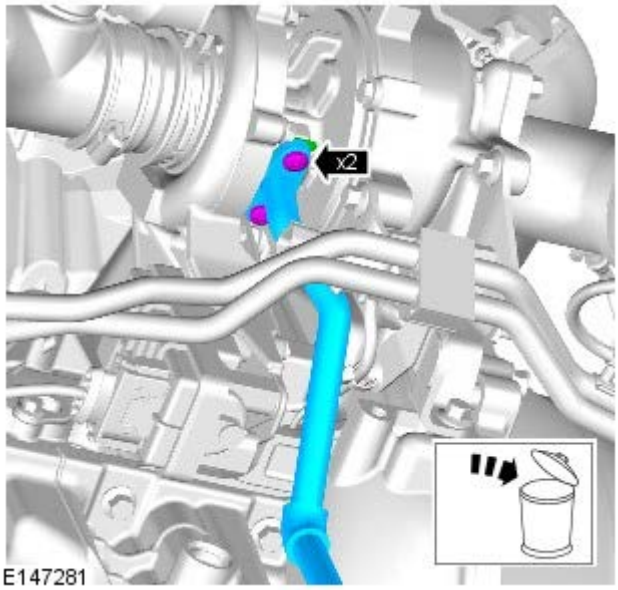
6. *Torque:* 10 Nm

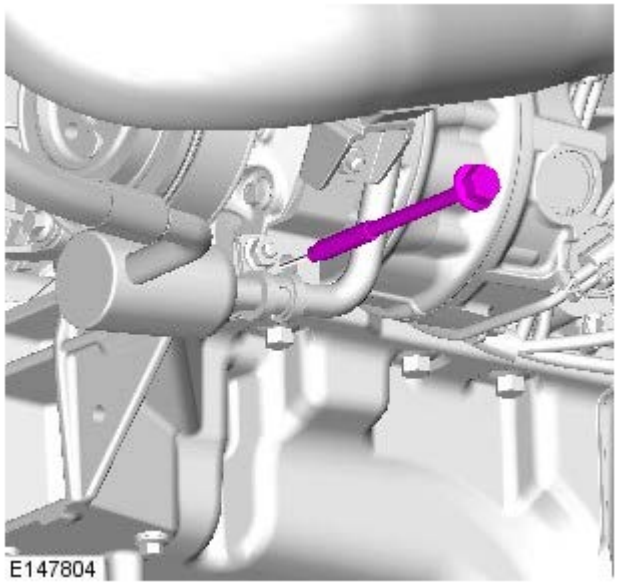


7. NOTE: Remove and discard the gasket.

   Torque: 10 Nm





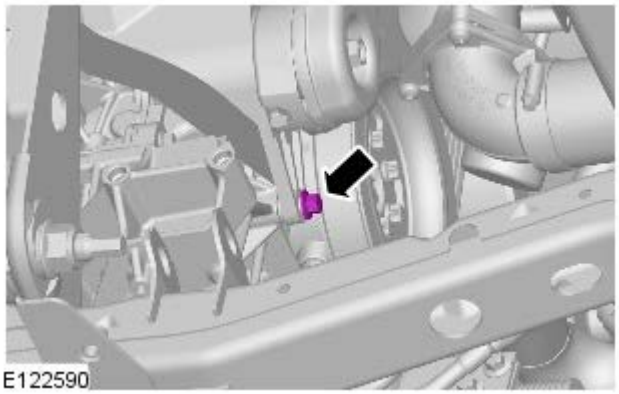


8. NOTE: Remove and discard the gasket.

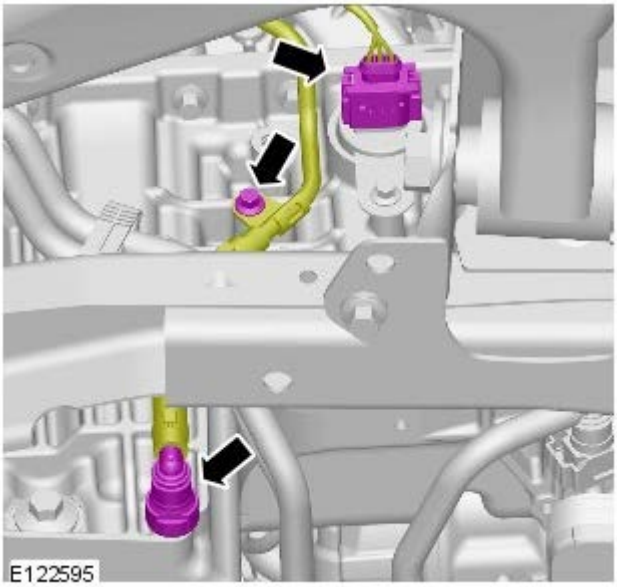
   Torque: 10 Nm

9. *Torque:* 25 Nm

10. *Torque:* 24 Nm

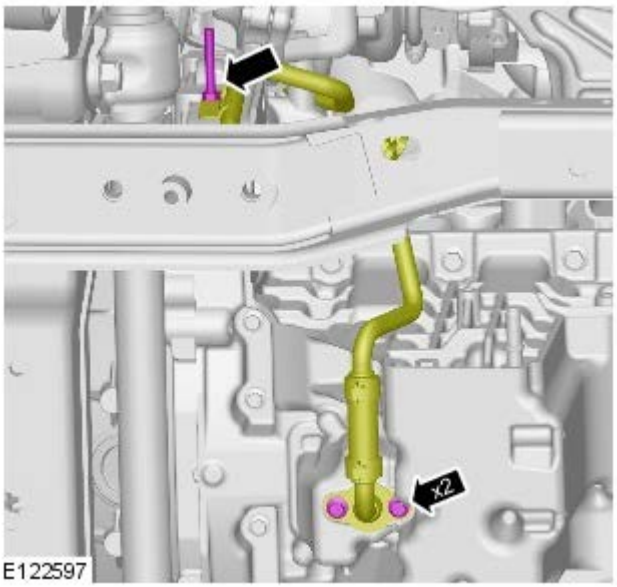


11. *Torque:* 10 Nm



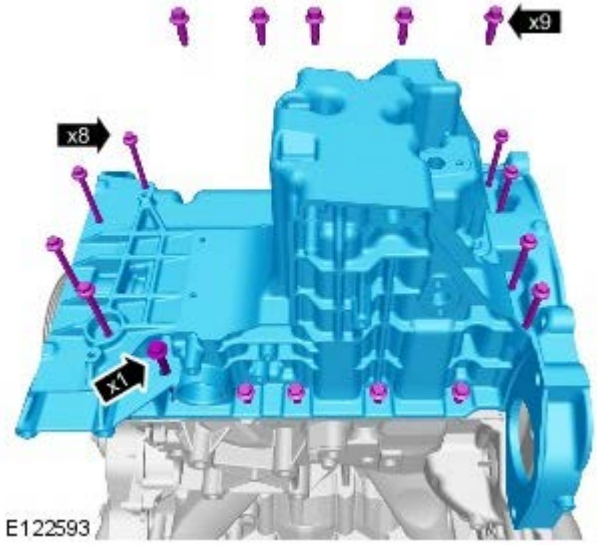
12. NOTE: Remove and discard the gasket.

Torque: 10 Nm

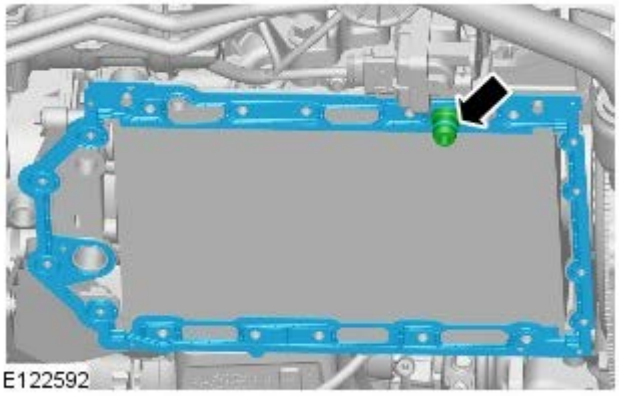


13. CAUTION: Note the position of the bolts, prior to removal.

- *Torque:*
  M8 23 Nm
- *Torque:*
  M6 10 Nm

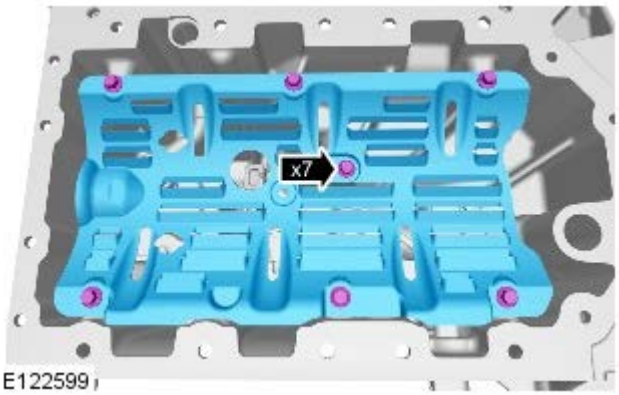


14.

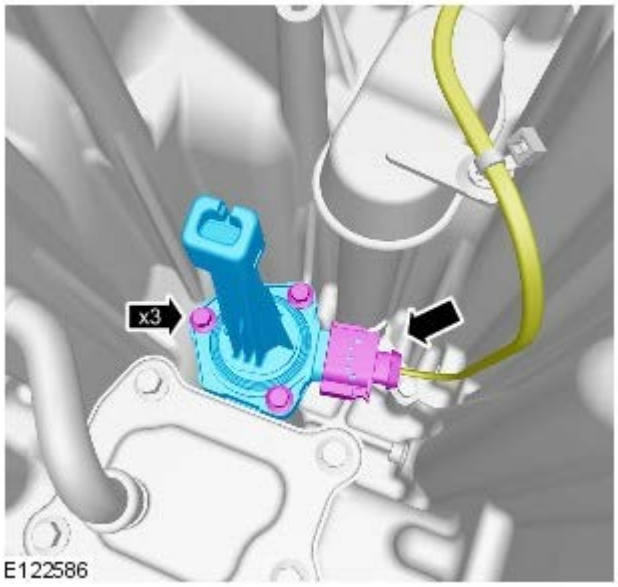


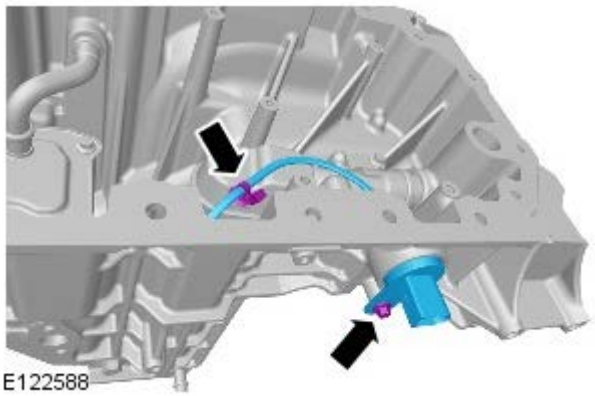
15. NOTE: Do not disassemble further if the component is removed for access only.

Torque: 10 Nm



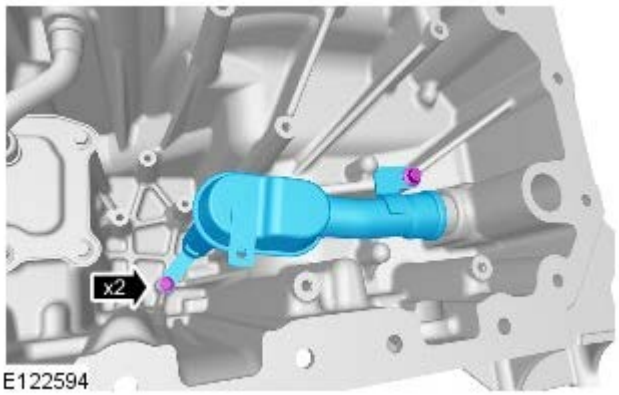
16. *Torque:* 10 Nm





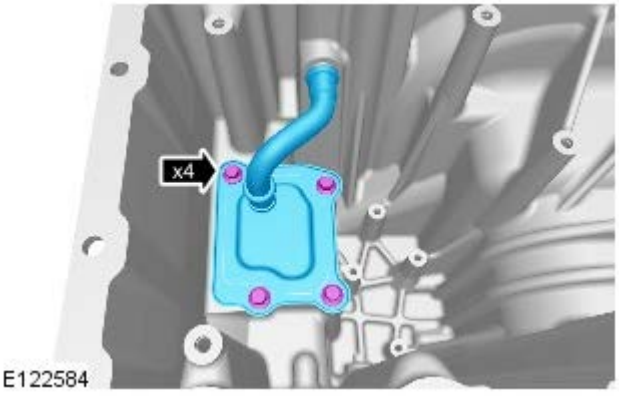
17. NOTE: Remove and discard the O-ring seal.

Torque: 10 Nm



18. NOTE: Remove and discard the O-ring seal.

Torque: 10 Nm



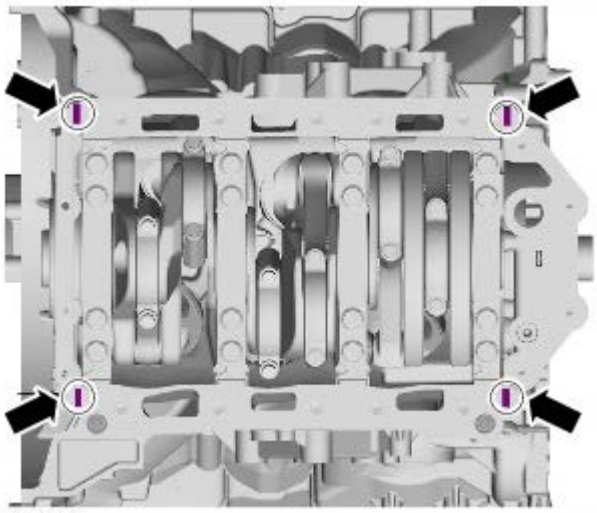
19. NOTES:

Remove and discard the O-ring seals.

Remove and discard the gasket.

Torque: 10 Nm

Installation



E122585

1. CAUTIONS:

   Installation of the oil pan and tightening must be carried out within 7 minutes of applying the sealant.

   Make sure that the mating faces are clean and free of corrosion and foreign material.

   NOTE: Right-hand shown, left-hand similar.

   Apply sealant WSE-M4G323-A5 in an 8mm bead to the cylinder block in the area illustrated.

2. To install, reverse the removal procedure.

3. Refer to: Hybrid Electric Vehicle (HEV) Decommission (414-01, General Procedures).

Published: 20-Mar-2013

Engine - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Oil Pump

Removal and Installation

Removal

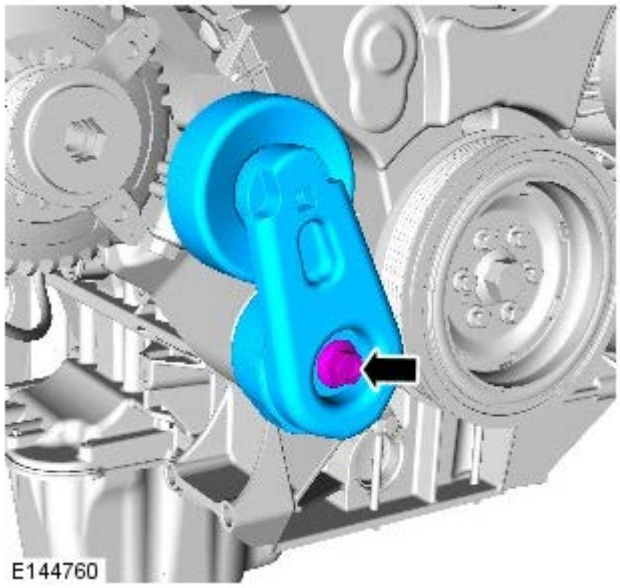
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

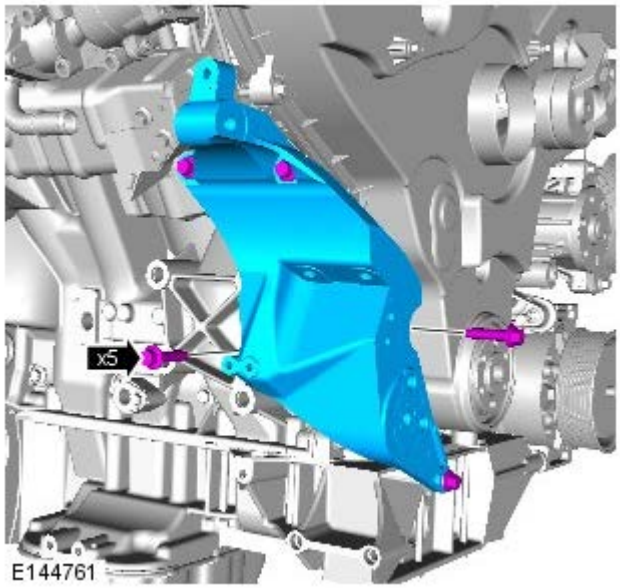
2. Remove the generator.

   Refer to: Generator (414-02A Generator and Regulator - TDV6 3.0L Diesel, Removal and Installation).

3.

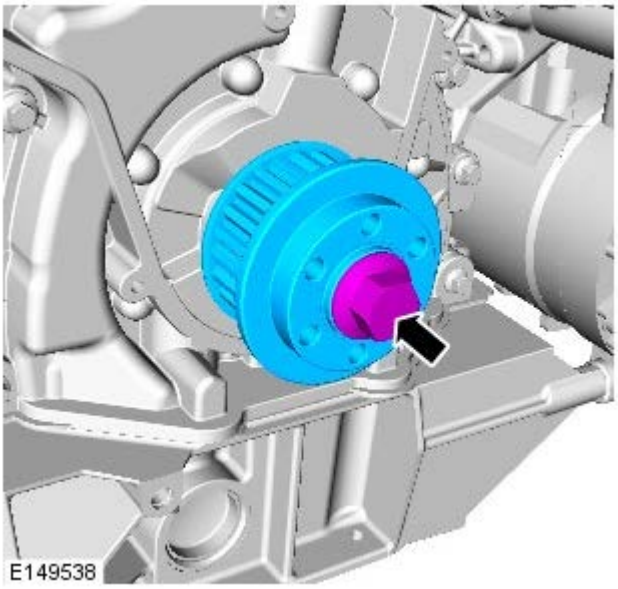


4.



5. Refer to: Timing Belt (303-01A Engine - TDV6 3.0L Diesel, Removal and Installation).

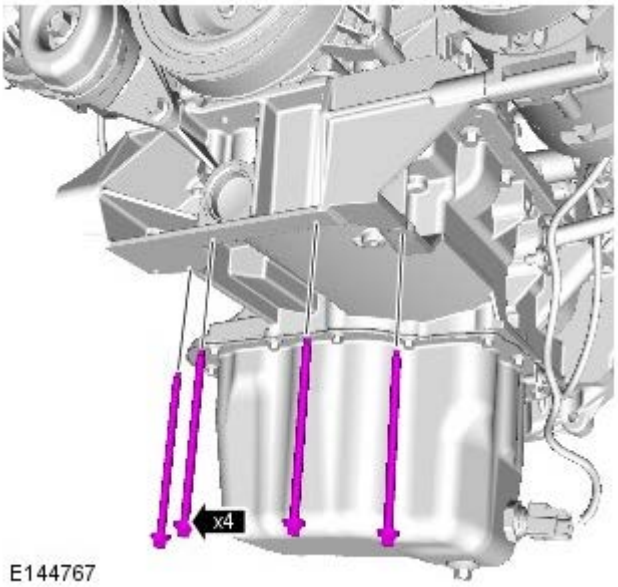
6.



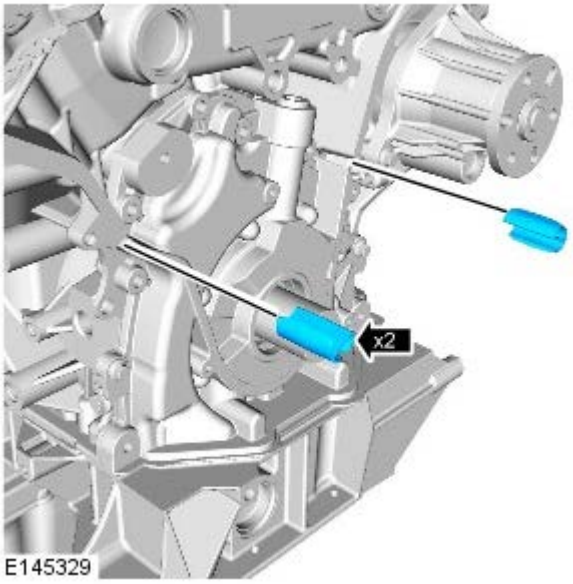
7. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

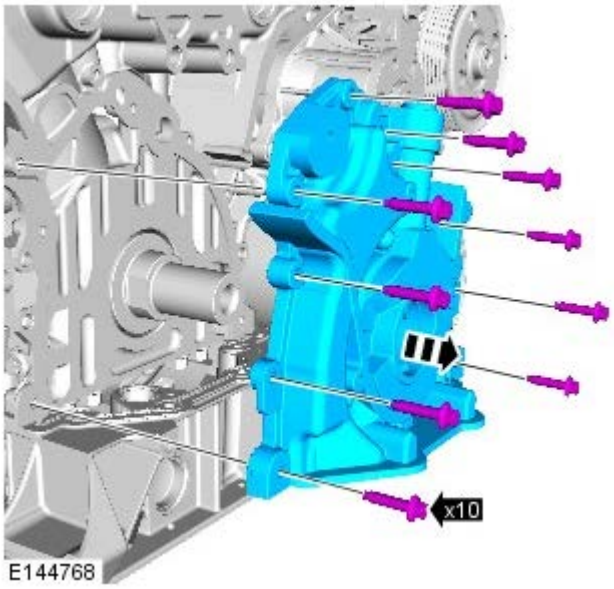
8.



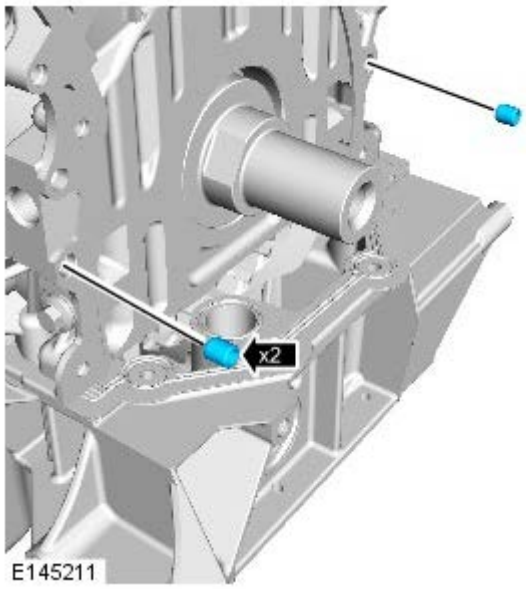
9. Remove the timing belt cover sealing strips.



10.

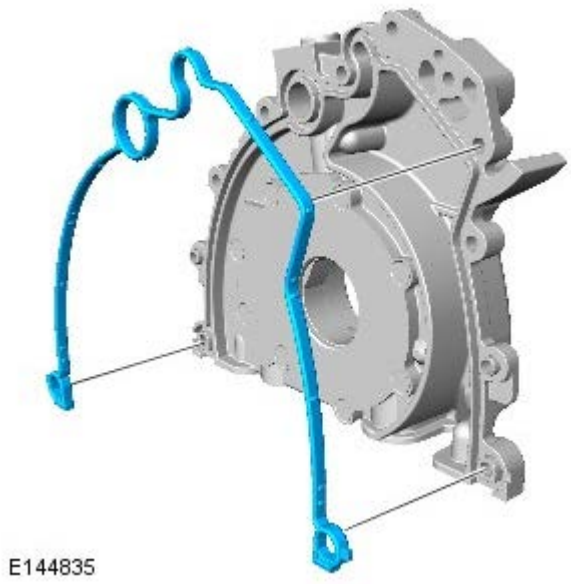


11. Remove the alignment dowels (if equipped).



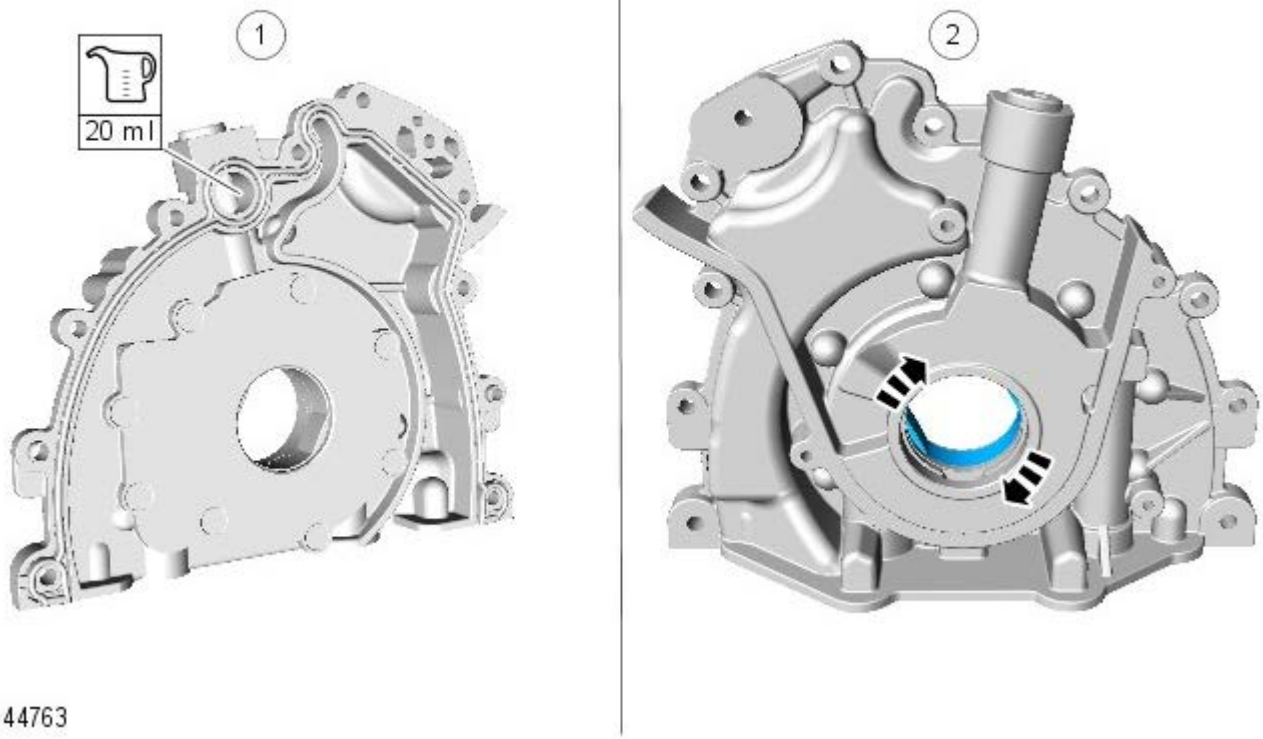
Installation

1.

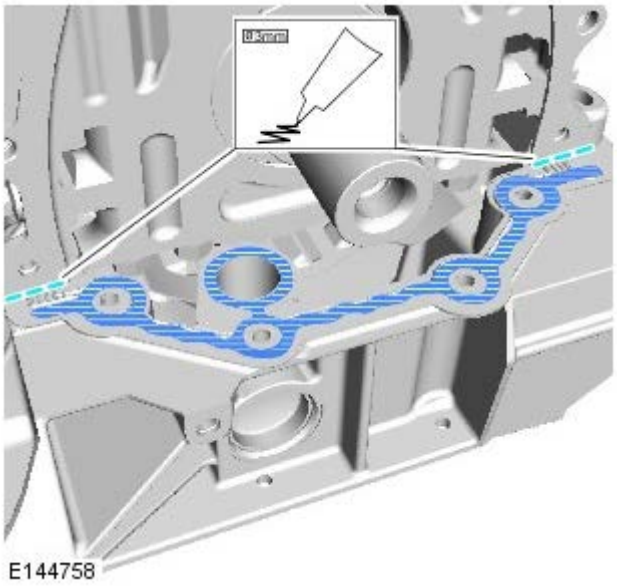


2. NOTE: **Prime the oil pump.**

- Fill the orifice shown with 20 ml of engine oil.
- Rotate the oil pump drive 2 complete turns.



E144763



E144758

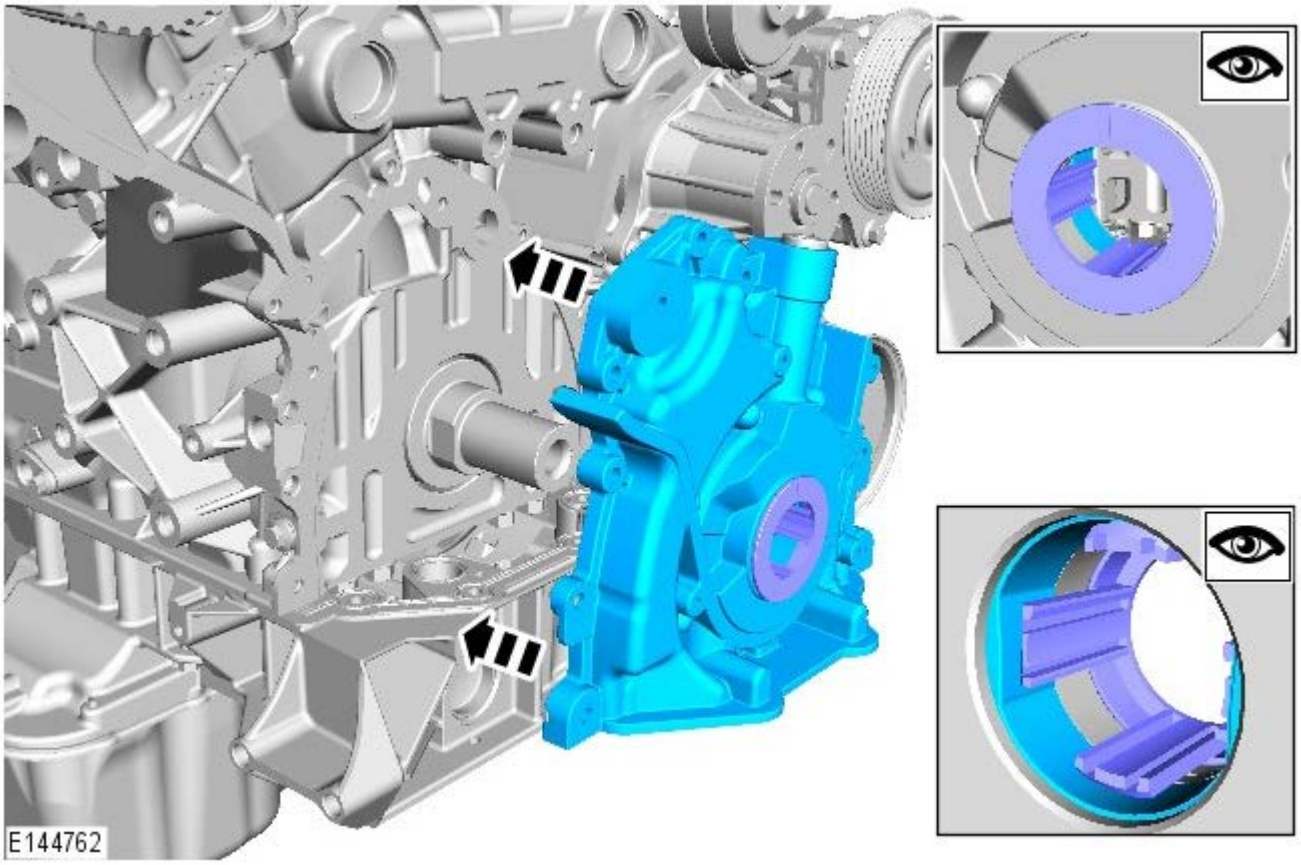
3. CAUTION: Make sure that the mating faces are clean and free of foreign material.

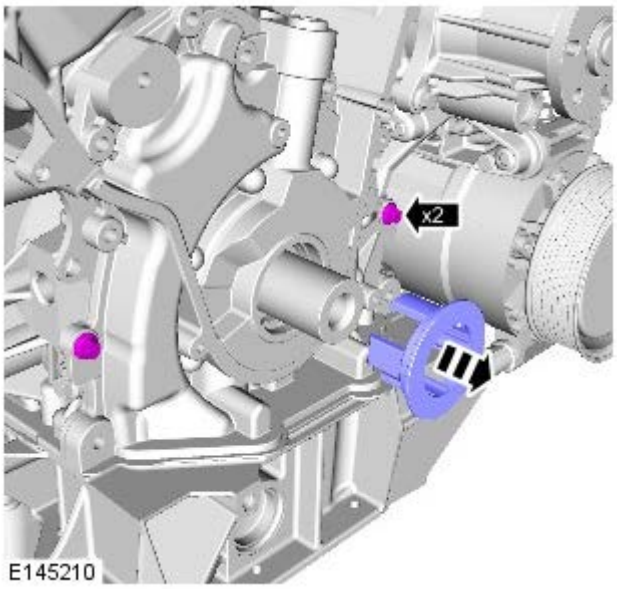
   Apply sealant WSE-M4G323-A5 in an 3mm bead to the two areas shown, also apply a smear of sealant to the gasket face as illustrated.

4. CAUTION: Make sure that the mating faces are clean and free of foreign material.

   NOTE: Make sure the gasket is installed correctly.

   Install the oil pump.



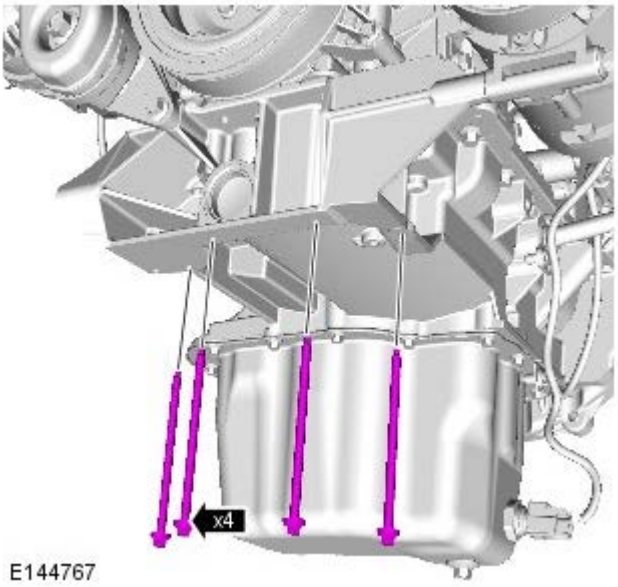


5. NOTE: Remove the oil pump locator.

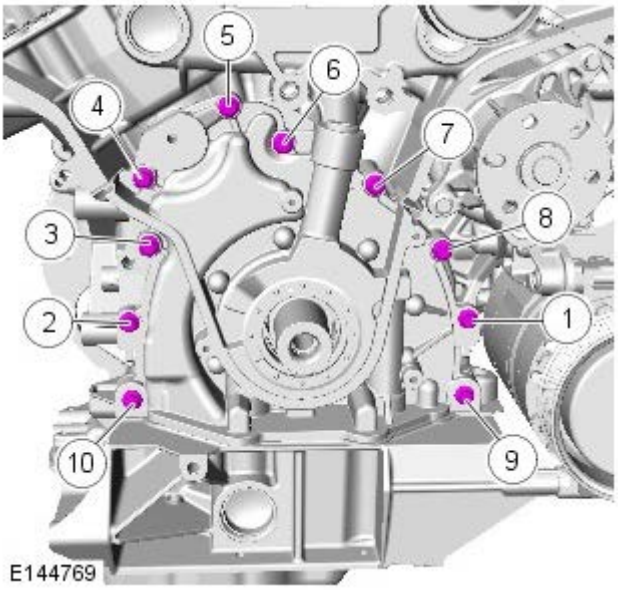
   Install two bolts to the oil pump, only finger tighten at this stage.

6. Install the oil pump lower retaining bolts.

   Torque: 10 Nm



E144767

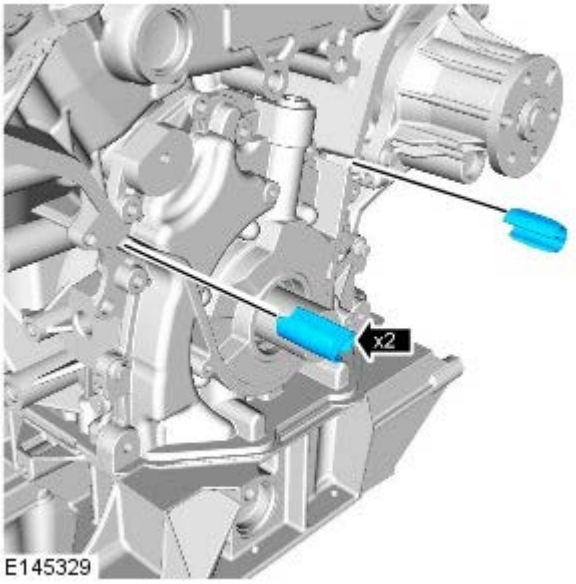


E144769

7. NOTE: Tighten the bolts in the sequence shown to 10 Nm .

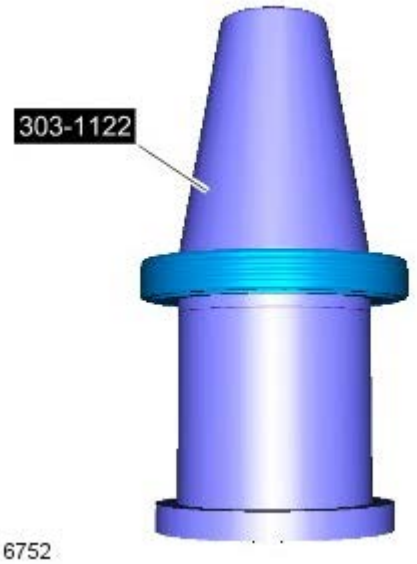
   Secure the oil pump.

8. Install the timing belt cover sealing strips.



E145329

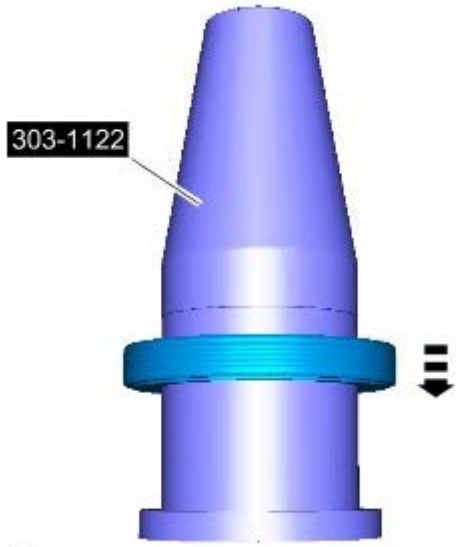
9. CAUTION: Do not use any lubricant on the crankshaft front seal, special tools or the crankshaft. Failure to follow this instruction may result in damage to the vehicle.



E116752

NOTE: Make sure all component mating faces are clean.

Install a new crankshaft front seal to the special tool.

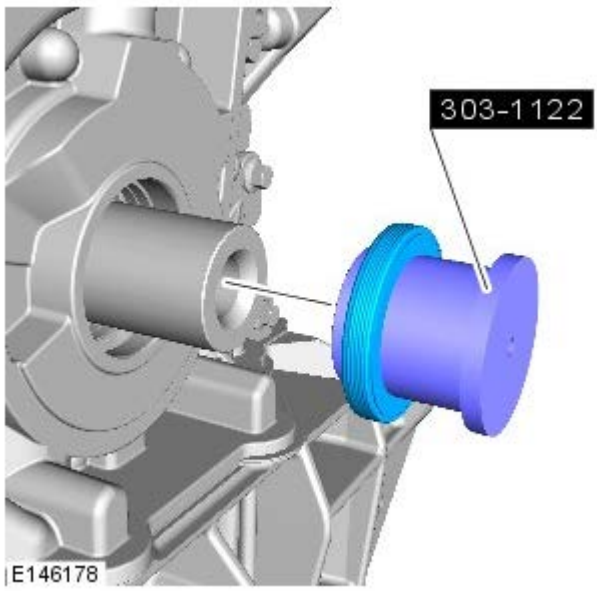


E116753

10. NOTE: Remove the sleeve from the special tool.

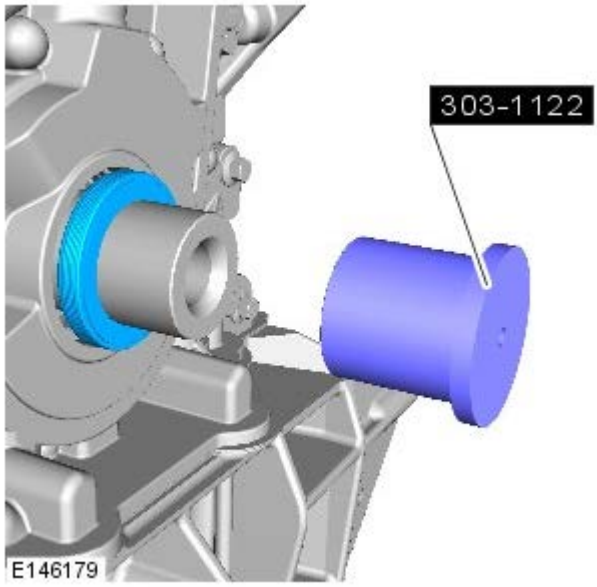
    Reposition the crankshaft front seal along the special tool.

11. Install the special tool to the crankshaft.

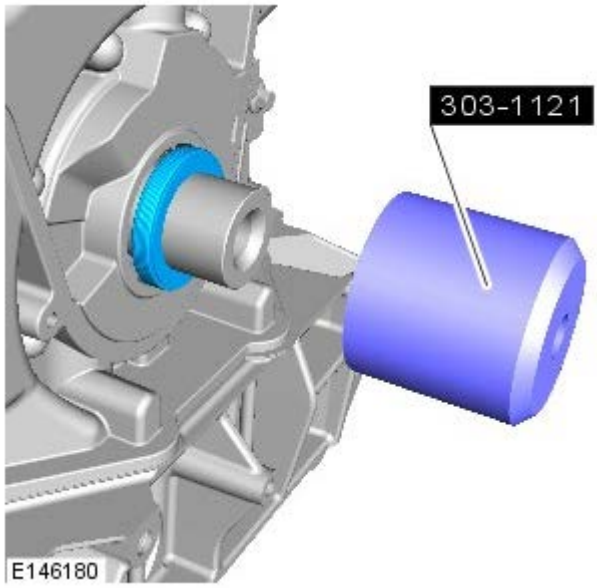


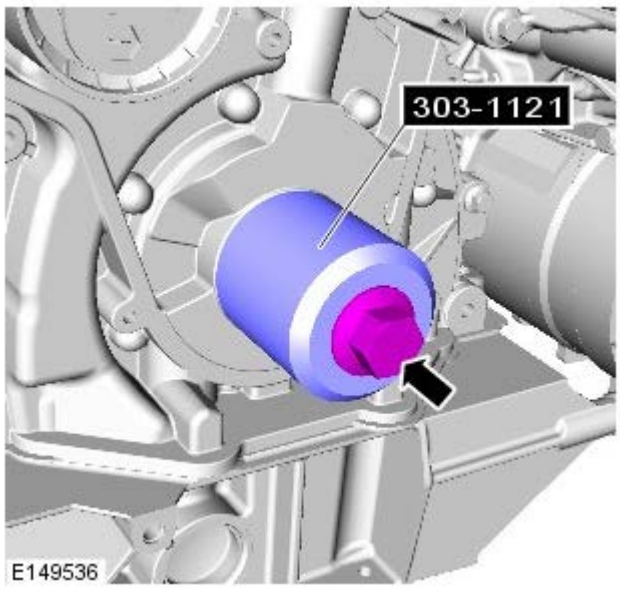
E146178

12. Remove the special tool from the crankshaft.



13. Install the special tool to the crankshaft.





14. NOTES:

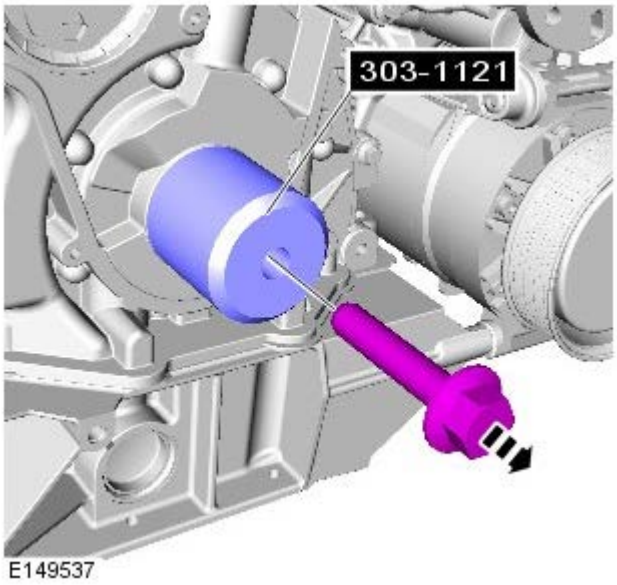
Make sure the seal is installed correctly.

Use the crankshaft bolt with the service tool.

Install the special tool to the crankshaft.

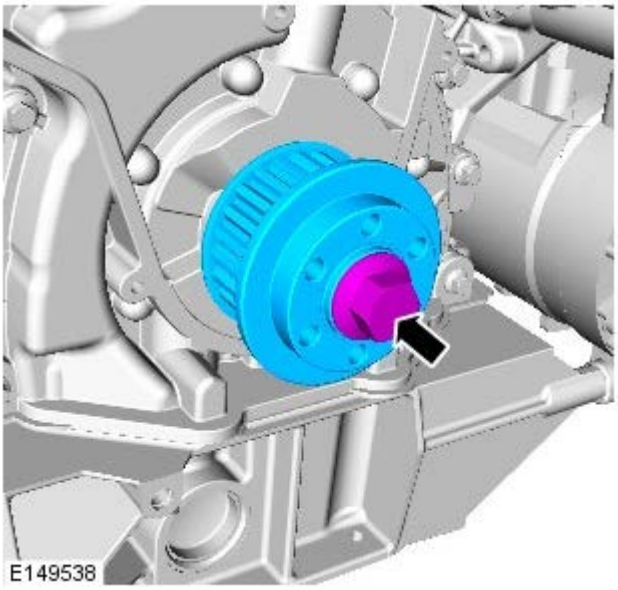
15. NOTES:

Make sure the seal is installed correctly.



Wait 10 seconds before removing the crankshaft seal installation tool.

Remove and discard the crankshaft pulley retaining bolt.



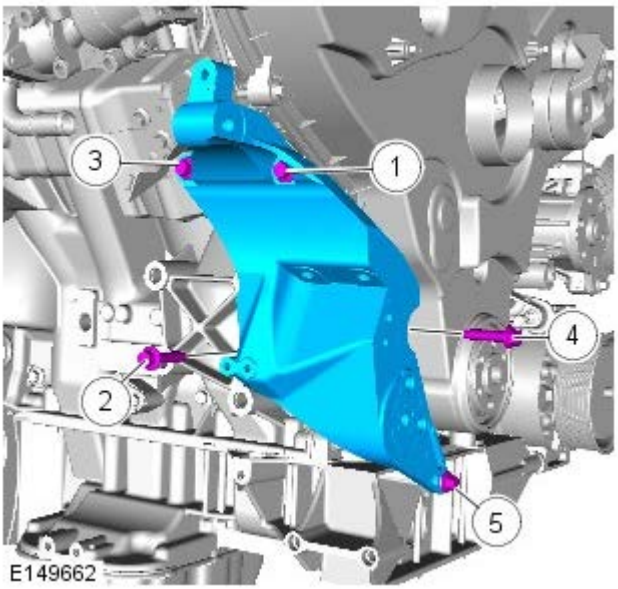
16. CAUTION: Make sure that a new crankshaft pulley bolt is installed.

NOTE: Before installing the crankshaft pulley retaining bolt, note the thread size of the bolt (there are two different sized threads, M14 and M16). Failure to follow this instruction may result in damage to the vehicle.

Install the crankshaft pulley.

Torque:
Tighten the M14 retaining bolt in two stages:
Stage 1: 140 Nm
Stage 2: 90°
Tighten the M16 retaining bolt in three stages:
Stage 1: 150 Nm
Stage 2: 300°

17. Refer to: Timing Belt (303-01A Engine - TDV6 3.0L Diesel, Removal and Installation).



18. Tighten the bolts in the sequence shown.

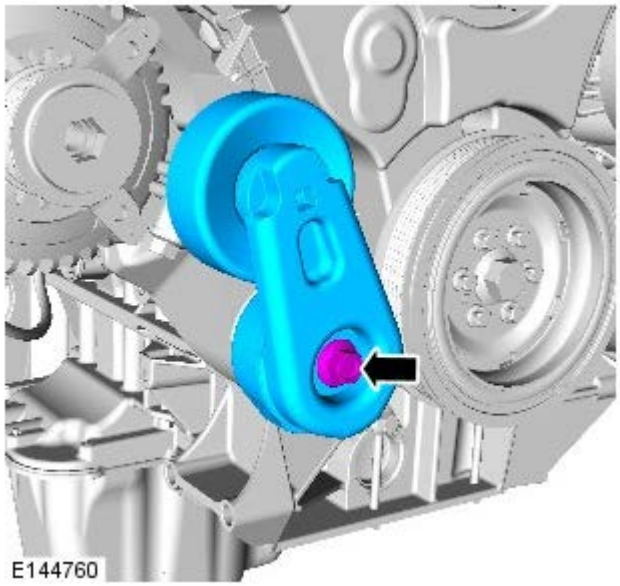
Torque: 22 Nm

19. Remove the generator.

Refer to: Generator (414-02A Generator and Regulator - TDV6 3.0L

Diesel, Removal and Installation).

20. *Torque:* 45 Nm



21. Connect the battery ground cable.

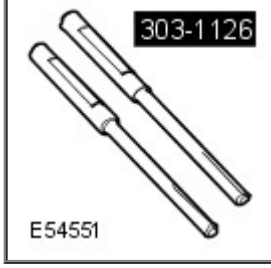
    Refer to: Specifications (414-00, Specifications).

Published: 10-Sep-2012

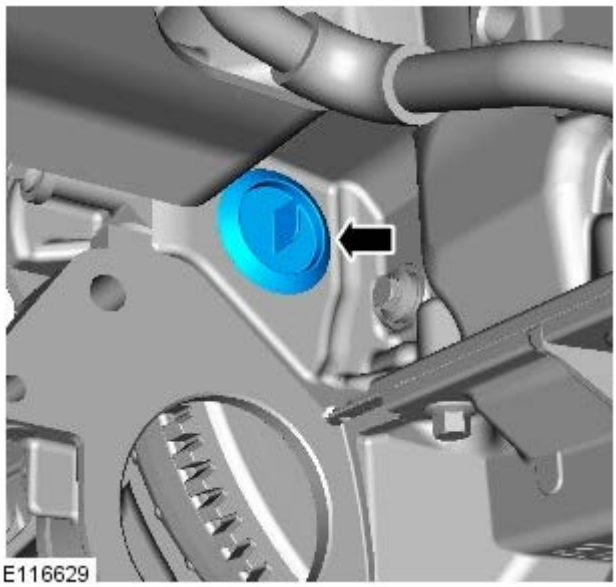
Engine - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Timing Belt

Removal and Installation

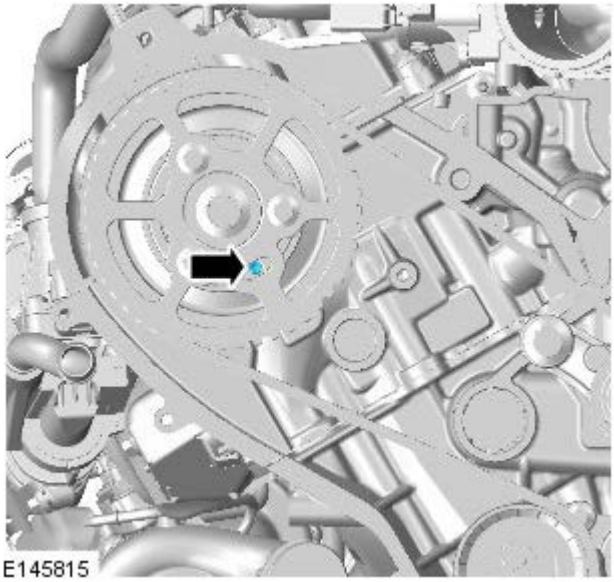
Special Tool(s)

	303-1117 Timing Peg, Automatic Transmission
	303-1126 Timing Peg, Camshaft Pulley

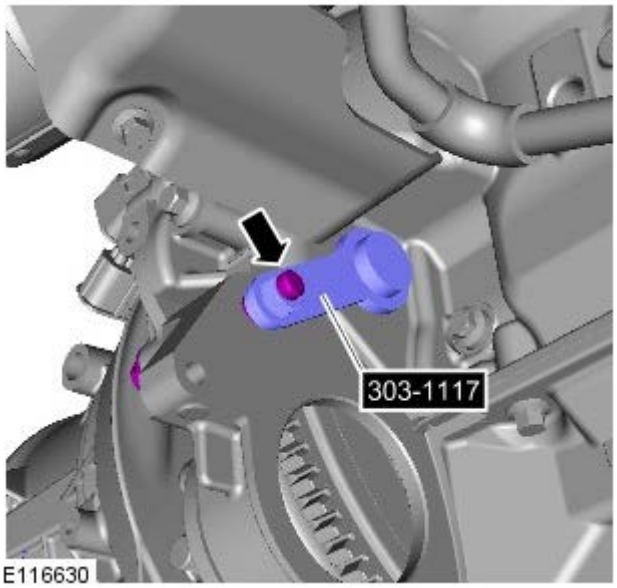
Removal

1. Refer to: Timing Cover (303-01A Engine - TDV6 3.0L Diesel, Removal and Installation).
2. Refer to: Starter Motor (303-06A Starting System - TDV6 3.0L Diesel, Removal and Installation).
3. 

4. Rotate the crankshaft clockwise to align the crankshaft alignment hole in the flywheel or flexplate with the block aperture.
5. Check the camshaft pulley alignment holes are correctly aligned. If the alignment holes are not aligned, rotate the crankshaft one full turn clockwise.

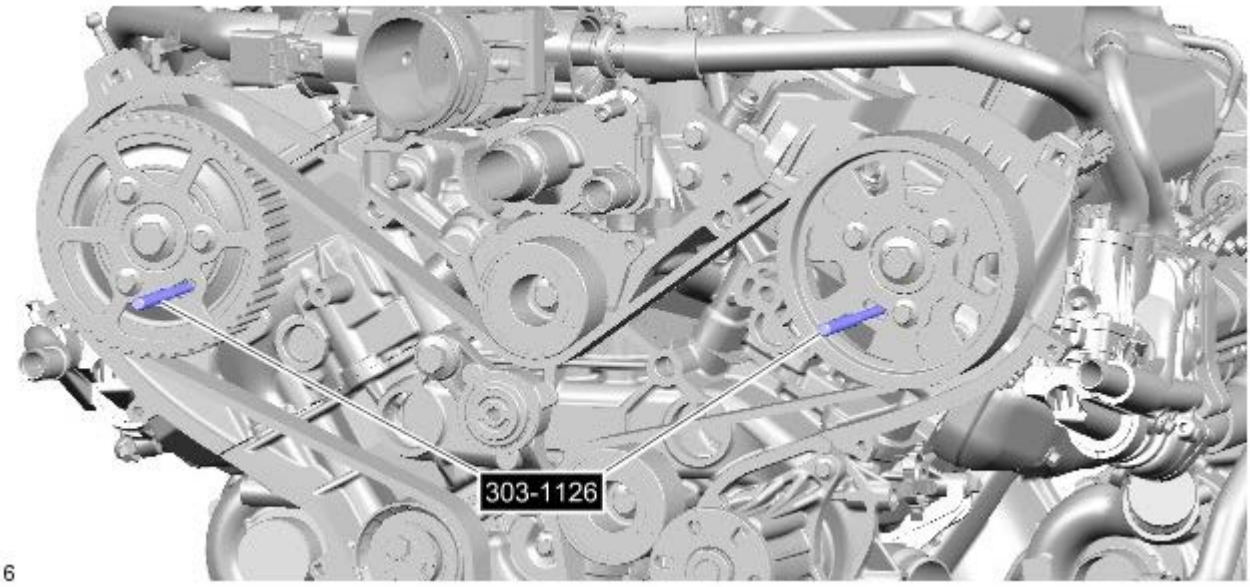

E145815

6. *Special Tool(s):* 303-1117



E116630

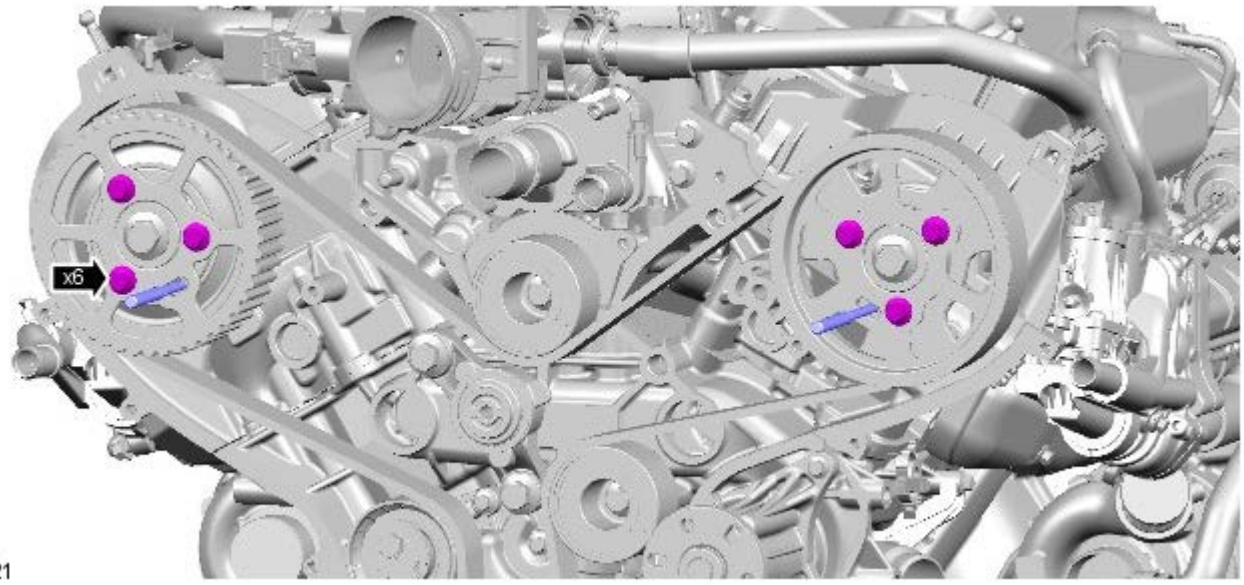
7. *Special Tool(s):* 303-1126



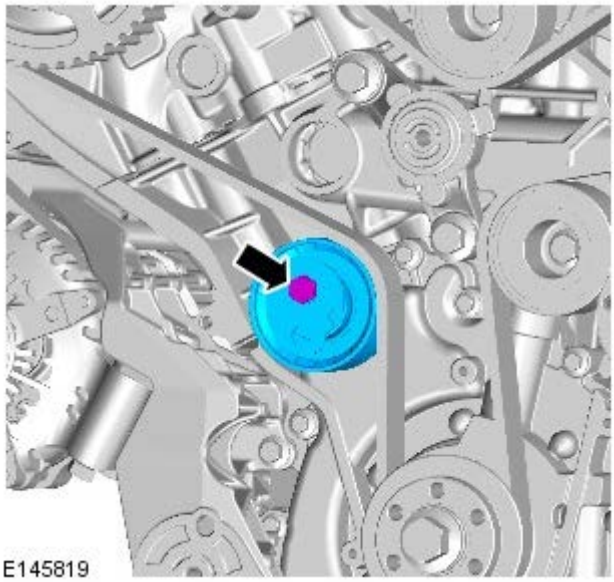
E145816

8. 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.



E145821

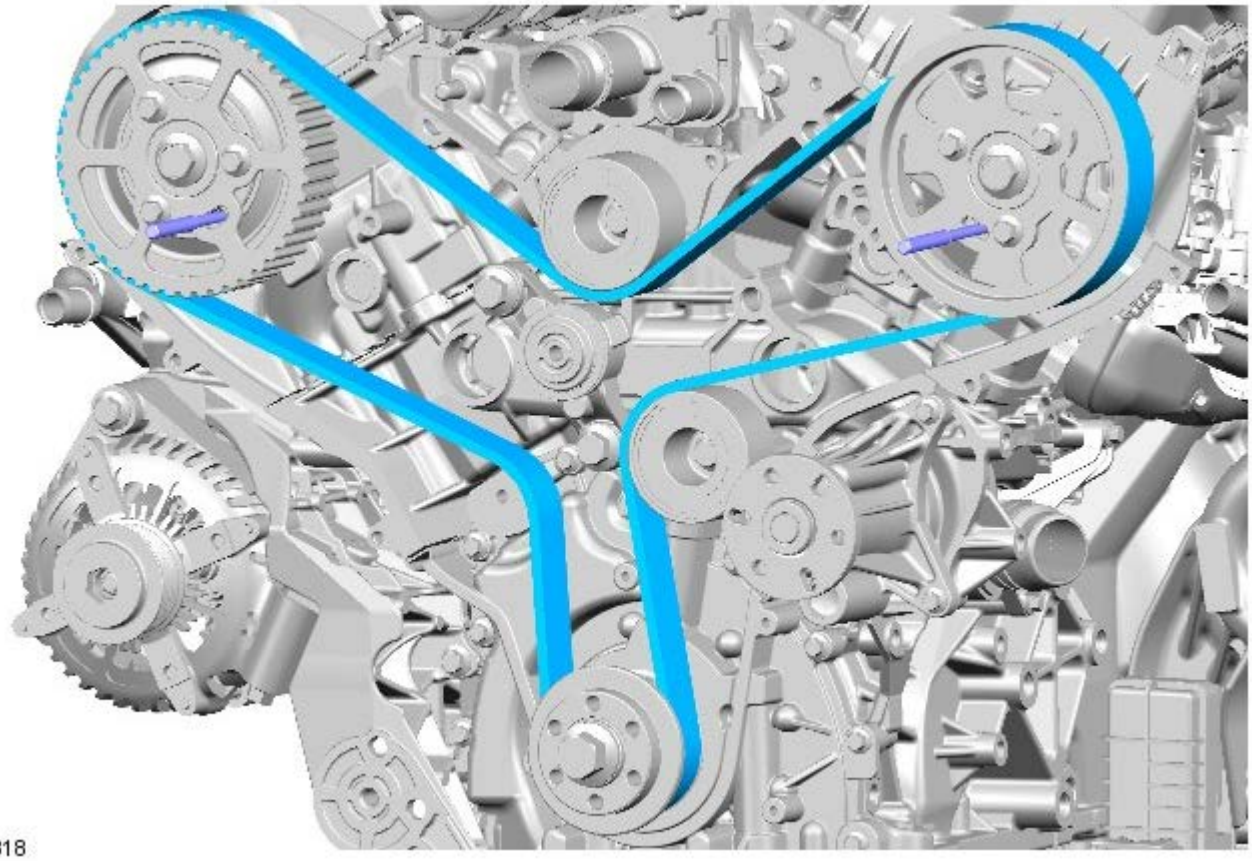

E145819

9. CAUTIONS:

   Discard the component.

   Discard the bolt.

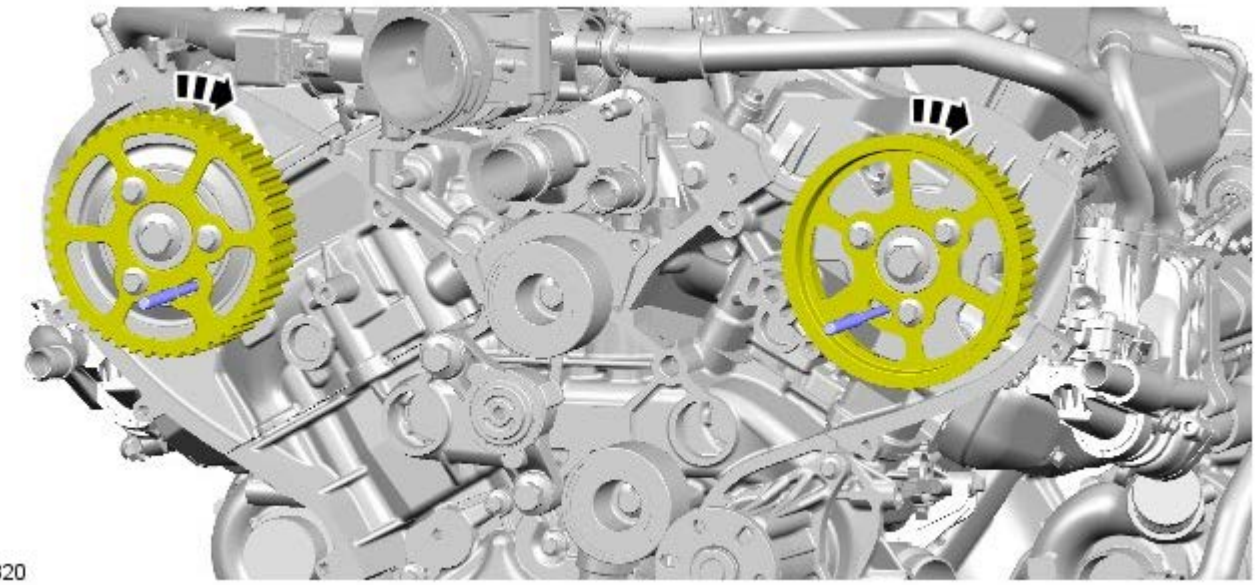
10. CAUTION: Discard the component.



E145818

Installation

1.

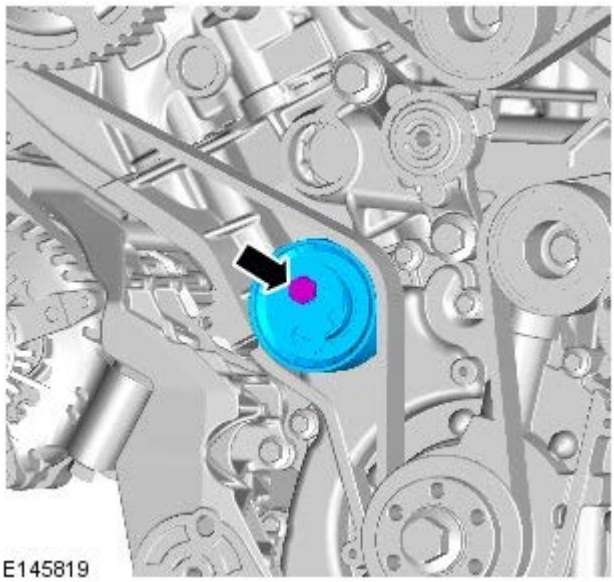


E145820

2. CAUTIONS:

Make sure that a new bolt is installed.

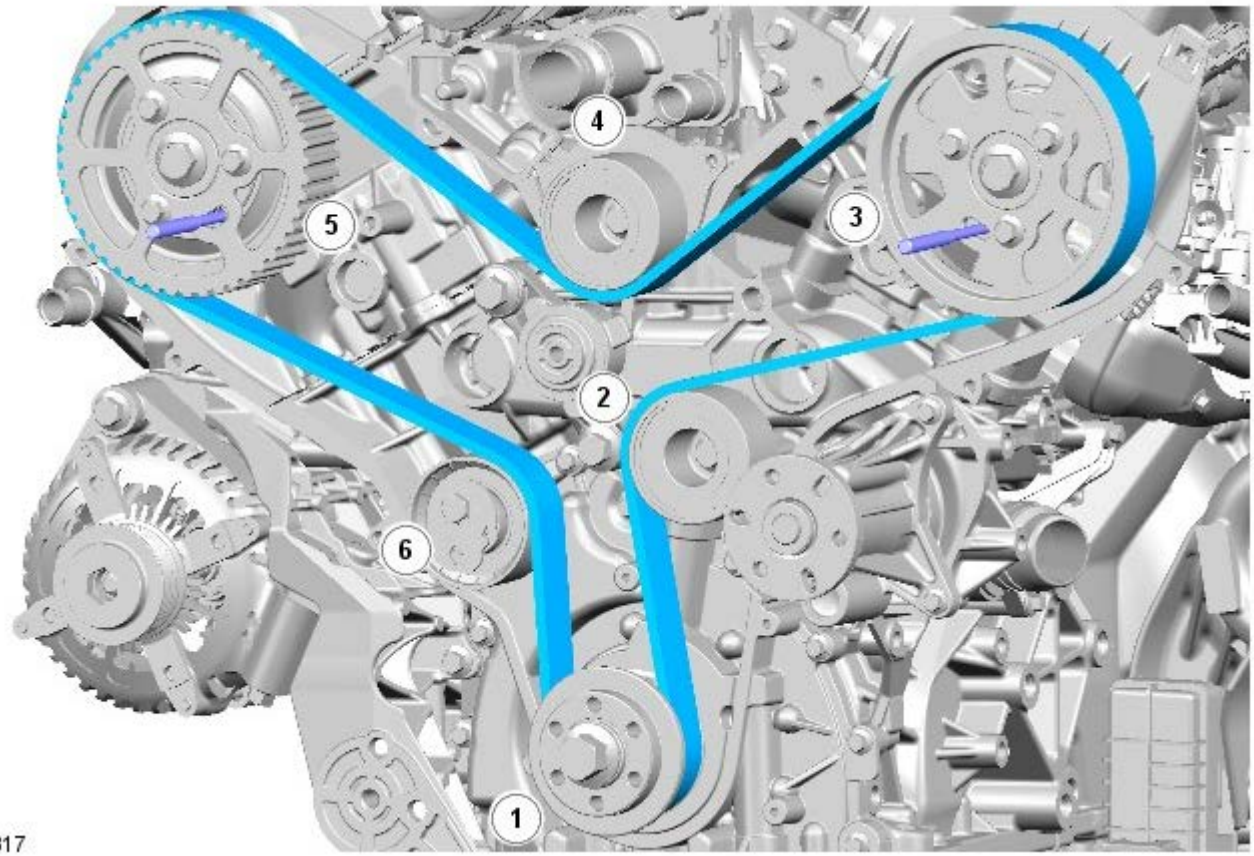
Only tighten the bolts finger-tight at this stage.



E145819

3. CAUTION: Make sure the camshaft pulleys remain in the clockwise position.

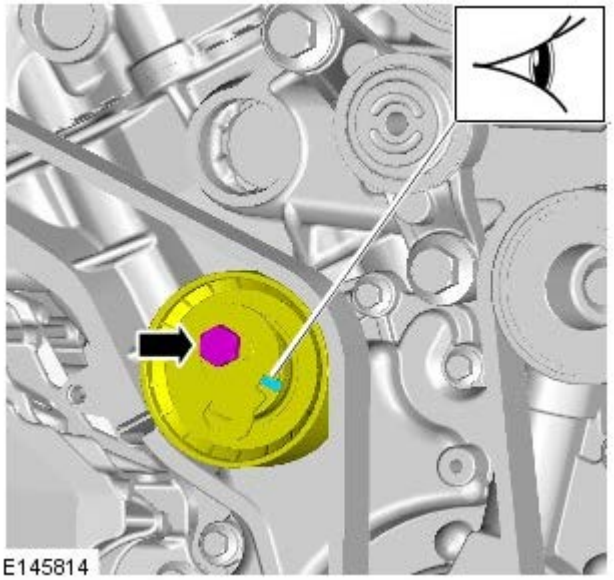
- Install the new timing belt.
- Starting at the crankshaft pulley, install the timing belt in a counter-clockwise direction, in the sequence shown.
- Stage one: Attach the timing belt to the crankshaft pulley.
- Stage two: Attach the timing belt to the idler pulley.
- Stage three: Attach the timing 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.



E145817

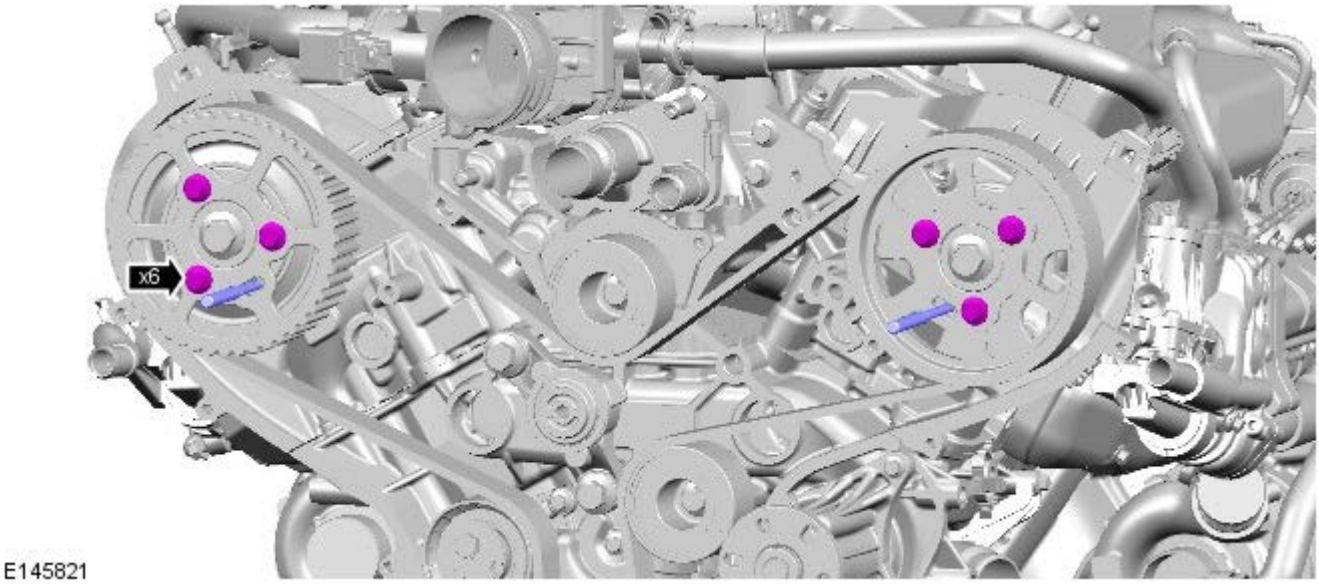
4. CAUTION: Make sure the timing belt tensioner window is aligned with the groove as illustrated.

- Tension the timing belt.
- Rotate the tensioner assembly counter-

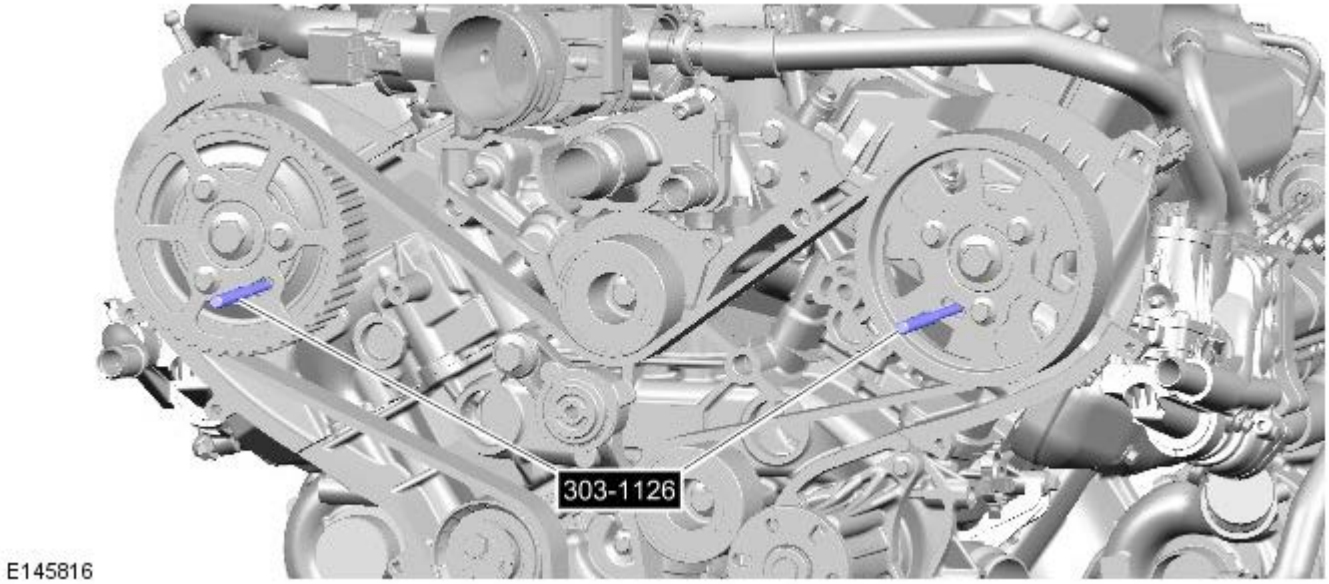


clockwise.
- *Torque:*
  Stage 1: 10 Nm
  Stage 2: 65°

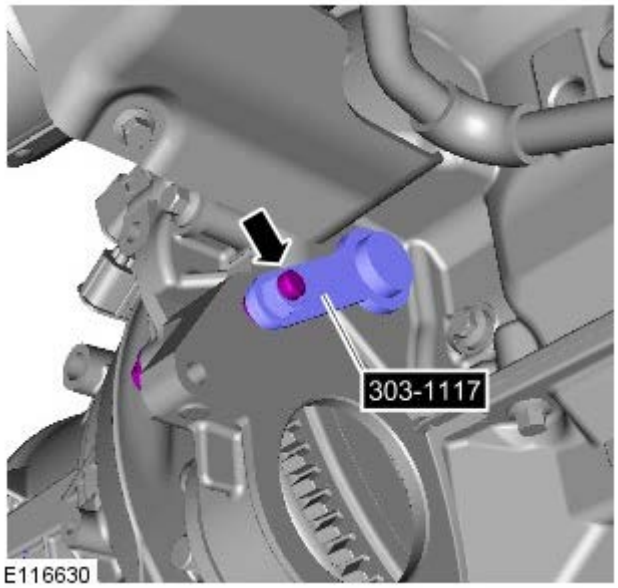
5. CAUTION: Do not use the special tools to lock the camshafts. Failure to follow this instruction may result in damage to the engine or the special tools.
   - Using a suitable tool, counterhold the camshaft pulley center retaining bolts.
   - *Torque:* 23 Nm



6. *Special Tool(s):* 303-1126



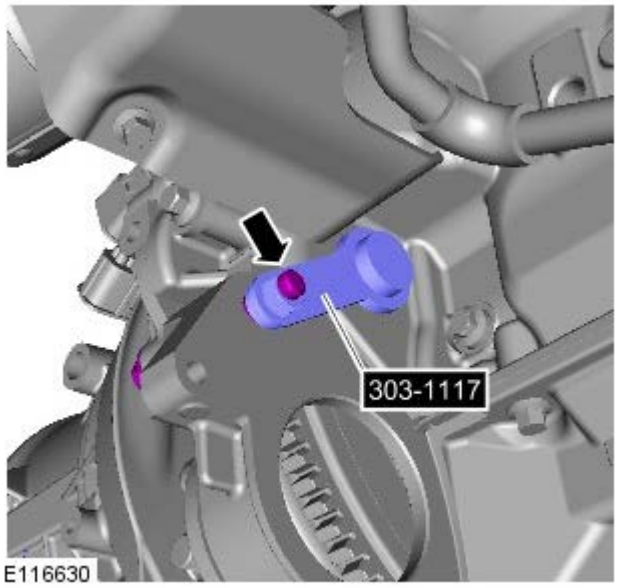
7. *Special Tool(s):* 303-1117



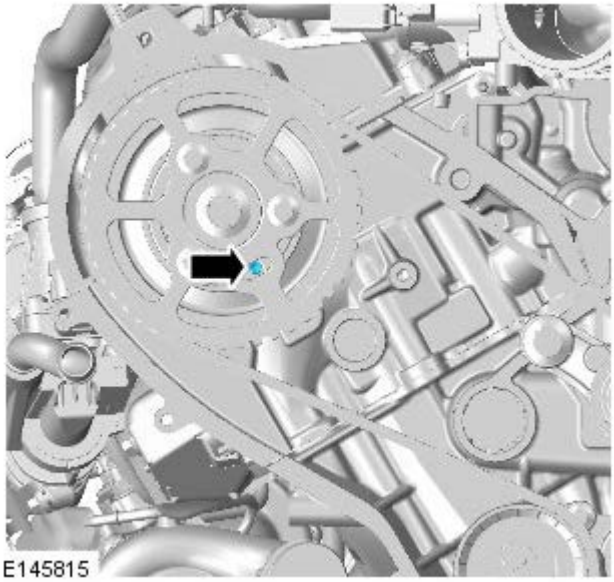
8. CAUTION: Only rotate the crankshaft clockwise.

Rotate the engine two complete turns clockwise.

9. *Special Tool(s):* 303-1117



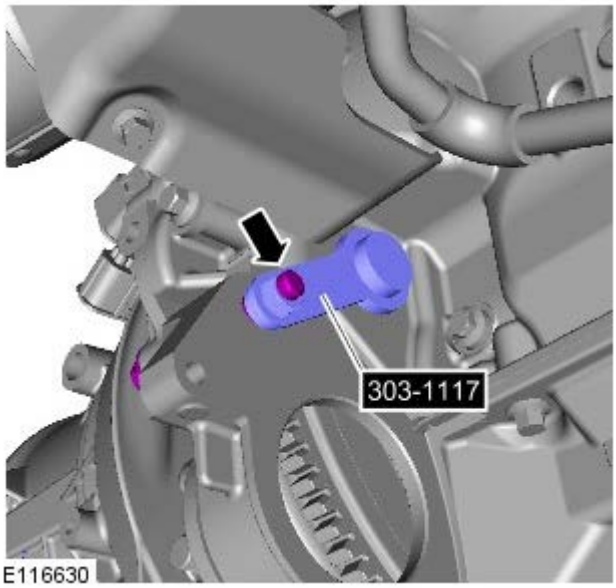
10.



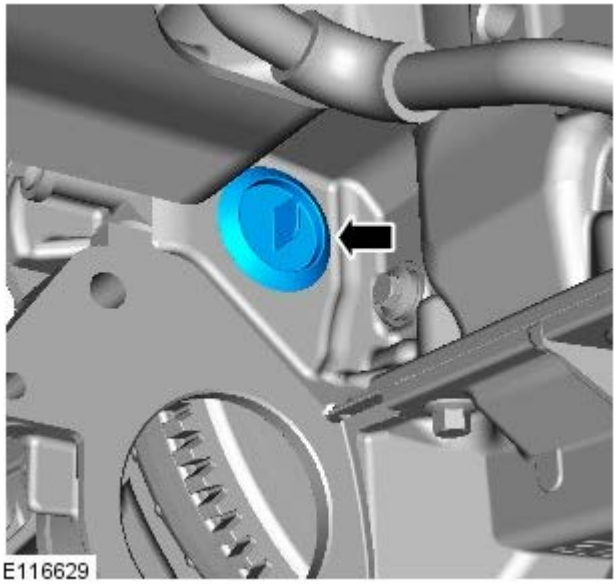
Install the special tools to the exhaust camshaft pulleys.

- If the special tool does not fit correctly, repeat the timing belt installation procedure.
- Remove the special tools from the camshaft pulleys.

11. *Special Tool(s):* 303-1117



12.



13. Refer to: Starter Motor (303-06A Starting System - TDV6 3.0L Diesel, Removal and Installation).

14. Refer to: Timing Cover (303-01A Engine - TDV6 3.0L Diesel, Removal and Installation).

Published: 31-Jul-2012

Engine - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Timing Cover

Removal and Installation

Removal

1. Disconnect the battery ground cable.

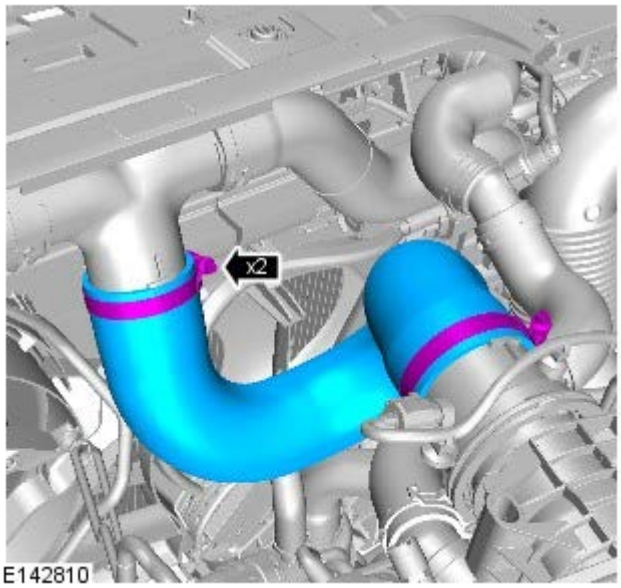
   Refer to: Specifications (414-00, Specifications).

2. Refer to: Cooling System Draining, Filling and Bleeding (303-03A Engine Cooling - TDV6 3.0L Diesel, General Procedures).

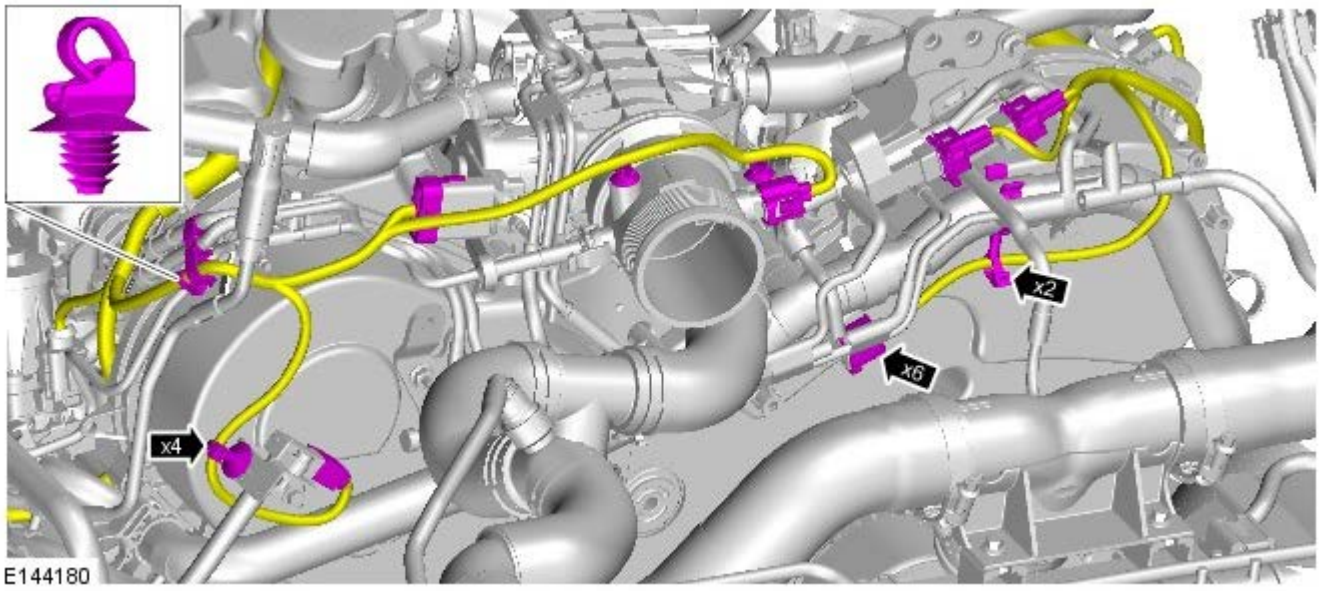
3. Refer to: Secondary Bulkhead Center Panel - TDV6 3.0L Diesel (501-02, Removal and Installation).

4. Refer to: Accessory Drive Belt Idler Pulley (303-05A Accessory Drive - TDV6 3.0L Diesel, Removal and Installation).

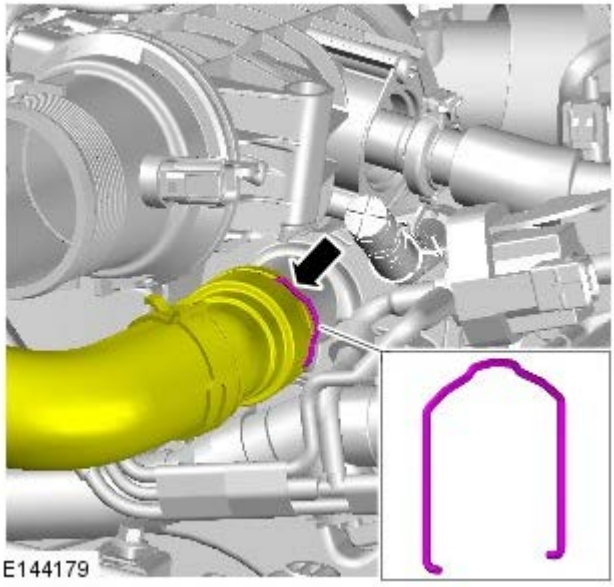
5. *Torque:* 3 Nm



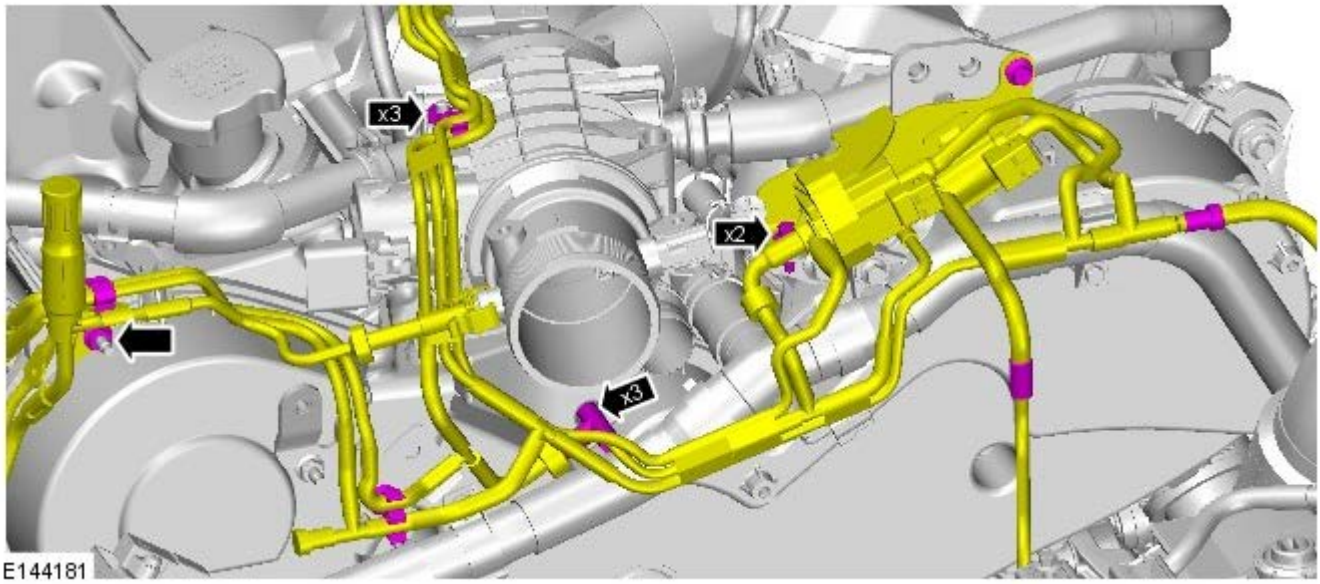
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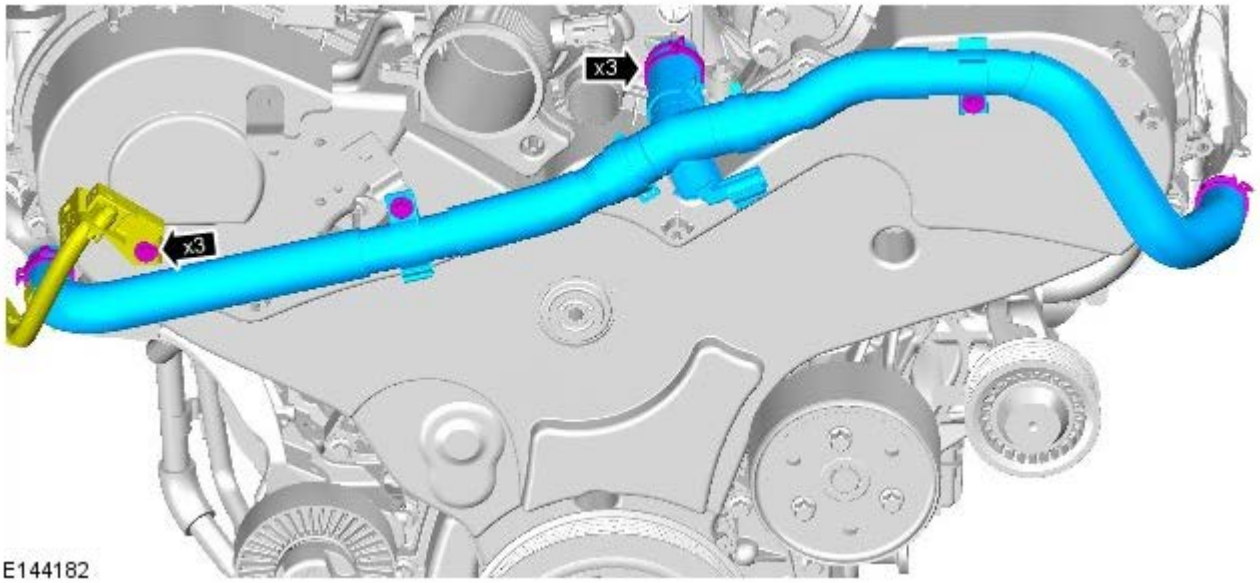
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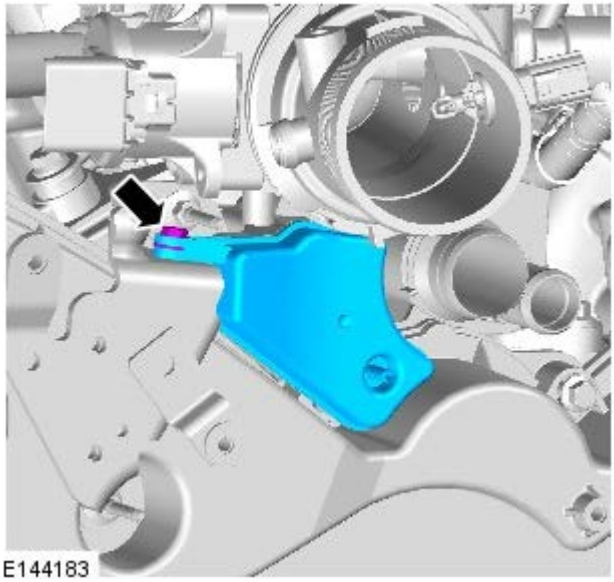
8. *Torque:* 8 Nm



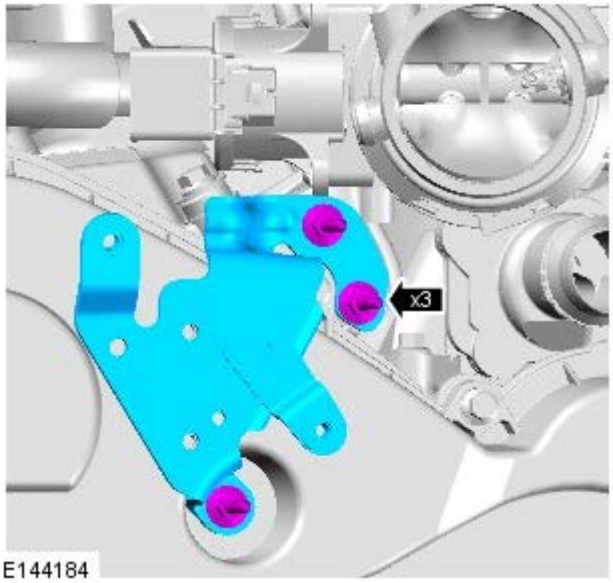
9. *Torque:* 8 Nm



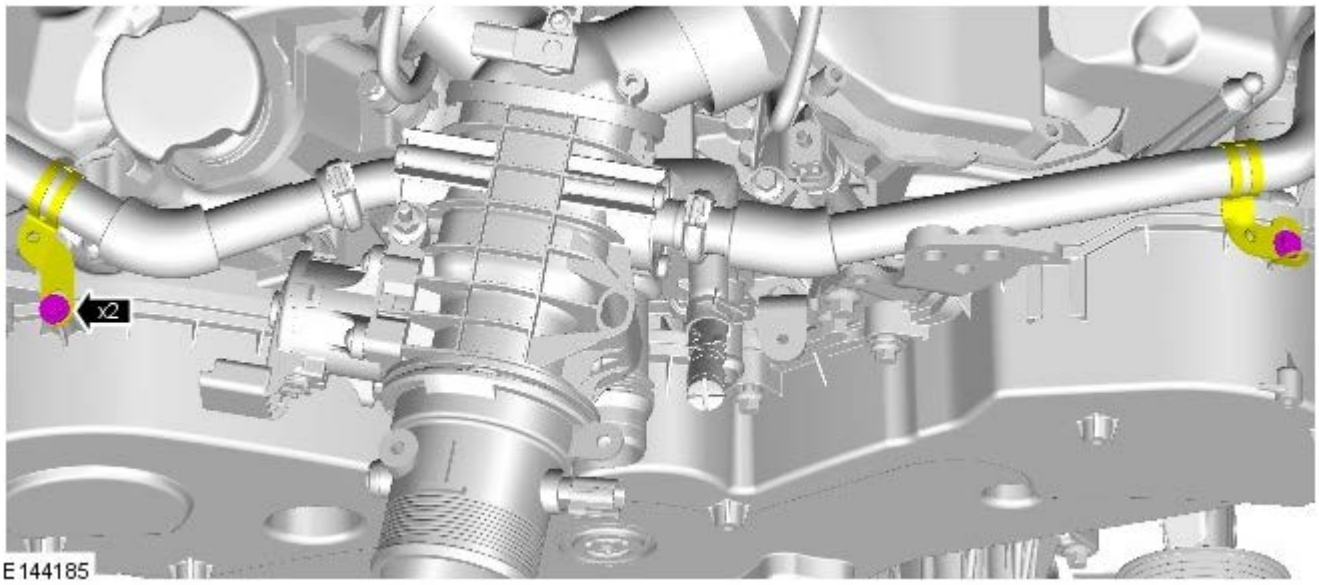
10. *Torque:* 8 Nm



11. *Torque:* 8 Nm

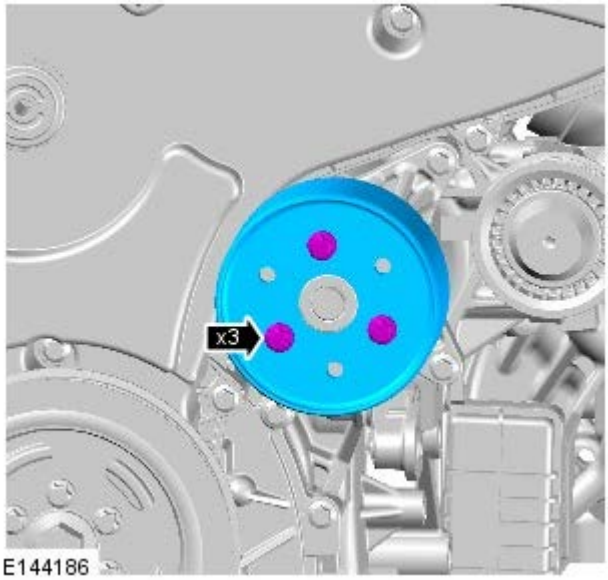


12. *Torque:* 8 Nm



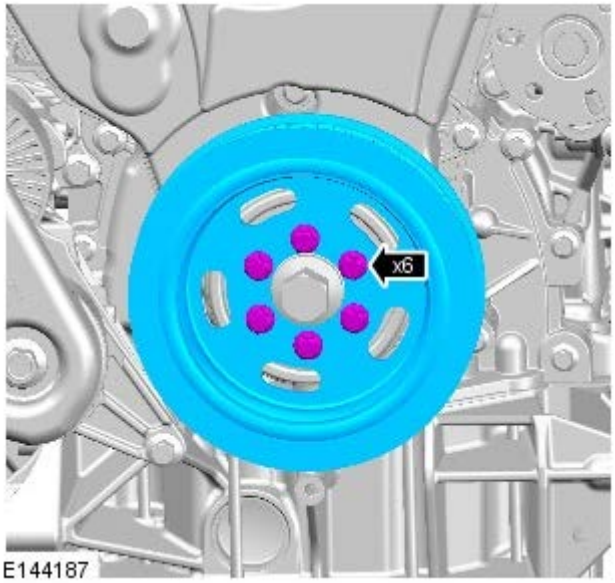
13. CAUTION: Discard the bolts.

- Using a suitable 6mm bar, retain the coolant

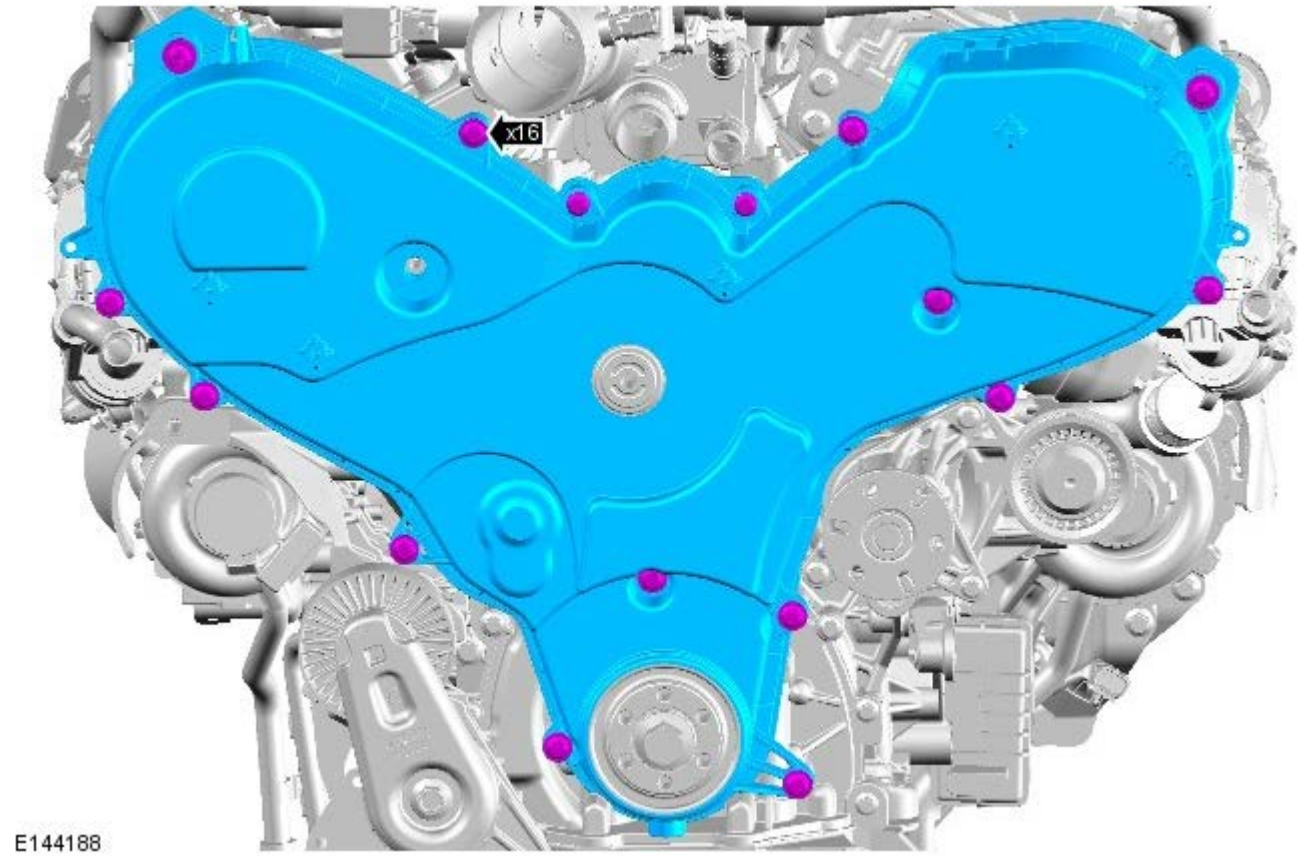


pump pulley.
- *Torque:* 25 Nm

14. *Torque:* 25 Nm



15. *Torque:* 10 Nm



Installation

1. To install, reverse the removal procedure.

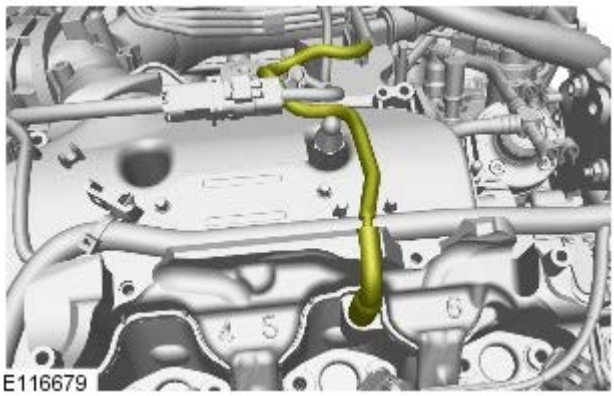
Published: 24-Aug-2012

Engine - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Valve Cover LH

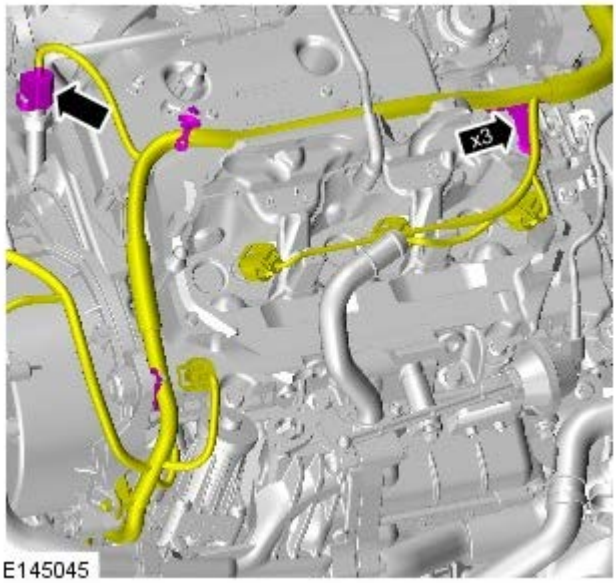
Removal and Installation

Removal

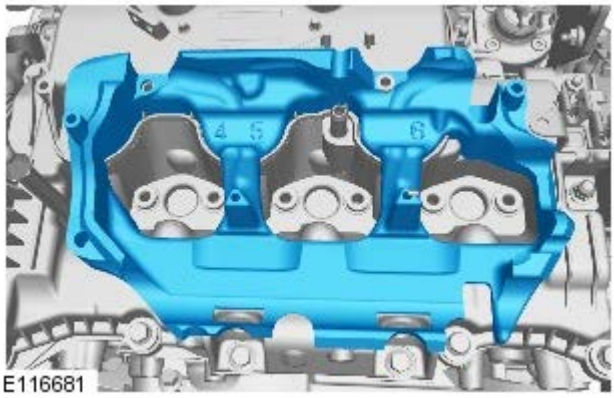
1. Refer to: Specifications (414-00, Specifications).
2. Refer to: Timing Belt (303-01A Engine - TDV6 3.0L Diesel, Removal and Installation).
3. Refer to: Fuel Injectors LH (303-04A Fuel Charging and Controls - TDV6 3.0L Diesel, Removal and Installation).
4. Refer to: Fuel Rail LH (303-04A Fuel Charging and Controls - TDV6 3.0L Diesel, Removal and Installation).
5. Refer to: Intake Air Shutoff Throttle (303-04A Fuel Charging and Controls - TDV6 3.0L Diesel, Removal and Installation).
6.



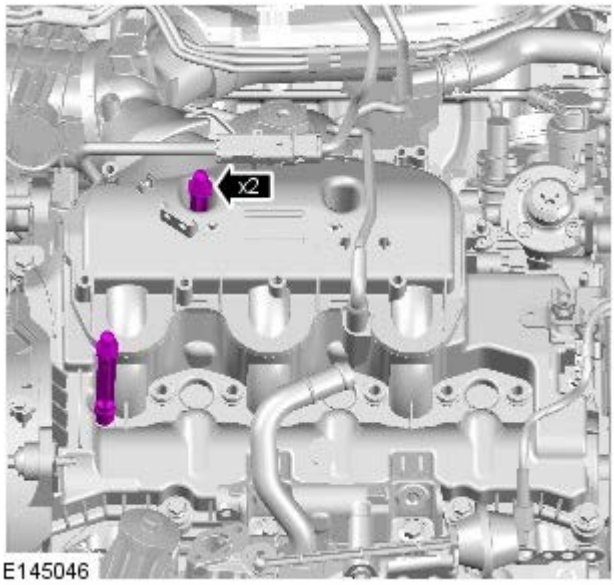
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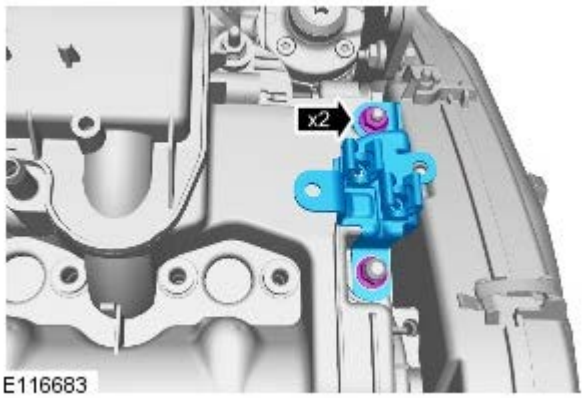
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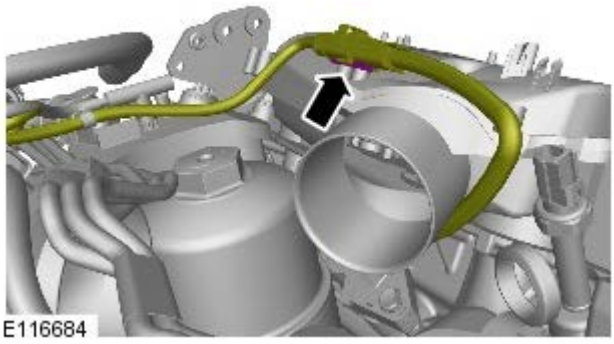
9. *Torque:* 5 Nm



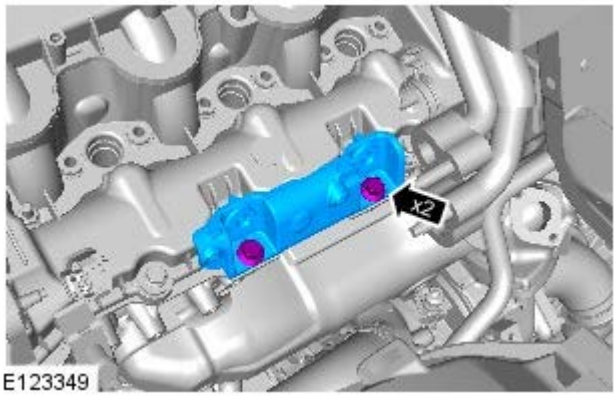
10. *Torque:* 10 Nm

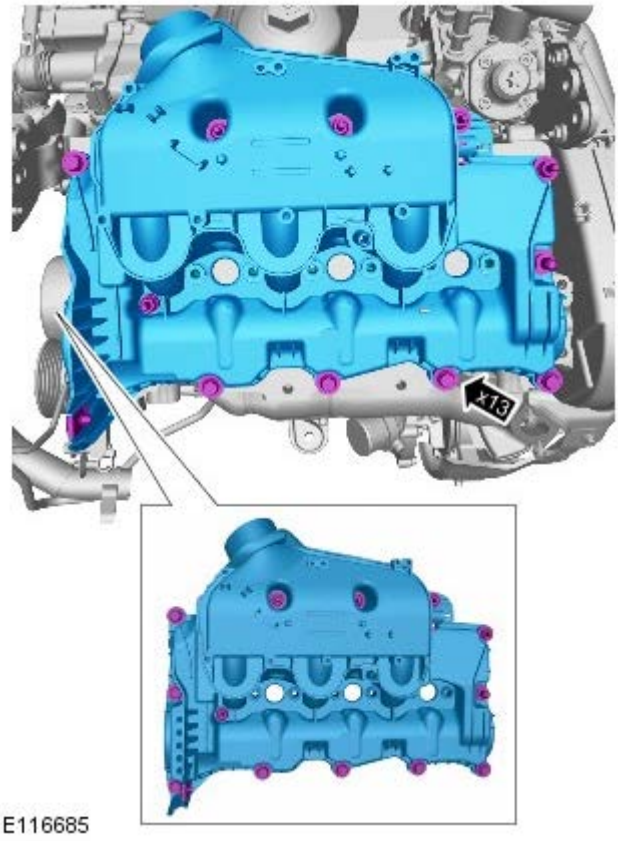


11.



12. *Torque:* 23 Nm





13. 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.

    NOTES:

    Install a new gasket.

    Some variation in the illustrations may occur, but the essential information is always correct.

    Torque: 10 Nm

Installation

1. To install, reverse the removal procedure.

Published: 13-Dec-2013

Engine - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Valve Cover RH

Removal and Installation

Special Tool(s)

	100-012 Slide Hammer
	310-213 Fuel Injector Removal Adapter

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).

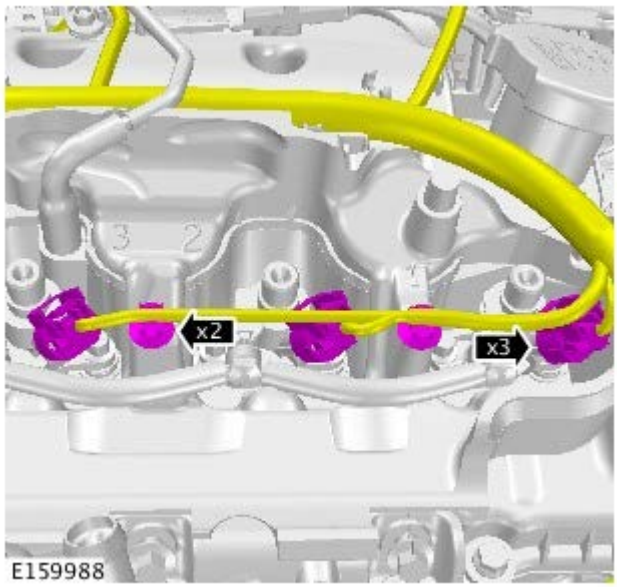
2. Raise and support the vehicle.

3. Refer to: Timing Cover (303-01A Engine - TDV6 3.0L Diesel, Removal and Installation).

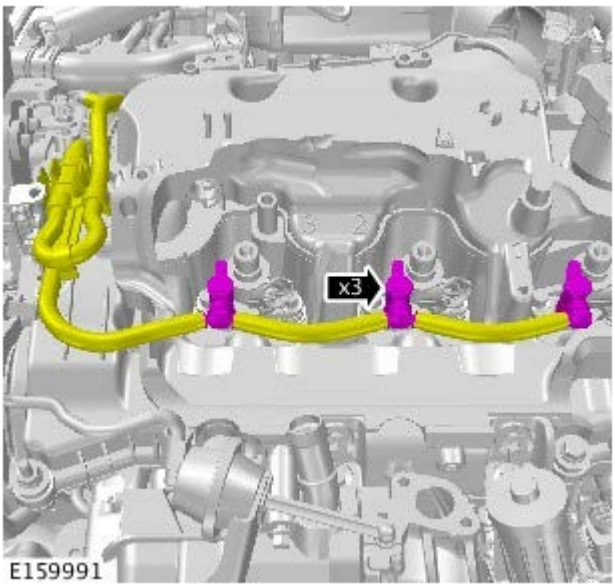
4. Refer to: Fuel Rail RH (303-04A Fuel Charging and Controls - TDV6 3.0L Diesel, Removal and Installation).

5. Refer to: Intake Air Shutoff Throttle (303-04A Fuel Charging and Controls - TDV6 3.0L Diesel, Removal and Installation).

6.

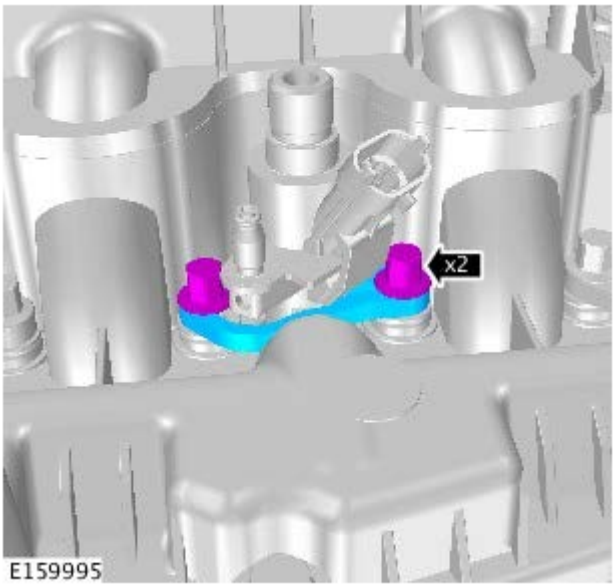


7. Refer to: Fuel Injection Component Cleaning (303-04A Fuel Charging and Controls - TDV6 3.0L Diesel, General Procedures).



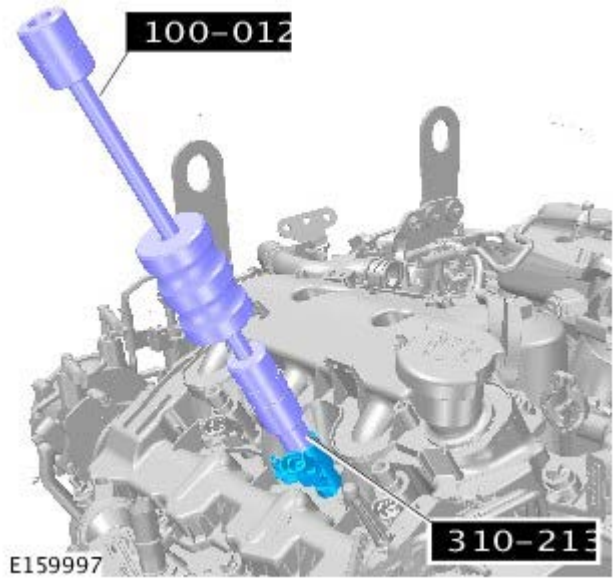
8. CAUTION: Be prepared to collect escaping fuel.

9.

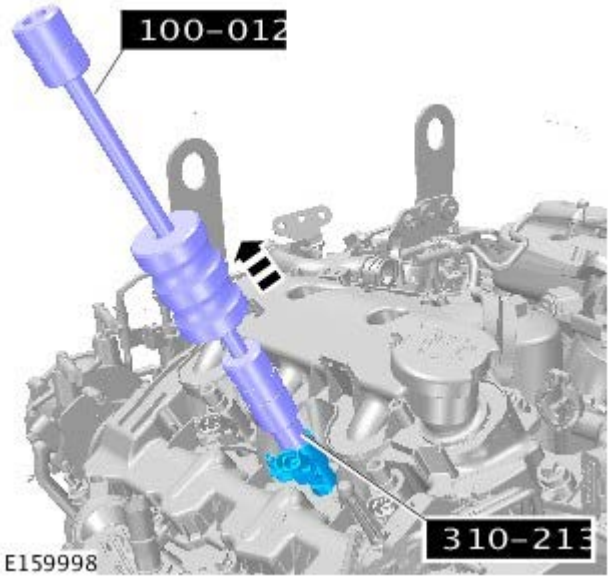


10. Install the special tool.

Special Tool(s): 100-012, 310-213

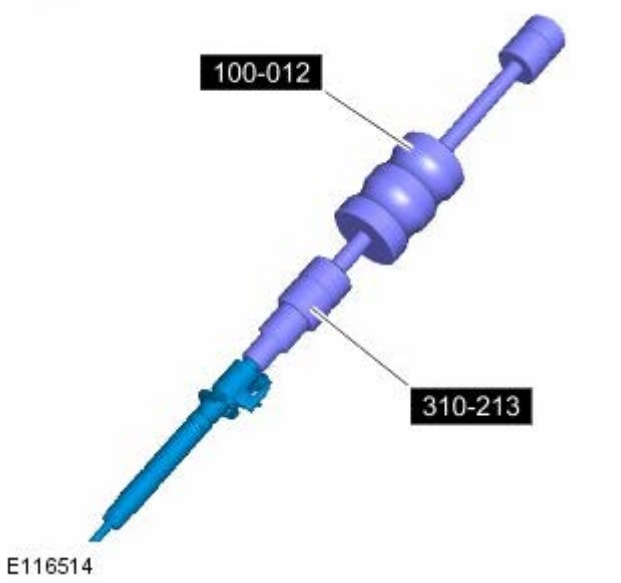


11. *Special Tool(s):* 100-012, 310-213

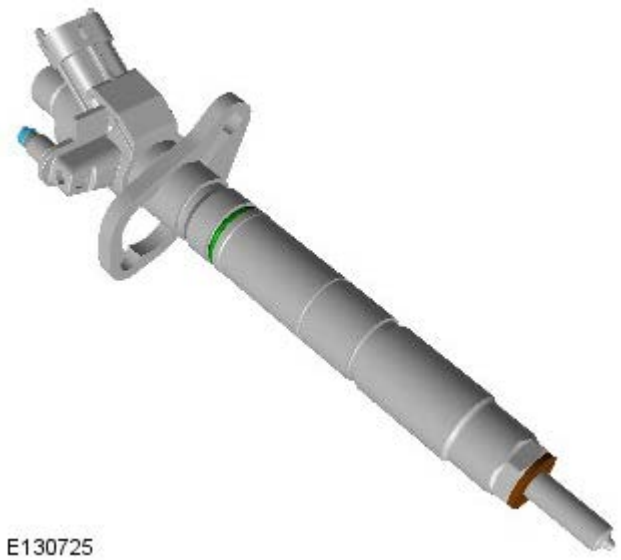


12. Remove the special tool.

    Special Tool(s): 100-012, 310-213



13. Remove the 2 remaining fuel injectors.



14. NOTES:

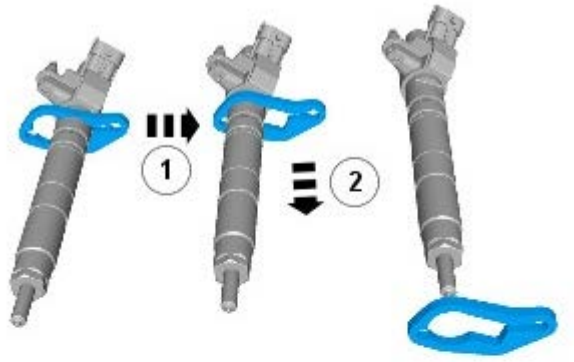
    This step is only required if new components have not been installed.

    Remove and discard the O-ring seals.

    Discard the sealing washers.

    Repeat this step for each of the fuel injectors.

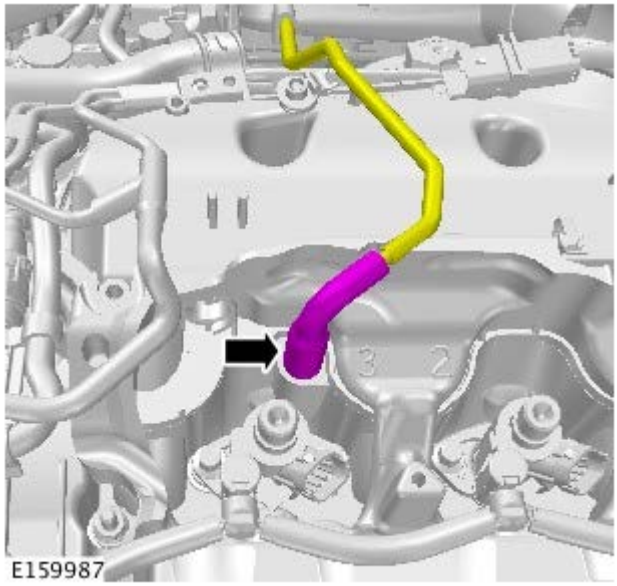
15. NOTE: This step is only required if new components have not been installed.



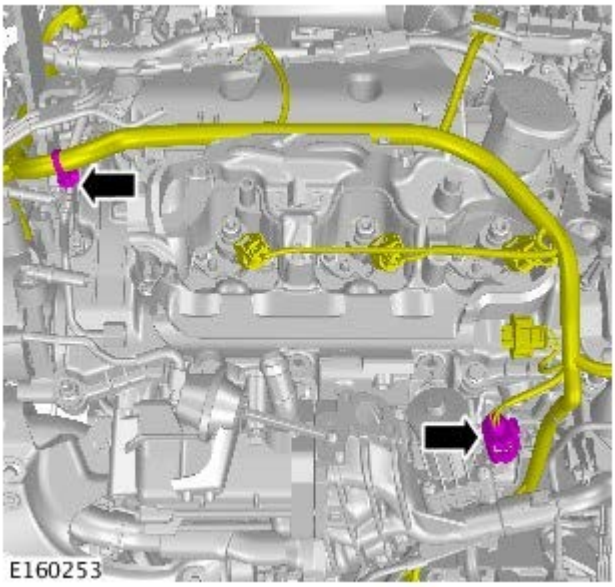


E144699

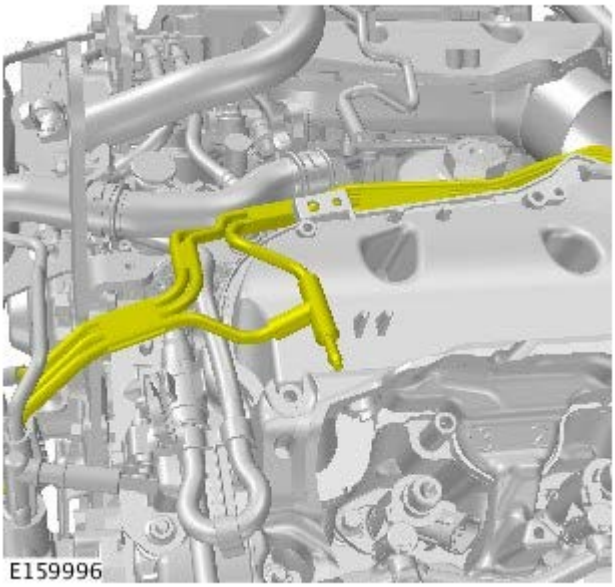
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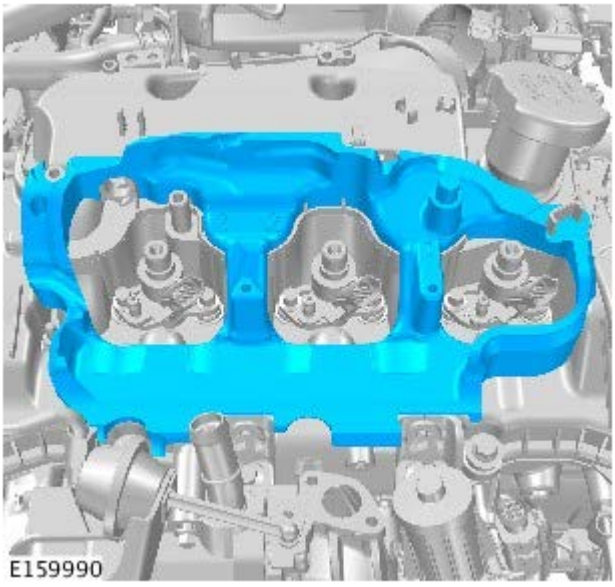
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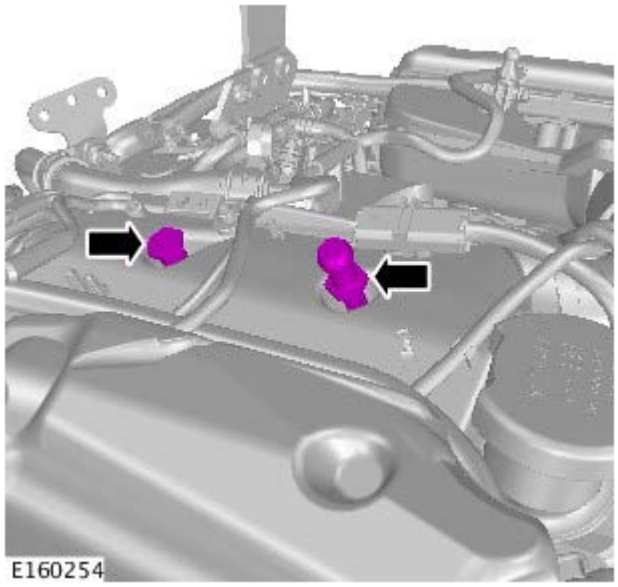
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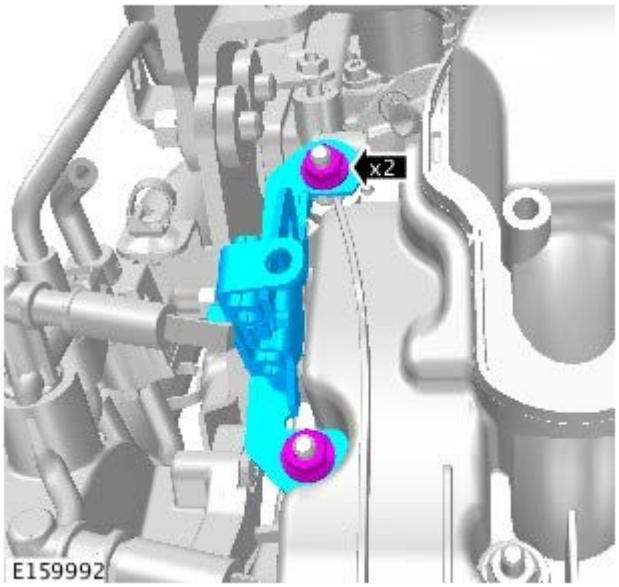
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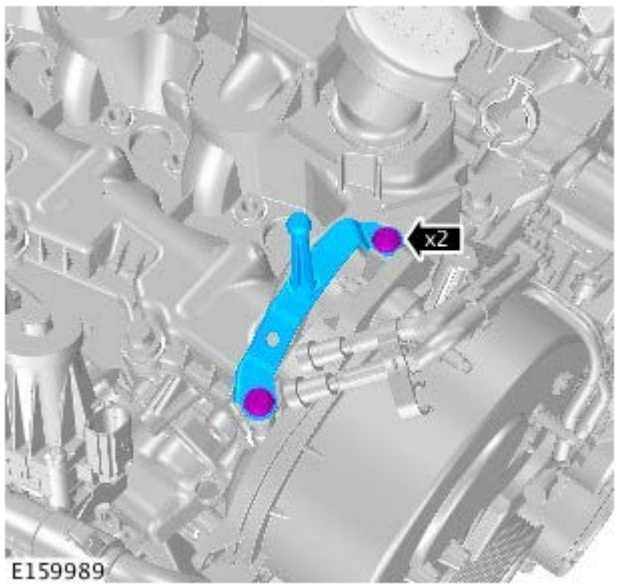
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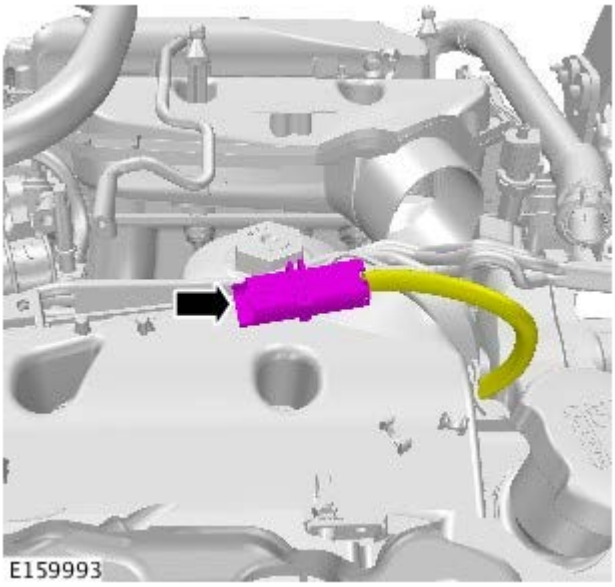
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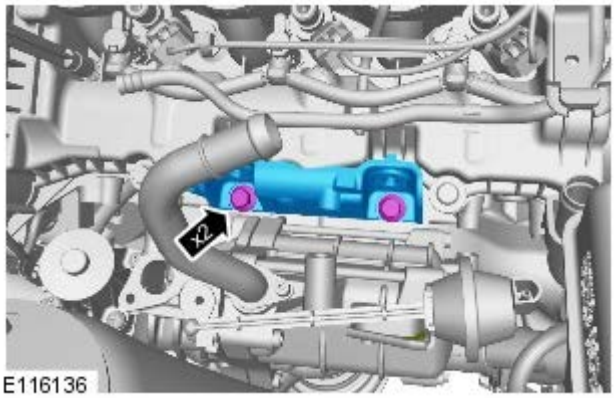
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23.



24.

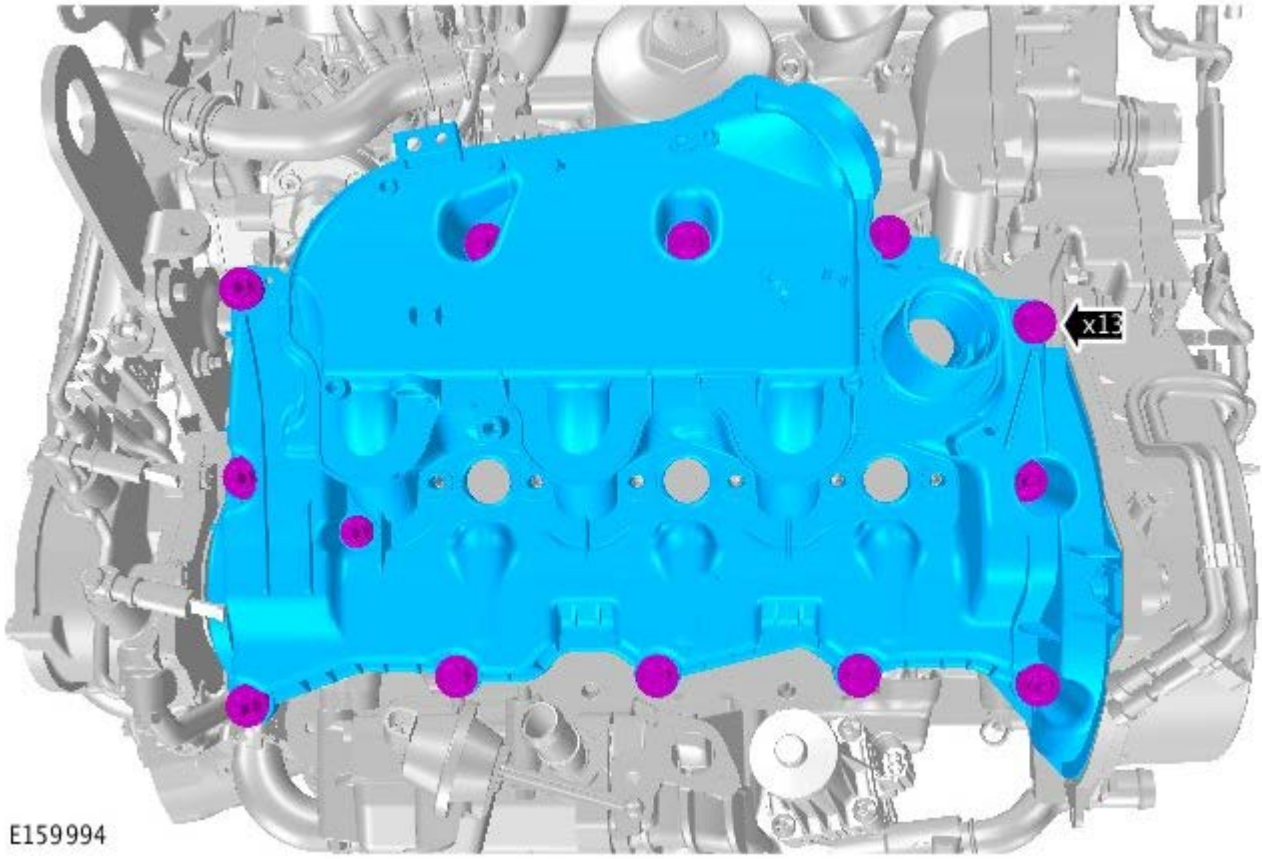


25. CAUTION: Make sure that the mating faces are clean and free of corrosion and foreign material.

NOTES:

Discard the gasket.

Some variation in the illustrations may occur, but the essential information is always correct.



Installation

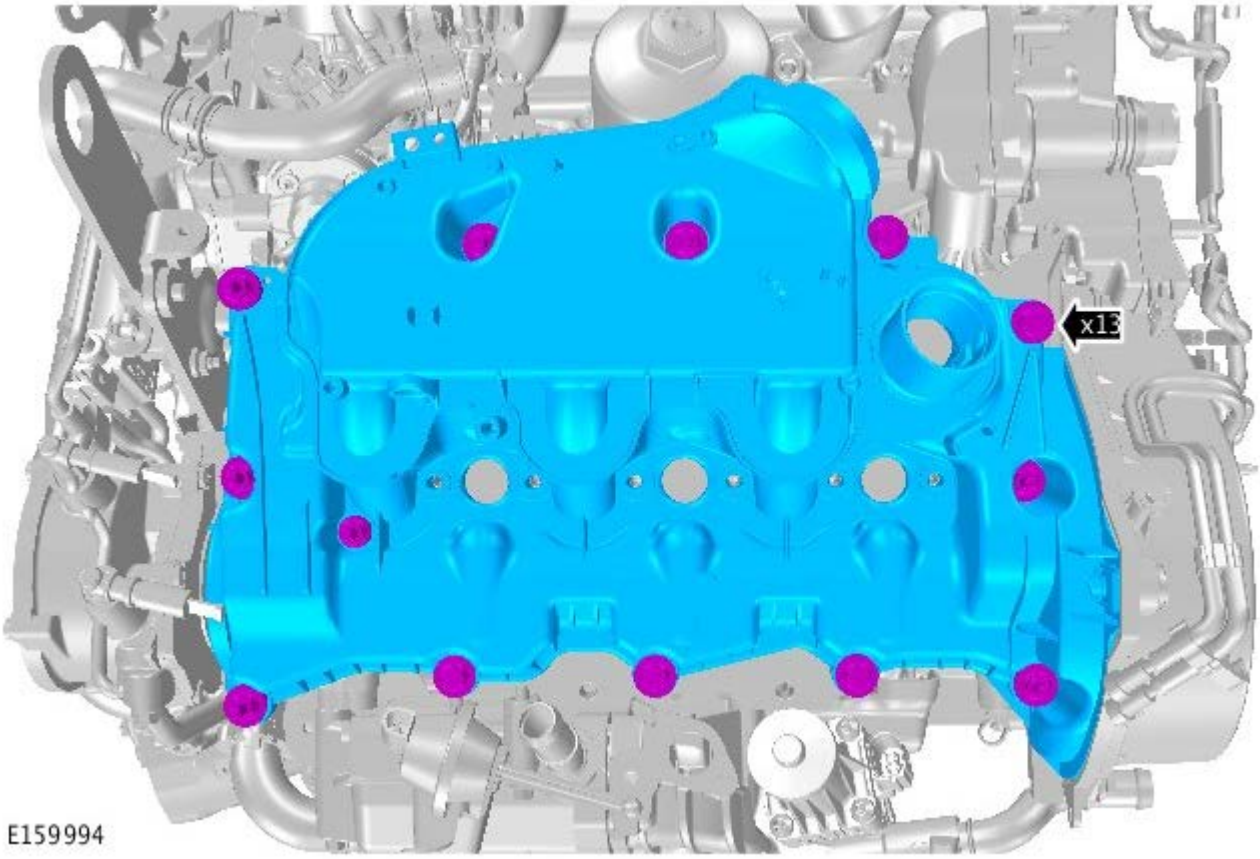
1. CAUTIONS:

   Make sure that the mating faces are clean and free of corrosion and foreign material.

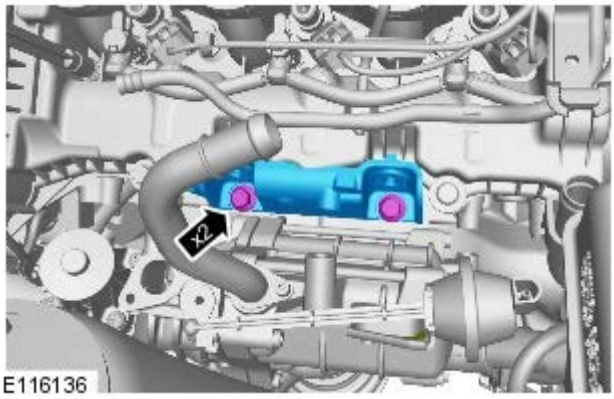
   Install all the bolts finger tight before final tightening.

   NOTE: Install a new gasket.

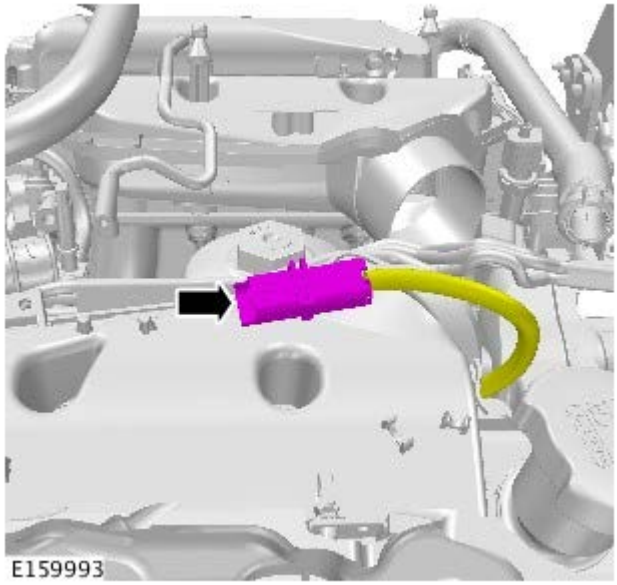
   Torque: 10 Nm



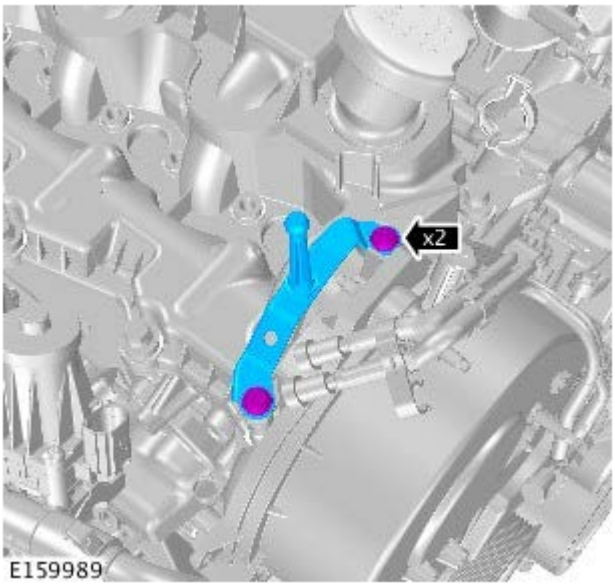
2. *Torque:* 24 Nm



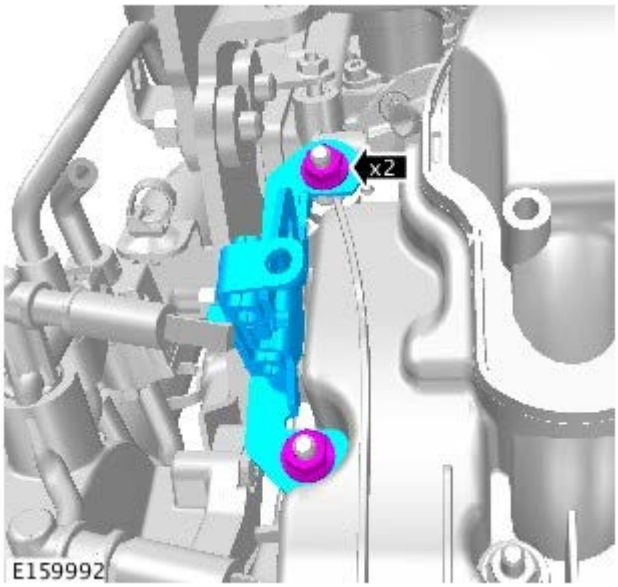
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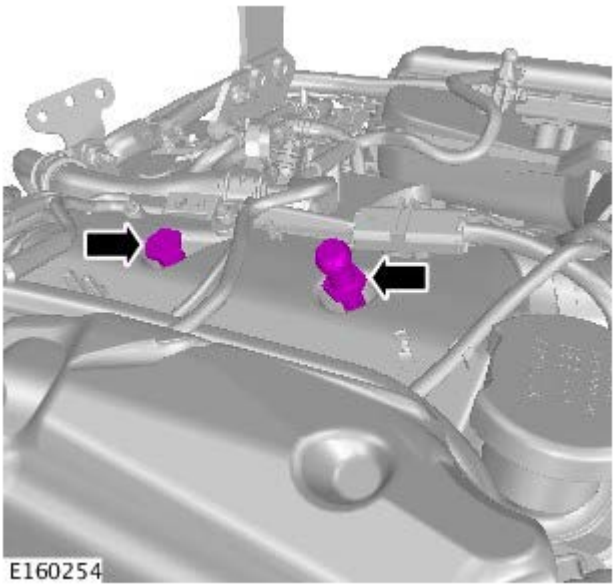
4. *Torque:* 9 Nm



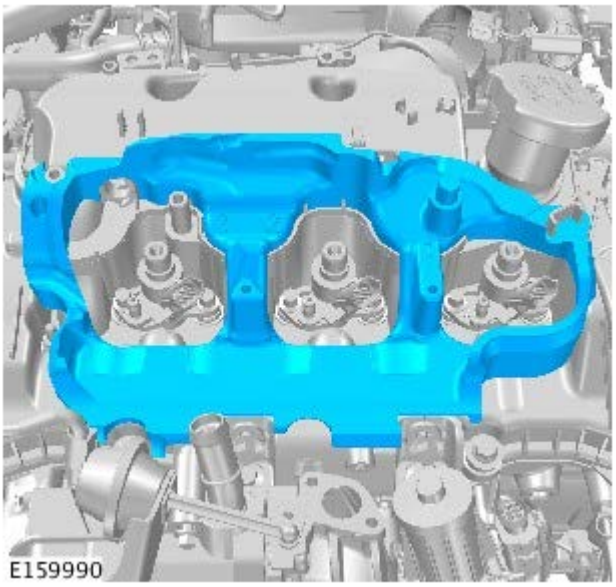
5. *Torque:* 9 Nm



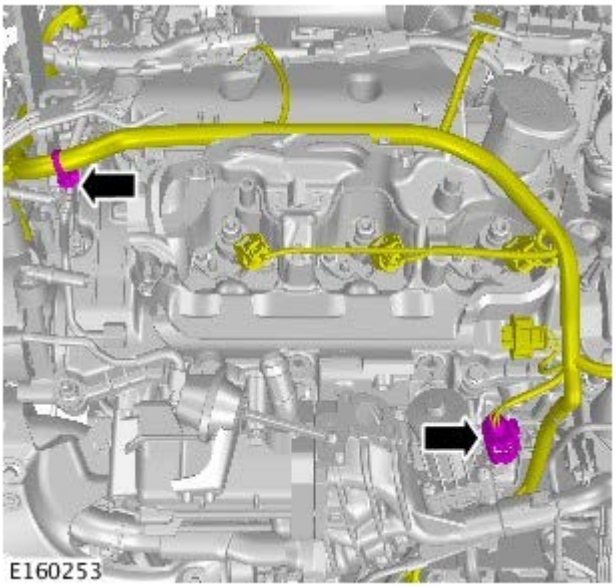
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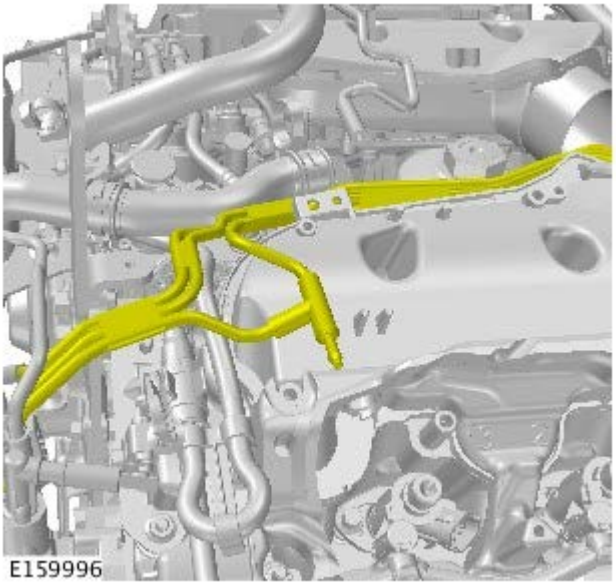
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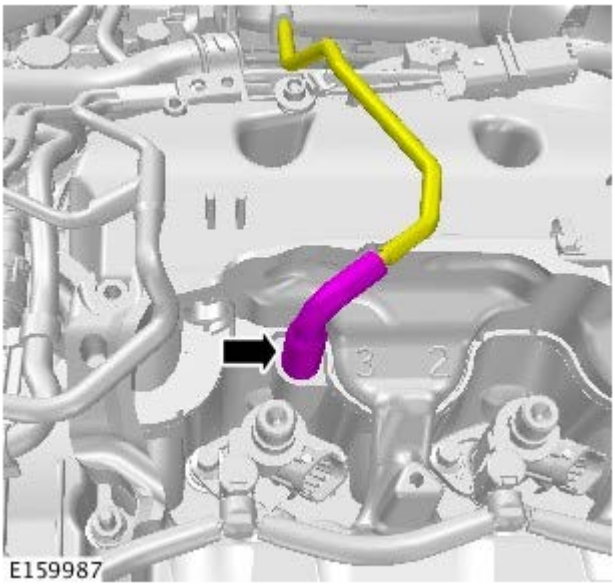
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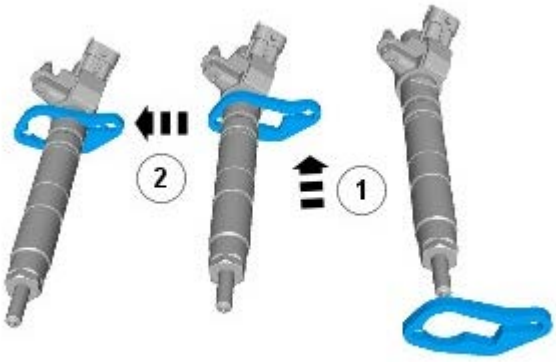


9.



10.







11. NOTE: This step is only required if previously removed.

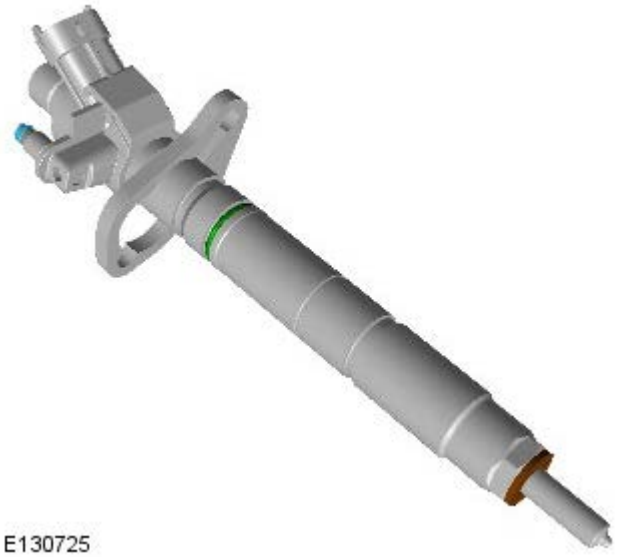
12. CAUTION: Make sure that new sealing washers are installed.

    NOTES:

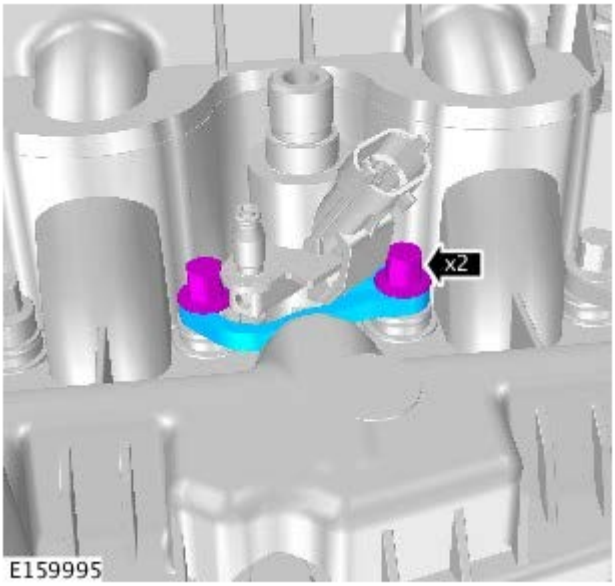
    This step is only required if new components are not installed.

    Install new O-ring seals.

    Repeat this step for each of the fuel injectors.



E130725

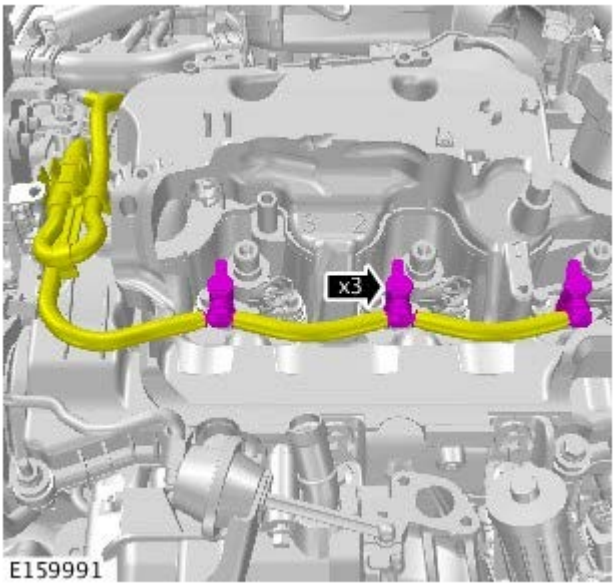


E159995

13. 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.

NOTE: Tighten the retaining bolts evenly and progressively.

Torque: 9 Nm



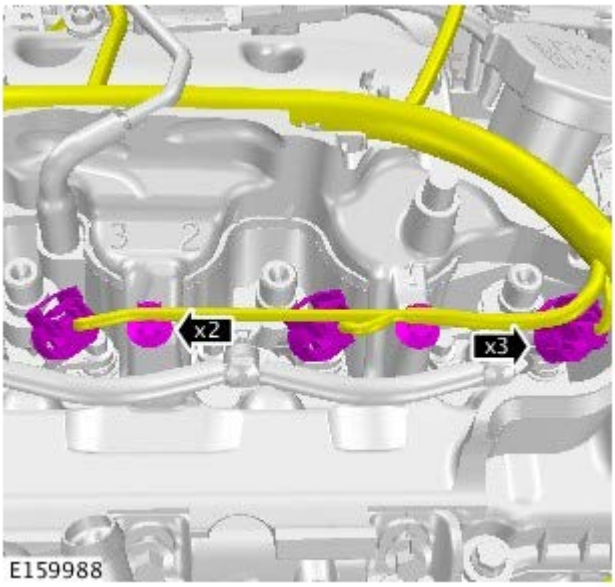
E159991

14. CAUTION: Be prepared to collect escaping fuel.

NOTE: Make sure that the fuel injector return line has a maximum of 8 uses.

15. Install the 2 remaining fuel injectors.

16.



17. Refer to: Intake Air Shutoff Throttle (303-04A Fuel Charging and Controls - TDV6 3.0L Diesel, Removal and Installation).

18. Refer to: Fuel Rail RH (303-04A Fuel Charging and Controls - TDV6 3.0L Diesel, Removal and Installation).

19. Refer to: Timing Cover (303-01A Engine - TDV6 3.0L Diesel, Removal and Installation).

20. Connect the battery ground cable

    Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 06-Sep-2013

Engine - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Dual Mass Flywheel

Removal and Installation

Removal

NOTES:

Some variation in the illustrations may occur, but the essential information is always correct.

Component shown removed for clarity.

1. Refer to: Transmission (307-01B Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed - Hybrid Electric Vehicle - Automatic Transmission – AWD, Removal).



E159641

2. CAUTIONS:

   It is essential that absolute cleanliness is observed when working on the hybrid drive assembly. Always cover any open orifices using lint free non-flocking material to prevent the ingress of foreign matter. Failure to follow this instruction may result damage to the components.

   Discard the component.

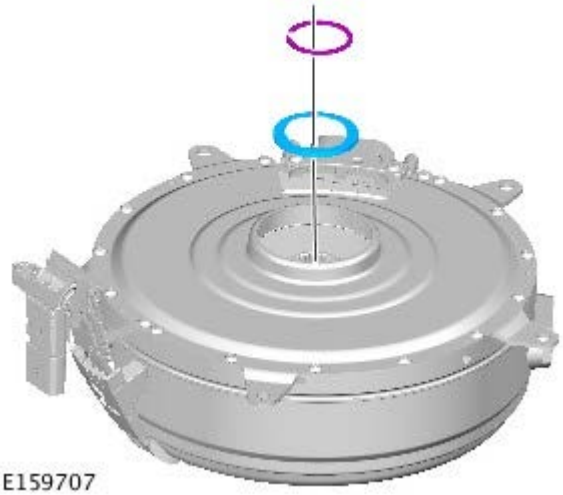


E159610

3. CAUTION: Remove the bolts in the indicated sequence.

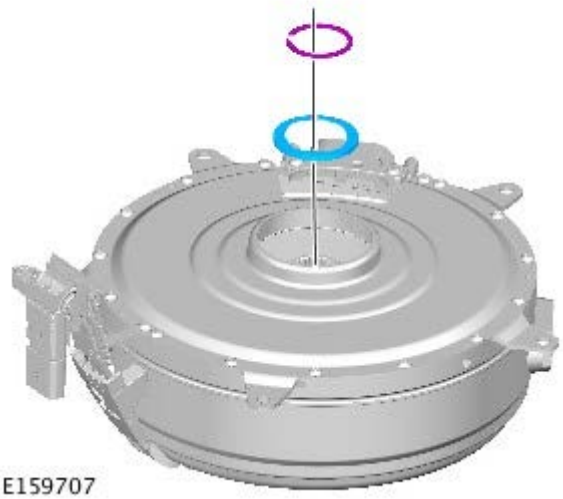
   NOTE: This step requires the aid of another technician.

4. CAUTION: Discard the components.


E159707

Installation

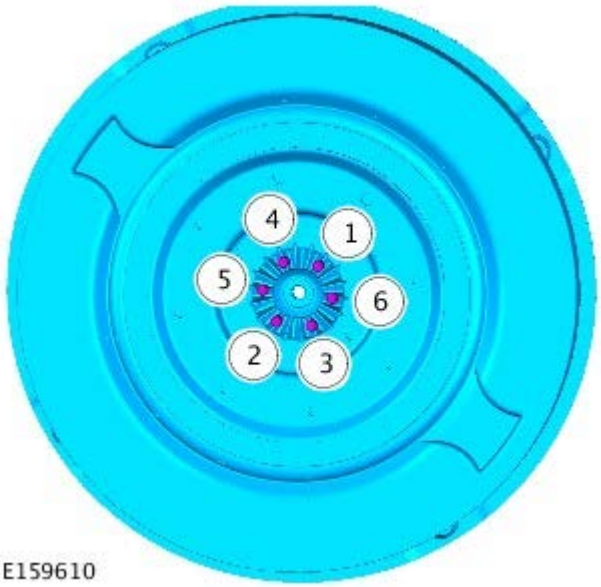
1. CAUTION: Make sure that new components are installed.


E159707

2. CAUTION: Tighten the bolts in the sequence shown.

   NOTE: This step requires the aid of another technician.

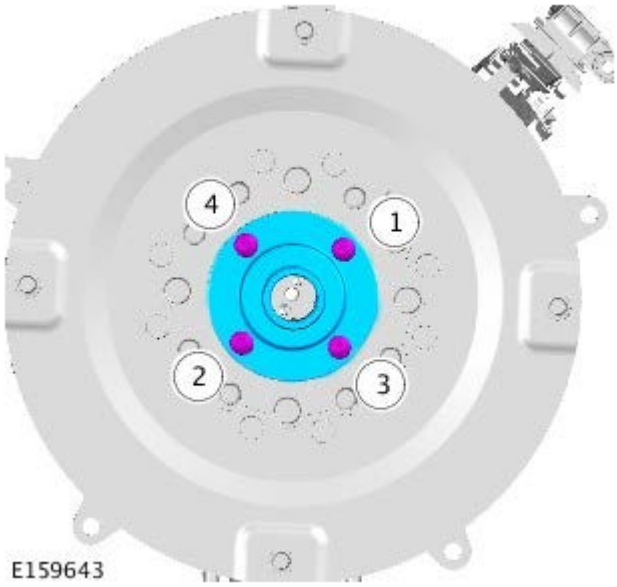
   Torque: 15 Nm



E159610

3. CAUTIONS:

   Make sure that a new component is installed.



Tighten the bolts in the sequence shown.

Torque: 15 Nm

4. NOTE: Make sure that the hybrid drive assembly is fully engaged to the transmission.



5. Refer to: Transmission (307-01B Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed - Hybrid Electric Vehicle - Automatic Transmission – AWD, Installation).

Published: 06-Sep-2013

Engine - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Engine

Removal

Special Tool(s)

 303-021	303-021 Engine support bracket

WARNING: This procedure can only be carried out after the vehicle has been decommissioned, by an approved person.

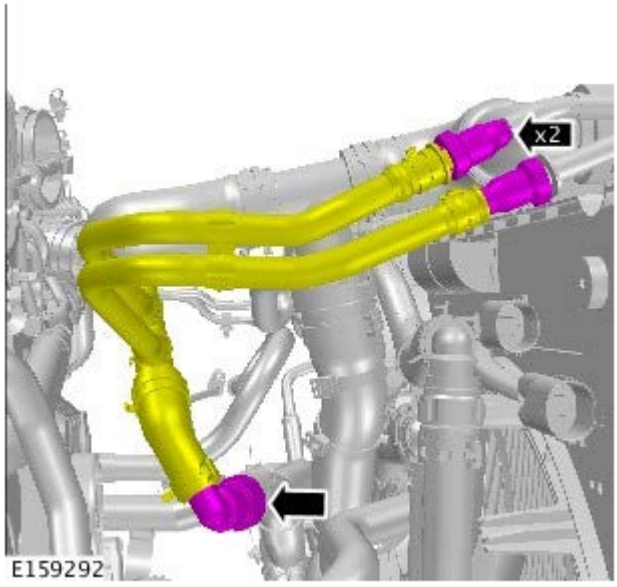
CAUTION: Make sure that all openings are sealed. Use new blanking caps.

NOTES:

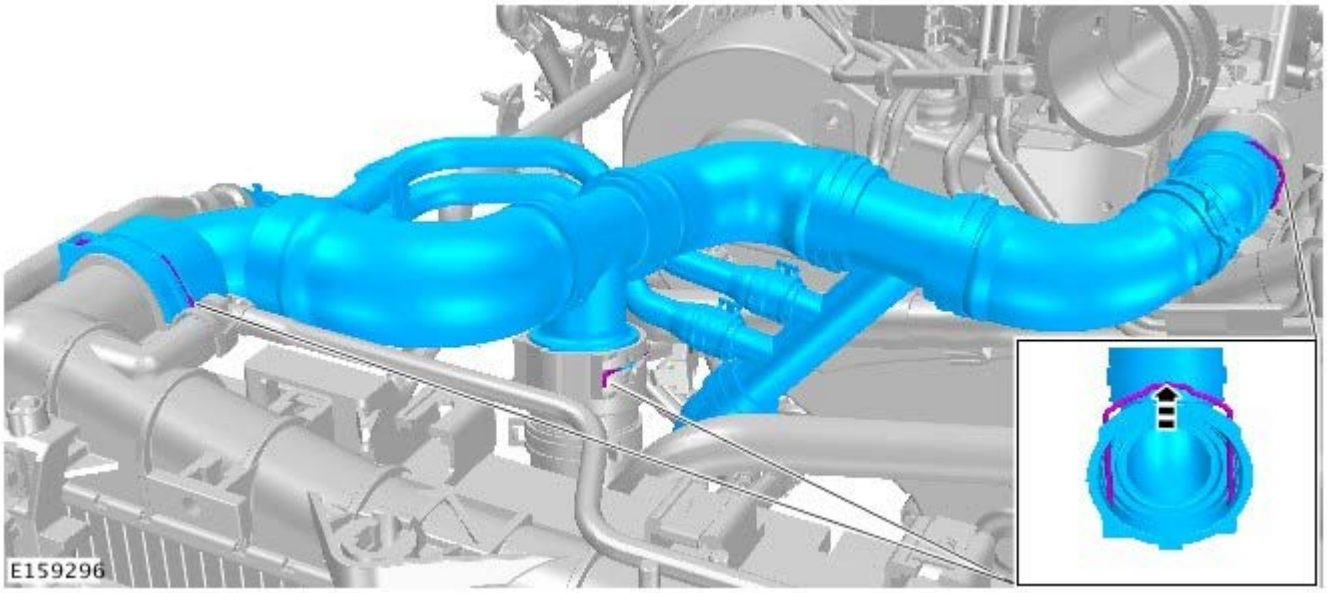
Removal steps in this procedure may contain installation details.

Some variation in the illustrations may occur, but the essential information is always correct.

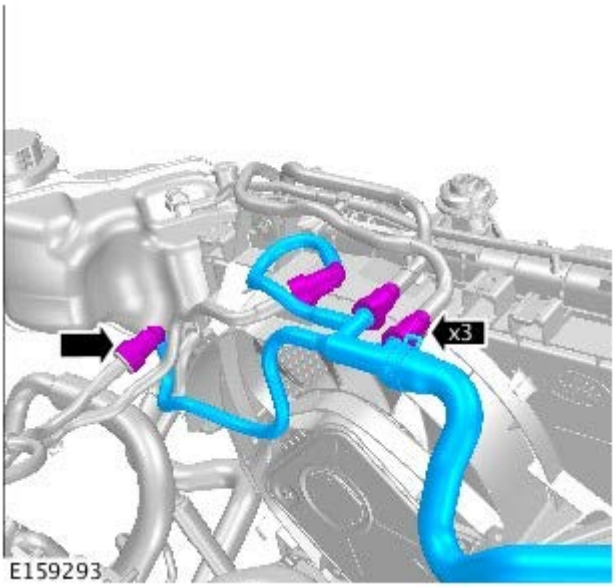
1. Refer to: Hybrid Electric Vehicle (HEV) Decommission (414-01, General Procedures).
2. Refer to: Hood (501-02, Removal and Installation).
3. Refer to: Cooling System Partial Draining, Filling and Bleeding (303-03G Engine Cooling - SDV6 3.0L Diesel - Hybrid Electric Vehicle, General Procedures).
4. Refer to: Secondary Bulkhead Center Panel - TDV6 3.0L Diesel (501-02, Removal and Installation).
5. Refer to: Intake Air Shutoff Throttle (303-04A Fuel Charging and Controls - TDV6 3.0L Diesel, Removal and Installation).
6. CAUTION: Be prepared to collect escaping coolant.



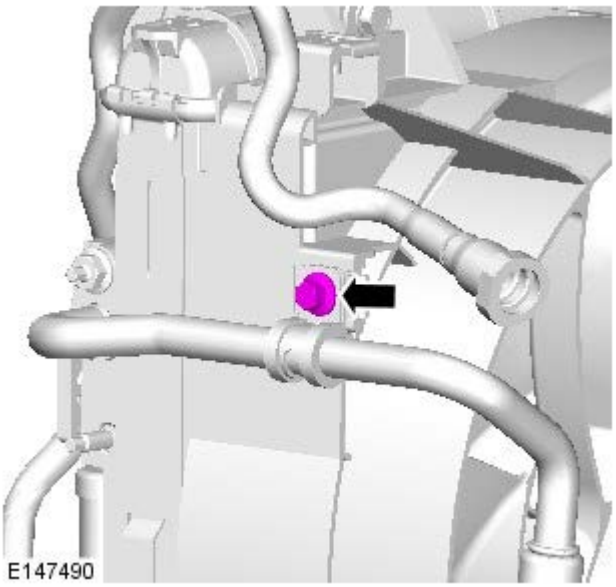
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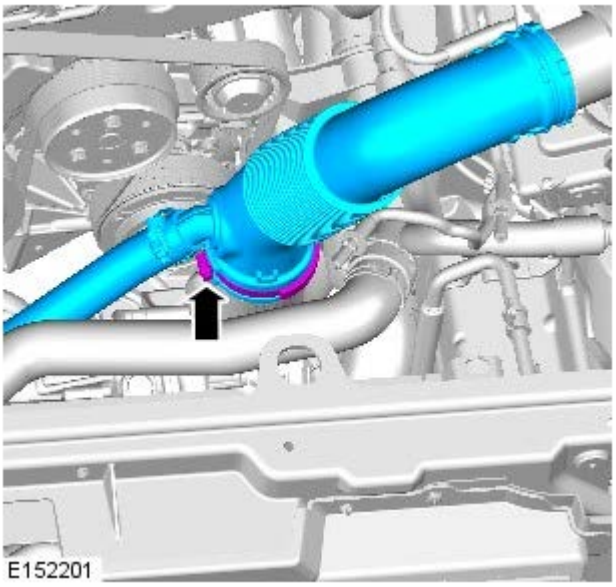
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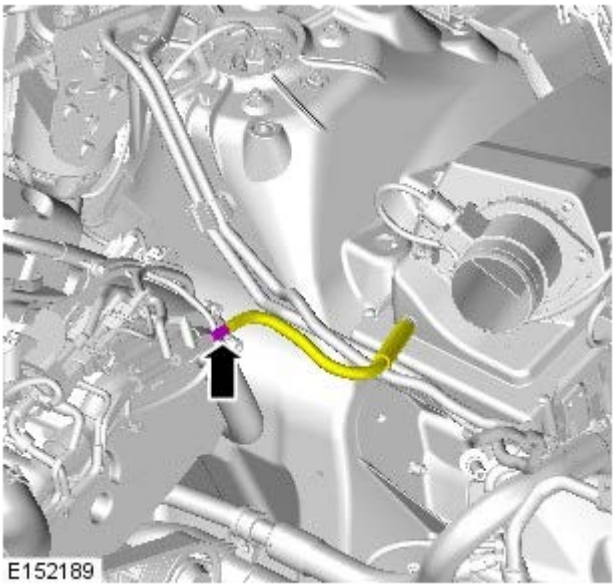
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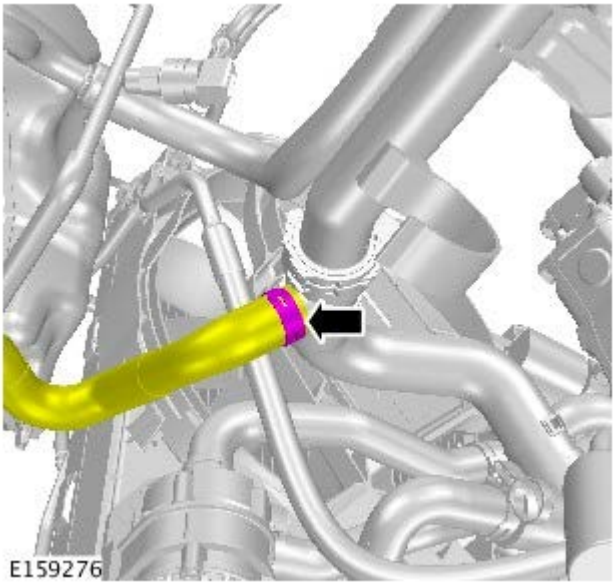
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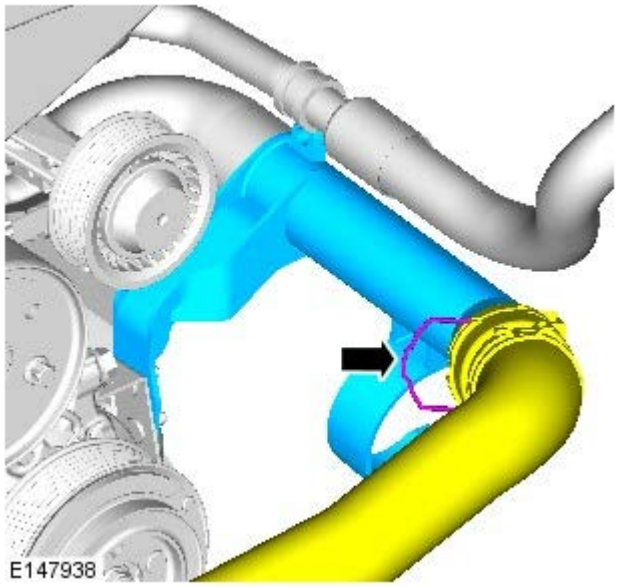
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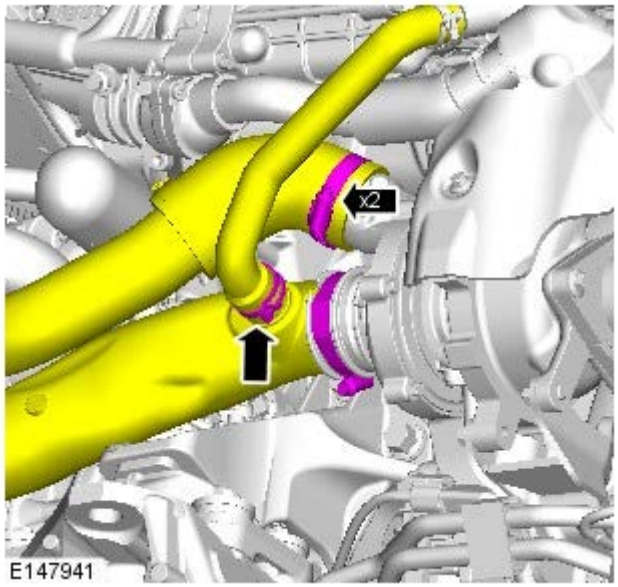
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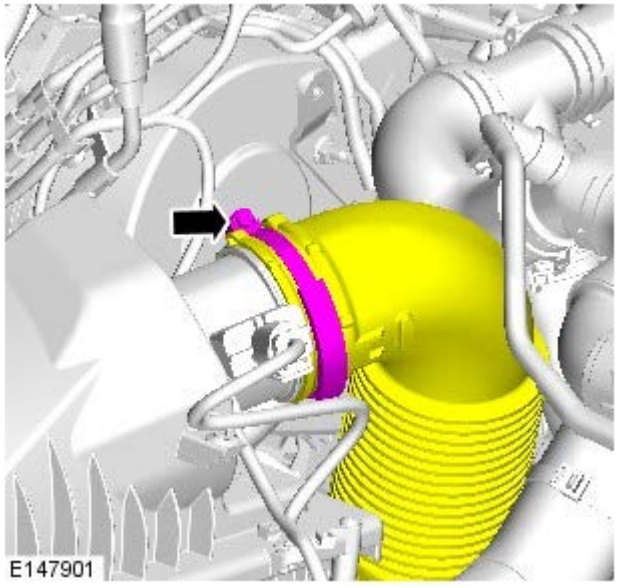
13. CAUTION: Be prepared to collect escaping coolant.



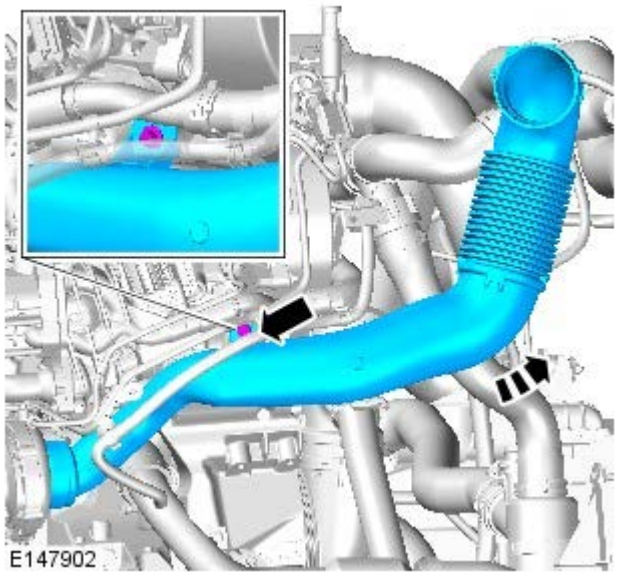
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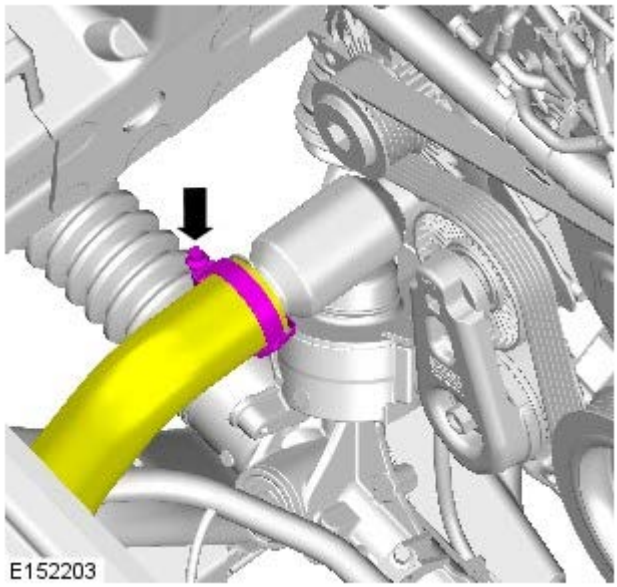
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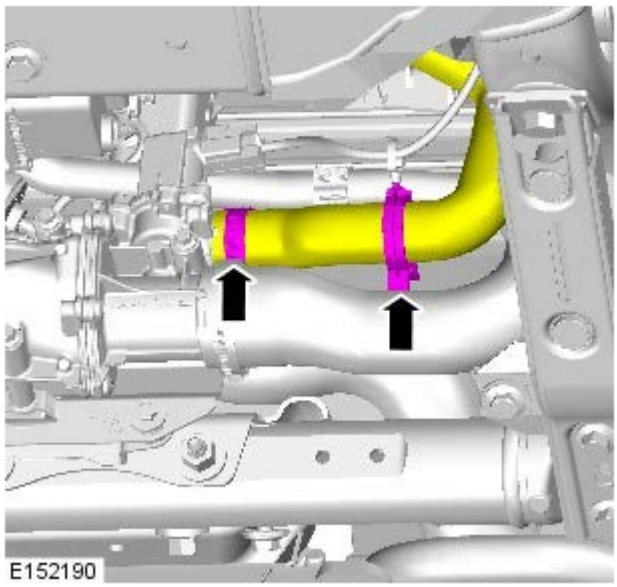
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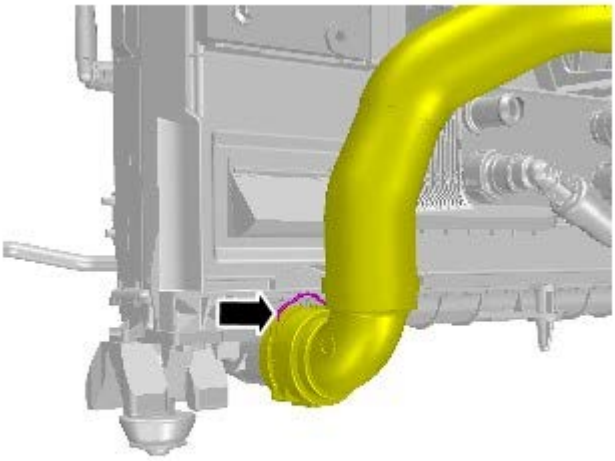
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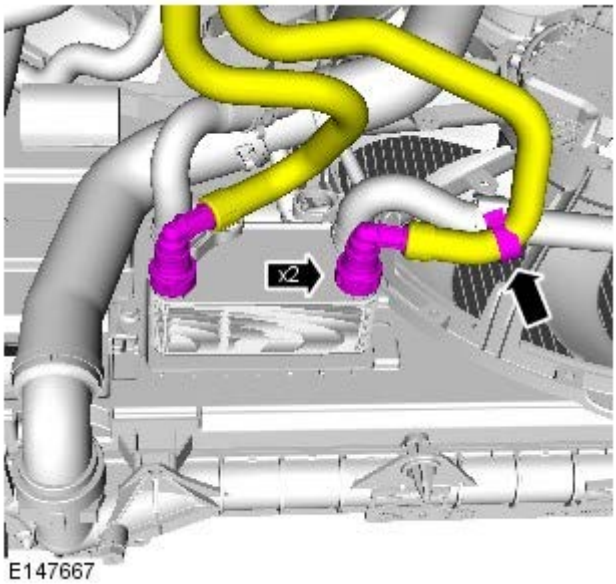
18.



19. CAUTION: Be prepared to collect escaping coolant.



E159277

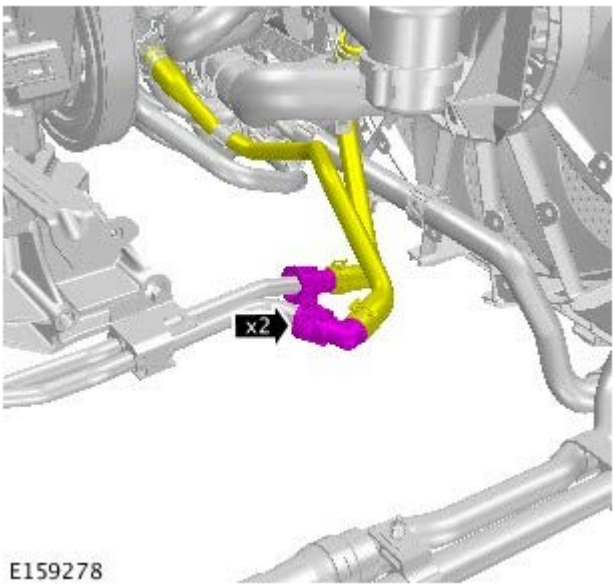


E147667

20. CAUTIONS:

    Be prepared to collect escaping fluids.

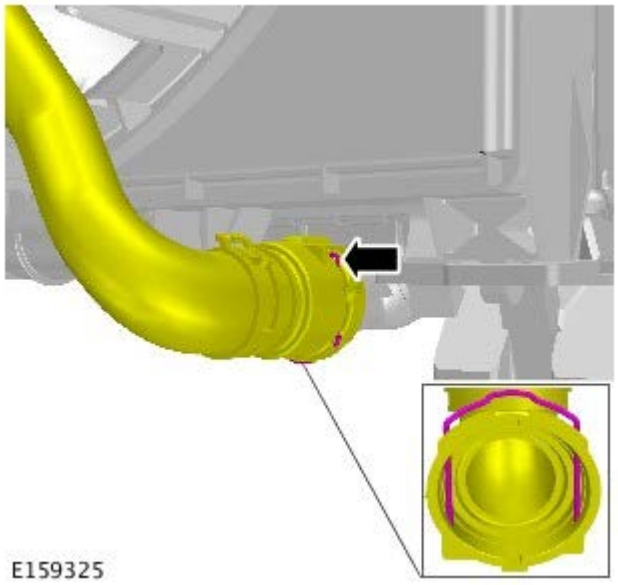
    Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean and dry. Plug open connections to prevent contamination.



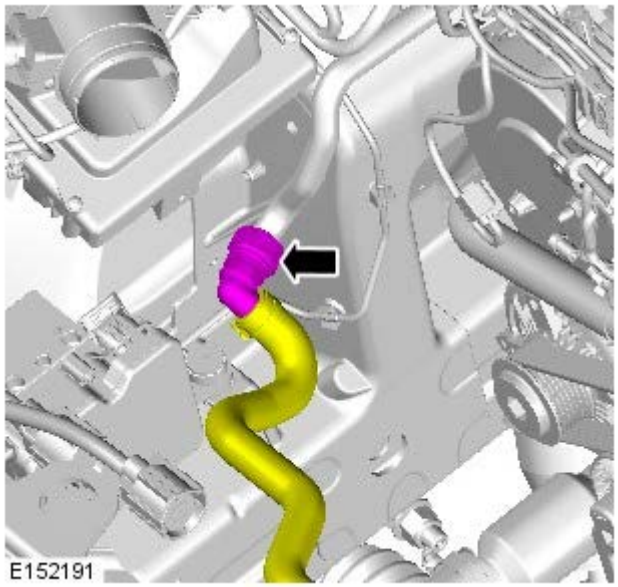
E159278

21. CAUTION: Be prepared to collect escaping coolant.

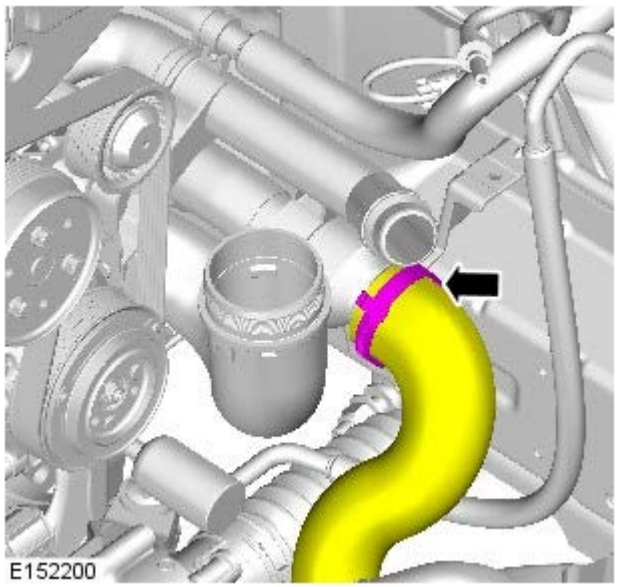
22. CAUTION: Be prepared to collect escaping coolant.



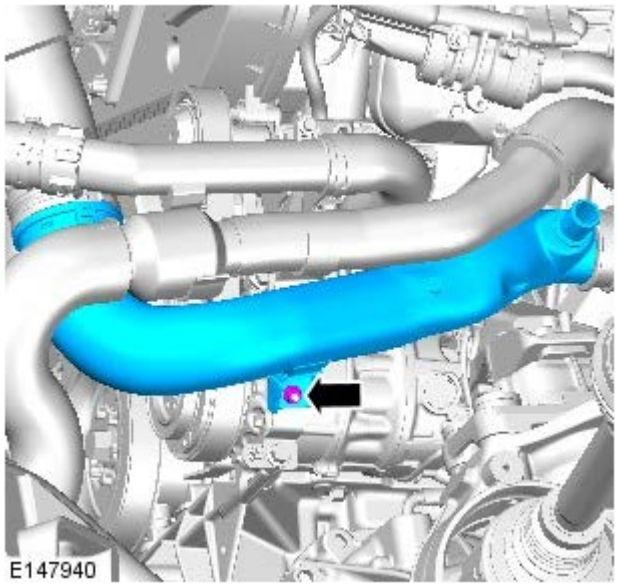
23.



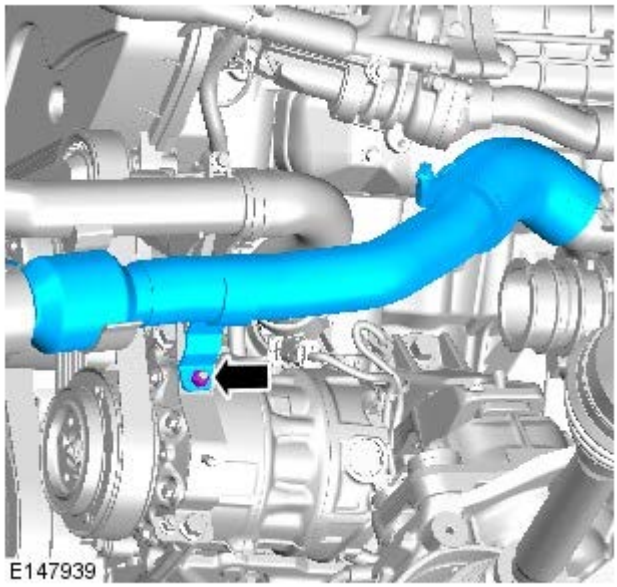
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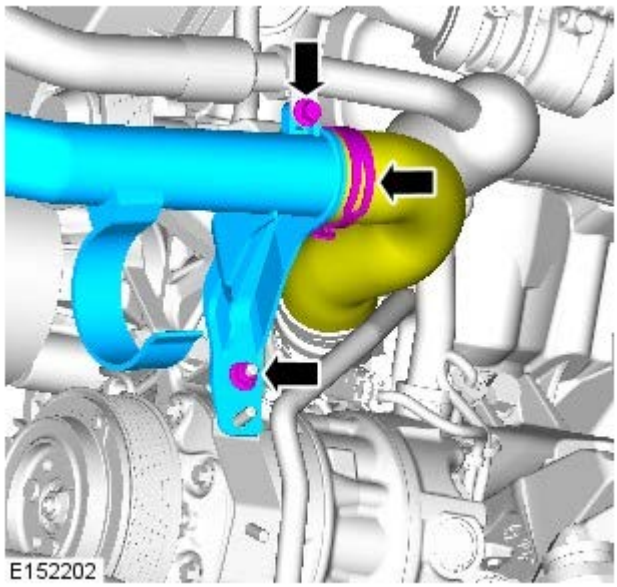
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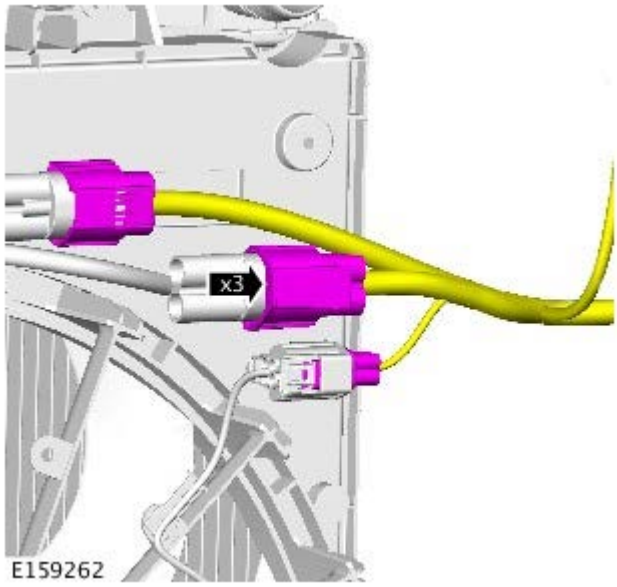
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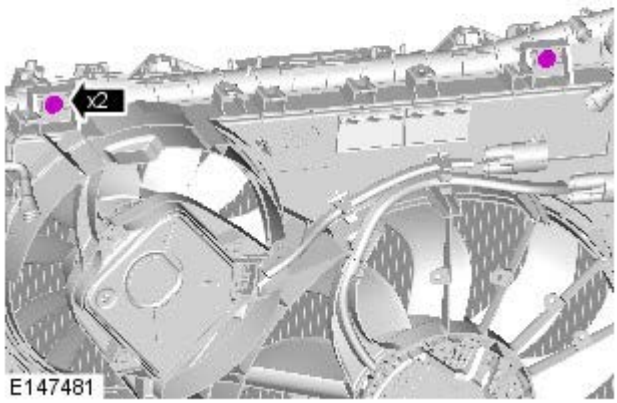
27. CAUTION: Be prepared to collect escaping coolant.



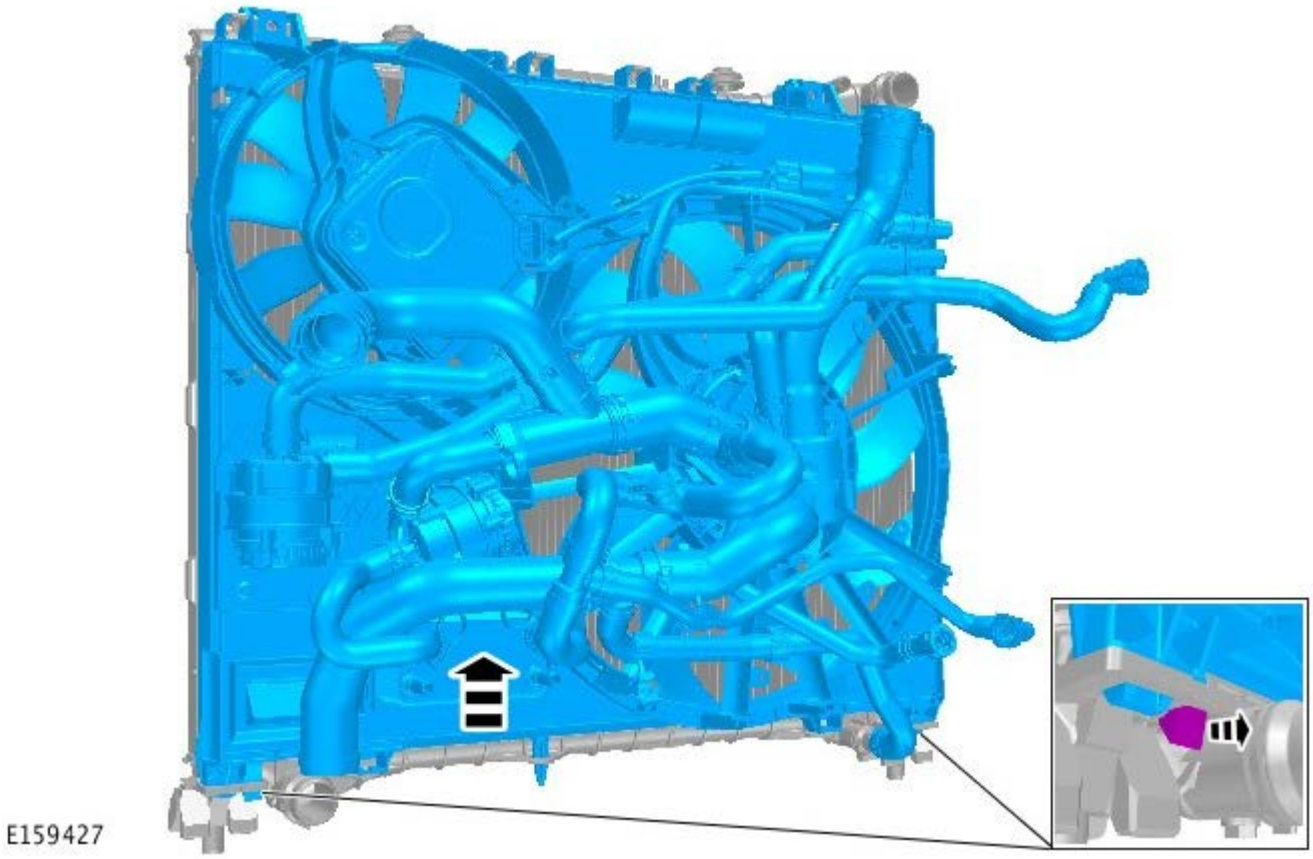
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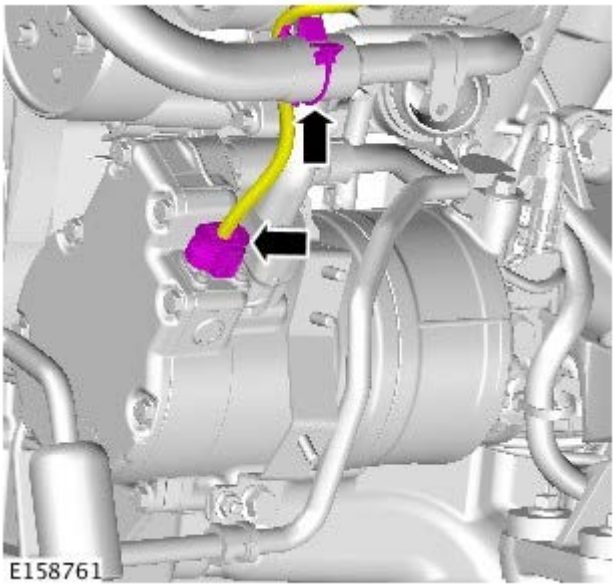
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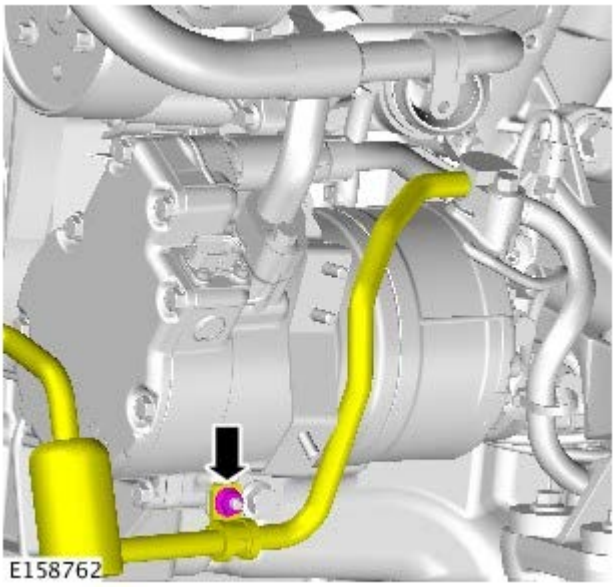
30. CAUTION: Take extra care not to damage the surrounding components.



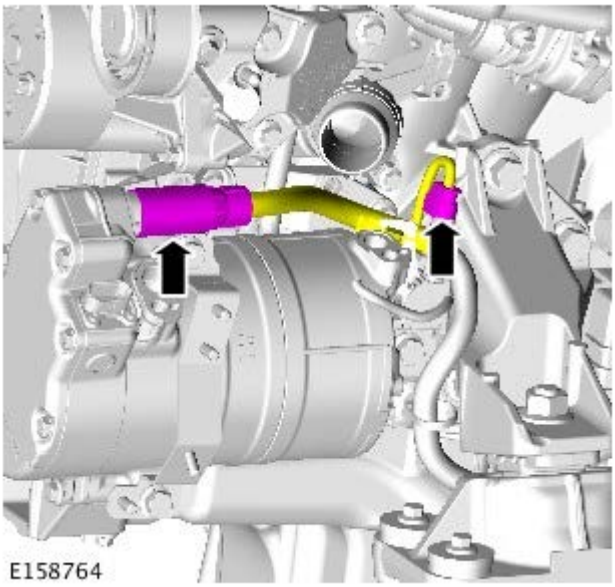
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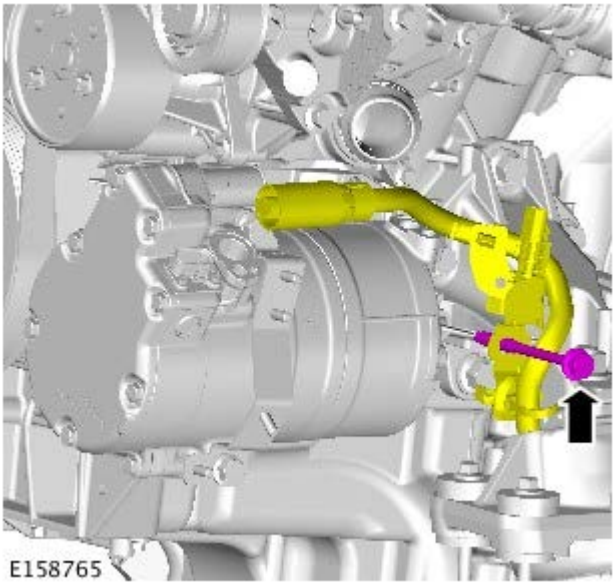
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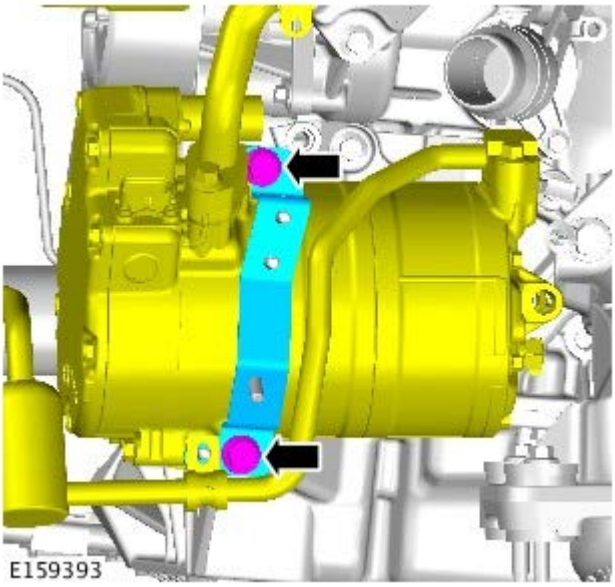
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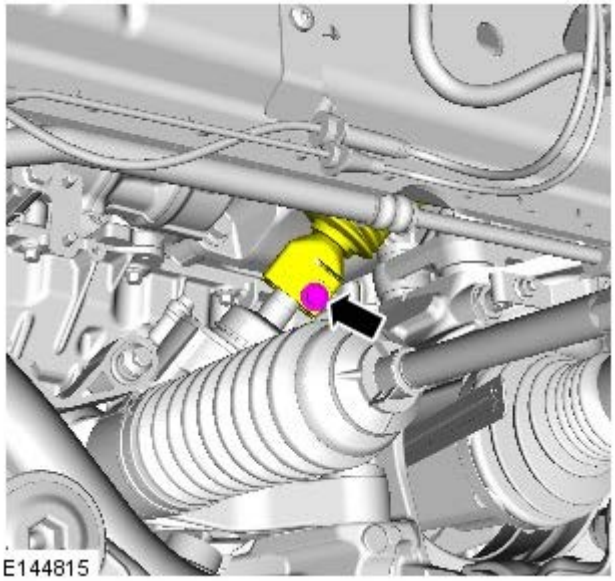


34.



35.



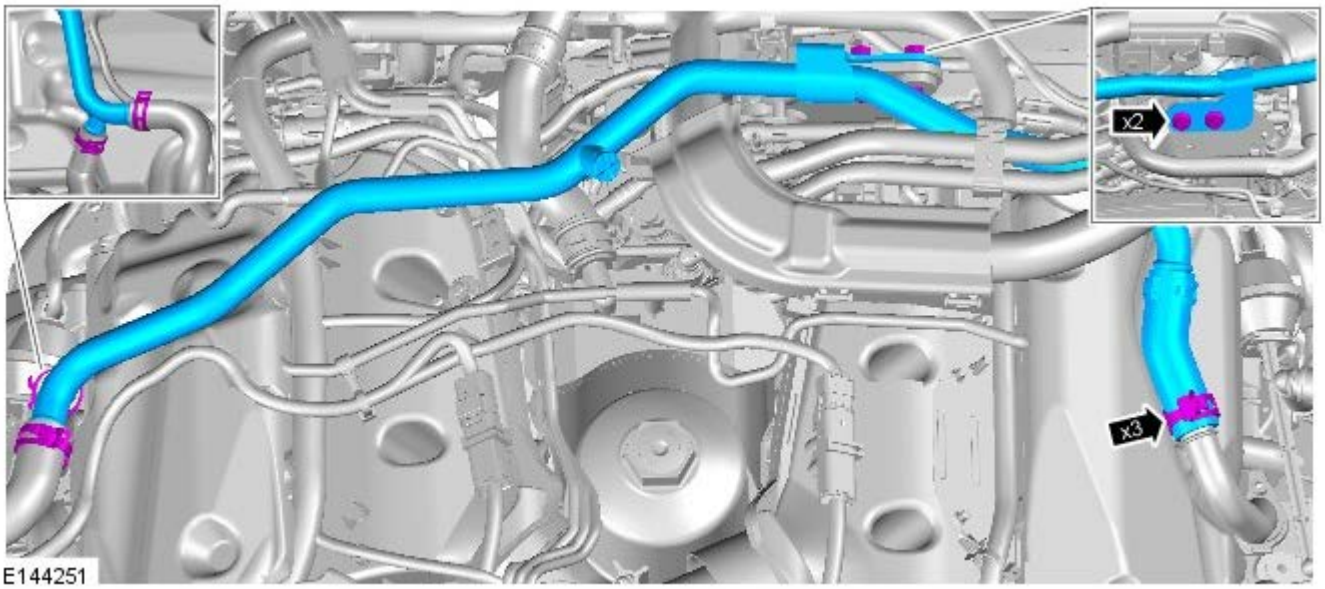


36. CAUTION: Discard the bolt.

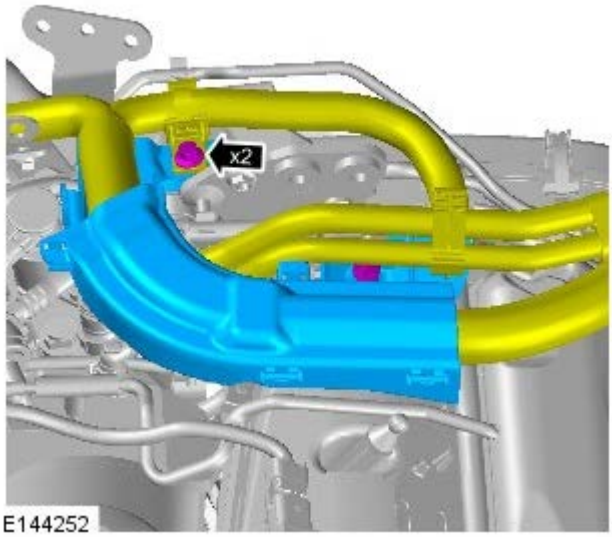
NOTE: RHD shown, LHD is similar.

Align the steering wheel to straight ahead.

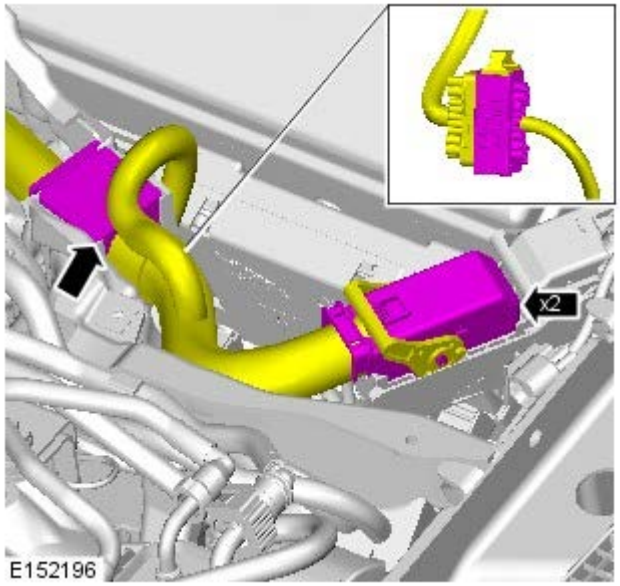
37. CAUTION: Be prepared to collect escaping coolant.



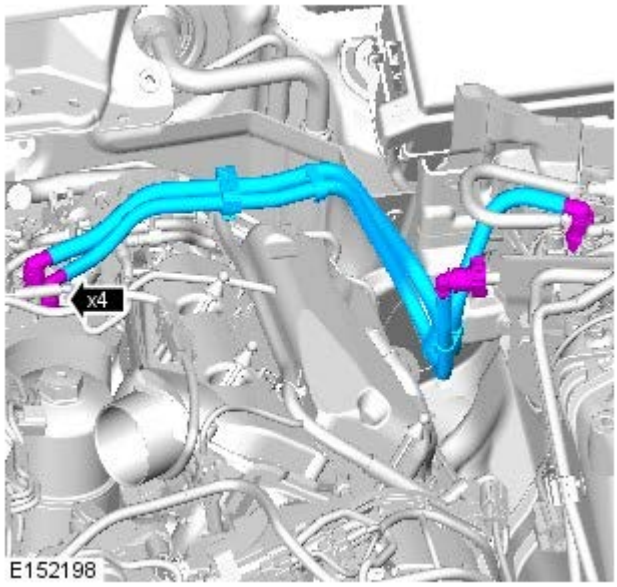
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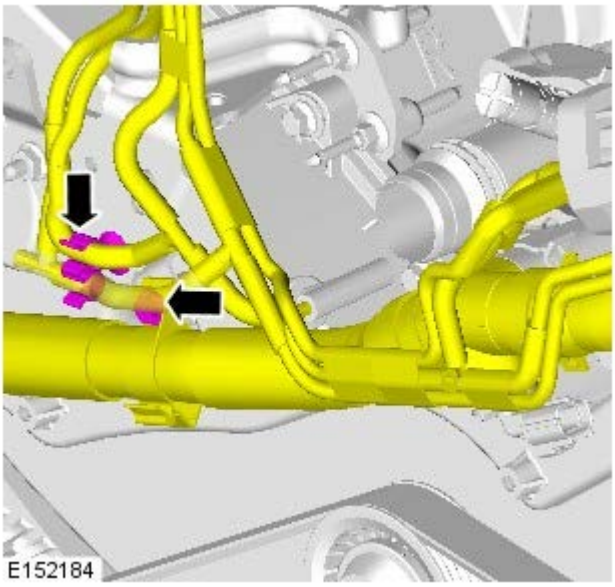
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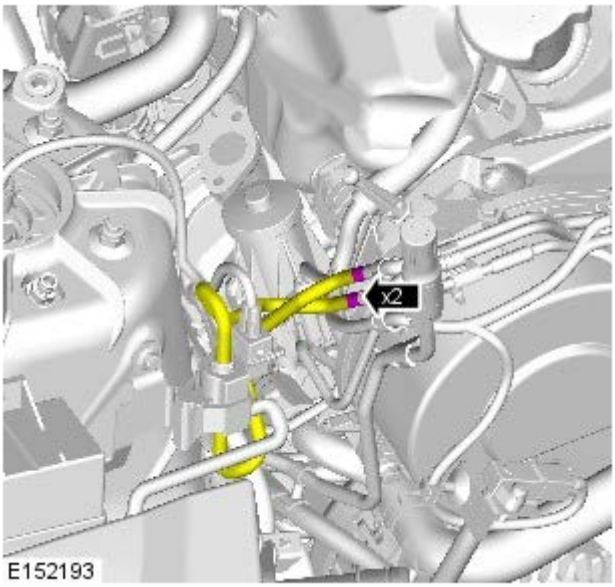
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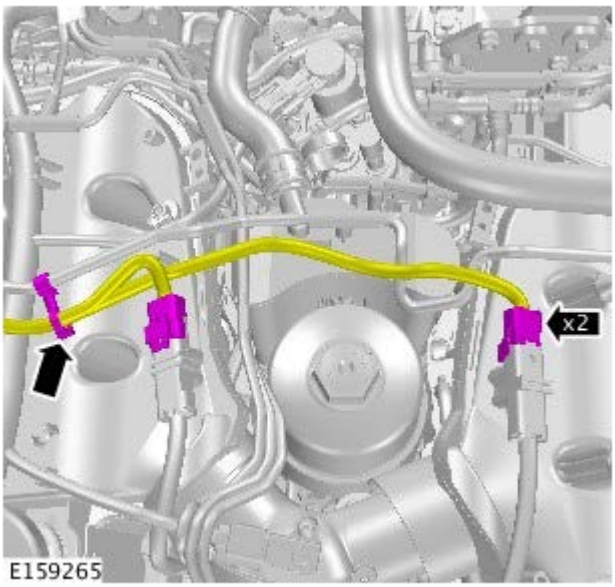
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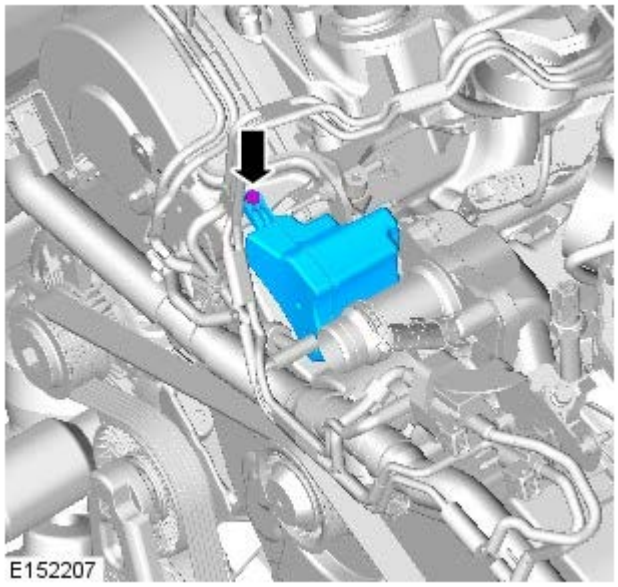
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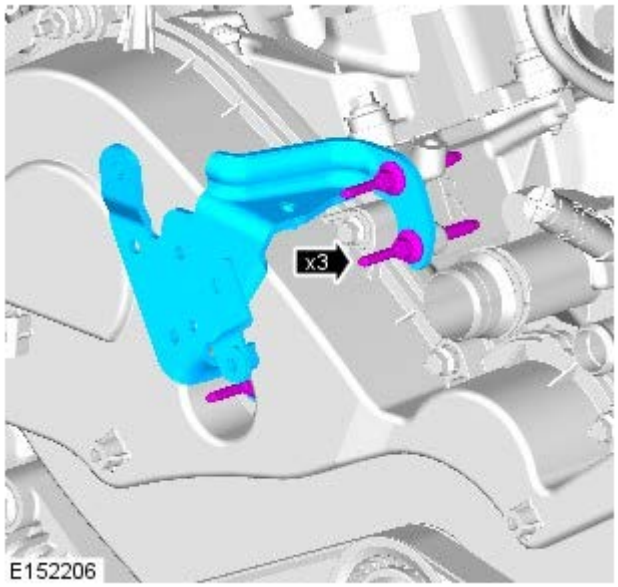
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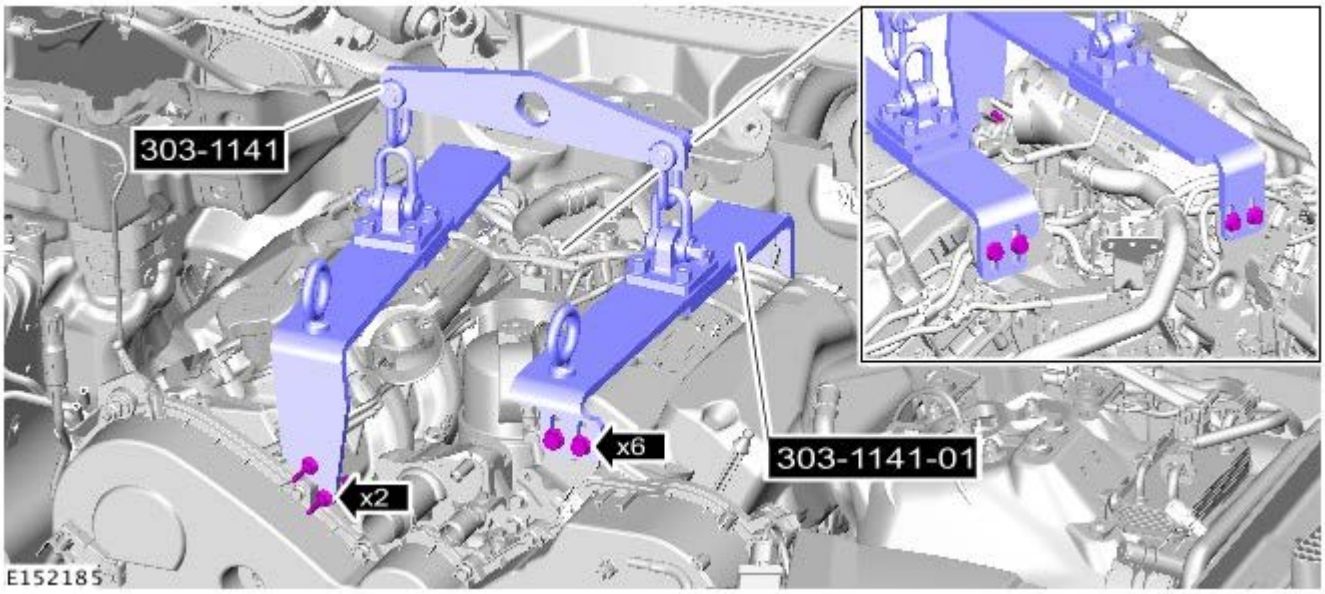
44.



45.



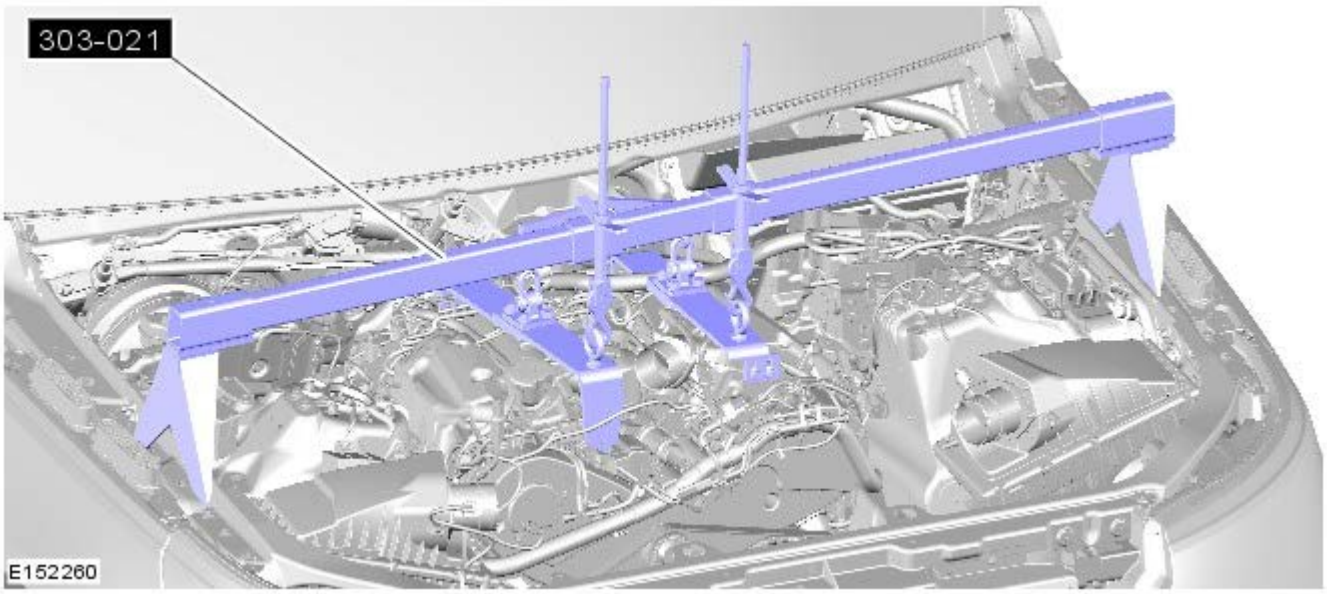
46.



47.

- Install the special tool.

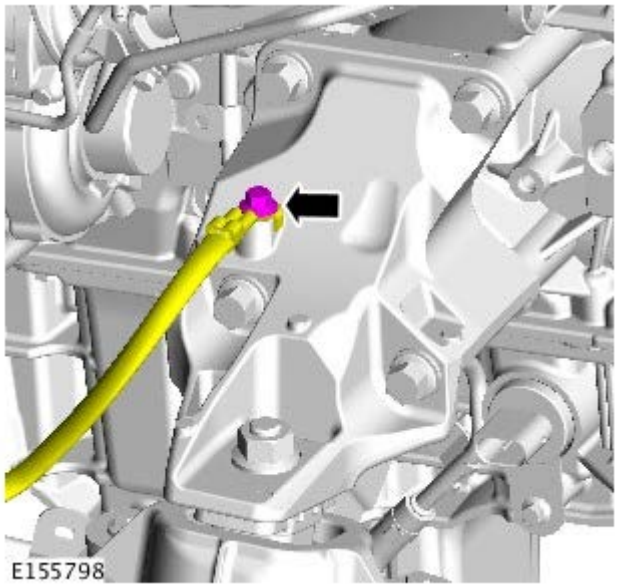
Special Tool(s): 303-021



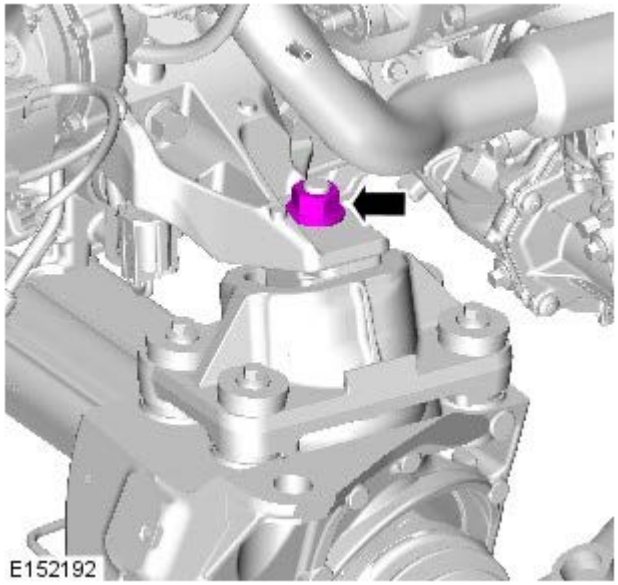
48. Needs this include changing for the hybrid transmission.

    Refer to: Transmission (307-01B, Removal).

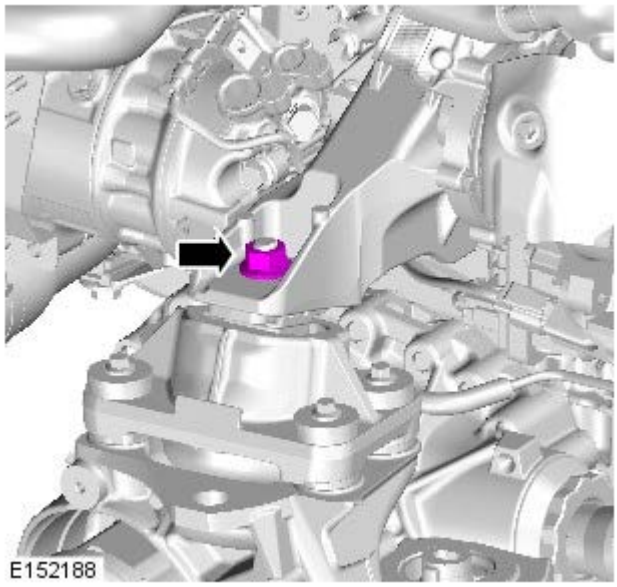
49.



50.



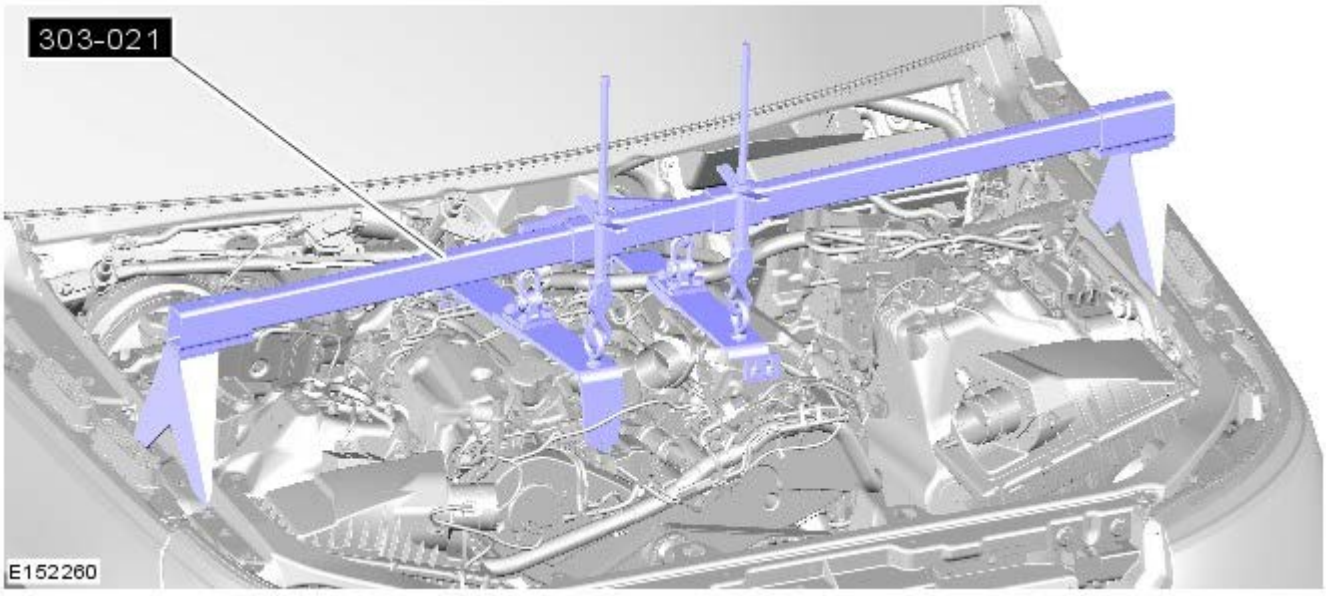
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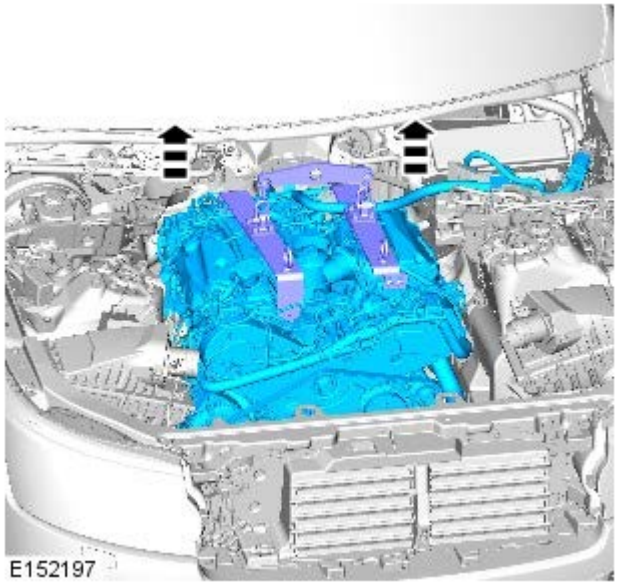


52.

- Remove the special tool.

Special Tool(s): 303-021





53. WARNING: This step requires the aid of another technician.

CAUTION: Be prepared to collect escaping fluids.

Carefully and progressively raise and remove the engine.

Published: 06-Sep-2013

Engine - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Engine

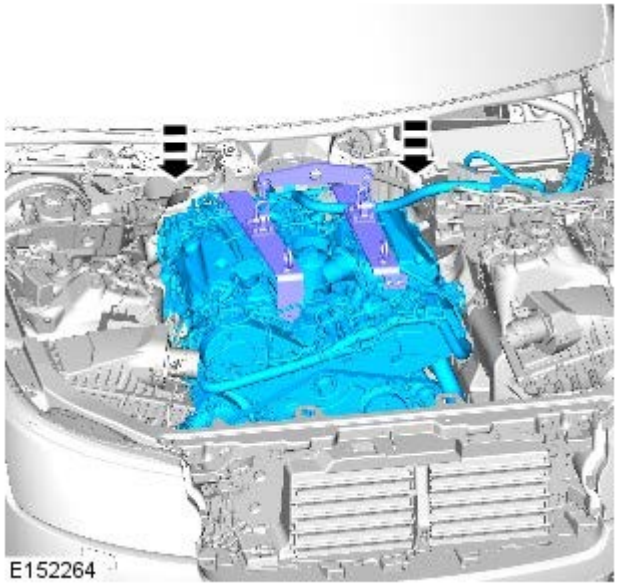
Installation

Special Tool(s)

 303-021	303-021 Engine support bracket

CAUTION: 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.

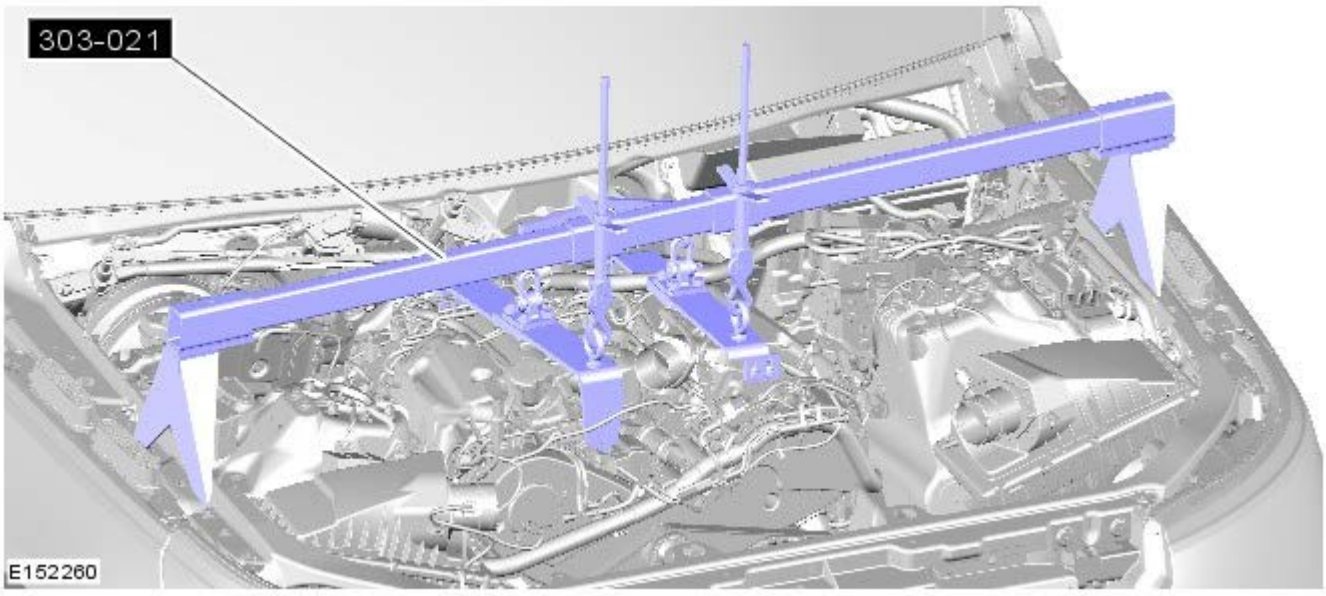

E152264

1. WARNING: This step requires the aid of another technician.

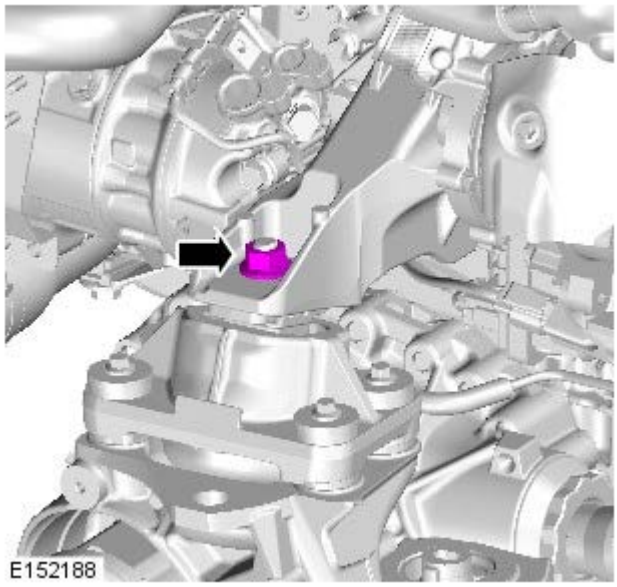
   CAUTION: Be prepared to collect escaping fluids.

2. Install the special tool.

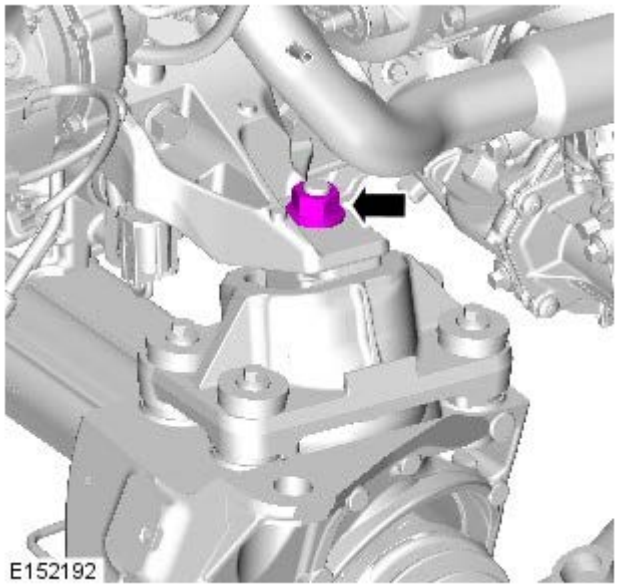
   Special Tool(s): 303-021



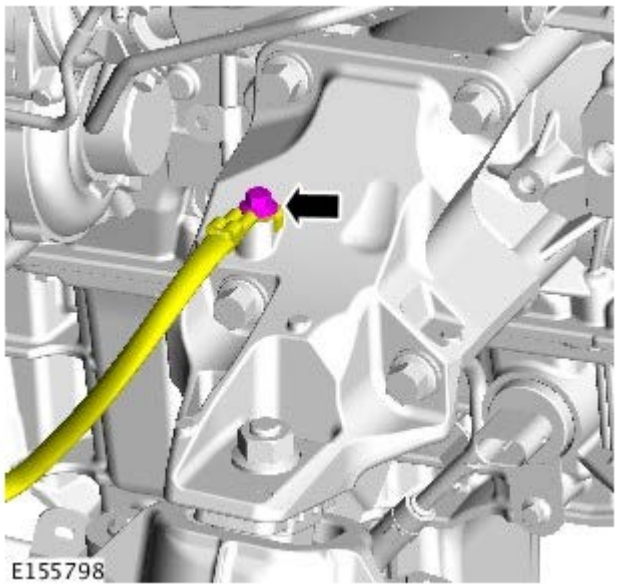
3. *Torque:* 110 Nm



4. *Torque:* 110 Nm



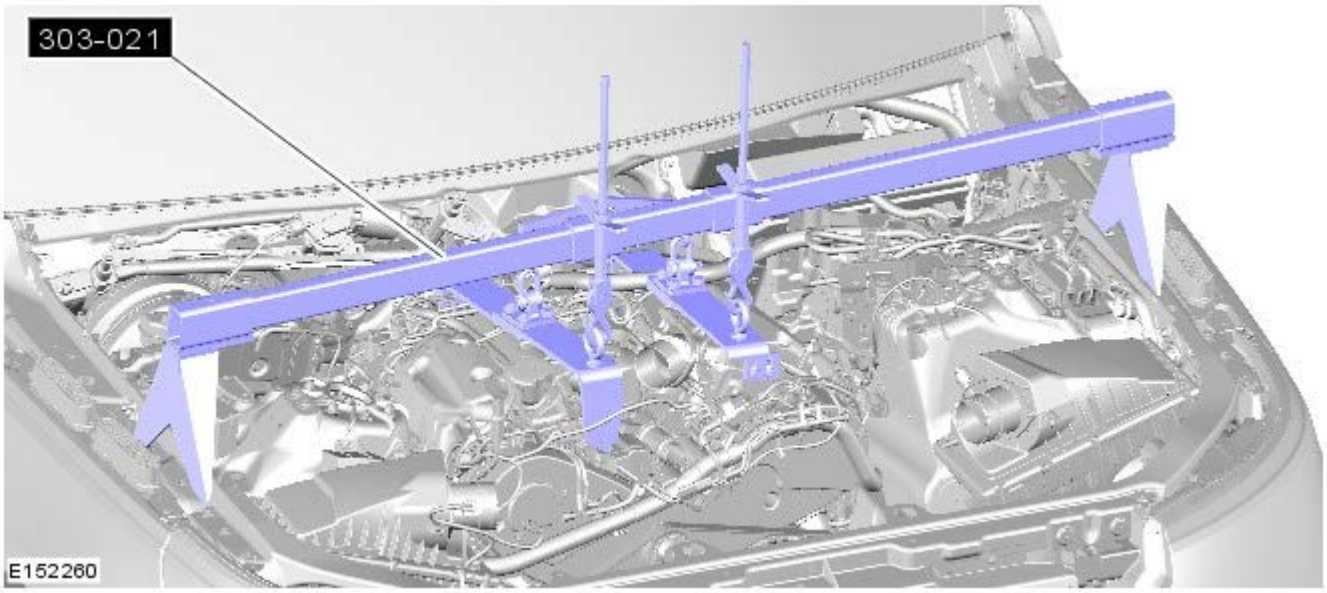
5. *Torque:* 9 Nm



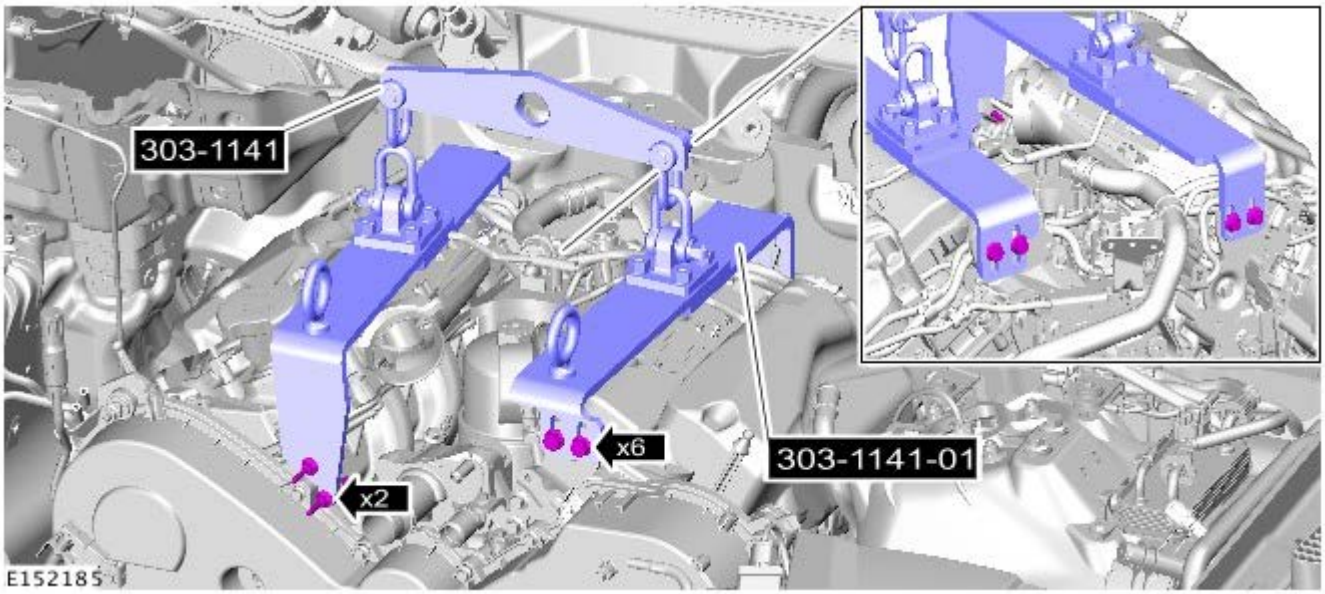
6. Refer to: Transmission (307-01 Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed - Hybrid Electric Vehicle - Automatic Transmission – AWD, Removal).

7. Remove the special tool.

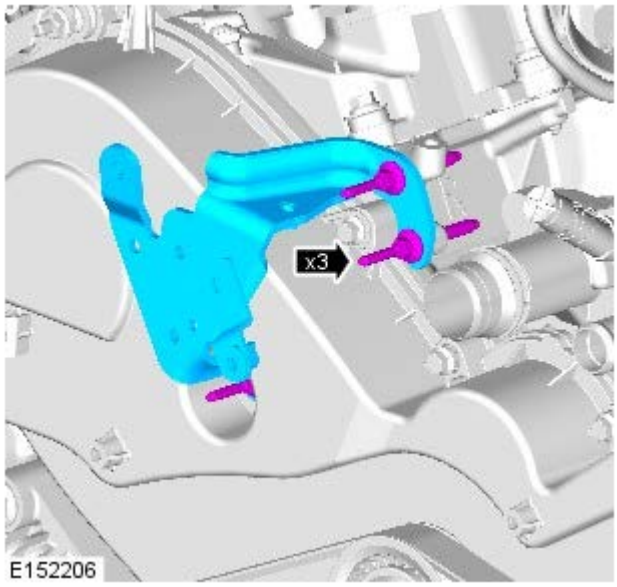
Special Tool(s): 303-021



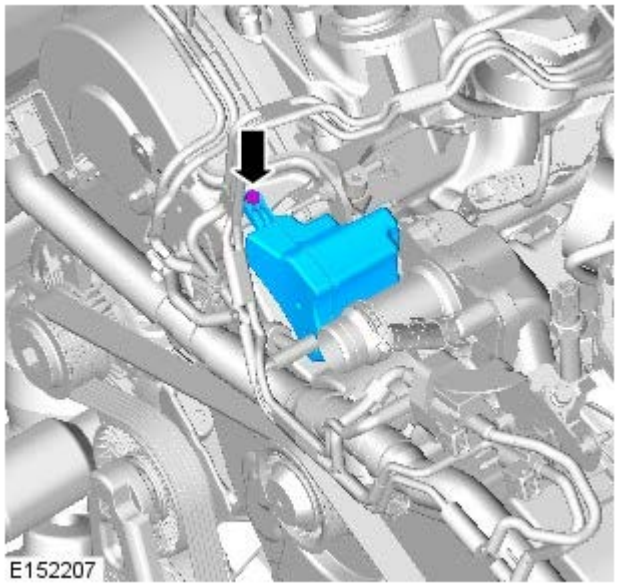
8. Remove the special tool.



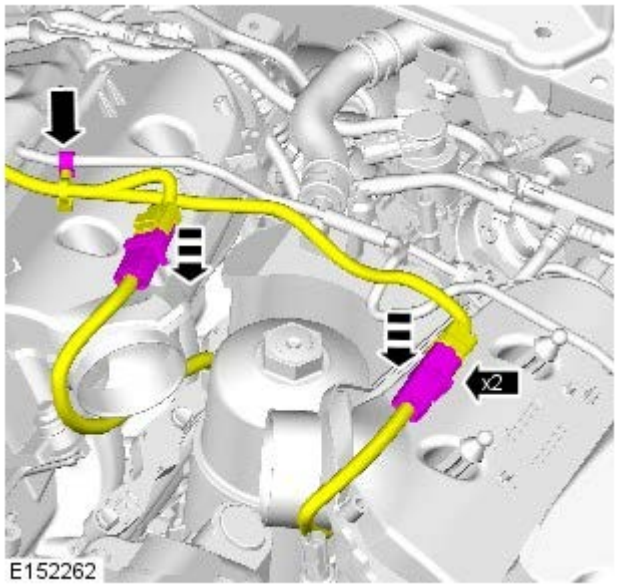
9. *Torque:* 8 Nm



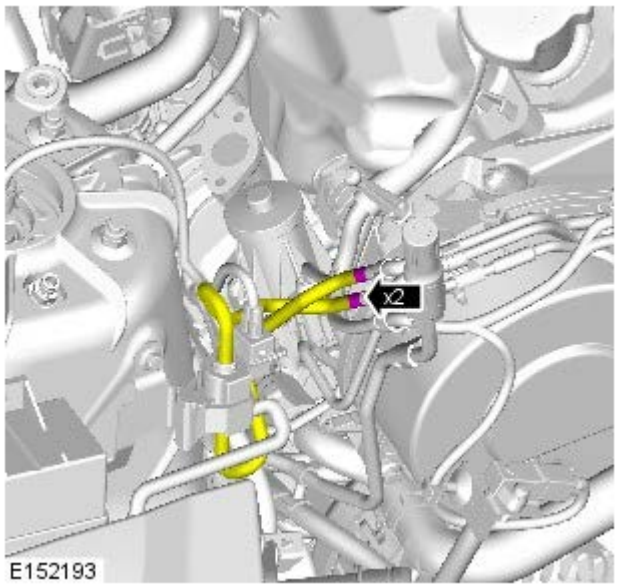
10. *Torque:* 8 Nm



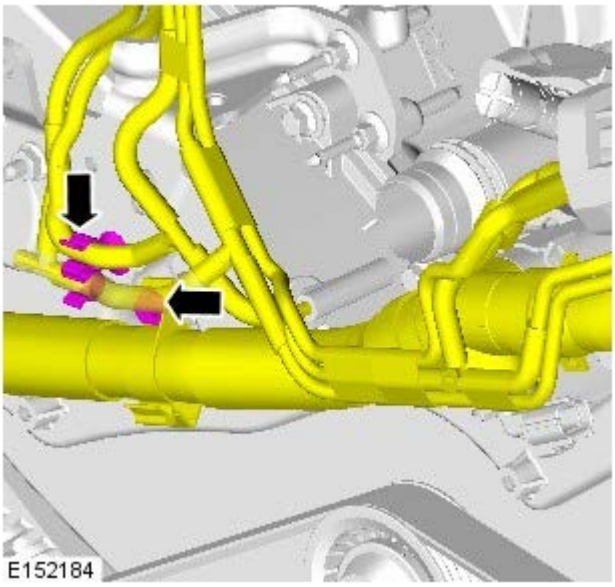
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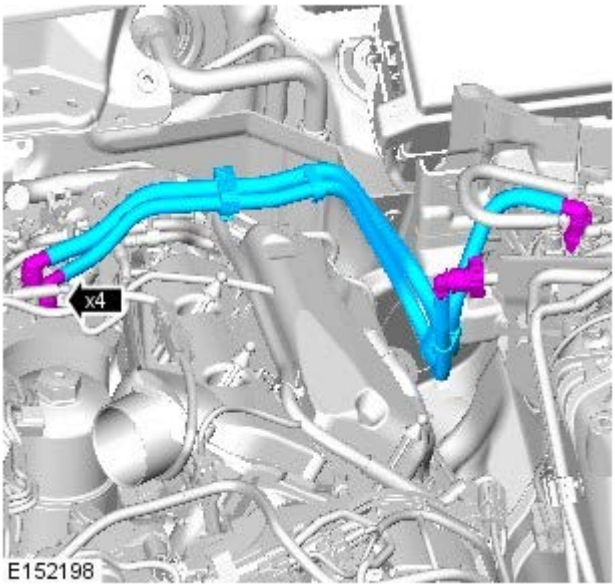
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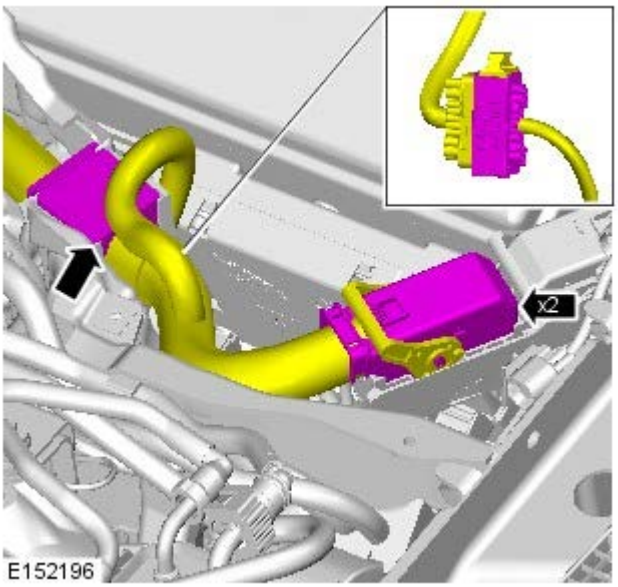
13. *Torque:* 8 Nm



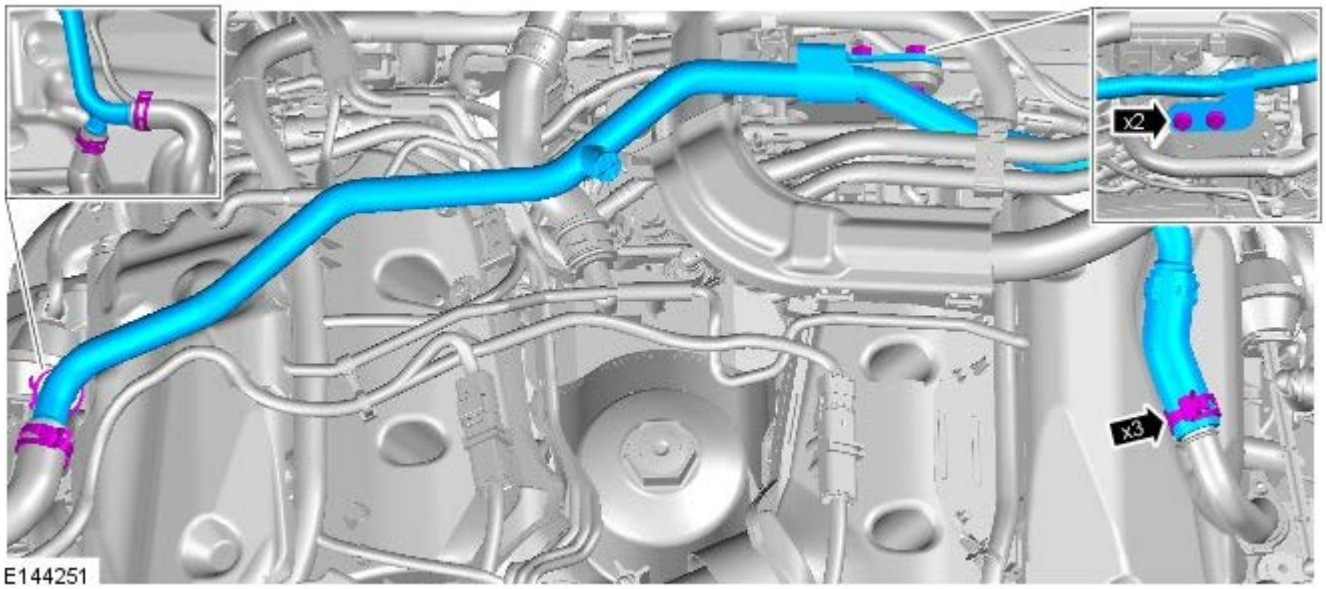
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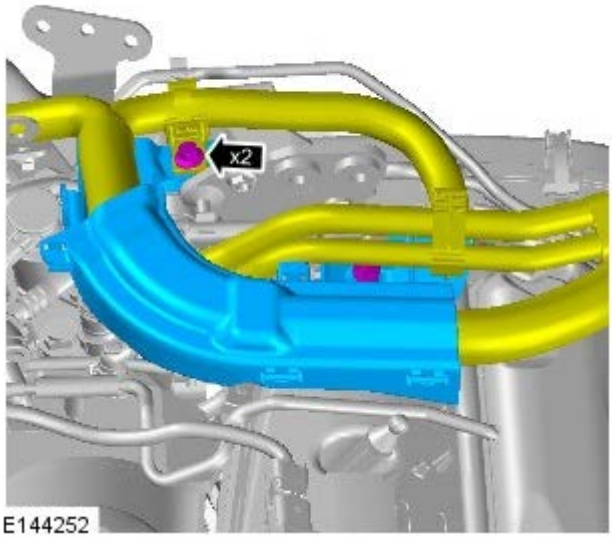
15.



16. *Torque:* 10 Nm



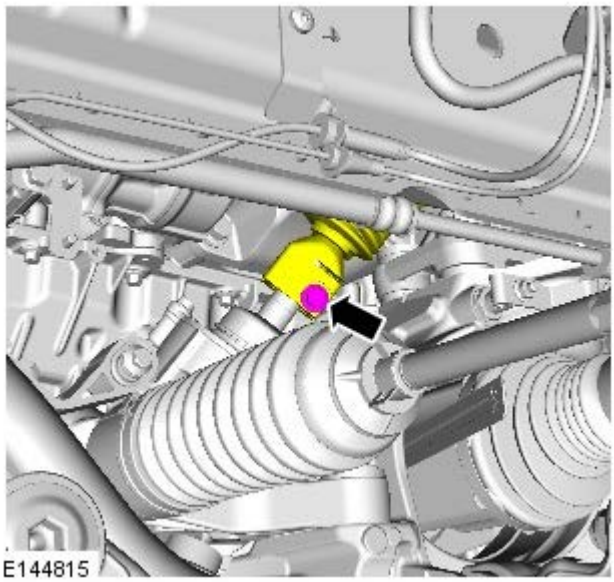
17. *Torque:* 10 Nm



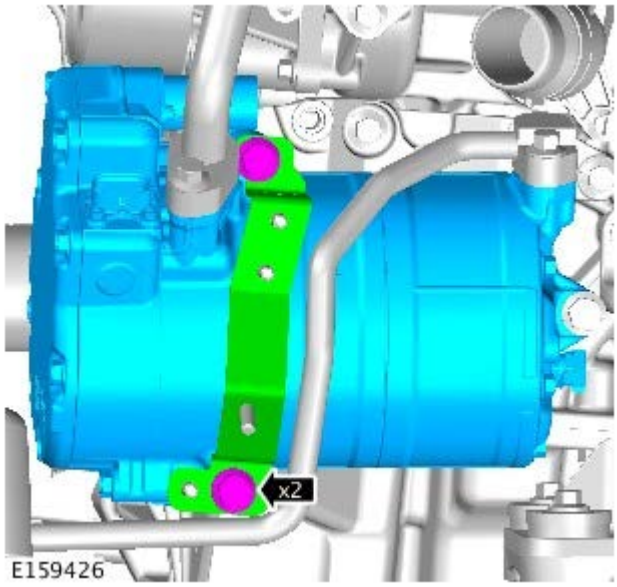
18. CAUTION: Make sure that a new bolt is installed.

NOTE: LHD illustration shown, RHD is similar.

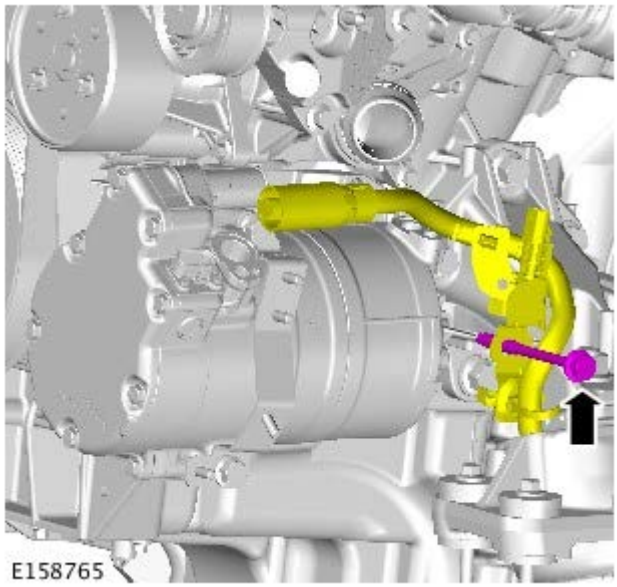
- *Torque:* 30 Nm



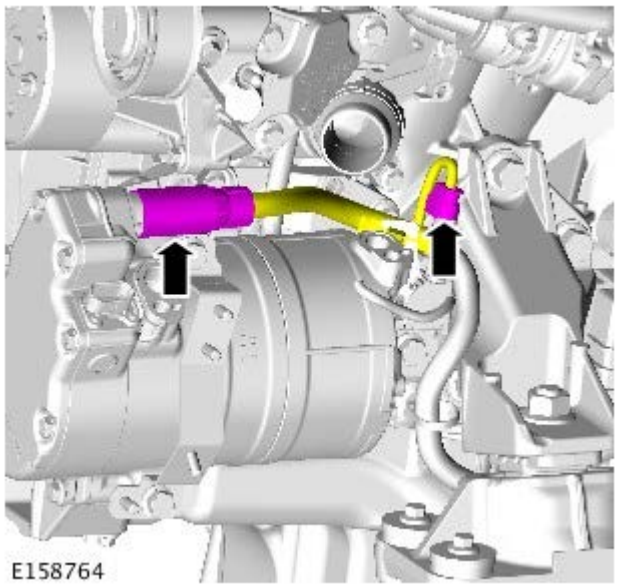
19. *Torque:* 25 Nm



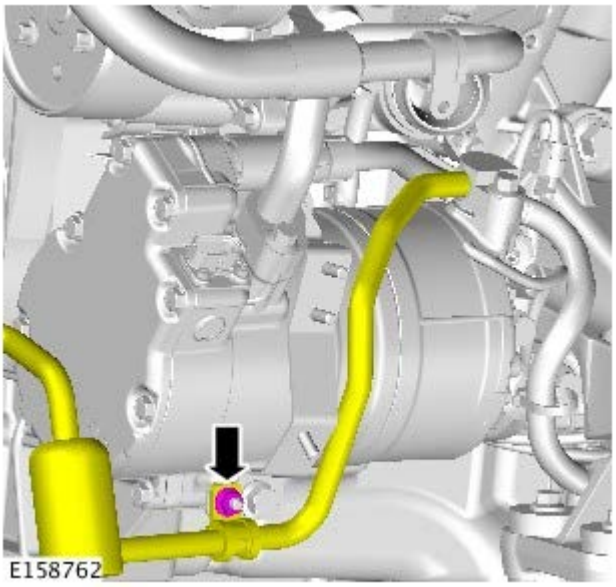
20. *Torque:* 25 Nm



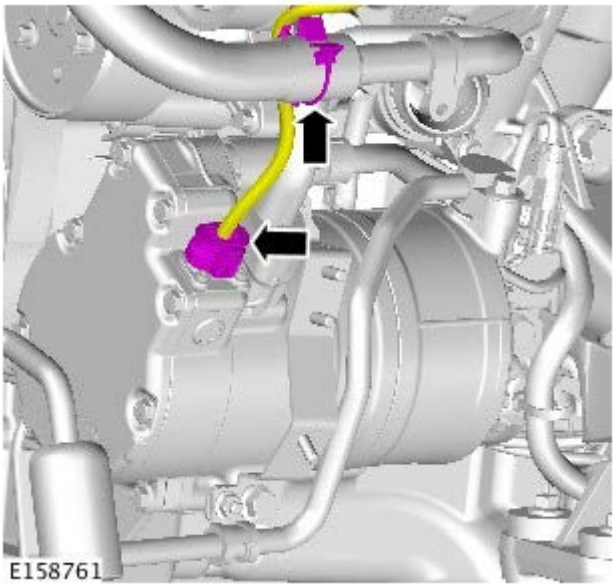
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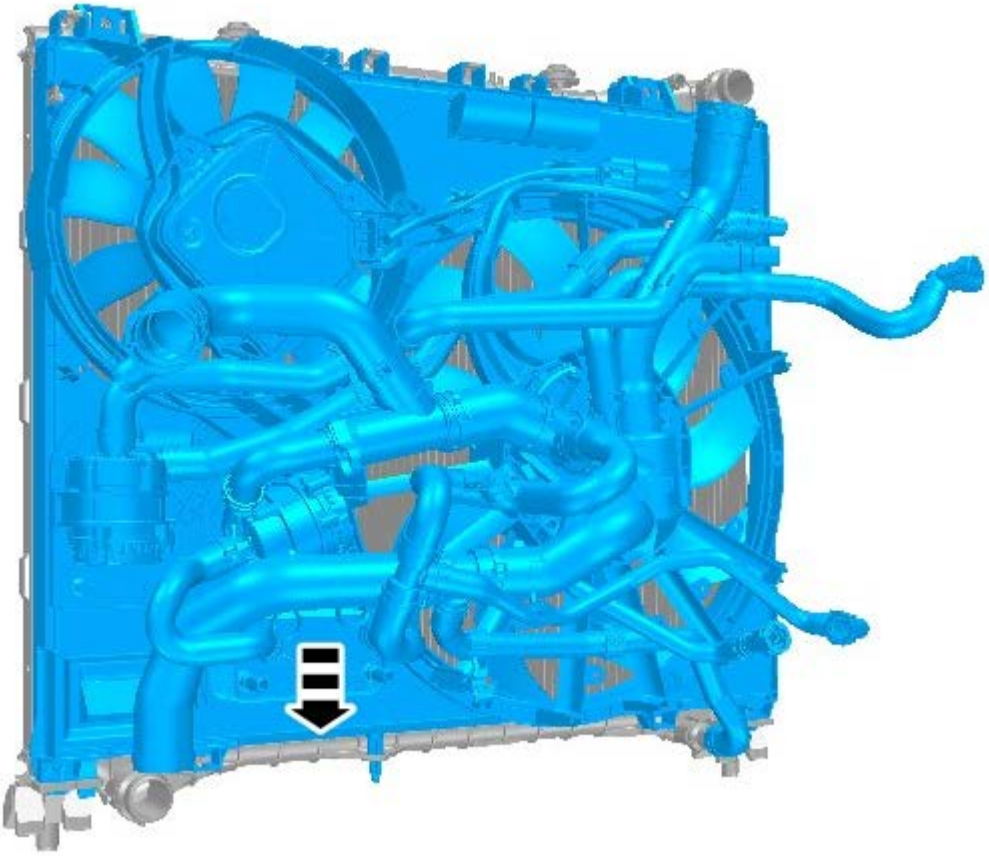
22. *Torque:* 6 Nm



23.

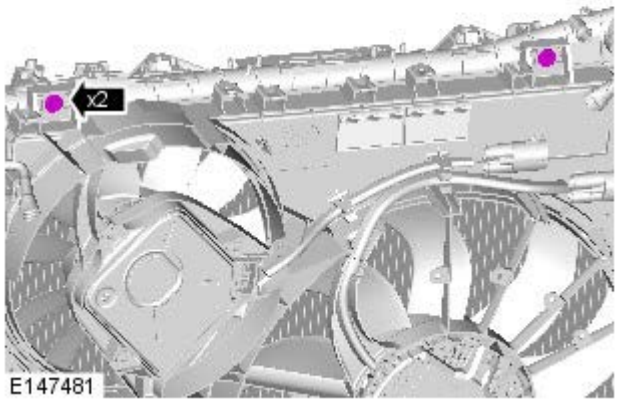


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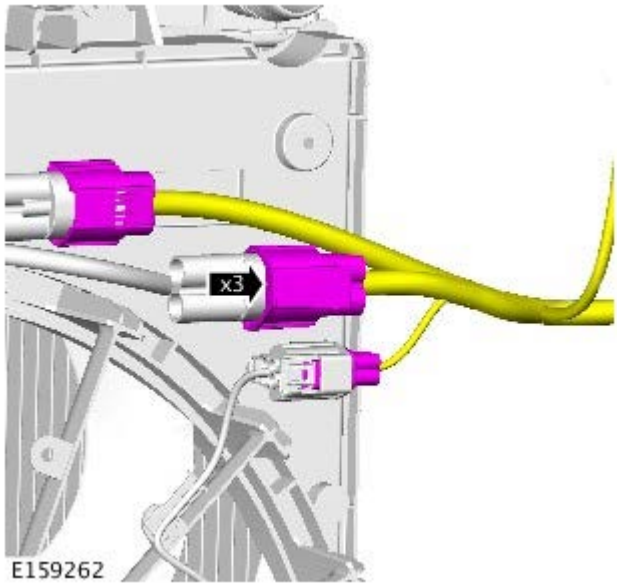
E159442

25. *Torque:* 7 Nm

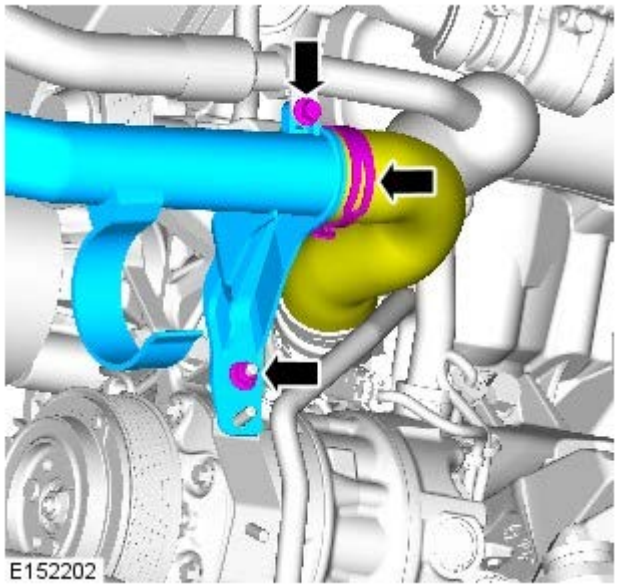


E147481

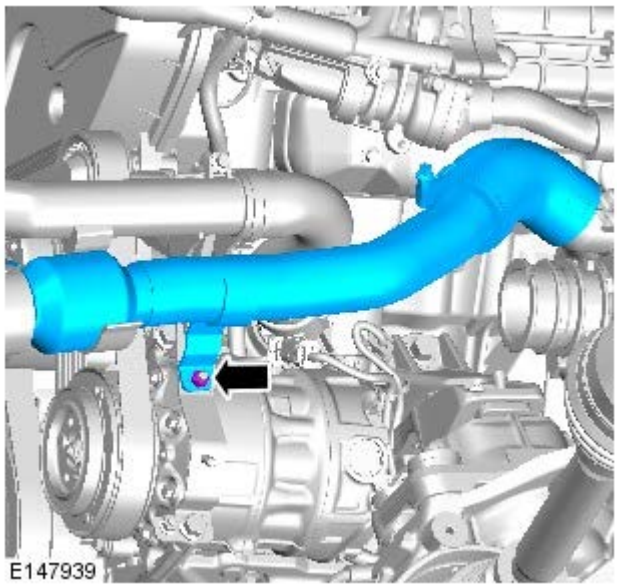
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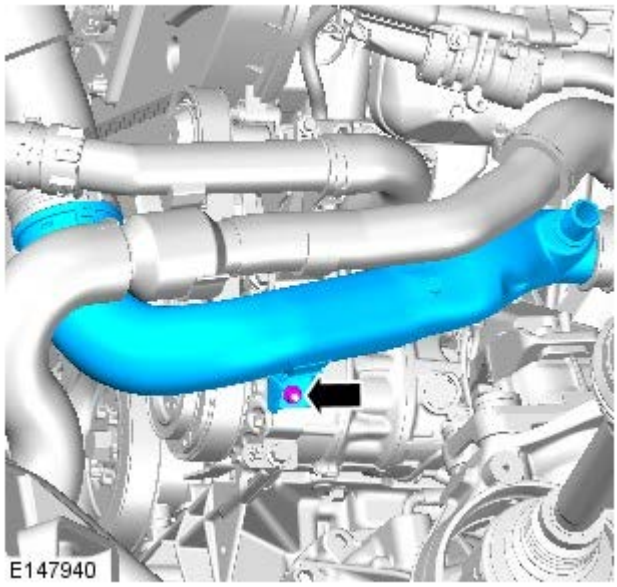
27. *Torque:* 6 Nm



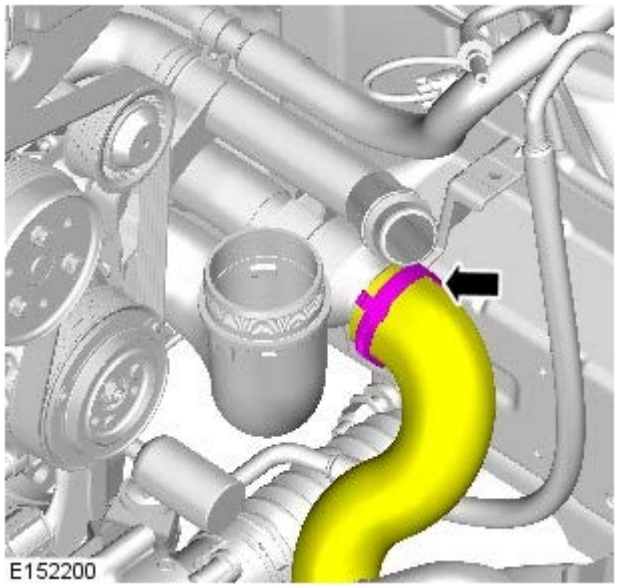
28. *Torque:* 6 Nm



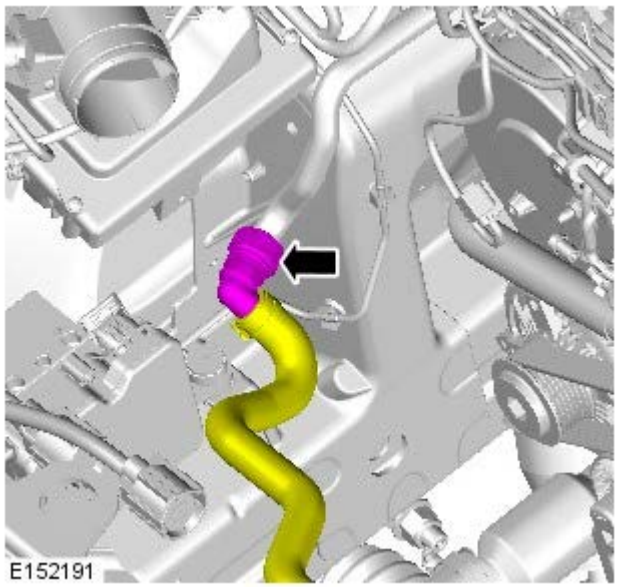
29. *Torque:* 6 Nm



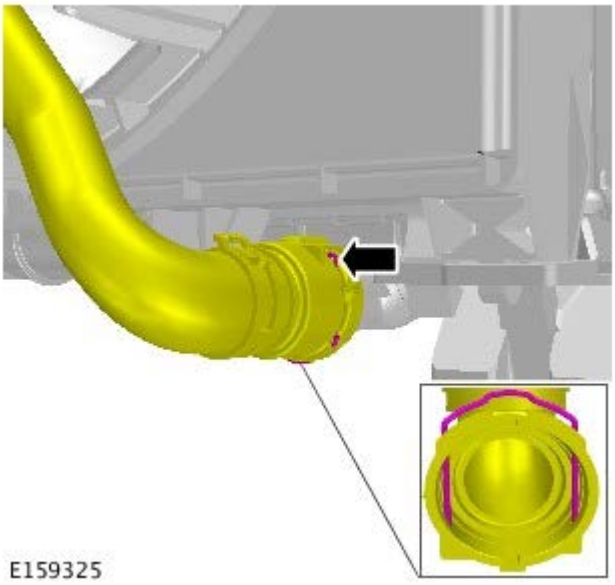
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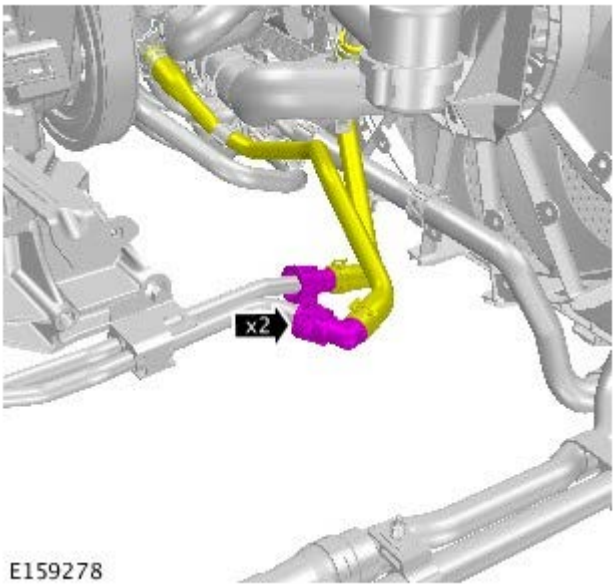
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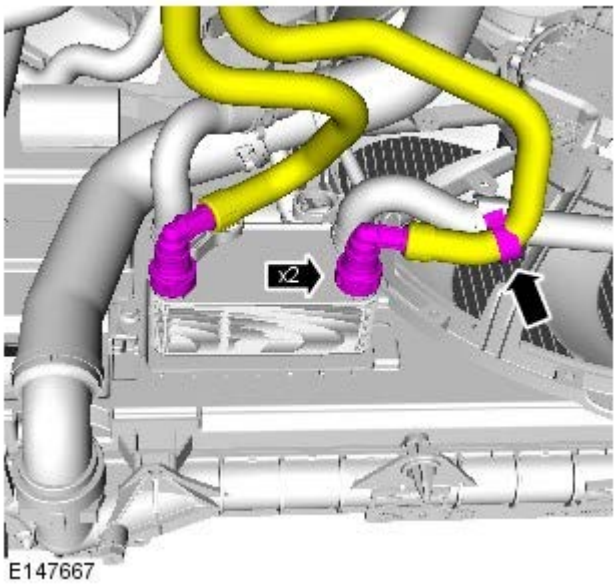
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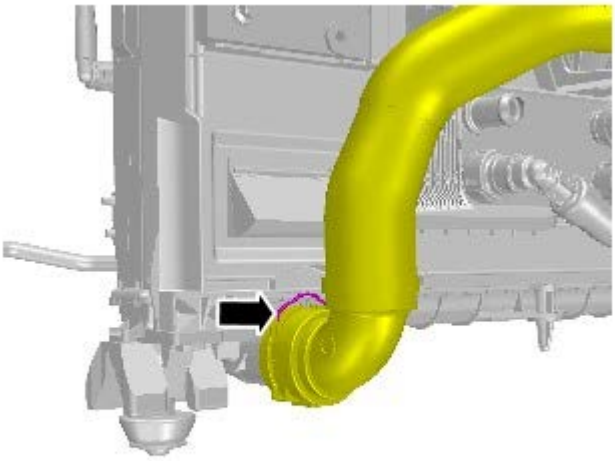
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34.

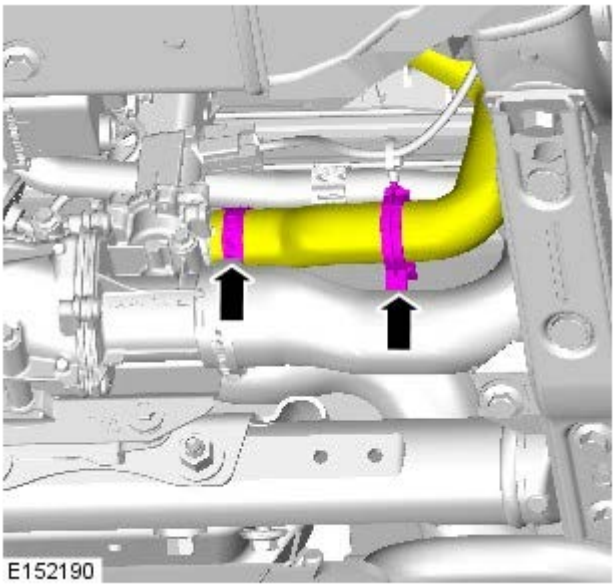


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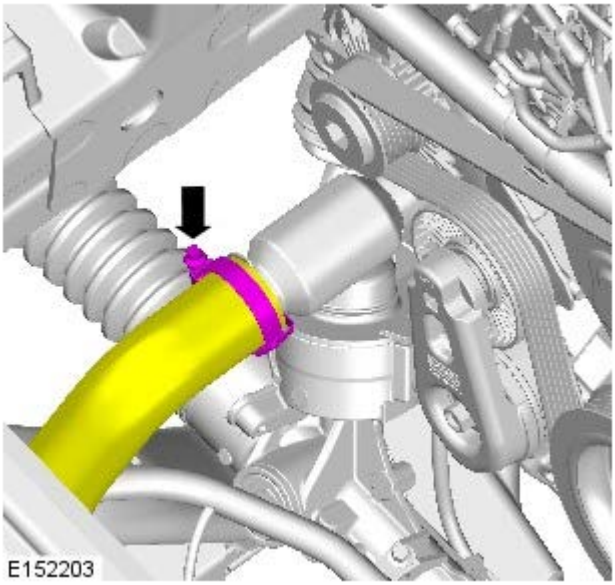


E159277

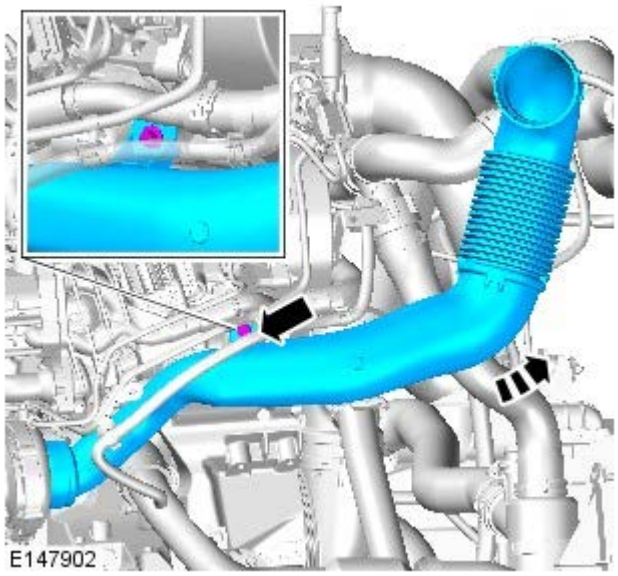
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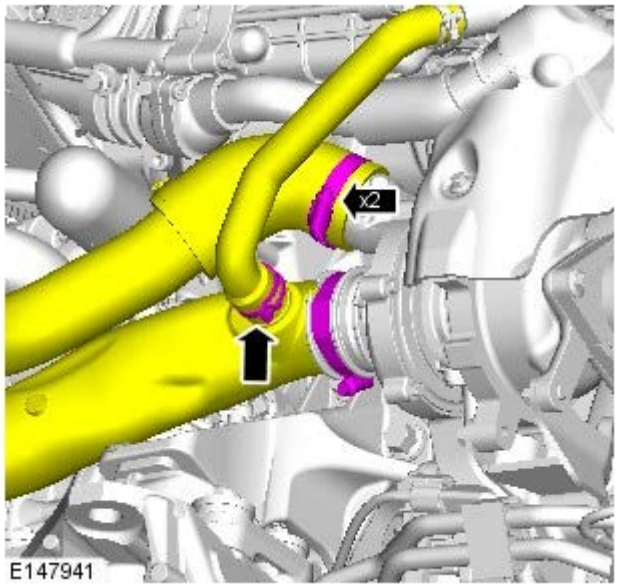
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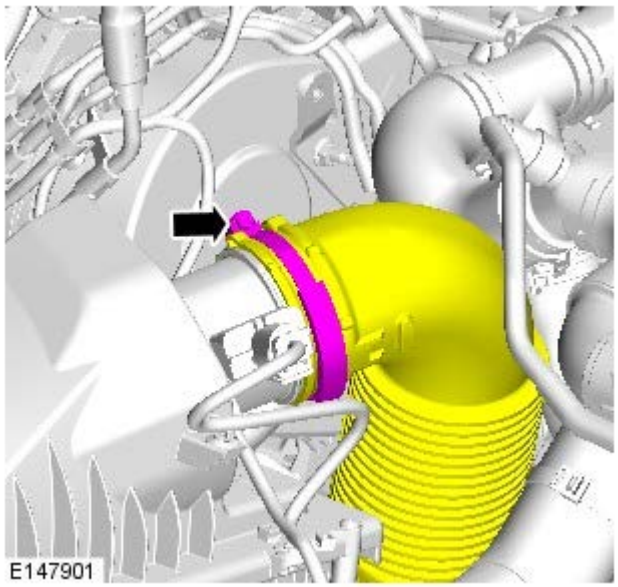
38. *Torque:* 10 Nm



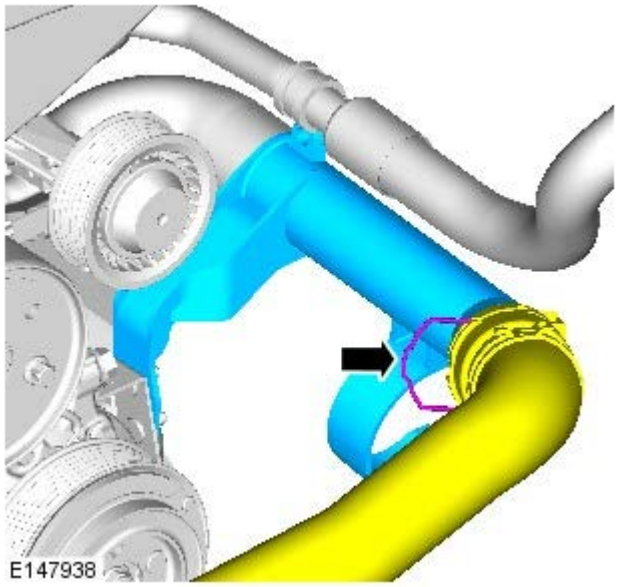
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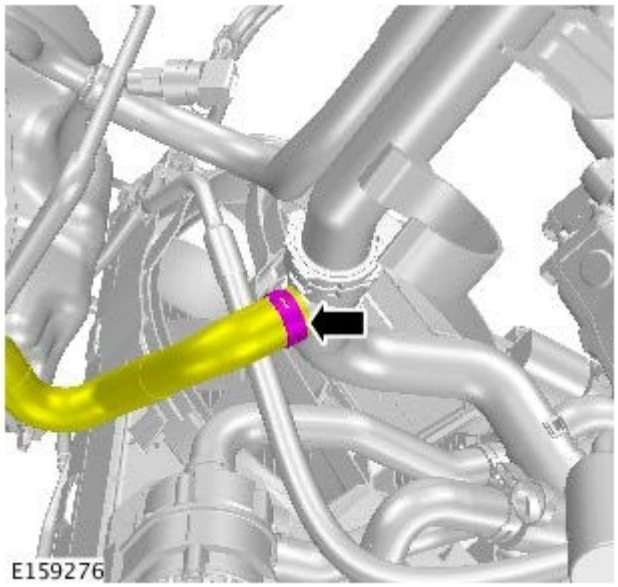
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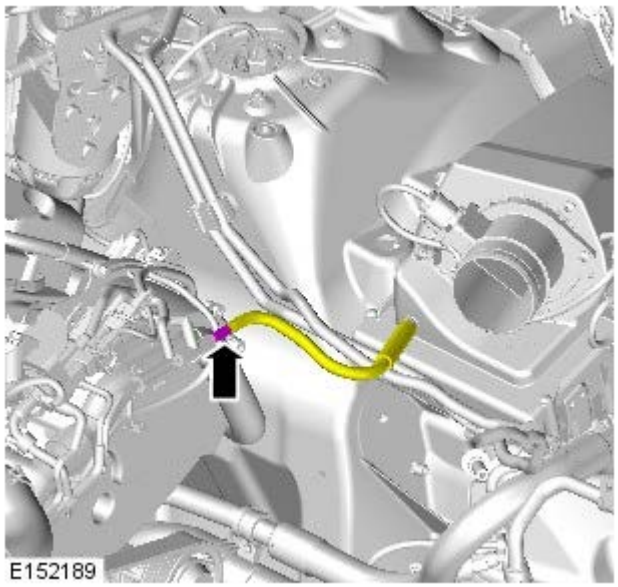
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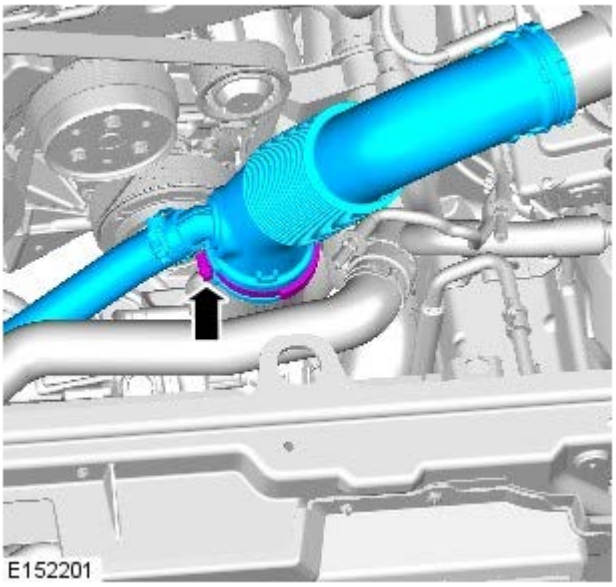
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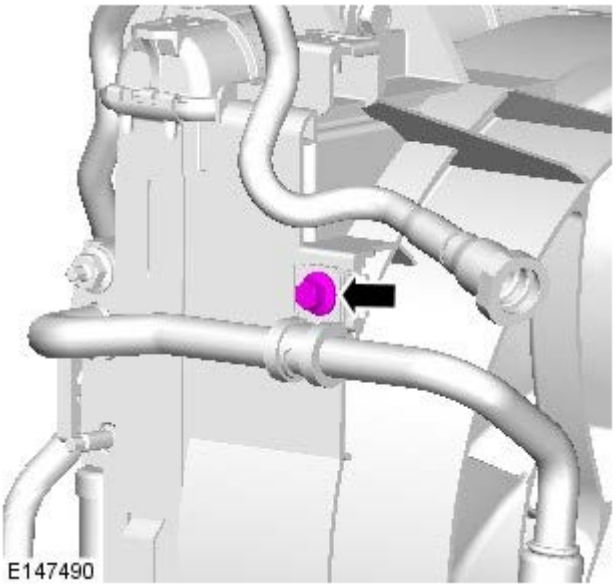
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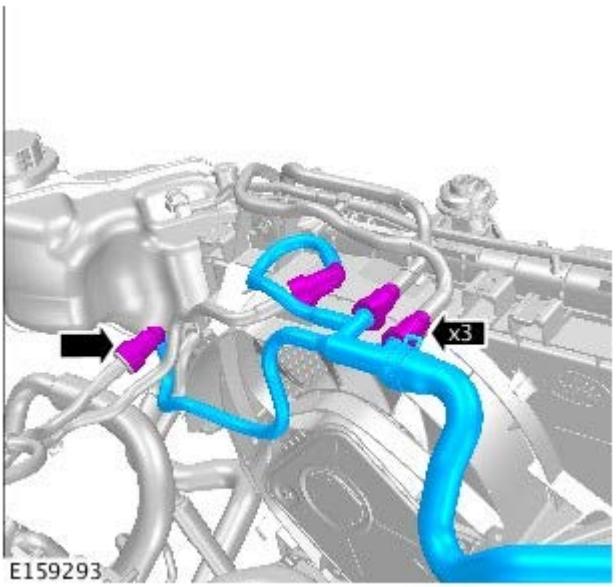
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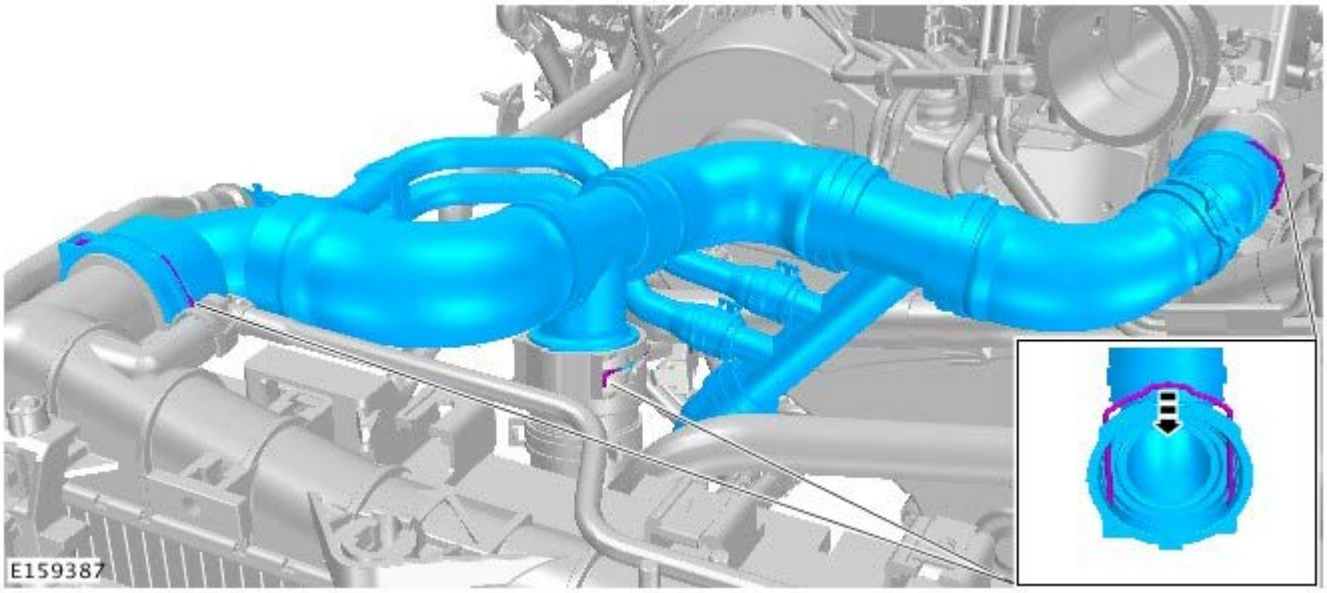
45. *Torque:* 10 Nm



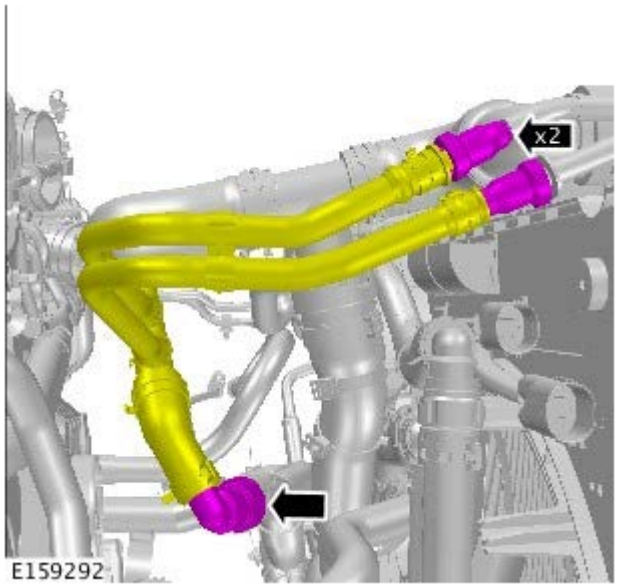
46.



47.



48.



49. Refer to: Intake Air Shutoff Throttle (303-04A Fuel Charging and Controls - TDV6 3.0L Diesel, Removal and Installation).

50. Refer to: Secondary Bulkhead Center Panel - TDV6 3.0L Diesel (501-02 Front End Body Panels, Removal and Installation).

51. Refer to: Cooling System Partial Draining, Filling and Bleeding (303-03G Engine Cooling - SDV6 3.0L Diesel - Hybrid Electric Vehicle, General Procedures).

52. Refer to: Hood (501-02 Front End Body Panels, Removal and Installation).

53. Refer to: Hybrid Electric Vehicle (HEV) System Bonding Test (414-01, General Procedures).

54. Refer to: Hybrid Electric Vehicle (HEV) Decommission (414-01 Battery, Mounting and Cables, General Procedures).

55. Refer to: Low-Pressure Fuel System Bleeding (310-00 Fuel System - General Information, General Procedures).

Published: 19-Aug-2013

Engine Cooling - TDV6 3.0L Diesel -

Fluid

Description	Specification
Land Rover premium cooling system fluid	Havoline XLC

Capacity

Item	Litres
Vehicles fitted with 2 zone air conditioning (A/C)	9.4
Vehicles fitted with 2 zone A/C and fuel fired booster heater (FFBH)	9.6
Vehicles fitted with 4 zone A/C	11.2
Vehicles fitted with 4 zone A/C and FFBH	11.4
HEV battery circuit	1.5

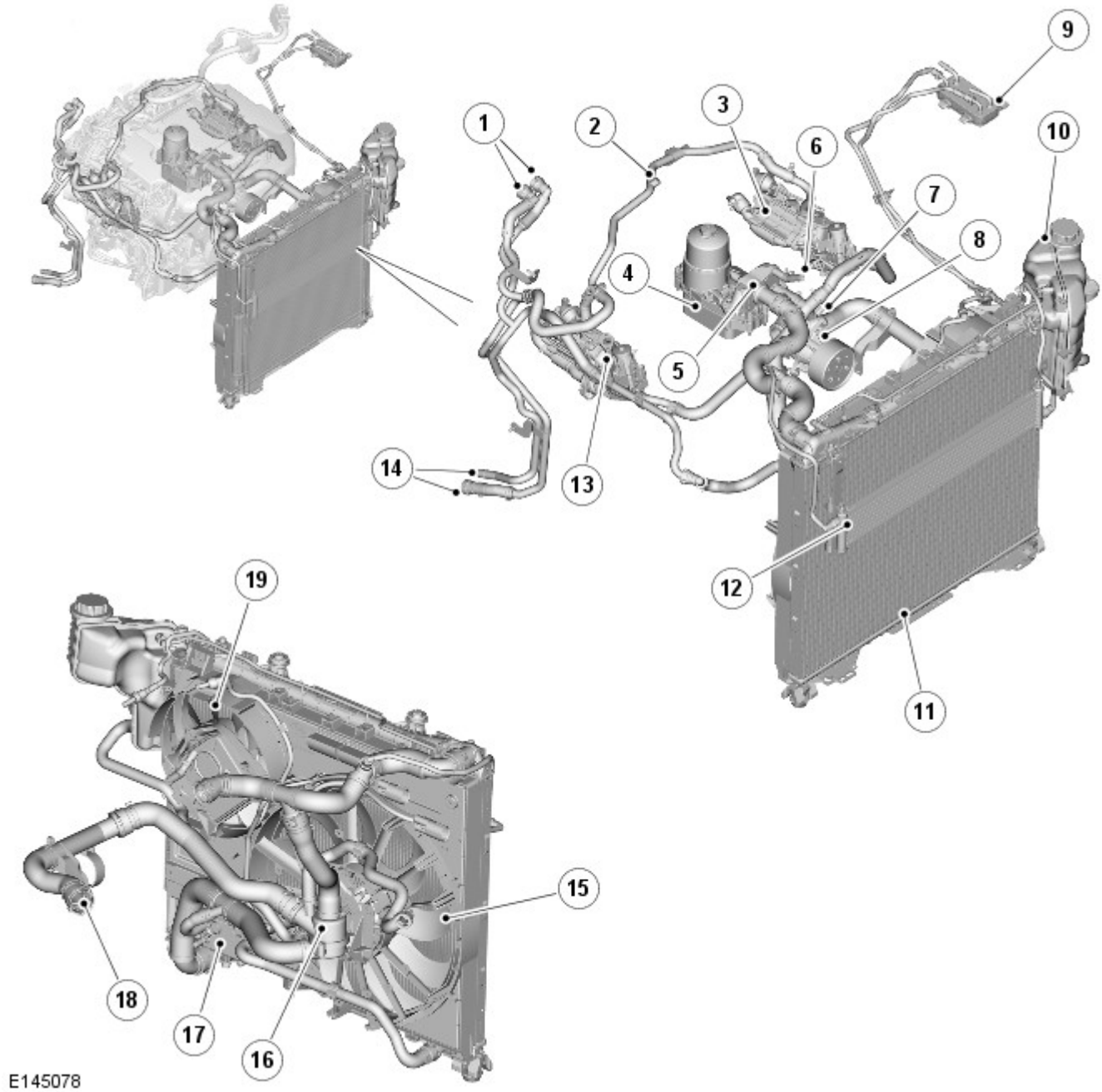
Description	Nm	lb-ft	lb-in
Coolant expansion tank bolt	2.8	2.0	25
Coolant outlet assembly bolts	10	7	88
Coolant pump bolts	10	7	88
Coolant pump pulley bolts	25	18	221
Thermostat housing bracket to fan shroud bolt	5	4	44
Thermostat housing bolts	5	4	44
A/C pipes to condenser nuts	8	6	71
A/C pipe to fan shroud bolt	7	5	62
Charge air cooler pipe connector to fan shroud bolt	8	6	71
Charge air cooler hose clamp to fan shroud bolt	7	5	62
Engine cooling module bolts	15	11	133
Cooling fan shroud bolts	7	5	62
Transmission fluid cooler to fan shroud bolt	7	5	62
Coolant bleed screw(s)	3	2	27

Published: 02-May-2013

Engine Cooling - TDV6 3.0L Diesel - Engine Cooling

Description and Operation

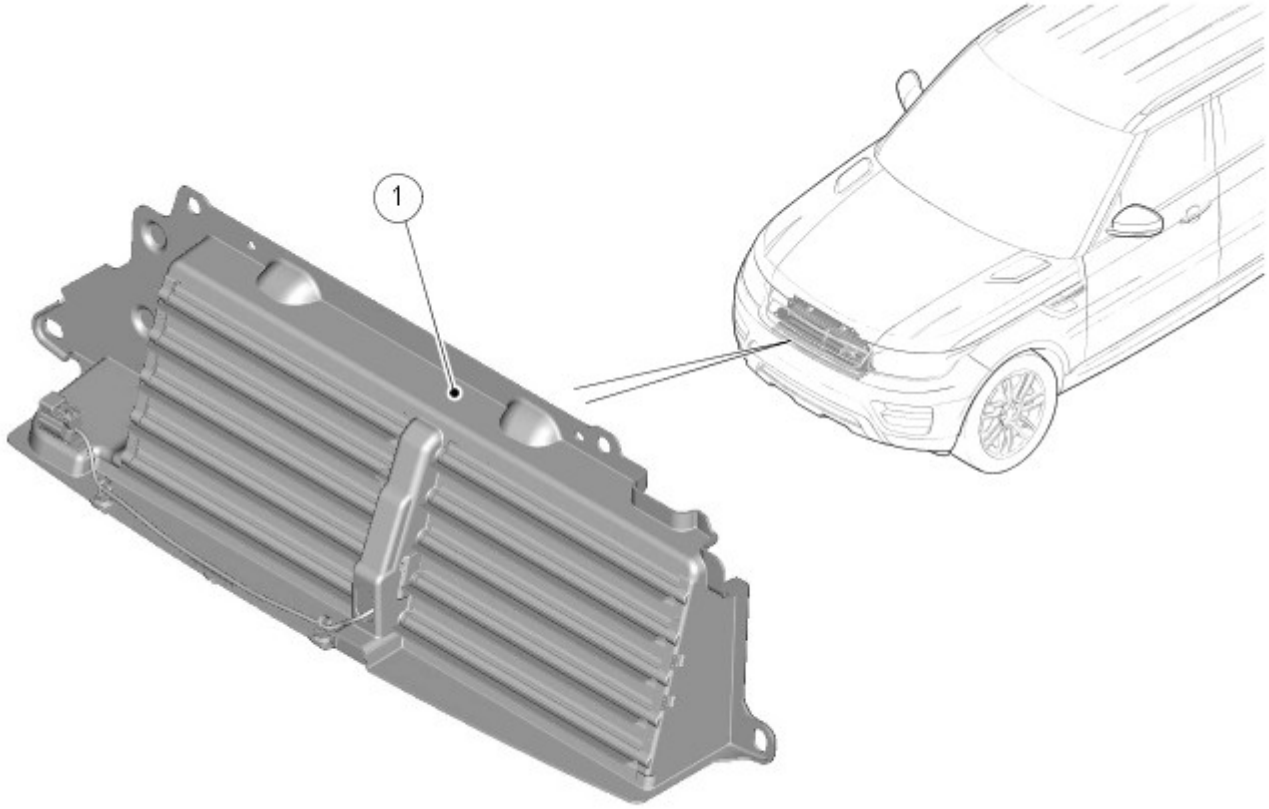
COMPONENT LOCATION - SHEET 1 OF 2



Item	Part Number	Description
1	-	Heater connections
2	-	Bleed screw
3	-	Left exhaust gas recirculation cooler
4	-	Engine oil cooler
5	-	Coolant outlet connector
6	-	Bleed screw
7	-	Engine coolant temperature sensor
8	-	Coolant pump
9	-	Fuel cooler
10	-	Expansion tank
11	-	Radiator
12	-	Auxiliary fuel cooler
13	-	Right exhaust gas recirculation cooler
14	-	Auxiliary heater connections

15	-	Cooling fan 1
16	-	Thermostat
17	-	Transmission oil cooler
18	-	Coolant intake connector
19	-	Cooling fan 2 (where fitted)

COMPONENT LOCATION - SHEET 2 OF 2



E152298

Item	Part Number	Description
1	-	Active grille air shutter

OVERVIEW

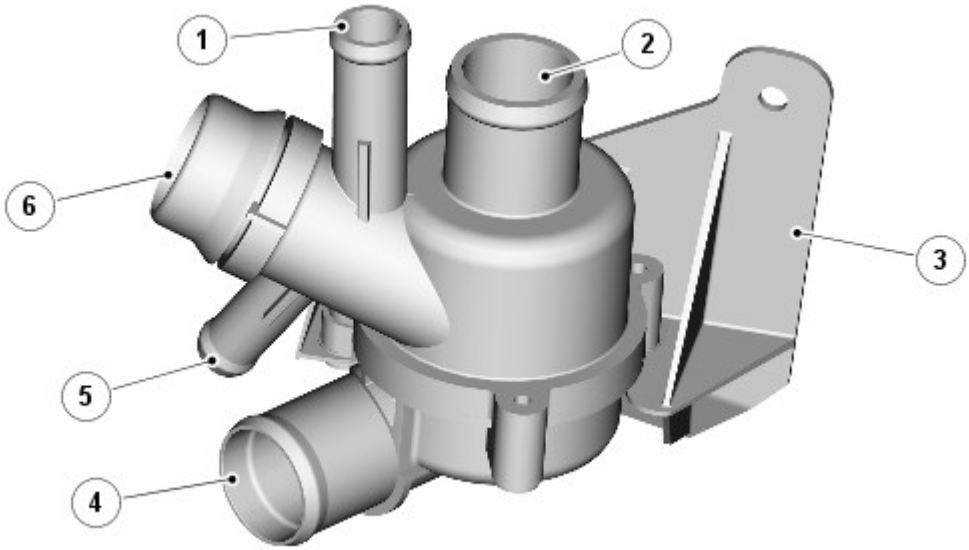
The engine cooling system maintains the engine within an optimum temperature range under changing ambient and engine operating conditions. It also provides:

- Heating for the passenger compartment. For additional information, refer to:
  Heating and Ventilation (412-01A Climate Control, Description and Operation),
  Fuel Fired Booster Heater (412-02A Auxiliary Climate Control, Description and Operation).
- Cooling for:
  - The engine oil.
    For additional information, refer to: Engine (303-01A Engine - TDV6 3.0L Diesel, Description and Operation).
  - The fuel.
    For additional information, refer to: Fuel Tank and Lines (310-01A Fuel Tank and Lines - TDV6 3.0L Diesel, Description and Operation).
  - The EGR (exhaust gas recirculation) system.
    For additional information, refer to: Engine Emission Control (303-08A Engine Emission Control - TDV6 3.0L Diesel, Description and Operation).
  - The transmission fluid.
    For additional information, refer to: Transmission Cooling (307-02A Transmission/Transaxle Cooling - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, Description and Operation).

In some markets, an active grille air shutter is installed to reduce aerodynamic drag and engine warm up time.

DESCRIPTION

Thermostat

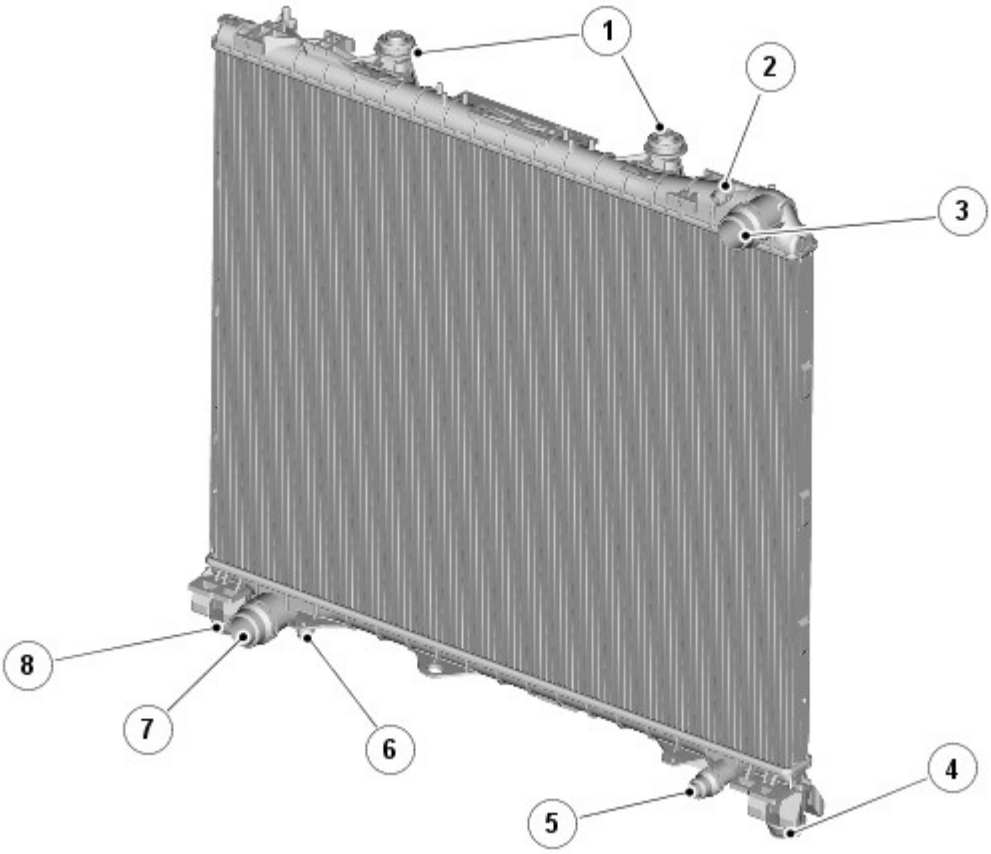


E145079

Item	Part Number	Description
1	-	Heater return connection
2	-	Upper hose connection
3	-	Thermostat bracket
4	-	Lower hose connection
5	-	Expansion tank connection
6	-	Cylinder block coolant intake connection

A pressure relief type thermostat is located behind the radiator, on a bracket attached to the cooling fan shroud. The thermostat body has connections for the radiator lower hose, the radiator upper hose, the feed hose to the cylinder block, the heater return hose and the expansion tank supply hose. The thermostat body contains a wax element and a spring loaded bypass valve.

Radiator



E145080

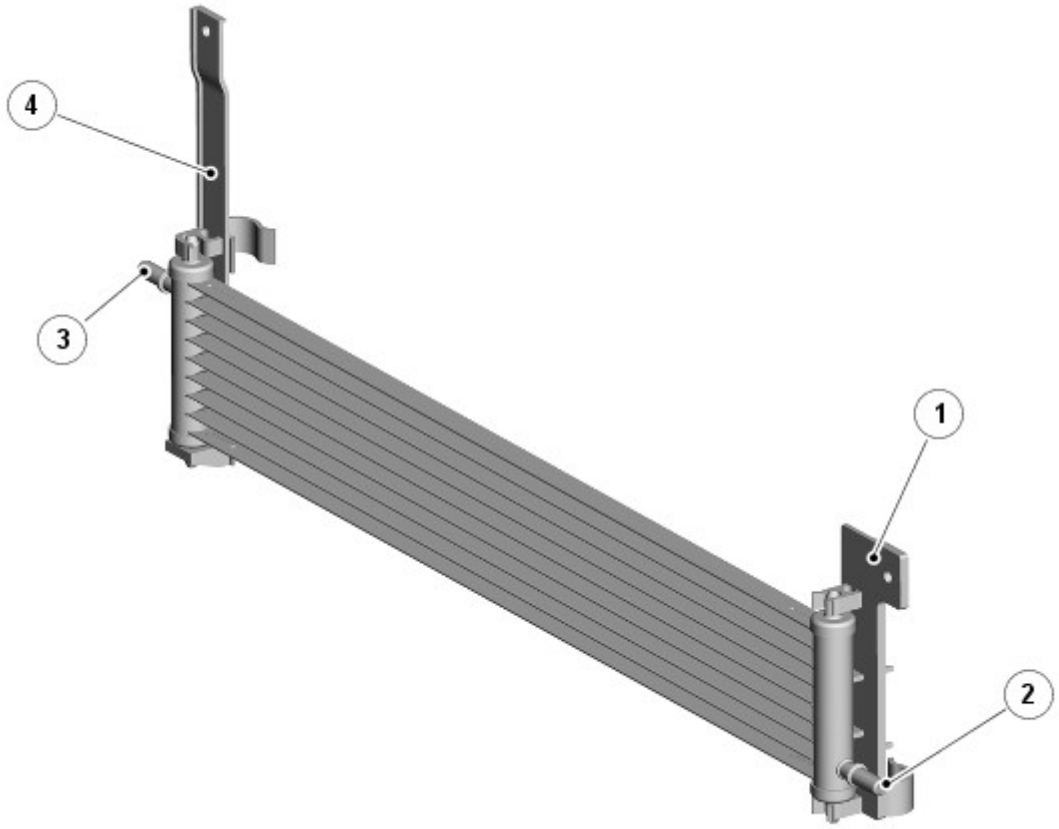
Item	Part Number	Description
1	-	Upper mounts
2	-	Vent hose connection
3	-	Upper hose connection

4	-	Lower mount
5	-	Transmission cooler hose connection
6	-	Drain screw
7	-	Lower hose connection
8	-	Lower mount

The radiator is a vertical-flow type with an integral transmission sub-cooler. The radiator is located in the vehicle by bushes attached to the end tanks. The lower bushes are installed in the front subframe. The upper bushes are installed in the front end carrier.

Upper and lower hose connections are incorporated into the upper and lower end tanks respectively. The lower end tank also incorporates a drain screw, and a connection for the coolant feed hose of the transmission fluid cooler. The upper end tank incorporates a connection for a vent hose to the expansion tank. The end tanks also incorporate mounting points for the cooling fan shroud and the climate control condenser.

Auxiliary Fuel Cooler

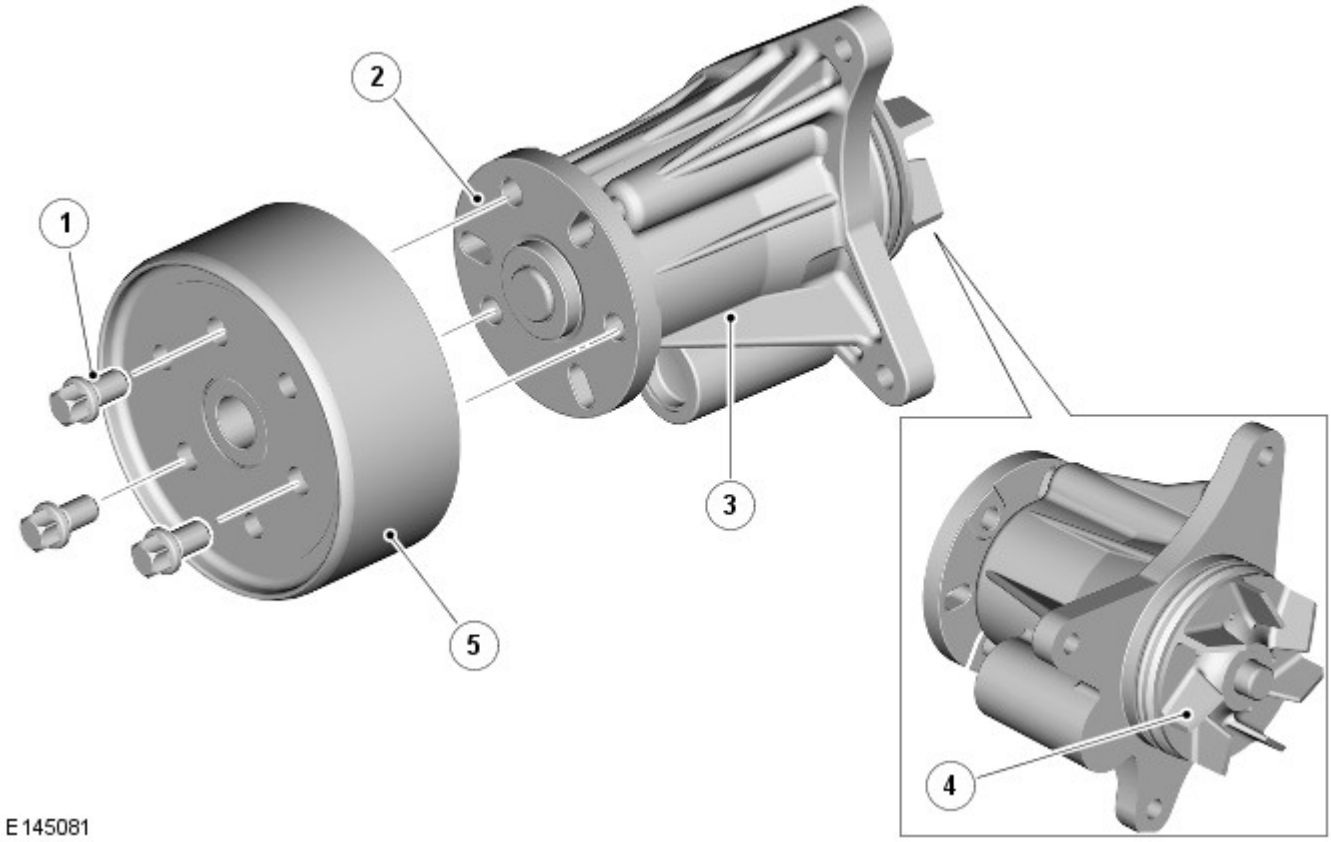


E145152

Item	Part Number	Description
1	-	Left support bracket
2	-	Coolant outlet connection
3	-	Coolant intake connection
4	-	Right support bracket

The auxiliary fuel cooler is attached to the front of the A/C (Air Conditioning) condenser. The end tanks of the cooler incorporate a coolant intake connection from the radiator upper hose and a coolant outlet connection to the fuel cooler in the fuel tank and lines system.

Coolant Pump

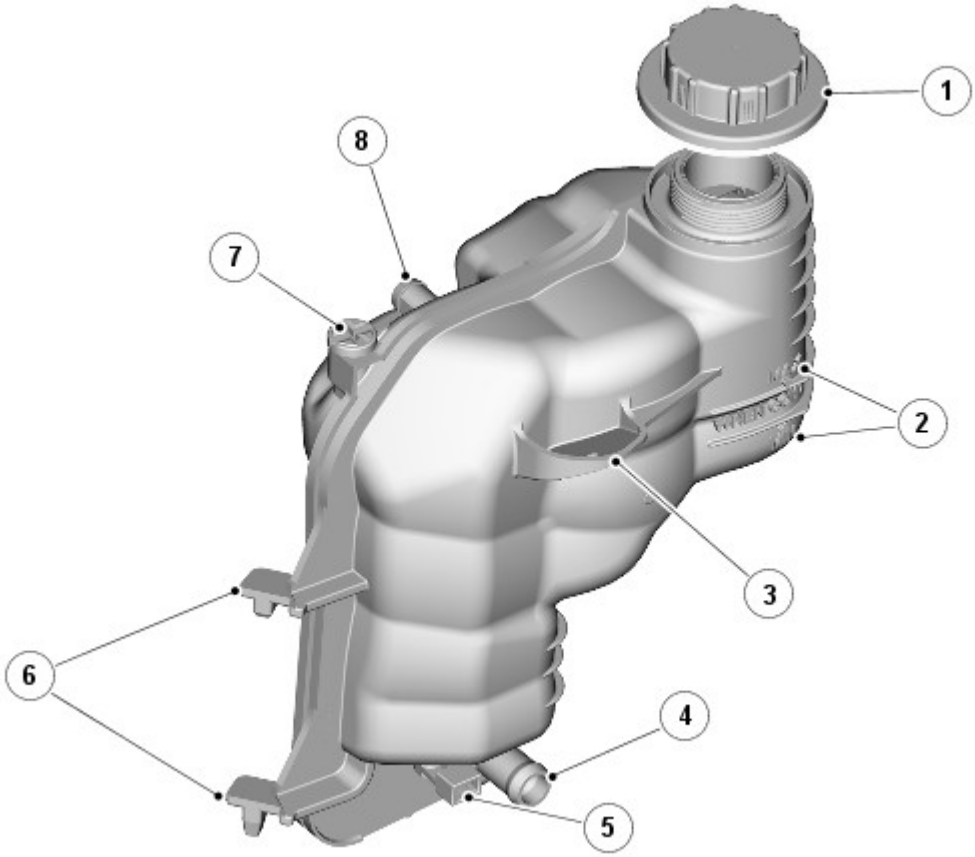


E145081

Item	Part Number	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 (303-05A Accessory Drive - TDV6 3.0L Diesel, Description and Operation).

Expansion Tank



E145082

Item	Part Number	Description
1	-	Filler cap
2	-	MAX and MIN level markings
3	-	Mounting lug
4	-	Supply hose connection
5	-	Coolant level sensor
6	-	Mounting lugs
7	-	Bleed screw
8	-	Vent hose connection

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 thermostat. A continuous vent into the expansion tank, through a hose connected to the radiator, prevents air locks from forming in the cooling system.

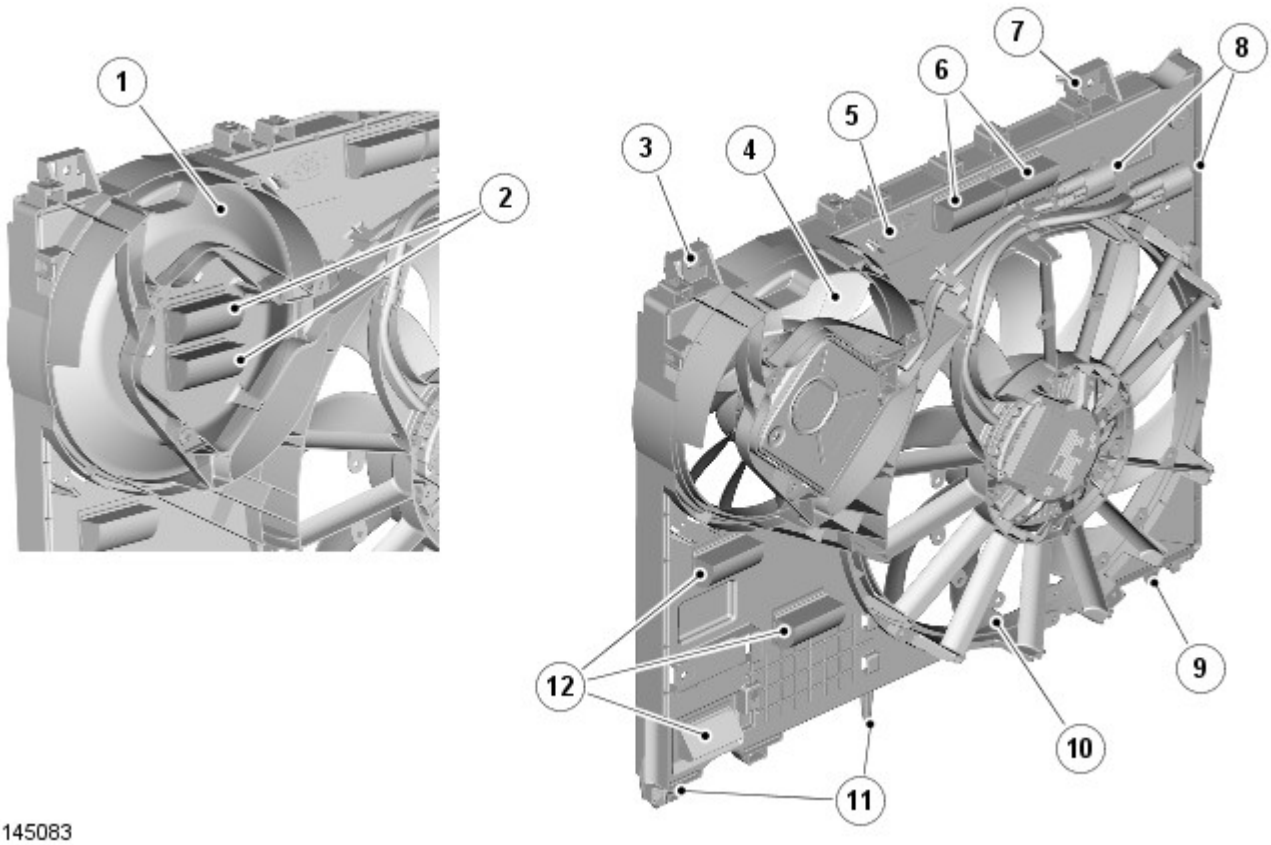
The expansion tank is attached to the front end carrier in the front left corner of the engine compartment. A filler cap, bleed screw and level sensor are incorporated into the expansion tank. MAX and MIN level markings are molded into the exterior of the tank.

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 0.5 to 1 liter (1.06 to 2,11 US pints), above the MAX level, to allow for coolant expansion.

Engine Cooling Fan(s)



E145083

Item	Part Number	Description
1	-	Blanking plate
2	-	Speed flaps
3	-	Mounting lug
4	-	Cooling fan 2
5	-	Shroud
6	-	Speed flaps
7	-	Mounting lug
8	-	Electrical connectors
9	-	Mounting lug
10	-	Cooling fan 1
11	-	Mounting lugs
12	-	Speed flaps

Depending on market and model specification, vehicles have either one or two variable speed electric engine cooling fans to help regulate the coolant temperature. The fan shroud is attached to the rear of the radiator. On vehicles with a single engine cooling fan, a blanking plate is installed in place of the second fan. The shroud incorporates speed flaps, which pivot open to allow engine compartment cooling at speed.

Each engine cooling fan is operated by a control module, integrated into their electric motor, which is controlled by the ECM (Engine Control Module). Electrical connectors at the right side of the fan shroud provide the interface between the cooling fan harnesses and the vehicle wiring. The control module of each engine cooling fan is provided with:

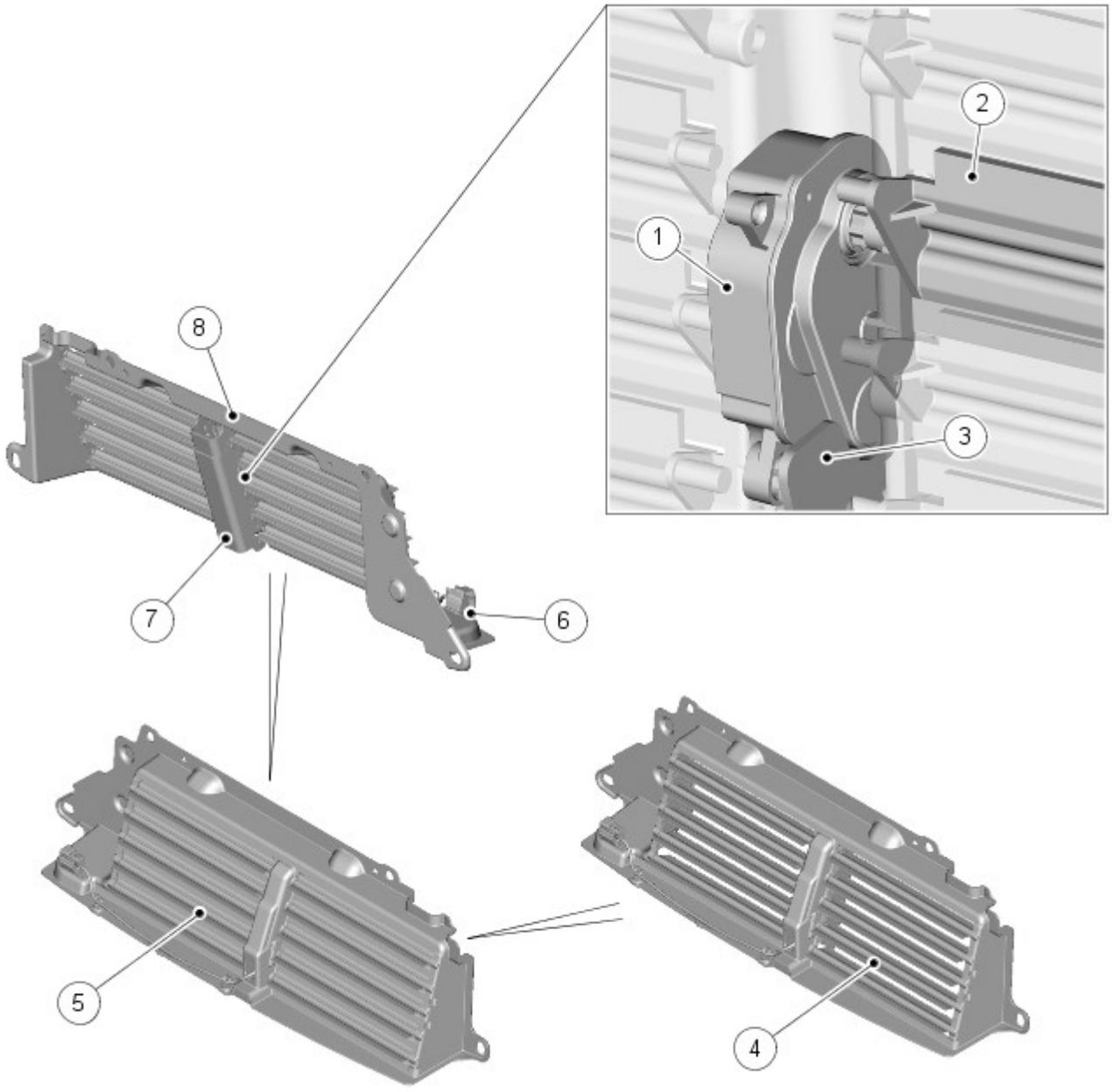
- A battery power supply from the AJB (Auxiliary Junction Box)
- An ignition signal from the ECM relay in the EJB (Engine Junction Box)
- A PWM (Pulse Width Modulation) signal from the ECM
- A ground.

To control each engine cooling fan, the ECM varies the duty cycle of the PWM signal. The fan control module translates the duty cycle into a fan target speed and sets the output current to the fan motor accordingly.

Engine Coolant

The coolant is silicate free and must not be mixed with conventional engine coolant.

Active Grille Air Shutter (Where Fitted)



E152300

Item	Part Number	Description
1	-	Motor
2	-	Master vane
3	-	Support bracket
4	-	Vane (10 off) fully open
5	-	Vane (10 off) fully closed
6	-	Electrical connector
7	-	Vane link
8	-	Housing

The active grille air shutter is installed behind the radiator grille and attached to the front end carrier. The active grille air shutter incorporates moveable vanes that control the air flow into the top half of the upstream main duct attached to the front of the cooling pack.

The vanes are installed in a housing in two groups of five and operated by an electric motor. The motor is held in a support bracket in the housing. The inboard hinge pin of one of the vanes (the master vane) is engaged in the output shaft of the motor. A lever on the inboard end of each vane is engaged in an motor link. When the motor turns the master vane, the motor link transfers the movement to the levers of the other nine vanes, which then turn in unison with the master vane.

The design of the vanes equalizes the wind loading on each side of the hinge pin, which reduces the resistance to turning when the vehicle is traveling at speed. A seal along the top edge of each vane provides sealing between adjacent vanes, and between the two upper vanes and the housing. The vanes can be set to one of 14 positions between fully closed and fully open, and have a range of movement of 80 degrees. During normal operation, for the vanes to move from fully closed to fully open takes approximately 30 seconds, and for the vanes to move from fully open to fully closed takes approximately 90 seconds.

Operation of the motor is controlled by the ECM, which communicates with the motor on a LIN (Local Interconnect Network) bus connection. Power for the motor is provided by a feed from the ECM relay in the EJB.

OPERATION

Coolant Circuit Flow

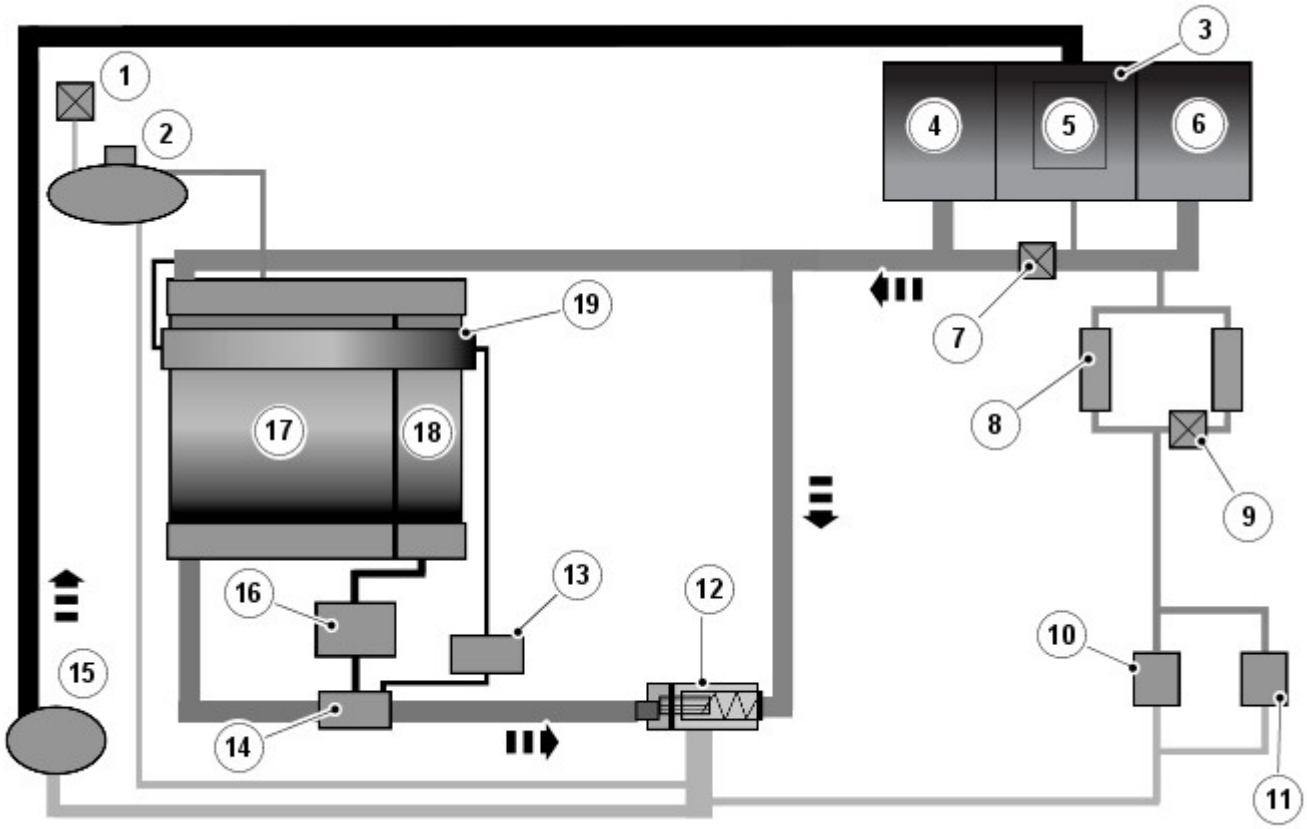
When the engine is running the coolant is circulated around the engine cooling system by the coolant pump. From the coolant pump, coolant flows through the cylinder block and the cylinder heads to the coolant outlet connector. Some of the coolant in the cylinder block is diverted through the engine oil cooler before returning to the coolant outlet connector.

From the coolant outlet connector, the majority of the coolant flows to the thermostat, either directly or via the radiator, depending on the temperature of the coolant and engine speed. The remainder of the coolant flows through the EGR (Exhaust Gas Recirculation) coolers and the heater circuit to the thermostat. From the outlet of the thermostat the coolant flows to the coolant inlet connector on the left side of the cylinder block and back to 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 returns to the system through a connector in the radiator lower hose.

A connection on the upper hose supplies coolant to the auxiliary fuel cooler. From the auxiliary fuel cooler, the coolant flows through the fuel cooler and returns to the system through the connector in the radiator lower hose.

Schematic Flow Diagram



E145085

Item	Part Number	Description
1	-	Static bleed point
2	-	Expansion tank
3	-	Cylinder block
4	-	Cylinder head
5	-	Engine oil cooler
6	-	Cylinder head
7	-	Static bleed point
8	-	Exhaust gas recirculation cooler (2 off)
9	-	Static bleed point
10	-	Heater
11	-	Auxiliary heater (where fitted)
12	-	Thermostat
13	-	Fuel cooler
14	-	Connector
15	-	Engine coolant pump

16	-	Transmission oil cooler
17	-	Radiator
18	-	Transmission oil sub-cooler
19	-	Auxiliary fuel cooler

Thermostat

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.

Coolant Level Sensor

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 IC (Instrument Cluster) on the high speed CAN (Controller Area Network) Powertrain bus to display a warning message.
For additional information, refer to: Instrument Cluster (413-01 Instrument Cluster, Description and Operation).

Engine Cooling Fan(s)

The ECM determines when to operate the cooling fan(s) from the ECT (Engine Coolant Temperature) sensor input and a cooling fan request from the ATCM (Automatic Temperature Control Module). The ECM also adjusts the fan speed to compensate for the ram effect of vehicle speed.

The ECM varies the duty cycle of the PWM signal to the fan control module between 0 and 100% to operate the fan motor in one of four modes: Off, minimum speed (750 rev/min), linear variable speed between minimum and maximum speeds, and maximum speed (2820 rev/min). Under hot operating conditions, the fan may continue to operate for up to five minutes after the engine has been switched off.

The fan control module monitors for over and under input voltage, a stalled motor and a partially stalled motor. If it detects any of these faults the fan control module temporarily pulls the PWM signal to ground to notify the fault to the ECM. The length of time the PWM signal is pulled to ground varies between 2 and 8 seconds, depending on the fault. The fan control module repeats the notification process at 5 second intervals until the fault is cleared. If there is more than one fault, only the highest priority fault is notified to the ECM. Fault priorities, in descending order, are over voltage, under voltage, stalled motor and partially stalled motor. The ECM records a related DTC (Diagnostic Trouble Code) for faults notified by the fan control module and signals the instrument cluster on the high speed CAN Powertrain bus to display a warning message.

The nominal operating voltage for the engine cooling fans is 9 to 16 volts. If the input voltage is outside of these limits, the fan control module stops operation of the cooling fan and notifies the ECM of the fault. After an under or over voltage occurs, cooling fan operation is resumed when the input voltage increases to 9.5 volts, or decreases to 15.5 volts, respectively.

To check for a stalled motor, each time it supplies power to start the fan motor the fan control module checks the fan motor speed after 2 seconds. If the speed is zero, the fan control module determines the fan motor is stalled and tries a restart. For a restart, the fan control motor disconnects the power from the fan motor then immediately reconnects it at an increased current level. The fan control module will try up to six restarts of a stalled motor, increasing the output current each time. If the fan motor remains stalled after the sixth restart, the fan control module waits 40 seconds then notifies the ECM of the fault and begins the start process again.

To check for a partially stalled motor, while the fan is running the fan control module monitors the current draw against fan speed. If the current draw is over the limit for more than 10 seconds, the fan control module disconnects the power from the fan motor and notifies the ECM of the fault. After 40 seconds, the fan control module starts the motor again.

The fan control module incorporates a temperature sensor to prevent damage caused by excessive heat at high ambient temperatures. Operation of the fan control module is discontinued if the temperature reaches 135 °C (275 °F). Operation resumes when the temperature decreases to 120 °C (248 °F).

If a fault occurs with the ignition signal or the PWM signal, the fan control module adopts the following fan speeds:

Signal	Fault	Fan Speed	
		Ignition On	Ignition Off
PWM	Duty cycle implausible	Maximum	Off
PWM	Frequency out of range	Maximum	Off
PWM	Open circuit	Maximum	Off
PWM	Short circuit to battery	Maximum (provided cooling fan is not damaged)	Off
PWM	Short circuit to ground	Maximum (provided cooling fan is not damaged)	Off
Ignition	Open circuit	Off	Off
Ignition	Short circuit to battery	According to PWM duty cycle	Maximum
Ignition	Short circuit to ground	Off (ECM relay fuse may blow)	Off

Active Grille Air Shutter

During normal driving operation, the ECM determines vane position from the thermal condition of the vehicle, which is an output of the fan control logic. The position of the vanes is calculated using:

- Engine coolant temperature
- A/C (Air Conditioning) demand
- Ambient air temperature
- Fuel temperature
- Terrain Response® mode selection.

If vehicle speed reaches 180 km/h (112 mph), the vanes move to the fully open position. The vanes resume a calculated opening position when vehicle speed decreases to 140 km/h (87 mph).

In the case of engine cooling fan after-run, the vanes remain open. Once the fan after-run ends, the vanes close and the motor will send a signal to the ECM indicating it is ready to power down.

CALIBRATION MODE

When the ECM shuts down, the motor loses its memory. Therefore a calibration is required every time the ignition is switched on unless the ECM has remained active between ignition off and ignition on (e.g. engine cooling fan after-run).

Calibration only commences after the engine has started.

The calibration process opens and closes the vanes to find the end stops and range of motion between them. This range of movement is checked and if it is within the specified limits, the cycle is passed. This cycle can take up to 16 seconds.

The software allows for a total of 6 calibration attempts.

If the first attempt fails; as soon as a position demand exceeds 45% it will carry out the remaining five attempts, one after the other, until they either pass a calibration or fail all 6 attempts.

If the vanes pass the 3rd calibration, e.g. the vanes had been frozen for the first 2 attempts and have since thawed out, the remaining attempts are saved for the rest of the drive cycle

A Calibration Failed Fault DTC will only be stored if the calibration fails from the first attempt and all attempts are used up.

The vanes will then be commanded to open as much as possible.

If the first calibration passes, then a Calibration Failed Fault DTC cannot be set until the next drive.

 NOTE: The motor is very sensitive to voltage drops from engine cranking and may trigger a further calibration.

JET WASH MODE

Jet wash mode allows the motor to fully open the vanes and then power down so that the radiator can be cleaned. To activate jet wash mode:

1. Start the engine.
2. Stop the engine and turn the ignition off.
3. Turn the ignition on (do not start the engine).
4. Select Terrain Response® sand mode.
5. Turn the ignition off.

This sequence prevents jet wash mode being entered accidentally if the ignition is turned off in sand mode.

The vanes will default to fully open whether the calibration has been completed or not. (See calibration)

Once the position feedback shows that the vanes are fully open, the motor will indicate to the ECM that it is ready to power down.

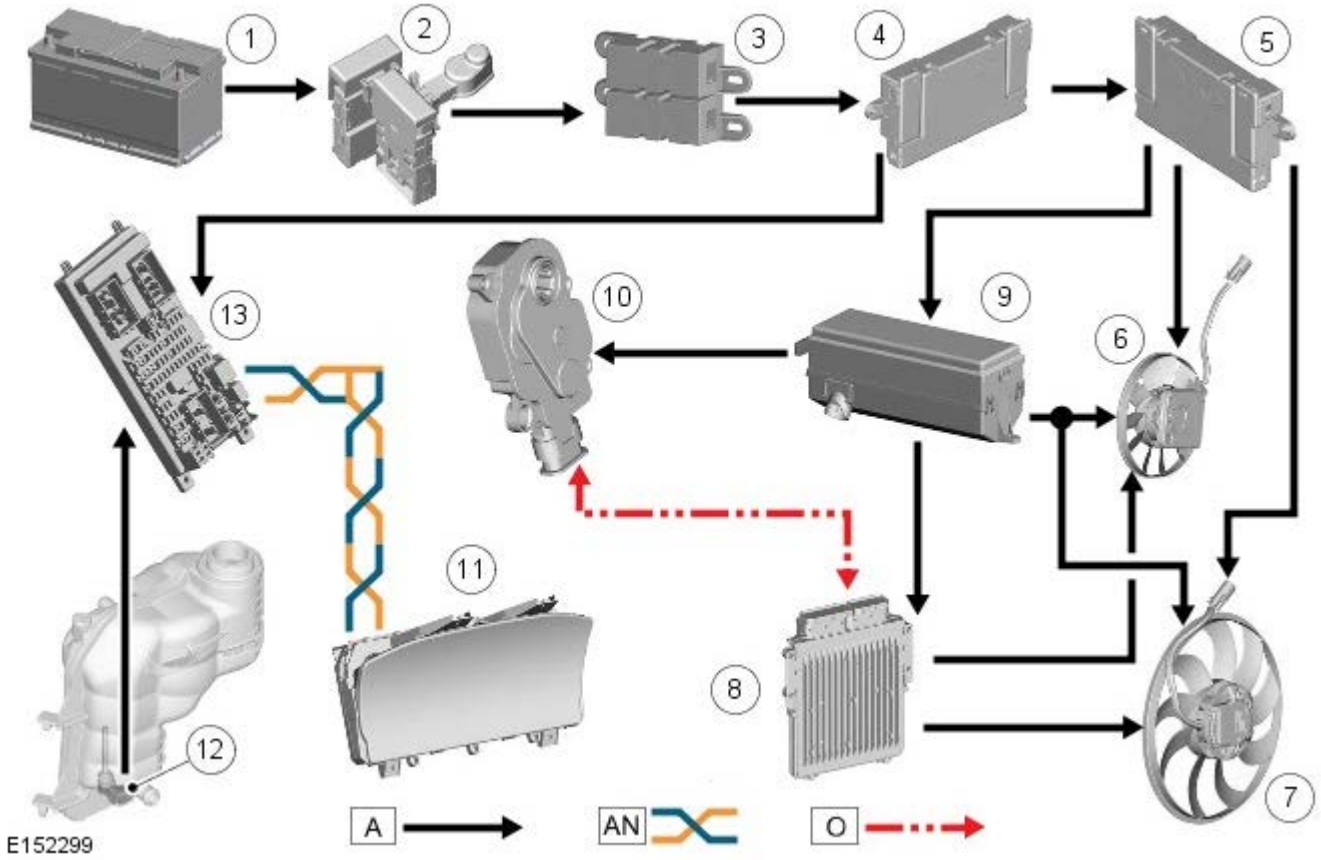
FAULT DIAGNOSIS

If there is a fault with the active grille air shutter, the Engine Over Temperature warning is displayed in the IC. For each fault, a flag is set and after a calibrated de-bounce time, a DTC is stored in the ECM. The following faults can be detected:

- Mechanical blockage fault – Motor encounters too much resistance and stalls. Max Torque = 0.7-0.8 Nm. Once blocked, the motor will try to recalibrate up to maximum number of attempts as described in the calibration section.
- Calibration Failed Fault – Fault stored if all calibration attempts have failed in that drive cycle.
- Electrical Fault – Motor reports an internal electrical fault.
- Supply Voltage Fault – Motor supply voltage falls outside the range 7.5V – 17.5V.
- Thermal Shutdown Fault – Motor circuits exceed their inbuilt temperature threshold.
- Disconnect Fault – Linkage between the motor and the vanes becomes disconnected.
- LIN Bus Error Fault and Node Detection Fault – A fault with the motor, its signal wire or its supply that causes a breakdown in signals to the ECM. If the motor is still operational and only the signal wire has a short circuit/open circuit, then the motor will fail safe fully open after 10 seconds of not receiving a signal.

Control Diagram

 NOTE: A = Hardwired, AN = High speed CAN (Controller Area Network) Powertrain bus, O = LIN (Local Interconnect Network) bus.



Item	Part Number	Description
1	-	Battery
2	-	Megafuse
3	-	Battery Junction Box 2 (BJB2)
4	-	Battery Junction Box (BJB)
5	-	Auxiliary Junction Box (AJB)
6	-	Coolong Fan 2 (where fitted)
7	-	Cooling Fan 1
8	-	Engine Control Module (ECM)
9	-	Engine Junction Box (EJB)
10	-	Active grille air shutter motor (where fitted)
11	-	Instrument Cluster (IC)
12	-	Coolant level sensor
13	-	Central Junction Box (CJB)

Published: 31-Jul-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: Engine Cooling (303-03A Engine Cooling - 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
• Coolant leaks • Coolant hoses • Coolant expansion tank • Radiator • Heater core • Active grill air shutter • Accessory drive belt • Cooling fan	• Fuses • Harnesses • Loose or corroded connector(s) • Engine coolant temperature 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. Refer to the relevant section of the workshop manual
Overheating	• Low/contaminated coolant • Thermostat • Cooling fan • Engine coolant temperature sensor • Restricted air flow over the radiator • Active grill air shutter	Check the coolant level and condition. Carry out a cooling system pressure test. Rectify any leaks as necessary. Check the thermostat and rectify as necessary. Check the cooling fan operation, make sure the cooling fan rotates freely. Check for obstructions to the air flow over the radiator. Check the active grill air shutter operation using the manufacturer approved service tool
Engine not reaching normal temperature	• Thermostat • Cooling fan	Check the thermostat operation. Check the cooling fan operation, make sure the cooling fan is not seized

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: 06-Aug-2012

Engine Cooling - TDV6 3.0L Diesel - Cooling System Draining, Filling and Bleeding

General Procedures

Draining

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.

NOTE: This procedure only needs to be carried out when the coolant system vacuum filler equipment is not available in the workshop.

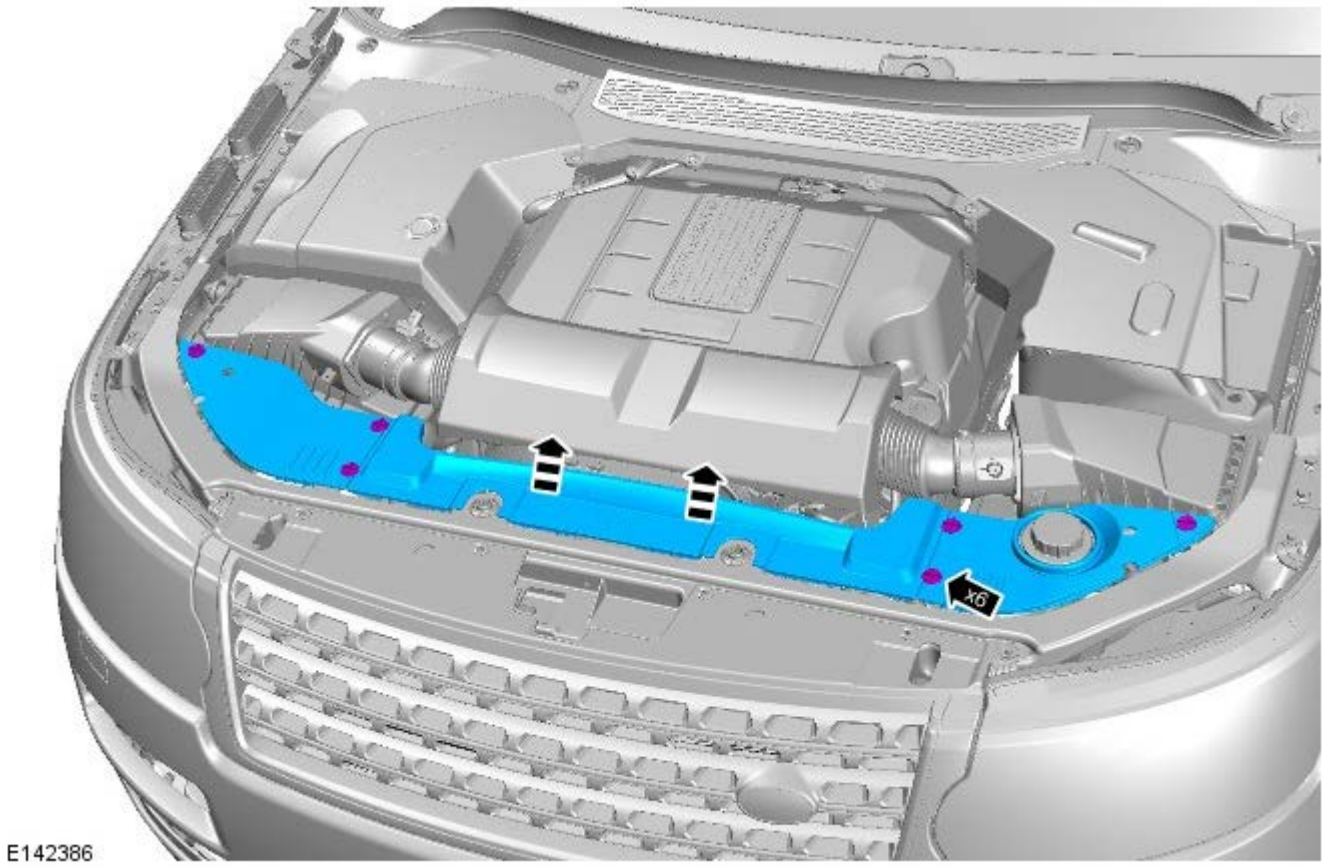
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

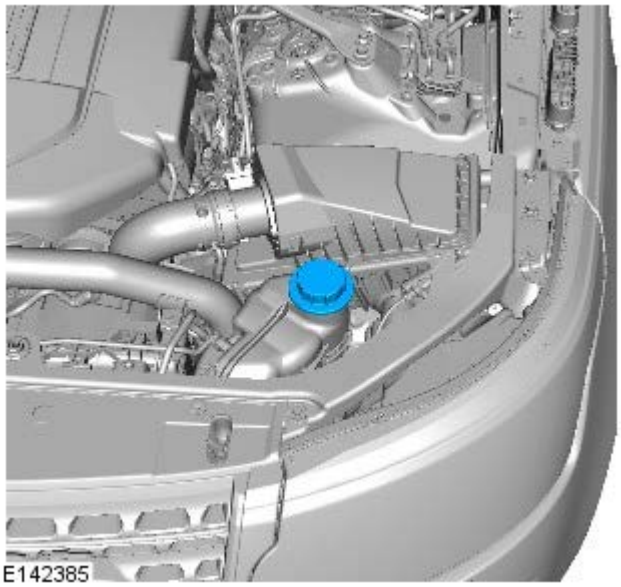
2. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

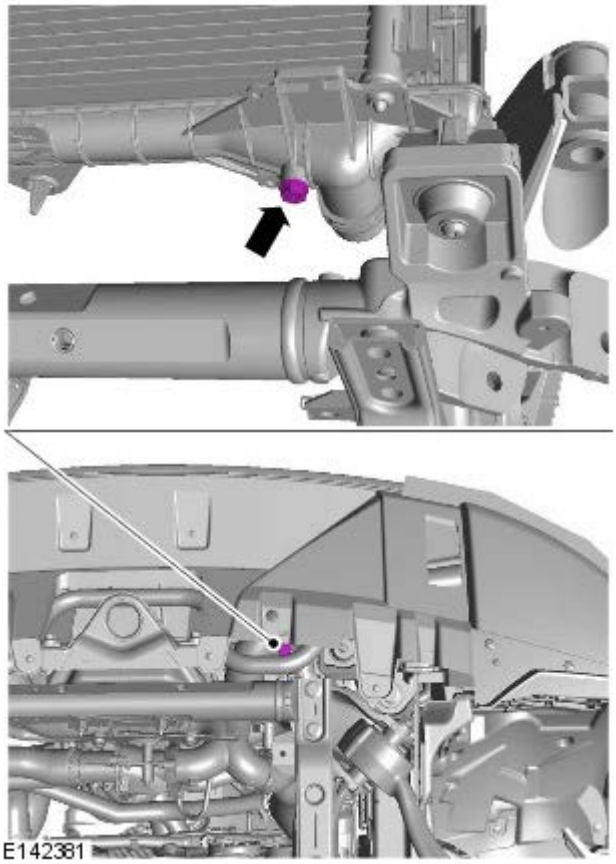
3. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05 Interior Trim and Ornamentation, Removal and Installation).

4.



5. WARNING: When releasing the cooling system pressure, cover the coolant expansion tank cap with a thick cloth.





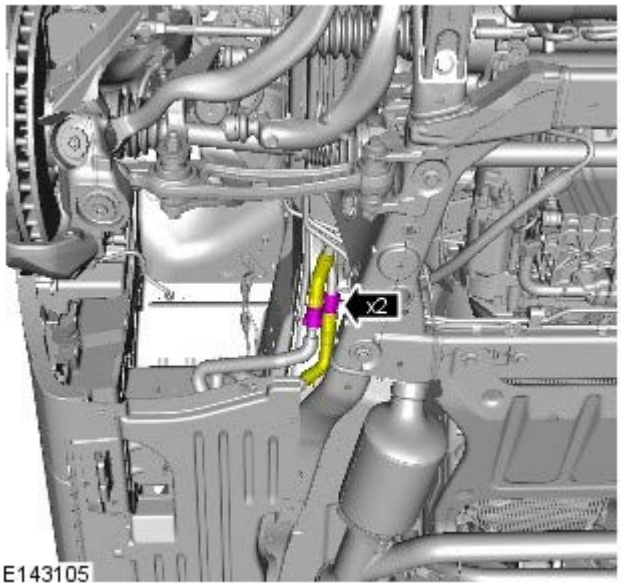
6. CAUTION: Be prepared to collect escaping coolant.

NOTE: Step 7-10 and 12-13 only needs to be carried out when auxiliary climate control system has been fitted to the vehicle.

7. Remove the front RH wheel arch liner.

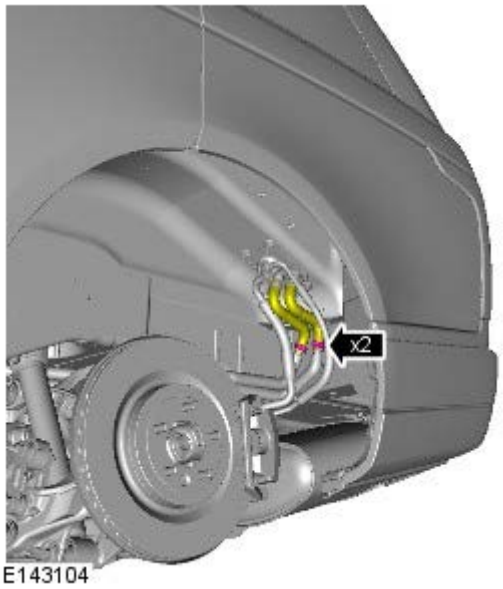
   Refer to: Fender Splash Shield (501-02 Front End Body Panels, Removal and Installation).

8. CAUTION: Be prepared to collect escaping coolant.



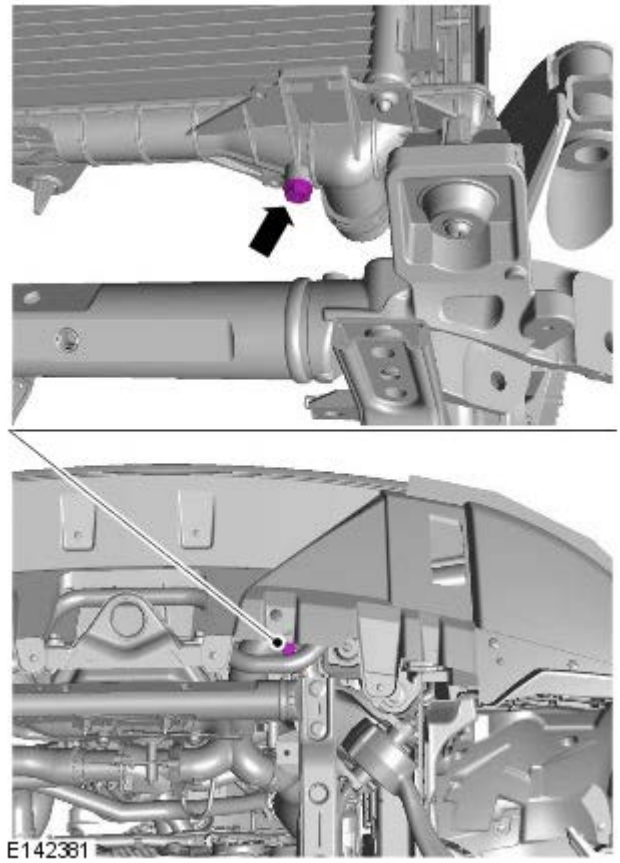
9. Remove the rear LH wheel arch liner.

   Refer to: Rear Fender Splash Shield (501-08 Exterior Trim and Ornamentation, Removal and Installation).

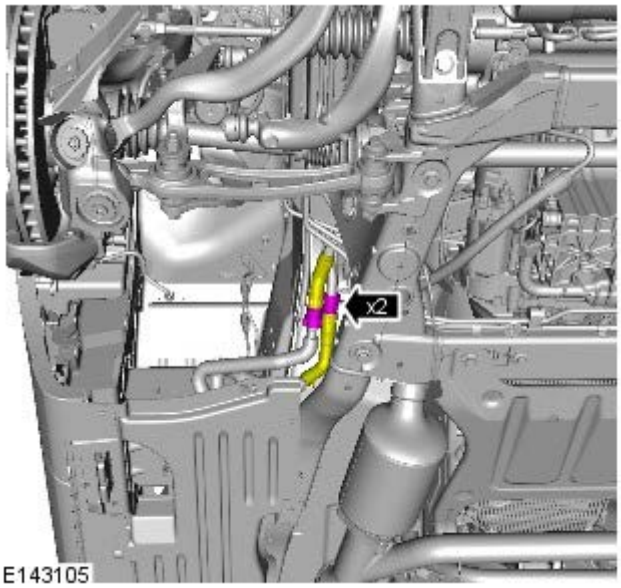


10. CAUTION: Be prepared to collect escaping coolant.

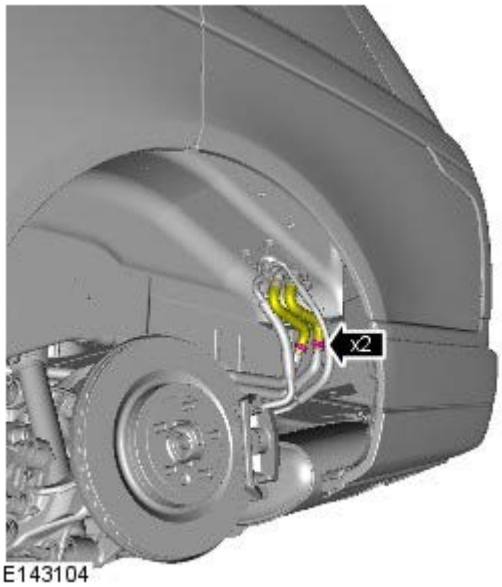
11. *Torque:* 5 Nm



12.



13.



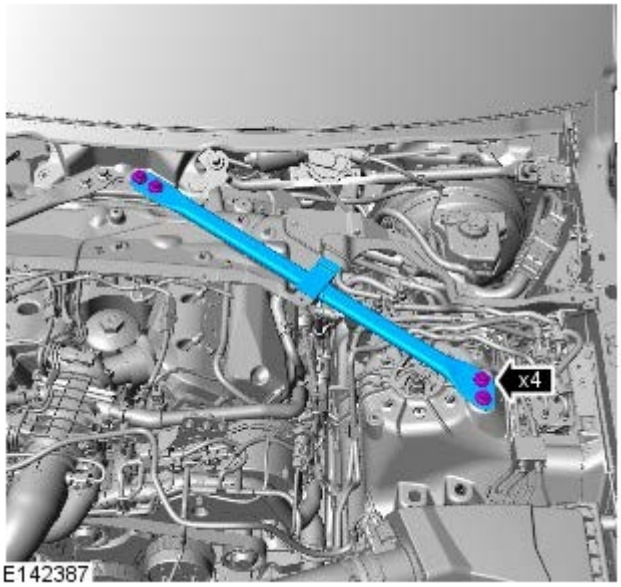
E143104

14. Carry out the procedure up to step 1 in the filling section three times, filling the cooling system with clean water after the first two drains. At the third refill, use a suitable measuring tool to make sure that the cooling system maintains a 50% mix.

Filling

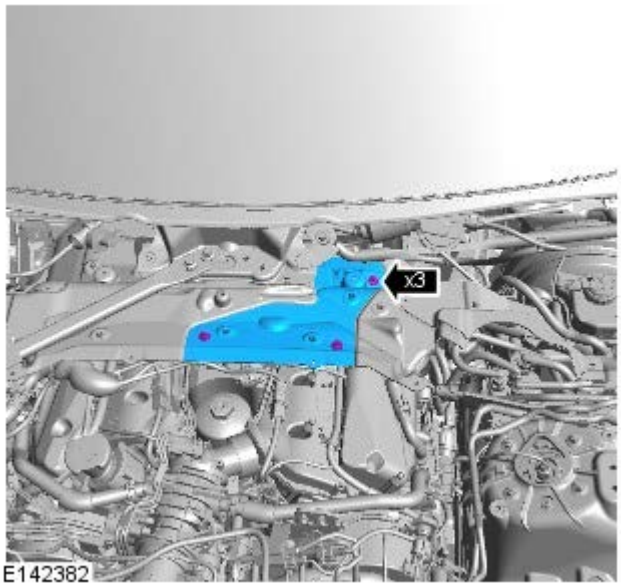
1. Refer to: Cowl Panel Grille (501-02 Front End Body Panels, Removal and Installation).

2.

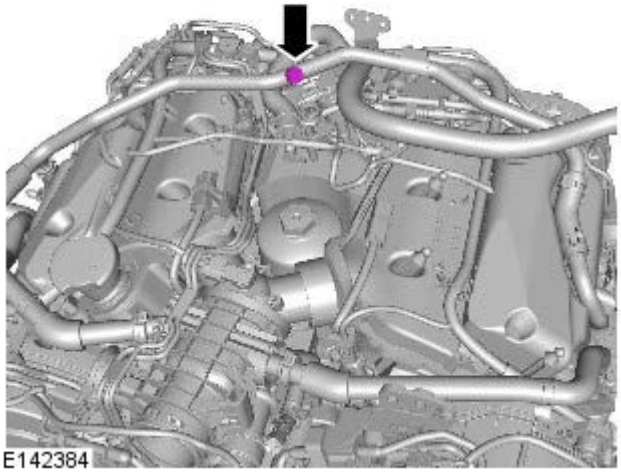


E142387

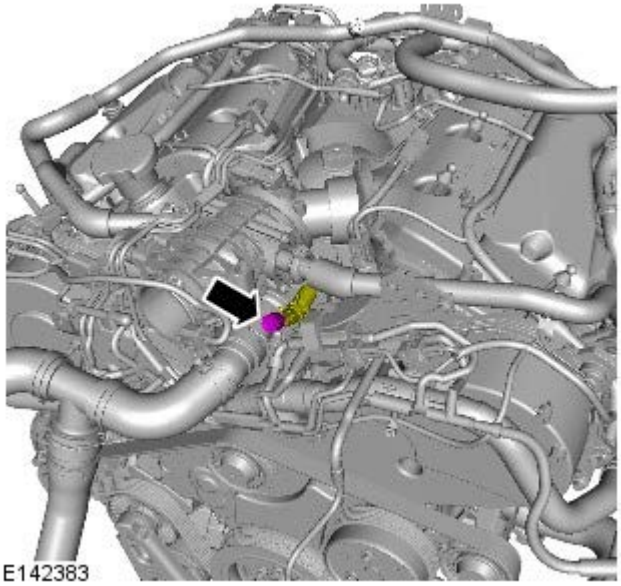
3.



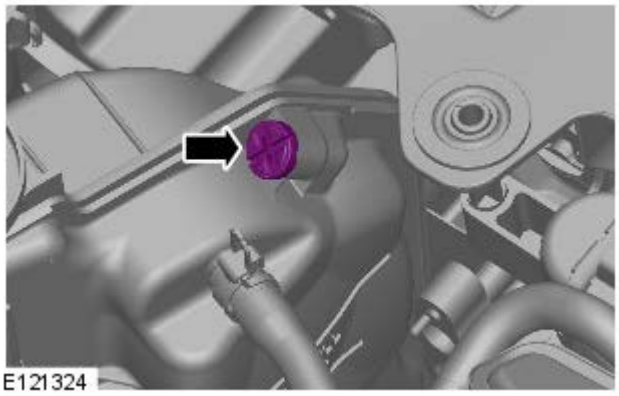
4.



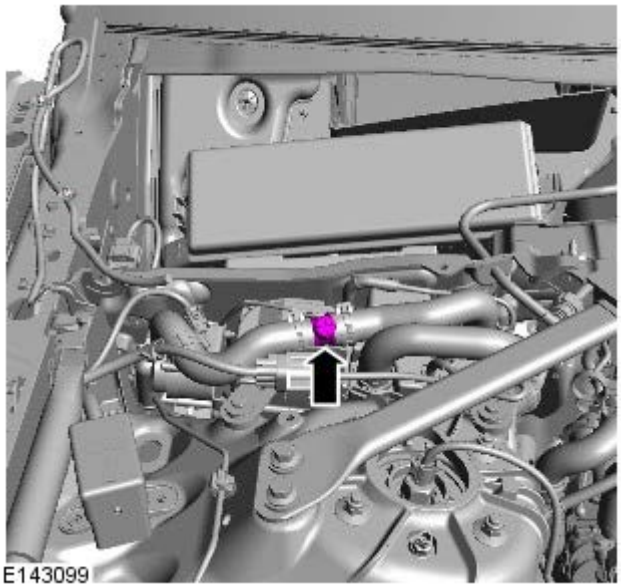
5.



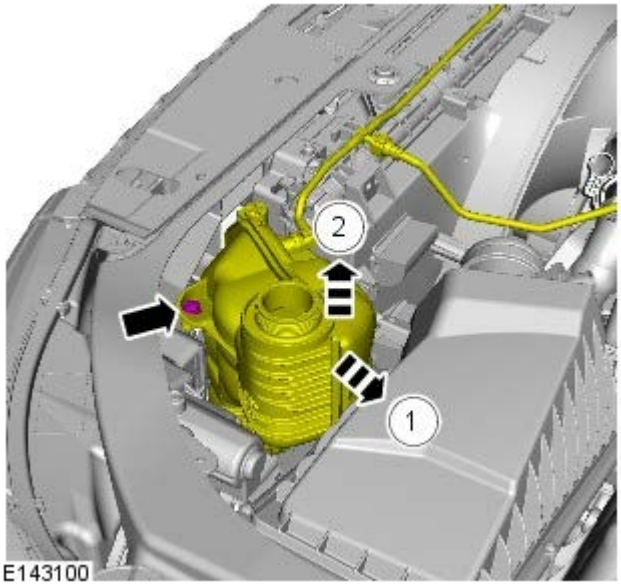
6.



7. NOTE: Where fitted.

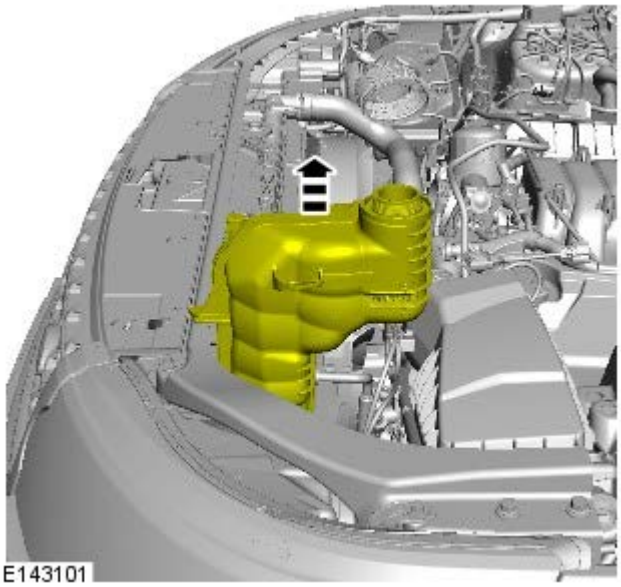


8. *Torque:* 9 Nm



9. NOTE: Keep the coolant expansion tank vertically.

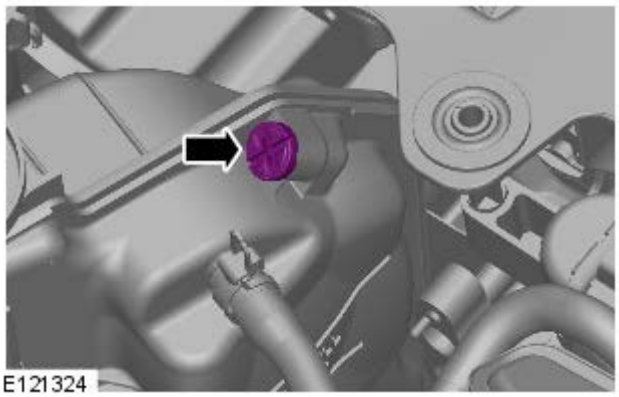
Raise the coolant expansion tank minimum 110mm from its original position.


E143101

10. CAUTION: Anti-freeze concentration must be maintained at 50%.

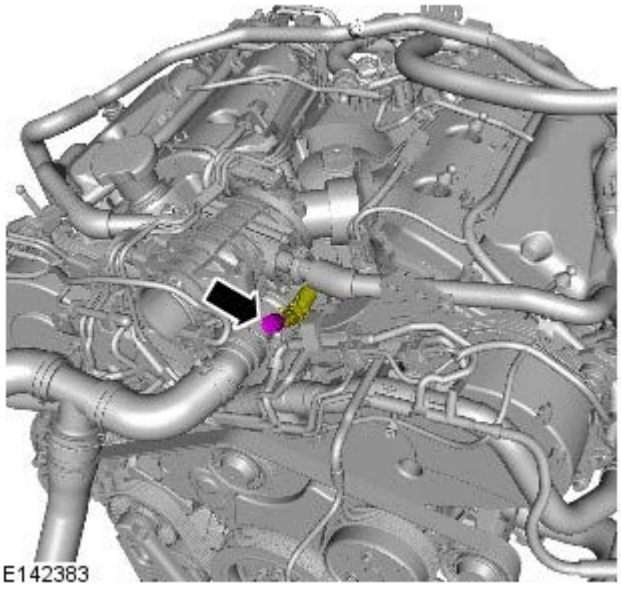
    Fill the coolant expansion tank to the rim and continue until coolant is visable from the outlet.

11.

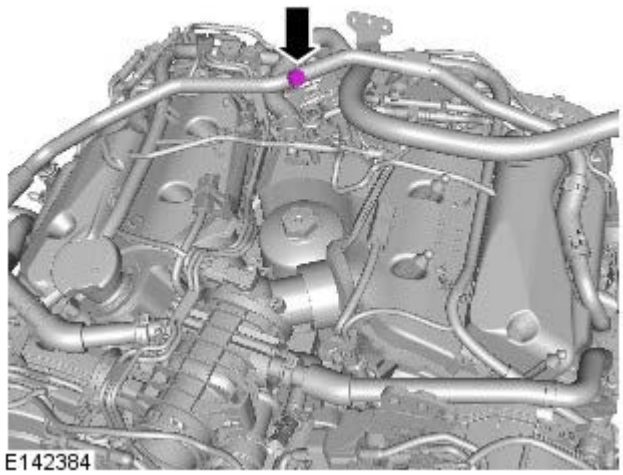

E121324

NOTE: Once coolant is visable from the outlet, close the bleeding points.

12.

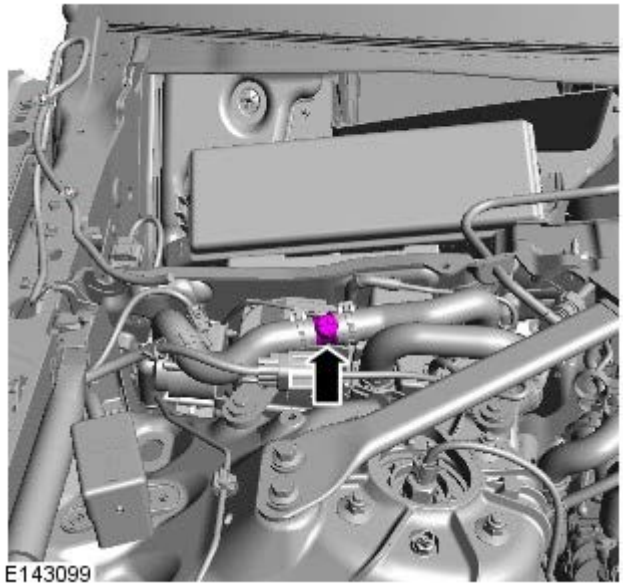

E142383

13.


E142384

14. Set the heater controls to maximum.

15. Start the engine and allow to idle.


E143099

16. NOTE: Where fitted.

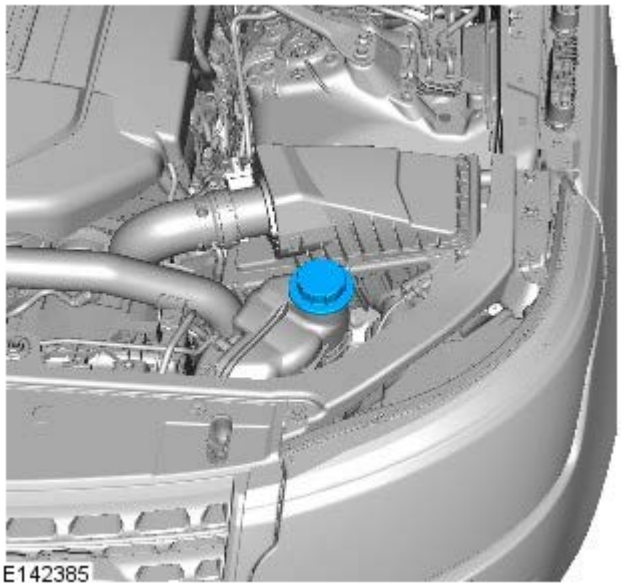
    Once coolant is visable from the outlet, close the bleeding points.

17. Hold the engine speed at 2000 rpm until warm air is expelled from the heater.

18. Continue to fill the coolant expansion tank to the rim until the coolant level stops dropping.

19. Install the coolant expansion tank.

20. Install the expansion tank cap after making sure that the final coolant level is 40mm above the maximum cold fill line.



21. Run the engine until the thermostat opens and hot air is emitted from the front and rear face vents.

22. Switch the engine off and allow to cool.

23. WARNINGS:

    When releasing the cooling system pressure, cover the coolant expansion tank cap with a thick cloth.

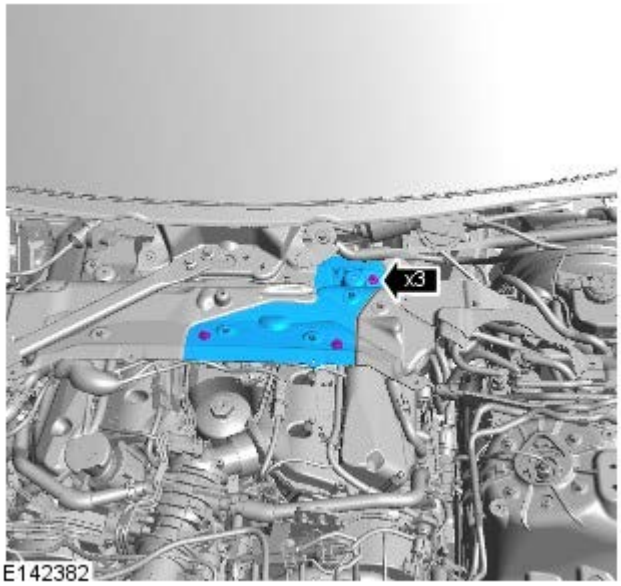
    Since injury such as scalding could be caused by escaping steam or coolant, make sure the vehicle cooling system is cool prior to carrying out this procedure.

    CAUTION: Make sure the coolant level remains above the "COLD FILL RANGE" lower level mark.

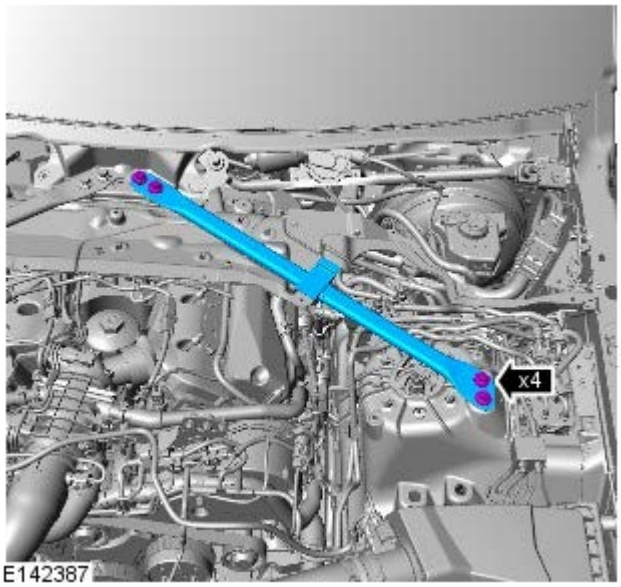
    Check and top-up the coolant if required.

24. Visually check the engine and cooling system for signs of coolant leakage.

25. *Torque:* 6 Nm

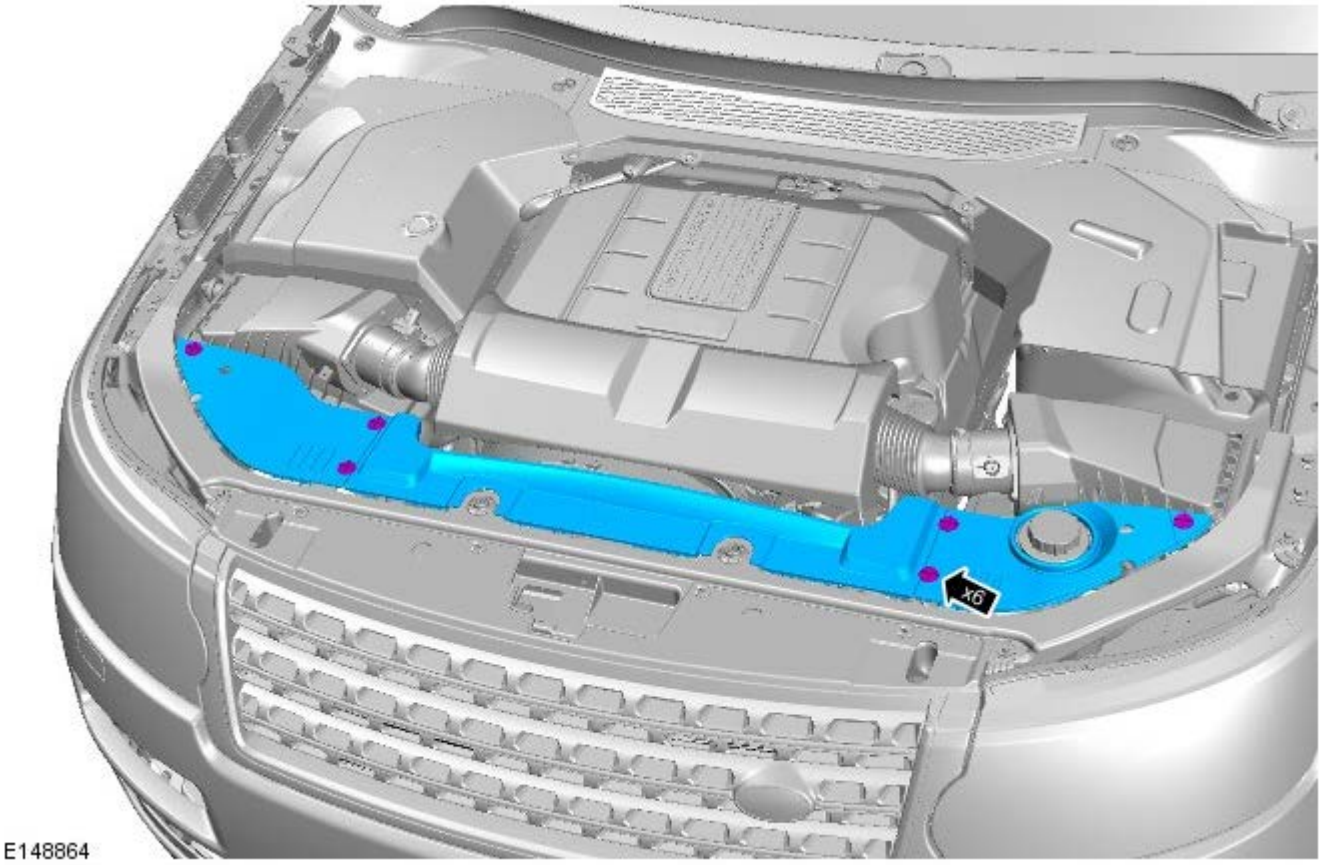


26. *Torque:* 55 Nm



27. Refer to: Cowl Panel Grille (501-02 Front End Body Panels, Removal and Installation).

28.



29. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05 Interior Trim and Ornamentation, Removal and Installation).

30. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

Published: 04-Aug-2012

Engine Cooling - TDV6 3.0L Diesel - Cooling System Partial Draining, Filling and Bleeding

General Procedures

Draining

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.

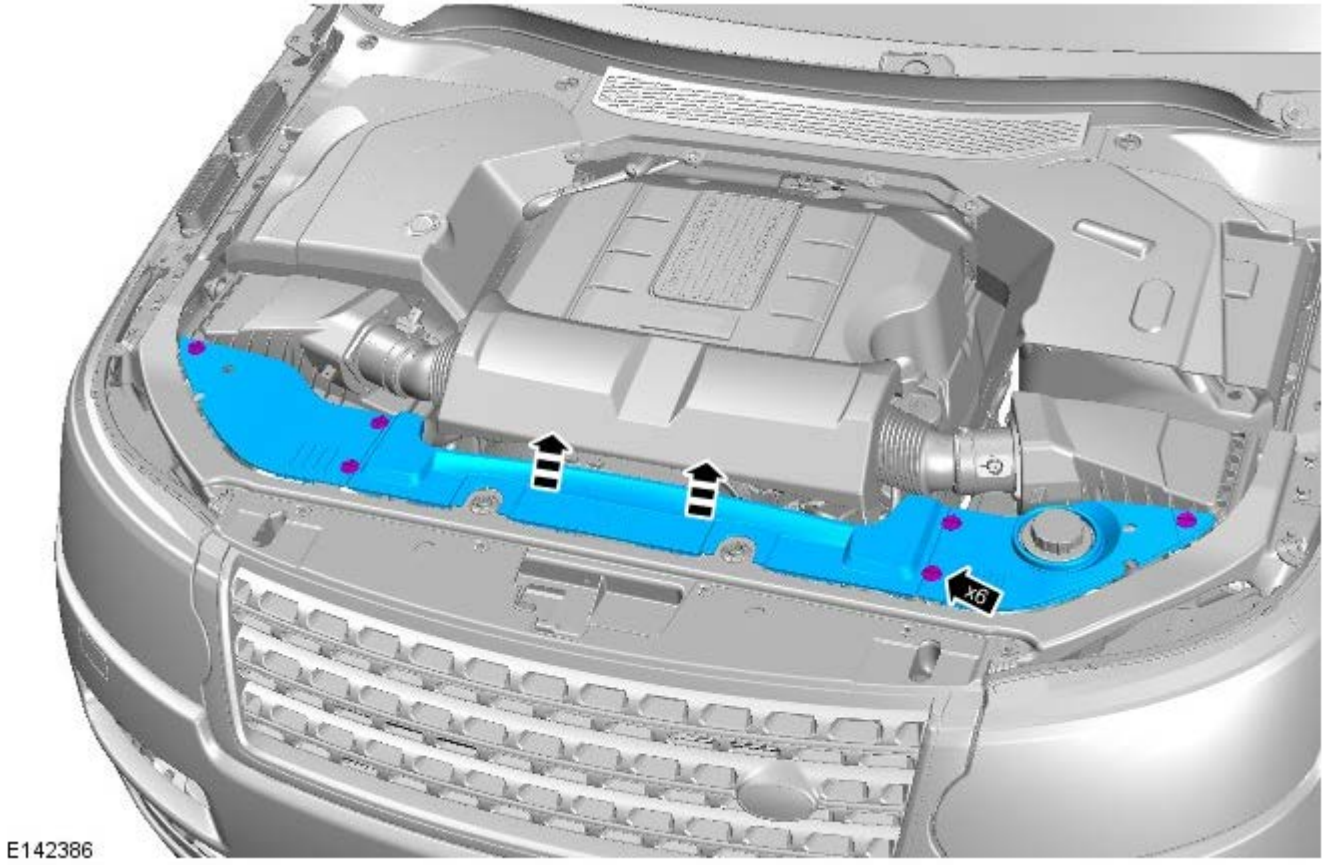
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

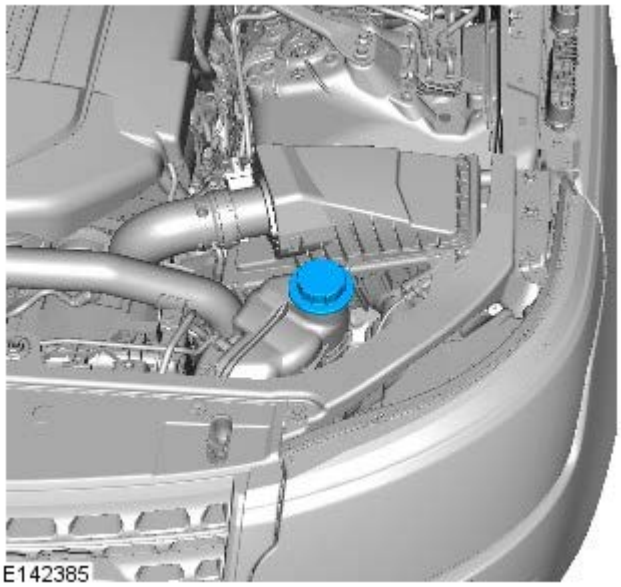
2. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

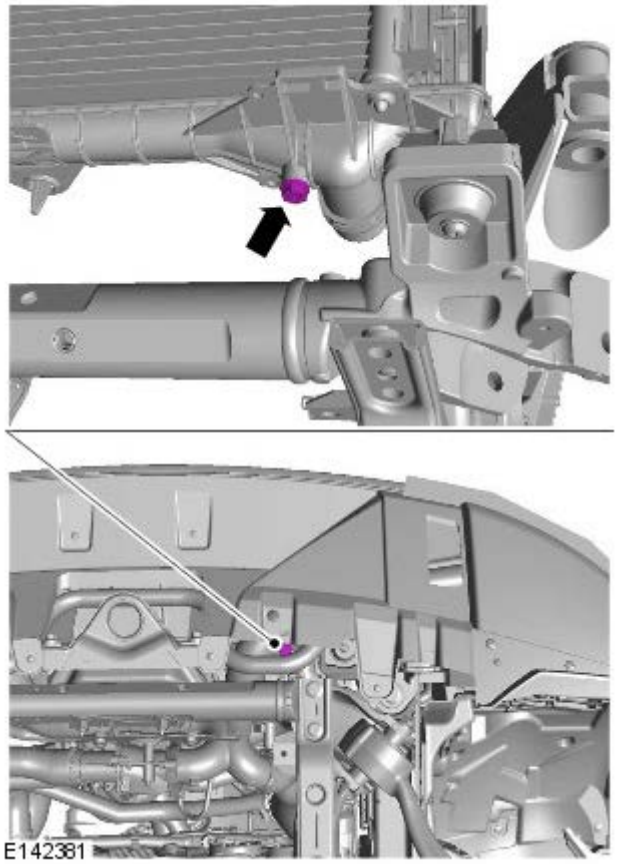
3. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05 Interior Trim and Ornamentation, Removal and Installation).

4.



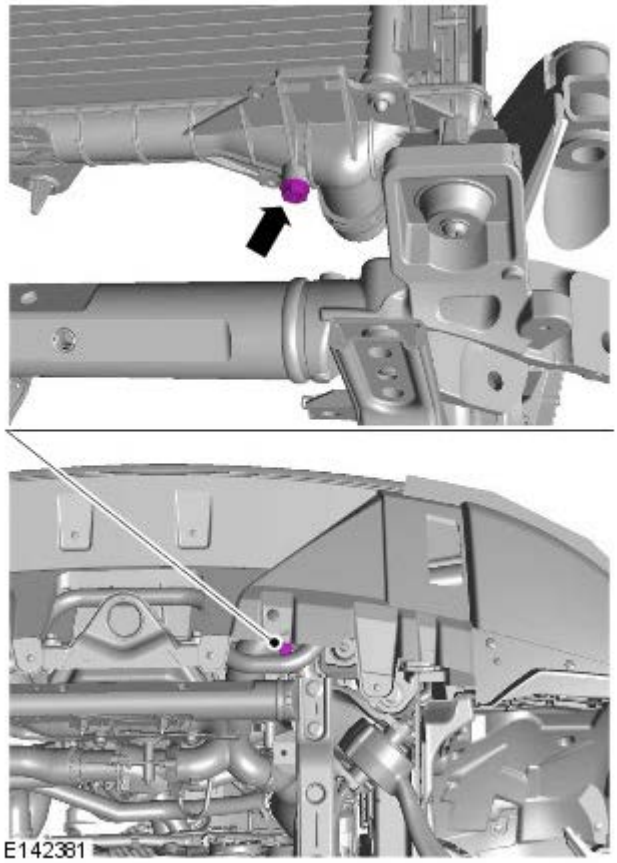
5. WARNING: When releasing the cooling system pressure, cover the coolant expansion tank cap with a thick cloth.





6. CAUTION: Be prepared to collect escaping coolant.

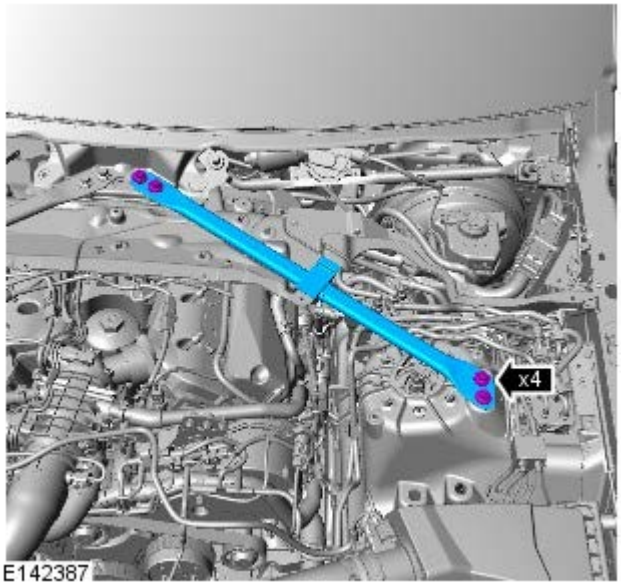
7. *Torque:* 5 Nm



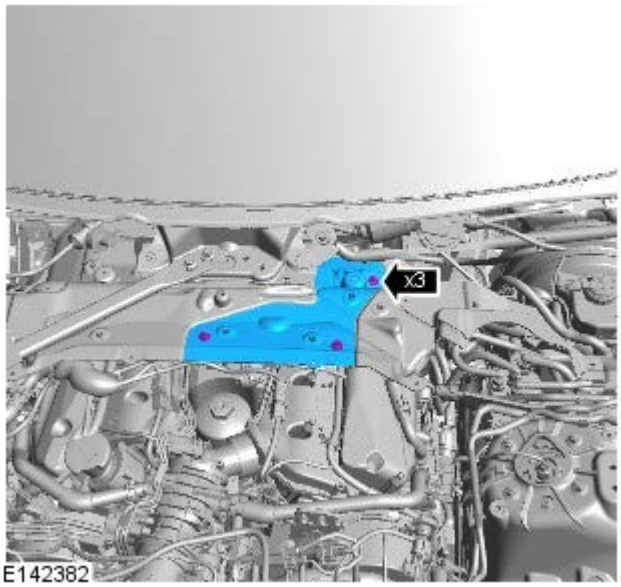
Filling

1. Refer to: Cowl Panel Grille (501-02 Front End Body Panels, Removal and Installation).

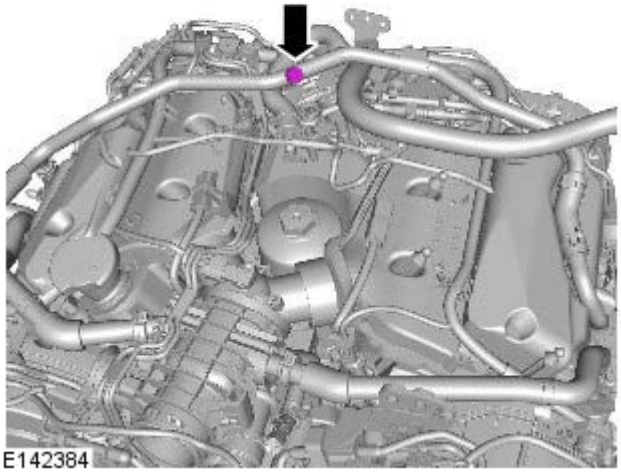
2.



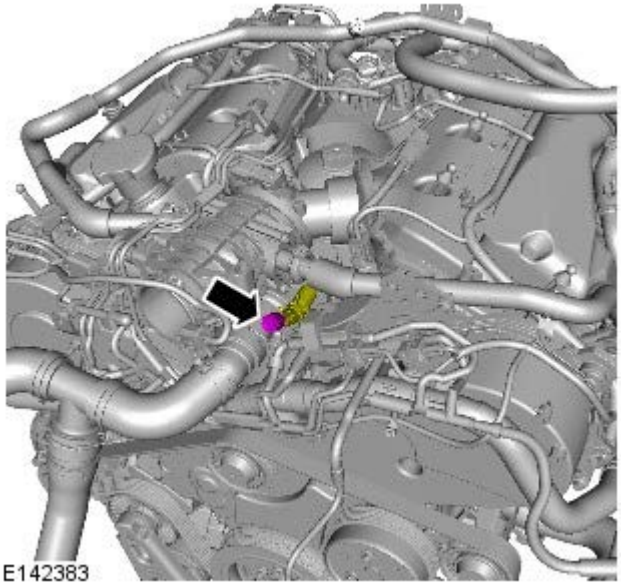
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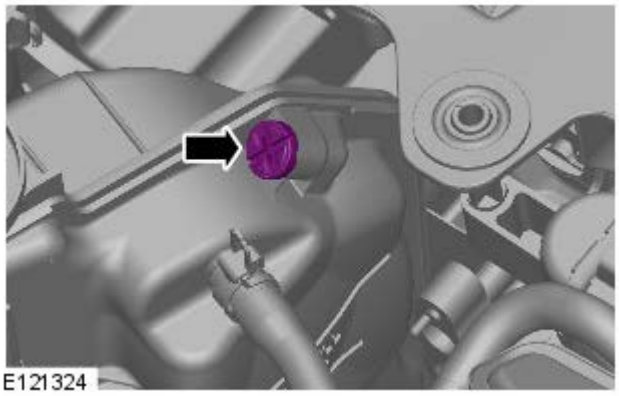
4.



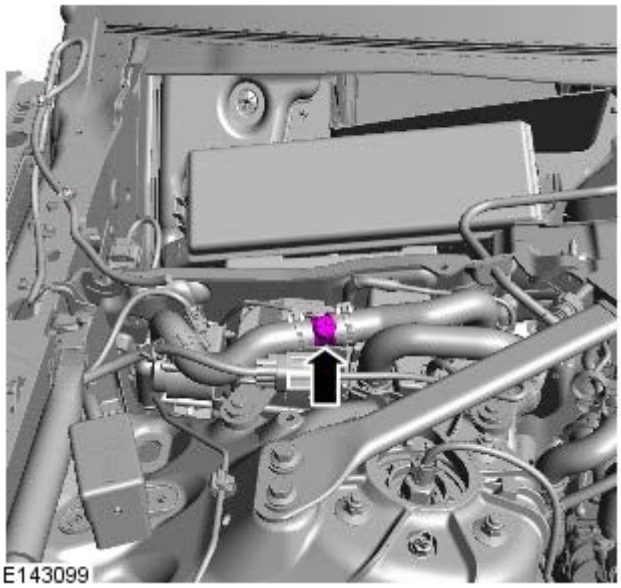
5.



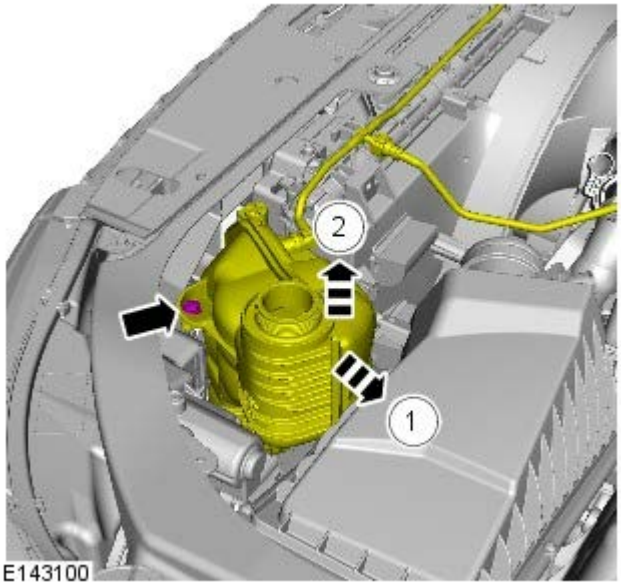
6.



7. NOTE: Where fitted.

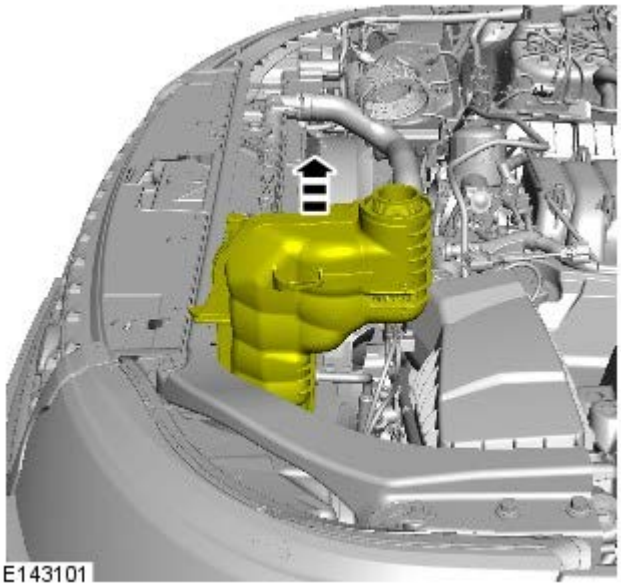


8. *Torque:* 9 Nm



9. NOTE: Keep the coolant expansion tank vertically.

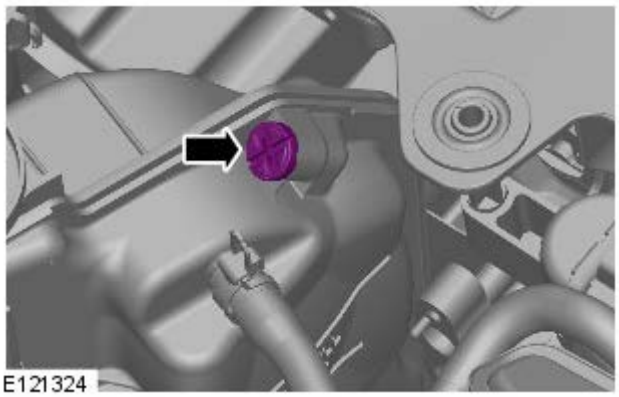
Raise the coolant expansion tank minimum 110mm from its original position.


E143101

10. CAUTION: Anti-freeze concentration must be maintained at 50%.

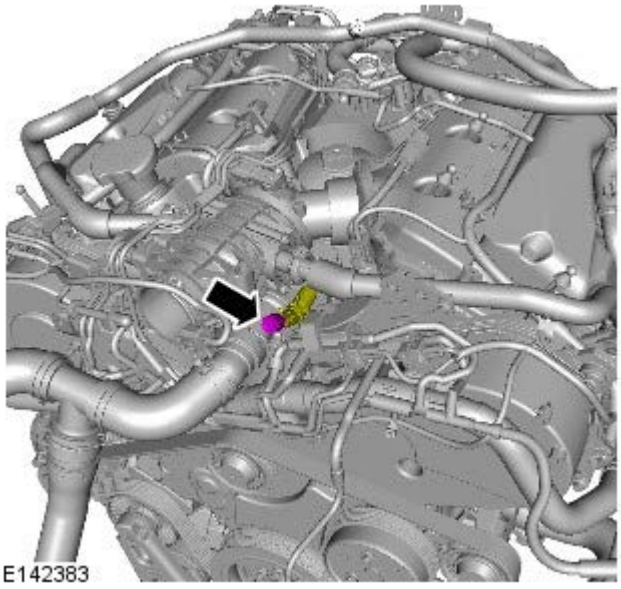
    Fill the coolant expansion tank to the rim and continue until coolant is visable from the outlet.

11.

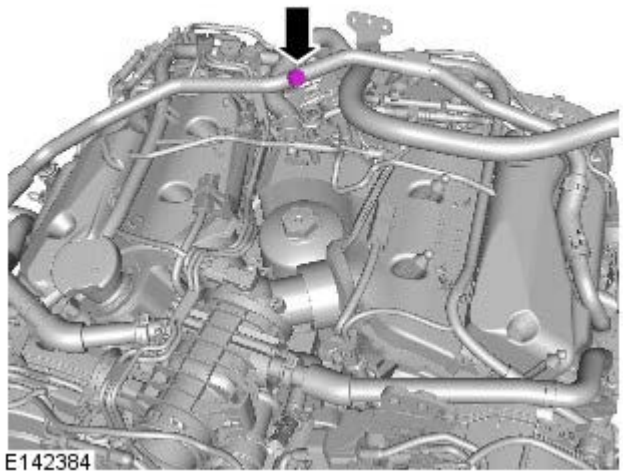

E121324

NOTE: Once coolant is visable from the outlet, close the bleeding points.

12.

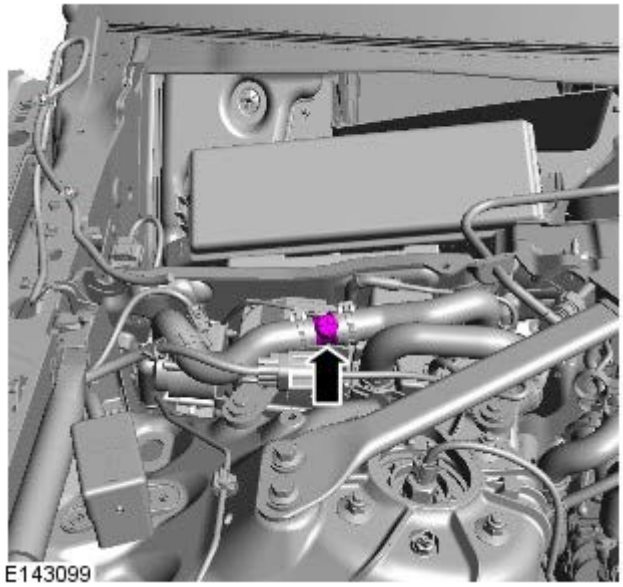

E142383

13.


E142384

14. Set the heater controls to maximum.

15. Start the engine and allow to idle.


E143099

16. NOTE: Where fitted.

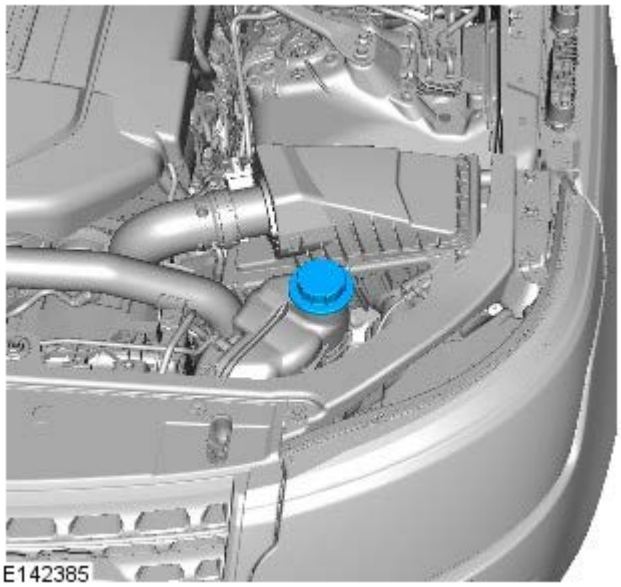
    Once coolant is visable from the outlet, close the bleeding points.

17. Hold the engine speed at 2000 rpm until warm air is expelled from the heater.

18. Continue to fill the coolant expansion tank to the rim until the coolant level stops dropping.

19. Install the coolant expansion tank.

20. Install the expansion tank cap after making sure that the final coolant level is 40mm above the maximum cold fill line.



21. Run the engine until the thermostat opens and hot air is emitted from the front and rear face vents.

22. Switch the engine off and allow to cool.

23. WARNINGS:

    When releasing the cooling system pressure, cover the coolant expansion tank cap with a thick cloth.

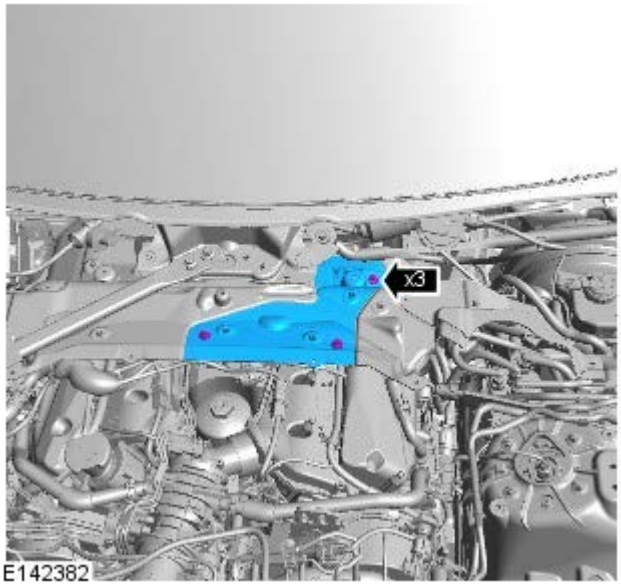
    Since injury such as scalding could be caused by escaping steam or coolant, make sure the vehicle cooling system is cool prior to carrying out this procedure.

    CAUTION: Make sure the coolant level remains above the "COLD FILL RANGE" lower level mark.

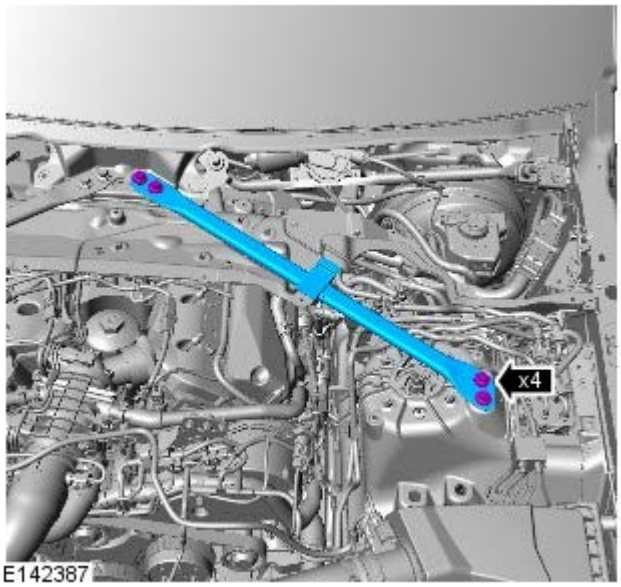
    Check and top-up the coolant if required.

24. Visually check the engine and cooling system for signs of coolant leakage.

25. *Torque:* 6 Nm

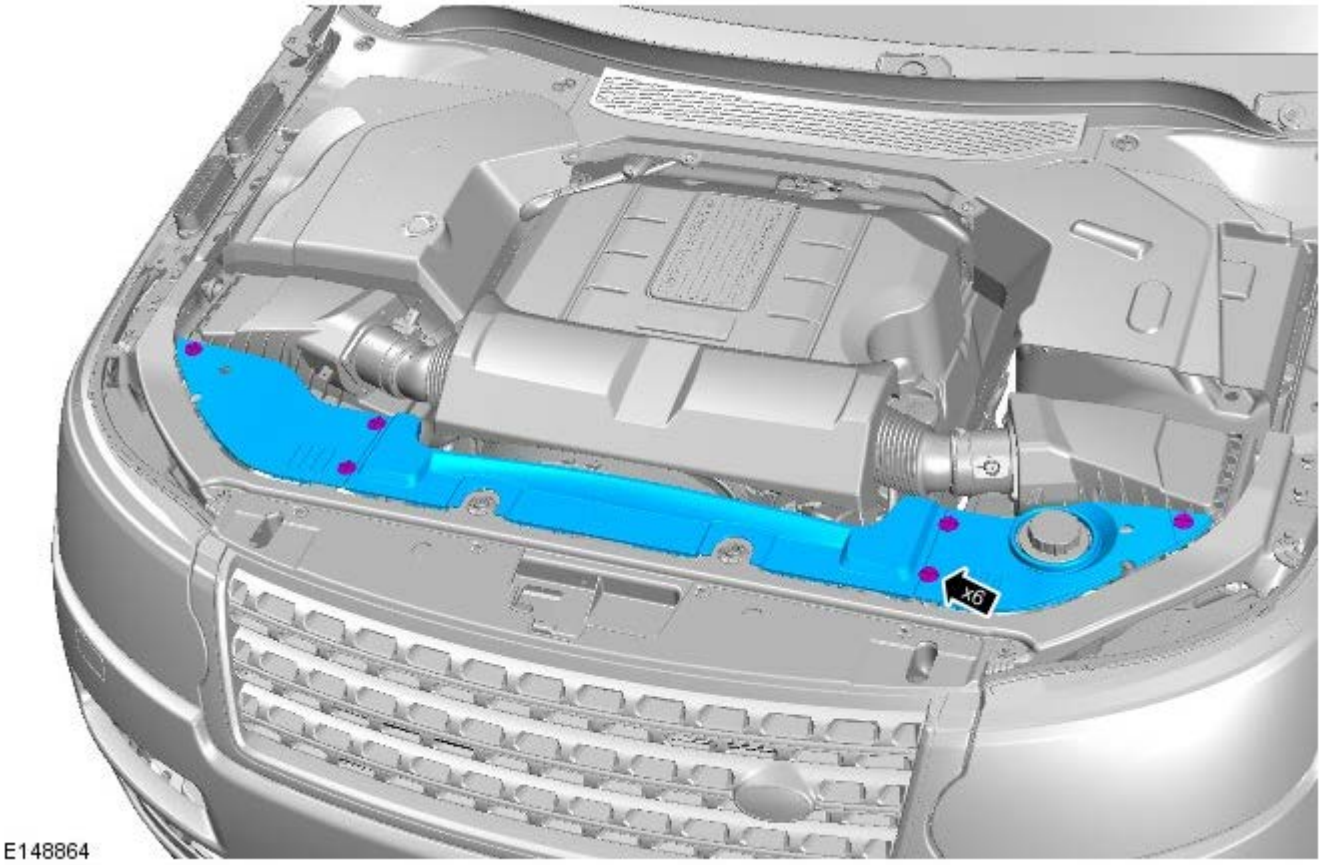


26. *Torque:* 55 Nm



27. Refer to: Cowl Panel Grille (501-02 Front End Body Panels, Removal and Installation).

28.



29. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05 Interior Trim and Ornamentation, Removal and Installation).

30. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

Published: 08-Aug-2012

Engine Cooling - TDV6 3.0L Diesel - Cooling System Draining and Vacuum Filling

General Procedures

Draining

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.

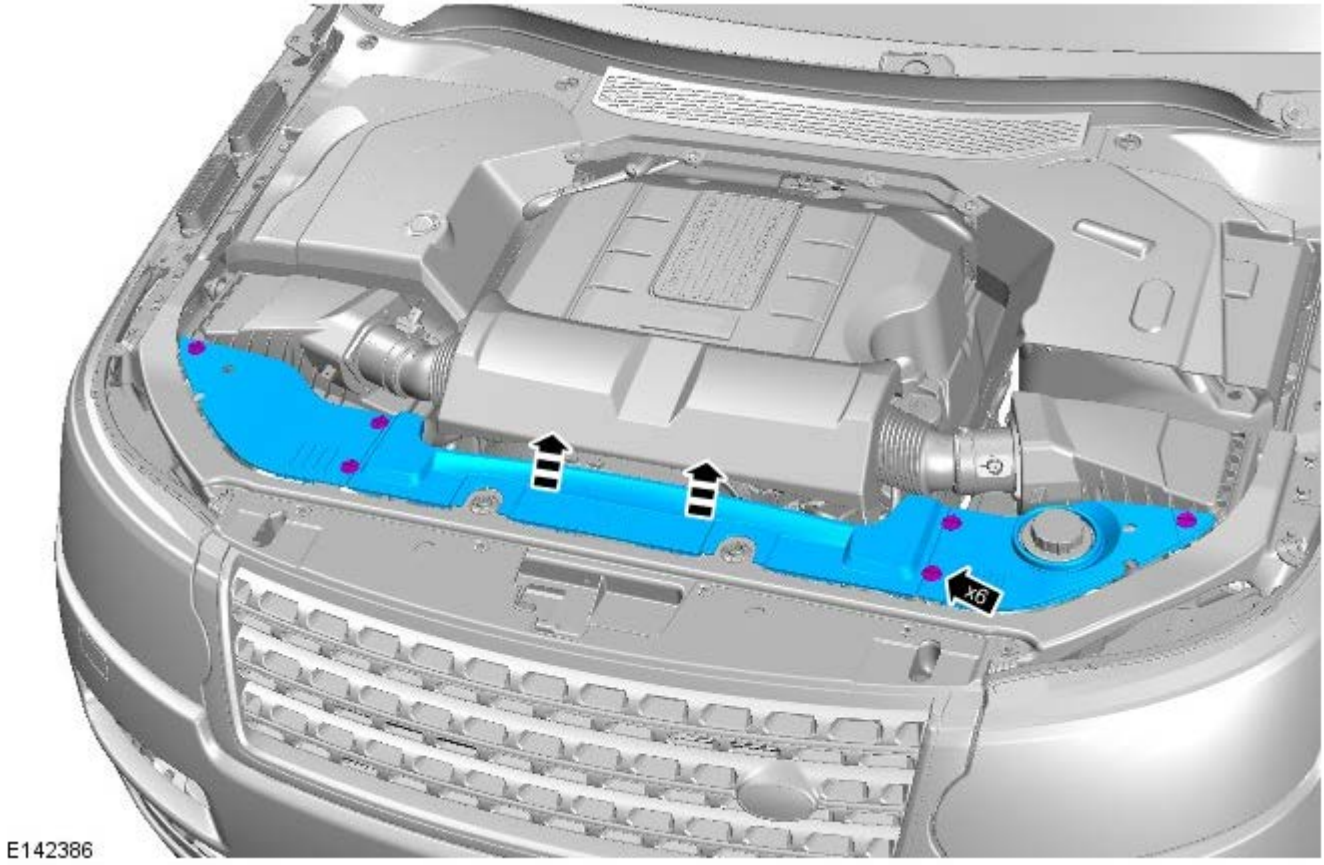
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

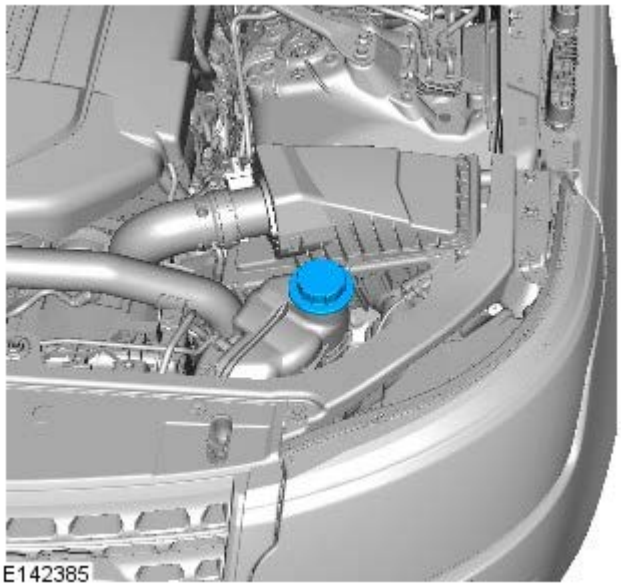
2. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

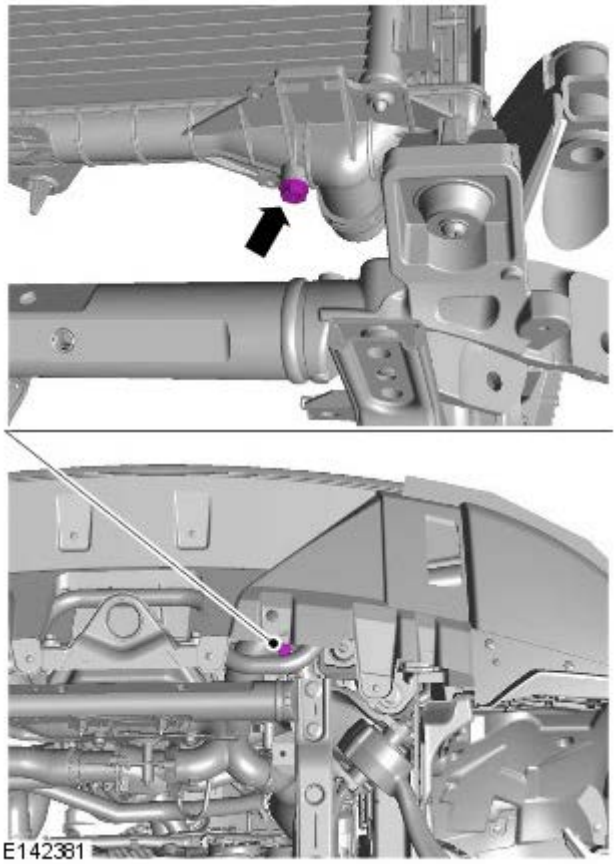
3. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05 Interior Trim and Ornamentation, Removal and Installation).

4.



5. WARNING: When releasing the cooling system pressure, cover the coolant expansion tank cap with a thick cloth.





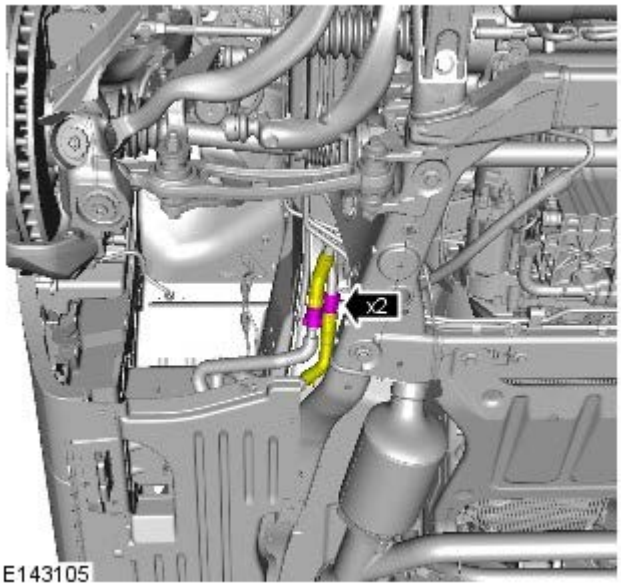
6. CAUTION: Be prepared to collect escaping coolant.

NOTE: Step 7-10 and 12-13 only needs to be carried out when the auxiliary climate control system has been fitted to the vehicle.

7. Remove the front RH wheel arch liner.

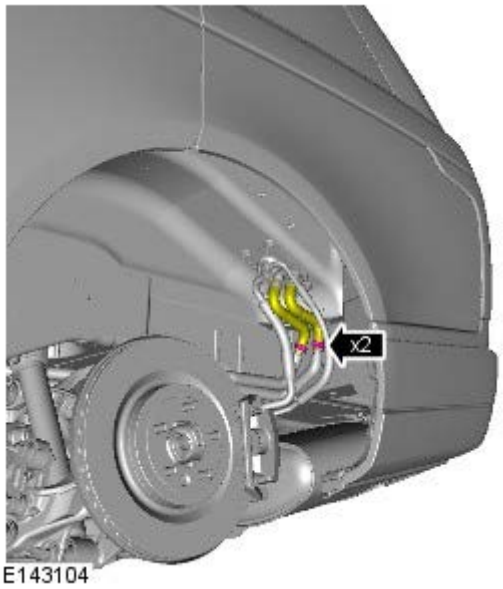
   Refer to: Fender Splash Shield (501-02 Front End Body Panels, Removal and Installation).

8. CAUTION: Be prepared to collect escaping coolant.



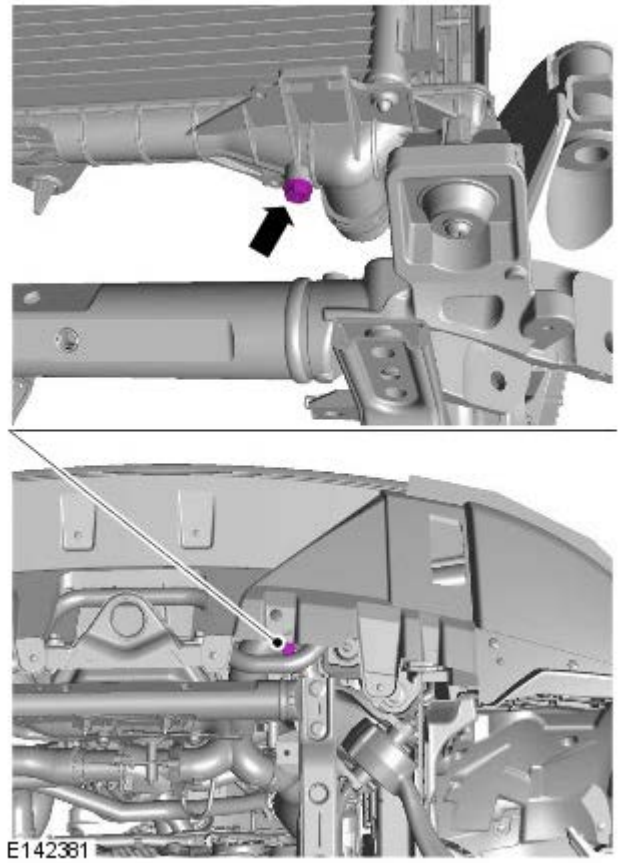
9. Remove the rear LH wheel arch liner.

   Refer to: Rear Fender Splash Shield (501-08 Exterior Trim and Ornamentation, Removal and Installation).

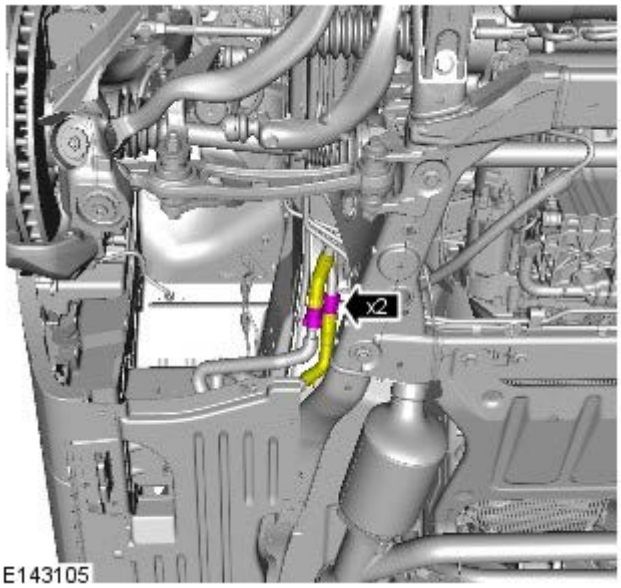


10. CAUTION: Be prepared to collect escaping coolant.

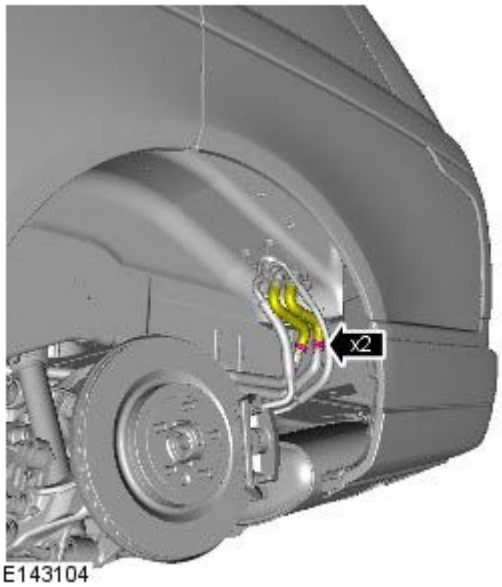
11. *Torque:* 5 Nm



12.



13.



E143104

14. Carry out the procedure up to step 1 in the filling section three times, filling the cooling system with clean water after the first two drains. At the third refill, use a suitable measuring tool to make sure that the cooling system maintains a 50% mix.

Filling

1. 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.

2. 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.

3. Position the evacuated air hose into a container.

4. Open the air supply valve.

5. 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 coolant supply hose.

    Open the coolant supply valve for 2 seconds to prime the coolant supply hose.

6. Apply air pressure progressively until the arrow on the vacuum filler gauge reaches the green segment.

7. Disconnect the compressed air supply line.

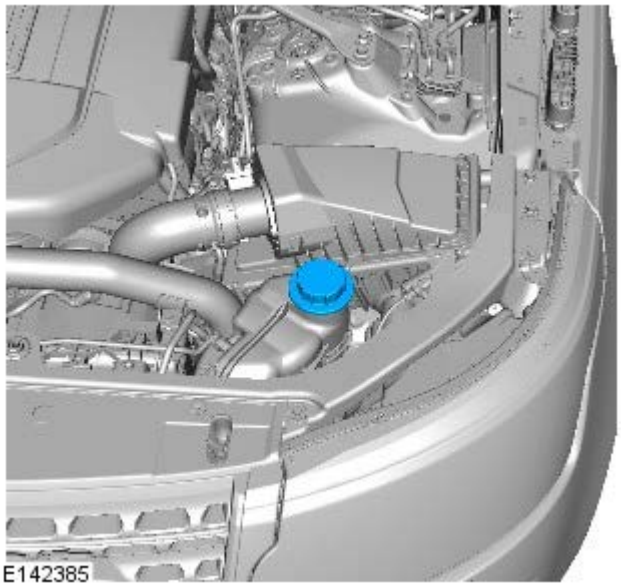
8. NOTE: Close the coolant supply valve when the coolant expansion tank MAX mark is reached or coolant movement has ceased.

   Open the coolant supply valve and allow the coolant to be drawn into the system.

9. Remove the vacuum filler gauge and cooling system vacuum refill adaptor assembly.

10. Continue to fill the coolant expansion tank to the rim until the coolant level stops dropping.

11.



12. Start and run the engine.

13. Set the heater controls to maximum.

14. Increase the engine speed from idle to 3500 RPM until hot air is emitted from the front and rear face vents.

15. Run the engine until the thermostat opens and hot air is emitted from the front and rear face vents.

16. Switch the engine off and allow to cool.

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: 02-Aug-2012

Engine Cooling - TDV6 3.0L Diesel - Cooling System Pressure Test

General Procedures

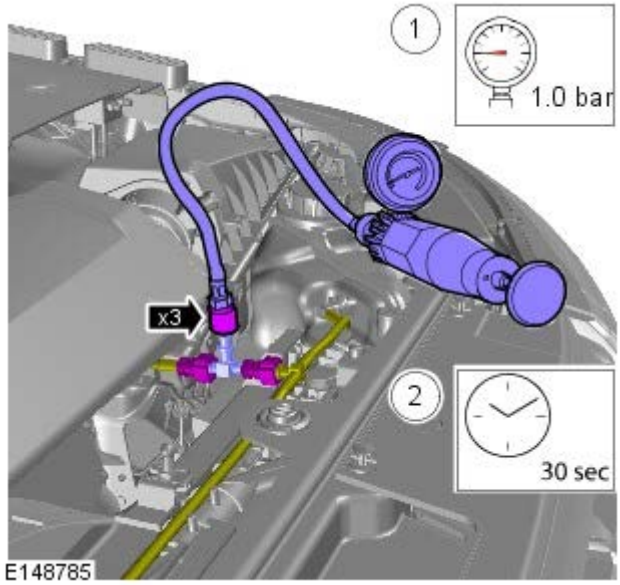
Check

WARNING: Since injury such as scalding could be caused by escaping steam or coolant, allow the vehicle cooling system to cool prior to carrying out this procedure.

NOTE: The following procedure will enable the cooling system to be pressure tested for condition and leaks. Stage 1 will check the expansion tank cap register seal and the cap for leaks. Stage 2 will check the entire cooling system.

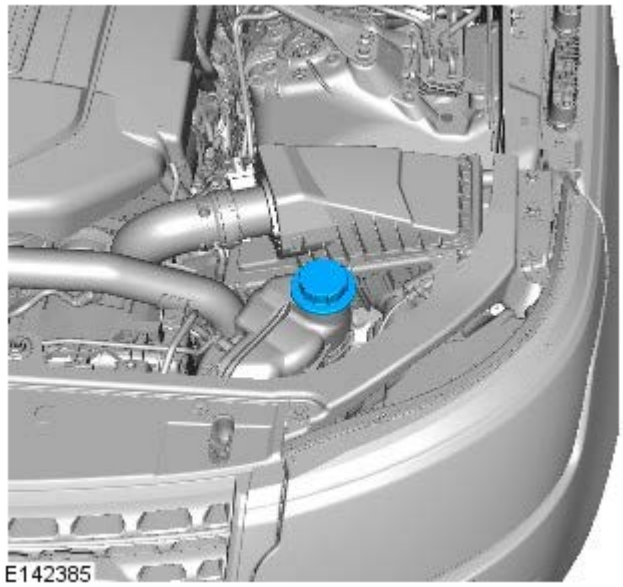
1. NOTE: If the coolant expansion tank cap is found to be leaking, replace the cap.

   Examine the coolant hoses for signs of cracking, distortion and security of the hose connections.

2. 

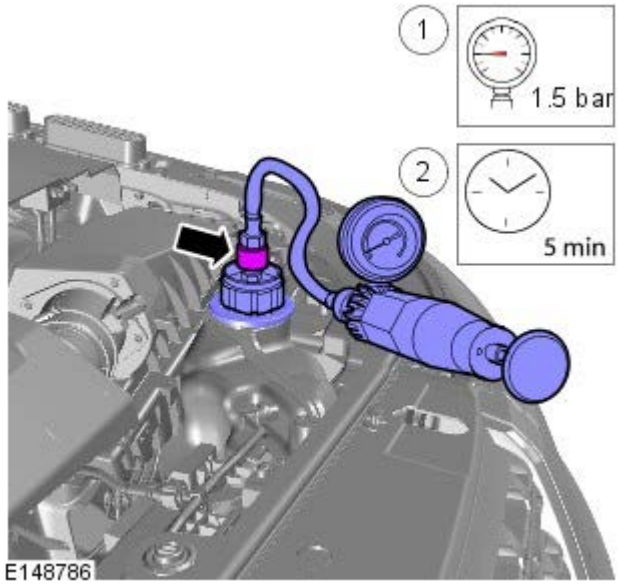
   - Slowly pressurize the cooling system.
   - Check the pressure remains above 0.9 bar (90 kPa) (13 psi) after waiting for 30 seconds.
   - During the pressure drop check, listen for a hissing noise from the expansion tank cap.

3. Depressurize and remove the pressure pump and gauge.

4. 

5. CAUTION: Make sure that the mating faces are clean and free of foreign material.

   NOTE: If the pressure continues to drop after the

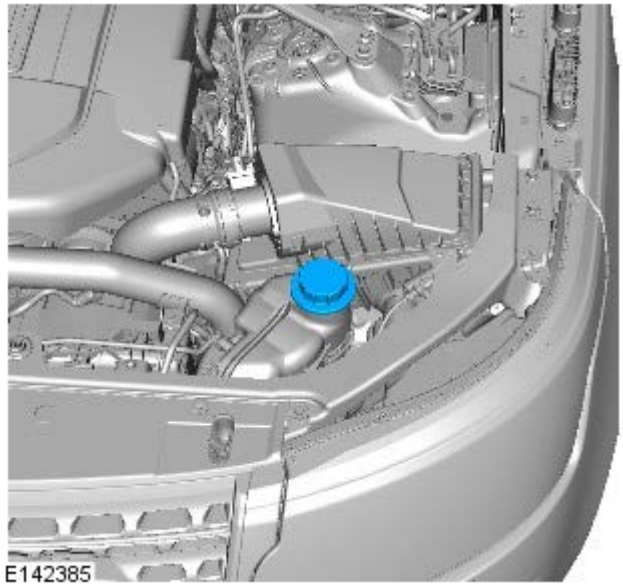


initial tolerance, there is a coolant leak.

- Slowly pressurize the cooling system.
- A small pressure decay of approximately 0.15 bar (15 kPa) (1 psi) over the first minute is normal.

6. Depressurize and remove the pressure pump and gauge.

7.



Published: 08-Aug-2012

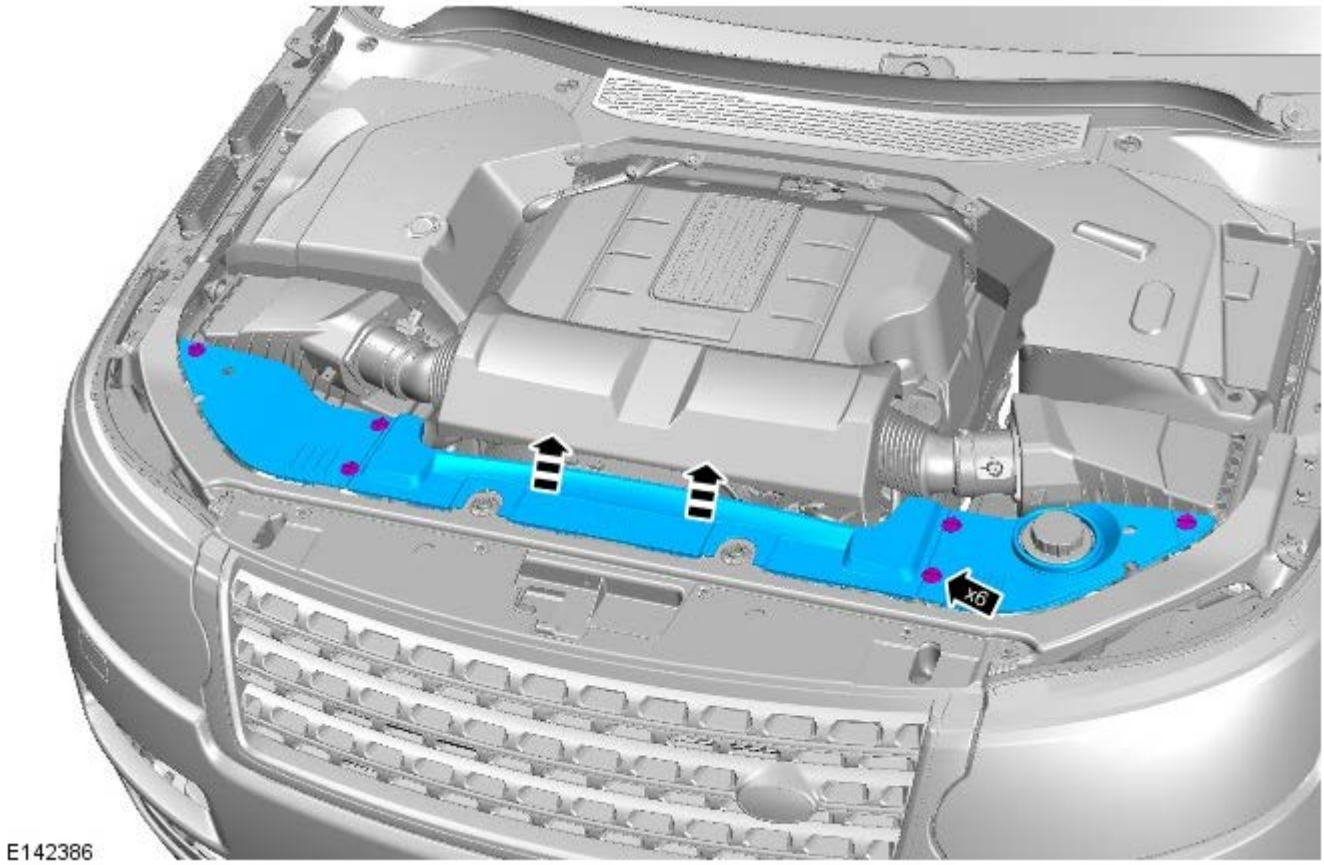
Engine Cooling - TDV6 3.0L Diesel - Coolant Expansion Tank

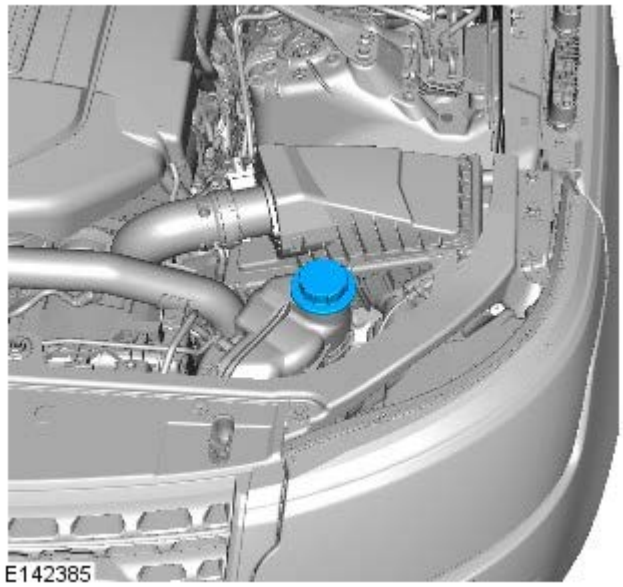
Removal and Installation

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.

1.

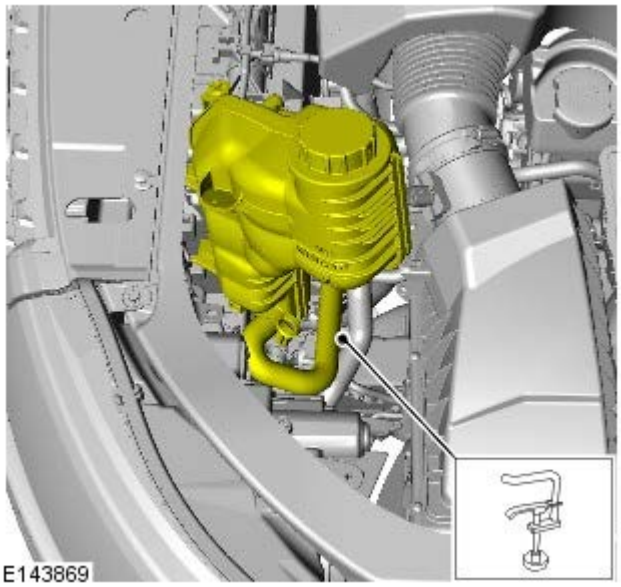




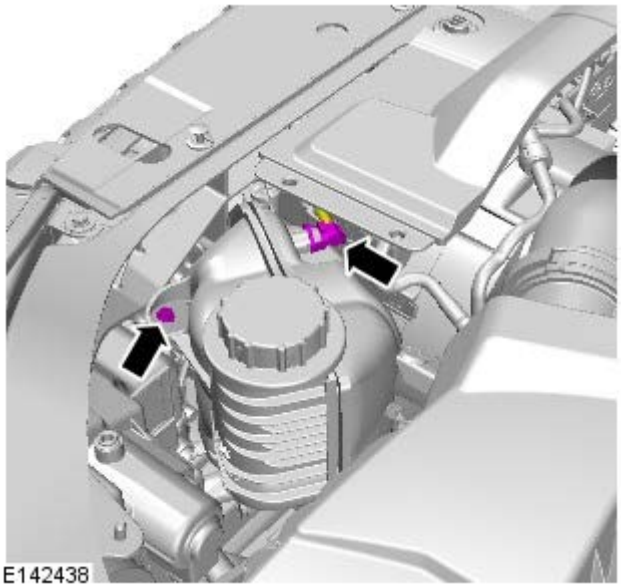
2. WARNING: When releasing the cooling system pressure, cover the coolant expansion tank cap with a thick cloth.

3. Using a syringe, remove the cooling fluid from the expansion tank.

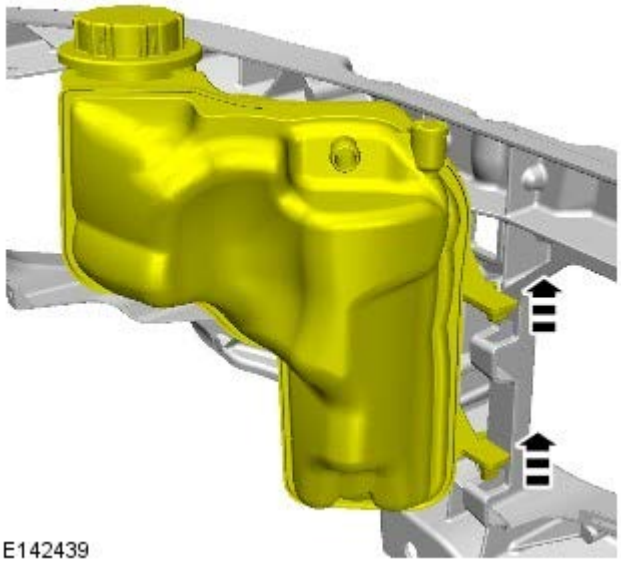
4. CAUTION: Clamp the hoses to minimize coolant loss.



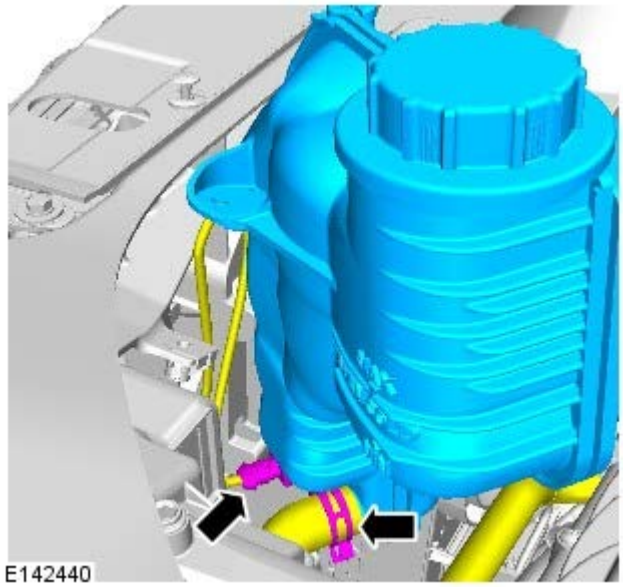
5. CAUTION: Be prepared to collect escaping coolant.



6.

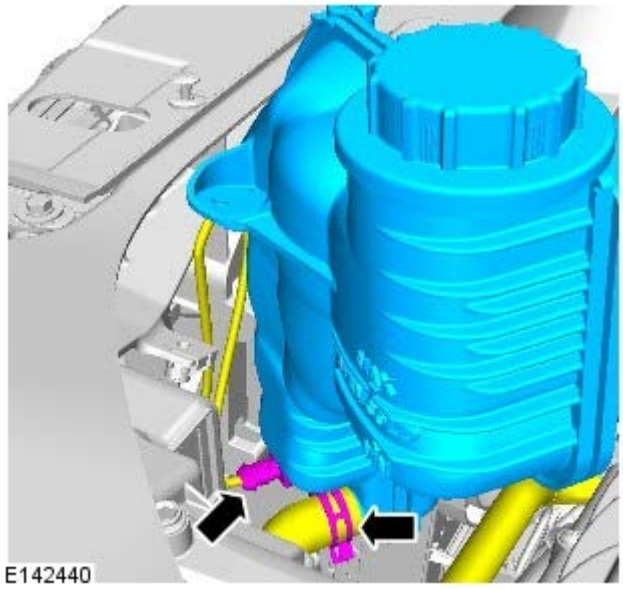


7. CAUTION: Be prepared to collect escaping coolant.

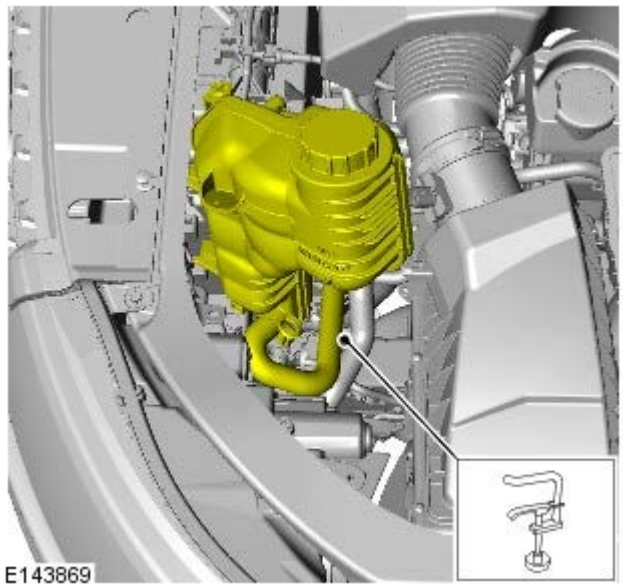


Installation

1.

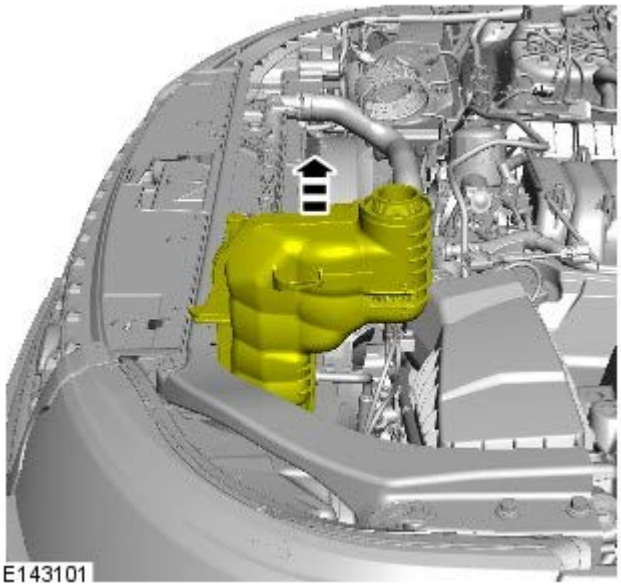


2.



3. NOTE: Keep the coolant expansion tank vertically.

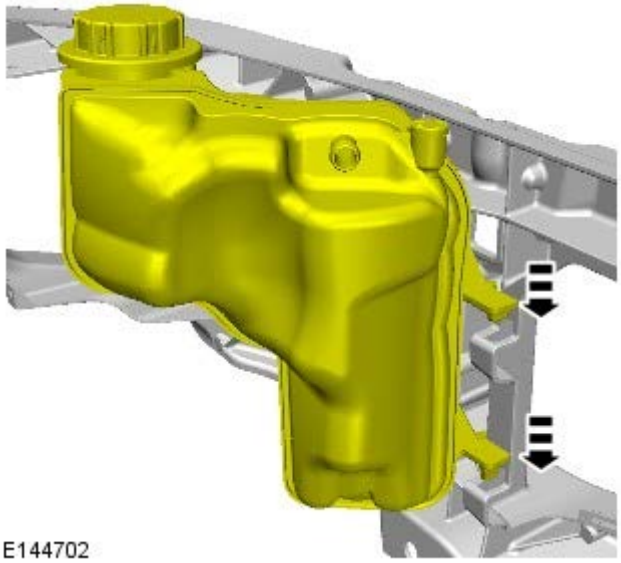
Raise the coolant expansion tank minimum 110mm


E143101

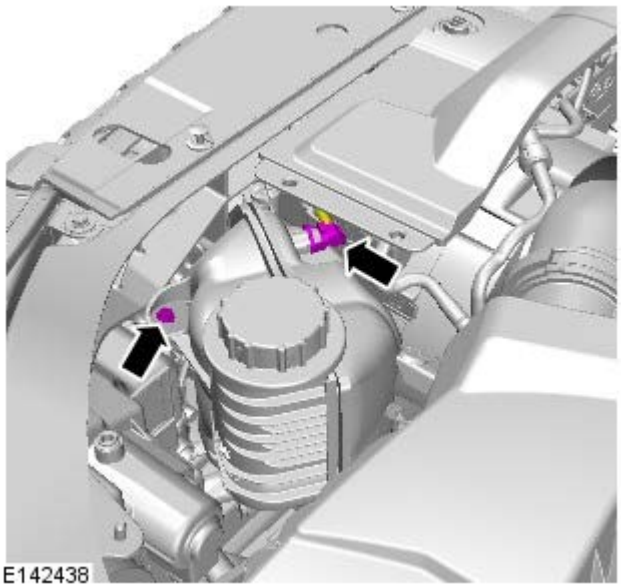
from its original position.

4. Fill the cooling system, keeping coolant to the upper level mark of the expansion tank, until a steady stream of coolant is seen returning to the tank.

5.


E144702

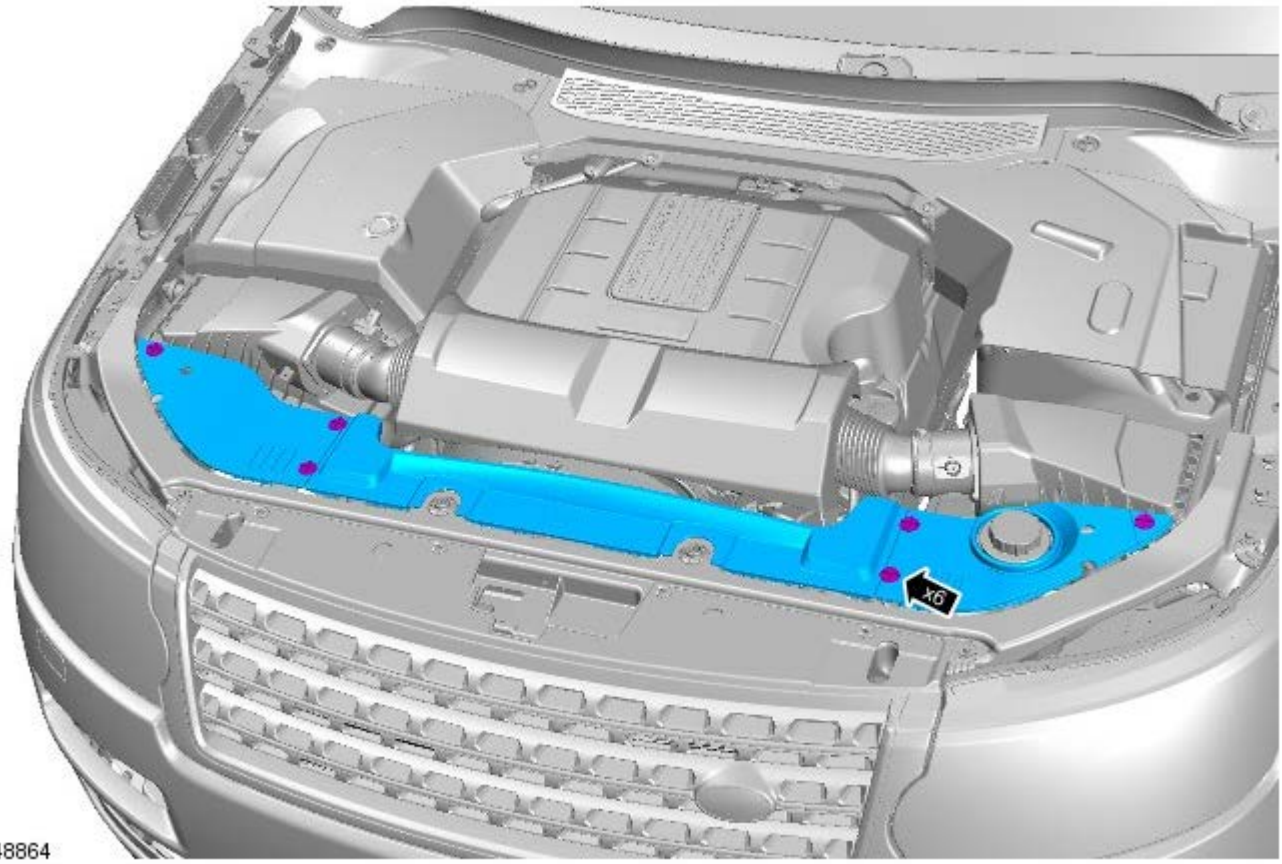
6. *Torque:* 2.8 Nm


E142438

7. CAUTION: Make sure the coolant level remains above the "COLD FILL RANGE" lower level mark.

Check and top up the cooling system as required.

8.



Published: 09-Aug-2012

Engine Cooling - TDV6 3.0L Diesel - Coolant Pump

Removal and Installation

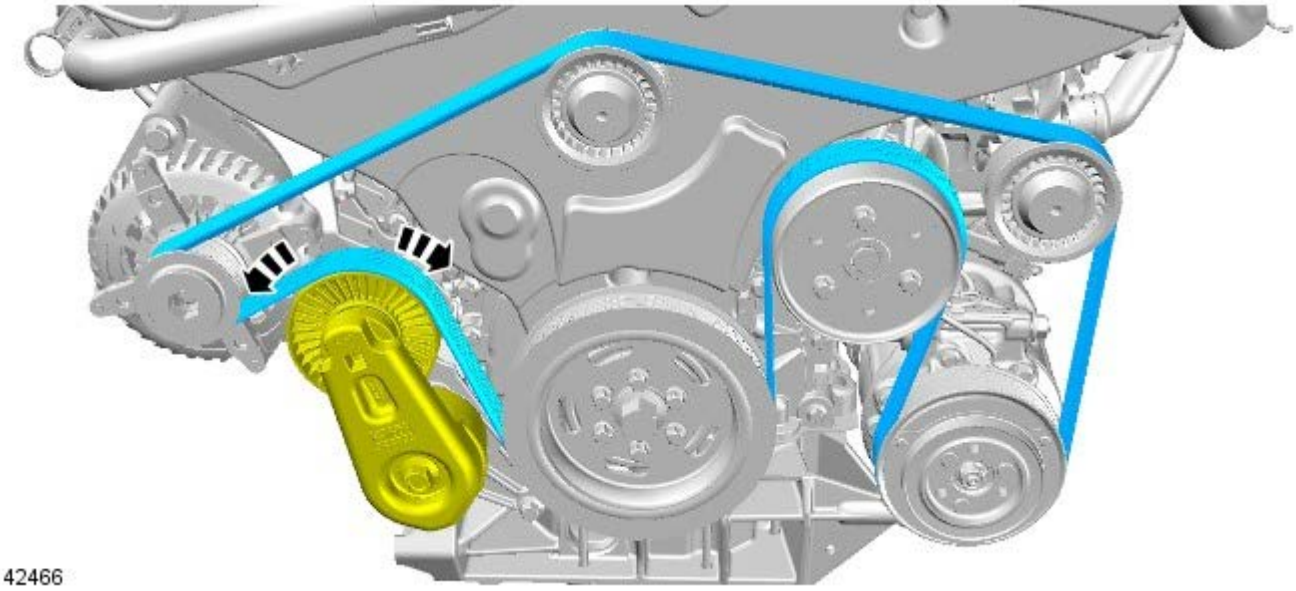
Removal

NOTE: Removal steps in this procedure may contain installation details.

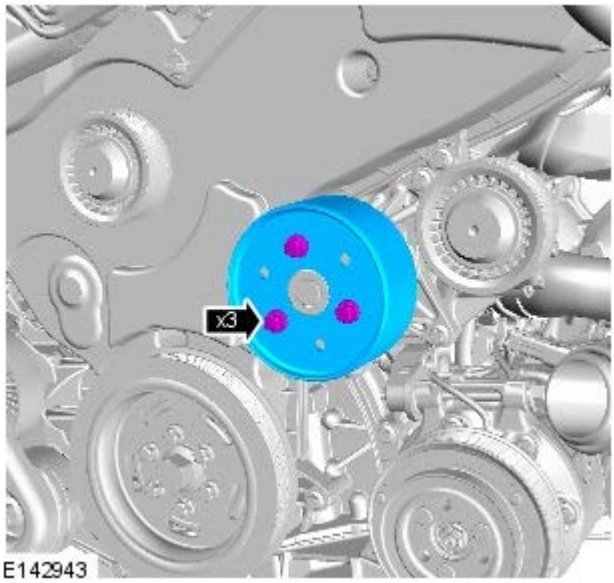
1. Refer to: Specifications (414-00, Specifications).
2. Refer to: Cooling System Partial Draining, Filling and Bleeding (303-03A Engine Cooling - TDV6 3.0L Diesel, General Procedures).
3. NOTES:

   Note the fitted position of the accessory drive belt.

   Engine shown removed for clarity.

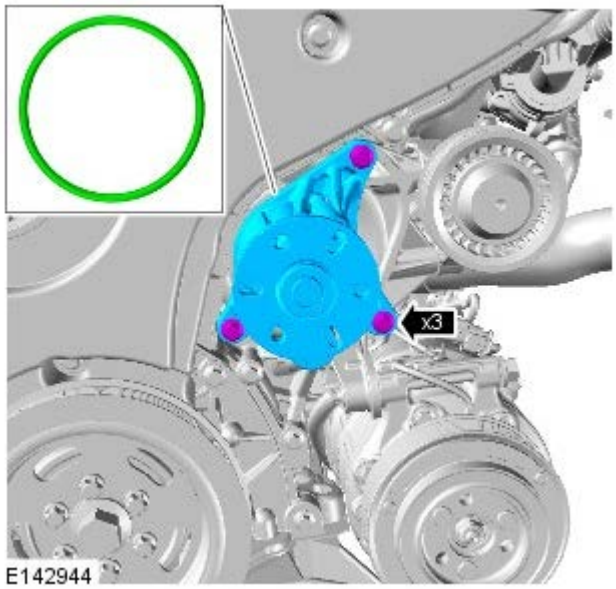


E142466



E142943

4. CAUTION: Discard the bolts.
   - Using a suitable 6mm bar, retain the coolant pump pulley.
   - *Torque:* 25 Nm
5. CAUTION: A new O-ring seal is to be installed.
   - *Torque:* 10 Nm



Installation

1. To install, reverse the removal procedure.

Published: 24-Aug-2012

Engine Cooling - TDV6 3.0L Diesel - Cooling Fan

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.

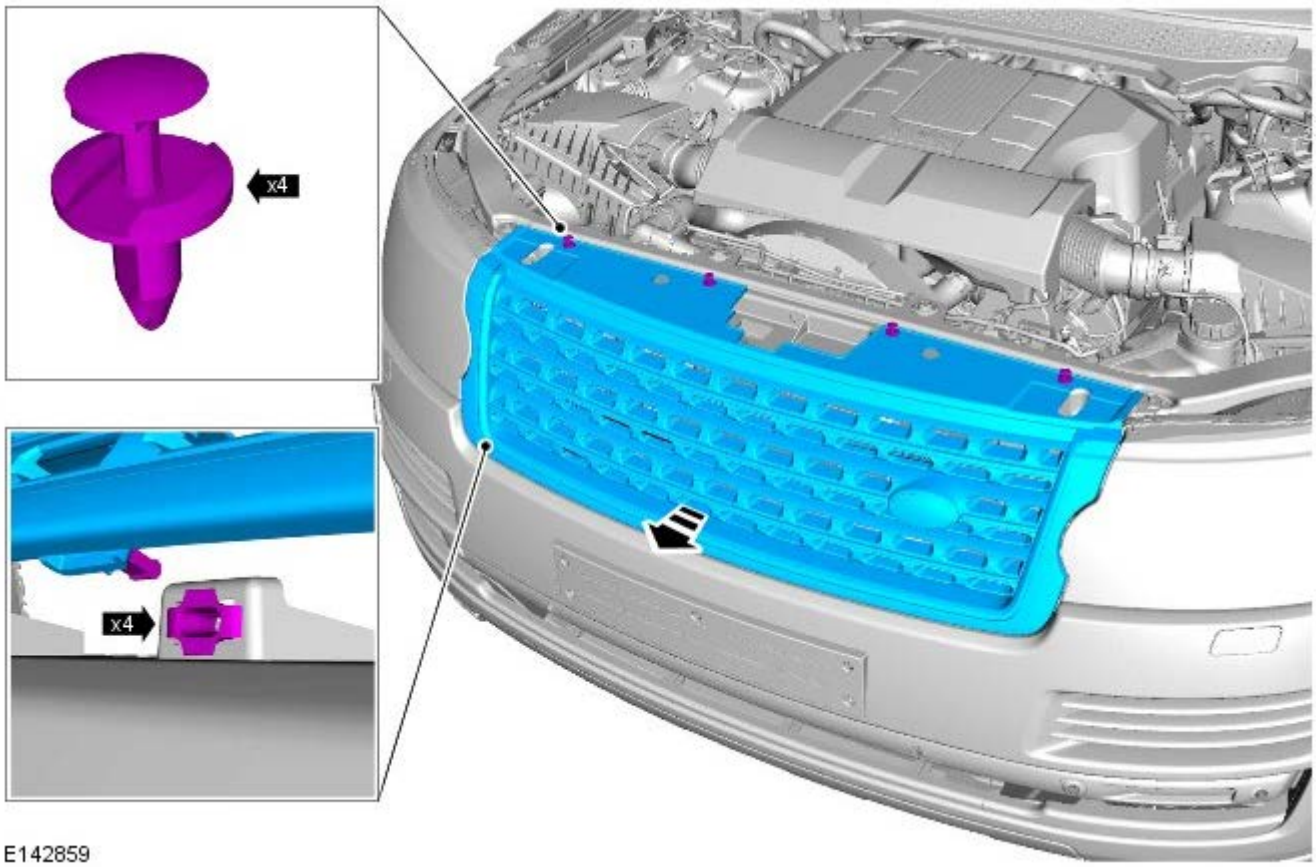
Some components shown removed for clarity.

All vehicles

1. Refer to: Specifications (414-00, Specifications).
2. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).
3. Refer to: Cooling System Partial Draining, Filling and Bleeding (303-03A Engine Cooling - TDV6 3.0L Diesel, General Procedures).
4. Refer to: Coolant Expansion Tank (303-03A Engine Cooling - TDV6 3.0L Diesel, Removal and Installation).

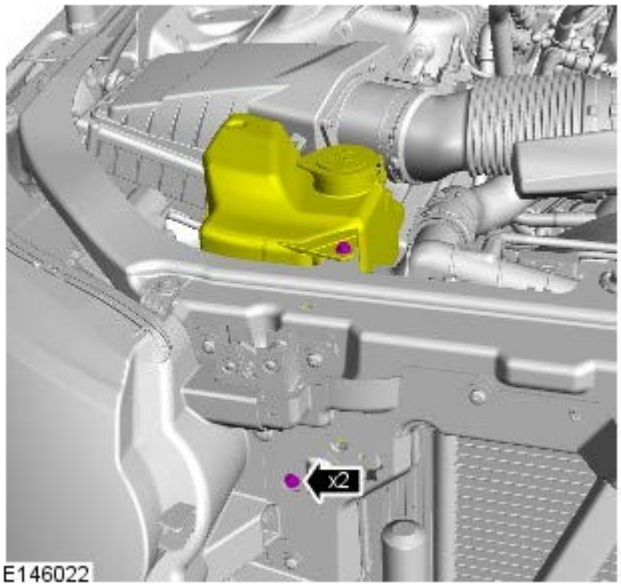
Cold climate vehicles

5.



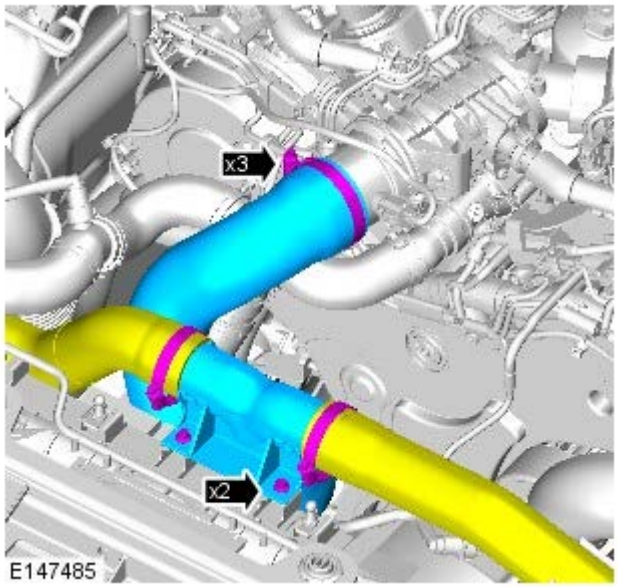
Cold climate vehicles

6. *Torque:* 7 Nm

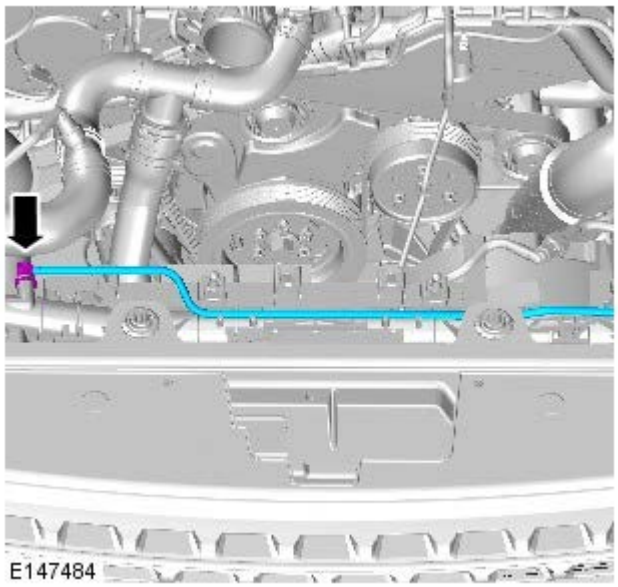


All vehicles

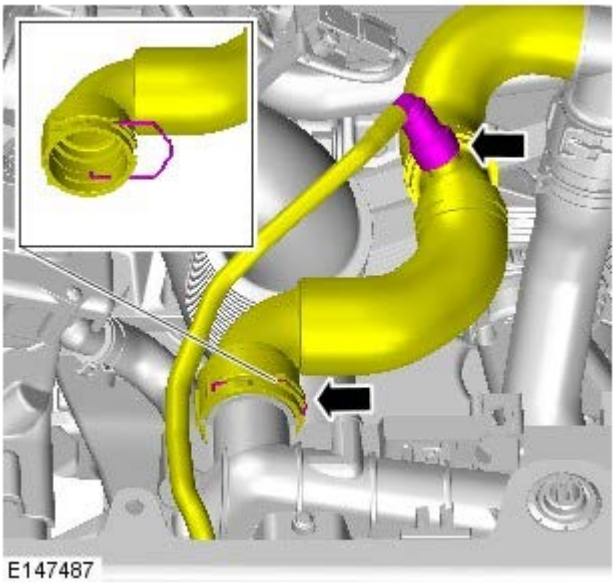
7. *Torque:* 8 Nm



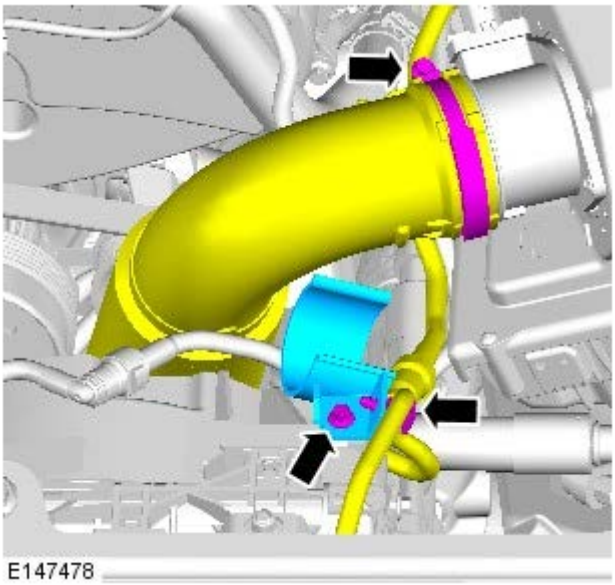
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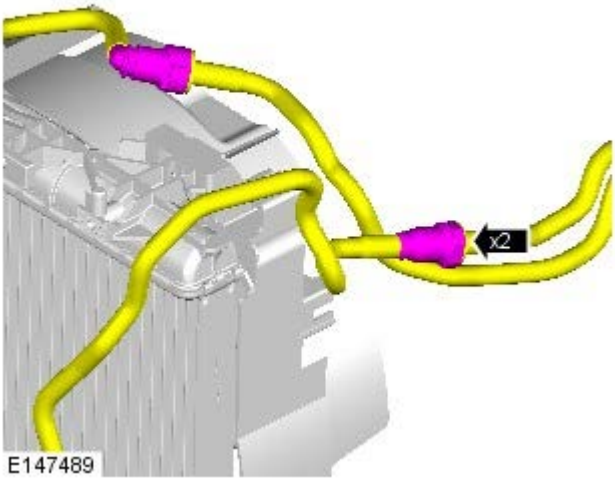
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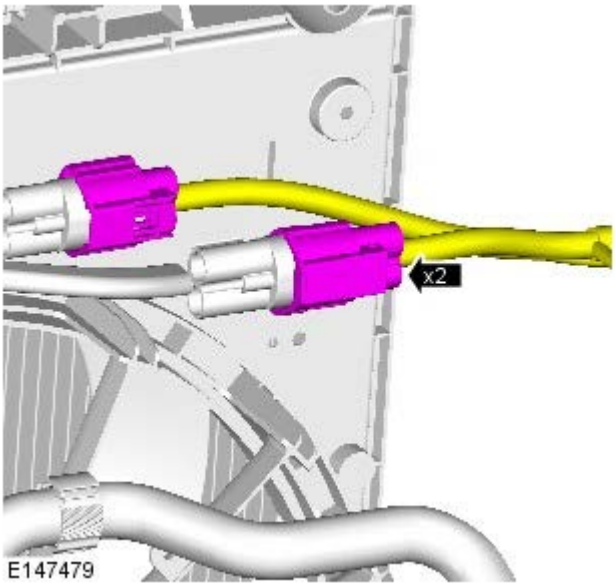
10. *Torque:* 7 Nm



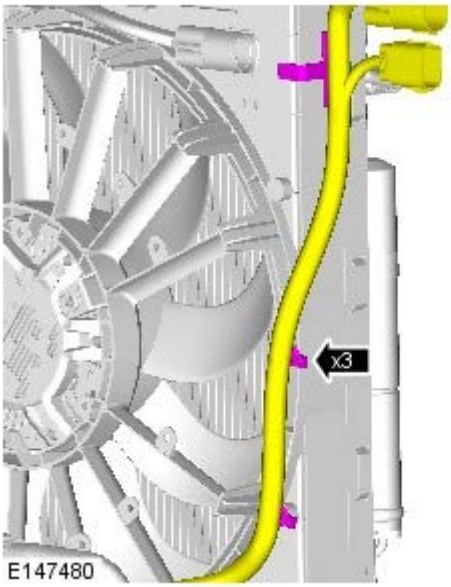
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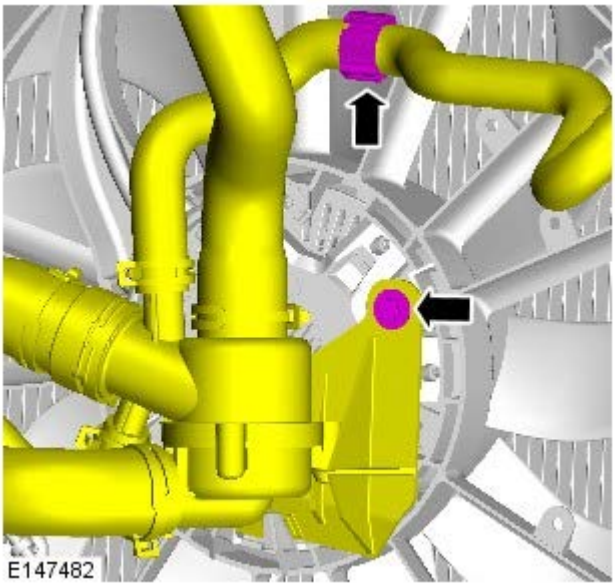
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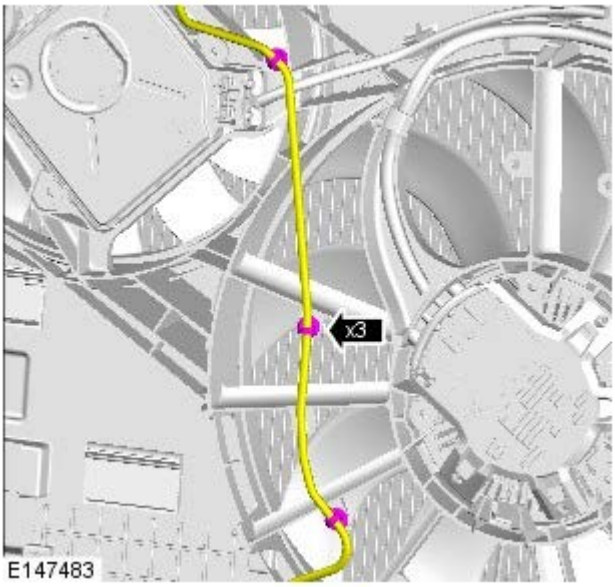
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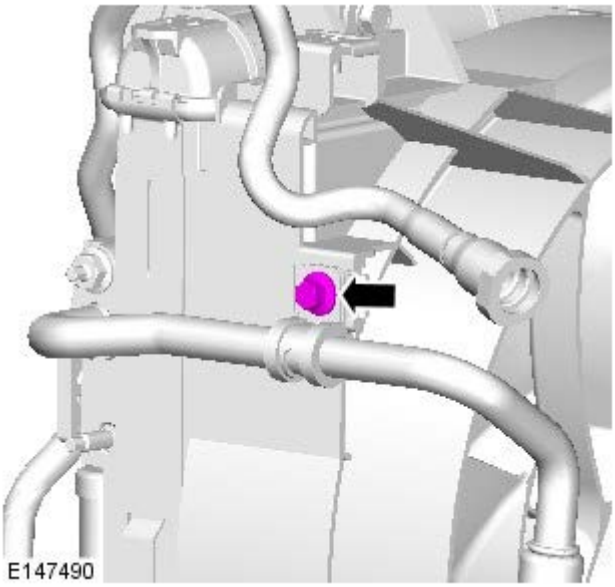
14. *Torque:* 5 Nm



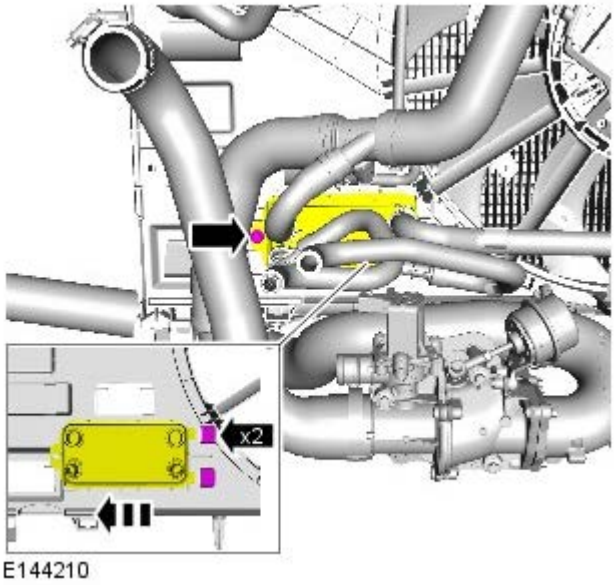
15.



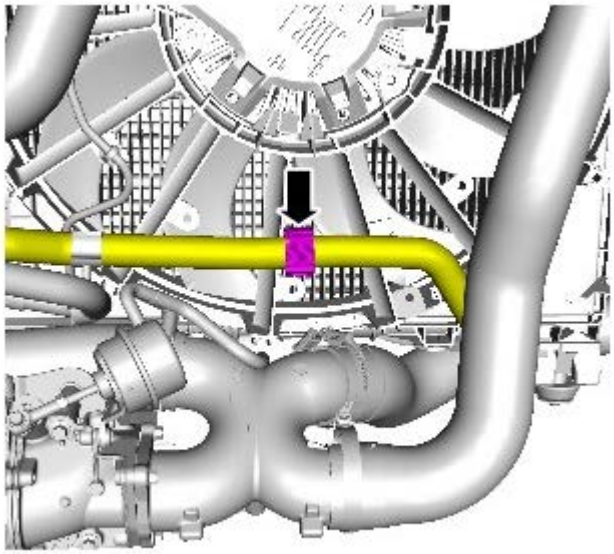
16. *Torque:* 7 Nm



17. *Torque:* 10 Nm

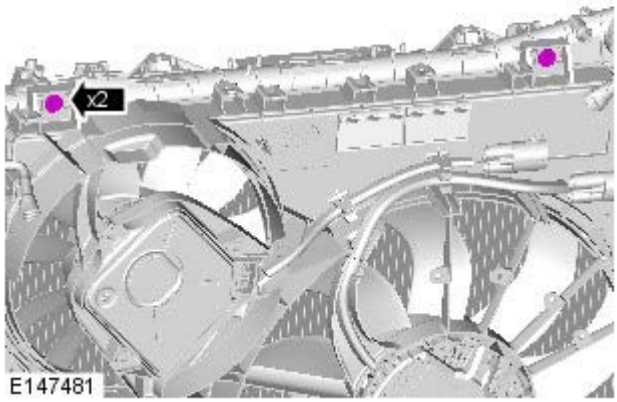


18.



E144208

19. *Torque:* 7 Nm

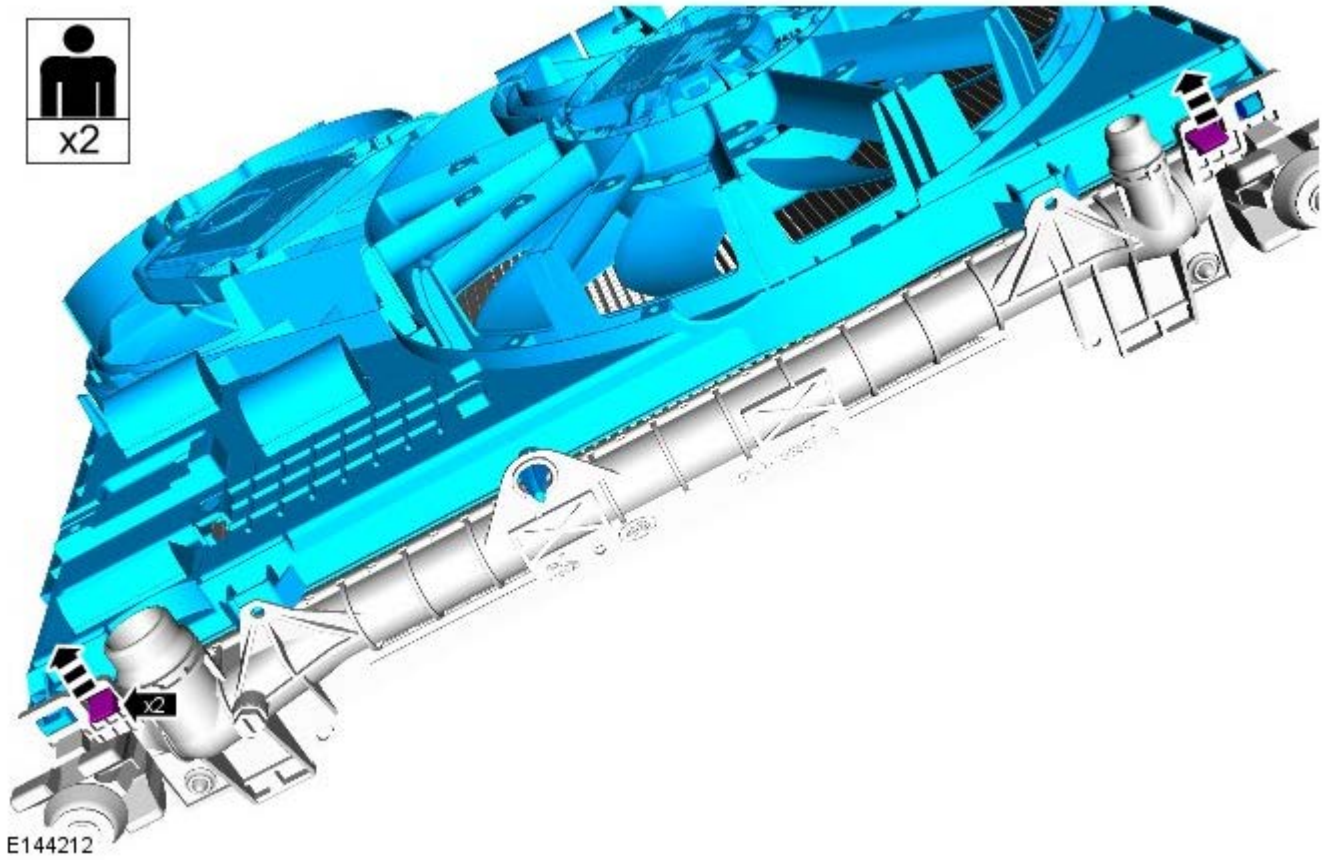


E147481

20. CAUTION: Protect the radiator during this operation.

NOTE: With assistance remove the component.

- Release both locking tangs.



Installation

1. To install, reverse the removal procedure.

Published: 04-Mar-2013

Engine Cooling - TDV6 3.0L Diesel - Radiator

Removal and Installation

Removal

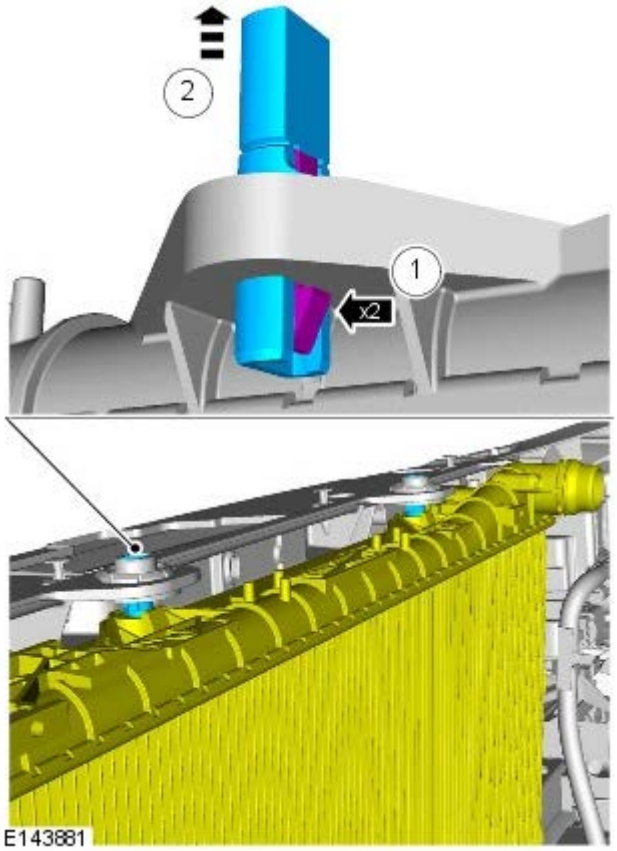
NOTES:

Removal steps in this procedure may contain installation details.

Some variation in the illustrations may occur, but the essential information is always correct.

Some components shown removed for clarity.

1. Refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging - TDV6 3.0L Diesel (412-00, General Procedures).
2. Refer to: Cooling Fan (303-03A Engine Cooling - TDV6 3.0L Diesel, Removal and Installation).
3.

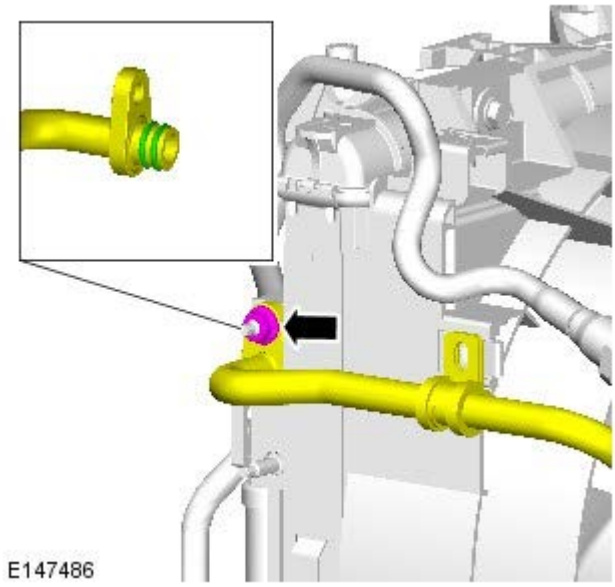


4. CAUTIONS:

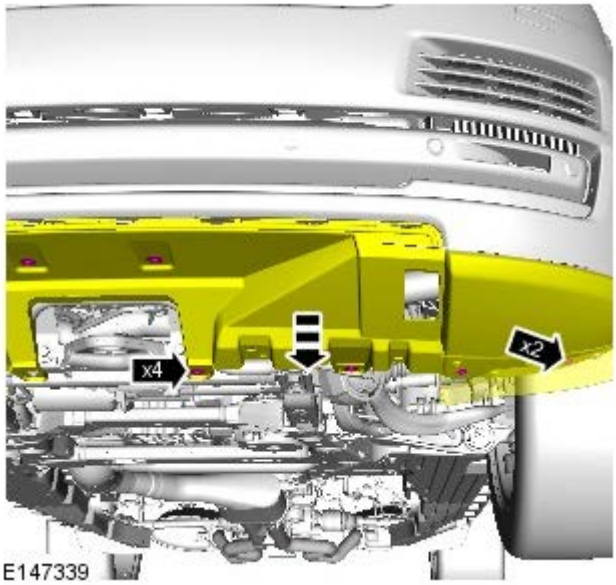
   Make sure that all openings are sealed.

   Remove and discard the O-ring seals.

   Torque: 8 Nm

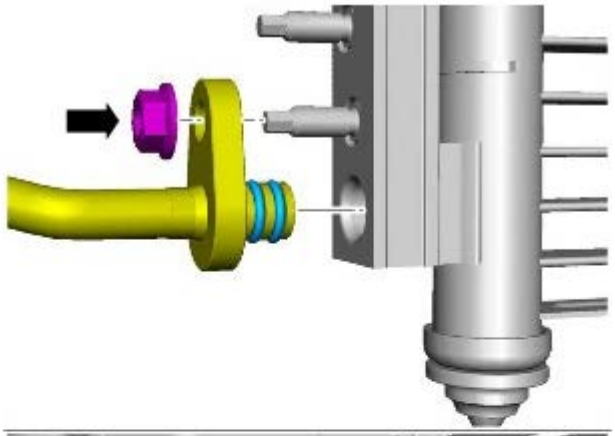


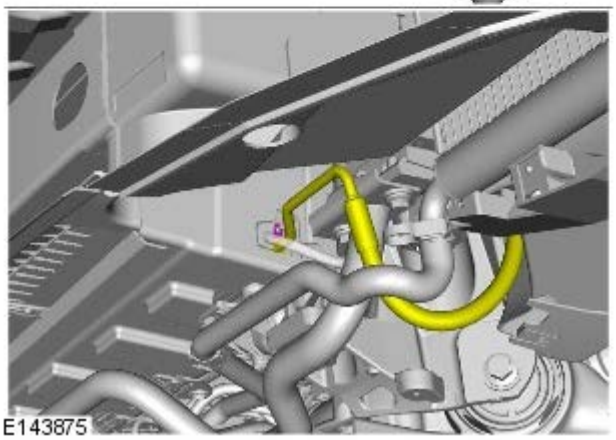
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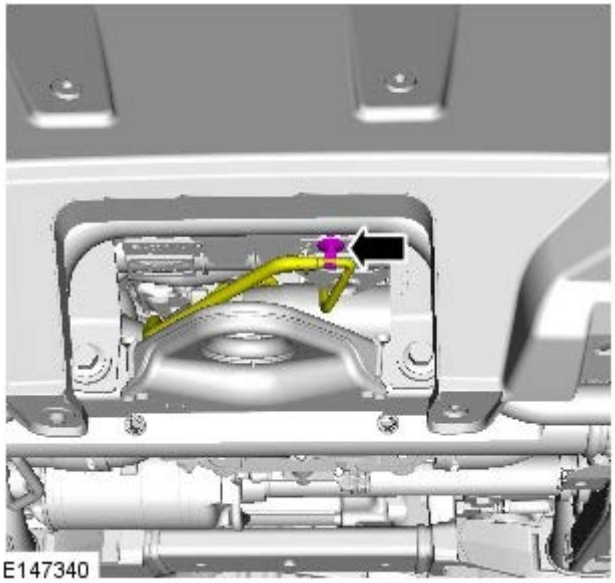
6. CAUTION: Remove and discard the O-ring seals.

Torque: 8 Nm

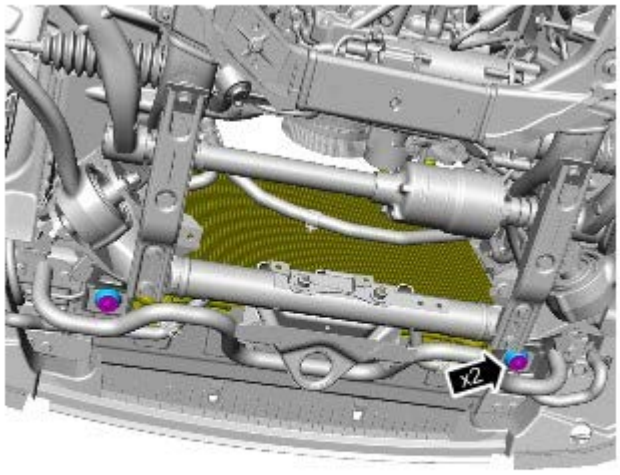




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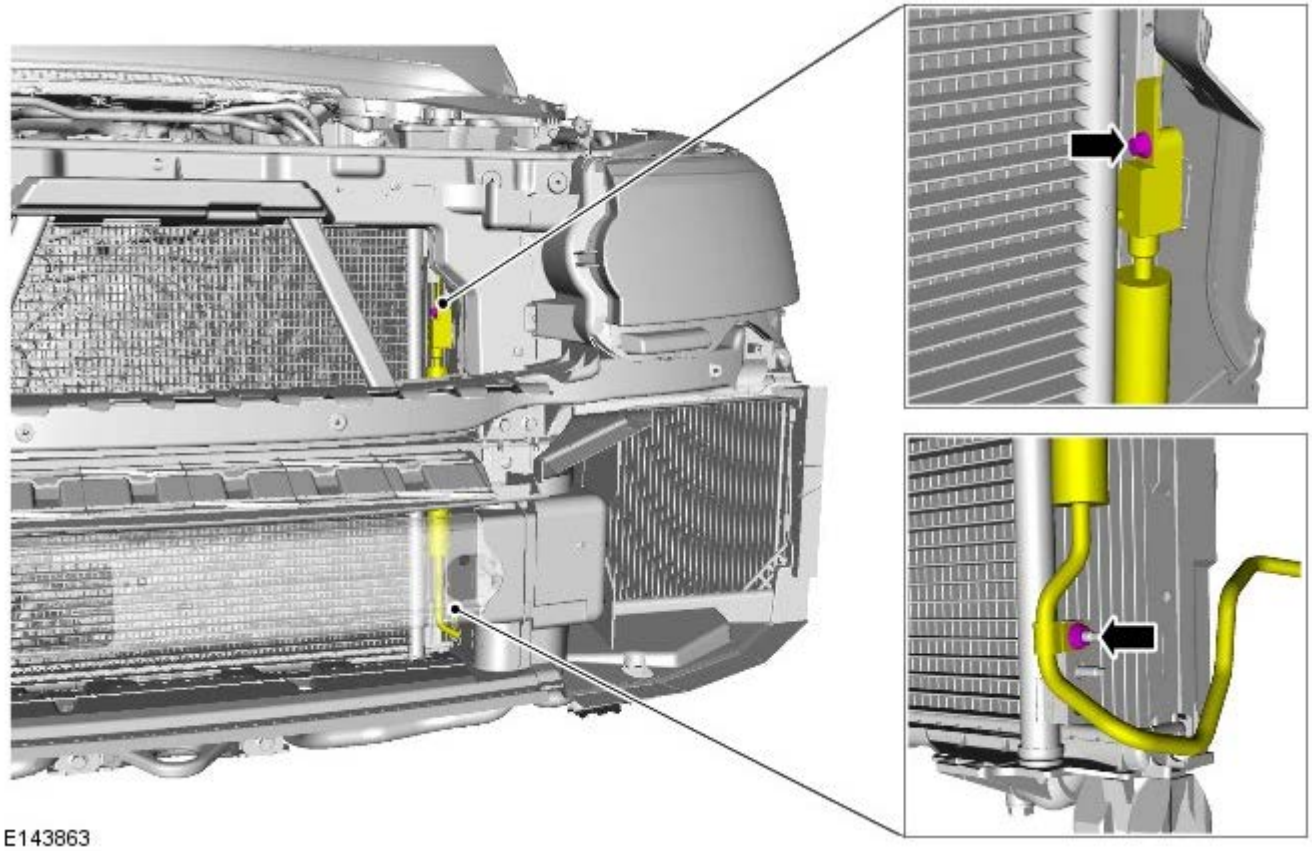
8. *Torque:* 15 Nm



E143877

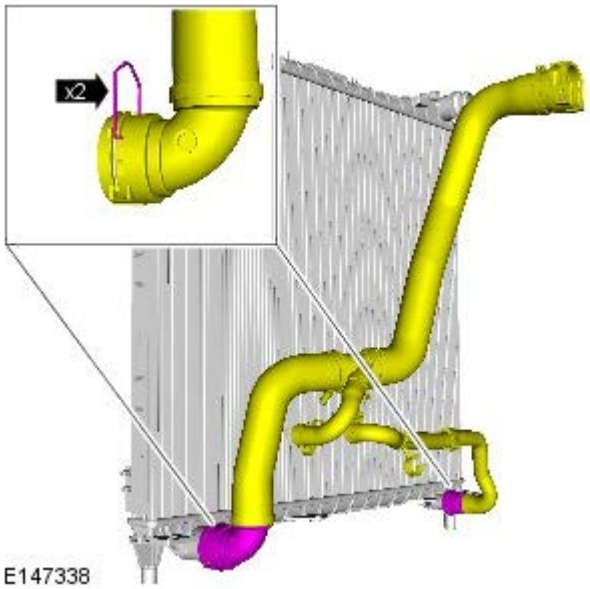
9. NOTE: If equipped.

Torque: 7 Nm

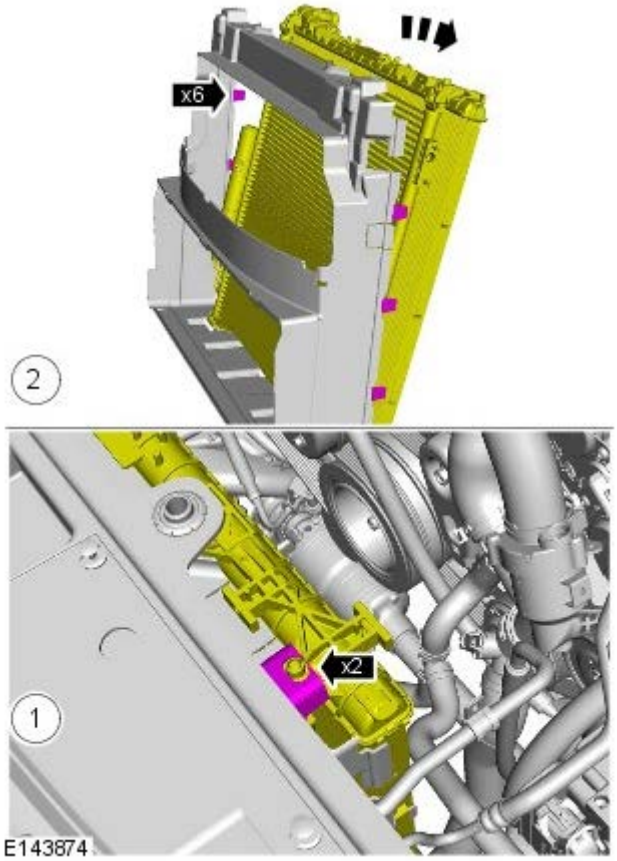


E143863

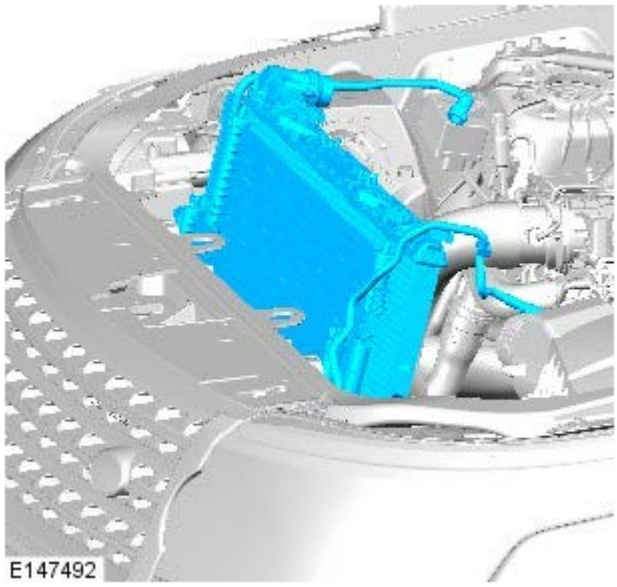
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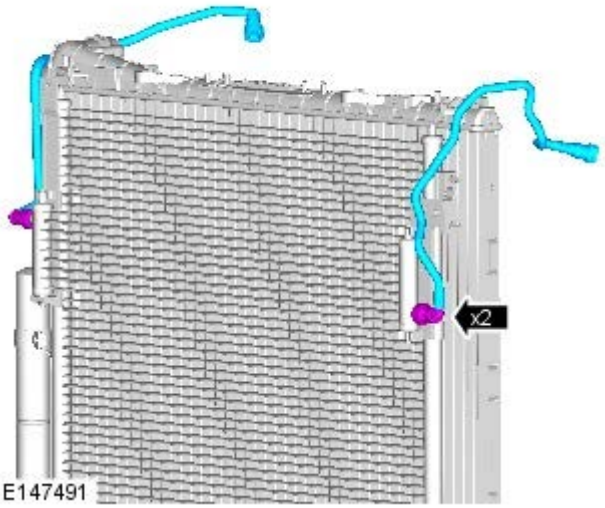
11. CAUTION: Always protect the cooling pack elements to prevent accidental damage.



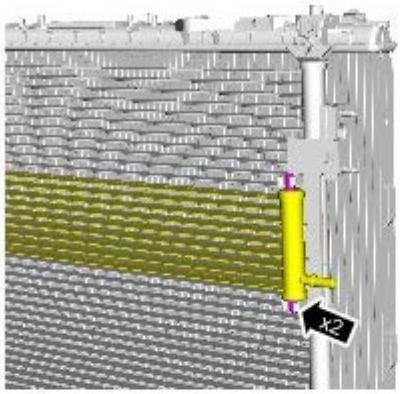
12. CAUTION: Always protect the cooling pack elements to prevent accidental damage.

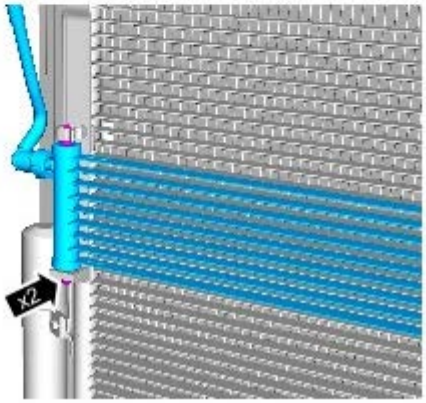


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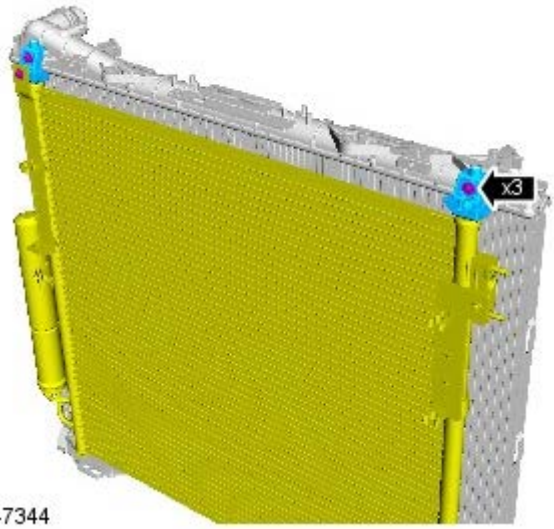
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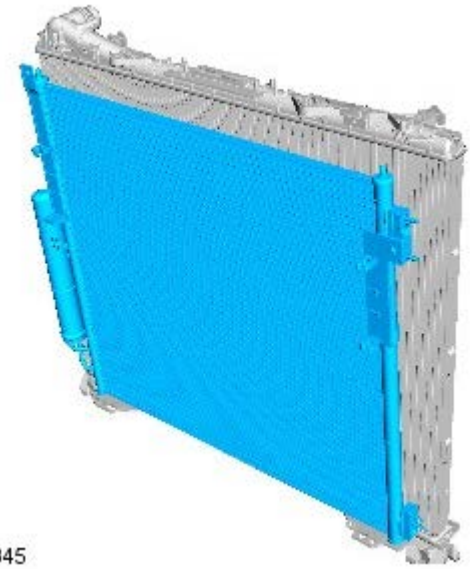
E147343

15. *Torque:* 4.5 Nm



E147344

16.



E147345

Installation

1. To install, reverse the removal procedure.

Published: 24-Aug-2012

Engine Cooling - TDV6 3.0L Diesel - Thermostat

Removal and Installation

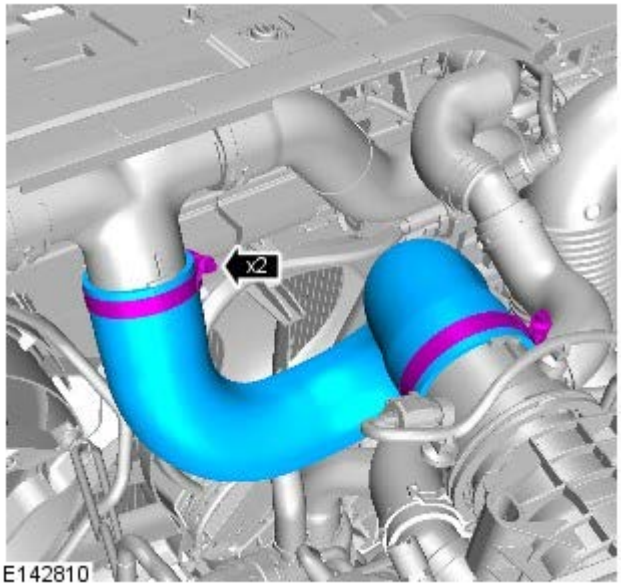
Removal

NOTE: Removal steps in this procedure may contain installation details.

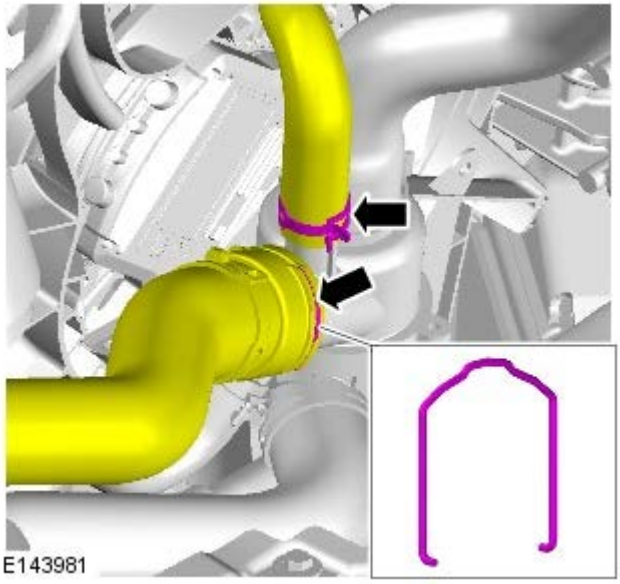
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

2. Refer to: Cooling System Partial Draining, Filling and Bleeding (303-03A Engine Cooling - TDV6 3.0L Diesel, General Procedures).

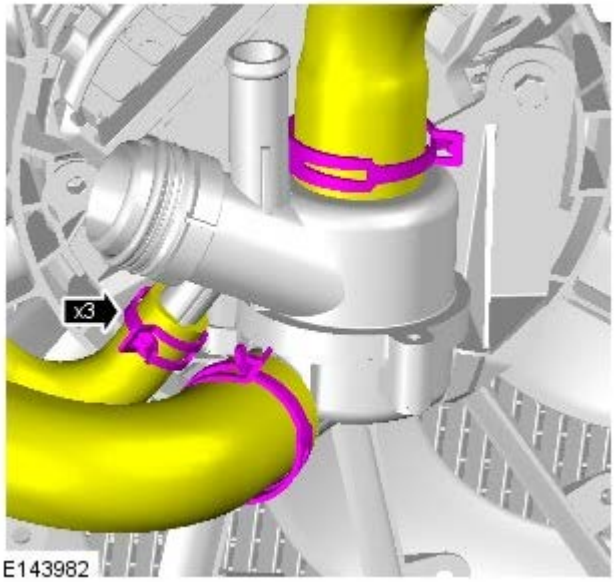


3. *Torque:* 5 Nm

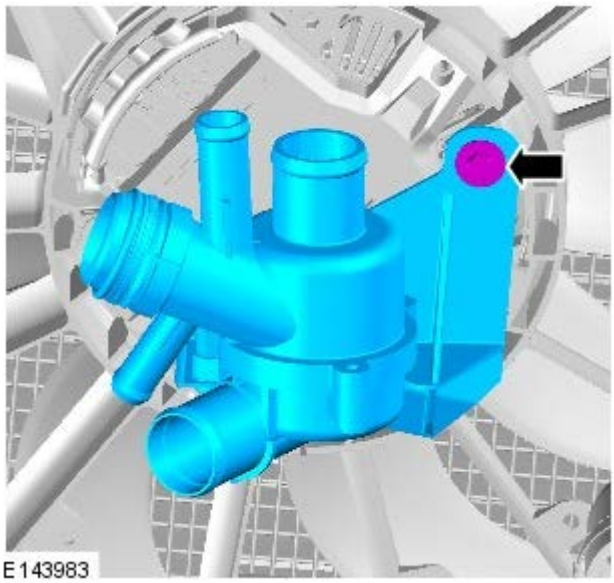


4. CAUTION: Be prepared to collect escaping coolant.

5. CAUTION: Be prepared to collect escaping coolant.

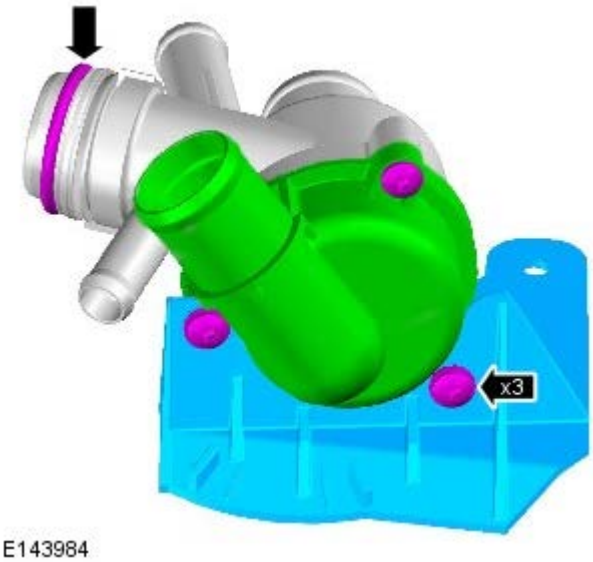


E143982


E143983

6. CAUTION: Be prepared to collect escaping coolant.

   Torque: 5 Nm



E143984

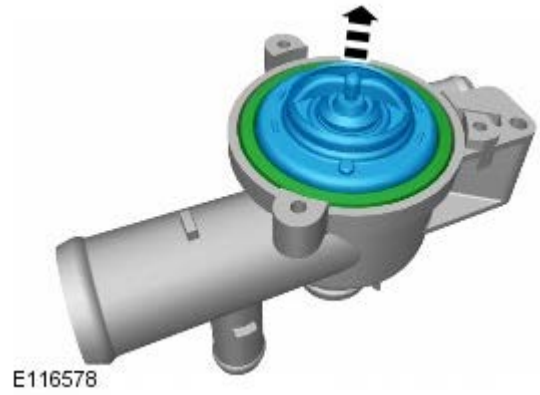
7. CAUTIONS:

   Be prepared to collect escaping coolant.

   Discard the seal.

   Torque: 5 Nm

8. CAUTION: Discard the seal.



Installation

1. To install, reverse the removal procedure.

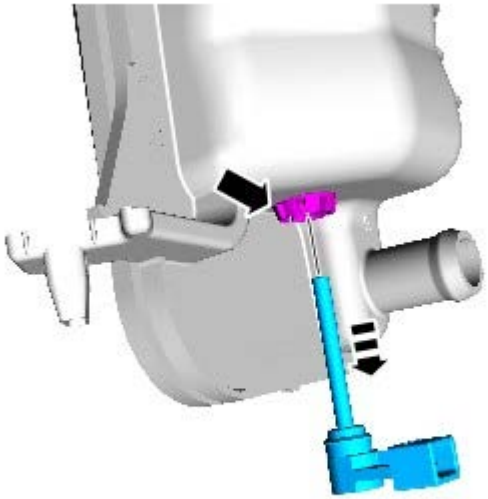
Published: 11-Dec-2013

Engine Cooling - TDV6 3.0L Diesel - Engine Coolant Level Switch

Removal and Installation

Removal

1. Refer to: Coolant Expansion Tank (303-03G Engine Cooling - SDV6 3.0L Diesel - Hybrid Electric Vehicle, Removal and Installation).



E162437

2. CAUTION: Care must be taken not to damage the component.

Installation

1. To install, reverse the removal procedure.

Published: 02-May-2013

Engine Cooling - V6 S/C 3.0L Petrol -

Lubricants

Description	Specification
Anti-freeze	Havoline Extended Life Coolant (XLC)
Anti-freeze concentration	50%

Capacities

Item	Litres
Vehicles fitted with 2 zone Air Conditioning (A/C)	8.05
Vehicles fitted with 2 zone Air Conditioning (A/C) and Fuel fired booster heater (FFBH)	8.22
Vehicles fitted with 4 zone Air Conditioning (A/C) and Fuel fired booster heater (FFBH)	9.86

Torque Specifications

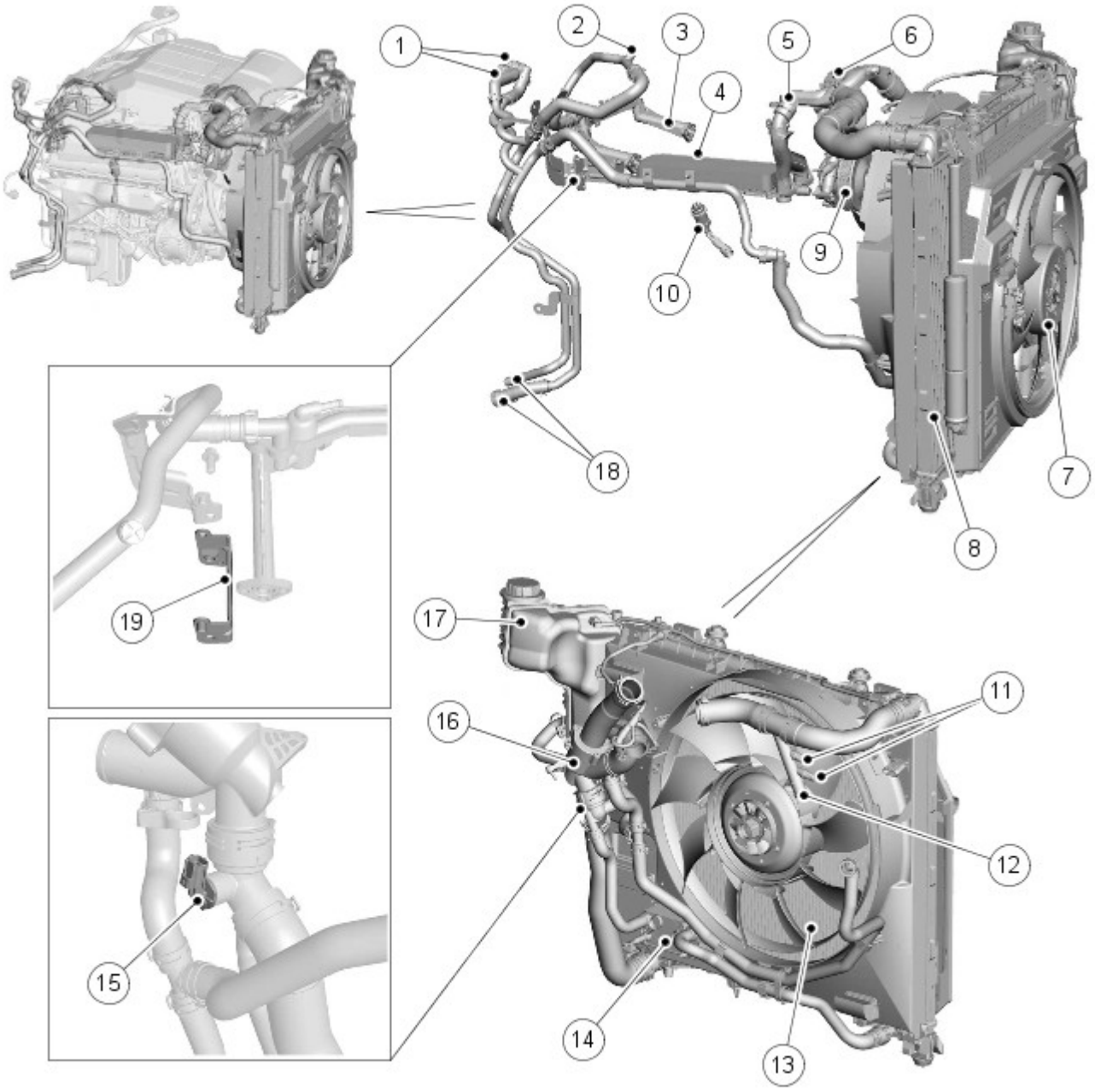
Description	Nm	lb-ft	lb-in
Coolant expansion tank retaining bolt	9	-	80
Cooling fan assembly retaining nut	65	48	-
Thermostat housing retaining bolts	10	7	-
Coolant pump retaining bolts	12	9	-
Accessory drive belt tensioner bolt	48	35	-
Radiator drain plug	5	-	44
Auxiliary radiator nut and bolt	9	-	80
Auxiliary radiator bolt	5	-	44
Auxiliary radiator nuts	9	-	80
Cooling fan shroud upper half screw	4	-	35
Transmission oil cooler to cooling fan shroud bolt	7	-	62
Cooling fan shroud to radiator bolt	7	-	62
Radiator lower bushing bolt	15	11	-
Condenser core retainer to coolant radiator bolt	4.5	-	40
Refrigerant line to condenser core nut	8	-	71
Coolant bleed screw	3	-	27

Published: 02-May-2013

Engine Cooling - V6 S/C 3.0L Petrol - Engine Cooling

Description and Operation

COMPONENT LOCATION



E152340

Item	Part Number	Description
1	-	Heater connections
2	-	Bleed screw
3	-	Heater manifold
4	-	Engine oil cooler
5	-	Outlet tube
6	-	Electric throttle
7	-	Electric cooling fan (where fitted)
8	-	Radiator
9	-	Coolant pump
10	-	Block heater (where fitted)
11	-	Connections for supercharger charge air coolers
12	-	Connections for supercharger charge air radiators
13	-	Viscous cooling fan
14	-	Transmission oil cooler
15	-	Radiator outlet temperature sensor

16	-	Thermostat
17	-	Expansion tank
18	-	Auxiliary heater connections (where fitted)
19	-	Heater pipe bracket

OVERVIEW

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:

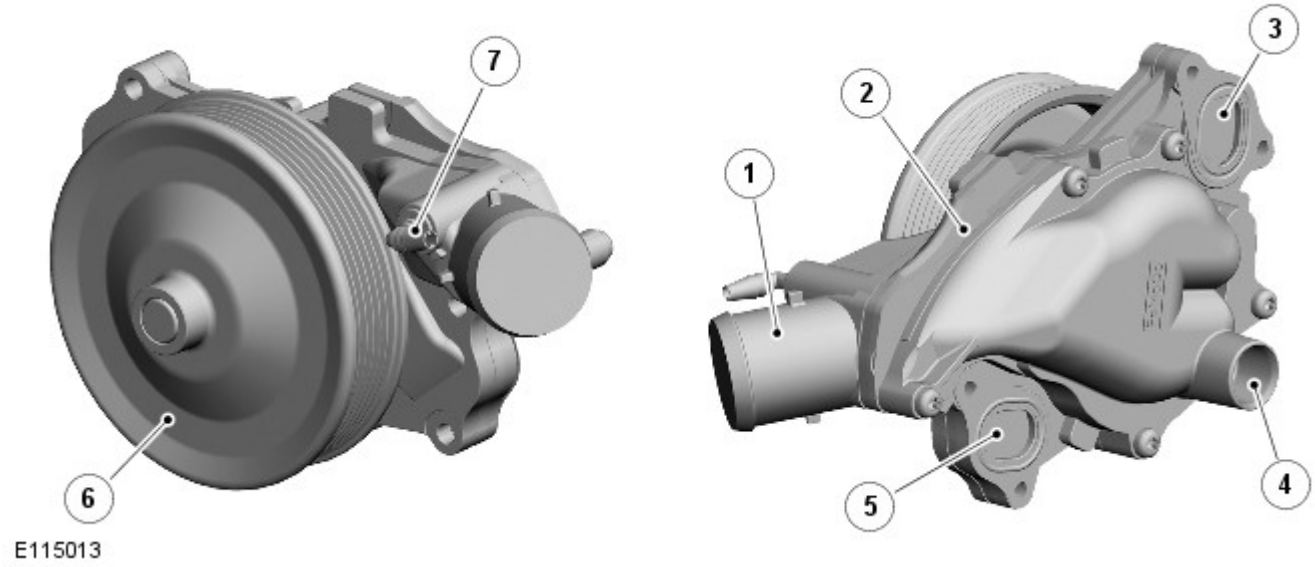
- Heating for:
  - The passenger compartment.
  - The throttle body.
- Cooling for:
  - The engine oil cooler.
  - The transmission fluid cooler.

The primary components of the engine cooling system are the:

- Coolant pump.
- Thermostat.
- Radiator.
- One or two engine cooling fans.
- Expansion tank.
- Outlet tube and heater manifold.
- Connecting hoses and pipes.

DESCRIPTION

Coolant Pump



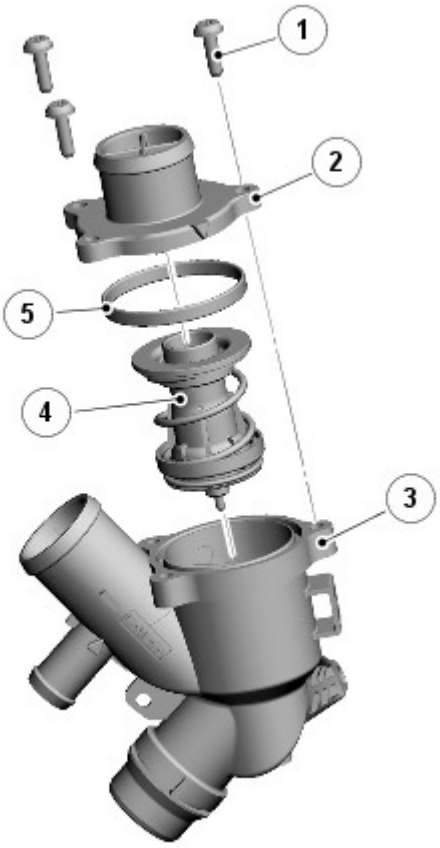
E115013

Item	Part Number	Description
1	-	Inlet connection
2	-	Pump body
3	-	Outlet flange to right cylinder head
4	-	Outlet to engine oil cooler
5	-	Outlet flange to left 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 (303-05B Accessory Drive - V6 S/C 3.0L Petrol, Description and Operation).

Two coolant outlet flanges attach the coolant pump to the front of the cylinder block. 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



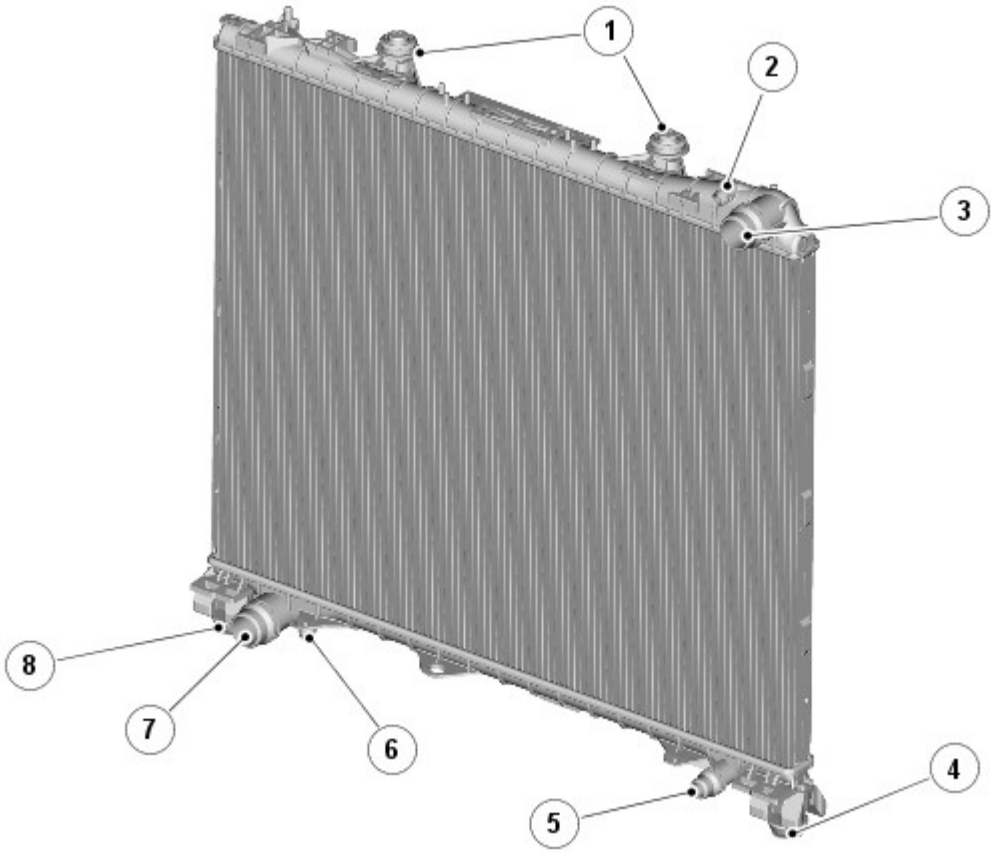
E115014

Item	Part Number	Description
1	-	Bolt (3 off)
2	-	Upper body
3	-	Lower 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.

Radiator



E145080

Item	Part Number	Description
1	-	Upper mounts
2	-	Vent hose connection
3	-	Upper hose connection
4	-	Lower mount
5	-	Transmission hose connection
6	-	Drain screw
7	-	Lower hose connection
8	-	Lower mount

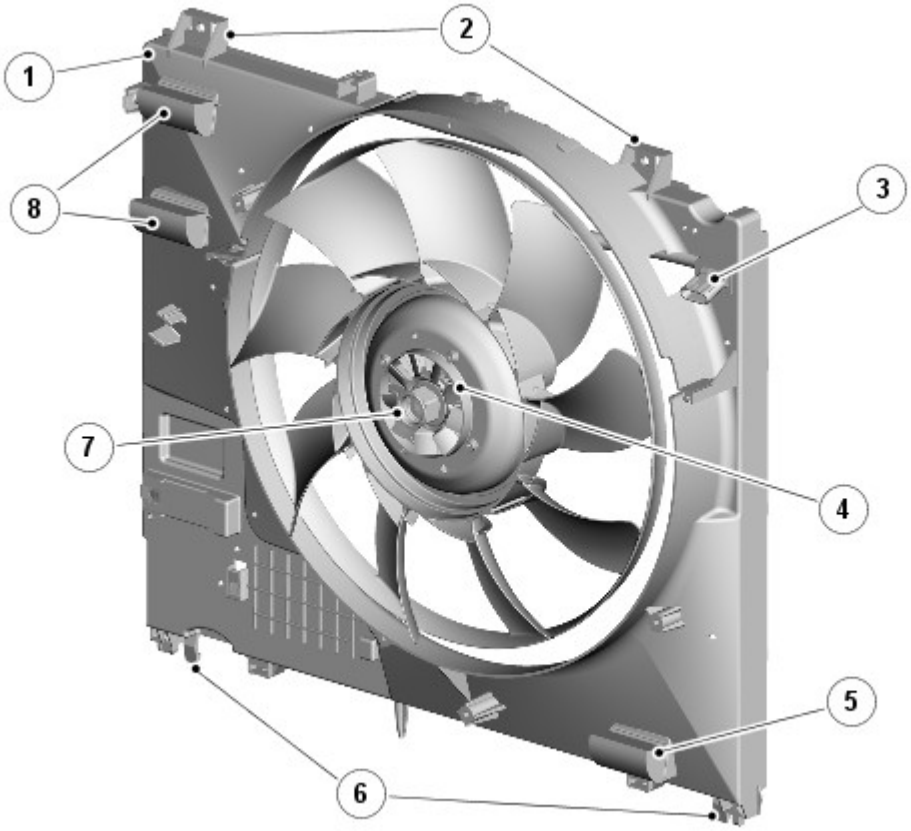
The radiator is a vertical-flow type with an integral transmission fluid sub-cooler. The radiator is located in the vehicle by bushes attached to the end tanks. The lower bushes are installed in the front subframe. The upper bushes are installed in the front end carrier.

Upper and lower hose connections are incorporated into the upper and lower end tanks respectively. The lower end tank also incorporates a drain screw, and a connection for the feed hose of the transmission fluid cooler. The upper end tank incorporates a connection for a vent hose to the expansion tank. The end tanks also incorporate mounting points for viscous and electric cooling fan shrouds, and the climate control condenser.

Engine Cooling Fan(s)

Depending on market and model specification, vehicles have either a viscous cooling fan, or a viscous cooling fan and an electric cooling fan, to help regulate the coolant temperature.

VISCOUS COOLING FAN



E145204

Item	Part Number	Description
1	-	Shroud
2	-	Mounting lugs
3	-	Electrical connector
4	-	Electro-viscous drive unit
5	-	Speed flap
6	-	Mounting lugs
7	-	Securing nut
8	-	Speed flaps

The viscous engine 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.

The blades of the cooling fan are located in a shroud attached to the rear of the radiator. The shroud incorporates speed flaps, which pivot open to allow engine compartment cooling at speed. 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.
For additional information, refer to: Accessory Drive (303-05B Accessory Drive - V6 S/C 3.0L Petrol, Description and Operation).

NOTE: The securing nut is made with right thread.

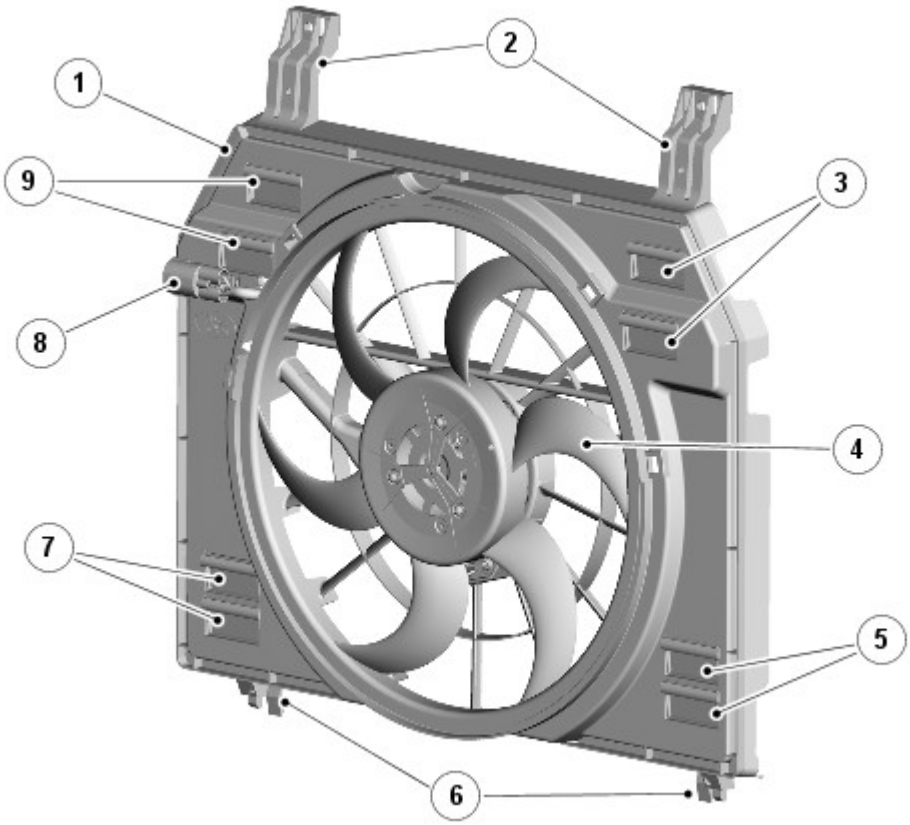
The viscous engine cooling fan is operated by a control module, integrated into the drive unit, which is controlled by the ECM. An electrical connector in the top right corner of the shroud provides the interface between the cooling fan harness and the vehicle wiring. The control module is provided with:

- Two battery power supplies from the ECM relay in the EJB (Engine Junction Box)
- A PWM (Pulse Width Modulation) signal from the ECM
- A ground.

A Hall effect sensor in the fan control module provides a fan speed signal for the ECM.

To control the cooling fan, the ECM varies the duty cycle of the PWM signal. The fan control module translates the duty cycle into a fan target speed and sets the level of engagement of the viscous clutch accordingly.

ELECTRIC COOLING FAN (where fitted)



E145205

Item	Part Number	Description
1	-	Shroud
2	-	Mounting lugs
3	-	Speed flaps
4	-	Fan blades and motor
5	-	Speed flaps
6	-	Mounting lugs
7	-	Speed flaps
8	-	Electrical connector
9	-	Speed flaps

The electric engine cooling fan is a variable speed fan installed in a shroud attached to the front of the radiator. The shroud incorporates speed flaps, which pivot open to allow engine compartment cooling at speed.

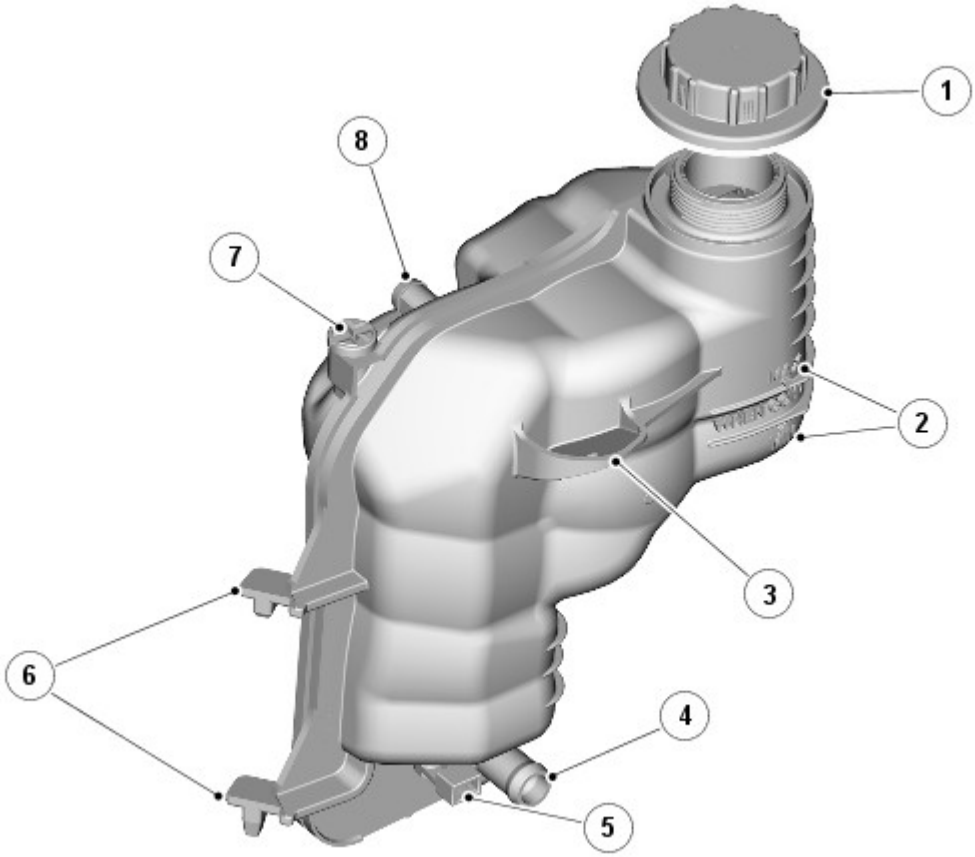
The cooling fan is operated by a fan control module, integrated into the electric motor, which is controlled by the ECM. An electrical connector at the right side of the fan shroud provide the interface between the cooling fan harnesses and the vehicle wiring.

The fan control module of each cooling fan is provided with:

- A battery power supply from the EJB
- An ignition signal from the ECM relay in the EJB
- A PWM signal from the ECM
- A ground.

To control the cooling fan, the ECM varies the duty cycle of the PWM signal. The fan control module translates the duty cycle into a fan target speed and sets the output current to the fan motor accordingly.

Expansion Tank



E145082

Item	Part Number	Description
1	-	Filler cap
2	-	MAX and MIN level markings
3	-	Mounting lug
4	-	Supply hose connection
5	-	Coolant level sensor
6	-	Mounting lugs
7	-	Bleed screw
8	-	Vent hose connection

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 thermostat. A continuous vent into the expansion tank, through a hose connected to the radiator, prevents air locks from forming in the cooling system.

The expansion tank is attached to the front end carrier in the front left corner of the engine compartment. A filler cap, bleed screw and level sensor are incorporated into the expansion tank. MAX and MIN level markings are molded into the exterior of the tank.

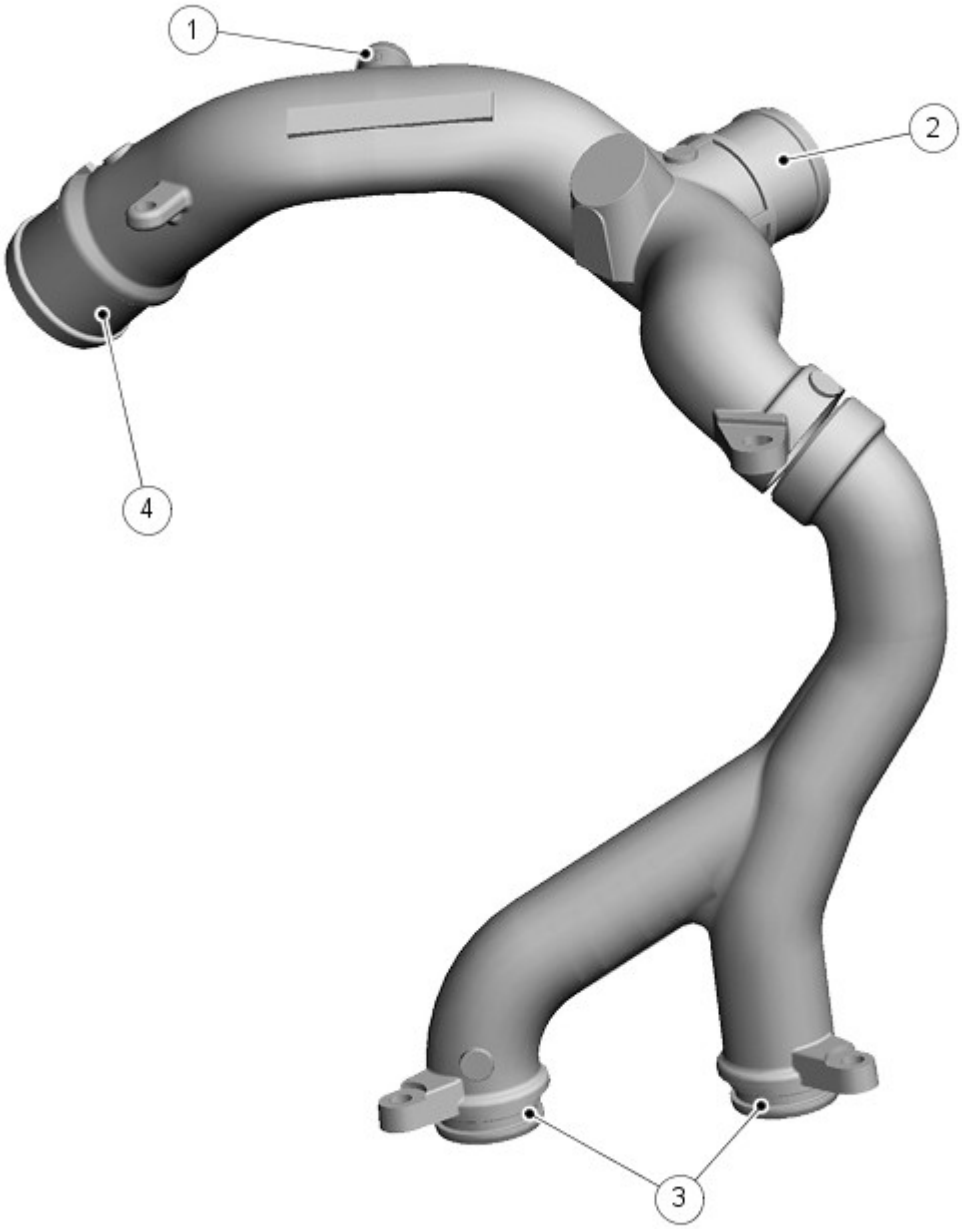
The expansion tank provides the following functions:

- 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 0.5 to 1 liter (1.06 to 2,11 US pints), above the MAX level, to allow for coolant expansion.

Outlet Tube and Heater Manifold

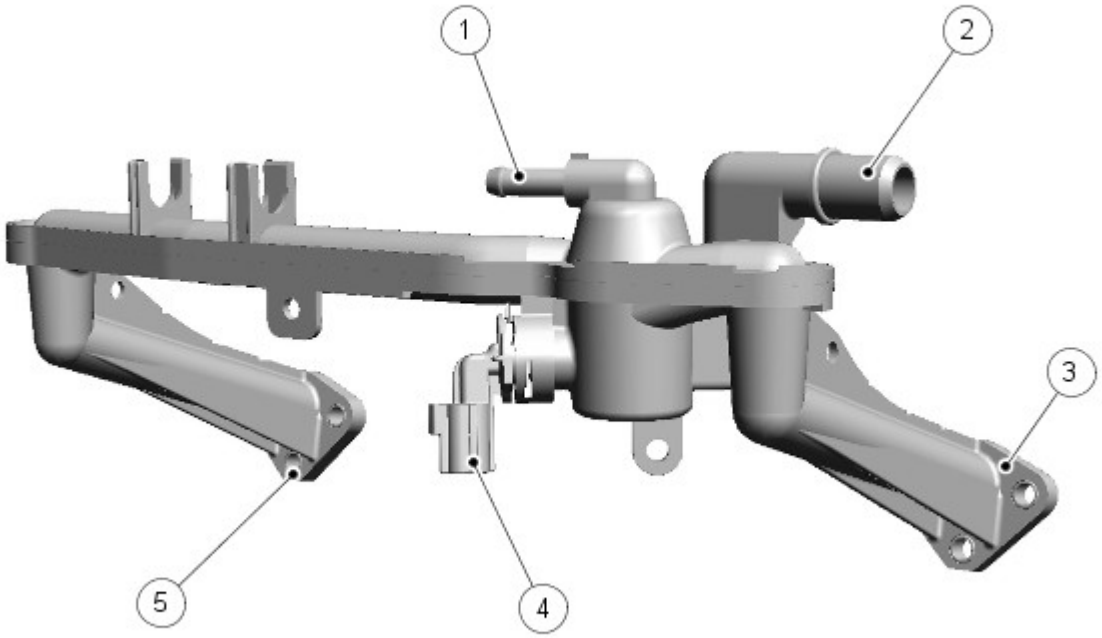
OUTLET TUBE



E152317

Item	Part Number	Description
1	-	Bleed spigot (fitted with blanking plug)
2	-	Radiator upper hose connection
3	-	Cylinder block connections
4	-	Thermostat hose connection

HEATER MANIFOLD



E152341

Item	Part Number	Description
1	-	Throttle body heater hose connection
2	-	Heater core supply hose connection
3	-	Right cylinder head connection
4	-	Engine coolant temperature sensor
5	-	Left cylinder head connection

The coolant is silicate free and must not be mixed with conventional engine coolant.

Coolant Circuit Flow

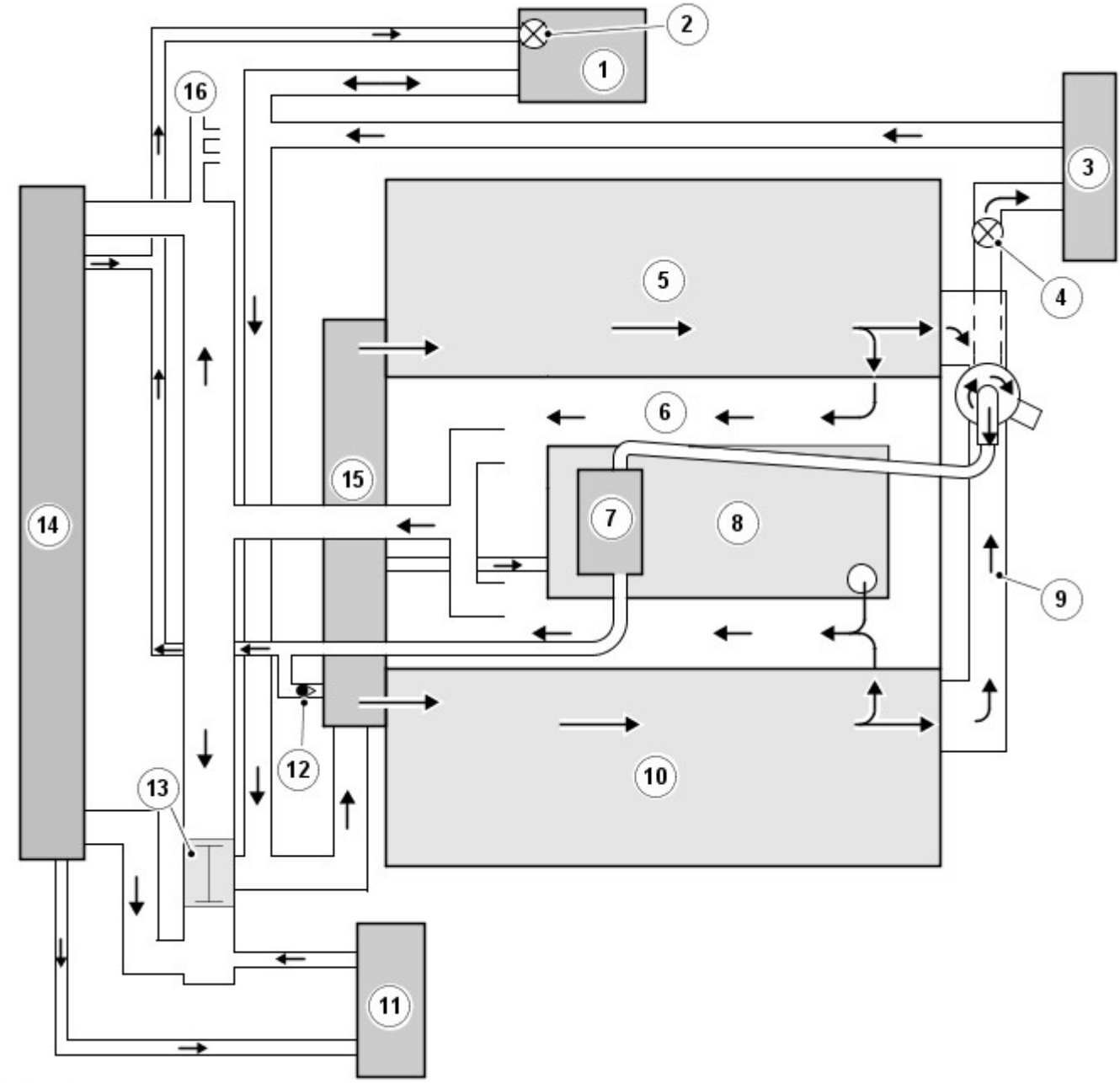
When the engine is running, the coolant is circulated around the engine cooling system by the coolant pump. From the coolant pump, coolant flows through the cylinder heads and the engine oil cooler into the cylinder block and the heater manifold.

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 electric throttle and the heater core, in parallel circuits that are unaffected by the position of the thermostat. From the electric throttle, the coolant merges with bleed coolant from the coolant pump and the outlet tube and flows to the expansion tank. From the heater core, 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.

Engine Cooling Flow Diagram



E145207

Item	Part Number	Description
1	-	Expansion tank
2	-	Bleed screw
3	-	Heater system
4	-	Bleed screw
5	-	Right cylinder head
6	-	Cylinder block
7	-	Throttle
8	-	Engine oil cooler
9	-	Heater manifold
10	-	Left cylinder head
11	-	Transmission fluid cooler
12	-	Check valve
13	-	Thermostat
14	-	Radiator
15	-	Coolant pump
16	-	Connections with SC cooling system

Thermostat

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).

Coolant Level Sensor

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 IC (Instrument Cluster) on the high speed CAN (Controller Area Network) Powertrain bus to display a warning message.
For additional information, refer to: Instrument Cluster (413-01 Instrument Cluster, Description and Operation).

Engine Cooling Fans

The ECM determines when to operate the cooling fans from the ECT (Engine Coolant Temperature) sensor input and a cooling fan request from the ATC (Automatic Temperature Control) module. The ECM also adjusts the fan speed to compensate for the ram effect of vehicle speed.

VISCOUS COOLING FAN

To control the viscous cooling fan, the ECM sends a PWM signal to the fan control module. The ECM varies the duty cycle of the PWM signal between 0 and 100% to vary the clutch engagement and thus fan speed. If the PWM signal is outside the 0 to 100% range, the fan control module interprets the signal as an open or short circuit and runs the fan at minimum speed to ensure the fan does not overspeed.

If the electrical connections to the viscous fan are disconnected the fan will idle and the engine may overheat. If ECM detects a cooling fan fault it stores the appropriate DTC (Diagnostic Trouble Code) and signals the IC on the high speed CAN Powertrain bus to display a warning message.

ELECTRIC COOLING FAN

The ECM varies the duty cycle of the PWM signal to the fan control module between 0 and 100% to operate the fan motor in one of four modes: Off, minimum speed (750 rev/min), linear variable speed between minimum and maximum speeds, and maximum speed (2820 rev/min). Under hot operating conditions, the electric cooling fan may continue to operate for up to five minutes after the engine has been switched off.

The fan control module monitors for over and under input voltage, a stalled motor and a partially stalled motor. If it detects any of these faults the fan control module temporarily pulls the PWM signal to ground to notify the fault to the ECM. The length of time the PWM signal is pulled to ground varies between 2 and 8 seconds, depending on the fault. The fan control module repeats the notification process at 5 second intervals until the fault is cleared. If there is more than one fault, only the highest priority fault is notified to the ECM. Fault priorities, in descending order, are over voltage, under voltage, stalled motor and partially stalled motor. The ECM records a related DTC for faults notified by the fan control module and signals the IC on the high speed CAN Powertrain bus to display a warning message.

The nominal operating voltage for the engine cooling fans is 9 to 16 volts. If the input voltage is outside of these limits, the fan control module stops operation of the cooling fan and notifies the ECM of the fault. After an under or over voltage occurs, cooling fan operation is resumed when the input voltage increases to 9.5 volts, or decreases to 15.5 volts, respectively.

To check for a stalled motor, each time it supplies power to start the fan motor the fan control module checks the fan motor speed after 2 seconds. If the speed is zero, the fan control module determines the fan motor is stalled and tries a restart. For a restart, the fan control motor disconnects the power from the fan motor then immediately reconnects it at an increased current level. The fan control module will try up to six restarts of a stalled motor, increasing the output current each time. If the fan motor remains stalled after the sixth restart, the fan control module waits 40 seconds then notifies the ECM of the fault and begins the start process again.

To check for a partially stalled motor, while the fan is running the fan control module monitors the current draw against fan speed. If the current draw is over the limit for more than 10 seconds, the fan control module disconnects the power from the fan motor and notifies the ECM of the fault. After 40 seconds, the fan control module starts the motor again.

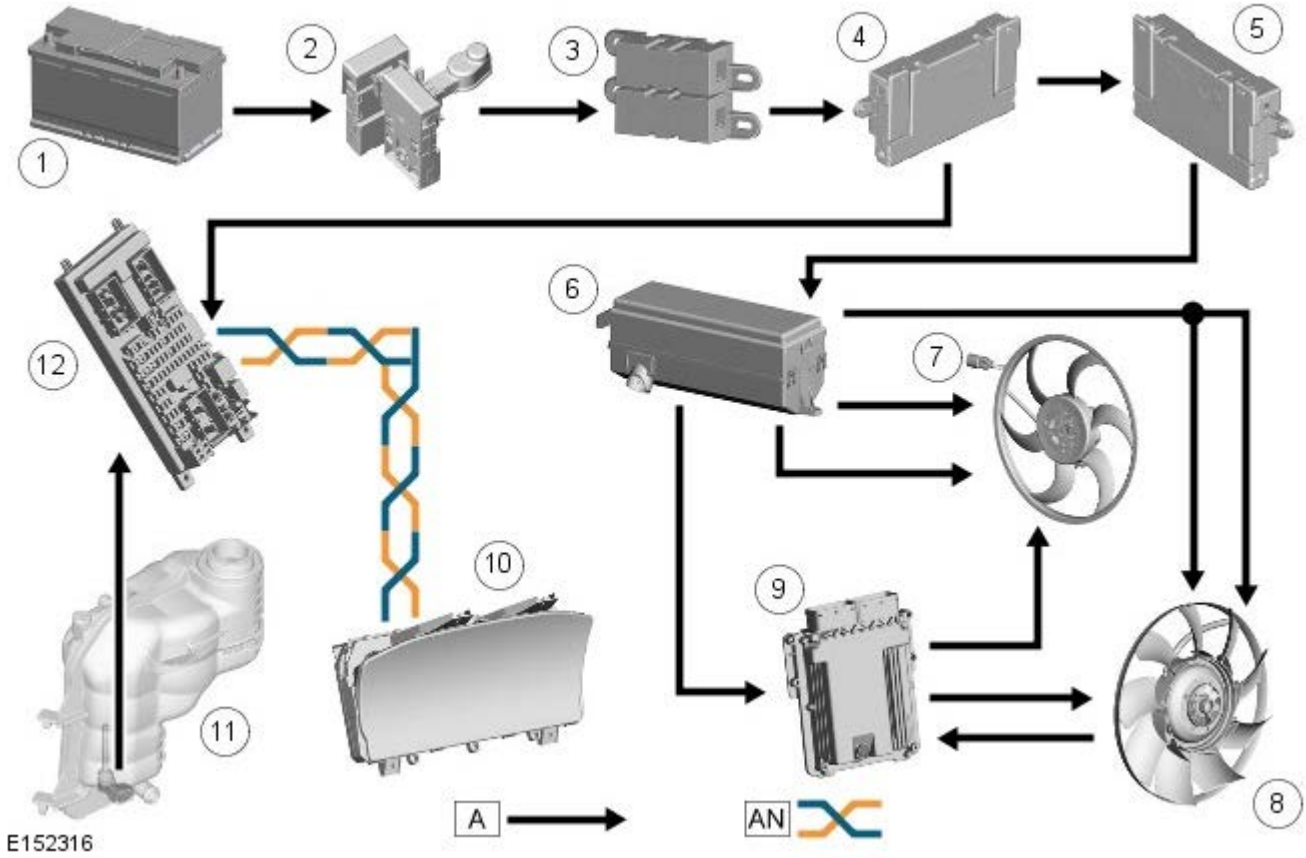
The fan control module incorporates a temperature sensor to prevent damage caused by excessive heat at high ambient temperatures. Operation of the fan control module is discontinued if the temperature reaches 135 °C (275 °F). Operation resumes when the temperature decreases to 120 °C (248 °F).

If a fault occurs with the ignition signal or the PWM signal, the fan control module adopts the following fan speeds:

Signal	Fault	Fan Speed	
		Ignition On	Ignition Off
PWM	Duty cycle implausible	Maximum	Off
PWM	Frequency out of range	Maximum	Off
PWM	Open circuit	Maximum	Off
PWM	Short circuit to battery	Maximum (provided cooling fan is not damaged)	Off
PWM	Short circuit to ground	Maximum (provided cooling fan is not damaged)	Off
Ignition	Open circuit	Off	Off
Ignition	Short circuit to battery	According to PWM duty cycle	Maximum
Ignition	Short circuit to ground	Off (ECM relay fuse may blow)	Off

Control Diagram

 NOTE: A = Hardwired, AN = High speed CAN (Controller Area Network) Powertrain bus.



Item	Part Number	Description
1	-	Battery
2	-	Megafuse
3	-	Battery Junction Box 2 (BJB2)
4	-	Battery Junction Box (BJB)
5	-	Auxiliary Junction Box (AJB)
6	-	Engine Junction Box (EJB)
7	-	Electric cooling fan
8	-	Viscous cooling fan
9	-	Engine Control Module (ECM)
10	-	Instrument Cluster (IC)
11	-	Coolant level sensor
12	-	Central Junction Box (CJB)

Published: 17-Jun-2013

Engine Cooling - V6 S/C 3.0L Petrol - Engine Cooling

Diagnosis and Testing

Principles of Operation

For a detailed description of the engine cooling system and operation, refer to the relevant Description and Operation section in the workshop manual. REFER to:

Engine Cooling (303-03B Engine Cooling - V6 S/C 3.0L Petrol, Description and Operation),
Engine Cooling (303-03 Engine Cooling - V6 S/C 3.0L Petrol, Description and Operation),
Engine Cooling (303-03 Engine Cooling - V6 S/C 3.0L 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 • Primary 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 condition is found, correct the cause (if possible) before proceeding to the symptom chart.
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 Cause	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 pressure test. Rectify as necessary. Refer to the relevant section of the workshop manual
Overheating	• Low/contaminated coolant • Thermostat • Viscous fan • Engine coolant temperature sensor • Restricted air flow over the radiator	Check the coolant level and condition. Check the thermostat and rectify as necessary. Carry out a cooling system pressure test. Refer to the relevant section of the workshop manual. Check the viscous fan operation, make sure the viscous fan rotates freely. Check for obstructions to the air flow over the radiator
Engine not reaching normal temperature	• Thermostat • Viscous fan • Thermostat • Electric fan • Fan speed module	Check the thermostat operation. Check the viscous fan operation, make sure the viscous fan is not seized

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 - V6 S/C 3.0L Petrol , DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation).

Published: 02-May-2013

Engine Cooling - V6 S/C 3.0L Petrol - Cooling System Draining, Filling and Bleeding

General Procedures

Draining

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.

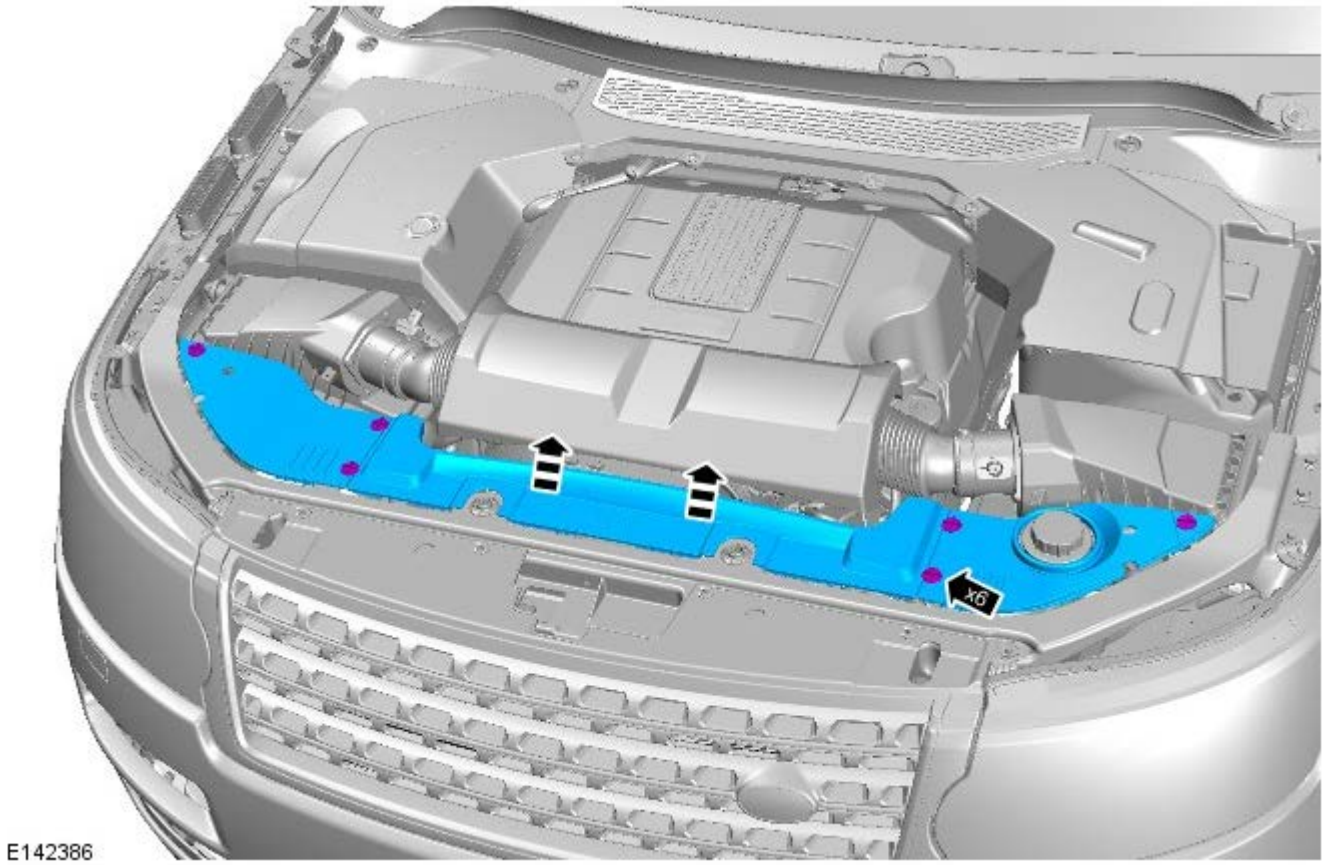
NOTE: This procedure only needs to be carried out when the coolant system vacuum filler equipment is not available in the workshop.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

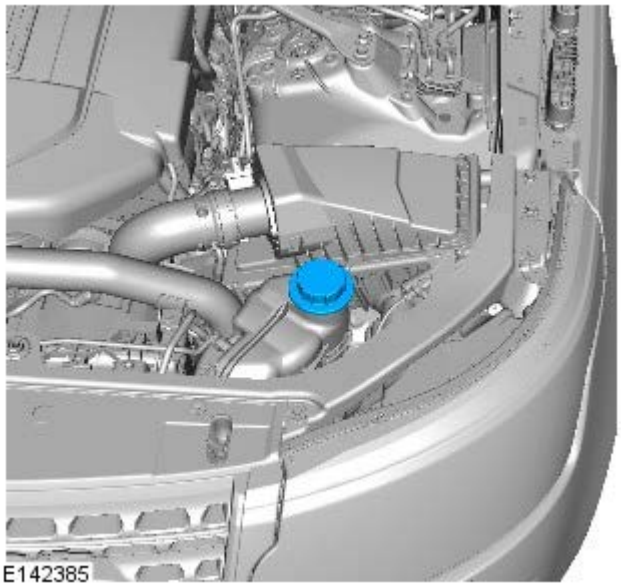
2. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

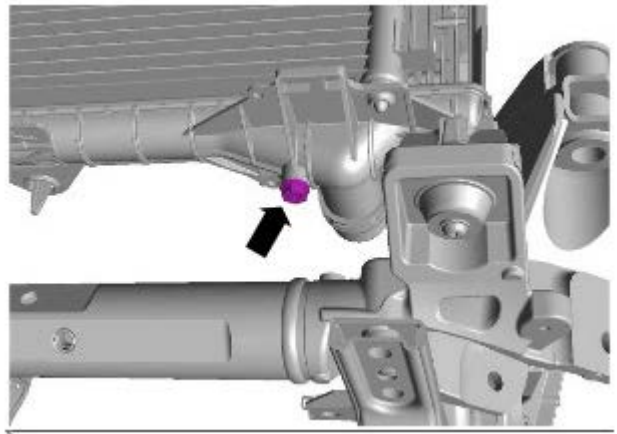
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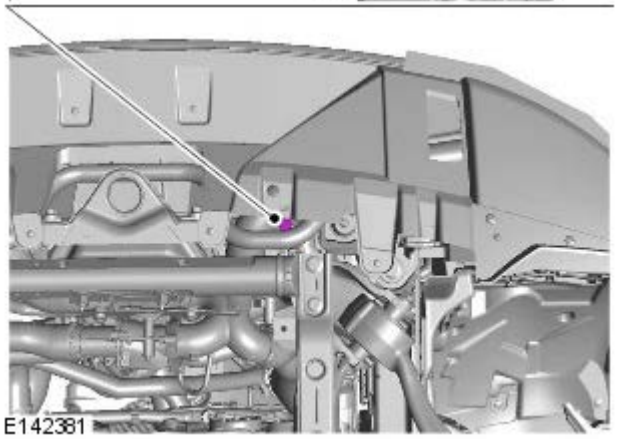


4. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12B Intake Air Distribution and Filtering - V6 S/C 3.0L Petrol, Removal and Installation).

5. WARNING: When releasing the cooling system pressure, cover the coolant expansion tank cap with a thick cloth.

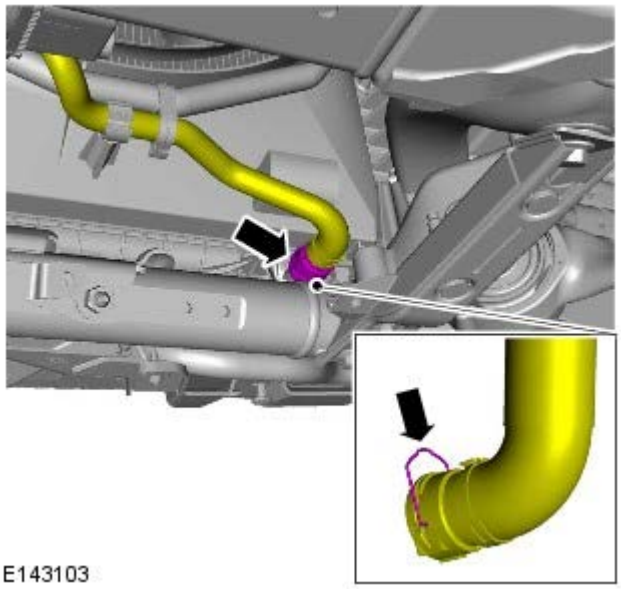

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E142381

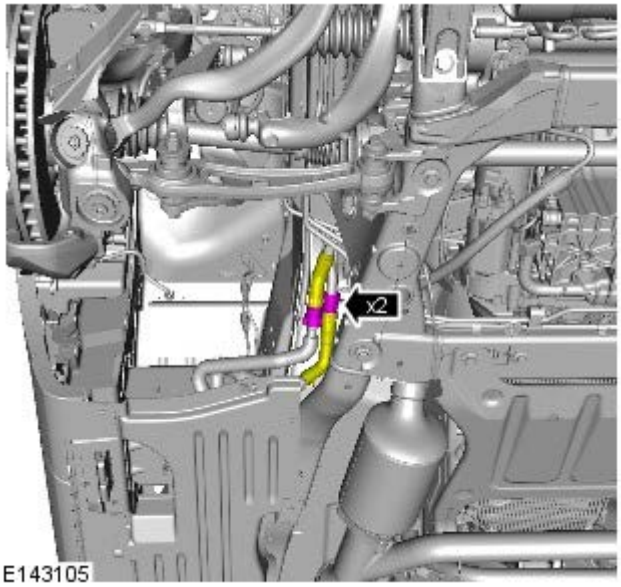
6. CAUTION: Be prepared to collect escaping coolant.

7. CAUTION: Be prepared to collect escaping coolant.


E143103

NOTE: Step 8-11 and 16-17 only needs to be carried out when auxiliary climate control system has been fitted to the vehicle.

8. Refer to: Fender Splash Shield (501-02 Front End Body Panels, Removal and Installation).

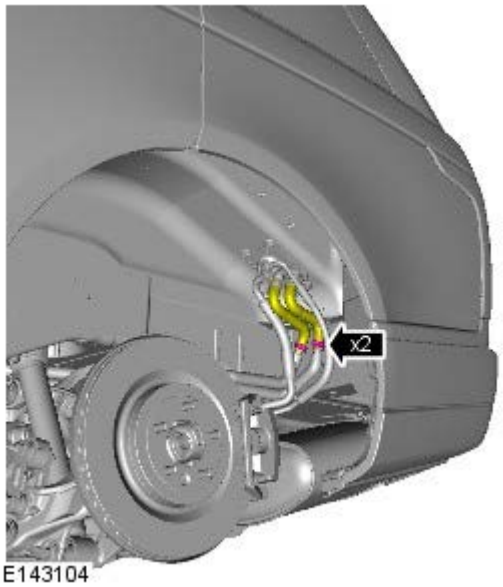


E143105

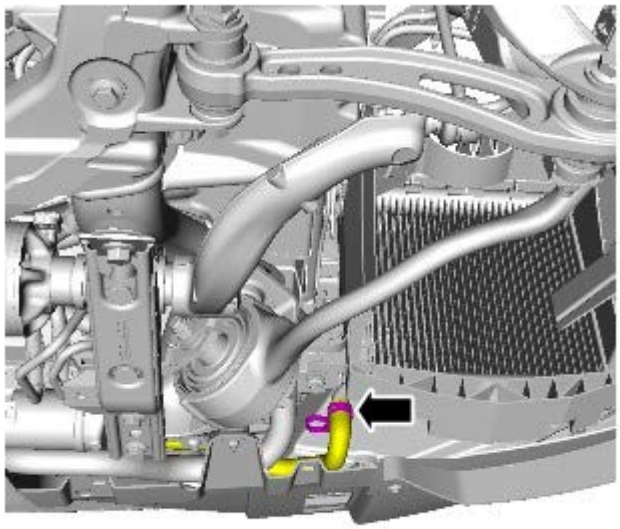
9. CAUTION: Be prepared to collect escaping coolant.

10. Refer to: Rear Fender Splash Shield (501-08 Exterior Trim and Ornamentation, Removal and Installation).

11. CAUTION: Be prepared to collect escaping coolant.



E143104



E143109

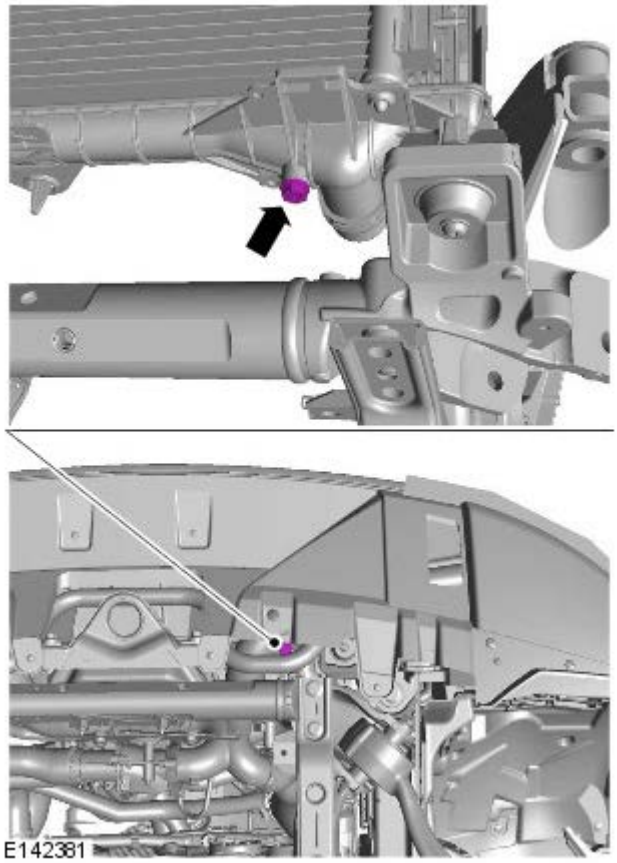
12. CAUTIONS:

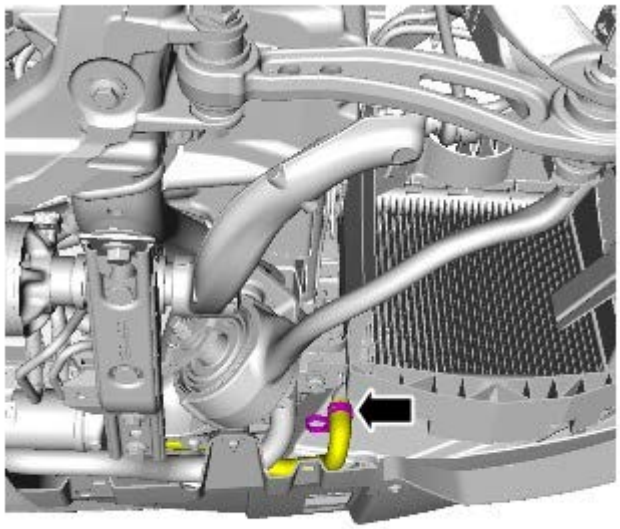
Be prepared to collect escaping coolant.

RH illustration shown, LH is similar.

NOTE: The procedure must be carried out on both sides.

13. *Torque:* 5 Nm

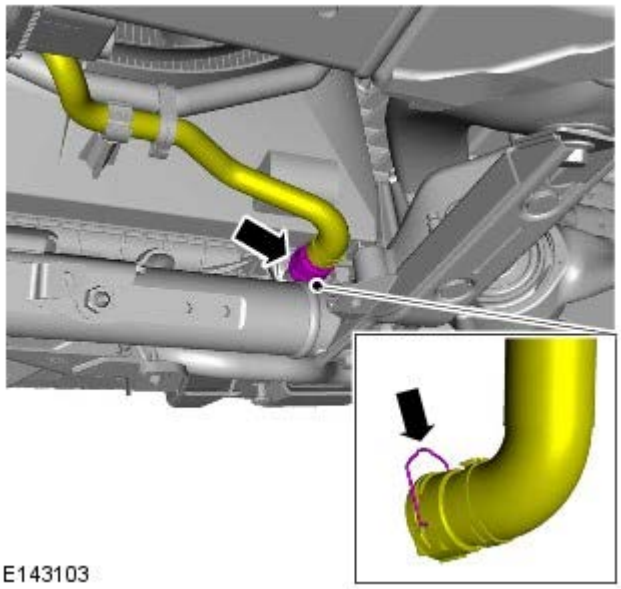

E142381


E143109

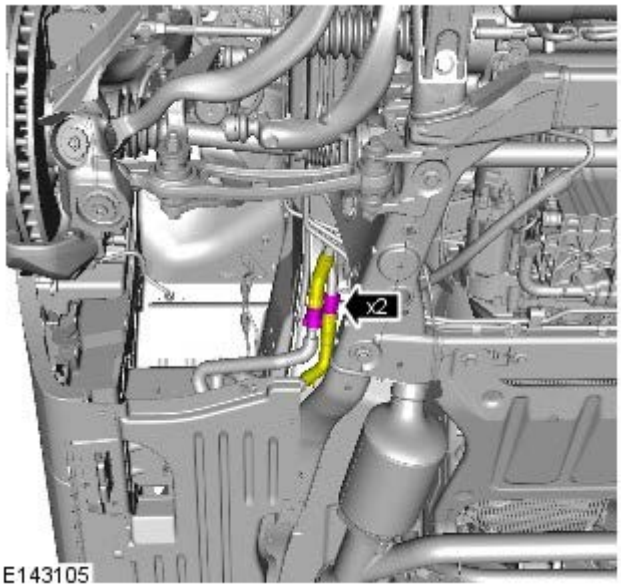
14. CAUTION: RH illustration shown, LH is similar.

NOTE: The procedure must be carried out on both sides.

15.

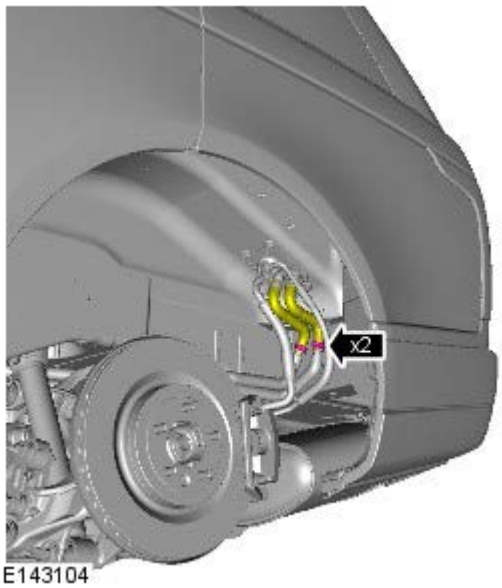

E143103

16.



E143105

17.

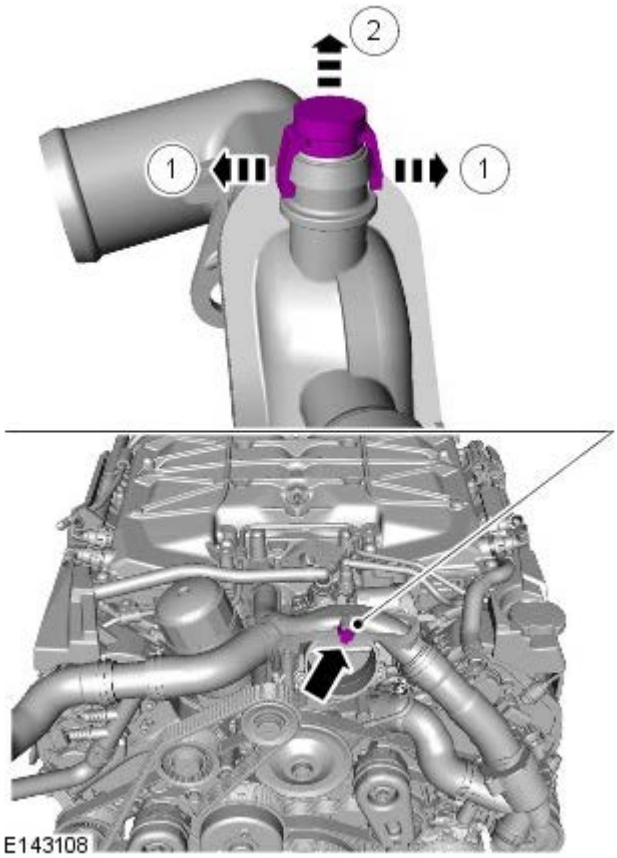


E143104

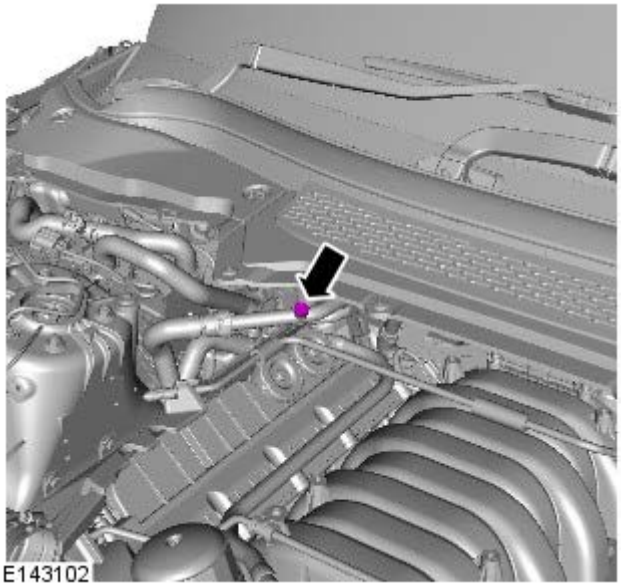
18. Carry out the procedure up to step 1 in the filling section three times, filling the cooling system with clean water at the first two drains. At the third refill, use a suitable measuring tool to make sure that the cooling system maintains a 50% mix.

Filling

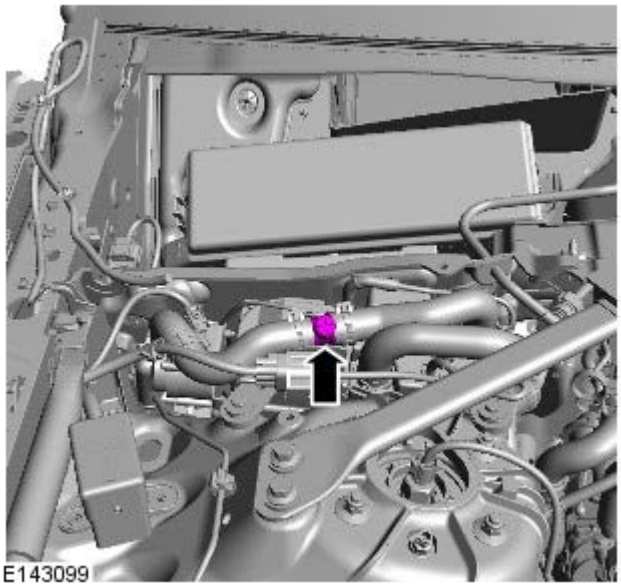
1.



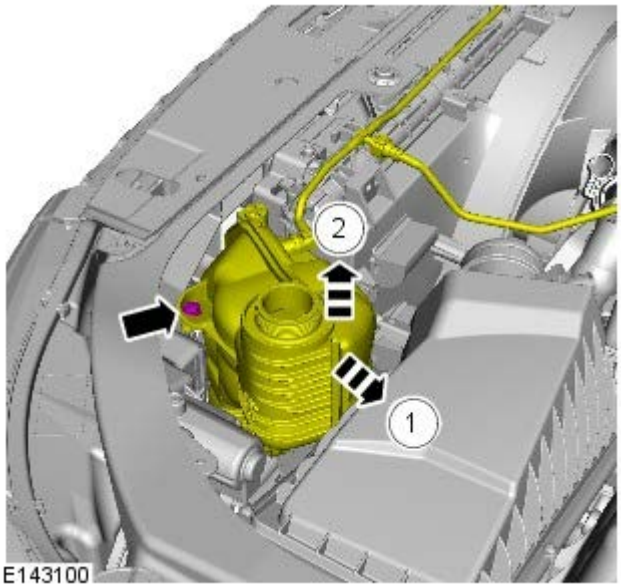
2.



3. NOTE: Where fitted.

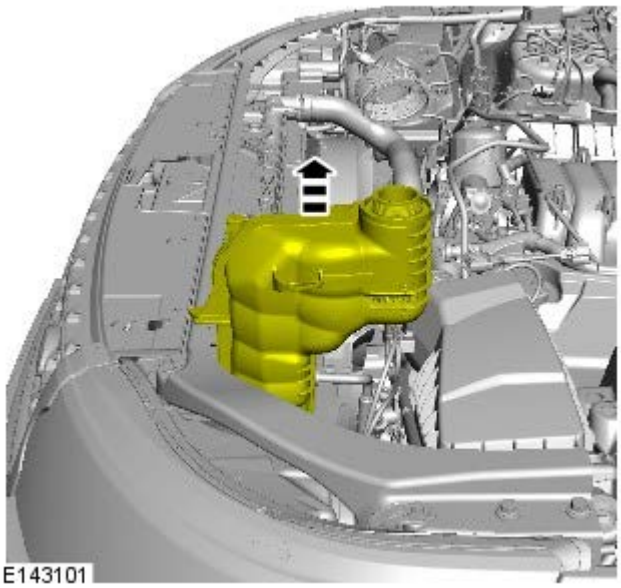


4. *Torque:* 9 Nm

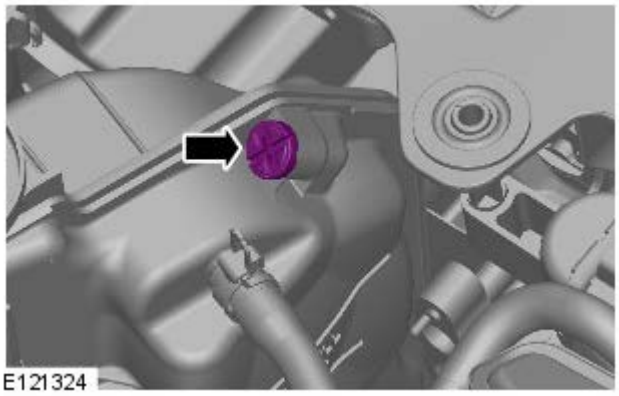


5. NOTE: Keep the coolant expansion tank vertically.

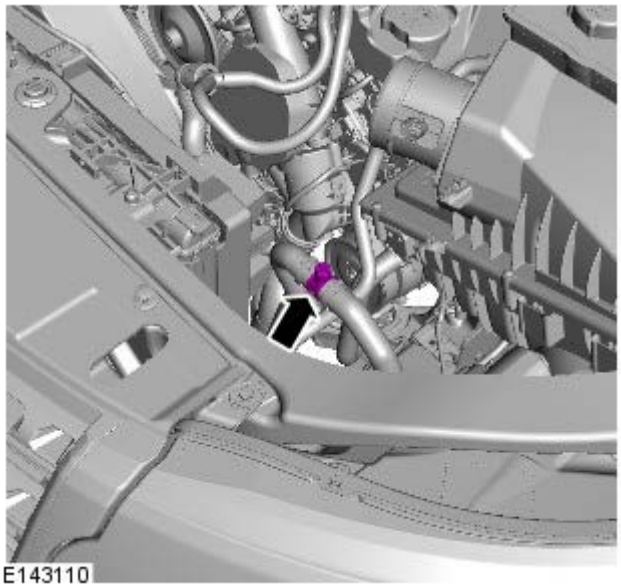
   Raise the coolant expansion tank minimum 110mm from its original position.



6.



7.

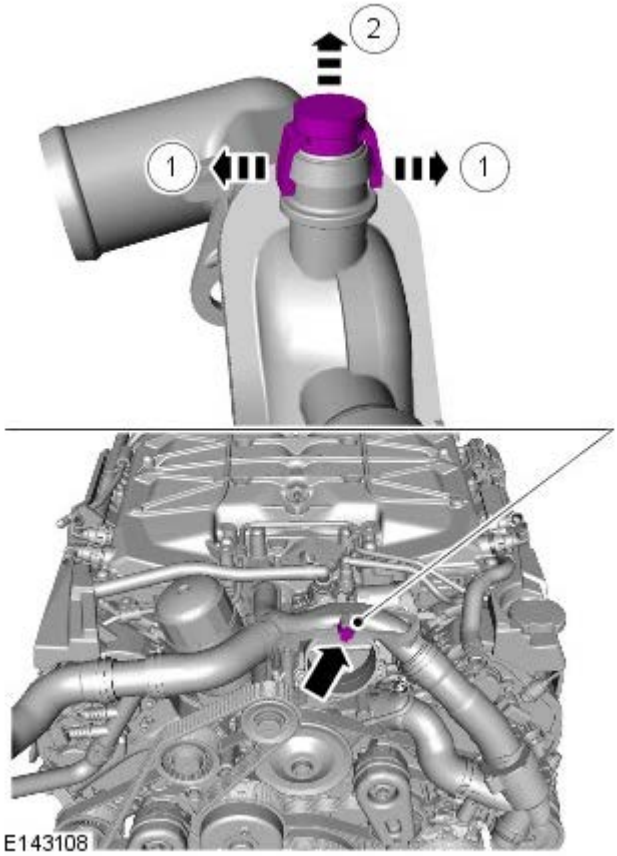


8. CAUTION: Anti-freeze concentration must be maintained at 50%.

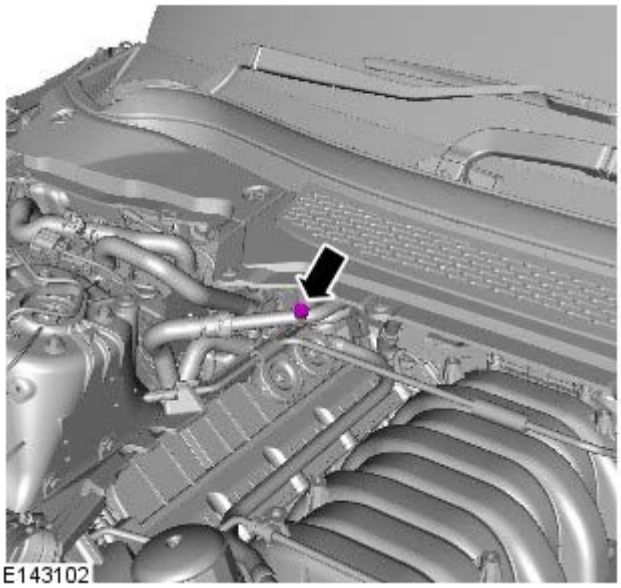
   Fill the coolant expansion tank to the rim and continue until coolant is visable from the outlet.

NOTE: Once coolant is visable from the outlet, close the bleeding points.

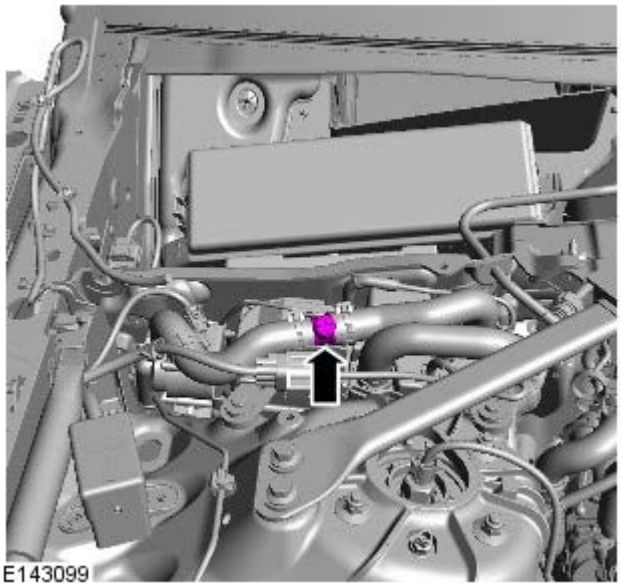
9.



10.

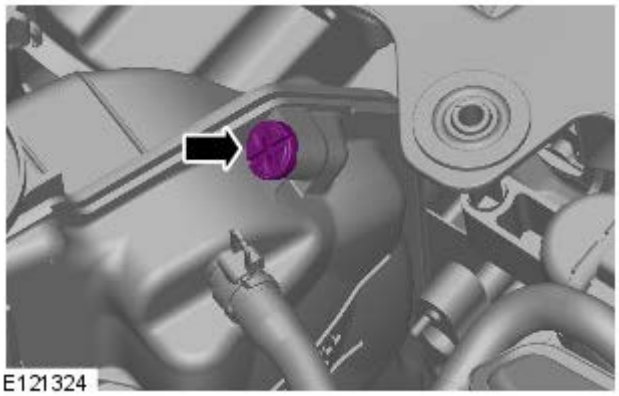


11. NOTE: Where fitted.


E143099

12. Continue to fill the coolant expansion tank to the rim until the coolant level stops dropping.

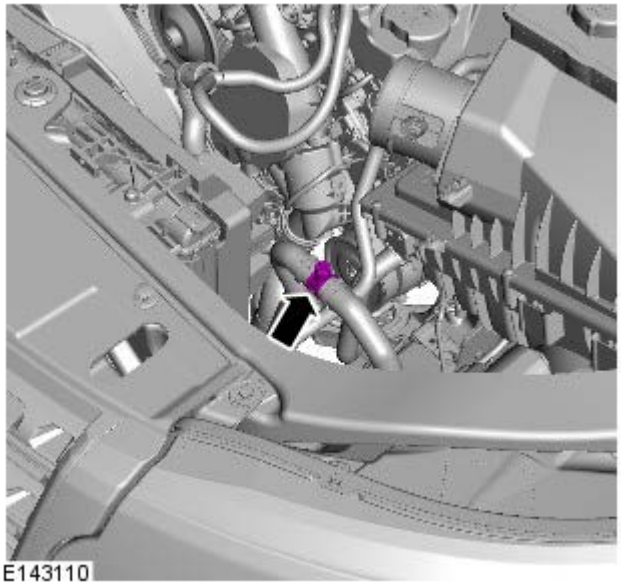
13.


E121324

14. Set the heater controls to maximum.

15. Start and run the engine.

16. Once coolant is visable from the outlet, close the bleeding points.


E143110

17. Continue to fill the coolant expansion tank to the rim until the coolant level stops dropping.

18.

- Switch the engine off.
- Wait a minimum of 1 minute.

19.
- Start and run the engine.
- Hold the engine speed at 2000 RPM until the coolant level stops dropping.

20. Increase the engine speed from idle to 3500 RPM until hot air is emitted from the front and rear face vents.

21. Install the expansion tank cap after making sure that the final coolant level is 40mm above the maximum cold fill line.

22. Run the engine until the thermostat opens and hot air is emitted from the front and rear face vents.

23. Switch the engine off and allow to cool.

24. Install the coolant expansion tank.

25. WARNINGS:

 When releasing the cooling system pressure, cover the coolant expansion tank cap with a thick cloth.

 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.

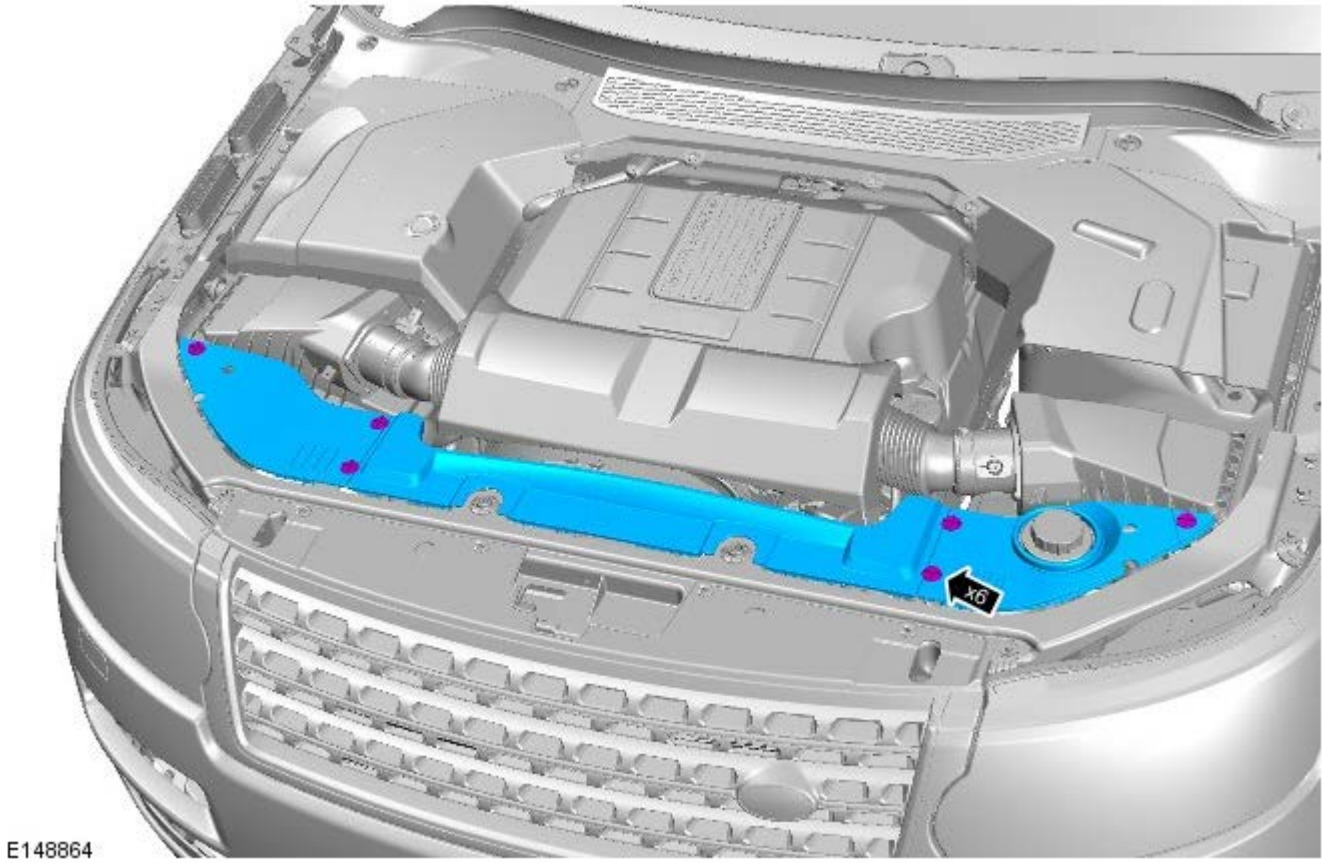
 CAUTION: Make sure the coolant level remains above the "COLD FILL RANGE" lower level mark.

Check and top-up the coolant if required.

26. Visually check the engine and cooling system for signs of coolant leakage.

27. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12B Intake Air Distribution and Filtering - V6 S/C 3.0L Petrol, Removal and Installation).

28.



29. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

Published: 02-May-2013

Engine Cooling - V6 S/C 3.0L Petrol - Cooling System Partial Draining, Filling and Bleeding

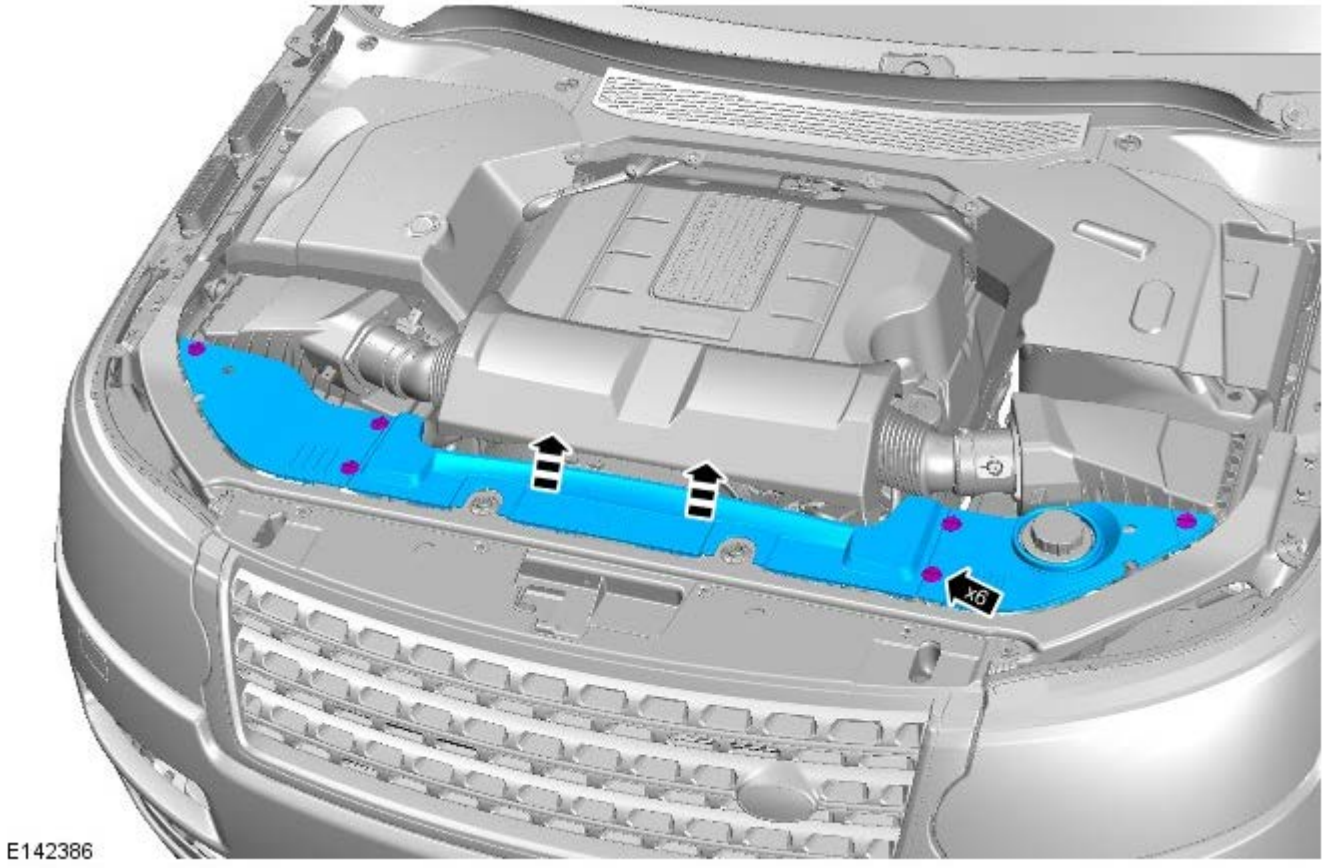
General Procedures

Draining

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.

1. WARNING: Make sure to support the vehicle with axle stands.

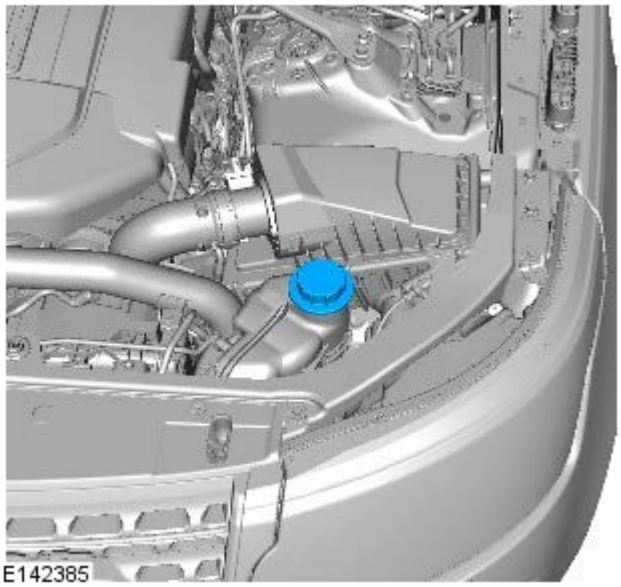
   Raise and support the vehicle.

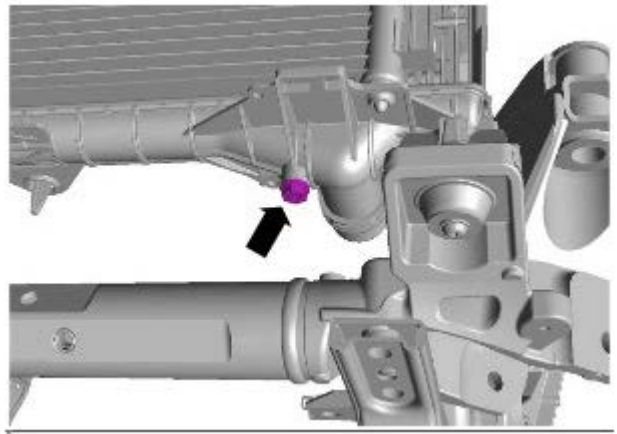
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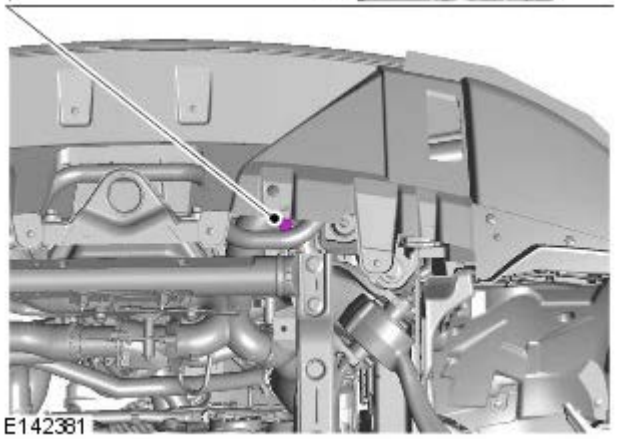
3. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12B Intake Air Distribution and Filtering - V6 S/C 3.0L Petrol, Removal and Installation).

4. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

5. WARNING: When releasing the cooling system pressure, cover the coolant expansion tank cap with a thick cloth.

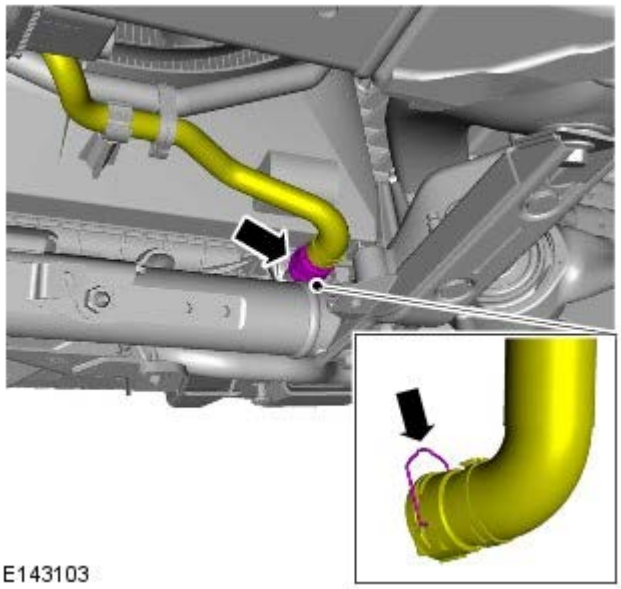

E142385



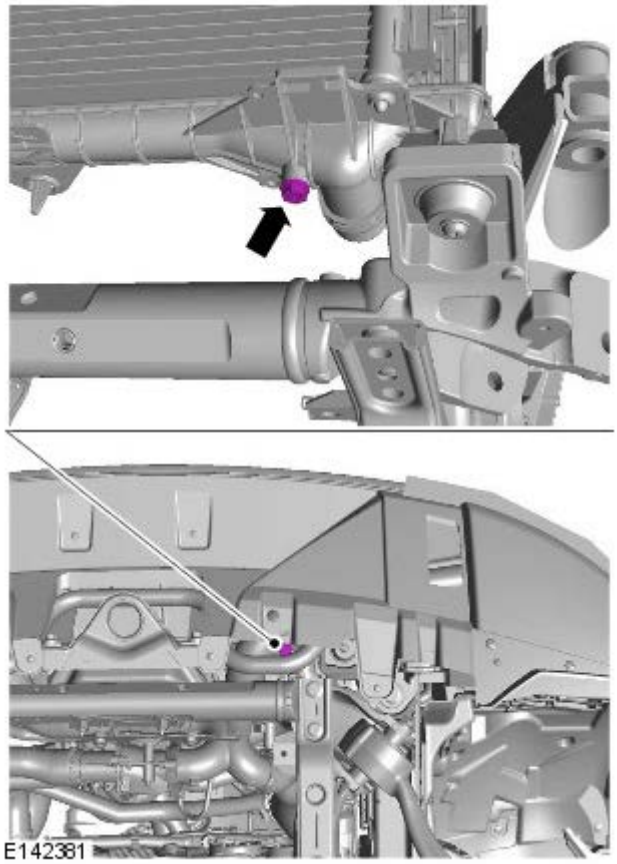

E142381

6. CAUTION: Be prepared to collect escaping coolant.

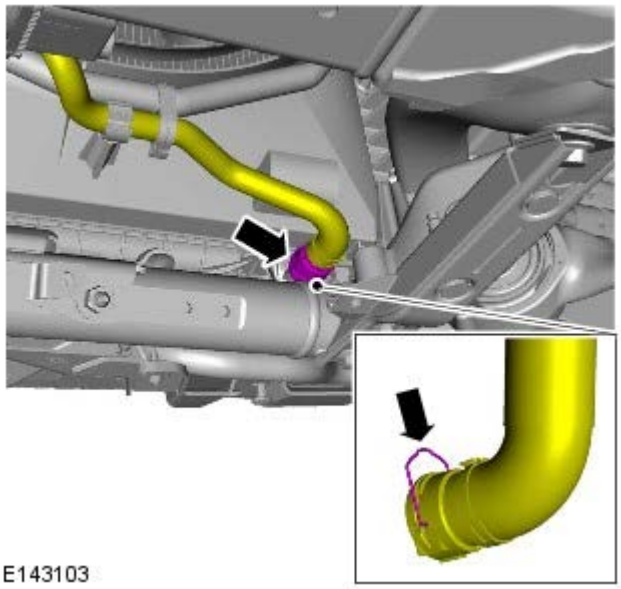
7. CAUTION: Be prepared to collect escaping coolant.


E143103

8. *Torque:* 5 Nm

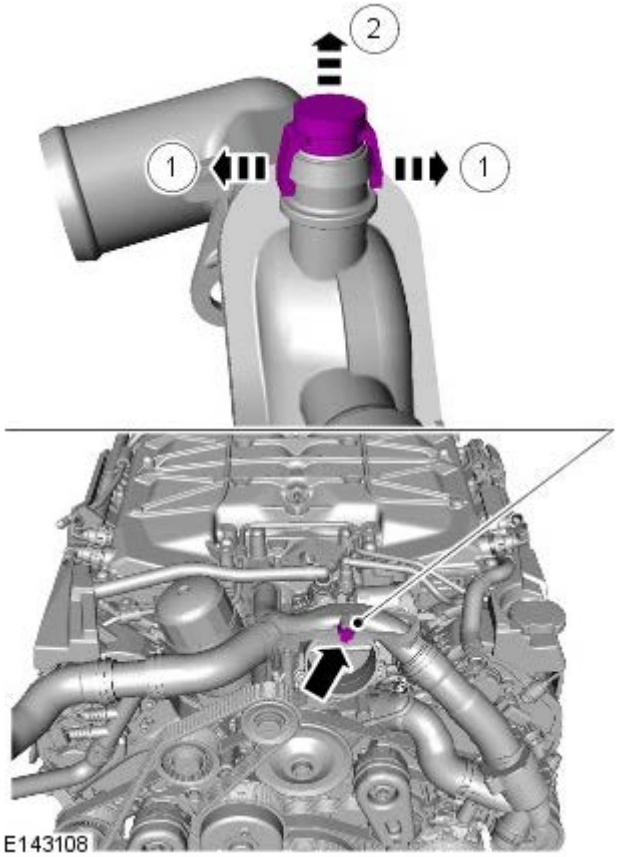

E142381

9.


E143103

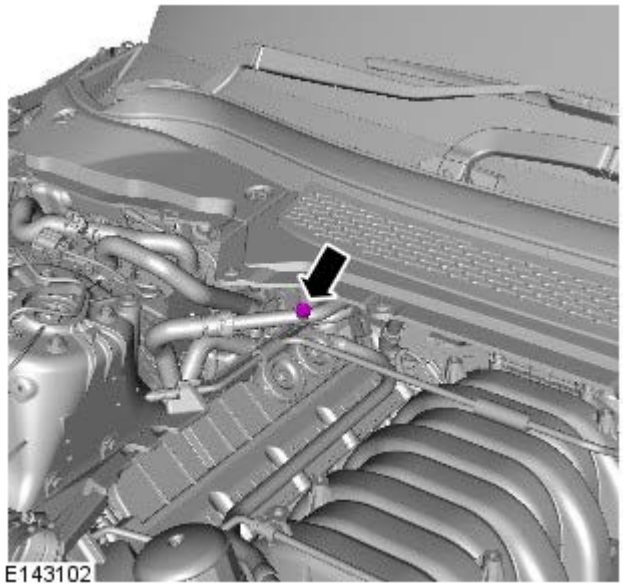
Filling

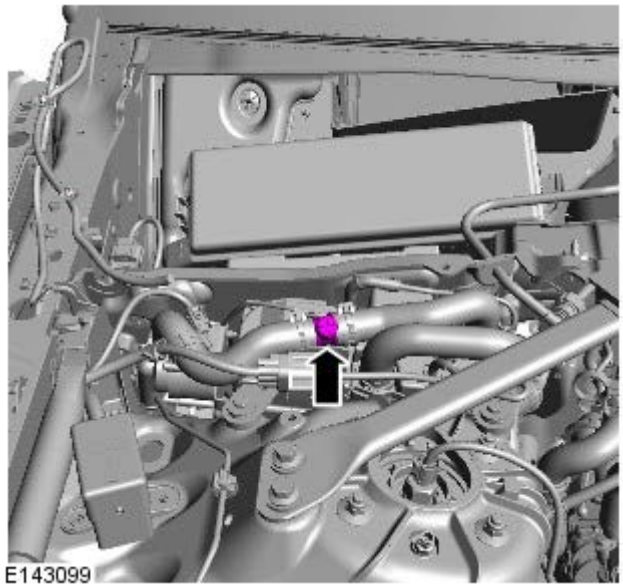
1.

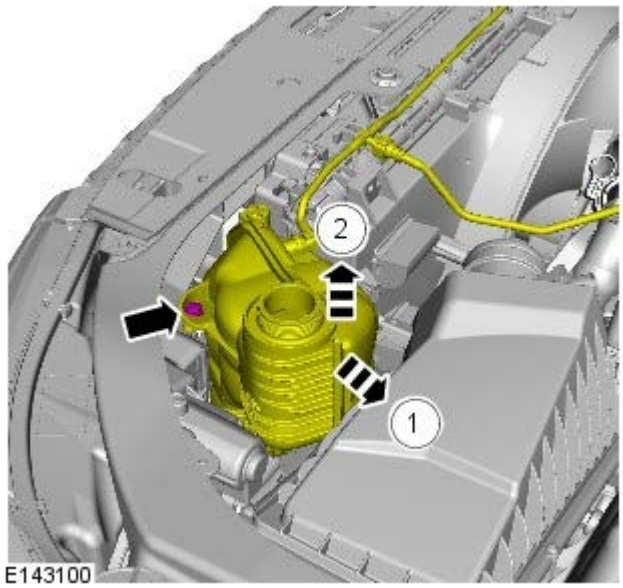


E143108

2.





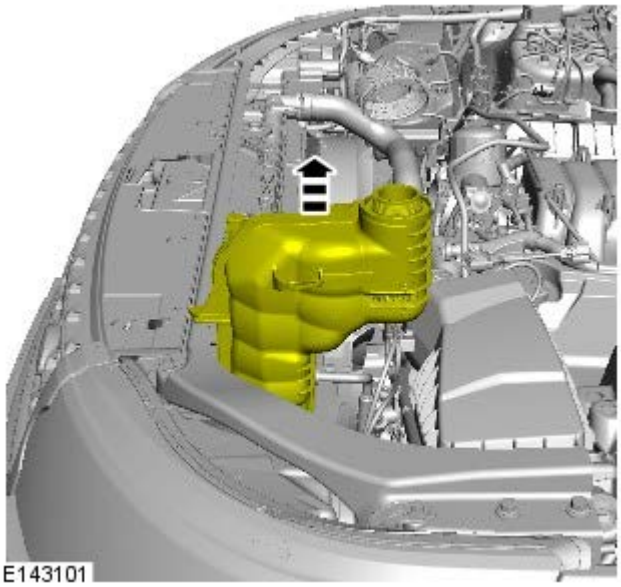


3. NOTE: Where fitted.

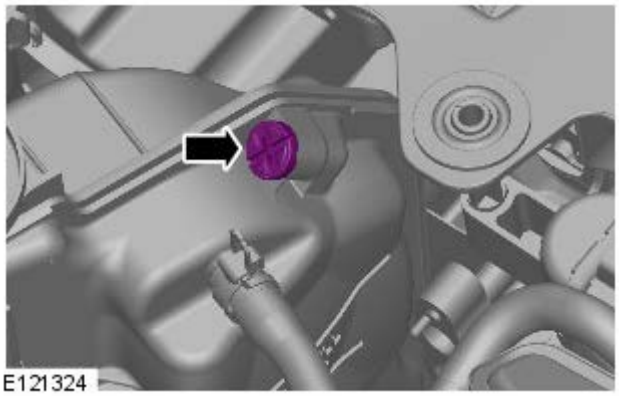
4. *Torque:* 9 Nm

5. NOTE: Keep the coolant expansion tank vertically.

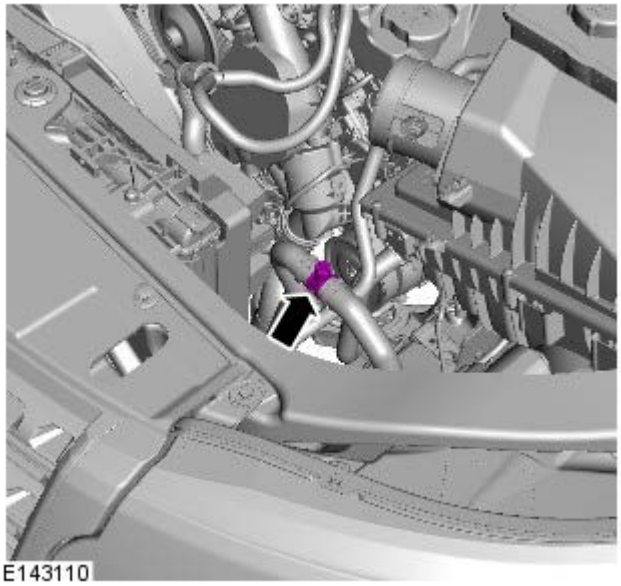
   Raise the coolant expansion tank minimum 110mm from its original position.



6.



7.

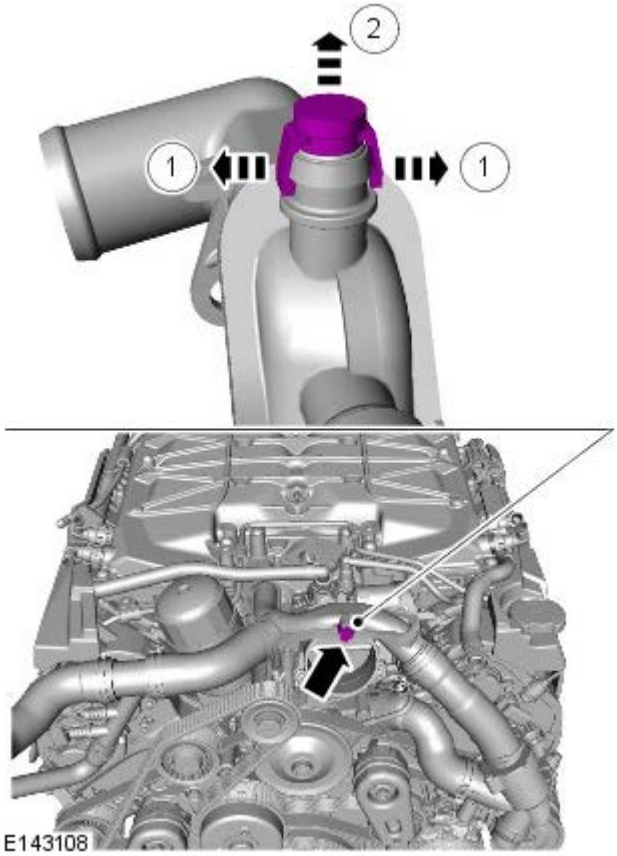


8. CAUTION: Anti-freeze concentration must be maintained at 50%.

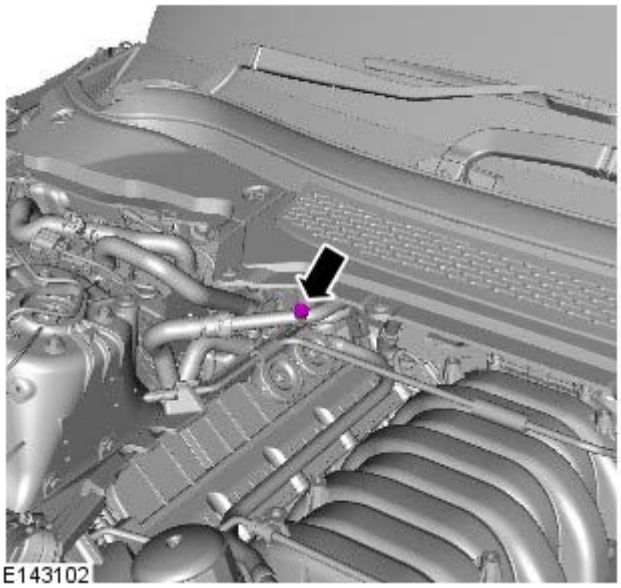
   Fill the coolant expansion tank to the rim and continue until coolant is visable from the outlet.

NOTE: Once coolant is visable from the outlet, close the bleeding points.

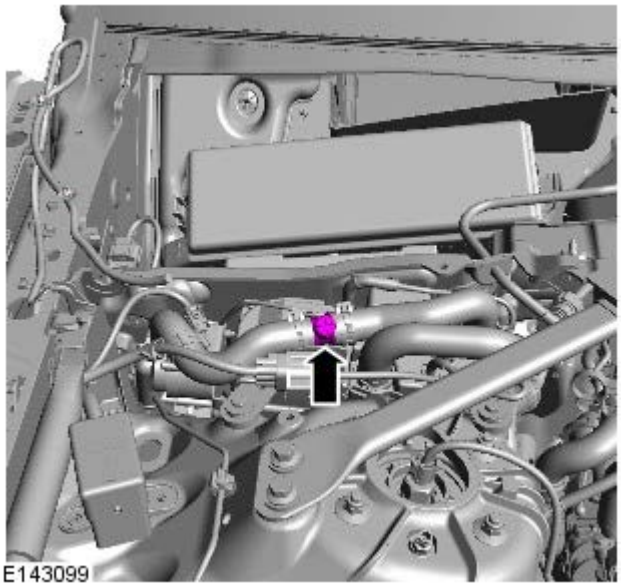
9.



10.

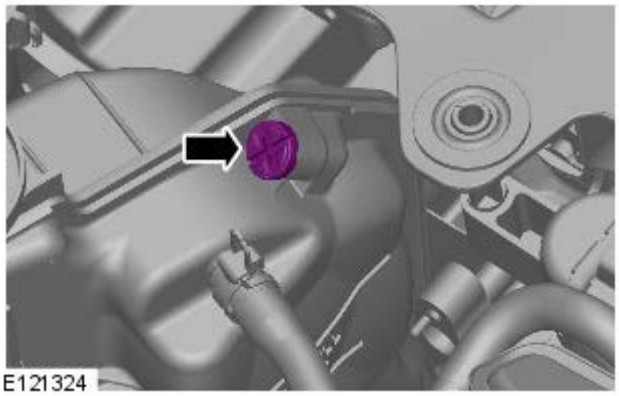


11. NOTE: Where fitted.


E143099

12. Continue to fill the coolant expansion tank to the rim until the coolant level stops dropping.

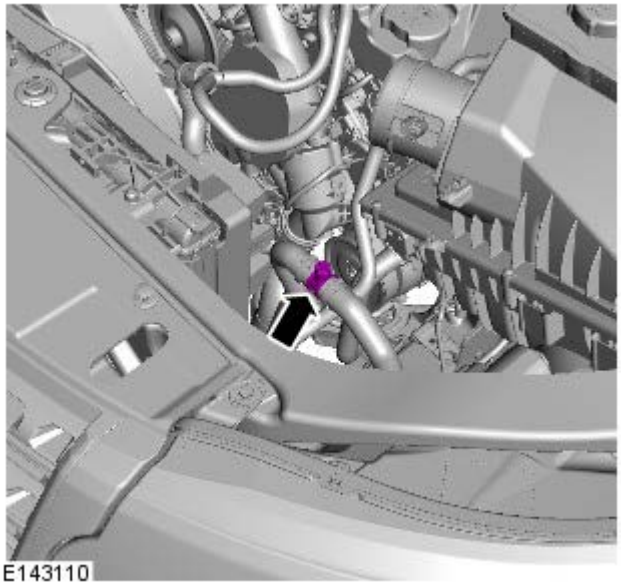
13.


E121324

14. Set the heater controls to maximum.

15. Start and run the engine.

16. Once coolant is visable from the outlet, close the bleeding points.


E143110

17. Continue to fill the coolant expansion tank to the rim until the coolant level stops dropping.

18.

- Switch the engine off.
- Wait a minimum of 1 minute.

19.
- Start and run the engine.
- Hold the engine speed at 2000 RPM until the coolant level stops dropping.

20. Increase the engine speed from idle to 3500 RPM until hot air is emitted from the front and rear face vents.

21. Install the expansion tank cap after making sure that the final coolant level is 40mm above the maximum cold fill line.

22. Run the engine until the thermostat opens and hot air is emitted from the front and rear face vents.

23. Switch the engine off and allow to cool.

24. Install the coolant expansion tank.

25. WARNINGS:

 When releasing the cooling system pressure, cover the coolant expansion tank cap with a thick cloth.

 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.

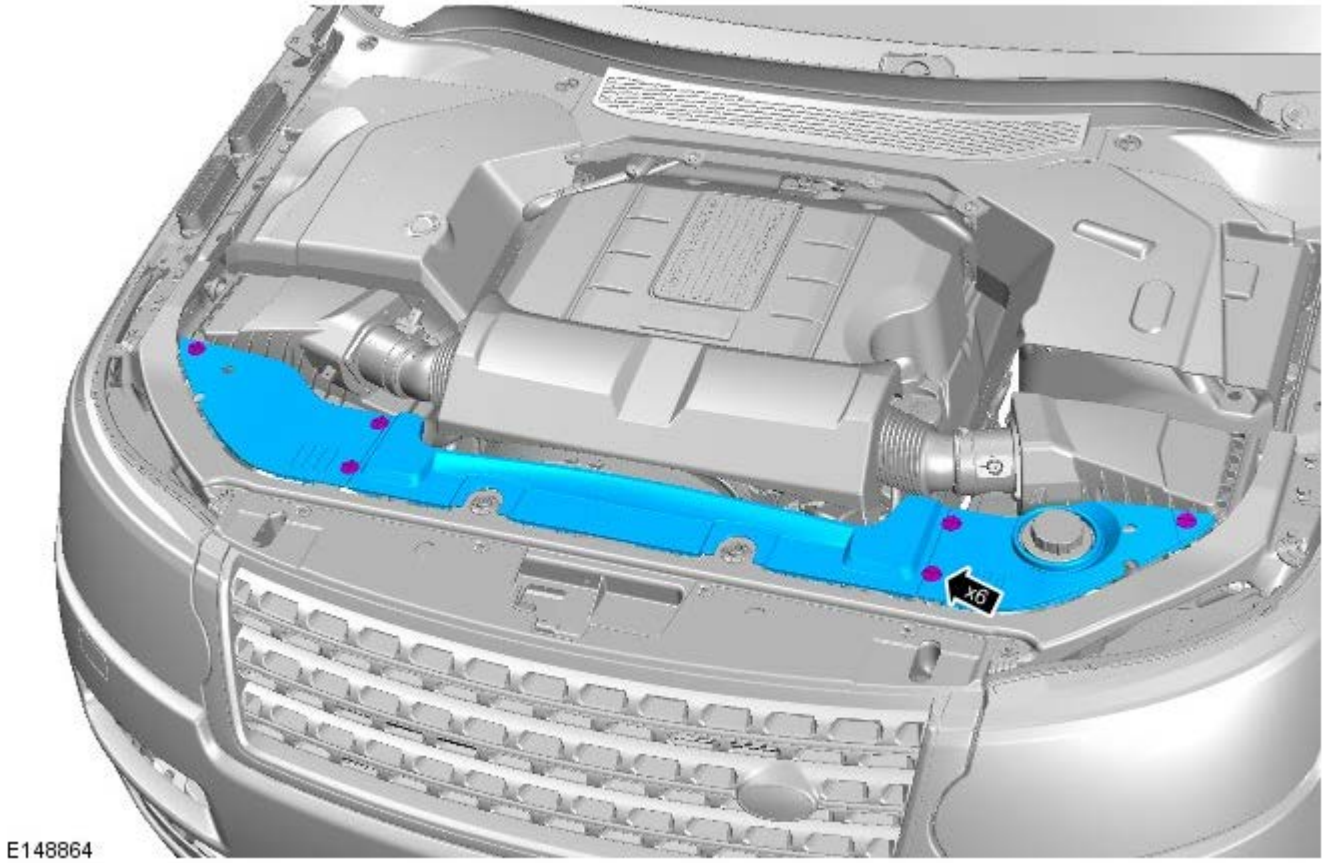
 CAUTION: Make sure the coolant level remains above the "COLD FILL RANGE" lower level mark.

Check and top-up the coolant if required.

26. Visually check the engine and cooling system for signs of coolant leakage.

27. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12B Intake Air Distribution and Filtering - V6 S/C 3.0L Petrol, Removal and Installation).

28.



29. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

Published: 30-Sep-2013

Engine Cooling - V6 S/C 3.0L Petrol - Cooling System Draining and Vacuum Filling

General Procedures

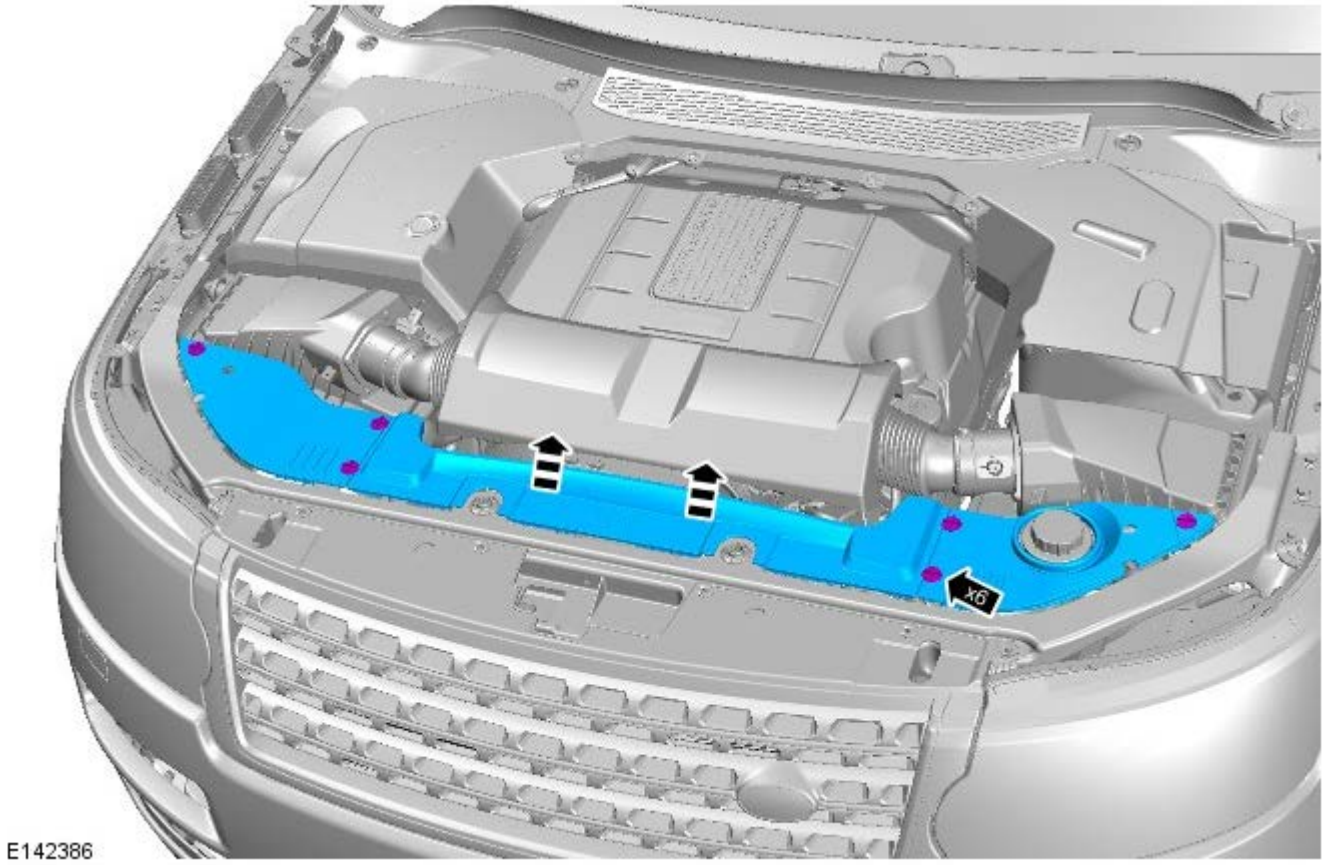
Draining

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.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2.



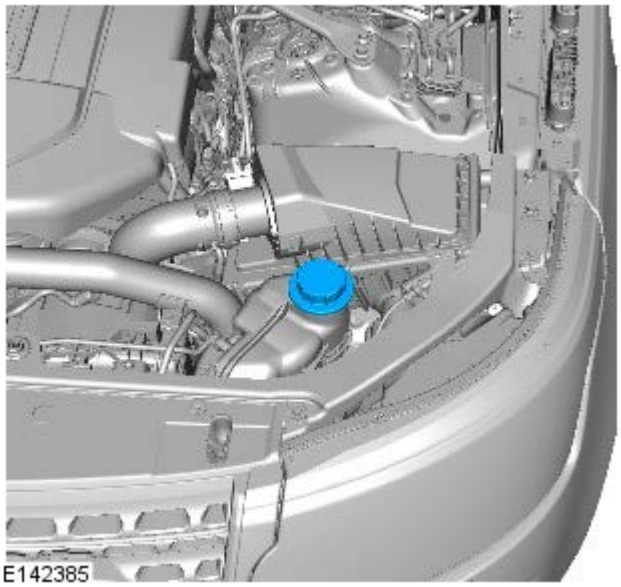
3. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12B Intake Air Distribution and Filtering - V6 S/C 3.0L Petrol, Removal and Installation).

4. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

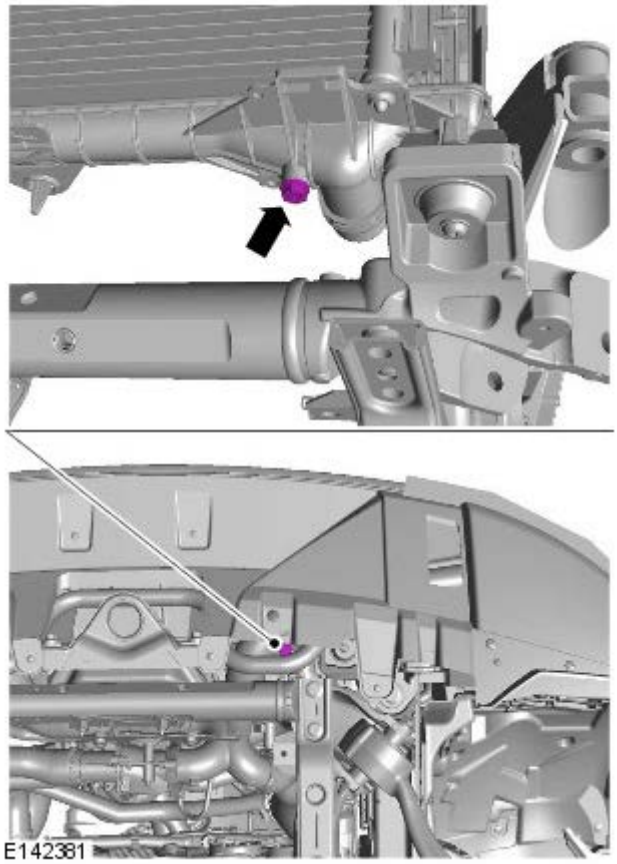
5. Refer to: Fender Splash Shield (501-02 Front End Body Panels, Removal and Installation).

6. Refer to: Rear Fender Splash Shield (501-08 Exterior Trim and Ornamentation, Removal and Installation).

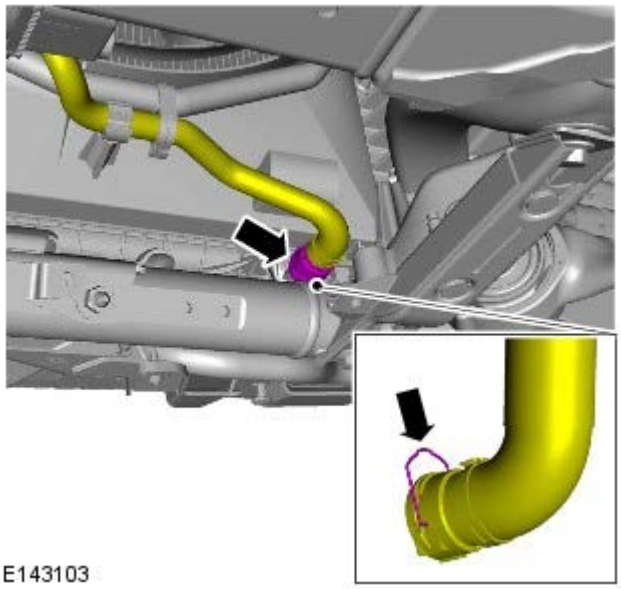
7.


E142385

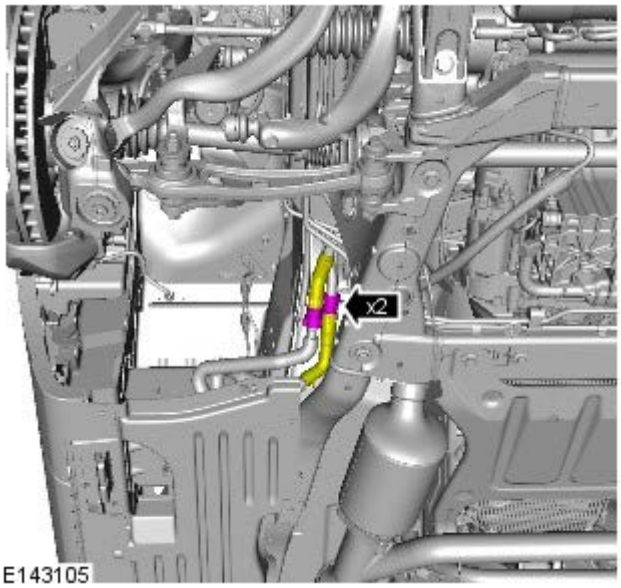
8.


E142381

9. CAUTION: Be prepared to collect escaping coolant.

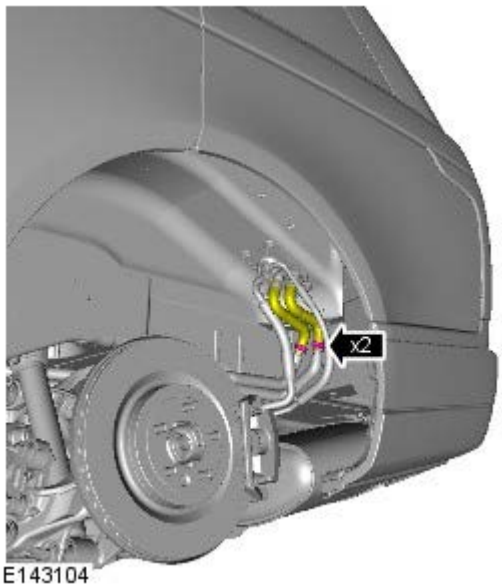


E143103



E143105

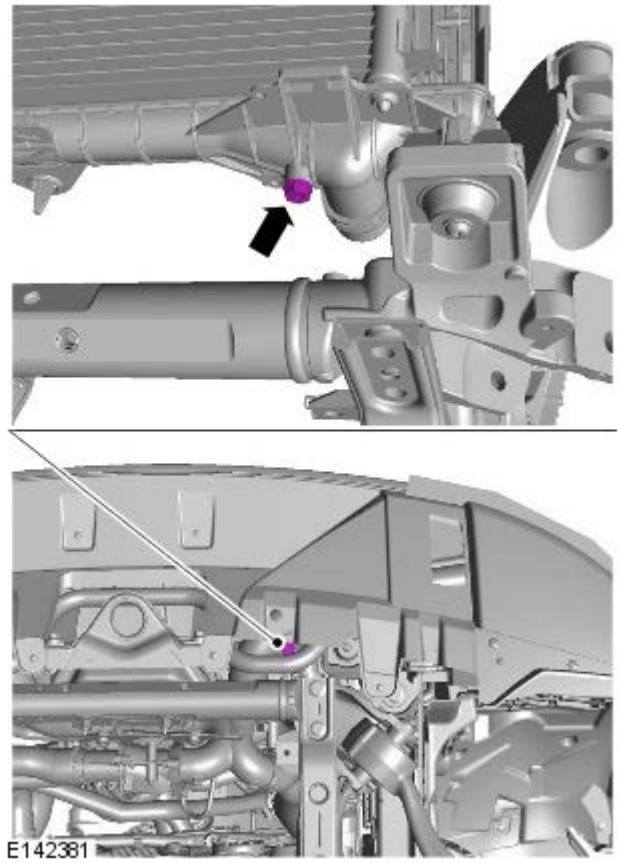
10. CAUTION: Be prepared to collect escaping coolant.



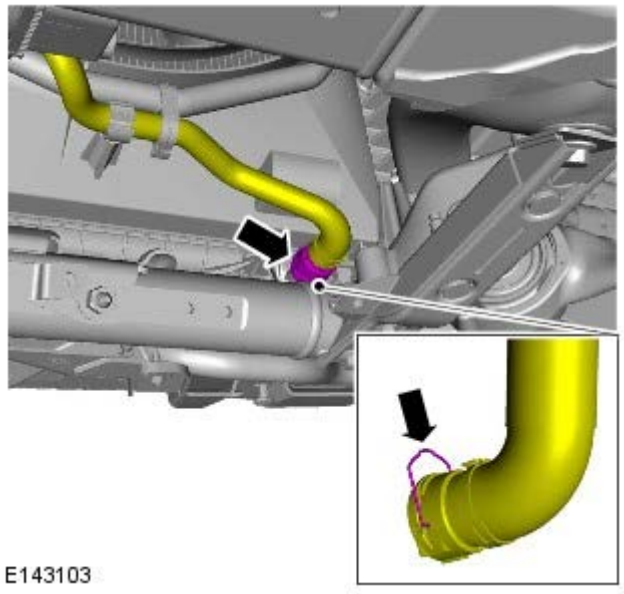
E143104

11. CAUTION: Be prepared to collect escaping coolant.

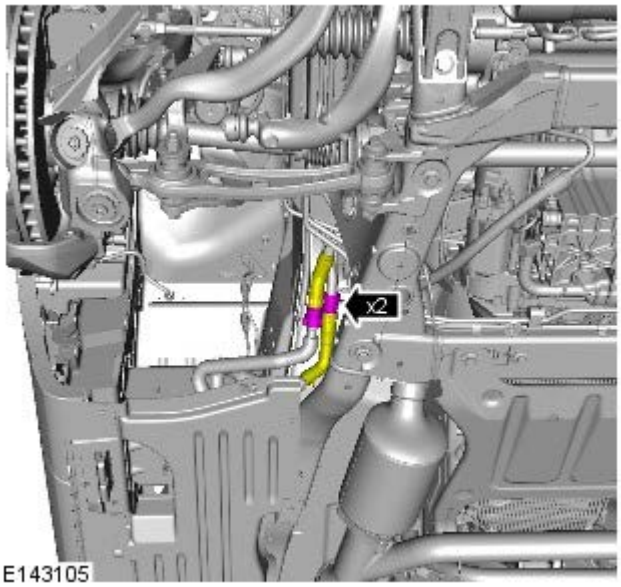
12. *Torque:* 5 Nm



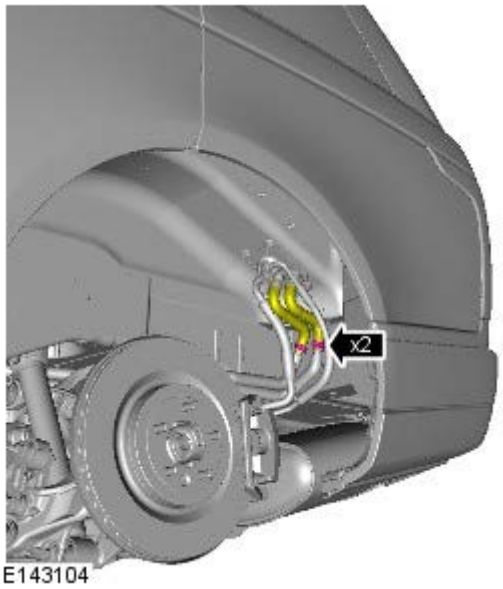
13.



14.



15.



16. Carry out the procedure up to step 1 in the filling section three times, filling the cooling system with clean water at the first two drains. At the third refill, use a suitable measuring tool to make sure that the cooling system maintains a 50% mix.

Filling

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.

1. 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.

2. 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.

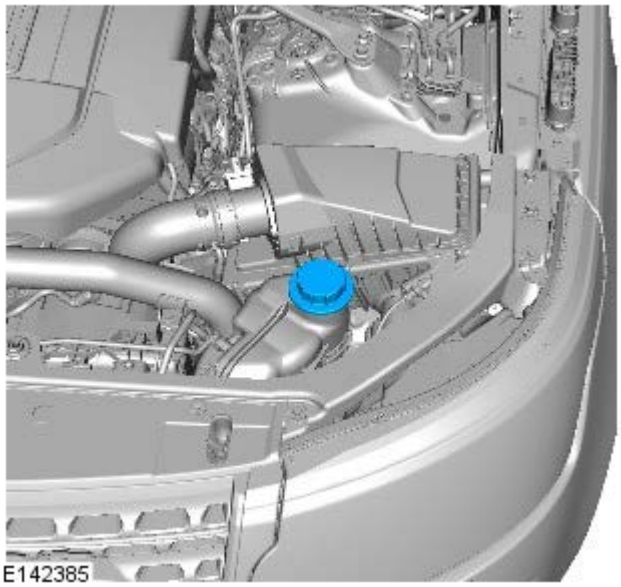
NOTE: Small diameter or long airlines may restrict airflow to the coolant vacuum fill tool.

- Connect a regulated compressed air supply to the venturi tube assembly.

3. Position the evacuated air hose into a container.
4. Open the air supply valve.
5. 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.
6. Apply air pressure progressively until the arrow on the vacuum filler gauge reaches the green segment.
7. Disconnect the compressed air supply line.
8. 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.
9. Remove the vacuum filler gauge and cooling system vacuum refill adaptor assembly.
10. Continue to fill the coolant expansion tank to the rim until the coolant level stops dropping.
11.



12. Start and run the engine.
13. Set the heater controls to maximum.
14. Increase the engine speed from idle to 3500 RPM until hot air is emitted from the front and rear face vents.
15. Run the engine until the thermostat opens and hot air is emitted from the front and rear face vents.
16. Switch the engine off and allow to cool.

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: 02-Aug-2012

Engine Cooling - V6 S/C 3.0L Petrol - Cooling System Pressure Test

General Procedures

Check

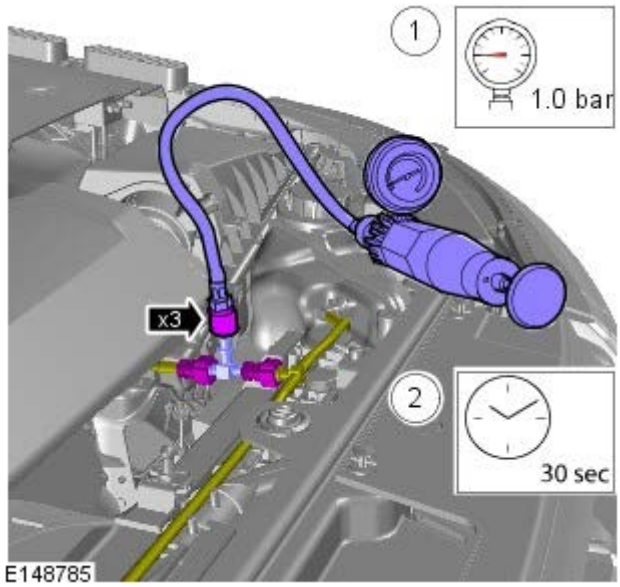
WARNING: Since injury such as scalding could be caused by escaping steam or coolant, allow the vehicle cooling system to cool prior to carrying out this procedure.

NOTE: The following procedure will enable the cooling system to be pressure tested for condition and leaks. Stage 1 will check the expansion tank cap register seal and the cap for leaks. Stage 2 will check the entire cooling system.

1. NOTE: If the coolant expansion tank cap is found to be leaking, replace the cap.

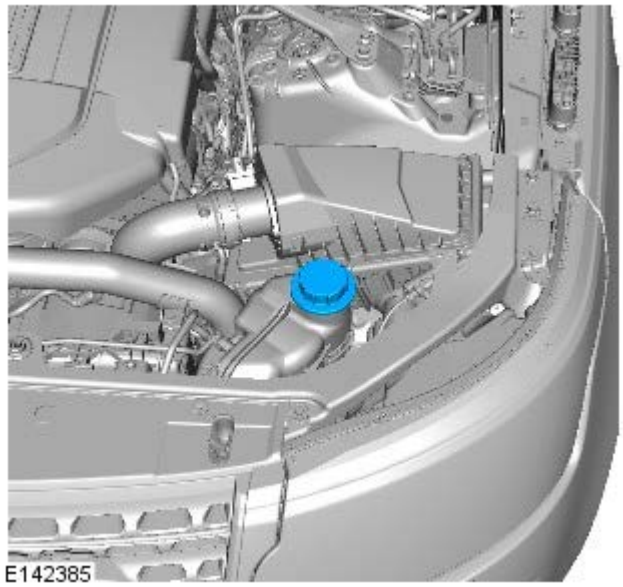
   Examine the coolant hoses for signs of cracking, distortion and security of the hose connections.

2.
   - Slowly pressurize the cooling system.
   - Check the pressure remains above 0.9 bar (90 kPa) (13 psi) after waiting for 30 seconds.
   - During the pressure drop check, listen for a hissing noise from the expansion tank cap.



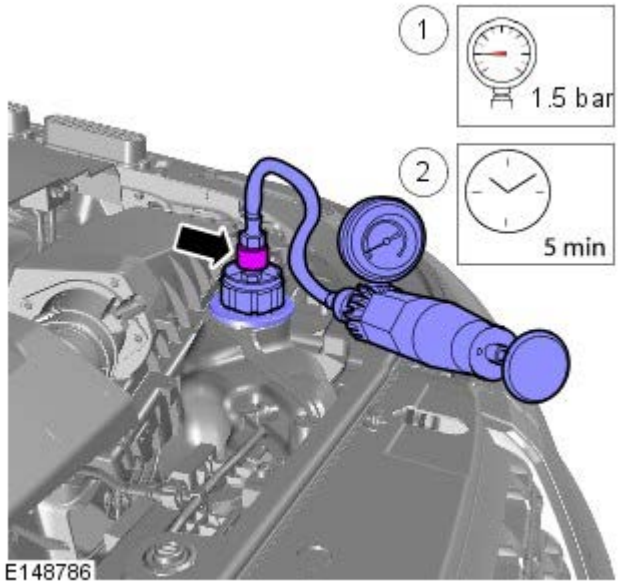
3. Depressurize and remove the pressure pump and gauge.

4.



5. CAUTION: Make sure that the mating faces are clean and free of foreign material.

   NOTE: If the pressure continues to drop after the

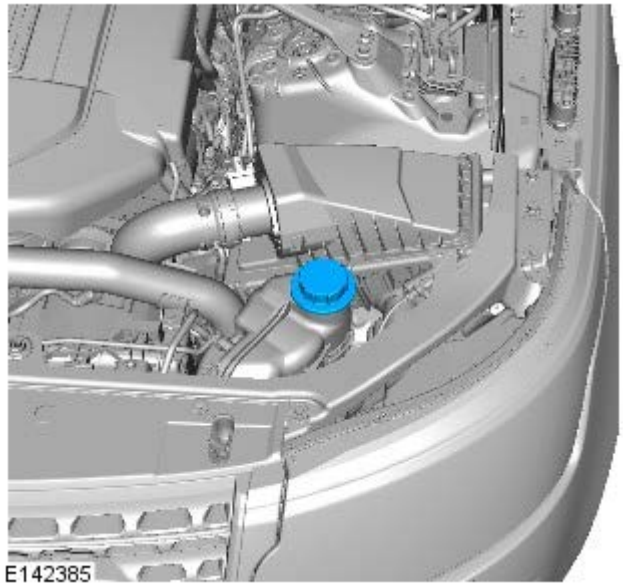


initial tolerance, there is a coolant leak.

- Slowly pressurize the cooling system.
- A small pressure decay of approximately 0.15 bar (15 kPa) (1 psi) over the first minute is normal.

6. Depressurize and remove the pressure pump and gauge.

7.



Published: 02-May-2013

Engine Cooling - V6 S/C 3.0L Petrol - Auxiliary Radiator

Removal and Installation

Removal

NOTES:

Removal steps in this procedure may contain installation details.

Make sure that all openings are sealed. Use new blanking caps.

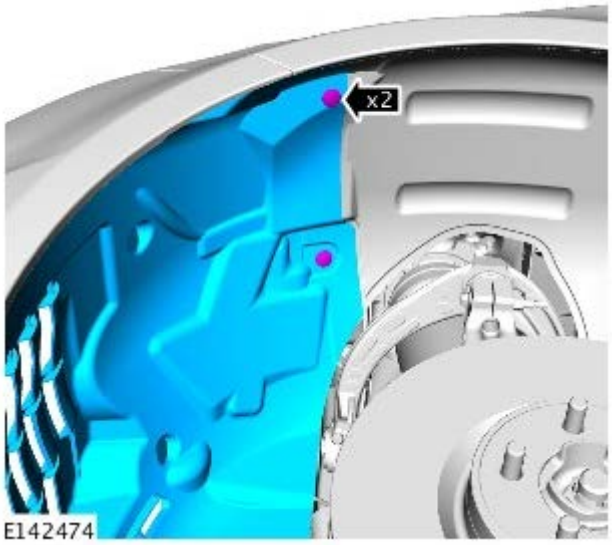
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Refer to: Front Bumper Cover (501-19 Bumpers, Removal and Installation).

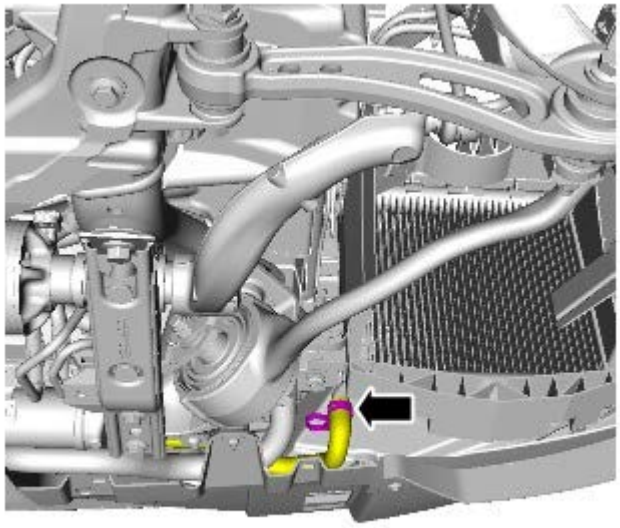
3. Refer to: Cooling System Partial Draining, Filling and Bleeding (303-03B Engine Cooling - V6 S/C 3.0L Petrol, General Procedures).

4.

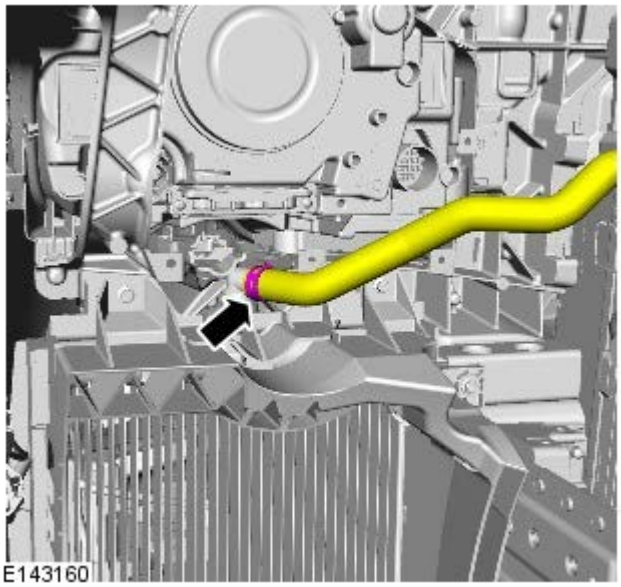


5. CAUTION: Be prepared to collect escaping coolant.

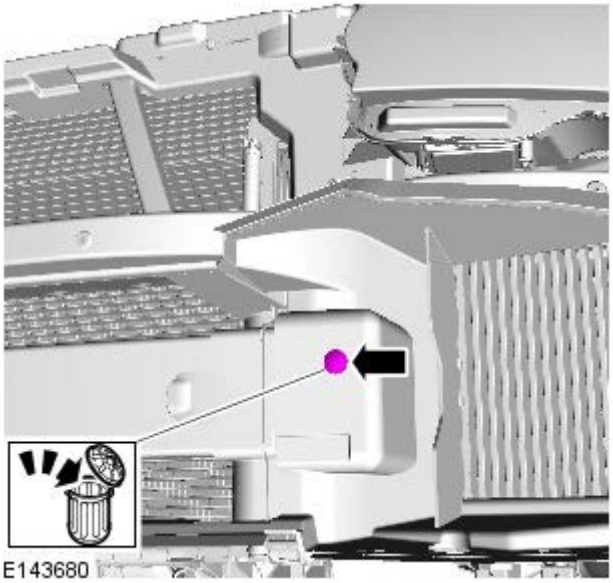
   NOTE: RH illustration shown, LH is similar.



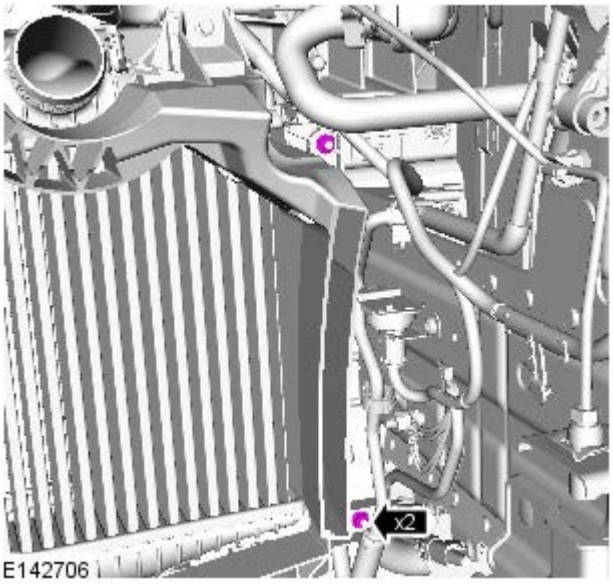
6.



7. CAUTION: Make sure that new components are installed.



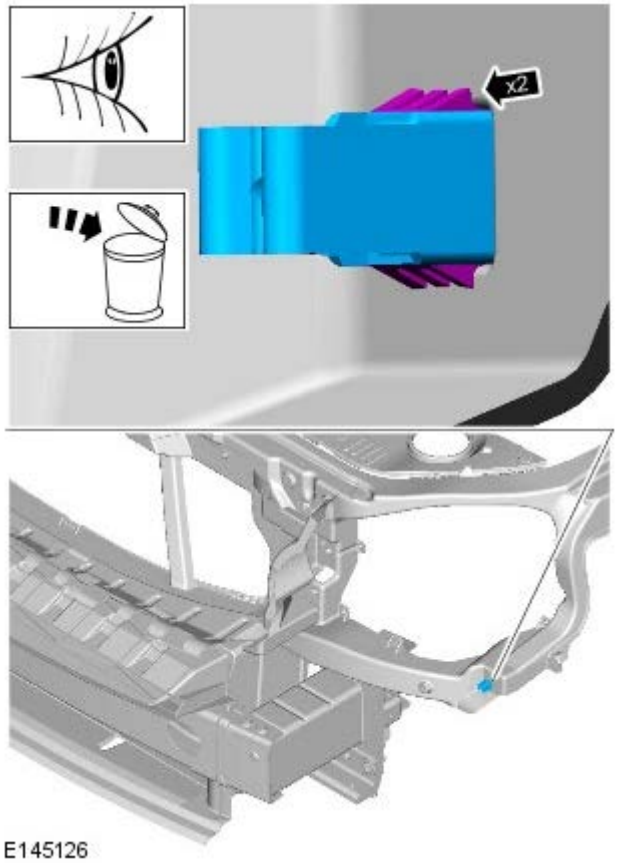
8. *Torque:* 9 Nm



9. *Torque:* 5 Nm



E142707

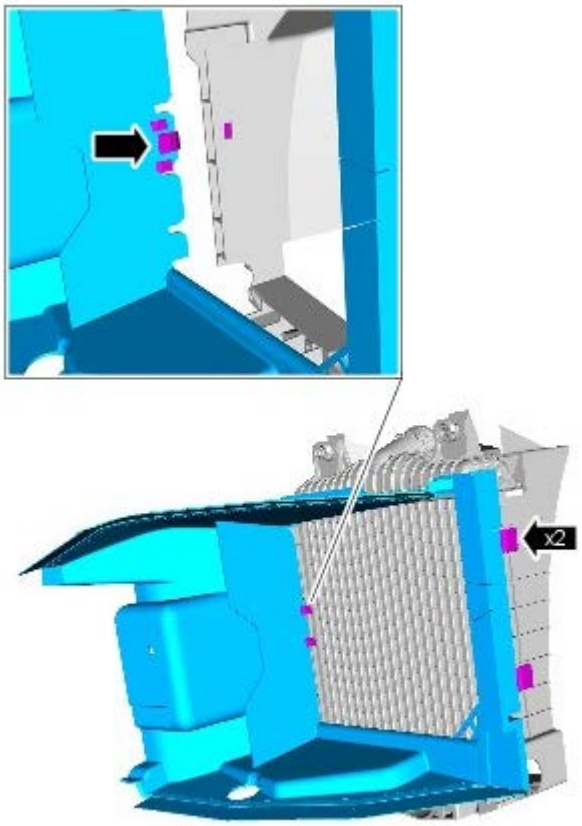


E145126

10. CAUTION: Make sure that new components are installed.

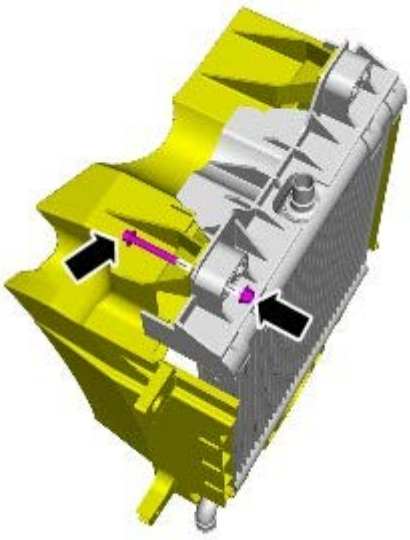
NOTE: Make sure that the locking tangs are installed correctly.

11. NOTE: Do not disassemble further if the component is removed for access only.



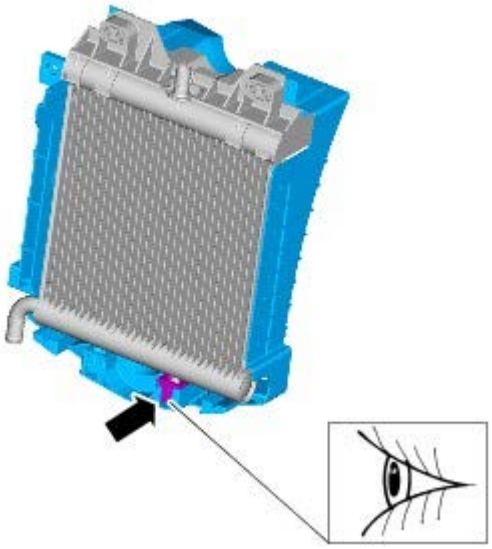
E142708

12. *Torque:* 9 Nm



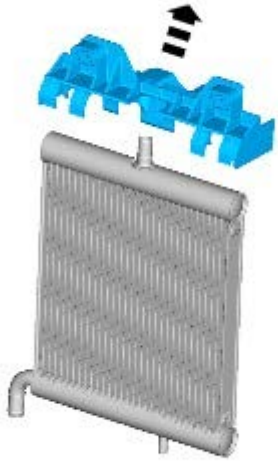
E143161

13.



E143163

14.



E143162

Installation

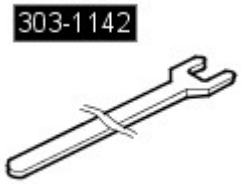
1. To install, reverse the removal procedure.

Published: 02-May-2013

Engine Cooling - V6 S/C 3.0L Petrol - Cooling Fan

Removal and Installation

Special Tool(s)

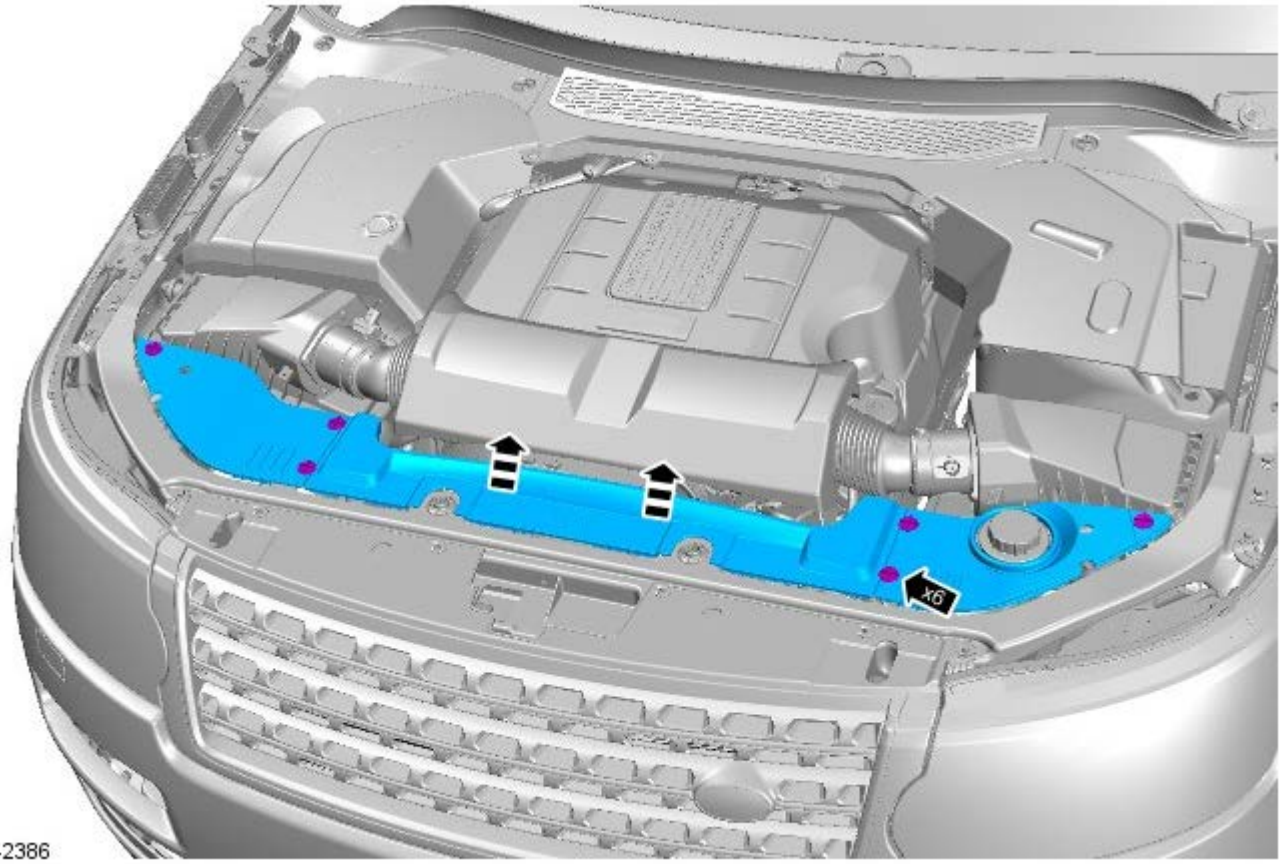
303-1142  E46076	303-1142 Viscous Coupling Wrench
303-1143  E55382	303-1143 Viscous Coupling Holding Tool

Removal

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

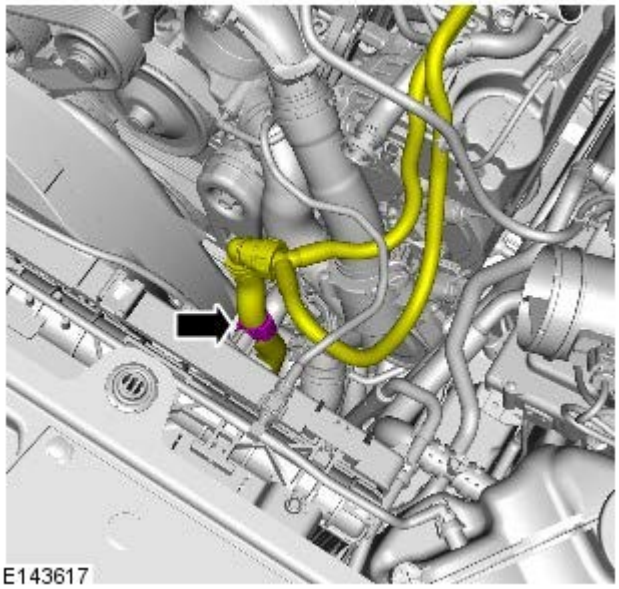
2.



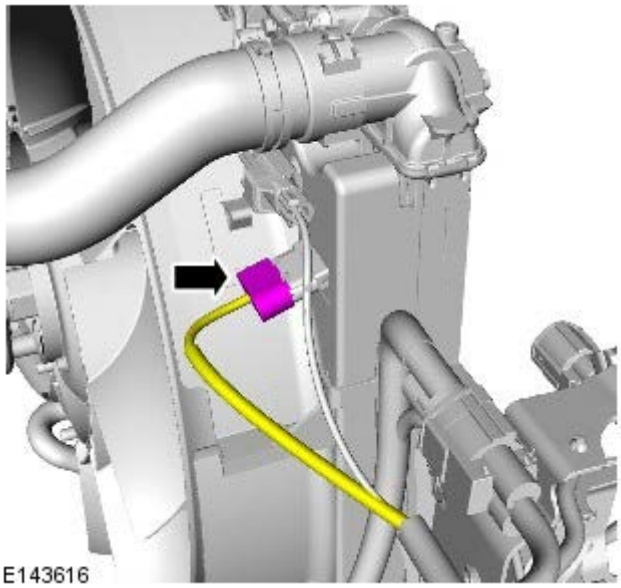
E142386

3. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12B Intake Air Distribution and Filtering - V6 S/C 3.0L Petrol, Removal and Installation).

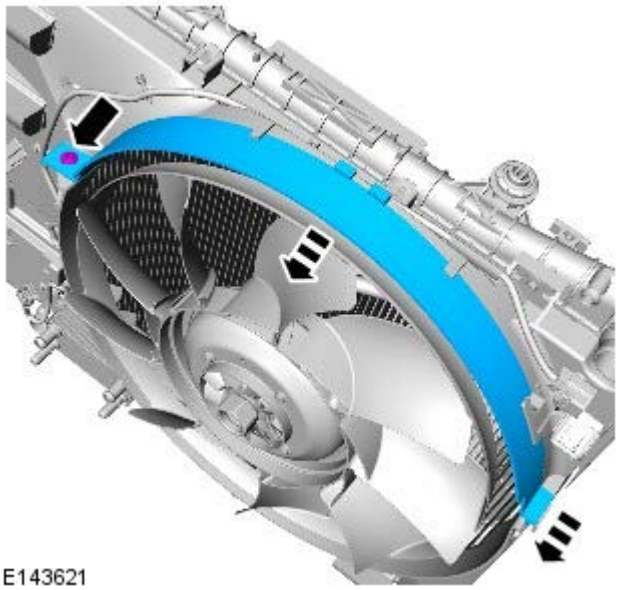
4.


E143617

5.


E143616

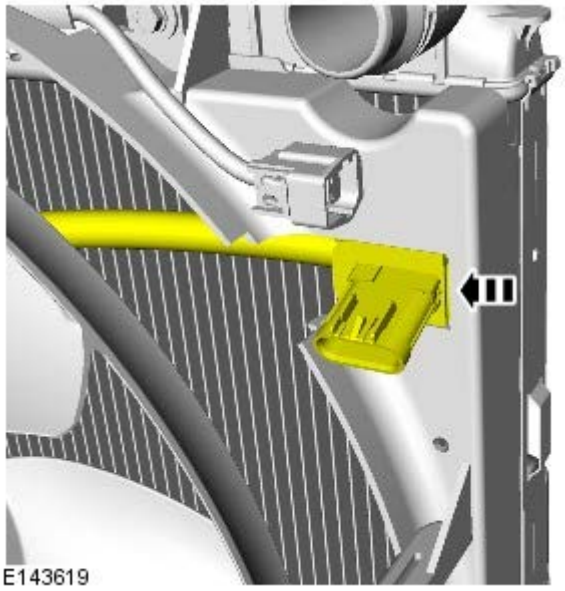
6. *Torque:* 4 Nm


E143621

7.



8.

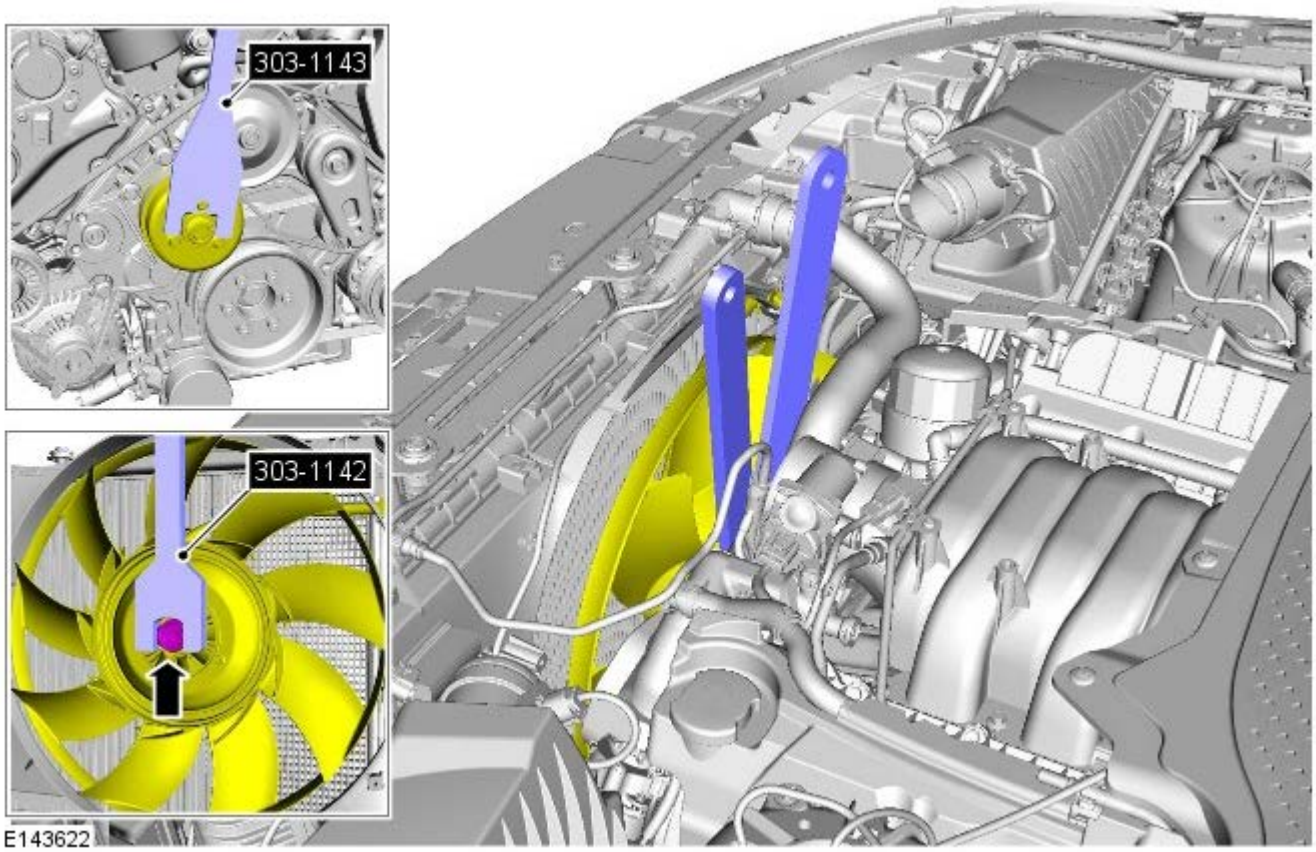


9. NOTES:

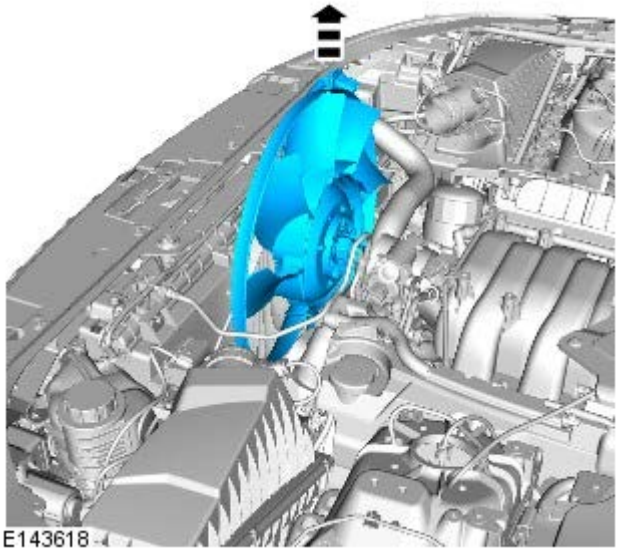
The thread is right handed.

Always protect the cooling pack elements to prevent accidental damage.

Special Tool(s): 303-1142, 303-1143
Torque: 65 Nm



10.



Installation

1. To install, reverse the removal procedure.

Published: 15-May-2013

Engine Cooling - V6 S/C 3.0L Petrol - Cooling Fan Shroud

Removal and Installation

Removal

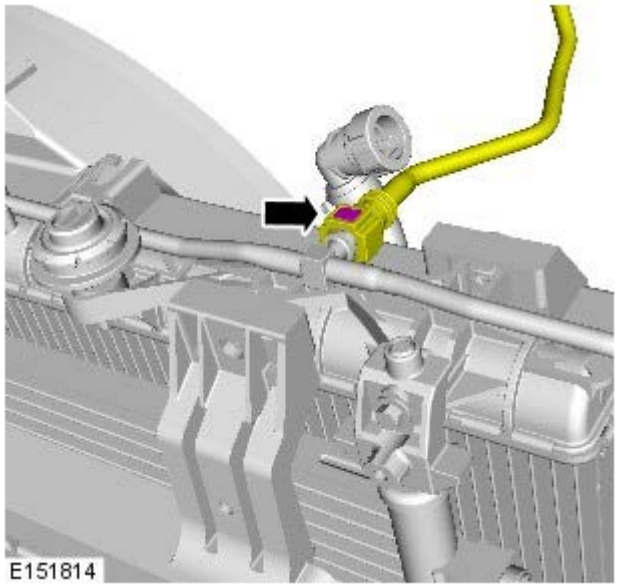
NOTES:

Removal steps in this procedure may contain installation details.

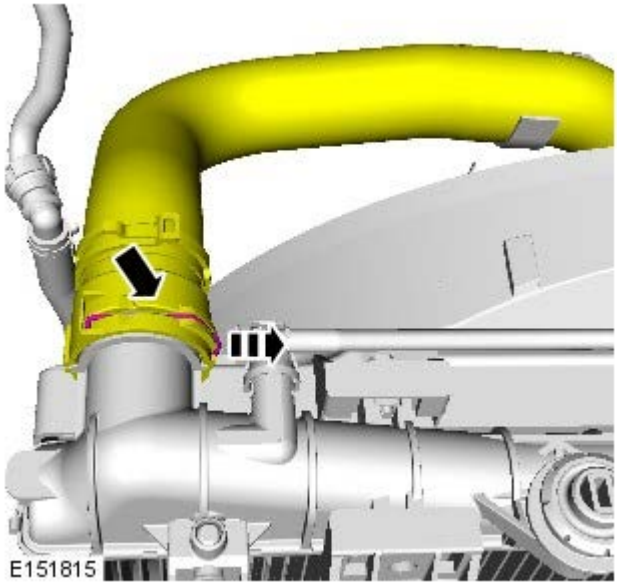
Some variation in the illustrations may occur, but the essential information is always correct.

Components shown removed for clarity.

1. Refer to: Cooling Fan (303-03B Engine Cooling - V6 S/C 3.0L Petrol, Removal and Installation).

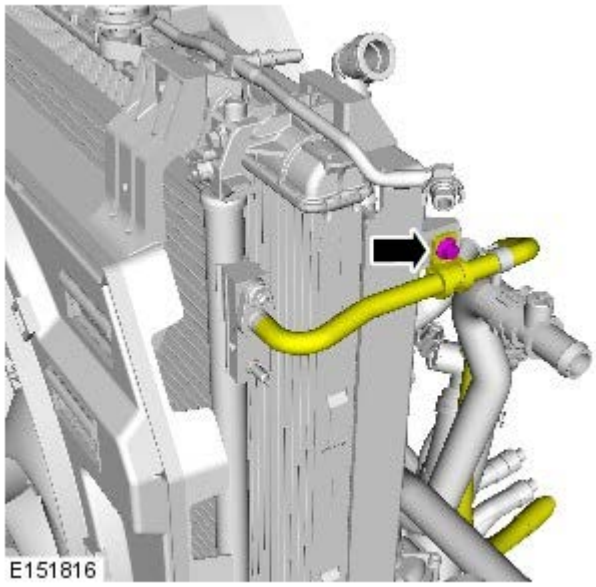


2. NOTE: Be prepared to collect escaping coolant.

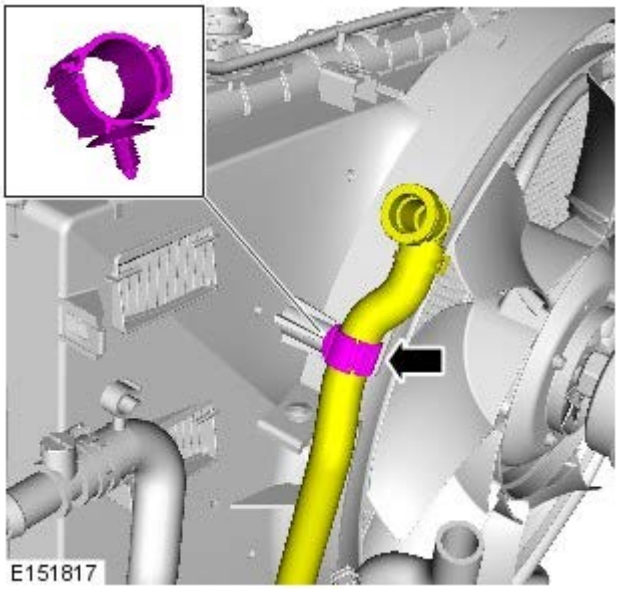


3. NOTE: Be prepared to collect escaping coolant.

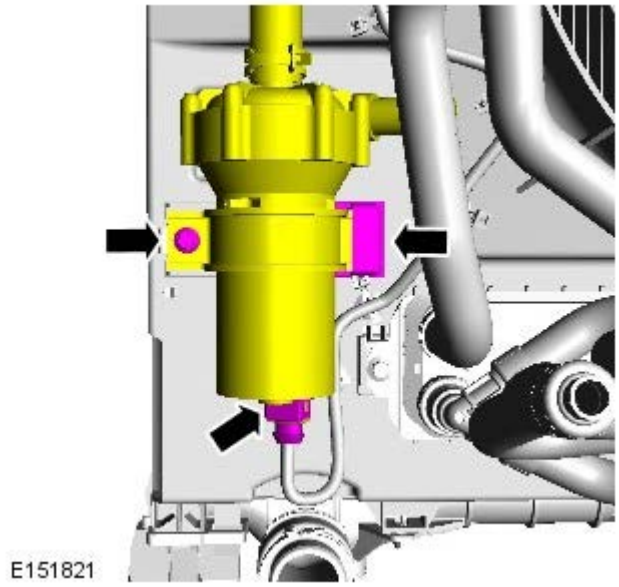
4. *Torque:* 7 Nm



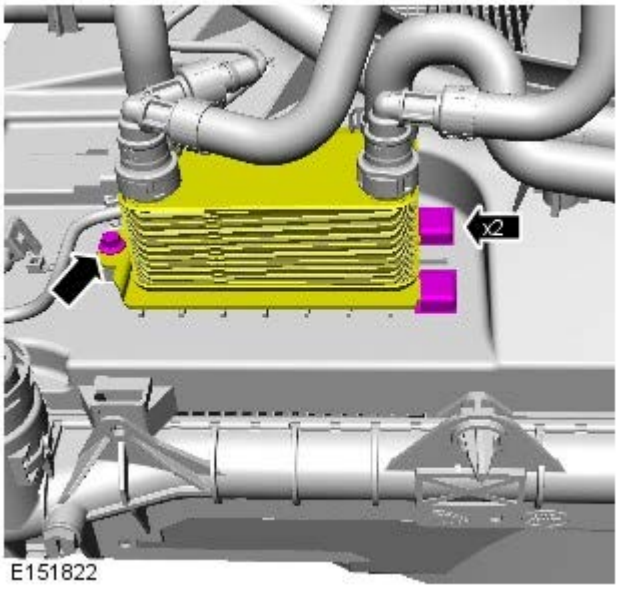
5.



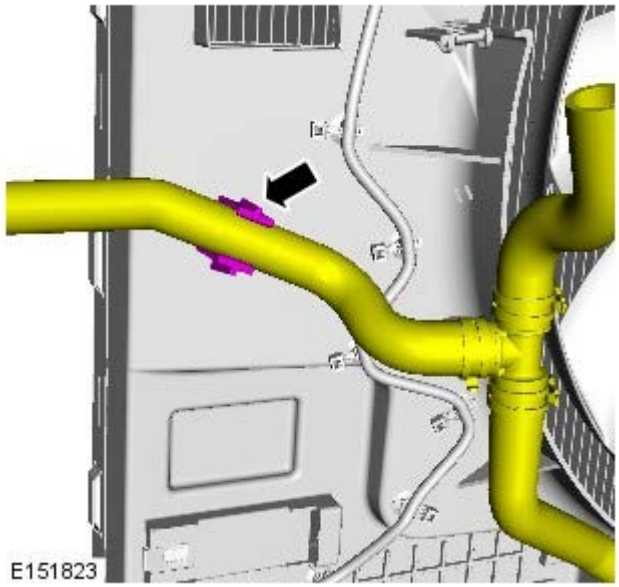
6. *Torque:* 5 Nm



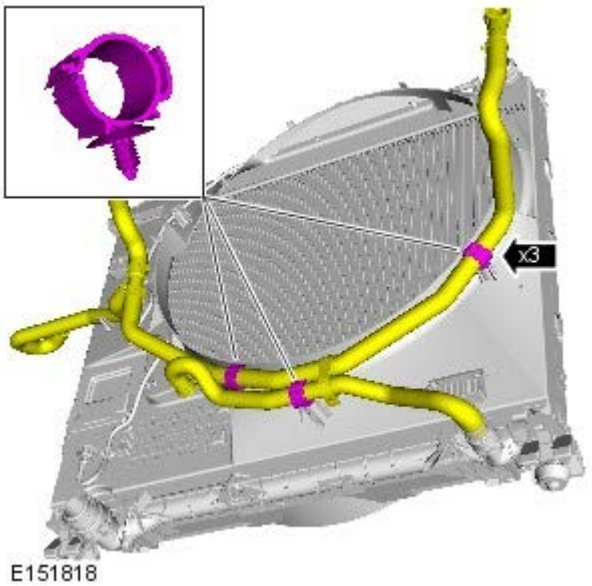
7. *Torque:* 7 Nm



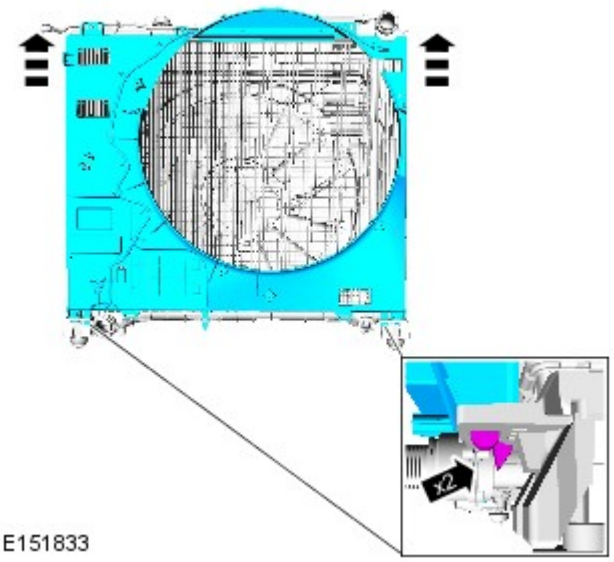
8.



9.

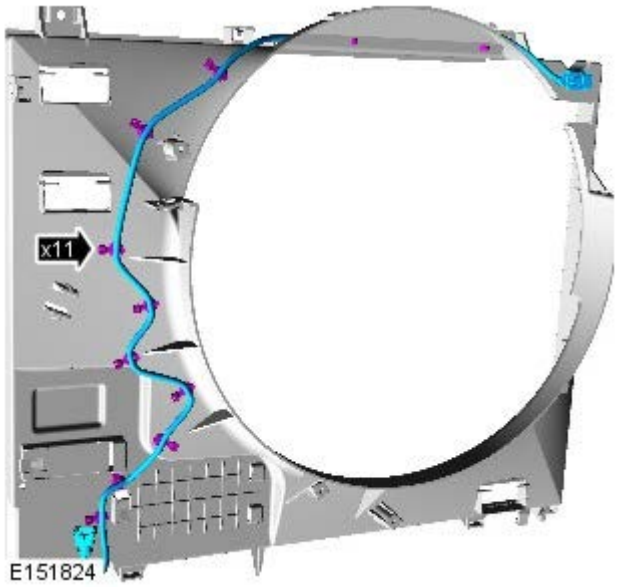


10.



NOTE: Do not disassemble further if component is removed for access only.

11.



Installation

1. To install, reverse the removal procedure.

Published: 02-May-2013

Engine Cooling - V6 S/C 3.0L Petrol - Cooling Module

Removal and Installation

Removal

1. WARNING: Make sure to support the vehicle with axle stands.

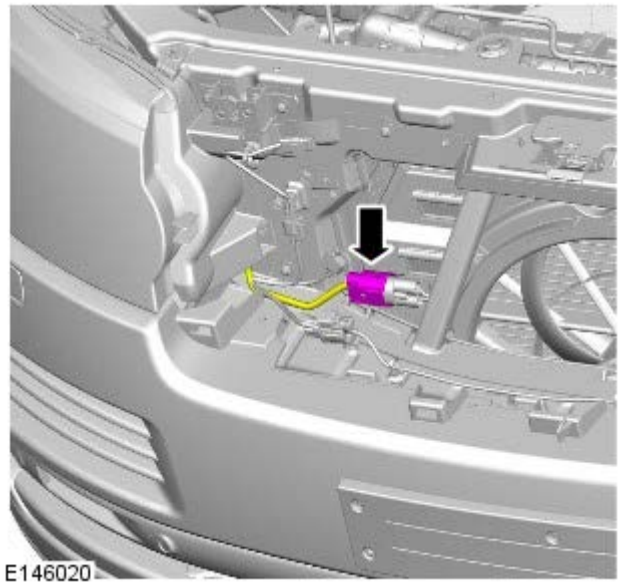
   Raise and support the vehicle.

2. Refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00 Climate Control System - General Information, General Procedures).

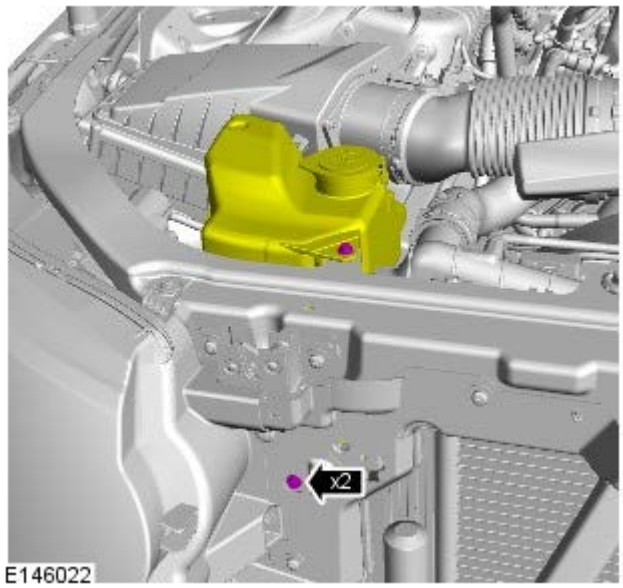
3. Refer to: Cooling System Partial Draining, Filling and Bleeding (303-03B Engine Cooling - V6 S/C 3.0L Petrol, General Procedures).

4. Refer to: Cooling Fan (303-03B Engine Cooling - V6 S/C 3.0L Petrol, Removal and Installation).

5. Refer to: Front Bumper Cover (501-19 Bumpers, Removal and Installation).



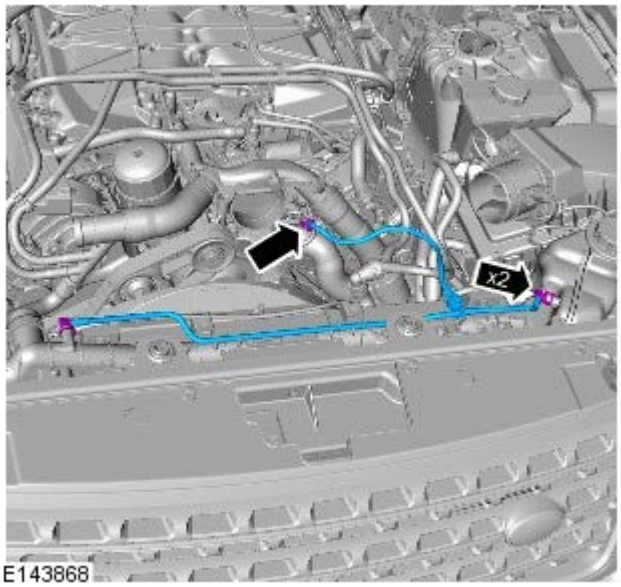
6. NOTE: If equipped.



7. NOTE: If equipped.

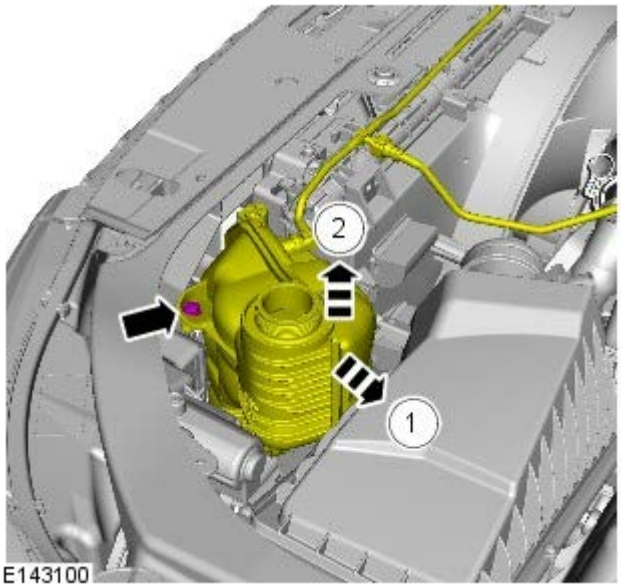
   Torque: 7 Nm

8.



E143868

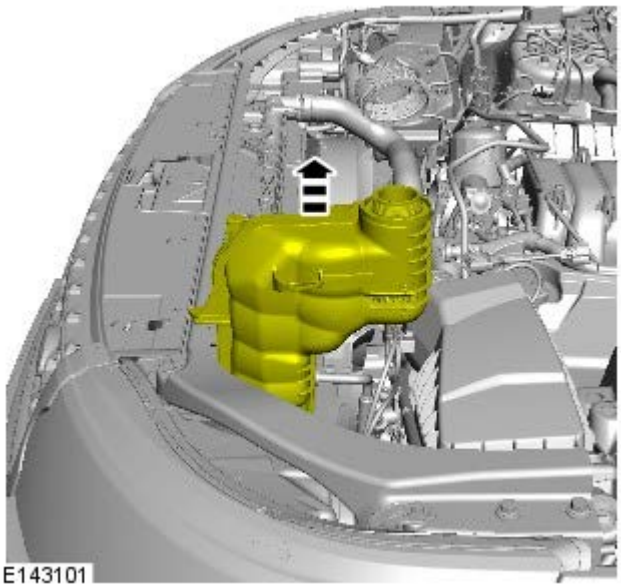
9. *Torque:* 2.8 Nm



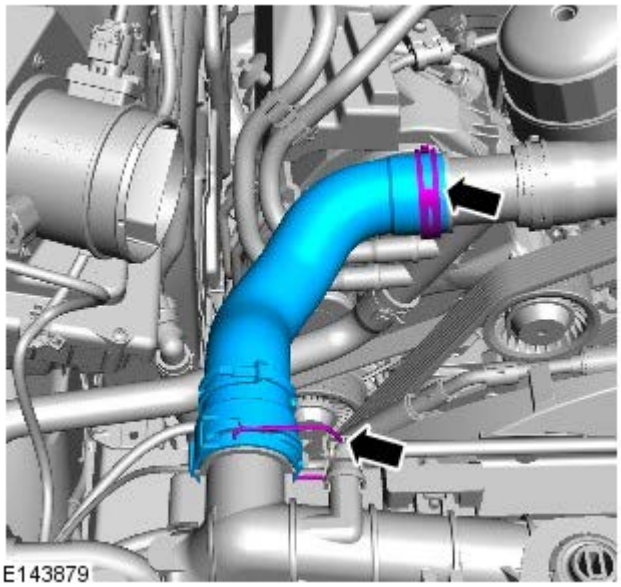
E143100

10. NOTE: Keep the coolant expansion tank vertically.

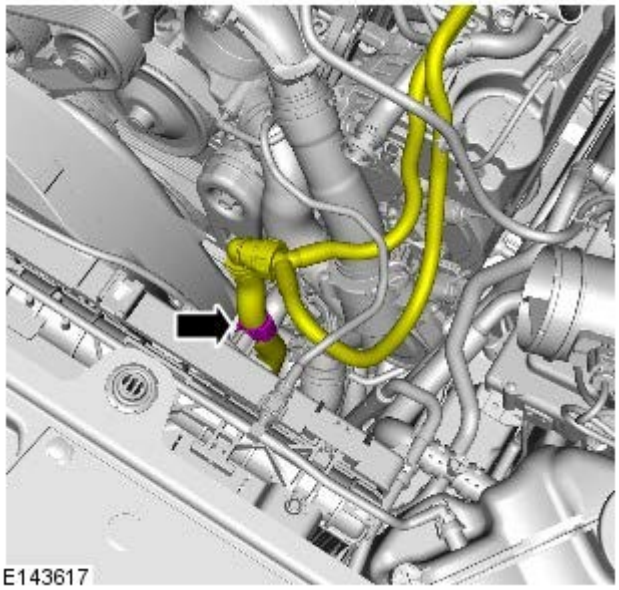
Raise the coolant expansion tank minimum 110mm from its original position.


E143101

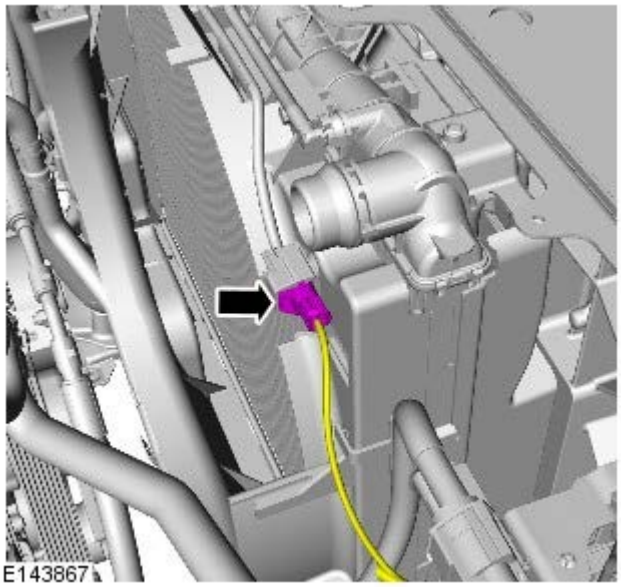
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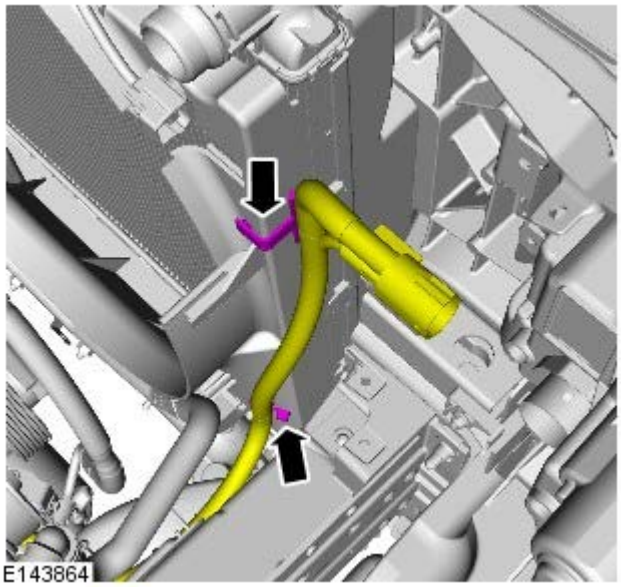
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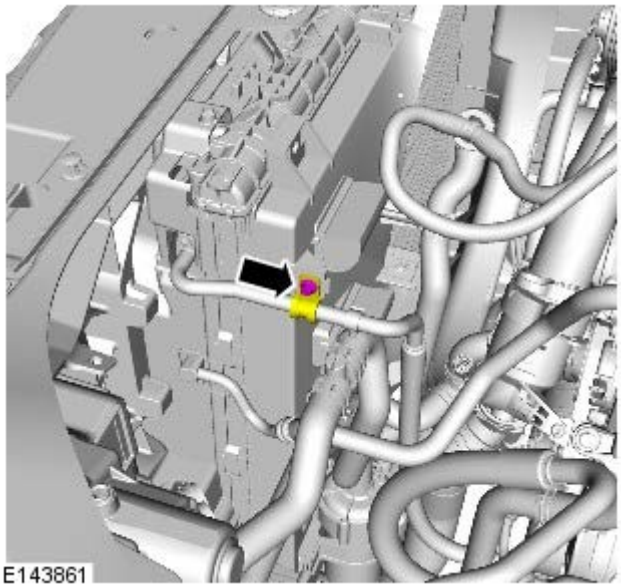
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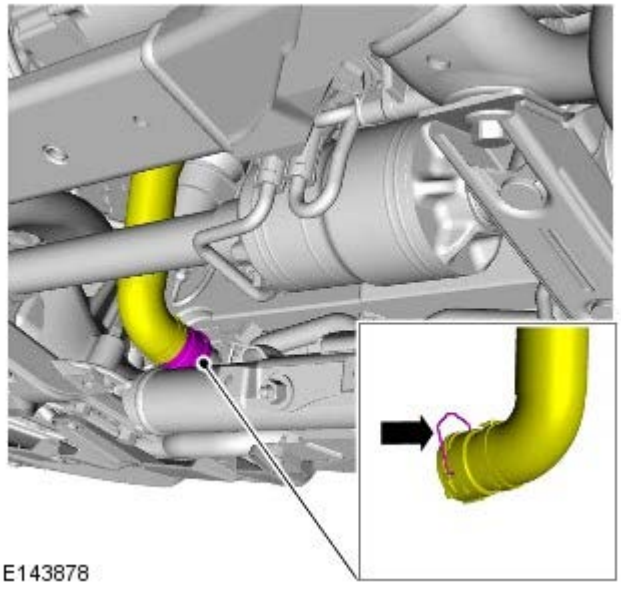
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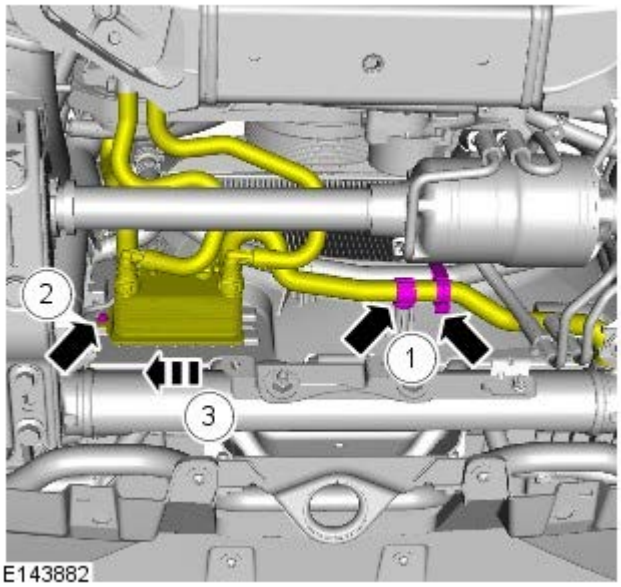
15. *Torque:* 7 Nm



16.

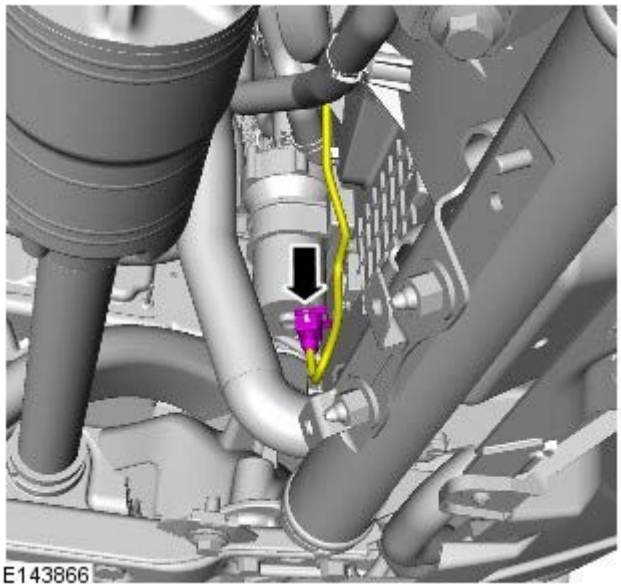


17. *Torque:* 7 Nm

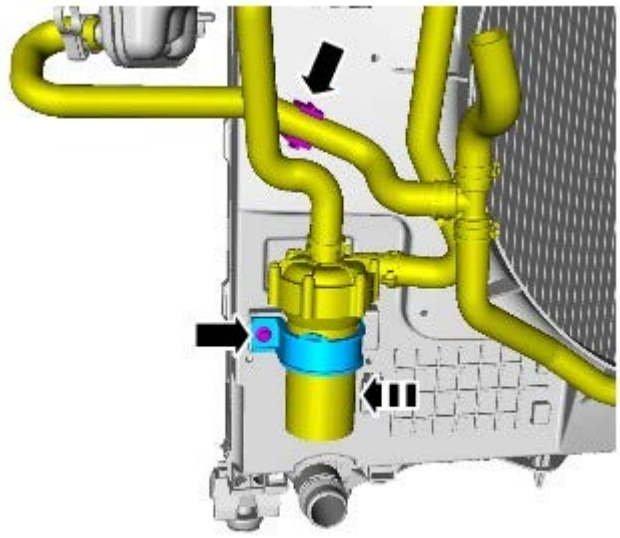


E143882

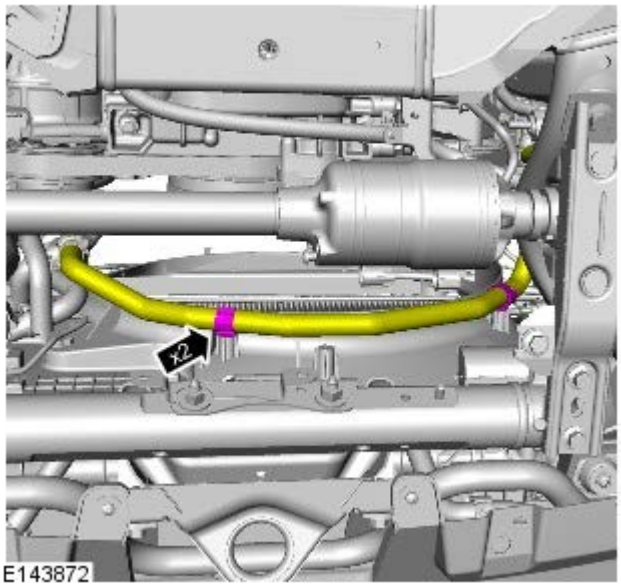
18.


E143866

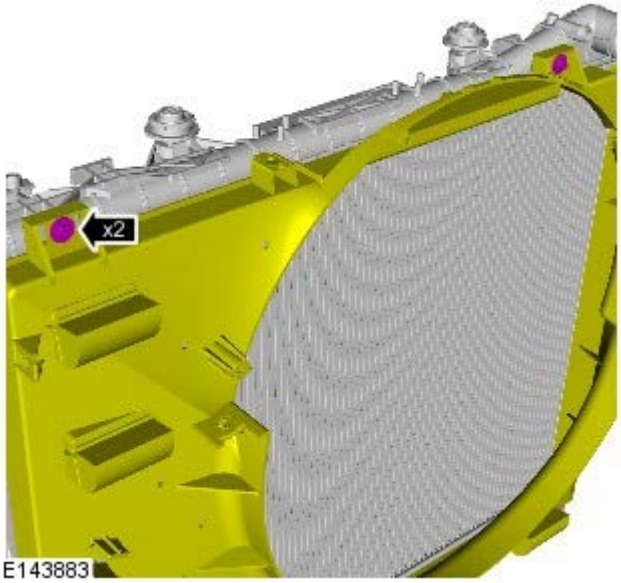
19. *Torque:* 7 Nm


E143865

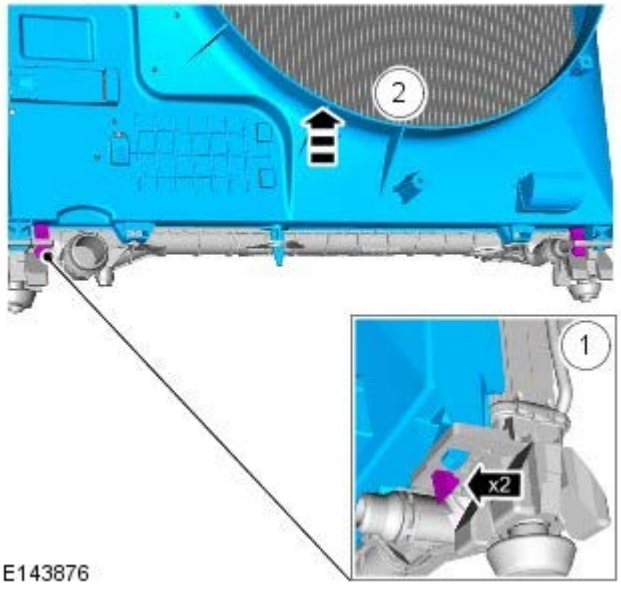
20.



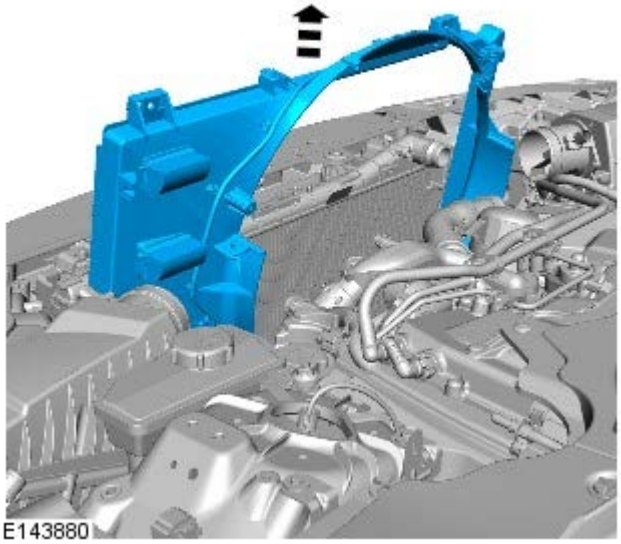
21. *Torque:* 7 Nm

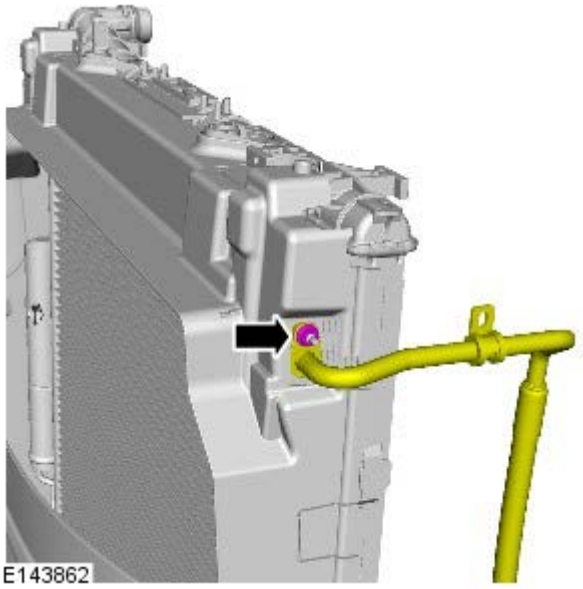


22.



23. CAUTION: Always protect the cooling pack elements to prevent accidental damage.





24. CAUTIONS:

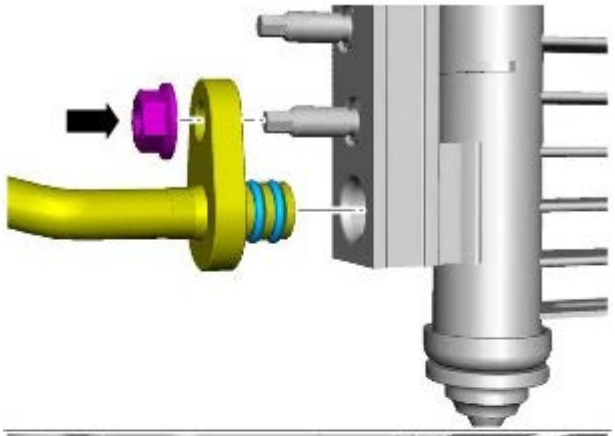
    Make sure that all openings are sealed. Use new blanking caps.

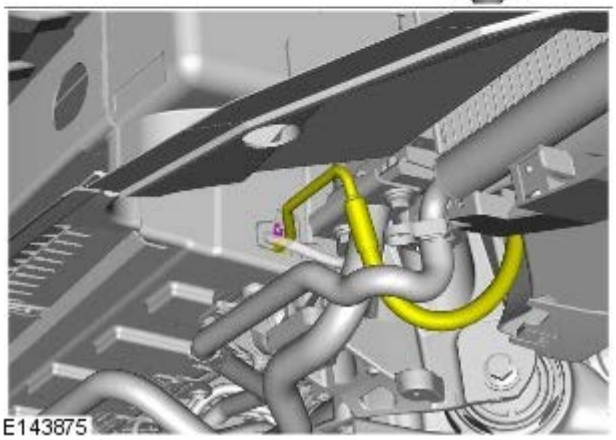
    Remove and discard the O-ring seals.

    Torque: 8 Nm

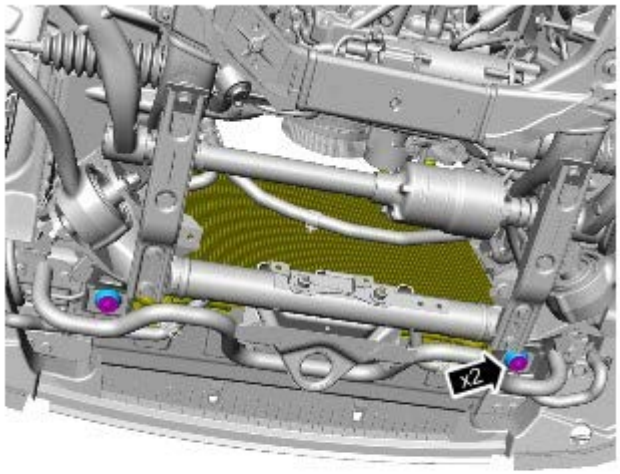
25. CAUTION: Remove and discard the O-ring seals.

    Torque: 8 Nm



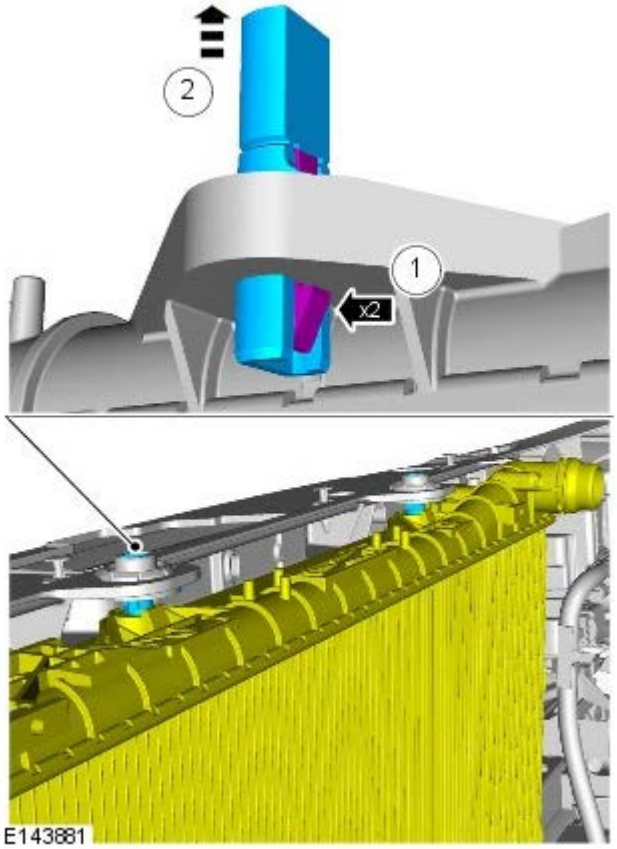


26. *Torque:* 15 Nm

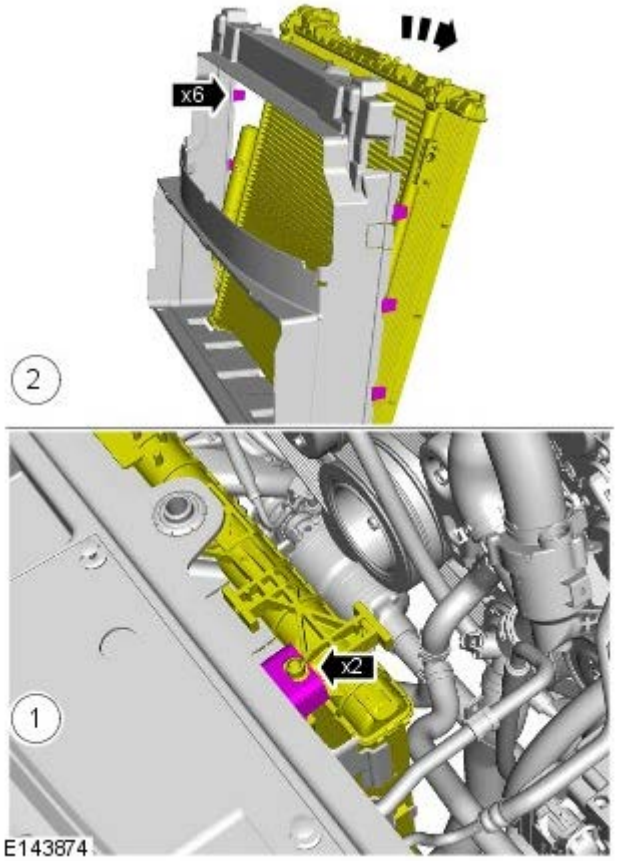


E143877

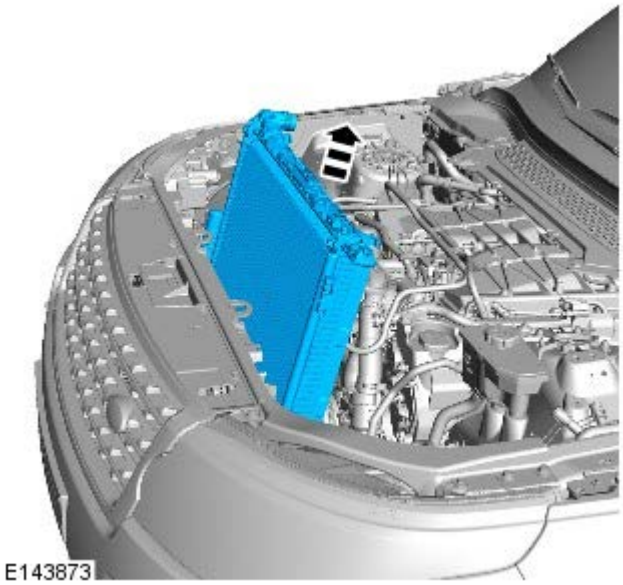
27.



28. CAUTION: Always protect the cooling pack elements to prevent accidental damage.



29. CAUTION: Always protect the cooling pack elements to prevent accidental damage.

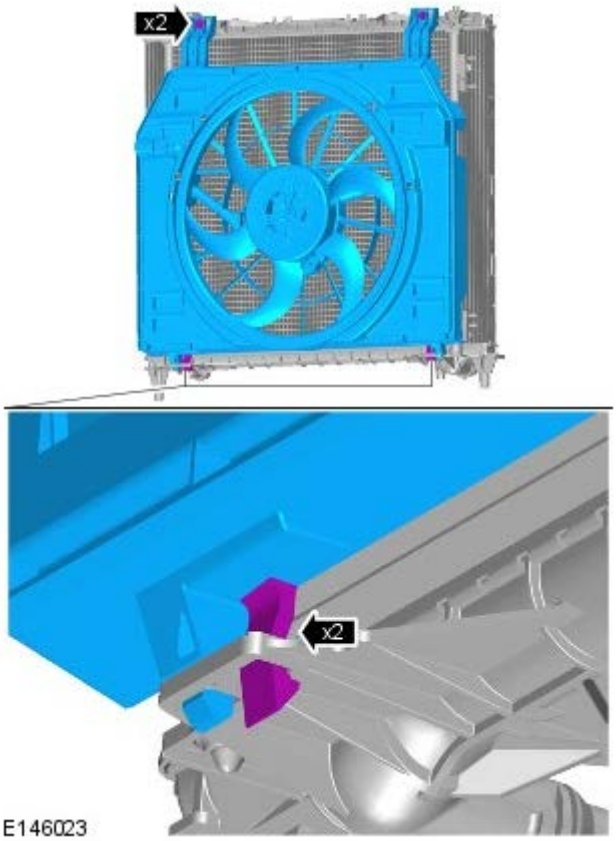


30. NOTES:

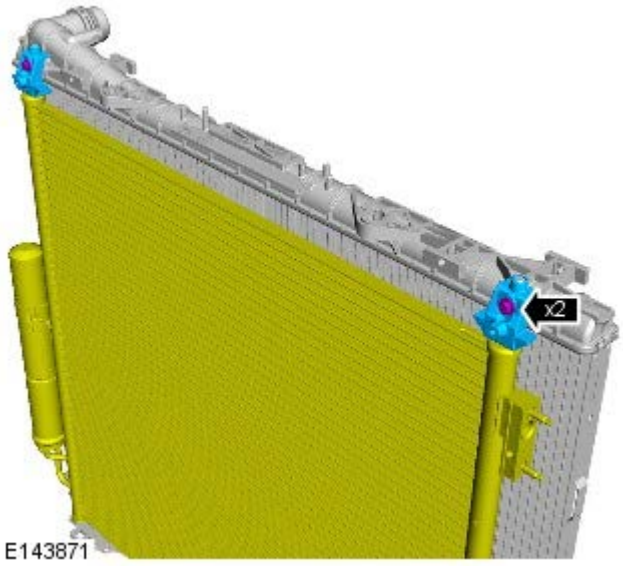
If equipped.

Do not disassemble further if the component is removed for access only.

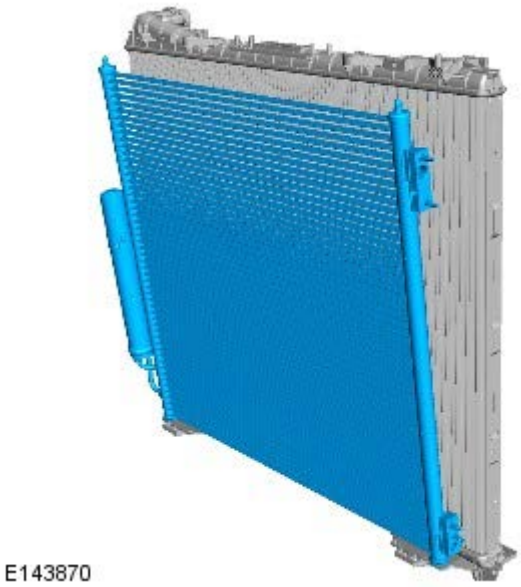
Torque: 7 Nm



31. *Torque:* 4.5 Nm



32.



Installation

1. To install, reverse the removal procedure.

Published: 02-May-2013

Engine Cooling - V6 S/C 3.0L Petrol - Coolant 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.

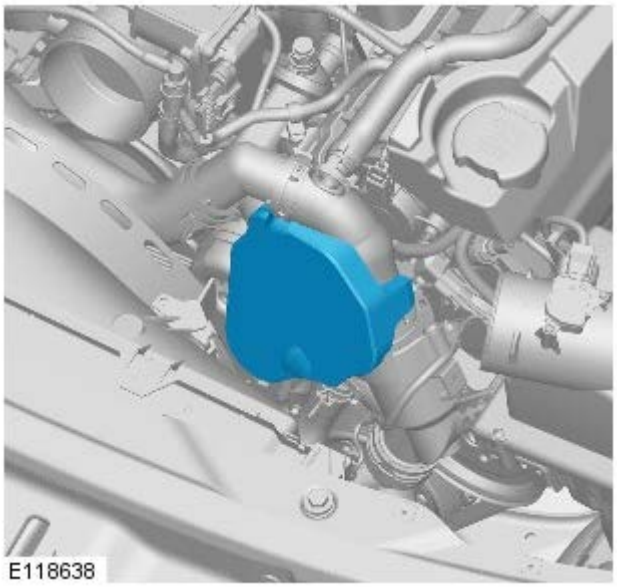
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

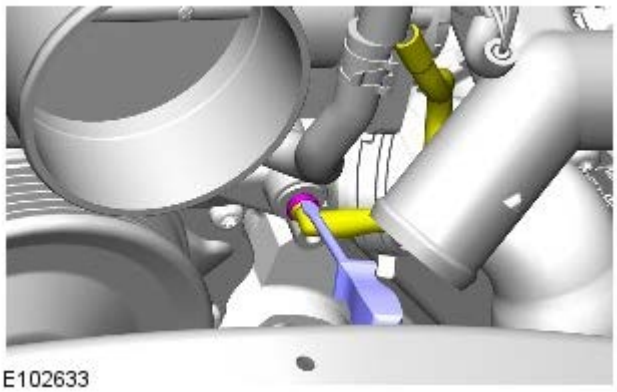
2. Refer to: Cooling System Partial Draining, Filling and Bleeding (303-03B Engine Cooling - V6 S/C 3.0L Petrol, General Procedures).

3. Refer to: Accessory Drive Belt (303-05B Accessory Drive - V6 S/C 3.0L Petrol, Removal and Installation).

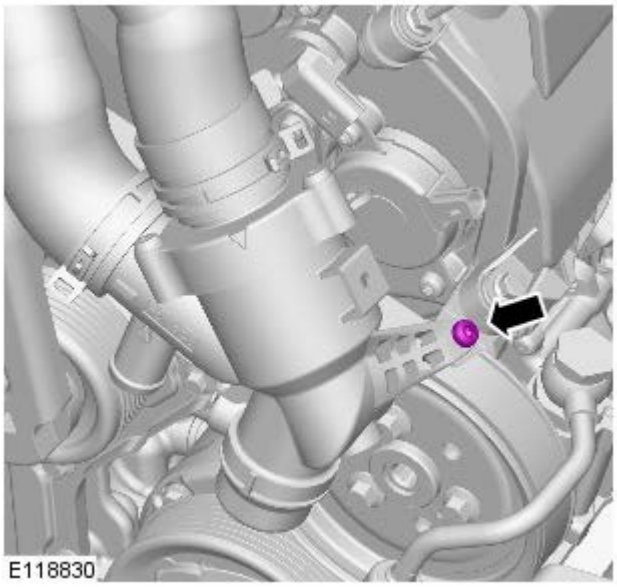
4.



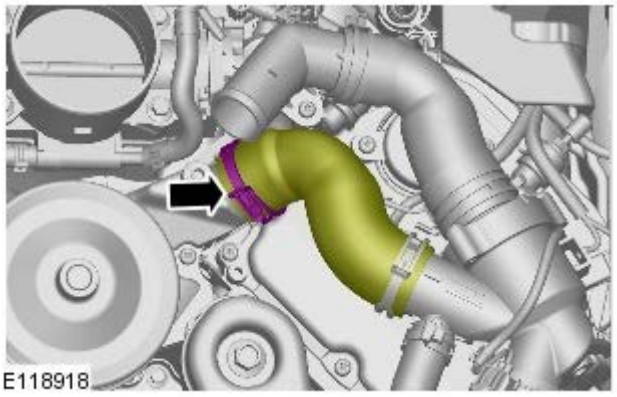
5.



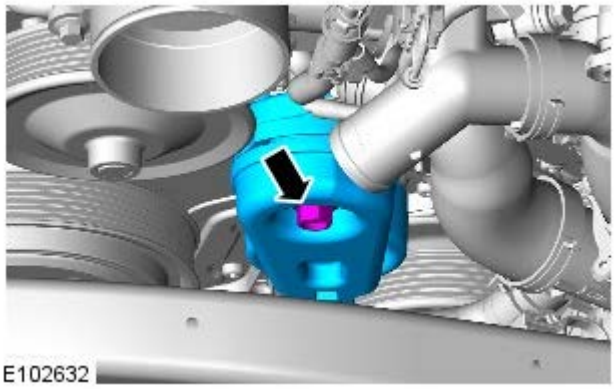
6. *Torque:* 10 Nm

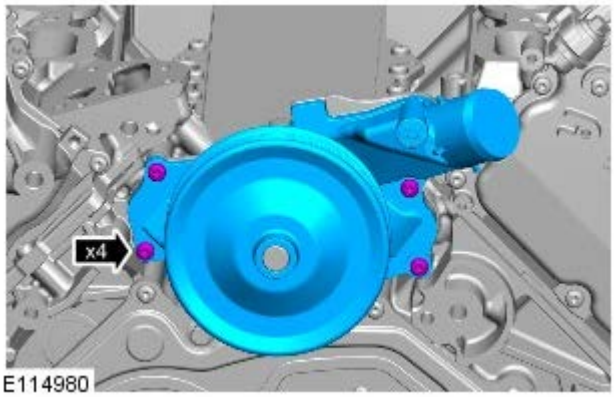


7.



8. *Torque:* 48 Nm



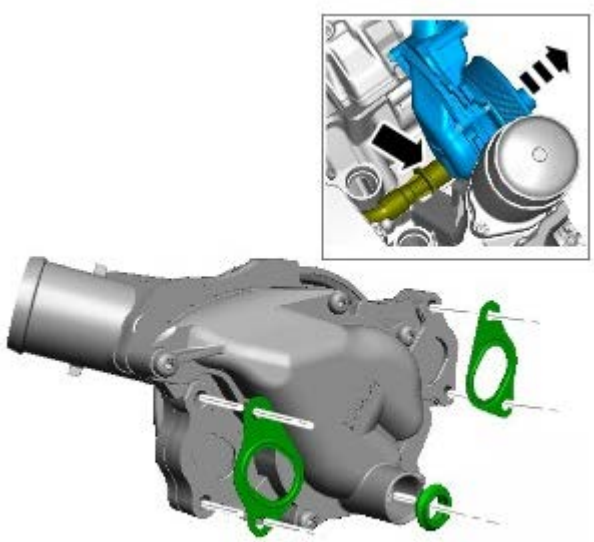


9. WARNING: Fluid loss is unavoidable, use absorbent cloth or a container to collect the fluid.

CAUTION: Engine coolant will damage the paint finished surfaces. If spilt, immediately remove the coolant and clean the area with water.

Torque: 12 Nm

10. CAUTIONS:



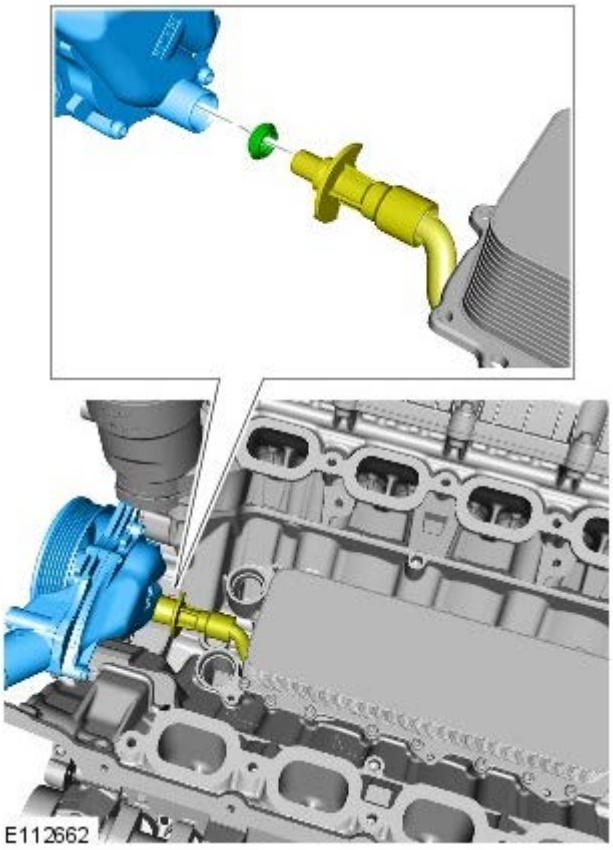
E102636

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: 02-May-2013

Engine Cooling - V6 S/C 3.0L Petrol - Radiator

Removal and Installation

Removal

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

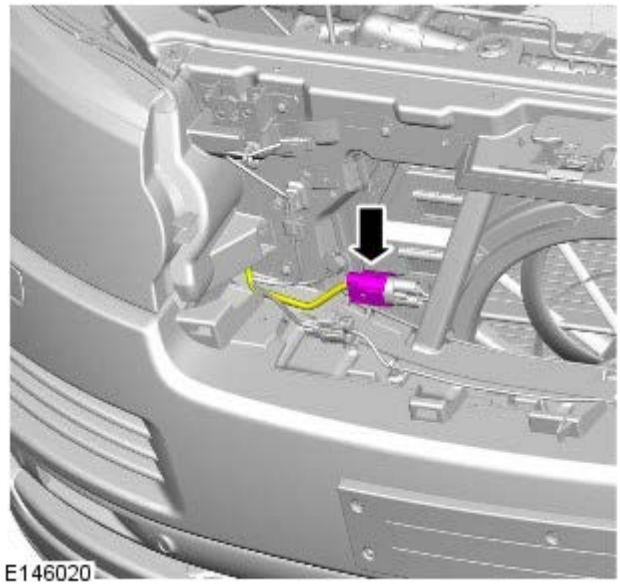
2. Refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00 Climate Control System - General Information, General Procedures).

3. Refer to: Cooling System Partial Draining, Filling and Bleeding (303-03B Engine Cooling - V6 S/C 3.0L Petrol, General Procedures).

4. Refer to: Cooling Fan (303-03B Engine Cooling - V6 S/C 3.0L Petrol, Removal and Installation).

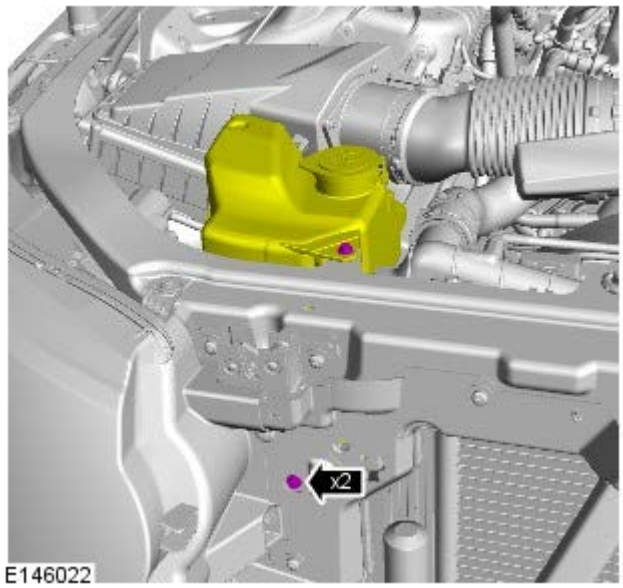
5. Refer to: Front Bumper Cover (501-19 Bumpers, Removal and Installation).

6. NOTE: If equipped.

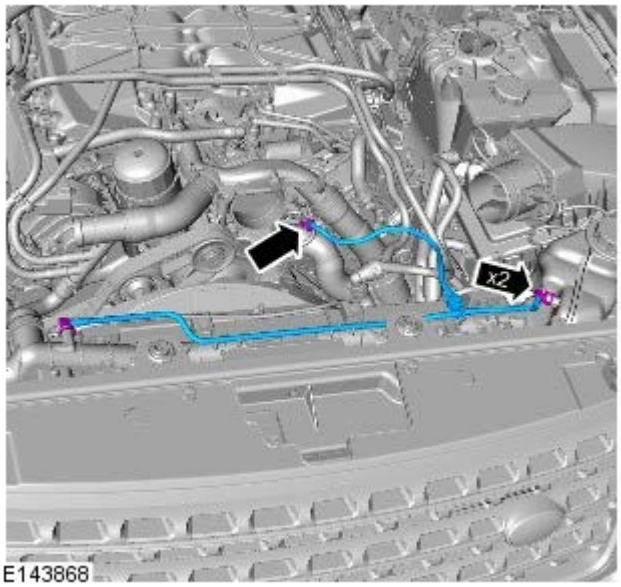


7. NOTE: If equipped.

   Torque: 7 Nm

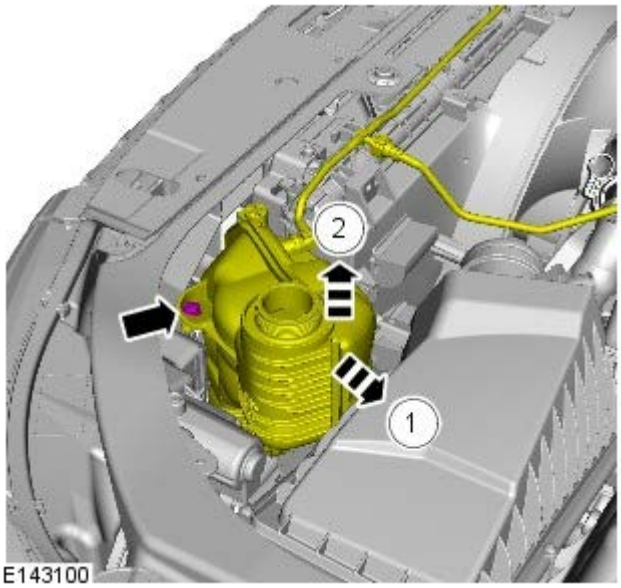


8.



E143868

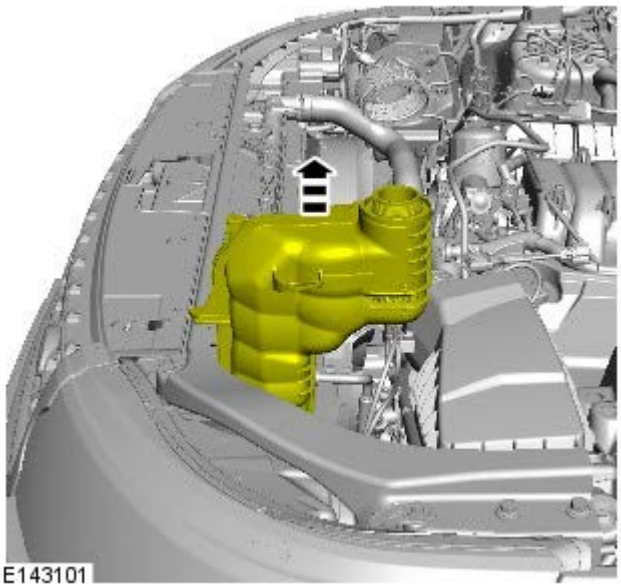
9. *Torque:* 2.8 Nm



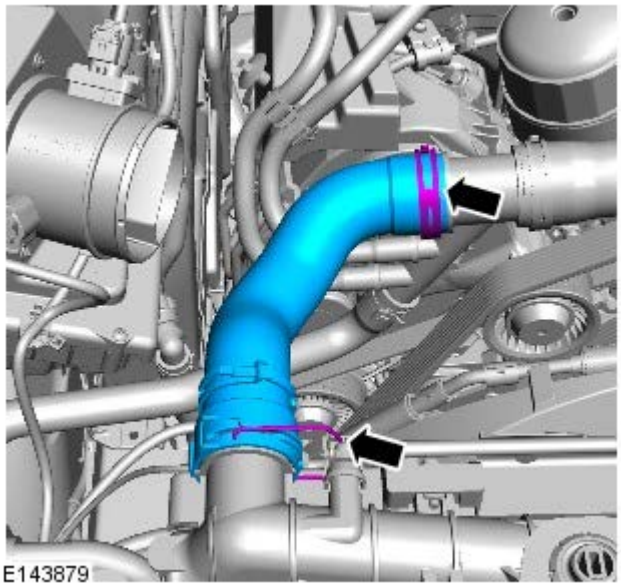
E143100

10. NOTE: Keep the coolant expansion tank vertically.

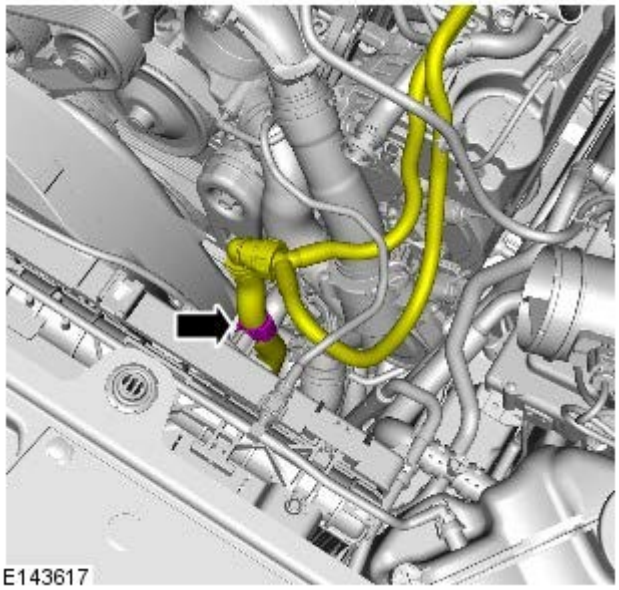
Raise the coolant expansion tank minimum 110mm from its original position.


E143101

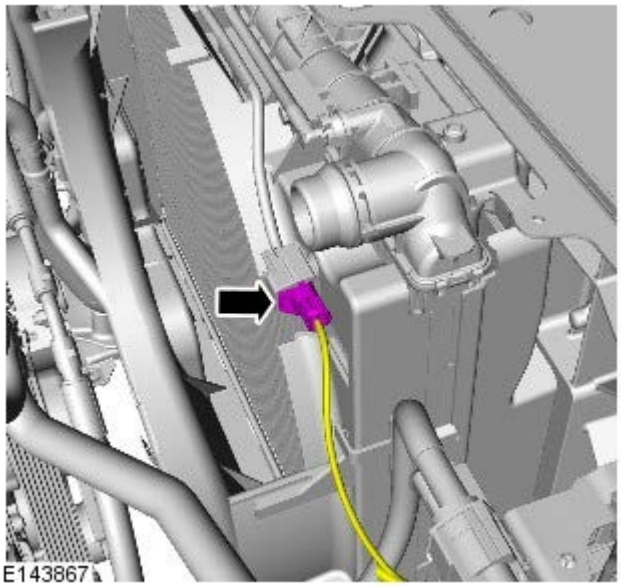
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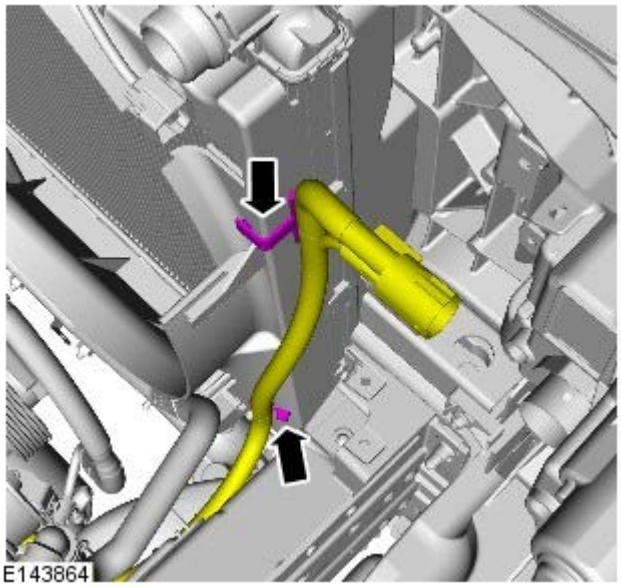
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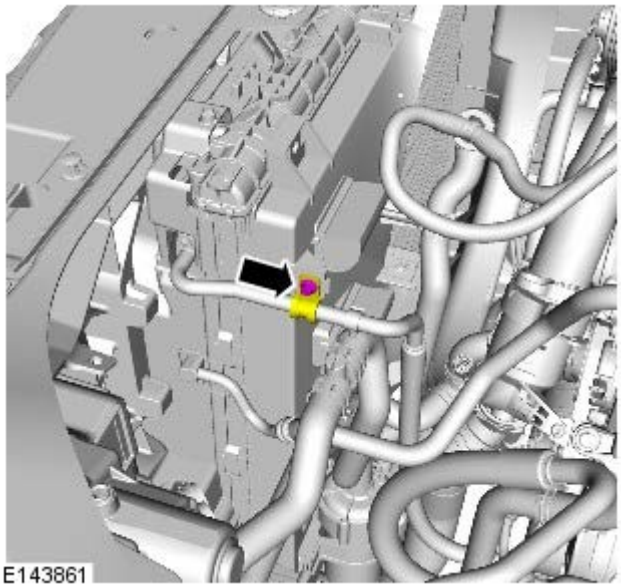
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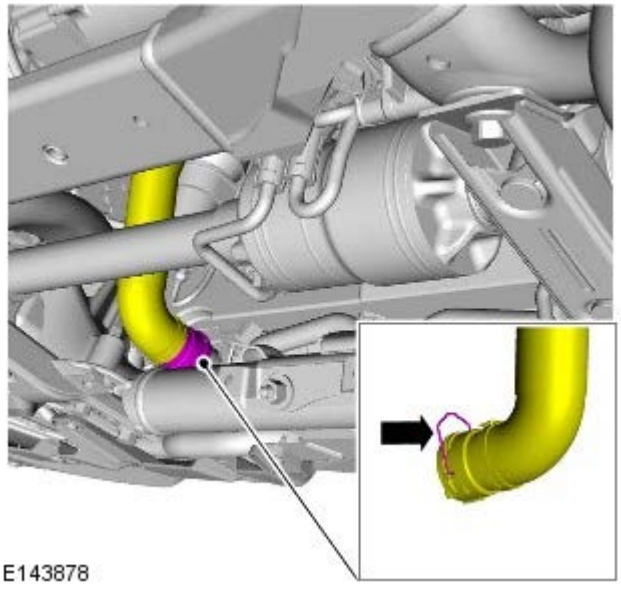
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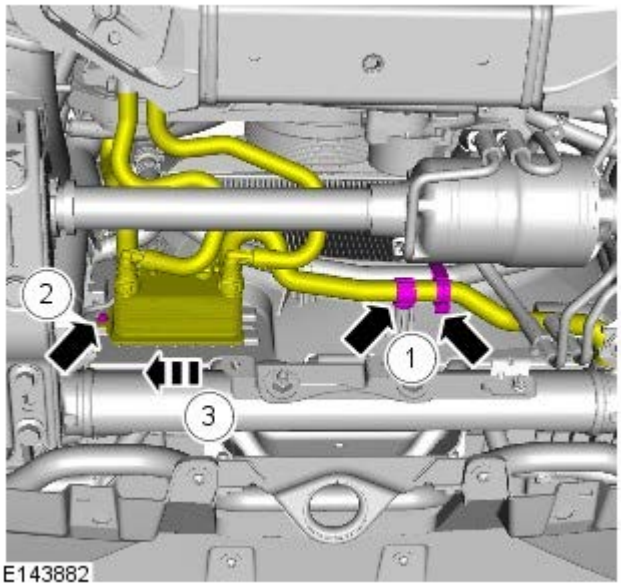
15. *Torque:* 7 Nm



16.

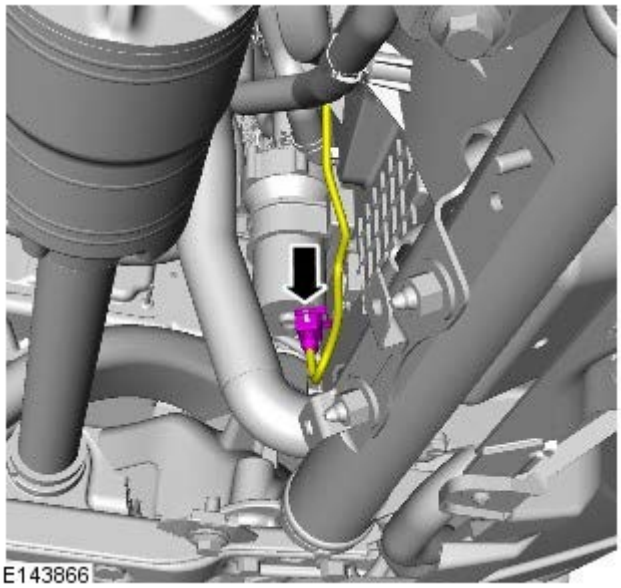


17. *Torque:* 7 Nm

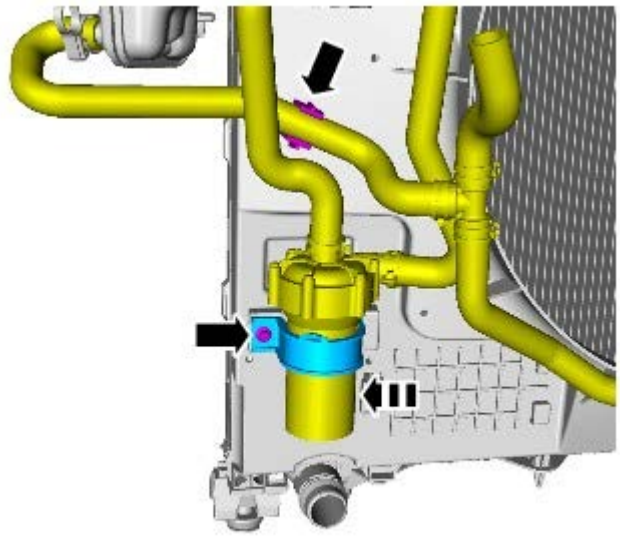


E143882

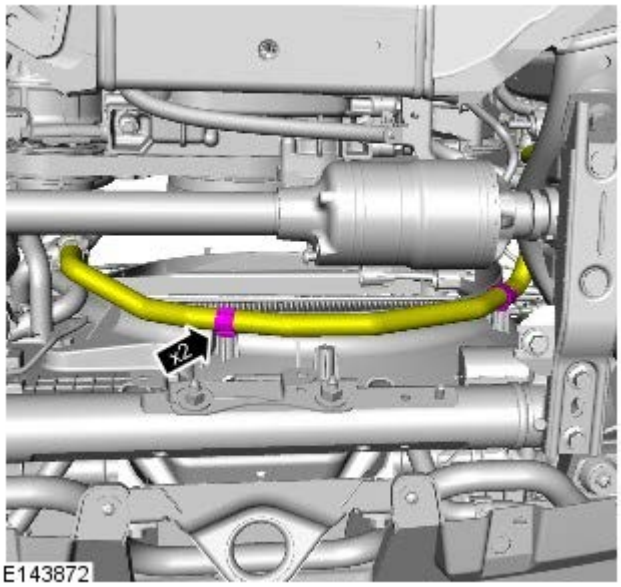
18.


E143866

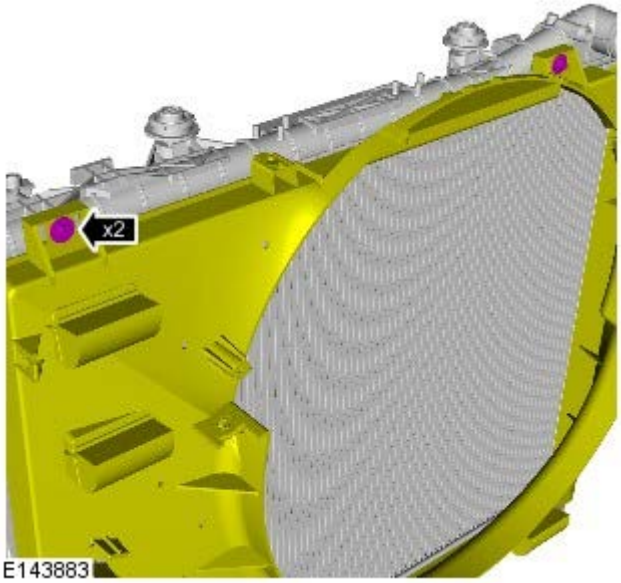
19. *Torque:* 7 Nm


E143865

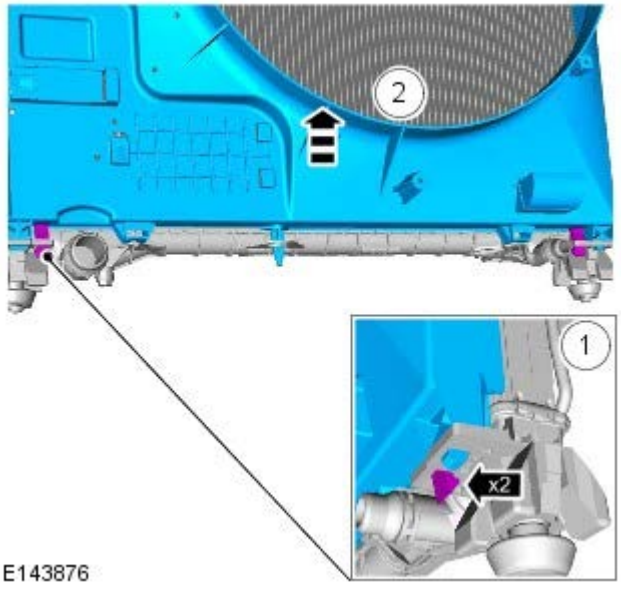
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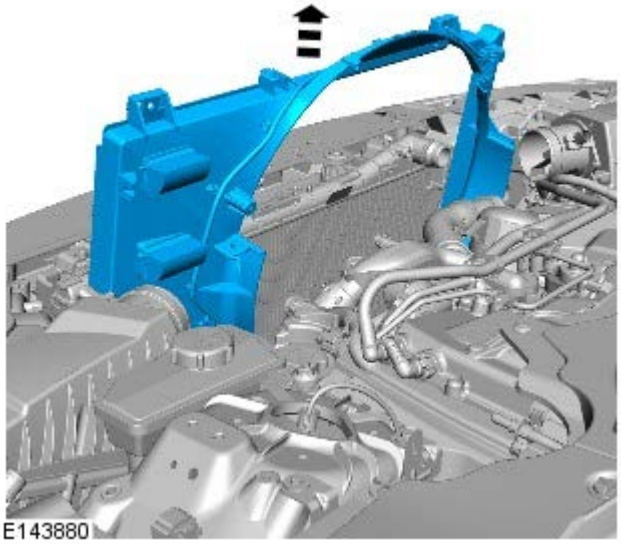
21. *Torque:* 7 Nm

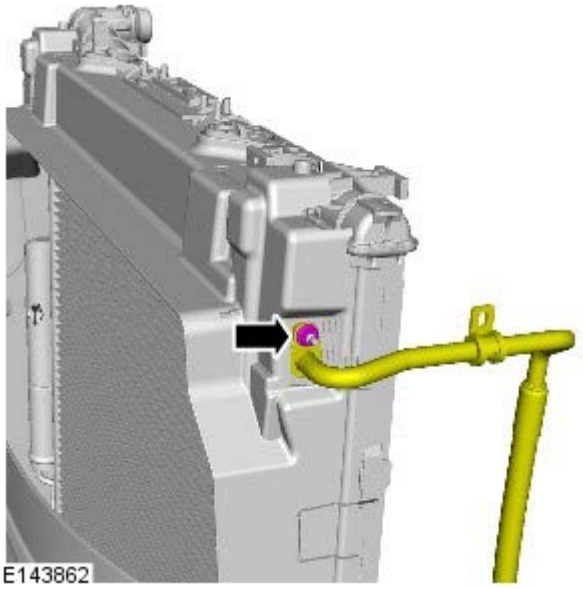


22.



23. CAUTION: Always protect the cooling pack elements to prevent accidental damage.





24. CAUTIONS:

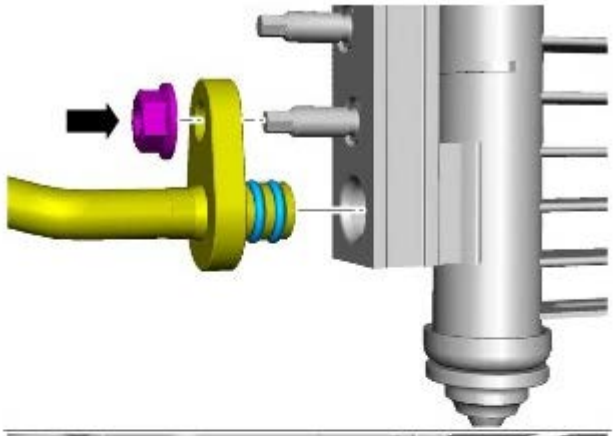
    Make sure that all openings are sealed. Use new blanking caps.

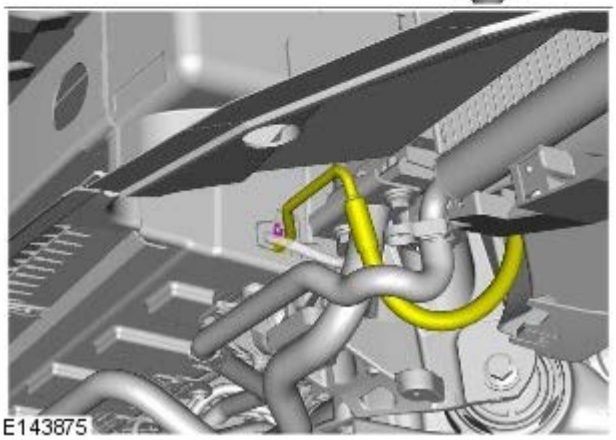
    Remove and discard the O-ring seals.

    Torque: 8 Nm

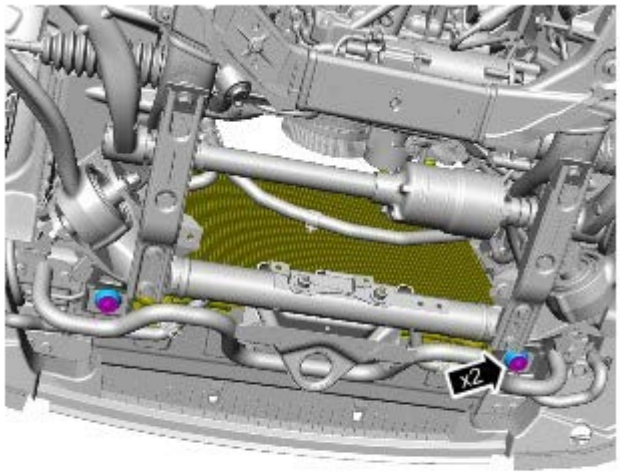
25. CAUTION: Remove and discard the O-ring seals.

    Torque: 8 Nm



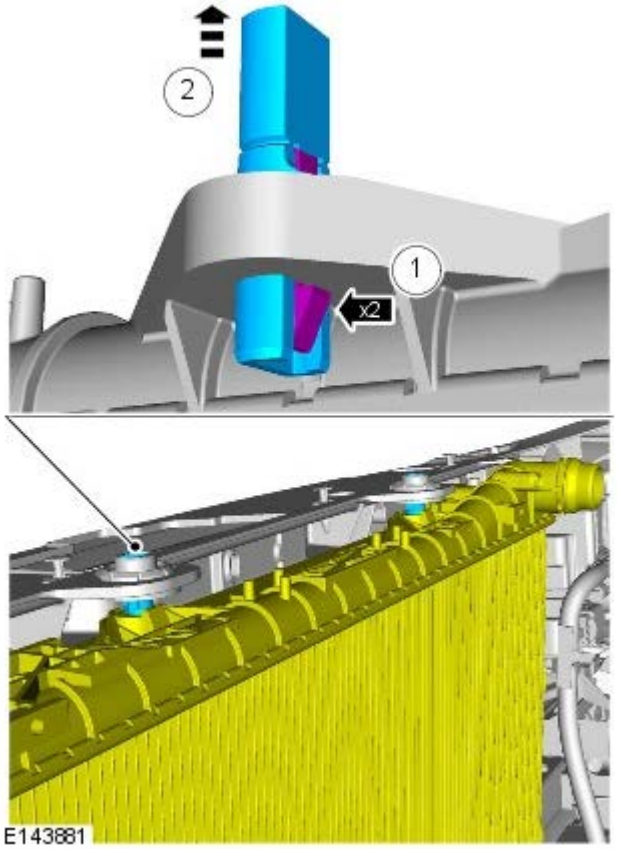


26. *Torque:* 15 Nm

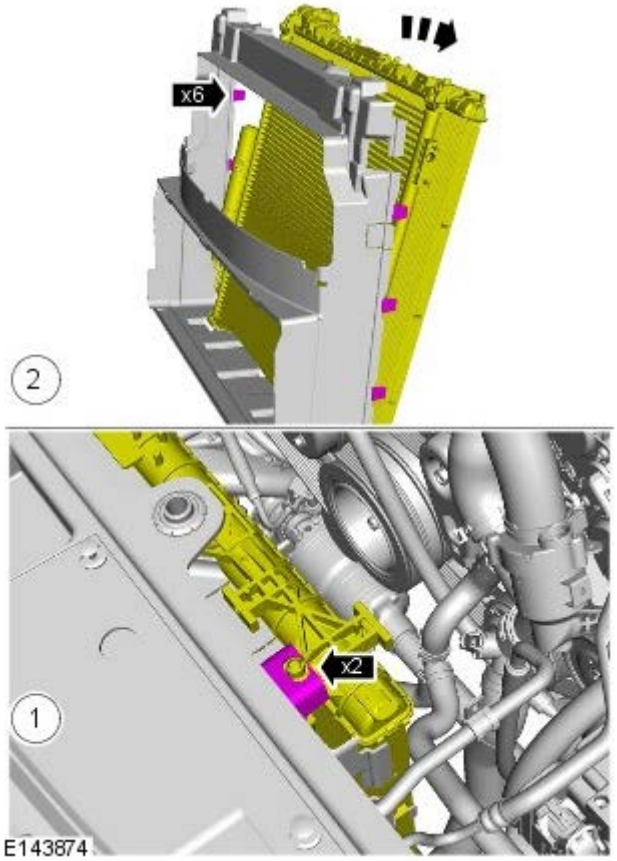


E143877

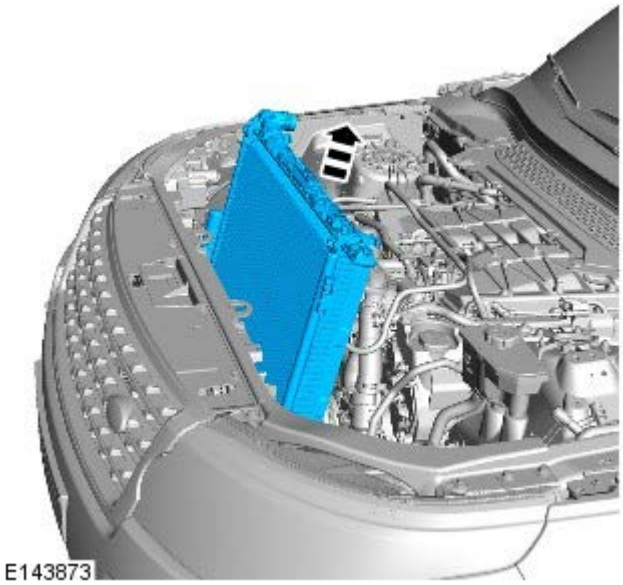
27.



28. CAUTION: Always protect the cooling pack elements to prevent accidental damage.



29. CAUTION: Always protect the cooling pack elements to prevent accidental damage.

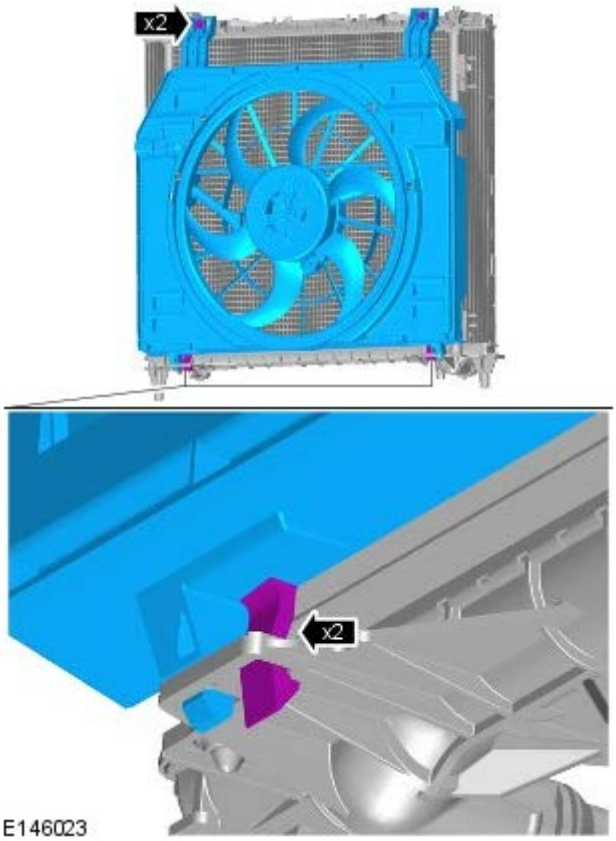


30. NOTES:

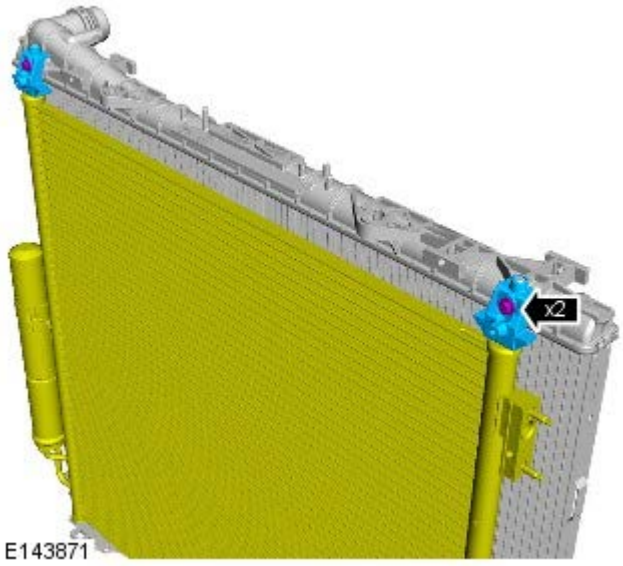
If equipped.

Do not disassemble further if the component is removed for access only.

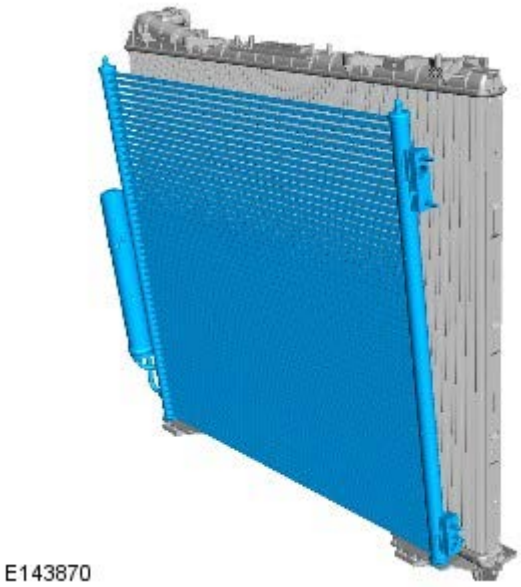
Torque: 7 Nm



31. *Torque:* 4.5 Nm



32.



Installation

1. To install, reverse the removal procedure.

Published: 02-May-2013

Engine Cooling - V6 S/C 3.0L Petrol - Thermostat Housing

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.

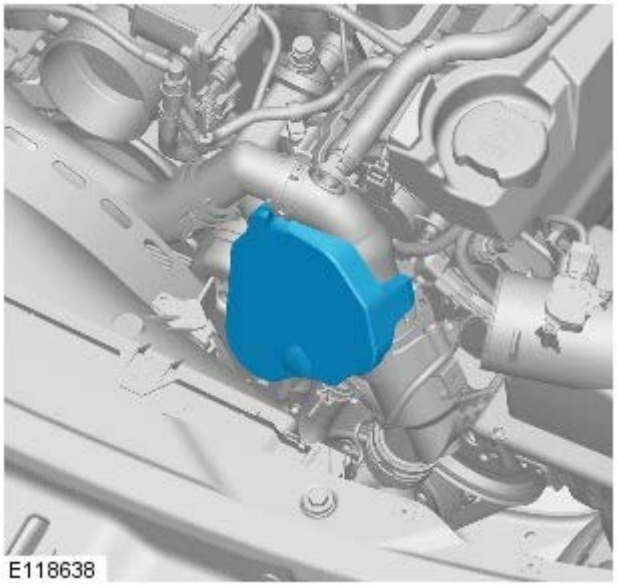
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

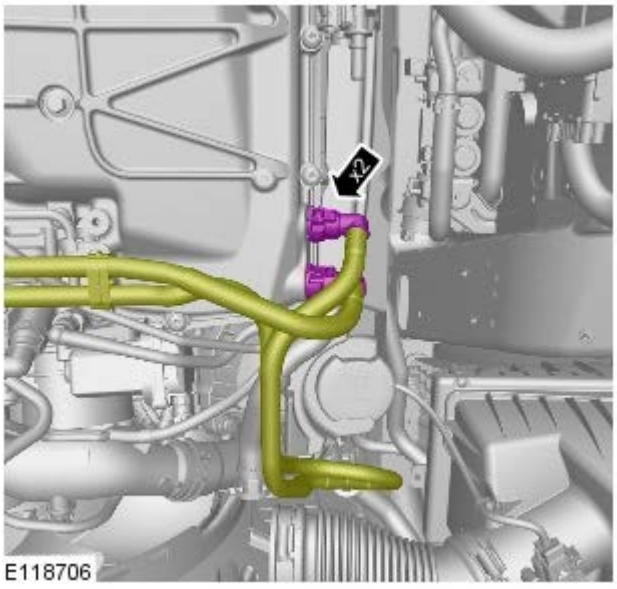
2. Refer to: Cooling System Partial Draining, Filling and Bleeding (303-03B Engine Cooling - V6 S/C 3.0L Petrol, General Procedures).

3. Refer to: Air Cleaner Outlet Pipe LH (303-12B Intake Air Distribution and Filtering - V6 S/C 3.0L Petrol, Removal and Installation).

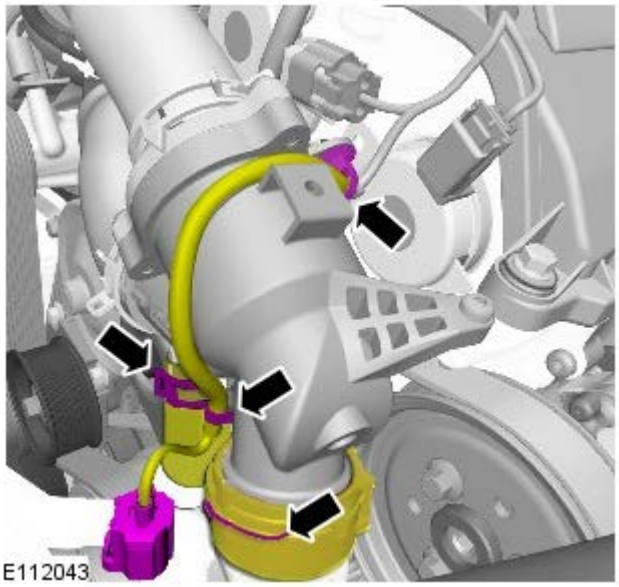
4.



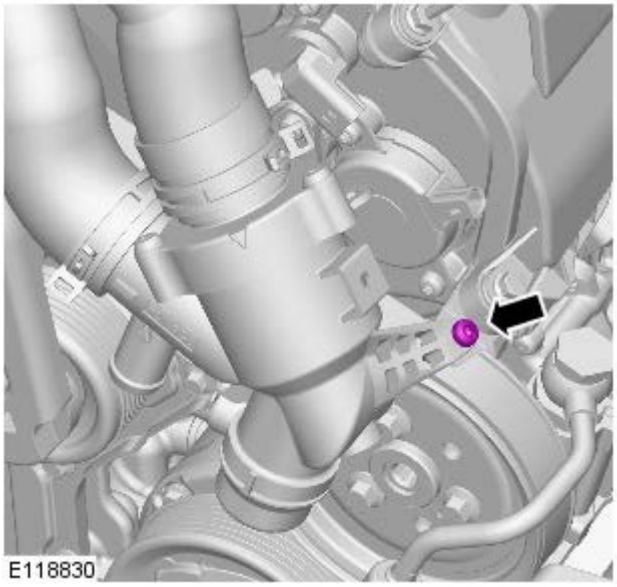
5.



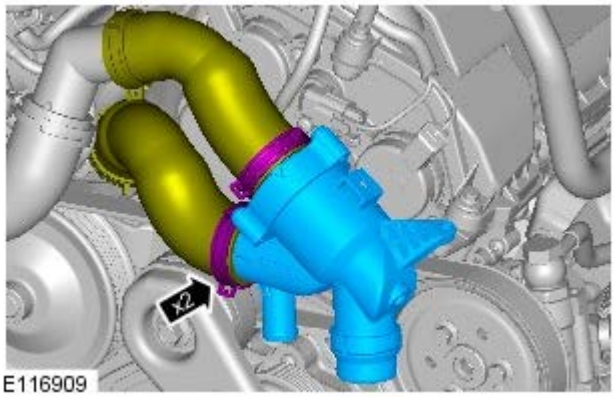
6.



7. *Torque:* 10 Nm



8. NOTE: The retaining clips cannot be removed from the pipe.



Installation

1. To install, reverse the removal procedure.

Published: 02-May-2013

Engine Cooling - V6 S/C 3.0L Petrol - Front Electric Cooling Fan

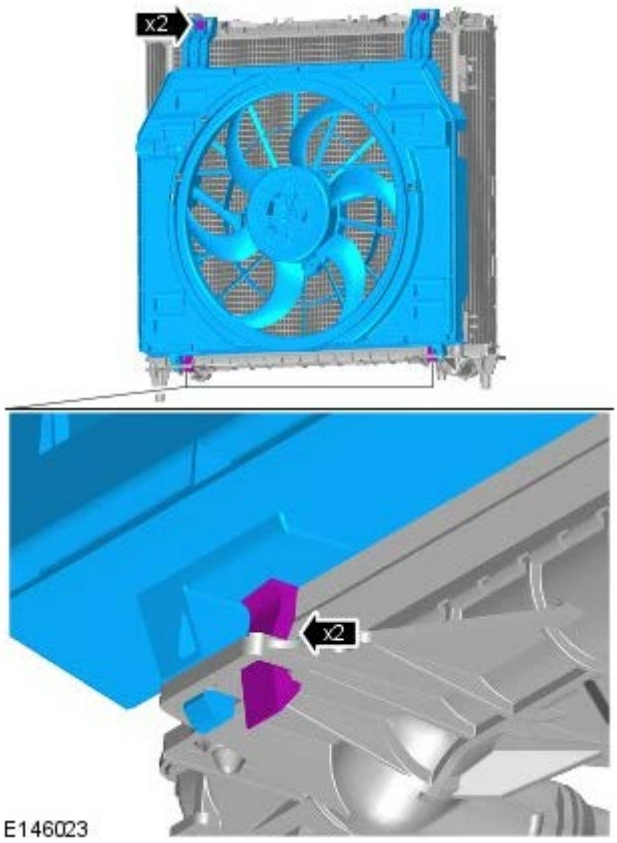
Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Cooling Module (303-03B Engine Cooling - V6 S/C 3.0L Petrol, Removal and Installation).

2. *Torque:* 7 Nm



Installation

1. To install, reverse the procedure.

Published: 08-Aug-2012

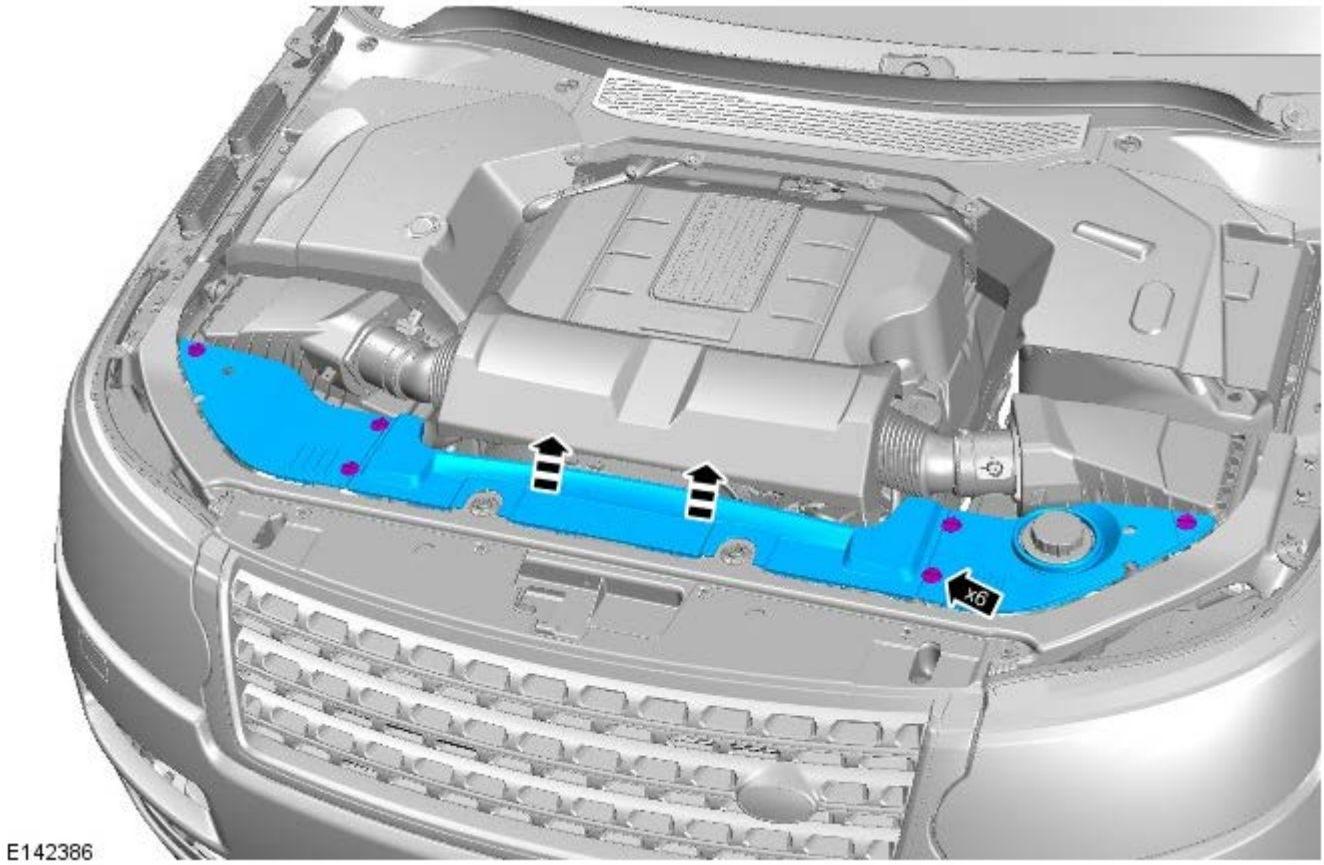
Engine Cooling - V6 S/C 3.0L Petrol - Coolant Expansion Tank

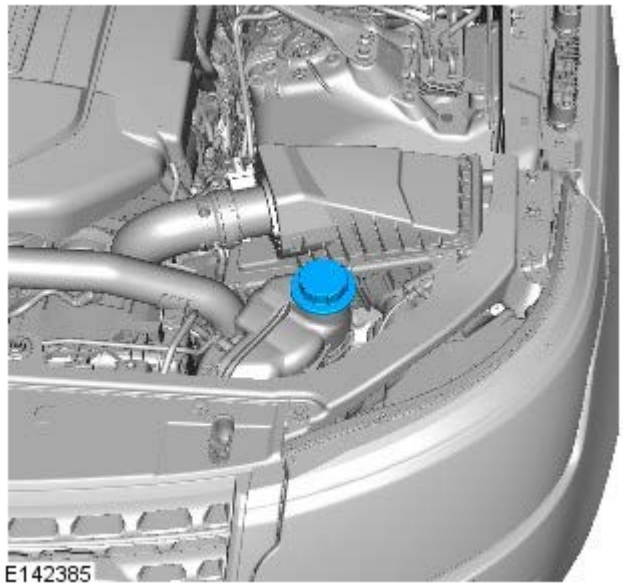
Removal and Installation

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.

1.

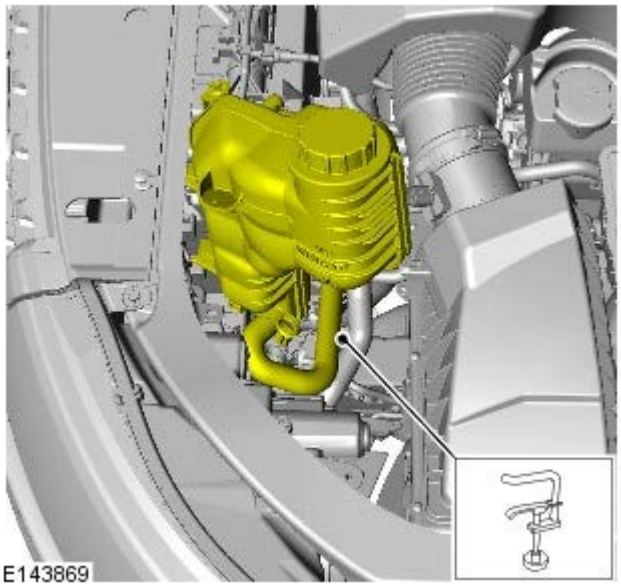




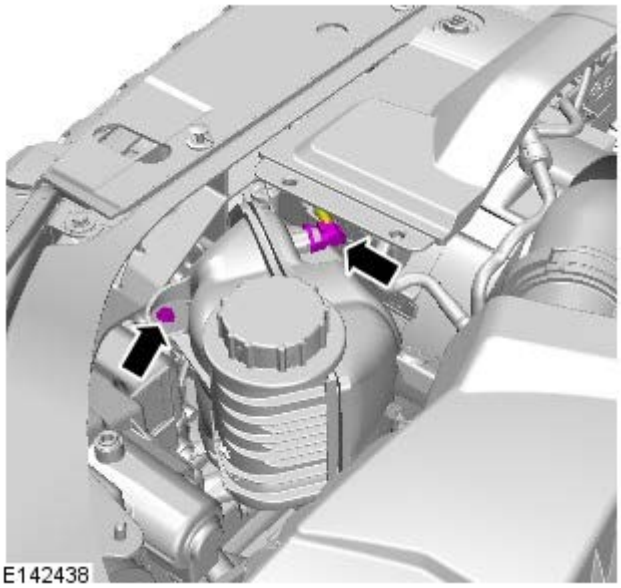
2. WARNING: When releasing the cooling system pressure, cover the coolant expansion tank cap with a thick cloth.

3. Using a syringe, remove the cooling fluid from the expansion tank.

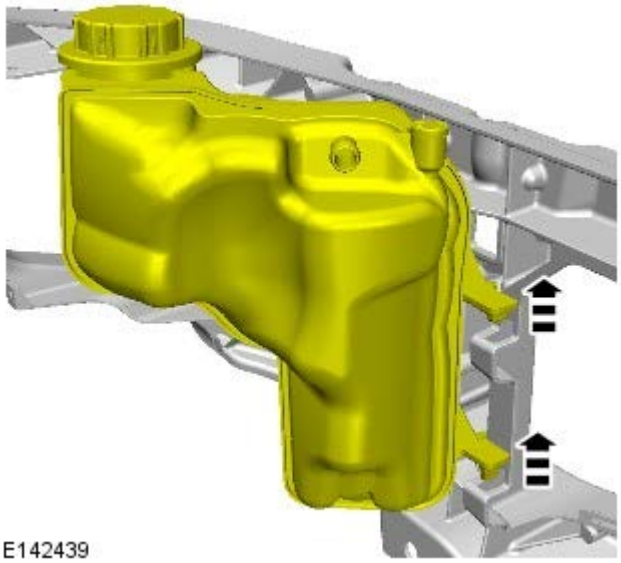
4. CAUTION: Clamp the hoses to minimize coolant loss.



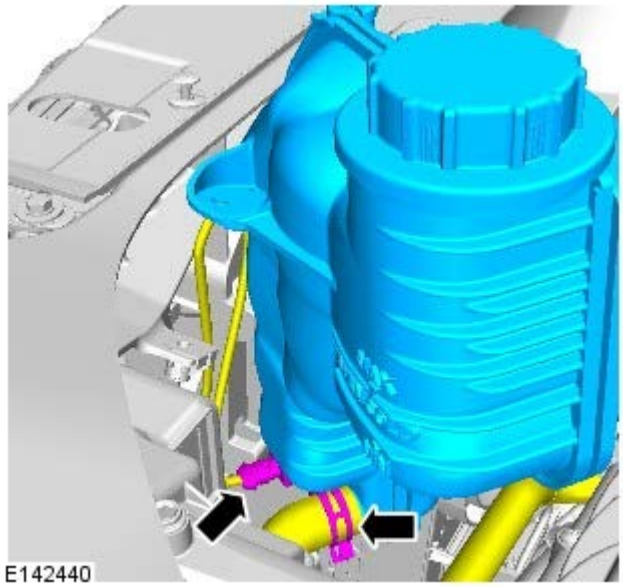
5. CAUTION: Be prepared to collect escaping coolant.



6.

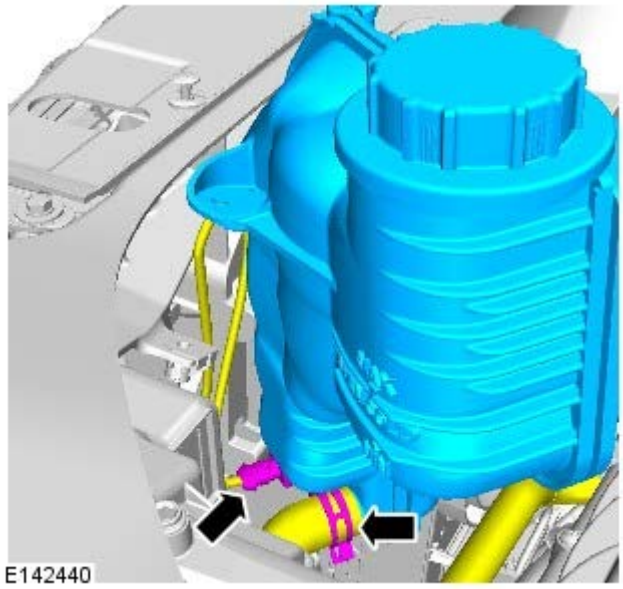


7. CAUTION: Be prepared to collect escaping coolant.

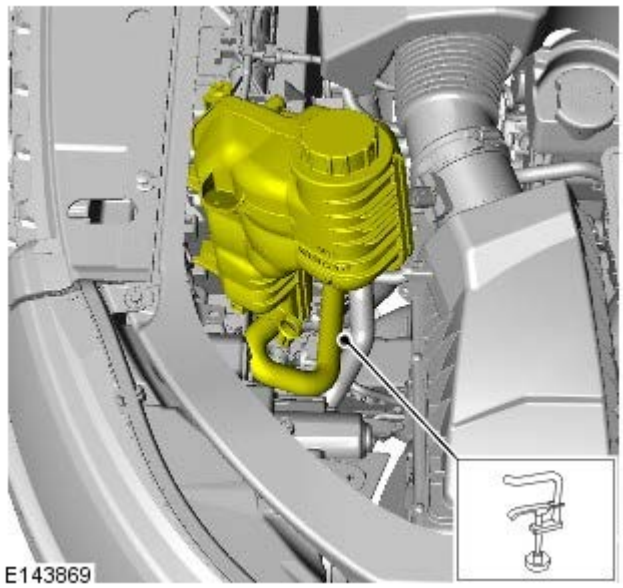


Installation

1.

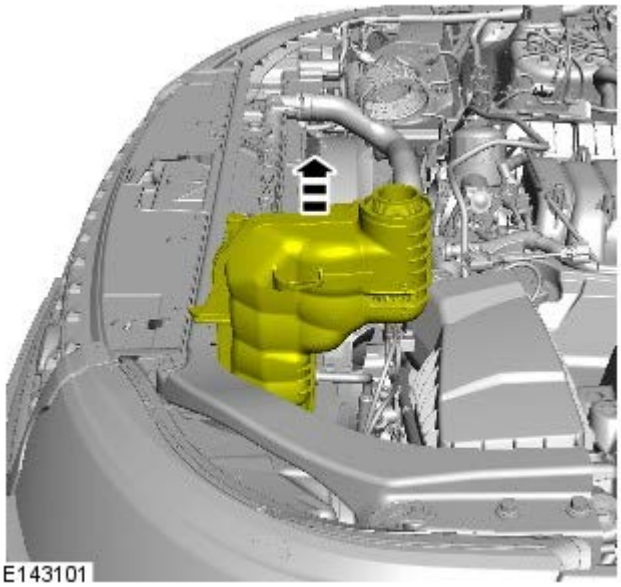


2.



3. NOTE: Keep the coolant expansion tank vertically.

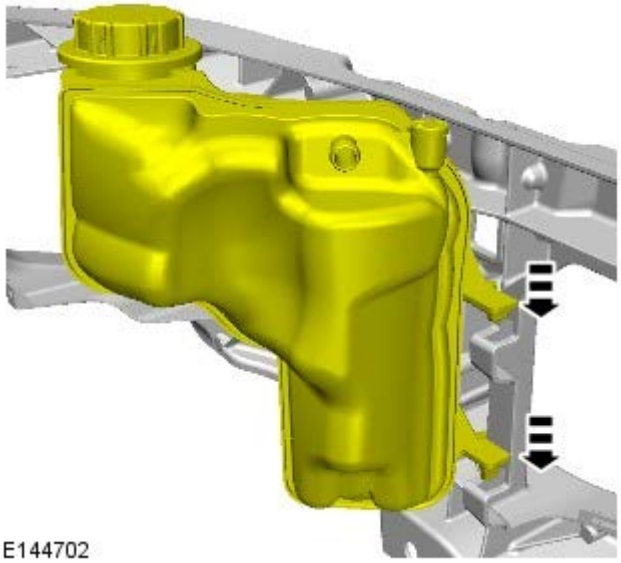
Raise the coolant expansion tank minimum 110mm


E143101

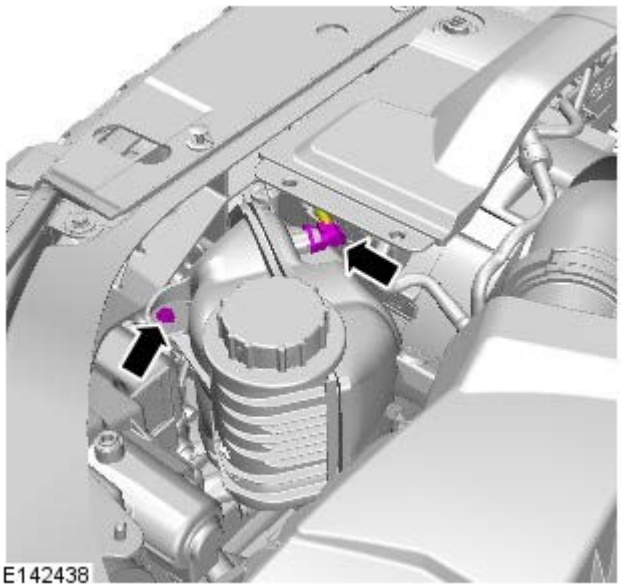
from its original position.

4. Fill the cooling system, keeping coolant to the upper level mark of the expansion tank, until a steady stream of coolant is seen returning to the tank.

5.


E144702

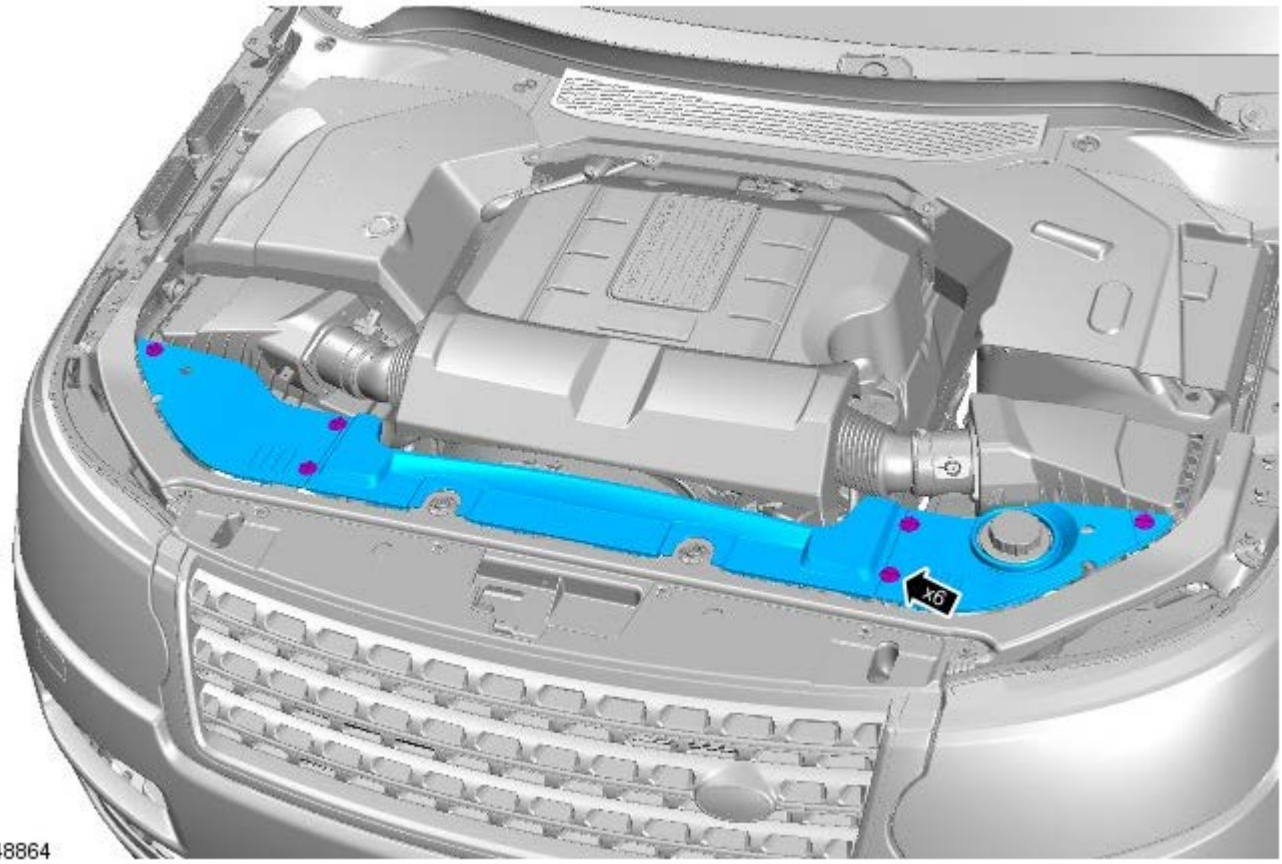
6. *Torque:* 2.8 Nm


E142438

7. CAUTION: Make sure the coolant level remains above the "COLD FILL RANGE" lower level mark.

Check and top up the cooling system as required.

8.



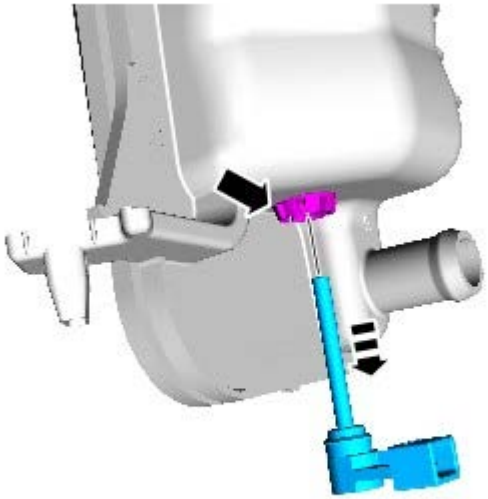
Published: 11-Dec-2013

Engine Cooling - V6 S/C 3.0L Petrol - Engine Coolant Level Switch

Removal and Installation

Removal

1. Refer to: Coolant Expansion Tank (303-03G Engine Cooling - SDV6 3.0L Diesel - Hybrid Electric Vehicle, Removal and Installation).



E162437

2. CAUTION: Care must be taken not to damage the component.

Installation

1. To install, reverse the removal procedure.

Published: 31-Jul-2012

Engine Cooling - V8 S/C 5.0L Petrol -

Lubricants

Description	Specification
Anti-freeze	Havoline Extended Life Coolant (XLC)
Anti-freeze concentration	50%

Capacities

Item	Vehicles without supercharger	Vehicles with supercharger
	Litres	Litres
Vehicles fitted with 2 zone Air Conditioning (A/C)	6.83	8.83
Vehicles fitted with 2 zone Air Conditioning (A/C) and Fuel fired booster heater (FFBH)	7	9
Vehicles fitted with 4 zone Air Conditioning (A/C)	8.47	10.47
Vehicles fitted with 4 zone Air Conditioning (A/C) and Fuel fired booster heater (FFBH)	8.64	10.64

Torque Specifications

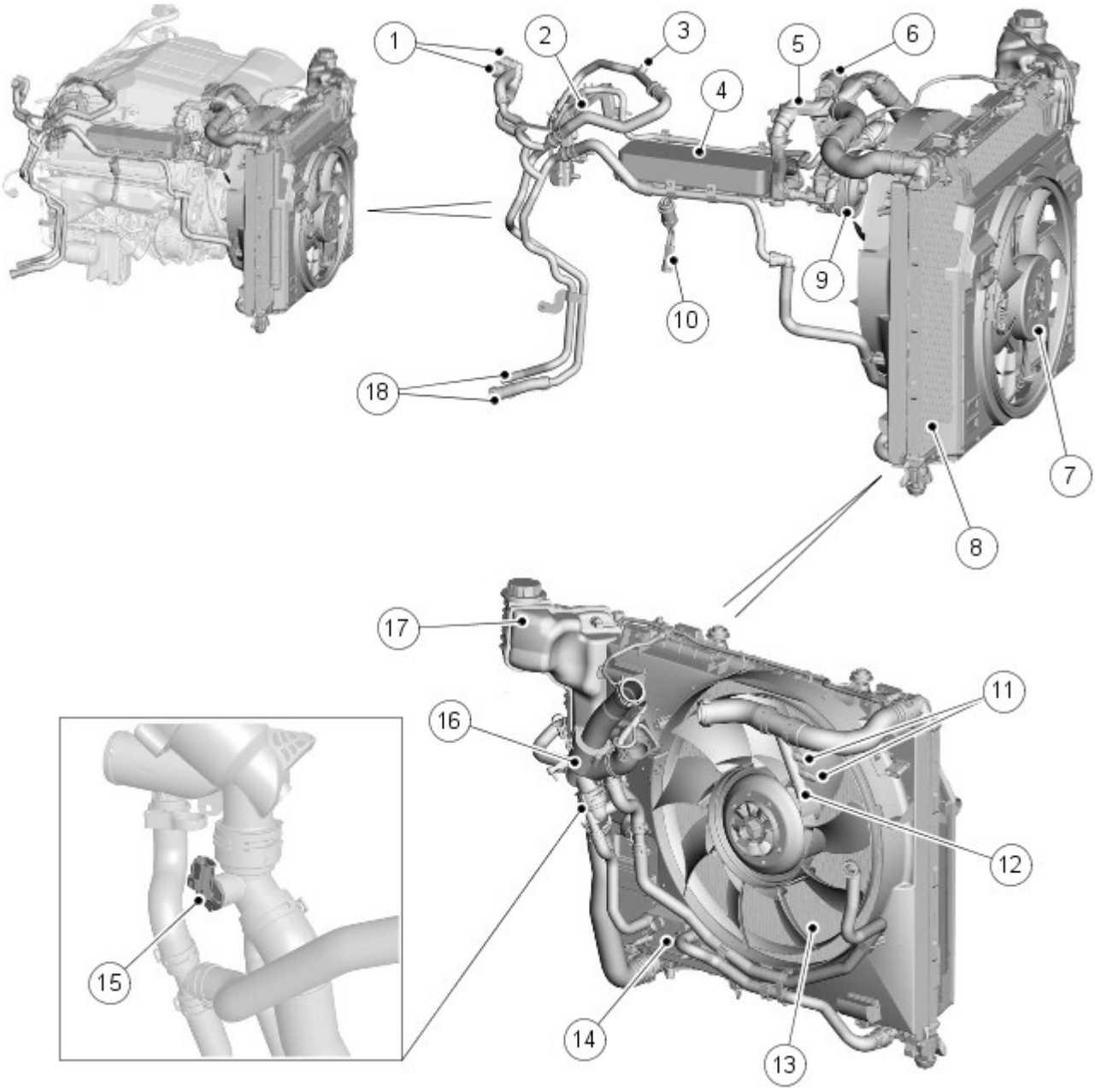
Description	Nm	lb-ft	lb-in
Coolant expansion tank retaining bolt	9	-	80
Cooling fan assembly retaining nut	65	48	-
Thermostat housing retaining bolts	10	7	-
Coolant pump retaining bolts	12	9	-
Accessory drive belt tensioner bolt	48	35	-
Radiator drain plug	5	-	44
Auxiliary radiator nut and bolt	9	-	80
Auxiliary radiator bolt	5	-	44
Auxiliary radiator nuts	9	-	80
Cooling fan shroud upper half screw	4	-	35
Transmission oil cooler to cooling fan shroud bolt	7	-	62
Cooling fan shroud to radiator bolt	7	-	62
Radiator lower bushing bolt	15	11	-
Condenser core retainer to coolant radiator bolt	4.5	-	40
Refrigerant line to condenser core nut	8	-	71
Coolant bleed screw	3	-	27

Published: 02-May-2013

Engine Cooling - V8 S/C 5.0L Petrol - Engine Cooling

Description and Operation

COMPONENT LOCATION



E152315

Item	Part Number	Description
1	-	Heater connections
2	-	Heater manifold
3	-	Bleed screw
4	-	Engine oil cooler
5	-	Outlet tube
6	-	Electric throttle
7	-	Electric cooling fan (where fitted)
8	-	Radiator
9	-	Coolant pump
10	-	Block heater (where fitted)
11	-	Connections for supercharger charge air coolers
12	-	Connections for supercharger charge air radiators
13	-	Viscous cooling fan
14	-	transmission oil cooler
15	-	Radiator outlet temperature sensor

16	-	thermostat
17	-	Expansion tank
18	-	Auxiliary heater connections (where fitted)

OVERVIEW

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:

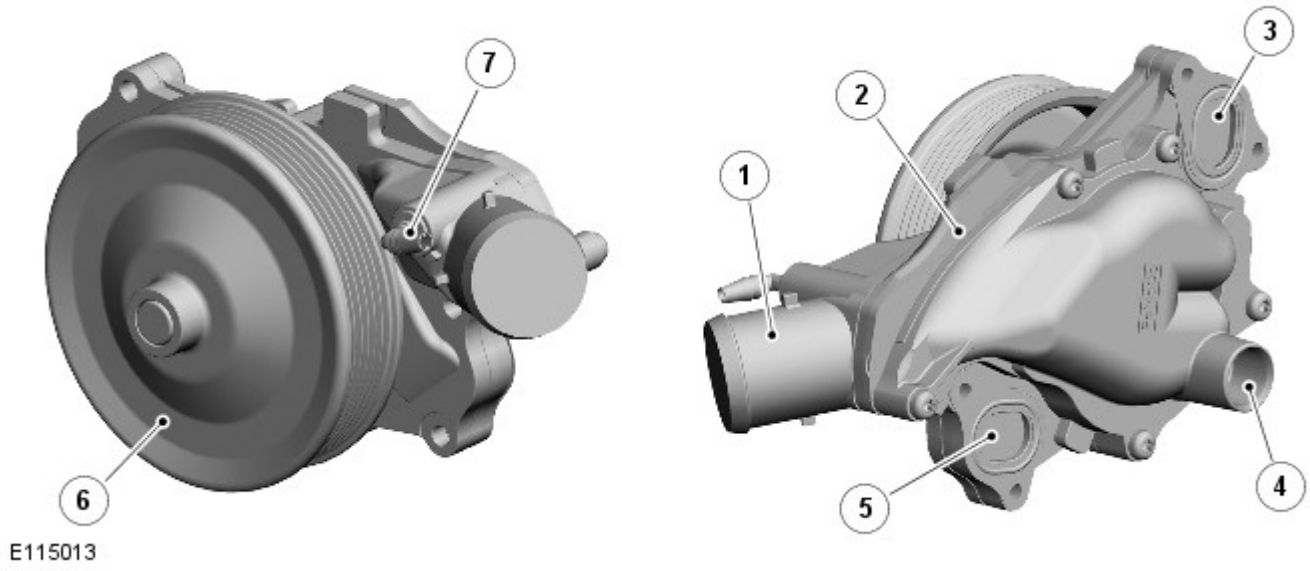
- Heating for:
  - The passenger compartment.
  - The throttle body.
- Cooling for:
  - The engine oil cooler.
  - The transmission fluid cooler.

The primary components of the engine cooling system are the:

- Coolant pump.
- Thermostat.
- Radiator.
- One or two engine cooling fans.
- Expansion tank.
- Outlet tube and heater manifold.
- Connecting hoses and pipes.

DESCRIPTION

Coolant Pump

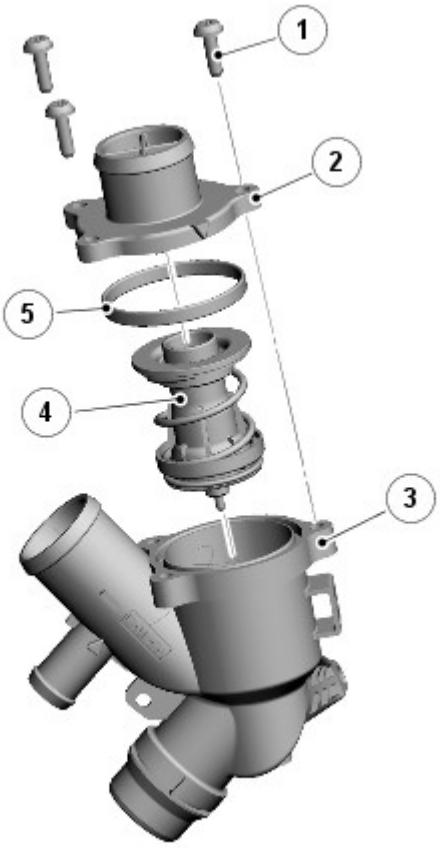


Item	Part Number	Description
1	-	Inlet connection
2	-	Pump body
3	-	Outlet flange to right cylinder head
4	-	Outlet to engine oil cooler
5	-	Outlet flange to left cylinder head
6	-	Pulley
7	-	Bleed pipe connection (containing check valve)

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 (303-05C Accessory Drive - V8 S/C 5.0L Petrol, Description and Operation).

Two coolant outlet flanges attach the coolant pump to the front of the cylinder block. 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



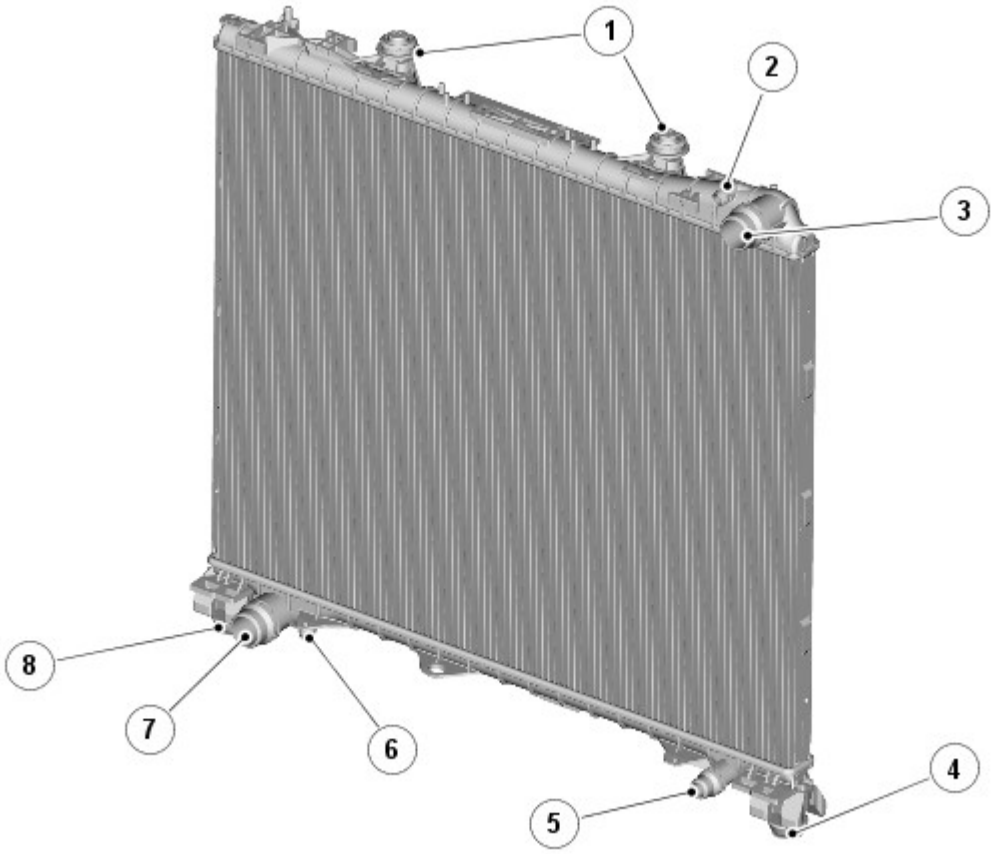
E115014

Item	Part Number	Description
1	-	Bolt (3 off)
2	-	Upper body
3	-	Lower 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.

Radiator



E145080

Item	Part Number	Description
1	-	Upper mounts
2	-	Vent hose connection
3	-	Upper hose connection
4	-	Lower mount
5	-	Transmission hose connection
6	-	Drain screw
7	-	Lower hose connection
8	-	Lower mount

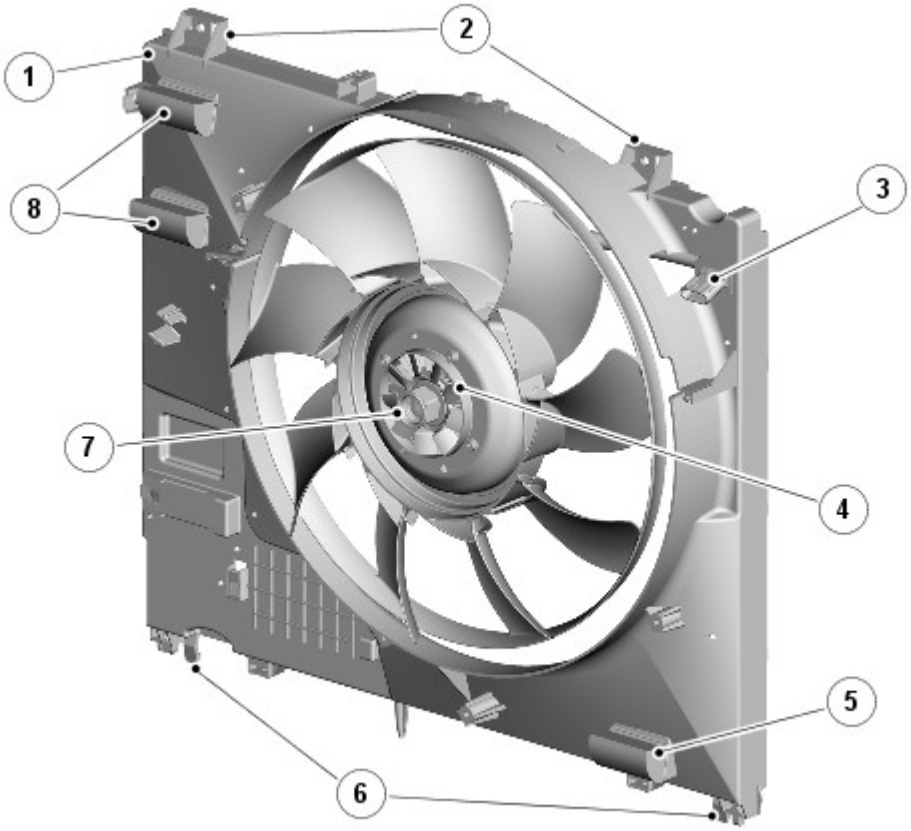
The radiator is a vertical-flow type with an integral transmission fluid sub-cooler. The radiator is located in the vehicle by bushes attached to the end tanks. The lower bushes are installed in the front subframe. The upper bushes are installed in the front end carrier.

Upper and lower hose connections are incorporated into the upper and lower end tanks respectively. The lower end tank also incorporates a drain screw, and a connection for the feed hose of the transmission fluid cooler. The upper end tank incorporates a connection for a vent hose to the expansion tank. The end tanks also incorporate mounting points for viscous and electric cooling fan shrouds, and the climate control condenser.

Engine Cooling Fan(s)

Depending on market and model specification, vehicles have either a viscous cooling fan, or a viscous cooling fan and an electric cooling fan, to help regulate the coolant temperature.

VISCOUS COOLING FAN



E145204

Item	Part Number	Description
1	-	Shroud
2	-	Mounting lugs
3	-	Electrical connector
4	-	Electro-viscous drive unit
5	-	Speed flap
6	-	Mounting lugs
7	-	Securing nut
8	-	Speed flaps

The viscous engine 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.

The blades of the cooling fan are located in a shroud attached to the rear of the radiator. The shroud incorporates speed flaps, which pivot open to allow engine compartment cooling at speed. 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.
For additional information, refer to: Accessory Drive (303-05C Accessory Drive - V8 S/C 5.0L Petrol, Description and Operation).

NOTE: The securing nut is made with right thread.

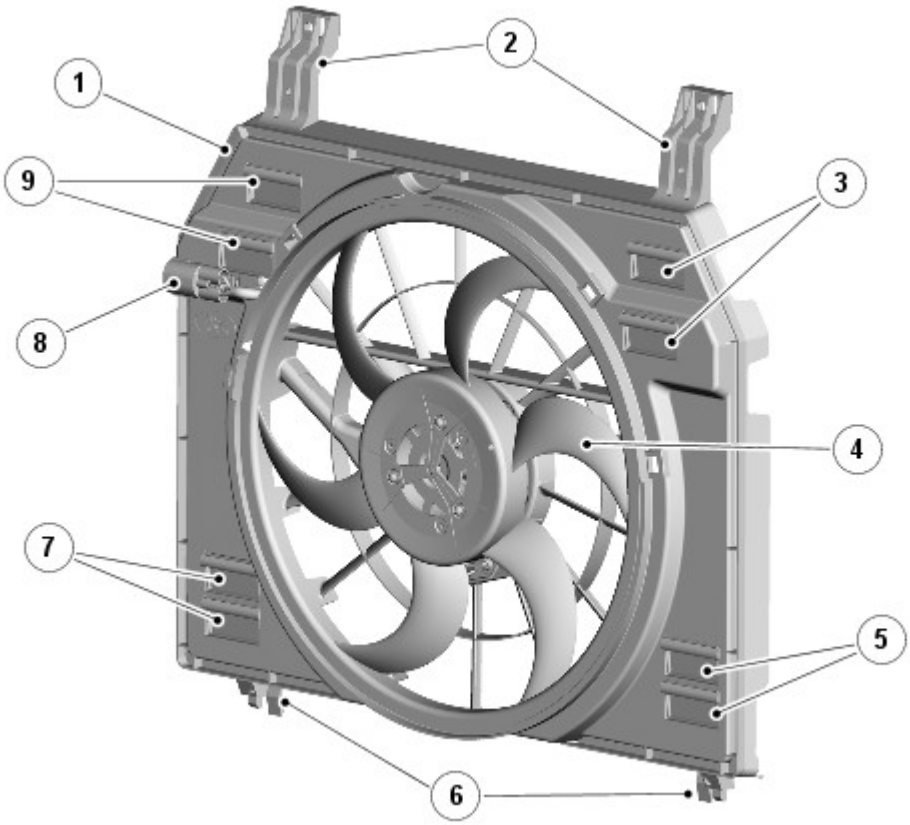
The viscous engine cooling fan is operated by a control module, integrated into the drive unit, which is controlled by the ECM. An electrical connector in the top right corner of the shroud provides the interface between the cooling fan harness and the vehicle wiring. The control module is provided with:

- Two battery power supplies from the ECM relay in the EJB (Engine Junction Box)
- A PWM (Pulse Width Modulation) signal from the ECM
- A ground.

A Hall effect sensor in the fan control module provides a fan speed signal for the ECM.

To control the cooling fan, the ECM varies the duty cycle of the PWM signal. The fan control module translates the duty cycle into a fan target speed and sets the level of engagement of the viscous clutch accordingly.

ELECTRIC COOLING FAN (where fitted)



E145205

Item	Part Number	Description
1	-	Shroud
2	-	Mounting lugs
3	-	Speed flaps
4	-	Fan blades and motor
5	-	Speed flaps
6	-	Mounting lugs
7	-	Speed flaps
8	-	Electrical connector
9	-	Speed flaps

The electric engine cooling fan is a variable speed fan installed in a shroud attached to the front of the radiator. The shroud incorporates speed flaps, which pivot open to allow engine compartment cooling at speed.

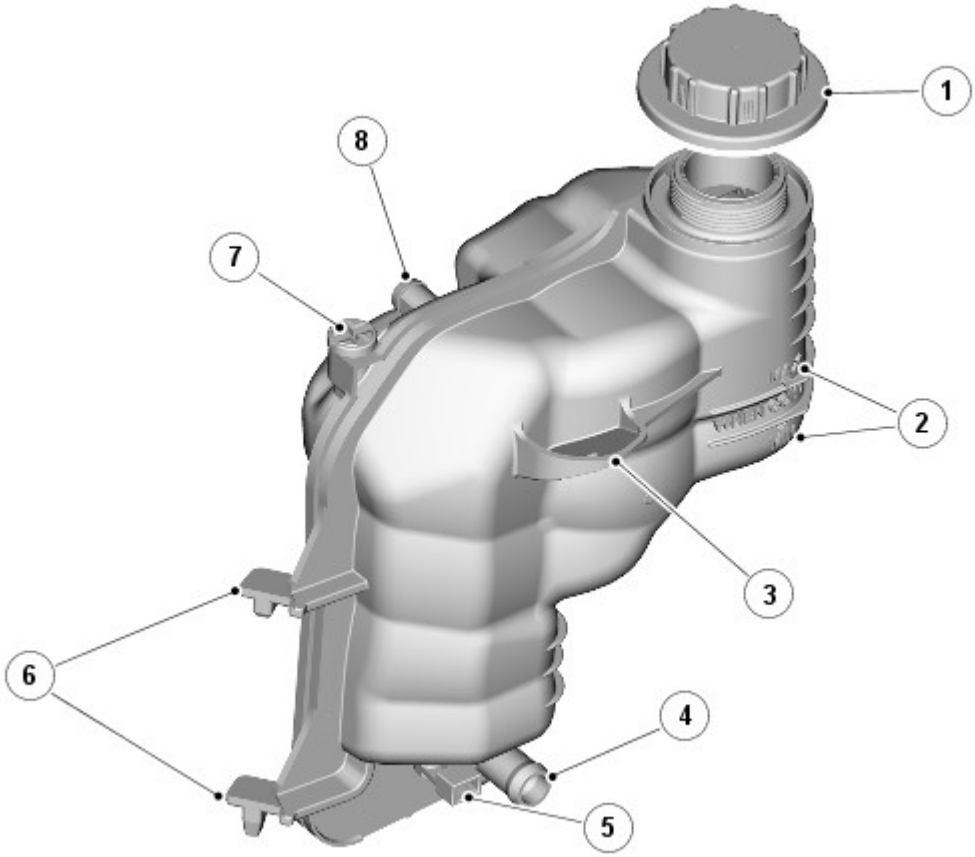
The cooling fan is operated by a fan control module, integrated into the electric motor, which is controlled by the ECM. An electrical connector at the right side of the fan shroud provide the interface between the cooling fan harnesses and the vehicle wiring.

The fan control module of each cooling fan is provided with:

- A battery power supply from the EJB
- An ignition signal from the ECM relay in the EJB
- A PWM signal from the ECM
- A ground.

To control the cooling fan, the ECM varies the duty cycle of the PWM signal. The fan control module translates the duty cycle into a fan target speed and sets the output current to the fan motor accordingly.

Expansion Tank



E145082

Item	Part Number	Description
1	-	Filler cap
2	-	MAX and MIN level markings
3	-	Mounting lug
4	-	Supply hose connection
5	-	Coolant level sensor
6	-	Mounting lugs
7	-	Bleed screw
8	-	Vent hose connection

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 thermostat. A continuous vent into the expansion tank, through a hose connected to the radiator, prevents air locks from forming in the cooling system.

The expansion tank is attached to the front end carrier in the front left corner of the engine compartment. A filler cap, bleed screw and level sensor are incorporated into the expansion tank. MAX and MIN level markings are molded into the exterior of the tank.

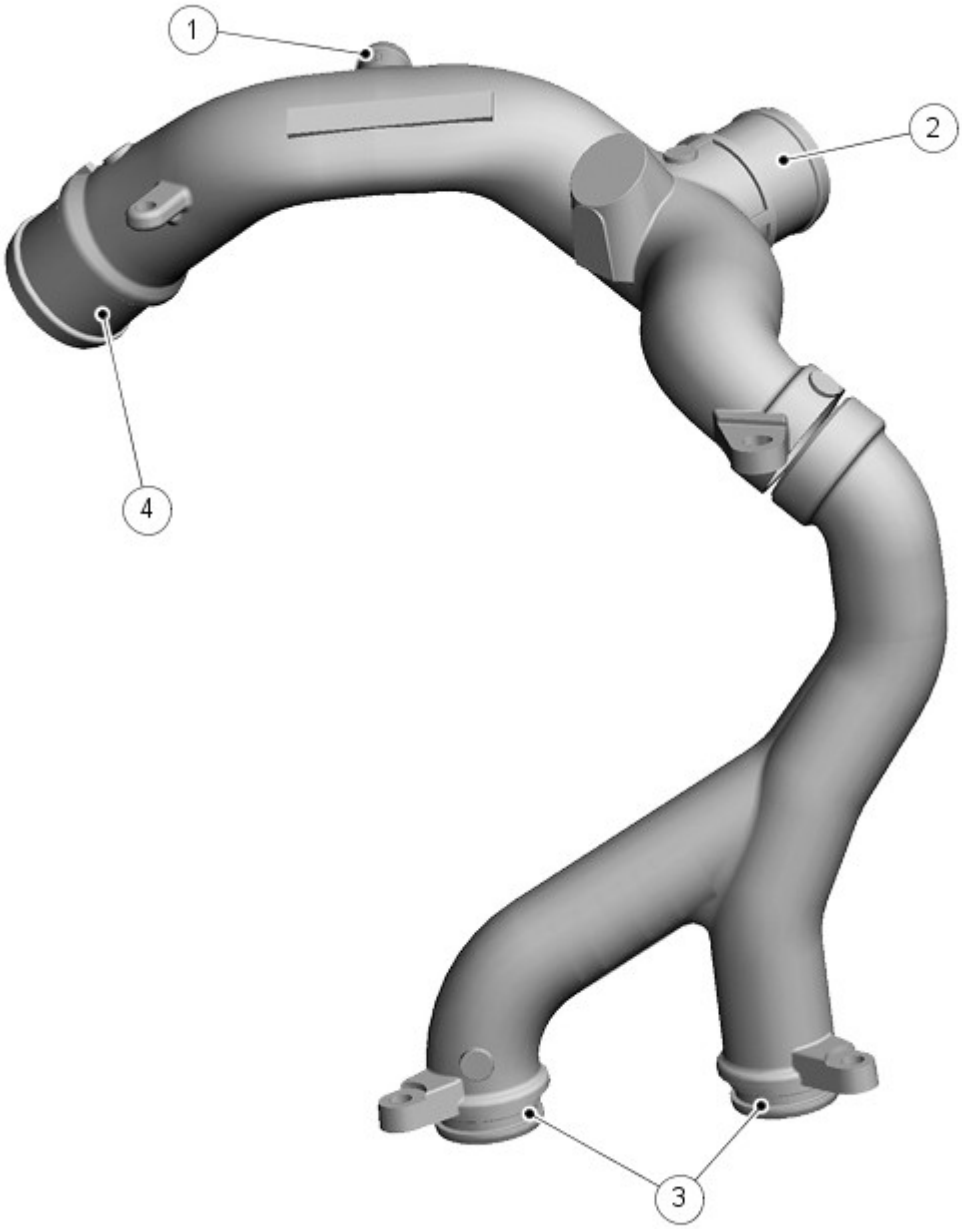
The expansion tank provides the following functions:

- 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 0.5 to 1 liter (1.06 to 2,11 US pints), above the MAX level, to allow for coolant expansion.

Outlet Tube and Heater Manifold

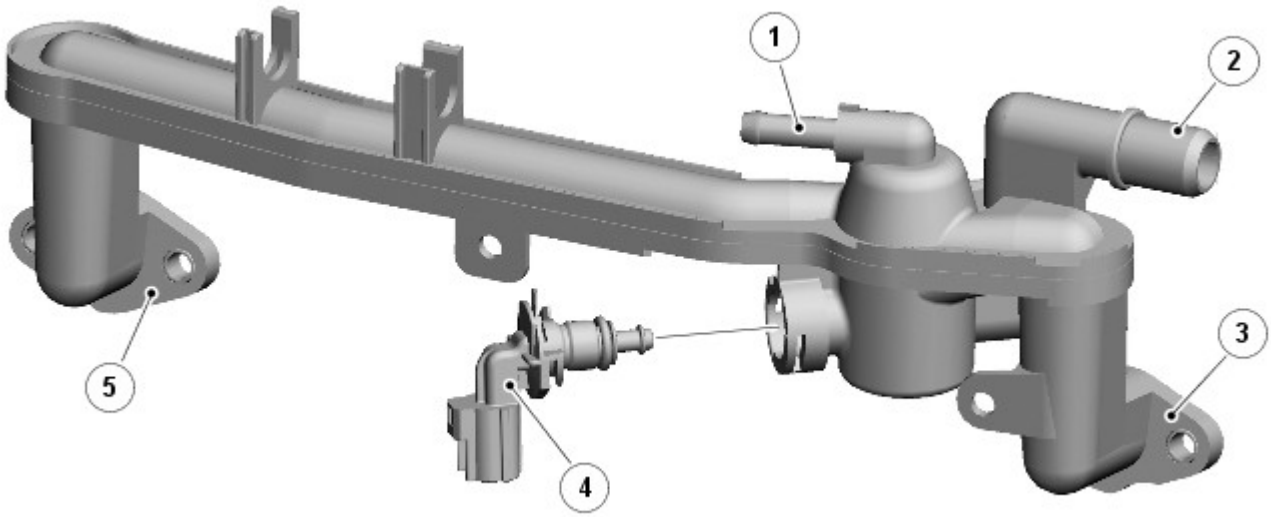
OUTLET TUBE



E152317

Item	Part Number	Description
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	-	Right cylinder head connection
4	-	Engine coolant temperature sensor
5	-	Left cylinder head connection

Engine Coolant

The coolant is silicate free and must not be mixed with conventional engine coolant.

OPERATION

Coolant Circuit Flow

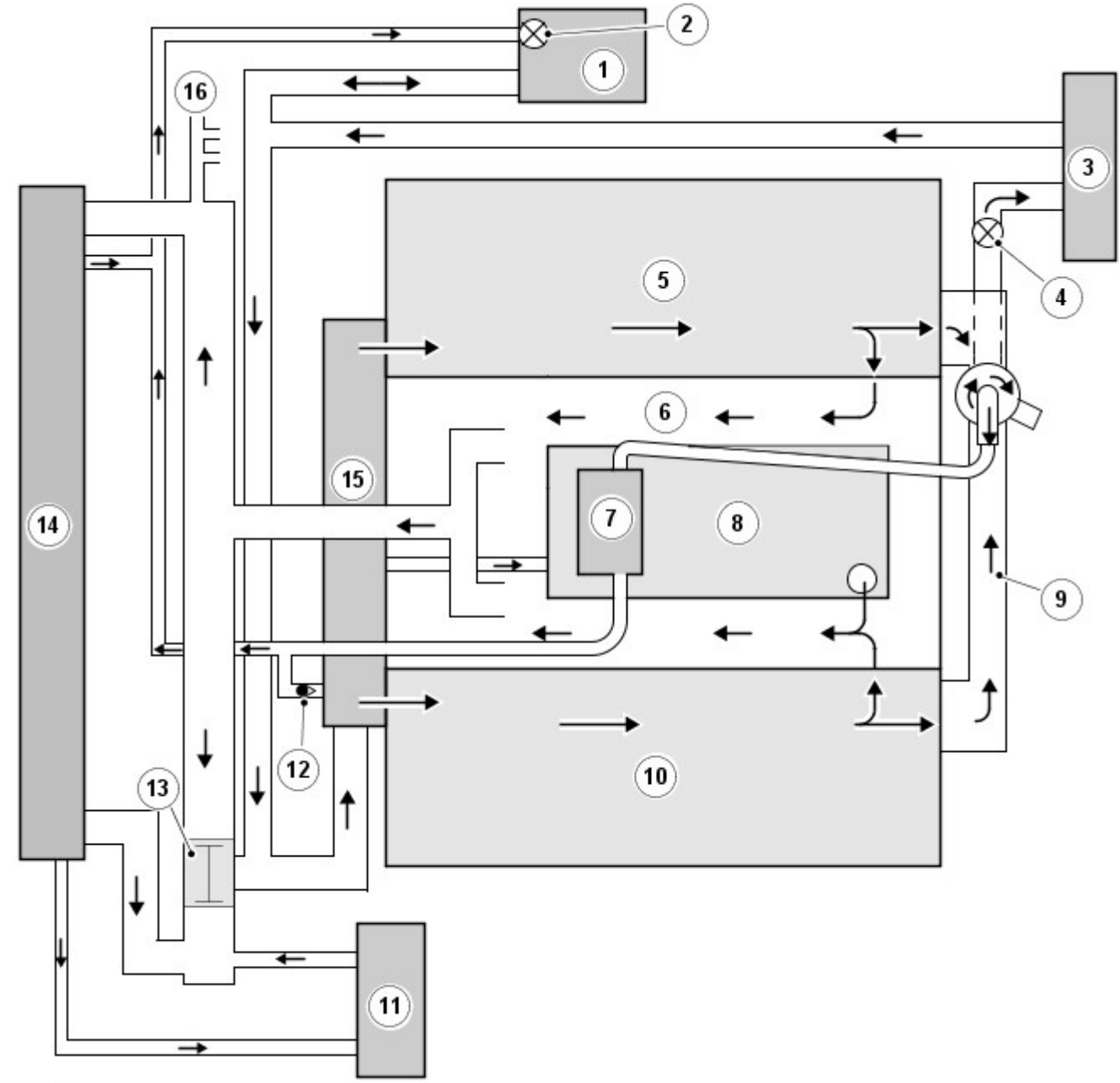
When the engine is running, the coolant is circulated around the engine cooling system by the coolant pump. From the coolant pump, coolant flows through the cylinder heads and the engine oil cooler into the cylinder block and the heater manifold.

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 electric throttle and the heater core, in parallel circuits that are unaffected by the position of the thermostat. From the electric throttle, the coolant merges with bleed coolant from the coolant pump and the outlet tube and flows to the expansion tank. From the heater core, 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.

Engine Cooling Flow Diagram



E145207

Item	Part Number	Description
1	-	Expansion tank
2	-	Bleed screw
3	-	Heater system
4	-	Bleed screw
5	-	Right cylinder head
6	-	Cylinder block
7	-	Throttle
8	-	Engine oil cooler
9	-	Heater manifold
10	-	Left cylinder head
11	-	Transmission fluid cooler
12	-	Check valve
13	-	Thermostat
14	-	Radiator
15	-	Coolant pump
16	-	Connections with SC cooling system

Thermostat

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).

Coolant Level Sensor

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 IC (Instrument Cluster) on the high speed CAN (Controller Area Network) Powertrain bus to display a warning message.
For additional information, refer to: Instrument Cluster (413-01 Instrument Cluster, Description and Operation).

Engine Cooling Fans

The ECM determines when to operate the cooling fans from the ECT (Engine Coolant Temperature) sensor input and a cooling fan request from the ATC (Automatic Temperature Control) module. The ECM also adjusts the fan speed to compensate for the ram effect of vehicle speed.

VISCOUS COOLING FAN

To control the viscous cooling fan, the ECM sends a PWM signal to the fan control module. The ECM varies the duty cycle of the PWM signal between 0 and 100% to vary the clutch engagement and thus fan speed. If the PWM signal is outside the 0 to 100% range, the fan control module interprets the signal as an open or short circuit and runs the fan at minimum speed to ensure the fan does not overspeed.

If the electrical connections to the viscous fan are disconnected the fan will idle and the engine may overheat. If ECM detects a cooling fan fault it stores the appropriate DTC (Diagnostic Trouble Code) and signals the IC on the high speed CAN Powertrain bus to display a warning message.

ELECTRIC COOLING FAN

The ECM varies the duty cycle of the PWM signal to the fan control module between 0 and 100% to operate the fan motor in one of four modes: Off, minimum speed (750 rev/min), linear variable speed between minimum and maximum speeds, and maximum speed (2820 rev/min). Under hot operating conditions, the electric cooling fan may continue to operate for up to five minutes after the engine has been switched off.

The fan control module monitors for over and under input voltage, a stalled motor and a partially stalled motor. If it detects any of these faults the fan control module temporarily pulls the PWM signal to ground to notify the fault to the ECM. The length of time the PWM signal is pulled to ground varies between 2 and 8 seconds, depending on the fault. The fan control module repeats the notification process at 5 second intervals until the fault is cleared. If there is more than one fault, only the highest priority fault is notified to the ECM. Fault priorities, in descending order, are over voltage, under voltage, stalled motor and partially stalled motor. The ECM records a related DTC for faults notified by the fan control module and signals the IC on the high speed CAN Powertrain bus to display a warning message.

The nominal operating voltage for the engine cooling fans is 9 to 16 volts. If the input voltage is outside of these limits, the fan control module stops operation of the cooling fan and notifies the ECM of the fault. After an under or over voltage occurs, cooling fan operation is resumed when the input voltage increases to 9.5 volts, or decreases to 15.5 volts, respectively.

To check for a stalled motor, each time it supplies power to start the fan motor the fan control module checks the fan motor speed after 2 seconds. If the speed is zero, the fan control module determines the fan motor is stalled and tries a restart. For a restart, the fan control motor disconnects the power from the fan motor then immediately reconnects it at an increased current level. The fan control module will try up to six restarts of a stalled motor, increasing the output current each time. If the fan motor remains stalled after the sixth restart, the fan control module waits 40 seconds then notifies the ECM of the fault and begins the start process again.

To check for a partially stalled motor, while the fan is running the fan control module monitors the current draw against fan speed. If the current draw is over the limit for more than 10 seconds, the fan control module disconnects the power from the fan motor and notifies the ECM of the fault. After 40 seconds, the fan control module starts the motor again.

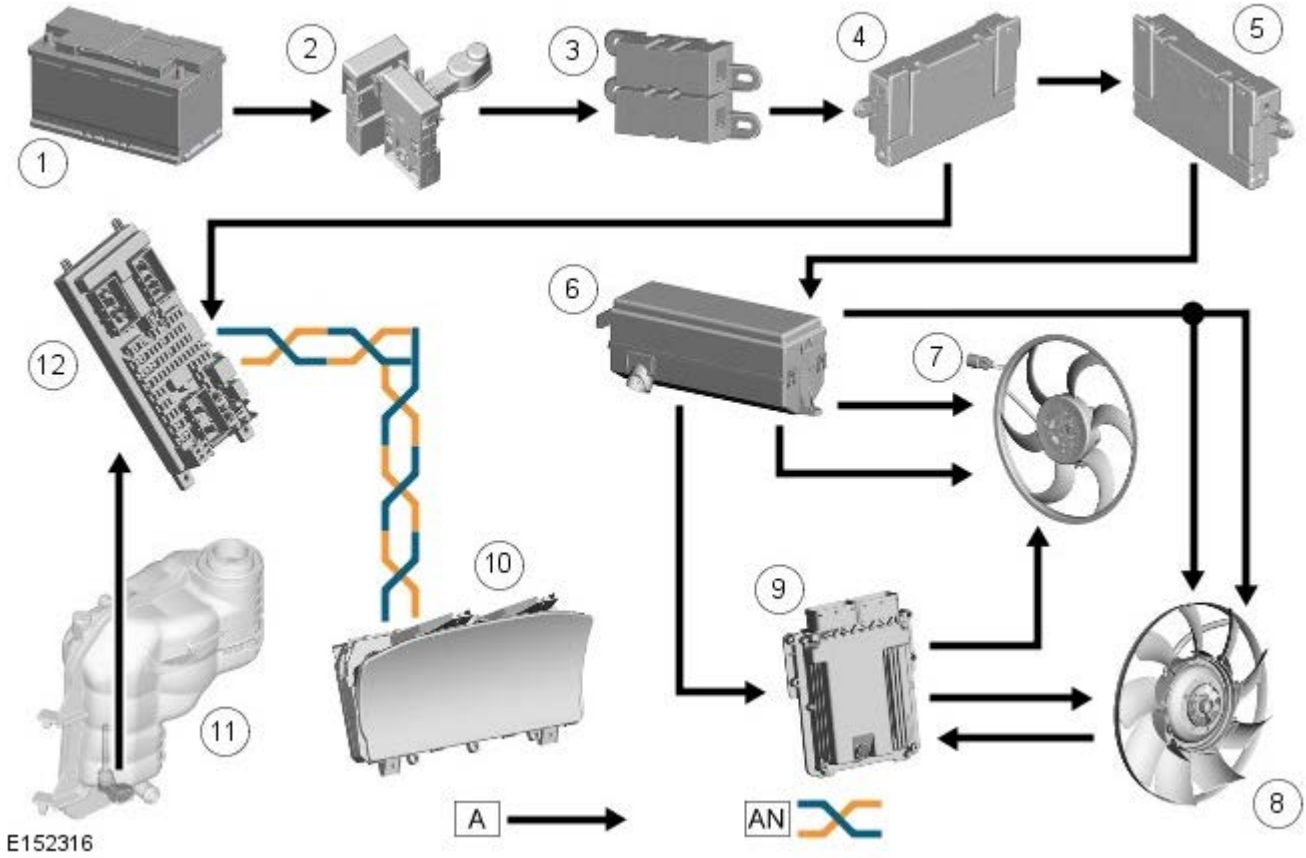
The fan control module incorporates a temperature sensor to prevent damage caused by excessive heat at high ambient temperatures. Operation of the fan control module is discontinued if the temperature reaches 135 °C (275 °F). Operation resumes when the temperature decreases to 120 °C (248 °F).

If a fault occurs with the ignition signal or the PWM signal, the fan control module adopts the following fan speeds:

Signal	Fault	Fan Speed	
		Ignition On	Ignition Off
PWM	Duty cycle implausible	Maximum	Off
PWM	Frequency out of range	Maximum	Off
PWM	Open circuit	Maximum	Off
PWM	Short circuit to battery	Maximum (provided cooling fan is not damaged)	Off
PWM	Short circuit to ground	Maximum (provided cooling fan is not damaged)	Off
Ignition	Open circuit	Off	Off
Ignition	Short circuit to battery	According to PWM duty cycle	Maximum
Ignition	Short circuit to ground	Off (ECM relay fuse may blow)	Off

Control Diagram

 NOTE: A = Hardwired, AN = High speed CAN (Controller Area Network) Powertrain bus.



Item	Part Number	Description
1	-	Battery
2	-	Megafuse
3	-	Battery Junction Box 2 (BJB2)
4	-	Battery Junction Box (BJB)
5	-	Auxiliary Junction Box (AJB)
6	-	Engine Junction Box (EJB)
7	-	Electric cooling fan
8	-	Viscous cooling fan
9	-	Engine Control Module (ECM)
10	-	Instrument Cluster (IC)
11	-	Coolant level sensor
12	-	Central Junction Box (CJB)

Published: 11-May-2011

Engine Cooling - 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 (303-03C Engine 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. Check the thermostat and rectify as necessary. Check the viscous fan operation, make sure the viscous fan rotates freely. Check for obstructions to the air flow over the radiator. Rectify as necessary.
Engine not reaching normal temperature	• Thermostat • Viscous fan • Thermostat • Electric fan • Fan speed module	Check the thermostat operation. Check the viscous fan operation, make sure the viscous fan is not seized. Rectify as necessary.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - V8 S/C 5.0L Petrol, DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation).

Published: 04-Aug-2012

Engine Cooling - V8 S/C 5.0L Petrol - Cooling System Draining, Filling and Bleeding

General Procedures

Draining

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.

NOTE: This procedure only needs to be carried out when the coolant system vacuum filler equipment is not available in the workshop.

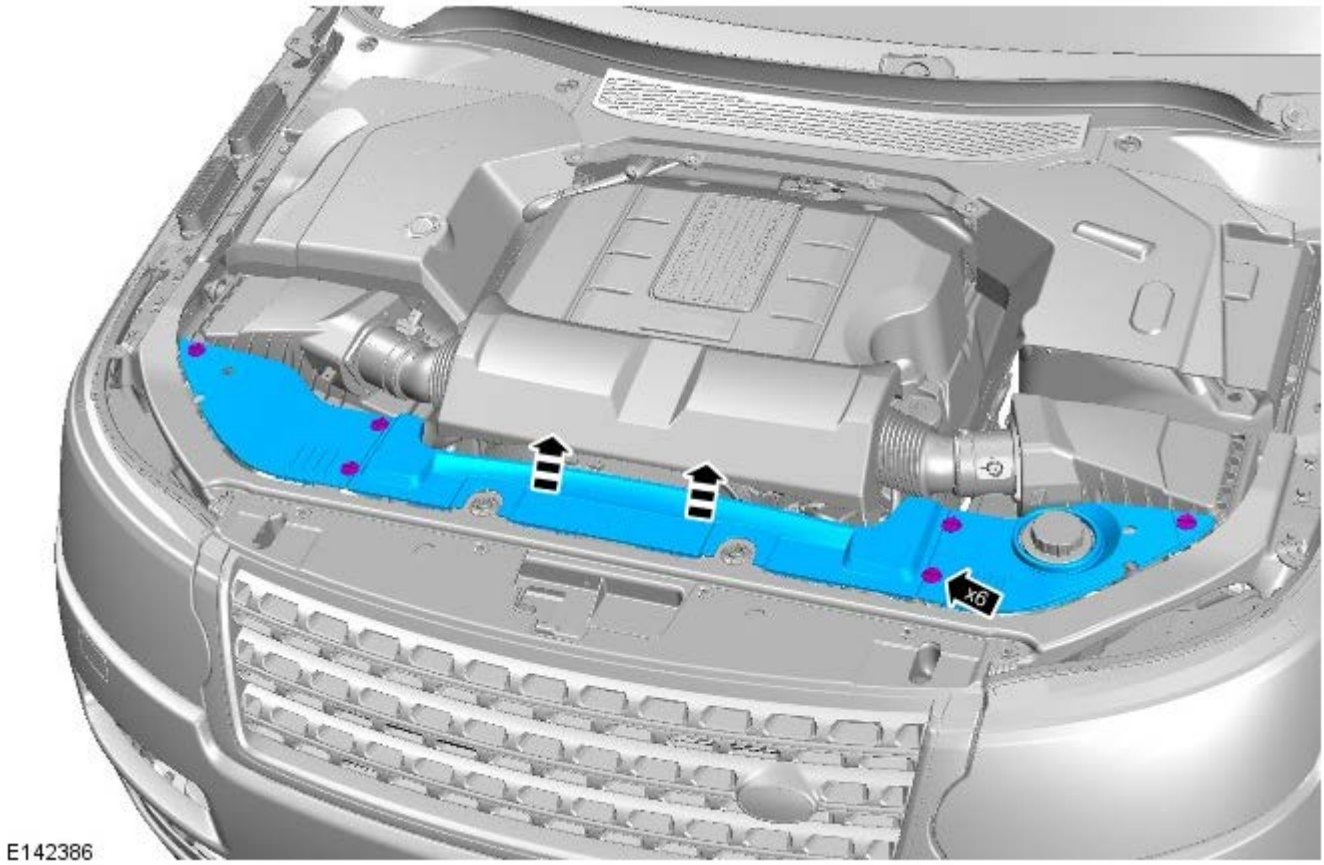
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

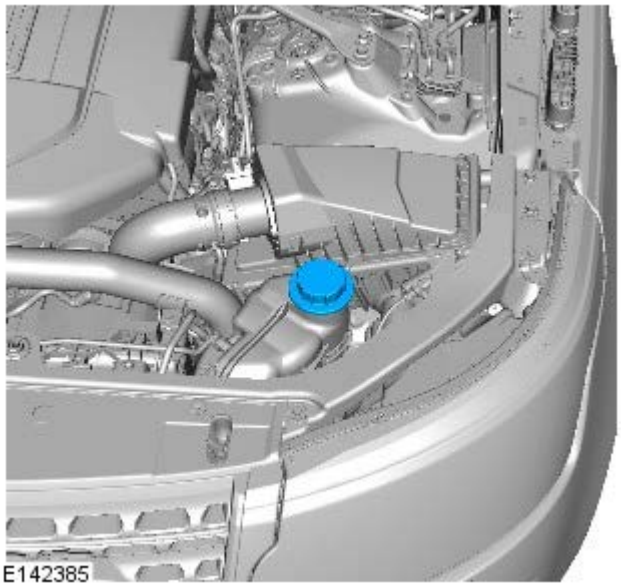
2. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

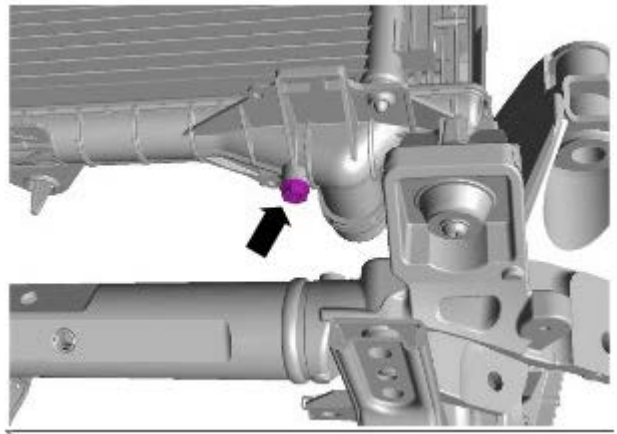
3. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).

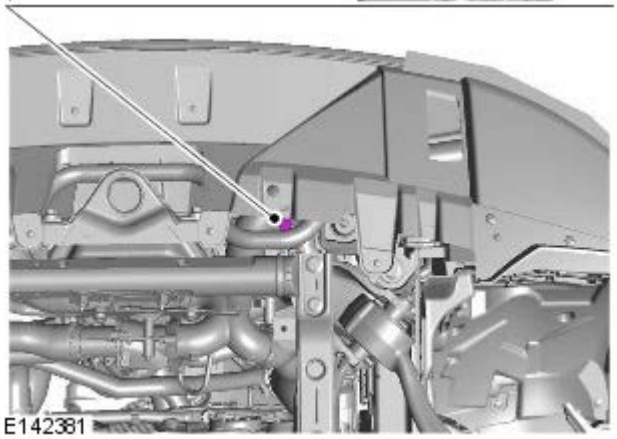
4.



5. WARNING: When releasing the cooling system pressure, cover the coolant expansion tank cap with a thick cloth.

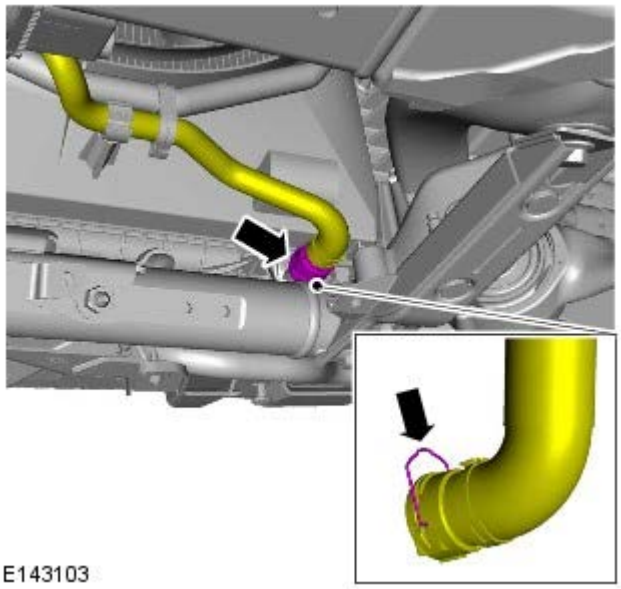

E142385




E142381

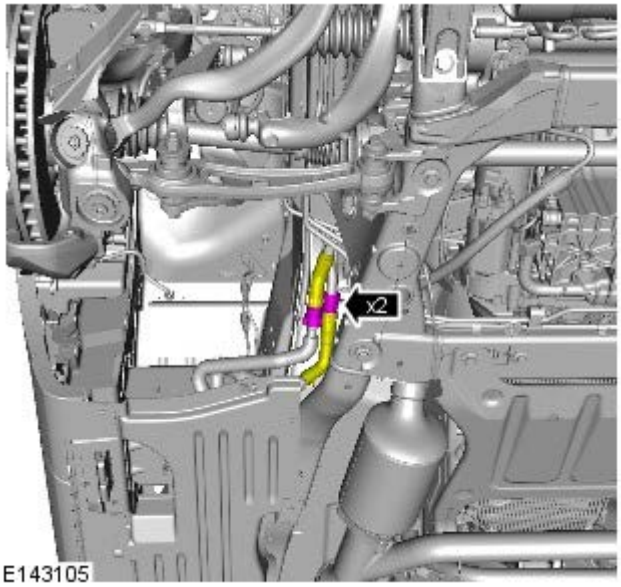
6. CAUTION: Be prepared to collect escaping coolant.

7. CAUTION: Be prepared to collect escaping coolant.


E143103

NOTE: Step 8-11 and 16-17 only needs to be carried out when auxiliary climate control system has been fitted to the vehicle.

8. Refer to: Fender Splash Shield (501-02 Front End Body Panels, Removal and Installation).

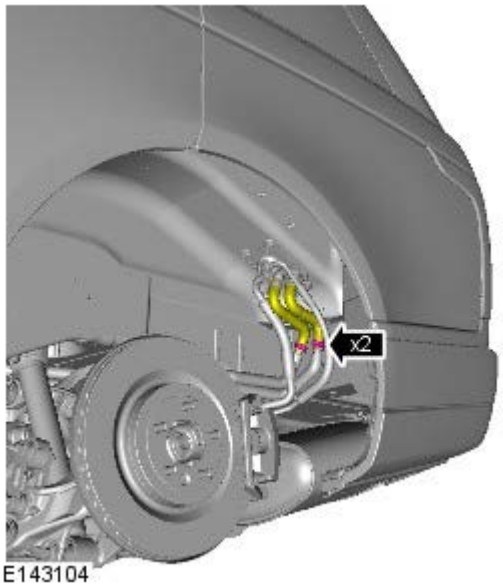


E143105

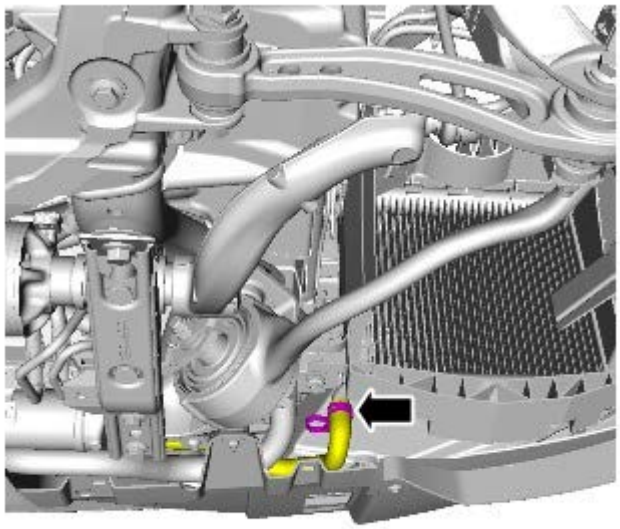
9. CAUTION: Be prepared to collect escaping coolant.

10. Refer to: Rear Fender Splash Shield (501-08 Exterior Trim and Ornamentation, Removal and Installation).

11. CAUTION: Be prepared to collect escaping coolant.



E143104



E143109

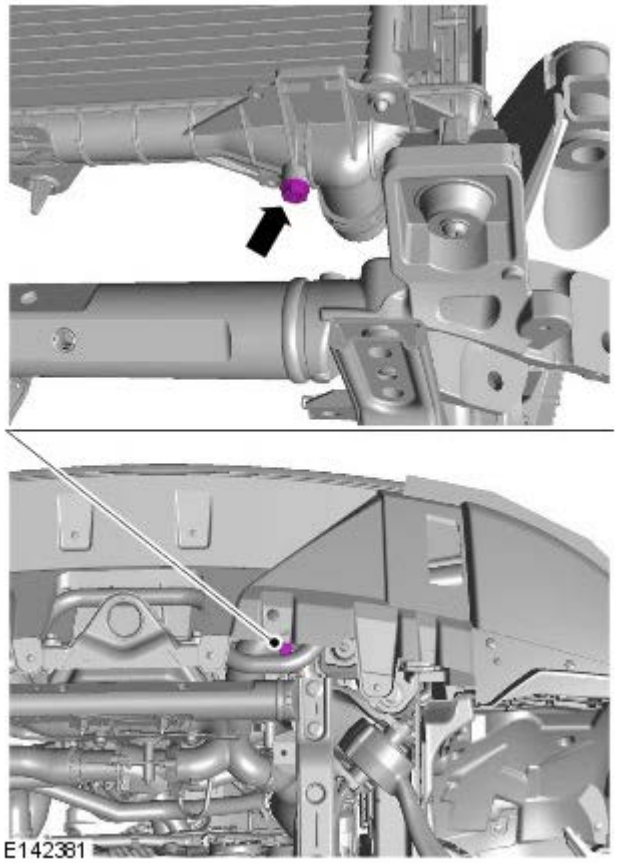
12. CAUTIONS:

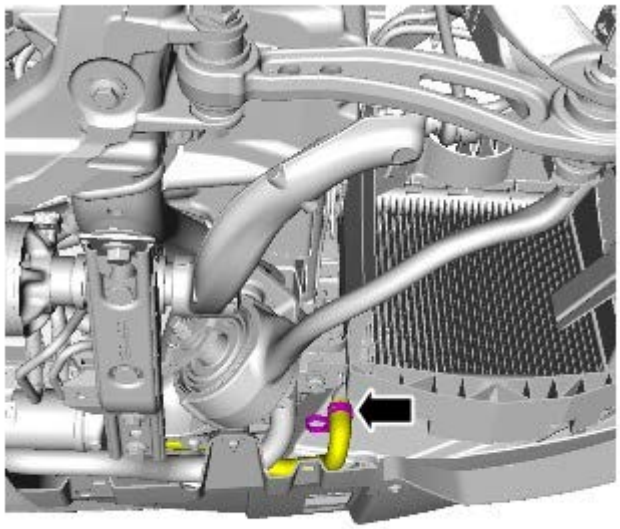
Be prepared to collect escaping coolant.

RH illustration shown, LH is similar.

NOTE: The procedure must be carried out on both sides.

13. *Torque:* 5 Nm

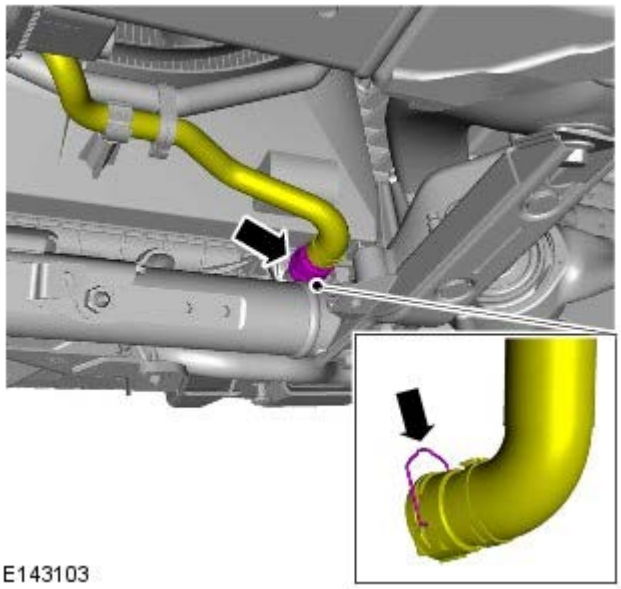

E142381


E143109

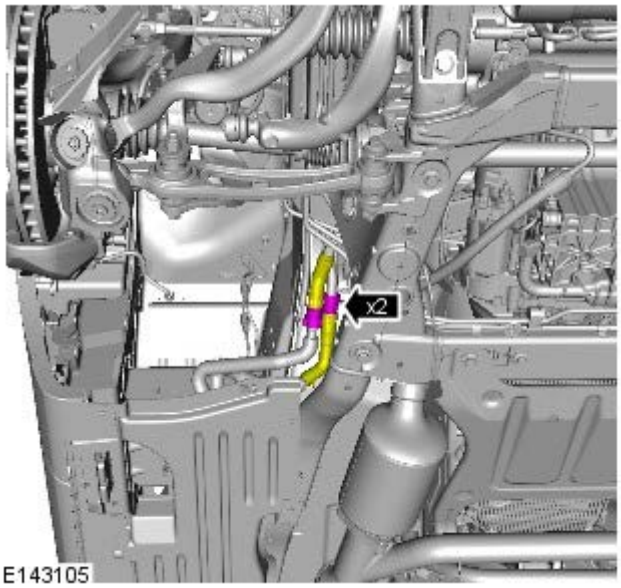
14. CAUTION: RH illustration shown, LH is similar.

NOTE: The procedure must be carried out on both sides.

15.

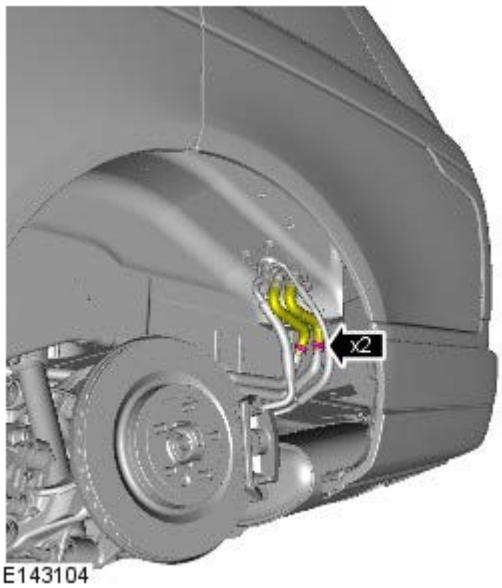

E143103

16.



E143105

17.

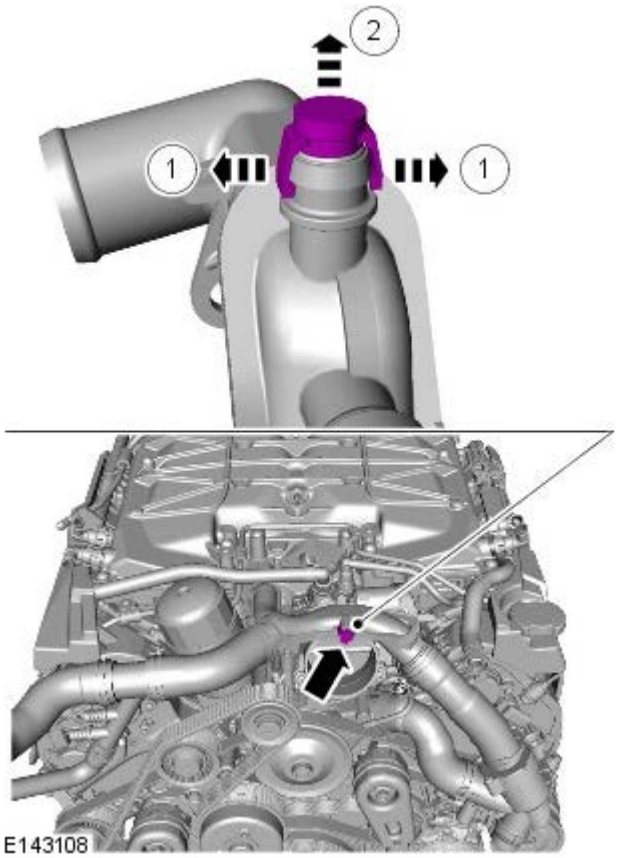


E143104

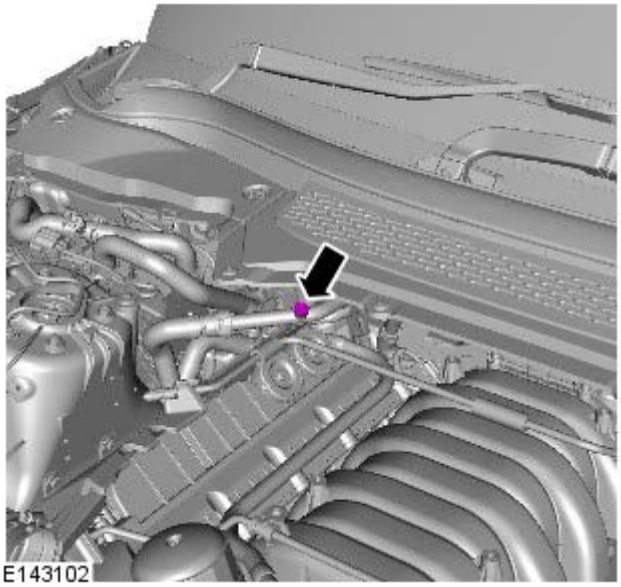
18. Carry out the procedure up to step 1 in the filling section three times, filling the cooling system with clean water at the first two drains. At the third refill, use a suitable measuring tool to make sure that the cooling system maintains a 50% mix.

Filling

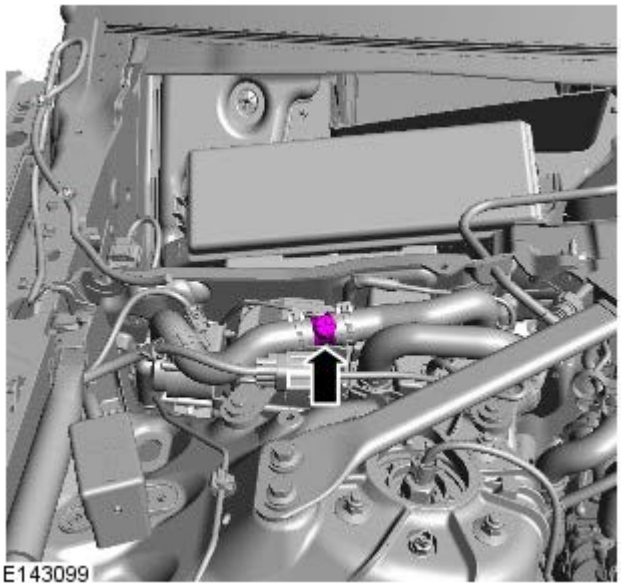
1.



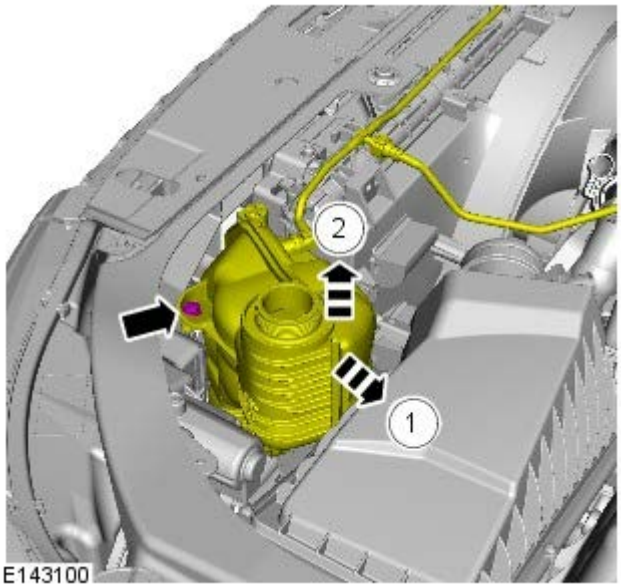
2.



3. NOTE: Where fitted.

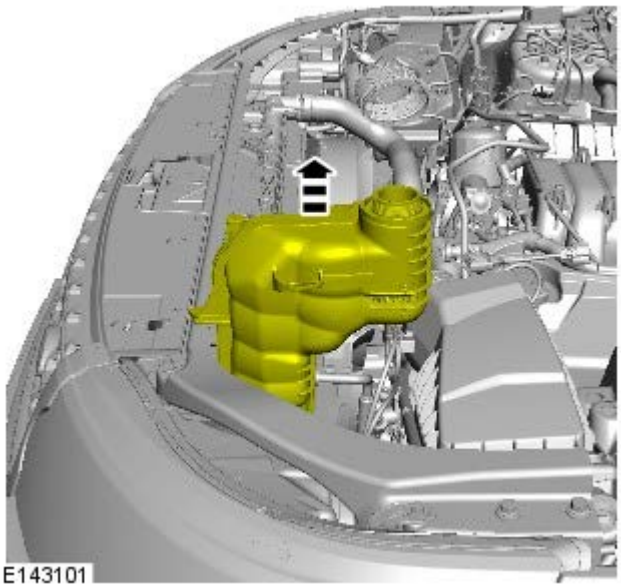


4. *Torque:* 9 Nm

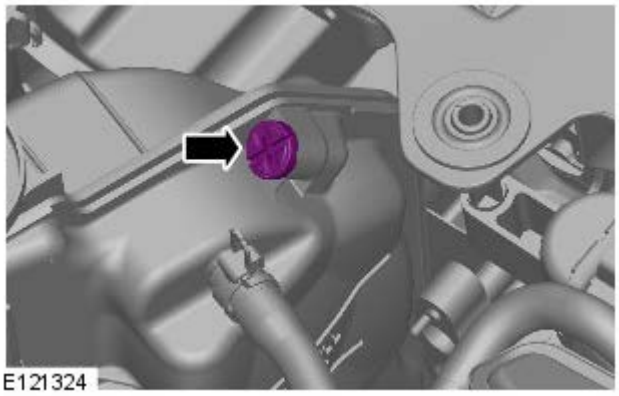


5. NOTE: Keep the coolant expansion tank vertically.

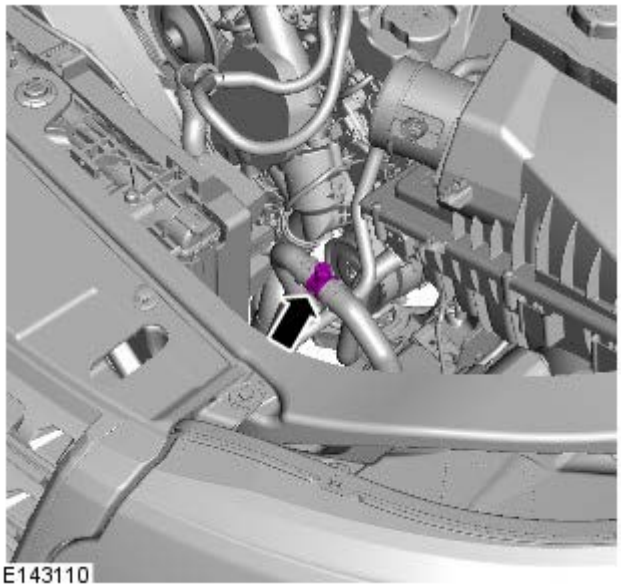
   Raise the coolant expansion tank minimum 110mm from its original position.



6.



7.

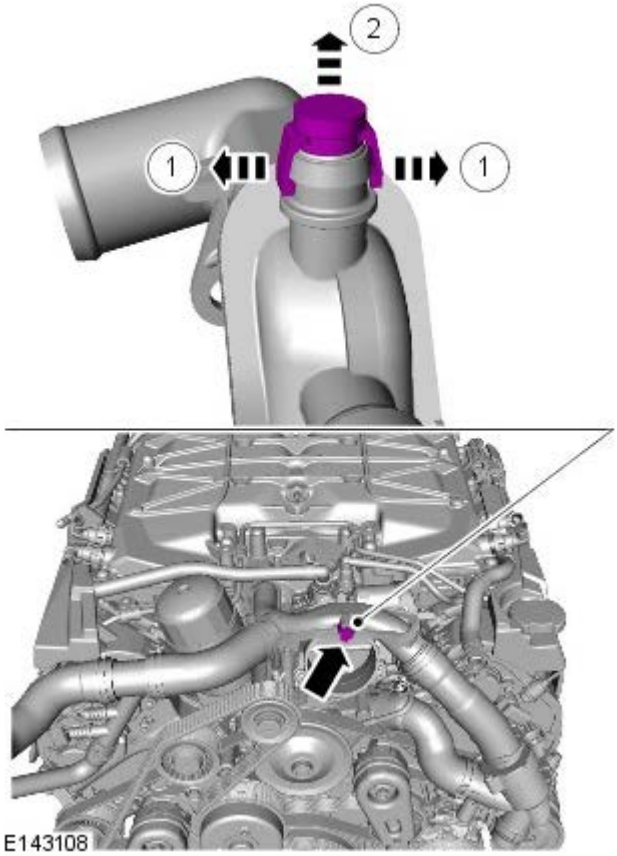


8. CAUTION: Anti-freeze concentration must be maintained at 50%.

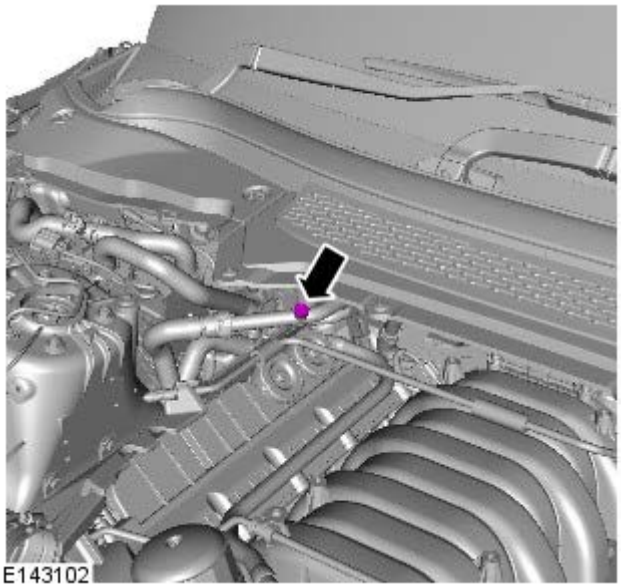
   Fill the coolant expansion tank to the rim and continue until coolant is visable from the outlet.

NOTE: Once coolant is visable from the outlet, close the bleeding points.

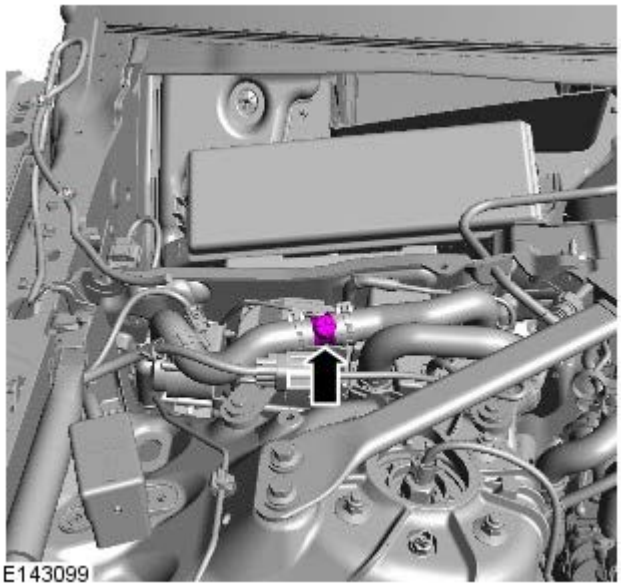
9.



10.

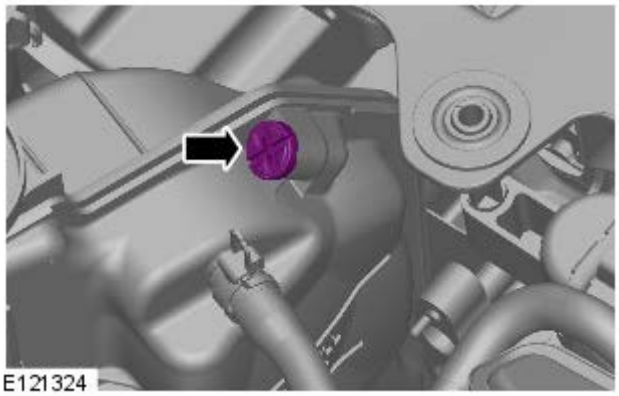


11. NOTE: Where fitted.


E143099

12. Continue to fill the coolant expansion tank to the rim until the coolant level stops dropping.

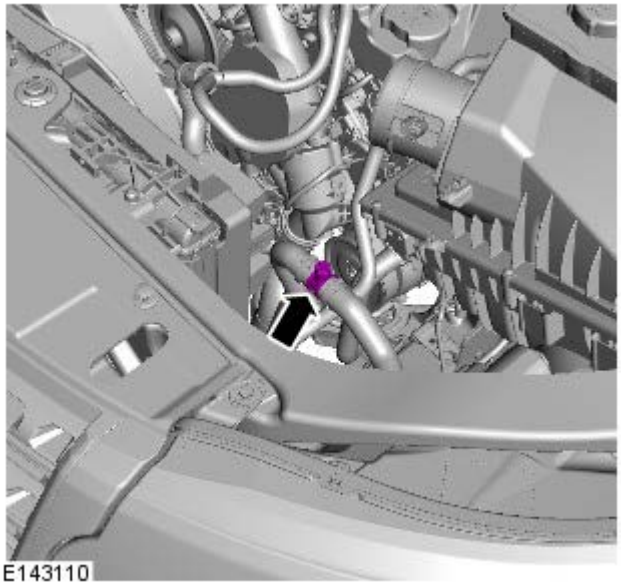
13.


E121324

14. Set the heater controls to maximum.

15. Start and run the engine.

16. Once coolant is visable from the outlet, close the bleeding points.


E143110

17. Continue to fill the coolant expansion tank to the rim until the coolant level stops dropping.

18.

- Switch the engine off.
- Wait a minimum of 1 minute.

19.
- Start and run the engine.
- Hold the engine speed at 2000 RPM until the coolant level stops dropping.

20. Increase the engine speed from idle to 3500 RPM until hot air is emitted from the front and rear face vents.

21. Install the expansion tank cap after making sure that the final coolant level is 40mm above the maximum cold fill line.

22. Run the engine until the thermostat opens and hot air is emitted from the front and rear face vents.

23. Switch the engine off and allow to cool.

24. Install the coolant expansion tank.

25. WARNINGS:

When releasing the cooling system pressure, cover the coolant expansion tank cap with a thick cloth.

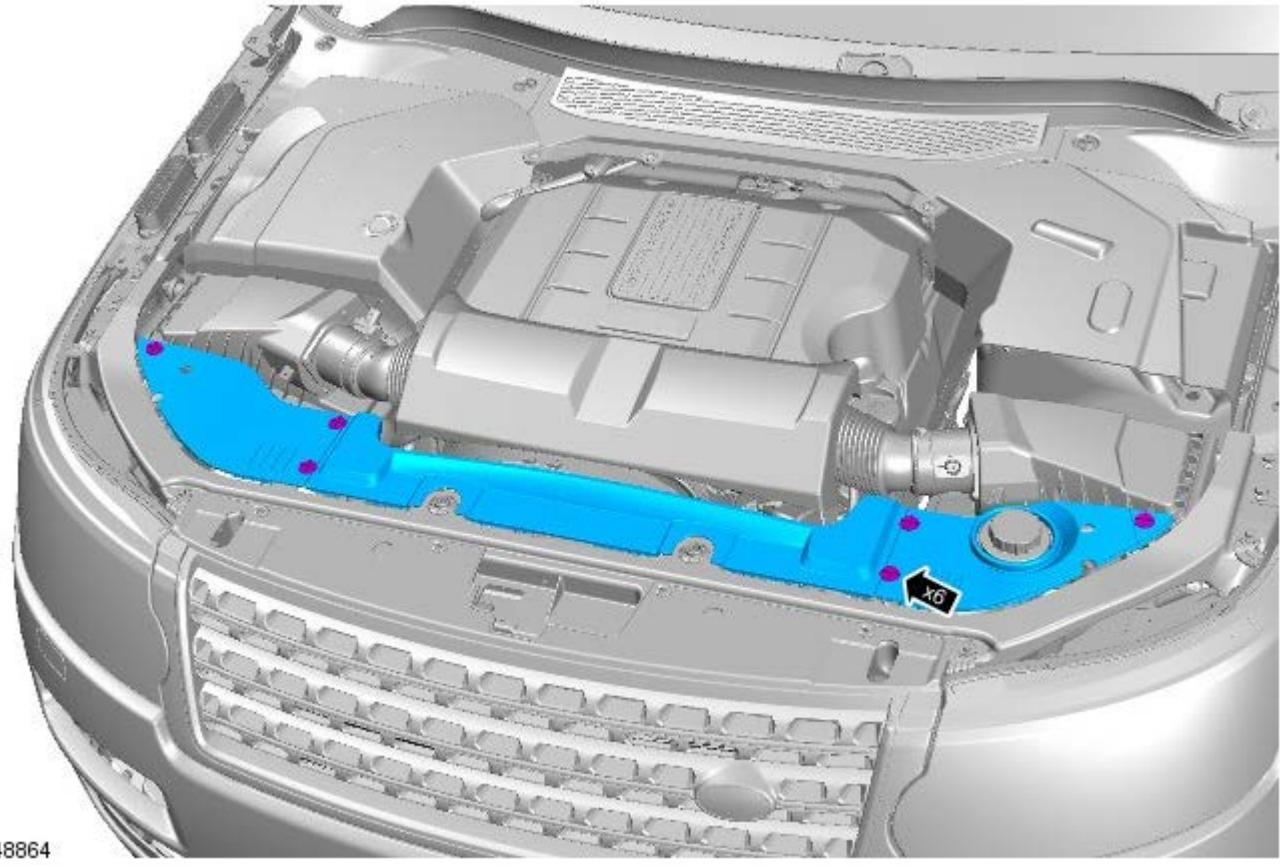
Since injury such as scalding could be caused by escaping steam or coolant, make sure the vehicle cooling system is cool prior to carrying out this procedure.

CAUTION: Make sure the coolant level remains above the "COLD FILL RANGE" lower level mark.

Check and top-up the coolant if required.

26. Visually check the engine and cooling system for signs of coolant leakage.

27.



28. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and

Installation).

29. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

Published: 06-Aug-2012

Engine Cooling - V8 S/C 5.0L Petrol - Cooling System Partial Draining, Filling and Bleeding V8 S/C 5.0L Petrol

General Procedures

Draining

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.

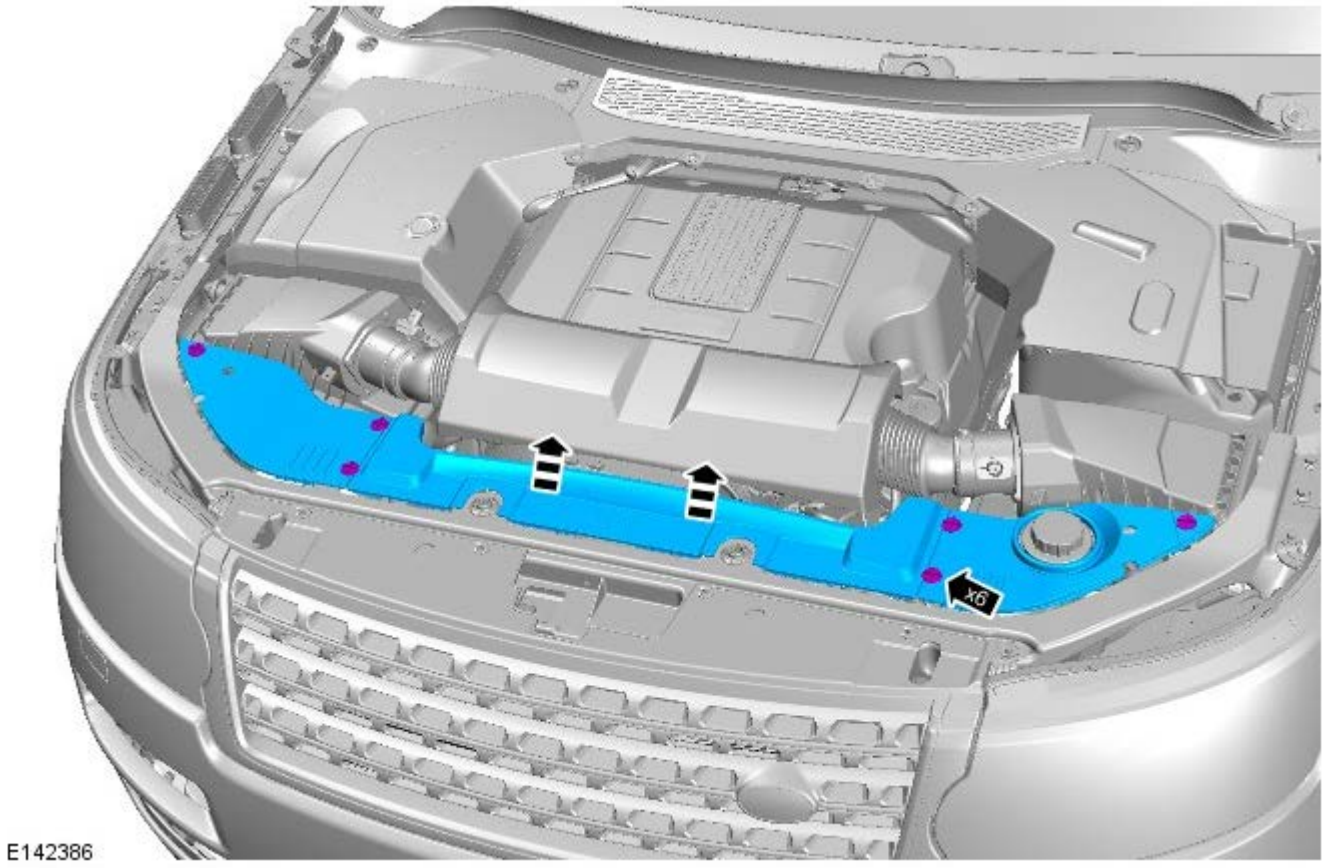
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

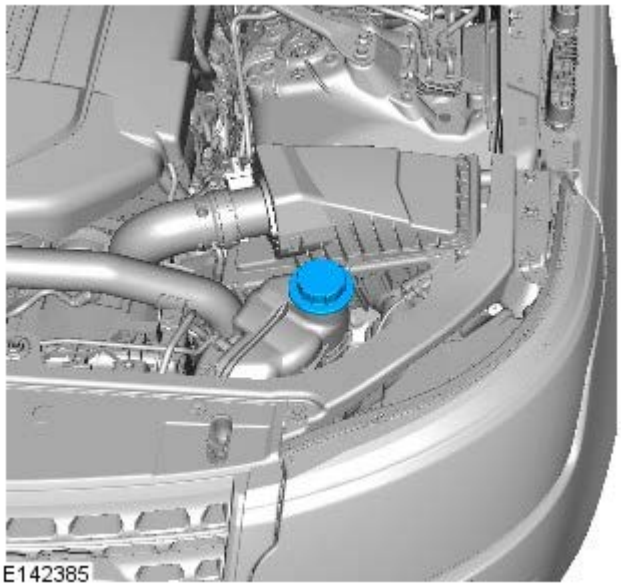
2. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).

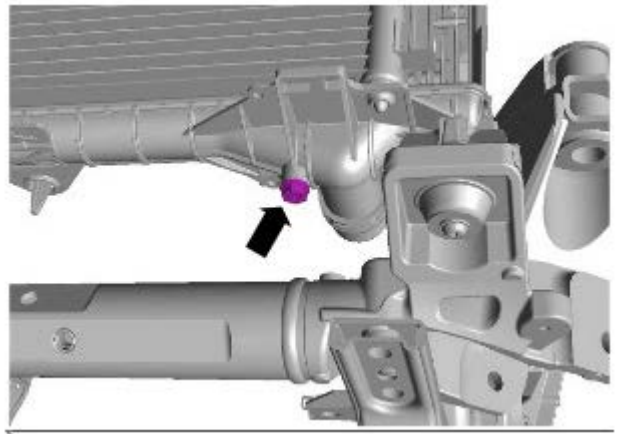
3. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

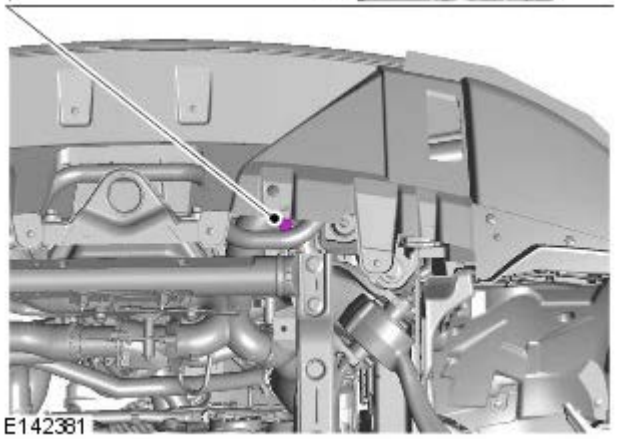
4.



5. WARNING: When releasing the cooling system pressure, cover the coolant expansion tank cap with a thick cloth.

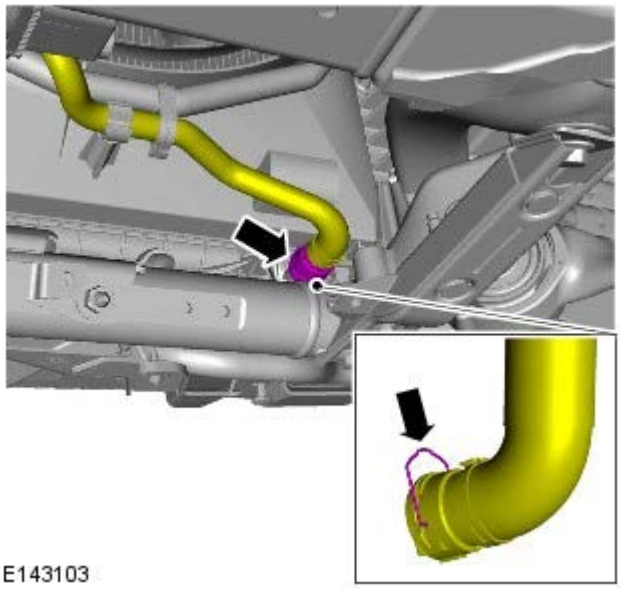

E142385



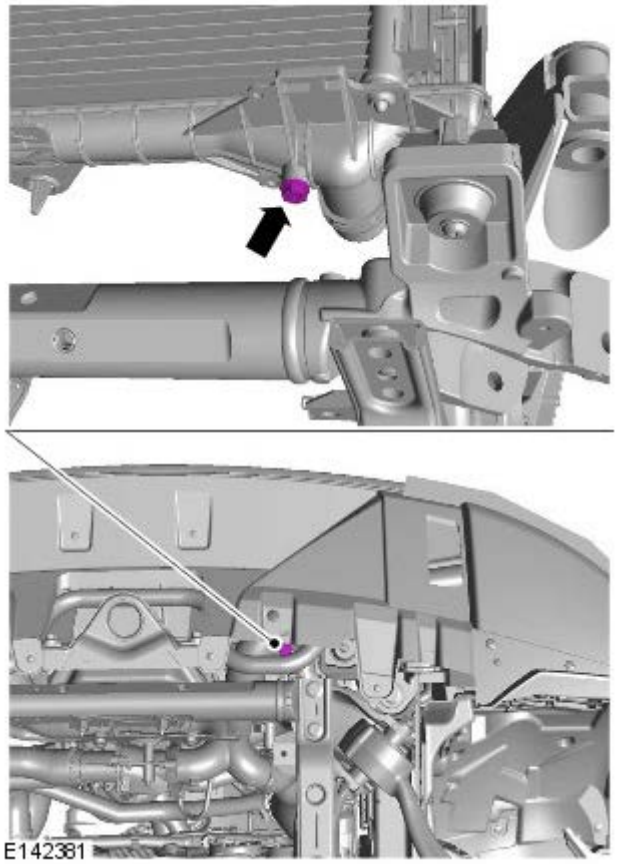

E142381

6. CAUTION: Be prepared to collect escaping coolant.

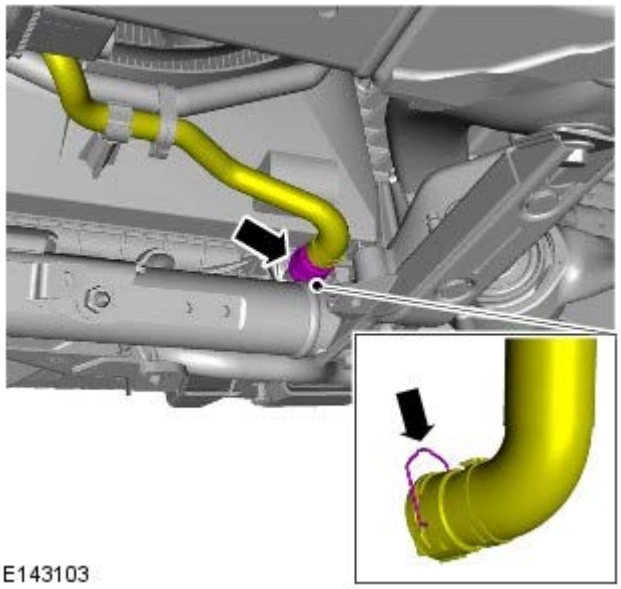
7. CAUTION: Be prepared to collect escaping coolant.


E143103

8. *Torque:* 5 Nm

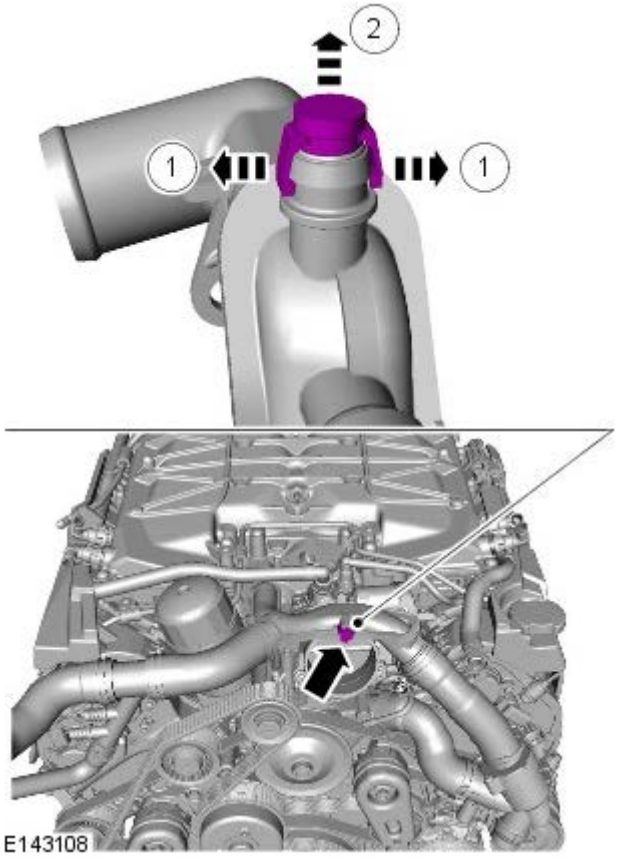

E142381

9.


E143103

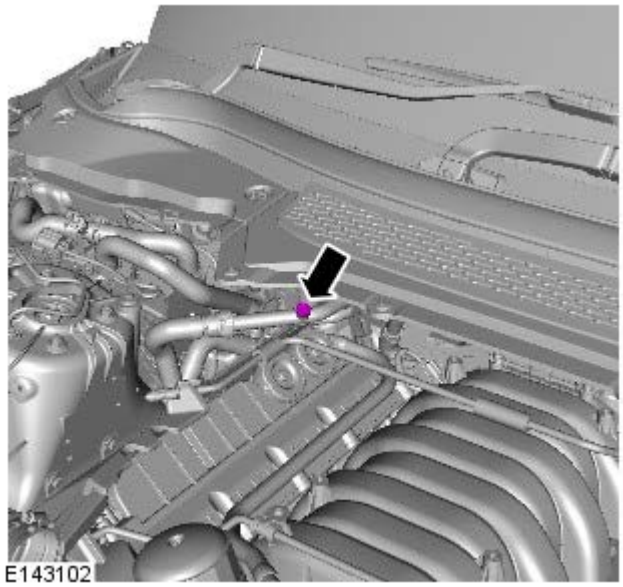
Filling

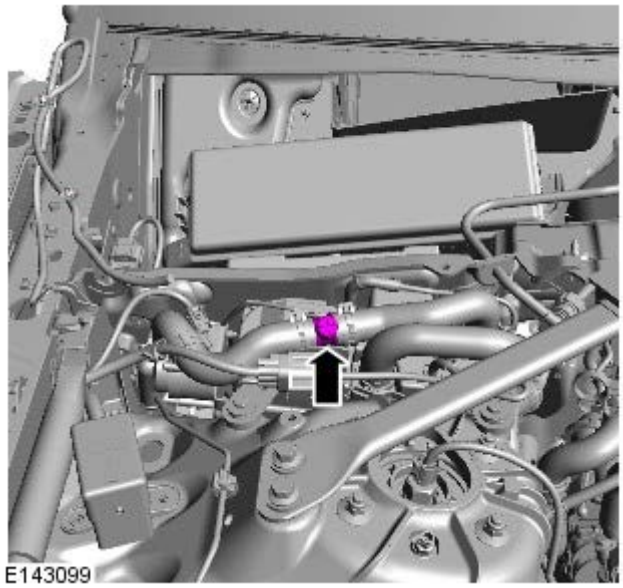
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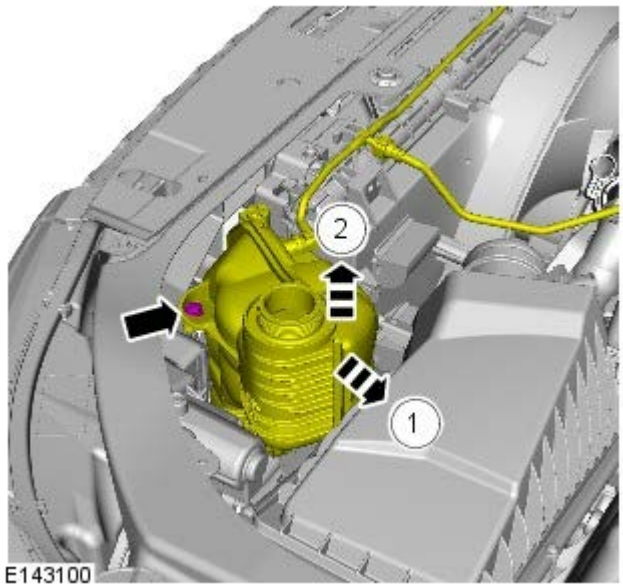


E143108

2.





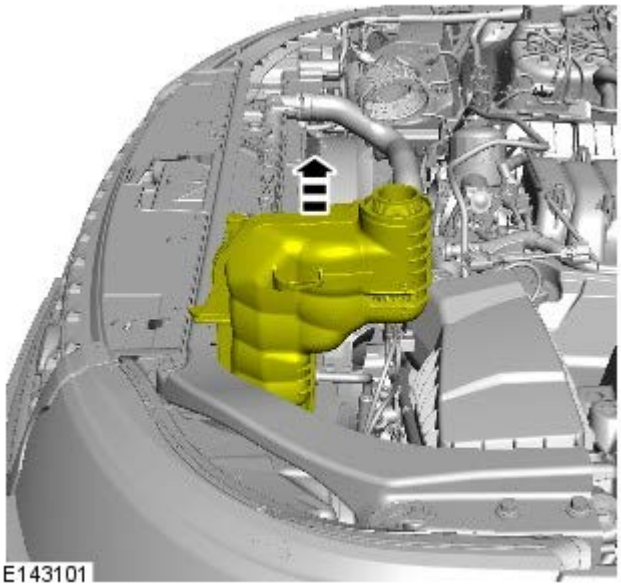


3. NOTE: Where fitted.

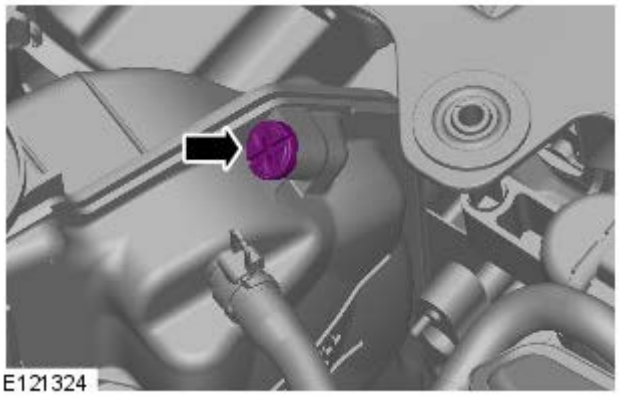
4. *Torque:* 9 Nm

5. NOTE: Keep the coolant expansion tank vertically.

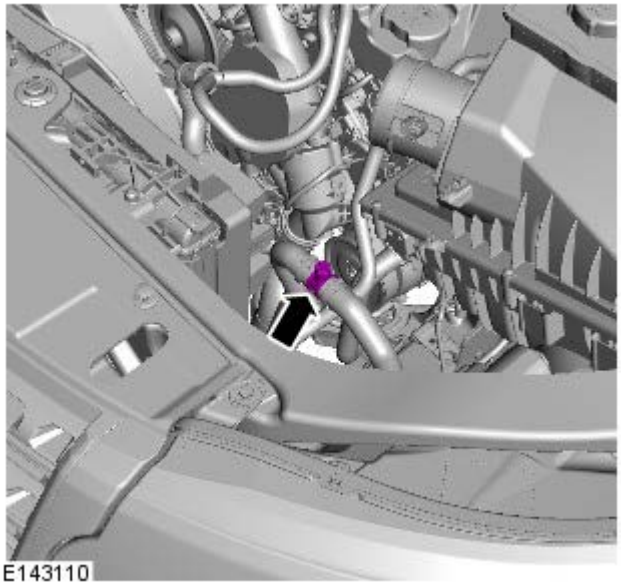
   Raise the coolant expansion tank minimum 110mm from its original position.



6.



7.

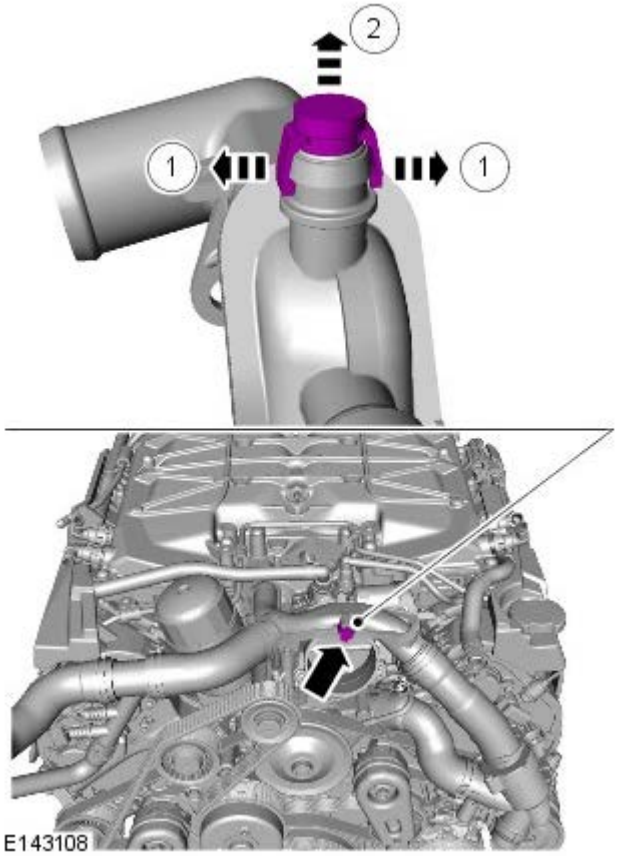


8. CAUTION: Anti-freeze concentration must be maintained at 50%.

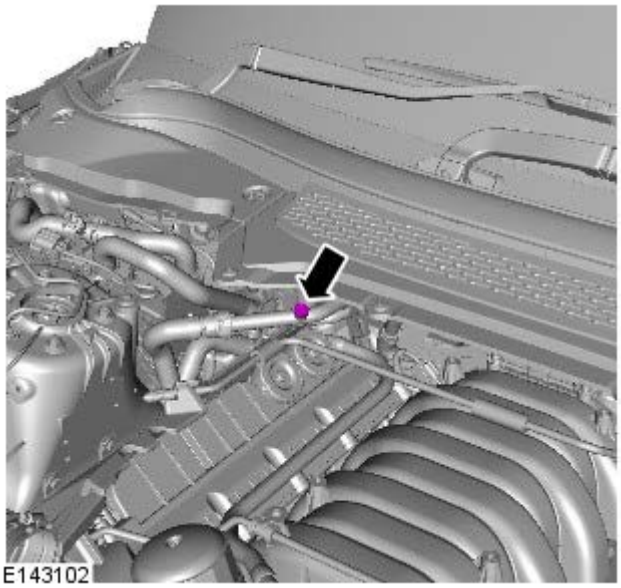
   Fill the coolant expansion tank to the rim and continue until coolant is visable from the outlet.

NOTE: Once coolant is visable from the outlet, close the bleeding points.

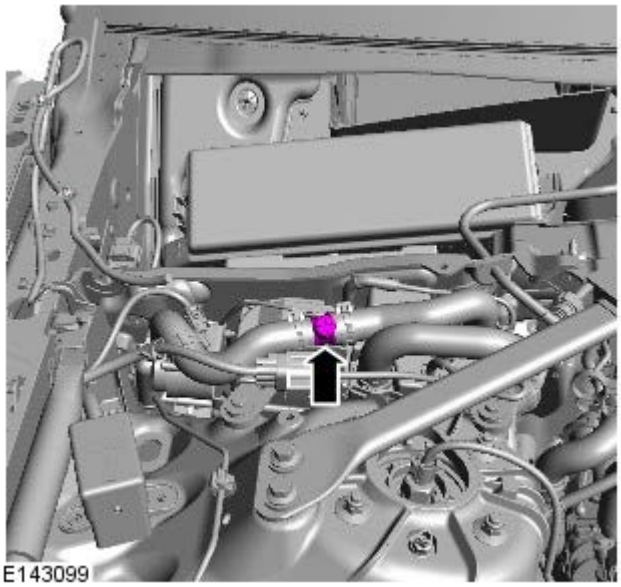
9.



10.

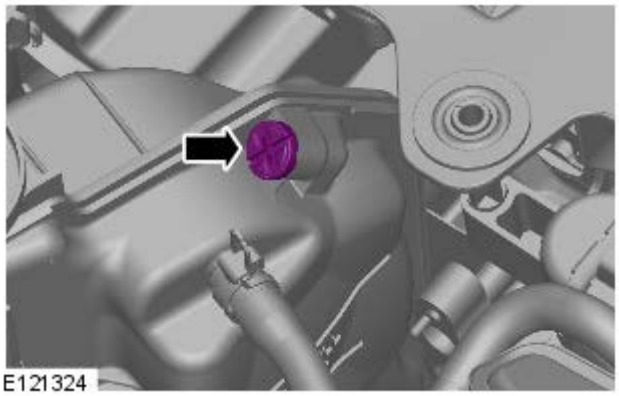


11. NOTE: Where fitted.


E143099

12. Continue to fill the coolant expansion tank to the rim until the coolant level stops dropping.

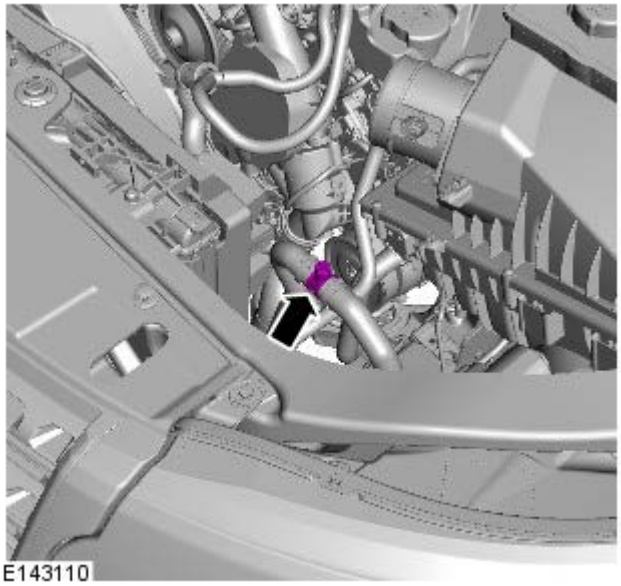
13.


E121324

14. Set the heater controls to maximum.

15. Start and run the engine.

16. Once coolant is visable from the outlet, close the bleeding points.


E143110

17. Continue to fill the coolant expansion tank to the rim until the coolant level stops dropping.

18.

- Switch the engine off.
- Wait a minimum of 1 minute.

19.
- Start and run the engine.
- Hold the engine speed at 2000 RPM until the coolant level stops dropping.

20. Increase the engine speed from idle to 3500 RPM until hot air is emitted from the front and rear face vents.

21. Install the expansion tank cap after making sure that the final coolant level is 40mm above the maximum cold fill line.

22. Run the engine until the thermostat opens and hot air is emitted from the front and rear face vents.

23. Switch the engine off and allow to cool.

24. Install the coolant expansion tank.

25. WARNINGS:

When releasing the cooling system pressure, cover the coolant expansion tank cap with a thick cloth.

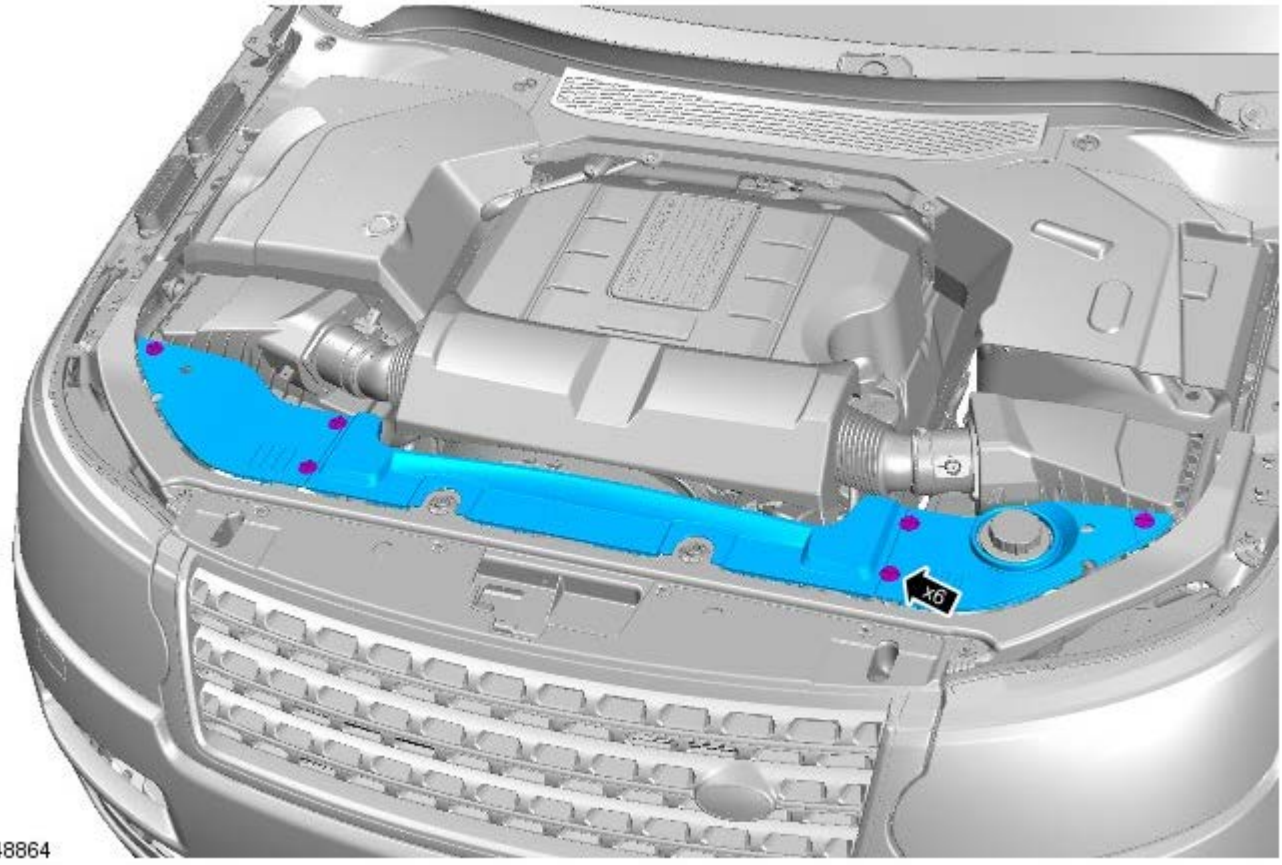
Since injury such as scalding could be caused by escaping steam or coolant, make sure the vehicle cooling system is cool prior to carrying out this procedure.

CAUTION: Make sure the coolant level remains above the "COLD FILL RANGE" lower level mark.

Check and top-up the coolant if required.

26. Visually check the engine and cooling system for signs of coolant leakage.

27.



28. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and

Installation).

29. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

Published: 30-Sep-2013

Engine Cooling - V8 S/C 5.0L Petrol - Cooling System Draining and Vacuum Filling

General Procedures

Draining

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.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

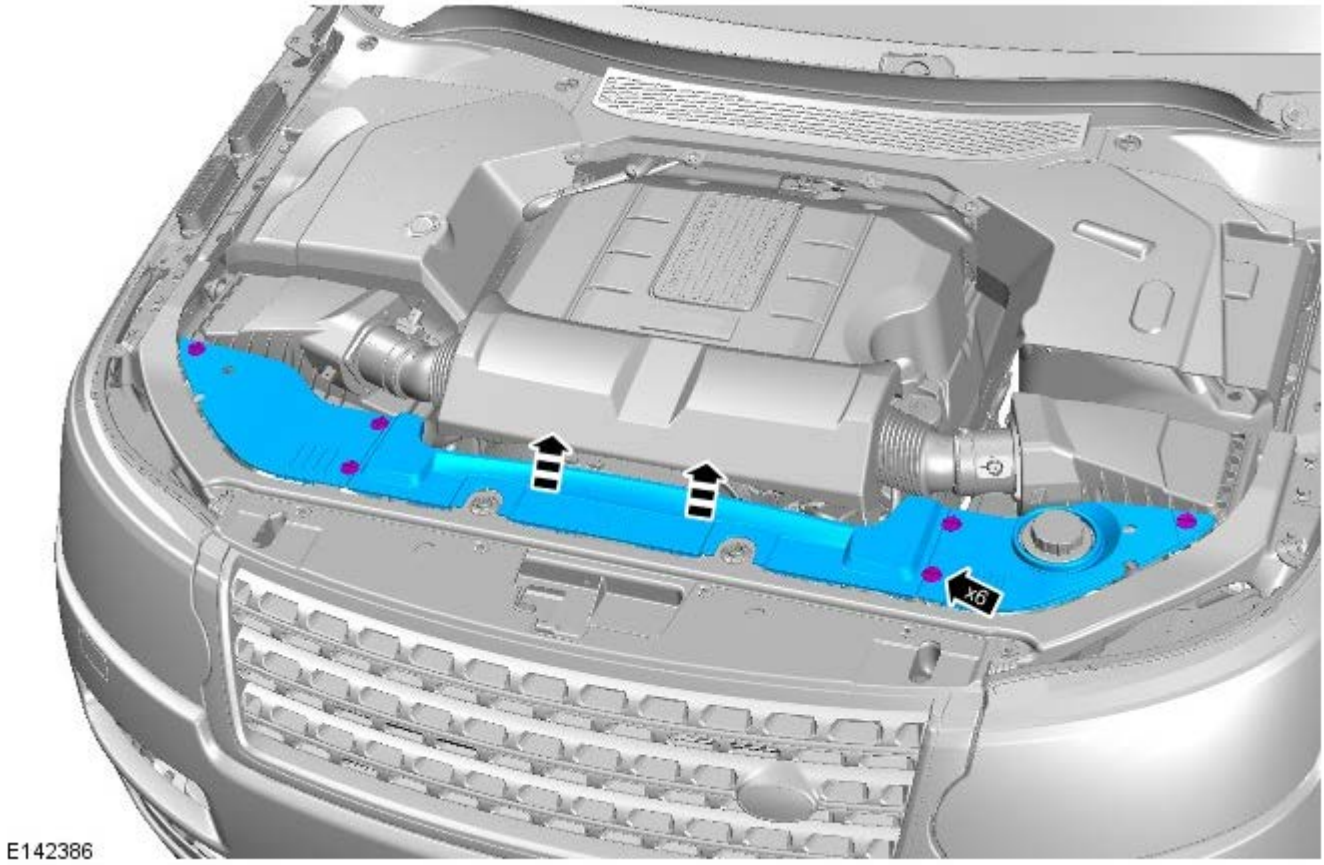
2. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).

3. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

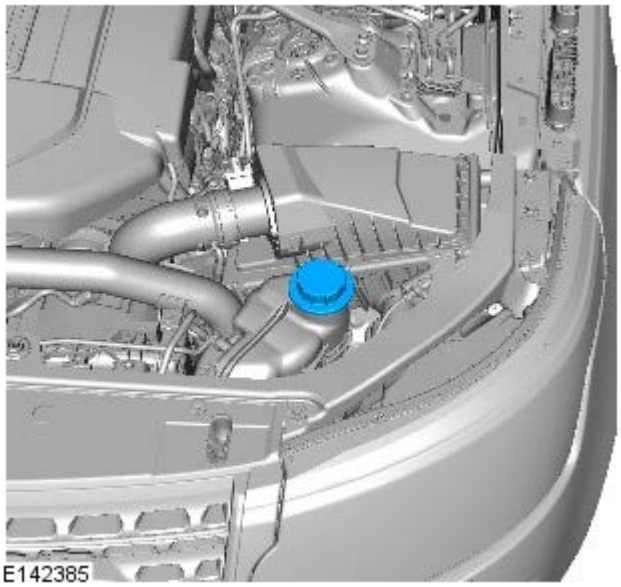
4. Refer to: Fender Splash Shield (501-02 Front End Body Panels, Removal and Installation).

5. Refer to: Rear Fender Splash Shield (501-08 Exterior Trim and Ornamentation, Removal and Installation).

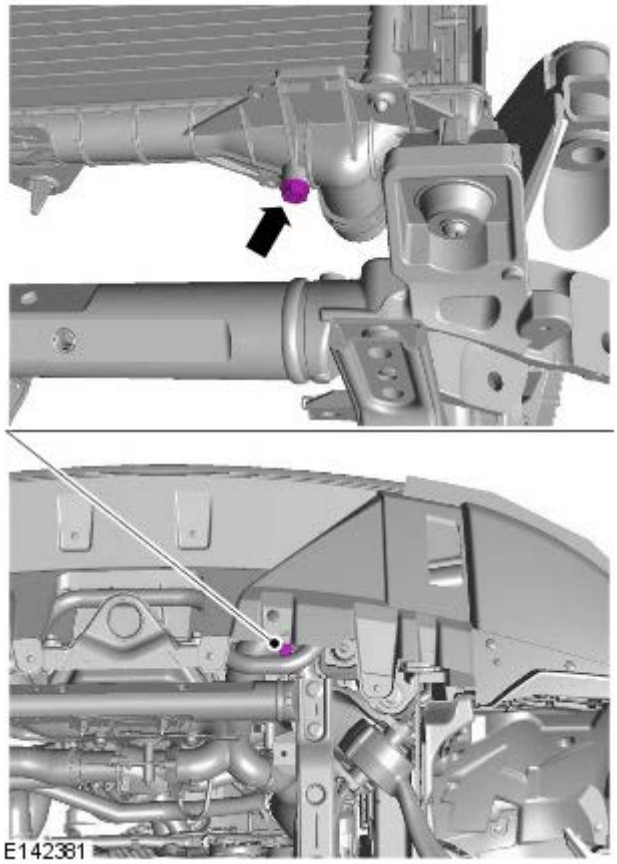
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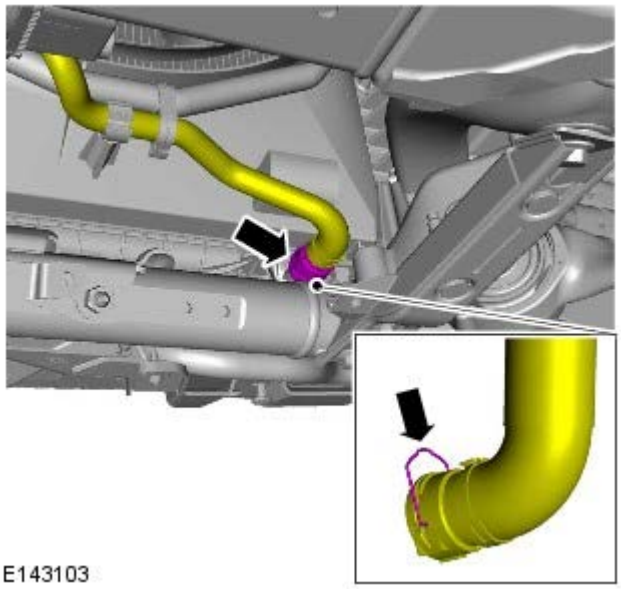
7.


E142385

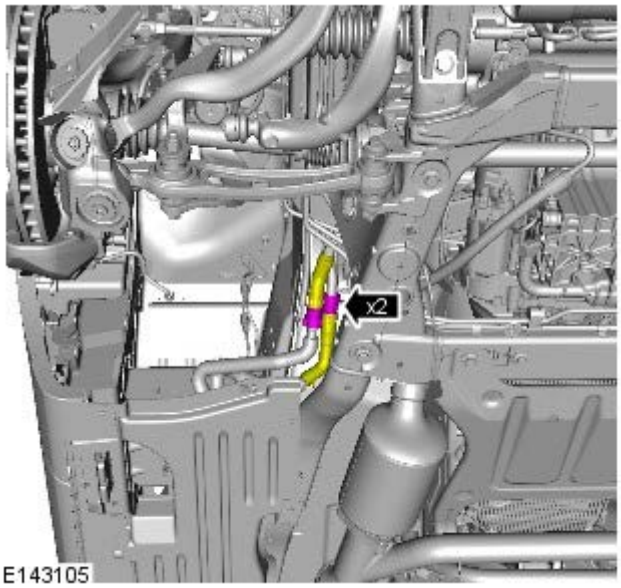
8.


E142381

9. CAUTION: Be prepared to collect escaping coolant.

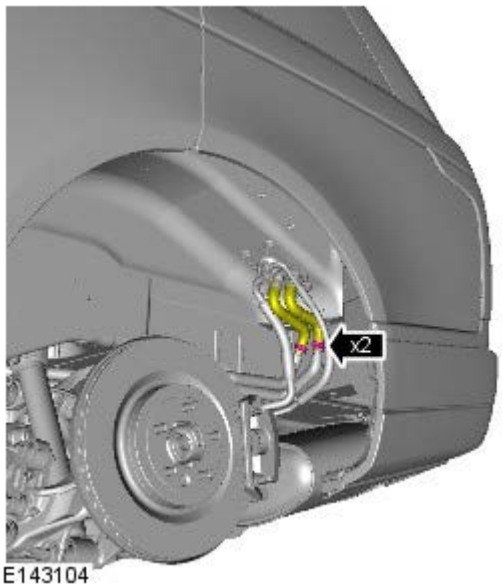


E143103



E143105

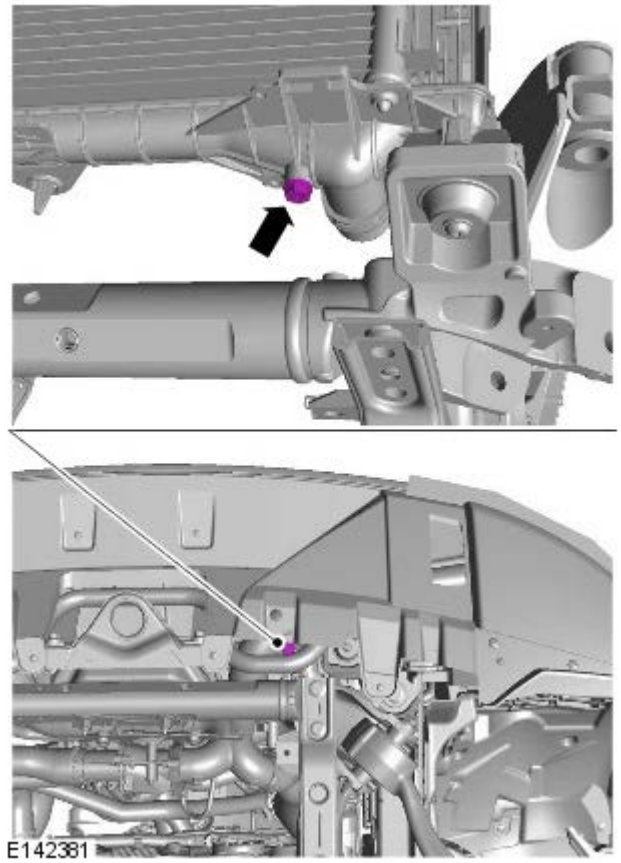
10. CAUTION: Be prepared to collect escaping coolant.



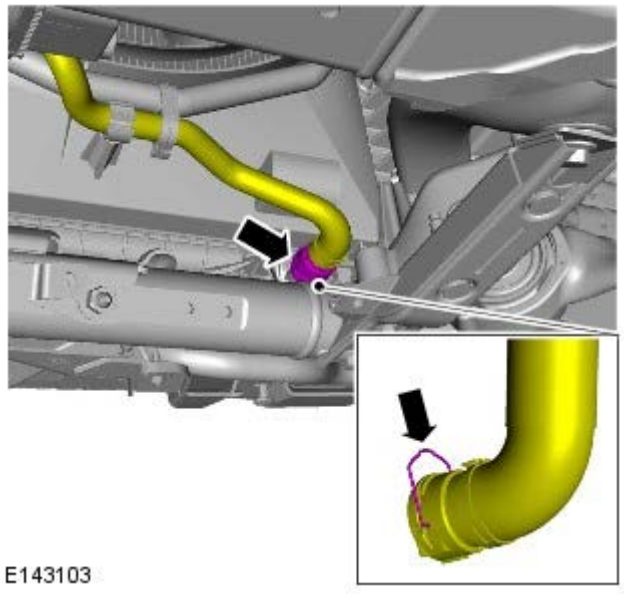
E143104

11. CAUTION: Be prepared to collect escaping coolant.

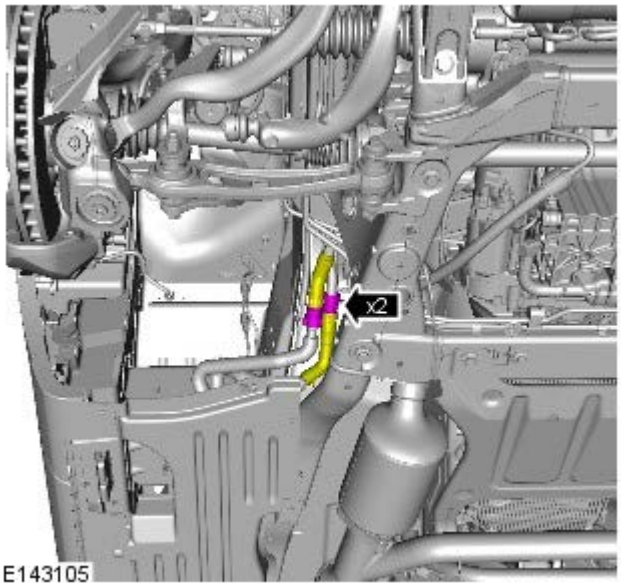
12. *Torque:* 5 Nm



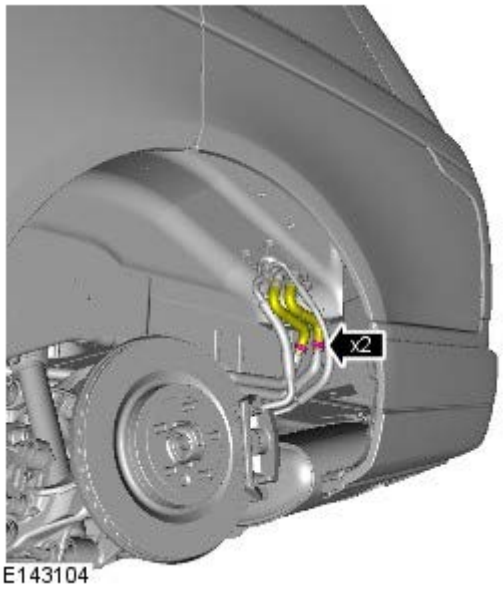
13.



14.



15.



16. Carry out the procedure up to step 1 in the filling section three times, filling the cooling system with clean water at the first two drains. At the third refill, use a suitable measuring tool to make sure that the cooling system maintains a 50% mix.

Filling

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.

1. 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.

2. 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.

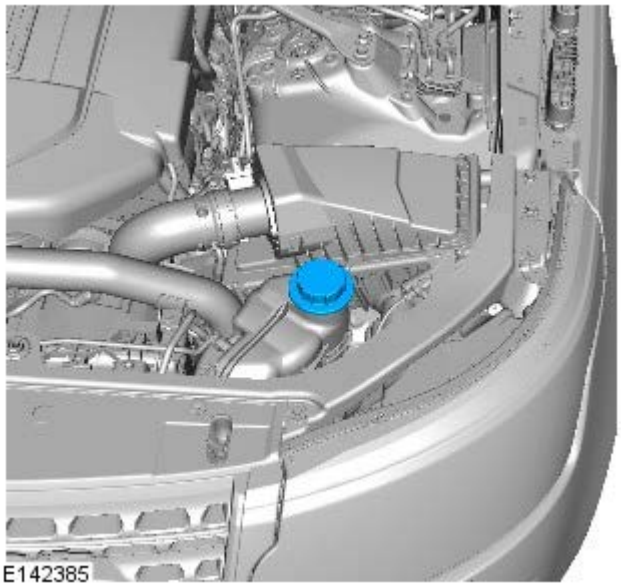
NOTE: Small diameter or long airlines may restrict airflow to the coolant vacuum fill tool.

- Connect a regulated compressed air supply to the venturi tube assembly.

3. Position the evacuated air hose into a container.
4. Open the air supply valve.
5. 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.
6. Apply air pressure progressively until the arrow on the vacuum filler gauge reaches the green segment.
7. Disconnect the compressed air supply line.
8. 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.
9. Remove the vacuum filler gauge and cooling system vacuum refill adaptor assembly.
10. Continue to fill the coolant expansion tank to the rim until the coolant level stops dropping.
11.



12. Start and run the engine.
13. Set the heater controls to maximum.
14. Increase the engine speed from idle to 3500 RPM until hot air is emitted from the front and rear face vents.
15. Run the engine until the thermostat opens and hot air is emitted from the front and rear face vents.
16. Switch the engine off and allow to cool.

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: 02-Aug-2012

Engine Cooling - V8 S/C 5.0L Petrol - Cooling System Pressure Test

General Procedures

Check

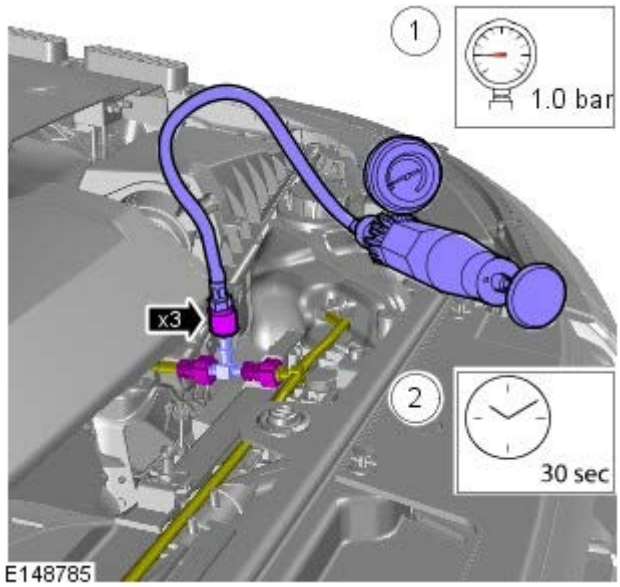
WARNING: Since injury such as scalding could be caused by escaping steam or coolant, allow the vehicle cooling system to cool prior to carrying out this procedure.

NOTE: The following procedure will enable the cooling system to be pressure tested for condition and leaks. Stage 1 will check the expansion tank cap register seal and the cap for leaks. Stage 2 will check the entire cooling system.

1. NOTE: If the coolant expansion tank cap is found to be leaking, replace the cap.

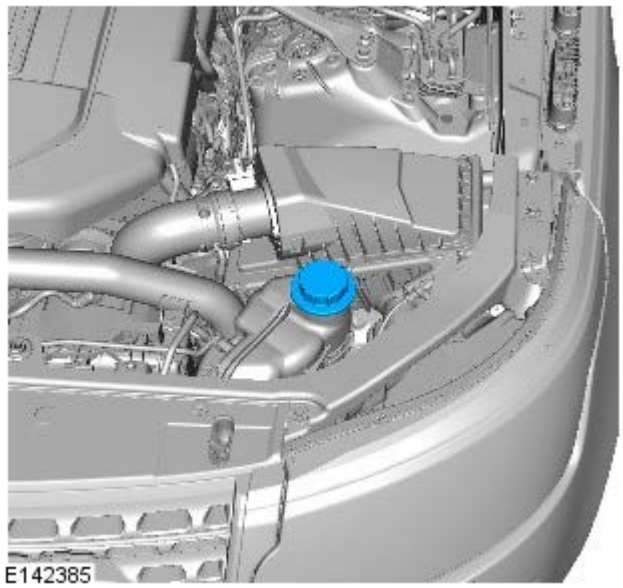
   Examine the coolant hoses for signs of cracking, distortion and security of the hose connections.

2.
   - Slowly pressurize the cooling system.
   - Check the pressure remains above 0.9 bar (90 kPa) (13 psi) after waiting for 30 seconds.
   - During the pressure drop check, listen for a hissing noise from the expansion tank cap.



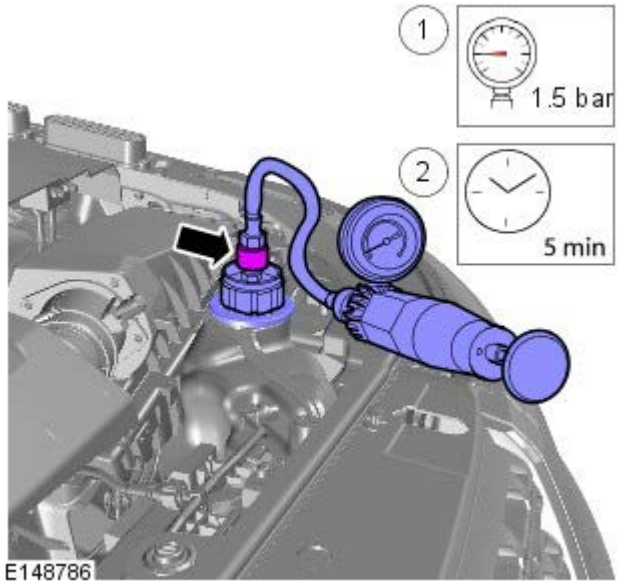
3. Depressurize and remove the pressure pump and gauge.

4.



5. CAUTION: Make sure that the mating faces are clean and free of foreign material.

   NOTE: If the pressure continues to drop after the

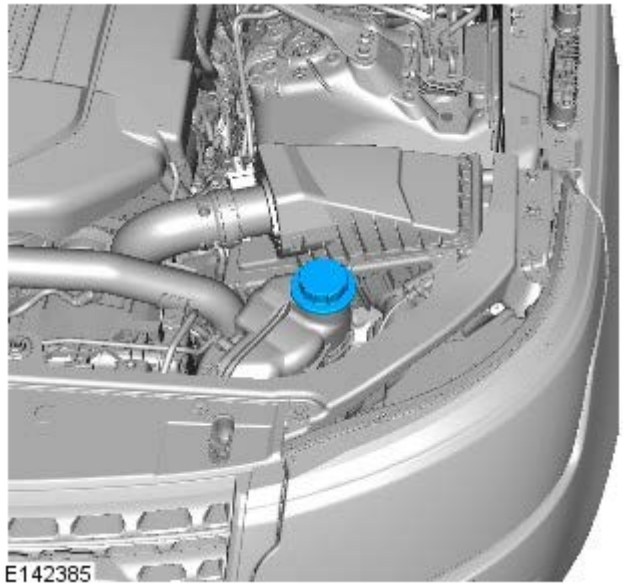


initial tolerance, there is a coolant leak.

- Slowly pressurize the cooling system.
- A small pressure decay of approximately 0.15 bar (15 kPa) (1 psi) over the first minute is normal.

6. Depressurize and remove the pressure pump and gauge.

7.



Published: 10-Sep-2012

Engine Cooling - V8 S/C 5.0L Petrol - Auxiliary Radiator

Removal and Installation

Removal

NOTES:

Removal steps in this procedure may contain installation details.

Make sure that all openings are sealed. Use new blanking caps.

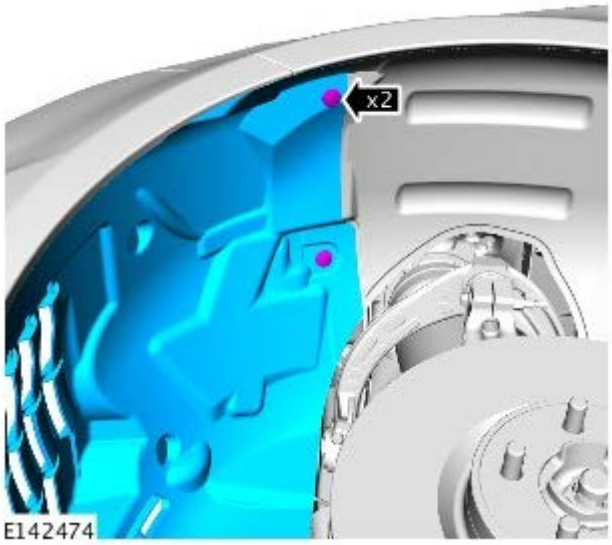
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Refer to: Front Bumper Cover (501-19 Bumpers, Removal and Installation).

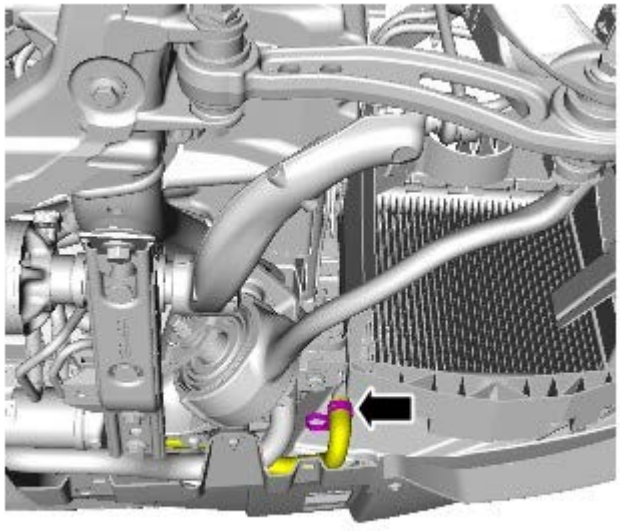
3. Refer to: Cooling System Partial Draining, Filling and Bleeding - V8 S/C 5.0L Petrol (303-03, General Procedures).

4.

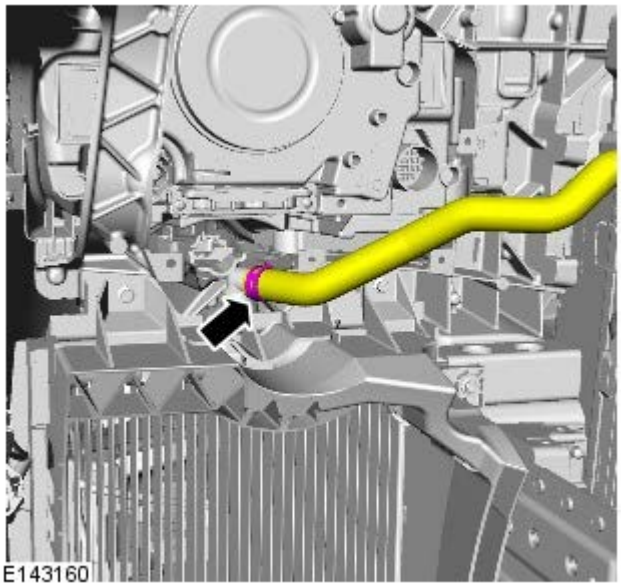


5. CAUTION: Be prepared to collect escaping coolant.

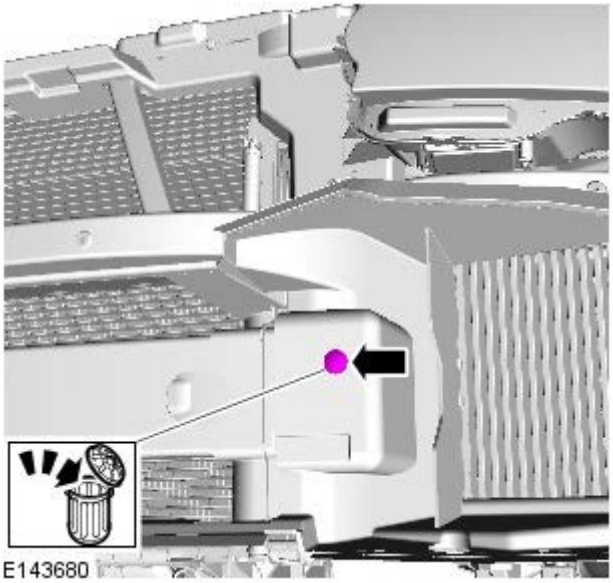
   NOTE: RH illustration shown, LH is similar.



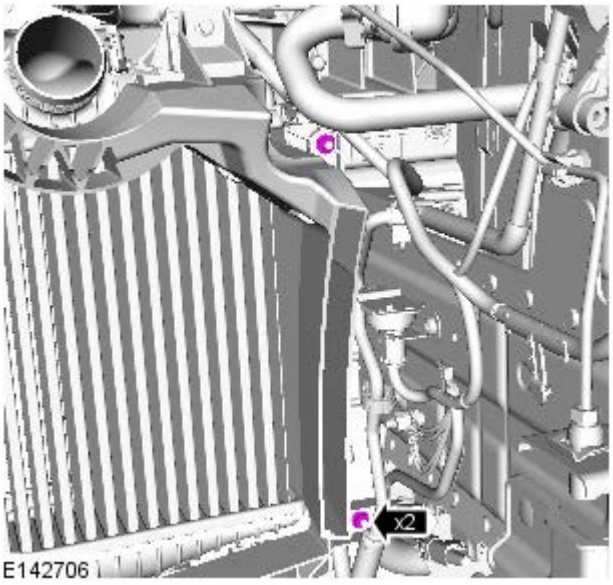
6.



7. CAUTION: Make sure that new components are installed.



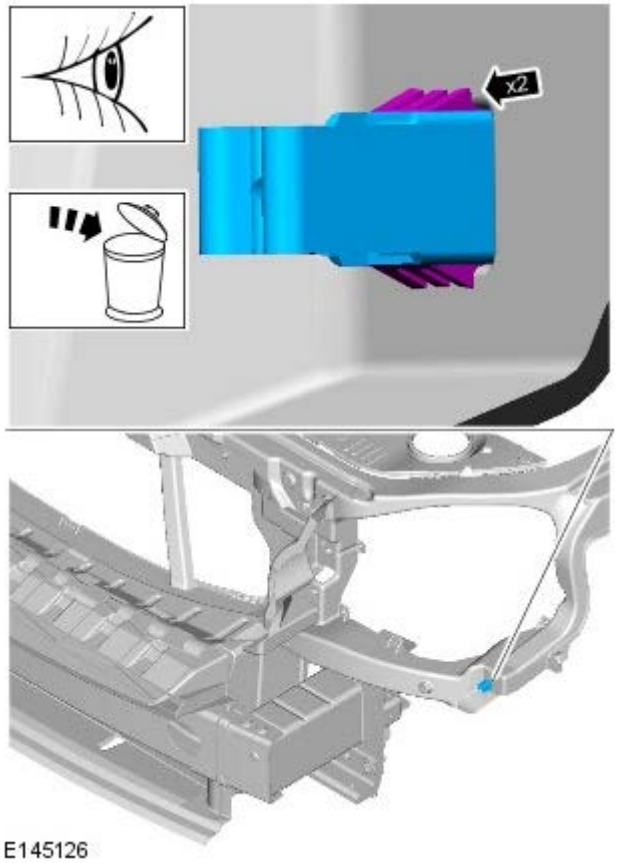
8. *Torque:* 9 Nm



9. *Torque:* 5 Nm



E142707

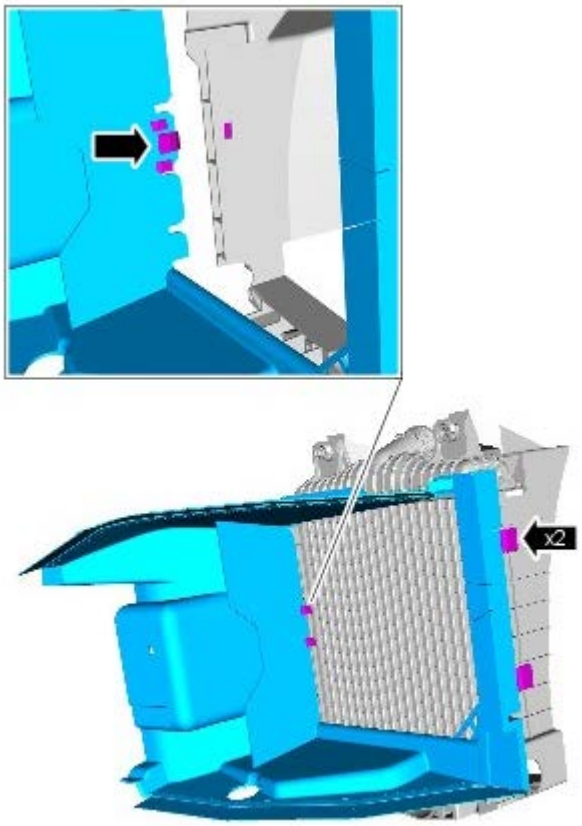


E145126

10. CAUTION: Make sure that new components are installed.

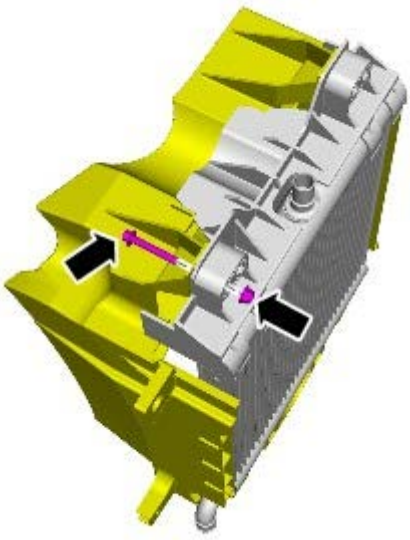
NOTE: Make sure that the locking tangs are installed correctly.

11. NOTE: Do not disassemble further if the component is removed for access only.



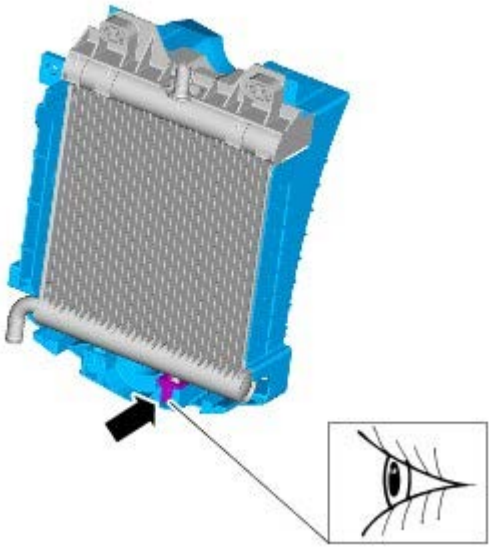
E142708

12. *Torque:* 9 Nm



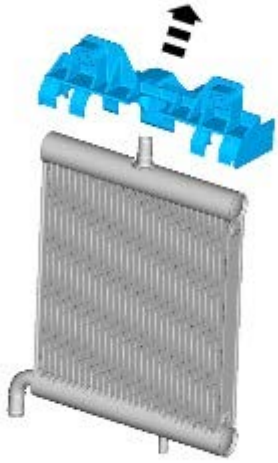
E143161

13.



E143163

14.



E143162

Installation

1. To install, reverse the removal procedure.

Published: 08-Aug-2012

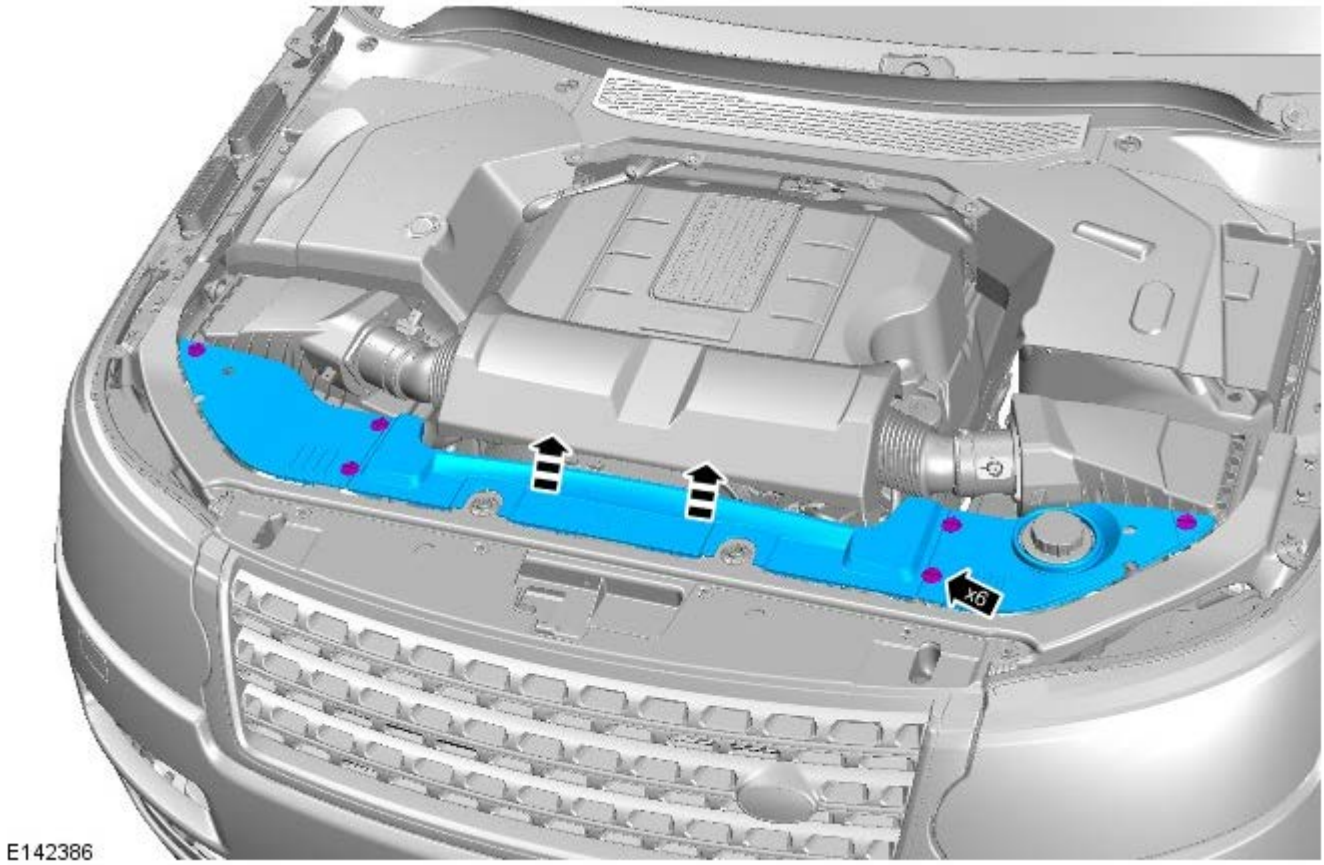
Engine Cooling - V8 S/C 5.0L Petrol - Coolant Expansion Tank

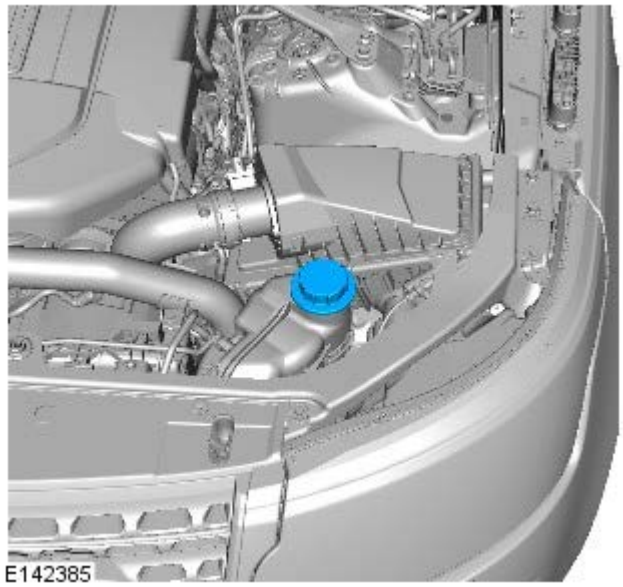
Removal and Installation

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.

1.

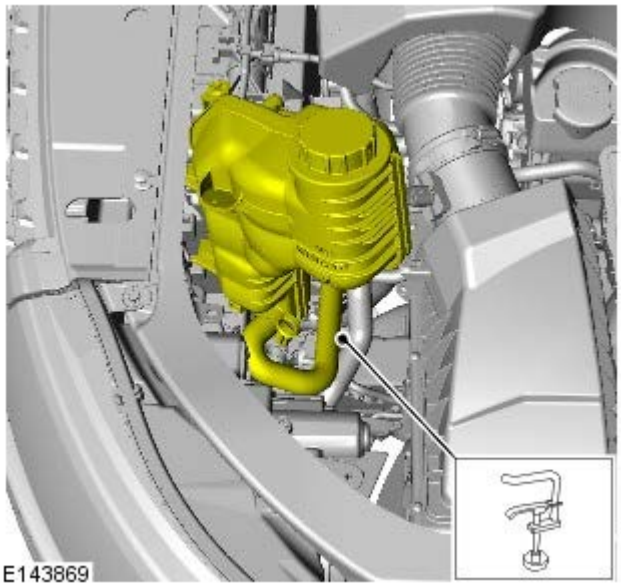




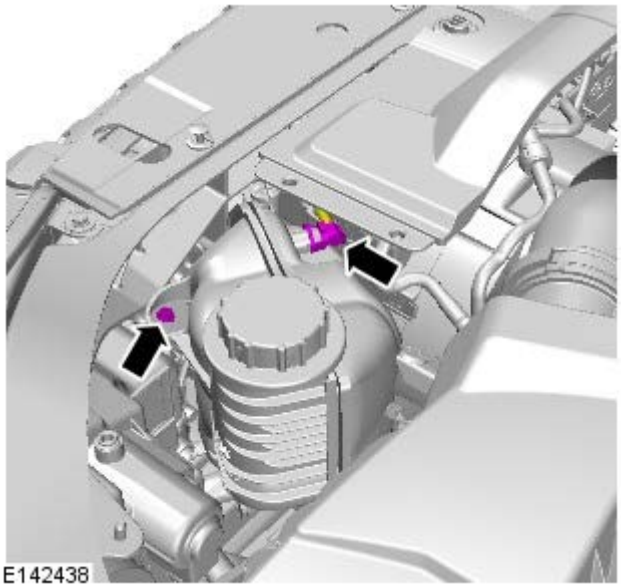
2. WARNING: When releasing the cooling system pressure, cover the coolant expansion tank cap with a thick cloth.

3. Using a syringe, remove the cooling fluid from the expansion tank.

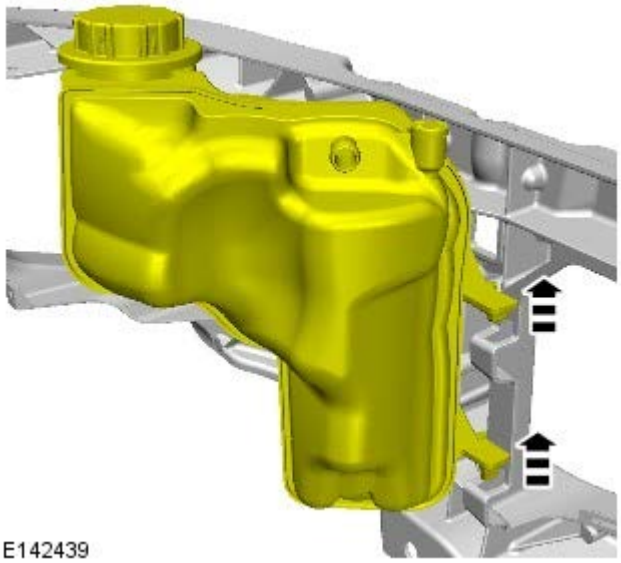
4. CAUTION: Clamp the hoses to minimize coolant loss.



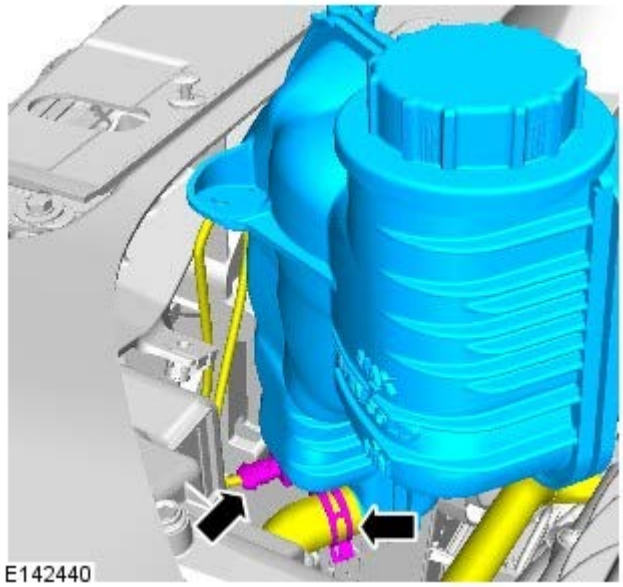
5. CAUTION: Be prepared to collect escaping coolant.



6.

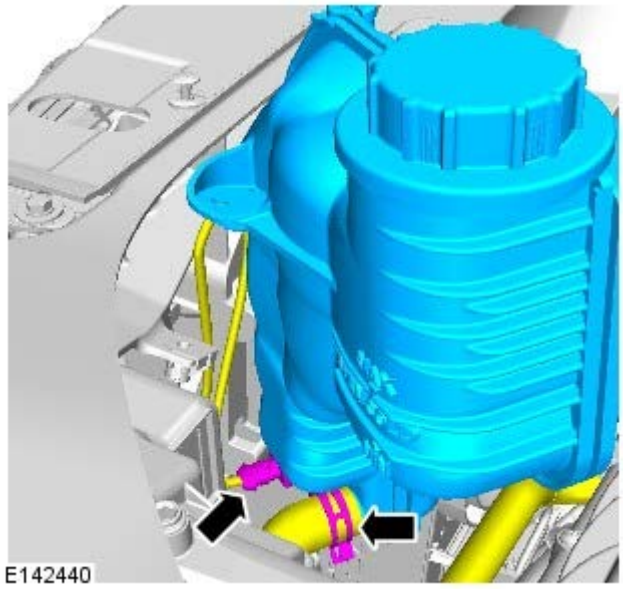


7. CAUTION: Be prepared to collect escaping coolant.

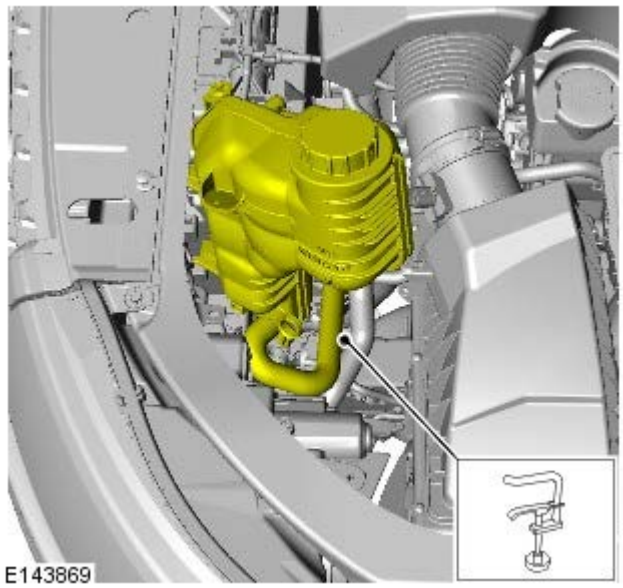


Installation

1.

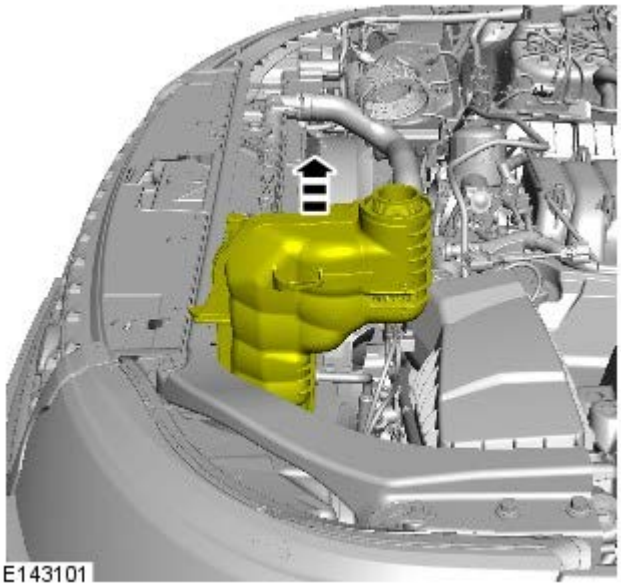


2.



3. NOTE: Keep the coolant expansion tank vertically.

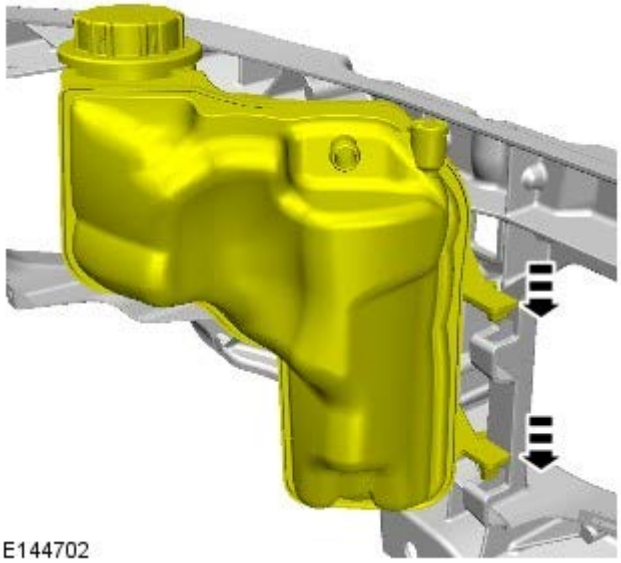
Raise the coolant expansion tank minimum 110mm


E143101

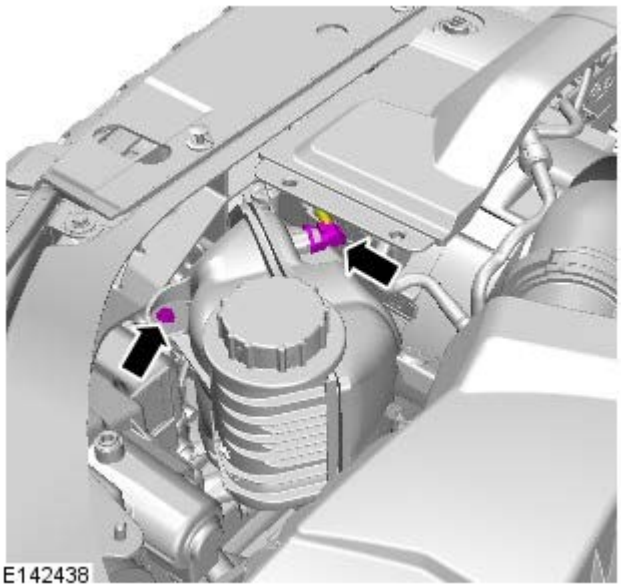
from its original position.

4. Fill the cooling system, keeping coolant to the upper level mark of the expansion tank, until a steady stream of coolant is seen returning to the tank.

5.


E144702

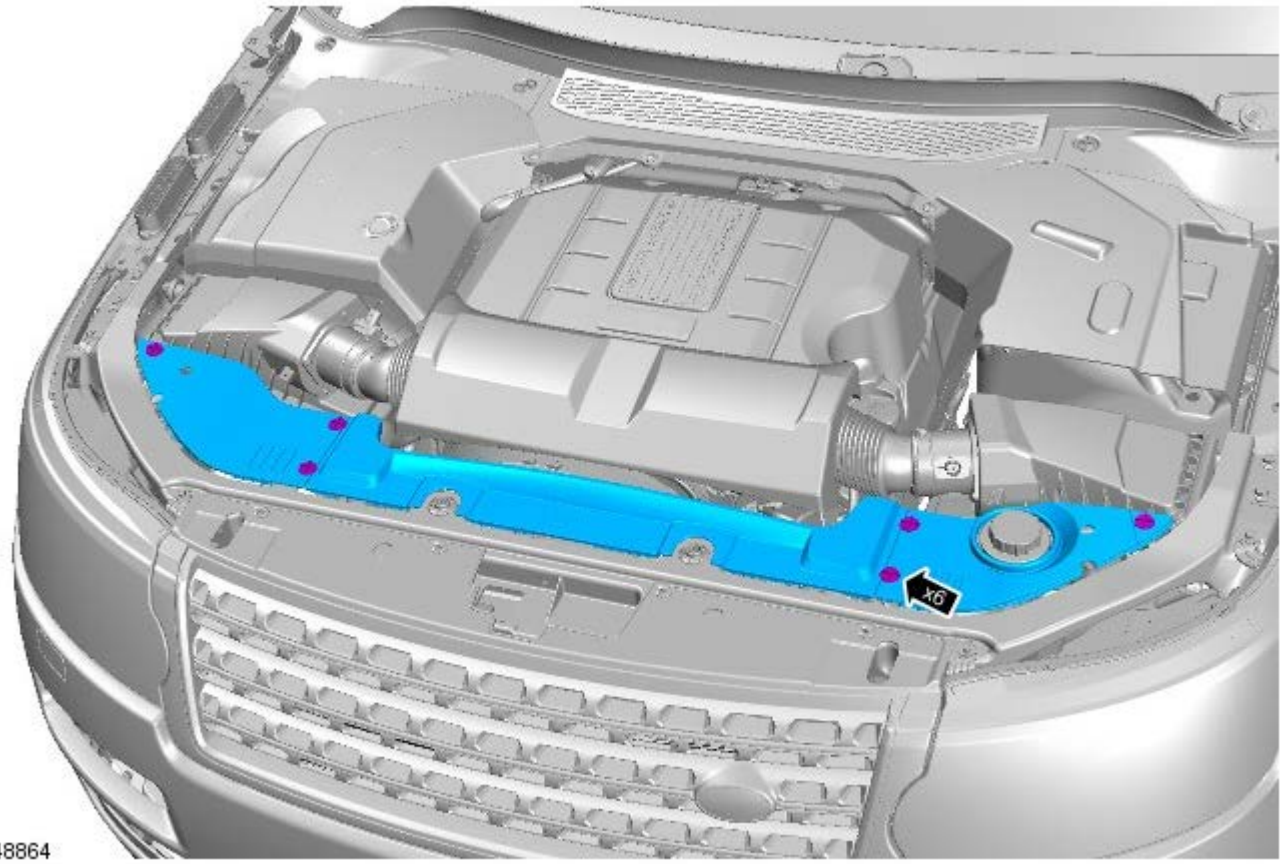
6. *Torque:* 2.8 Nm


E142438

7. CAUTION: Make sure the coolant level remains above the "COLD FILL RANGE" lower level mark.

Check and top up the cooling system as required.

8.



Published: 04-Mar-2013

Engine Cooling - V8 S/C 5.0L Petrol - Cooling Module

Removal and Installation

Removal

1. WARNING: Make sure to support the vehicle with axle stands.

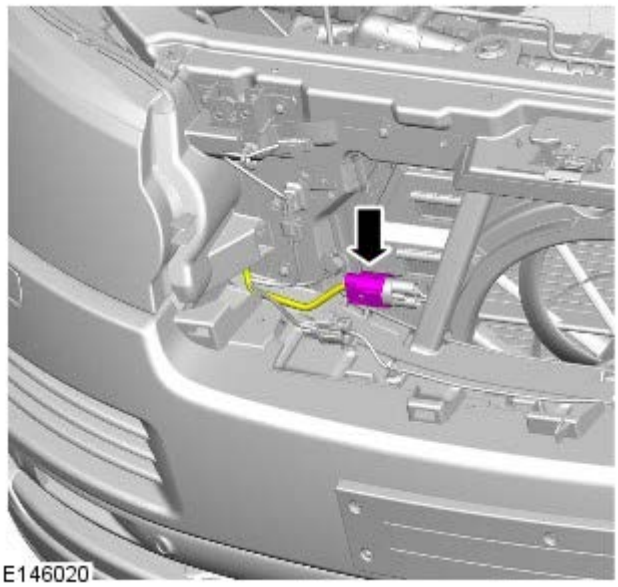
   Raise and support the vehicle.

2. Refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00 Climate Control System - General Information, General Procedures).

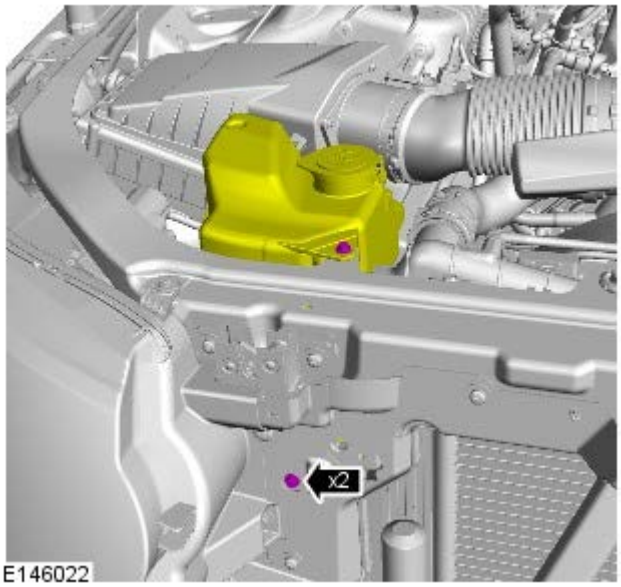
3. Refer to: Cooling System Partial Draining, Filling and Bleeding - V8 S/C 5.0L Petrol (303-03C Engine Cooling - V8 S/C 5.0L Petrol, General Procedures).

4. Refer to: Cooling Fan (303-03C Engine Cooling - V8 S/C 5.0L Petrol, Removal and Installation).

5. Refer to: Front Bumper Cover (501-19 Bumpers, Removal and Installation).



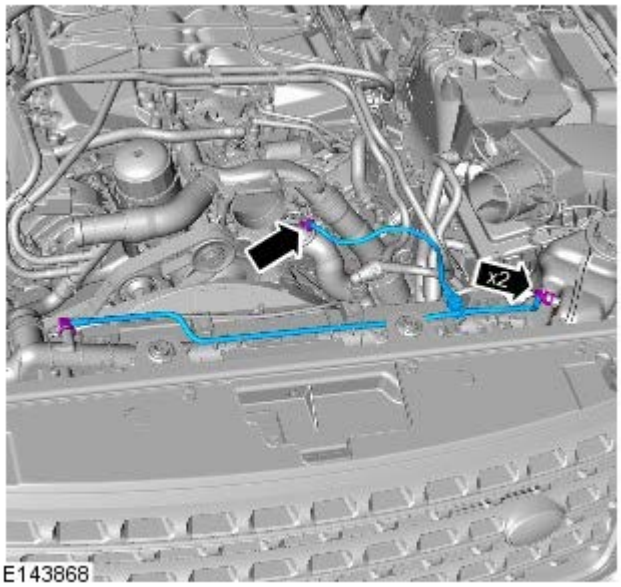
6. NOTE: If equipped.



7. NOTE: If equipped.

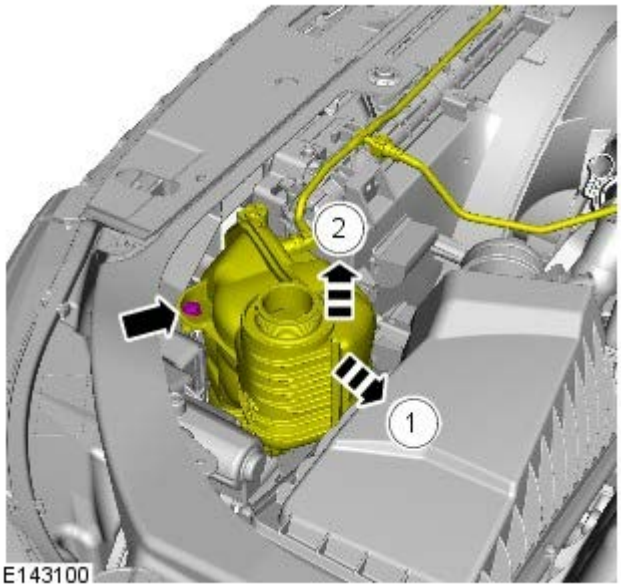
   Torque: 7 Nm

8.



E143868

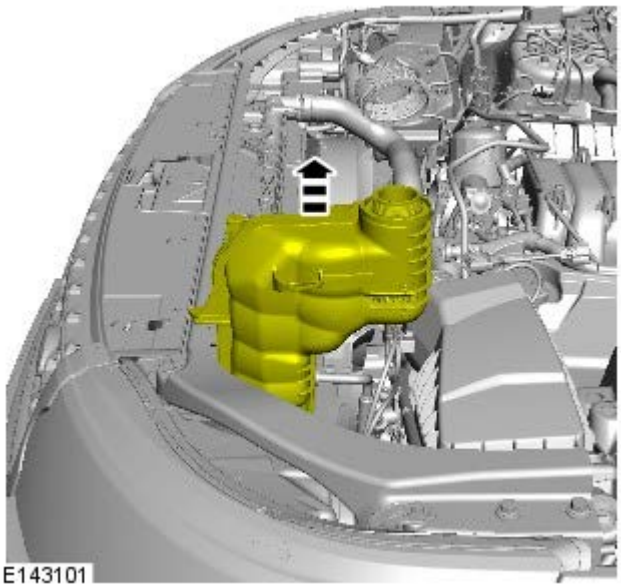
9. *Torque:* 2.8 Nm



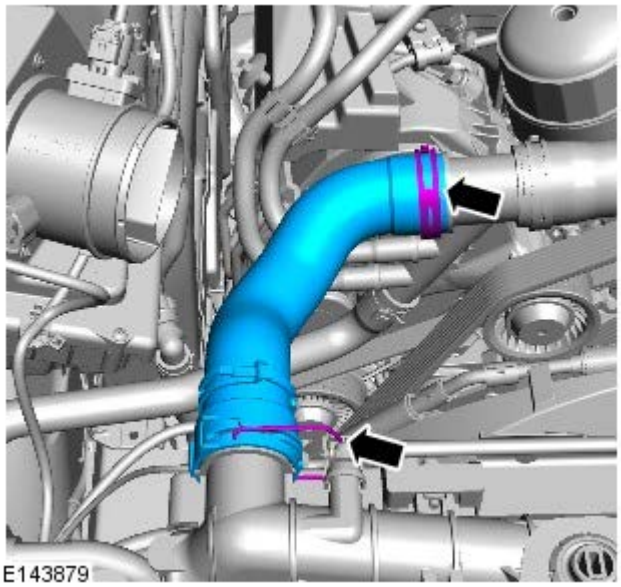
E143100

10. NOTE: Keep the coolant expansion tank vertically.

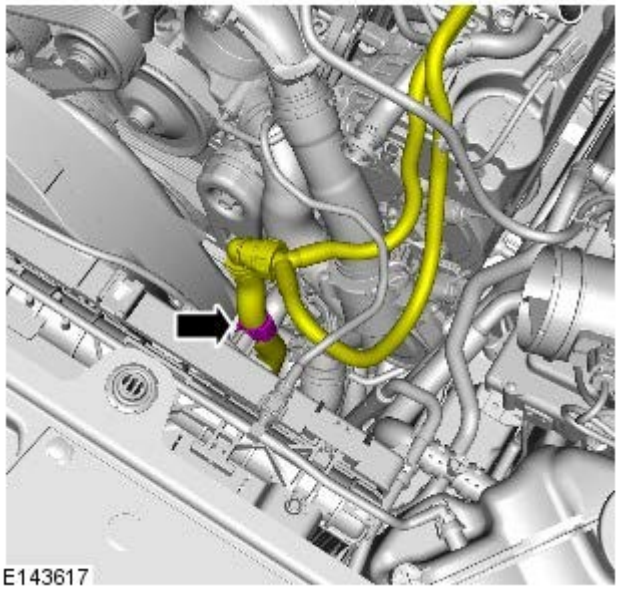
Raise the coolant expansion tank minimum 110mm from its original position.


E143101

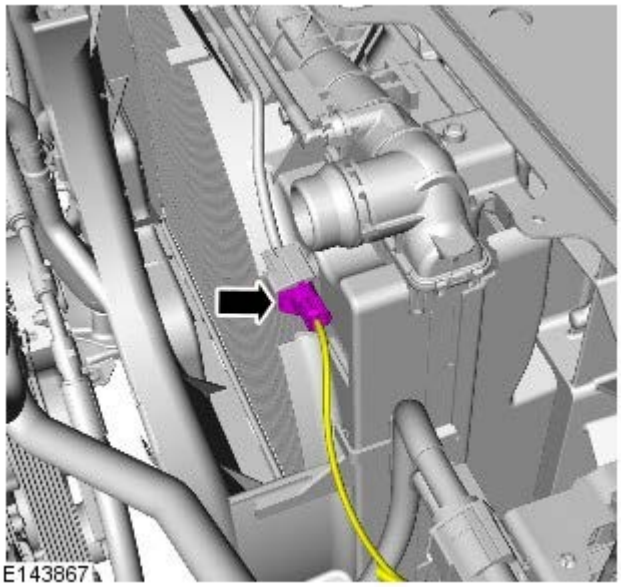
11.



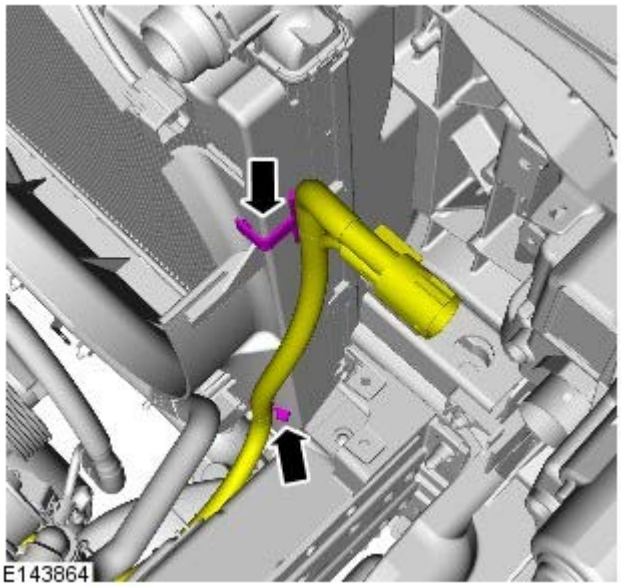
12.



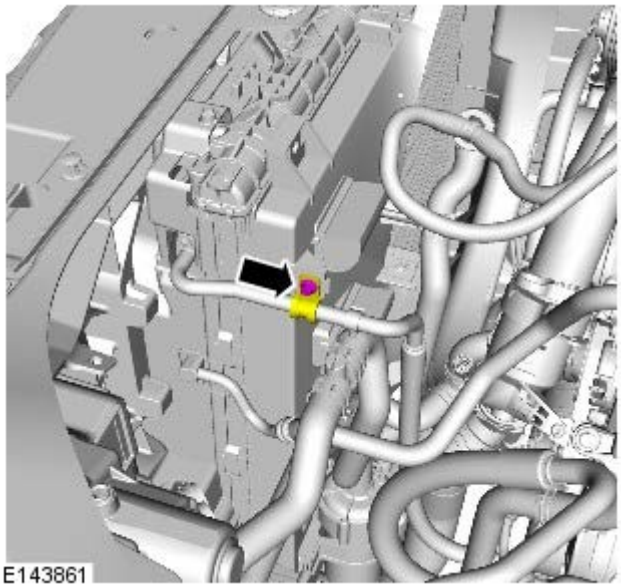
13.



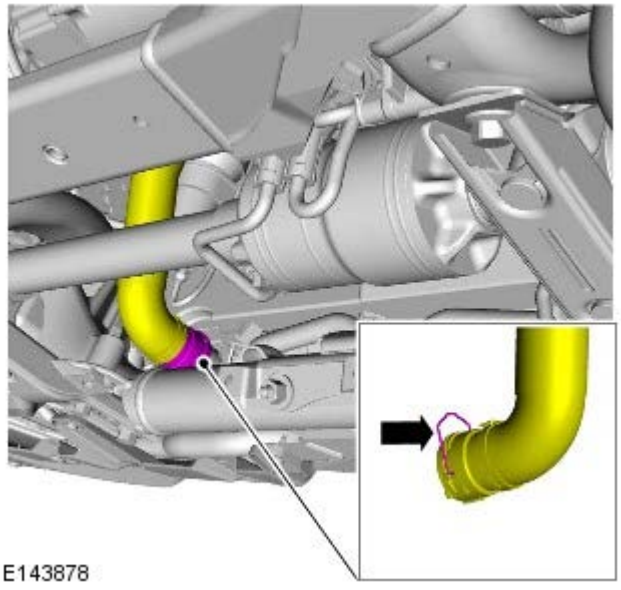
14.



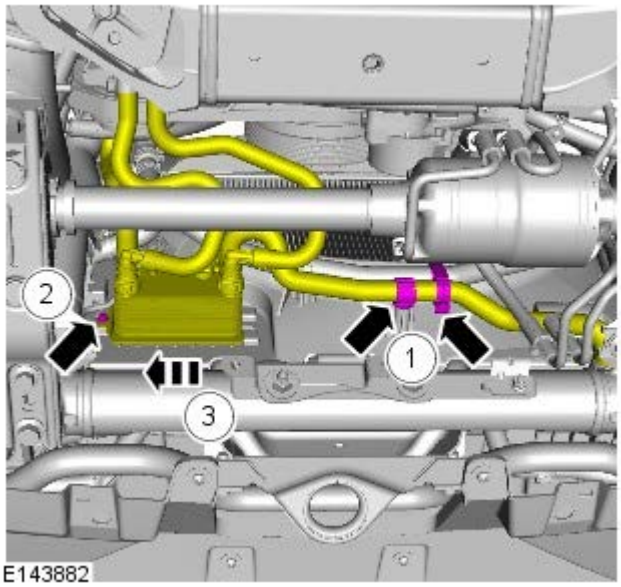
15. *Torque:* 7 Nm



16.

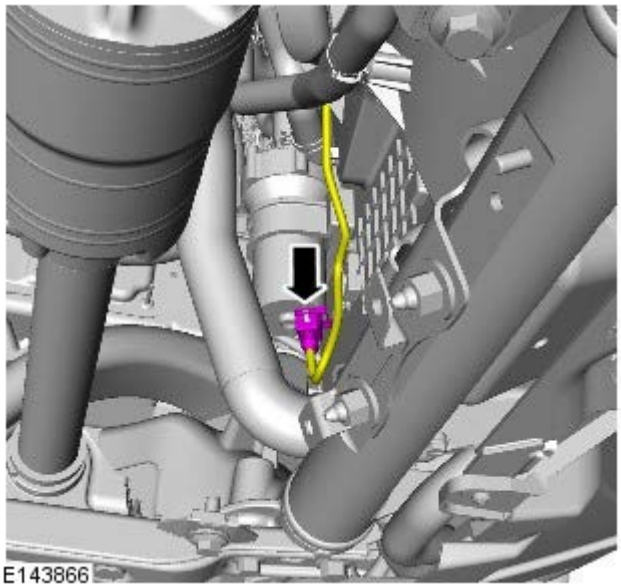


17. *Torque:* 7 Nm

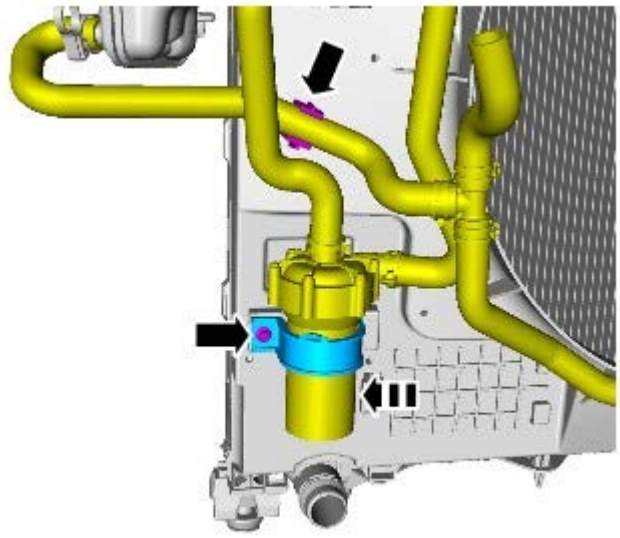


E143882

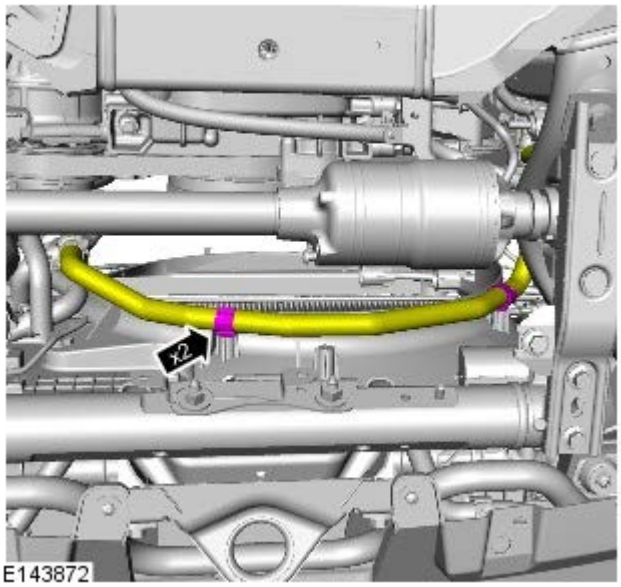
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E143866

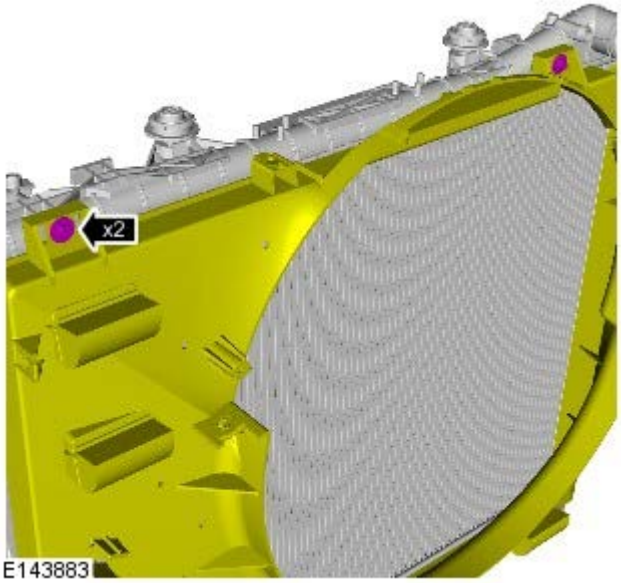
19. *Torque:* 7 Nm


E143865

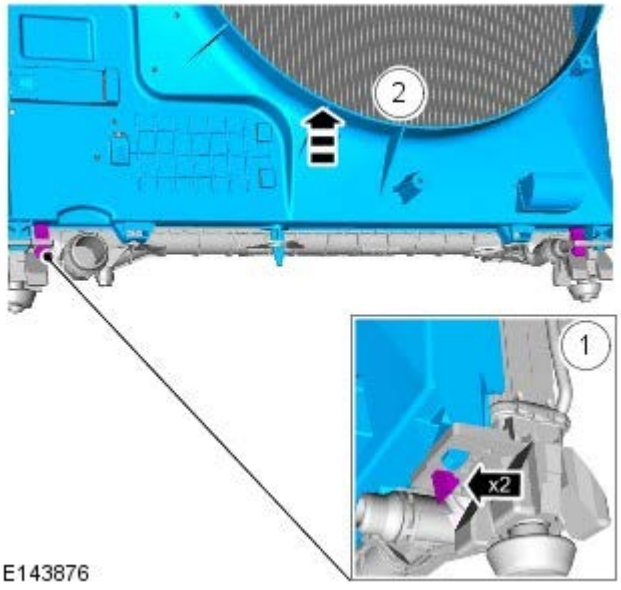
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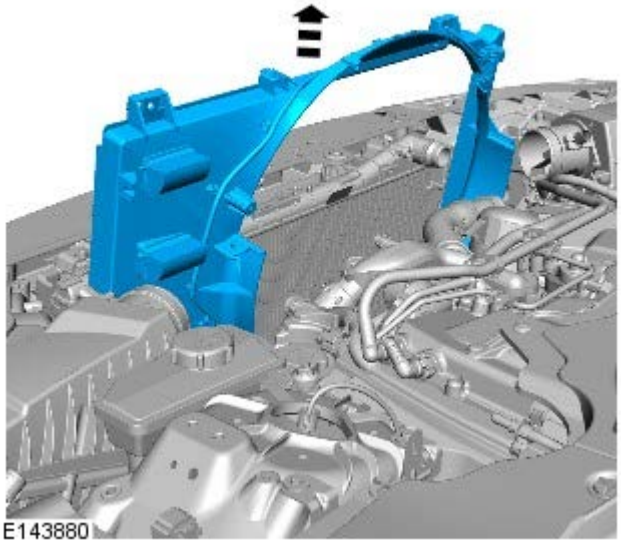
21. *Torque:* 7 Nm

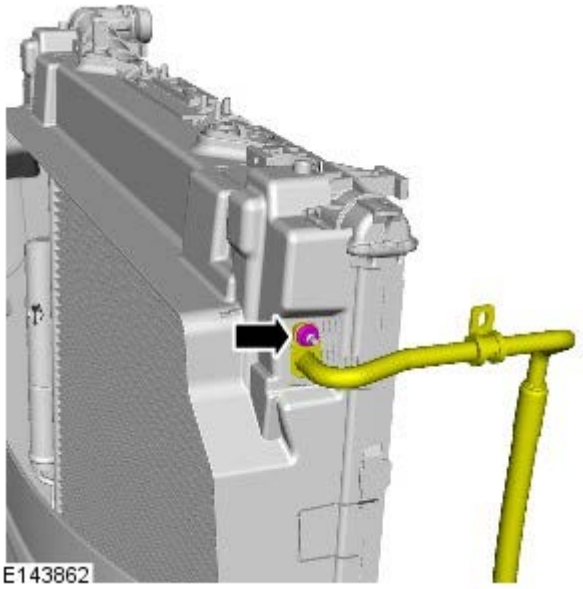


22.



23. CAUTION: Always protect the cooling pack elements to prevent accidental damage.





24. CAUTIONS:

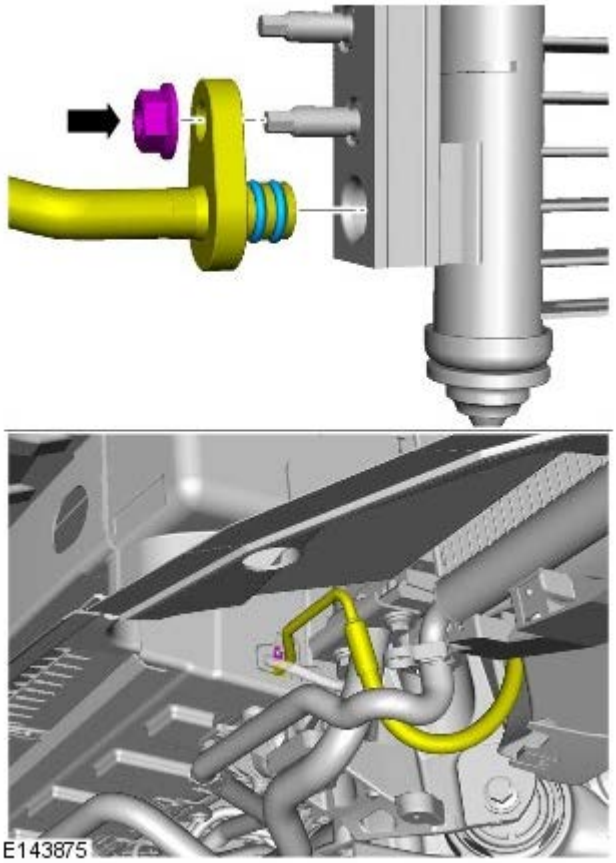
    Make sure that all openings are sealed. Use new blanking caps.

    Remove and discard the O-ring seals.

    Torque: 8 Nm

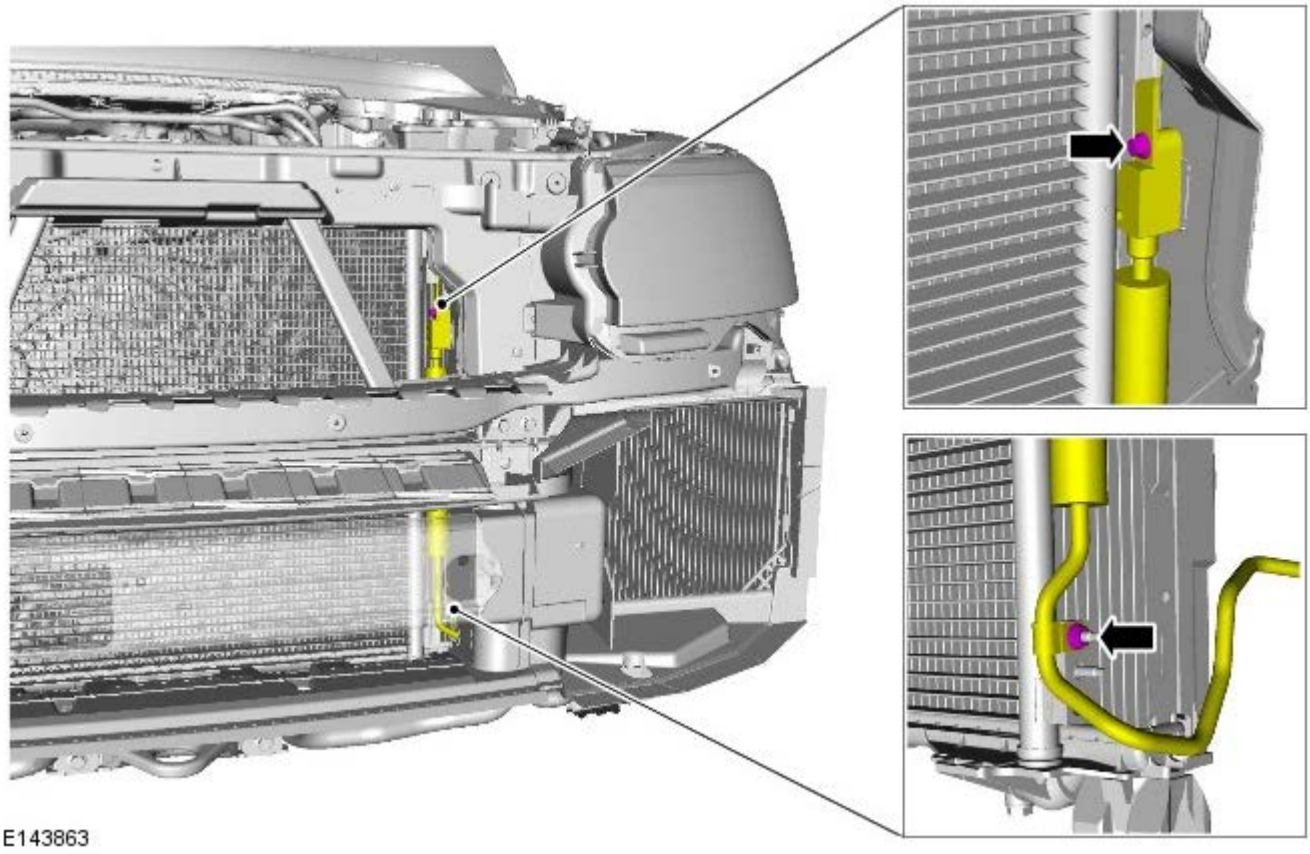
25. CAUTION: Remove and discard the O-ring seals.

    Torque: 8 Nm

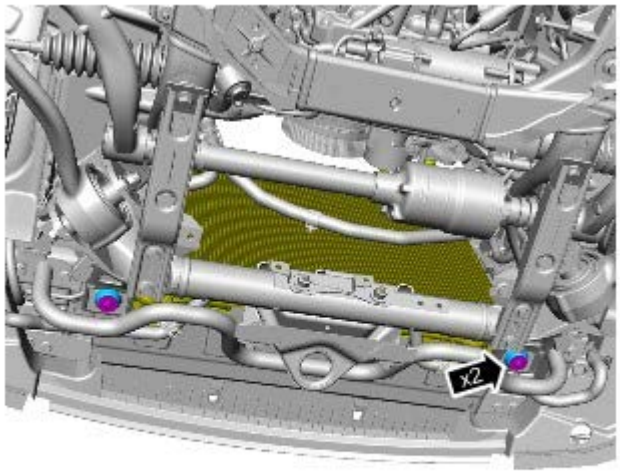


26. NOTE: If equipped.

Torque: 7 Nm

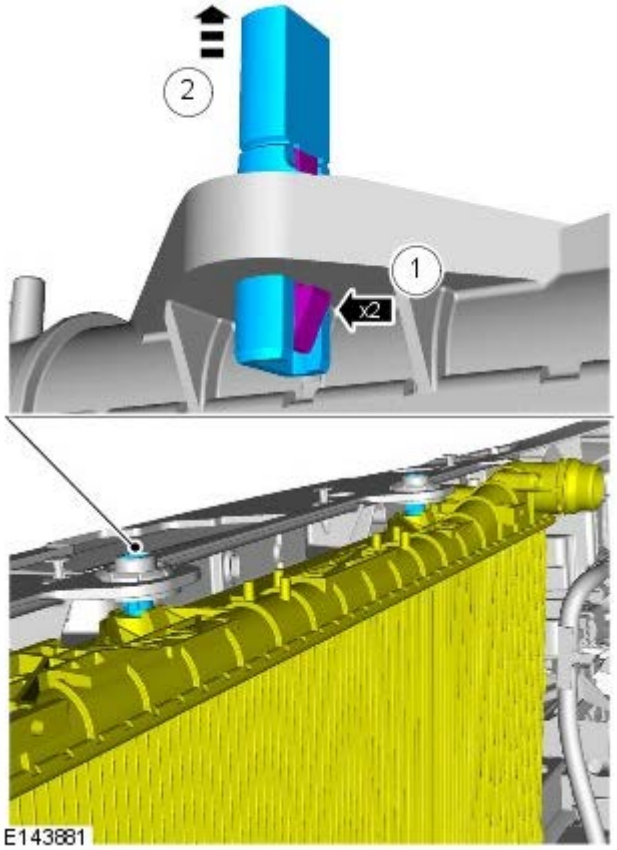


27. *Torque:* 15 Nm



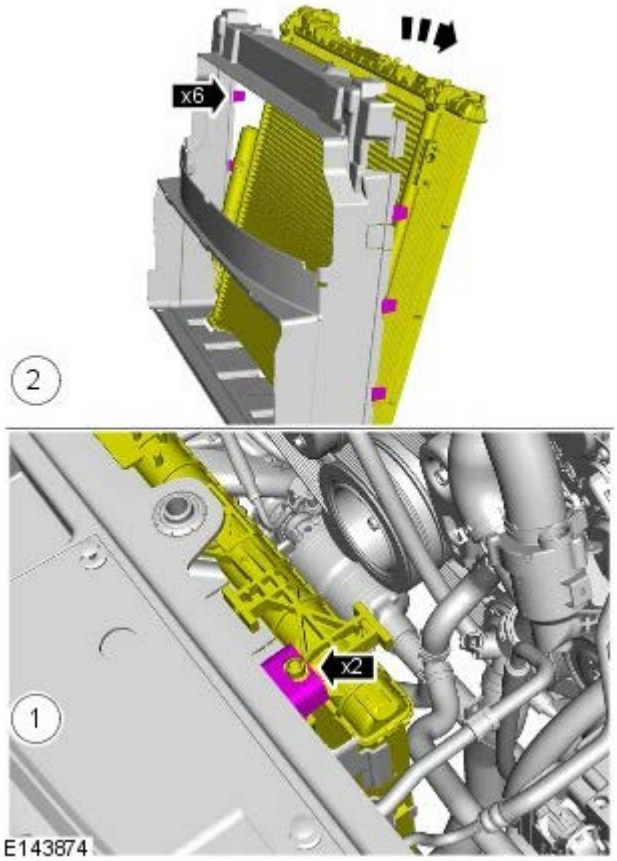
E143877

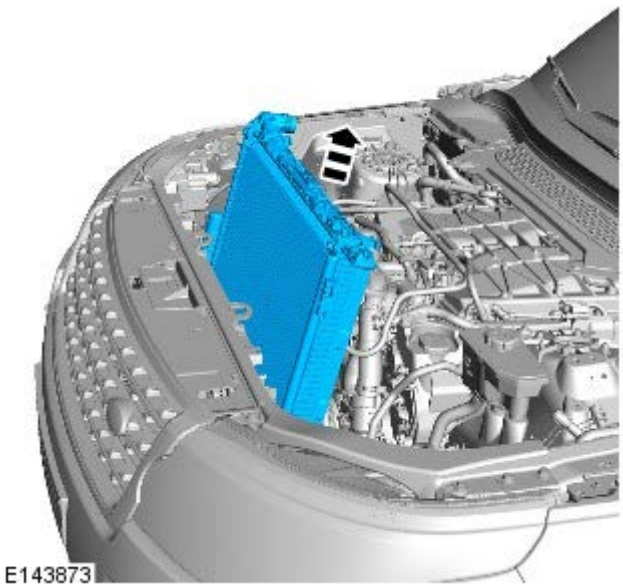
28.



E143881

29. CAUTION: Always protect the cooling pack elements to prevent accidental damage.





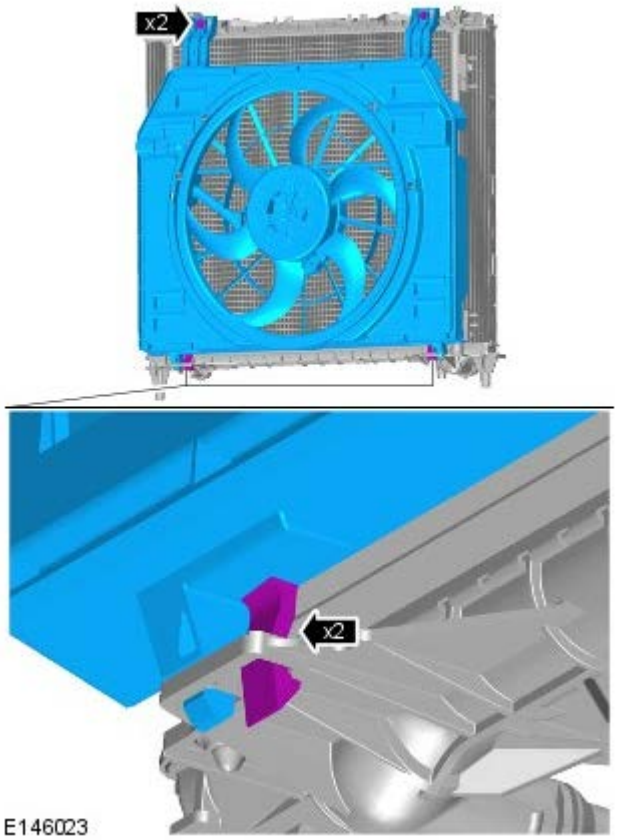
30. CAUTION: Always protect the cooling pack elements to prevent accidental damage.

31. NOTES:

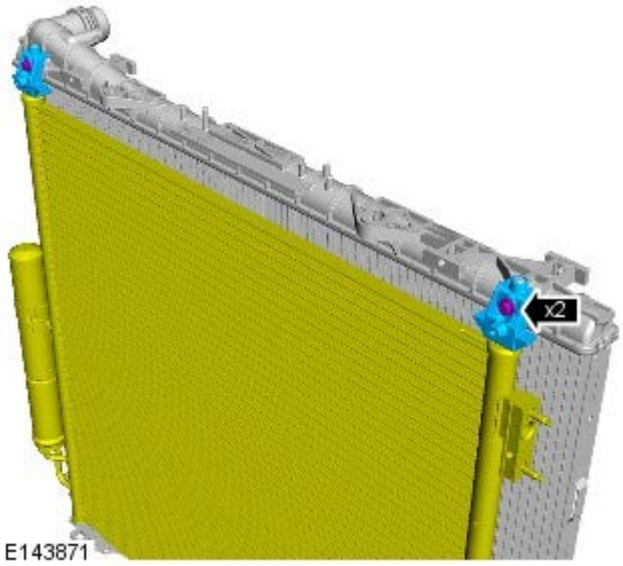
If equipped.

Do not disassemble further if the component is removed for access only.

Torque: 7 Nm



32. *Torque:* 4.5 Nm



33.



E143870

Installation

1. To install, reverse the removal procedure.

Published: 15-Oct-2013

Engine Cooling - V8 S/C 5.0L Petrol - Coolant 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.

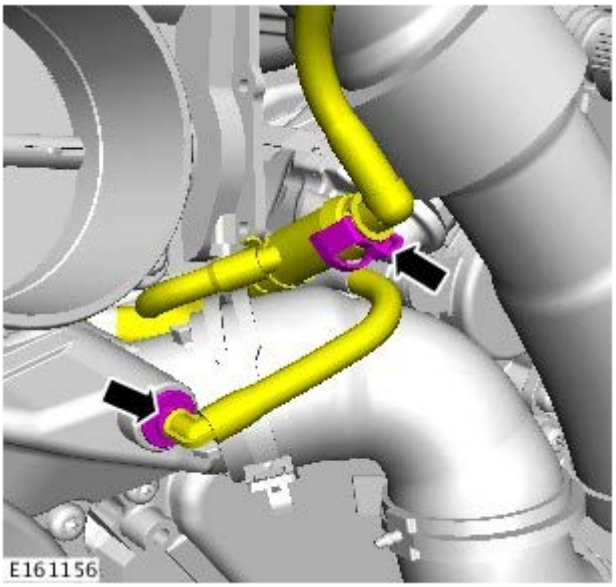
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

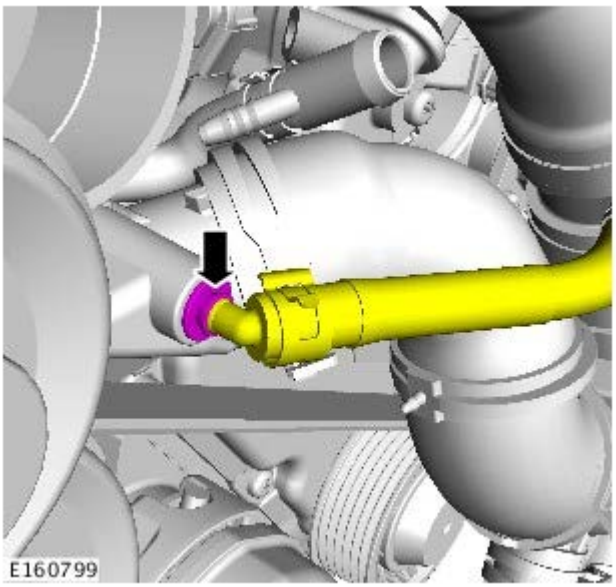
2. Refer to: Cooling System Partial Draining, Filling and Bleeding - V8 S/C 5.0L Petrol (303-03C Engine Cooling - V8 S/C 5.0L Petrol, General Procedures).

3. Refer to: Accessory Drive Belt (303-05C Accessory Drive - V8 S/C 5.0L Petrol, Removal and Installation).

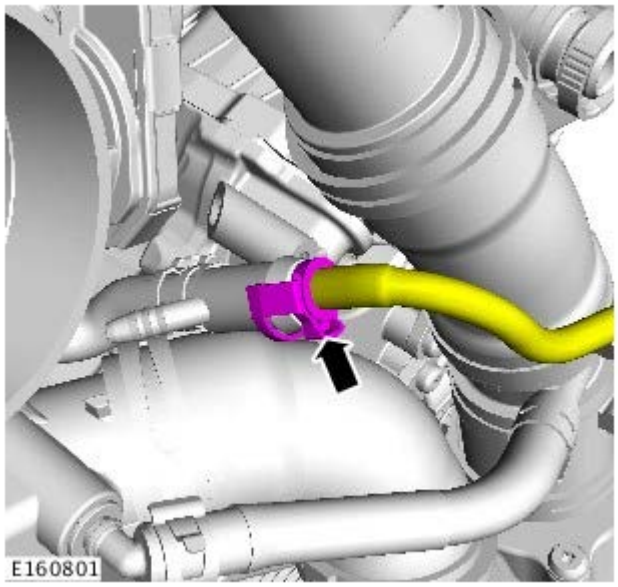
4. NOTE: If equipped.



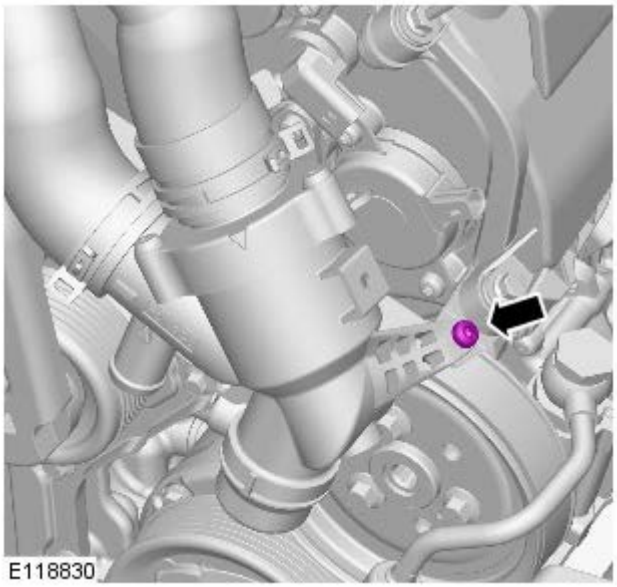
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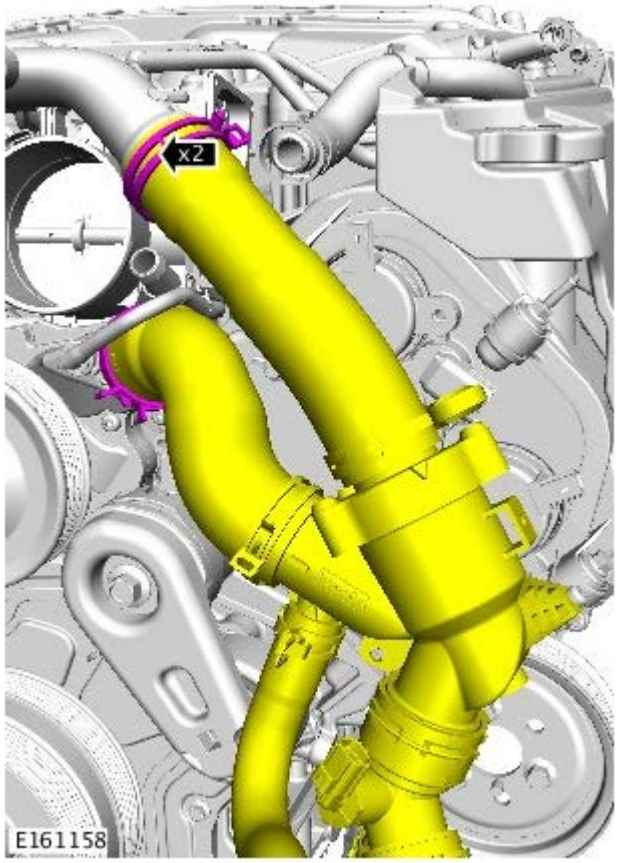
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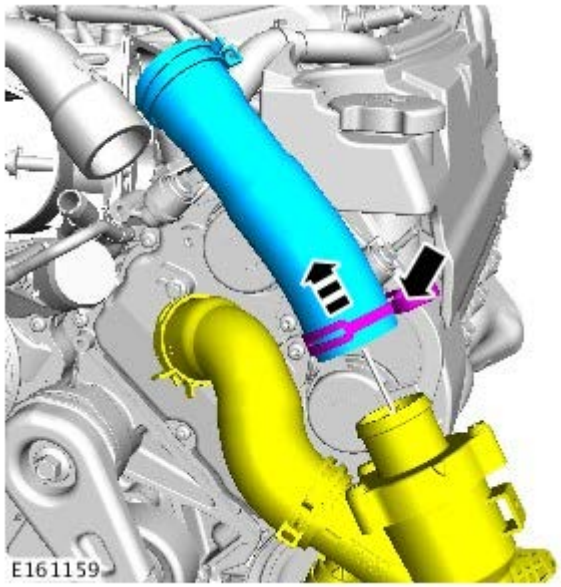


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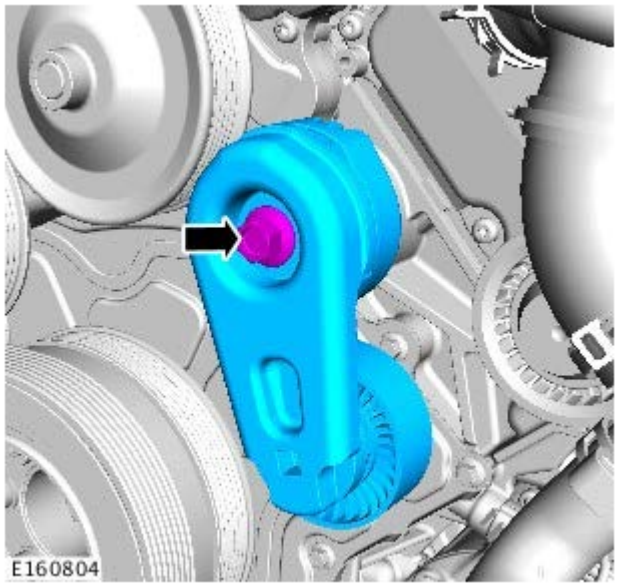
8.





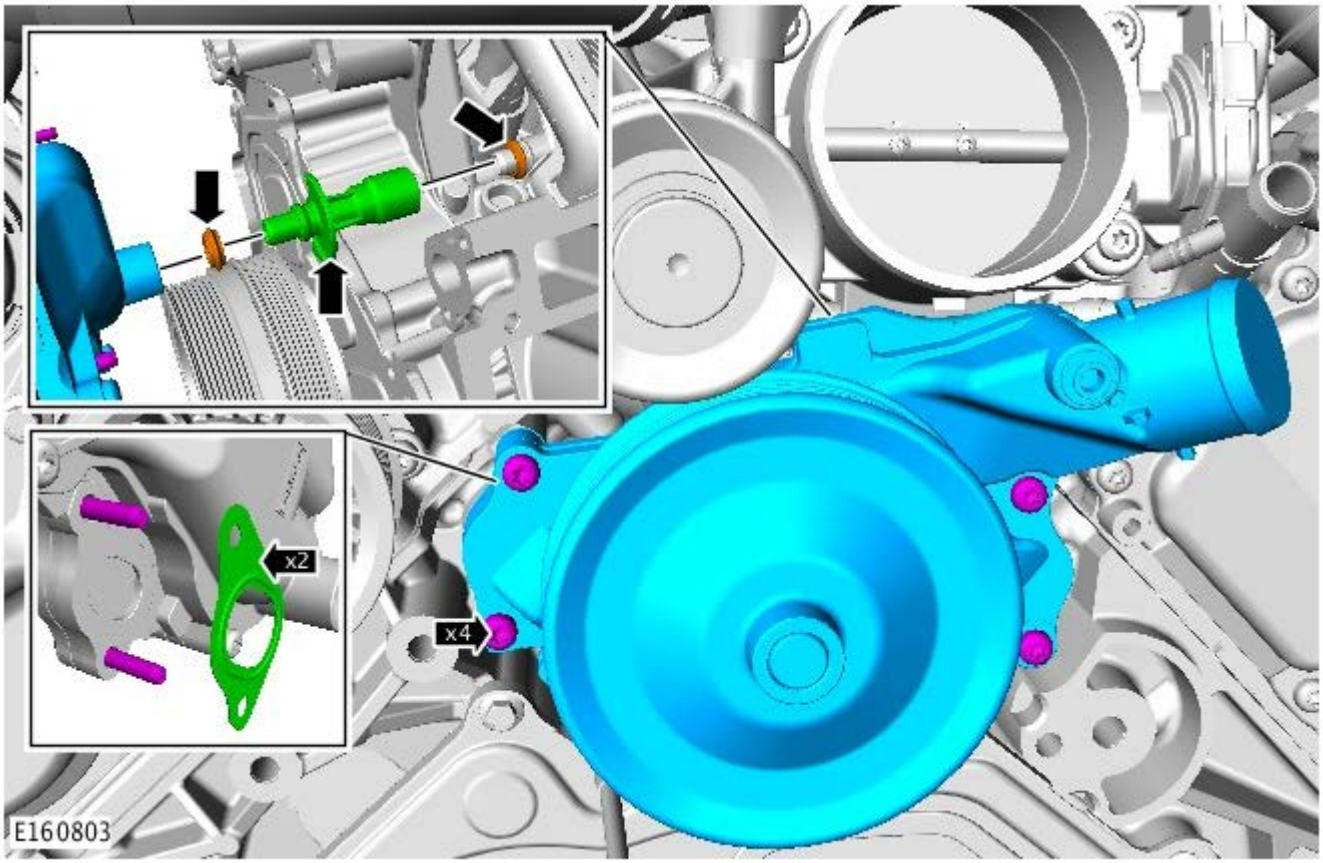
9. NOTE: If equipped.

10.

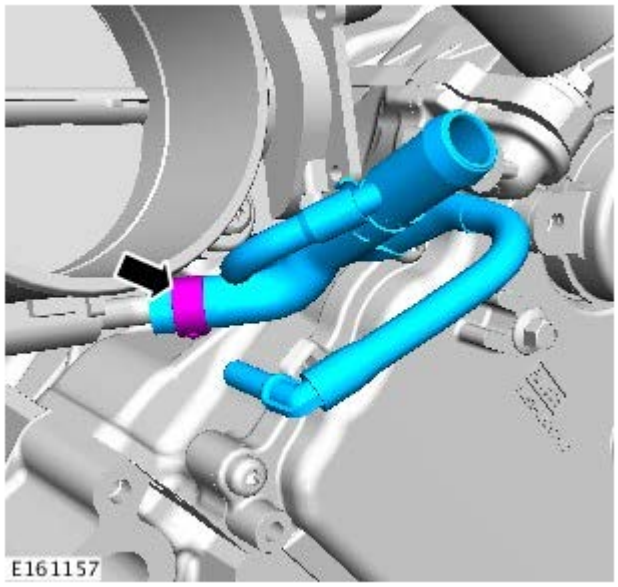


11. WARNING: Fluid loss is unavoidable, use absorbent cloth or a container to collect the fluid.

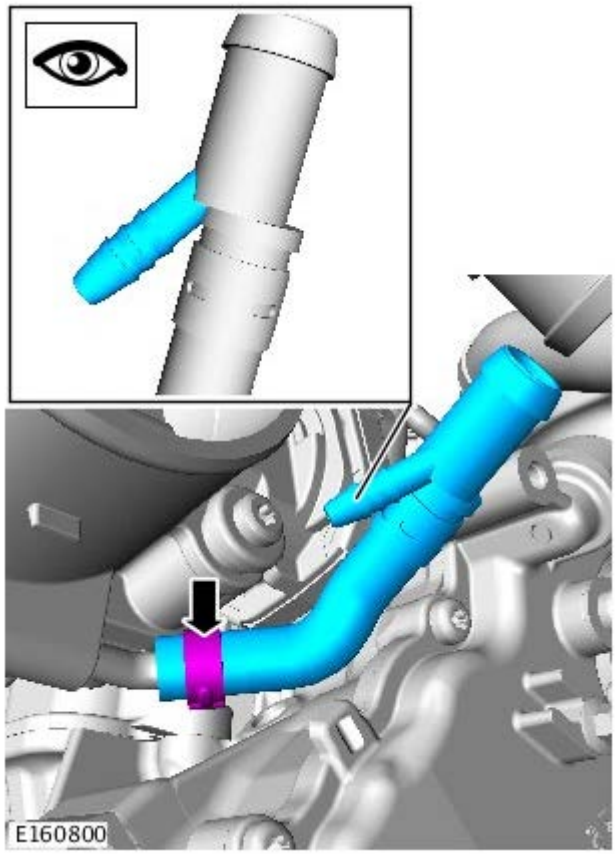
CAUTION: Engine coolant will damage the paint finished surfaces. If spilt, immediately remove the coolant and clean the area with water.



12. NOTE: If equipped.



Installation



1. NOTES:

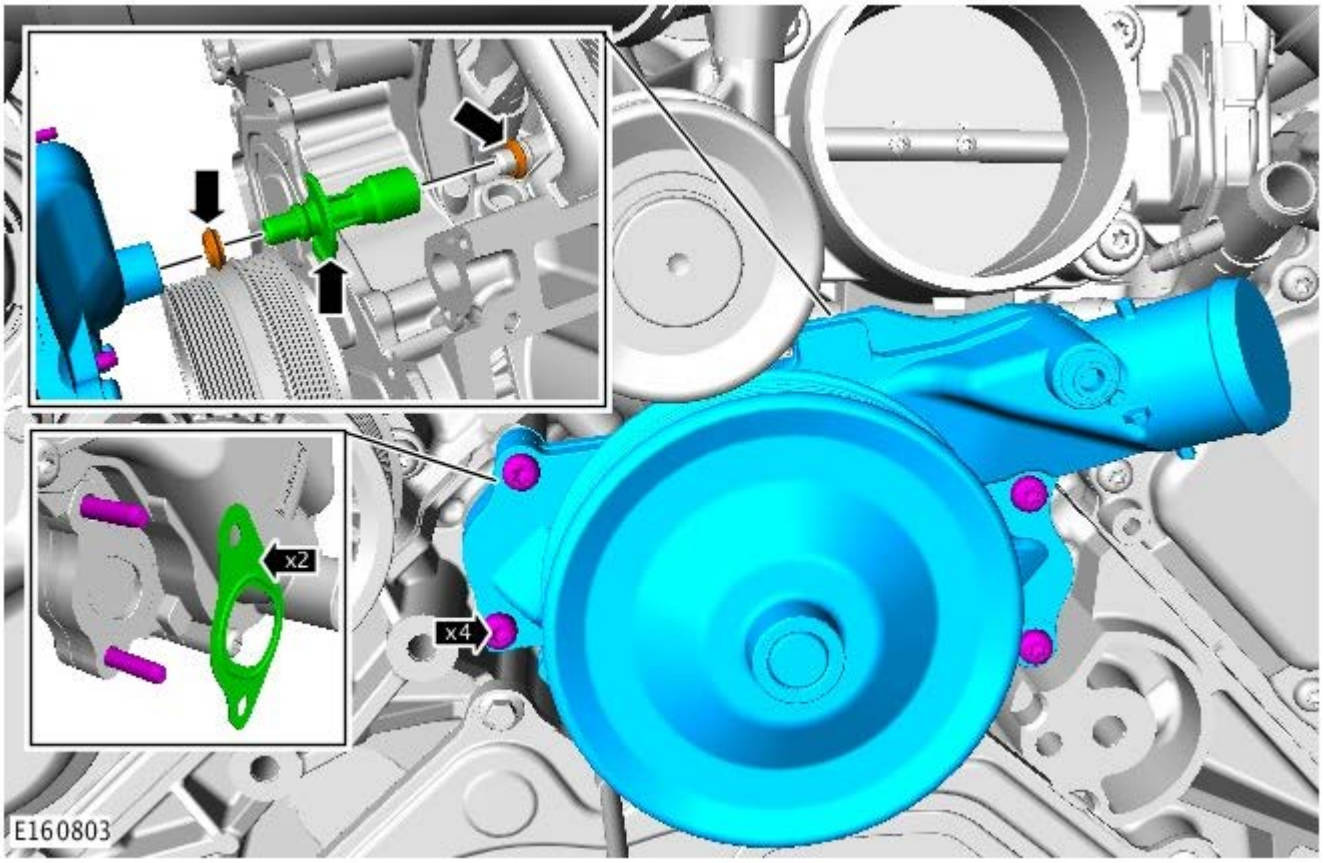
   If the component removed from the vehicle is not as what is detailed in the illustration, make sure the new version of the component is installed (refer to the parts catalogue).

   The spare hose outlet must remain blank as indicated.

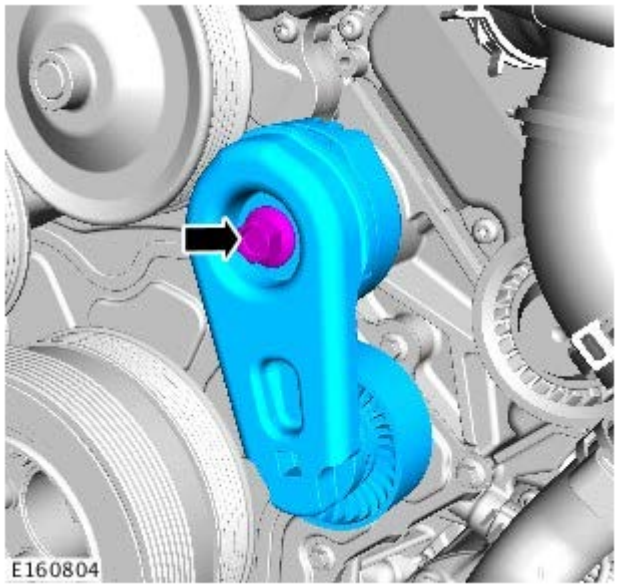
2. CAUTION: Install new O-ring seals.

   NOTE: Install new gaskets.

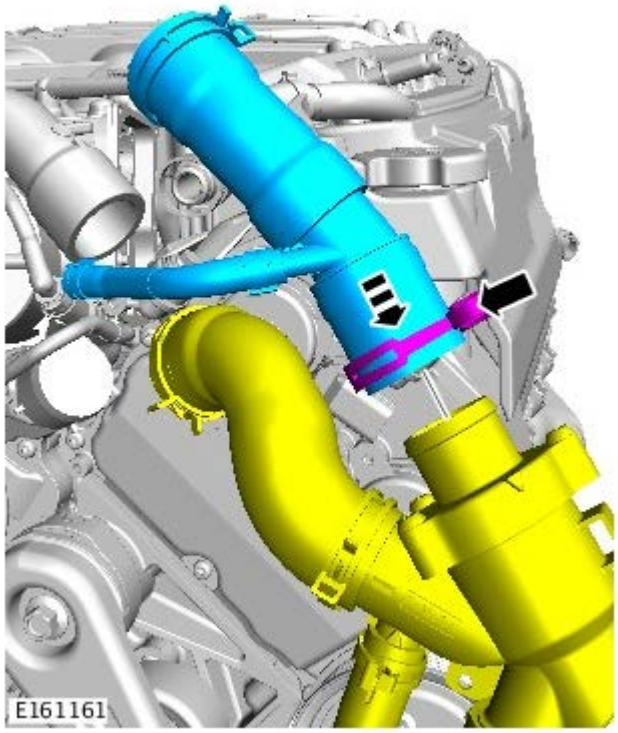
   Torque: 12 Nm



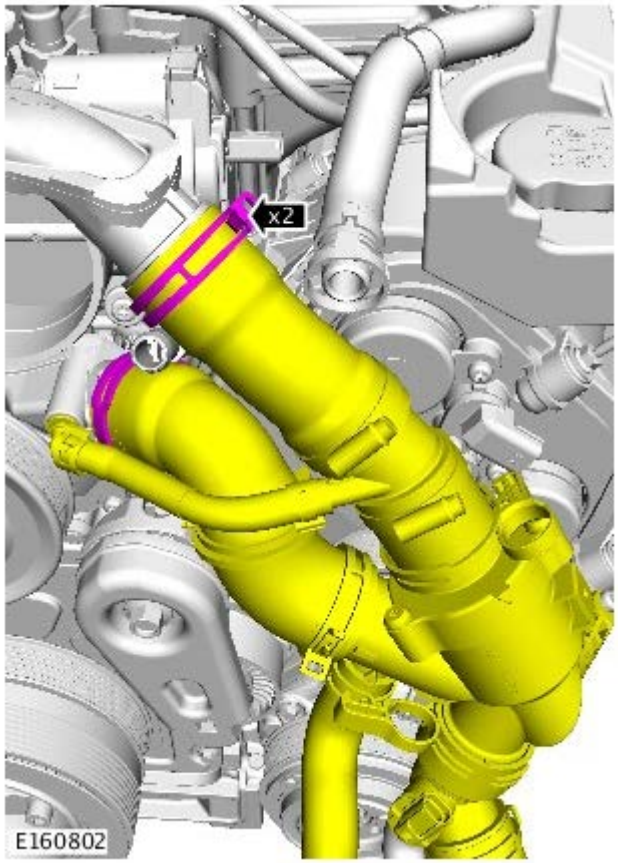
3. *Torque:* 48 Nm



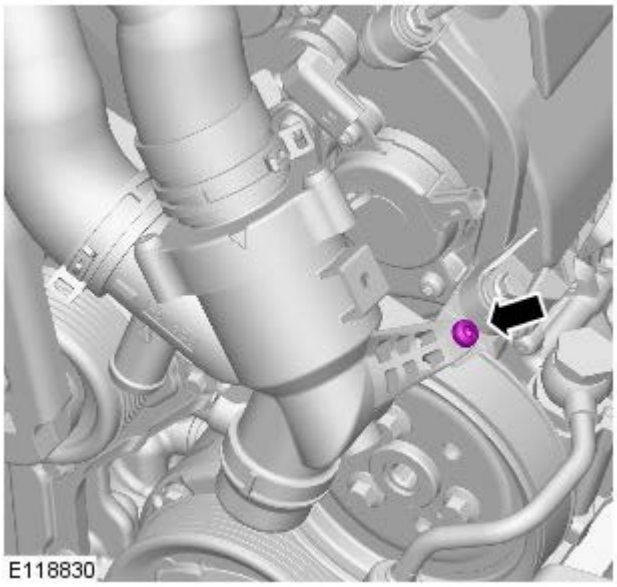
4. NOTE: If the component removed from the vehicle is not as what is detailed in the illustration, make sure the new version of the component is installed (refer to the parts catalogue).



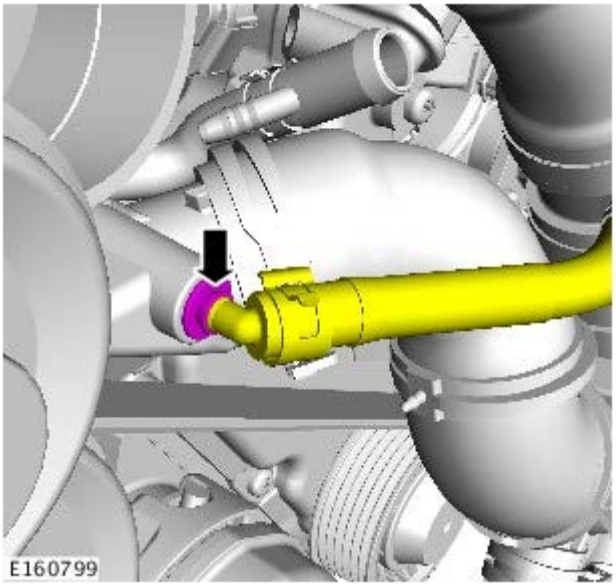
5.



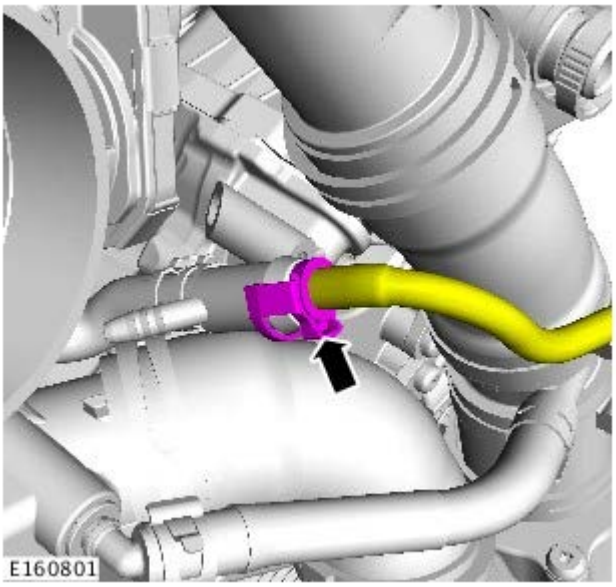
6. *Torque:* 10 Nm



7.



8.



9. Refer to: Accessory Drive Belt (303-05C Accessory Drive - V8 S/C 5.0L Petrol, Removal and Installation).

10. Refer to: Cooling System Partial Draining, Filling and Bleeding - V8 S/C 5.0L Petrol (303-03C Engine Cooling - V8 S/C 5.0L Petrol, General Procedures).

Published: 04-Mar-2013

Engine Cooling - V8 S/C 5.0L Petrol - Radiator

Removal and Installation

Removal

1. WARNING: Make sure to support the vehicle with axle stands.

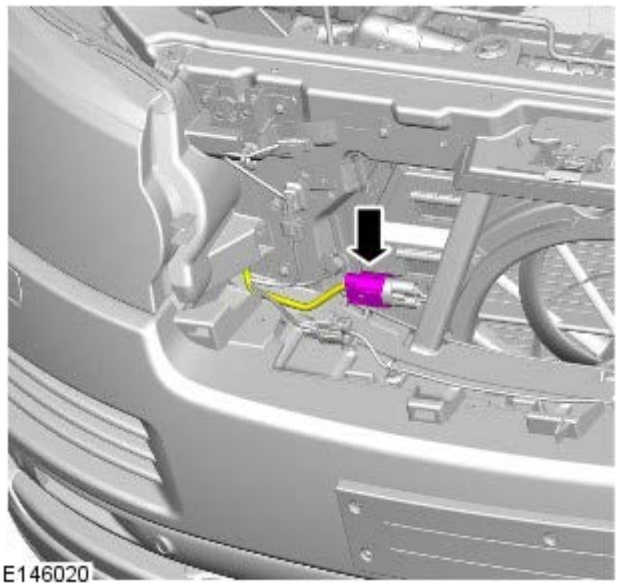
   Raise and support the vehicle.

2. Refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00 Climate Control System - General Information, General Procedures).

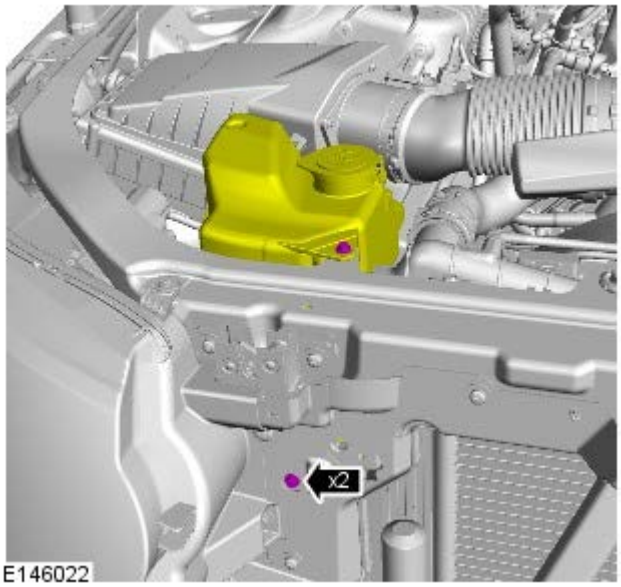
3. Refer to: Cooling System Partial Draining, Filling and Bleeding - V8 S/C 5.0L Petrol (303-03C Engine Cooling - V8 S/C 5.0L Petrol, General Procedures).

4. Refer to: Cooling Fan (303-03C Engine Cooling - V8 S/C 5.0L Petrol, Removal and Installation).

5. Refer to: Front Bumper Cover (501-19 Bumpers, Removal and Installation).



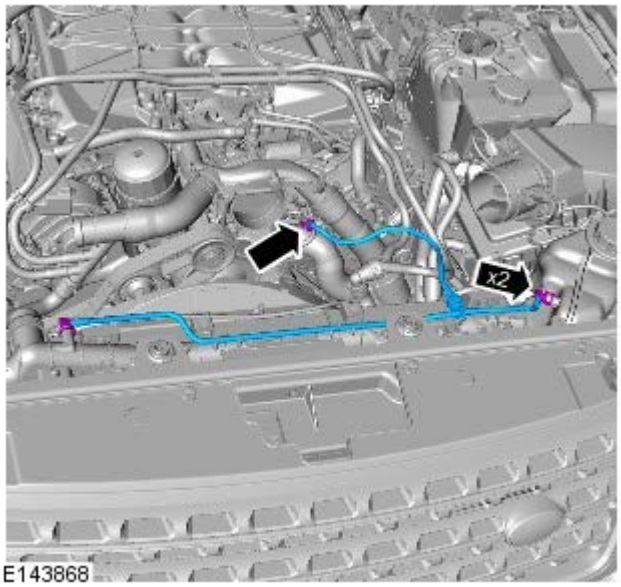
6. NOTE: If equipped.



7. NOTE: If equipped.

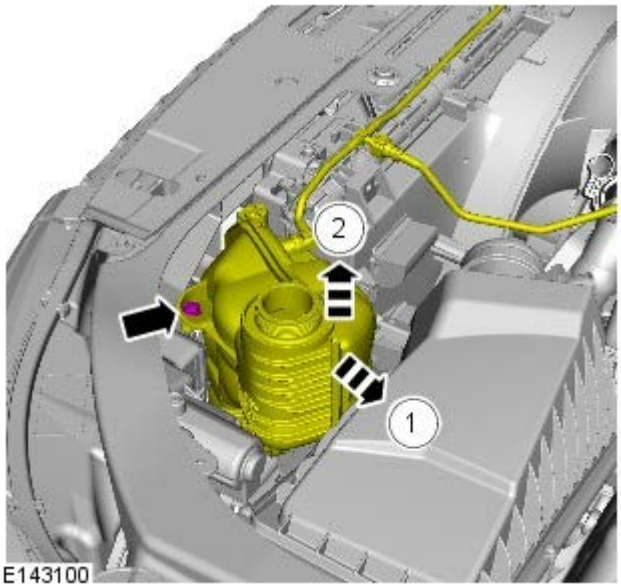
   Torque: 7 Nm

8.



E143868

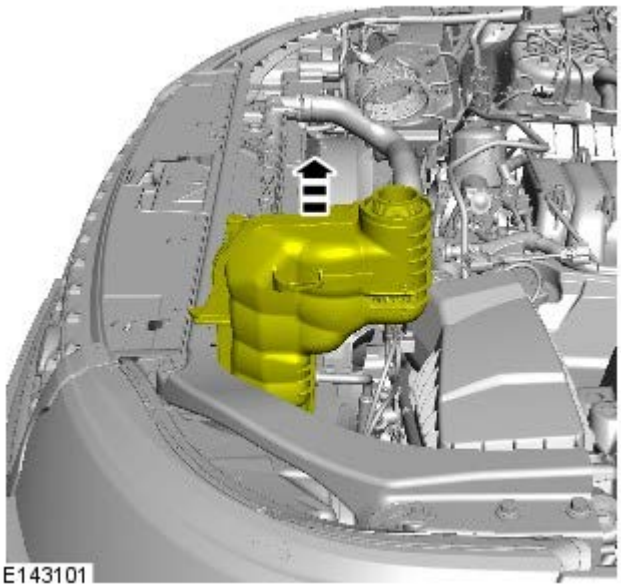
9. *Torque:* 2.8 Nm



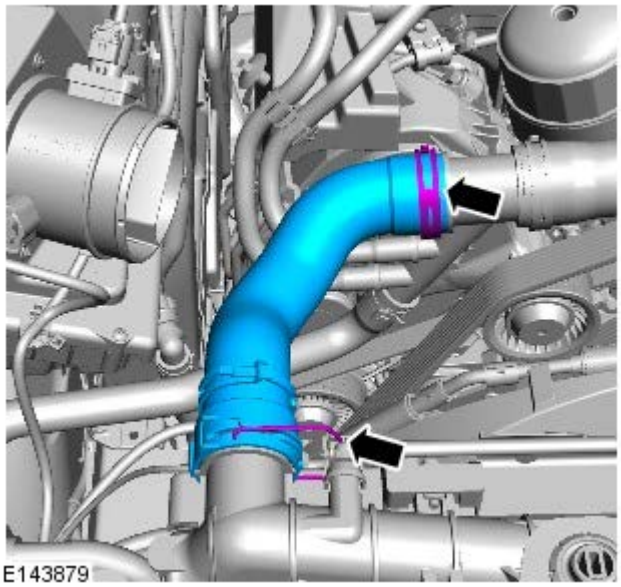
E143100

10. NOTE: Keep the coolant expansion tank vertically.

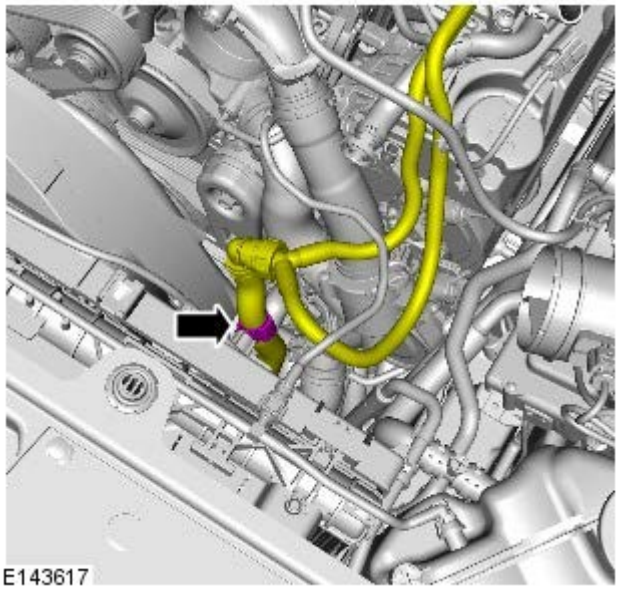
Raise the coolant expansion tank minimum 110mm from its original position.


E143101

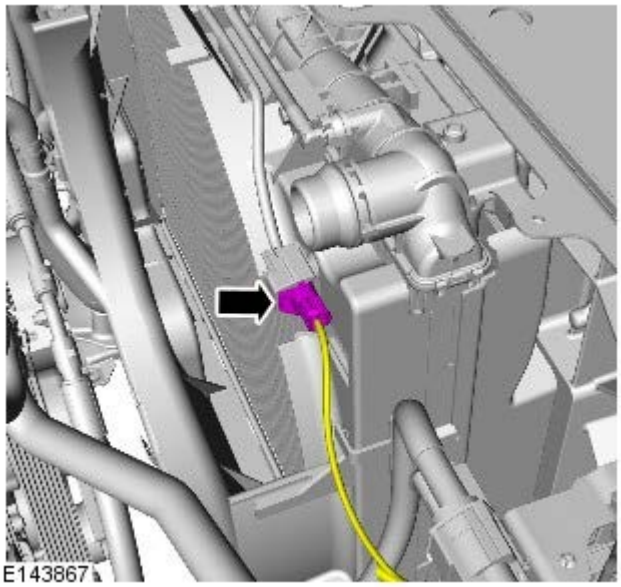
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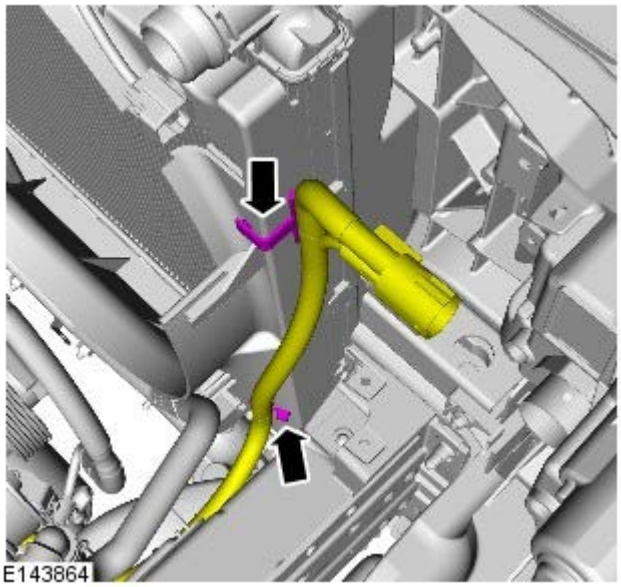
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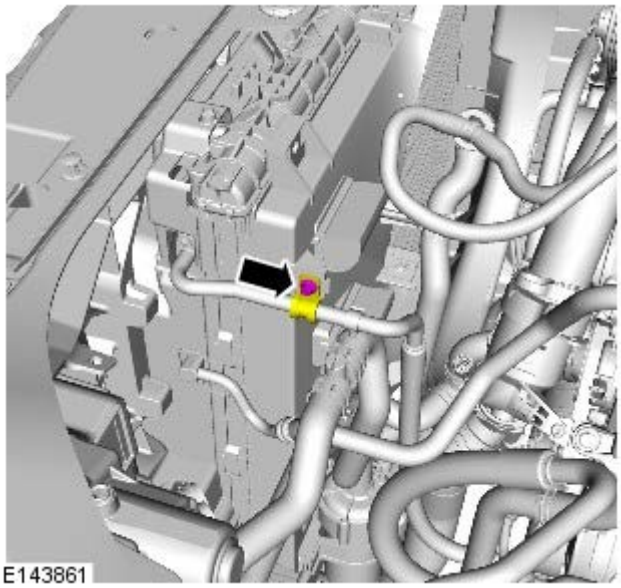
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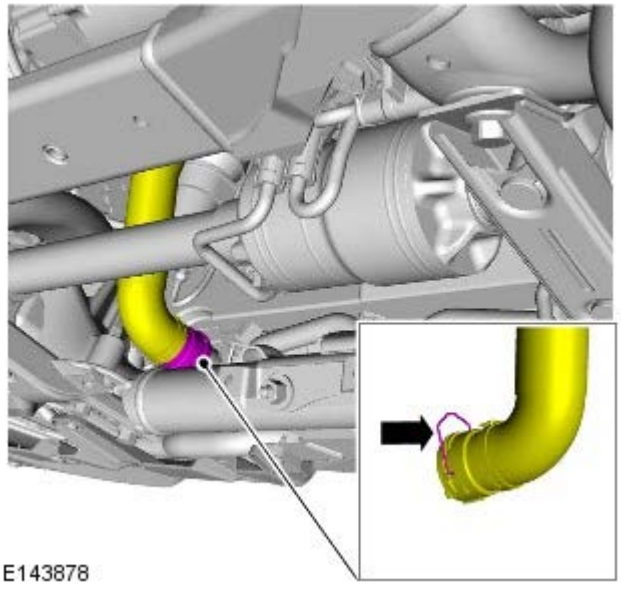
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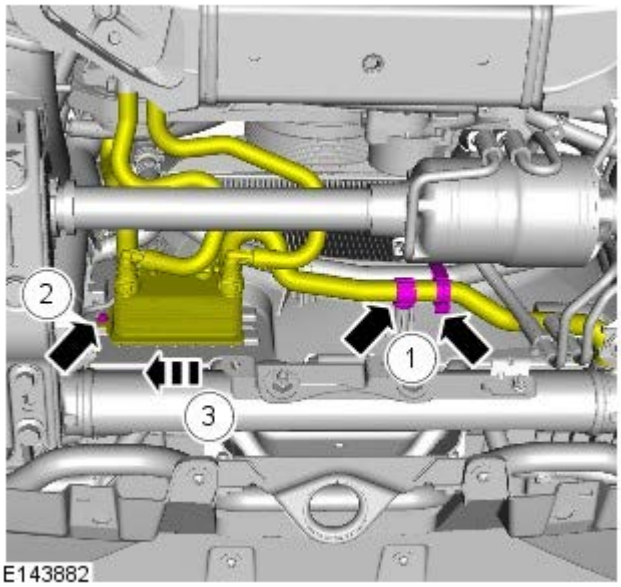
15. *Torque:* 7 Nm



16.

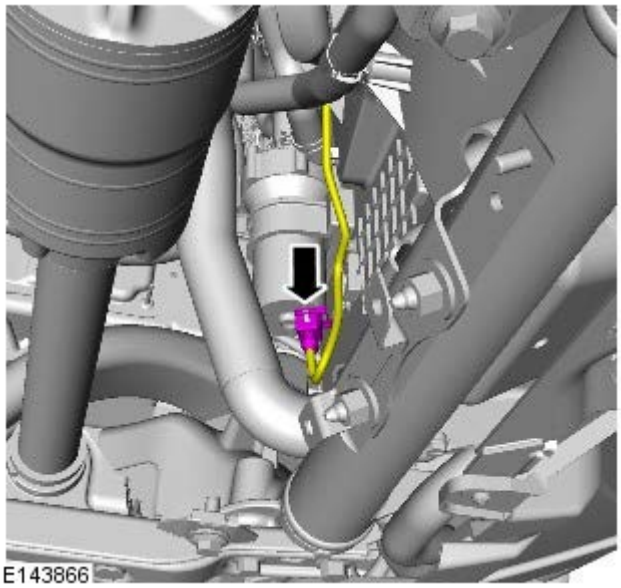


17. *Torque:* 7 Nm

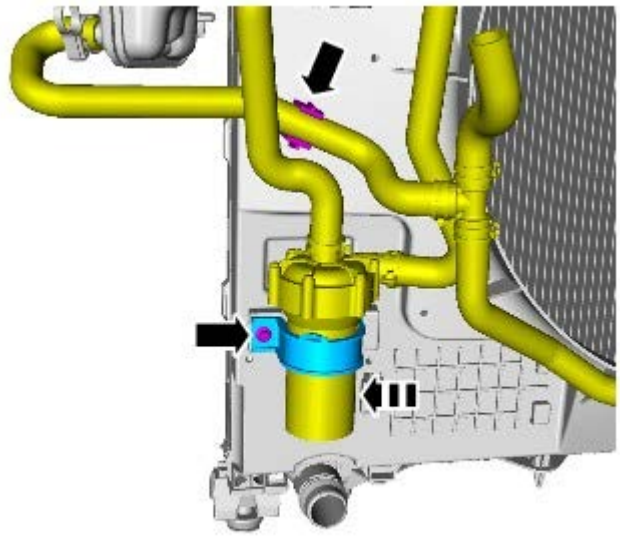


E143882

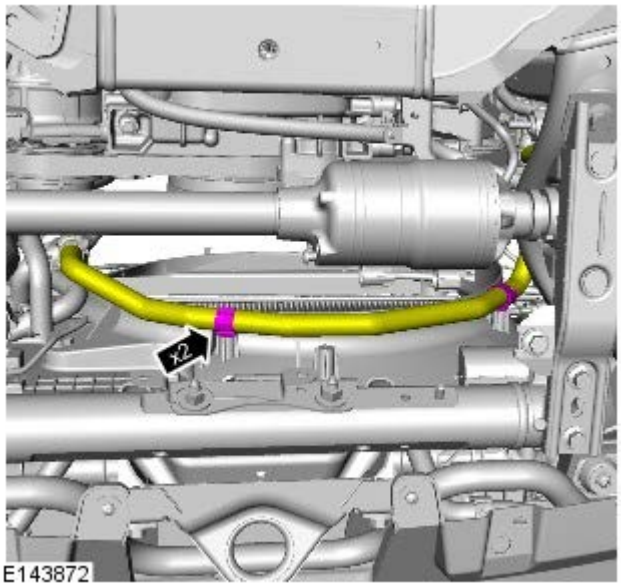
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E143866

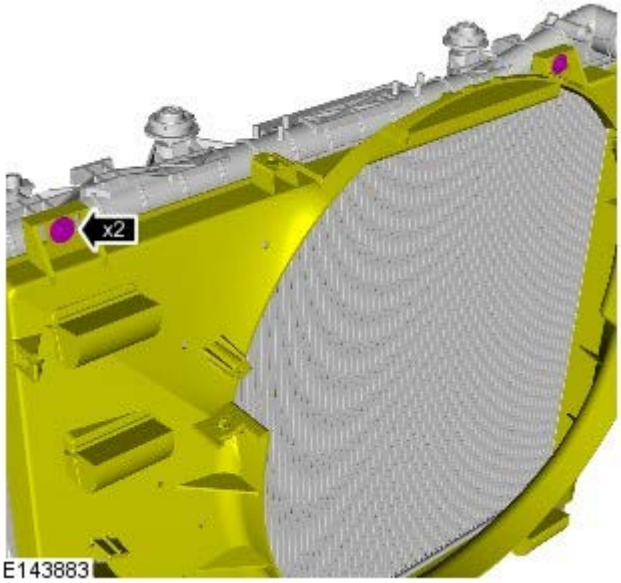
19. *Torque:* 7 Nm


E143865

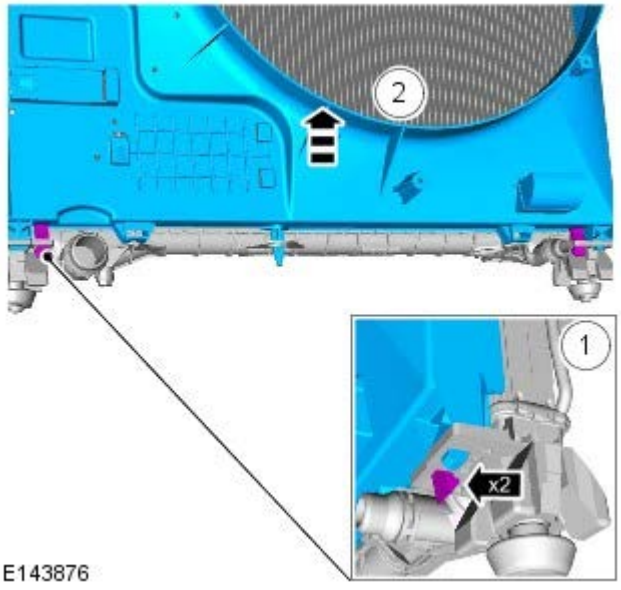
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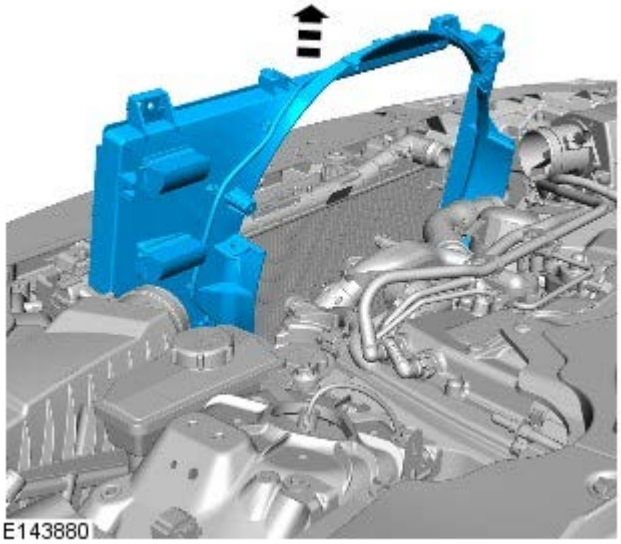
21. *Torque:* 7 Nm

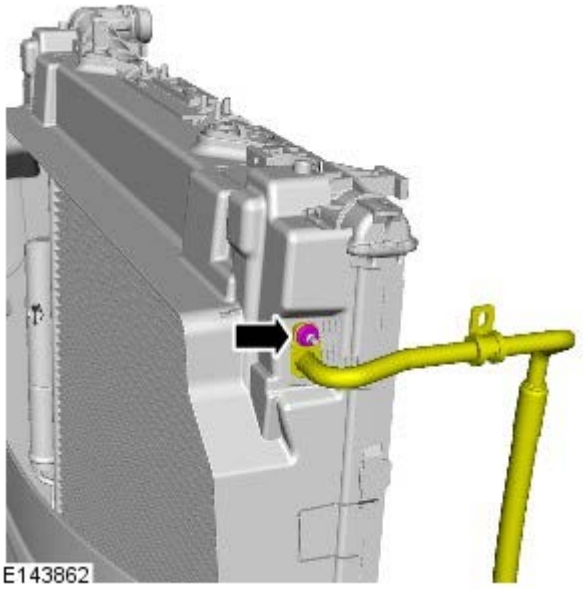


22.



23. CAUTION: Always protect the cooling pack elements to prevent accidental damage.





24. CAUTIONS:

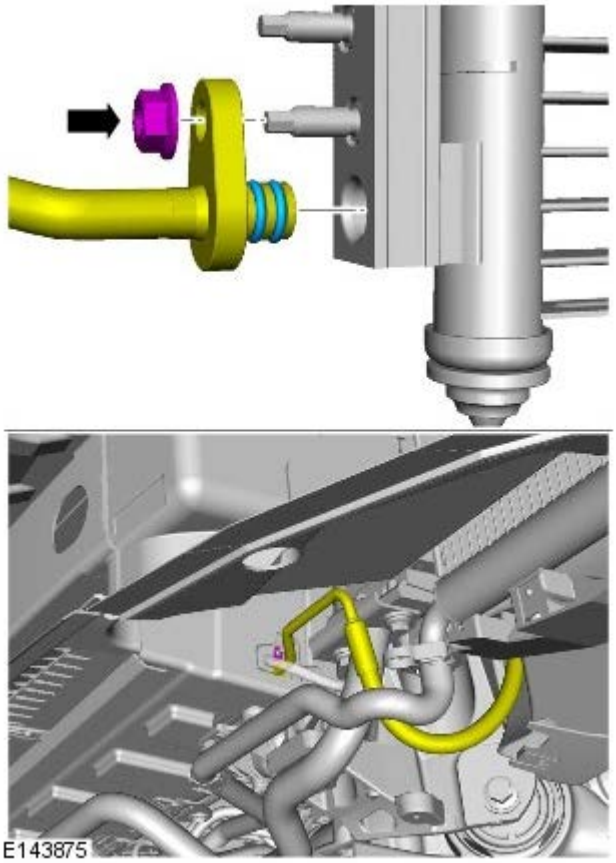
    Make sure that all openings are sealed. Use new blanking caps.

    Remove and discard the O-ring seals.

    Torque: 8 Nm

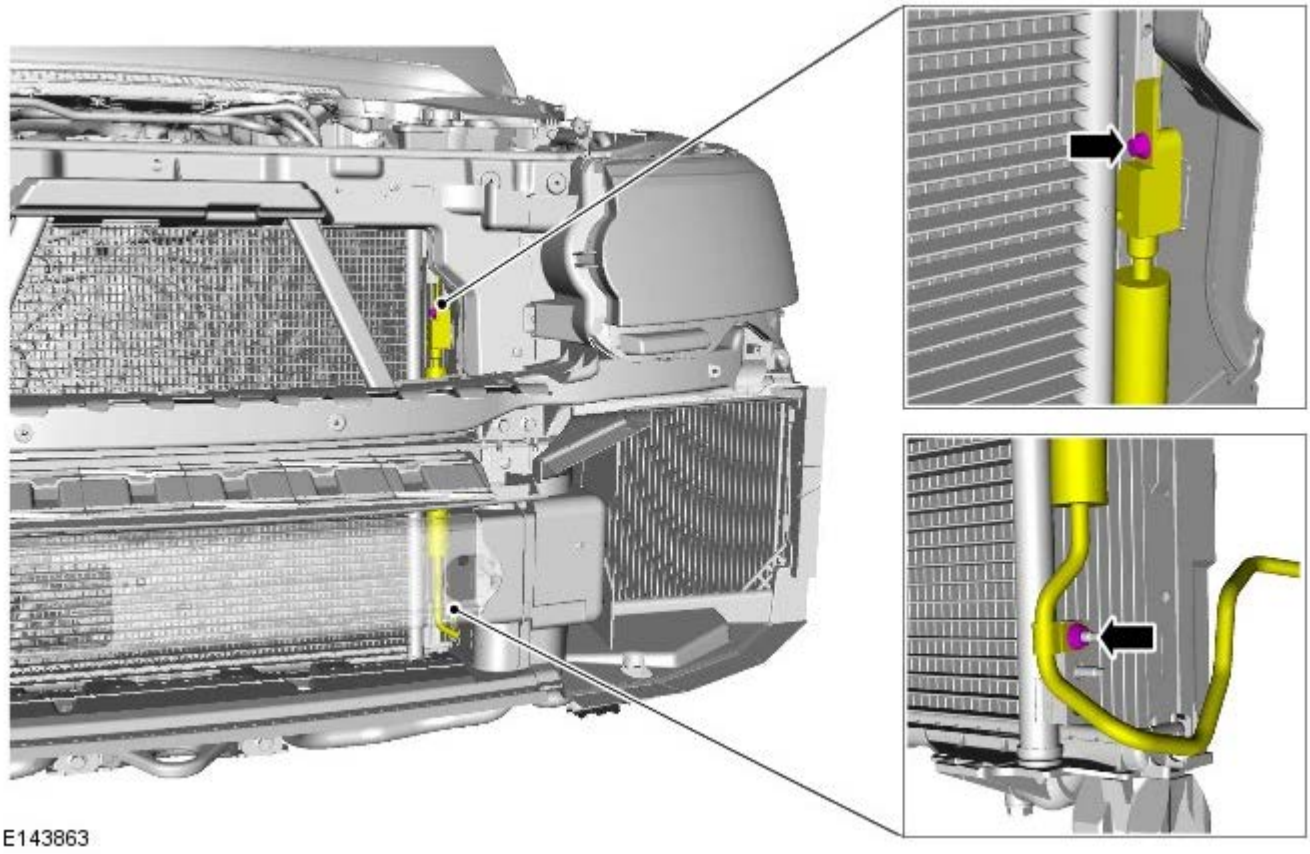
25. CAUTION: Remove and discard the O-ring seals.

    Torque: 8 Nm

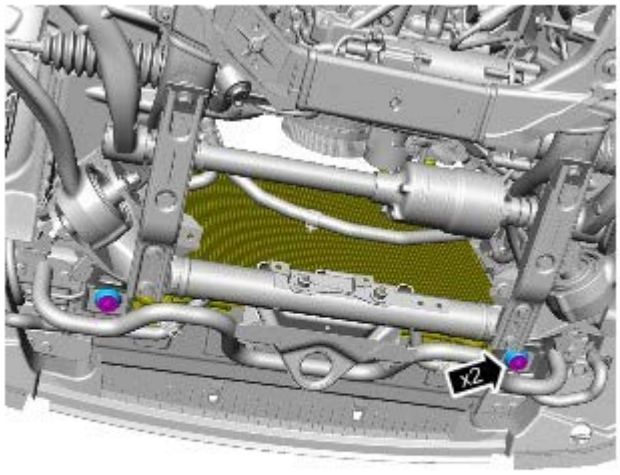


26. NOTE: If equipped.

Torque: 7 Nm

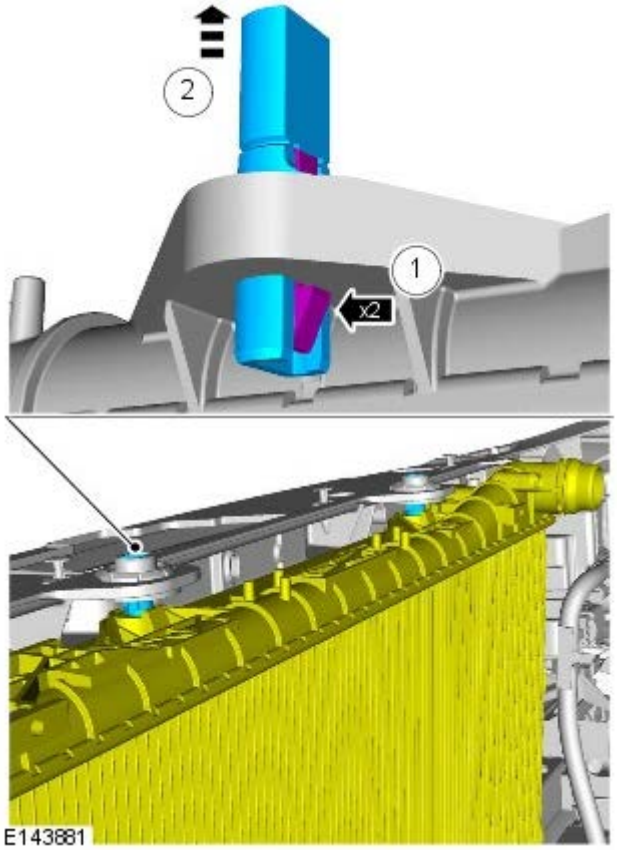


27. *Torque:* 15 Nm



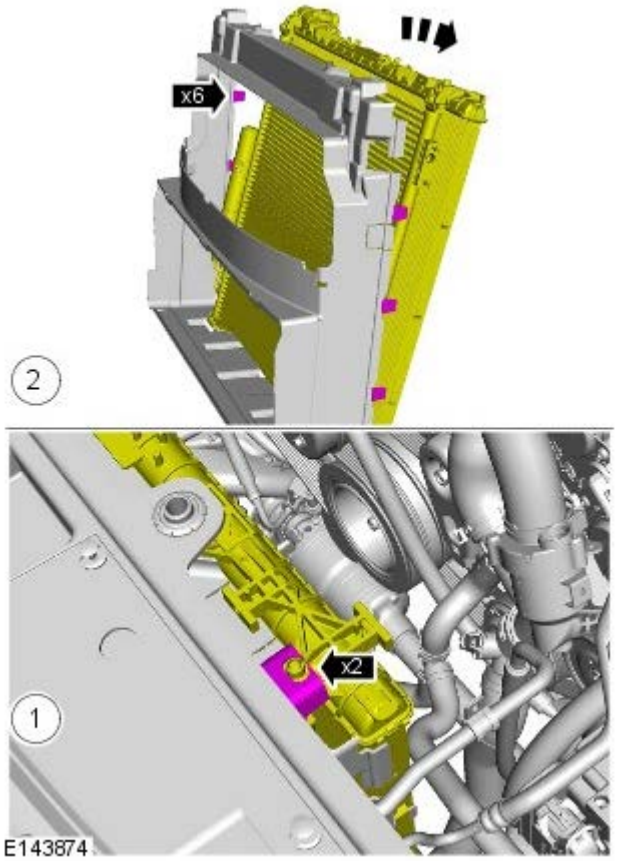
E143877

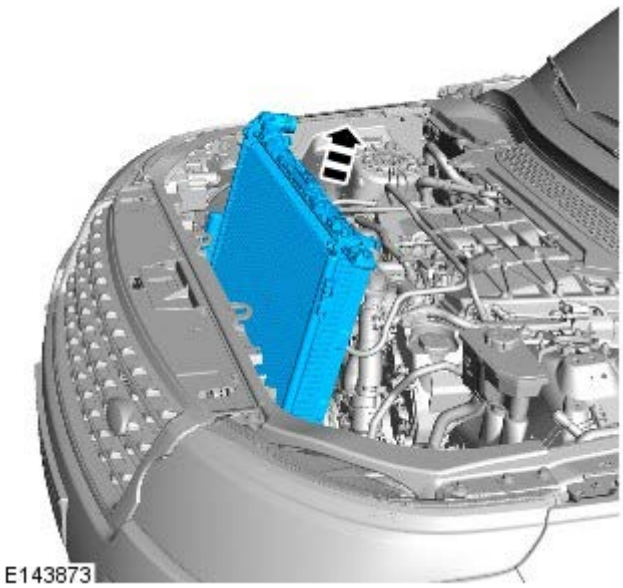
28.



E143881

29. CAUTION: Always protect the cooling pack elements to prevent accidental damage.





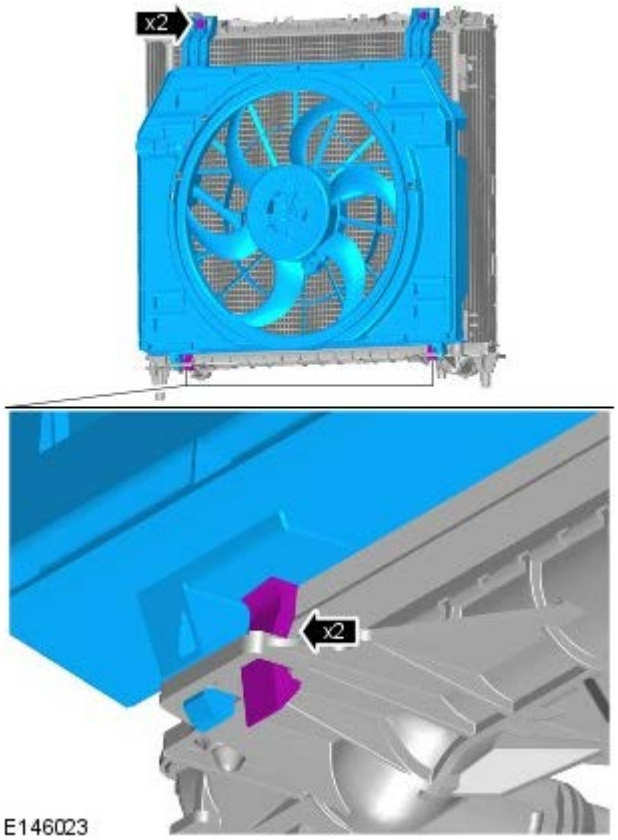
30. CAUTION: Always protect the cooling pack elements to prevent accidental damage.

31. NOTES:

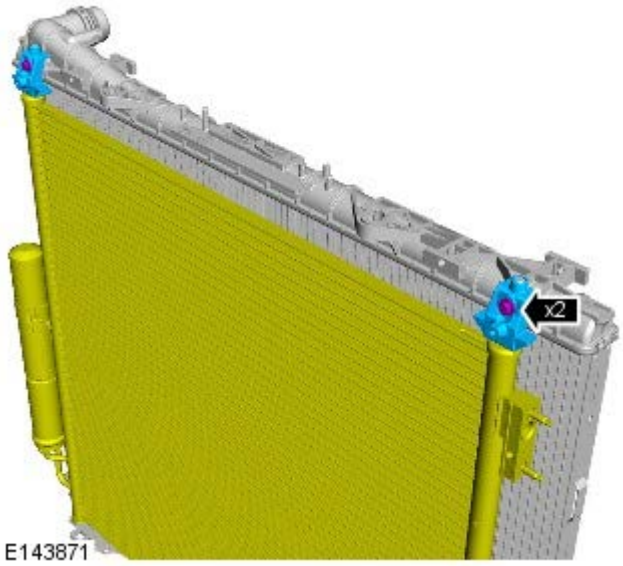
If equipped.

Do not disassemble further if the component is removed for access only.

Torque: 7 Nm



32. *Torque:* 4.5 Nm



33.



E143870

Installation

1. To install, reverse the removal procedure.

Published: 31-Jul-2012

Engine Cooling - V8 S/C 5.0L Petrol - Thermostat Housing

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.

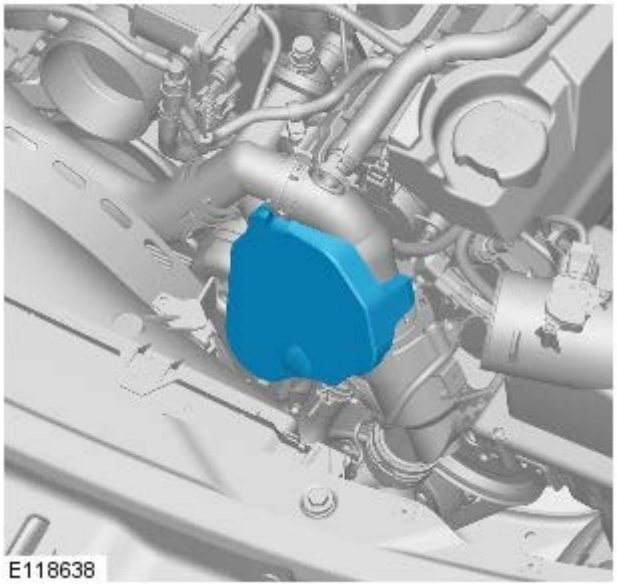
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

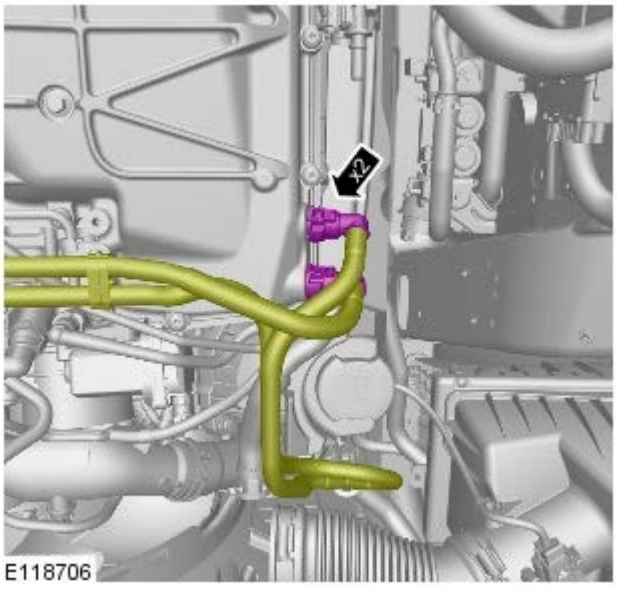
2. Refer to: Cooling System Partial Draining, Filling and Bleeding - V8 S/C 5.0L Petrol (303-03, General Procedures).

3. Refer to: Air Cleaner Outlet Pipe LH (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).

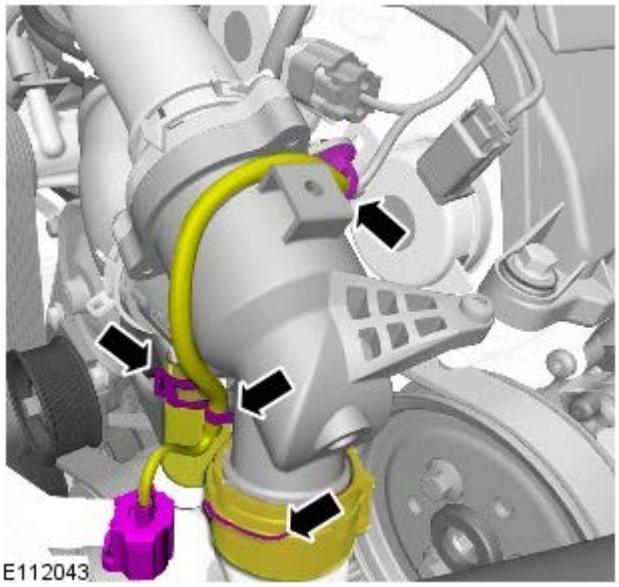
4.



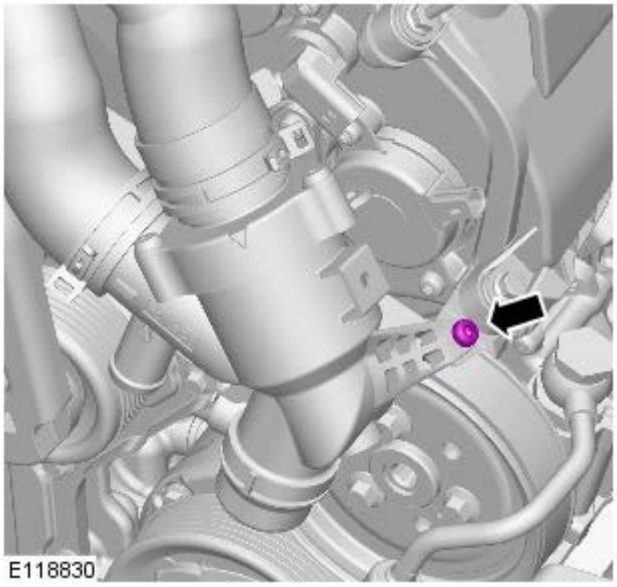
5.



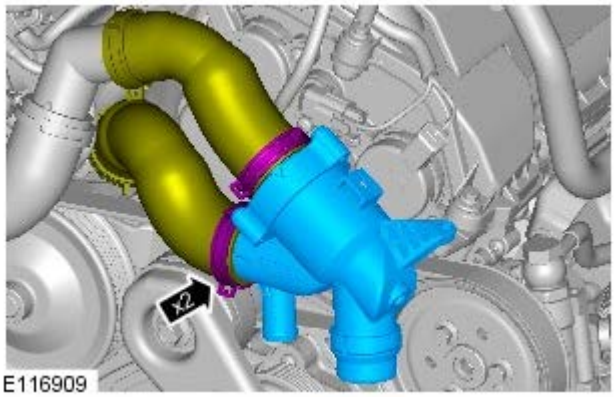
6.



7. *Torque:* 10 Nm



8. NOTE: The retaining clips cannot be removed from the pipe.



Installation

1. To install, reverse the removal procedure.

Published: 02-May-2013

Engine Cooling - V8 S/C 5.0L Petrol - Front Electric Cooling Fan

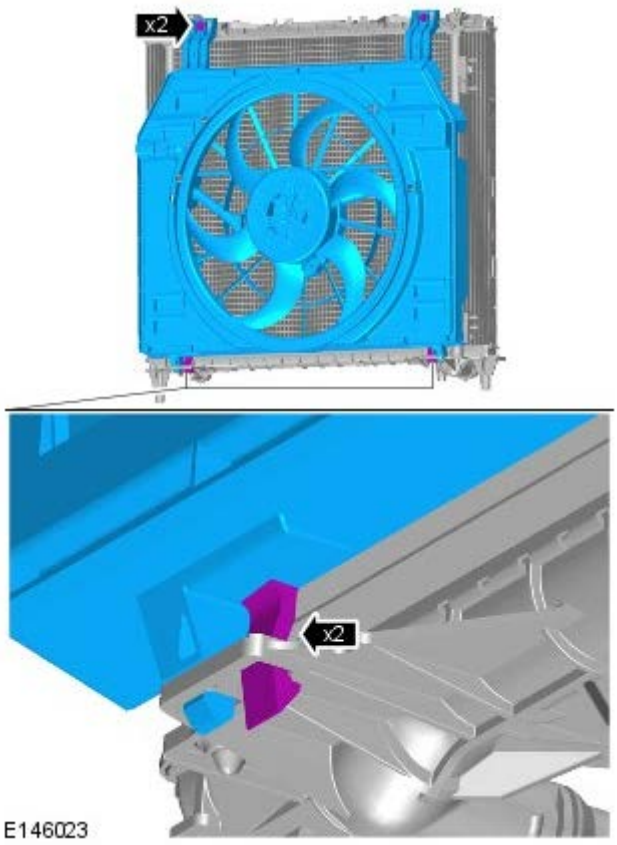
Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Cooling Module (303-03B, Removal and Installation).
   Refer to: Cooling Module (303-03C Engine Cooling - V8 S/C 5.0L Petrol, Removal and Installation).

2. *Torque:* 7 Nm



Installation

1. To install, reverse the procedure.

Published: 02-May-2013

Engine Cooling - V8 S/C 5.0L Petrol - Cooling Fan

Removal and Installation

Special Tool(s)

 E46076	303-1142 Viscous Coupling Wrench
 E55382	303-1143 Viscous Coupling Holding Tool

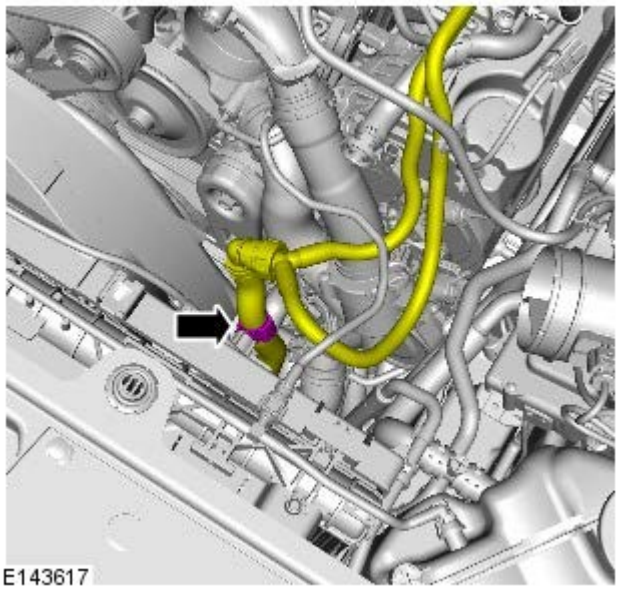
Removal

1. Disconnect the battery ground cable.

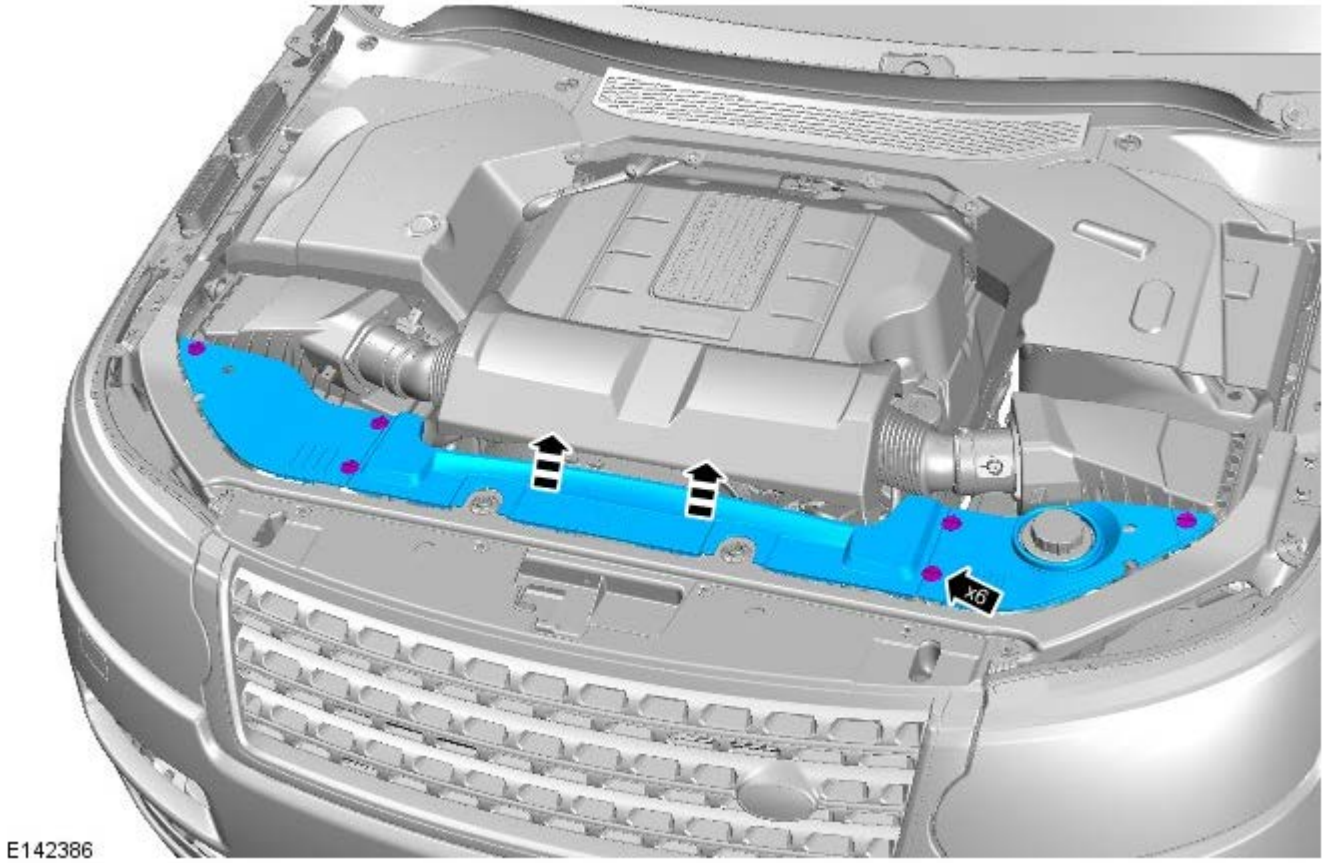
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

2. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).

3.

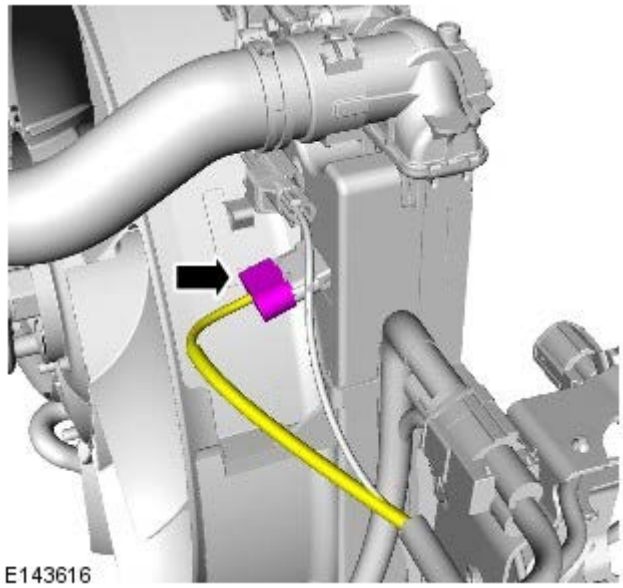


4.

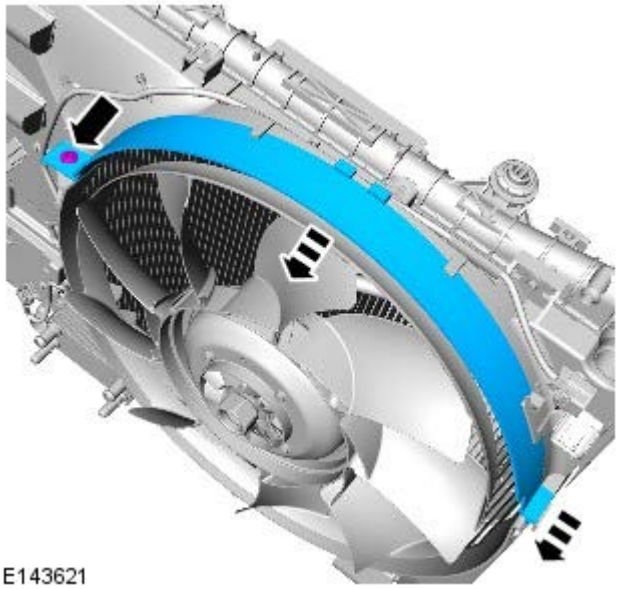


E142386

5.

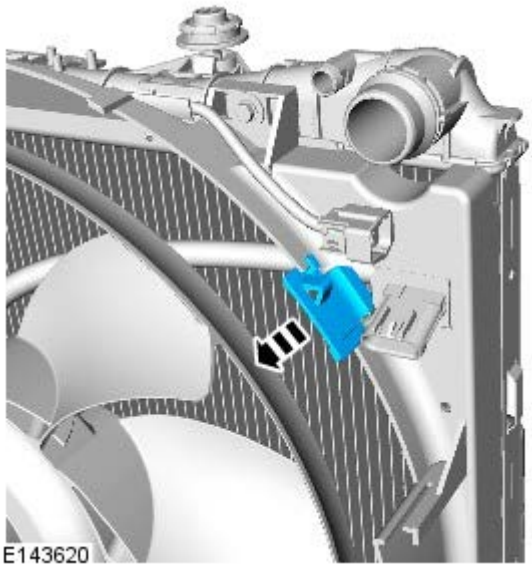

E143616

6. *Torque:* 4 Nm



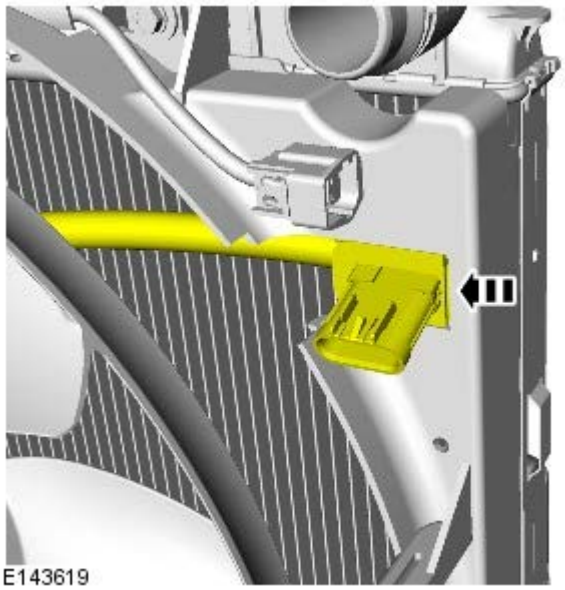
E143621

7.



E143620

8.



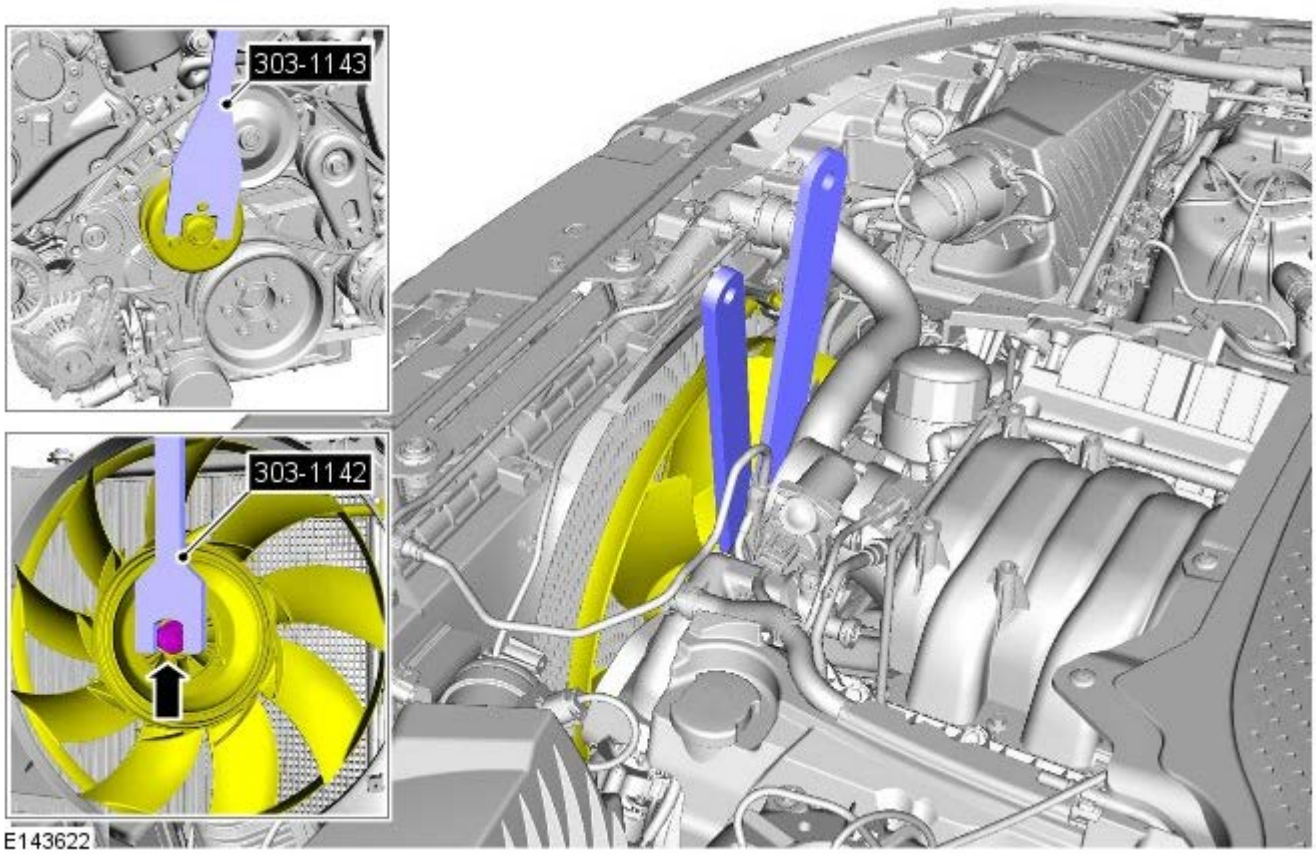
E143619

9. NOTES:

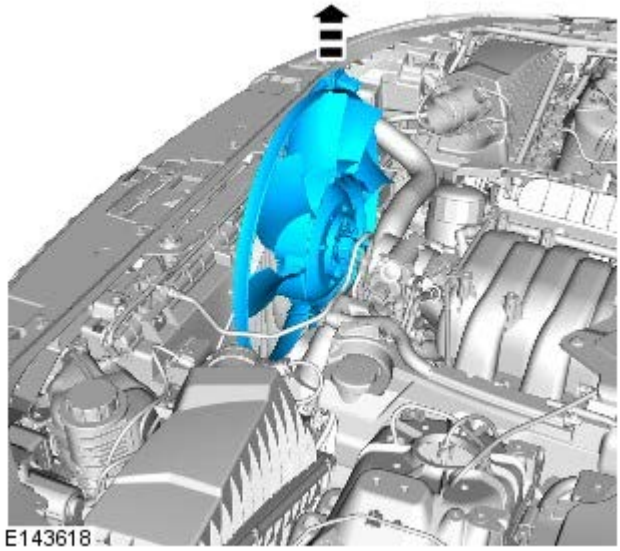
The thread is right handed.

Always protect the cooling pack elements to prevent accidental damage.

Special Tool(s): 303-1142, 303-1143
Torque: 65 Nm



10.



Installation

1. To install, reverse the removal procedure.

Published: 02-May-2013

Engine Cooling - V8 S/C 5.0L Petrol - Cooling Fan Shroud

Removal and Installation

Removal

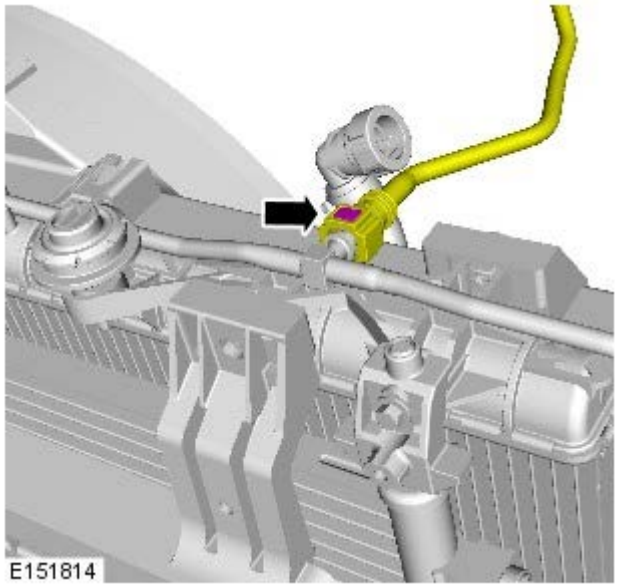
NOTES:

Removal steps in this procedure may contain installation details.

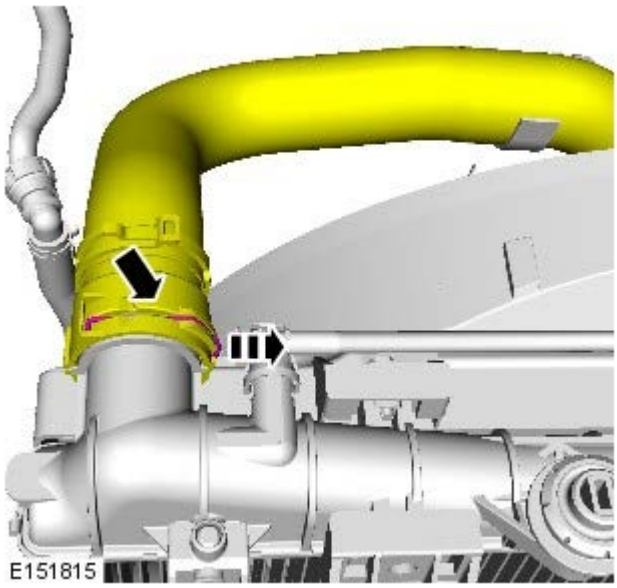
Some variation in the illustrations may occur, but the essential information is always correct.

Components shown removed for clarity.

1. Refer to: Cooling Fan (303-03 Engine Cooling - V6 S/C 3.0L Petrol, Removal and Installation).

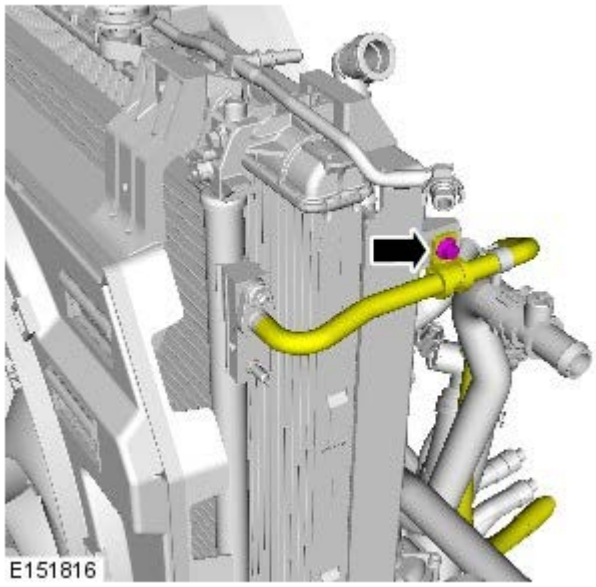


2. NOTE: Be prepared to collect escaping coolant.

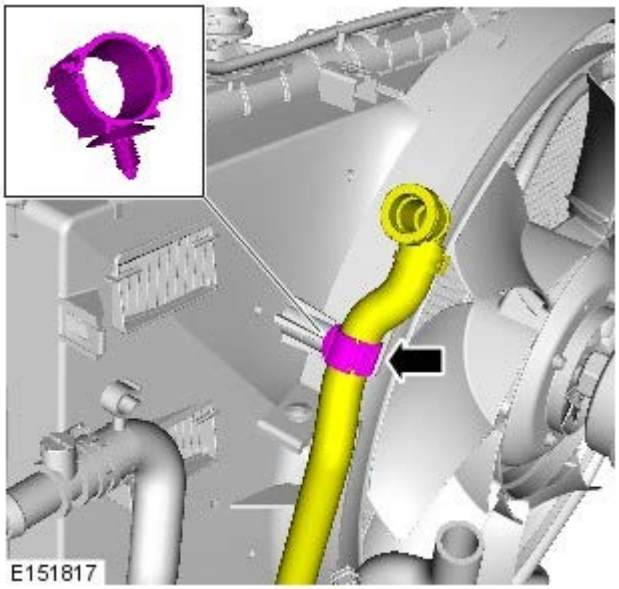


3. NOTE: Be prepared to collect escaping coolant.

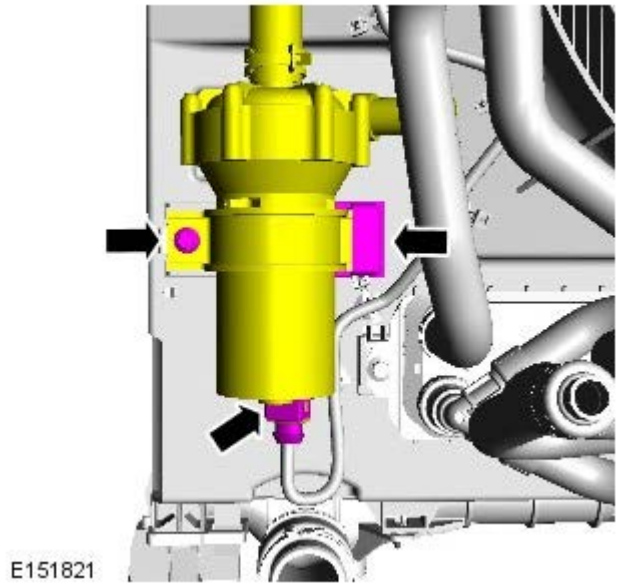
4. *Torque:* 7 Nm



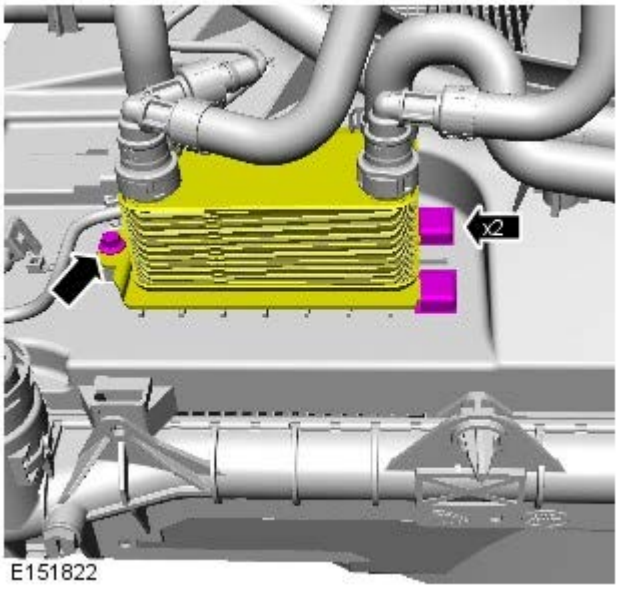
5.



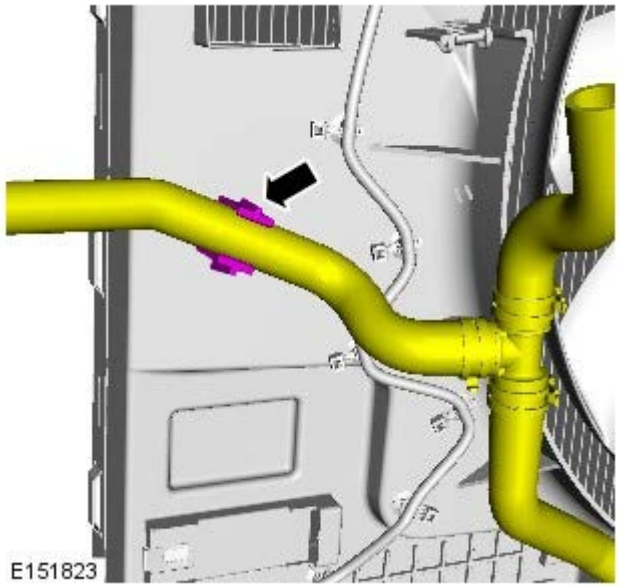
6. *Torque:* 5 Nm



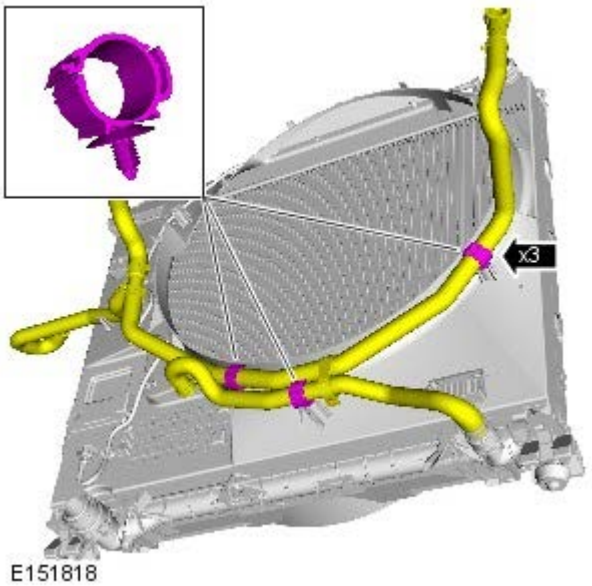
7. *Torque:* 7 Nm



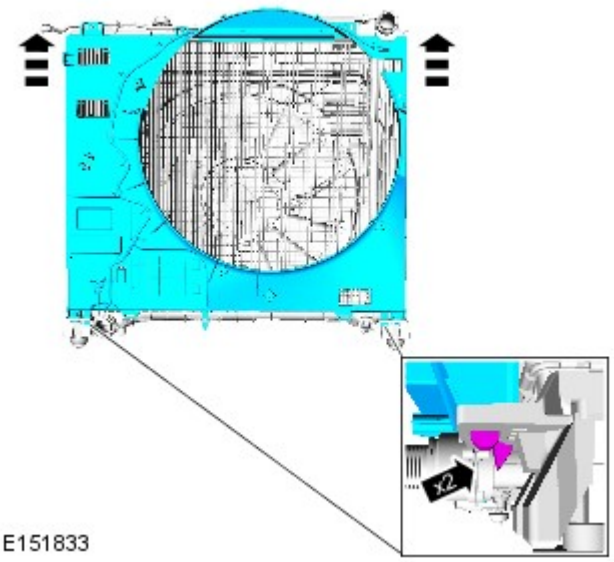
8.



9.

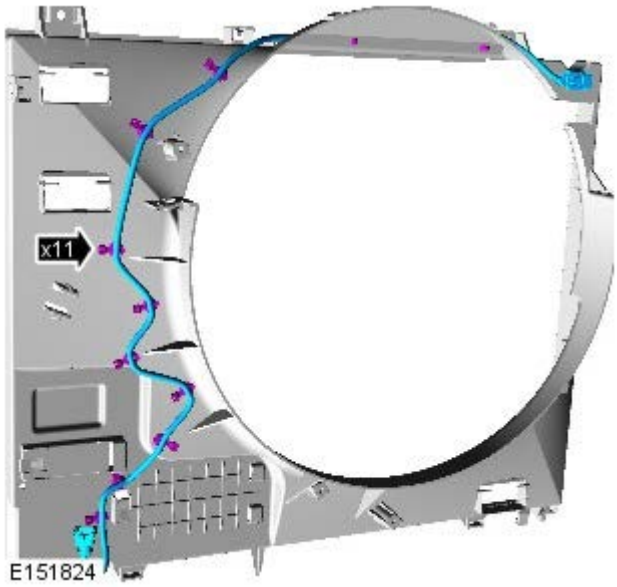


10.



NOTE: Do not disassemble further if component is removed for access only.

11.



Installation

1. To install, reverse the removal procedure.

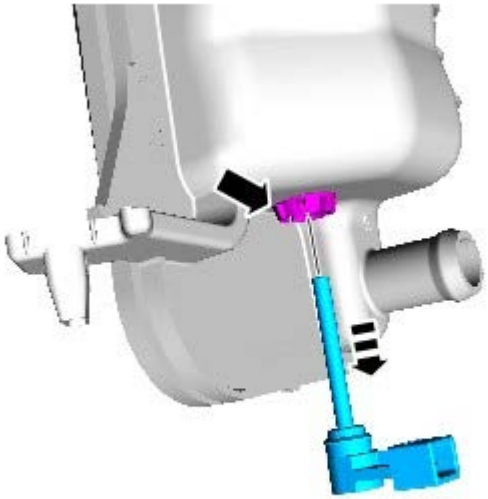
Published: 11-Dec-2013

Engine Cooling - V8 S/C 5.0L Petrol - Engine Coolant Level Switch

Removal and Installation

Removal

1. Refer to: Coolant Expansion Tank (303-03G Engine Cooling - SDV6 3.0L Diesel - Hybrid Electric Vehicle, Removal and Installation).



E162437

2. CAUTION: Care must be taken not to damage the component.

Installation

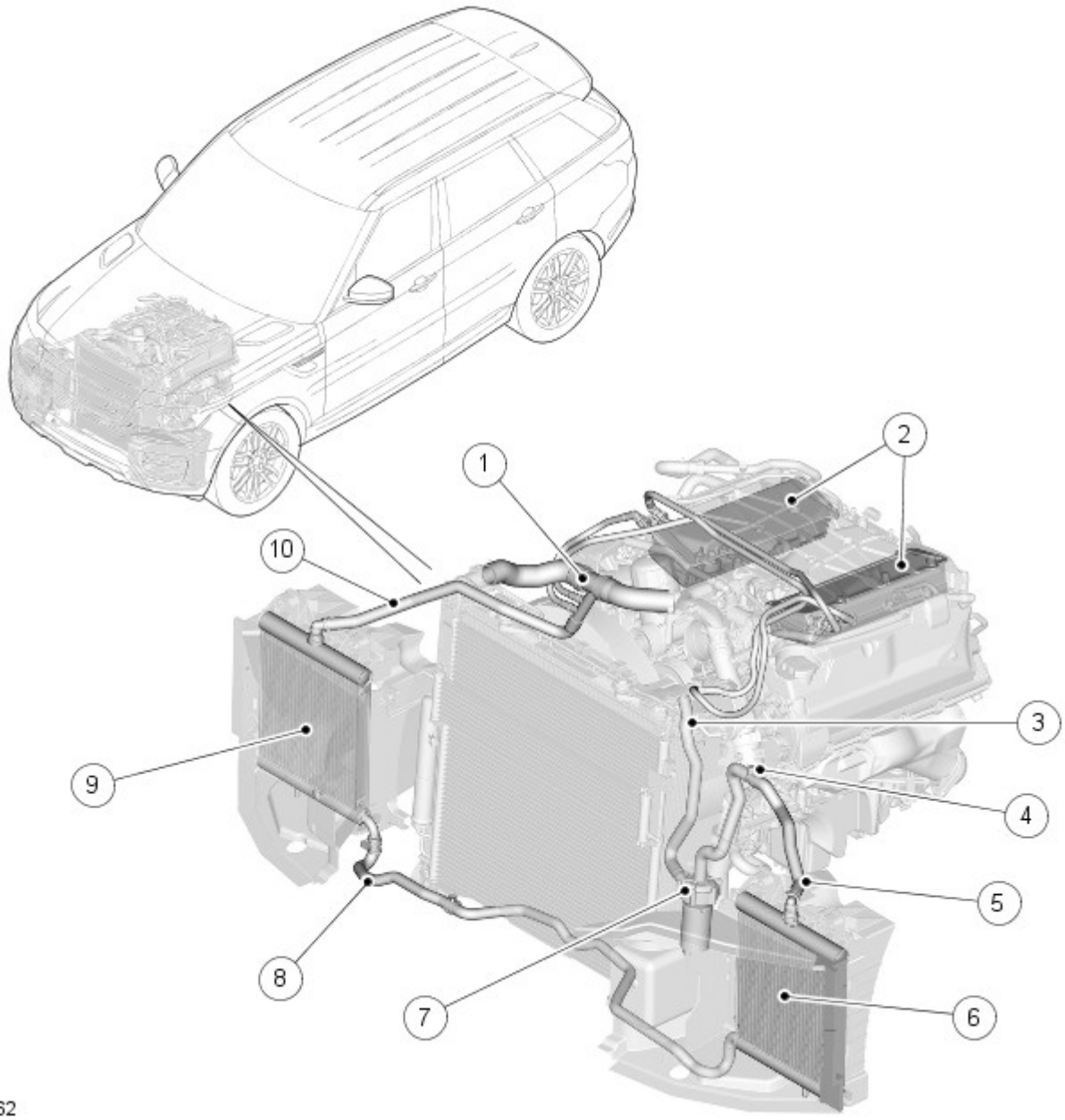
1. To install, reverse the removal procedure.

Published: 02-May-2013

Supercharger Cooling - V6 S/C 3.0L Petrol - Supercharger Cooling

Description and Operation

COMPONENT LOCATION



E152362

Item	Part Number	Description
1	-	Radiator upper hose
2	-	Charge air coolers
3	-	Hose - coolant feed to air charge coolers
4	-	Bleed screw
5	-	Hose - charge air radiator to coolant pump
6	-	Left air charge air radiator
7	-	Charge air coolant pump
8	-	Hose - charge air radiators
9	-	Right air charge radiator
10	-	Hose - return from charge air coolers

OVERVIEW

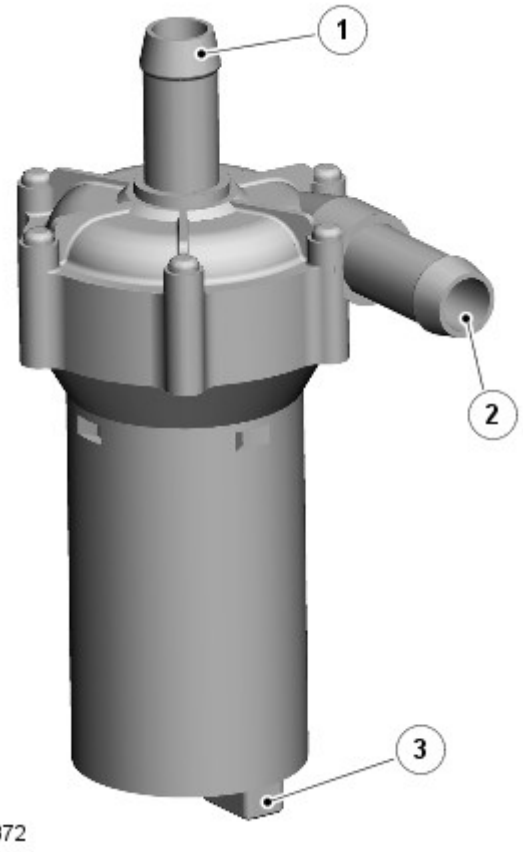
The supercharger cooling system uses engine coolant to cool the pressurized charge air from the supercharger. The supercharger cooling system consists of:

A charge air coolant pump.
- Two charge air radiators.
- 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.

DESCRIPTION

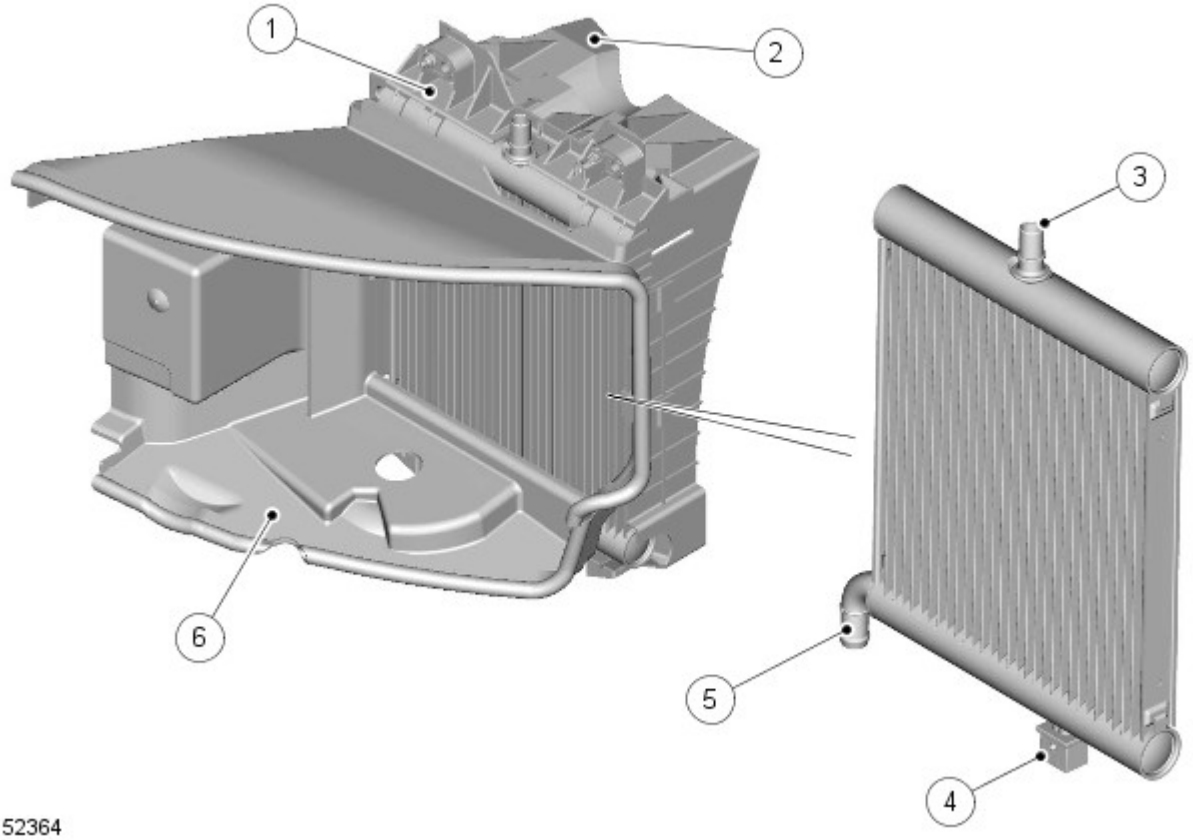
Charge Air Coolant Pump



Item	Part Number	Description
1	-	Coolant intake connection
2	-	Coolant outlet connection
3	-	Electrical connector

The charge air coolant pump is an electric pump attached to the rear left side of the engine cooling fan shroud. Hoses connect the intake of the charge air coolant pump to the left 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 Radiators



E152364

Item	Part Number	Description
1	-	Radiator support bracket
2	-	Rear air duct
3	-	Coolant hose connection - outlet on left radiator, inlet on right radiator
4	-	Isolator
5	-	Coolant hose connection - inlet on left radiator, outlet on right radiator
6	-	Front air duct

A charge air radiator is located each side of the cooling pack, behind the outer air intakes in the front bumper. The charge air radiators are installed in air ducts attached to the front bumper armature and the front end carrier. The lower end tank of each charge air radiator is located in the air ducts by a spigot fitted with an isolator bush. The upper end tank of each charge air radiator is held in a support bracket in the air duct.

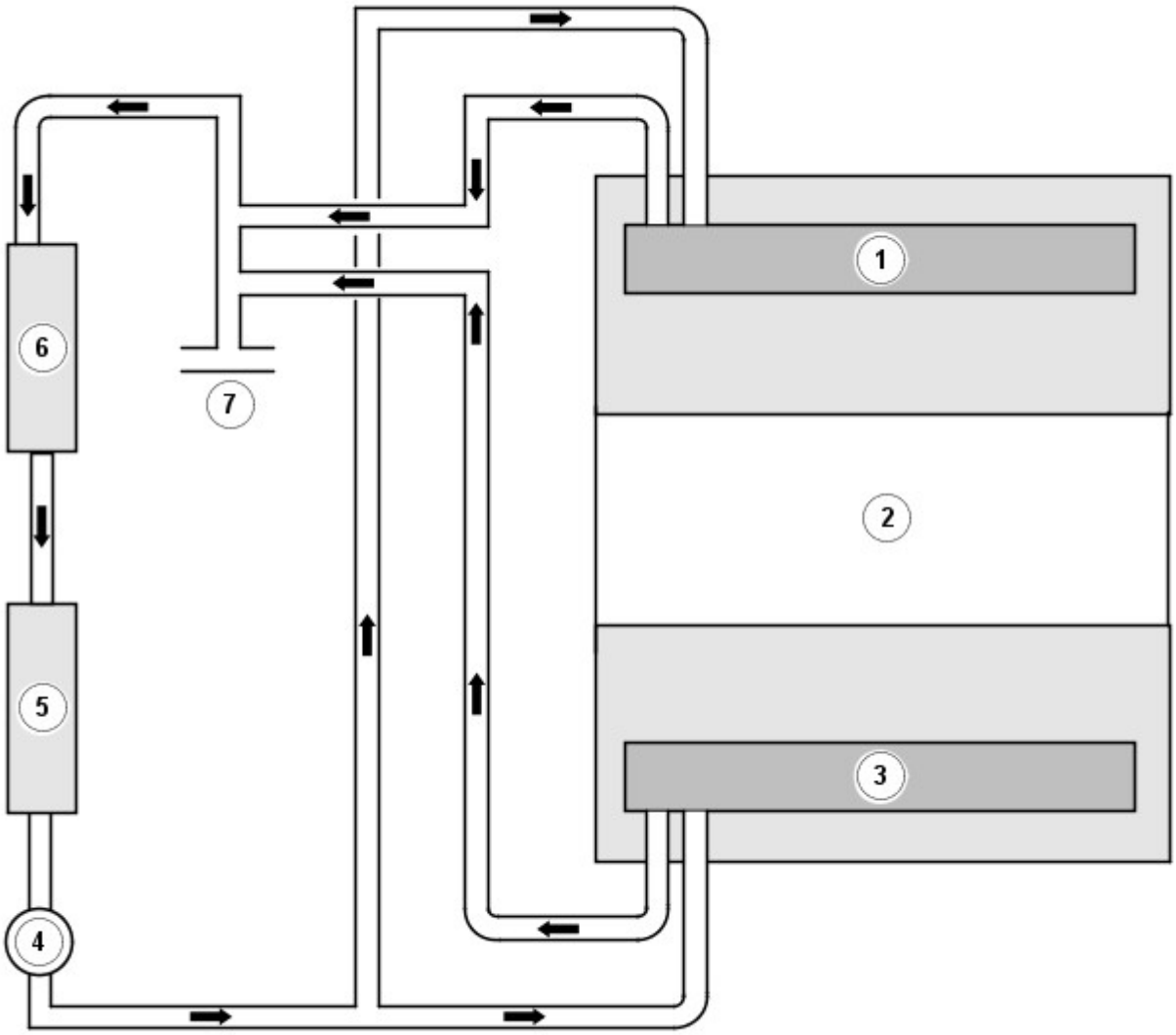
Hoses connect the two charge air radiators in series, the intake of the right radiator to the charge air coolers, and the outlet of the left radiator to the charge air coolant pump.

Charge Air Coolers

A charge air cooler is installed in each intake manifold.
For additional information, refer to: Intake Air Distribution and Filtering (303-12B Intake Air Distribution and Filtering - V6 S/C 3.0L Petrol, Description and Operation).

OPERATION

Supercharger Cooling Flow Diagram



E144929

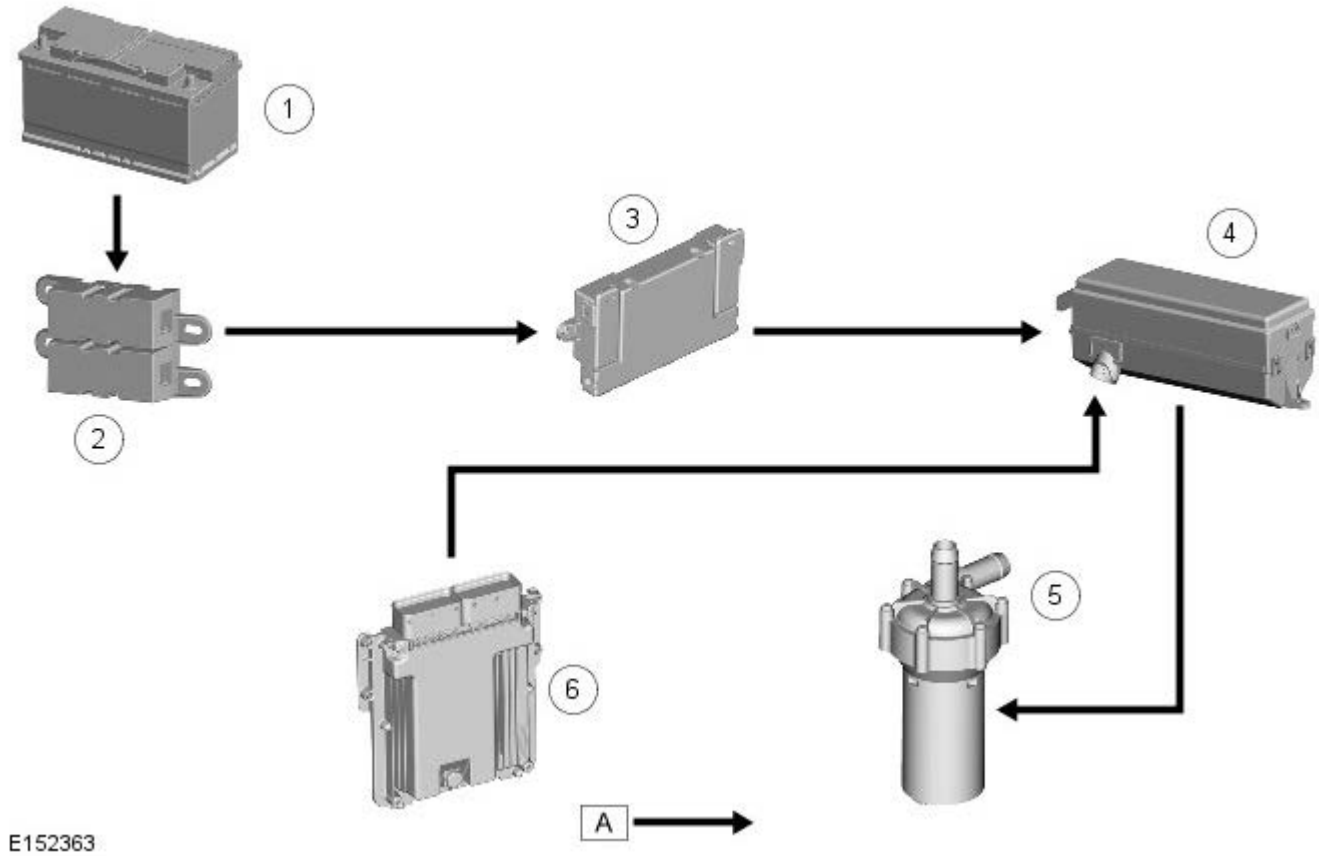
Item	Part Number	Description
1	-	Right charge air cooler
2	-	Engine
3	-	Left charge air cooler
4	-	Charge air coolant pump
5	-	Left charge air radiator
6	-	Right charge air radiator
7	-	Radiator upper hose

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 radiators and back to the pump intake.

Control Diagram

NOTE: A = Hardwired



E152363

Item	Part Number	Description
1	-	Battery
2	-	Battery Junction Box 2 (BJB2)
3	-	Battery Junction Box (BJB)
4	-	Engine Junction Box (EJB) (charge air coolant pump relay)
5	-	Charge air coolant pump
6	-	Engine Control Module (ECM)

Published: 17-Jun-2013

Supercharger Cooling - V6 S/C 3.0L Petrol - Supercharger Cooling

Diagnosis and Testing

Principle of Operation

For a detailed description of the supercharger cooling system and operation, refer to the relevant Description and Operation section in the workshop manual. REFER to:

Supercharger Cooling (303-03D Supercharger Cooling - V6 S/C 3.0L Petrol, Description and Operation),
Supercharger Cooling (303-03 Supercharger Cooling - V6 S/C 3.0L Petrol, Description and Operation),
Supercharger Cooling (303-03 Supercharger Cooling - V6 S/C 3.0L 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 • Primary 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 condition is found, correct the cause (if possible) before proceeding to the symptom chart.
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.

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 - V6 S/C 3.0L Petrol , DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation).

Published: 15-May-2013

Supercharger Cooling - V6 S/C 3.0L Petrol - Coolant Pump

Removal and Installation

Removal

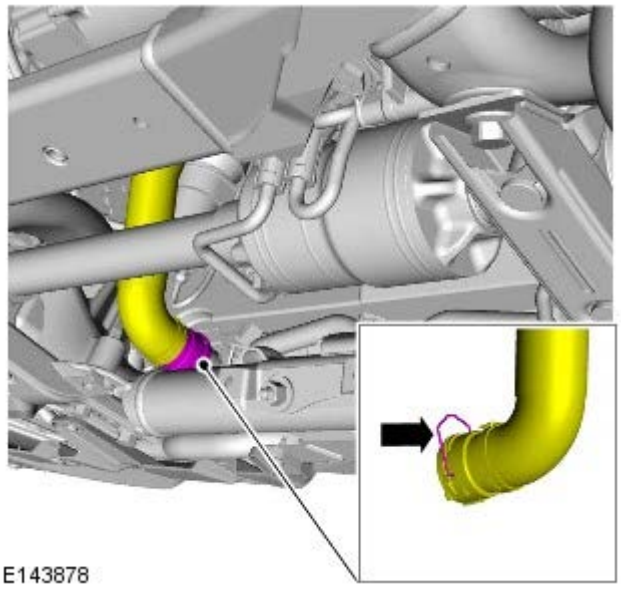
NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

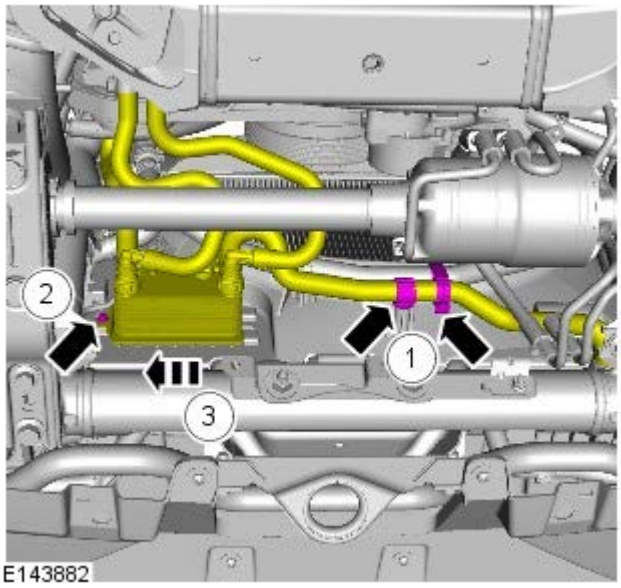
2. Refer to: Cooling System Partial Draining, Filling and Bleeding (303-03B Engine Cooling - V6 S/C 3.0L Petrol, General Procedures).

3.

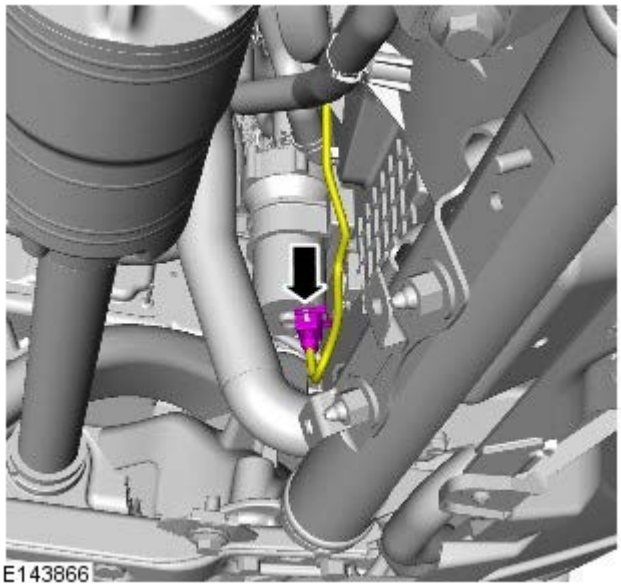


4. Tie aside.

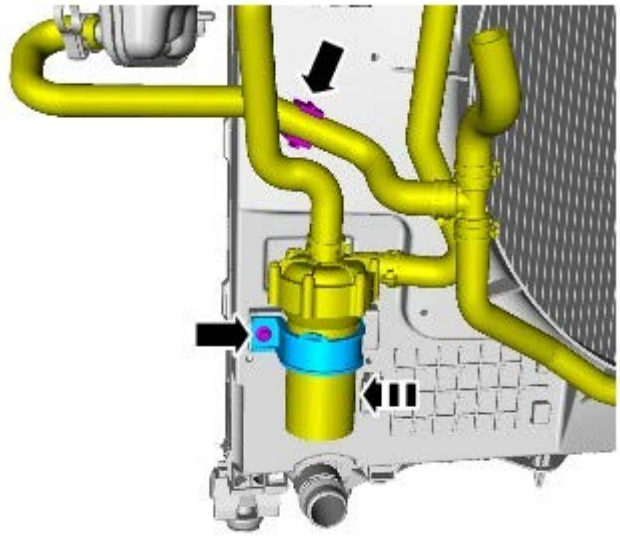
   Torque: 7 Nm



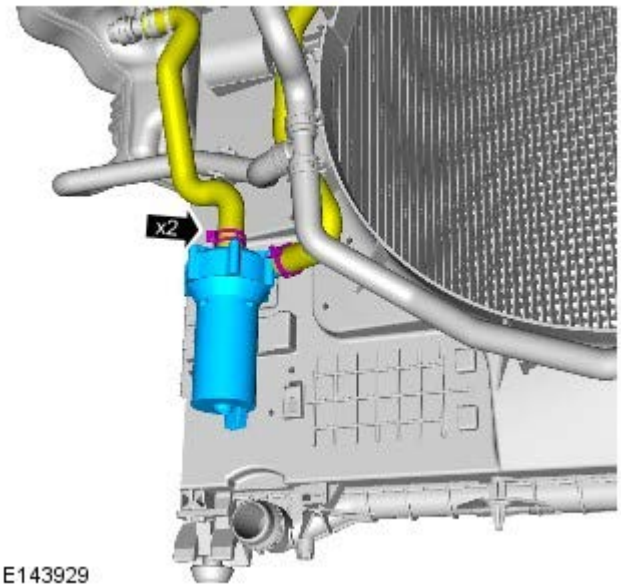
5.


E143866

6. *Torque:* 7 Nm


E143865

7. CAUTION: Be prepared to collect escaping coolant.



E143929

Installation

1. CAUTIONS:

Damage to the charge air cooler coolant pump will occur if the

pump is allowed to cavitate.

 Make sure the charge air coolant pump is primed prior to running the pump.

 If accidentally dropped install a new charger cooler coolant pump.

To install, reverse the removal procedure.

Published: 31-Jul-2012

Supercharger Cooling - V8 S/C 5.0L Petrol -

Torque Specifications

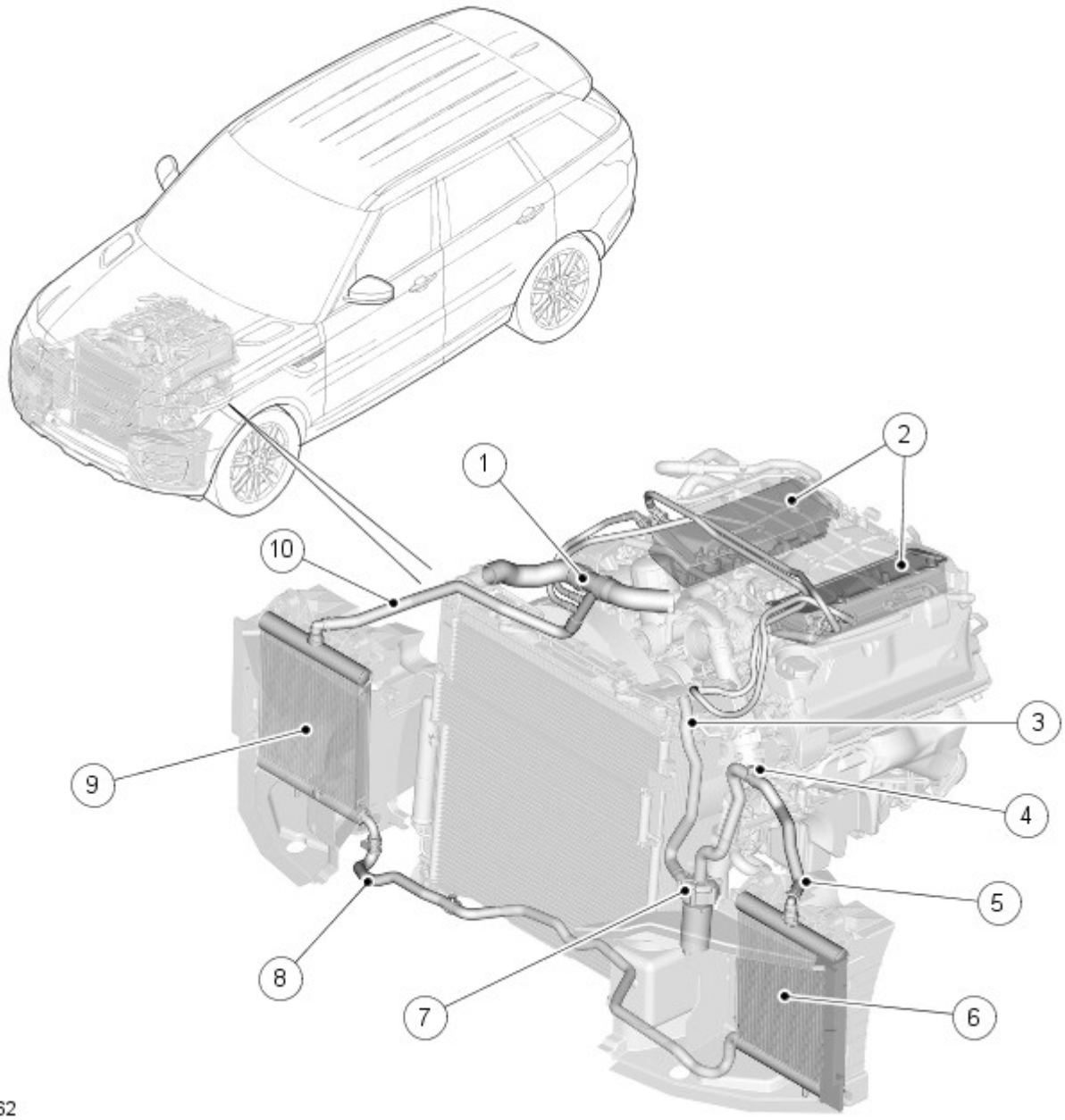
Description	Nm	lb-ft
Transmission oil cooler to cooling fan shroud bolt	7	62
Auxiliary coolant pump bracket to cooling fan shroud bolt	7	62

Published: 02-May-2013

Supercharger Cooling - V8 S/C 5.0L Petrol - Supercharger Cooling

Description and Operation

COMPONENT LOCATION



E152362

Item	Part Number	Description
1	-	Radiator upper hose
2	-	Charge air coolers
3	-	Hose - coolant feed to air charge coolers
4	-	Bleed screw
5	-	Hose - charge air radiator to coolant pump
6	-	Left air charge air radiator
7	-	Charge air coolant pump
8	-	Hose - charge air radiators
9	-	Right air charge radiator
10	-	Hose - return from charge air coolers

OVERVIEW

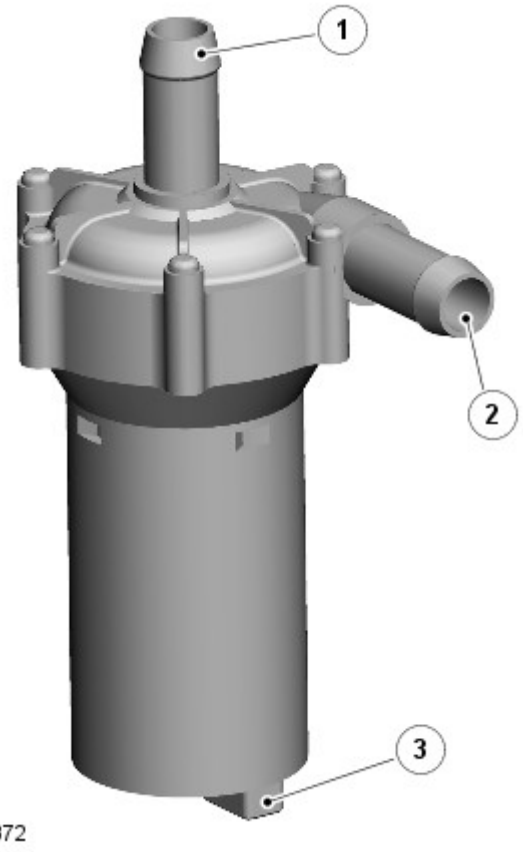
The supercharger cooling system uses engine coolant to cool the pressurized charge air from the supercharger. The supercharger cooling system consists of:

A charge air coolant pump.
- Two charge air radiators.
- 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.

DESCRIPTION

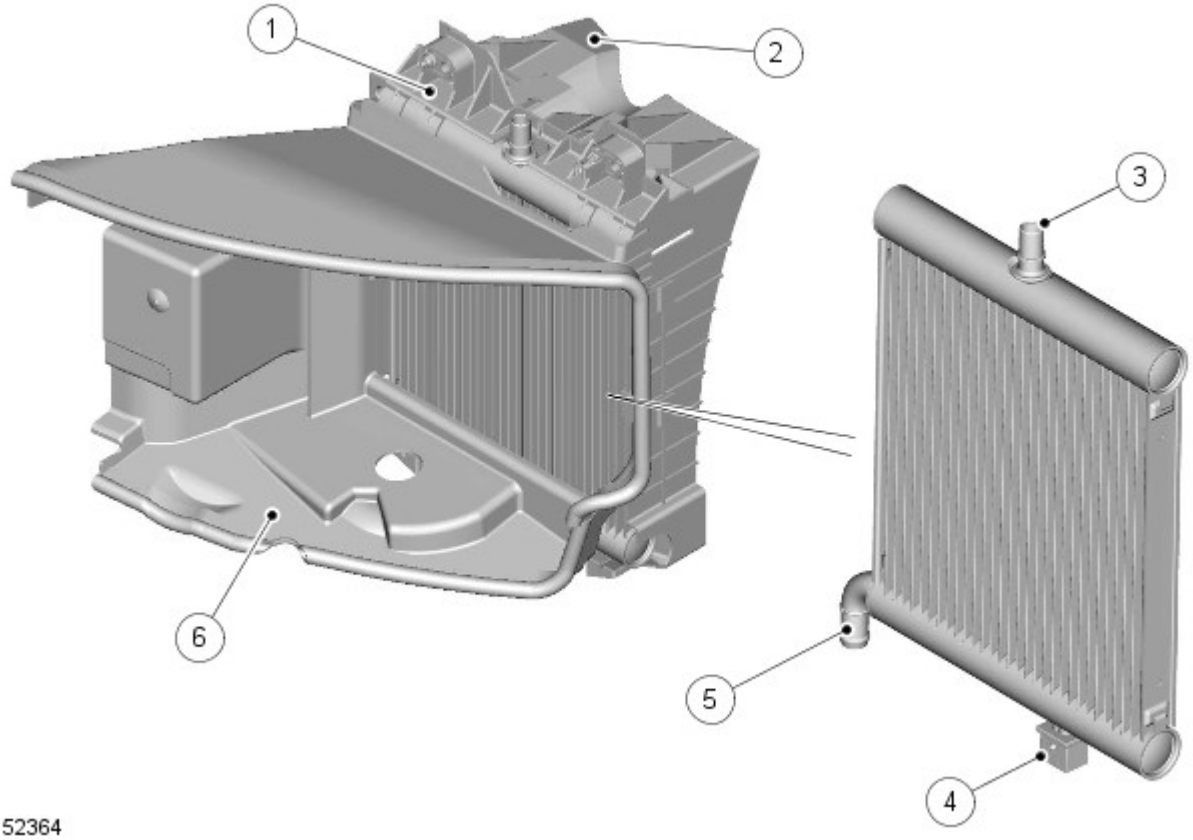
Charge Air Coolant Pump



Item	Part Number	Description
1	-	Coolant intake connection
2	-	Coolant outlet connection
3	-	Electrical connector

The charge air coolant pump is an electric pump attached to the rear left side of the engine cooling fan shroud. Hoses connect the intake of the charge air coolant pump to the left 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 Radiators



E152364

Item	Part Number	Description
1	-	Radiator support bracket
2	-	Rear air duct
3	-	Coolant hose connection - outlet on left radiator, inlet on right radiator
4	-	Isolator
5	-	Coolant hose connection - inlet on left radiator, outlet on right radiator
6	-	Front air duct

A charge air radiator is located each side of the cooling pack, behind the outer air intakes in the front bumper. The charge air radiators are installed in air ducts attached to the front bumper armature and the front end carrier. The lower end tank of each charge air radiator is located in the air ducts by a spigot fitted with an isolator bush. The upper end tank of each charge air radiator is held in a support bracket in the air duct.

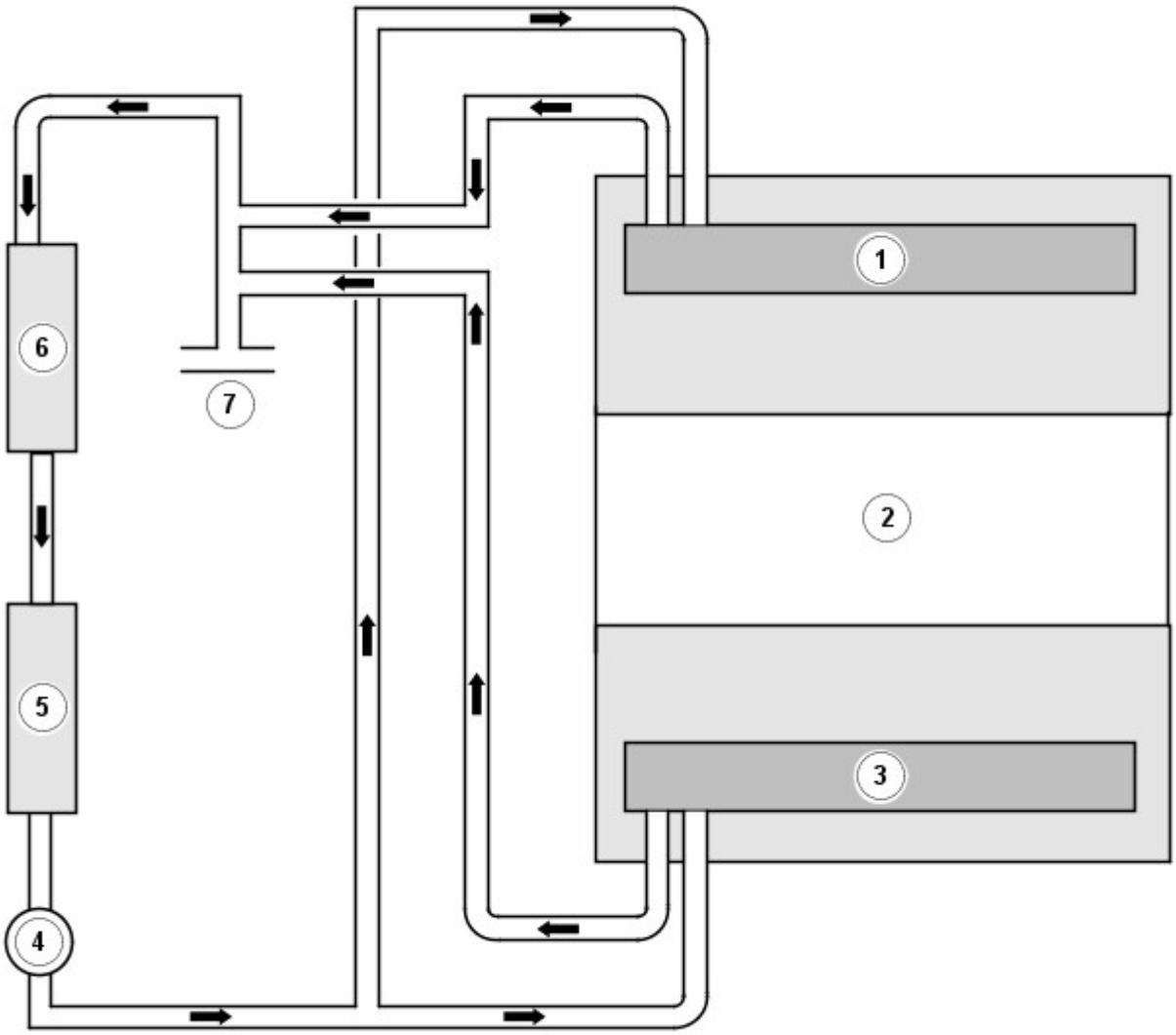
Hoses connect the two charge air radiators in series, the intake of the right radiator to the charge air coolers, and the outlet of the left radiator to the charge air coolant pump.

Charge Air Coolers

A charge air cooler is installed in each intake manifold.
For additional information, refer to: Intake Air Distribution and Filtering (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Description and Operation).

OPERATION

Supercharger Cooling Flow Diagram



E144929

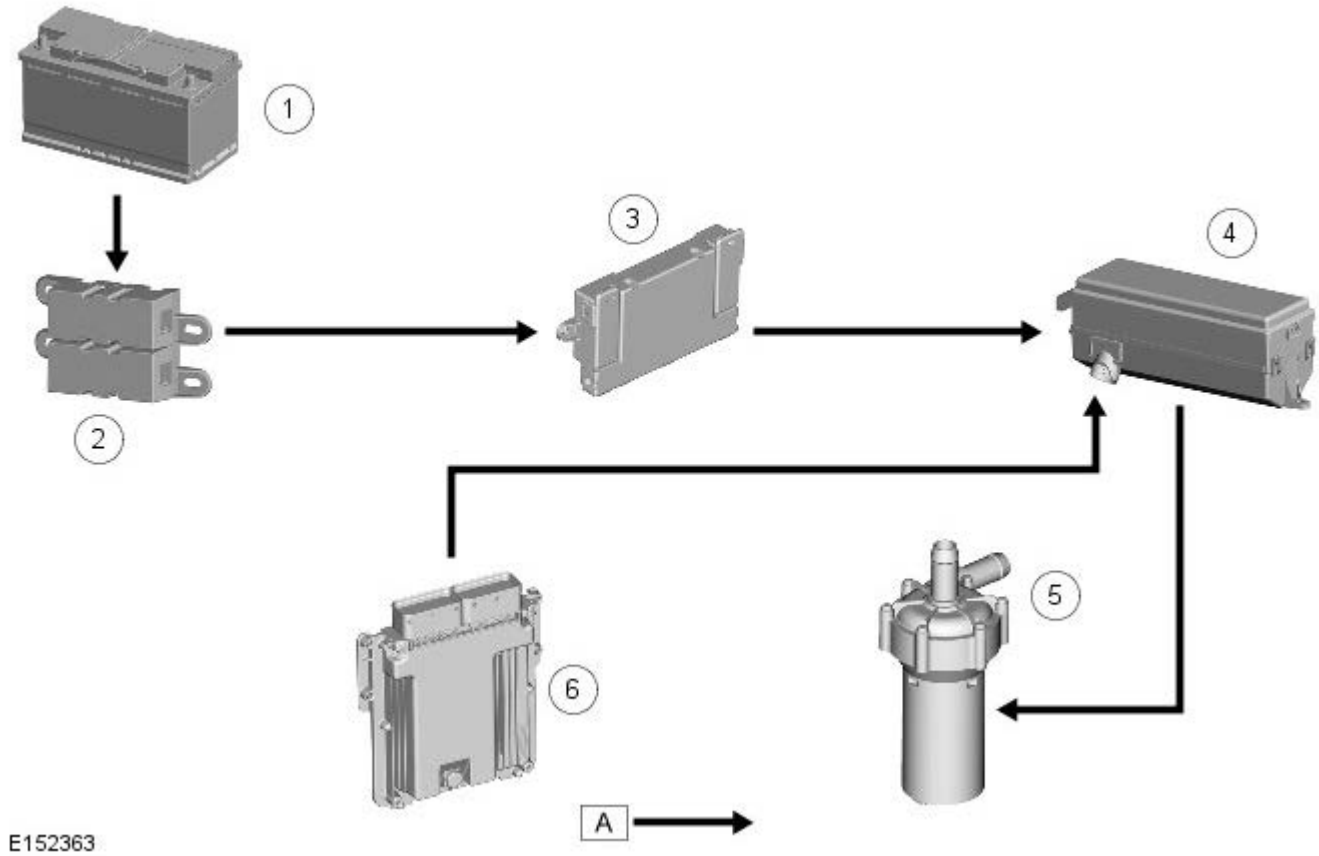
Item	Part Number	Description
1	-	Right charge air cooler
2	-	Engine
3	-	Left charge air cooler
4	-	Charge air coolant pump
5	-	Left charge air radiator
6	-	Right charge air radiator
7	-	Radiator upper hose

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 radiators and back to the pump intake.

Control Diagram

NOTE: A = Hardwired



E152363

Item	Part Number	Description
1	-	Battery
2	-	Battery Junction Box 2 (BJB2)
3	-	Battery Junction Box (BJB)
4	-	Engine Junction Box (EJB) (charge air coolant pump relay)
5	-	Charge air coolant pump
6	-	Engine Control Module (ECM)

Published: 11-May-2011

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 (303-03E 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. Check the thermostat and rectify as necessary. Check the viscous fan operation, make sure the viscous fan rotates freely. Check for obstructions to the air flow over the radiator. Rectify as necessary.
Engine not reaching normal temperature	• Thermostat • Viscous fan • Thermostat • Electric fan • Fan speed module	Check the thermostat operation. Check the viscous fan operation, make sure the viscous fan is not seized. Rectify as necessary.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - V8 S/C 5.0L Petrol, DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation).

Published: 02-Aug-2012

Supercharger Cooling - V8 S/C 5.0L Petrol - Coolant Pump

Removal and Installation

Removal

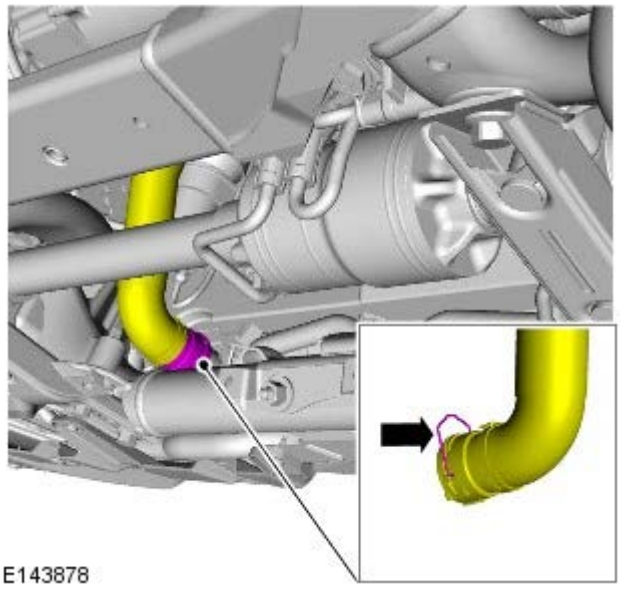
NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

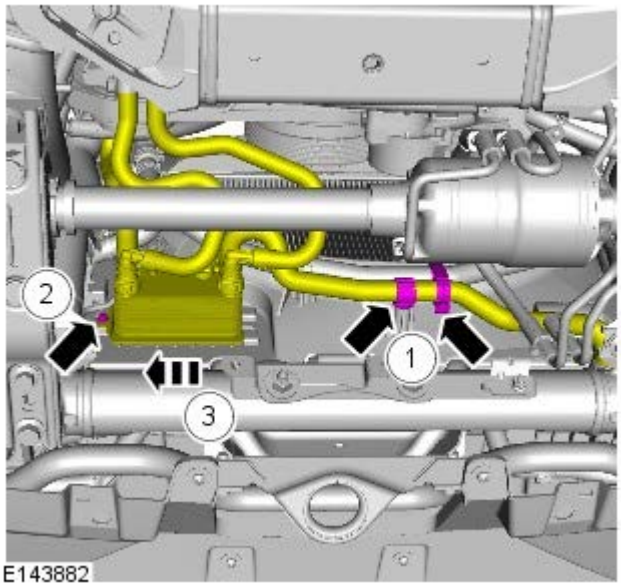
2. Refer to: Cooling System Partial Draining, Filling and Bleeding - V8 S/C 5.0L Petrol (303-03, General Procedures).

3.

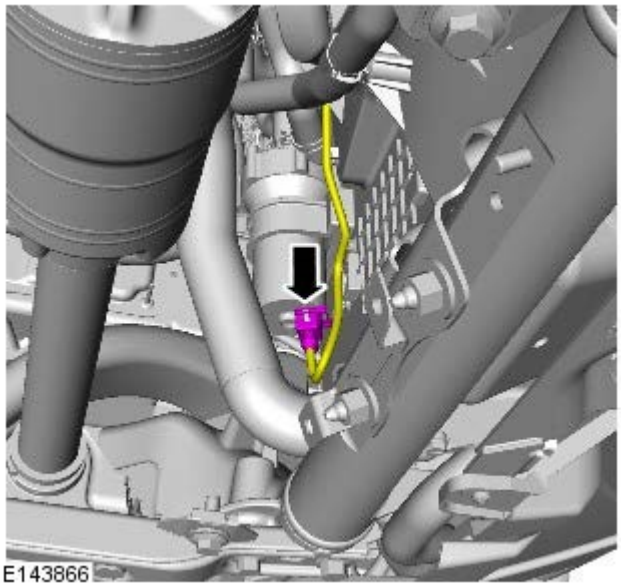


4. Tie aside.

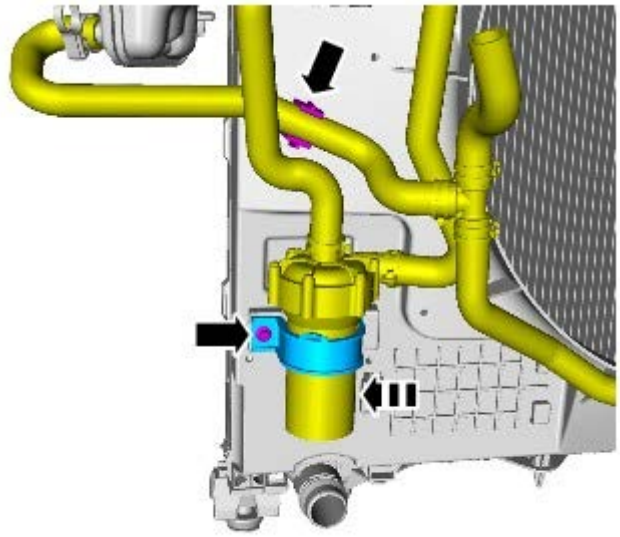
   Torque: 7 Nm



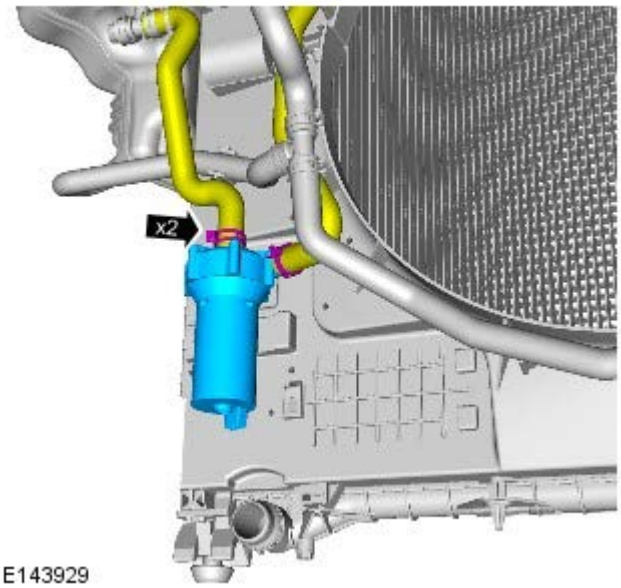
5.


E143866

6. *Torque:* 7 Nm


E143865

7. CAUTION: Be prepared to collect escaping coolant.



E143929

Installation

1. CAUTIONS:

Damage to the charge air cooler coolant pump will occur if the

pump is allowed to cavitate.

 Make sure the charge air coolant pump is primed prior to running the pump.

 If accidentally dropped install a new charger cooler coolant pump.

To install, reverse the removal procedure.

Published: 07-Aug-2012

Engine Cooling - TDV8 4.4L Diesel -

Fluid

Description	Specification
Land Rover premium cooling system fluid	Havoline XLC

Capacity

Item	Litres
Vehicles fitted with 2 zone air conditioning (A/C)	7.13
Vehicles fitted with 2 zone A/C and fuel fired booster heater (FFBH)	7.3
Vehicles fitted with 4 zone A/C	8.77
Vehicles fitted with 4 zone A/C and FFBH	8.94

General Specifications

Item	Specification
Cooling system type	Pressurised, thermostatically controlled with remote header tank
Expansion tank	Remote - fitted with a bleed screw and low coolant level sensor
Pressure cap rating	110 kPa (1.1 bar) (16 lbf/in²)
Thermostat:	
Starts to open	88° C (190° F)
Fully open	96° C (204° F)
Cooling fan	Variable speed electric fans
Direction of rotation	Clockwise when viewed from front of engine
Coolant pump	Centrifugal flow impellor, belt driven from crankshaft

Torque Specifications

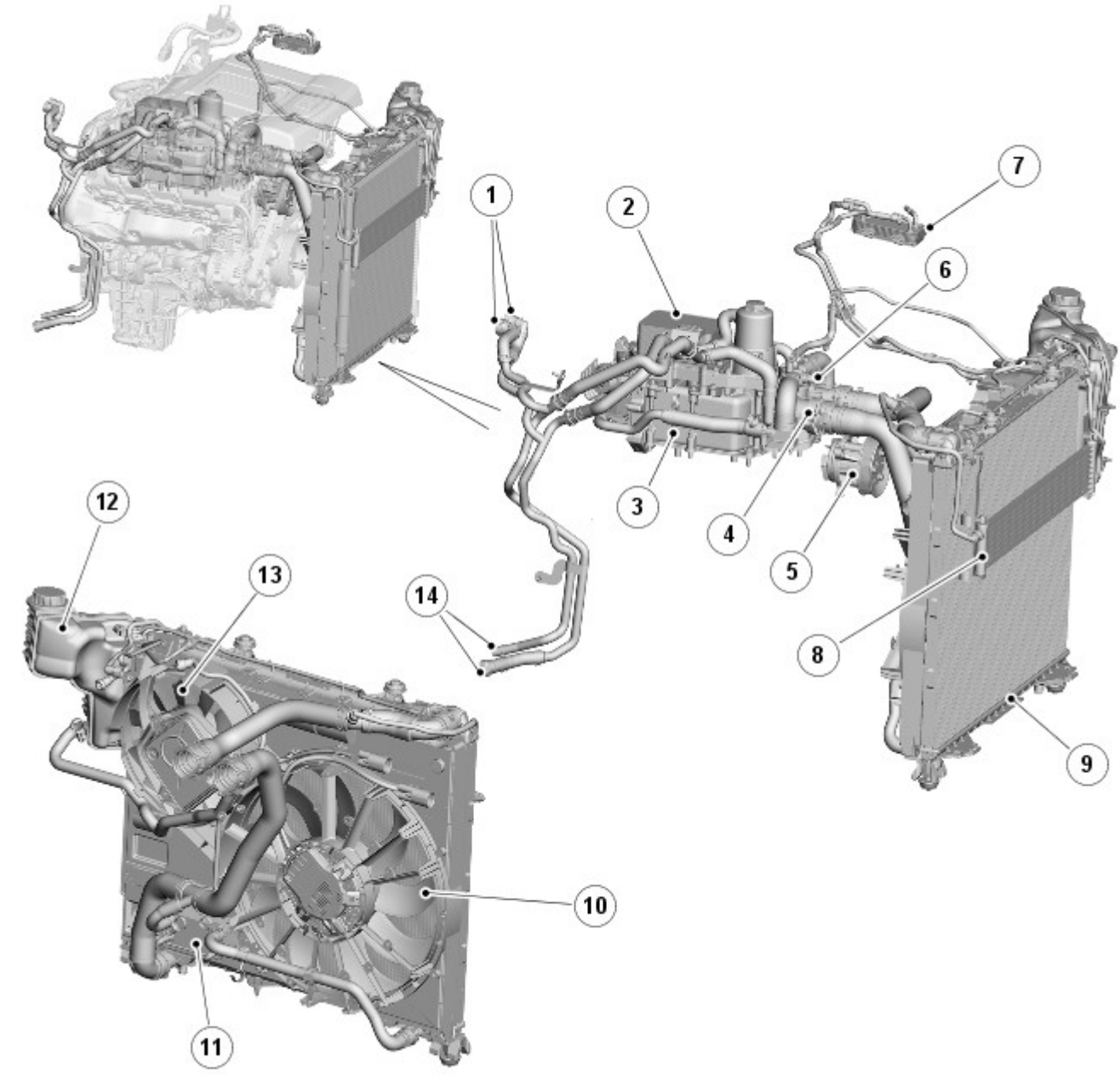
Item	Nm	lb-ft	lb-in
Coolant pump pulley bolt	23	17	-
Coolant pump bolts	23	17	-
Air intake pipe connector	8	-	71
Charge air cooler hose clamp	3.5	-	40
Coolant expansion tank bolt	2.8	-	25
Charge air cooler hose retaining clamp to fan shroud bolt	7	-	62
Fan shroud studs	7	-	62
A/C pipe to fan shroud	7	-	62
A/C pipe to condenser nut	8	-	71
Transmission oil cooler to fan shroud	7	-	62
Cooling fan shroud to radiator bolt	7	-	62
Dynamic response pressure pipe to engine	10	7	-
Coolant radiator lower retaining bolt	15	11	-
Dynamic response cooler to condenser bolt	7	-	62
Dynamic response cooler to condenser nut	7	-	62
Condenser retainer to radiator bolt	4.5	-	40

Published: 02-Dec-2013

Engine Cooling - TDV8 4.4L Diesel - Engine Cooling

Description and Operation

COMPONENT LOCATION



E145150

Item	Part Number	Description
1	-	Heater connections
2	-	Engine oil cooler
3	-	Exhaust gas recirculation cooler
4	-	Thermostat
5	-	Coolant pump
6	-	Engine Coolant Temperature (ECT) sensor
7	-	Fuel cooler
8	-	Auxiliary fuel cooler
9	-	Radiator
10	-	Cooling fan 1
11	-	Transmission oil cooler
12	-	Expansion tank
13	-	Cooling fan 2
14	-	Auxiliary heater connections

OVERVIEW

The pressurized cooling system circulates coolant around the engine and interior heater circuits while the thermostat main valve is closed. The primary function of the cooling system is to maintain engine metal temperatures within an optimum temperature range under changing ambient and engine operating conditions. Secondary functions are to provide:

- Optimized cabin heating during the engine warm-up phase. For additional information, refer to:
  Heating and Ventilation (412-01A Climate Control, Description and Operation),
  Auxiliary Climate Control (412-02A Auxiliary Climate Control, Description and Operation).
- Automatic transmission fluid temperature control.
  For additional information, refer to: Transmission Cooling (307-02A Transmission/Transaxle Cooling - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, Description and Operation).
- Low temperature fuel cooling.
  For additional information, refer to: Fuel Tank and Lines (310-01D Fuel Tank and Lines - TDV8 4.4L Diesel, Description and Operation).
- EGR (Exhaust Gas Recirculation) cooling.
  For additional information, refer to: Engine Emission Control (303-08D Engine Emission Control - TDV8 4.4L Diesel, Description and Operation).

During the initial engine warm-up, when the main thermostat is closed, warm coolant is directed to the ancillary heat exchangers:

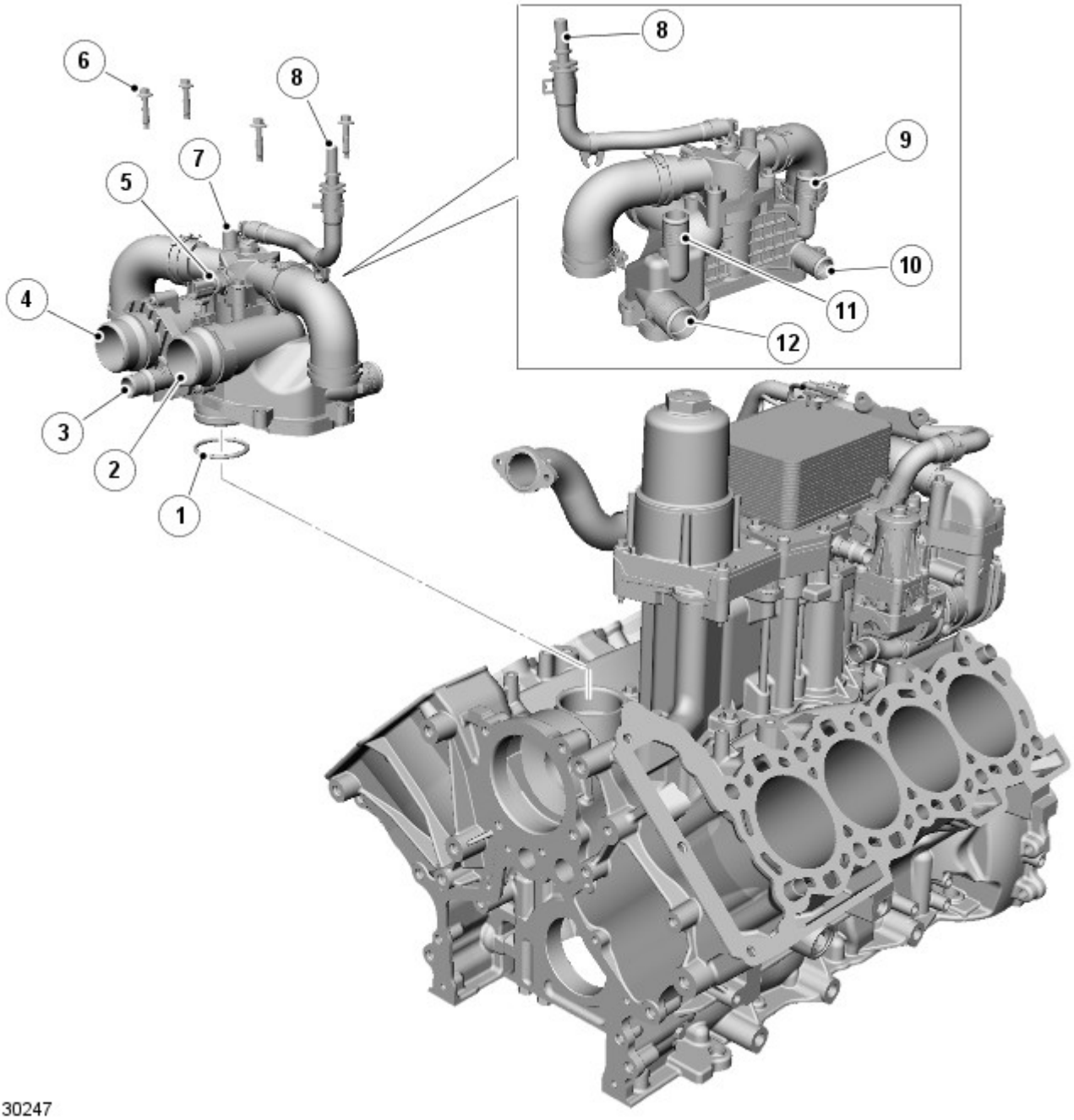
- Cabin heater
- Engine oil heat exchanger.

The main engine thermostat is of a pressure relief design. The prime function of this thermostat is to use the heater and ancillary circuit as the only radiator by-pass while the thermostat is closed.

The pressure relief thermostat gradually opens the main radiator by-pass circuit at engine speeds above 1500 rev/min. This system ensures that the maximum available coolant flow is directed to the heater and ancillary heat exchangers during warm-up without affecting the durability of the engine. By using this type of thermostat there is enough heater flow for all conditions without the need for a dedicated electric water pump.

DESCRIPTION

Thermostat Housing



E130247

Item	Part Number	Description
1	-	Seal
2	-	Connection for radiator upper hose
3	-	Connection for expansion tank hose
4	-	Thermostat/Connection for radiator lower hose
5	-	Engine Coolant Temperature (ECT) sensor
6	-	Bolt (4 off)
7	-	Housing
8	-	Coolant bleed to expansion tank
9	-	Connection for heater supply hose
10	-	Connection for EGR cooler supply hose
11	-	Connection for heater return hose
12	-	Connection for EGR cooler and engine oil cooler return hose

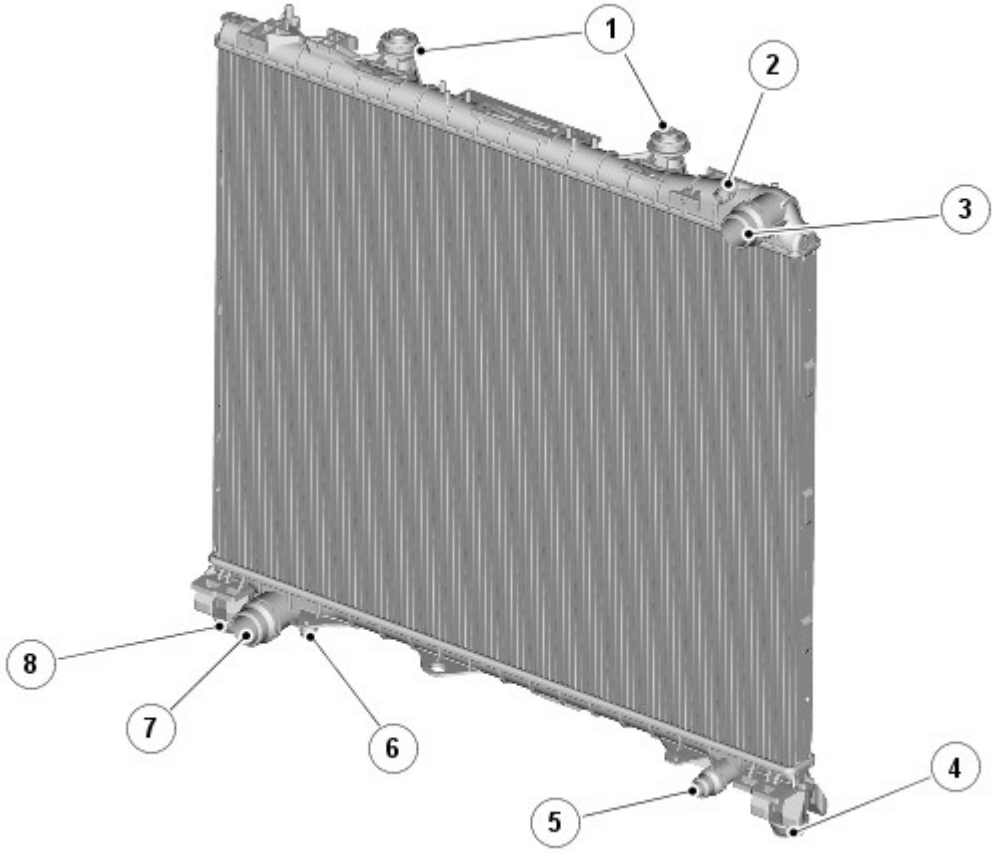
The thermostat housing contains the thermostat and connects the cooling channels of the cylinder block to the cooling channels of the cylinder heads. It also provides connections for:

- The radiator upper and lower hoses
- The expansion tank supply hose
- The EGR cooler supply hose
- The EGR cooler and engine oil cooler return hose
- The heater supply and return hoses
- A bleed hose.

An ECT (Engine Coolant Temperature) sensor is located in the front of the thermostat housing. The ECT sensor is

connected to the ECM (Engine Control Module) which uses the coolant temperature information for a number of functions.
For additional information, refer to: Electronic Engine Controls (303-14D Electronic Engine Controls - TDV8 4.4L Diesel, Description and Operation).

Radiator



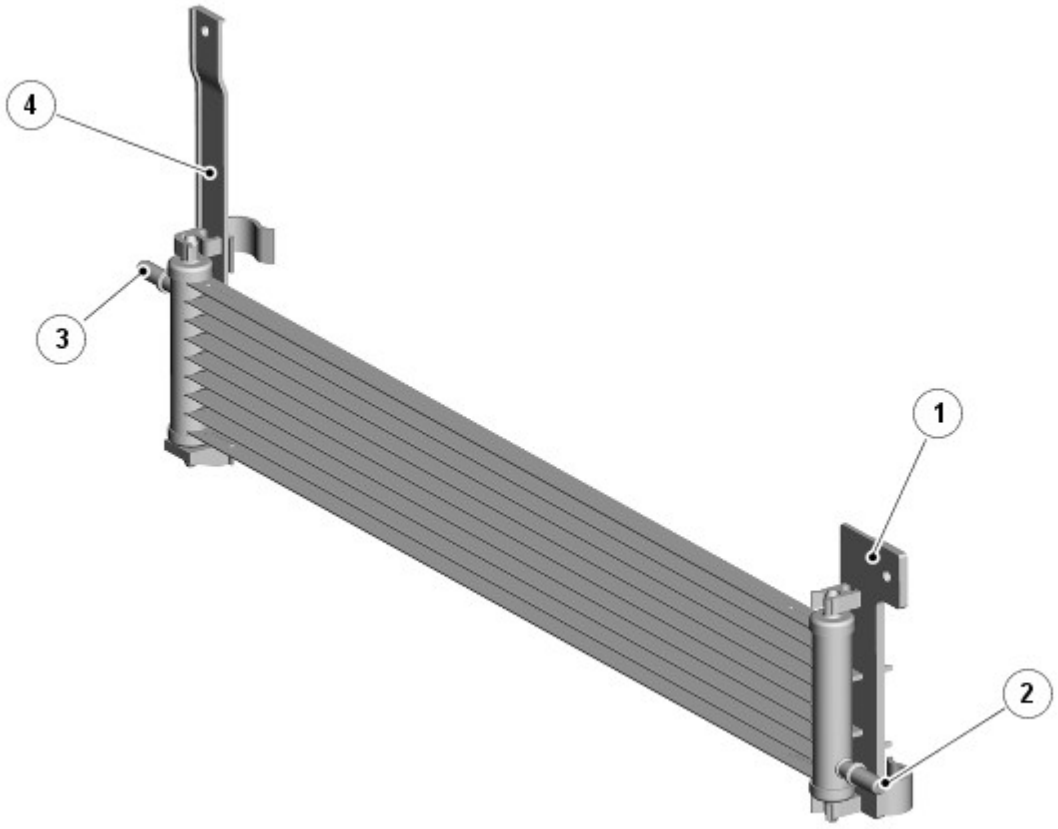
E145080

Item	Part Number	Description
1	-	Upper mounts
2	-	Vent hose connection
3	-	Upper hose connection
4	-	Lower mount
5	-	Transmission hose connection
6	-	Drain screw
7	-	Lower hose connection
8	-	Lower mount

The radiator is a vertical-flow type with an integral transmission sub-cooler. The radiator is located in the vehicle by bushes attached to the end tanks. The lower bushes are installed in the front subframe. The upper bushes are installed in the front end carrier.

Upper and lower hose connections are incorporated into the upper and lower end tanks respectively. The lower end tank also incorporates a drain screw, and a connection for the coolant feed hose of the transmission fluid cooler. The upper end tank incorporates a connection for a vent hose to the expansion tank. The end tanks also incorporate mounting points for the cooling fan shroud and the A/C (Air Conditioning) condenser.

Auxiliary Fuel Cooler

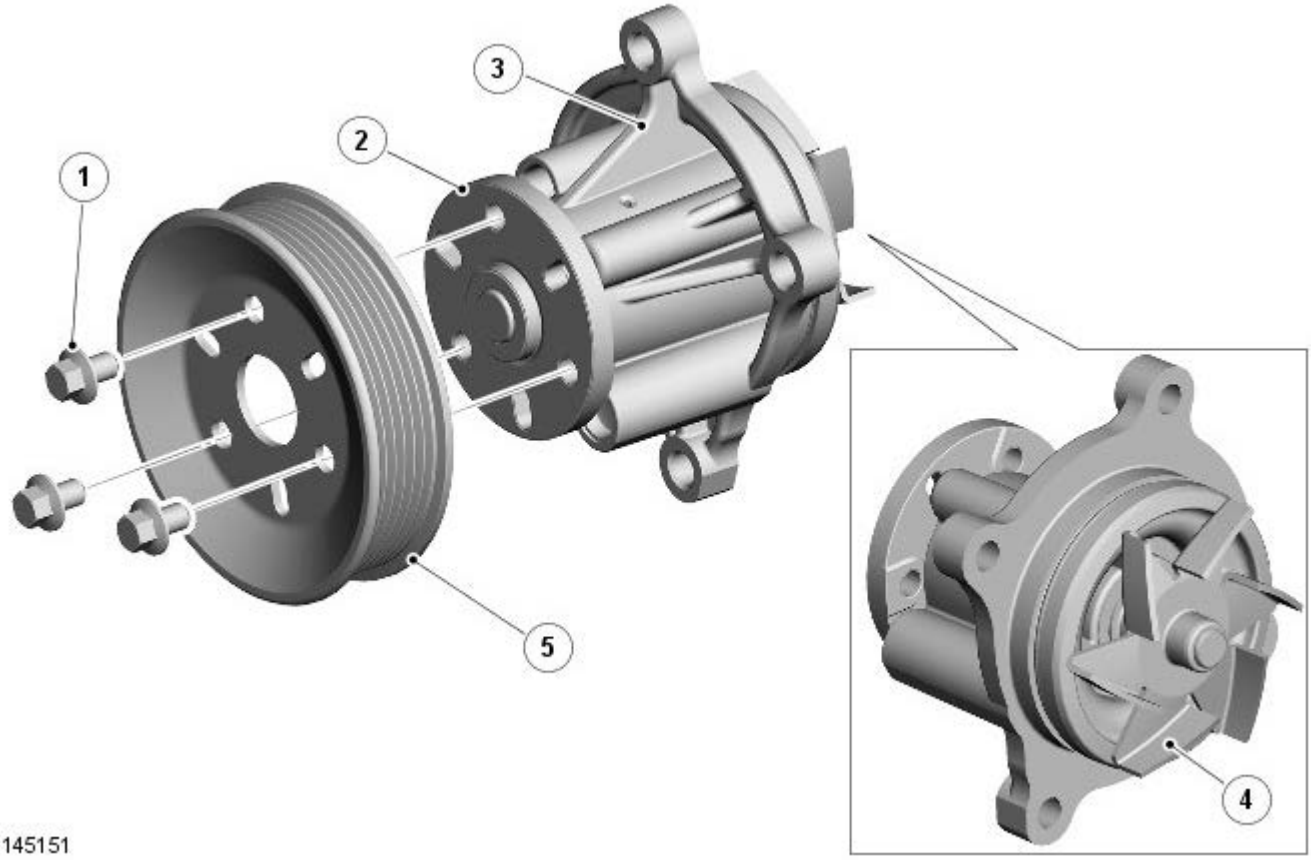


E145152

Item	Part Number	Description
1	-	Left support bracket
2	-	Coolant outlet connection
3	-	Coolant intake connection
4	-	Right support bracket

The auxiliary fuel cooler is attached to the front of the A/C condenser. The end tanks of the cooler incorporate a coolant intake connection from the radiator upper hose and a coolant outlet connection to the fuel cooler in the fuel tank and lines system.

Coolant Pump

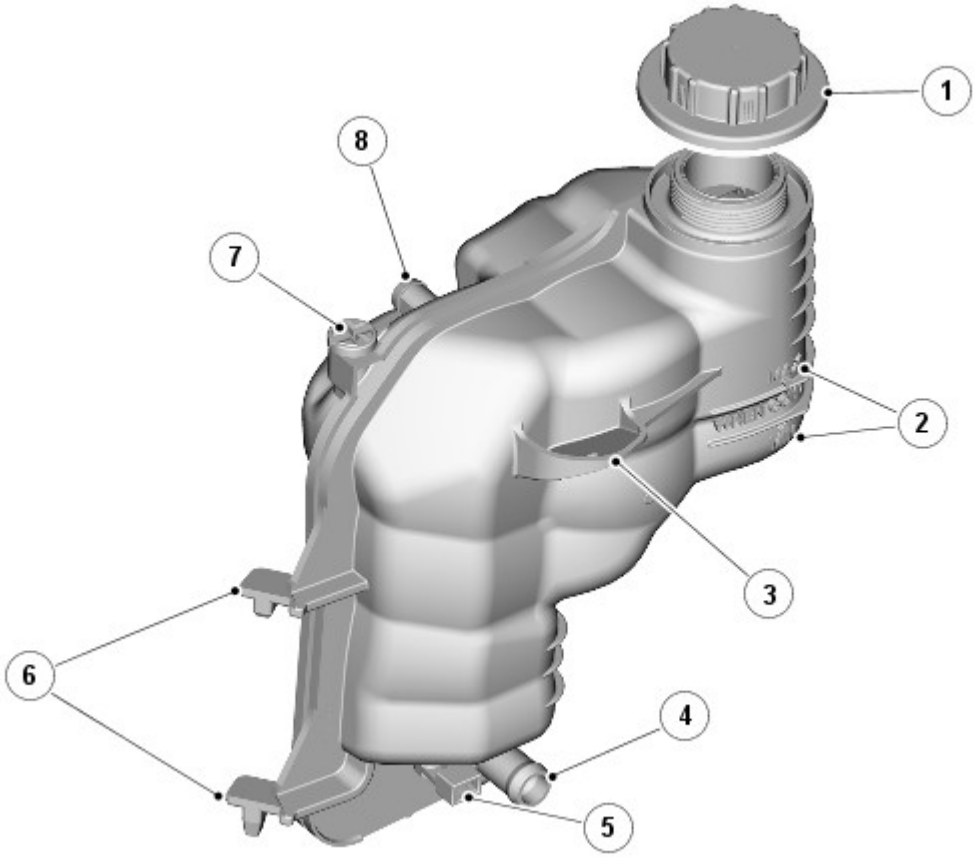


E145151

Item	Part Number	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 (303-05D Accessory Drive - TDV8 4.4L Diesel, Description and Operation).

Expansion Tank



E145082

Item	Part Number	Description
1	-	Filler cap
2	-	MAX and MIN level markings
3	-	Mounting lug
4	-	Supply hose connection
5	-	Coolant level sensor
6	-	Mounting lugs
7	-	Bleed screw
8	-	Vent hose connection

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 thermostat. A continuous vent into the expansion tank, through a hose connected to the radiator, prevents air locks from forming in the cooling system.

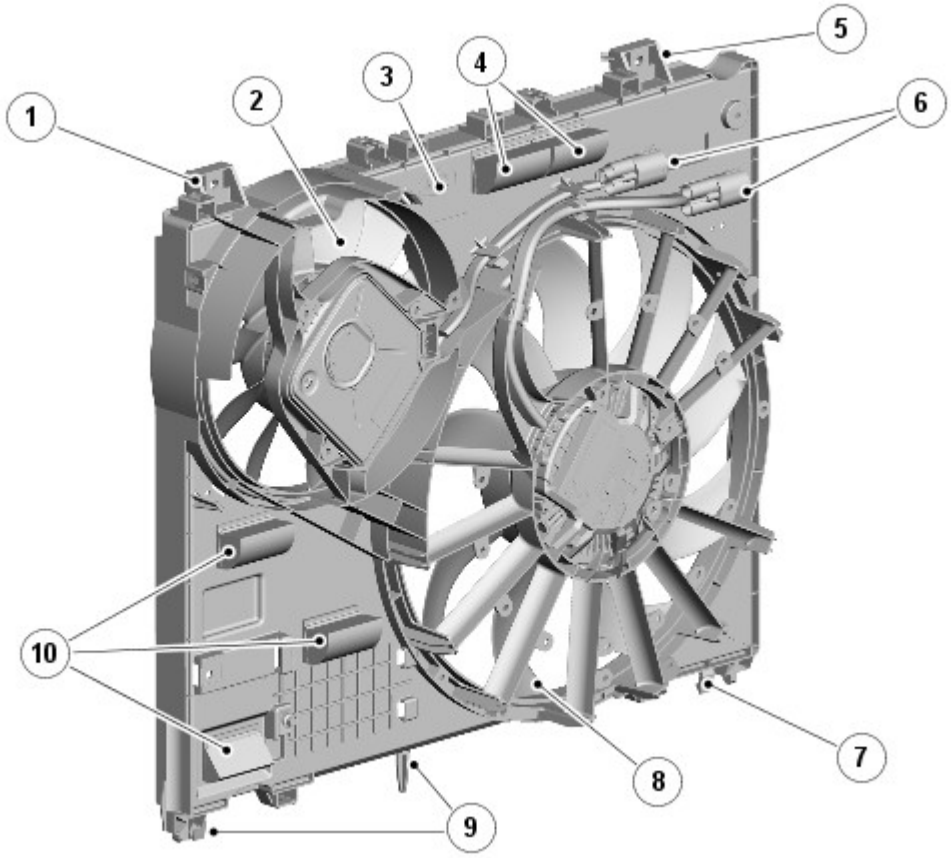
The expansion tank is attached to the front end carrier in the front left corner of the engine compartment. A filler cap, bleed screw and level sensor are incorporated into the expansion tank. MAX and MIN level markings are molded into the exterior of the tank.

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 0.5 to 1 liter (1.06 to 2,11 US pints), above the MAX level, to allow for coolant expansion.

Engine Cooling Fans



E145153

Item	Part Number	Description
1	-	Mounting lug
2	-	Cooling fan 2
3	-	Shroud
4	-	Speed flaps
5	-	Mounting lug
6	-	Electrical connectors
7	-	Mounting lug
8	-	Cooling fan 1
9	-	Mounting lugs
10	-	Speed flaps

Two variable speed electric engine cooling fans are installed to help regulate the coolant temperature. The fan shroud is attached to the rear of the radiator. The shroud incorporates speed flaps, which pivot open to allow engine compartment cooling at speed.

Each engine cooling fan is operated by a control module, integrated into their electric motor, which is controlled by the ECM. Electrical connectors at the right side of the fan shroud provide the interface between the cooling fan harnesses and the vehicle wiring.

The control module of each engine cooling fan is provided with:

- A battery power supply from the AJB (Auxiliary Junction Box)
- An ignition signal from the ECM relay in the EJB
- A PWM (Pulse Width Modulation) signal from the ECM
- A ground.

To control each engine cooling fan, the ECM varies the duty cycle of the PWM signal. The fan control module translates the duty cycle into a fan target speed and sets the output current to the fan motor accordingly.

Engine Coolant

The coolant is silicate free and must not be mixed with conventional engine coolant.

OPERATION

Coolant Circuit Flow

The coolant pump circulates coolant through the cylinder block and cylinder heads via a chamber located in the 'vee' of the engine. Having passed through the engine the coolant returns to the thermostat housing. Some of the coolant in the cylinder block is diverted through the engine oil cooler before returning to the thermostat housing.

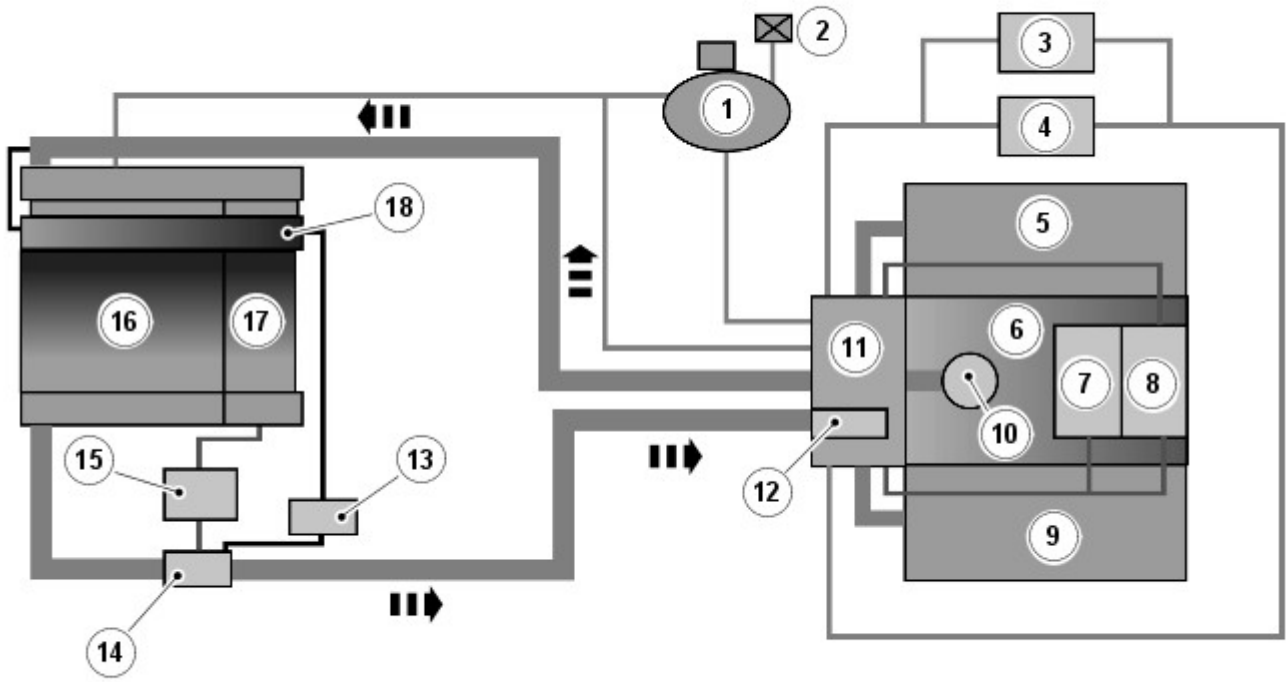
From the thermostat housing, the majority of the coolant returns to the coolant pump, either directly or via the thermostat and radiator, depending on the temperature of the coolant and engine speed. The remainder of the coolant

first flows through the EGR coolers and the heater circuit, then returns to the thermostat housing.

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 returns to the system through a connector in the radiator lower hose.

A connection on the upper hose supplies coolant to the auxiliary fuel cooler. From the auxiliary fuel cooler, the coolant flows through the fuel cooler and returns to the system through the connector in the radiator lower hose.

Schematic Flow Diagram



E145154

Item	Part Number	Description
1	-	Expansion tank
2	-	Static bleed point
3	-	Auxiliary heater (where fitted)
4	-	Heater
5	-	Cylinder head
6	-	Cylinder block
7	-	Engine oil cooler
8	-	Exhaust gas recirculation cooler
9	-	Cylinder head
10	-	Engine coolant pump
11	-	Thermostat housing
12	-	Thermostat
13	-	Fuel cooler
14	-	Connector
15	-	Transmission oil cooler
16	-	Radiator
17	-	Transmission oil sub-cooler
18	-	Auxiliary fuel cooler

Thermostat

The thermostat is closed at temperatures below approximately 88°C (190°F). When the coolant temperature reaches approximately 88°C (190°F) 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.

Coolant Level Sensor

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 IC (Instrument Cluster) on the high speed CAN (Controller Area Network) Powertrain bus to display a warning message.
For additional information, refer to: Instrument Cluster (413-01 Instrument Cluster, Description and Operation).

Cooling Fans

The ECM determines when to operate the cooling fans from the ECT sensor input and a cooling fan request from the ATCM (Automatic Temperature Control) module. The ECM also adjusts the fan speed to compensate for the ram effect of vehicle speed.

The ECM varies the duty cycle of the PWM signal to the fan control module between 0 and 100% to operate the fan motor in one of four modes: Off, minimum speed (750 rev/min), linear variable speed between minimum and maximum speeds, and maximum speed (2820 rev/min). Under hot operating conditions, the fan may continue to operate for up to five minutes after the engine has been switched off.

The fan control module monitors for over and under input voltage, a stalled motor and a partially stalled motor. If it detects any of these faults the fan control module temporarily pulls the PWM signal to ground to notify the fault to the ECM. The length of time the PWM signal is pulled to ground varies between 2 and 8 seconds, depending on the fault. The fan control module repeats the notification process at 5 second intervals until the fault is cleared. If there is more than one fault, only the highest priority fault is notified to the ECM. Fault priorities, in descending order, are over voltage, under voltage, stalled motor and partially stalled motor. The ECM records a related DTC (Diagnostic Trouble Code) for faults notified by the fan control module and signals the instrument cluster on the high speed CAN Powertrain bus to display a warning message.

The nominal operating voltage for the engine cooling fans is 9 to 16 volts. If the input voltage is outside of these limits, the fan control module stops operation of the cooling fan and notifies the ECM of the fault. After an under or over voltage occurs, cooling fan operation is resumed when the input voltage increases to 9.5 volts, or decreases to 15.5 volts, respectively.

To check for a stalled motor, each time it supplies power to start the fan motor the fan control module checks the fan motor speed after 2 seconds. If the speed is zero, the fan control module determines the fan motor is stalled and tries a restart. For a restart, the fan control motor disconnects the power from the fan motor then immediately reconnects it at an increased current level. The fan control module will try up to six restarts of a stalled motor, increasing the output current each time. If the fan motor remains stalled after the sixth restart, the fan control module waits 40 seconds then notifies the ECM of the fault and begins the start process again.

To check for a partially stalled motor, while the fan is running the fan control module monitors the current draw against fan speed. If the current draw is over the limit for more than 10 seconds, the fan control module disconnects the power from the fan motor and notifies the ECM of the fault. After 40 seconds, the fan control module starts the motor again.

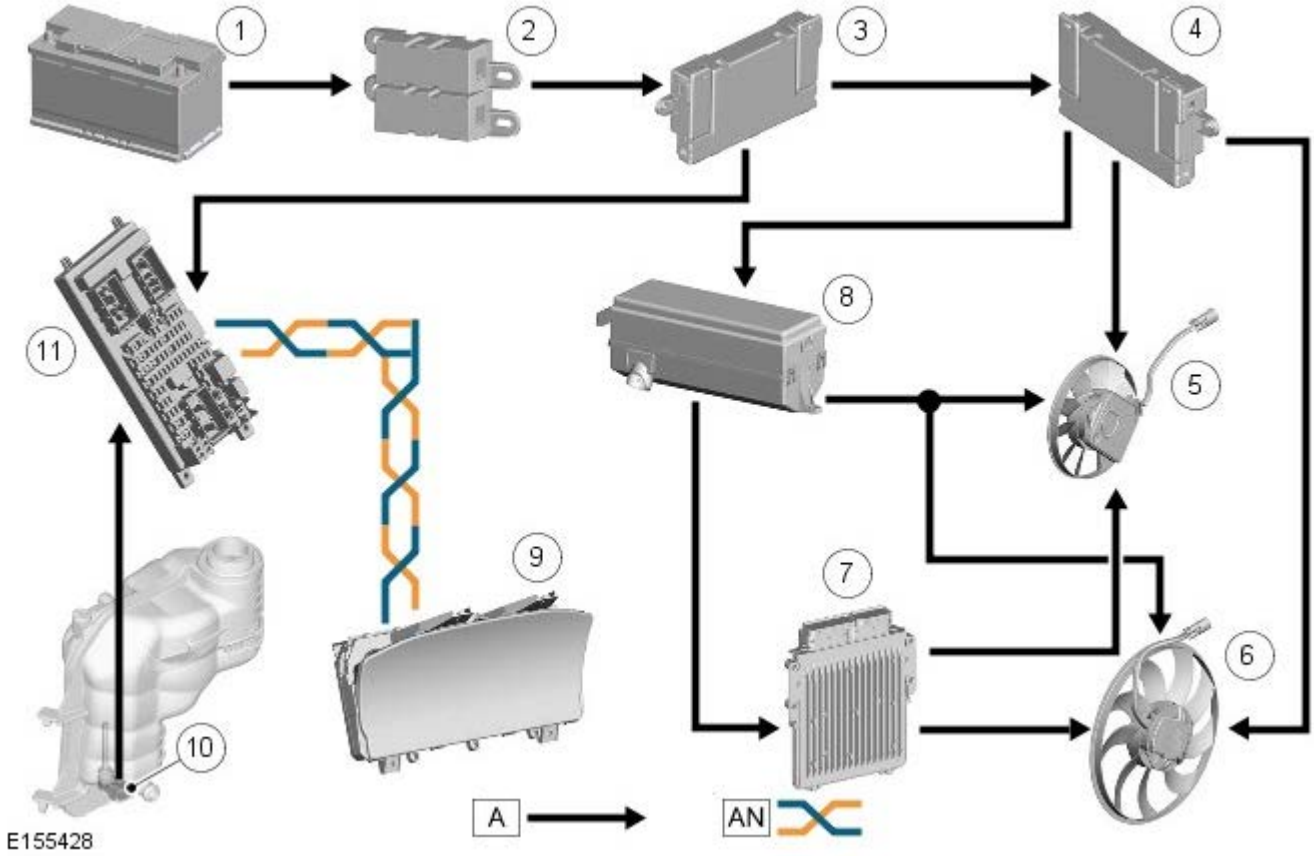
The fan control module incorporates a temperature sensor to prevent damage caused by excessive heat at high ambient temperatures. Operation of the fan control module is discontinued if the temperature reaches 135 °C (275 °F). Operation resumes when the temperature decreases to 120 °C (248 °F).

If a fault occurs with the ignition signal or the PWM signal, the fan control module adopts the following fan speeds:

Signal	Fault	Fan Speed	
		Ignition On	Ignition Off
PWM	Duty cycle implausible	Maximum	Off
PWM	Frequency out of range	Maximum	Off
PWM	Open circuit	Maximum	Off
PWM	Short circuit to battery	Maximum (provided cooling fan is not damaged)	Off
PWM	Short circuit to ground	Maximum (provided cooling fan is not damaged)	Off
Ignition	Open circuit	Off	Off
Ignition	Short circuit to battery	According to PWM duty cycle	Maximum
Ignition	Short circuit to ground	Off (ECM relay fuse may blow)	Off

Control Diagram

NOTE: A = Hardwired, AN = High speed CAN (Controller Area Network) Powertrain bus.



Item	Part Number	Description
1	-	Battery
2	-	Battery Junction Box 2 (BJB2)
3	-	Battery Junction Box (BJB)
4	-	Auxiliary Junction Box (AJB)
5	-	Engine cooling fan 2
6	-	Engine cooling fan 1
7	-	Engine Control Module (ECM)
8	-	Engine Junction Box (EJB)
9	-	Instrument Cluster (IC)
10	-	Coolant level sensor
11	-	Central Junction Box (CJB)

Published: 31-Jul-2012

Engine Cooling - TDV8 4.4L Diesel - Engine Cooling

Diagnosis and Testing

Principles of Operation

For a detailed description of the engine cooling system and operation, refer to the relevant Description and Operation section in the Workshop Manual.
REFER to: Engine Cooling (303-03B, 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 mechanical or electrical faults.

Visual Inspection

Mechanical	Electrical
• Coolant leaks • Coolant hoses • Coolant expansion tank • Radiator • Heater core • Active grill air shutter • Accessory drive belt • Cooling fan	• Fuses • Harnesses • Loose or corroded connector(s) • Engine coolant temperature sensor • Engine oil temperature 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. Refer to the relevant section of the workshop manual
Overheating	• Low/contaminated coolant • Thermostat • Cooling fan • Engine coolant temperature sensor • Restricted air flow over the radiator • Active grill air shutter	Check the coolant level and condition. Carry out a cooling system pressure test. Rectify any leaks as necessary. Check the thermostat and rectify as necessary. Check the cooling fan operation, make sure the cooling fan rotates freely. Check for obstructions to the air flow over the radiator. Check the active grill air shutter operation using the manufacturer approved service tool
Engine not reaching normal temperature	• Thermostat • Cooling fan	Check the thermostat operation. Check the cooling fan operation, make sure the cooling fan is not seized

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 - TDV8 4.4L Diesel, DTC: Module Name: Engine Control Module (100-00, Description and Operation).

Published: 10-Sep-2012

Engine Cooling - TDV8 4.4L Diesel - Cooling System Draining, Filling and Bleeding

General Procedures

Draining

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.

NOTE: This procedure only needs to be carried out when the coolant system vacuum filler equipment is not available in the workshop.

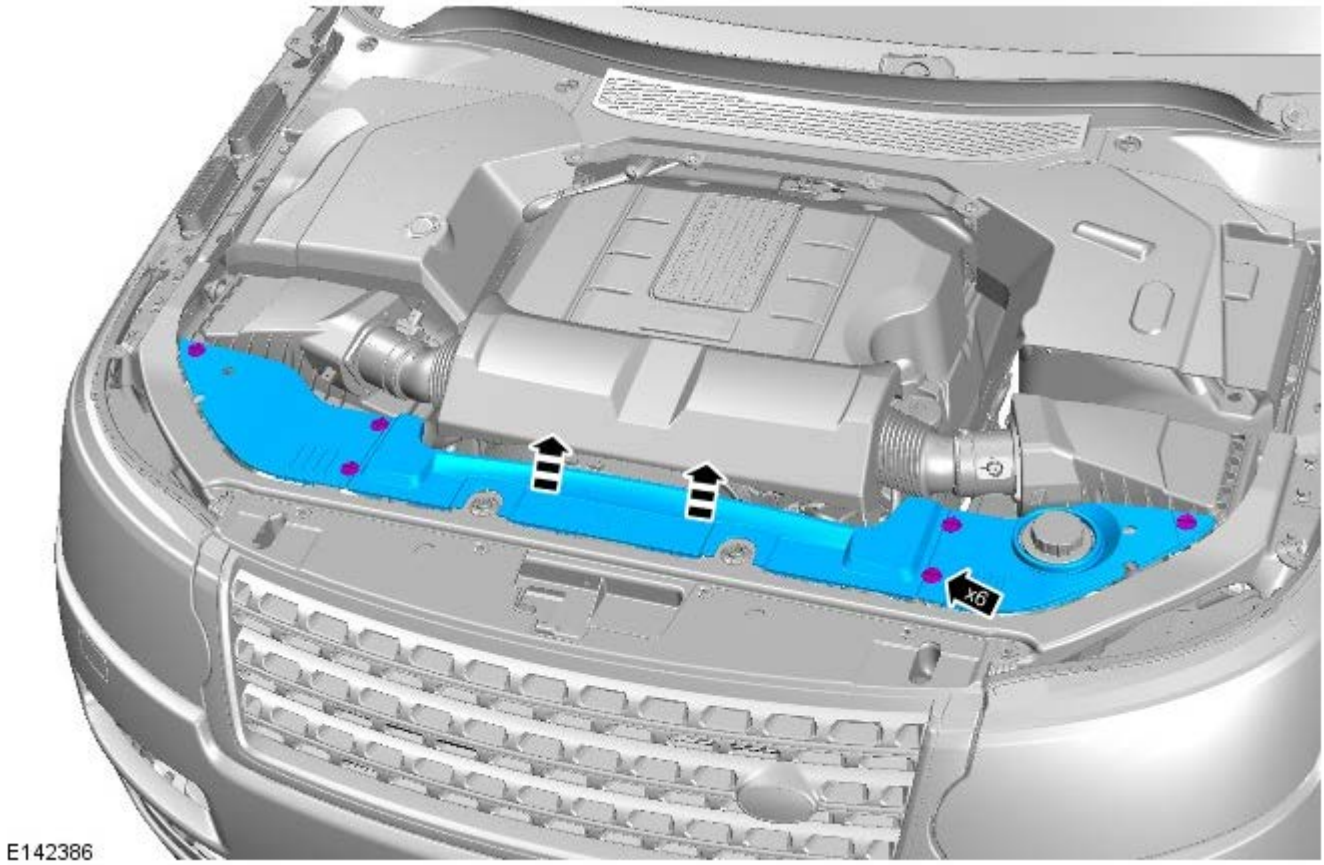
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

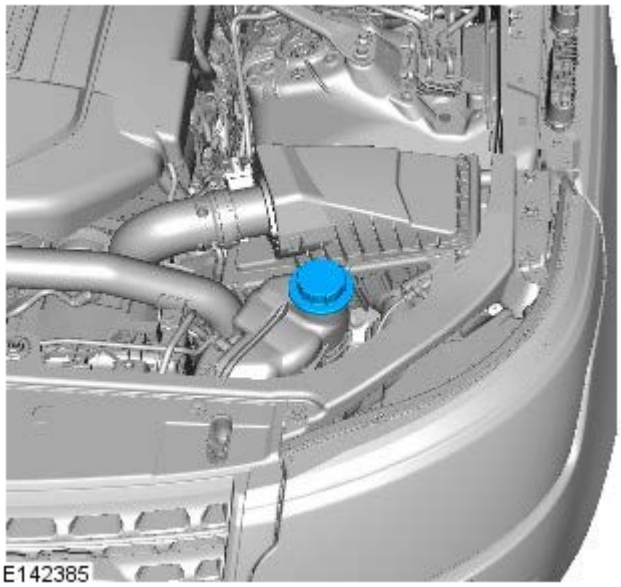
2. Refer to: Engine Undershield (501-02, Removal and Installation).

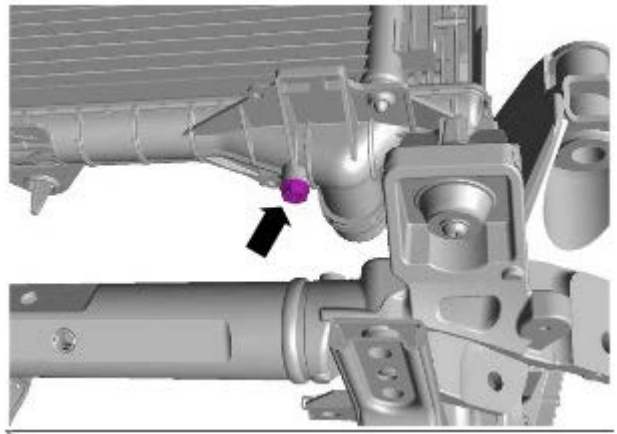
3. Refer to: Engine Cover - 4.4L V8 - TdV8 (501-05, Removal and Installation).

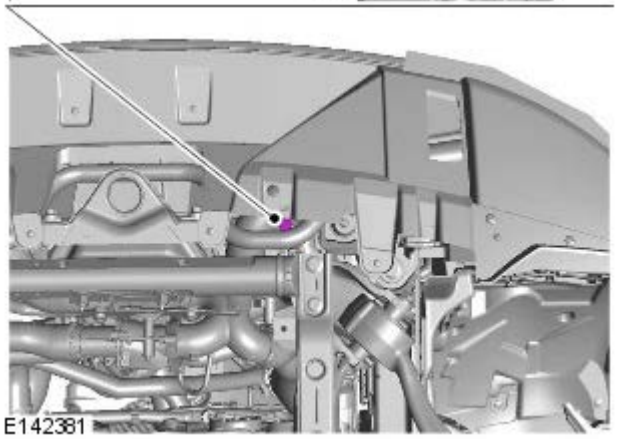
4.



5. WARNING: When releasing the cooling system pressure, cover the coolant expansion tank cap with a thick cloth.

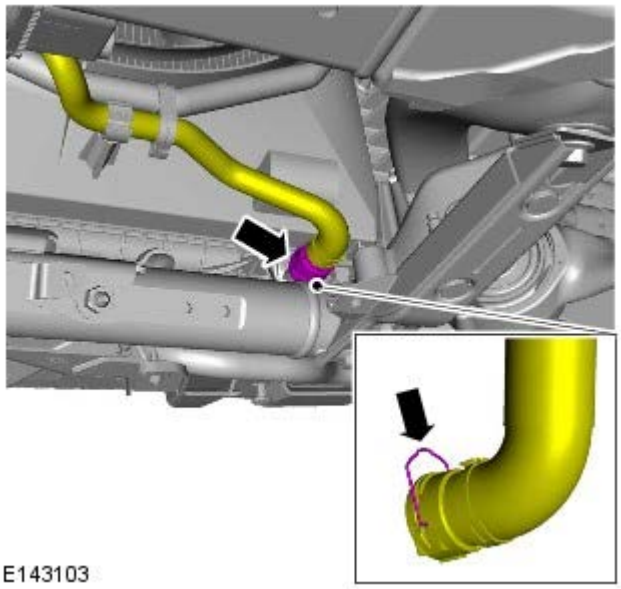

E142385




E142381

6. CAUTION: Be prepared to collect escaping coolant.

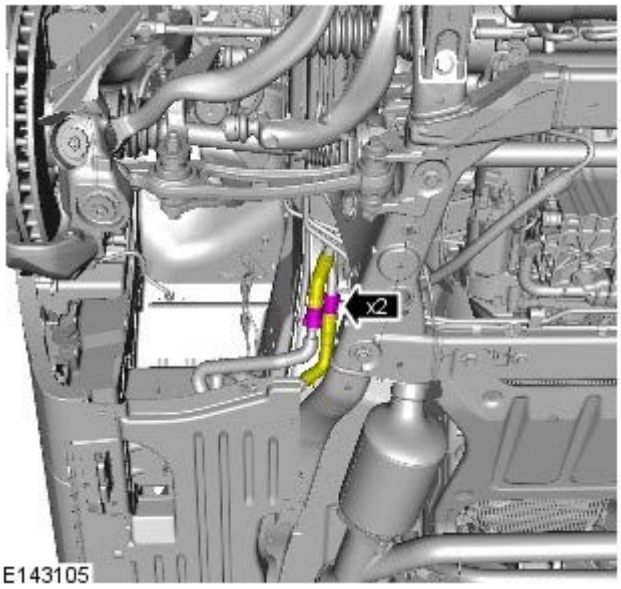
7. CAUTION: Be prepared to collect escaping coolant.


E143103

NOTE: Step 7-10 and 12-13 only needs to be carried out when the Auxiliary Climate System has been fitted.

8. Remove the front RH wheel arch liner.

   Refer to: Fender Splash Shield (501-02, Removal and Installation).



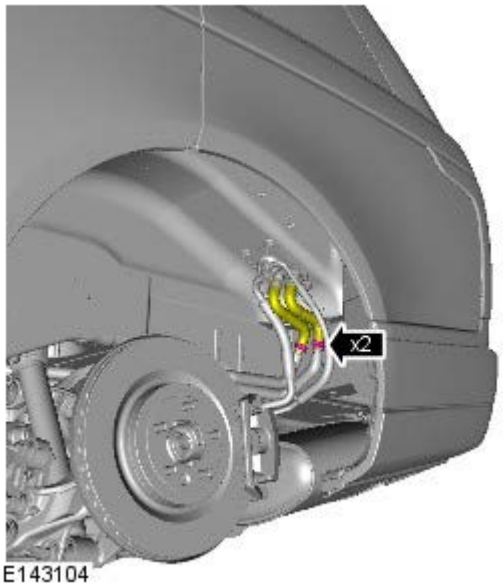
E143105

9. CAUTION: Be prepared to collect escaping coolant.

10. Remove the rear LH wheel arch liner.

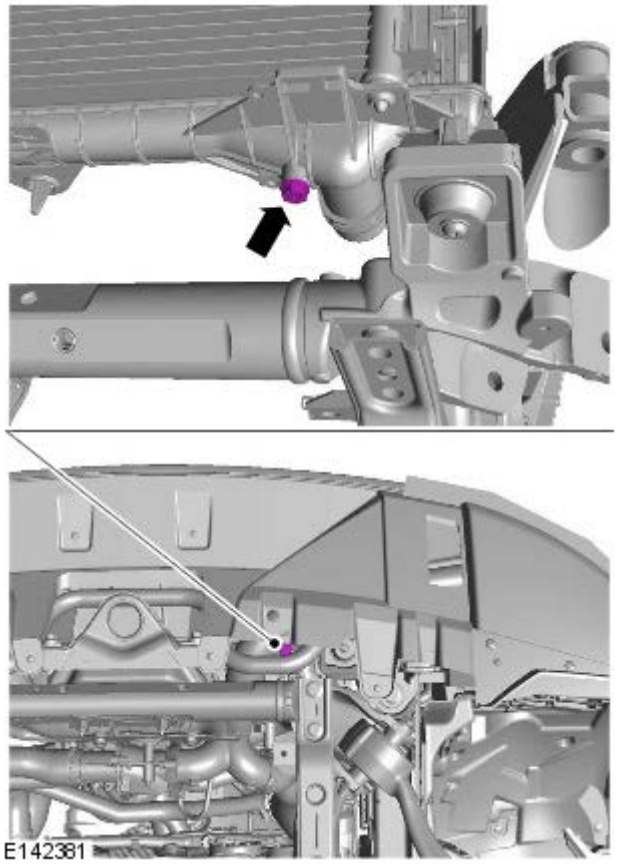
    Refer to: Rear Fender Splash Shield (501-08, Removal and Installation).

11. CAUTION: Be prepared to collect escaping coolant.

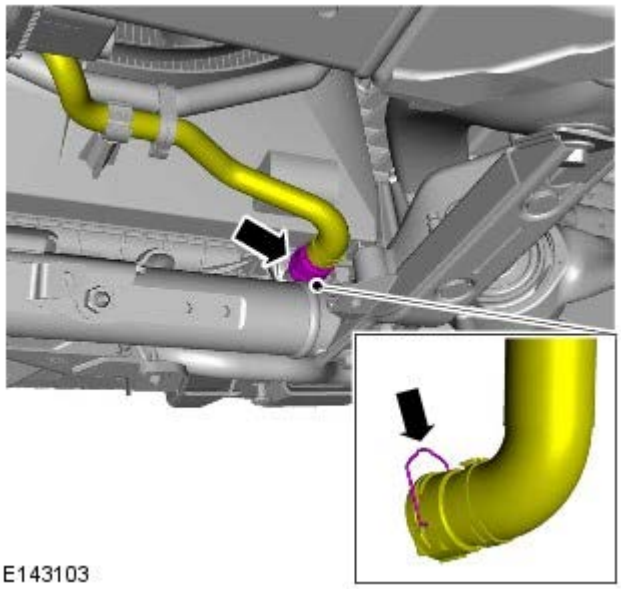


E143104

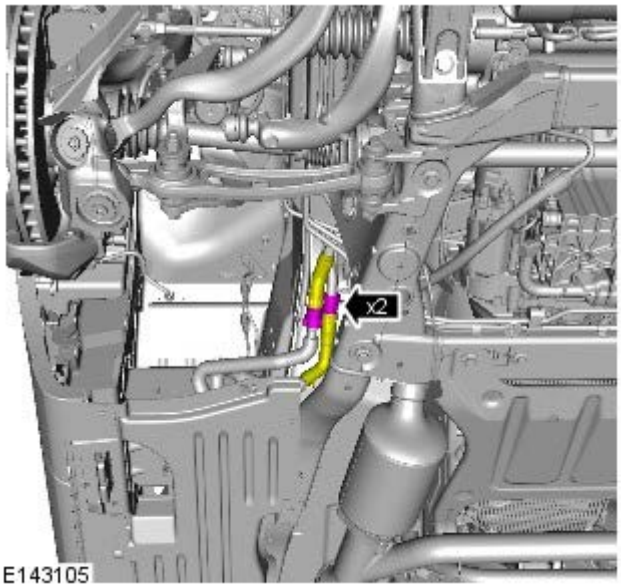
12. *Torque:* 5 Nm


E142381

13.

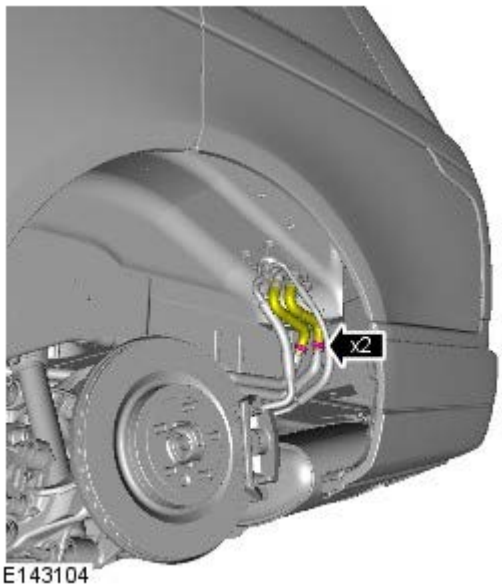

E143103

14.



E143105

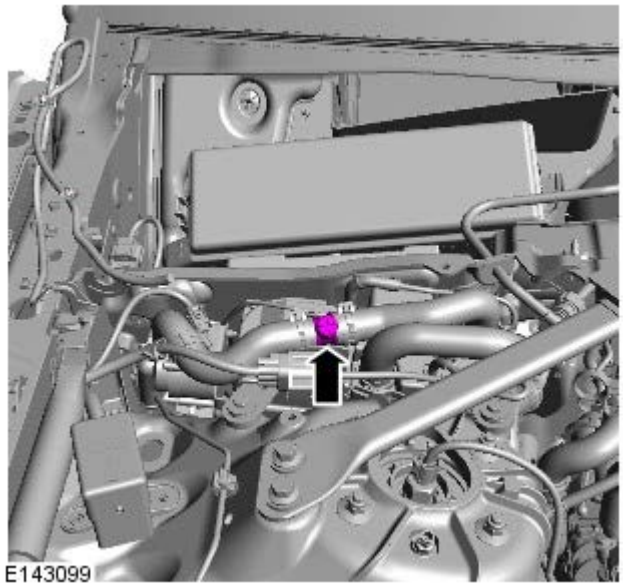
15.



E143104

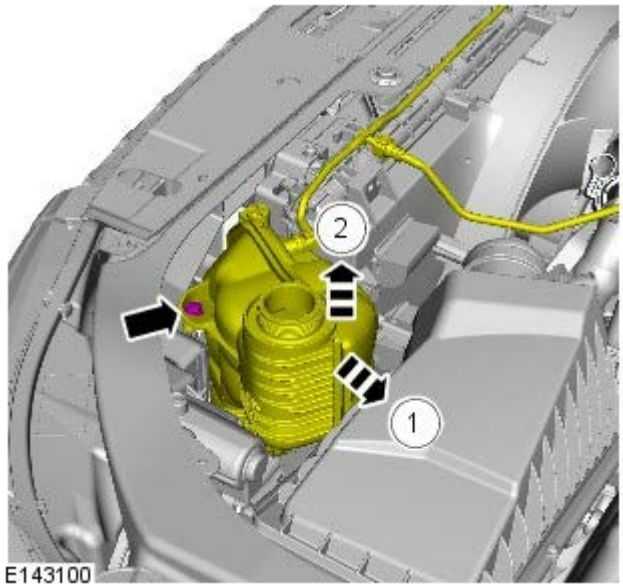
16. Carry out the procedure up to step 1 in the filling section three times, filling the cooling system with clean water at the first two drains. At the third refill, use a suitable measuring tool to make sure that the cooling system maintains a 50% mix.

Filling



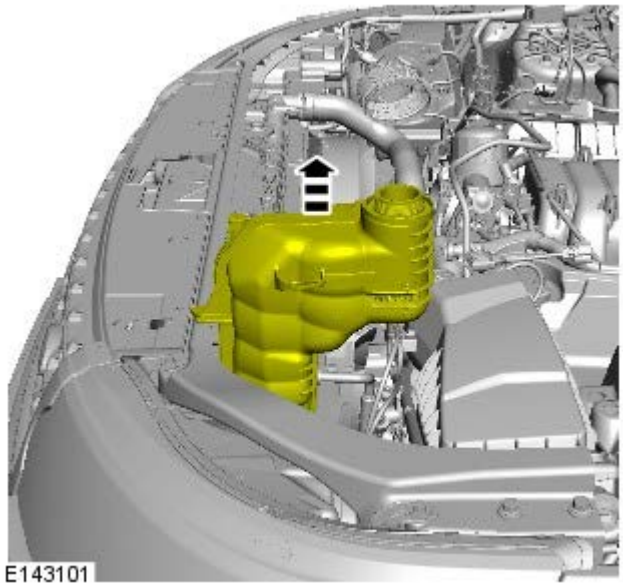
1. NOTE: Where fitted.

2. *Torque:* 9 Nm

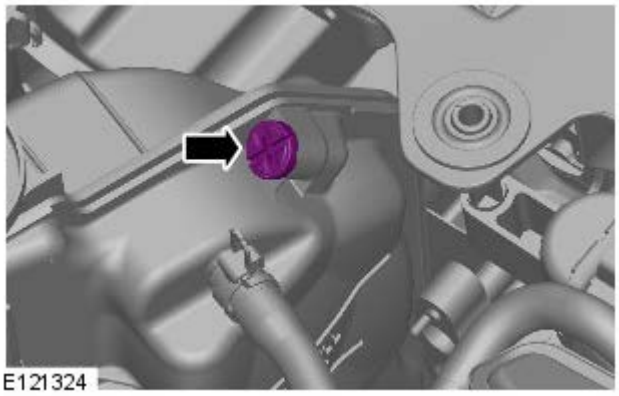


3. NOTE: Keep the coolant expansion tank vertically.

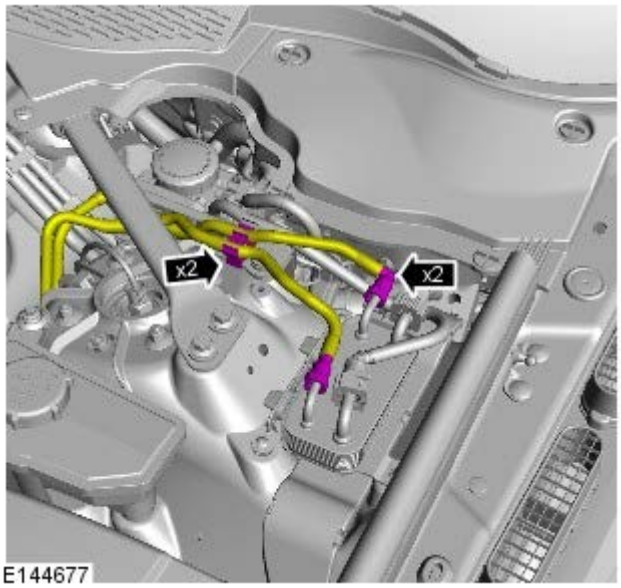
   Raise the coolant expansion tank minimum 110mm from its original position.



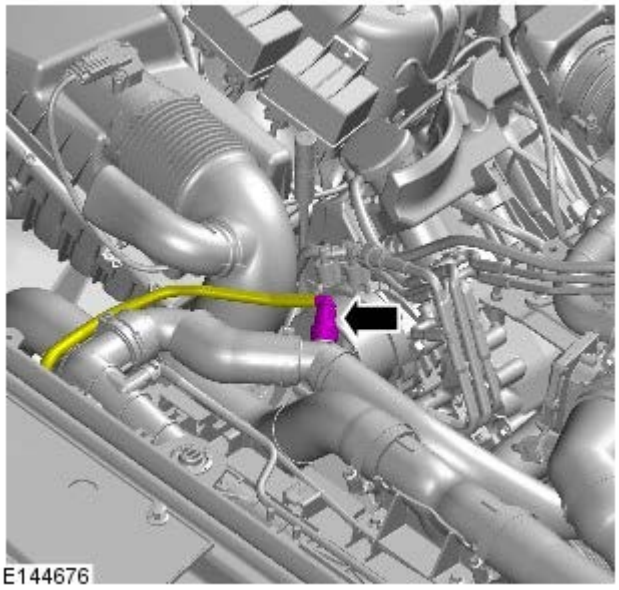
4.



5.



6.

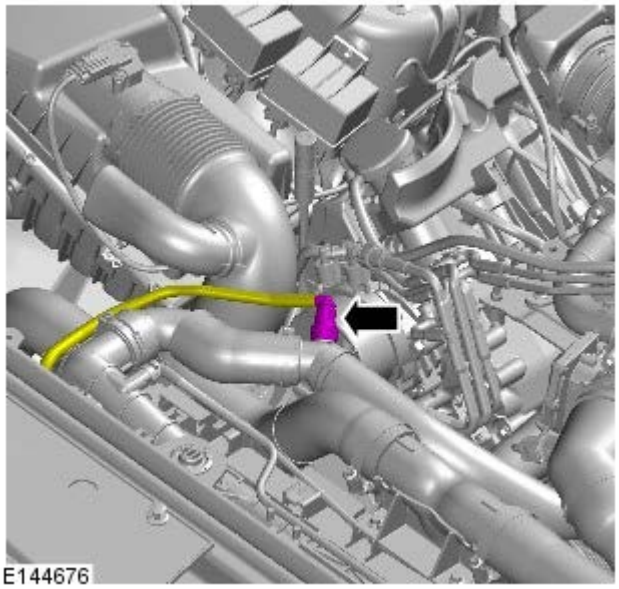


7. CAUTION: Anti-freeze concentration must be maintained at 50%.

   Fill the coolant expansion tank to the rim and continue until coolant is visable from the outlet.

8. Keep the coolant level at the top of the expansion tank.

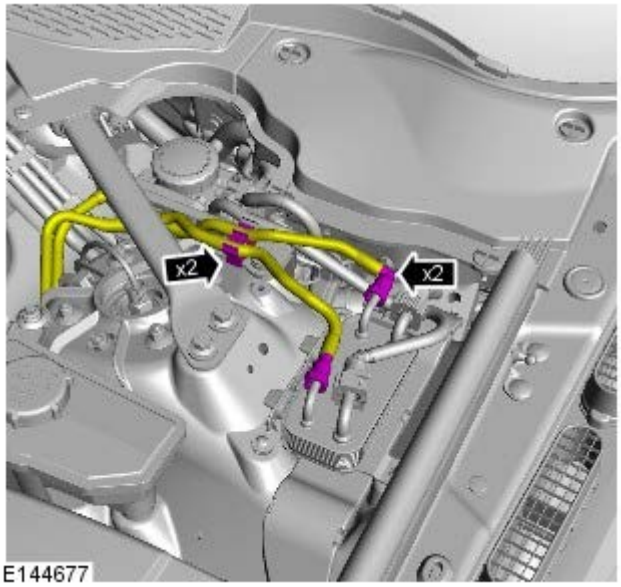
9. Once coolant is visable from the outlet, connect the pipe.


E144676

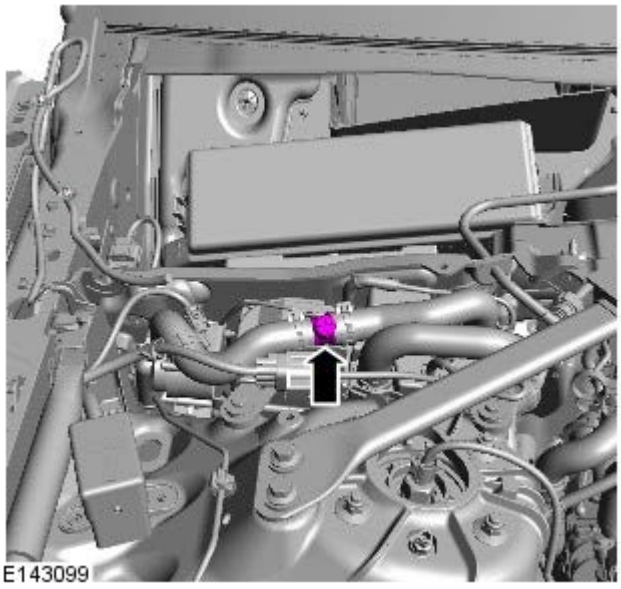
10. Set the heater controls to maximum.

11. Start and run the engine.

12. Once coolant is visable from the outlet, connect the pipe.



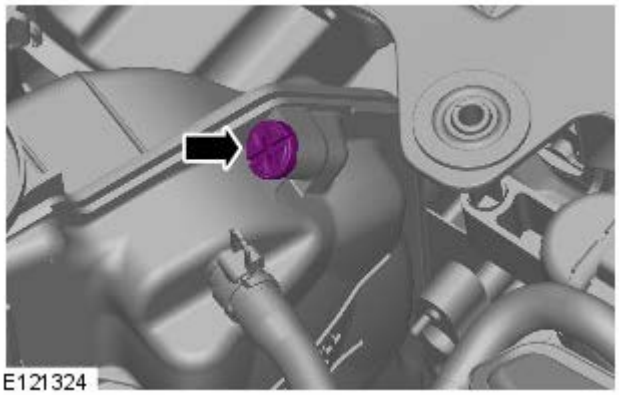
E144677


E143099

13. NOTE: Where fitted.

Once coolant is visable from the outlet, close the bleeding points.

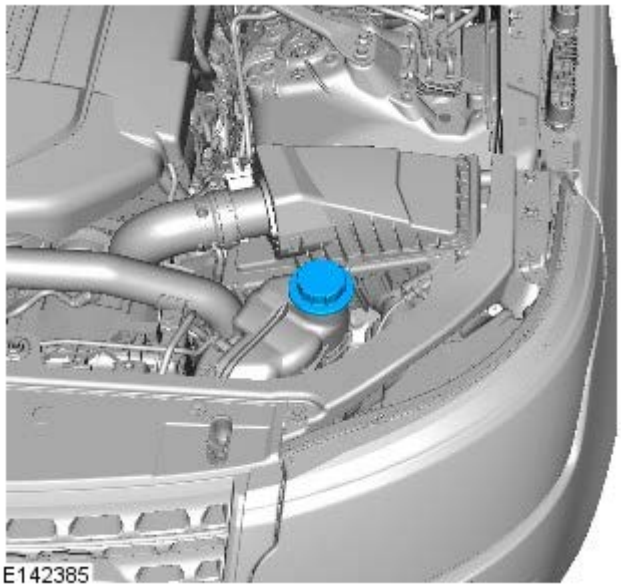
14. Once coolant is visable from the outlet, close the bleeding points.



15. Hold the engine speed at 2000 rpm, until the coolant level stops dropping.

16. Increase the engine speed from idle to 2500 RPM until warm air is emitted from the front and rear face vents.

17. Install the expansion tank cap after making sure that the final coolant level is 40mm above the maximum cold fill line.



18. Run the engine until the thermostat opens and hot air is emitted from the front and rear face vents.

19. Switch the engine off and allow to cool.

20. Install the coolant expansion tank.

21. WARNINGS:

    When releasing the cooling system pressure, cover the coolant expansion tank cap with a thick cloth.

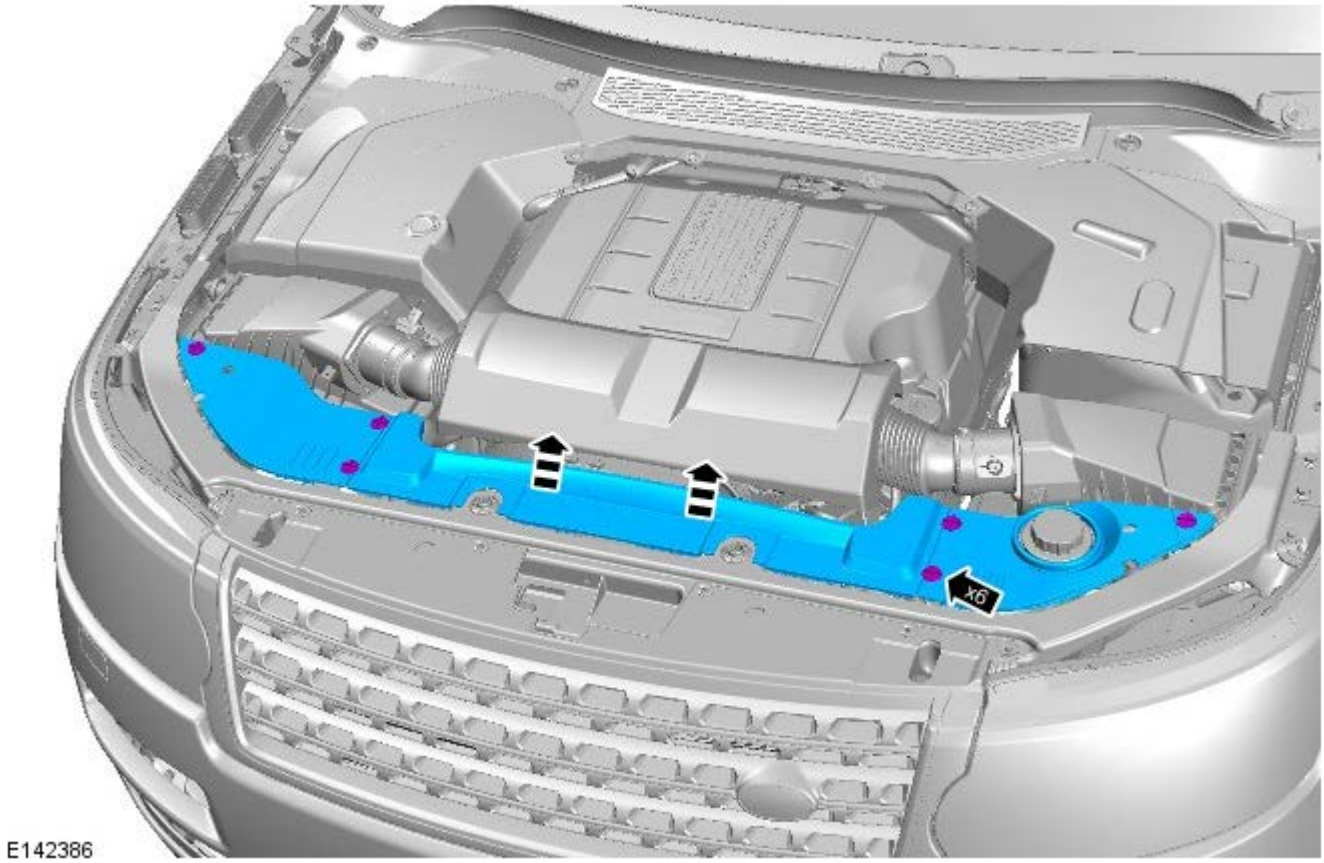
    Since injury such as scalding could be caused by escaping steam or coolant, make sure the vehicle cooling system is cool prior to carrying out this procedure.

    CAUTION: Make sure the coolant level remains above the "COLD FILL RANGE" lower level mark.

    Check and top-up the coolant if required.

22. Visually check the engine and cooling system for signs of coolant leakage.

23.



24. Refer to: Engine Cover - 4.4L V8 - TdV8 (501-05, Removal and Installation).

25. Refer to: Engine Undershield (501-02, Removal and Installation).

Published: 04-Aug-2012

Engine Cooling - TDV8 4.4L Diesel - Cooling System Partial Draining, Filling and Bleeding

General Procedures

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.

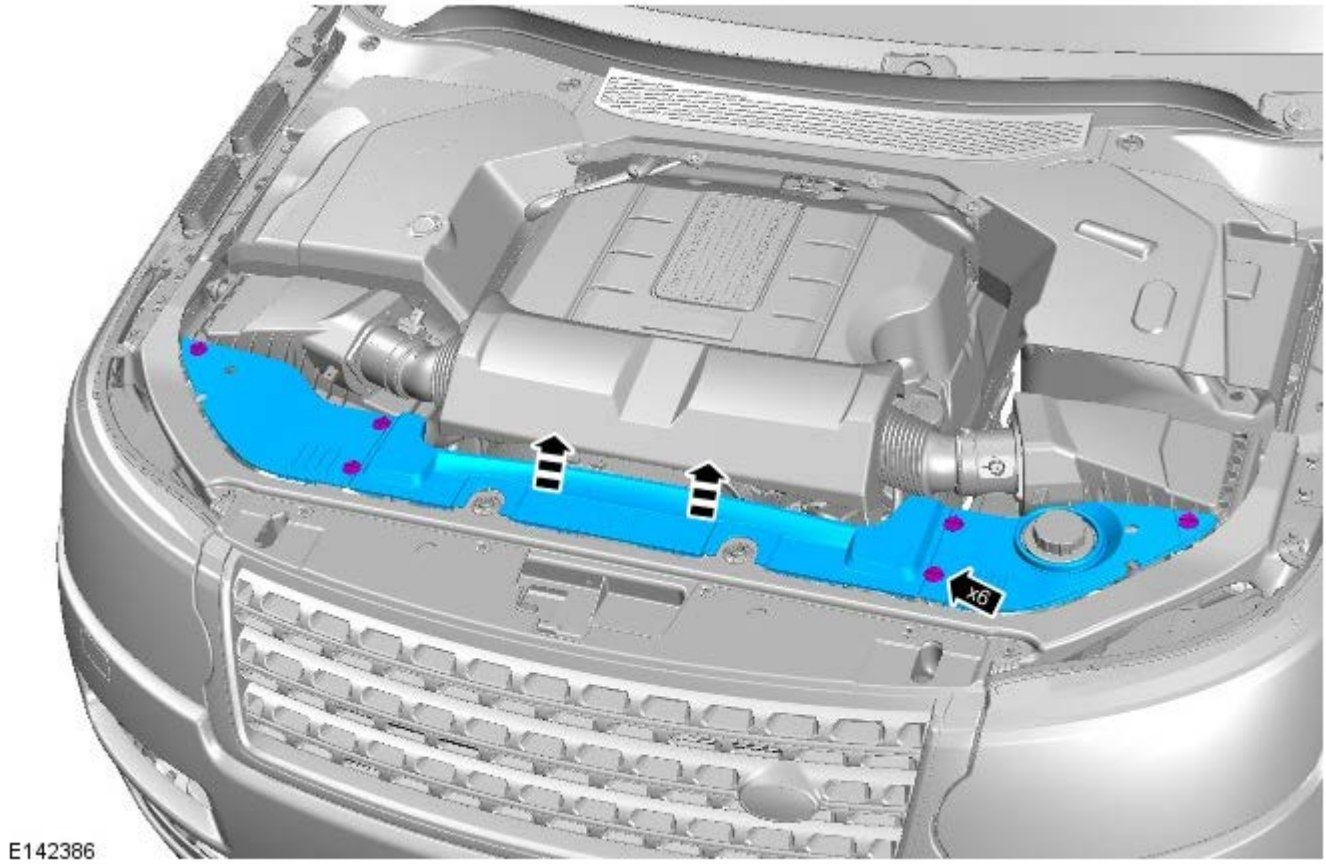
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

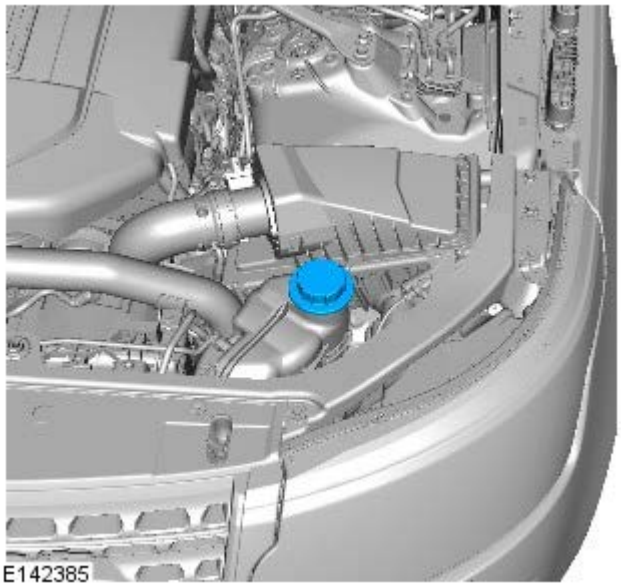
2. For additional information, refer to: Engine Undershield (501-02, Removal and Installation).

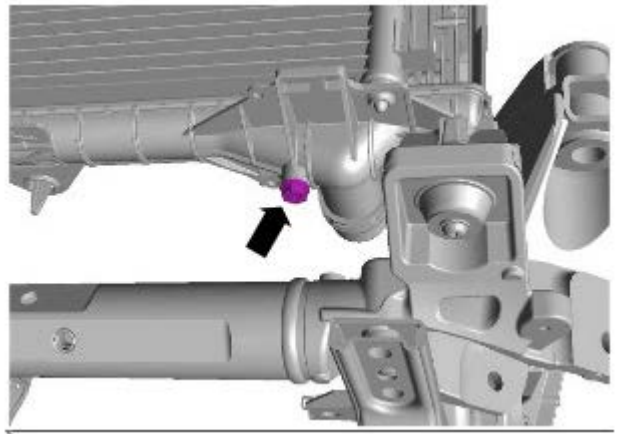
3. For additional information, refer to: Engine Cover - 4.4L V8 - TdV8 (501-05, Removal and Installation).

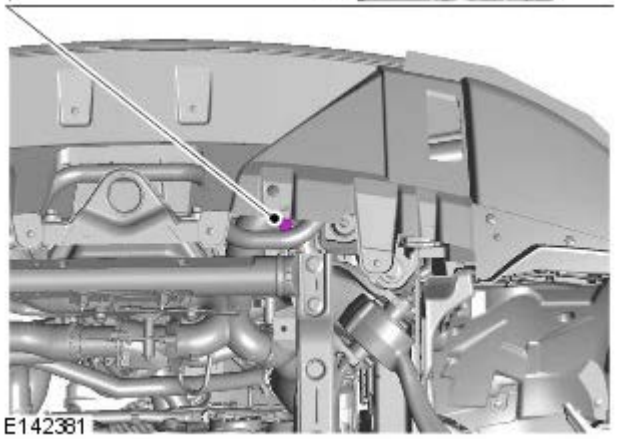
4.



5. WARNING: When releasing the cooling system pressure, cover the coolant expansion tank cap with a thick cloth.

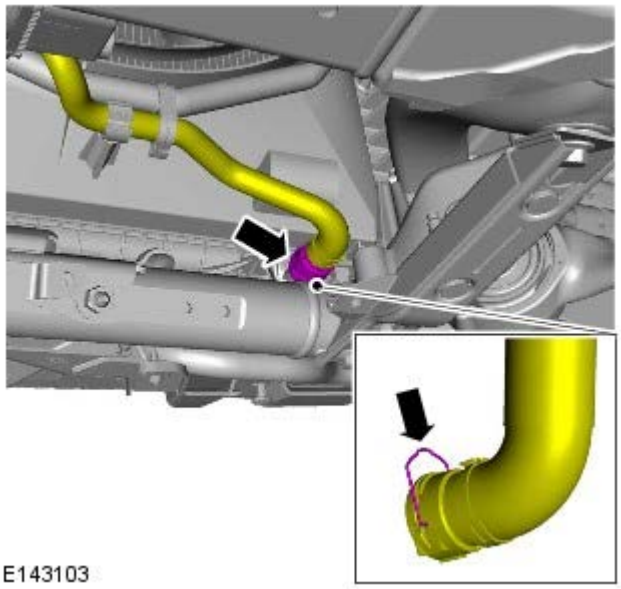

E142385




E142381

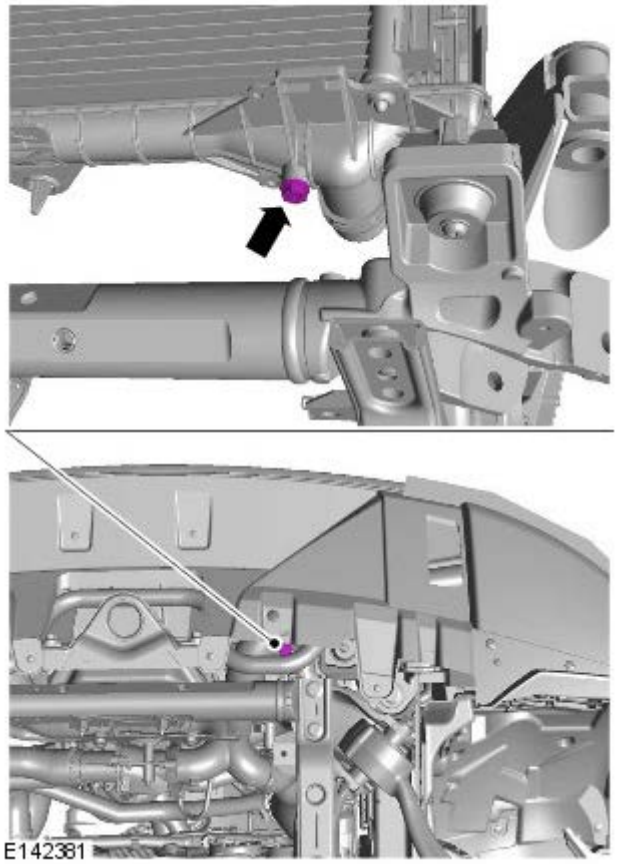
6. CAUTION: Be prepared to collect escaping coolant.

7. CAUTION: Be prepared to collect escaping coolant.



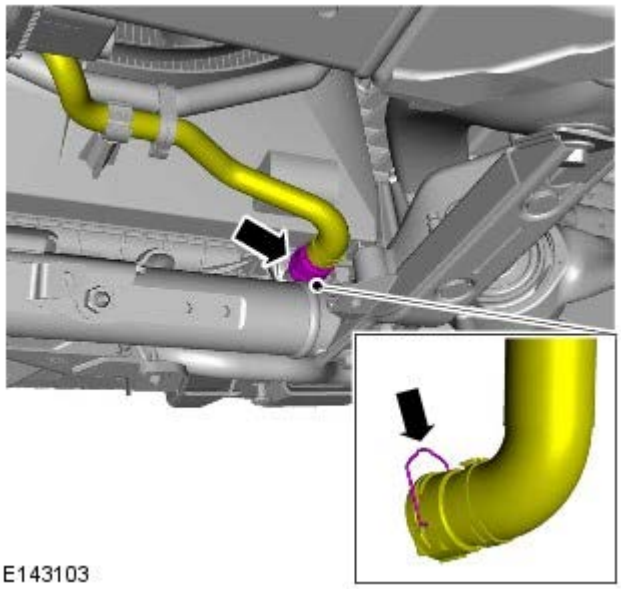
E143103

8. Torque: 5 Nm

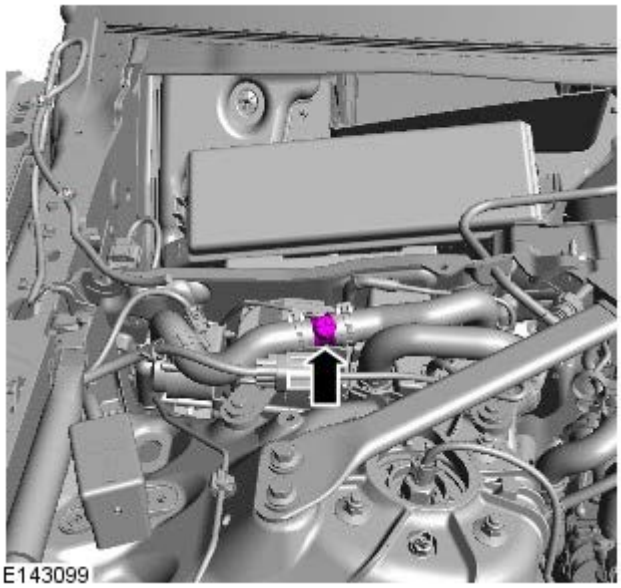


E142381

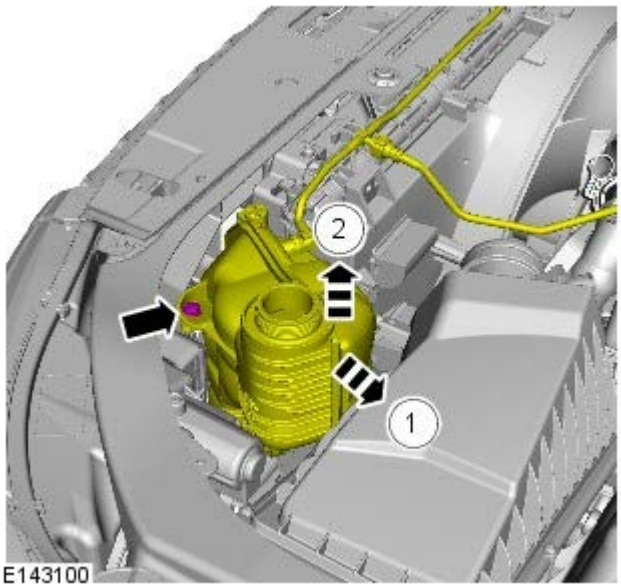
9.


E143103

10. NOTE: Where fitted.


E143099

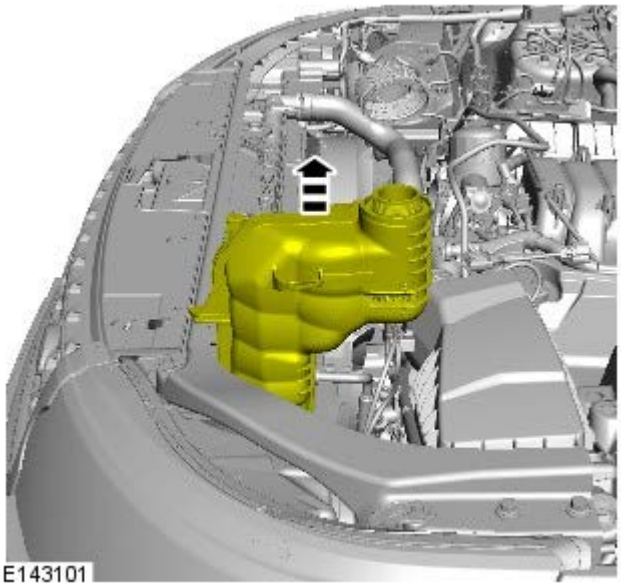
11. Torque: 9 Nm



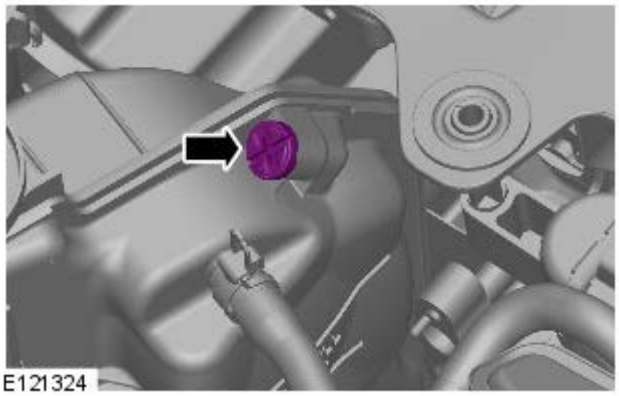
E143100

12. NOTE: Keep the coolant expansion tank vertically.

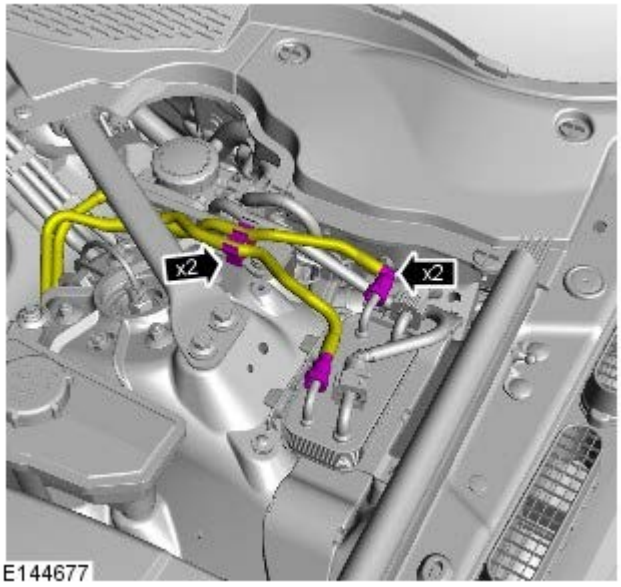
Raise the coolant expansion tank minimum 110mm from its original position.



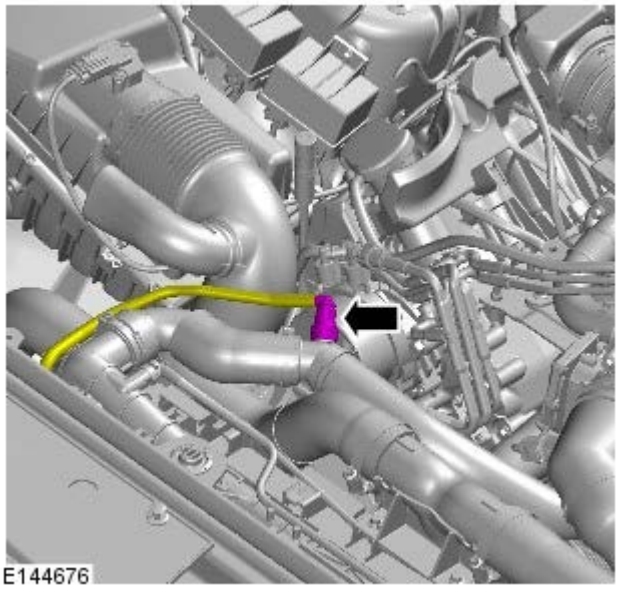
13.



14.



15.

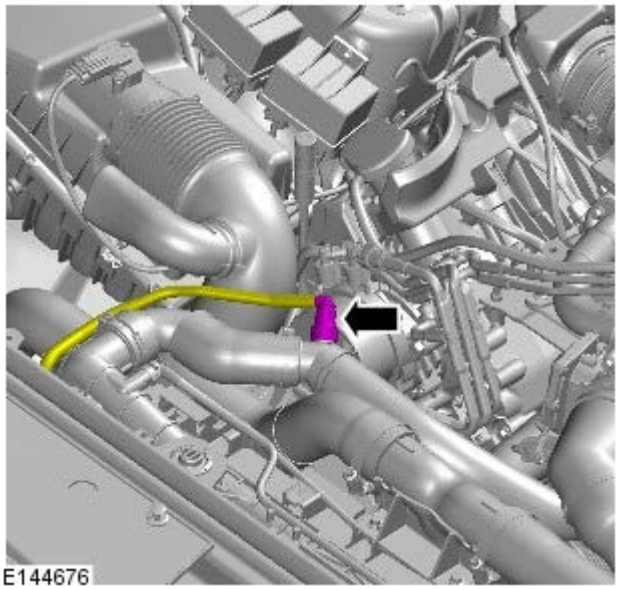


16. CAUTION: Anti-freeze concentration must be maintained at 50%.

    Fill the coolant expansion tank to the rim and continue until coolant is visable from the outlet.

17. Keep the coolant level at the top of the expansion tank.

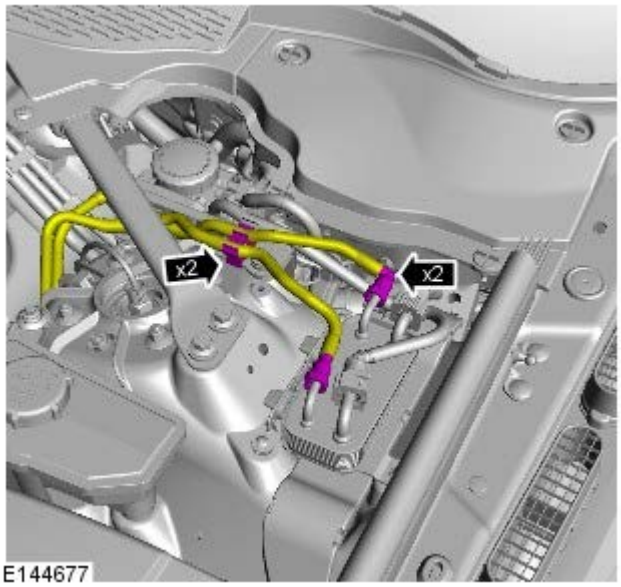
18. Once coolant is visable from the outlet, connect the pipe.

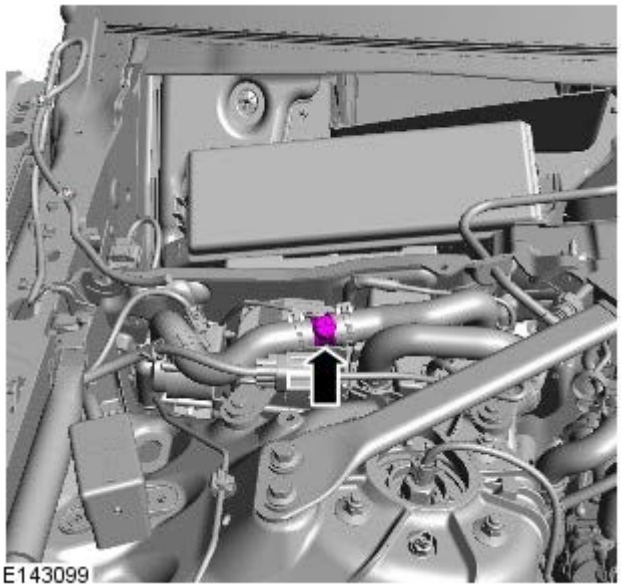


19. Set the heater controls to maximum.

20. Start and run the engine.

21. Once coolant is visable from the outlet, connect the pipe.

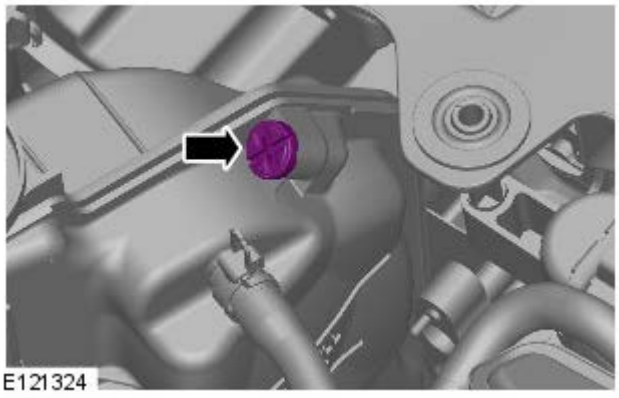




22. NOTE: Where fitted.

    Once coolant is visable from the outlet, close the bleeding points.

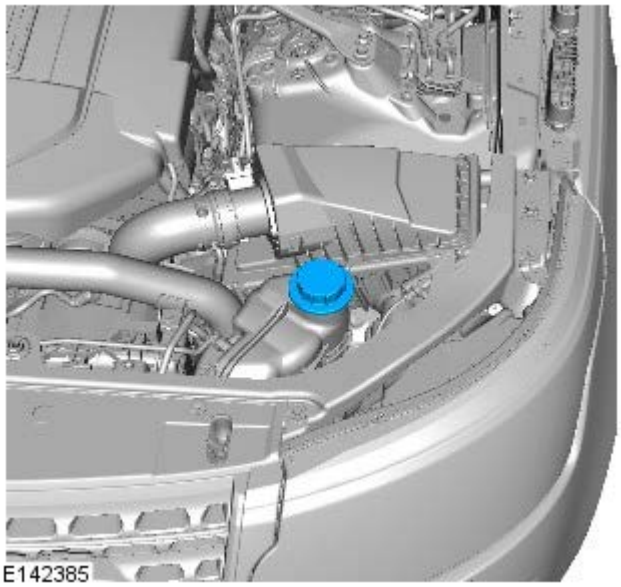
23. Once coolant is visable from the outlet, close the bleeding points.



24. Hold the engine speed at 2000 rpm, until the coolant level stops dropping.

25. Increase the engine speed from idle to 2500 RPM until warm air is emitted from the front and rear face vents.

26. Install the expansion tank cap after making sure that the final coolant level is 40mm above the maximum cold fill line.



27. Run the engine until the thermostat opens and hot air is emitted from the front and rear face vents.

28. Switch the engine off and allow to cool.

29. Install the coolant expansion tank.

30. WARNINGS:

    When releasing the cooling system pressure, cover the coolant expansion tank cap with a thick cloth.

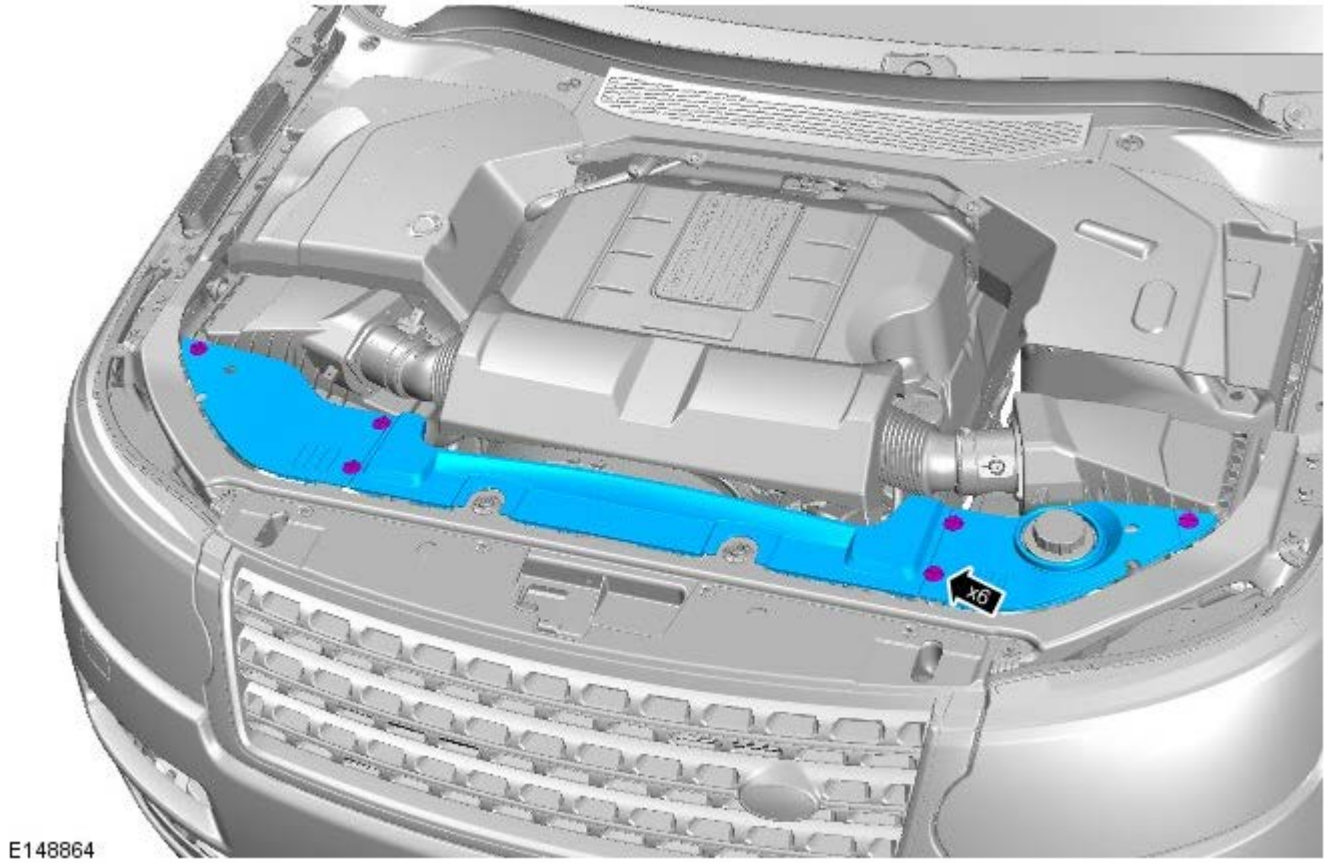
    Since injury such as scalding could be caused by escaping steam or coolant, make sure the vehicle cooling system is cool prior to carrying out this procedure.

    CAUTION: Make sure the coolant level remains above the "COLD FILL RANGE" lower level mark.

    Check and top-up the coolant if required.

31. Visually check the engine and cooling system for signs of coolant leakage.

32.



33. For additional information, refer to: Engine Cover - 4.4L V8 - TdV8 (501-05, Removal and Installation).

34. For additional information, refer to: Engine Undershield (501-02, Removal and Installation).

Published: 04-Aug-2012

Engine Cooling - TDV8 4.4L Diesel - Cooling System Draining and Vacuum Filling

General Procedures

Draining

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.

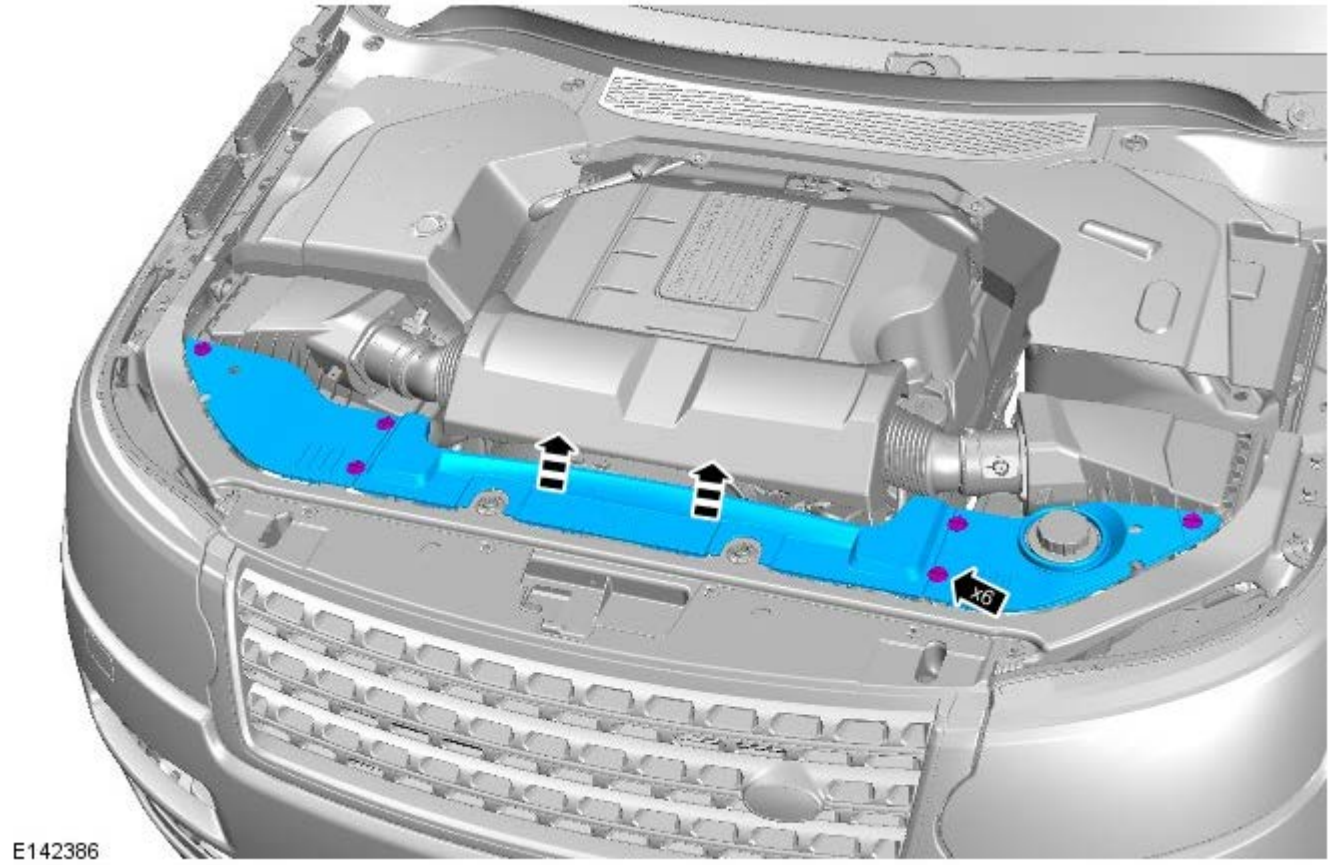
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

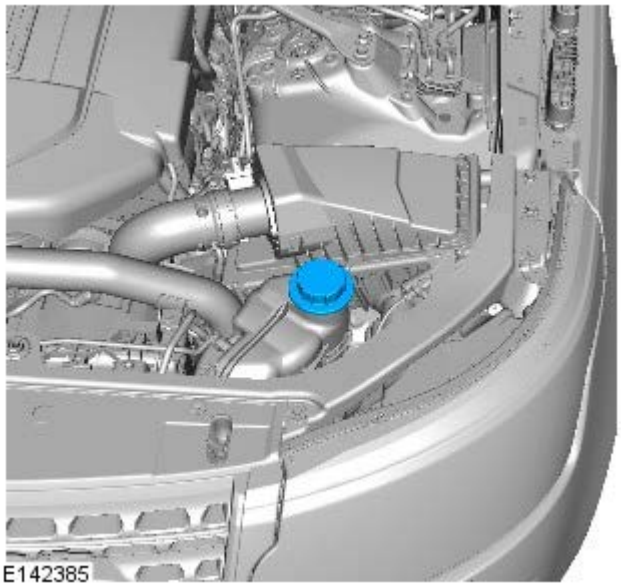
2. Refer to: Engine Undershield (501-02, Removal and Installation).

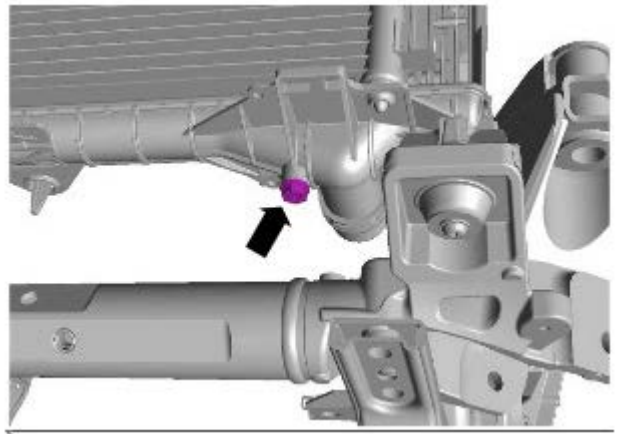
3. Refer to: Engine Cover - 4.4L V8 - TdV8 (501-05, Removal and Installation).

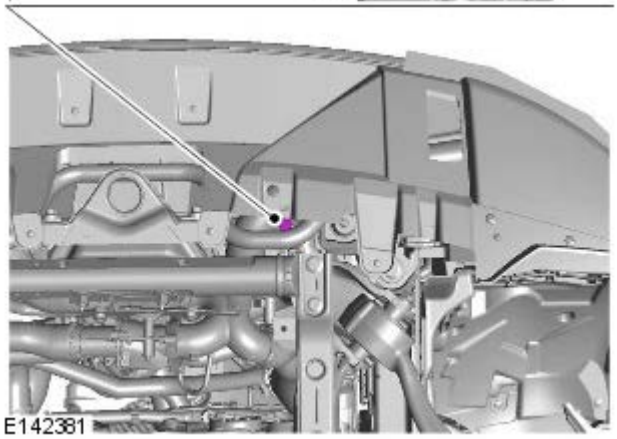
4.



5. WARNING: When releasing the cooling system pressure, cover the coolant expansion tank cap with a thick cloth.

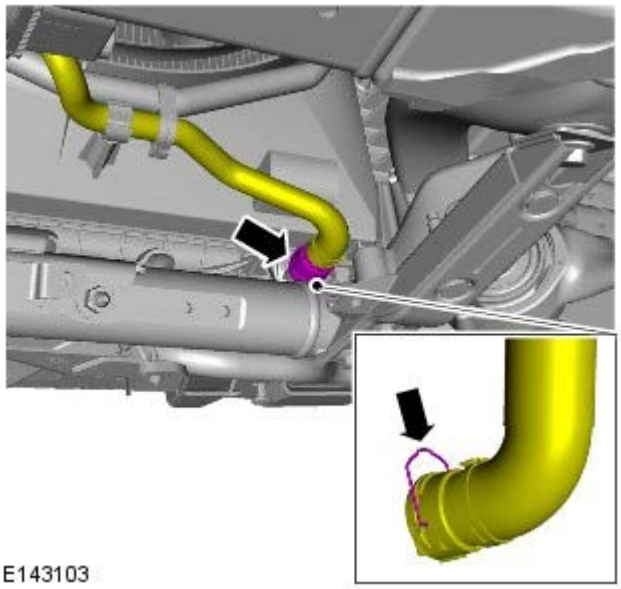

E142385




E142381

6. CAUTION: Be prepared to collect escaping coolant.

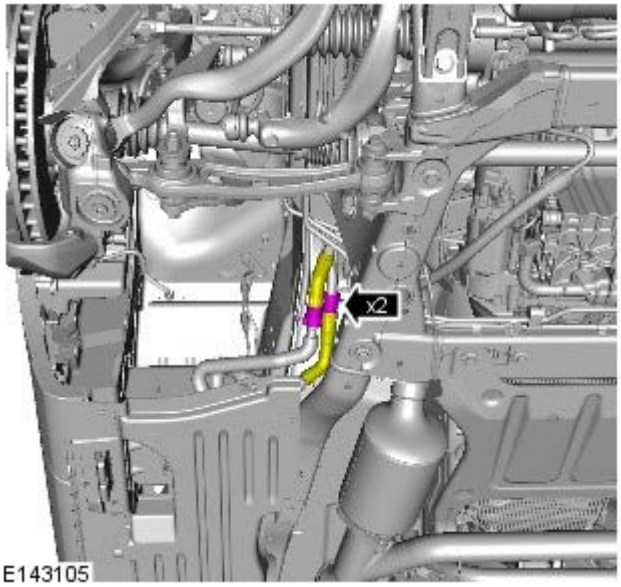
7. CAUTION: Be prepared to collect escaping coolant.


E143103

NOTE: Step 7-10 and 12-13 only needs to be carried out when the auxiliary climate control system has been fitted to the vehicle.

8. Remove the front RH wheel arch liner.

   Refer to: Fender Splash Shield (501-02, Removal and Installation).



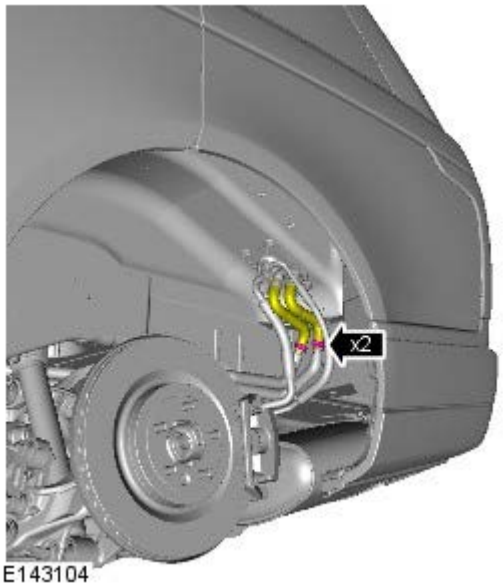
E143105

9. CAUTION: Be prepared to collect escaping coolant.

10. Remove the rear LH wheel arch liner.

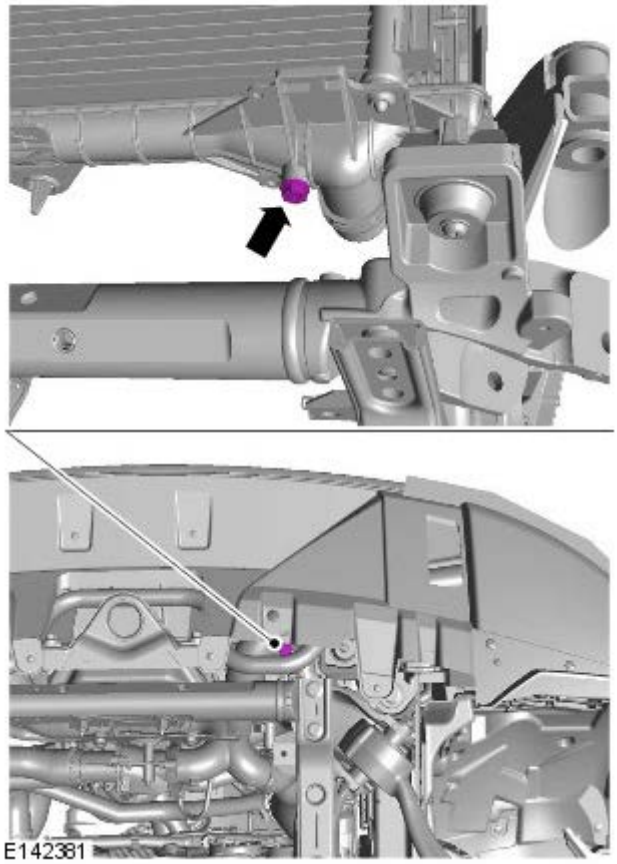
    Refer to: Rear Fender Splash Shield (501-08, Removal and Installation).

11. CAUTION: Be prepared to collect escaping coolant.

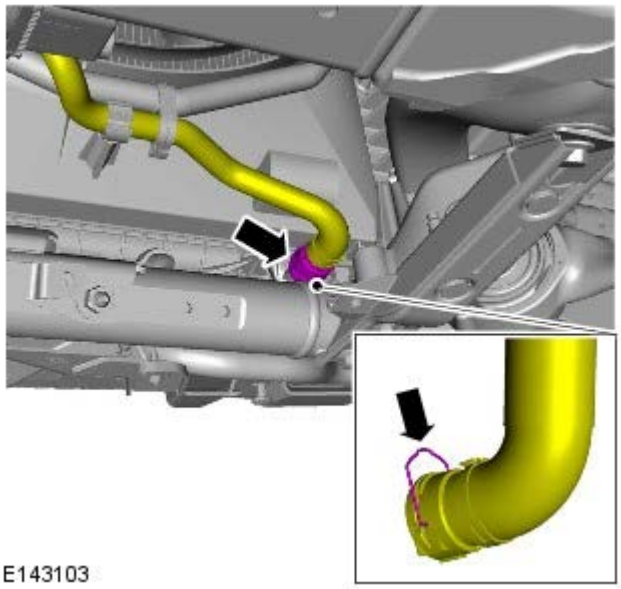


E143104

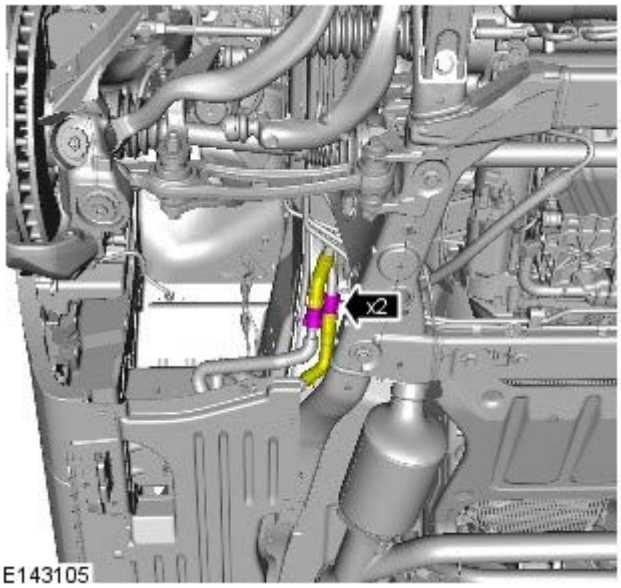
12. *Torque:* 5 Nm


E142381

13.

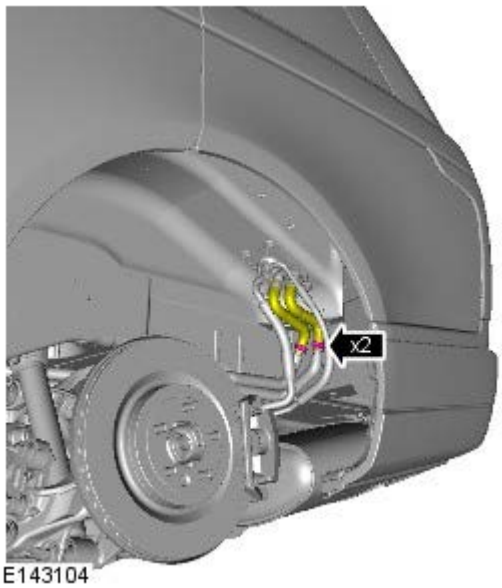

E143103

14.



E143105

15.



E143104

16. Carry out the procedure up to step 1 in the filling section three times, filling the cooling system with clean water at the first two drains. At the third refill, use a suitable measuring tool to make sure that the cooling system maintains a 50% mix.

Filling

1. 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.
2. NOTES:

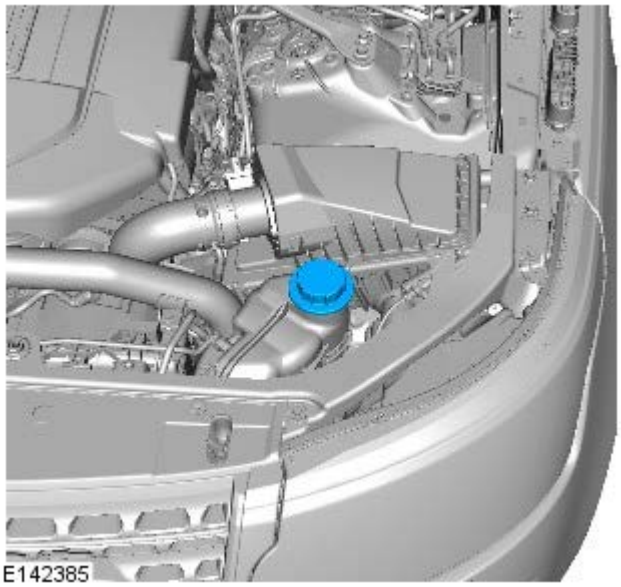
    Make sure the coolant supply valve is in the closed position on the vacuum filler gauge assembly.

    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.
3. Position the evacuated air hose into a container.
4. Open the air supply valve.
5. 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 coolant supply hose.

    Open the coolant supply valve for 2 seconds to prime the coolant supply hose.
6. Apply air pressure progressively until the arrow on the vacuum filler gauge reaches the green segment.
7. Disconnect the compressed air supply line.
8. 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.
9. Remove the vacuum filler gauge and cooling system vacuum refill adaptor assembly.
10. Continue to fill the coolant expansion tank to the rim until the coolant level stops dropping.
11.



12. Start and run the engine.
13. Set the heater controls to maximum.
14. Increase the engine speed from idle to 3500 RPM until hot air is emitted from the front and rear face vents.
15. Run the engine until the thermostat opens and hot air is emitted from the front and rear face vents.
16. Switch the engine off and allow to cool.
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: 02-Aug-2012

Engine Cooling - TDV8 4.4L Diesel - Cooling System Pressure Test

General Procedures

Check

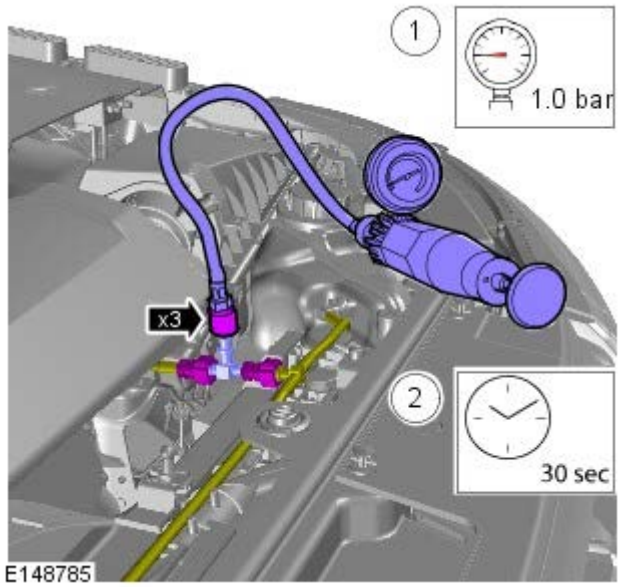
WARNING: Since injury such as scalding could be caused by escaping steam or coolant, allow the vehicle cooling system to cool prior to carrying out this procedure.

NOTE: The following procedure will enable the cooling system to be pressure tested for condition and leaks. Stage 1 will check the expansion tank cap register seal and the cap for leaks. Stage 2 will check the entire cooling system.

1. NOTE: If the coolant expansion tank cap is found to be leaking, replace the cap.

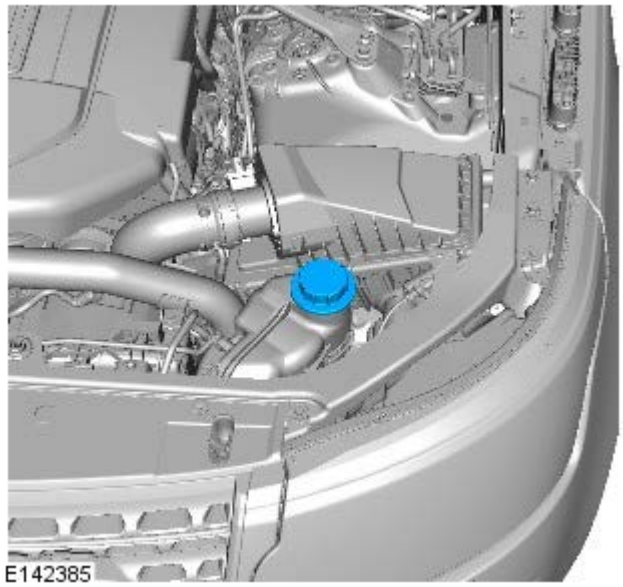
   Examine the coolant hoses for signs of cracking, distortion and security of the hose connections.

2.
   - Slowly pressurize the cooling system.
   - Check the pressure remains above 0.9 bar (90 kPa) (13 psi) after waiting for 30 seconds.
   - During the pressure drop check, listen for a hissing noise from the expansion tank cap.



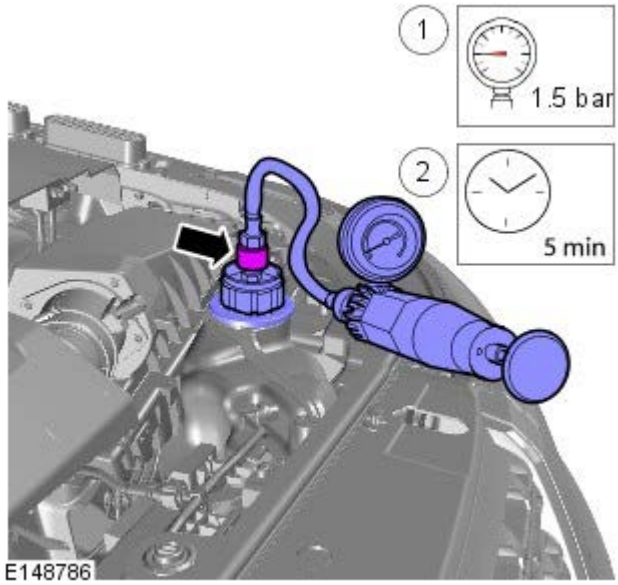
3. Depressurize and remove the pressure pump and gauge.

4.



5. CAUTION: Make sure that the mating faces are clean and free of foreign material.

   NOTE: If the pressure continues to drop after the

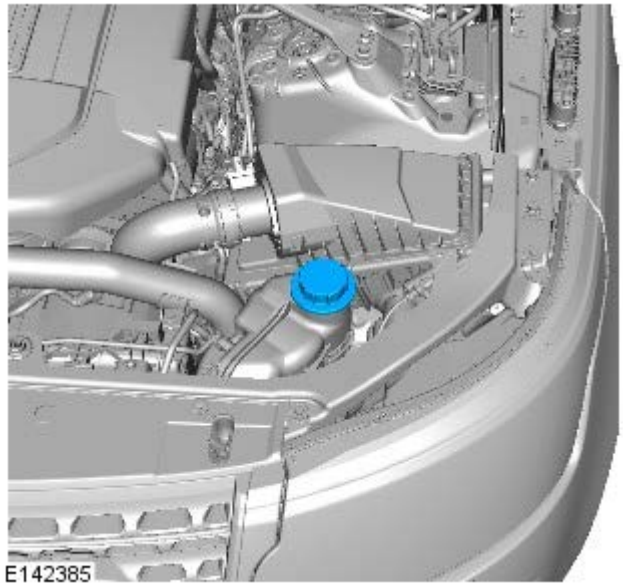


initial tolerance, there is a coolant leak.

- Slowly pressurize the cooling system.
- A small pressure decay of approximately 0.15 bar (15 kPa) (1 psi) over the first minute is normal.

6. Depressurize and remove the pressure pump and gauge.

7.



This section contains no data

Published: 08-Aug-2012

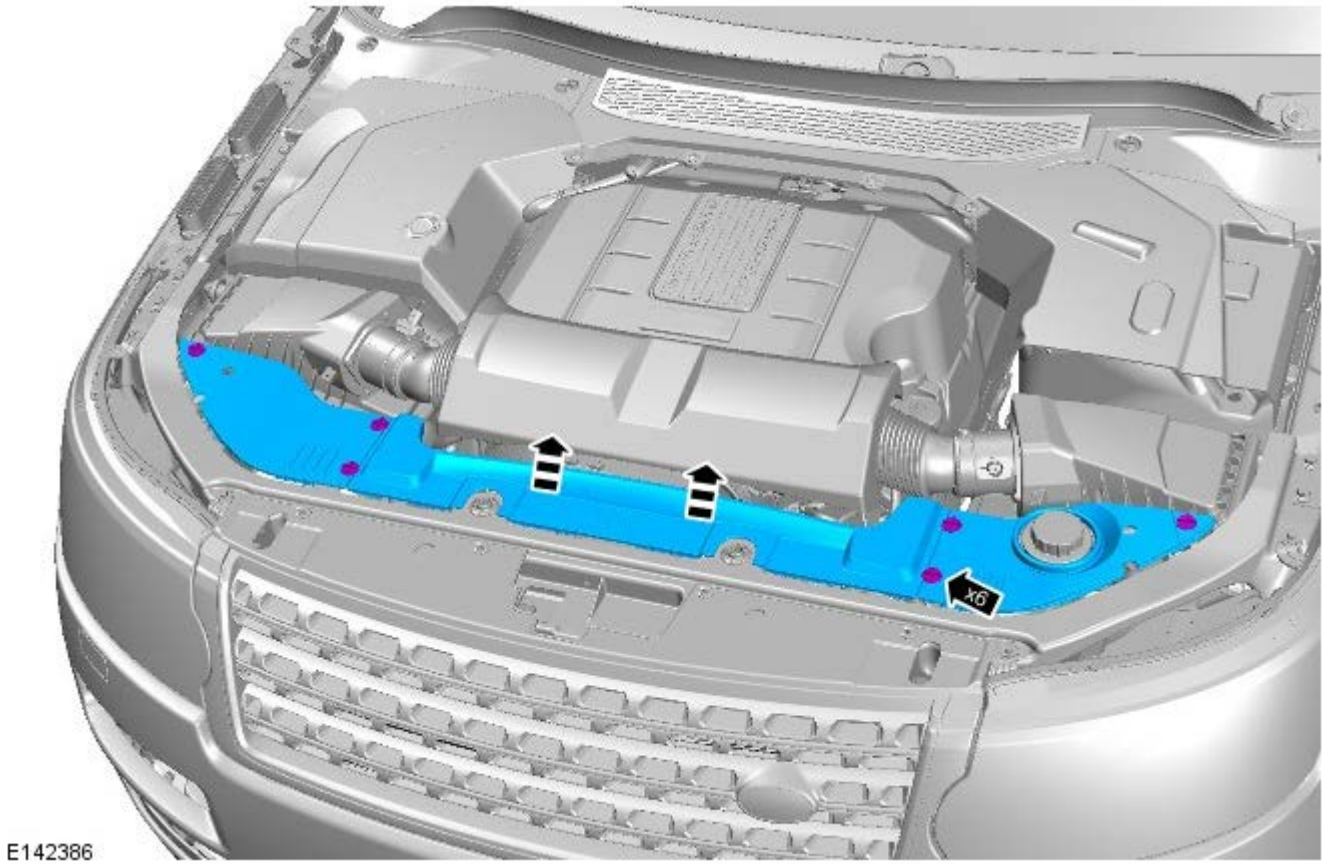
Engine Cooling - TDV8 4.4L Diesel - Coolant Expansion Tank

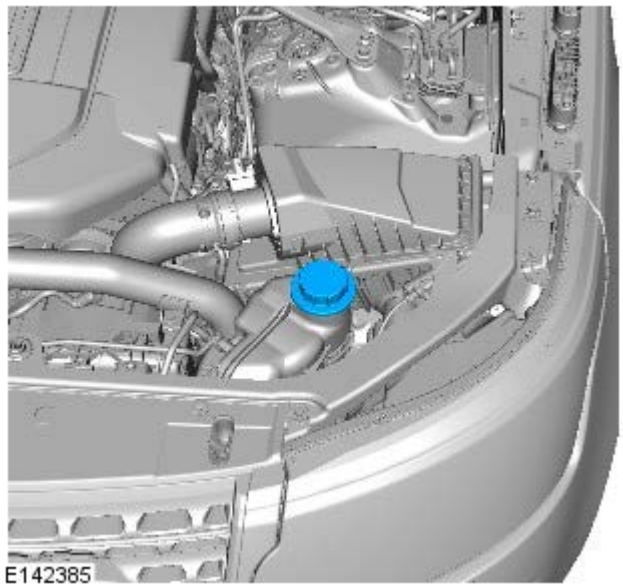
Removal and Installation

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.

1.

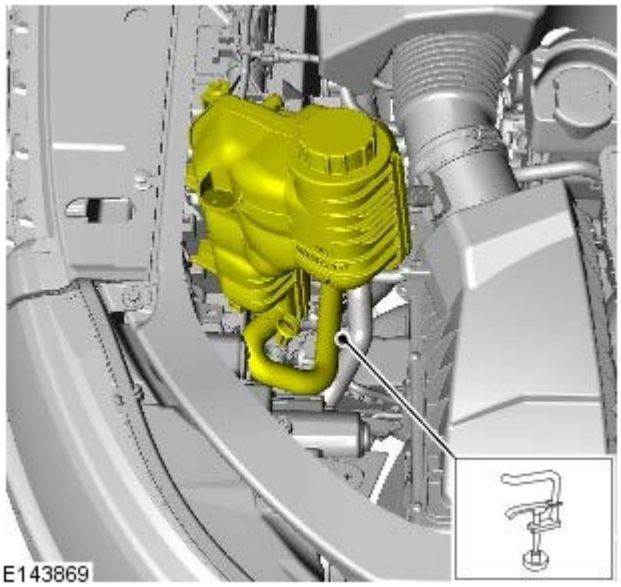




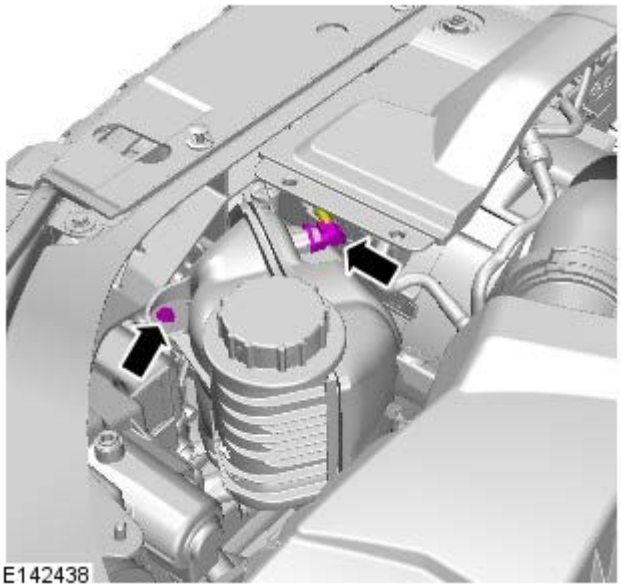
2. WARNING: When releasing the cooling system pressure, cover the coolant expansion tank cap with a thick cloth.

3. Using a syringe, remove the cooling fluid from the expansion tank.

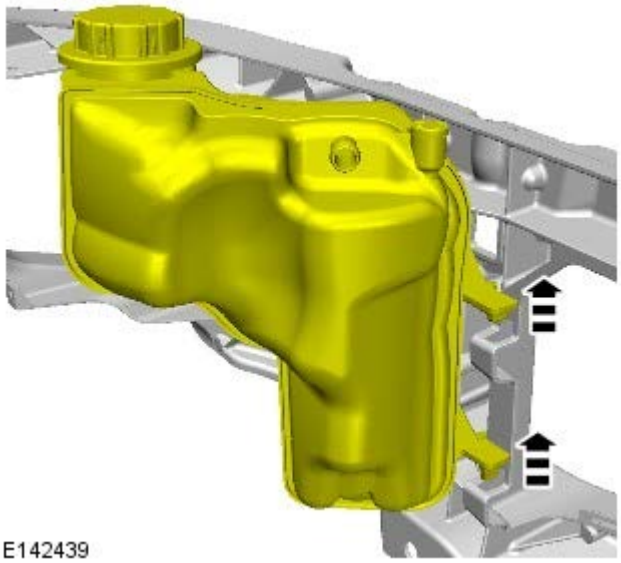
4. CAUTION: Clamp the hoses to minimize coolant loss.



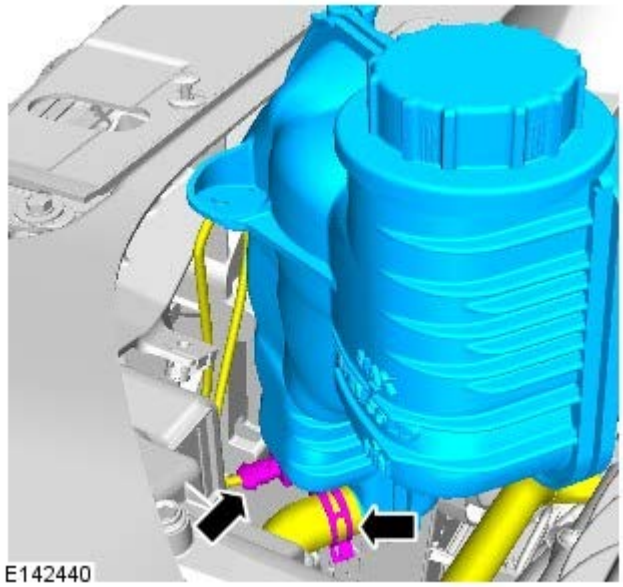
5. CAUTION: Be prepared to collect escaping coolant.



6.

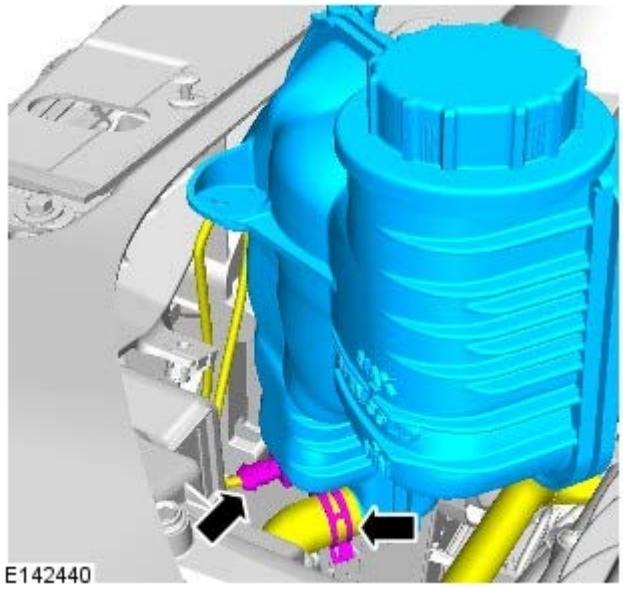


7. CAUTION: Be prepared to collect escaping coolant.

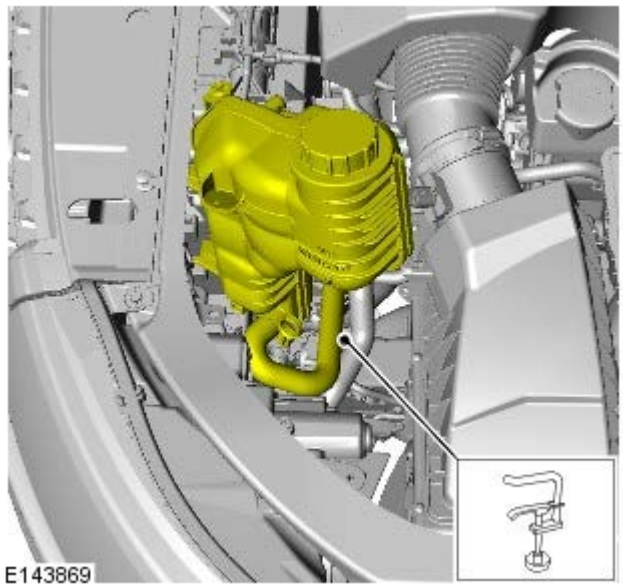


Installation

1.

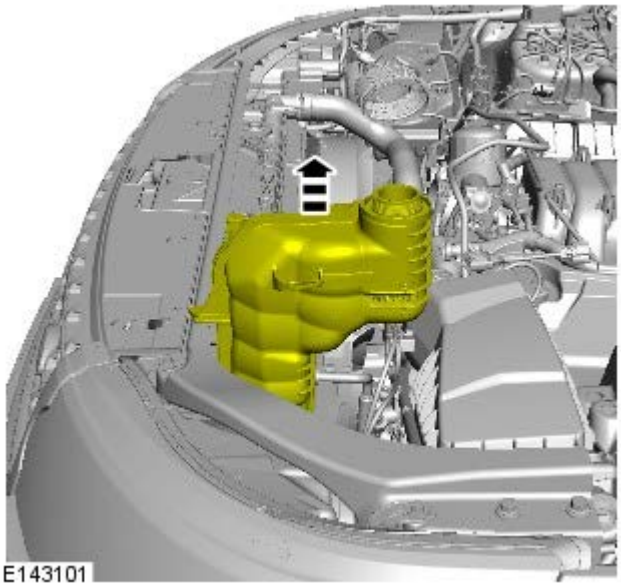


2.



3. NOTE: Keep the coolant expansion tank vertically.

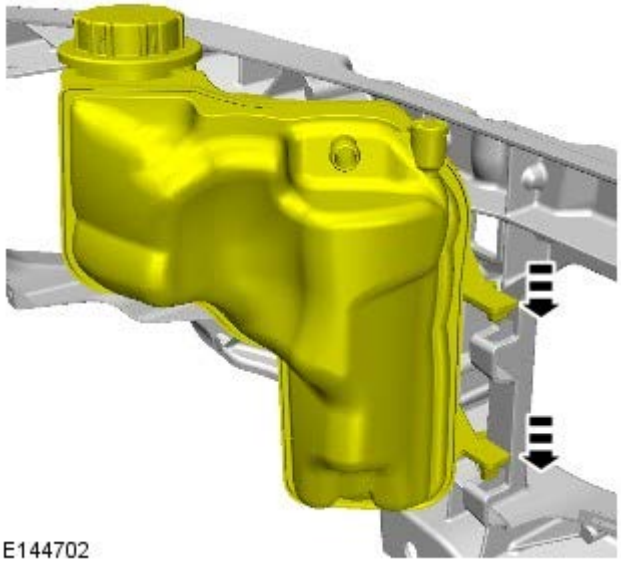
Raise the coolant expansion tank minimum 110mm


E143101

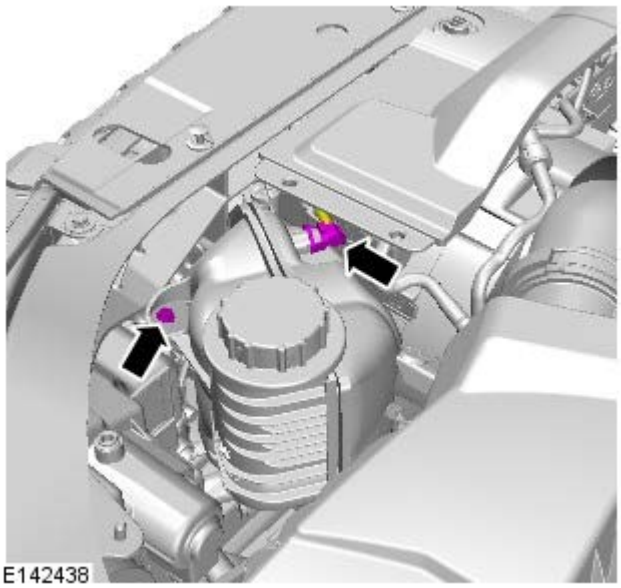
from its original position.

4. Fill the cooling system, keeping coolant to the upper level mark of the expansion tank, until a steady stream of coolant is seen returning to the tank.

5.


E144702

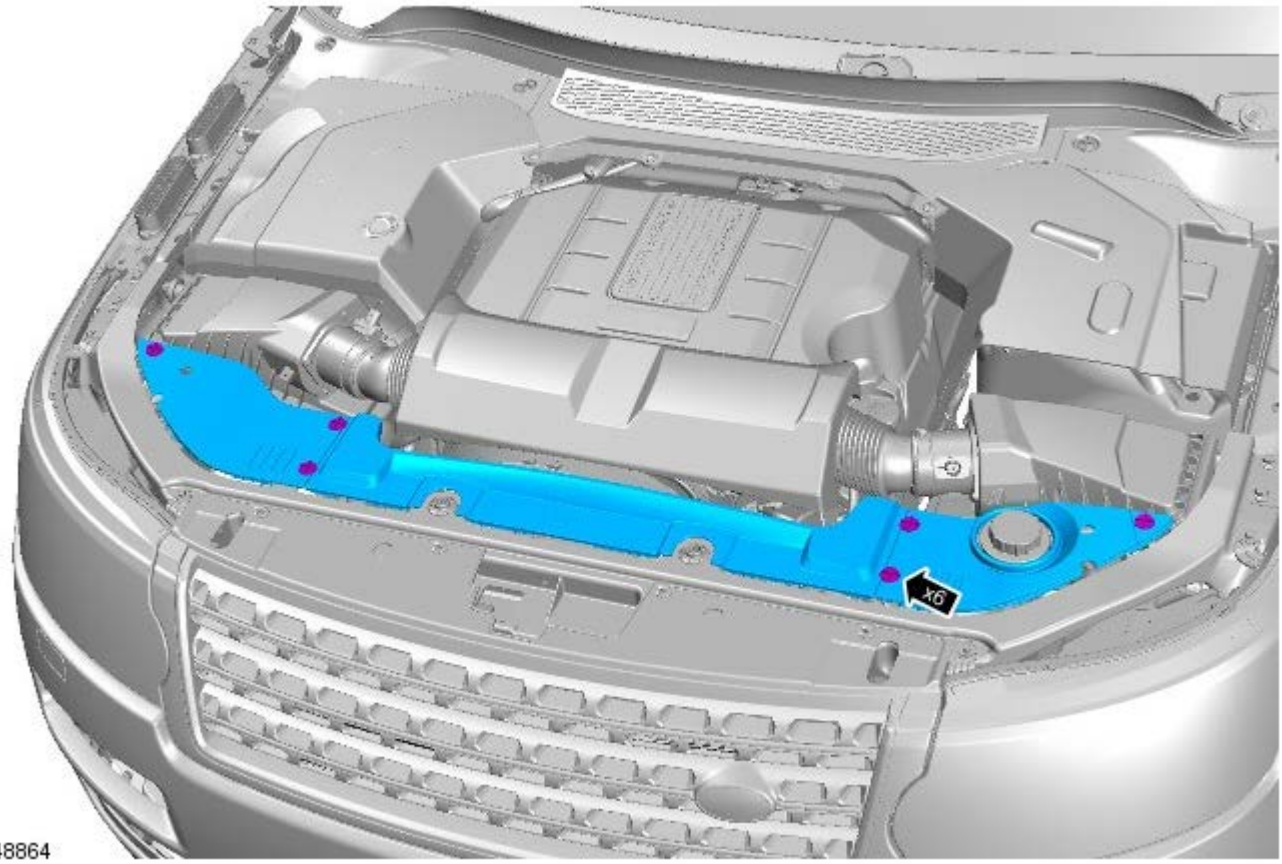
6. *Torque:* 2.8 Nm


E142438

7. CAUTION: Make sure the coolant level remains above the "COLD FILL RANGE" lower level mark.

Check and top up the cooling system as required.

8.



Published: 04-Aug-2012

Engine Cooling - TDV8 4.4L Diesel - Cooling Fan

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.

Component shown removed for clarity.

All vehicles

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. Refer to: Cooling System Partial Draining, Filling and Bleeding (303-03, General Procedures).

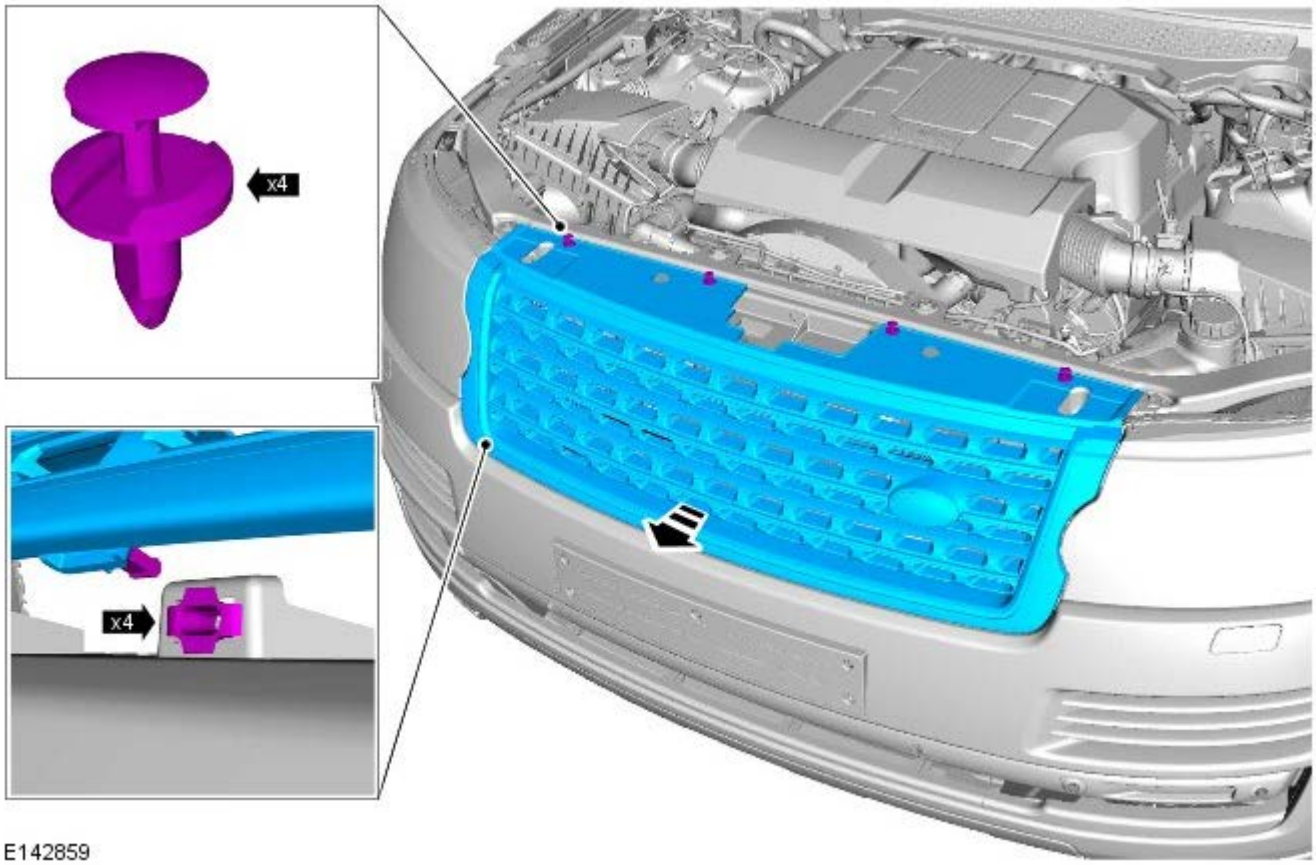
5. Refer to: Air Cleaner LH (303-12, Removal and Installation).

6. Refer to: Air Cleaner RH (303-12, Removal and Installation).

7. Refer to: Coolant Expansion Tank (303-03C Engine Cooling - V8 S/C 5.0L Petrol, Removal and Installation).

Cold climate vehicles

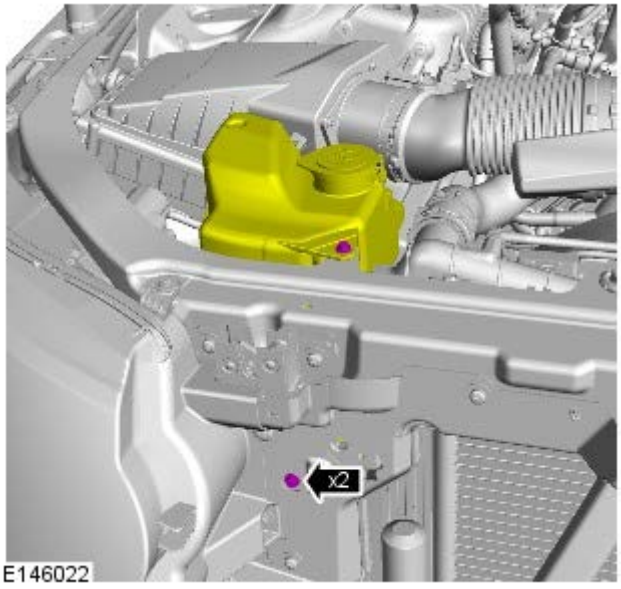
8.



E142859

Cold climate vehicles

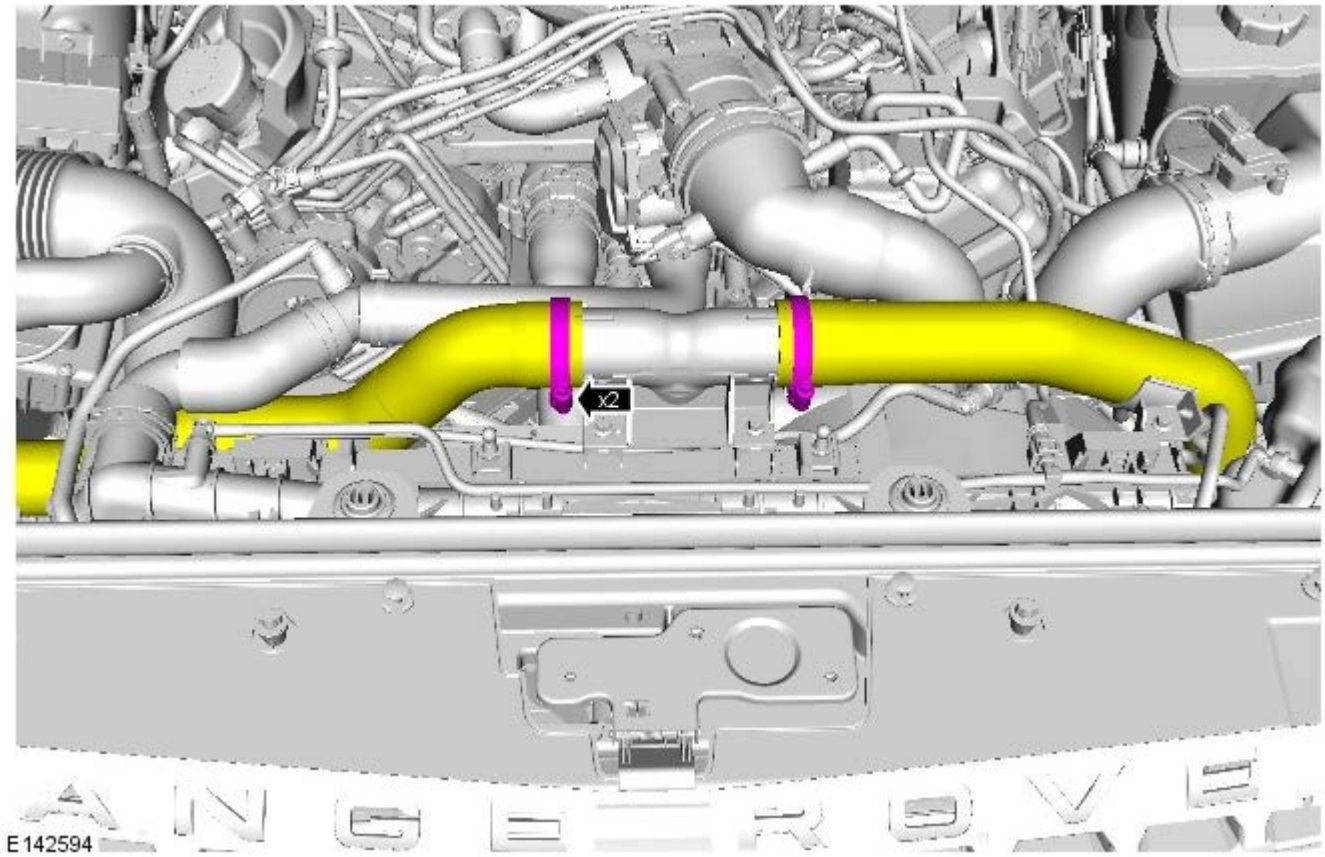
9. *Torque:* 7 Nm



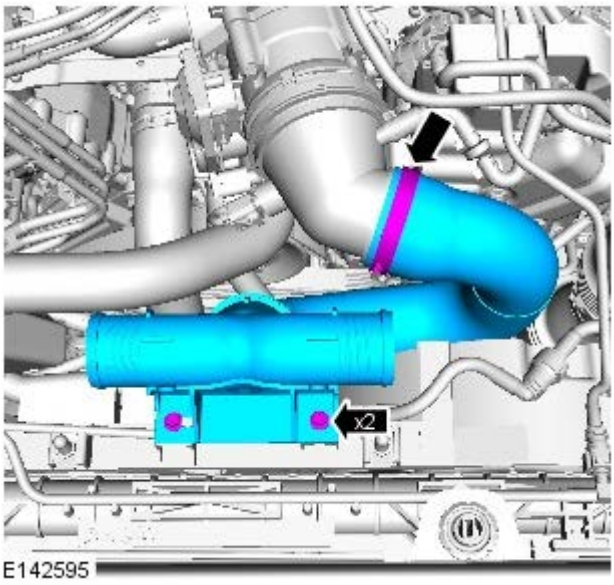
E146022

All vehicles

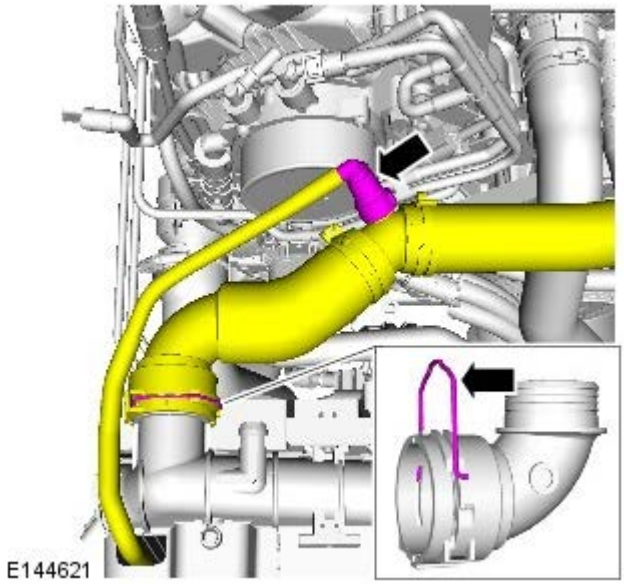
10. *Torque:* 5 Nm



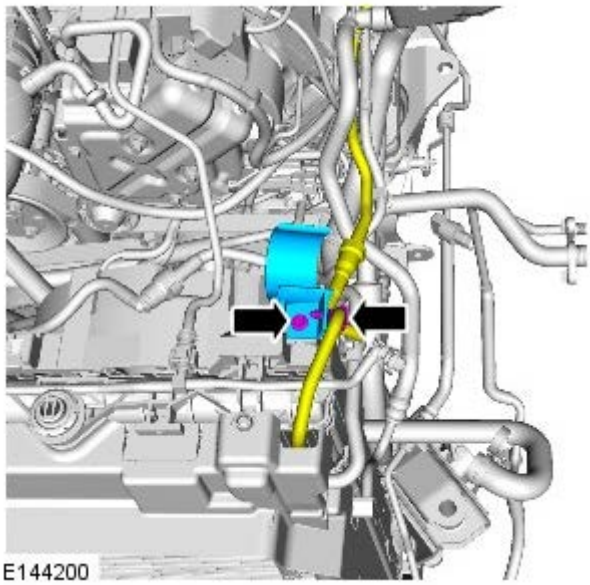
11. *Torque:*
    Clamp 3.5 Nm
    Bolt 8 Nm



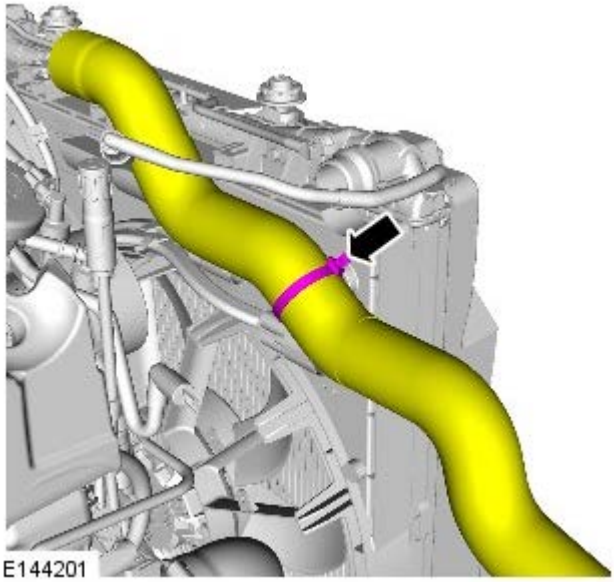
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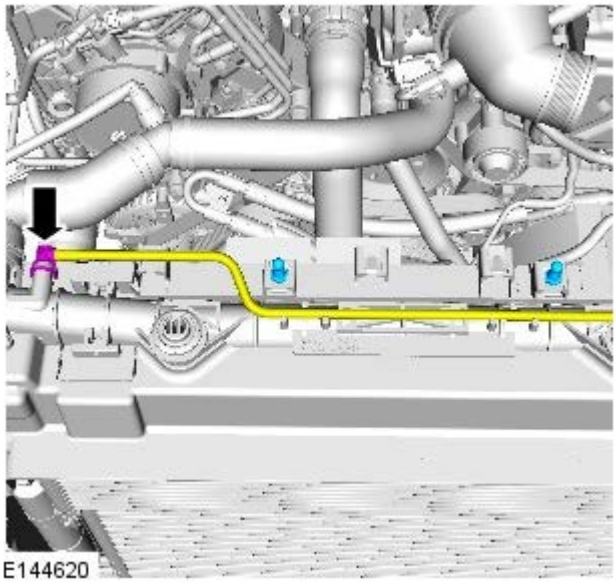
13. *Torque:* 7 Nm



14.

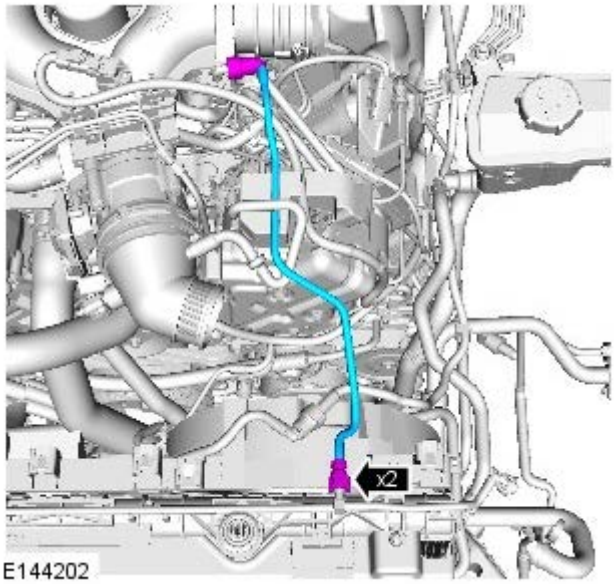


15. *Torque:* 7 Nm



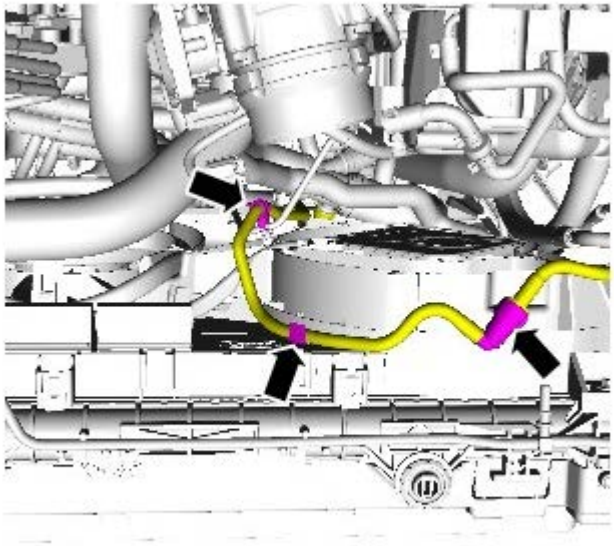
E144620

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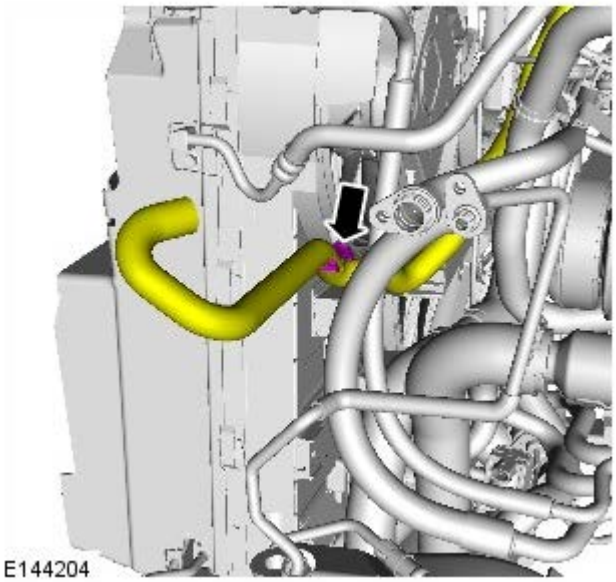
E144202

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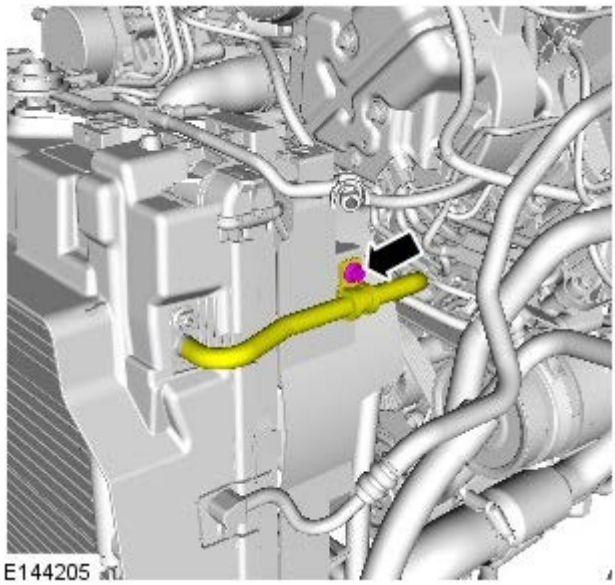


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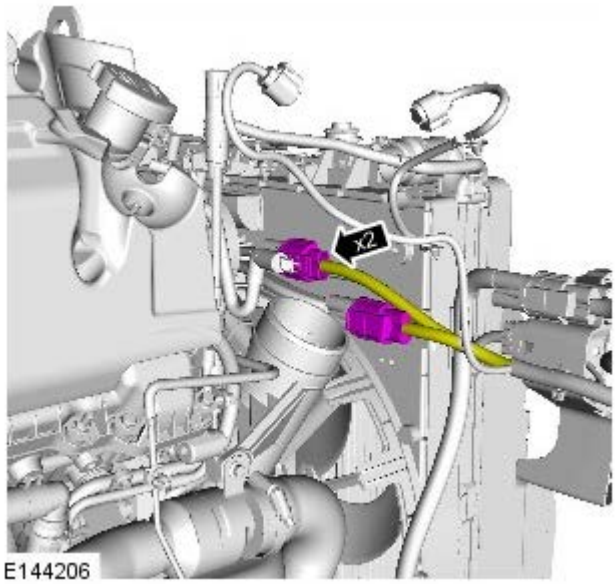
18.


E144204

19. *Torque:* 7 Nm

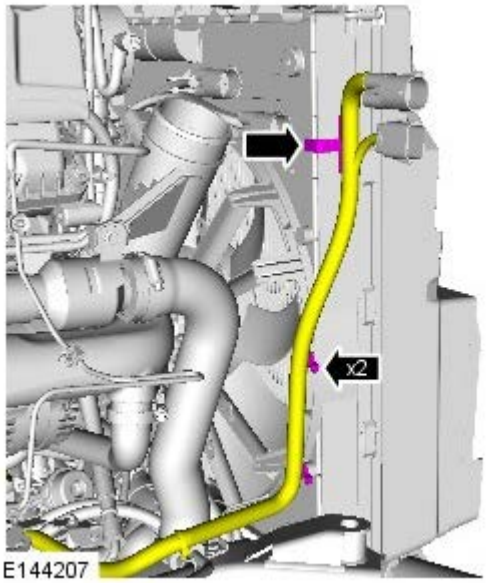

E144205

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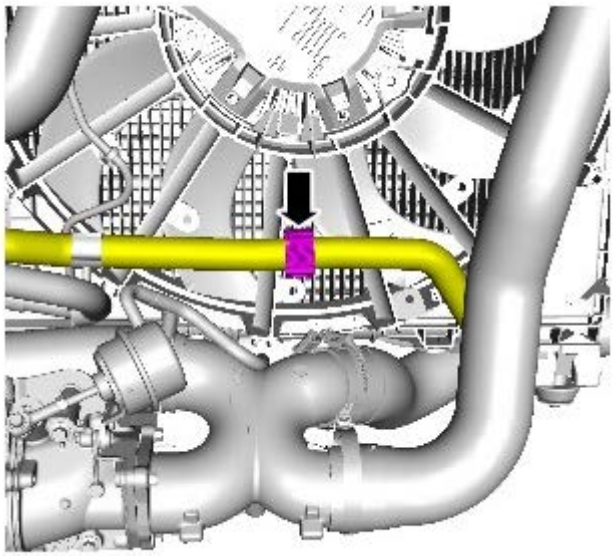
E144206

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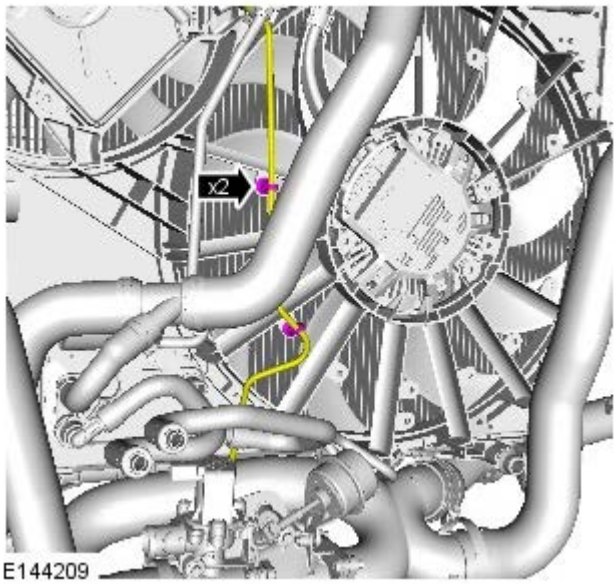


E144207

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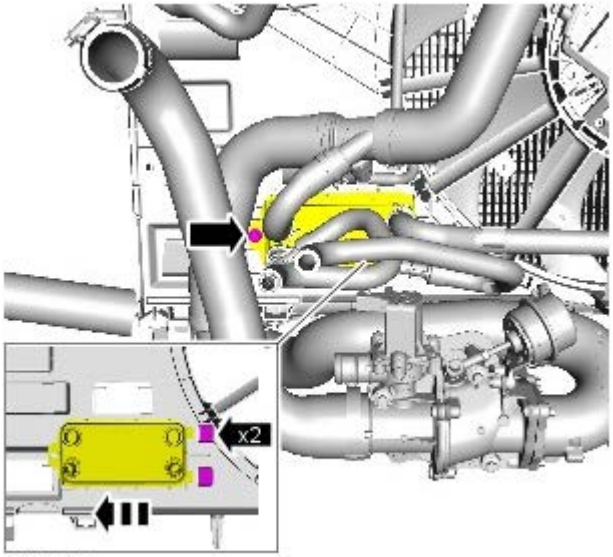

E144208

23.



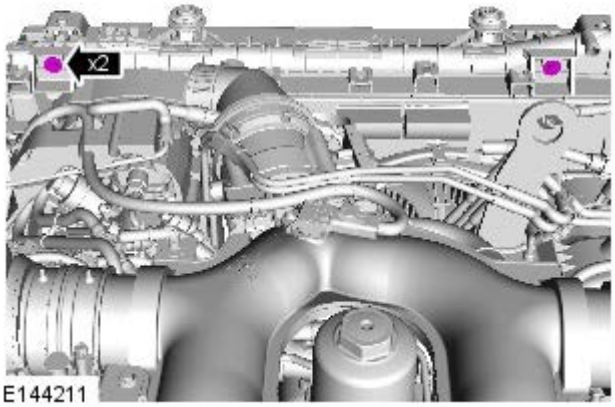
E144209

24. *Torque:* 10 Nm



E144210

25. *Torque:* 7 Nm

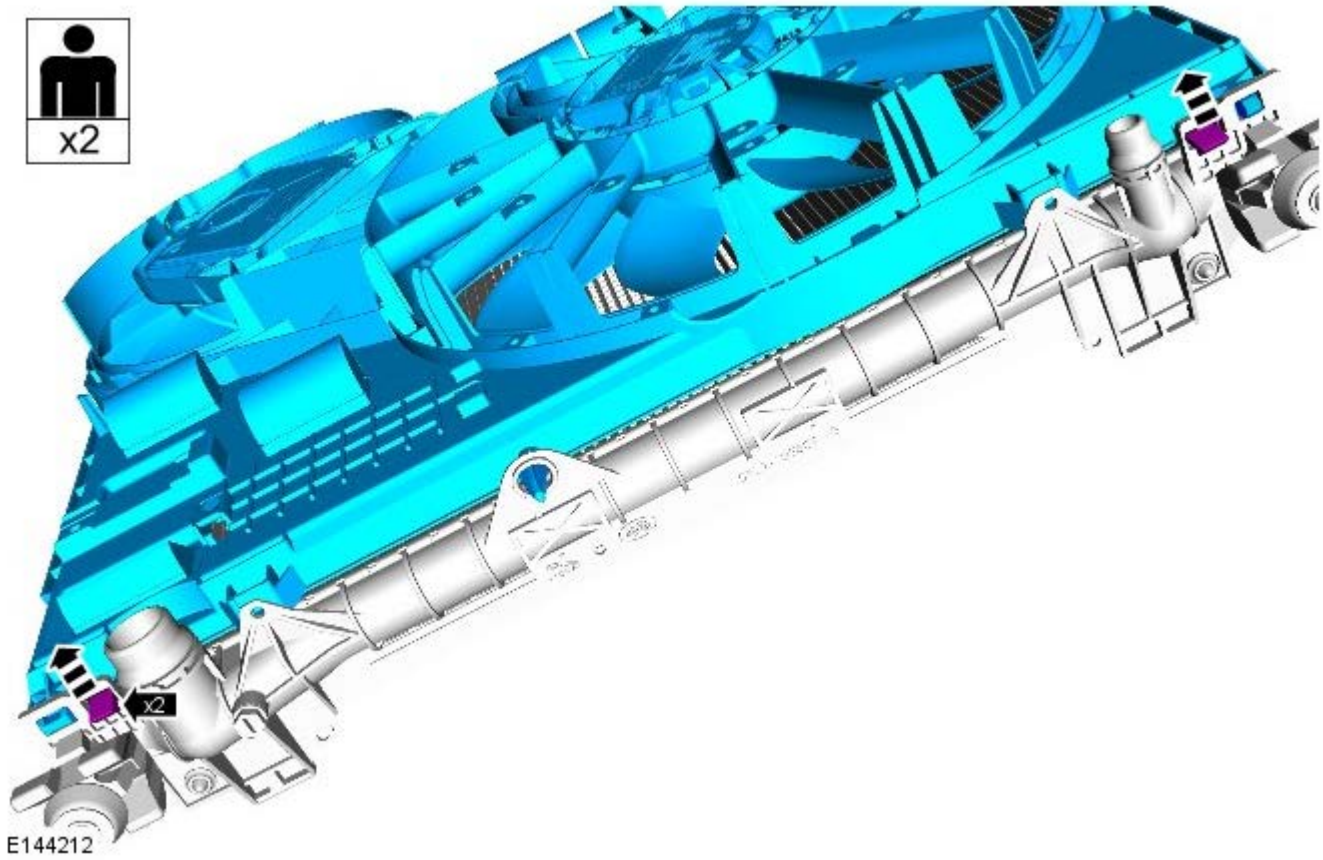


E144211

26. CAUTION: Protect the radiator during this operation.

NOTE: With assistance remove the component.

- Release both locking tangs.



Installation

1. To install, reverse the removal procedure.

Published: 06-Sep-2012

Engine Cooling - TDV8 4.4L Diesel - Coolant 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.

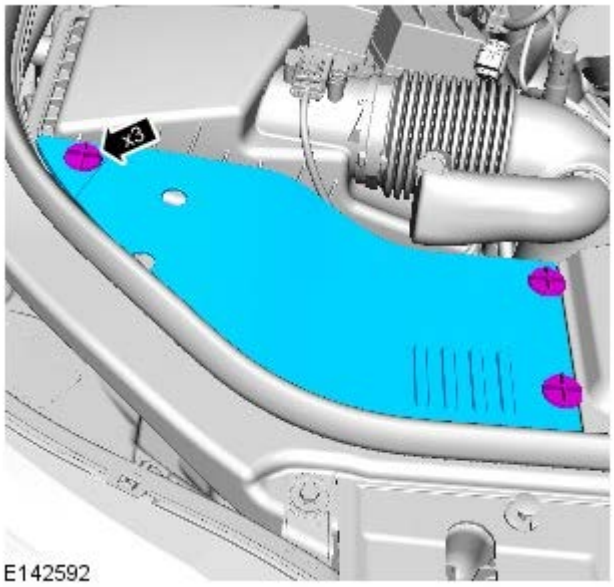
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

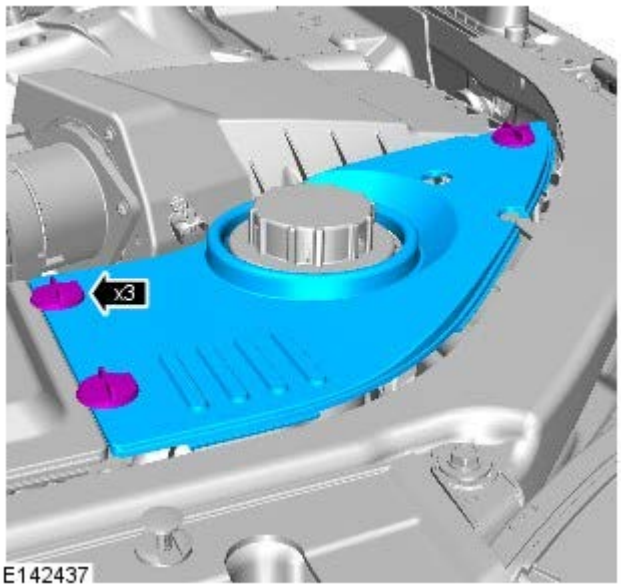
2. Refer to: Cooling System Partial Draining, Filling and Bleeding (303-03, General Procedures).

3. Refer to: Air Cleaner Outlet Pipe LH (303-12, Removal and Installation).

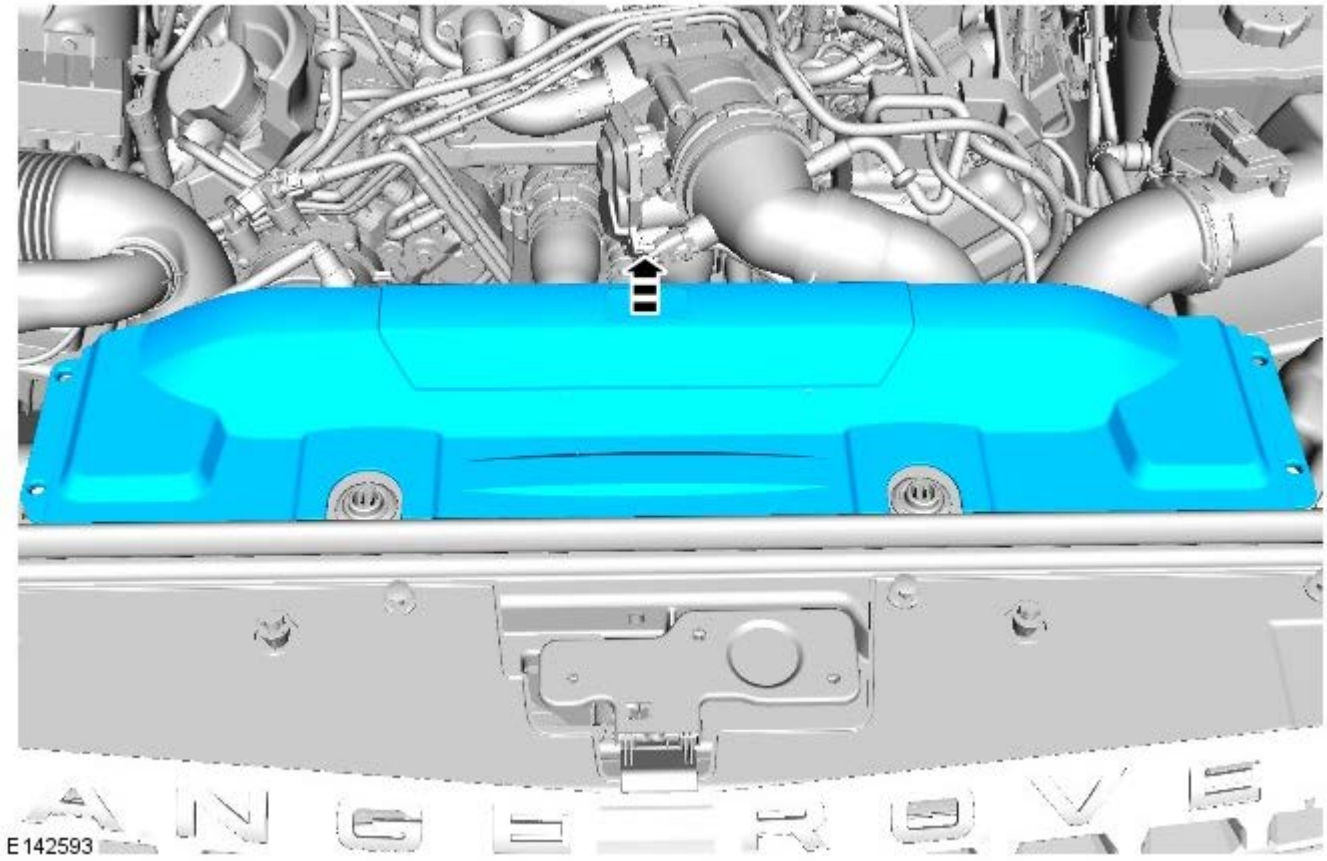
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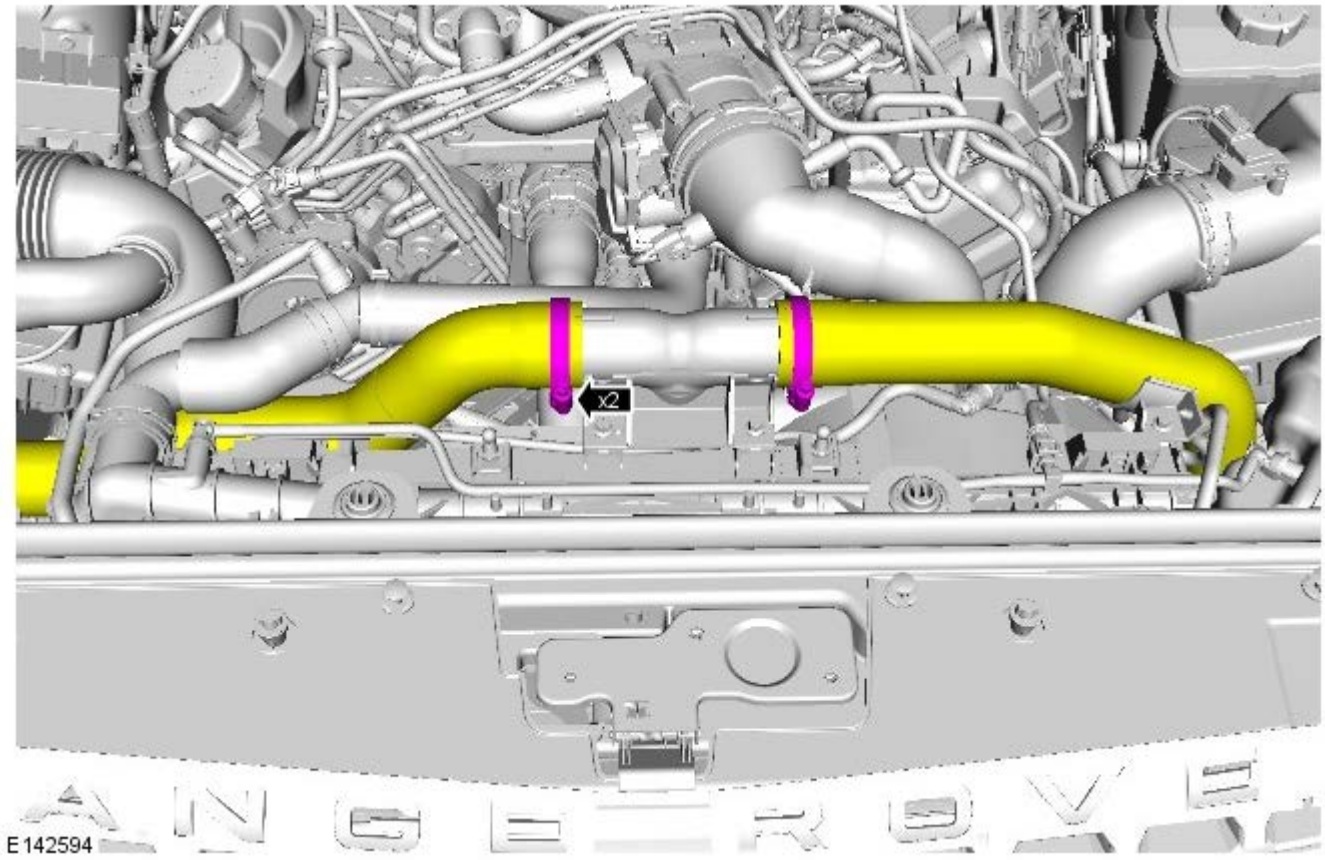
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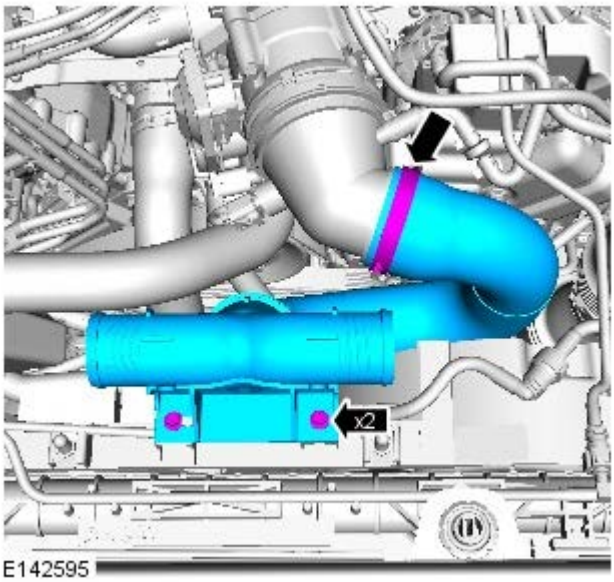
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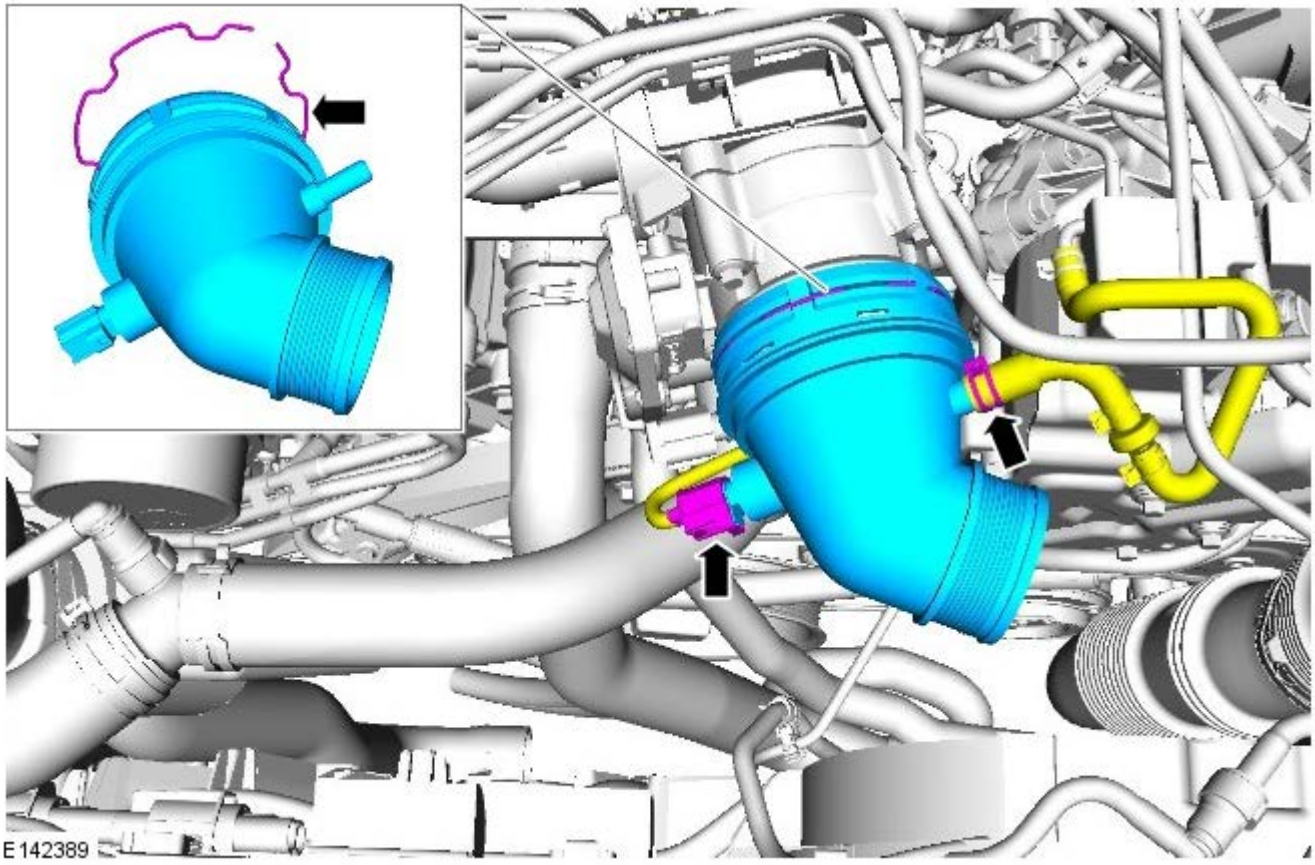
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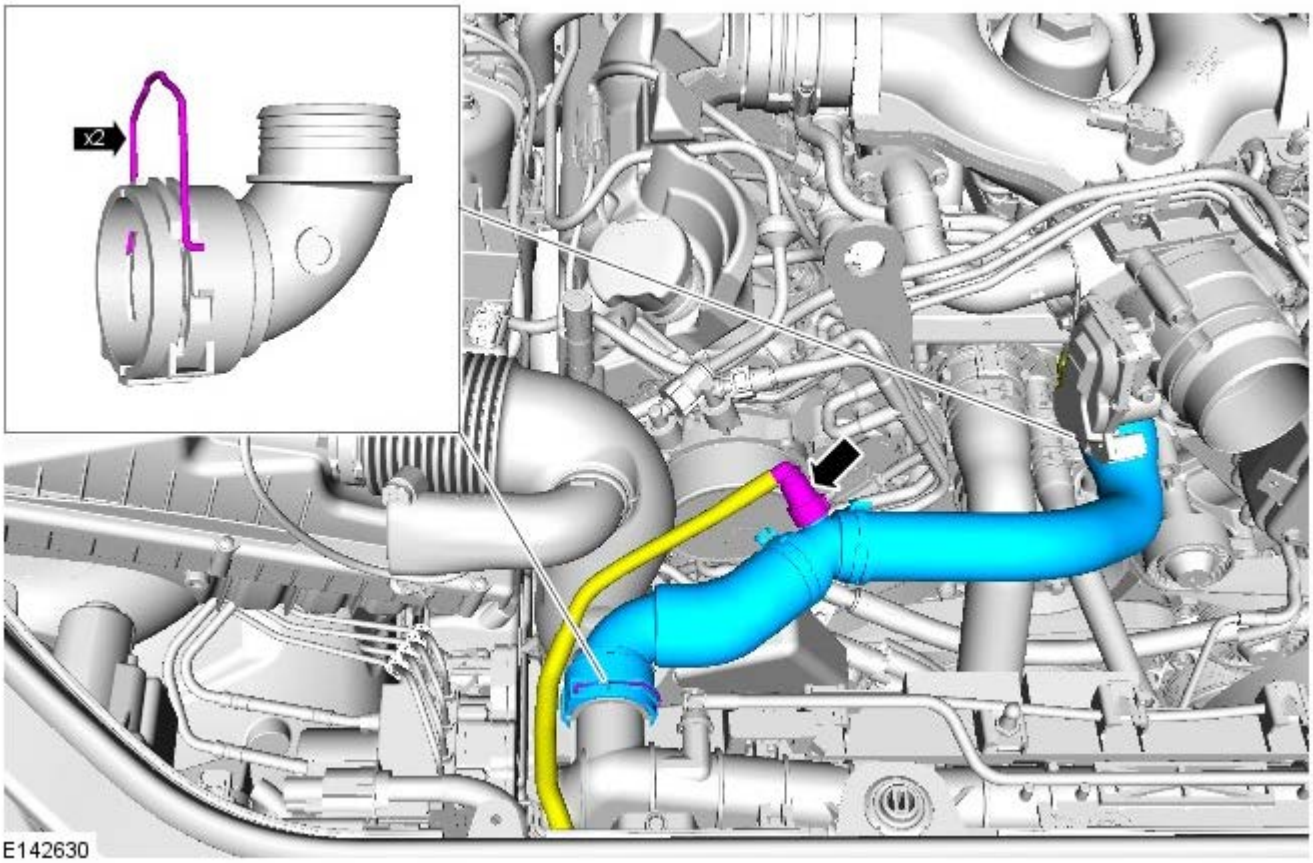
8. *Torque:* 10 Nm



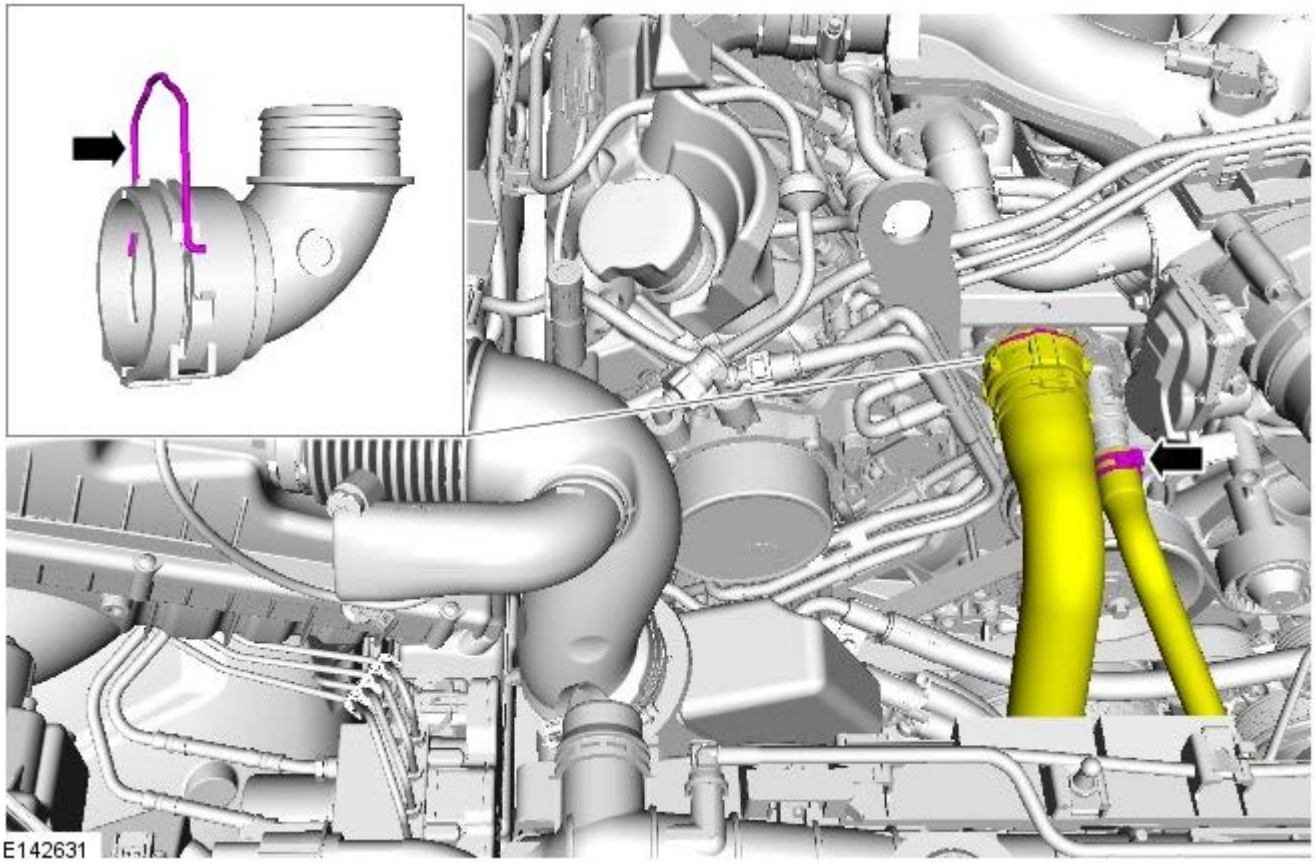
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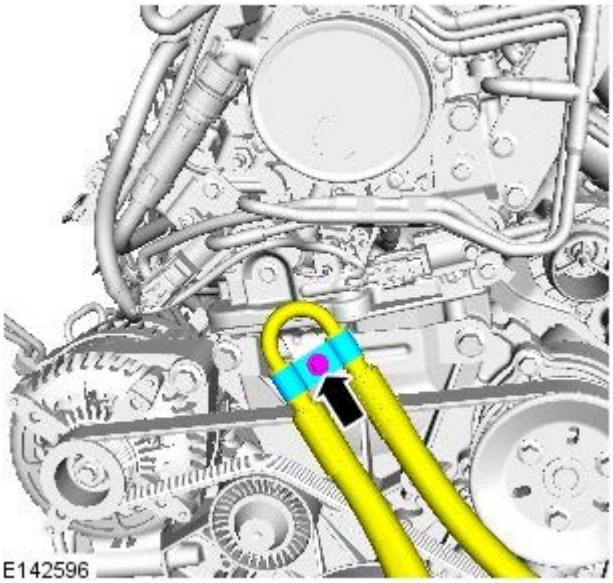
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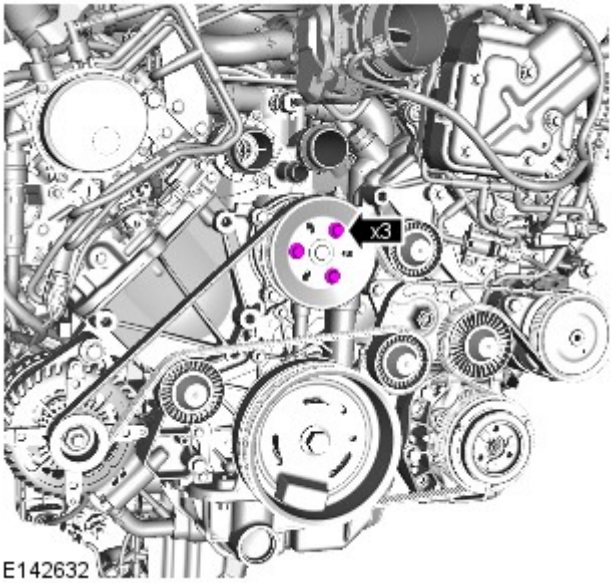
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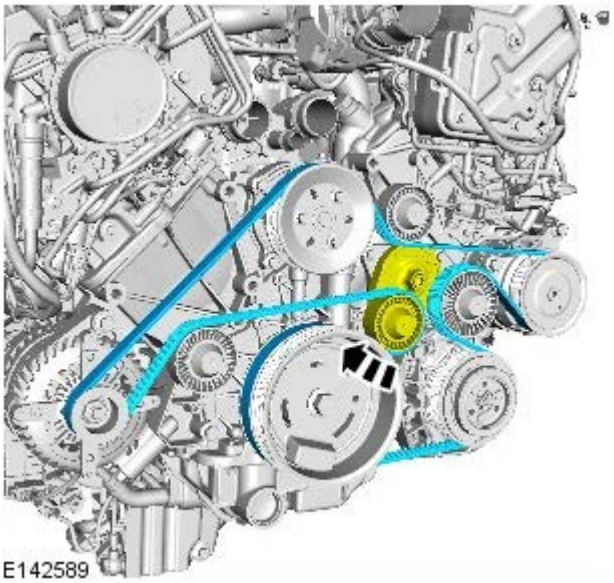
12. *Torque:* 10 Nm



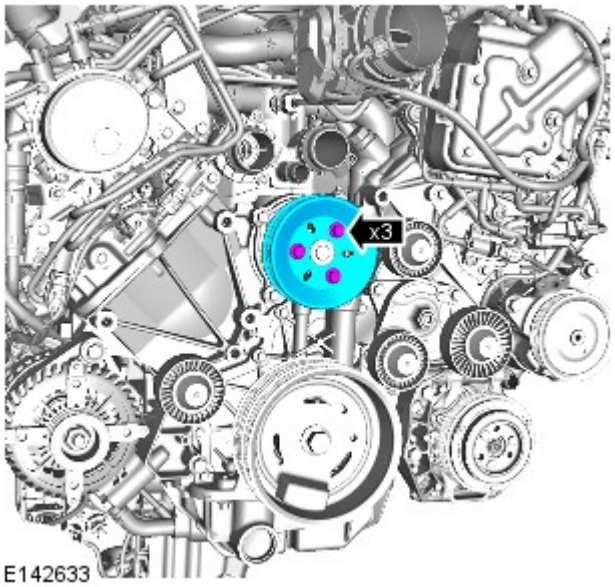
13. *Torque:* 23 Nm



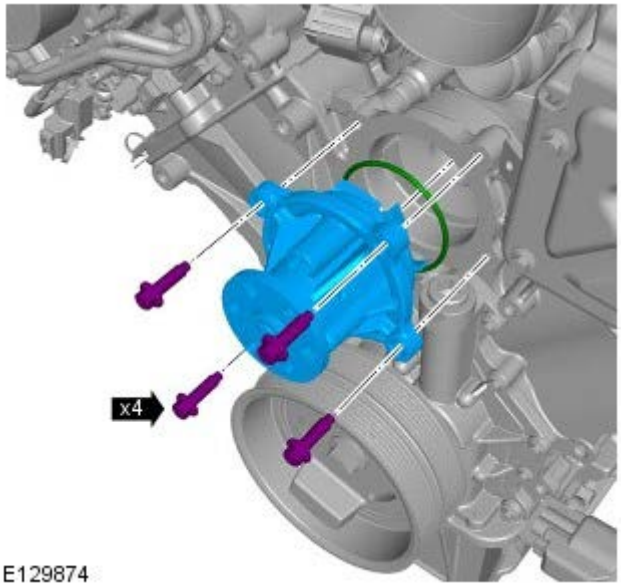
14.



15.



16. *Torque:* 23 Nm



Installation

1. To install reverse the removal procedure.

Published: 12-Sep-2012

Engine Cooling - TDV8 4.4L Diesel - Radiator

Removal and Installation

Removal

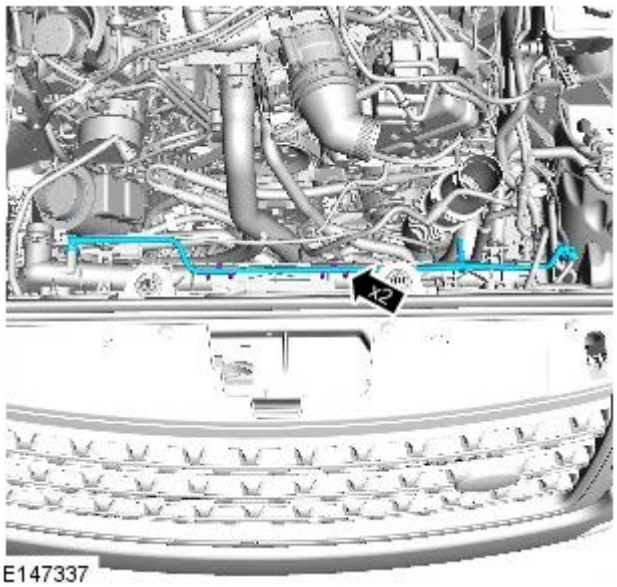
NOTES:

Removal steps in this procedure may contain installation details.

Some variation in the illustrations may occur, but the essential information is always correct.

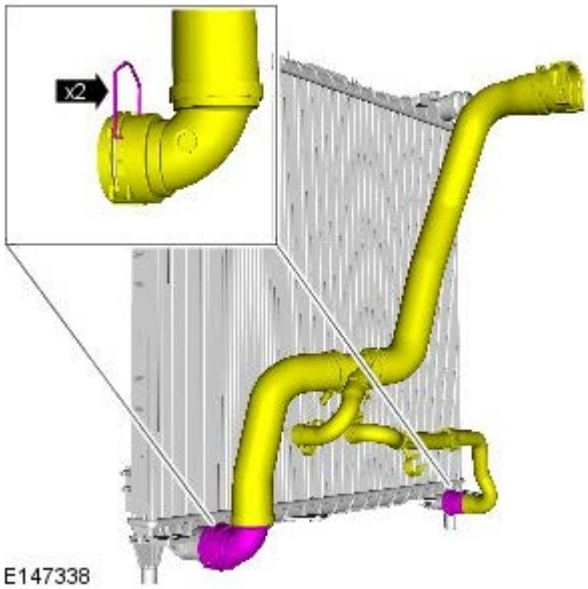
Some components shown removed for clarity.

1. Refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00, General Procedures).
2. Refer to: Cooling Fan (303-03 Engine Cooling - TDV8 4.4L Diesel, Removal and Installation).
3. Refer to: Radiator Grille (501-08 Exterior Trim and Ornamentation, Removal and Installation).
4.



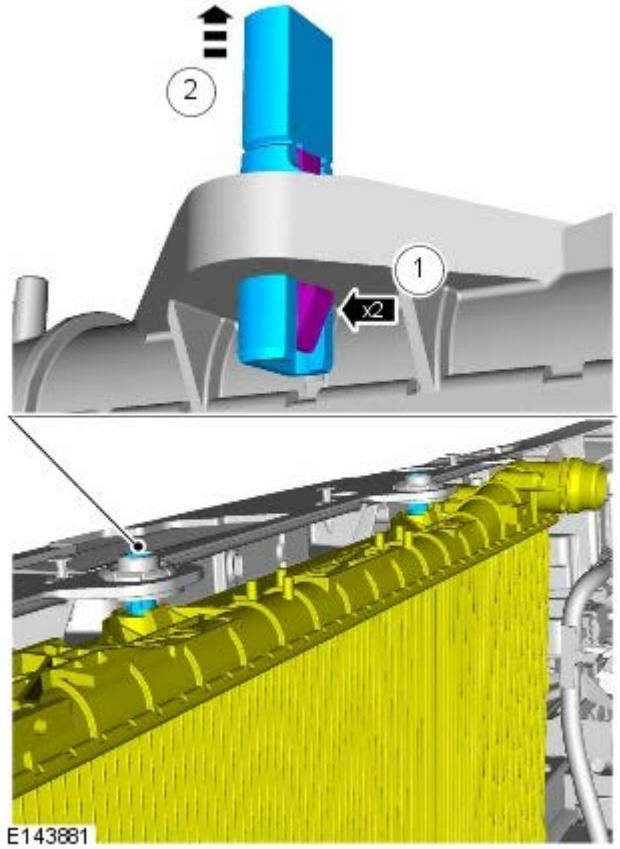
E147337

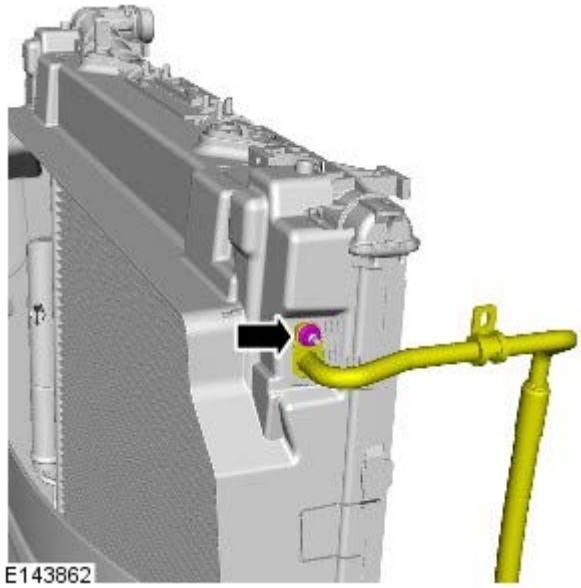
5.



E147338

6.





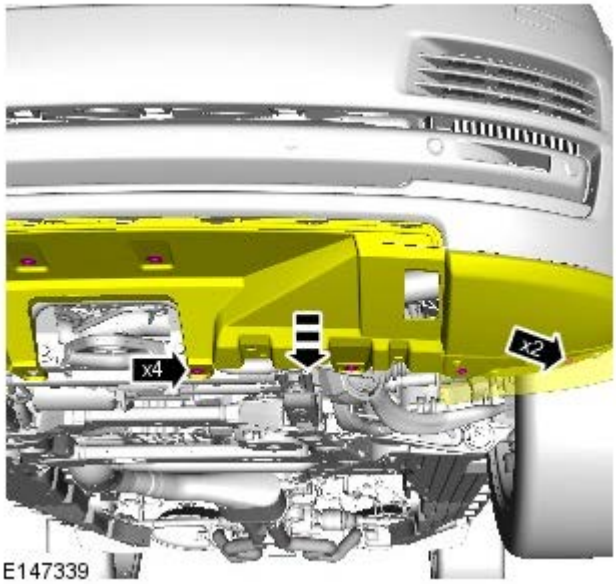
7. CAUTIONS:

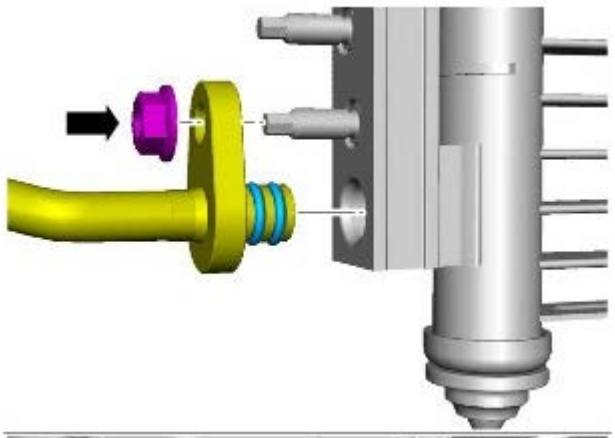
   Make sure that all openings are sealed.

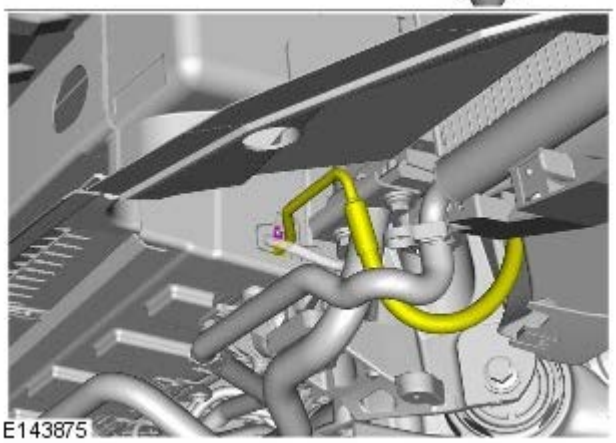
   Remove and discard the O-ring seals.

   Torque: 8 Nm

8.



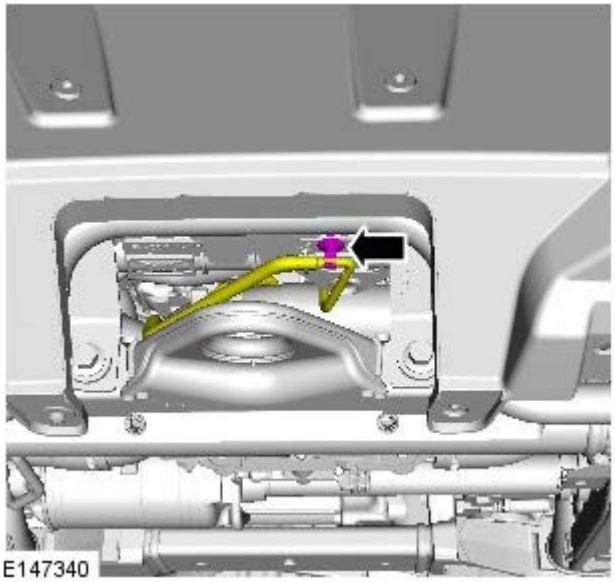




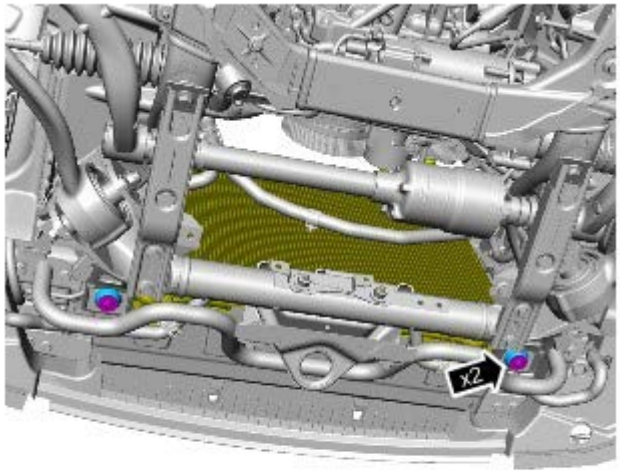
9. CAUTION: Remove and discard the O-ring seals.

Torque: 8 Nm

10.

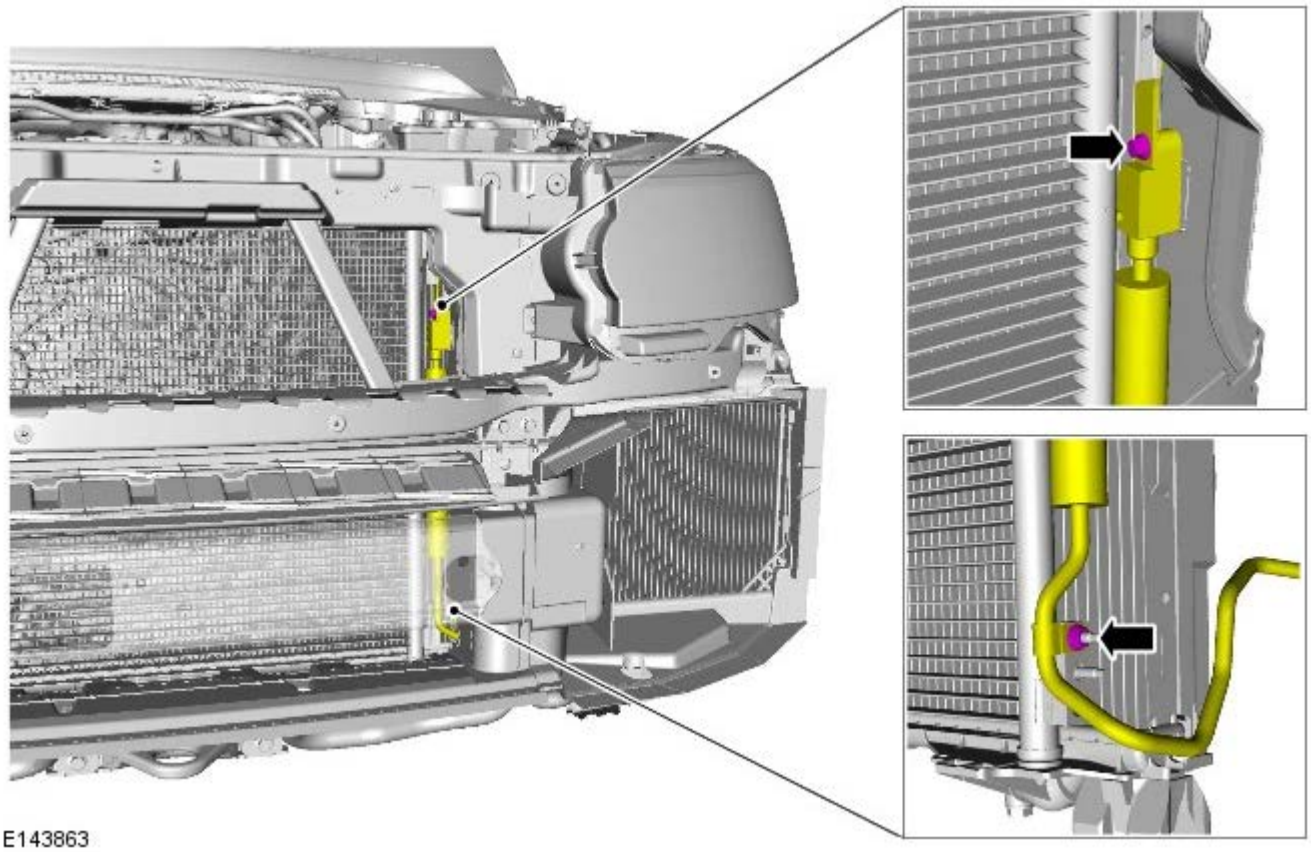


11. *Torque:* 15 Nm



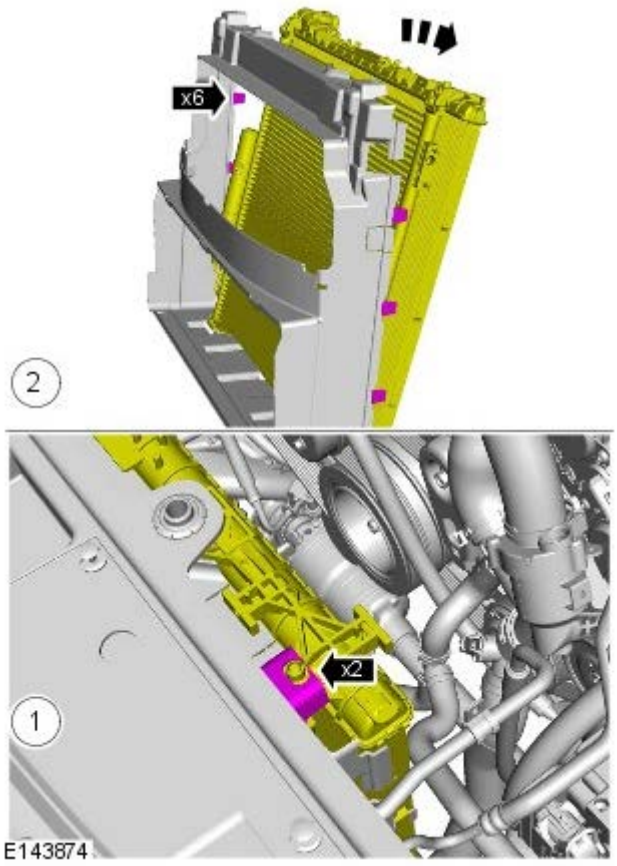
E143877

12. *Torque:* 7 Nm



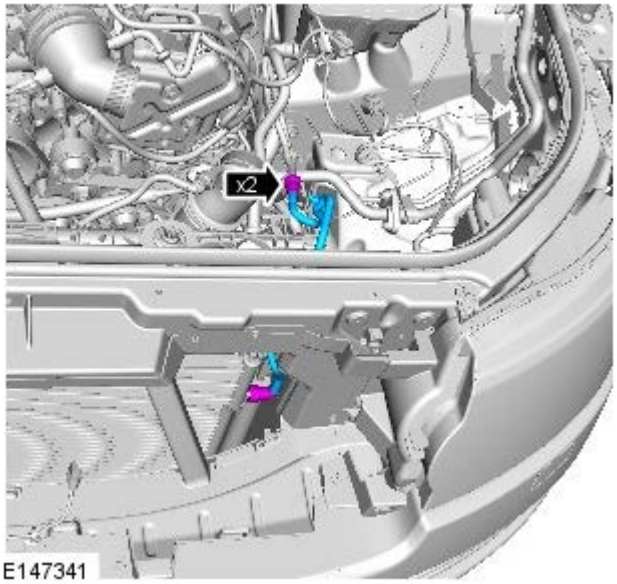
E143863

13. CAUTION: Always protect the cooling pack elements to prevent accidental damage.



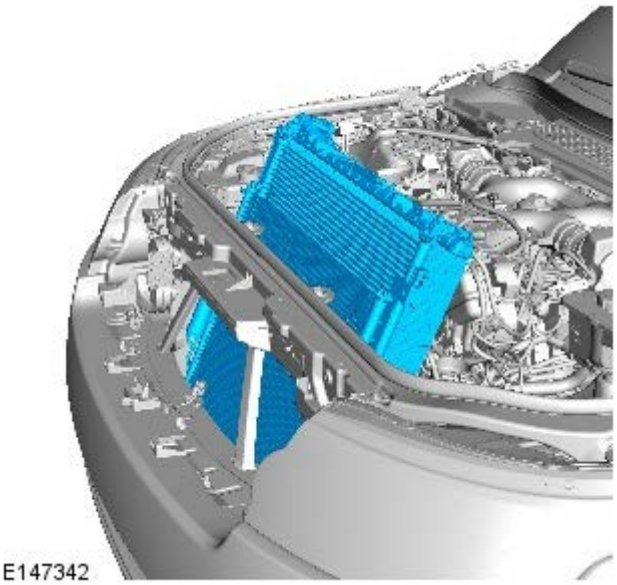
E143874

14.

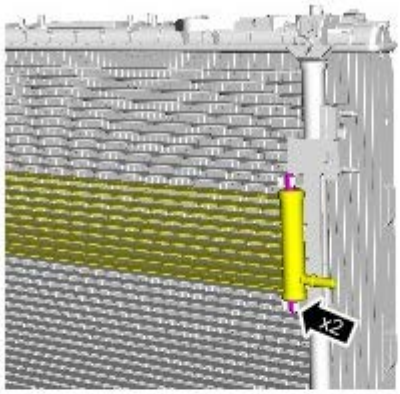


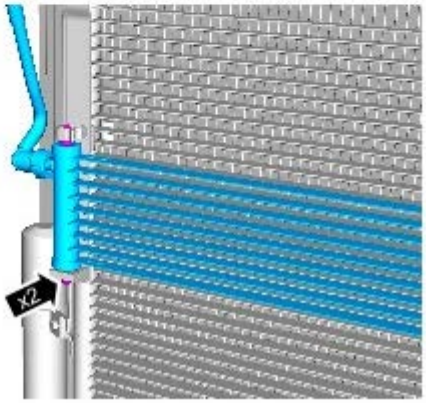
E147341

15. CAUTION: Always protect the cooling pack elements to prevent accidental damage.


E147342

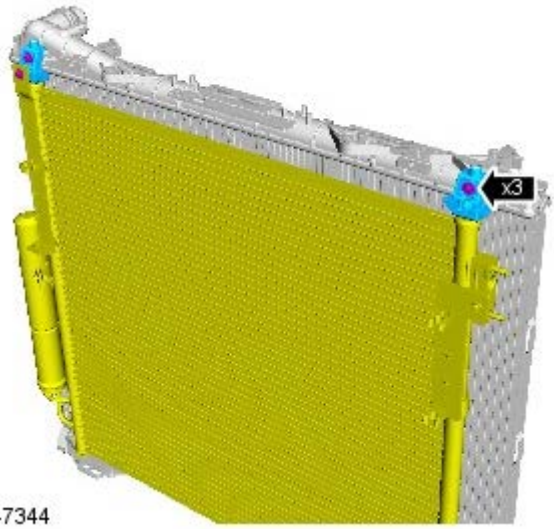
16.





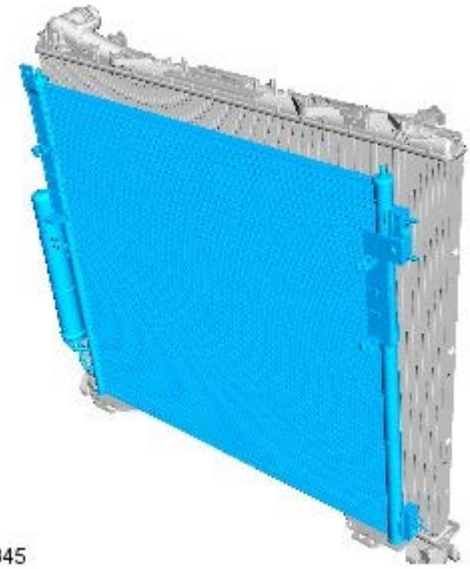
E147343

17. *Torque:* 4.5 Nm



E147344

18.



E147345

Installation

1. To install, reverse the removal procedure.

Published: 03-Aug-2012

Engine Cooling - TDV8 4.4L Diesel - Thermostat

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.

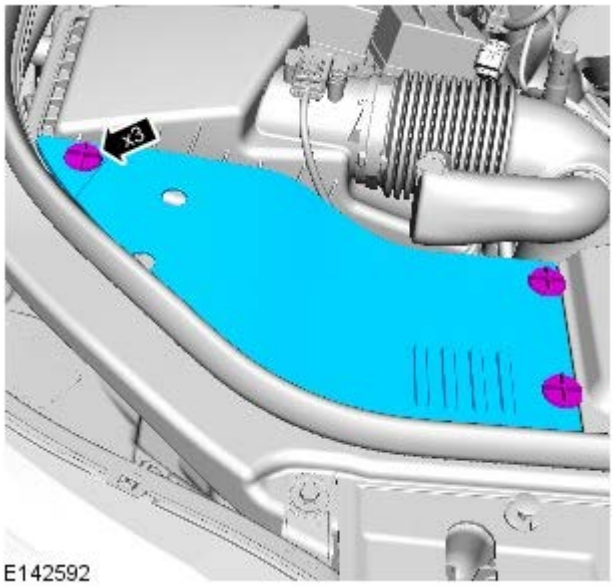
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

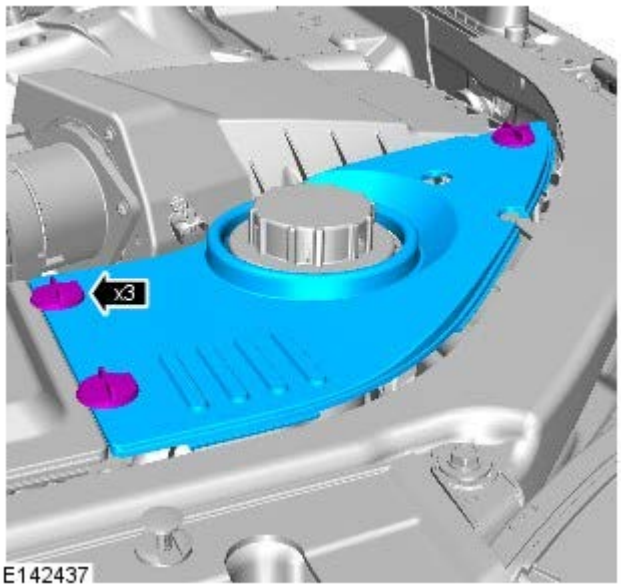
2. Refer to: Cooling System Partial Draining, Filling and Bleeding (303-03, General Procedures).

3. Refer to: Air Cleaner Outlet Pipe LH (303-12, Removal and Installation).

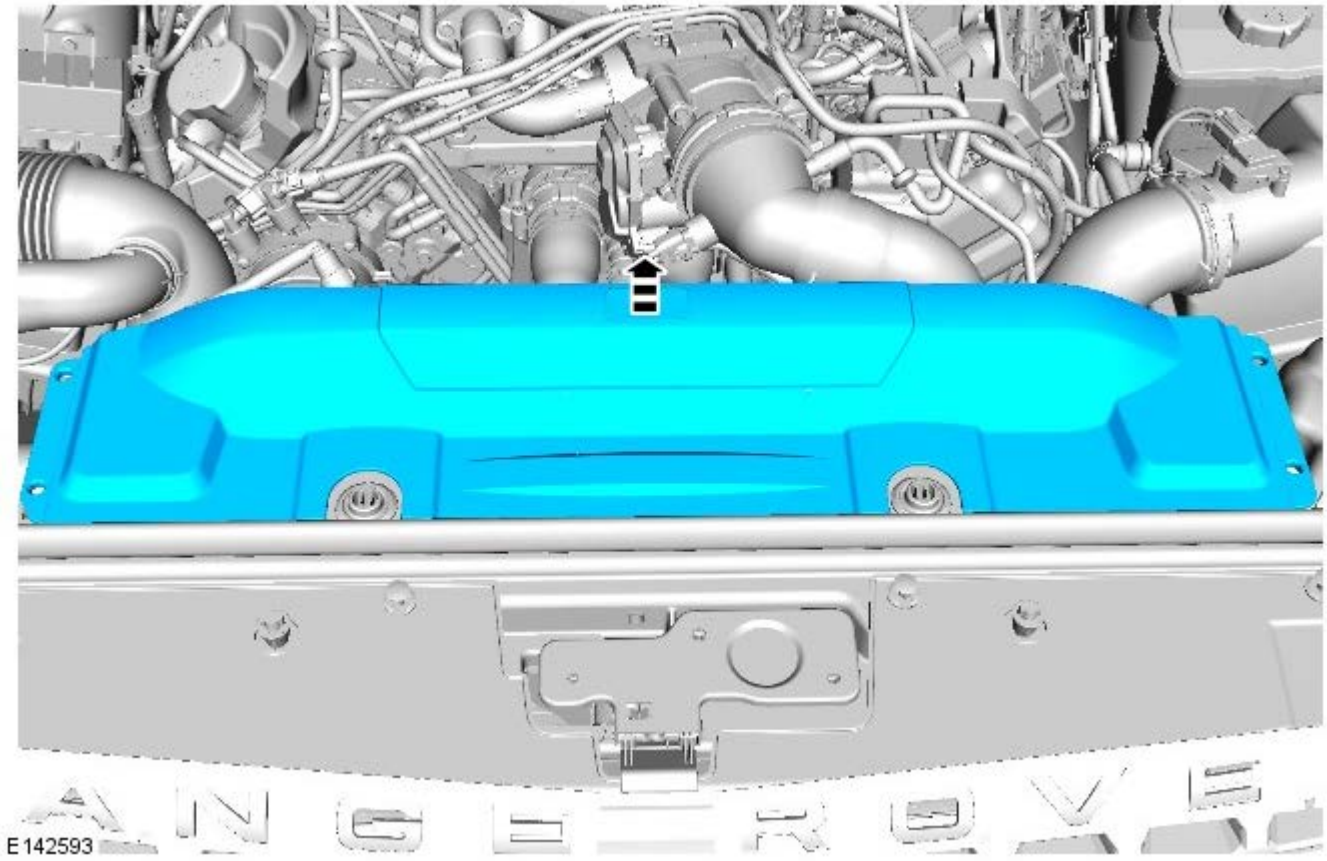
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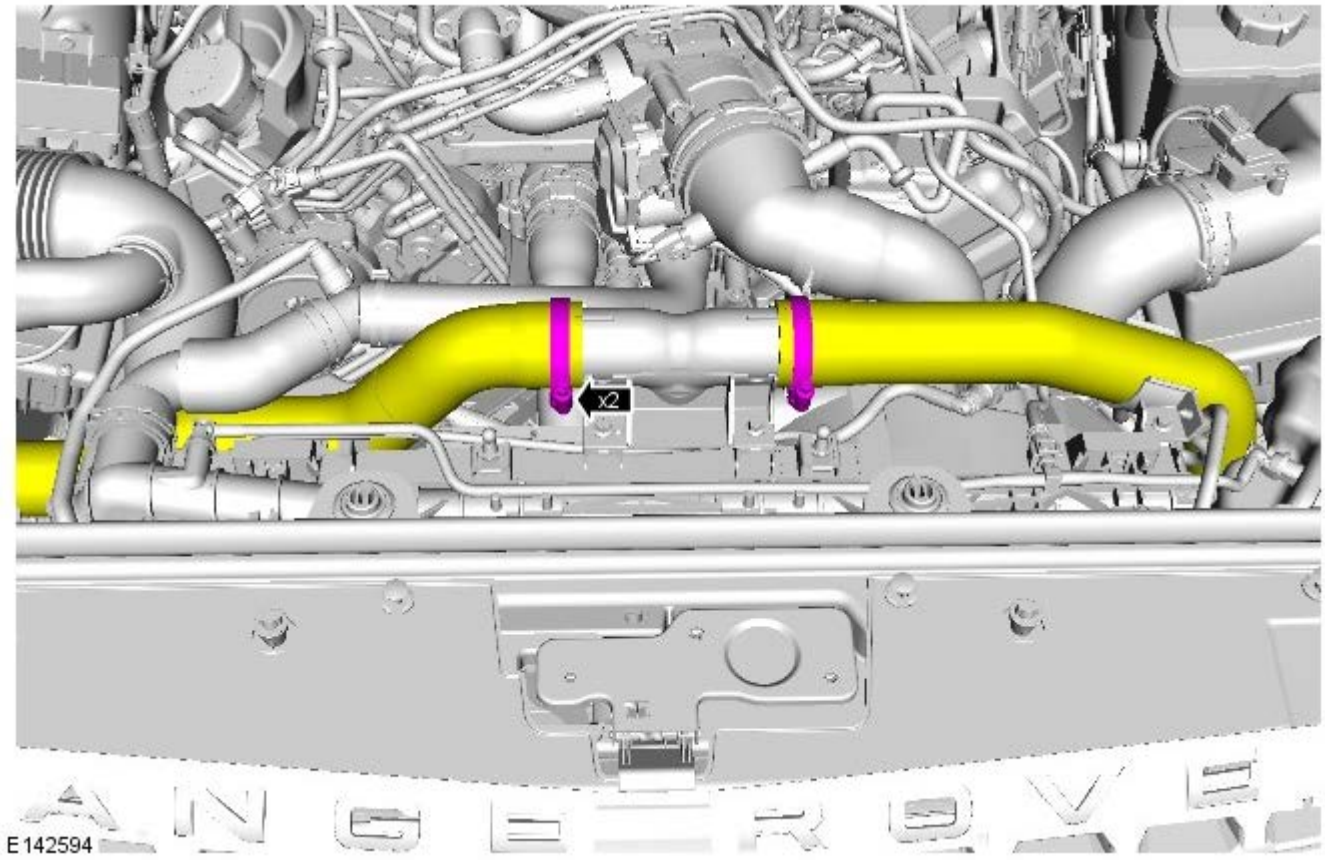
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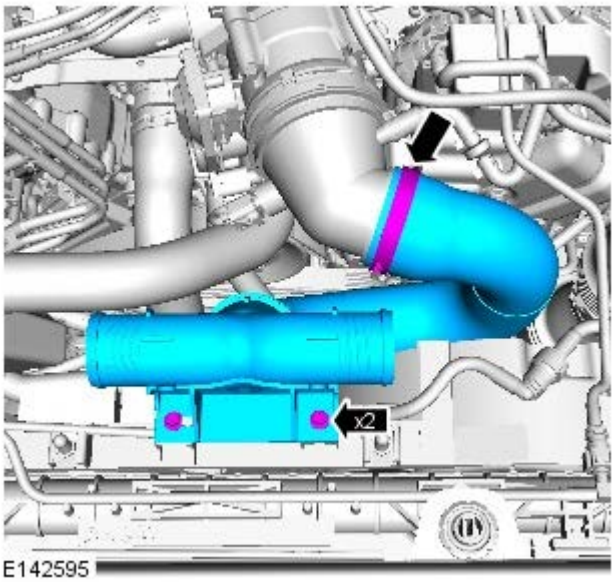
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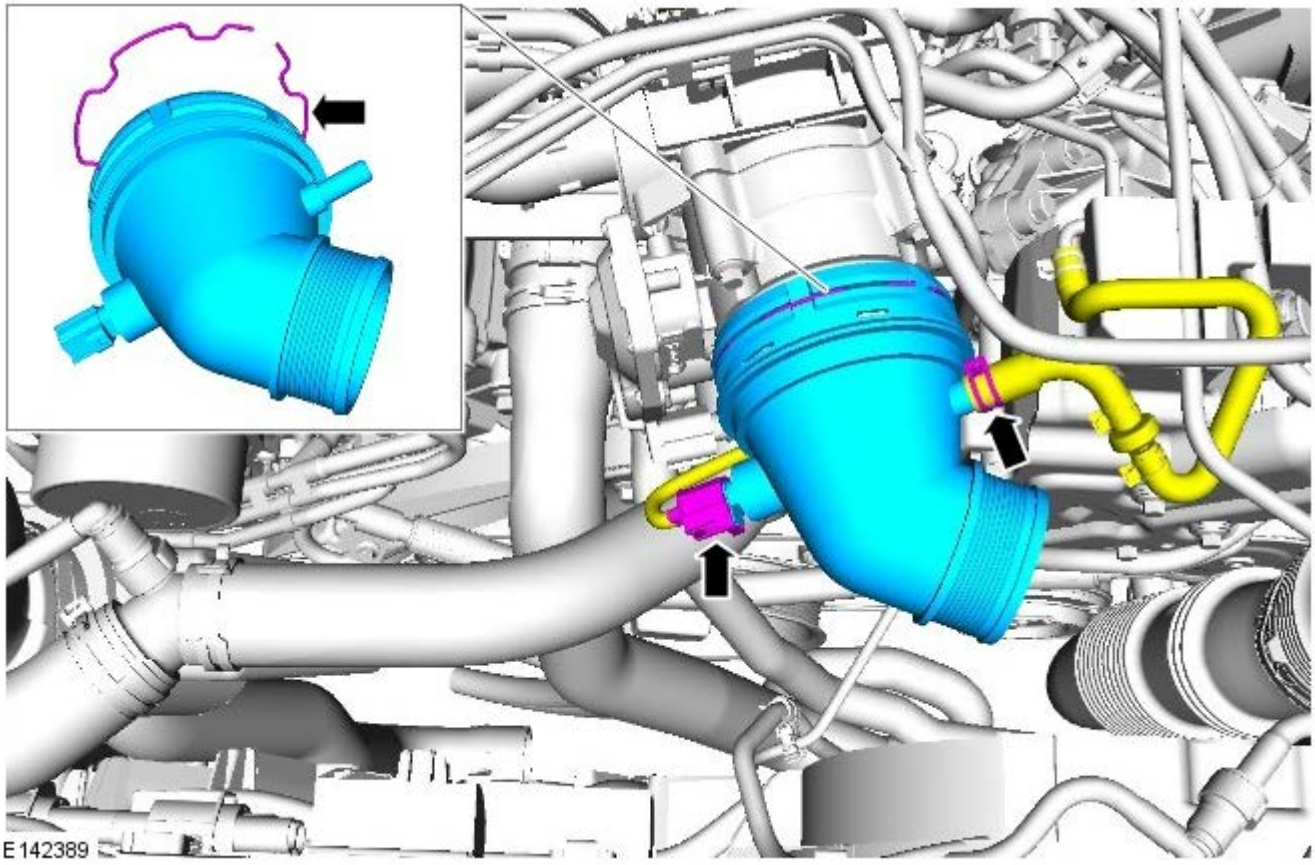
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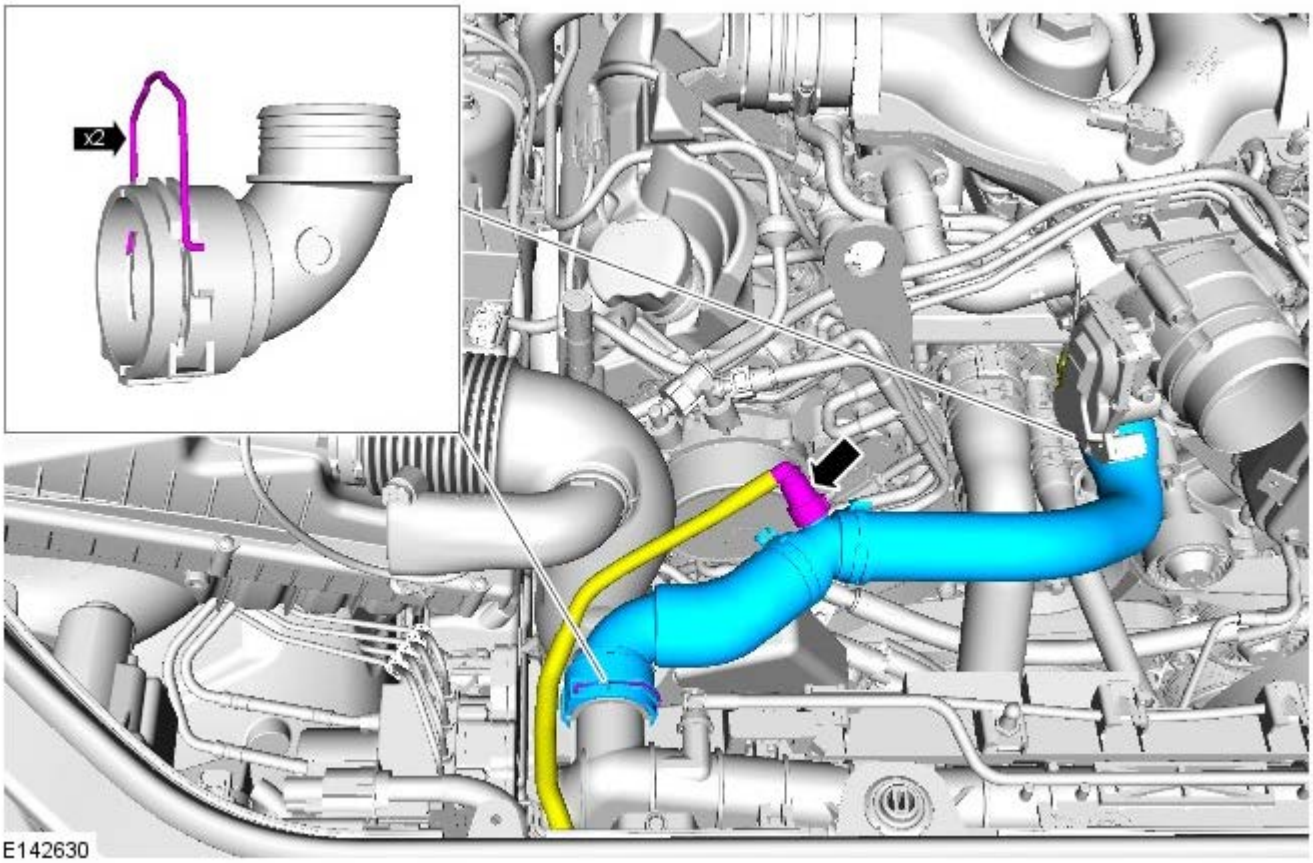
8. *Torque:* 10 Nm



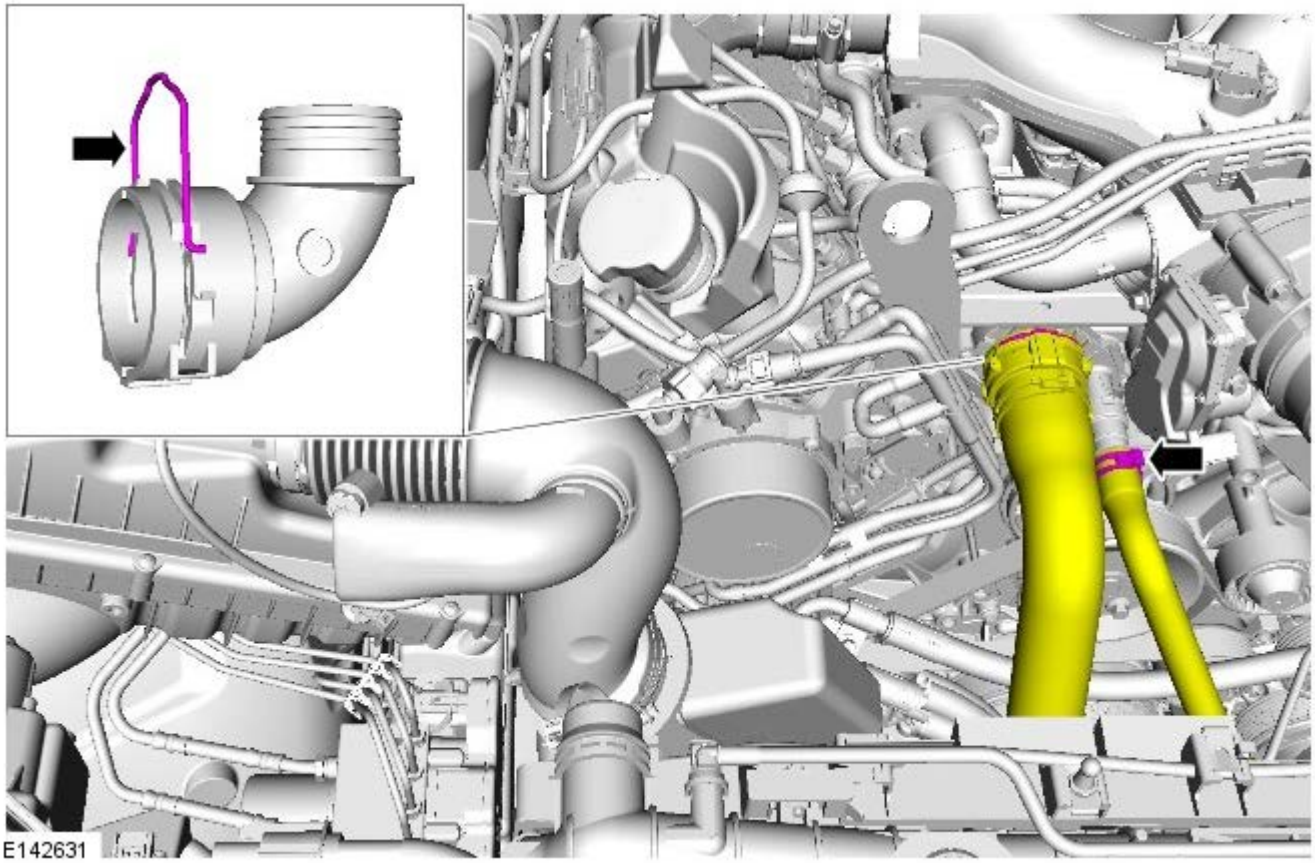
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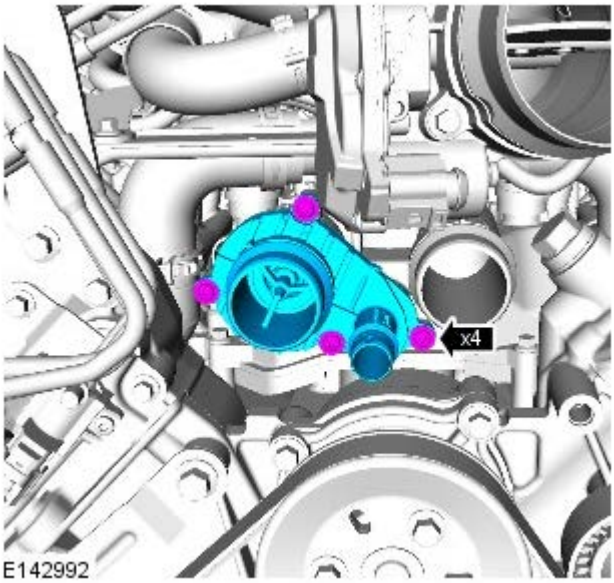


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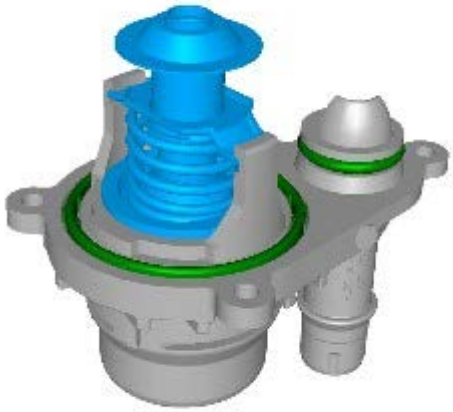
12. CAUTION: Be prepared to collect escaping fluids.

Torque: 10 Nm



E142992

13. WARNING: As the spring is under tension, care must be taken at all times on removal and installation of the component.
    - Discard the O-ring seals.


E130234

Installation

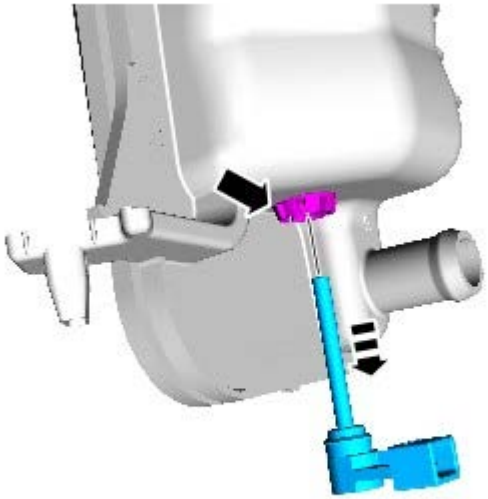
1. To install, reverse the removal procedure.

Published: 11-Dec-2013

Engine Cooling - TDV8 4.4L Diesel - Engine Coolant Level Switch

Removal and Installation

Removal



E162437

1. Refer to: Coolant Expansion Tank (303-03G Engine Cooling - SDV6 3.0L Diesel - Hybrid Electric Vehicle, Removal and Installation).
2. CAUTION: Care must be taken not to damage the component.

Installation

1. To install, reverse the removal procedure.

Published: 19-Aug-2013

Engine Cooling - SDV6 3.0L Diesel - Hybrid Electric Vehicle -

Fluid

Description	Specification
Land Rover premium cooling system fluid	Havoline XLC

Capacity

Item	Litres
Vehicles fitted with 2 zone air conditioning (A/C)	9.4
Vehicles fitted with 2 zone A/C and fuel fired booster heater (FFBH)	9.6
Vehicles fitted with 4 zone A/C	11.2
Vehicles fitted with 4 zone A/C and FFBH	11.4
HEV battery circuit	1.5

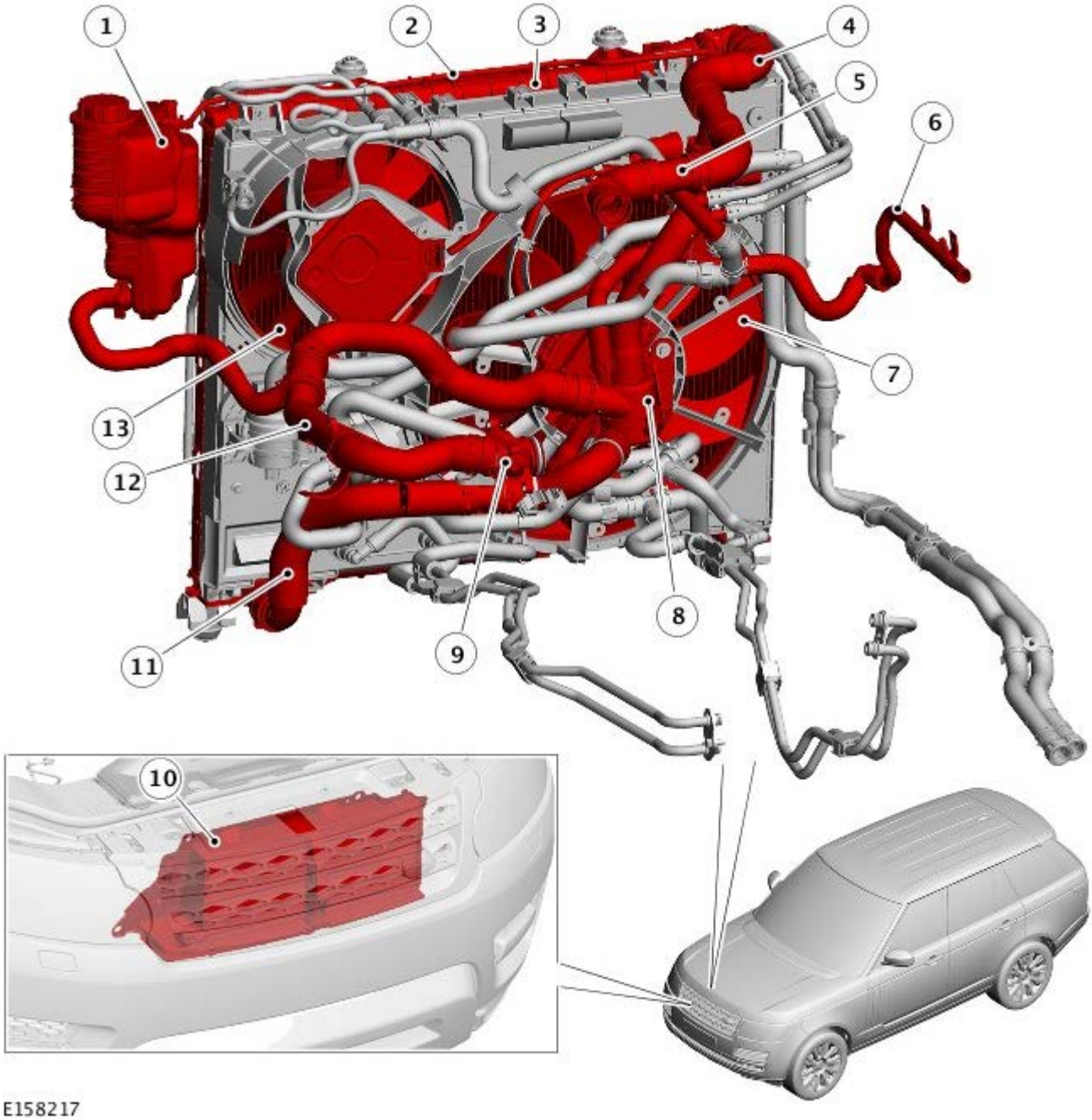
Description	Nm	lb-ft	lb-in
Coolant expansion tank bolt	2.8	2.0	25
Coolant outlet assembly bolts	10	7	88
Coolant pump bolts	10	7	88
Coolant pump pulley bolts	25	18	221
Thermostat housing bracket to fan shroud bolt	5	4	44
Thermostat housing bolts	5	4	44
A/C pipes to condenser nuts	8	6	71
A/C pipe to fan shroud bolt	7	5	62
Charge air cooler pipe connector to fan shroud bolt	8	6	71
Charge air cooler hose clamp to fan shroud bolt	7	5	62
Engine cooling module bolts	15	11	133
Cooling fan shroud bolts	7	5	62
Transmission fluid cooler to fan shroud bolt	7	5	62
Coolant bleed screw(s)	3	2	27

Published: 14-Aug-2013

Engine Cooling - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Engine Cooling

Description and Operation

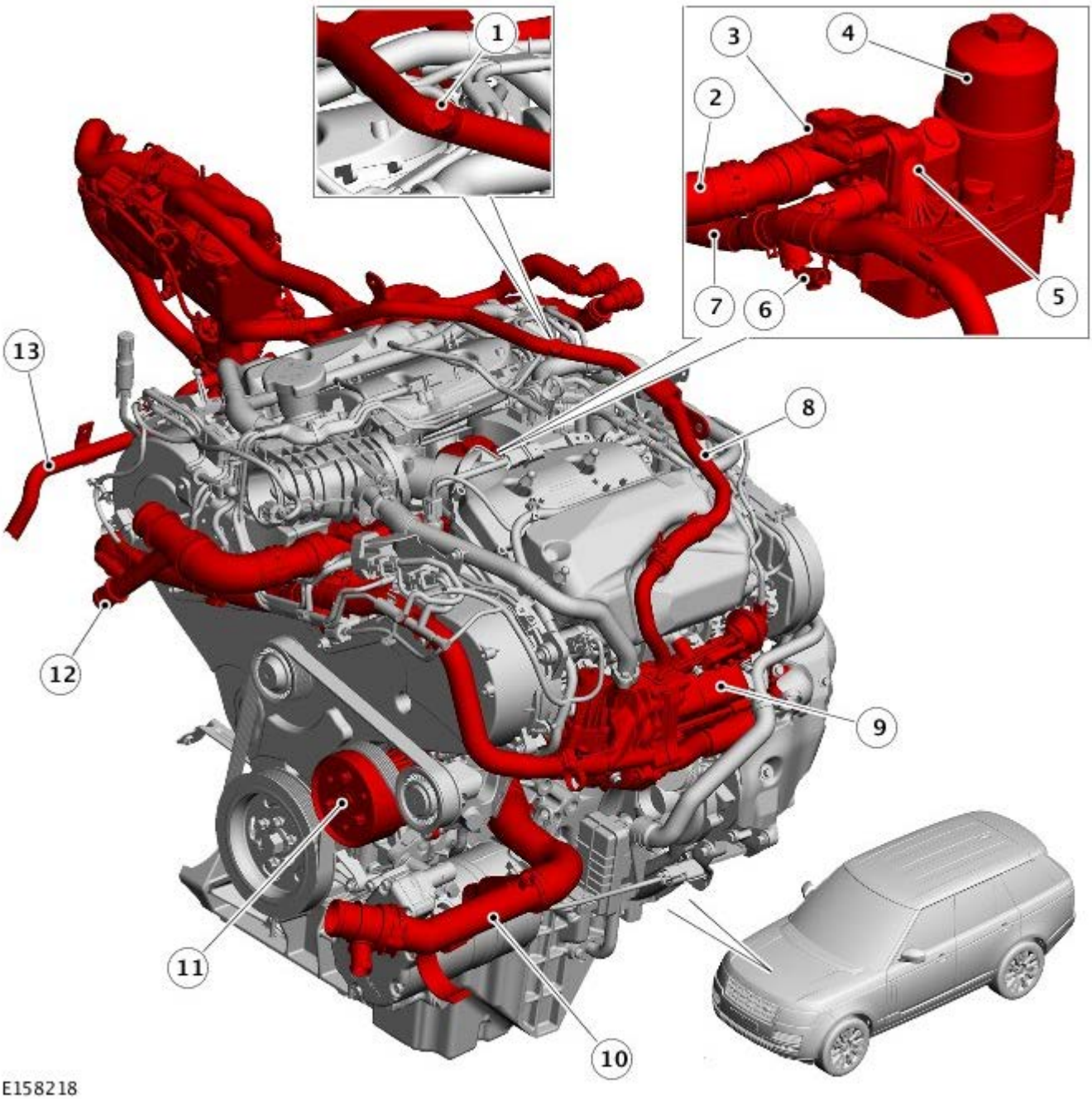
COMPONENT LOCATION - SHEET 1 OF 3



E158217

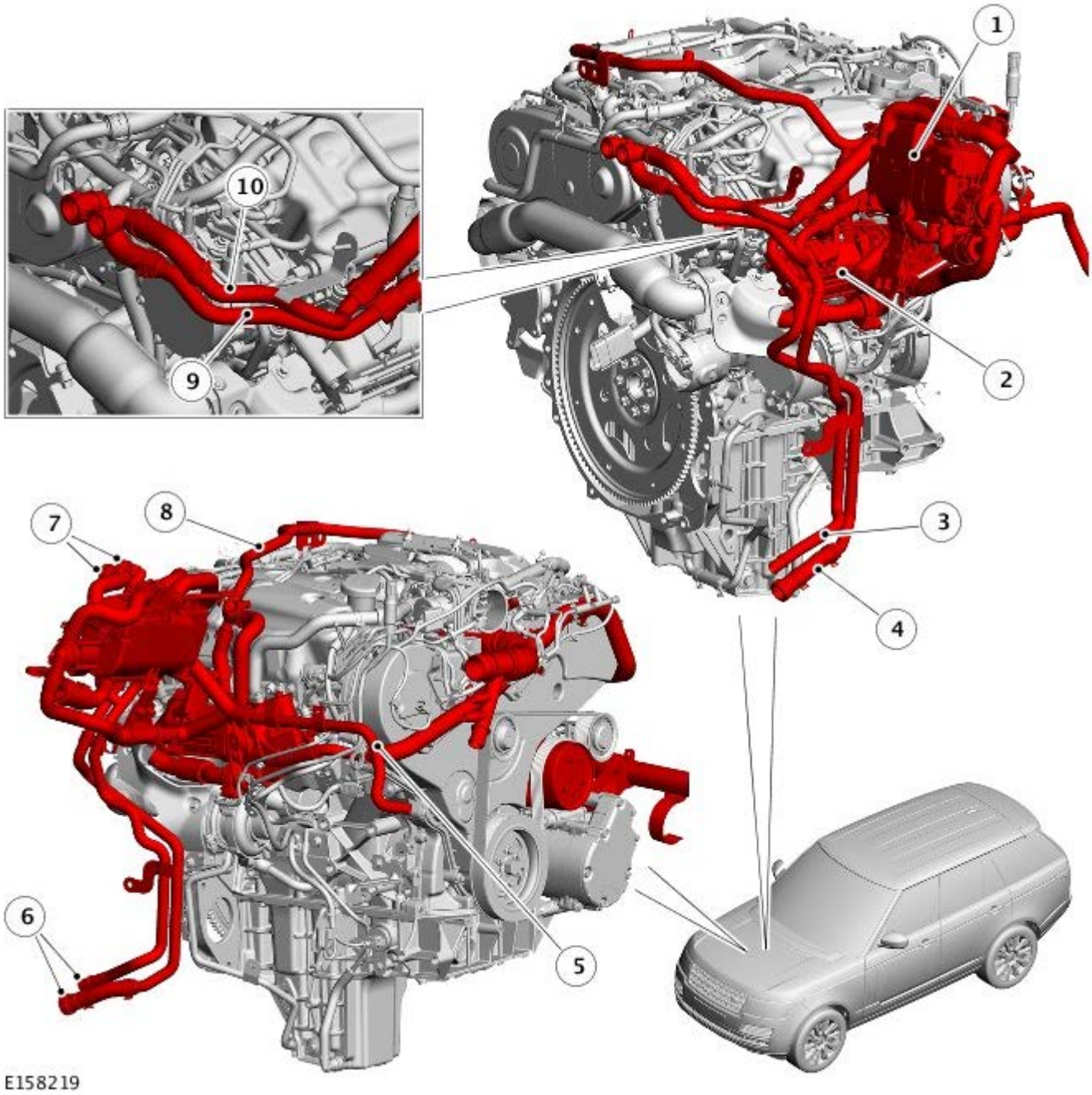
Item	Part Number	Description
1	-	Expansion tank
2	-	Radiator vent hose
3	-	Radiator
4	-	Upper hose
5	-	Vortex manifold
6	-	Heater rail
7	-	Main electric cooling fan
8	-	Thermostat
9	-	Coolant inlet connector
10	-	Active grille air shutter
11	-	Lower hose
12	-	Coolant inlet hose assembly
13	-	Auxiliary electric cooling fan

COMPONENT LOCATION - SHEET 2 OF 3



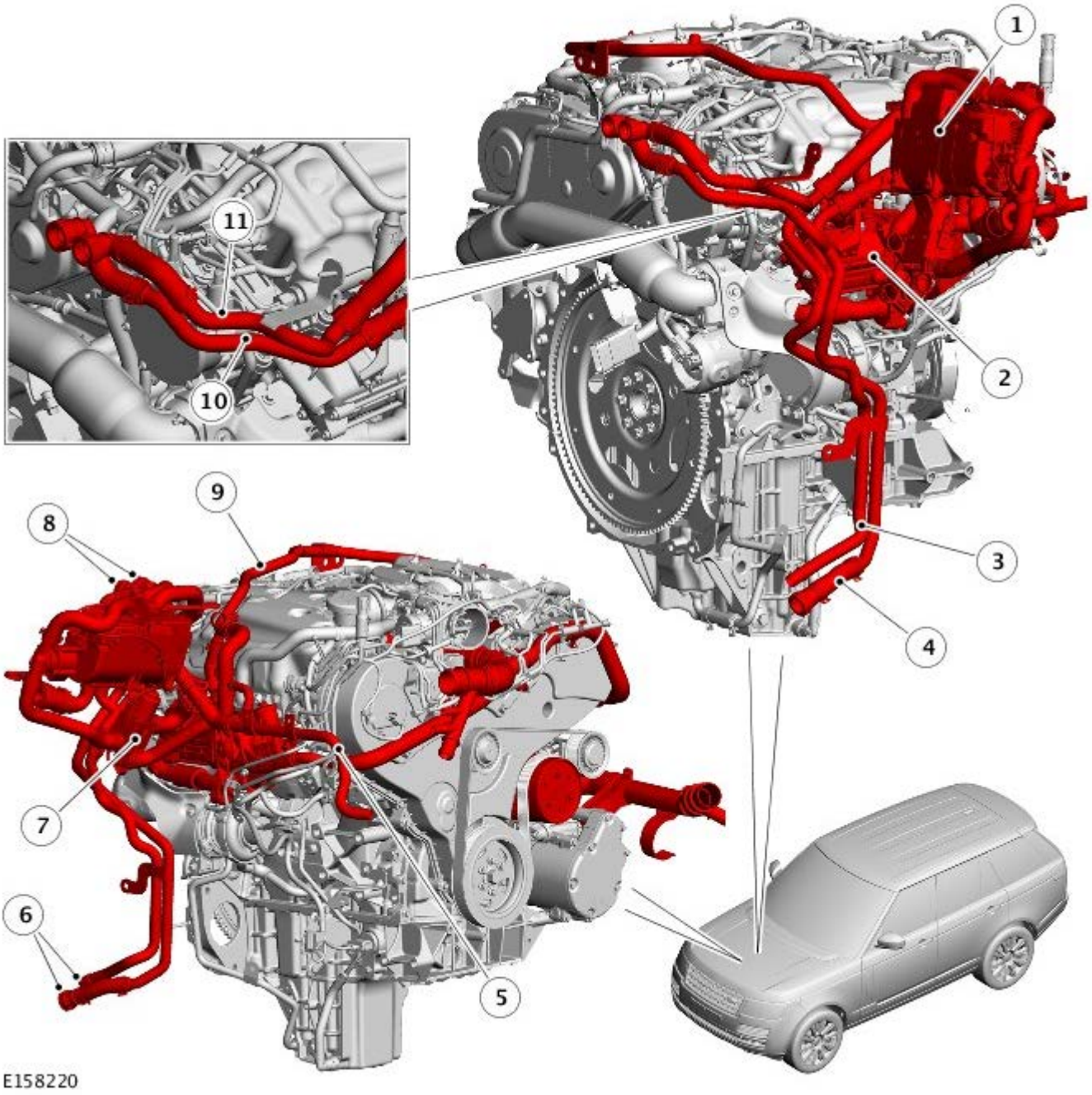
Item	Part Number	Description
1	-	Bleed screw
2	-	Upper hose
3	-	Bleed screw
4	-	Oil cooler and filter assembly
5	-	Coolant outlet connector
6	-	Engine coolant temperature sensor
7	-	Exhaust gas recirculation cooler inlet hose assembly
8	-	Exhaust gas recirculation cooler outlet hose assembly
9	-	Left exhaust gas recirculation cooler
10	-	Coolant inlet hose assembly
11	-	Coolant pump
12	-	Vortex manifold
13	-	Heater rail

COMPONENT LOCATION - SHEET 3 OF 3 (VEHICLES WITHOUT TIMED CLIMATE CONTROL)



Item	Part Number	Description
1	-	Fuel fired booster heater
2	-	Right exhaust gas recirculation cooler
3	-	Climate control outlet pipe (vehicles with auxiliary climate control)
4	-	Climate control inlet pipe (vehicles with auxiliary climate control)
5	-	Heater rail
6	-	Connections for auxiliary climate control assembly (where fitted)
7	-	Connections for climate control assembly
8	-	Exhaust gas recirculation cooler outlet hose assembly
9	-	Climate control inlet pipe (vehicles without auxiliary climate control)
10	-	Climate control outlet pipe (vehicles without auxiliary climate control)

COMPONENT LOCATION - SHEET 3 OF 3 (VEHICLES WITH TIMED CLIMATE CONTROL)



Item	Part Number	Description
1	-	Fuel fired booster heater
2	-	Right exhaust gas recirculation cooler
3	-	Climate control outlet pipe (vehicles with auxiliary climate control)
4	-	Climate control inlet pipe (vehicles with auxiliary climate control)
5	-	Heater rail
6	-	Connections for auxiliary climate control assembly (where fitted)
7	-	Changeover valve
8	-	Connections for climate control assembly
9	-	Exhaust gas recirculation cooler outlet hose assembly
10	-	Climate control inlet pipe (vehicles without auxiliary climate control)
11	-	Climate control outlet pipe (vehicles without auxiliary climate control)

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. For additional information, refer to:
  Heating and Ventilation (412-01B, Description and Operation),
  Auxiliary Climate Control (412-02B, Description and Operation).
- Cooling for:
  - The engine oil.
    For additional information, refer to: Engine (303-01E Engine - SDV6 3.0L Diesel - Hybrid Electric Vehicle,

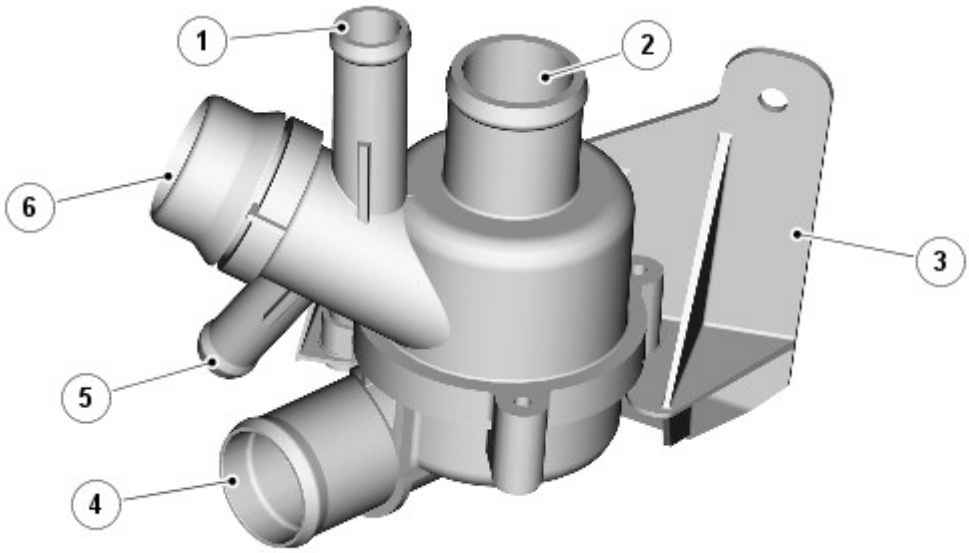
Description and Operation).
- The fuel.
  For additional information, refer to: Fuel Tank and Lines (310-01E, Description and Operation).
- The EGR (exhaust gas recirculation) system.
  For additional information, refer to: Engine Emission Control (303-08A, Description and Operation).
- The transmission fluid, the MG (motor generator) and the EPIC (electric power inverter converter).
  For additional information, refer to: Battery and Cables - TDV6 3.0L Diesel - Hybrid Electric Vehicle (414-01, Description and Operation).

An engine driven coolant pump circulates the coolant around the system. A thermostat controls the flow through the radiator and two electric cooling fans are installed to assist with cooling. An expansion tank connects to the engine coolant inlet and a vent line from the radiator. An active grille air shutter is installed in front of the cooling pack to reduce aerodynamic drag and engine warm up time.

A FFBH (fuel fired booster heater) is connected to the engine cooling system to assist with heating of the passenger compartment.
For additional information, refer to: Fuel Fired Booster Heater (412-02B, Description and Operation).

DESCRIPTION

Thermostat

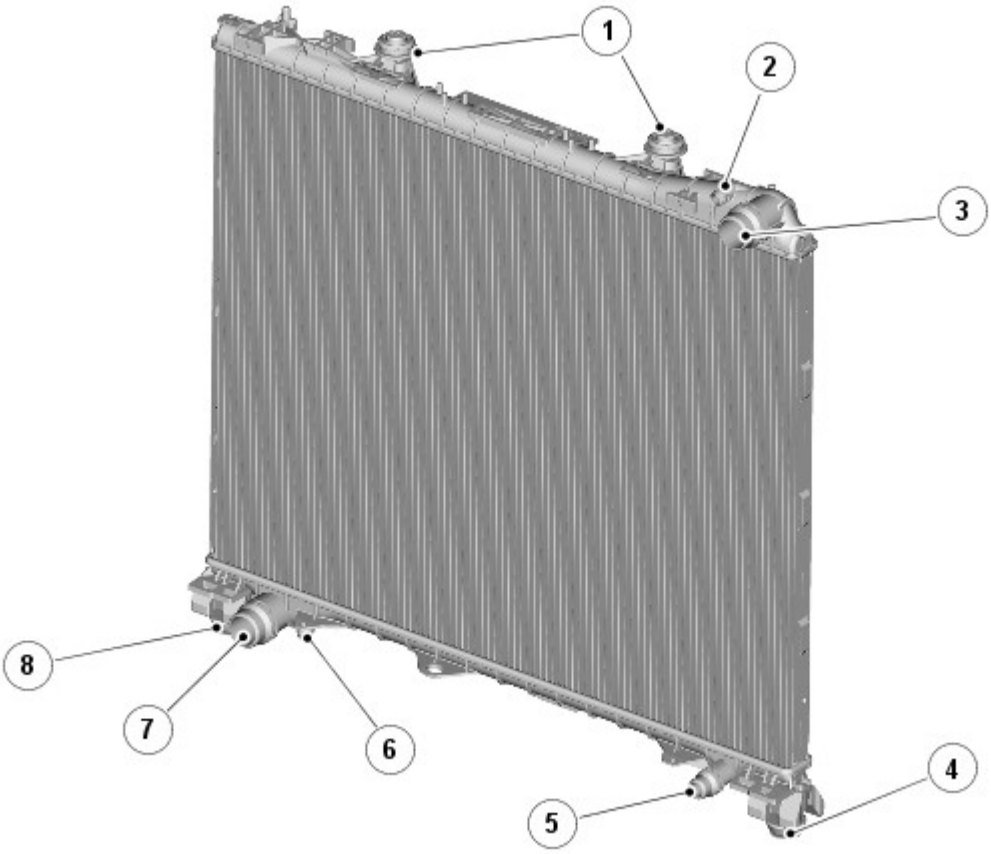


E145079

Item	Part Number	Description
1	-	Heater return hose connection
2	-	Upper hose connection
3	-	Thermostat bracket
4	-	Lower hose connection
5	-	Not used - connection capped off
6	-	Inlet hose connection

A pressure relief type thermostat is located behind the radiator, on a bracket attached to the cooling fan shroud. The thermostat body has connections for the lower hose, the upper hose, the heater return hose and the inlet hose. The thermostat body contains a wax element and a spring loaded bypass valve.

Radiator



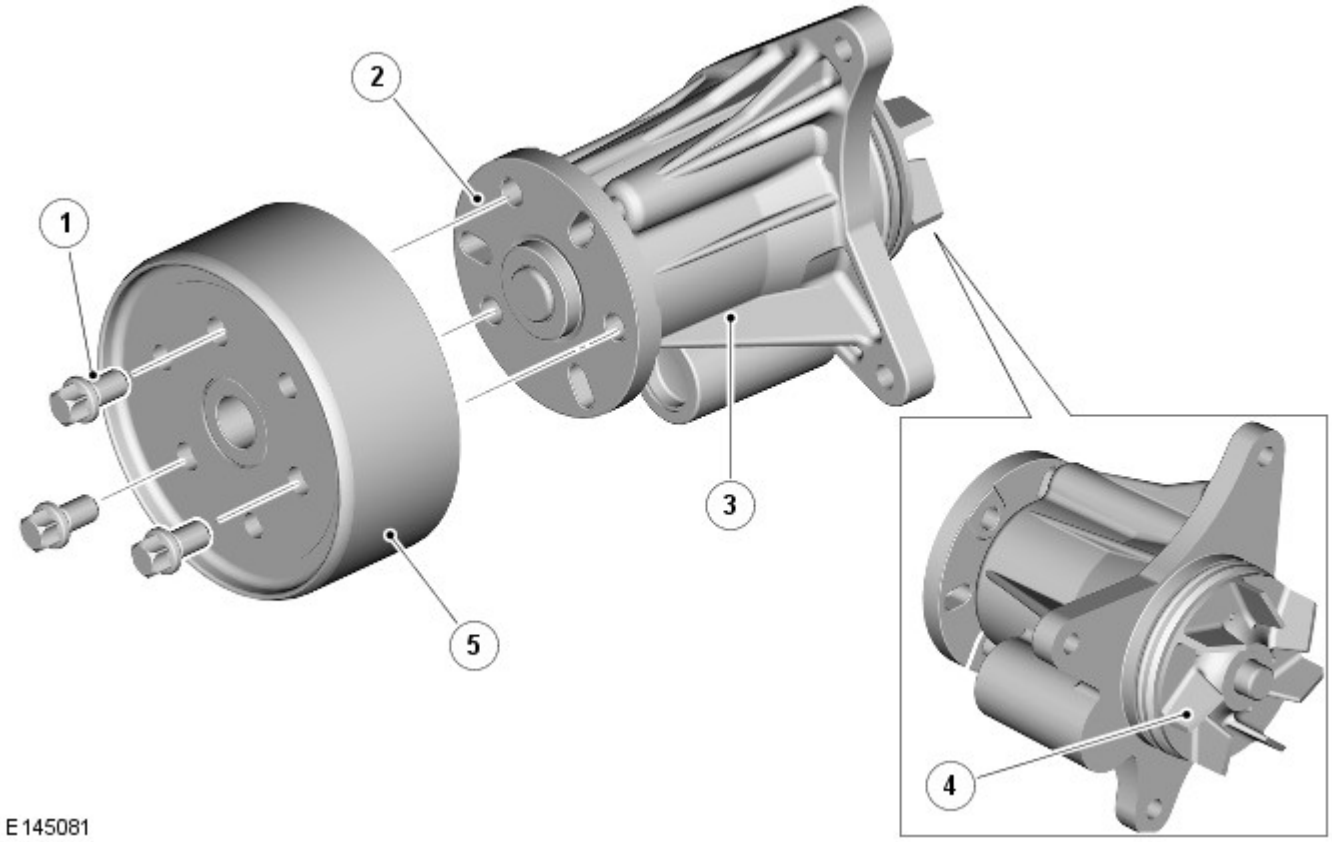
E145080

Item	Part Number	Description
1	-	Upper mounts
2	-	Vent hose connection
3	-	Upper hose connection
4	-	Lower mount
5	-	Lower hose sub-cooler connection
6	-	Drain screw
7	-	Lower hose connection
8	-	Lower mount

The radiator is a vertical-flow type with an integral sub-cooler. The radiator is located in the vehicle by bushes attached to the end tanks. The lower bushes are installed in the front subframe. The upper bushes are installed in the front end carrier.

Upper and lower hose connections are incorporated into the upper and lower end tanks respectively. The lower end tank also incorporates a drain screw. The upper end tank incorporates a connection for a vent hose to the expansion tank. The end tanks also incorporate mounting points for the cooling fan shroud and the climate control condenser.

Coolant Pump

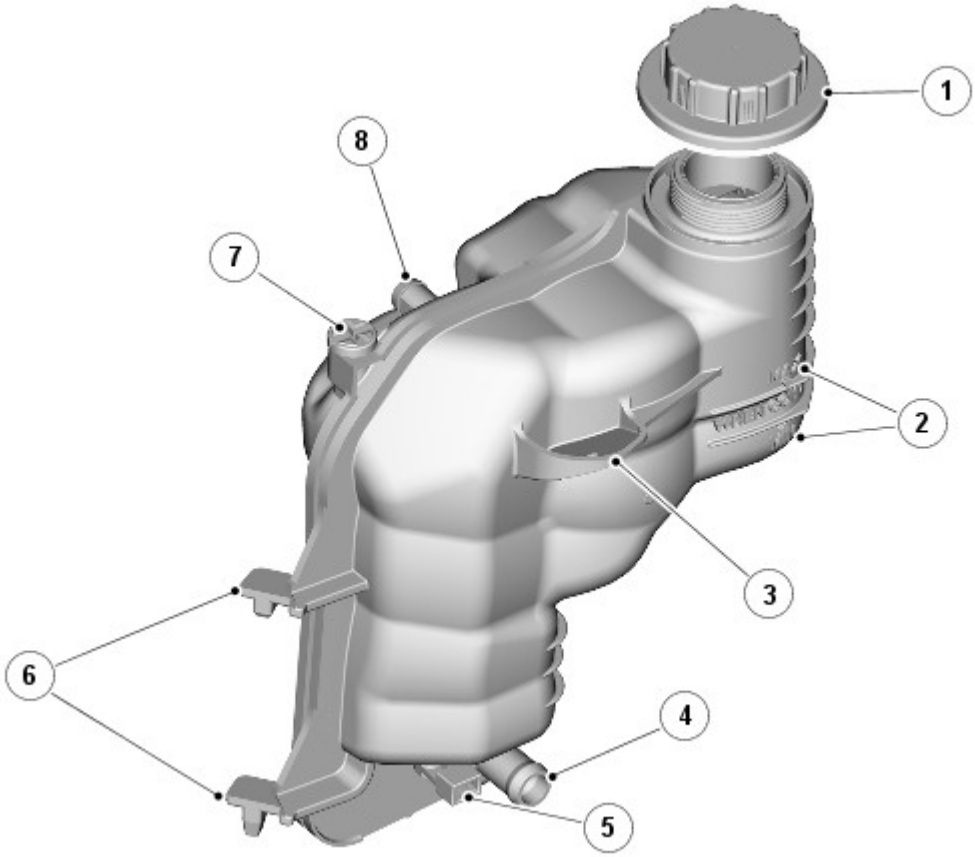


E145081

Item	Part Number	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 in the cylinder block. 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 (303-05E Accessory Drive - SDV6 3.0L Diesel - Hybrid Electric Vehicle, Description and Operation).

Expansion Tank



E145082

Item	Part Number	Description
1	-	Filler cap
2	-	MAX and MIN level markings
3	-	Mounting lug
4	-	Supply hose connection
5	-	Coolant level sensor
6	-	Mounting lugs
7	-	Bleed screw
8	-	Vent hose connection

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 engine coolant inlet hose assembly. A continuous vent into the expansion tank, through a hose connected to the radiator, prevents air locks from forming in the cooling system.

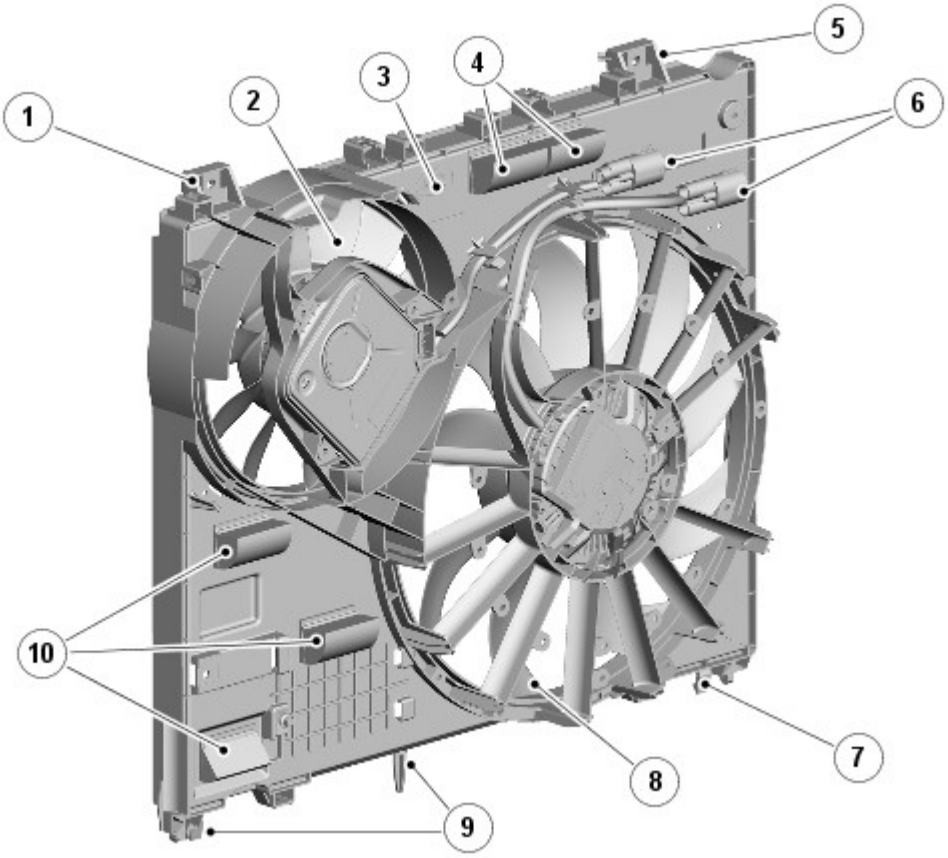
The expansion tank is attached to the front end carrier in the front left corner of the engine compartment. A filler cap, bleed screw and level sensor are incorporated into the expansion tank. MAX and MIN level markings are molded into the exterior of the tank.

The expansion tank provides the following functions:

- Service fill
- Coolant expansion during warm-up
- Air separation during operation
- System pressurization by the filler cap to 140 kPa (20.3 lbf/in²).

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.

Electric Cooling Fans



Item	Part Number	Description
1	-	Mounting lug
2	-	Auxiliary electric cooling fan
3	-	Shroud
4	-	Speed flaps
5	-	Mounting lug
6	-	Electrical connectors
7	-	Mounting lug
8	-	Main electric cooling fan
9	-	Mounting lugs
10	-	Speed flaps

Two variable speed electric cooling fans are installed to help regulate the coolant temperature. The fan shroud is attached to the rear of the radiator. The shroud incorporates speed flaps, which pivot open to allow engine compartment cooling at speed.

Each electric cooling fan is operated by a control module, integrated into their electric motor, which is controlled by the ECM (engine control module). Electrical connectors at the right side of the fan shroud provide the interface between the cooling fan harnesses and the vehicle wiring. The control module of each electric cooling fan is provided with:

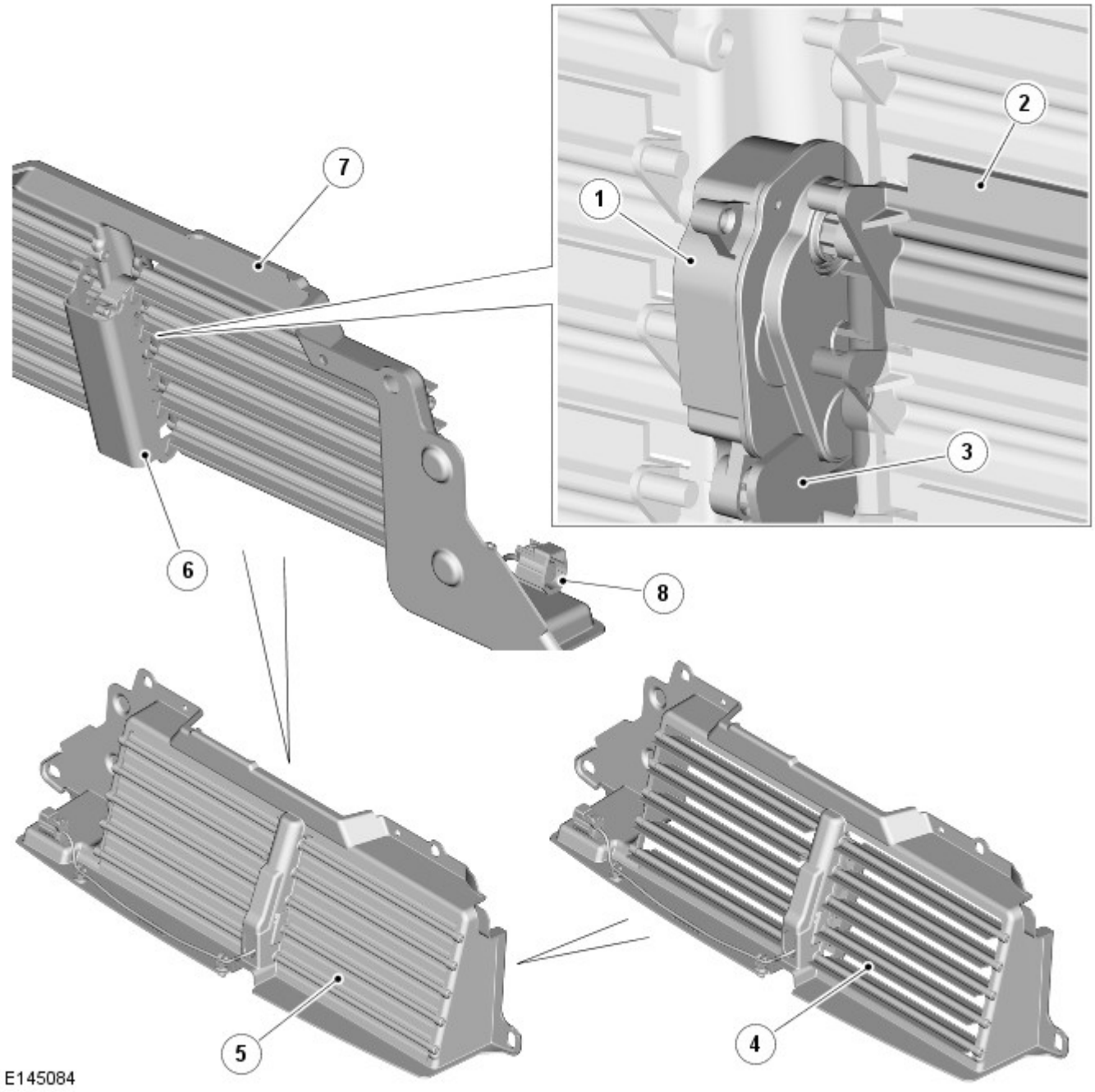
- A battery power supply from the AJB (auxiliary junction box)
- An ignition signal from the ECM relay in the EJB (engine junction box)
- A PWM (pulse width modulation) signal from the ECM
- A ground.

To control each electric cooling fan, the ECM varies the duty cycle of the PWM signal. The fan control module translates the duty cycle into a fan target speed and sets the output current to the fan motor accordingly.

Engine Coolant

The coolant is silicate free and must not be mixed with conventional engine coolant.

Active Grille Air Shutter



Item	Part Number	Description
1	-	Motor
2	-	Master vane
3	-	Support bracket
4	-	Vane (10 off) - fully open
5	-	Vane (10 off) - fully closed
6	-	Vane link
7	-	Housing
8	-	Electrical connector

The active grille air shutter is installed behind the radiator grille and attached to the front end carrier. The active grille air shutter incorporates moveable vanes that control the air flow into the top half of the upstream main duct attached to the front of the cooling pack.

The vanes are installed in a housing in two groups of five and operated by an electric motor. The motor is held in a support bracket in the housing. The inboard hinge pin of one of the vanes (the master vane) is engaged in the output shaft of the motor. A lever on the inboard end of each vane is engaged in an motor link. When the motor turns the master vane, the motor link transfers the movement to the levers of the other nine vanes, which then turn in unison with the master vane.

The design of the vanes equalizes the wind loading on each side of the hinge pin, which reduces the resistance to turning when the vehicle is traveling at speed. A seal along the top edge of each vane provides sealing between adjacent vanes, and between the two upper vanes and the housing. The vanes can be set to one of 14 positions between fully closed and fully open, and have a range of movement of 80 degrees. During normal operation, for the vanes to move from fully closed to fully open takes approximately 30 seconds, and for the vanes to move from fully open to fully closed takes approximately 90 seconds.

Operation of the motor is controlled by the ECM, which communicates with the motor on a LIN (local interconnect network) bus connection. Power for the motor is provided by a feed from the ECM relay in the EJB.

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 to the coolant outlet connector. Some of the coolant in the cylinder block is diverted through the engine oil cooler before returning to the coolant outlet connector.

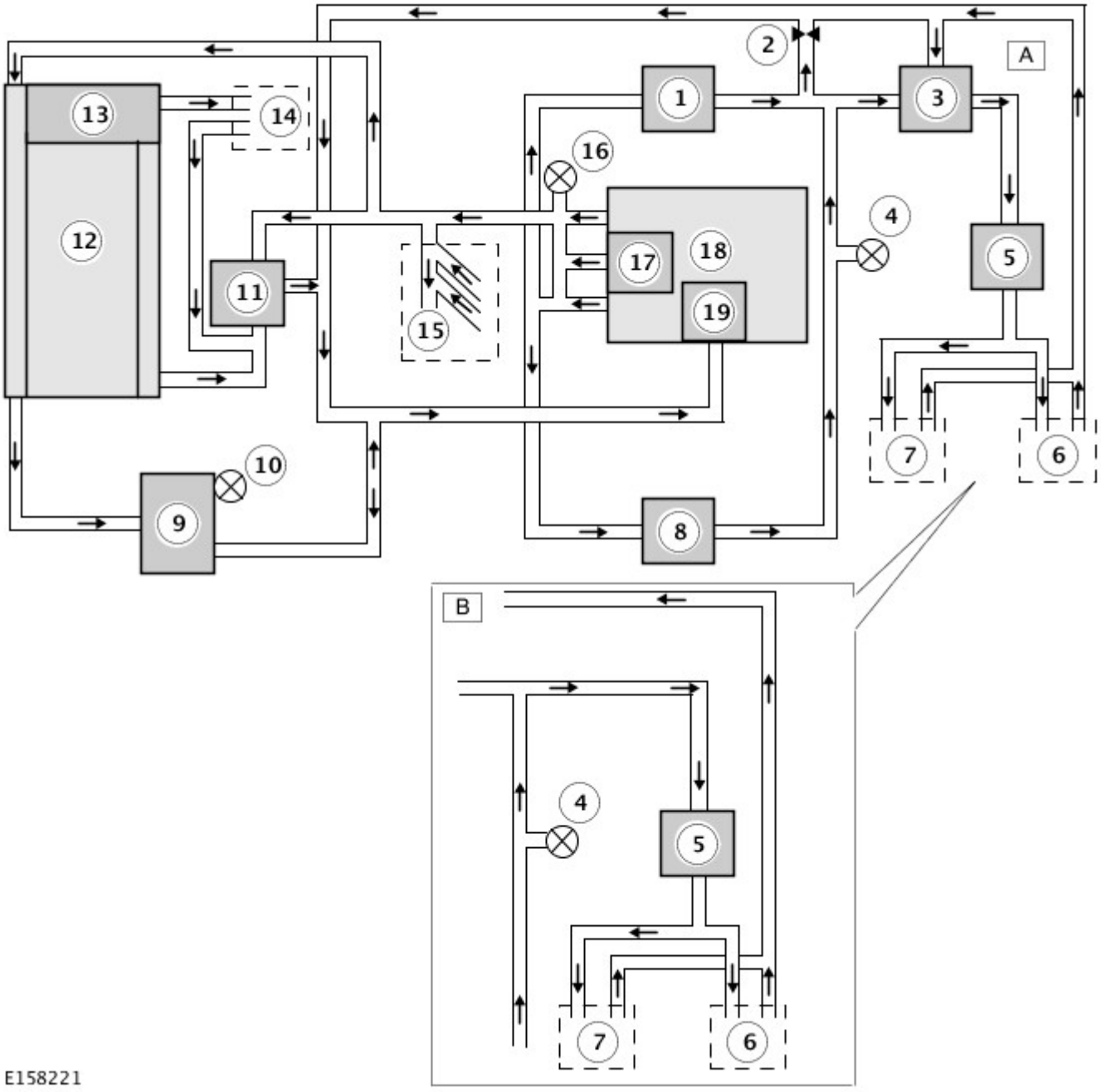
From the coolant outlet connector, the majority of the coolant flows to the thermostat, either directly or via the radiator, depending on the temperature of the coolant and engine speed. The remainder of the coolant flows through the EGR coolers and the FFBH (fuel fired booster heater) to the climate control assemblies, then to the outlet side of the thermostat. From the outlet of the thermostat the coolant flows to the coolant inlet connector on the left side of the cylinder block and back to the coolant pump.

The transmission cooling and the MG cooling circuits are connected to the engine cooling system at the radiator sub-cooler and the lower hose. For additional information, refer to:

Transmission Cooling (307-02B, Description and Operation),
Battery and Cables - TDV6 3.0L Diesel - Hybrid Electric Vehicle (414-01, Description and Operation).

A vortex manifold in the upper hose incorporates connections for the EPIC cooling circuit.
For additional information, refer to: Battery and Cables - TDV6 3.0L Diesel - Hybrid Electric Vehicle (414-01, Description and Operation).

Engine Cooling System Schematic



A = Vehicles with timed climate control; B = Vehicles without timed climate control.

Item	Part Number	Description
1	-	Exhaust gas recirculation cooler
2	-	Restrictor (in hose connector of heater rail)
3	-	Changeover valve
4	-	Static bleed point
5	-	Fuel fired booster heater
6	-	Connections for climate control assembly
7	-	Connections for auxiliary climate control assembly (where fitted)
8	-	Exhaust gas recirculation cooler
9	-	Expansion tank
10	-	Static bleed point
11	-	Thermostat
12	-	Radiator
13	-	Radiator sub-cooler
14	-	Connections for cooling circuit of transmission fluid and motor generator
15	-	Connections for cooling circuit of electric power inverter converter (vortex manifold)
16	-	Static bleed point
17	-	Oil cooler
18	-	Engine
19	-	Coolant pump

Thermostat

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.

Coolant Level Sensor

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 (controller area network) comfort and convenience systems to display a warning message.
For additional information, refer to: Instrument Cluster - TDV6 3.0L Diesel - Hybrid Electric Vehicle (413-01, Description and Operation).

Electric Cooling Fans / Active Grille Air Shutter Control

The ECM determines the speed of the cooling fans and the vane position of the active grille air shutter from the thermal condition of the vehicle. The thermal condition of the vehicle is an output of the fan control logic and is calculated using inputs from:

- The AAT (ambient air temperature) sensor
- The ECT (engine coolant temperature) sensor
- The fuel temperature sensor
- The ATCM (automatic temperature control module), for A/C (air conditioning) demand
- The TRS (Terrain Response® switchpack), for Terrain Response® mode selection
- The ABSCM (anti-lock brake system control module), for vehicle speed
- The TCM (transmission control module), for transmission fluid temperature and MG temperature.

In order to conserve as much energy as possible and so maximize fuel efficiency, when it determines additional cooling is required the ECM first opens the vanes of the active grille air shutter. Once the vanes are fully open, if further cooling is required the ECM then operates the electric cooling fans.

Electric Cooling Fans

The ECM operates the electric cooling fans in unison using a separate PWM signal to the control module in each fan. The ECM varies the duty cycle of the PWM signals between 0 and 100% to operate the fans in one of four modes: Off, minimum speed (750 rev/min), linear variable speed between minimum and maximum speeds, and maximum speed (2820 rev/min). Under hot operating conditions, the fans may continue to operate for up to five minutes after the engine has been switched off.

Each fan control module monitors for over and under input voltage, a stalled motor and a partially stalled motor. If it detects any of these faults the fan control module temporarily pulls the PWM signal to ground to notify the fault to the ECM. The length of time the PWM signal is pulled to ground varies between 2 and 8 seconds, depending on the fault. The fan control module repeats the notification process at 5 second intervals until the fault is cleared. If there is more than one fault, only the highest priority fault is notified to the ECM. Fault priorities, in descending order, are over voltage, under voltage, stalled motor and partially stalled motor. The ECM records a related DTC (diagnostic trouble code) for faults notified by the fan control module and signals the instrument cluster on the medium speed CAN bus to display a warning message.

The nominal operating voltage for the electric cooling fans is 9 to 16 volts. If the input voltage is outside of these limits, the fan control module stops operation of the cooling fan and notifies the ECM of the fault. After an under or over voltage occurs, cooling fan operation is resumed when the input voltage increases to 9.5 volts, or decreases to 15.5 volts, respectively.

To check for a stalled motor, each time it supplies power to start the fan motor the fan control module checks the fan motor speed after 2 seconds. If the speed is zero, the fan control module determines the fan motor is stalled and tries a restart. For a restart, the fan control motor disconnects the power from the fan motor then immediately reconnects it at an increased current level. The fan control module will try up to six restarts of a stalled motor, increasing the output current each time. If the fan motor remains stalled after the sixth restart, the fan control module waits 40 seconds then notifies the ECM of the fault and begins the start process again.

To check for a partially stalled motor, while the fan is running the fan control module monitors the current draw against fan speed. If the current draw is over the limit for more than 10 seconds, the fan control module disconnects the power from the fan motor and notifies the ECM of the fault. After 40 seconds, the fan control module starts the motor again.

The fan control module incorporates a temperature sensor to prevent damage caused by excessive heat at high ambient temperatures. Operation of the fan control module is discontinued if the temperature reaches 135 °C (275 °F). Operation resumes when the temperature decreases to 120 °C (248 °F).

If a fault occurs with the ignition signal or the PWM signal, the fan control module adopts the following fan speeds:

Signal	Fault	Fan Speed	
		Ignition On	Ignition Off
PWM	Duty cycle implausible	Maximum	Off
PWM	Frequency out of range	Maximum	Off
PWM	Open circuit	Maximum	Off
PWM	Short circuit to battery	Maximum (provided cooling fan is not damaged)	Off
PWM	Short circuit to ground	Maximum (provided cooling fan is not damaged)	Off
Ignition	Open circuit	Off	Off
Ignition	Short circuit to battery	According to PWM duty cycle	Maximum
Ignition	Short circuit to ground	Off (ECM relay fuse may blow)	Off

Active Grille Air Shutter

The ECM controls the active grille air shutter using a LIN signal to the active grille air shutter motor to set the vanes to a calculated opening position.

If vehicle speed reaches 180 km/h (112 mph), the vanes move to the fully open position. The vanes resume a calculated opening position when vehicle speed decreases to 140 km/h (87 mph).

In the case of electric cooling fan after-run, the vanes remain open. Once the fan after-run ends, the vanes close and the motor will send a signal to the ECM indicating it is ready to power down.

CALIBRATION MODE

When the ECM shuts down, the motor loses its memory. Therefore a calibration is required every time the ignition is switched on unless the ECM has remained active between ignition off and ignition on (e.g. electric cooling fan after-run).

Calibration only commences after the engine has started.

The calibration process opens and closes the vanes to find the end stops and range of motion between them. This range of movement is checked and if it is within the specified limits, the cycle is passed. This cycle can take up to 16 seconds.

The software allows for a total of 6 calibration attempts.

If the first attempt fails; as soon as a position demand exceeds 45% it will carry out the remaining five attempts, one after the other, until they either pass a calibration or fail all 6 attempts.

If the vanes pass the 3rd calibration, e.g. the vanes had been frozen for the first 2 attempts and have since thawed out, the remaining attempts are saved for the rest of the drive cycle.

A Calibration Failed Fault DTC will only be stored if the calibration fails from the first attempt and all attempts are used up.

The vanes will then be commanded to open as much as possible.

If the first calibration passes, then a Calibration Failed Fault DTC cannot be set until the next drive.

 NOTE: The motor is very sensitive to voltage drops from engine cranking and may trigger a further calibration.

JET WASH MODE

Jet wash mode allows the motor to fully open the vanes and then power down so that the radiator can be cleaned. To activate jet wash mode:

1. Start the engine.
2. Stop the engine and turn the ignition off.
3. Turn the ignition on (do not start the engine).
4. Select Terrain Response® sand mode.
5. Turn the ignition off.

This sequence prevents jet wash mode being entered accidentally if the ignition is turned off in sand mode.

The vanes will default to fully open whether the calibration has been completed or not (see CALIBRATION MODE).

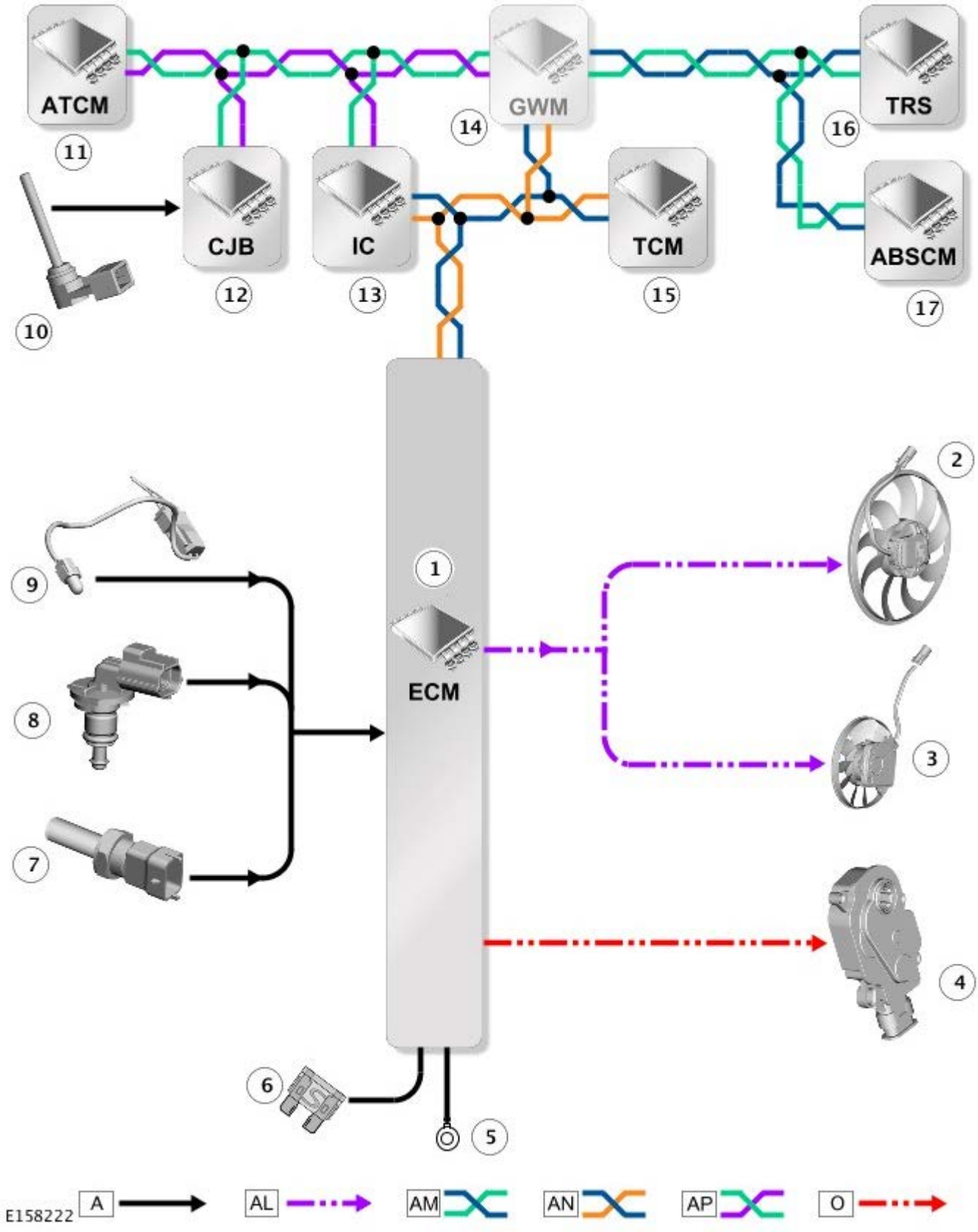
Once the position feedback shows that the vanes are fully open, the motor will indicate to the ECM that it is ready to power down.

FAULT DIAGNOSIS

If there is a fault with the active grille air shutter, the Engine Over Temperature warning is displayed in the instrument cluster. For each fault, a flag is set and after a calibrated de-bounce time, a DTC is stored in the ECM. The following faults can be detected:

- Mechanical blockage fault – Motor encounters too much resistance and stalls. Max Torque = 0.7-0.8 Nm. Once blocked, the motor will try to recalibrate up to maximum number of attempts as described in the calibration section.
- Calibration Failed Fault – Fault stored if all calibration attempts have failed in that drive cycle.
- Electrical Fault – Motor reports an internal electrical fault.
- Supply Voltage Fault – Motor supply voltage falls outside the range 7.5V – 17.5V.
- Thermal Shutdown Fault – Motor circuits exceed their inbuilt temperature threshold.
- Disconnect Fault – Linkage between the motor and the vanes becomes disconnected.
- LIN Bus Error Fault and Node Detection Fault – A fault with the motor, its signal wire or its supply that causes a breakdown in signals to the ECM. If the motor is still operational and only the signal wire has a short circuit/open circuit, then the motor will fail safe fully open after 10 seconds of not receiving a signal.

Input/Output Diagram



A = Hardwired; AL = PWM signal; AM = High speed CAN chassis systems; AN = High speed CAN powertrain systems; AP = Medium speed CAN comfort and convenience systems; O = LIN bus.

Item	Part Number	Description
1	-	Engine control module
2	-	Main electric cooling fan
3	-	Auxiliary electric cooling fan
4	-	Active grille air shutter motor
5	-	Ground
6	-	Power supply
7	-	Fuel temperature sensor
8	-	Engine coolant temperature sensor

9	-	Ambient air temperature sensor
10	-	Engine coolant level sensor
11	-	Automatic temperature control module
12	-	Central junction box
13	-	Instrument cluster
14	-	Gateway module
15	-	Transmission control module
16	-	Terrain Response® switchpack
17	-	Anti-lock brake system control module

Published: 25-Jul-2013

Engine Cooling - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Cooling System Draining, Filling and Bleeding

General Procedures

Draining

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.

NOTE: This procedure only needs to be carried out when the coolant system vacuum filler equipment is not available in the workshop.

All vehicles

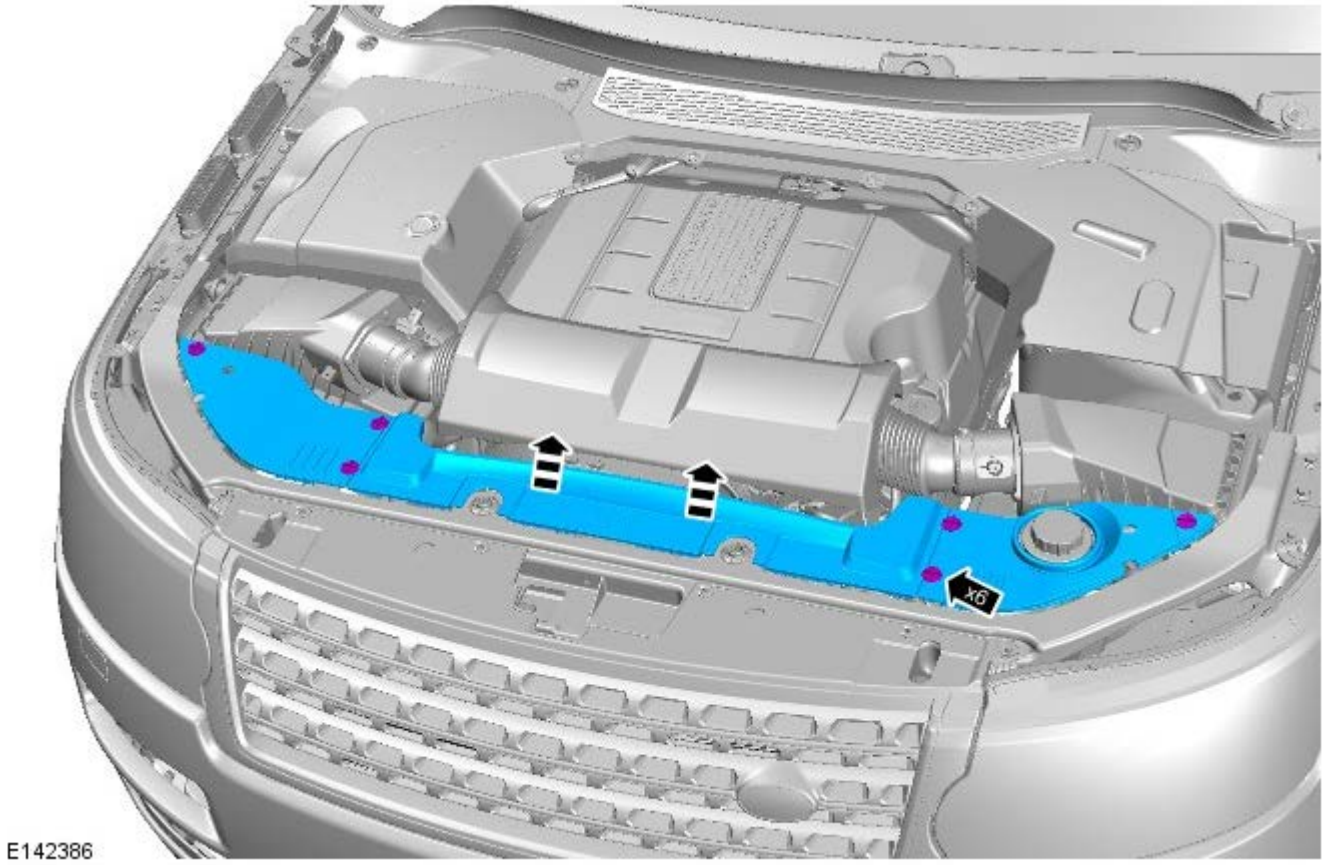
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

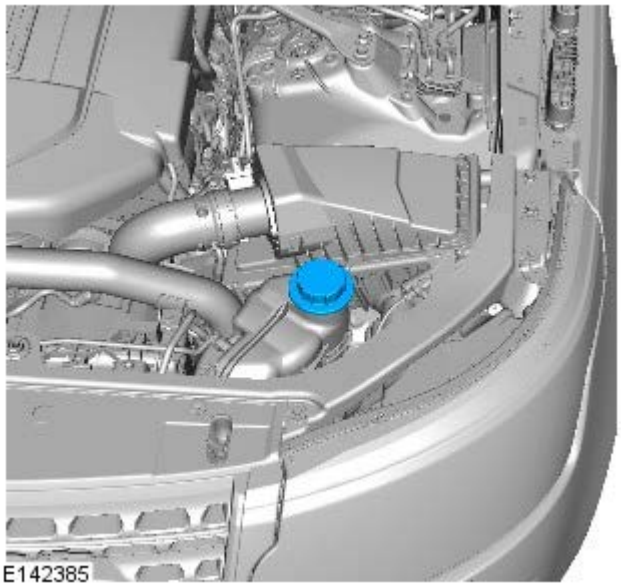
2. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

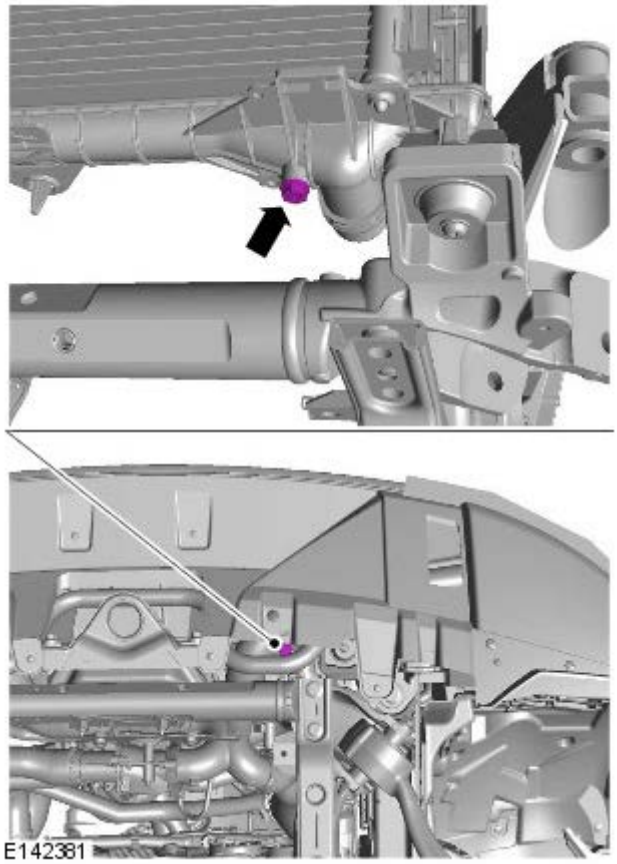
3. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05 Interior Trim and Ornamentation, Removal and Installation).

4.



5. WARNING: When releasing the cooling system pressure, cover the coolant expansion tank cap with a thick cloth.





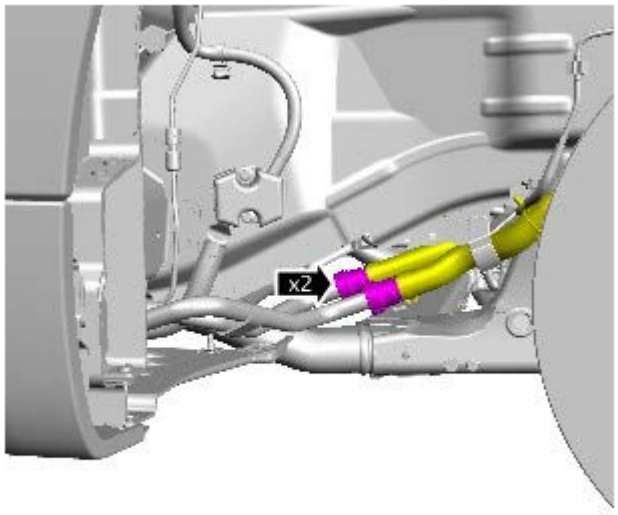
6. CAUTION: Be prepared to collect escaping coolant.

7. Remove the front right fender splash shield.

   Refer to: Fender Splash Shield (501-02 Front End Body Panels, Removal and Installation).

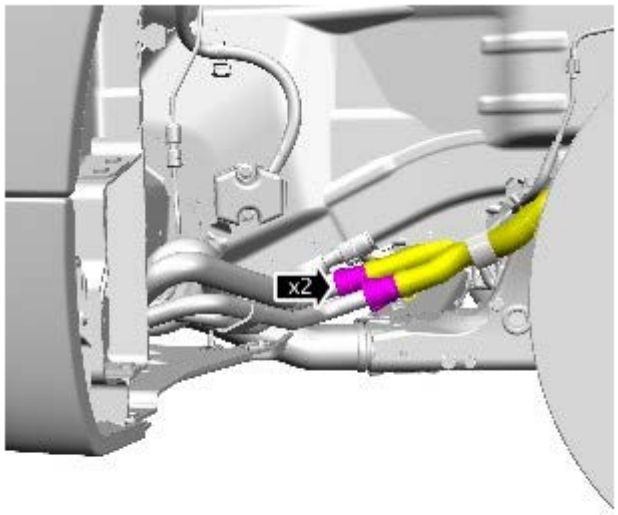
Vehicles without rear air conditioning

8. CAUTION: Be prepared to collect escaping coolant.



E158944

Vehicles with rear air conditioning



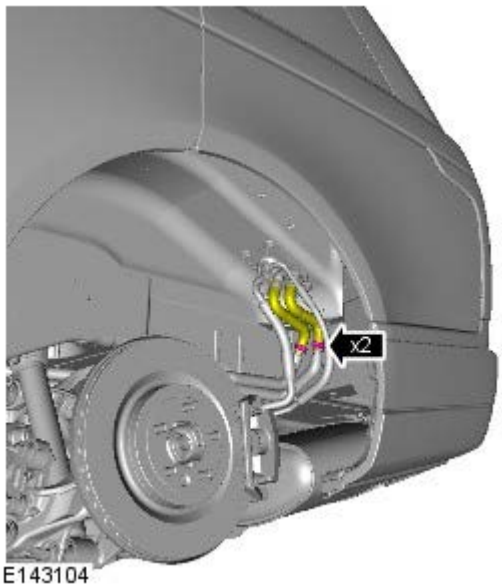
E158945

9. CAUTION: Be prepared to collect escaping coolant.

10. Remove the rear left fender splash shield.

    Refer to: Rear Fender Splash Shield (501-08 Exterior Trim and Ornamentation, Removal and Installation).

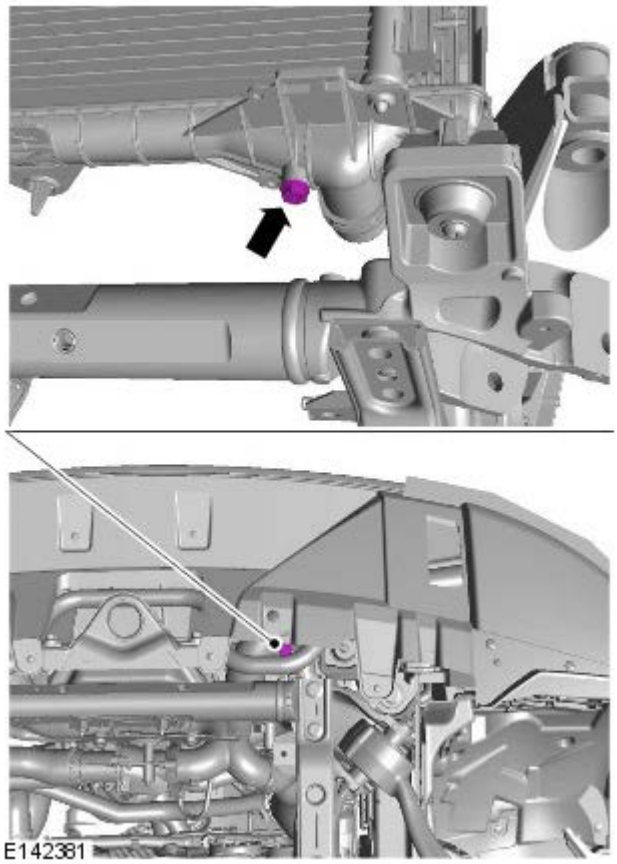
11. CAUTION: Be prepared to collect escaping coolant.



E143104

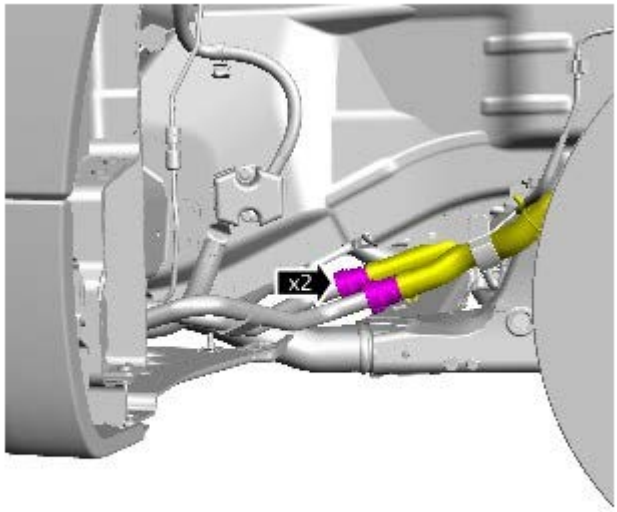
All vehicles

12. *Torque:* 5 Nm



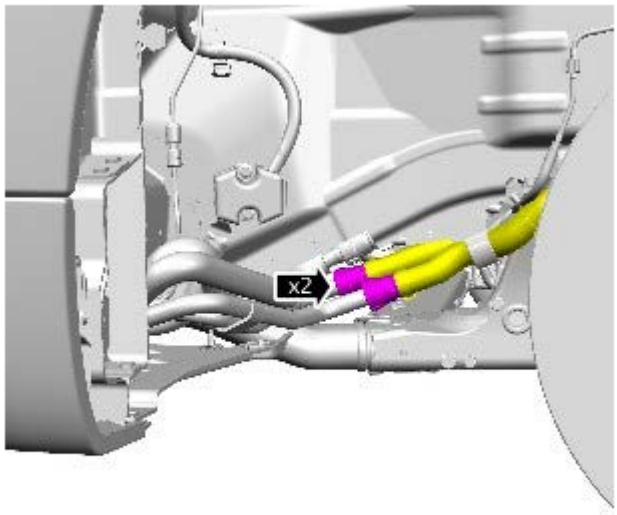
Vehicles without rear air conditioning

13.



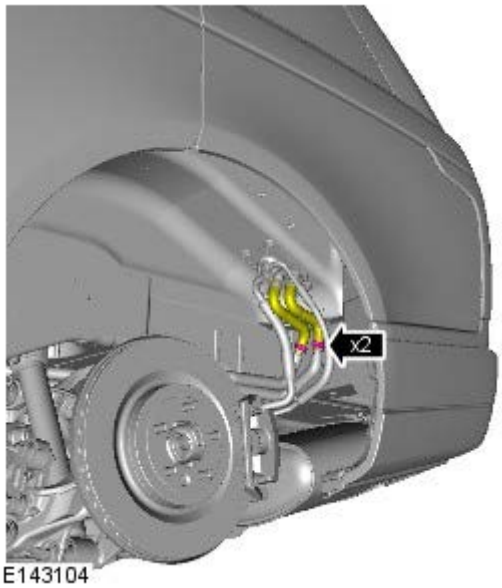
Vehicles with rear air conditioning

14.



E158945

15.



E143104

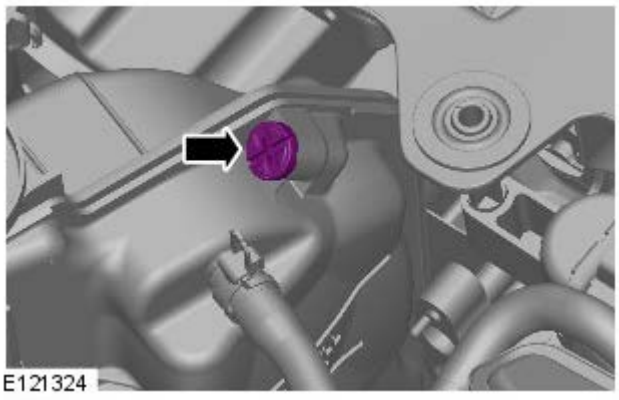
All vehicles

16. Carry out the procedure up to step 1 in the filling section three times, filling the cooling system with clean water after the first two drains. At the third refill, use a suitable measuring tool to make sure that the cooling system maintains a 50% mix.

Filling

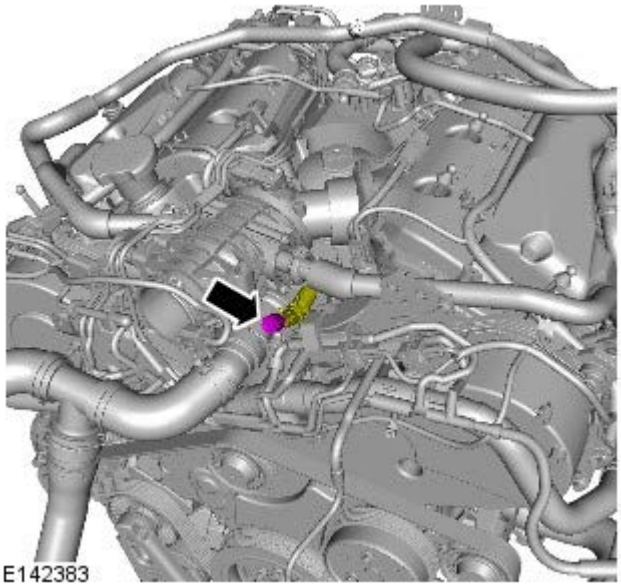
All vehicles

1.

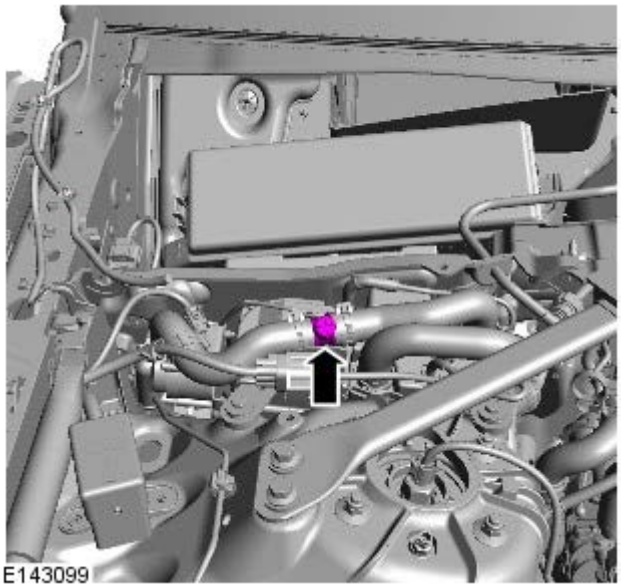


E121324

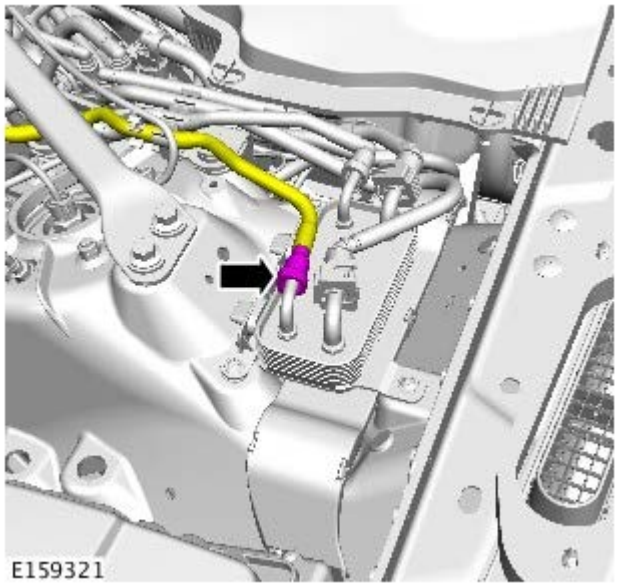
2.



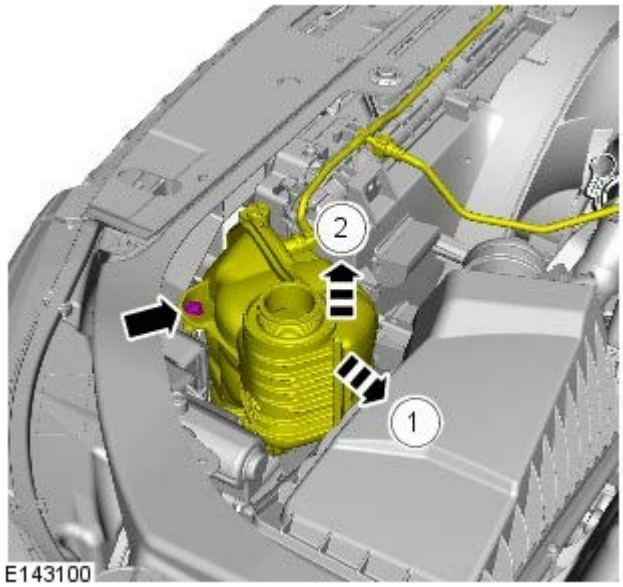
3. NOTE: Where fitted.

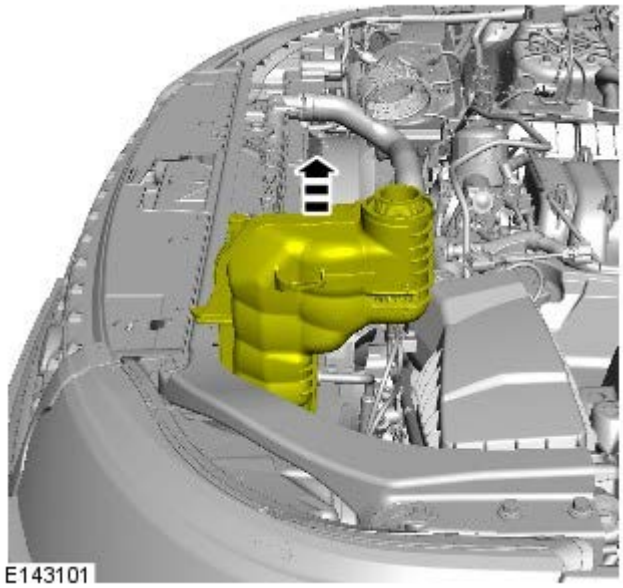


4.



5. *Torque:* 9 Nm





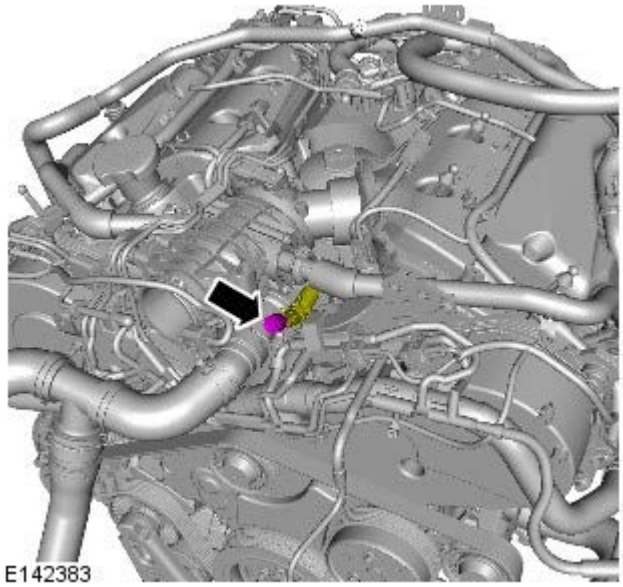
6. NOTE: Keep the coolant expansion tank vertical.

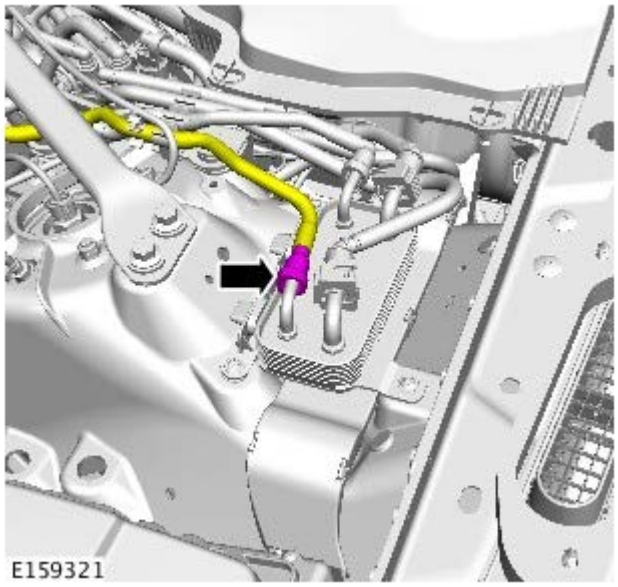
   Raise the coolant expansion tank minimum 110mm from its original position.

7. CAUTION: Anti-freeze concentration must be maintained at 50%.

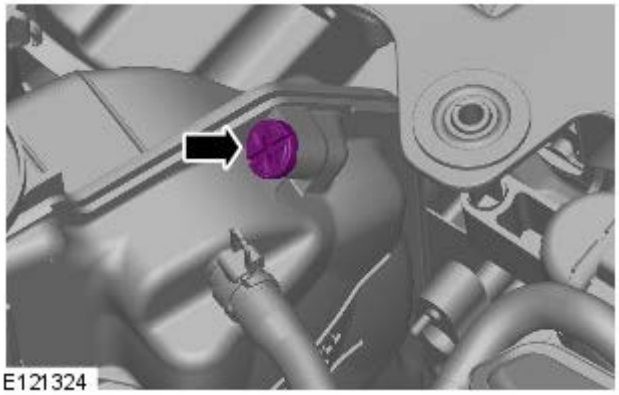
   Fill the coolant expansion tank to the rim and continue until coolant is visible from the outlet.

8. Once coolant is visible from the outlet, close the bleeding point.





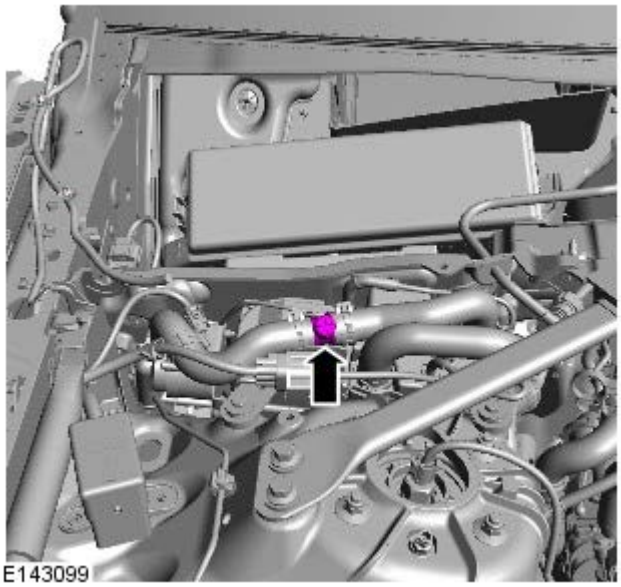
9. Once coolant is visible from the outlet, close the bleeding point.



10. Once coolant is visible from the outlet, close the bleeding point.

11. Set the heater controls to maximum.

12. Start the engine and allow to idle.



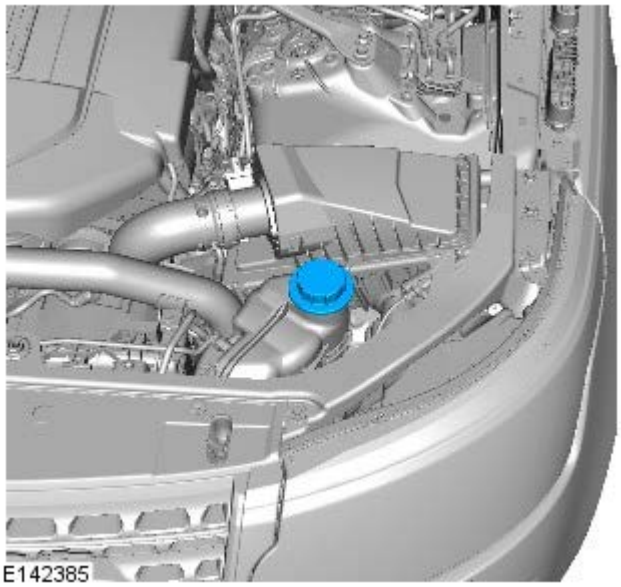
13. NOTE: Where fitted.

    Once coolant is visible from the outlet, close the bleeding point.

14. Hold the engine speed at 2000 rpm until warm air is expelled from the heater.

15. Continue to fill the coolant expansion tank to the rim until the coolant level stops dropping.

16. Install the coolant expansion tank.



17. Install the expansion tank cap after making sure that the final coolant level is 40mm above the maximum cold fill line.

18. Run the engine until the thermostat opens and hot air is emitted from the front and rear face vents.

19. Switch the engine off and allow to cool.

20. WARNINGS:

    When releasing the cooling system pressure, cover the coolant expansion tank cap with a thick cloth.

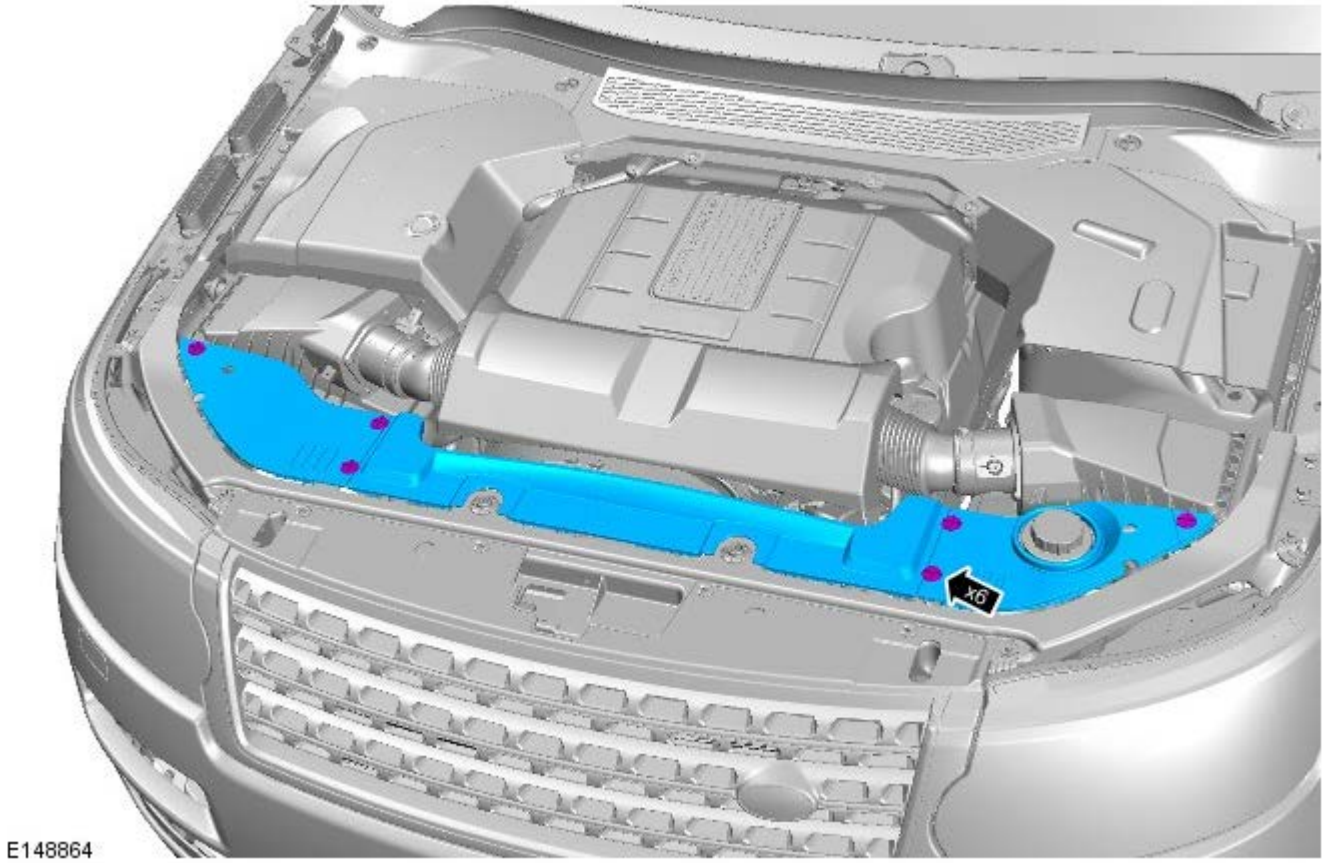
    Since injury such as scalding could be caused by escaping steam or coolant, make sure the vehicle cooling system is cool prior to carrying out this procedure.

    CAUTION: Make sure the coolant level remains above the "COLD FILL RANGE" lower level mark.

    Check and top-up the coolant if required.

21. Visually check the engine and cooling system for signs of coolant leakage.

22.



23. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05 Interior Trim and Ornamentation, Removal and Installation).

24. Install the front right fender splash shield.

    Refer to: Fender Splash Shield (501-02 Front End Body Panels, Removal and Installation).

Vehicles with rear air conditioning

25. Install the rear left fender splash shield.

    Refer to: Rear Fender Splash Shield (501-08 Exterior Trim and Ornamentation, Removal and Installation).

All vehicles

26. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

Published: 04-Aug-2012

Engine Cooling - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Cooling System Partial Draining, Filling and Bleeding

General Procedures

Draining

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.

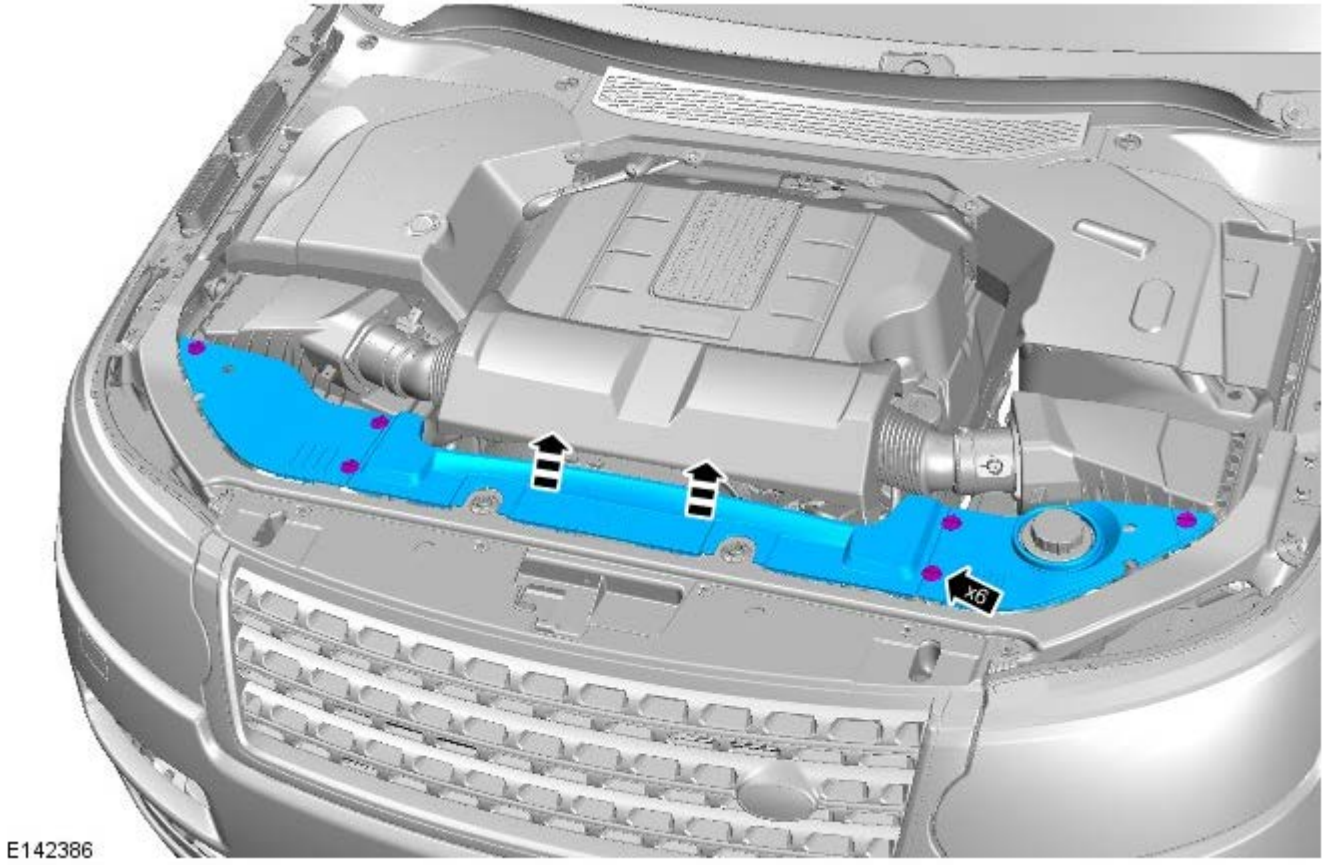
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

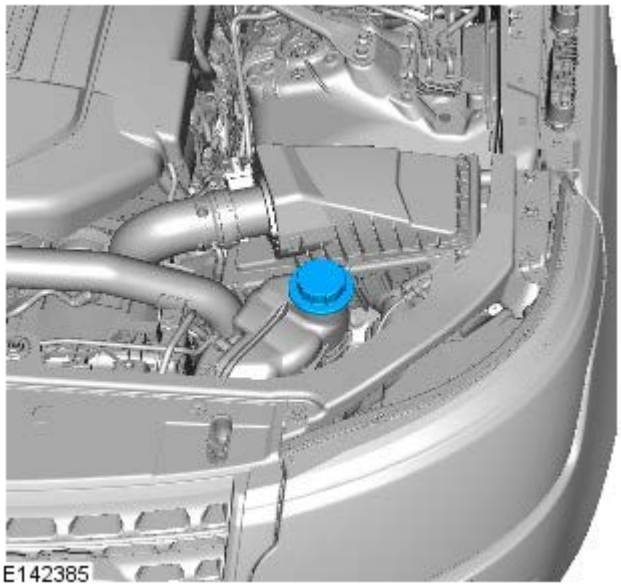
2. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

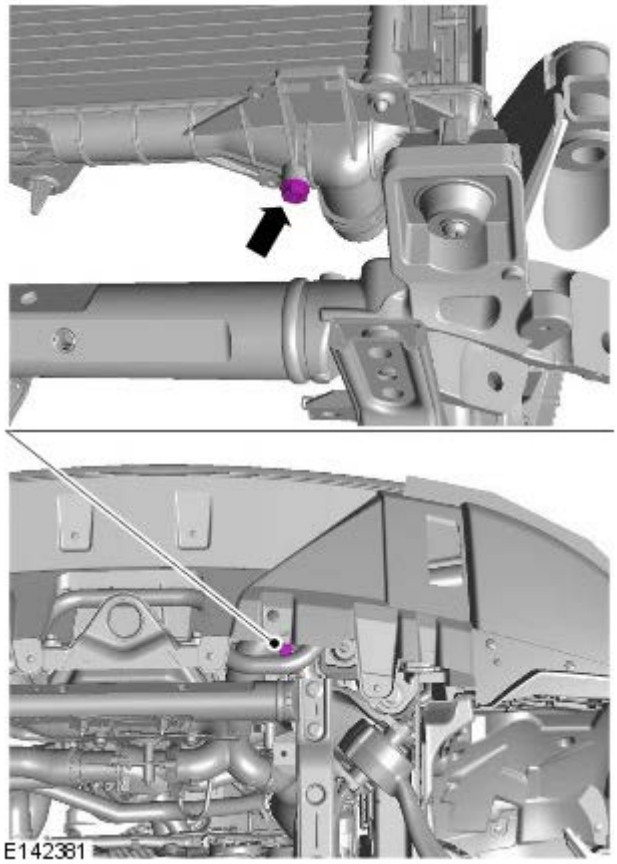
3. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05 Interior Trim and Ornamentation, Removal and Installation).

4.



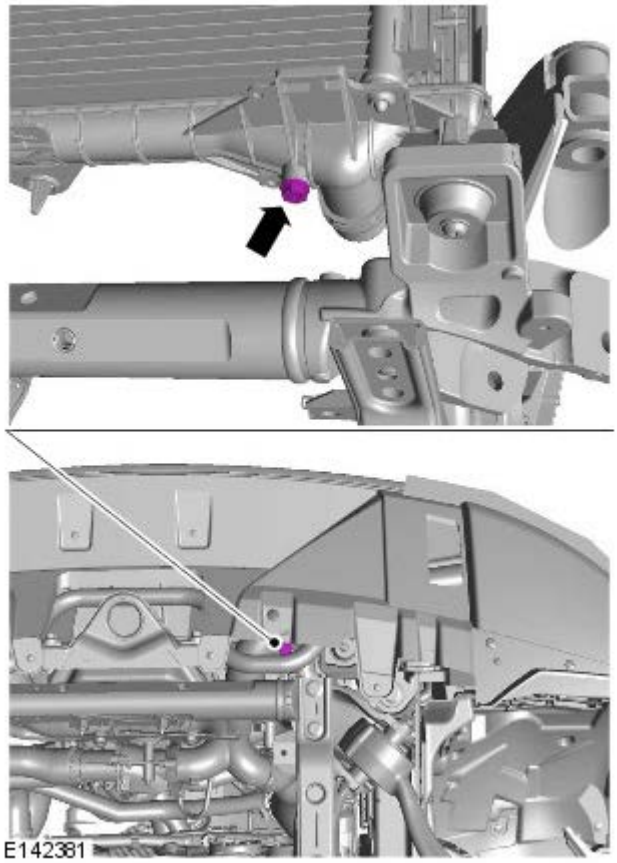
5. WARNING: When releasing the cooling system pressure, cover the coolant expansion tank cap with a thick cloth.





6. CAUTION: Be prepared to collect escaping coolant.

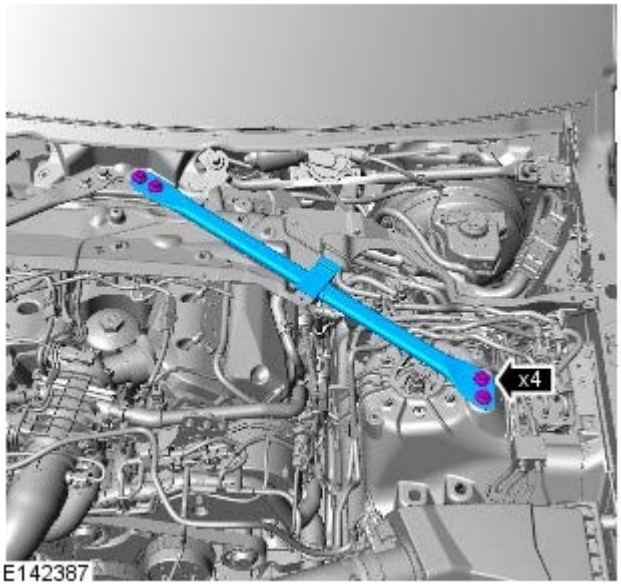
7. *Torque:* 5 Nm



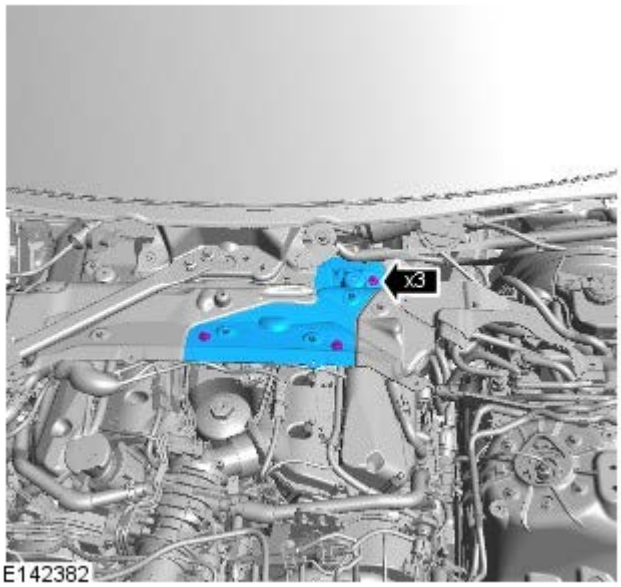
Filling

1. Refer to: Cowl Panel Grille (501-02 Front End Body Panels, Removal and Installation).

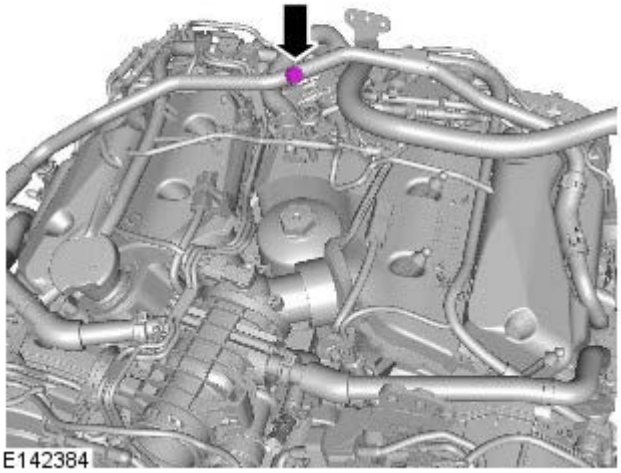
2.



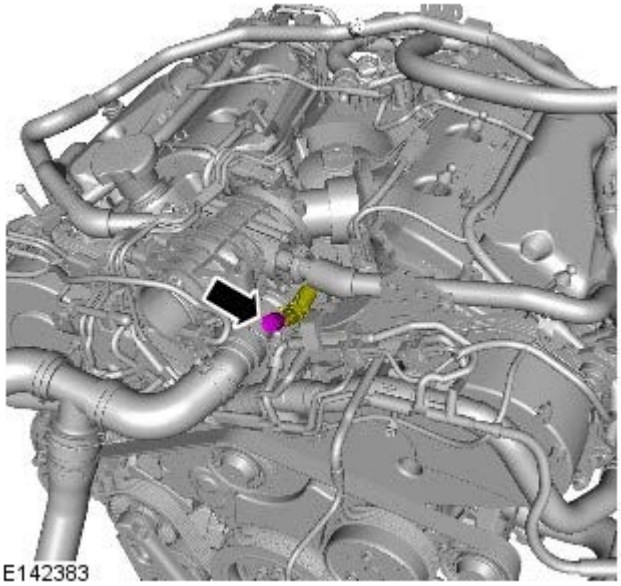
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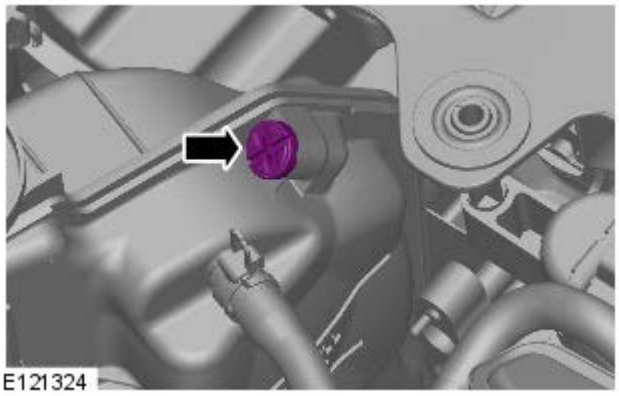
4.



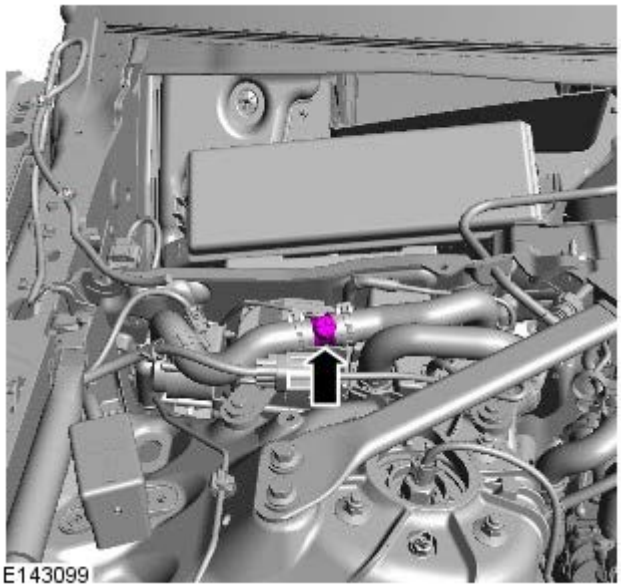
5.



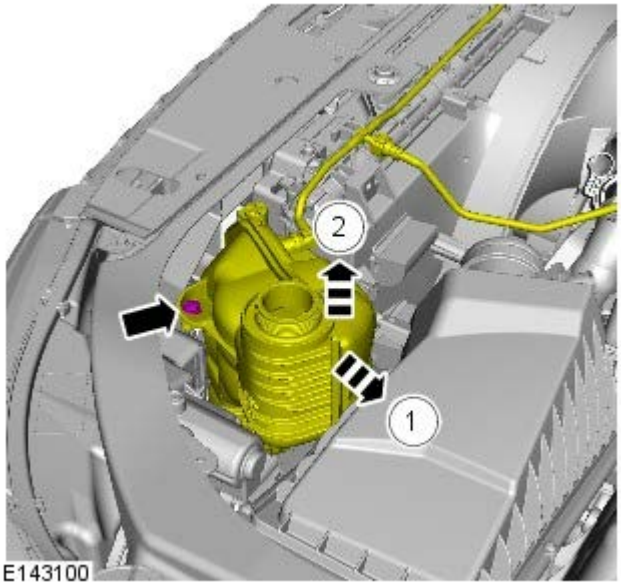
6.



7. NOTE: Where fitted.

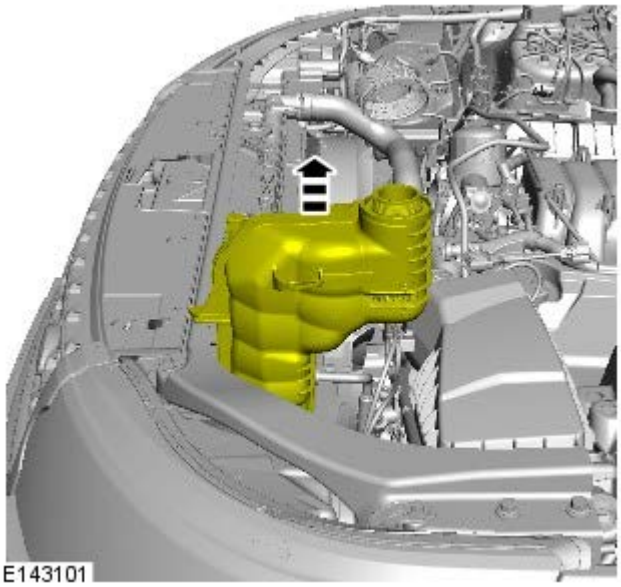


8. *Torque:* 9 Nm



9. NOTE: Keep the coolant expansion tank vertically.

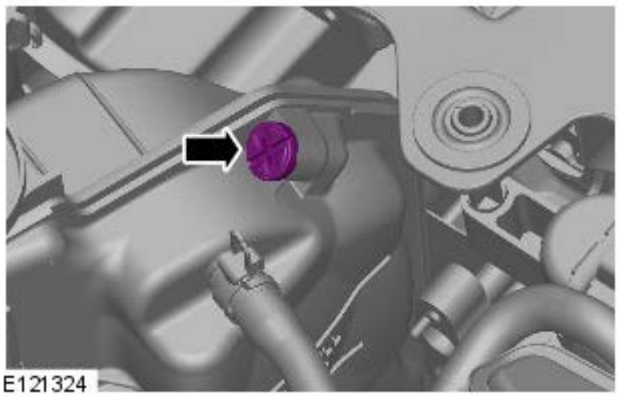
Raise the coolant expansion tank minimum 110mm from its original position.


E143101

10. CAUTION: Anti-freeze concentration must be maintained at 50%.

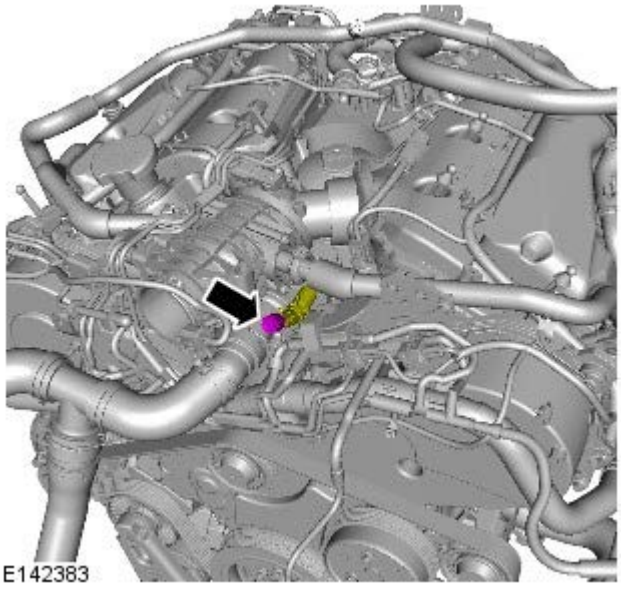
    Fill the coolant expansion tank to the rim and continue until coolant is visable from the outlet.

11.

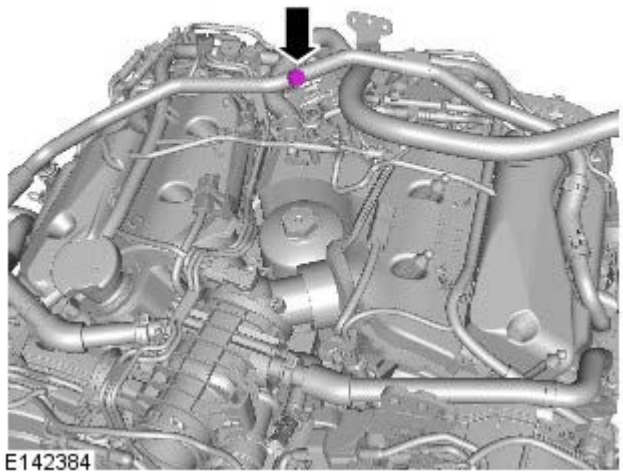

E121324

NOTE: Once coolant is visable from the outlet, close the bleeding points.

12.

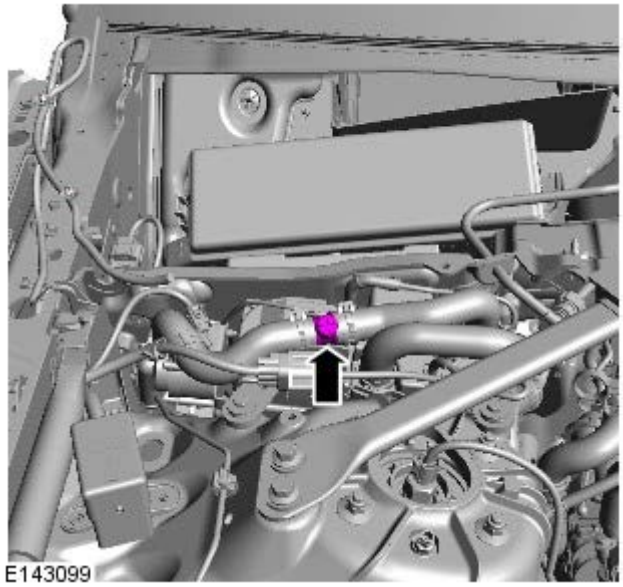

E142383

13.


E142384

14. Set the heater controls to maximum.

15. Start the engine and allow to idle.


E143099

16. NOTE: Where fitted.

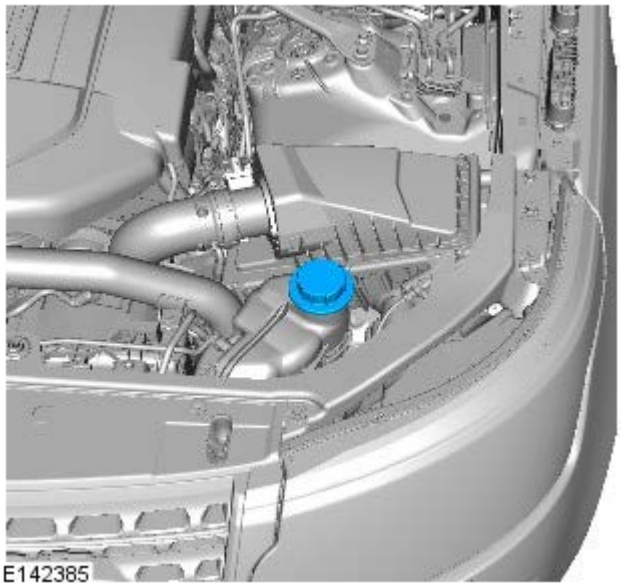
    Once coolant is visable from the outlet, close the bleeding points.

17. Hold the engine speed at 2000 rpm until warm air is expelled from the heater.

18. Continue to fill the coolant expansion tank to the rim until the coolant level stops dropping.

19. Install the coolant expansion tank.

20. Install the expansion tank cap after making sure that the final coolant level is 40mm above the maximum cold fill line.



21. Run the engine until the thermostat opens and hot air is emitted from the front and rear face vents.

22. Switch the engine off and allow to cool.

23. WARNINGS:

    When releasing the cooling system pressure, cover the coolant expansion tank cap with a thick cloth.

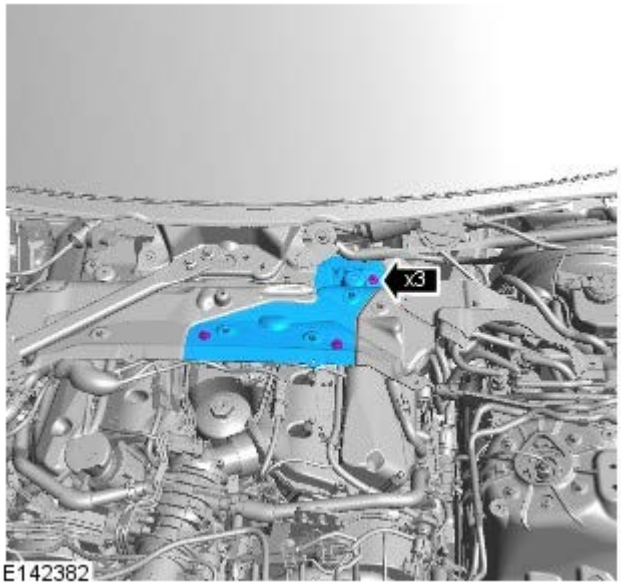
    Since injury such as scalding could be caused by escaping steam or coolant, make sure the vehicle cooling system is cool prior to carrying out this procedure.

    CAUTION: Make sure the coolant level remains above the "COLD FILL RANGE" lower level mark.

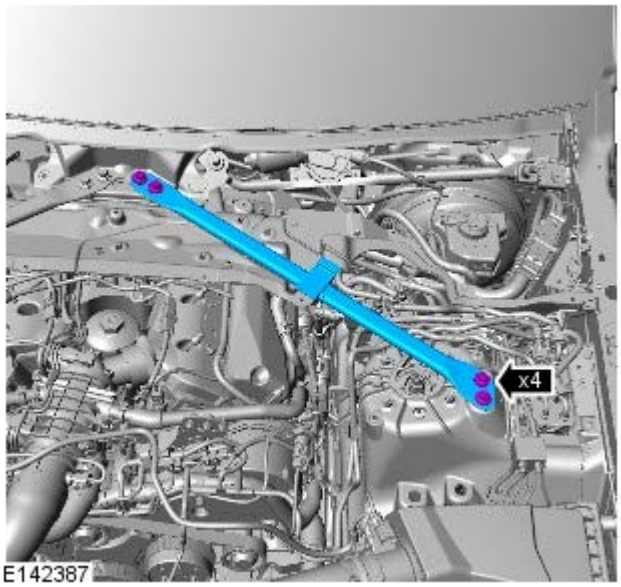
    Check and top-up the coolant if required.

24. Visually check the engine and cooling system for signs of coolant leakage.

25. *Torque:* 6 Nm

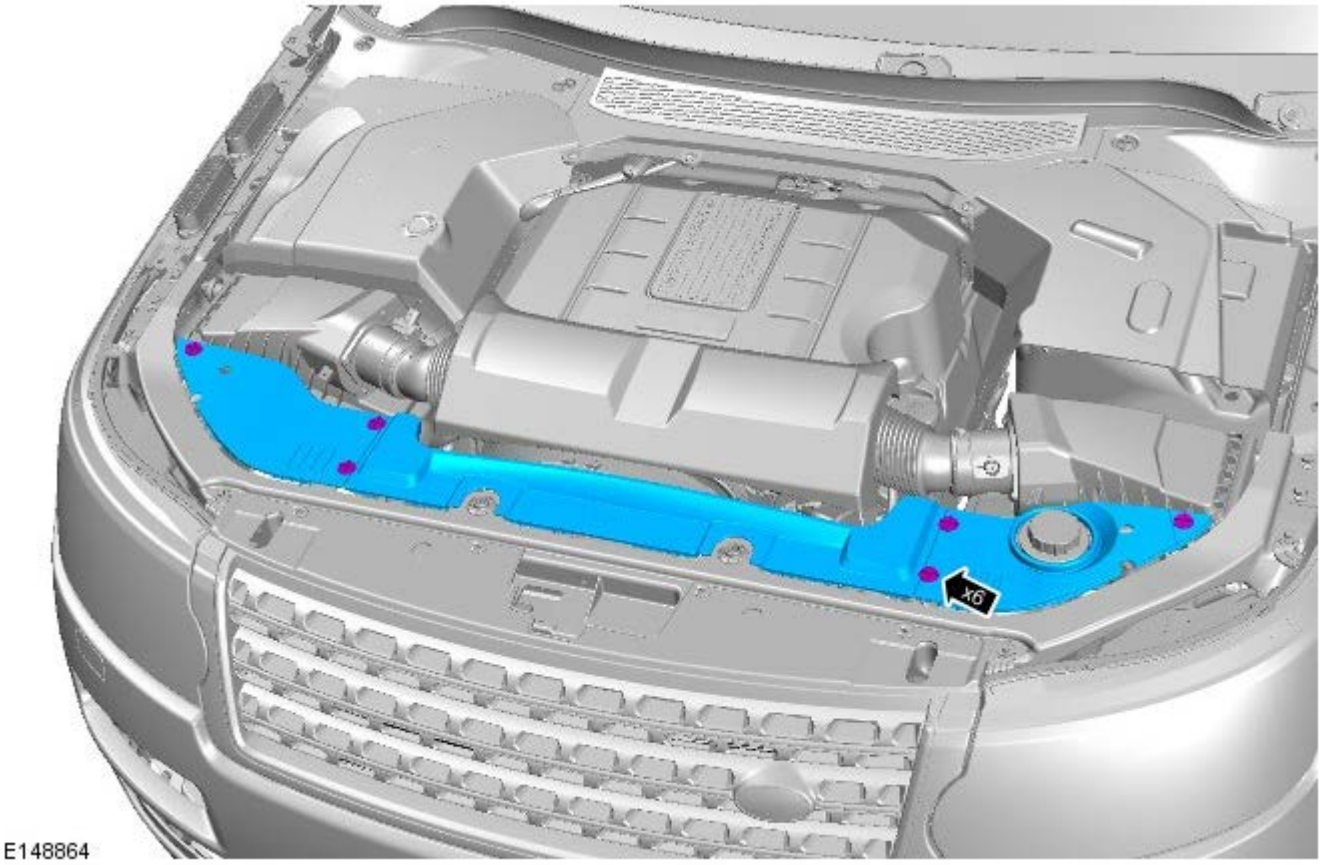


26. *Torque:* 55 Nm



27. Refer to: Cowl Panel Grille (501-02 Front End Body Panels, Removal and Installation).

28.



29. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05 Interior Trim and Ornamentation, Removal and Installation).

30. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

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Engine Cooling - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Cooling System Draining and Vacuum Filling

General Procedures

Draining

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.

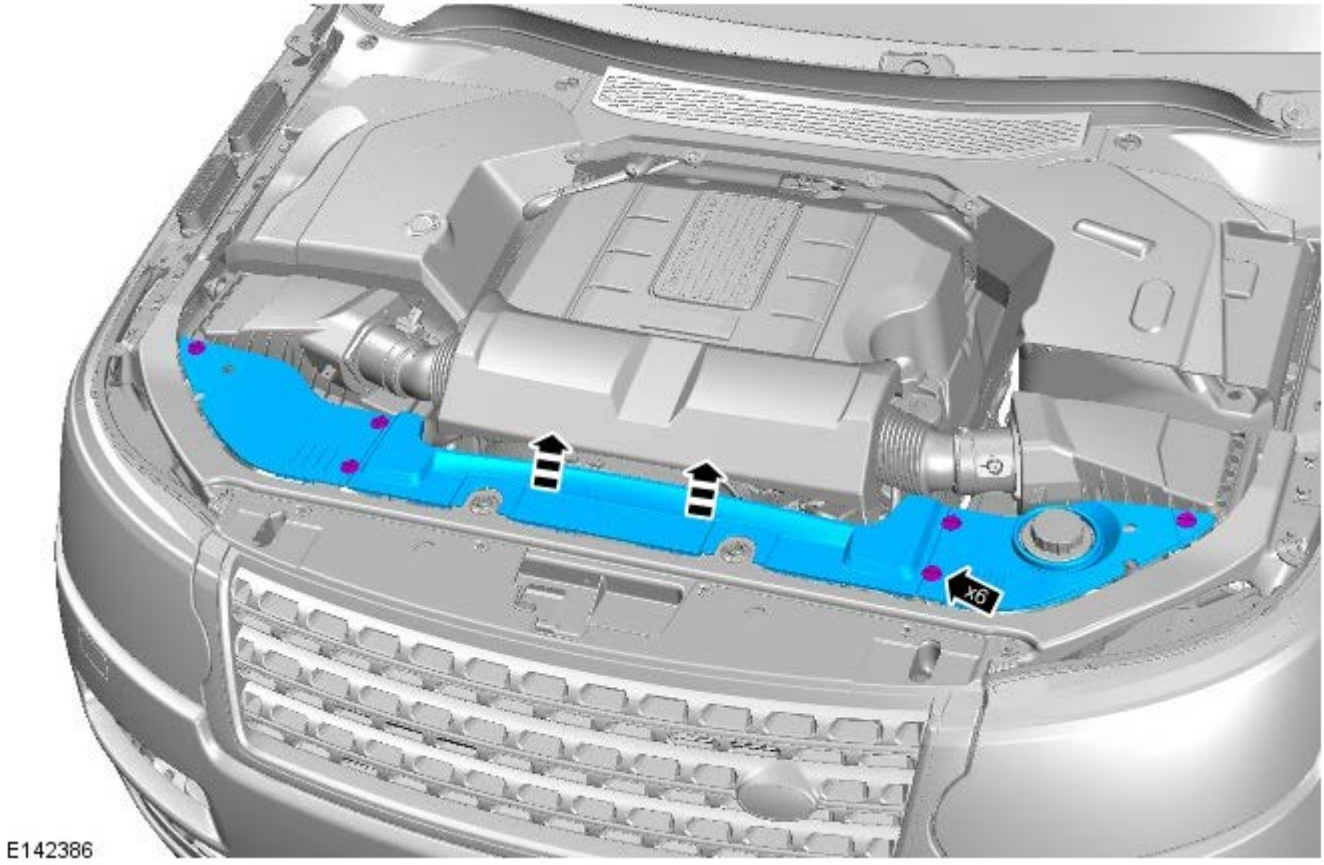
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

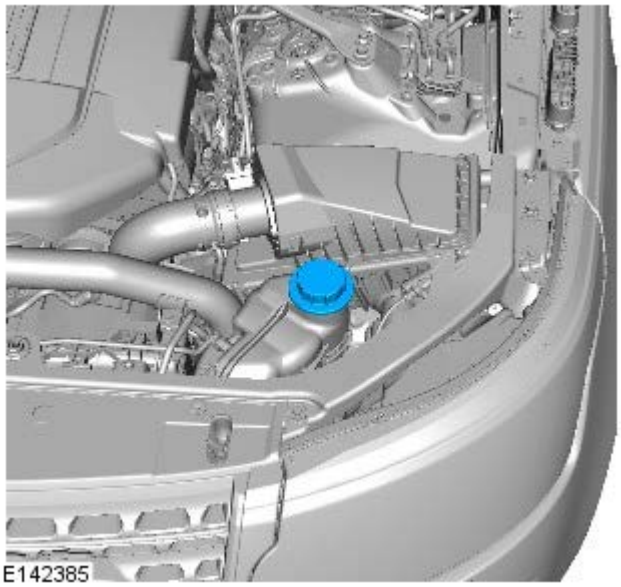
2. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

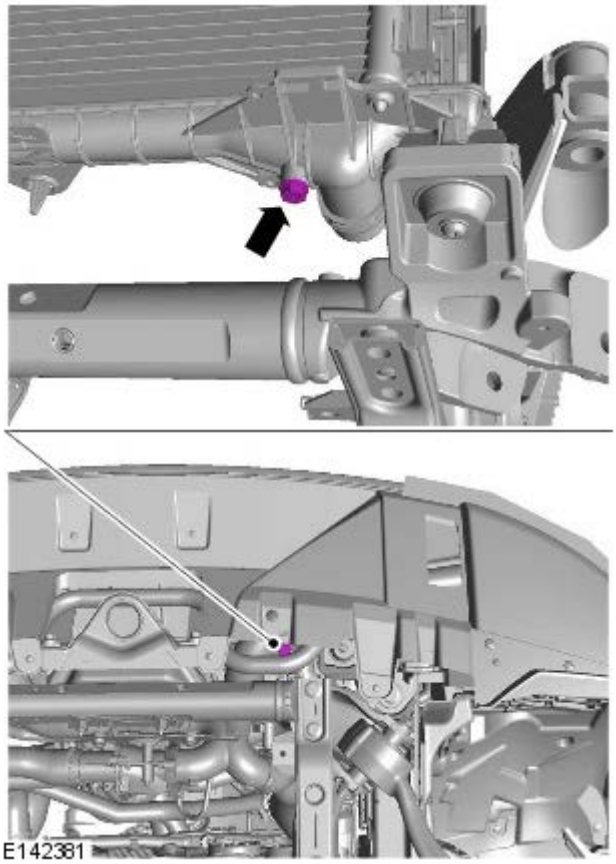
3. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05 Interior Trim and Ornamentation, Removal and Installation).

4.



5. WARNING: When releasing the cooling system pressure, cover the coolant expansion tank cap with a thick cloth.





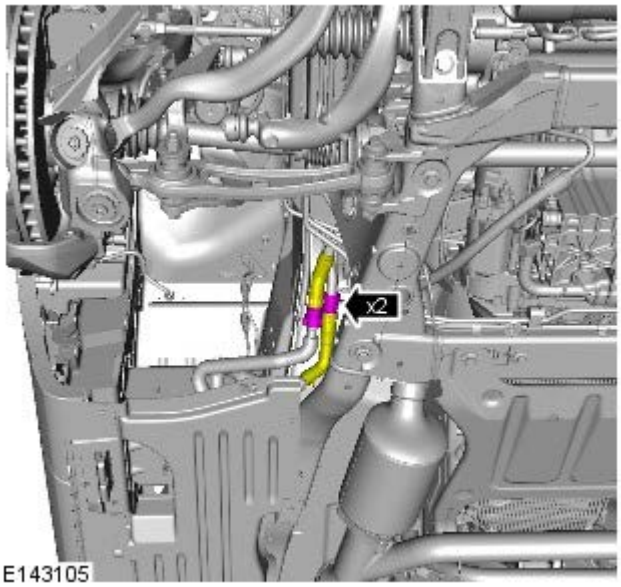
6. CAUTION: Be prepared to collect escaping coolant.

NOTE: Step 7-10 and 12-13 only needs to be carried out when the auxiliary climate control system has been fitted to the vehicle.

7. Remove the front RH wheel arch liner.

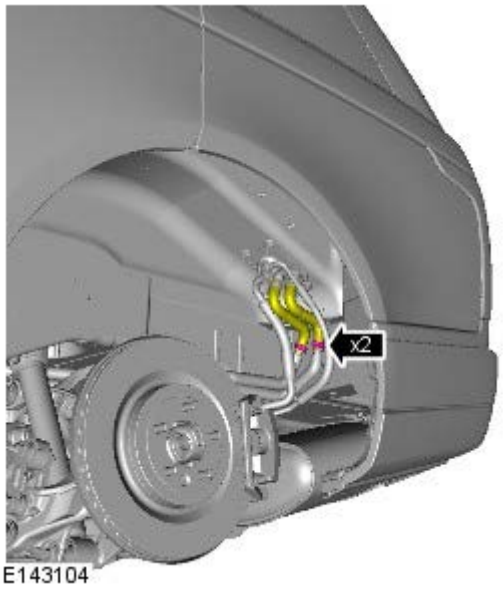
   Refer to: Fender Splash Shield (501-02 Front End Body Panels, Removal and Installation).

8. CAUTION: Be prepared to collect escaping coolant.



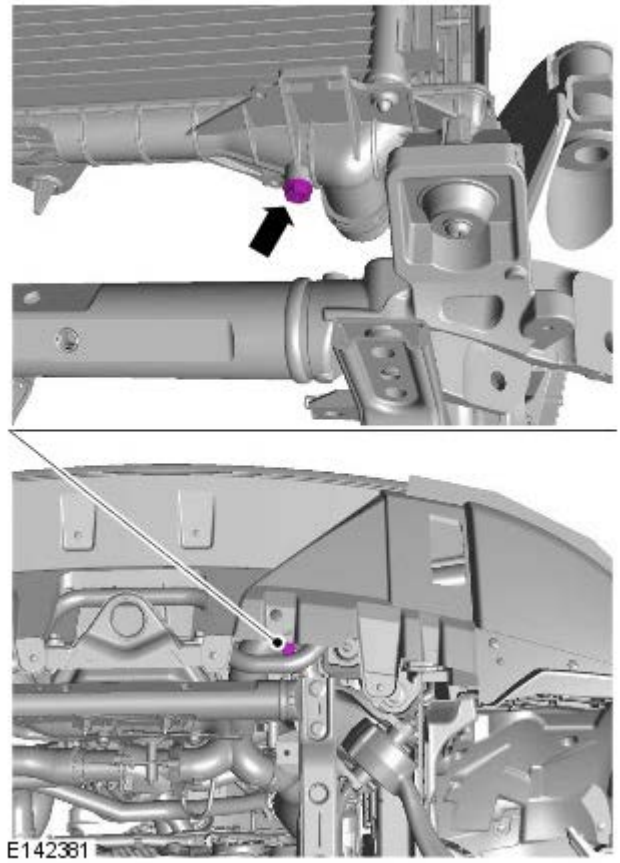
9. Remove the rear LH wheel arch liner.

   Refer to: Rear Fender Splash Shield (501-08 Exterior Trim and Ornamentation, Removal and Installation).

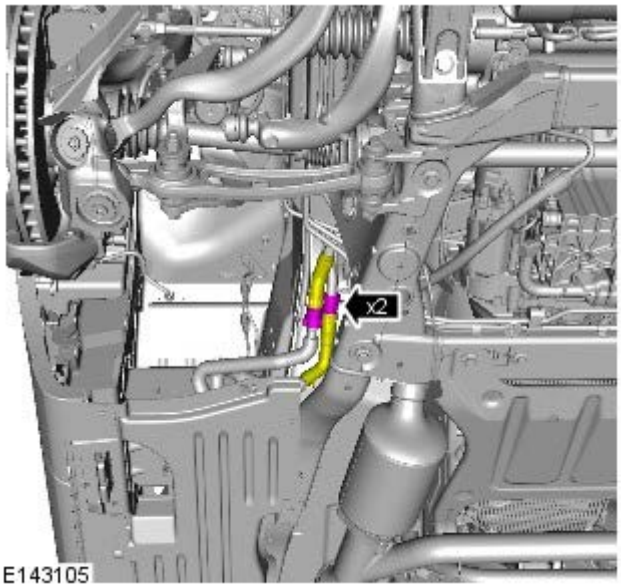


10. CAUTION: Be prepared to collect escaping coolant.

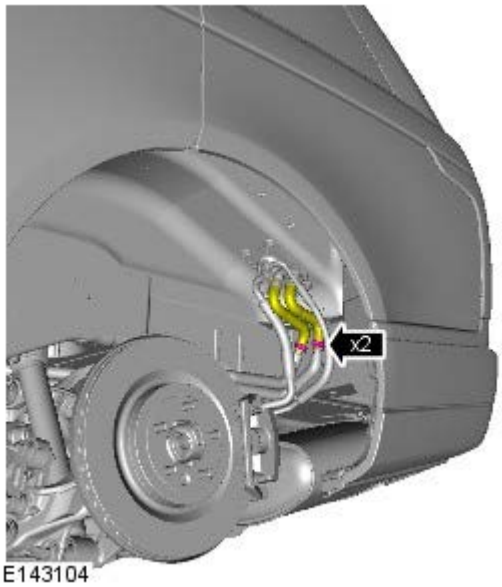
11. *Torque:* 5 Nm



12.



13.



E143104

14. Carry out the procedure up to step 1 in the filling section three times, filling the cooling system with clean water after the first two drains. At the third refill, use a suitable measuring tool to make sure that the cooling system maintains a 50% mix.

Filling

1. 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.

2. 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.

3. Position the evacuated air hose into a container.

4. Open the air supply valve.

5. 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 coolant supply hose.

    Open the coolant supply valve for 2 seconds to prime the coolant supply hose.

6. Apply air pressure progressively until the arrow on the vacuum filler gauge reaches the green segment.

7. Disconnect the compressed air supply line.

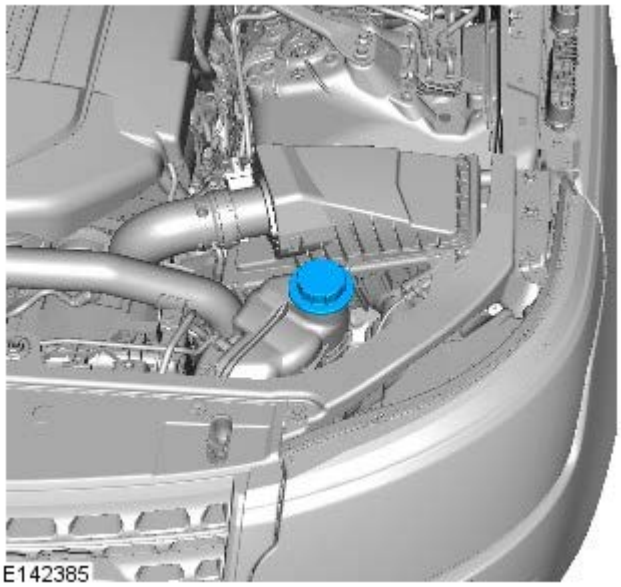
8. NOTE: Close the coolant supply valve when the coolant expansion tank MAX mark is reached or coolant movement has ceased.

   Open the coolant supply valve and allow the coolant to be drawn into the system.

9. Remove the vacuum filler gauge and cooling system vacuum refill adaptor assembly.

10. Continue to fill the coolant expansion tank to the rim until the coolant level stops dropping.

11.



12. Start and run the engine.

13. Set the heater controls to maximum.

14. Increase the engine speed from idle to 3500 RPM until hot air is emitted from the front and rear face vents.

15. Run the engine until the thermostat opens and hot air is emitted from the front and rear face vents.

16. Switch the engine off and allow to cool.

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: 02-Aug-2012

Engine Cooling - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Cooling System Pressure Test

General Procedures

Check

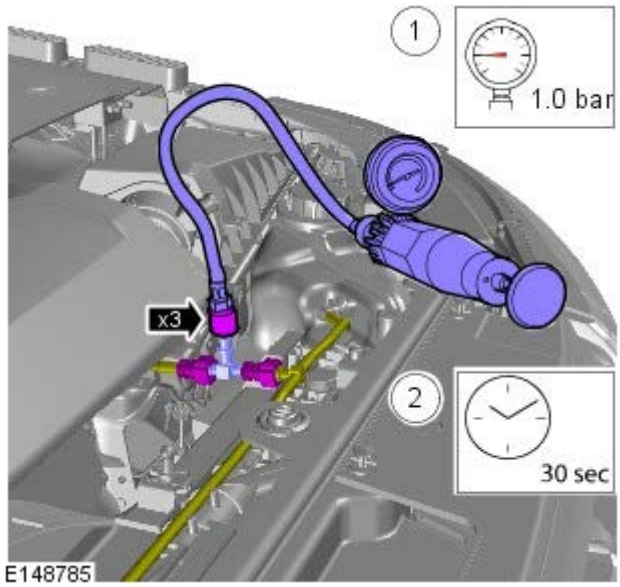
WARNING: Since injury such as scalding could be caused by escaping steam or coolant, allow the vehicle cooling system to cool prior to carrying out this procedure.

NOTE: The following procedure will enable the cooling system to be pressure tested for condition and leaks. Stage 1 will check the expansion tank cap register seal and the cap for leaks. Stage 2 will check the entire cooling system.

1. NOTE: If the coolant expansion tank cap is found to be leaking, replace the cap.

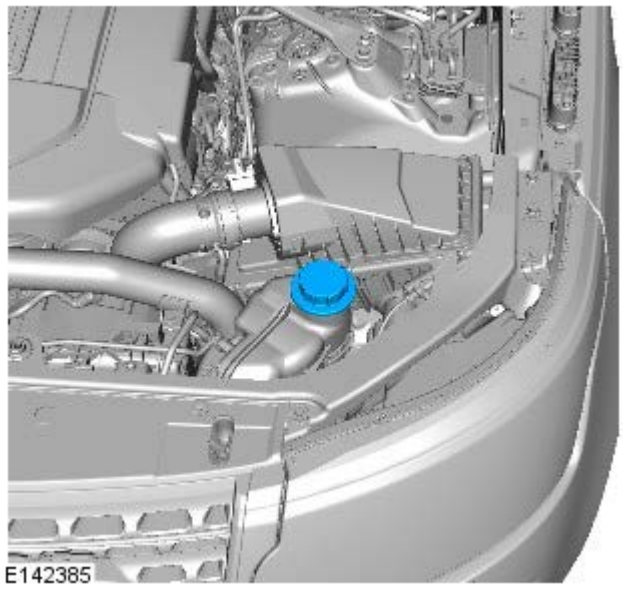
   Examine the coolant hoses for signs of cracking, distortion and security of the hose connections.

2.
   - Slowly pressurize the cooling system.
   - Check the pressure remains above 0.9 bar (90 kPa) (13 psi) after waiting for 30 seconds.
   - During the pressure drop check, listen for a hissing noise from the expansion tank cap.

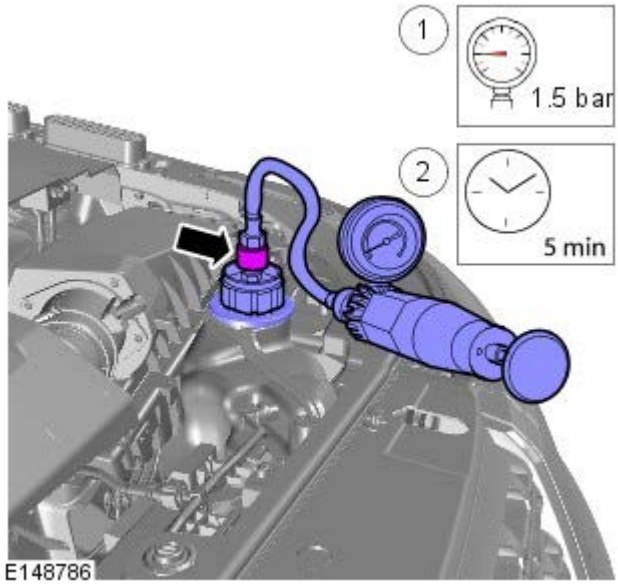


3. Depressurize and remove the pressure pump and gauge.

4.



5. CAUTION: Make sure that the mating faces are clean and free of foreign material.

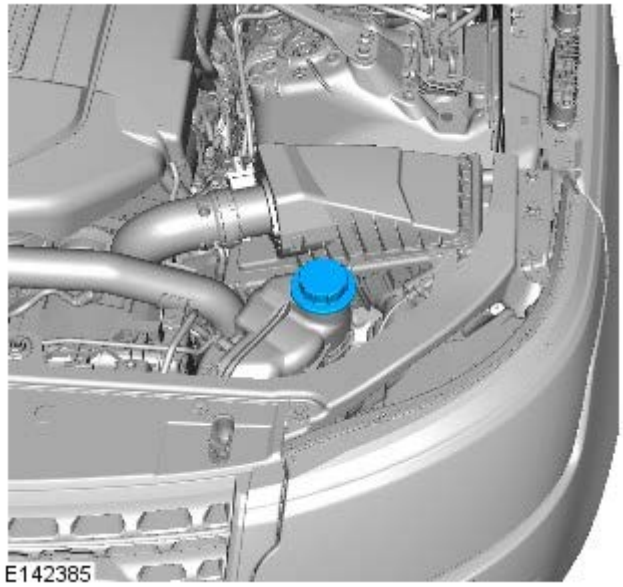


NOTE: If the pressure continues to drop after the initial tolerance, there is a coolant leak.

- Slowly pressurize the cooling system.
- A small pressure decay of approximately 0.15 bar (15 kPa) (1 psi) over the first minute is normal.

6. Depressurize and remove the pressure pump and gauge.

7.



Published: 08-Aug-2012

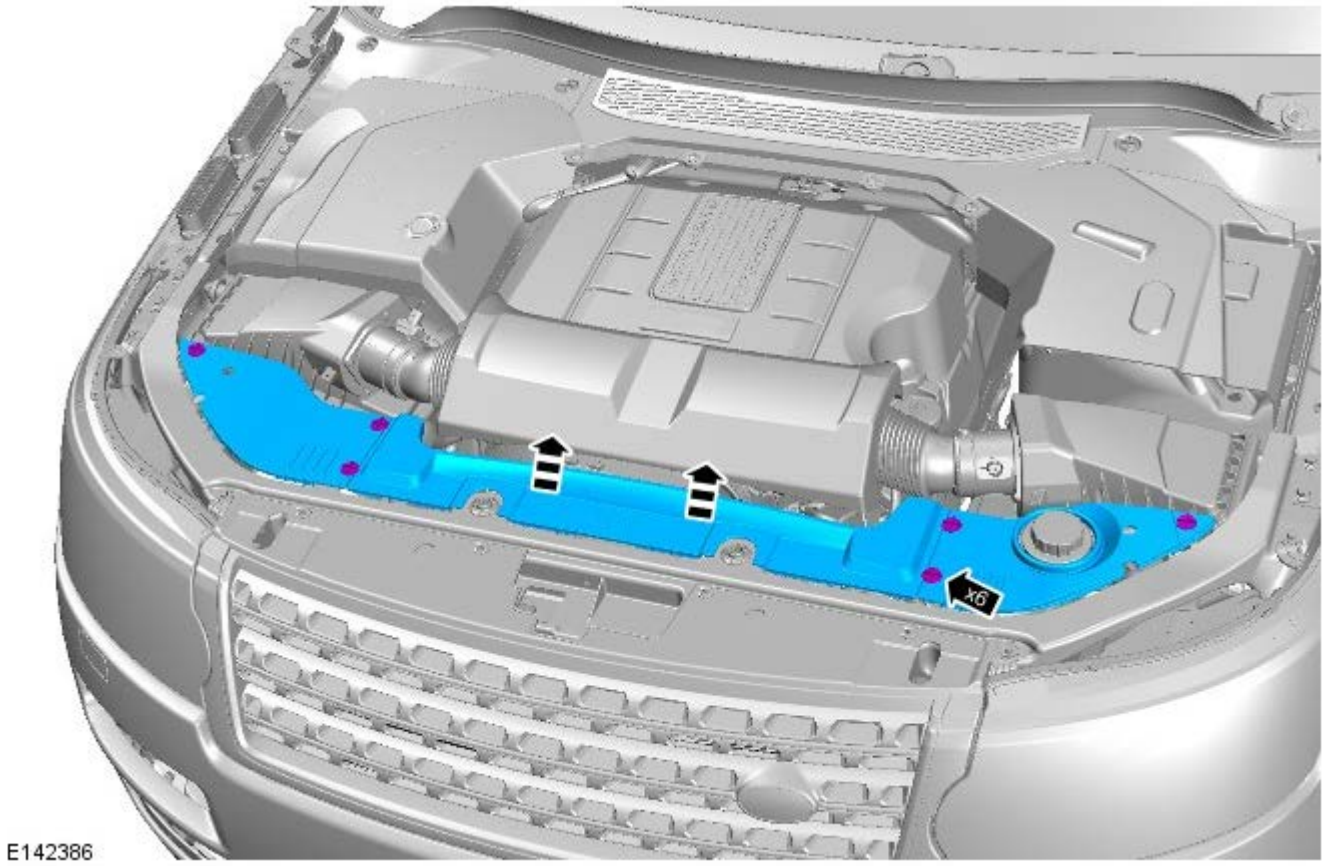
Engine Cooling - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Coolant Expansion Tank

Removal and Installation

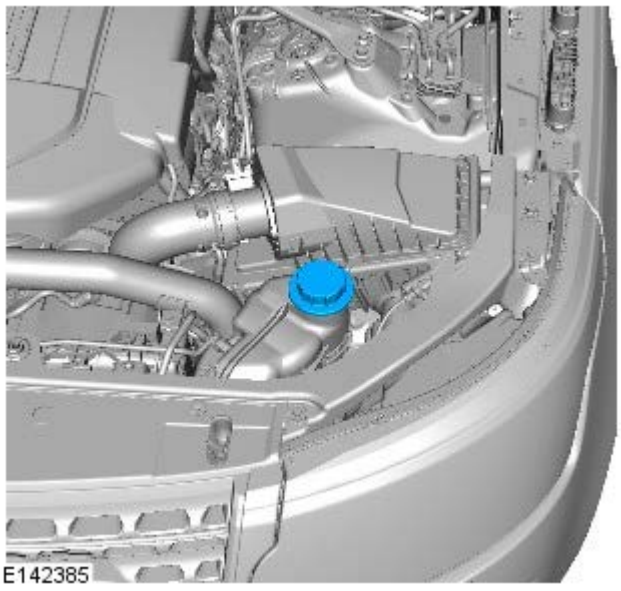
Removal

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.

1.



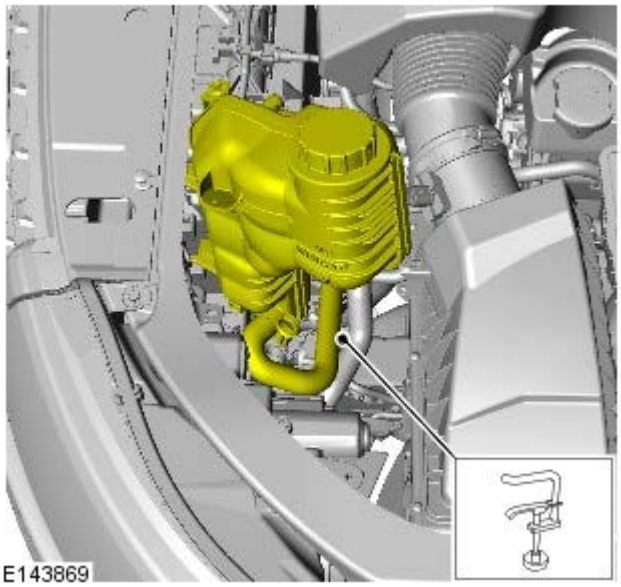
E142386


E142385

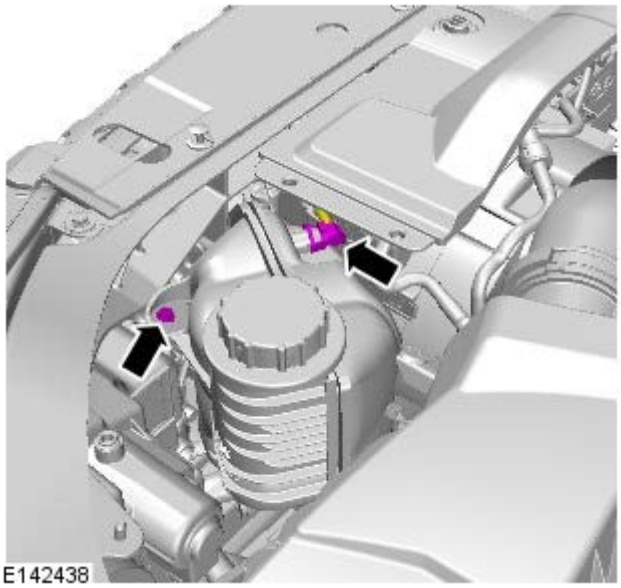
2. WARNING: When releasing the cooling system pressure, cover the coolant expansion tank cap with a thick cloth.

3. Using a syringe, remove the cooling fluid from the expansion tank.

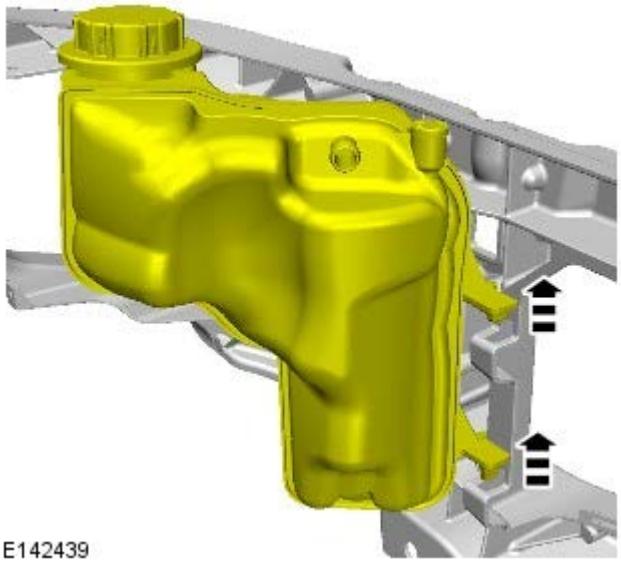
4. CAUTION: Clamp the hoses to minimize coolant loss.



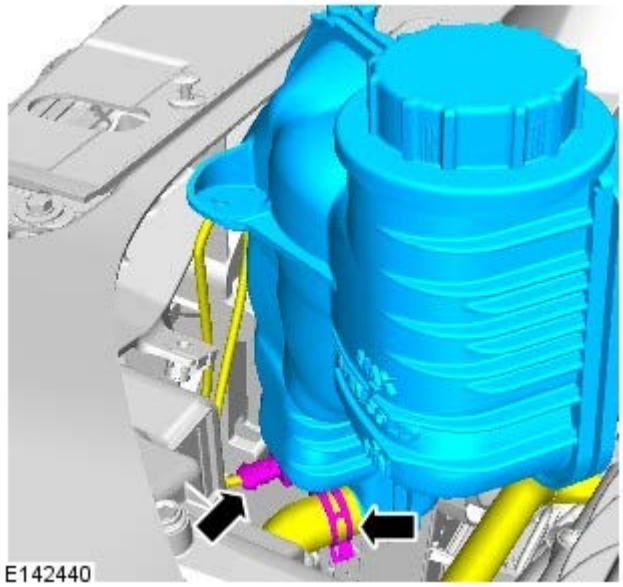
5. CAUTION: Be prepared to collect escaping coolant.



6.

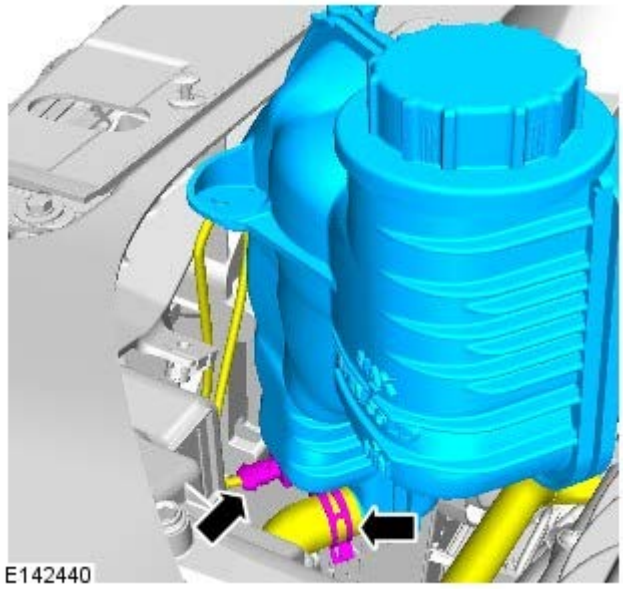


7. CAUTION: Be prepared to collect escaping coolant.

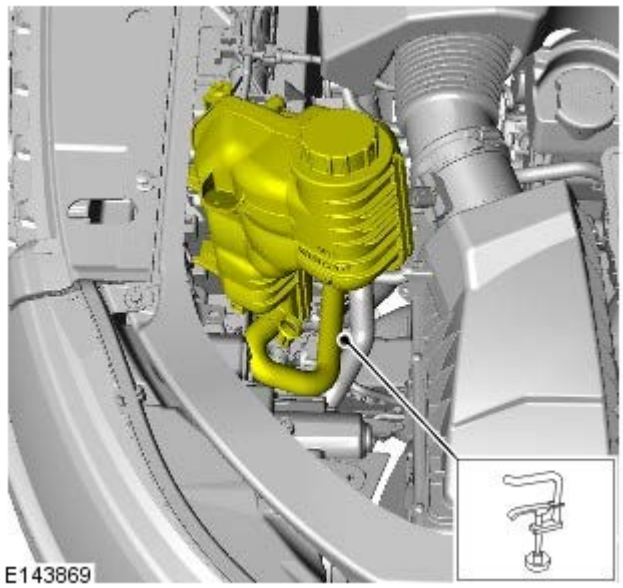


Installation

1.

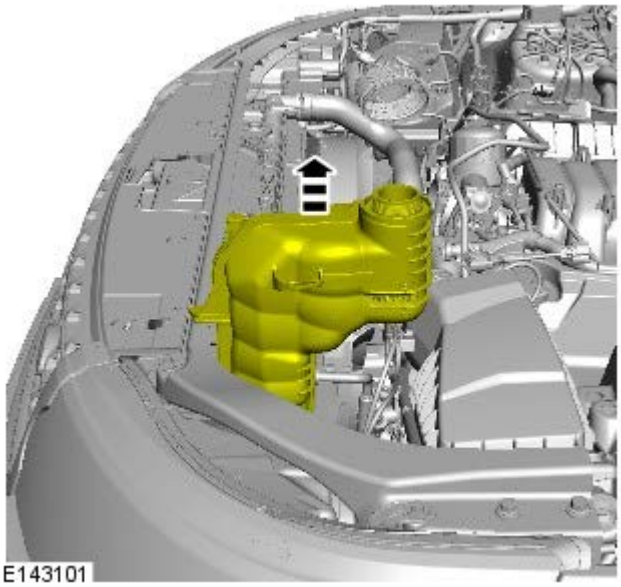


2.



3. NOTE: Keep the coolant expansion tank vertically.

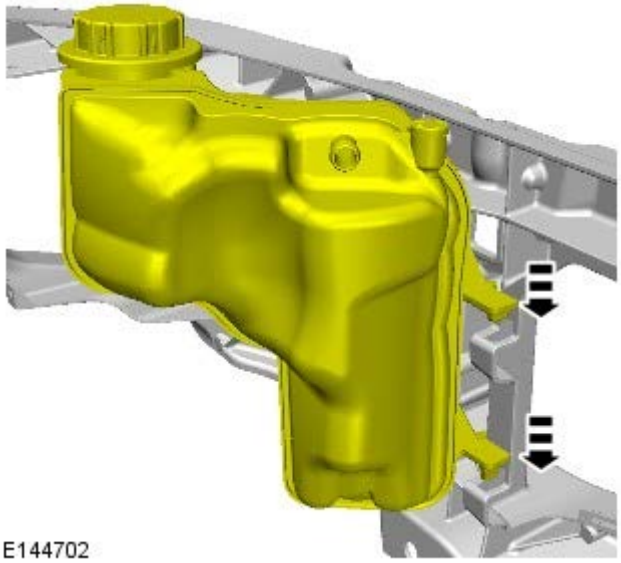
Raise the coolant expansion tank minimum 110mm


E143101

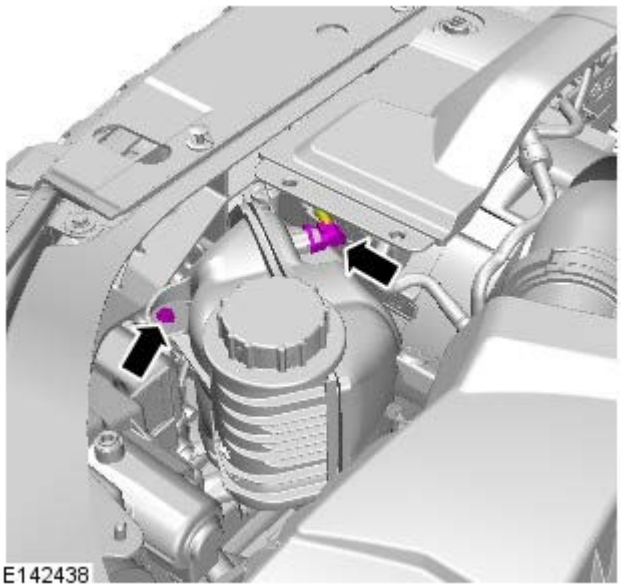
from its original position.

4. Fill the cooling system, keeping coolant to the upper level mark of the expansion tank, until a steady stream of coolant is seen returning to the tank.

5.


E144702

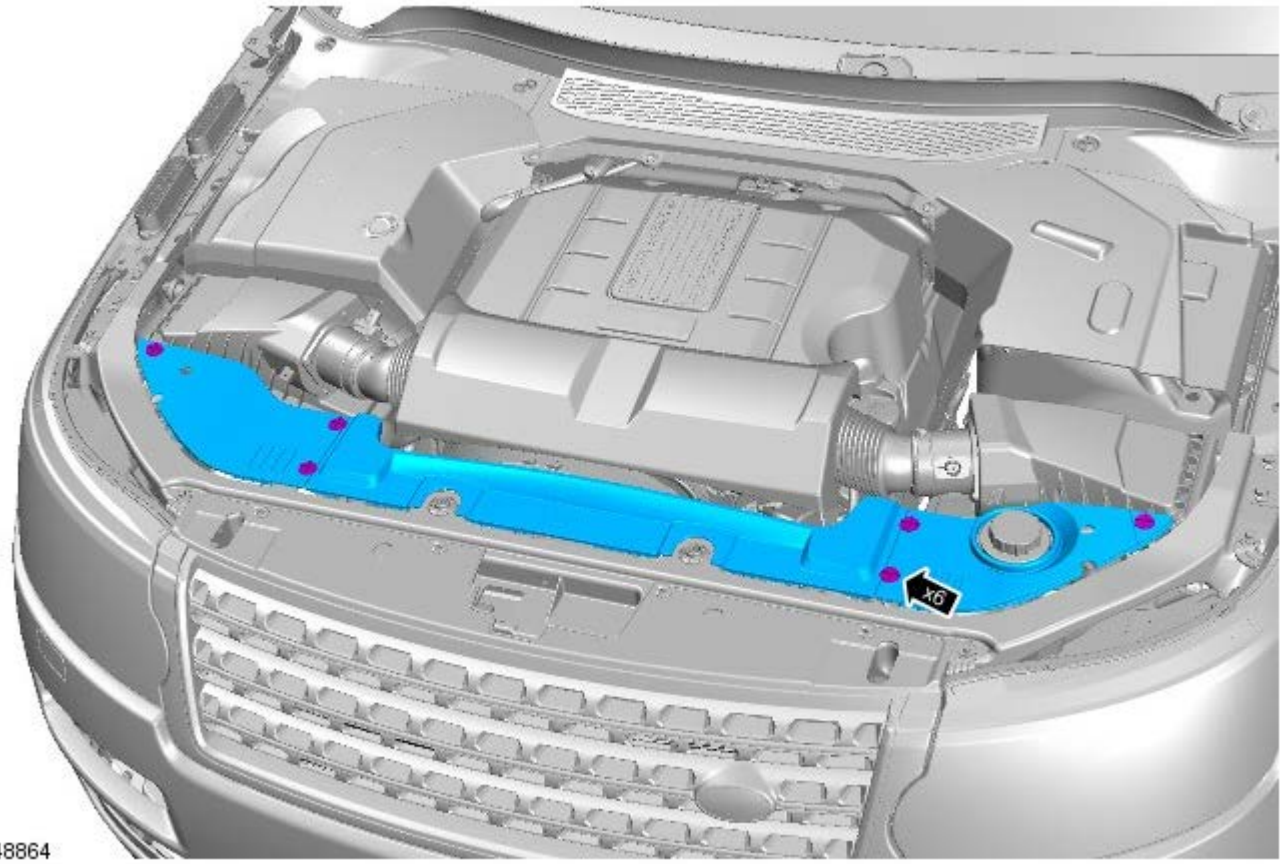
6. *Torque:* 2.8 Nm


E142438

7. CAUTION: Make sure the coolant level remains above the "COLD FILL RANGE" lower level mark.

Check and top up the cooling system as required.

8.



Published: 18-Jul-2013

Engine Cooling - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Coolant Pump

Removal and Installation

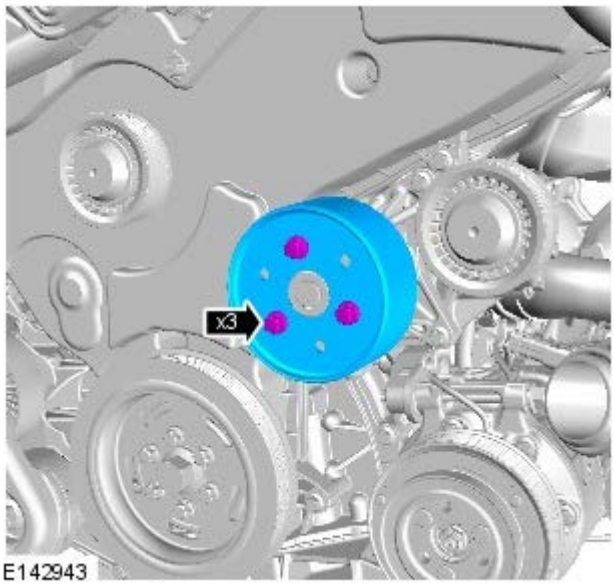
Removal

NOTES:

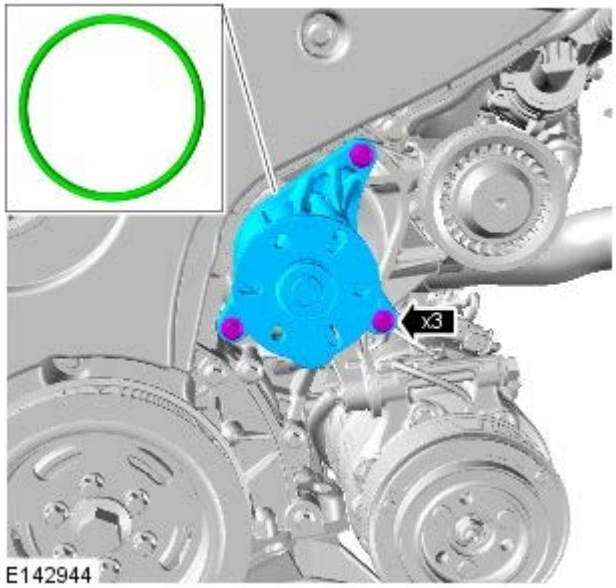
Removal steps in this procedure may contain installation details.

Some variation in the illustrations may occur, but the essential information is always correct.

1. Refer to: Specifications (414-00, Specifications).
2. Refer to: Cooling System Partial Draining, Filling and Bleeding (303-03 Engine Cooling - TDV6 3.0L Diesel - Hybrid Electric Vehicle, General Procedures).
3. Refer to: Accessory Drive Belt (303-05E, Removal and Installation).



4. CAUTION: Discard the bolts.
   - Using a suitable 6mm bar, retain the coolant pump pulley.
   - *Torque:* 25 Nm



5. CAUTION: A new O-ring seal is to be installed.
   - *Torque:* 10 Nm

Installation

1. To install, reverse the removal procedure.

Published: 06-Sep-2013

Engine Cooling - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Cooling Fan

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.

Some components shown removed for clarity.

All vehicles

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

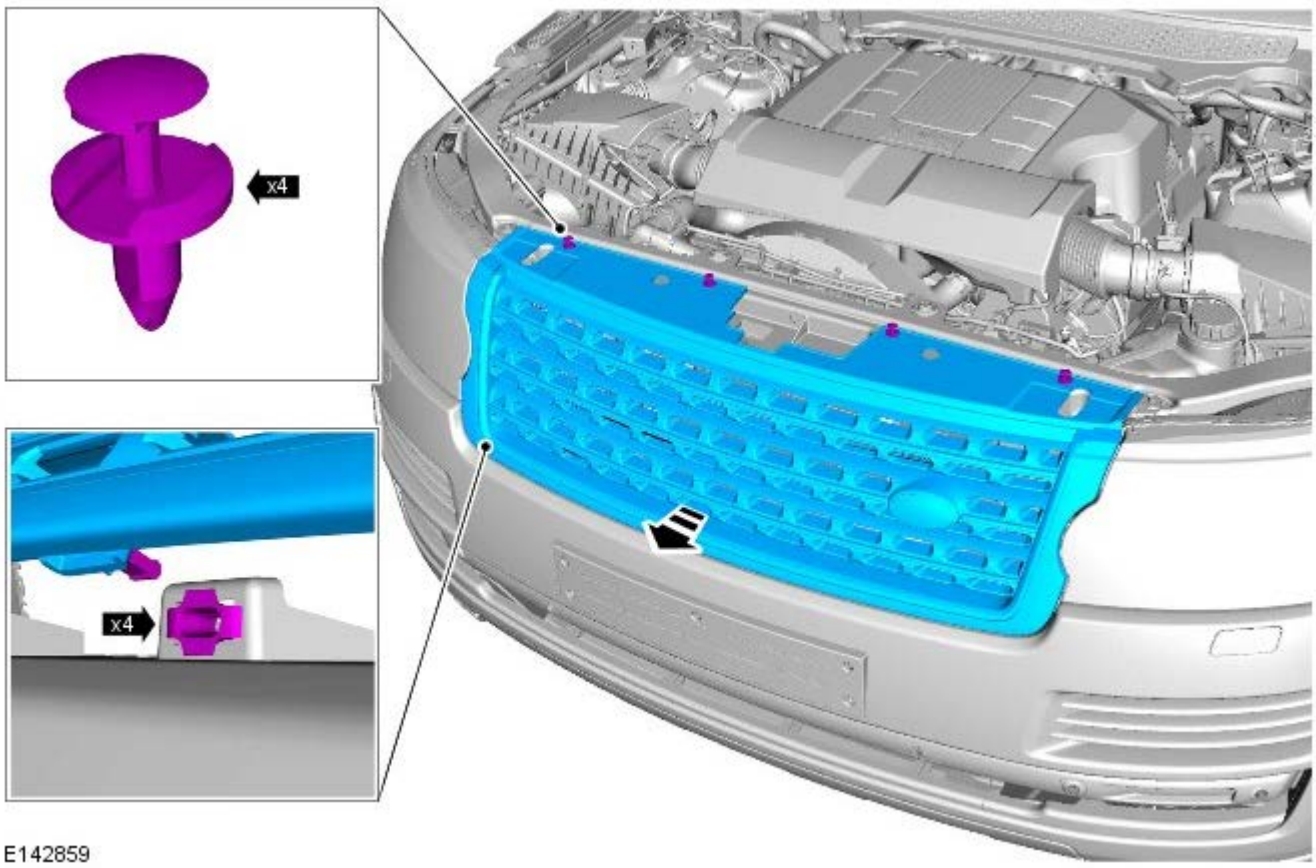
2. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

3. Refer to: Cooling System Partial Draining, Filling and Bleeding (303-03G Engine Cooling - SDV6 3.0L Diesel - Hybrid Electric Vehicle, General Procedures).

4. Refer to: Coolant Expansion Tank (303-03G Engine Cooling - SDV6 3.0L Diesel - Hybrid Electric Vehicle, Removal and Installation).

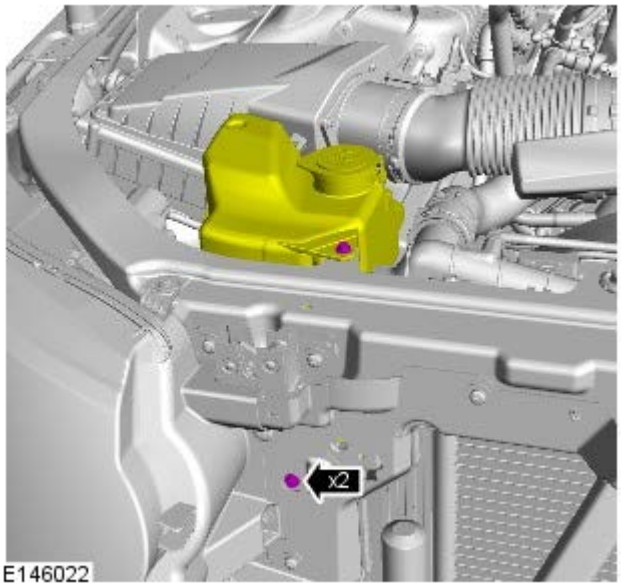
Cold climate vehicles

5.



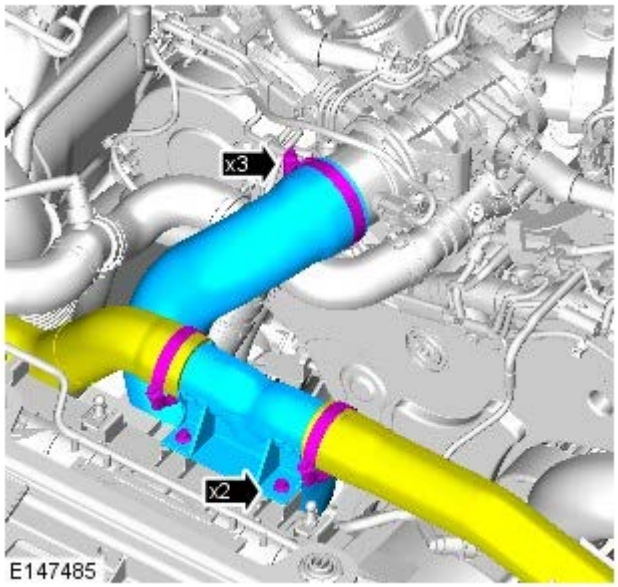
E142859

6. *Torque:* 7 Nm

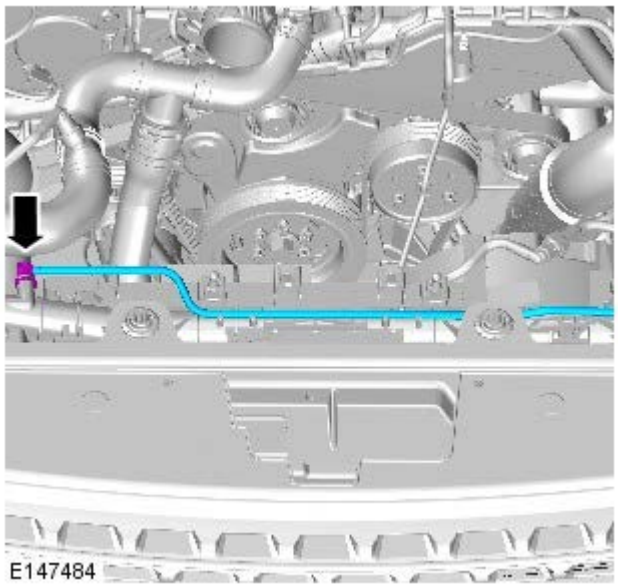


All vehicles

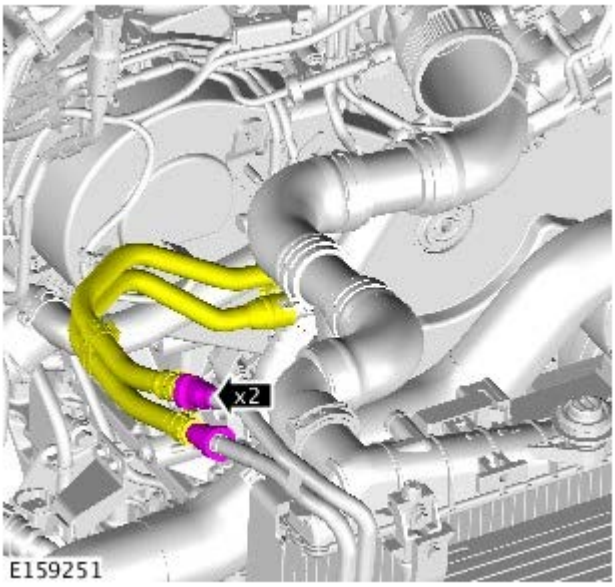
7. *Torque:* 8 Nm



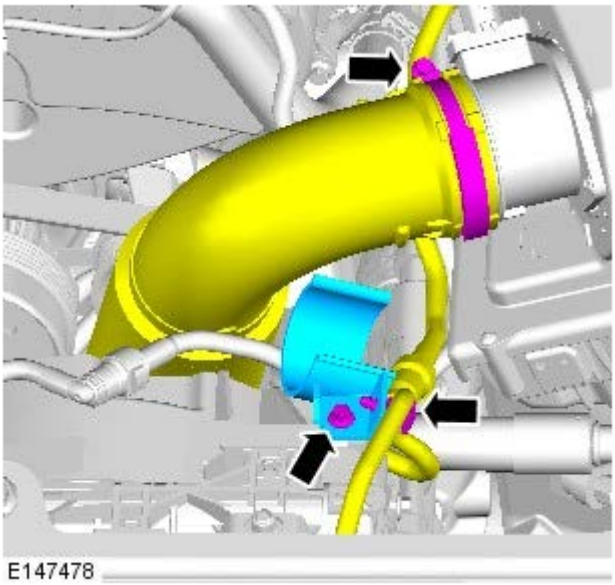
8.



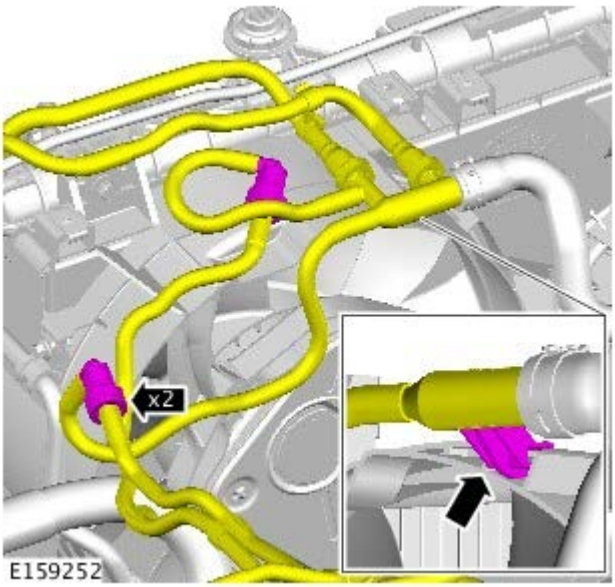
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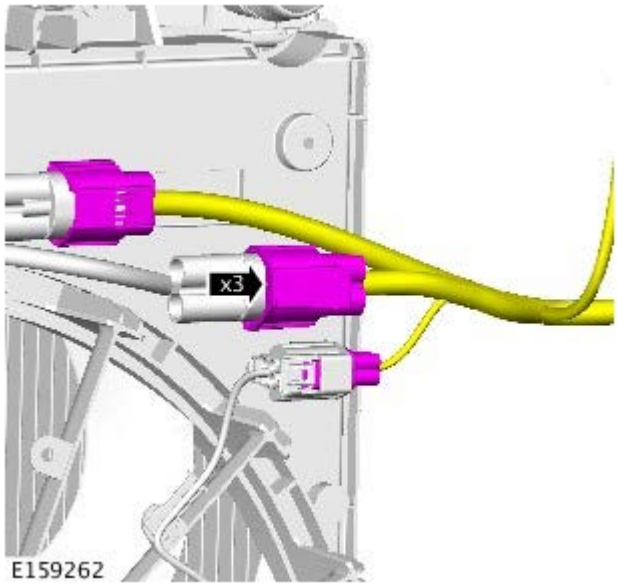
10. *Torque:* 7 Nm



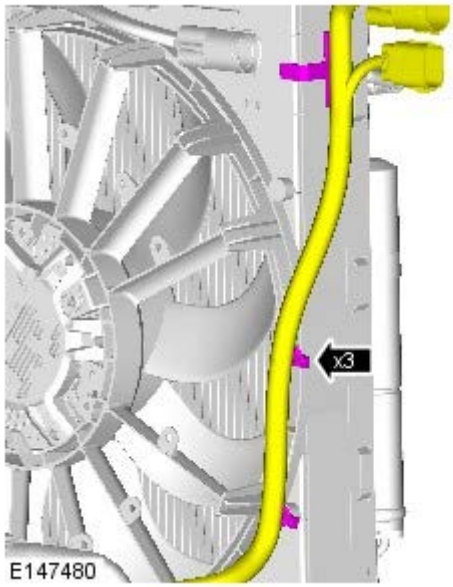
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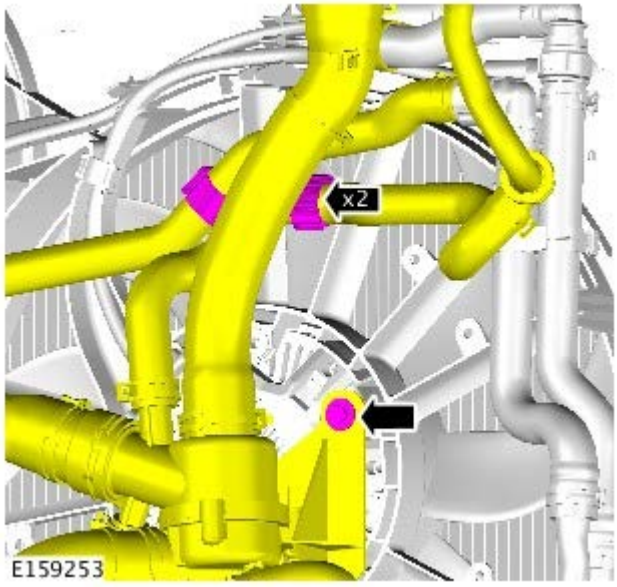
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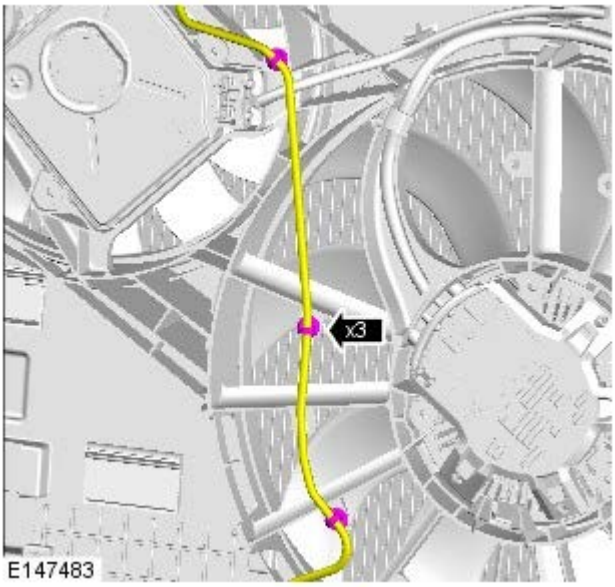
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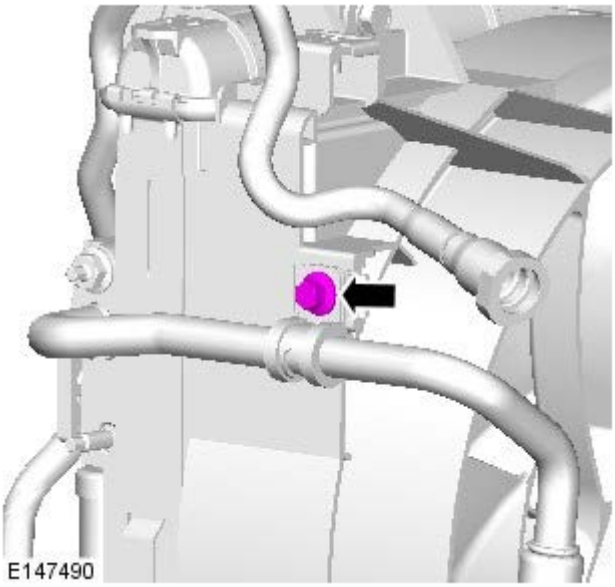
14. *Torque:* 5 Nm



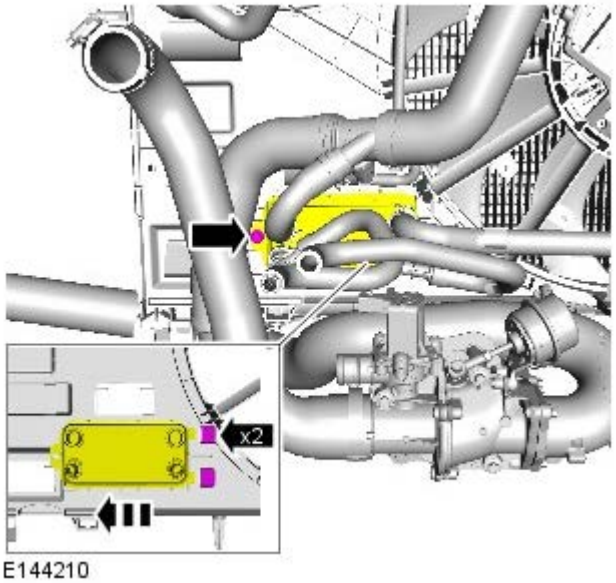
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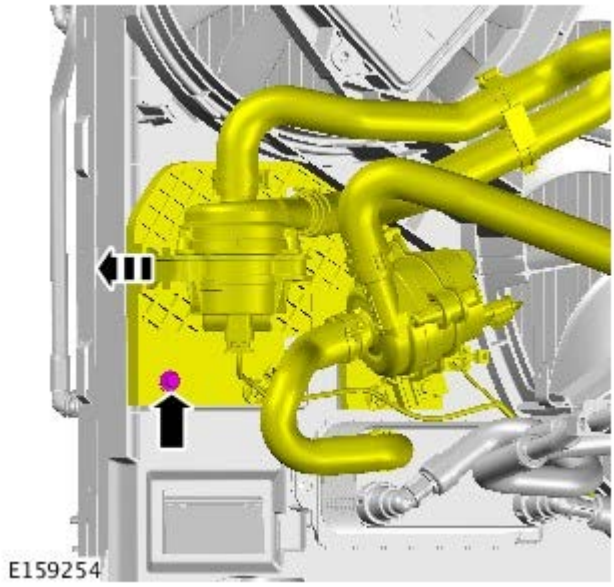
16. *Torque:* 7 Nm



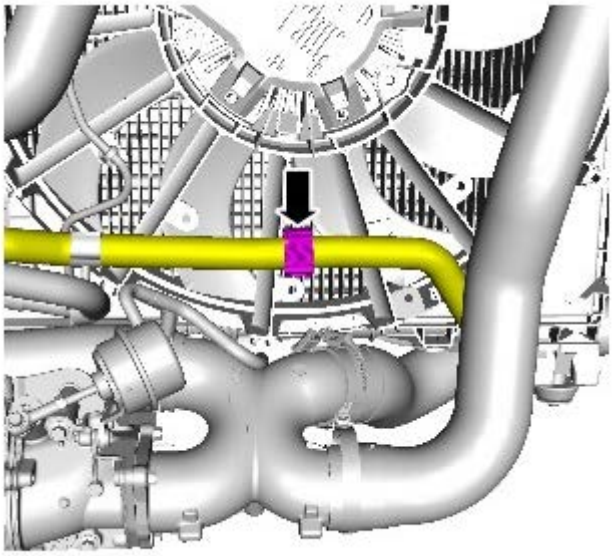
17. *Torque:* 10 Nm



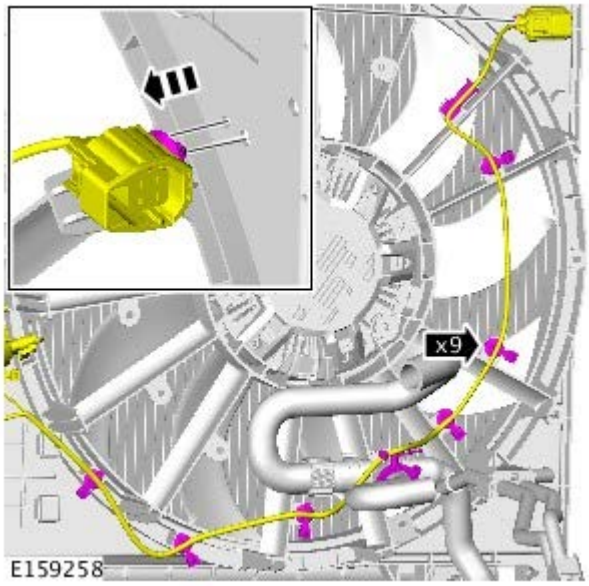
18. *Torque:* 5 Nm



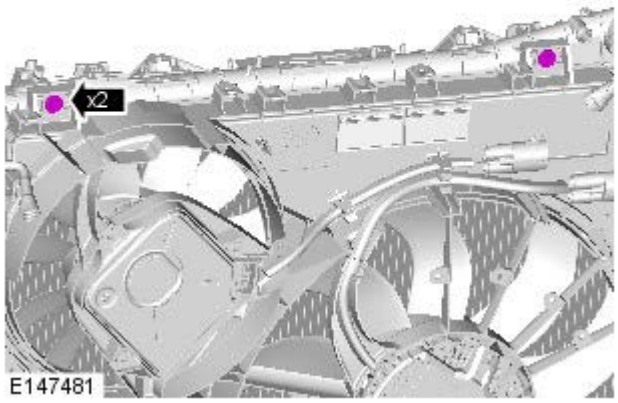
19.



20.



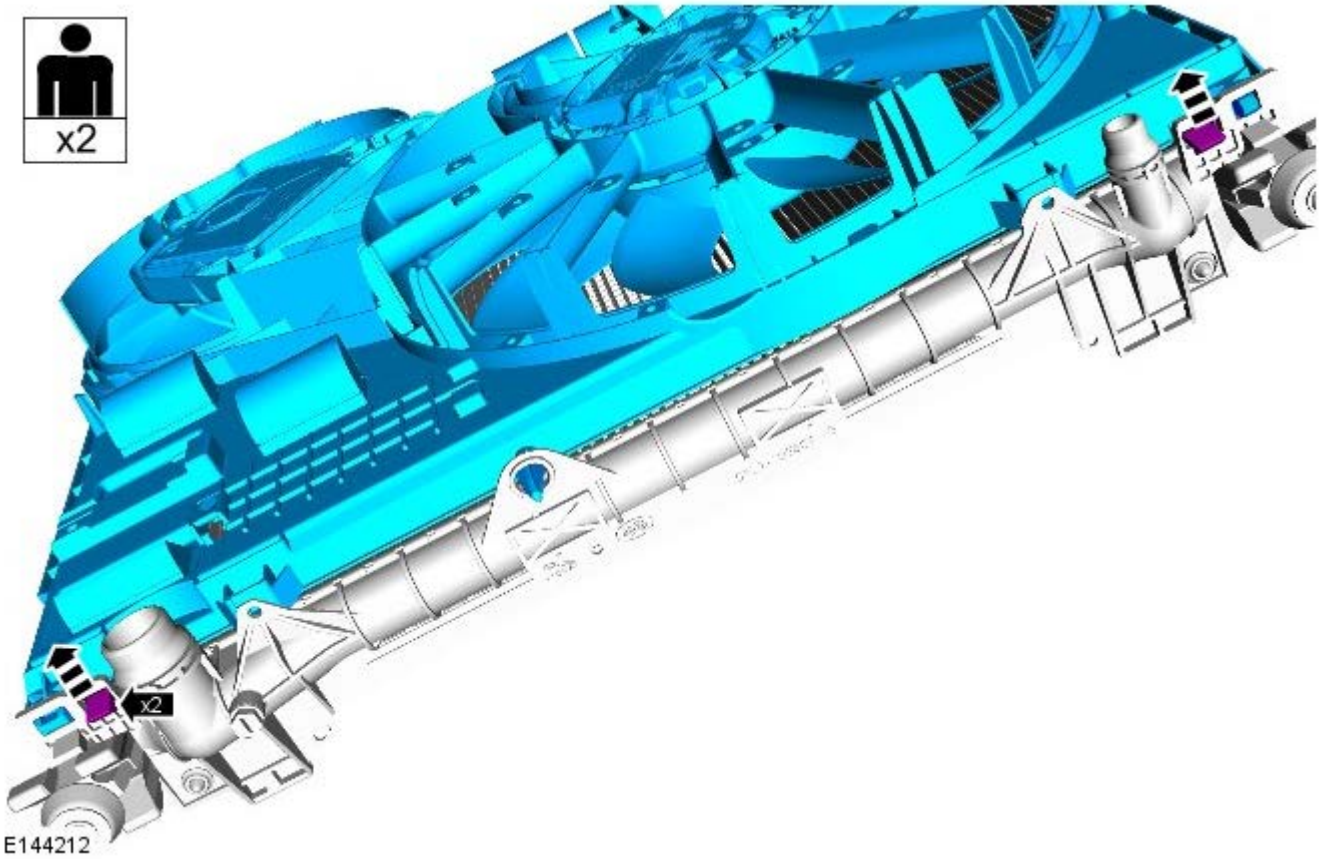
21. *Torque:* 7 Nm



22. CAUTION: Protect the radiator during this operation.

NOTE: With assistance remove the component.

- Release both locking tangs.



Installation

1. To install, reverse the removal procedure.

Published: 24-Jul-2013

Engine Cooling - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Radiator

Removal and Installation

Removal

NOTES:

Removal steps in this procedure may contain installation details.

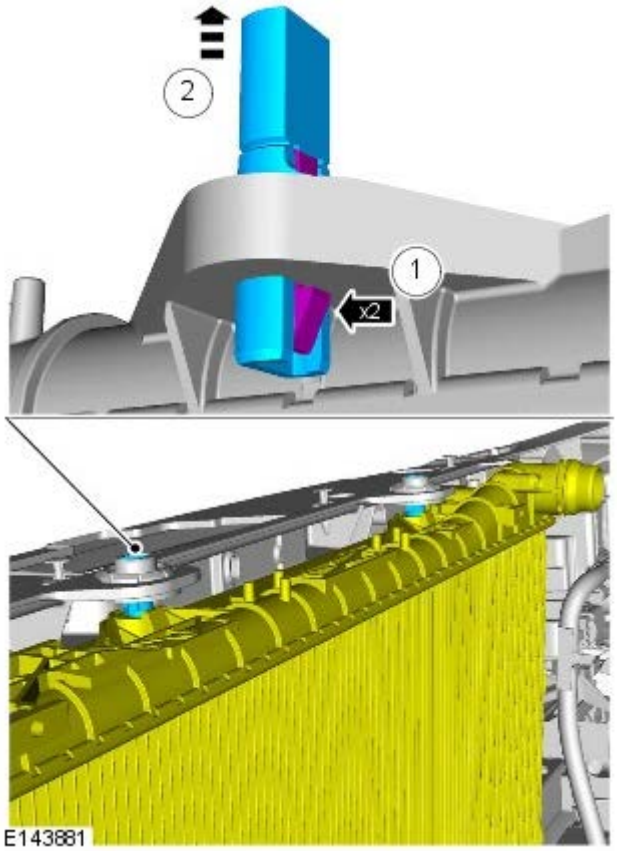
Some variation in the illustrations may occur, but the essential information is always correct.

Some components shown removed for clarity.

1. Refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00, General Procedures).

2. Refer to: Cooling Fan (303-03 Engine Cooling - TDV6 3.0L Diesel - Hybrid Electric Vehicle, Removal and Installation).

3.

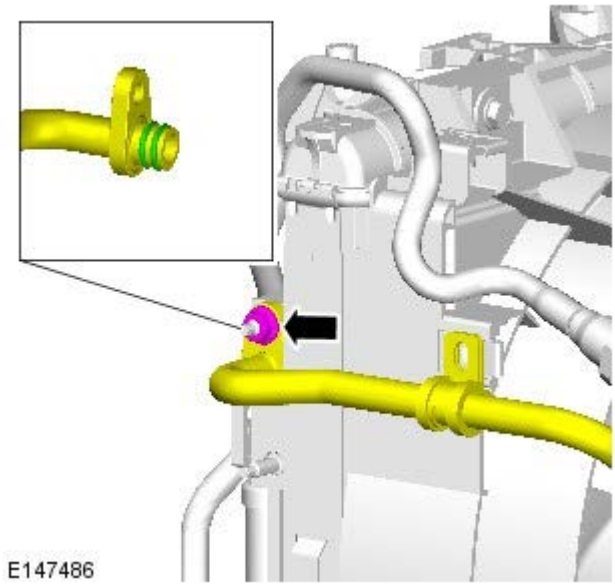


4. CAUTIONS:

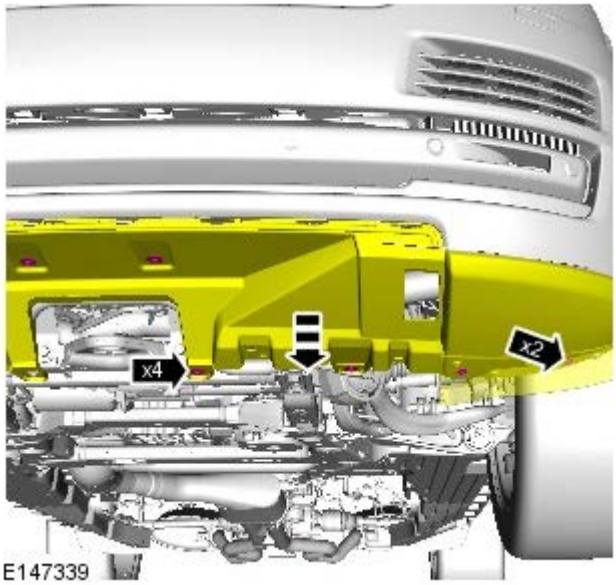
   Make sure that all openings are sealed.

   Remove and discard the O-ring seals.

   Torque: 8 Nm

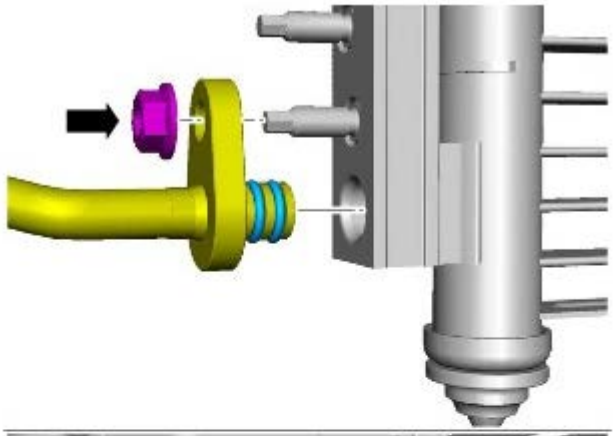


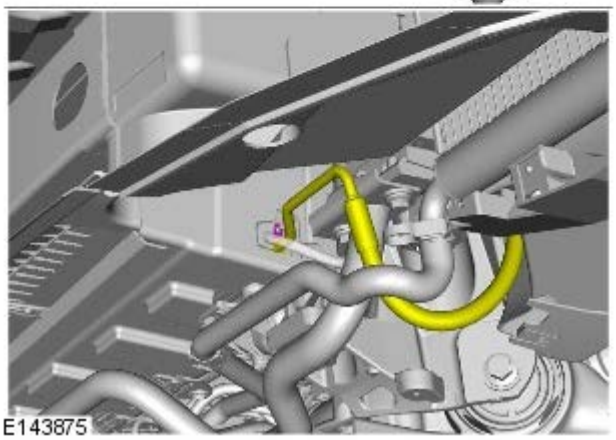
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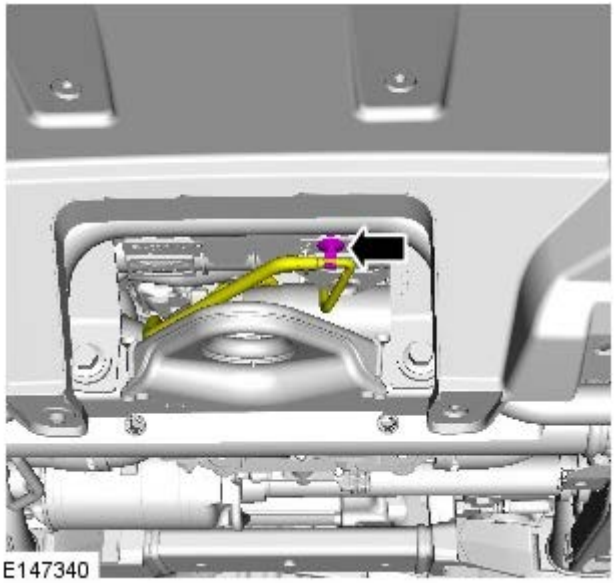
6. CAUTION: Remove and discard the O-ring seals.

Torque: 8 Nm

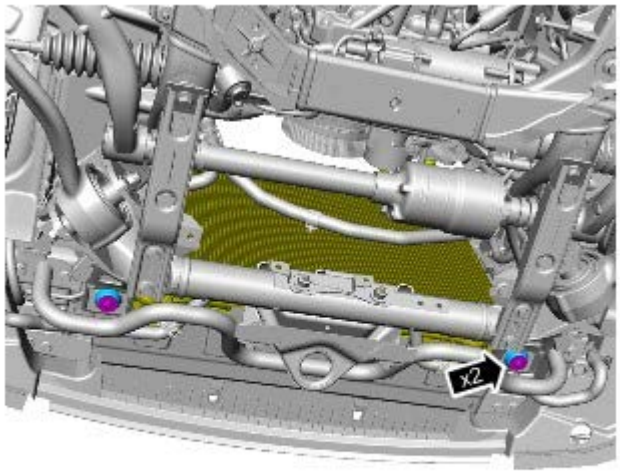




7.



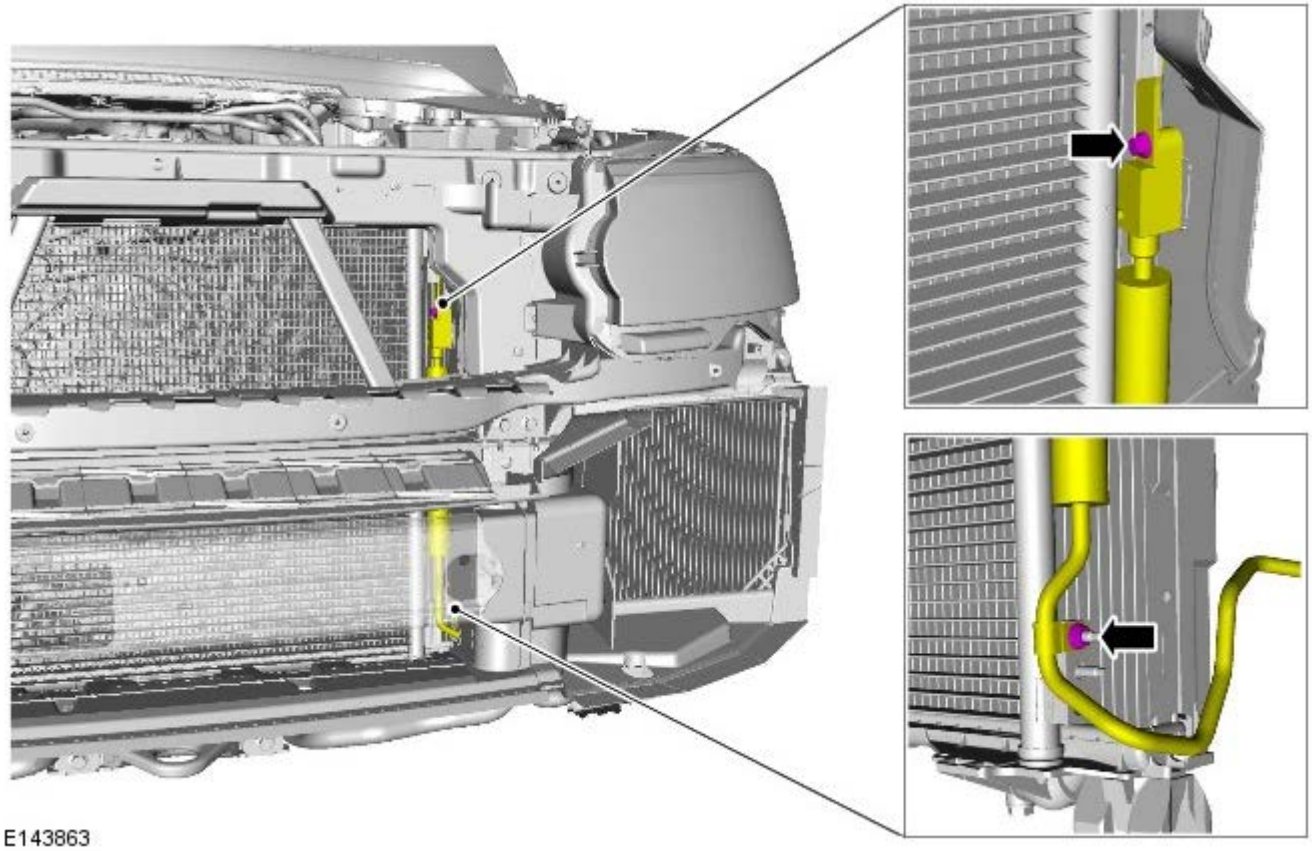
8. *Torque:* 15 Nm



E143877

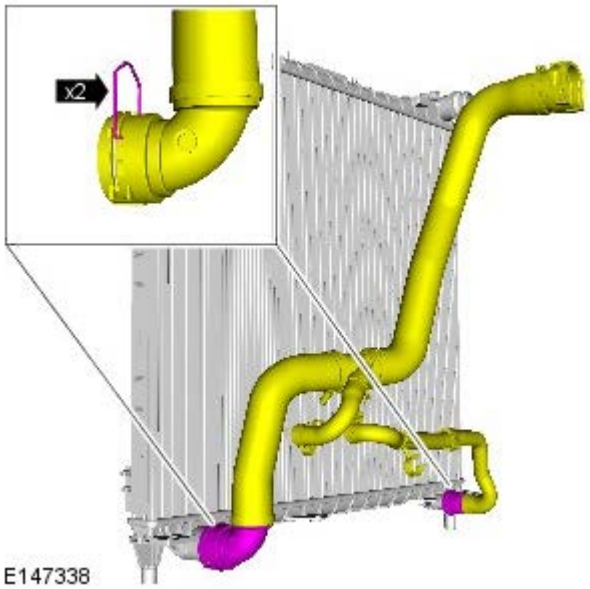
9. NOTE: If equipped.

Torque: 7 Nm

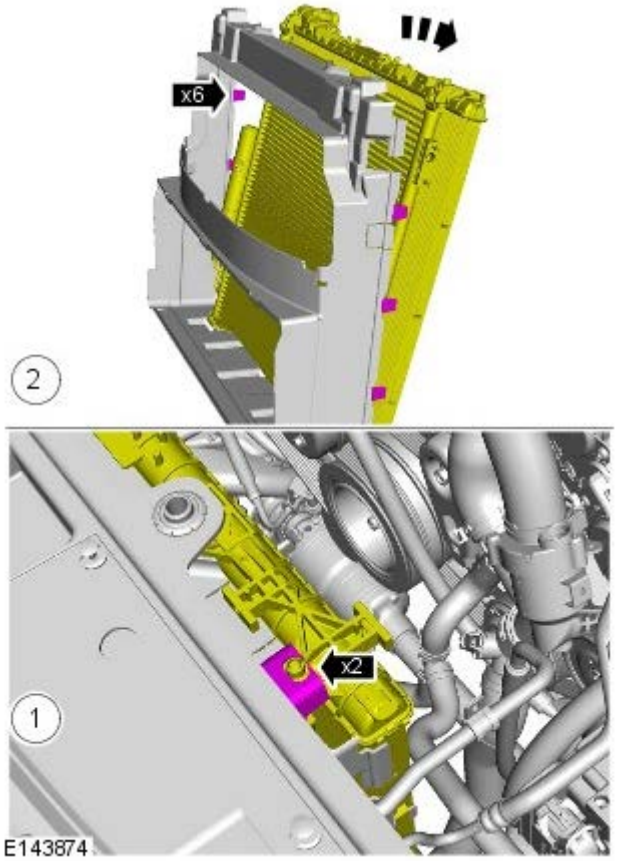


E143863

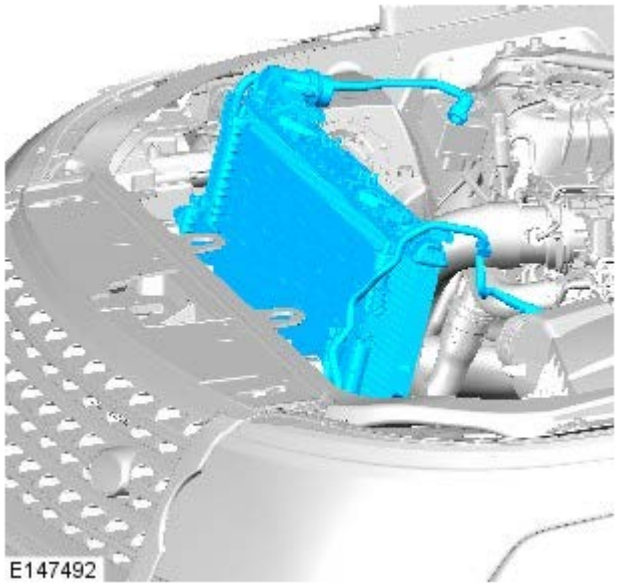
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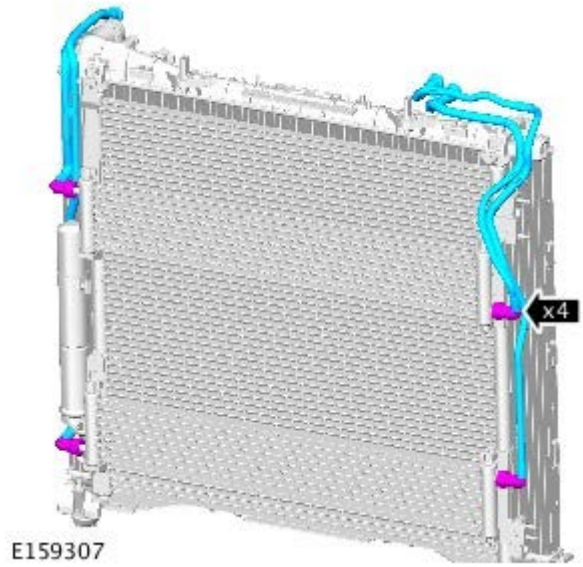
11. CAUTION: Always protect the cooling pack elements to prevent accidental damage.



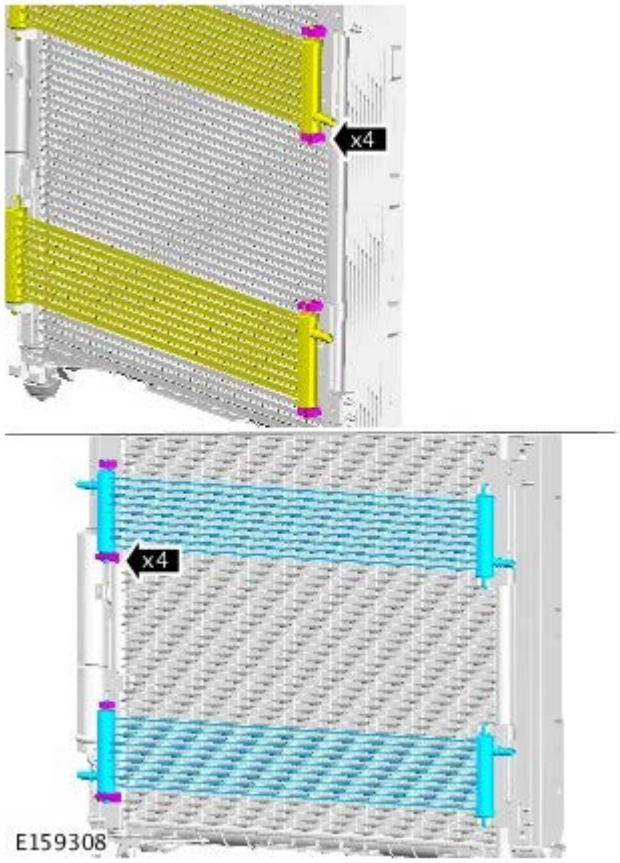
12. CAUTION: Always protect the cooling pack elements to prevent accidental damage.



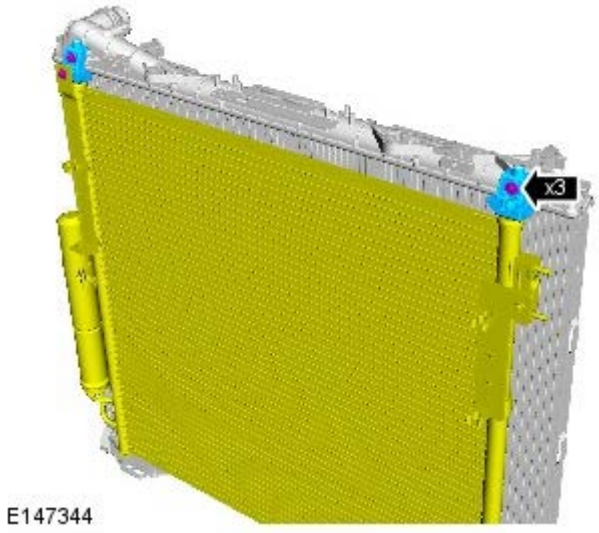
13.



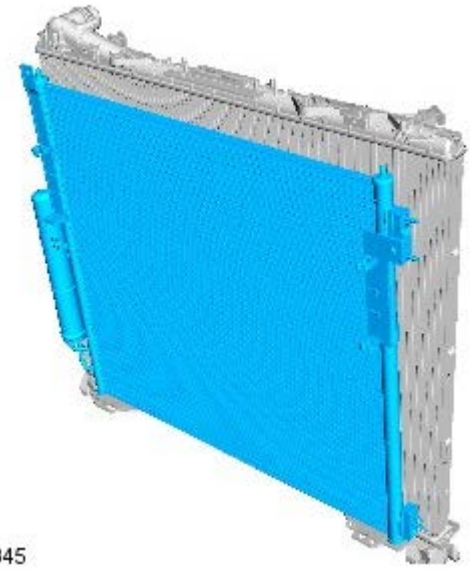
14.



15. *Torque:* 4.5 Nm



16.



E147345

Installation

1. To install, reverse the removal procedure.

Published: 24-Aug-2012

Engine Cooling - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Thermostat

Removal and Installation

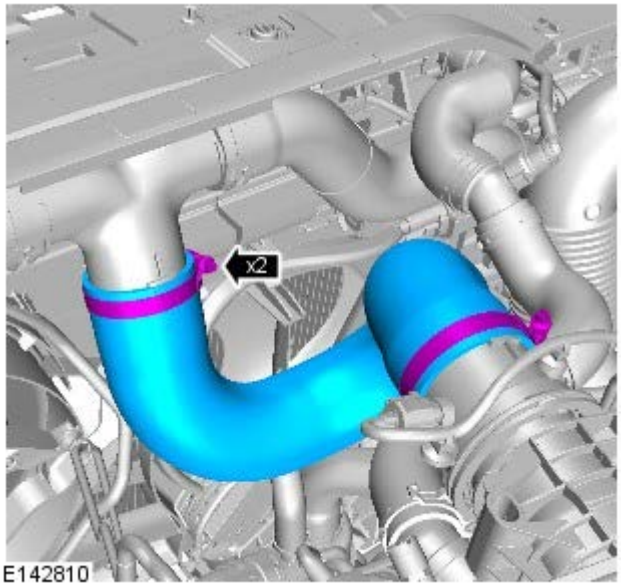
Removal

NOTE: Removal steps in this procedure may contain installation details.

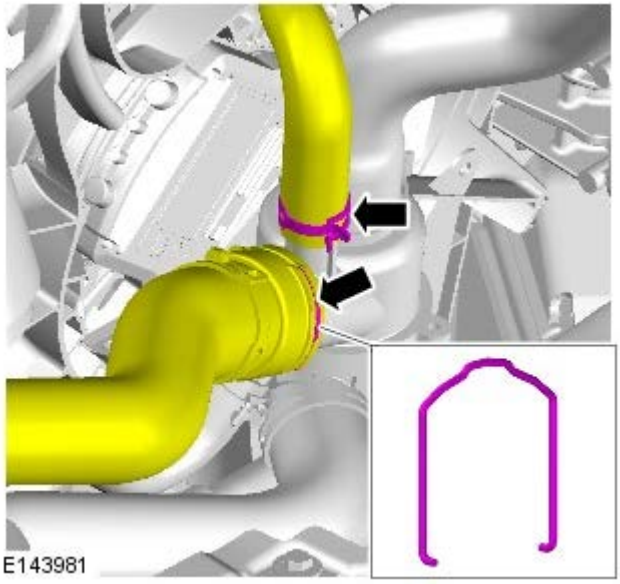
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

2. Refer to: Cooling System Partial Draining, Filling and Bleeding (303-03A Engine Cooling - TDV6 3.0L Diesel, General Procedures).

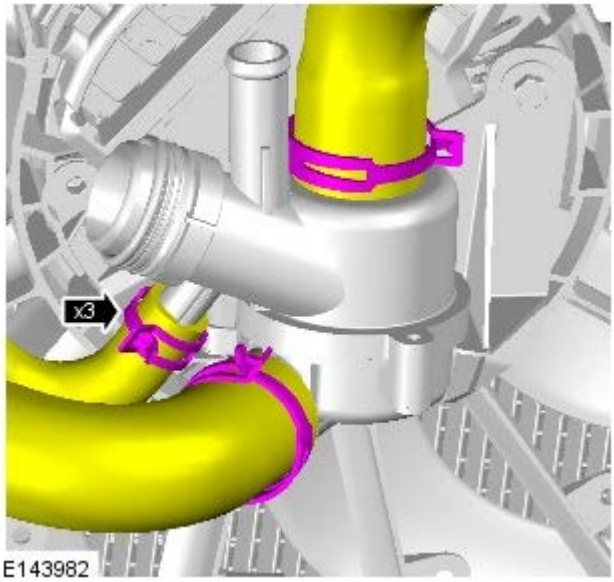


3. *Torque:* 5 Nm

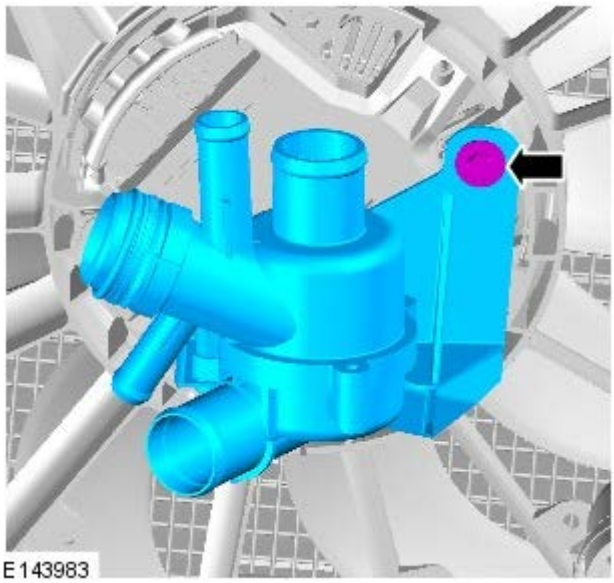


4. CAUTION: Be prepared to collect escaping coolant.

5. CAUTION: Be prepared to collect escaping coolant.

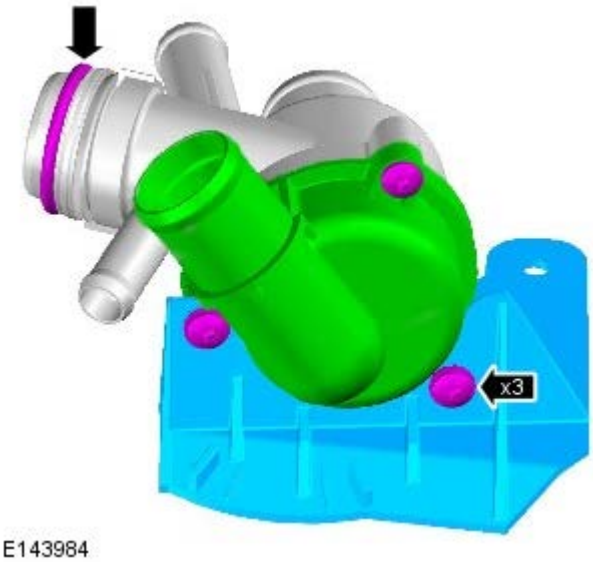


E143982


E143983

6. CAUTION: Be prepared to collect escaping coolant.

   Torque: 5 Nm



E143984

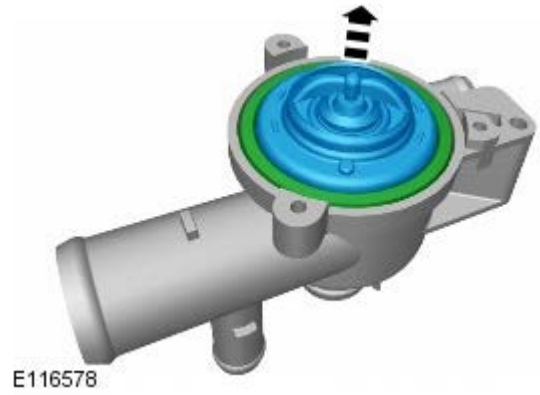
7. CAUTIONS:

   Be prepared to collect escaping coolant.

   Discard the seal.

   Torque: 5 Nm

8. CAUTION: Discard the seal.



Installation

1. To install, reverse the removal procedure.

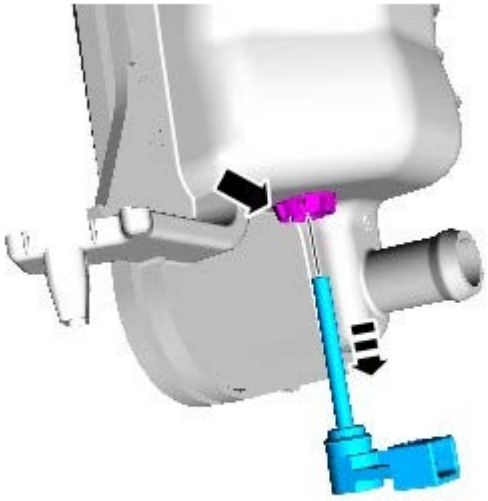
Published: 11-Dec-2013

Engine Cooling - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Engine Coolant Level Switch

Removal and Installation

Removal

1. Refer to: Coolant Expansion Tank (303-03G Engine Cooling - SDV6 3.0L Diesel - Hybrid Electric Vehicle, Removal and Installation).



E162437

2. CAUTION: Care must be taken not to damage the component.

Installation

1. To install, reverse the removal procedure.

Published: 24-Oct-2012

Fuel Charging and Controls - TDV6 3.0L Diesel -

Torque Specification

NOTE: A = refer to procedure for the correct torque sequence.

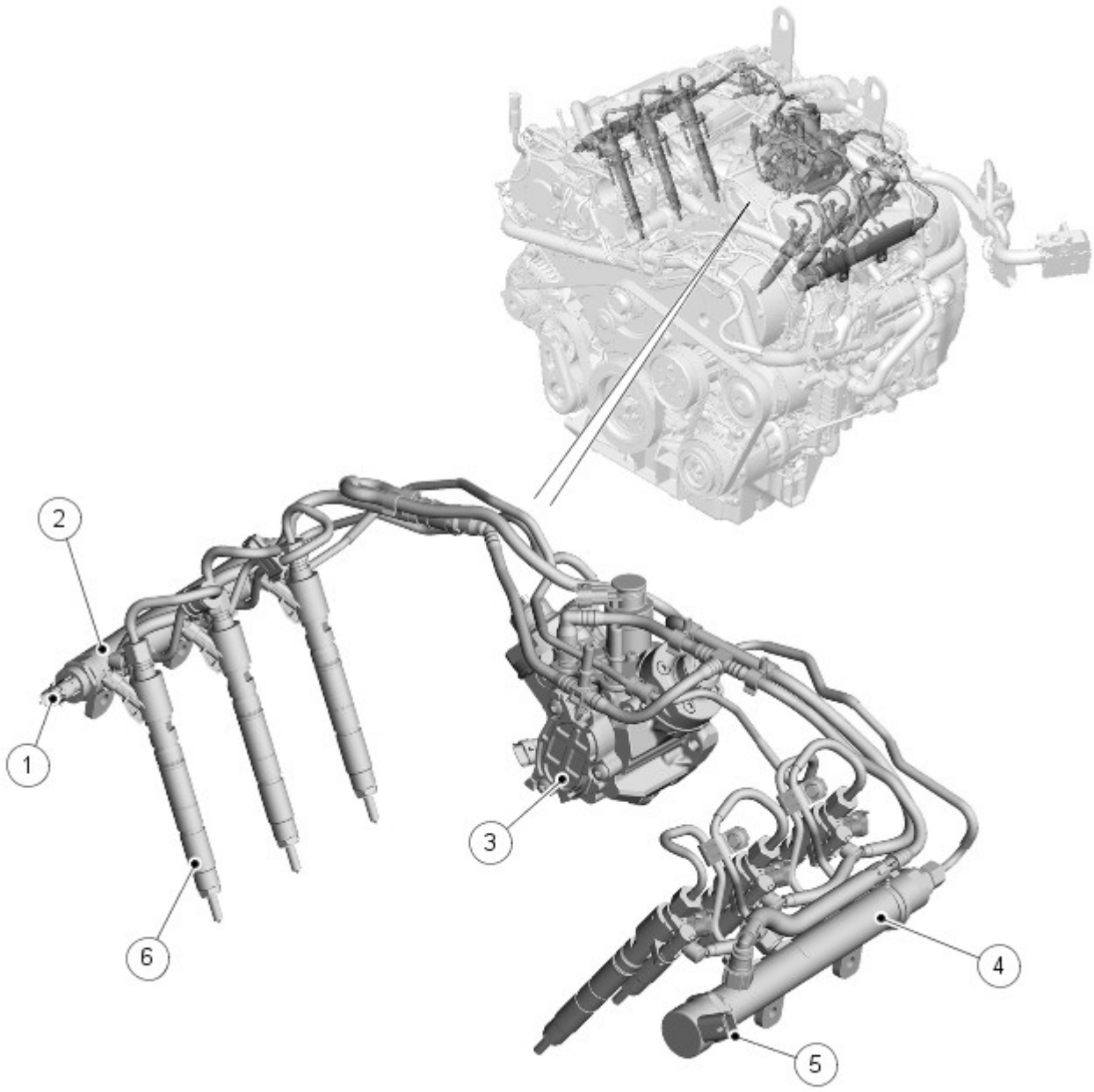
Description	Nm	lb-ft	lb-in
Fuel injection pump cradle bolts	3	-	26
Fuel injection pump retaining bolts	23	16	-
Fuel injection pump bracket	10	-	88
Fuel injection pump sprocket bolt	50	37	-
Fuel injection pump belt rear cover retaining bolts	10	-	88
Camshaft rear end accessory drive (READ) pulley hub retaining bolt	A	-	-
Fuel injection pump belt tensioner retaining bolt	23	16	-
Camshaft READ pulley retaining bolt	A	-	-
Fuel injector retaining bolts	9	-	80
Fuel rail retaining bolts	24	18	
High-pressure fuel line bracket retaining bolts	10	-	88
High-pressure fuel line union nuts	A	-	-
Fuel rail supply tube union nuts	A	-	-
Fuel crossover line union nuts	A	-	-
Crankcase ventilation pipe retain bolts	10	-	88
Intake air shutoff valve retaining nut	10	-	88

Published: 30-May-2013

Fuel Charging and Controls - TDV6 3.0L Diesel - Fuel Charging and Controls

Description and Operation

COMPONENT LOCATION



E152419

Item	Part Number	Description
1	-	Fuel Rail Pressure (FRP) sensor
2	-	Right fuel rail
3	-	High pressure fuel pump - with internal transfer pump
4	-	Left fuel rail
5	-	Fuel rail pressure control valve
6	-	Fuel injector (6 off)

OVERVIEW

The TDV6 3.0L diesel engine is equipped with a HP (high pressure) common rail fuel injection system. With this fuel injection process, a HP fuel pump delivers a uniform level of pressure to the shared fuel lines (the fuel 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:

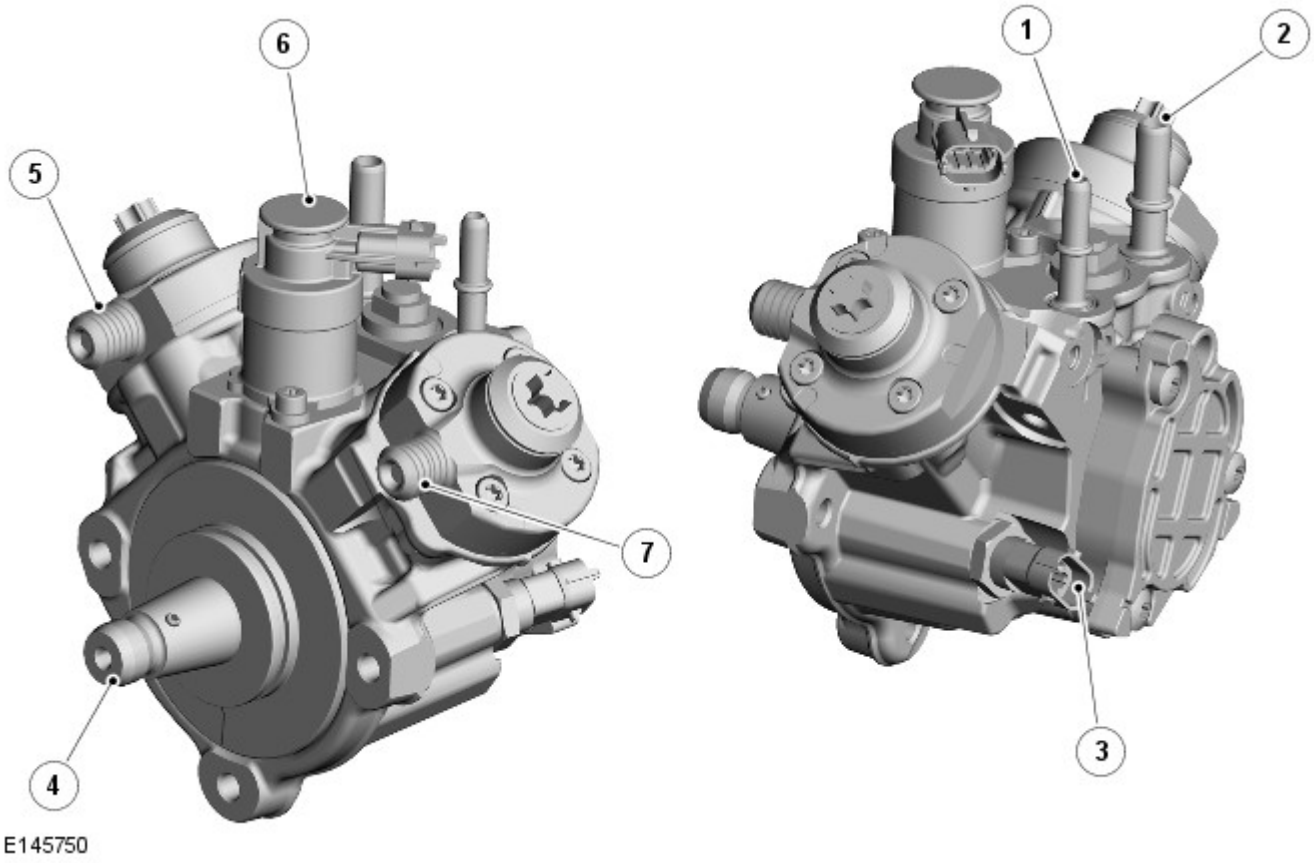
- High fuel injection pressures of up to 2000 bar (29007 lbf/in²) for greater atomization of fuel (increasing performance and lowering emissions)
- Variable injection to optimize combustion in all engine operating conditions
- Low tolerances and high precision throughout the life of the system.

The system features the following components:

- HP fuel pump
- Fuel rails
- HP and LP (low pressure) fuel pipes
- Fuel injectors.

DESCRIPTION

High Pressure Fuel Pump



Item	Part Number	Description
1	-	Low pressure fuel return connection
2	-	Low pressure fuel supply connection
3	-	Fuel temperature sensor
4	-	Drive shaft
5	-	Fuel outlet to left fuel rail
6	-	Fuel volume control valve
7	-	Fuel outlet to right fuel rail

The HP fuel 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 HP fuel pump is driven from the left 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.
For additional information, refer to: Engine (303-01A Engine - TDV6 3.0L Diesel, Description and Operation) / Fuel Pump (303-04A Fuel Charging and Controls - TDV6 3.0L Diesel, Removal and Installation).

The HP fuel pump comprises 2 HP pumping elements, a fuel 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.
For additional information, refer to: Fuel Tank and Lines (310-01A Fuel Tank and Lines - TDV6 3.0L Diesel, Description

and Operation).

The fuel volume control valve is located in the feed port between the HP pumping elements and the internal transfer pump. The fuel volume control valve is a variable position solenoid-operated valve that is controlled by the ECM. The fuel 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 fuel volume control valve, the valve is closed and there is no fuel delivery.

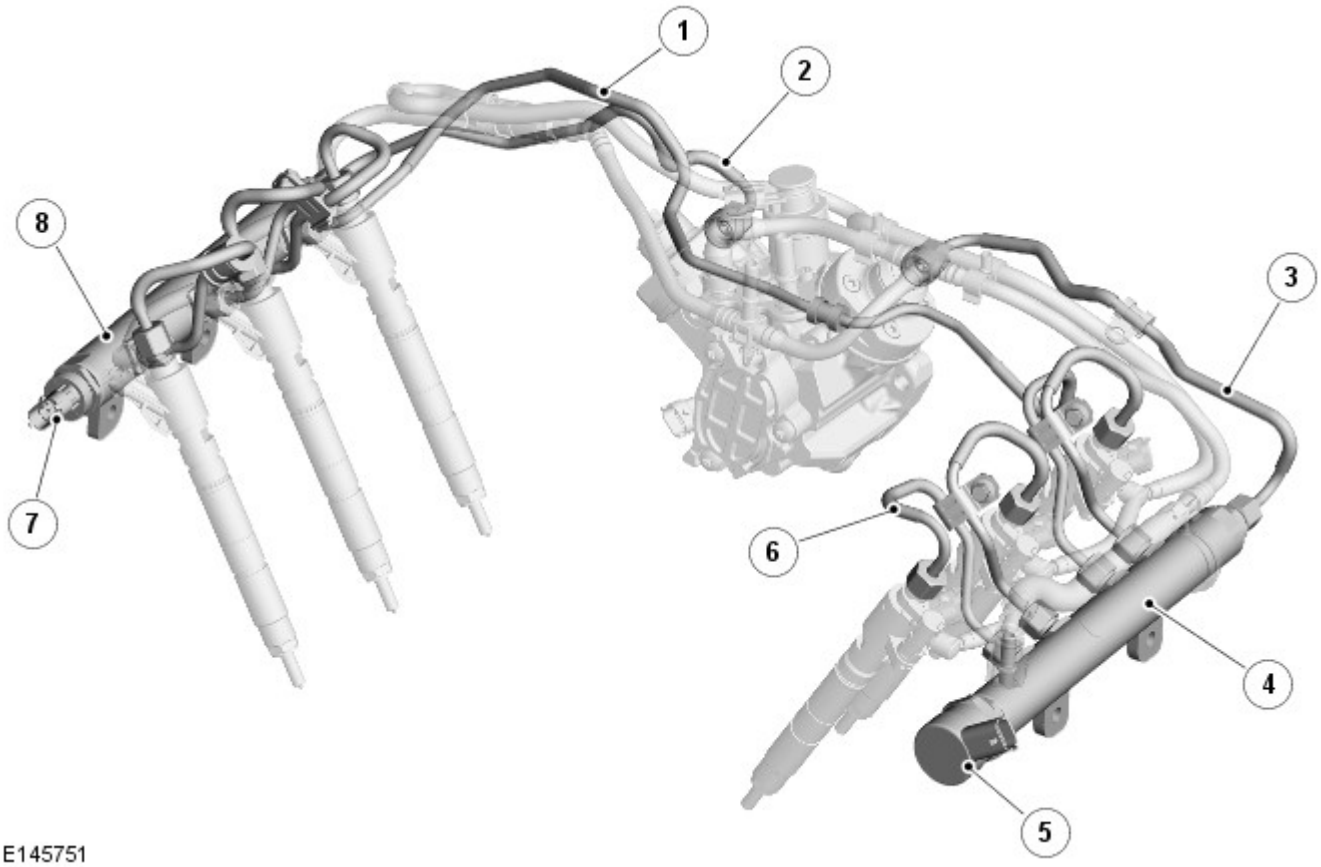
The fuel from the internal transfer pump is passed to the HP pumping elements at a constant pressure known as transfer pressure. The transfer pressure is controlled by an internal pressure relief valve. Once the fuel enters each of the HP pumping elements the pressure rises rapidly, with each element providing a HP supply to one of the fuel rails. The pressure is controlled by the fuel pressure control valve and the FRP (Fuel Rail Pressure) sensor.

A controlled amount of fuel is allowed to leak-off from the internal transfer pump. This fuel cools and lubricates the internal components of the HP fuel pump, then returns to the fuel tank through the LP (low pressure) fuel return line.

The fuel temperature sensor is located on the rear of the HP fuel pump. It measures the fuel temperature in the low-pressure side of the HP 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.

Fuel Rails

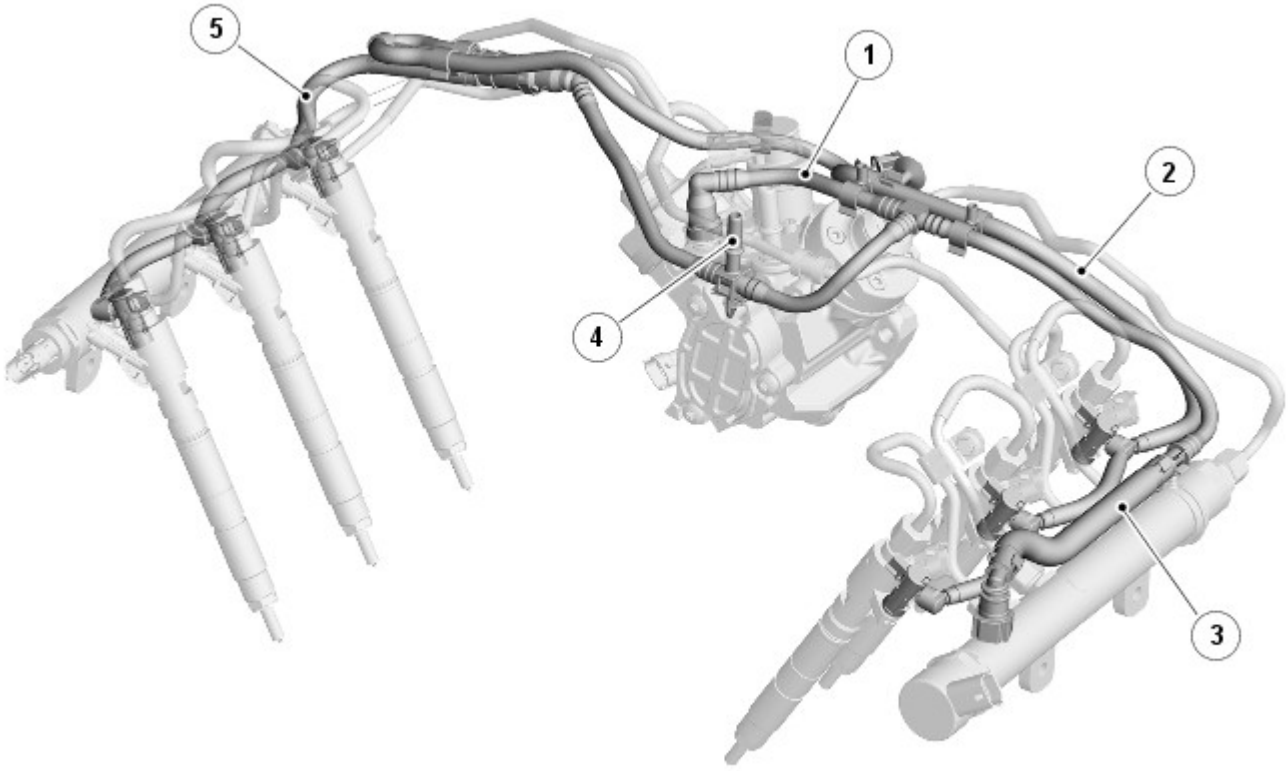
Fuel Rails and High Pressure Fuel Lines



E145751

Item	Part Number	Description
1	-	Fuel rail balance pipe
2	-	Supply pipe to right fuel rail
3	-	Supply pipe to left fuel rail
4	-	Left fuel rail
5	-	Fuel pressure control valve
6	-	Supply pipe to fuel injector (6 off)
7	-	Fuel rail pressure sensor
8	-	Right fuel rail

Low Pressure Fuel Lines



E145752

Item	Part Number	Description
1	-	High pressure fuel pump fuel return tube
2	-	Left bank fuel injector leak-back tube
3	-	Fuel pressure control valve fuel return tube
4	-	Fuel return connection to fuel cooler
5	-	Right bank fuel injector leak-back tube

Two fuel rails are used with each rail supplying high pressure fuel to 3 fuel injectors.

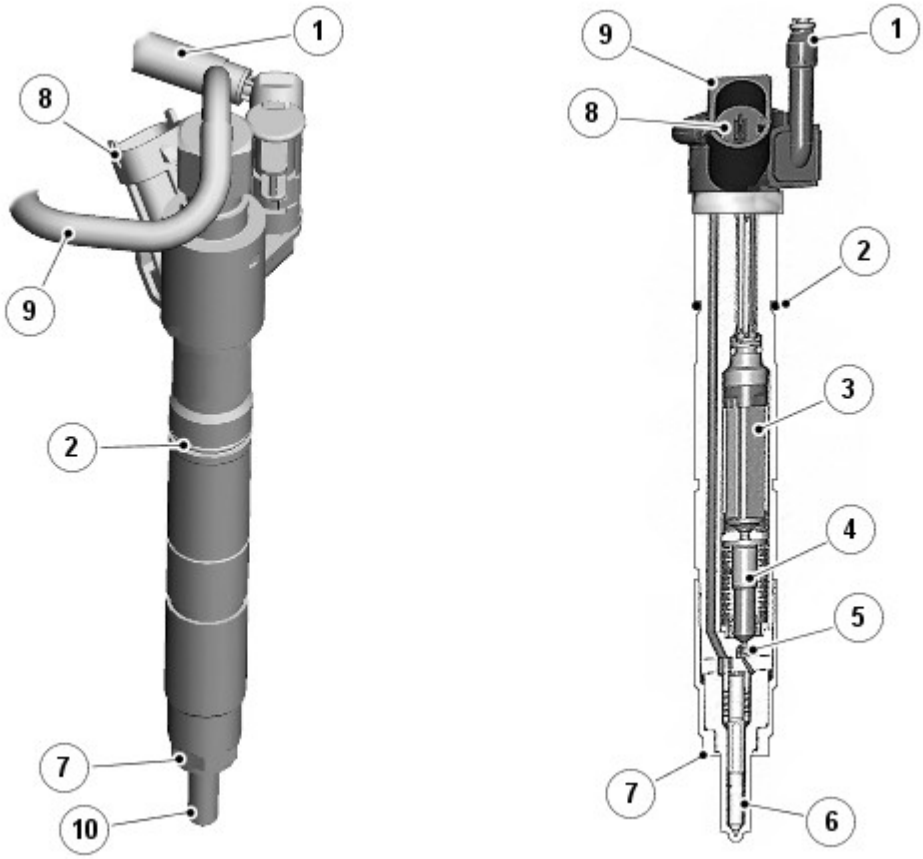
Each rail has 5 threaded connections which provide for the attachment of the high pressure fuel supply from the HP fuel pump, the balance pipe and connections for the 3 injectors supplied with fuel from that rail.

The fuel pressure in the rails is detected by the FRP sensor which is located in the front of the right rail. The left rail houses a fuel pressure control valve. The ECM controls the fuel pressure control valve using signals from the FRP sensor. Fuel released by the fuel pressure control valve flows into the LP fuel return line.

The FRP 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 fuel pump.

Fuel Injectors



E115475

Item	Part Number	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

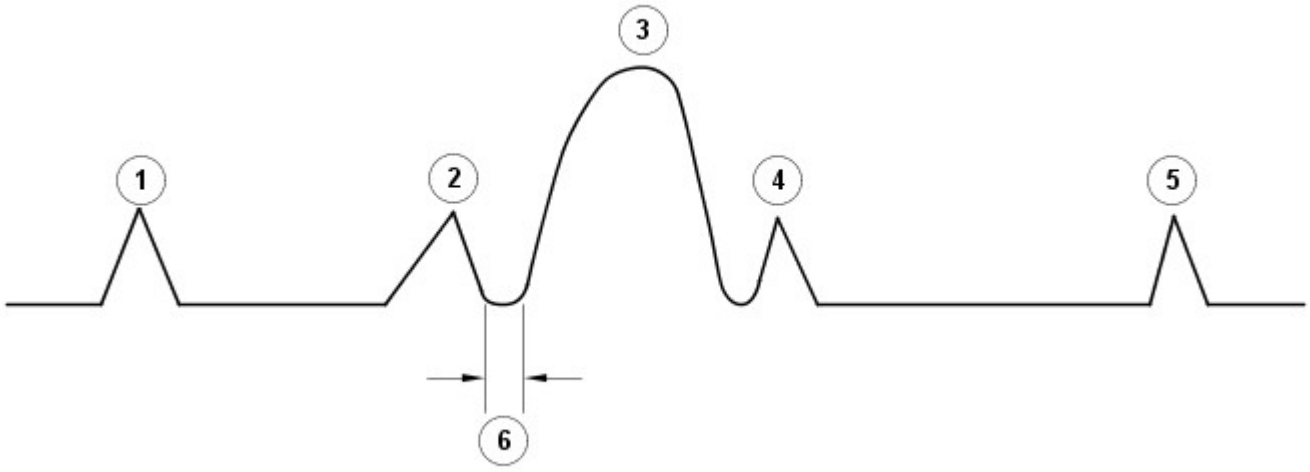
CAUTION: Each injection event is controlled by a charge and discharge cycle allowing energy to dissipate in, and recover from, the injector. Never disconnect the wiring connector when the vehicle is running. The injector may remain open thus causing engine damage.

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 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 related fuel rail. A second fuel connection allows fuel leakage within the injector to drain into the LP fuel return line.

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 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.

OPERATION

Engine Starting

During starting, the fuel rail pressure must be at least 120 bar (1740 lbf/in²). Should the pressure be below this figure, the injectors will not operate, resulting in the vehicle not starting.

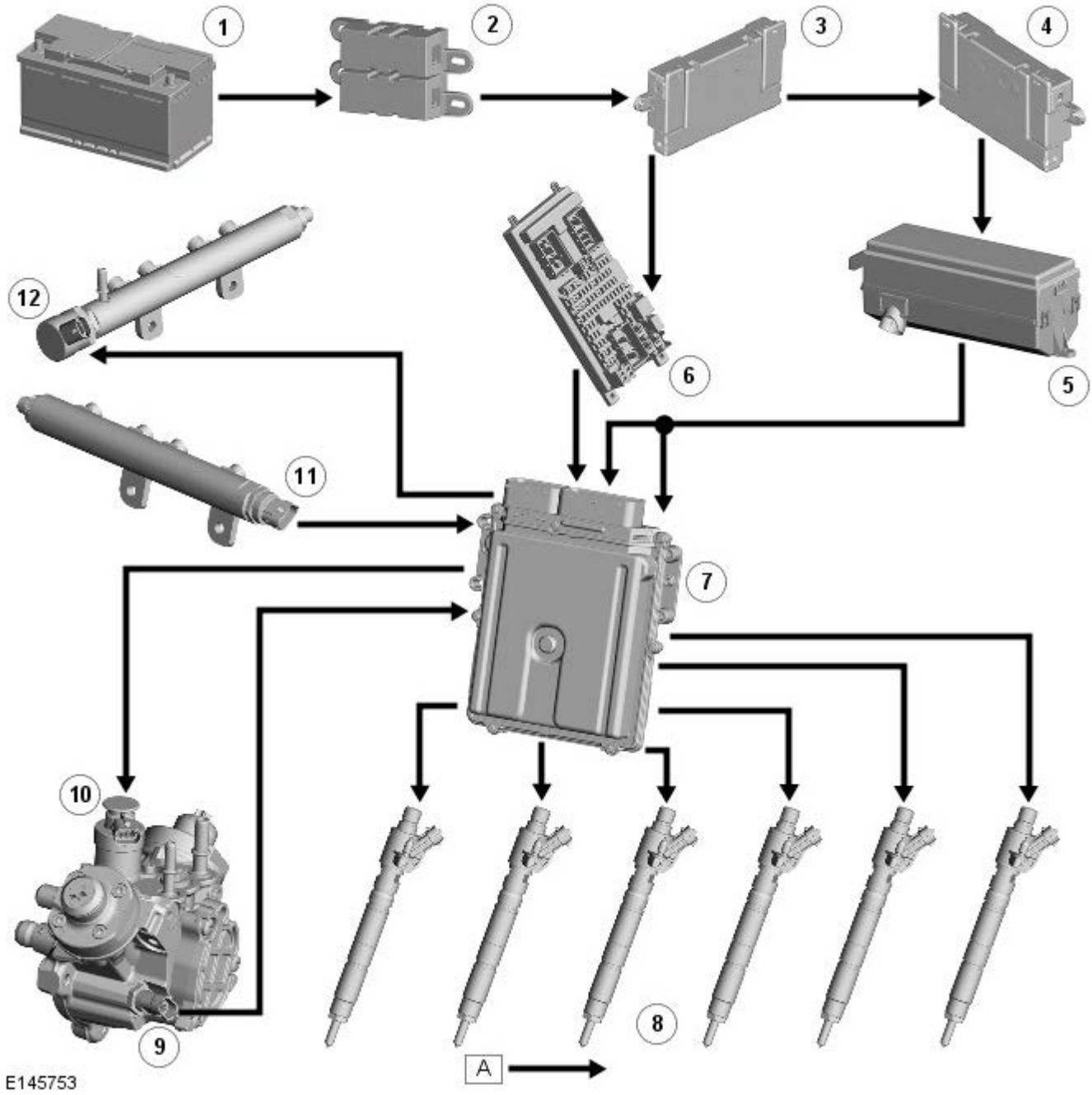
Engine Stopping

To stop the engine the ECM stops energizing the actuators in the fuel injectors, therefore, no fuel is injected and the engine speed drops to zero.
For additional information, 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 fuel volume control valve is open and the fuel 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 fuel injectors, the fuel rail pressure drop is off-set by additional fuel being delivered to the fuel rails by the fuel pressure control valve. The fuel pressure in the system is reduced within a few seconds after the engine has stopped as the fuel 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 released into the LP fuel return line through the open fuel pressure control valve.

Control Diagram



Item	Part Number	Description
1	-	Battery
2	-	Battery junction box 2 (BJB2)
3	-	Battery junction box (BJB)
4	-	Auxiliary junction box AJB)
5	-	Engine junction box (EJB)
6	-	Central junction box (CJB)
7	-	Engine control module (ECM)
8	-	Fuel injector (6 off)
9	-	Fuel temperature sensor
10	-	Fuel volume control valve
11	-	Fuel rail pressure (FRP) sensor
12	-	Fuel pressure control valve

Published: 31-Jul-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: Fuel Charging and Controls (303-04A Fuel Charging and Controls - TDV6 3.0L Diesel, 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) • High-pressure fuel supply 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 system	• Fuses • Glow plug indicator • Inertia fuel shut off switch • Fuel pump module • Sensor(s) • Engine control module • Fuel volume control valve • Fuel pressure control valve • Fuel rail pressure sensor • Fuel temperature sensor • Fuel injector(s) • Exhaust gas recirculation 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 shut off 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 sensor	Check that the inertia switch has not tripped. 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, check for DTCs indicating a fuel volume or pressure control valve fault. Check the fuel pump. Check the CKP sensor circuits. Refer to the electrical guides.

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 valve fault	Check the glow plug circuits. Refer to the electrical guides. 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, check for DTCs indicating a fuel volume or pressure control valve fault. Check the exhaust gas recirculation 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 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 low-pressure fuel system for leaks/damage. Check the fuel filter, check for DTCs indicating a fuel volume or pressure control valve fault. Check the exhaust gas recirculation system.
Lack of power when accelerating	• Intake air system fault • Restricted exhaust system • Low fuel pressure • Exhaust gas recirculation valve 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. Check for DTCs indicating a fuel pressure fault. Check the exhaust gas recirculation 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 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: Check for DTCs indicating a fuel volume or pressure control valve fault. Check the exhaust gas recirculation 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	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, check for DTCs indicating a fuel volume or pressure control valve fault. Check the fuel pump.

	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 valve fault	Check the low-pressure fuel system for leaks/damage. Check for DTCs indicating a fuel volume or pressure control valve fault. Check the fuel temperature sensor, fuel pump, etc for leaks. Check for injector DTCs. Check the exhaust gas recirculation 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: 23-Aug-2012

Fuel Charging and Controls - TDV6 3.0L Diesel - Fuel Injectors LH

Removal and Installation

Special Tool(s)

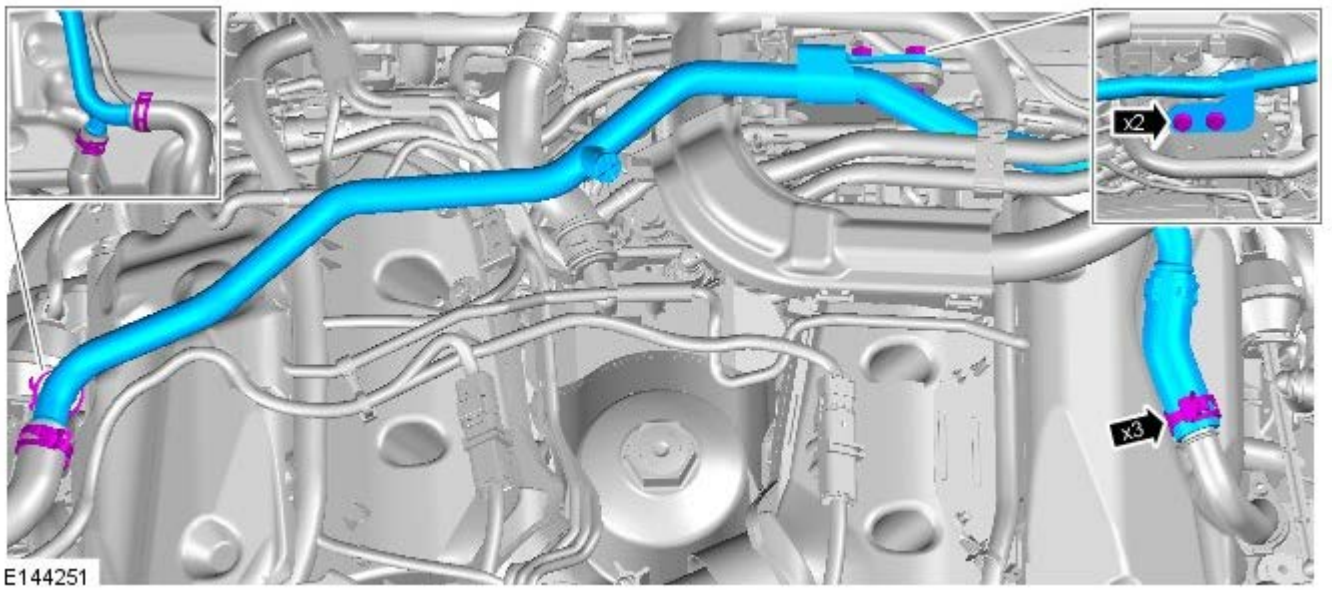
 E54135	100-012 Slide Hammer
 E116924	310-213 Fuel Injector Removal Adapter

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.

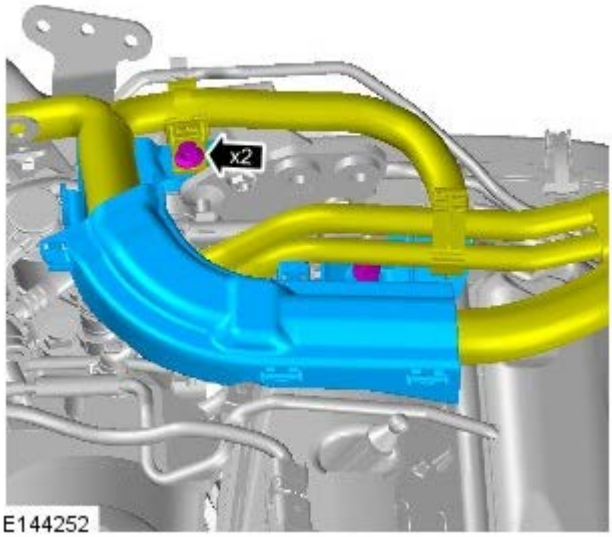
NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. Refer to: Fuel Injection Component Cleaning (303-04, General Procedures).
2. Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).
3. Refer to: Secondary Bulkhead Center Panel - TDV6 3.0L Diesel (501-02 Front End Body Panels, Removal and Installation).
4. Refer to: Cooling System Partial Draining, Filling and Bleeding (303-03A Engine Cooling - TDV6 3.0L Diesel, General Procedures).
5. CAUTION: Be prepared to collect escaping coolant.



E144251

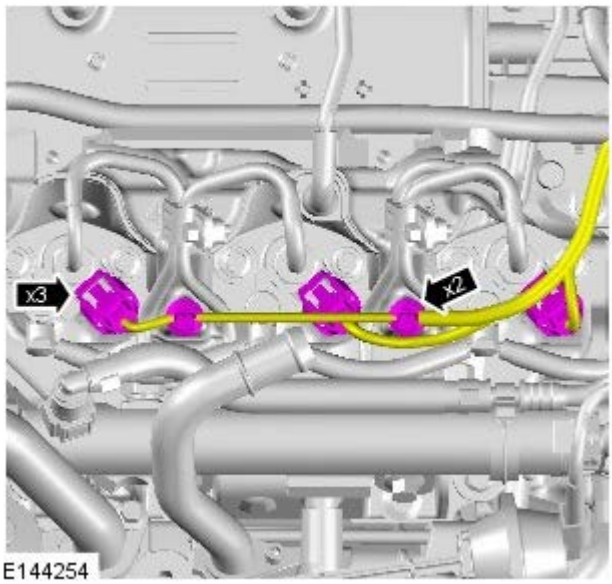
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7.

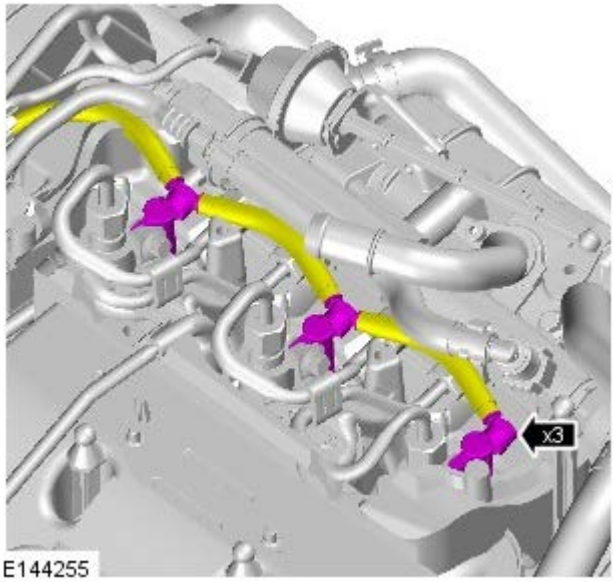


8.



9. CAUTIONS:

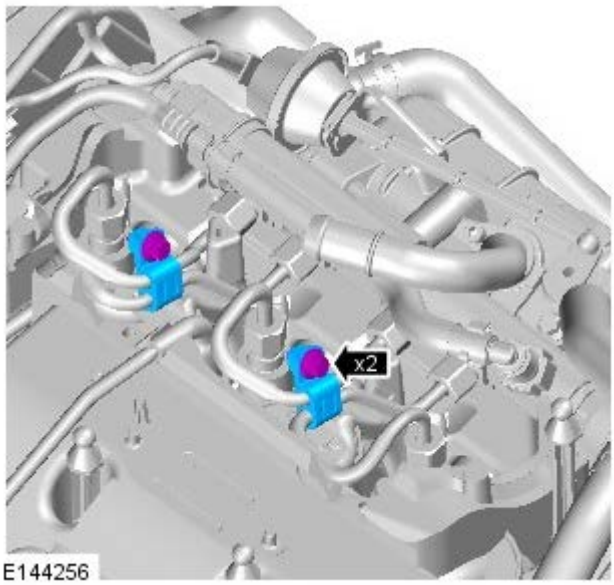
Be prepared to collect escaping fuel.



Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

NOTE: Make sure that the fuel injector return line has a maximum of 8 uses.

10.

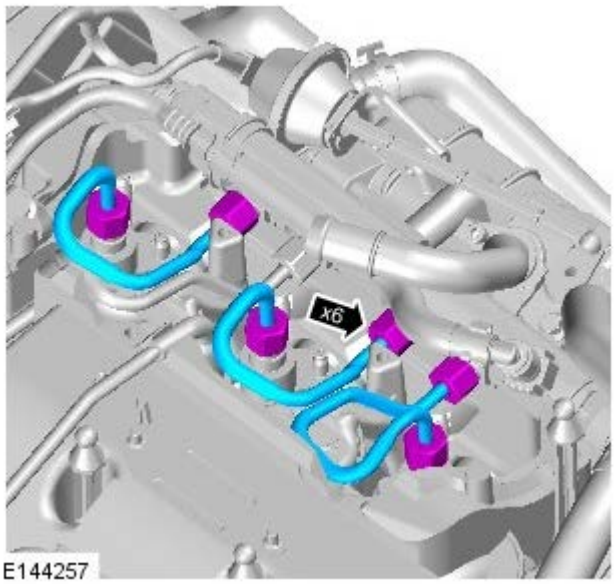


11. CAUTIONS:

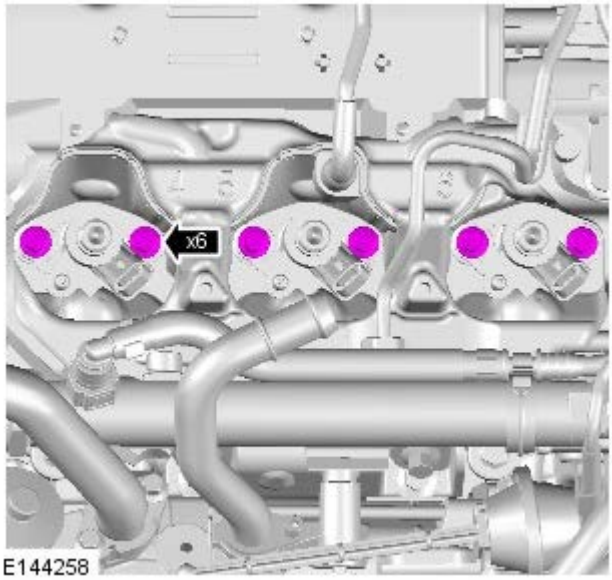
Be prepared to collect escaping fuel.

Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean.

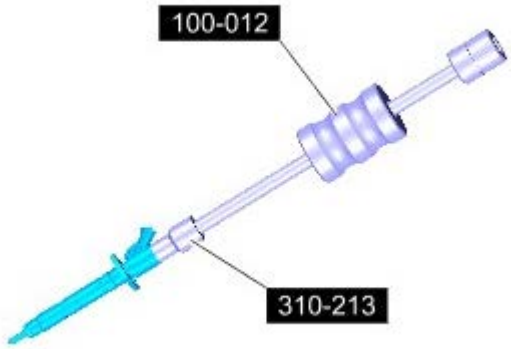
Remove and discard the high-pressure fuel supply lines.



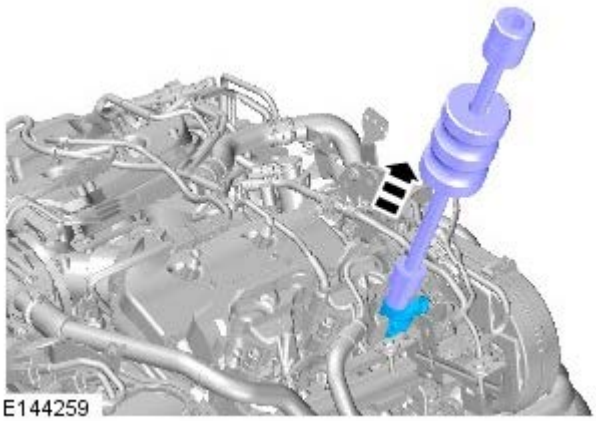
12.



E144258



13. NOTE: Repeat this step for each of the fuel injectors.
    - *Special Tool(s):* 310-213
    - *Special Tool(s):* 100-012

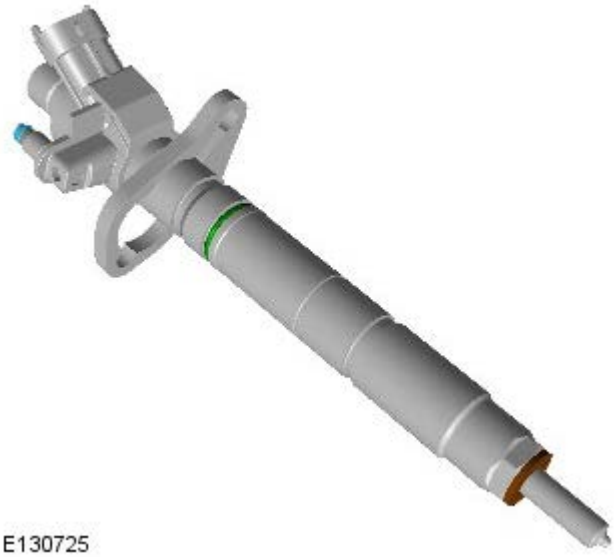

E144259

14. NOTES:

    Remove and discard the O-ring seals.

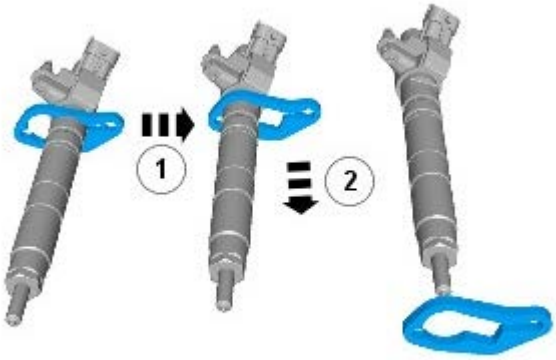
    Discard the sealing washers.

    Repeat this step for each of the fuel injectors.



E130725

15. NOTE: This step is only required if new components are not installed.

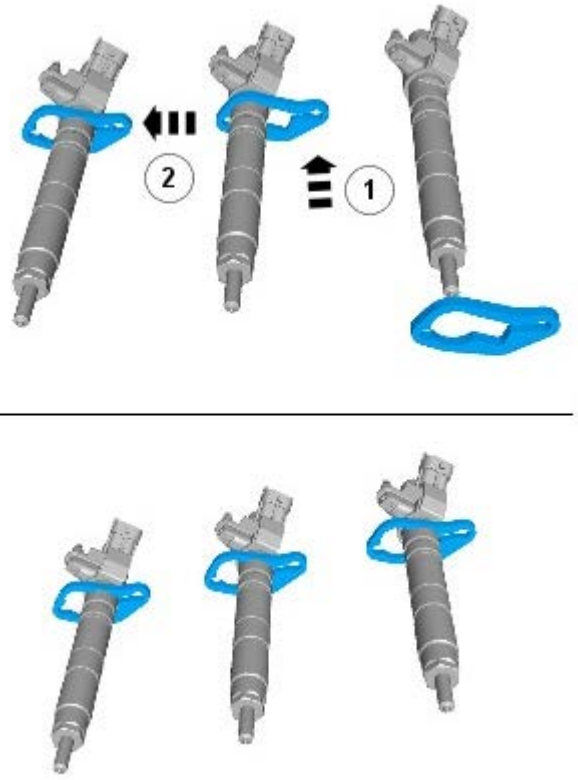




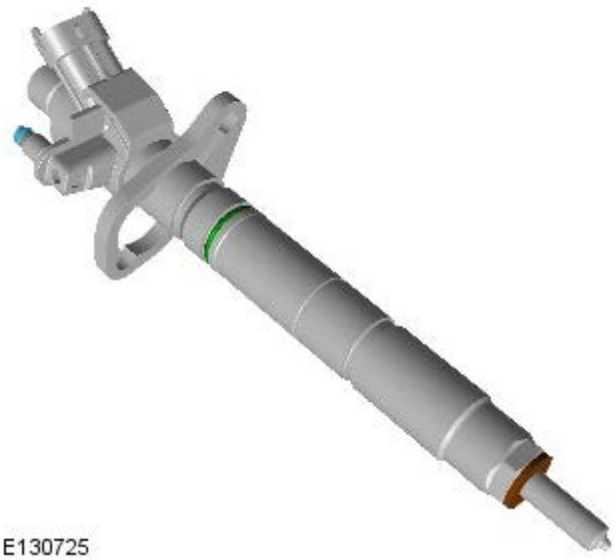
E144699

Installation

1. NOTE: This step is only required if previously removed.



E144700



E130725

2. CAUTION: Make sure that new sealing washers are installed.

   NOTES:

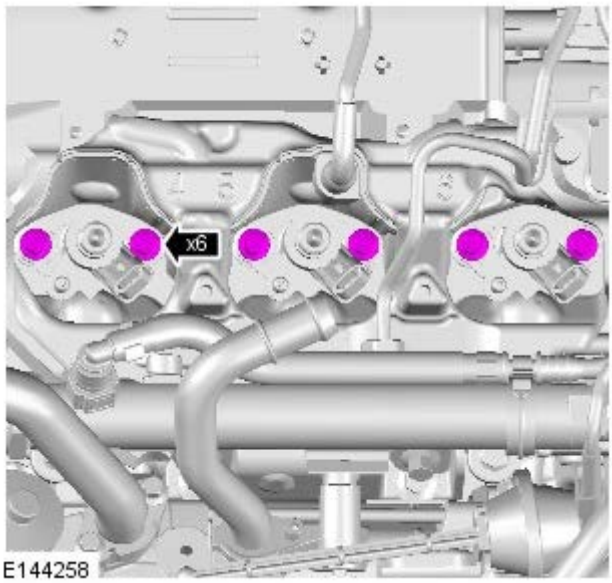
   This step is only required if previously removed.

   Install new O-ring seals.

   Repeat this step for each of the fuel injectors.

3. 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.

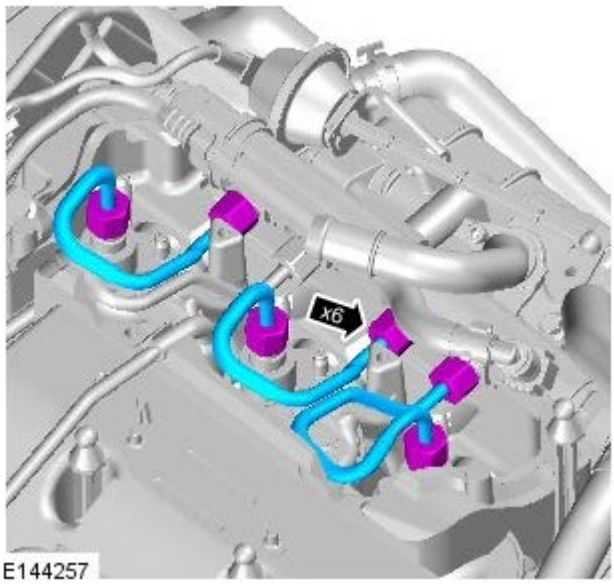

E144688



E144258

4. NOTE: Tighten the retaining bolts evenly and progressively.

   Torque: 9 Nm



E144257

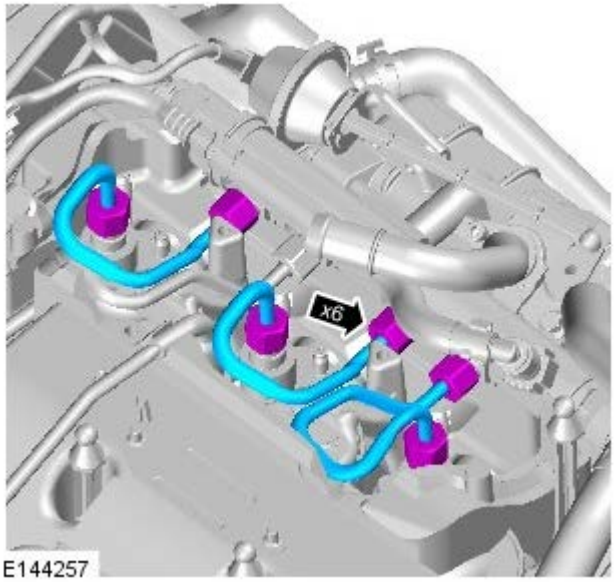
5. CAUTIONS:

   Make sure that a new component is installed.

   Only tighten the unions finger-tight at this stage.

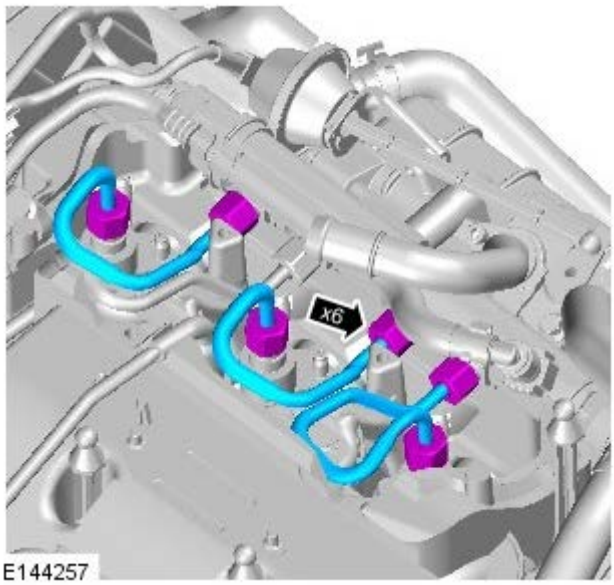
6.

   - 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.

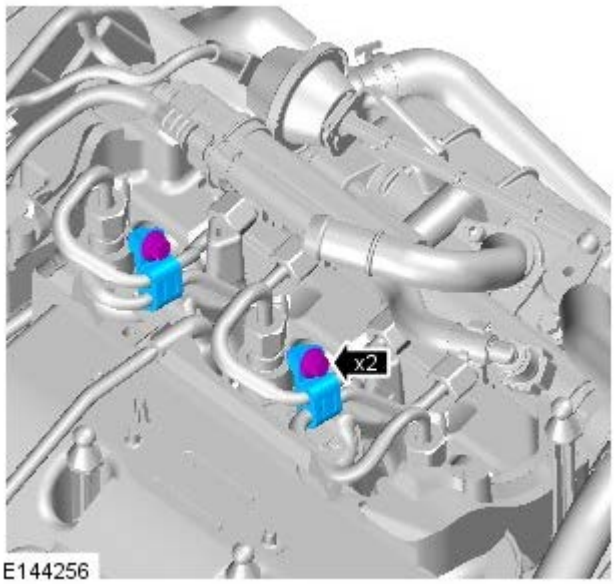


7.

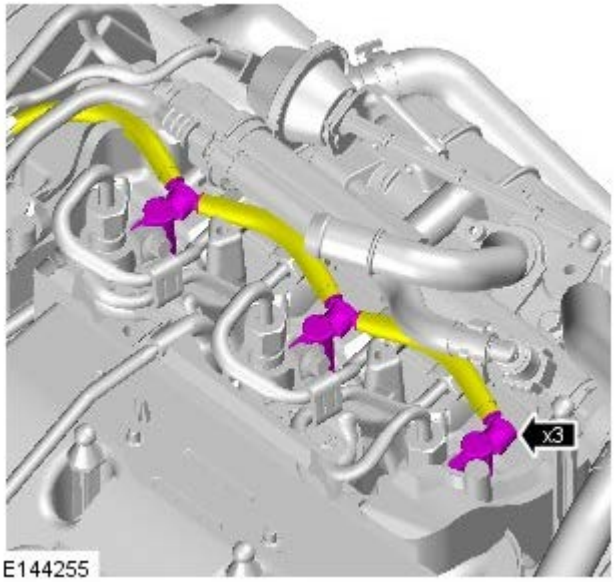
- Stage 1: Tighten the high-pressure fuel supply line unions at the fuel rail to 35Nm.
- Stage 2: Tighten the high-pressure fuel supply line unions at the injector to 35Nm.



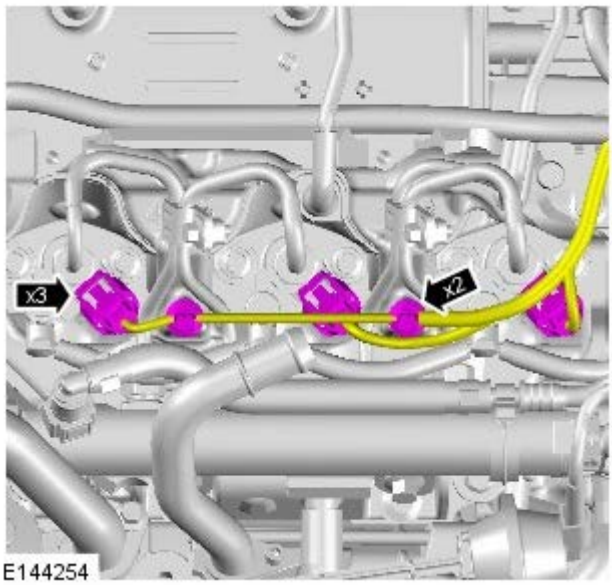
8. *Torque:* 10 Nm



9. NOTE: Make sure that the fuel injector return line has a maximum of 8 uses.



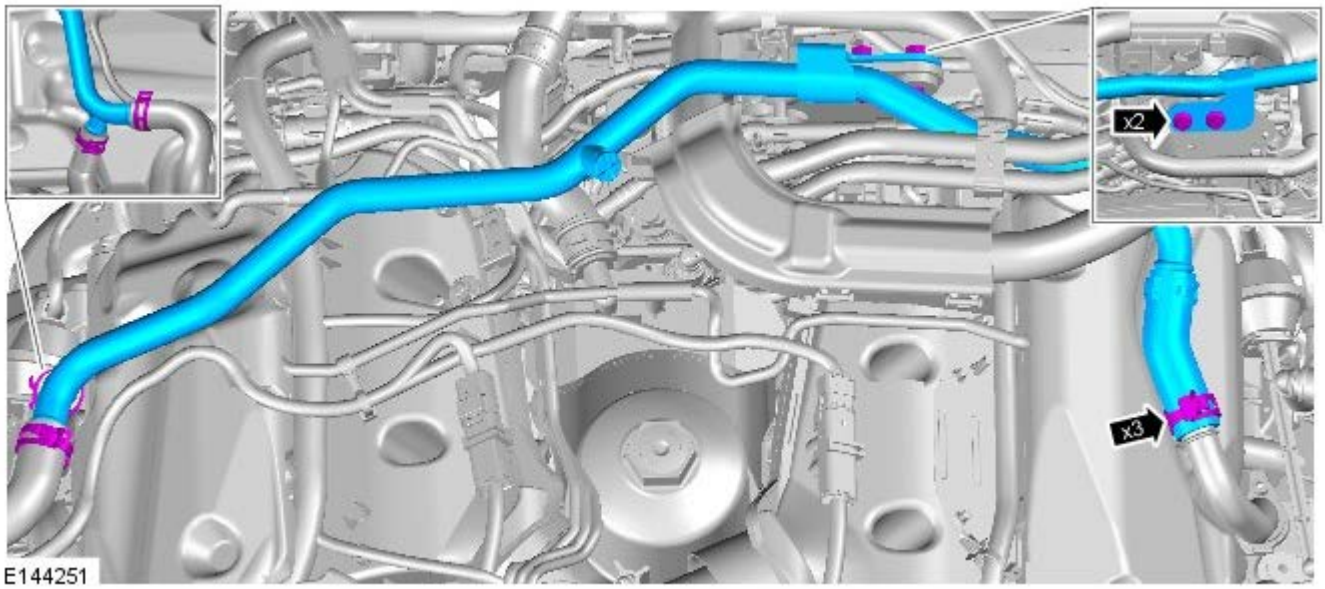
10.



11.



12. *Torque:* 10 Nm



13. Refer to: Cooling System Partial Draining, Filling and Bleeding (303-03A Engine Cooling - TDV6 3.0L Diesel, General Procedures).

14. Refer to: Secondary Bulkhead Center Panel - TDV6 3.0L Diesel (501-02 Front End Body Panels, Removal and Installation).

15. Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

16. If a new unit is installed, configure using the approved diagnostic tool.

Published: 10-Sep-2012

Fuel Charging and Controls - TDV6 3.0L Diesel - Fuel Injectors RH

Removal and Installation

Special Tool(s)

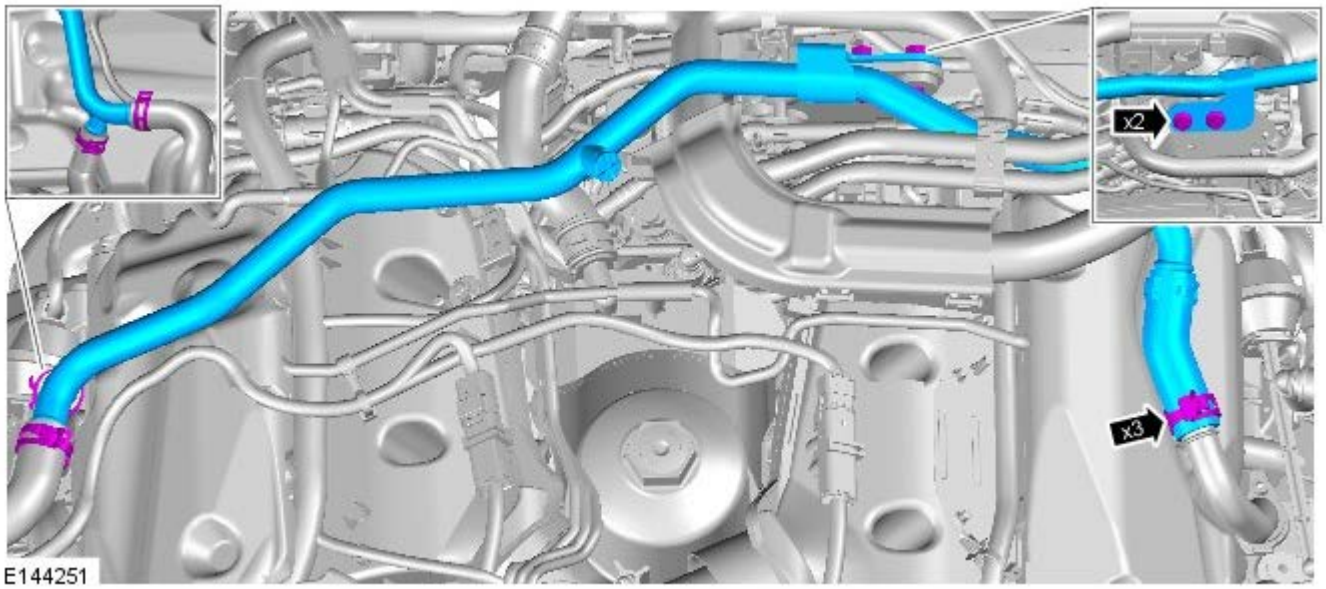
 E54135	100-012 Slide Hammer
 E116924	310-213 Fuel Injector Removal Adapter
 E124125	JLR-310-237 Remover, Fuel Injector

Removal

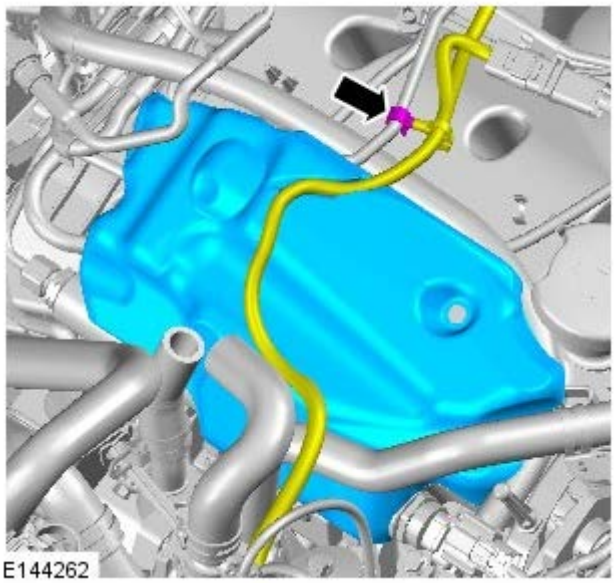
WARNING: Diesel fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install new blanking plugs to any open orifices or lines. Failure to follow this instruction 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.

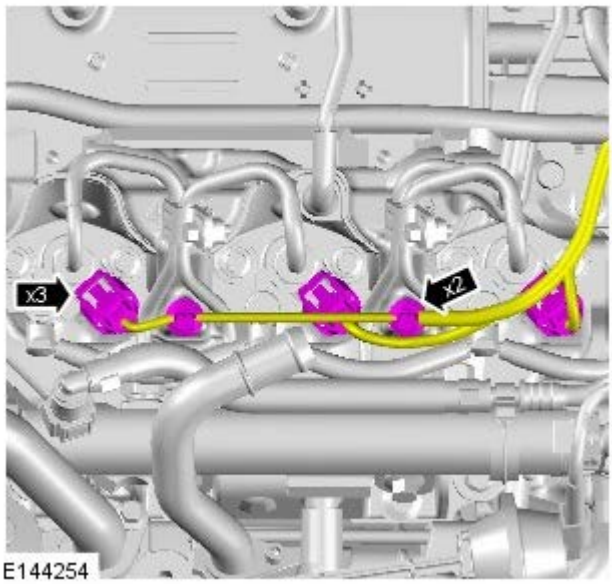
1. Refer to: Fuel Injection Component Cleaning (303-04, General Procedures).
2. Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).
3. Refer to: Secondary Bulkhead Center Panel - TDV6 3.0L Diesel (501-02 Front End Body Panels, Removal and Installation).
4. Refer to: Cooling System Partial Draining, Filling and Bleeding (303-03A Engine Cooling - TDV6 3.0L Diesel, General Procedures).
5. CAUTION: Be prepared to collect escaping coolant.



6.

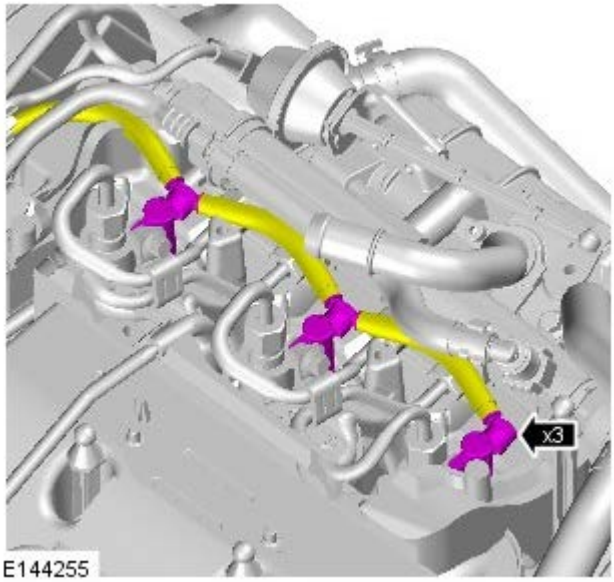


7. CAUTION: LH illustration shown, RH is similar.



8. CAUTIONS:

Be prepared to collect escaping fuel.

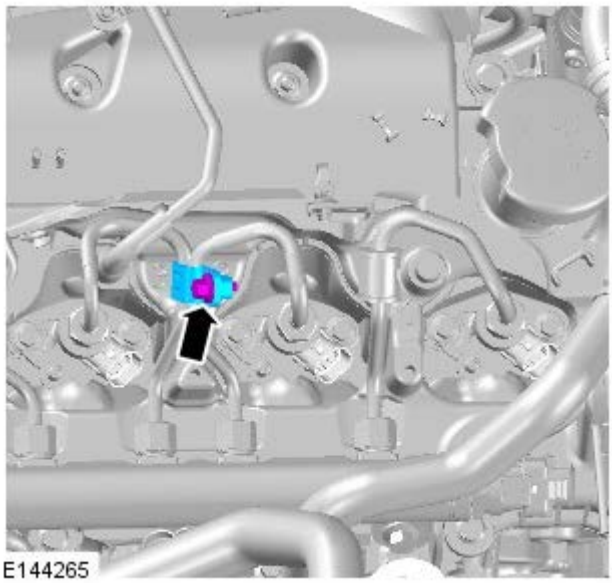


Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

LH illustration shown, RH is similar.

NOTE: Make sure that the fuel injector return line has a maximum of 8 uses.

9.

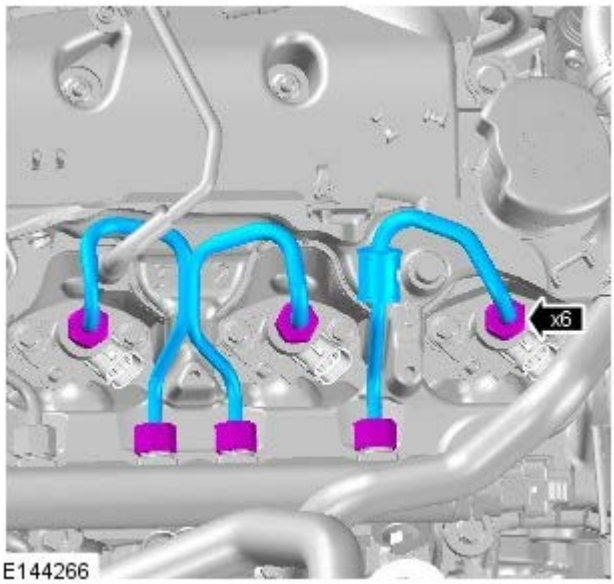


10. CAUTIONS:

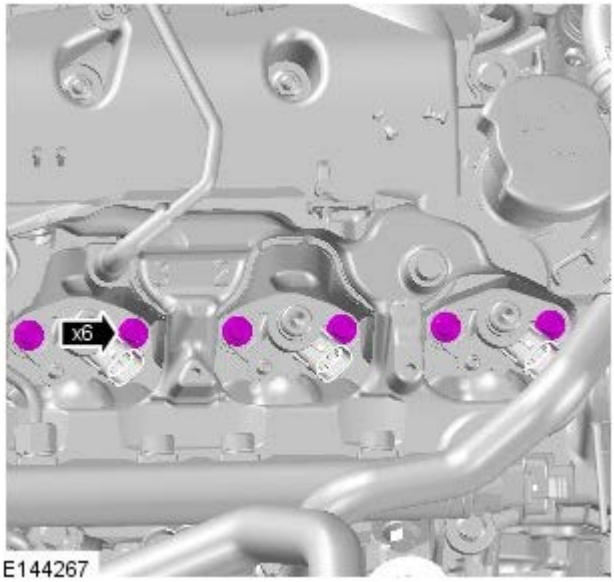
Be prepared to collect escaping fuel.

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.



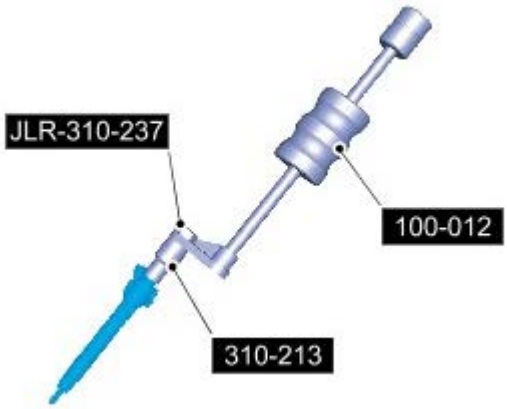
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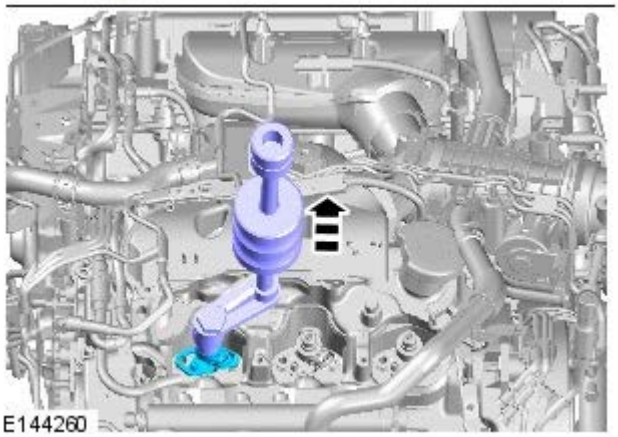


12.

- Install the special tools

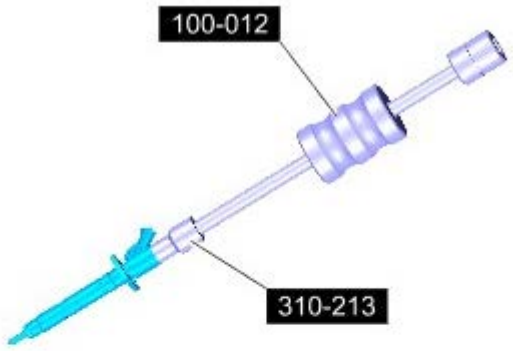
  Special Tool(s): 310-213, 100-012, JLR-310-237

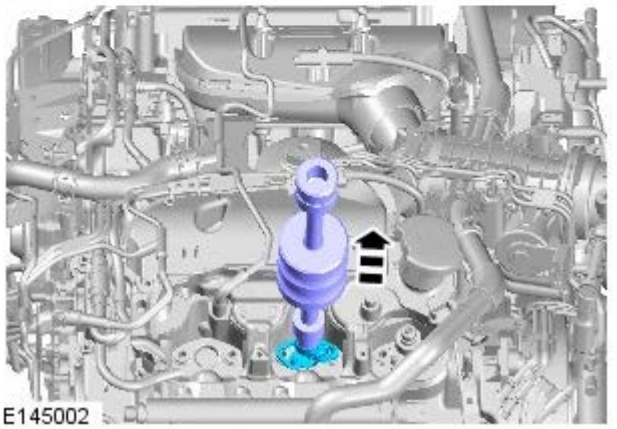


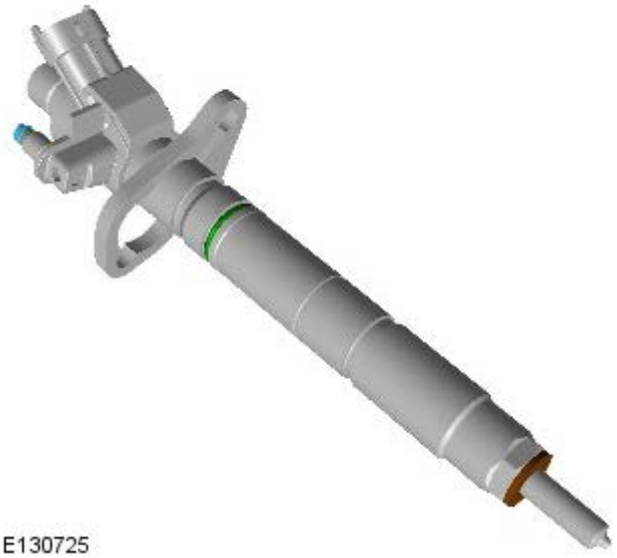


13. NOTE: Repeat this step for the remaining fuel injectors.

- *Special Tool(s):* 310-213, 100-012




E145002


E130725

14. NOTES:

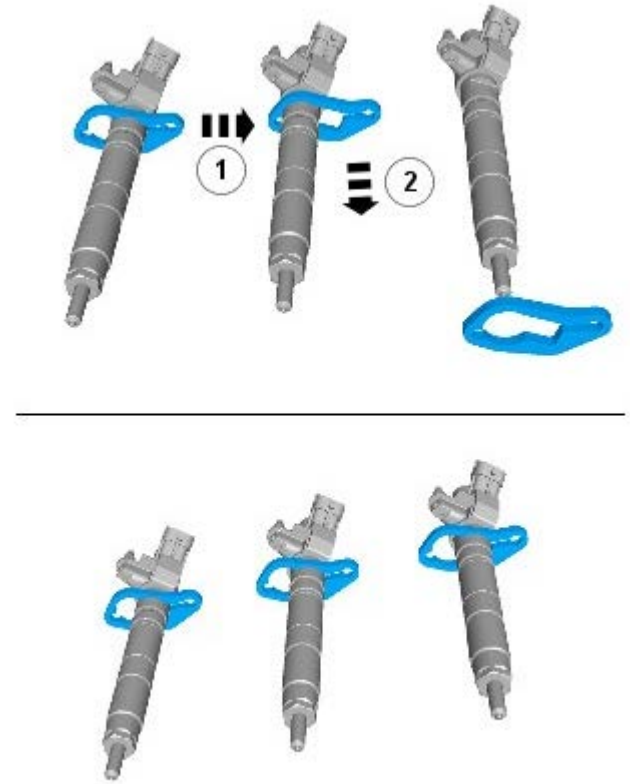
This step is only required if new components are not installed.

Remove and discard the O-ring seals.

Discard the sealing washers.

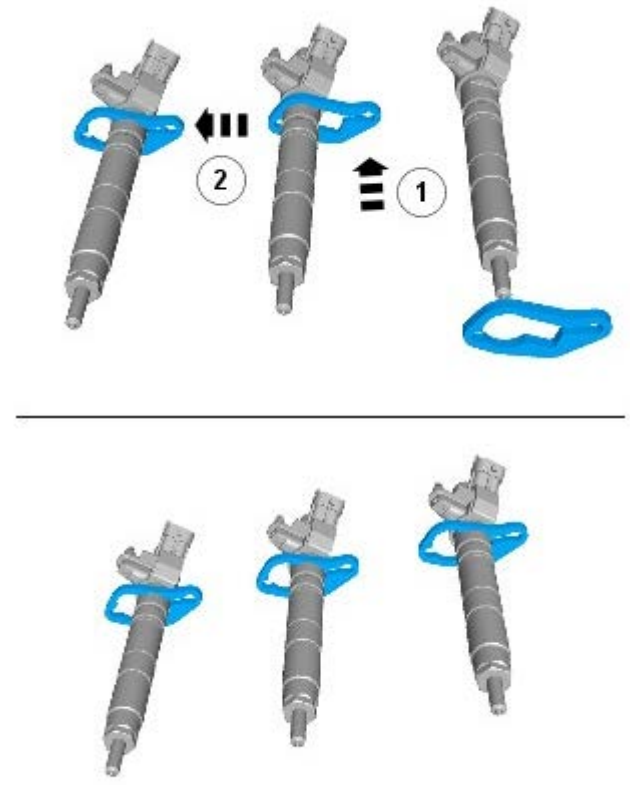
Repeat this step for each of the fuel injectors.

15. NOTE: This step is only required if new components are not installed.



E144699

Installation

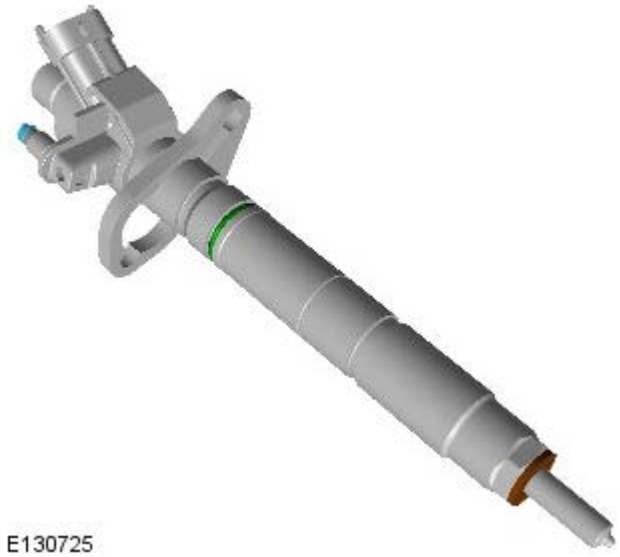


E144700

1. NOTE: This step is only required if previously removed.

2. CAUTION: Make sure that new sealing washers are installed.

   NOTES:



E130725

This step is only required if previously removed.

Install new O-ring seals.

Repeat this step for each of the fuel injectors.

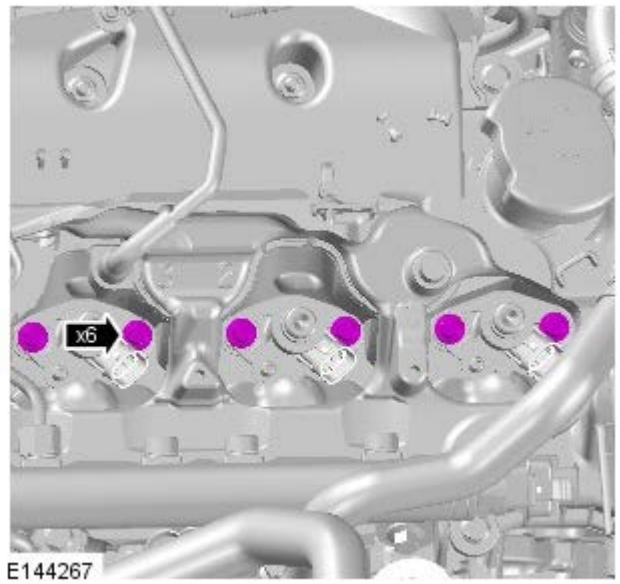
3. CAUTIONS:



E144688

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.



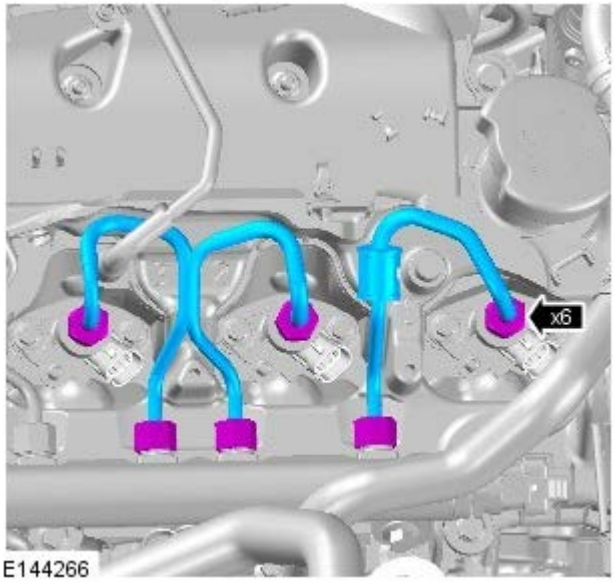
E144267

4. NOTE: Tighten the retaining bolts evenly and progressively.

Torque: 9 Nm

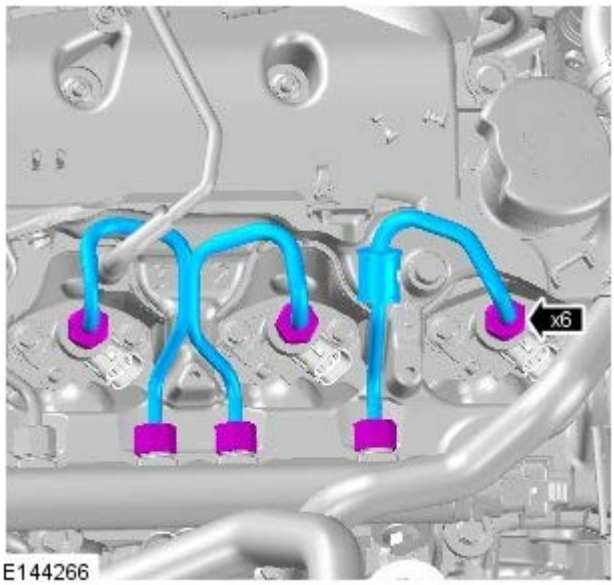
5. CAUTIONS:

Make sure that a new component is installed.



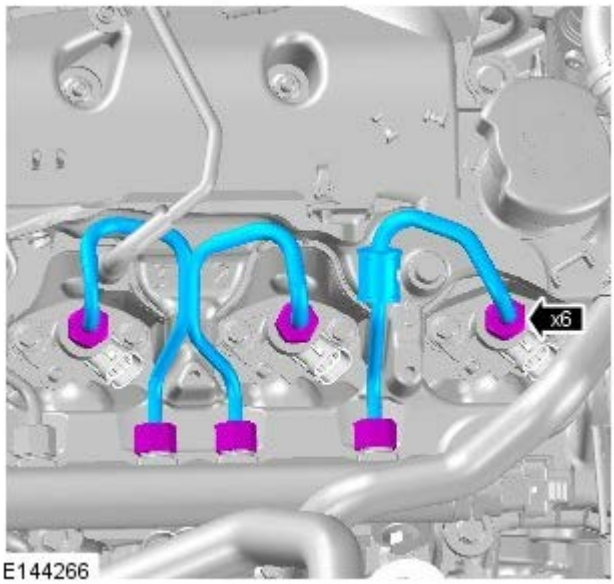
Only tighten the unions finger-tight at this stage.

6.



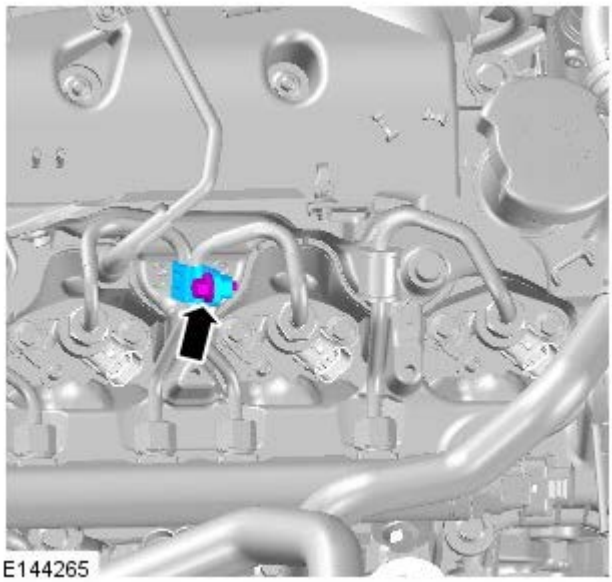
- Stage 1:Tighten the high-pressure fuel supply line unions at the fuel rail to 15Nm.
- Stage 2: Tighten the high-pressure fuel supply line unions at the injector to 15Nm.

7.



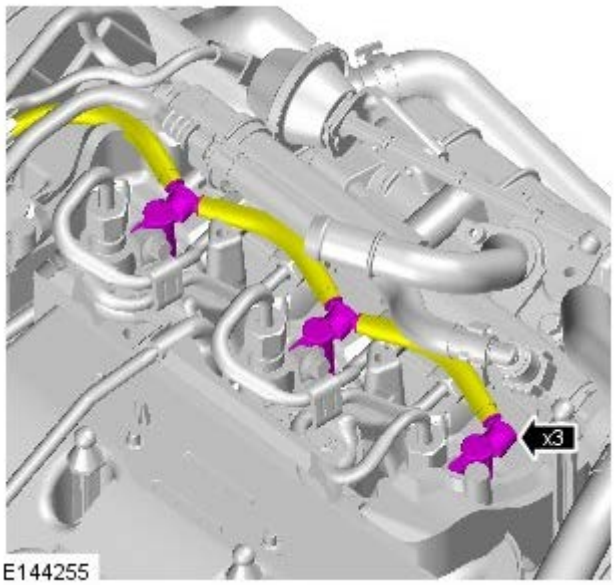
- Stage 1: Tighten the high-pressure fuel supply line unions at the fuel rail to 35Nm.
- Stage 2: Tighten the high-pressure fuel supply line unions at the injector to 35Nm.

8. *Torque:* 10 Nm


E144265

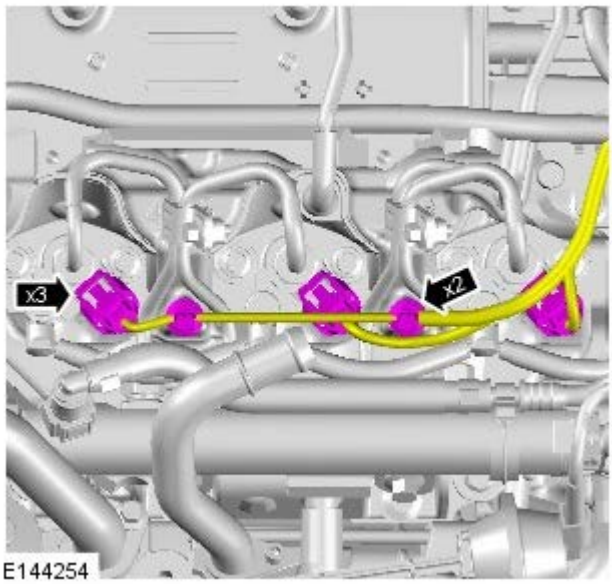
9. CAUTION: LH illustration shown, RH is similar.

NOTE: Make sure that the fuel injector return line has a maximum of 8 uses.



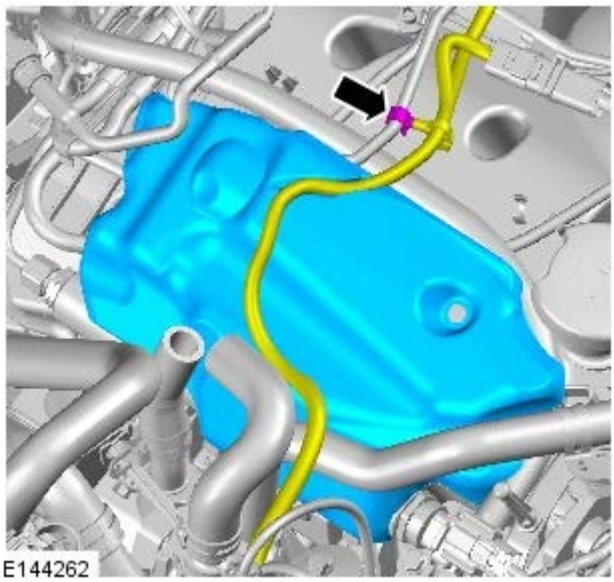
E144255

10. CAUTION: LH illustration shown, RH is similar.

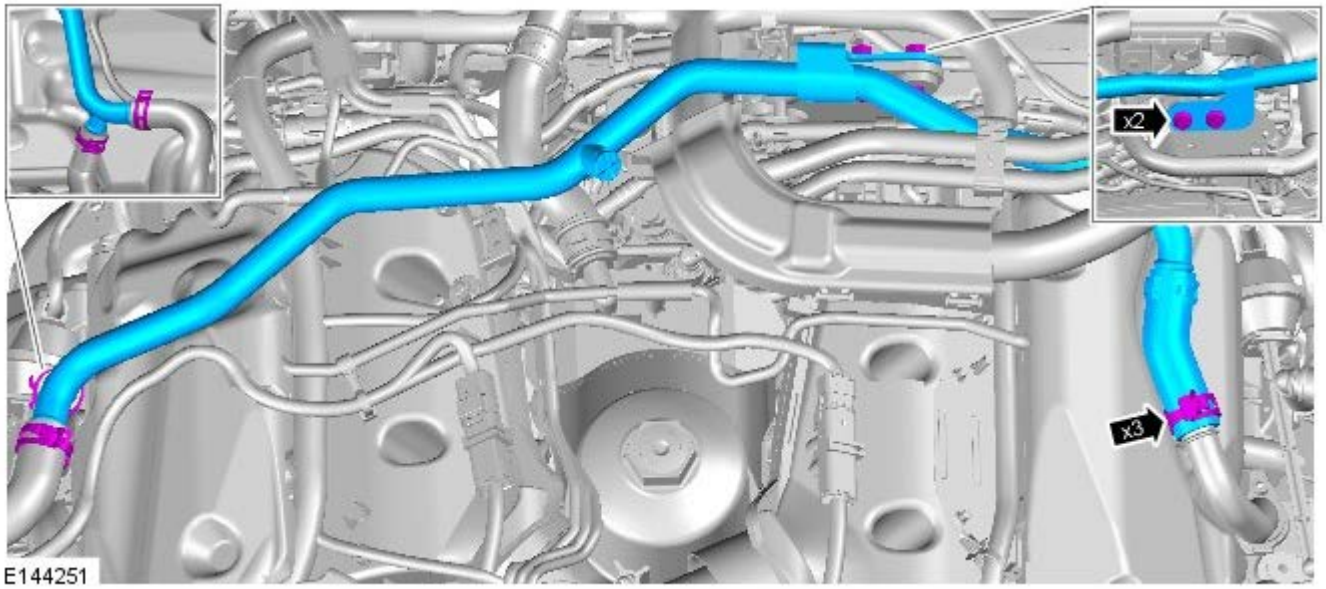


E144254

11.



12. *Torque:* 10 Nm



13. Refer to: Cooling System Partial Draining, Filling and Bleeding (303-03A Engine Cooling - TDV6 3.0L Diesel, General Procedures).

14. Refer to: Secondary Bulkhead Center Panel - TDV6 3.0L Diesel (501-02 Front End Body Panels, Removal and Installation).

15. Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

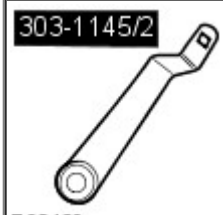
16. If a new unit is installed, configure using the approved diagnostic tool.

Published: 08-Aug-2012

Fuel Charging and Controls - TDV6 3.0L Diesel - Fuel 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:

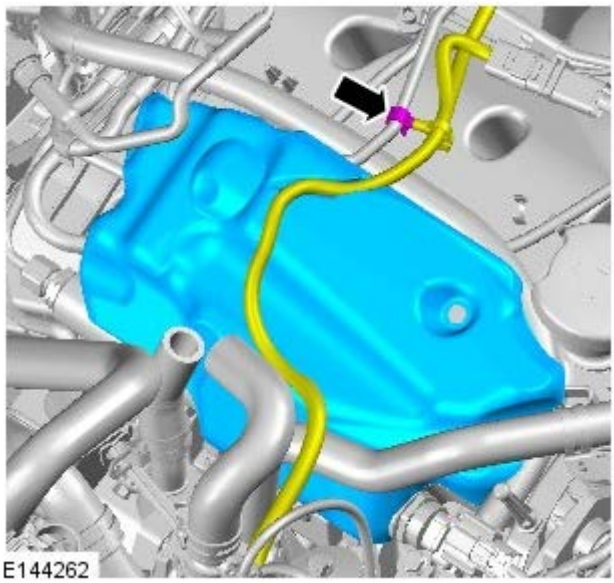
Removal steps in this procedure may contain installation details.

Some variation in the illustrations may occur, but the essential information is always correct.

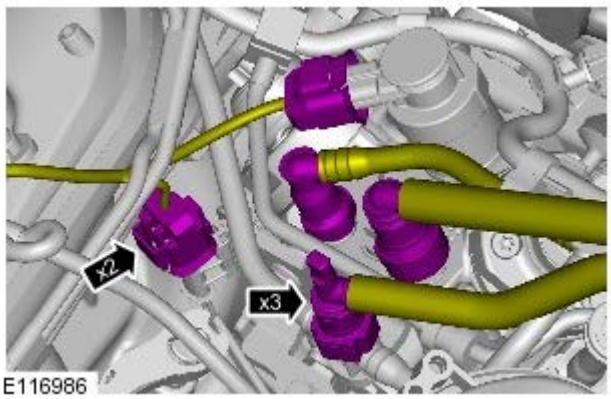
1. Refer to: Fuel Injection Component Cleaning (303-04A Fuel Charging and Controls - TDV6 3.0L Diesel, General Procedures).
2. Refer to: Rear End Accessory Drive (READ) (303-05A Accessory Drive - TDV6 3.0L Diesel, Removal and Installation).
3. Refer to: Crankcase Vent Oil Separator (303-08A Engine Emission Control - TDV6 3.0L Diesel, Removal and Installation).


E144253

5.

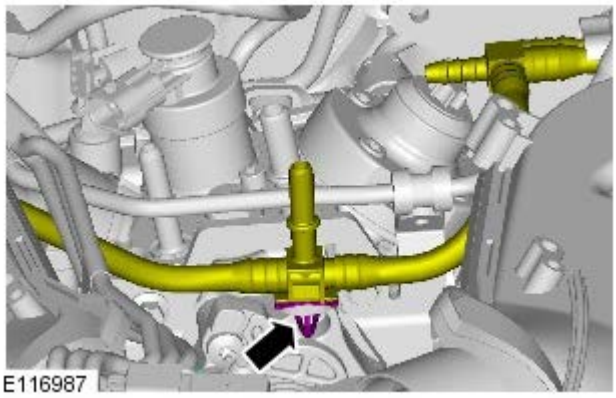

E144262

6. CAUTION: Be prepared to collect escaping fuel.

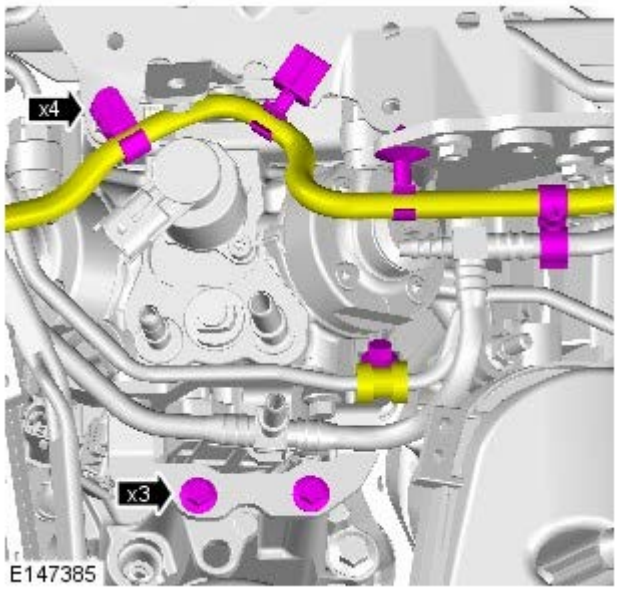


E116986

7. CAUTION: Be prepared to collect escaping fuel.



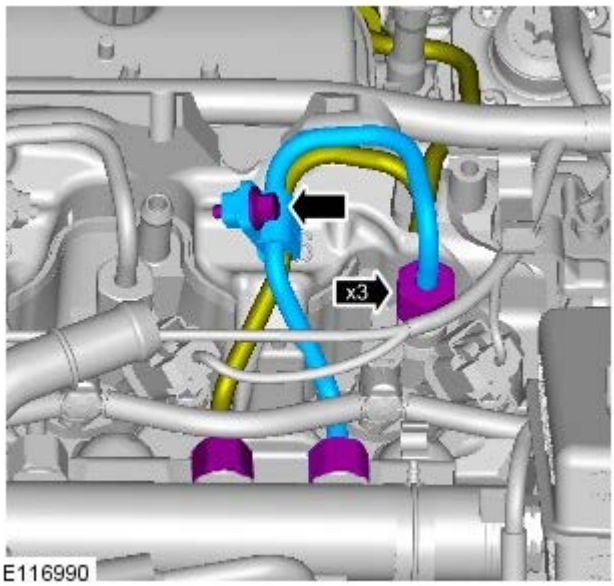
8.



9. CAUTIONS:

Be prepared to collect escaping fuel.

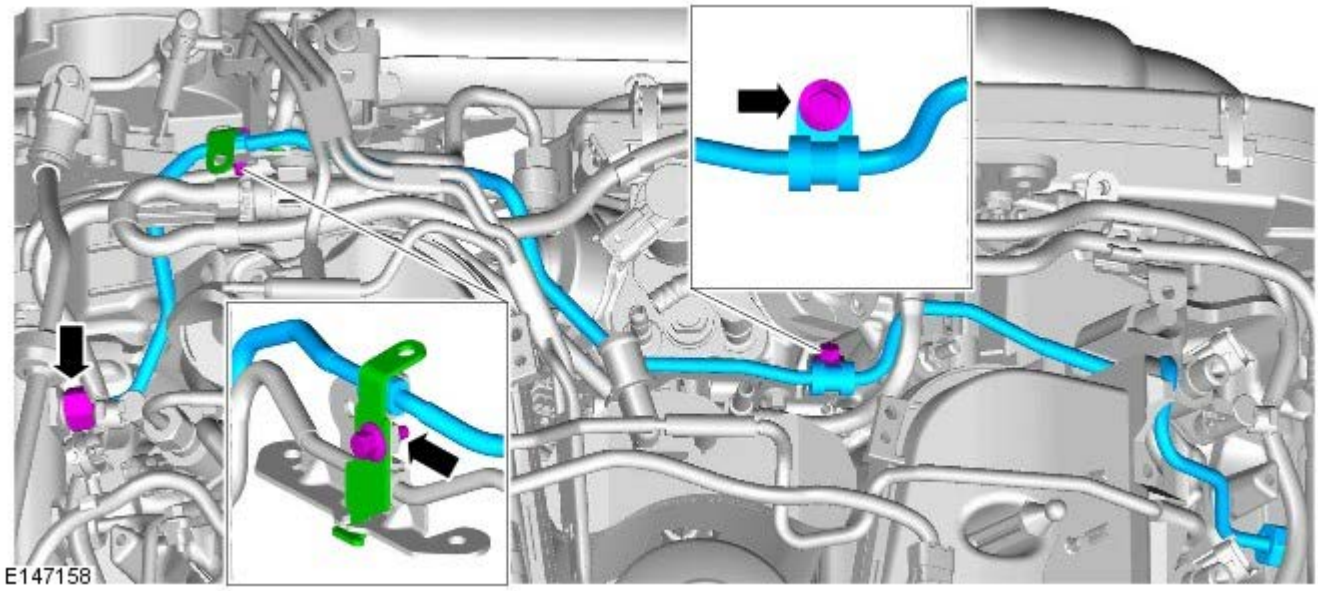
Discard the component.

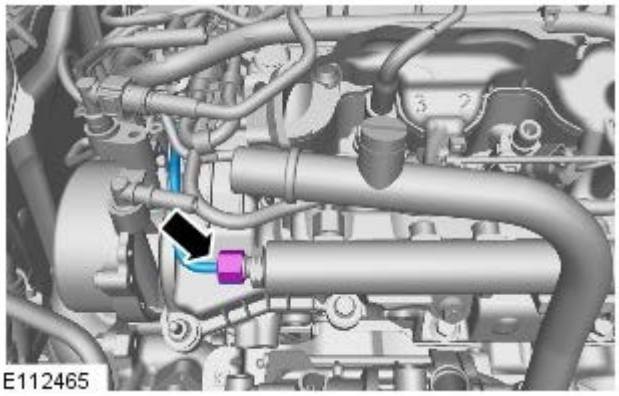


10. CAUTIONS:

Be prepared to collect escaping fuel.

Discard the component.



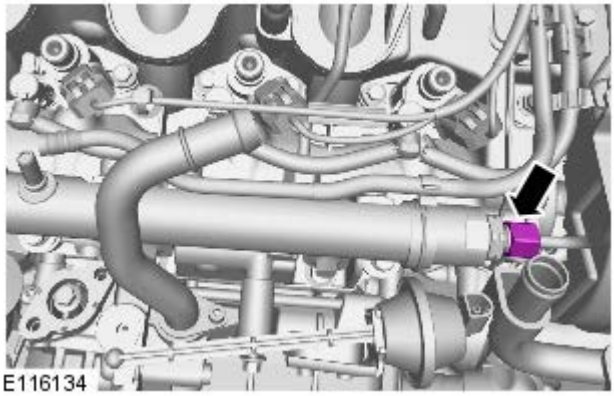


11. CAUTIONS:

Be prepared to collect escaping fuel.

Discard the component.

NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

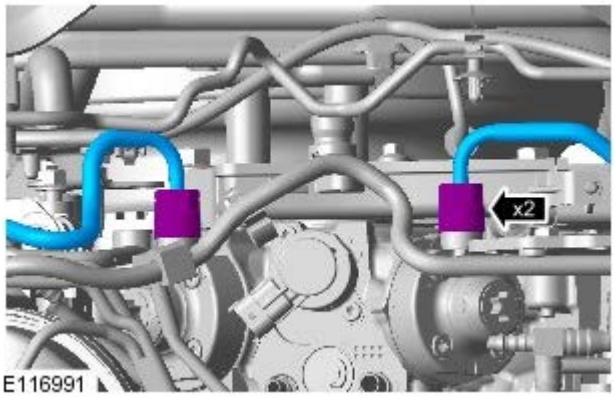


12. CAUTIONS:

Be prepared to collect escaping fuel.

Discard the component.

NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

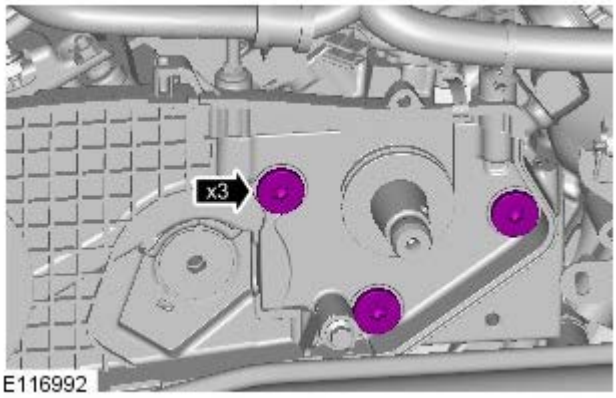


13. CAUTIONS:

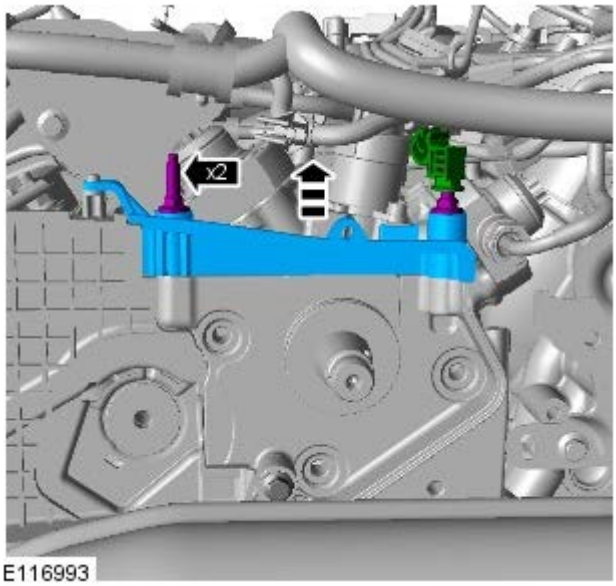
Be prepared to collect escaping fuel.

Discard the components.

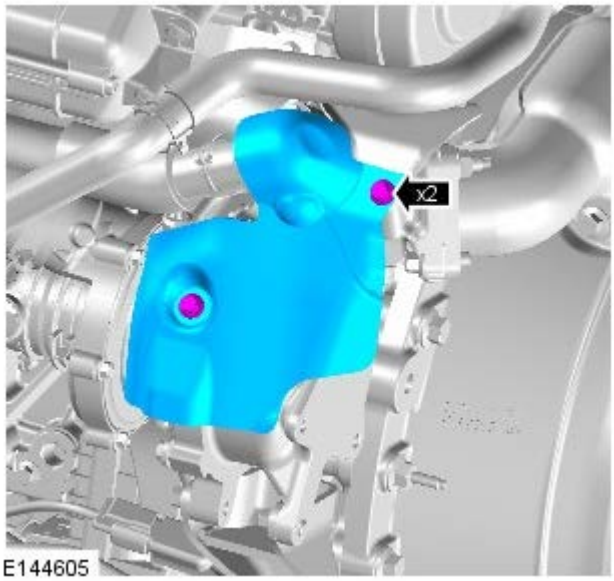
14. NOTE: Fuel injection pump pulley shown removed for clarity.



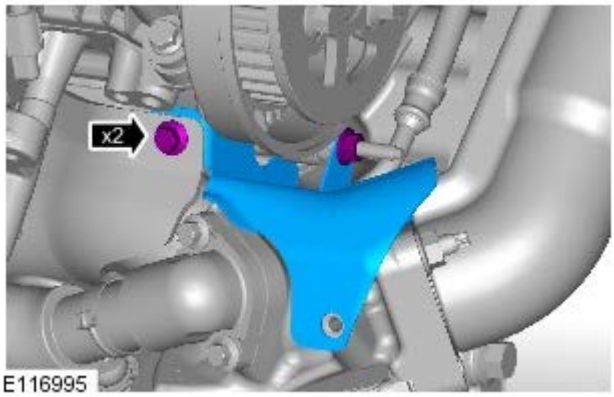
15. NOTE: Fuel injection pump pulley shown removed for clarity.



16.



17.



18. *Special Tool(s):* JLR-303-1523



19. *Special Tool(s):* JLR-303-1523



20. Remove the camshaft rear pulley retaining bolt.

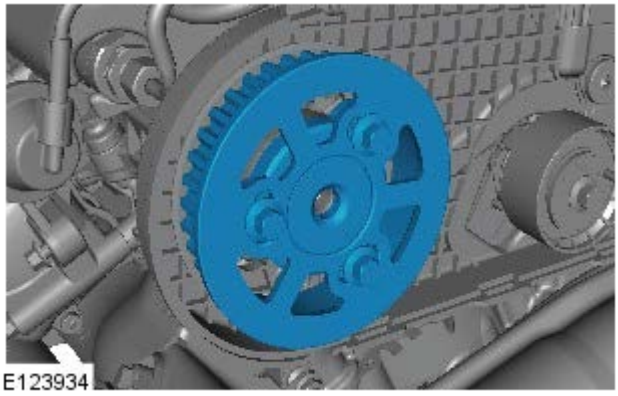
    Special Tool(s): 303-1145/2



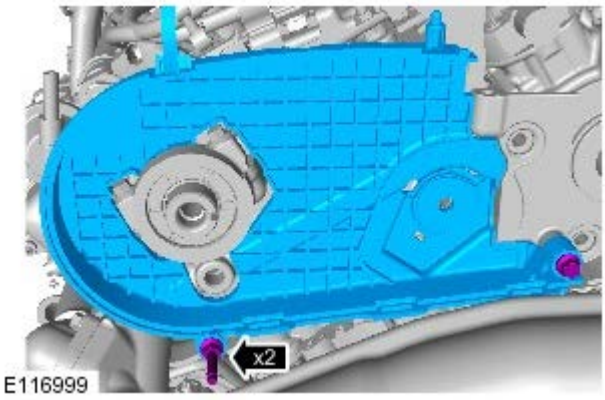
E123895

21. Remove the special tools.

22.

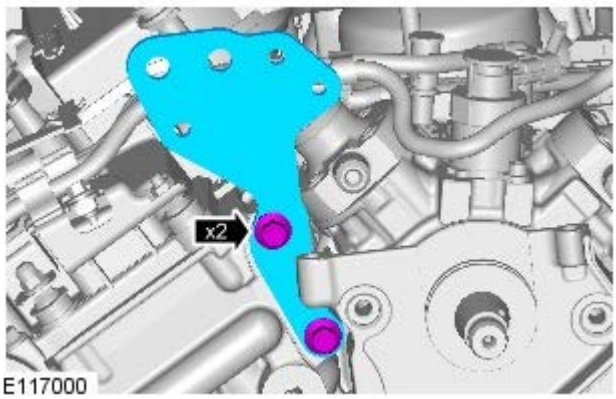

E123934

23.



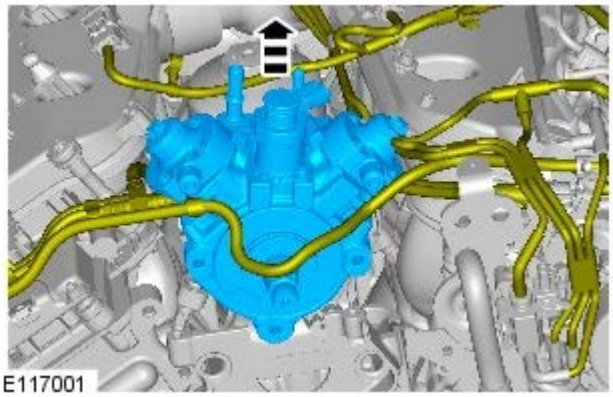
E116999

24.

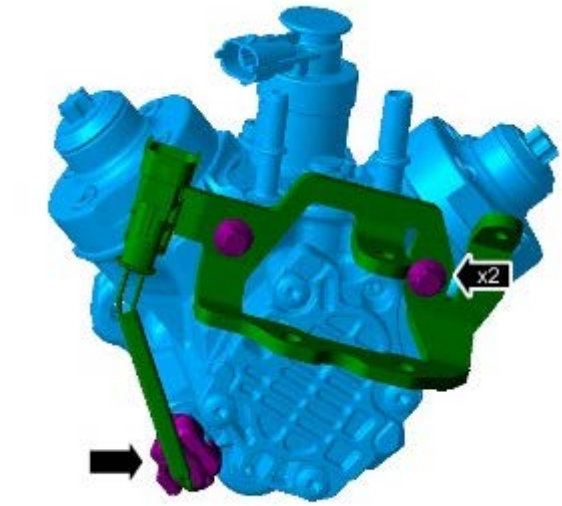


E117000

25.

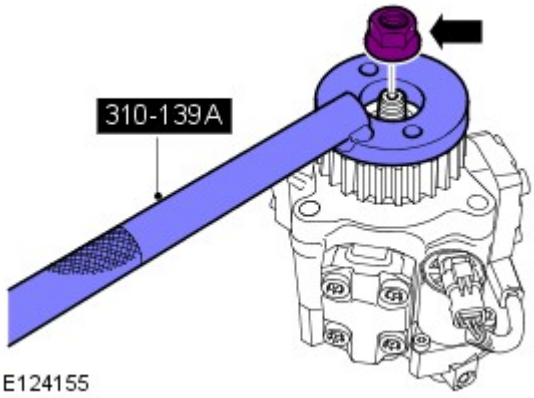

E117001

26. NOTE: Do not disassemble further if the component is removed for access only.



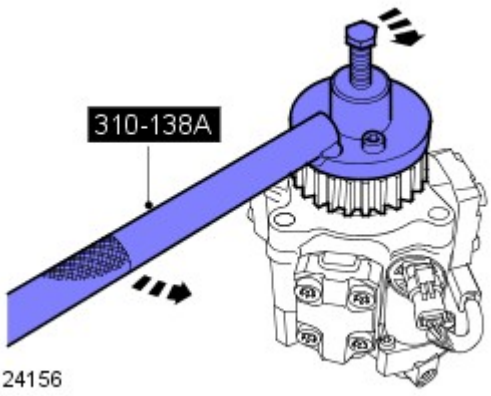
E117002

27. *Special Tool(s):* 310-139A



E124155

28. *Special Tool(s):* 310-138A

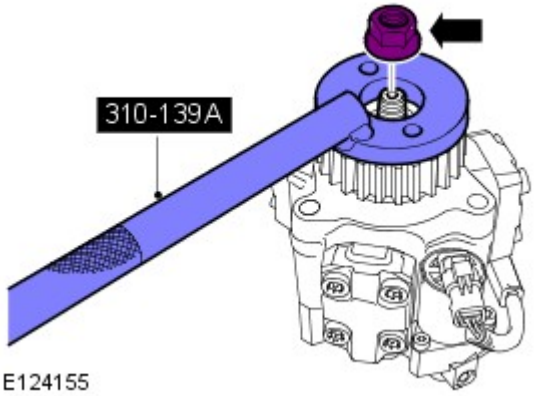


E124156

Installation

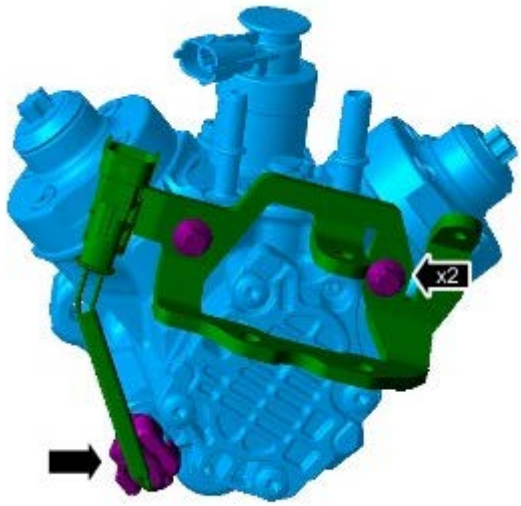
1. *Special Tool(s):* 310-139A

Torque: 50 Nm



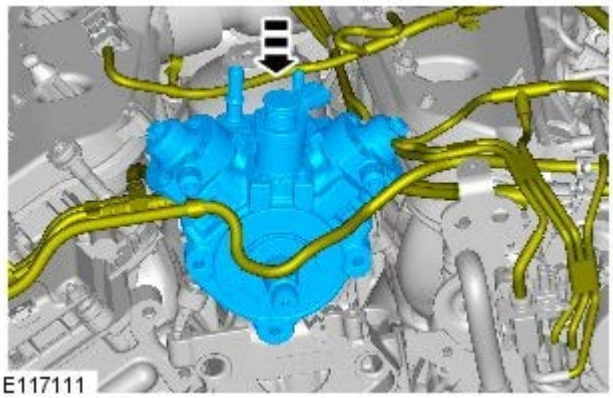
E124155

2. *Torque:* 3 Nm

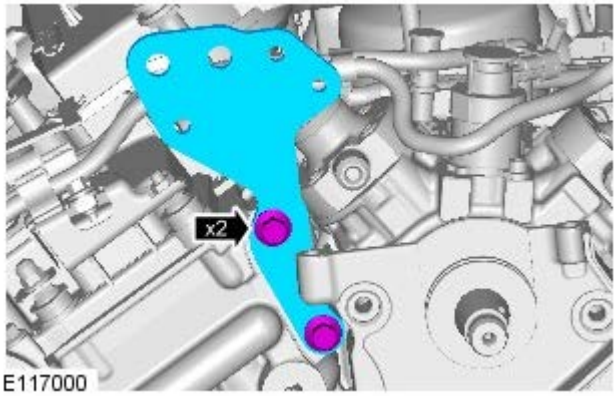


E117002

3.

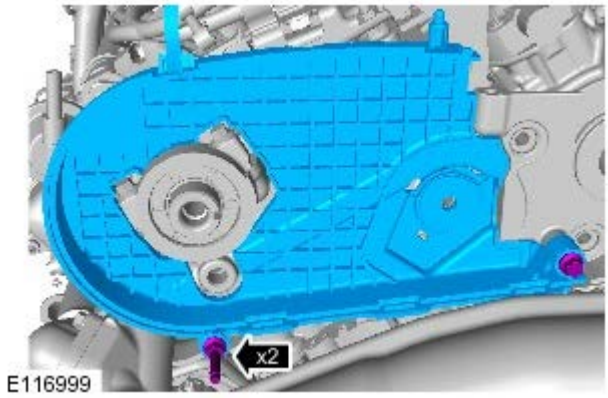

E117111

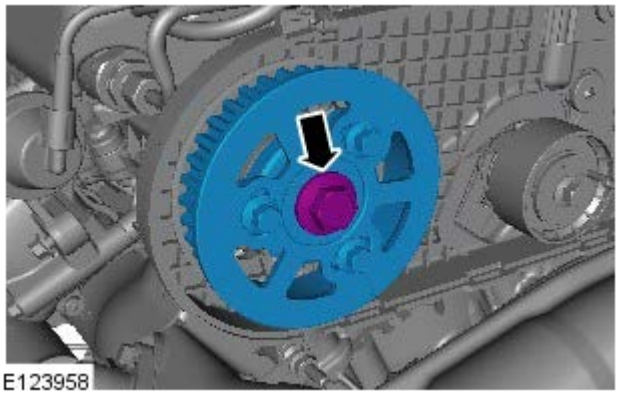
4. *Torque:* 23 Nm



E117000

5. *Torque:* 10 Nm





6. CAUTIONS:

   Apply loctite 242 to the new camshaft pulley bolt.

   Install the bolt finger tight.

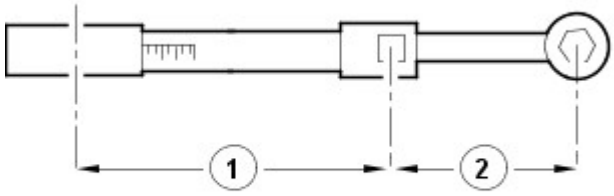


7. *Special Tool(s):* JLR-303-1523
   Torque: 10 Nm

8. *Special Tool(s):* JLR-303-1523



E123894



E37107

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 arrived at in stage 3.



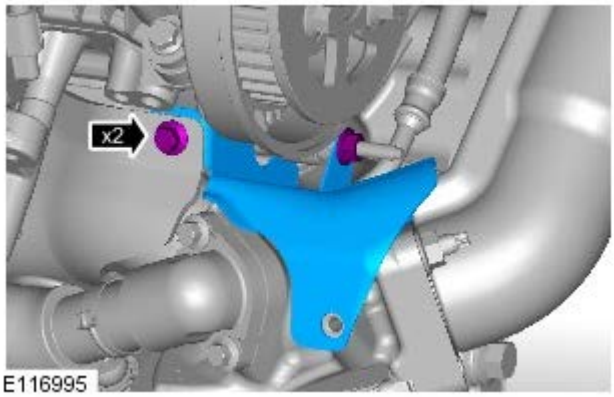
E123895

10. CAUTION: Make sure the torque wrench setting procedure is followed correctly. Failure to follow this instruction may result in damage to the vehicle.

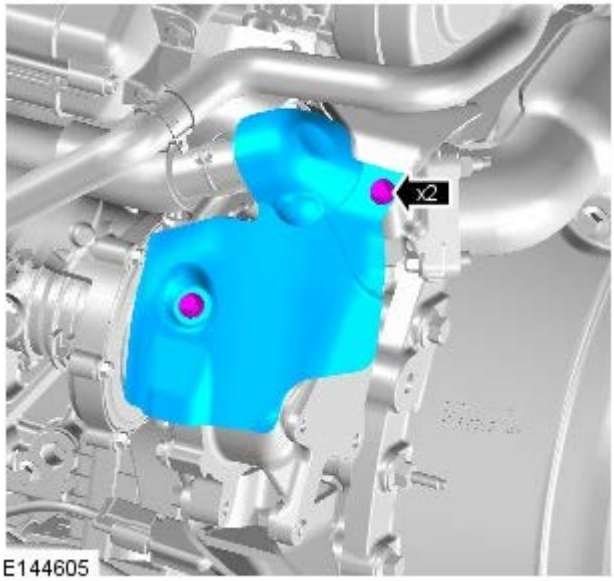
Special Tool(s): 303-1145/2
Torque:
Stage 1: 80 Nm
Stage 2: 80°

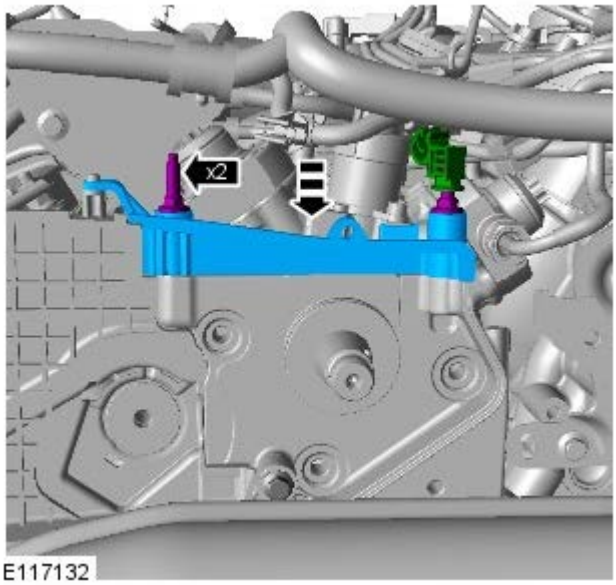
11. Remove the special tools.

12. *Torque:* 10 Nm



13. *Torque:* 10 Nm



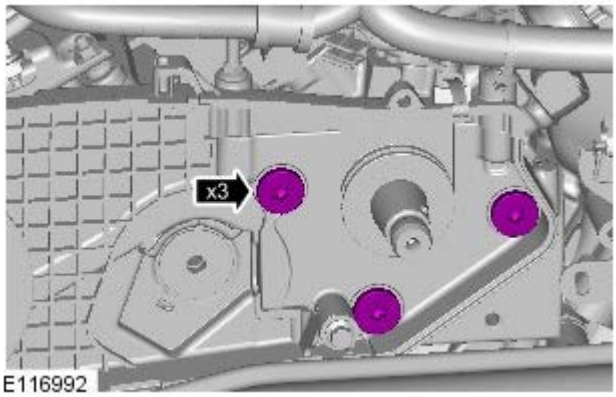


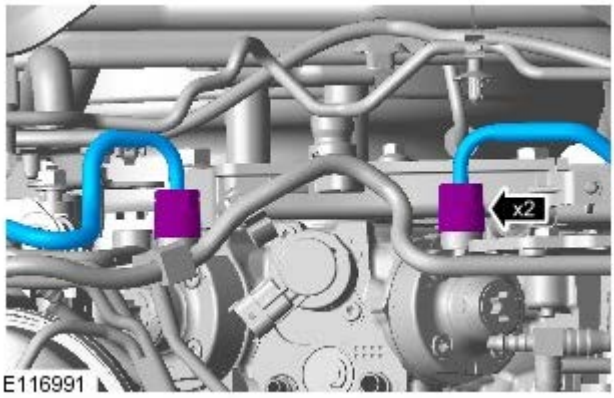
14. NOTE: Fuel injection pump pulley shown removed for clarity.

Torque: 10 Nm

15. NOTE: Fuel injection pump pulley shown removed for clarity.

Torque: 23 Nm

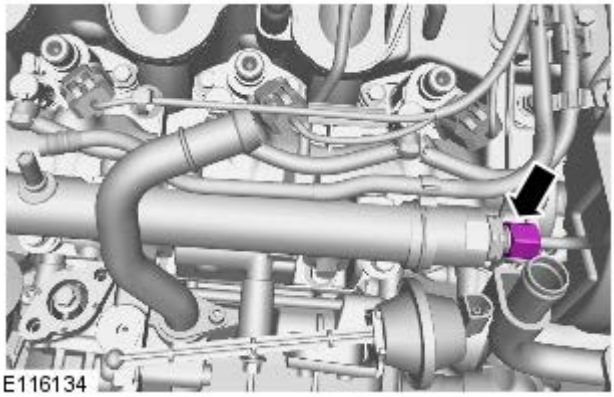




16. CAUTIONS:

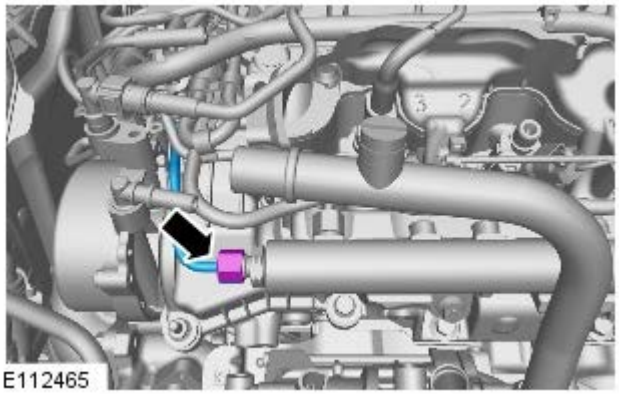
Tighten the fuel supply line unions finger tight.

Make sure that a new component is installed.



17. CAUTION: Tighten the fuel supply line unions finger tight.

NOTE: Some variation in the illustrations may occur, but the essential information is always correct.



18. CAUTION: Tighten the fuel supply line unions finger tight.

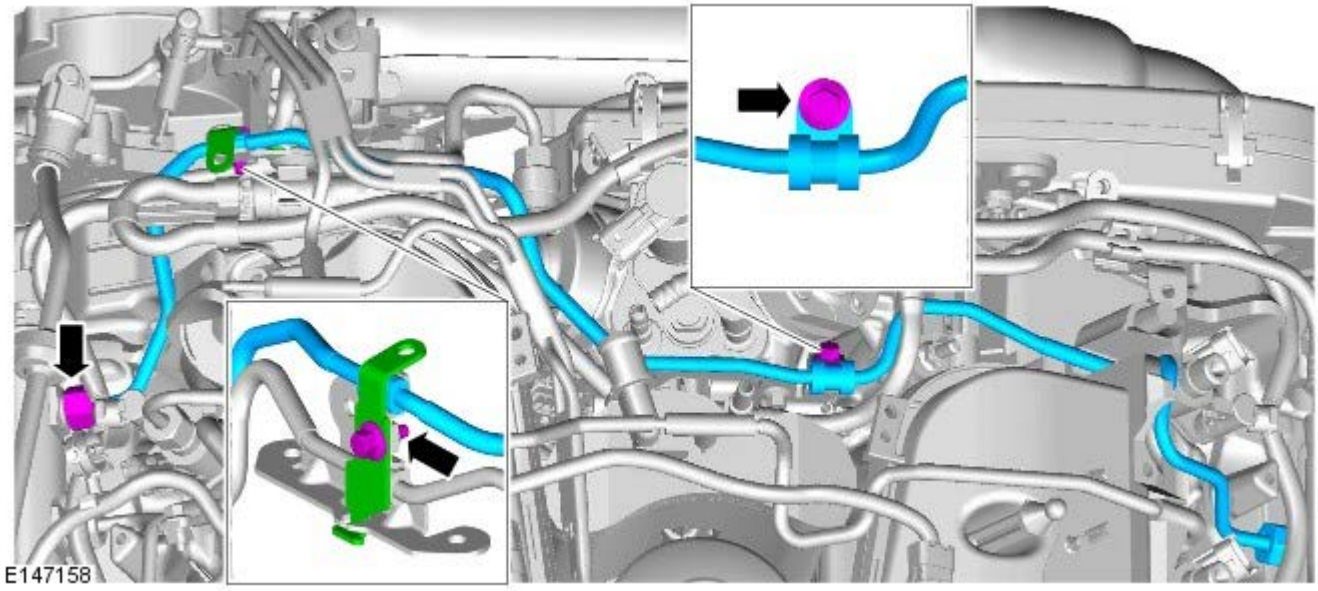
NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

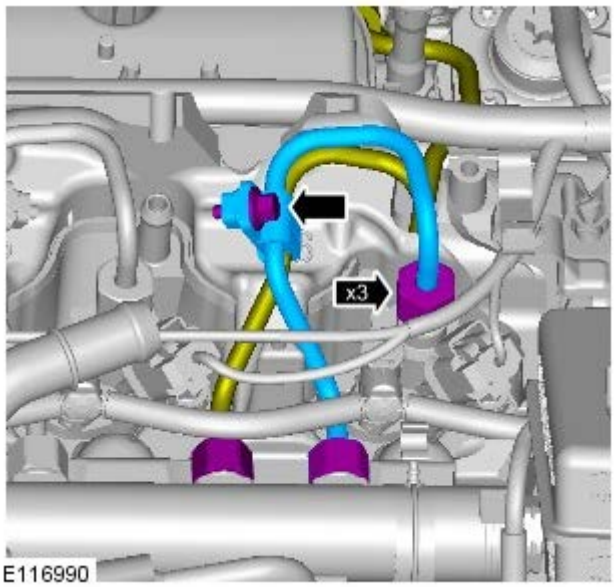
19. CAUTIONS:

Make sure that a new component is installed.

Tighten the fuel supply line unions finger tight.

Only tighten the bolts finger-tight at this stage.



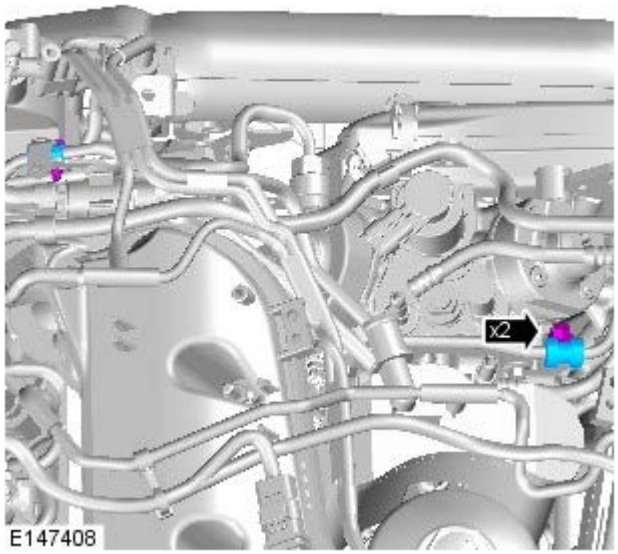


20. CAUTIONS:

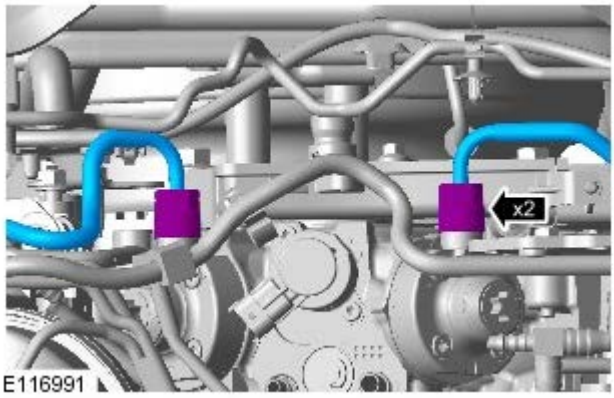
    Tighten the fuel supply line unions finger tight.

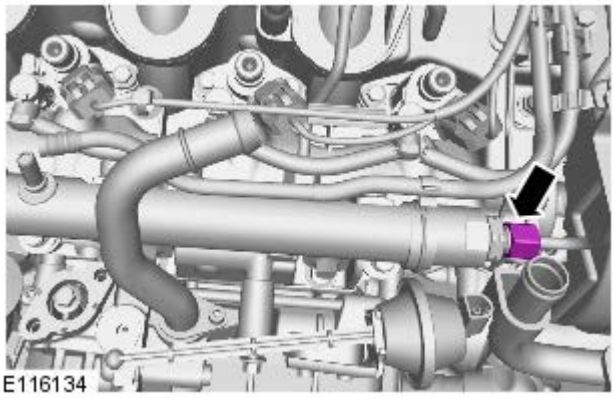
    Make sure that new components are installed.

21. *Torque:* 10 Nm



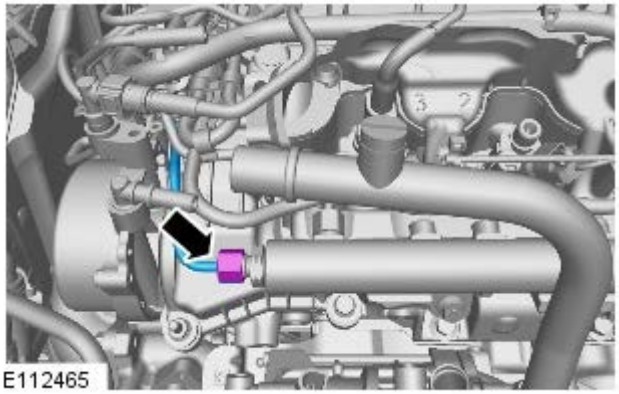
22. Tighten the high-pressure fuel lines union to 15Nm.





23. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

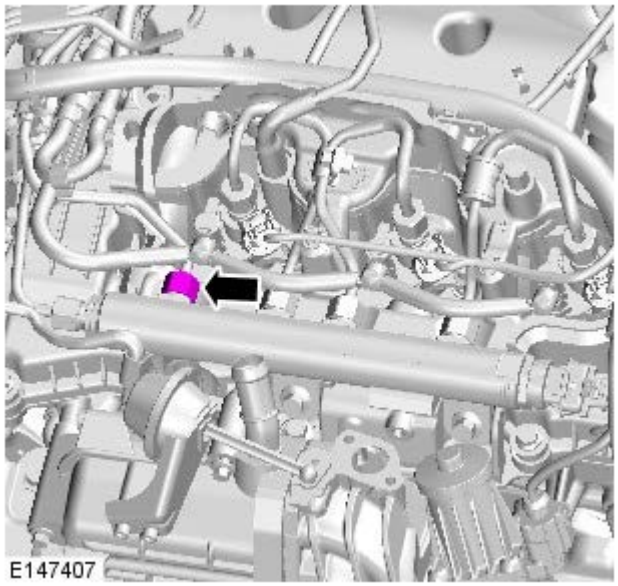
Tighten the high-pressure fuel lines union to 15Nm.



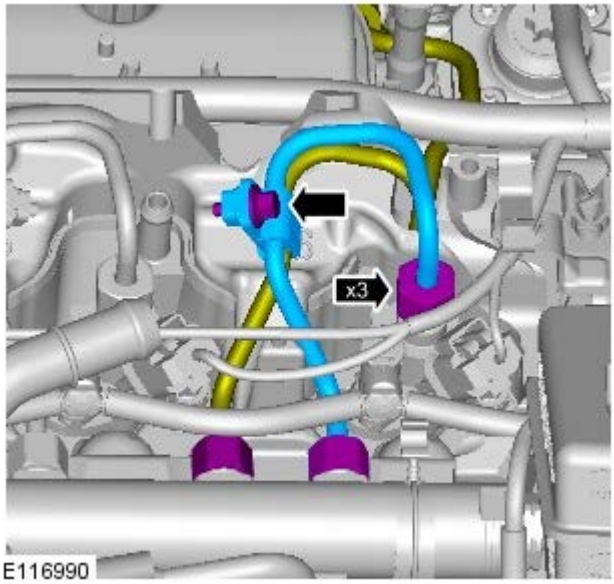
24. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Tighten the high-pressure fuel lines union to 15Nm.

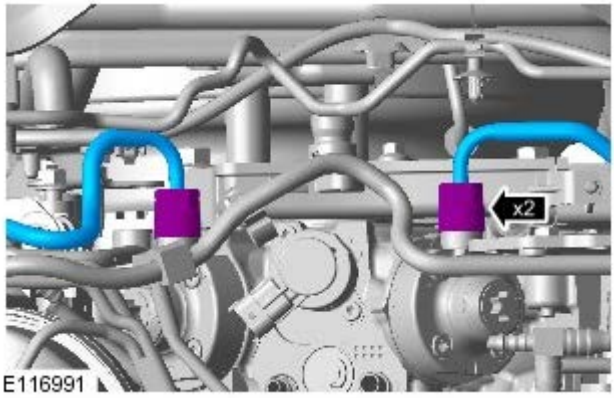
25. Tighten the high-pressure fuel line union to 15 Nm.



26. Tighten the high-pressure fuel lines union to 15Nm.

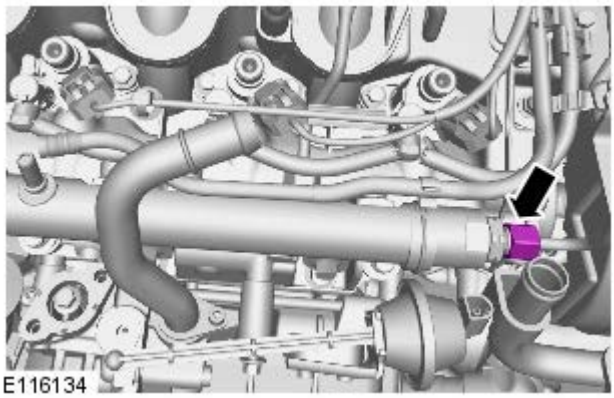


27. Tighten the high-pressure fuel line union to 35 Nm.



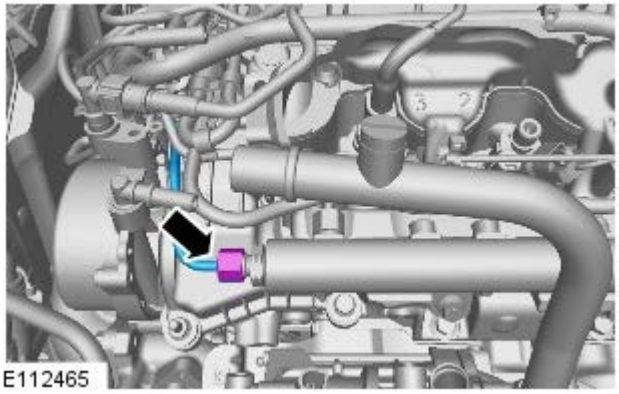
28. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Tighten the high-pressure fuel line union to 35 Nm.

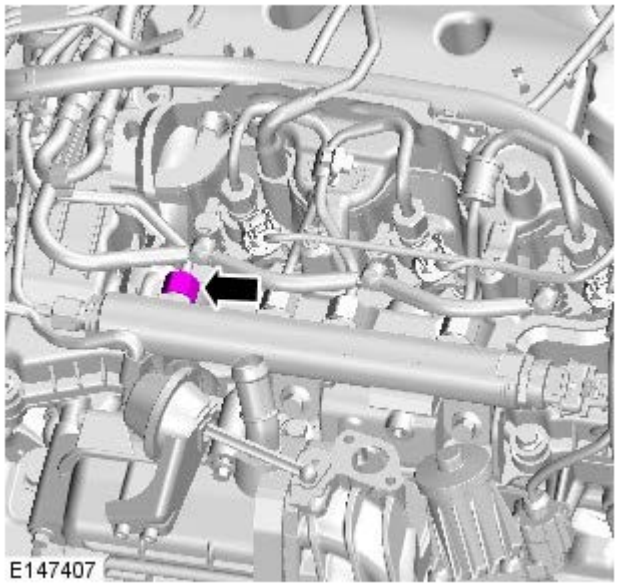


29. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

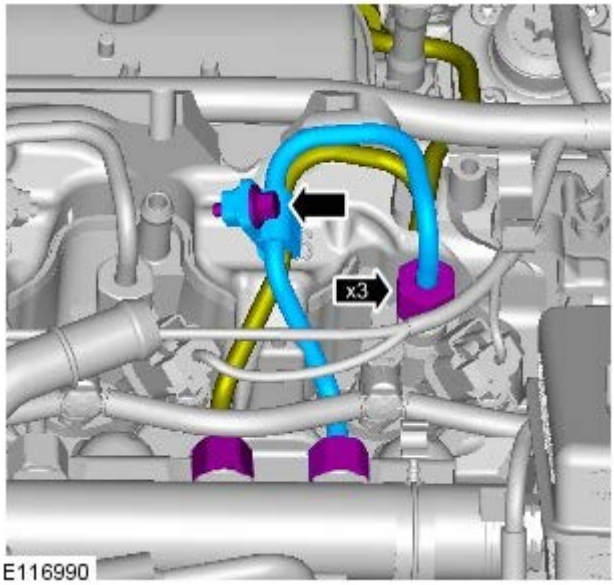
Tighten the high-pressure fuel line union to 35 Nm.



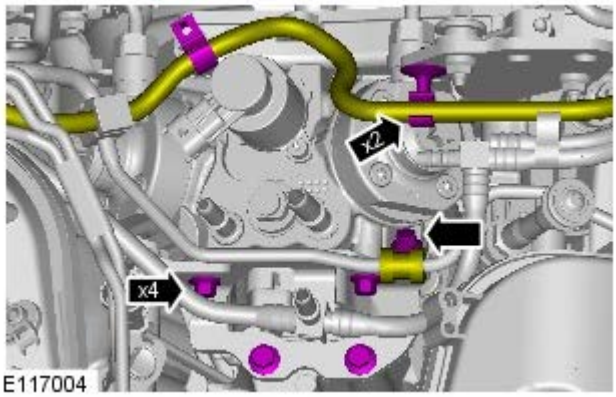
30. Tighten the high-pressure fuel line union to 35 Nm.



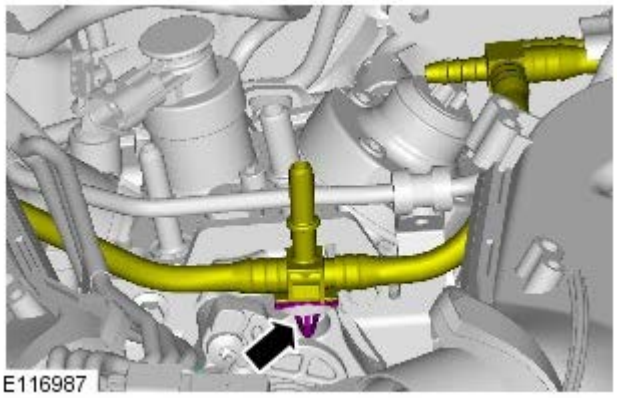
31. Tighten the high-pressure fuel line union to 35 Nm.



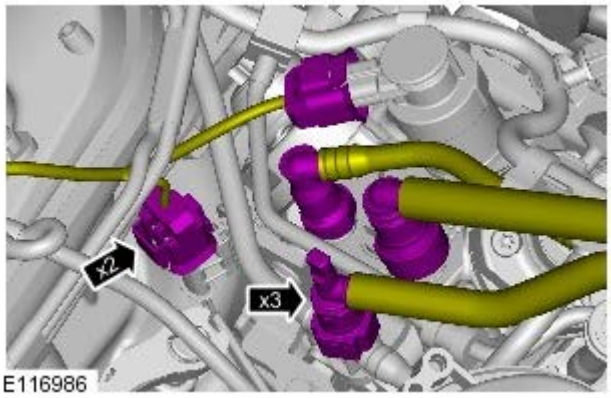
32. *Torque:* 10 Nm



33.


E116987

34.

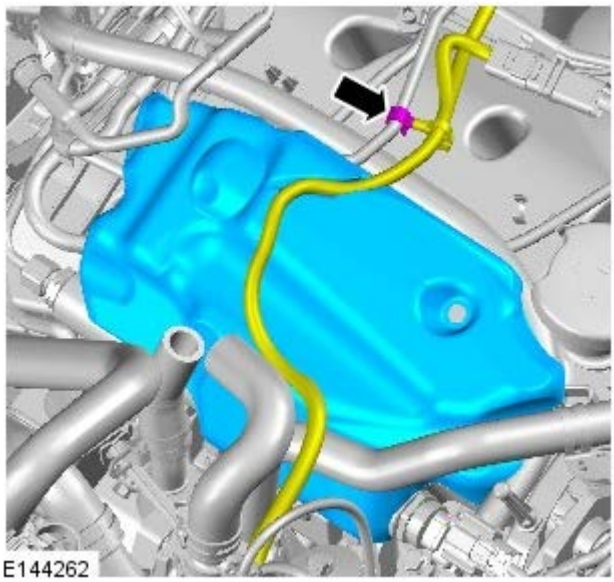


E116986

35.


E144253

36.


E144262

37. Refer to: Crankcase Vent Oil Separator (303-08A Engine Emission Control - TDV6 3.0L Diesel, Removal and Installation).

38. Refer to: Rear End Accessory Drive (READ) (303-05A Accessory Drive - TDV6 3.0L Diesel, Removal and Installation).

39. Refer to: High-Pressure Fuel System Bleeding (310-00 Fuel System - General Information, General Procedures).

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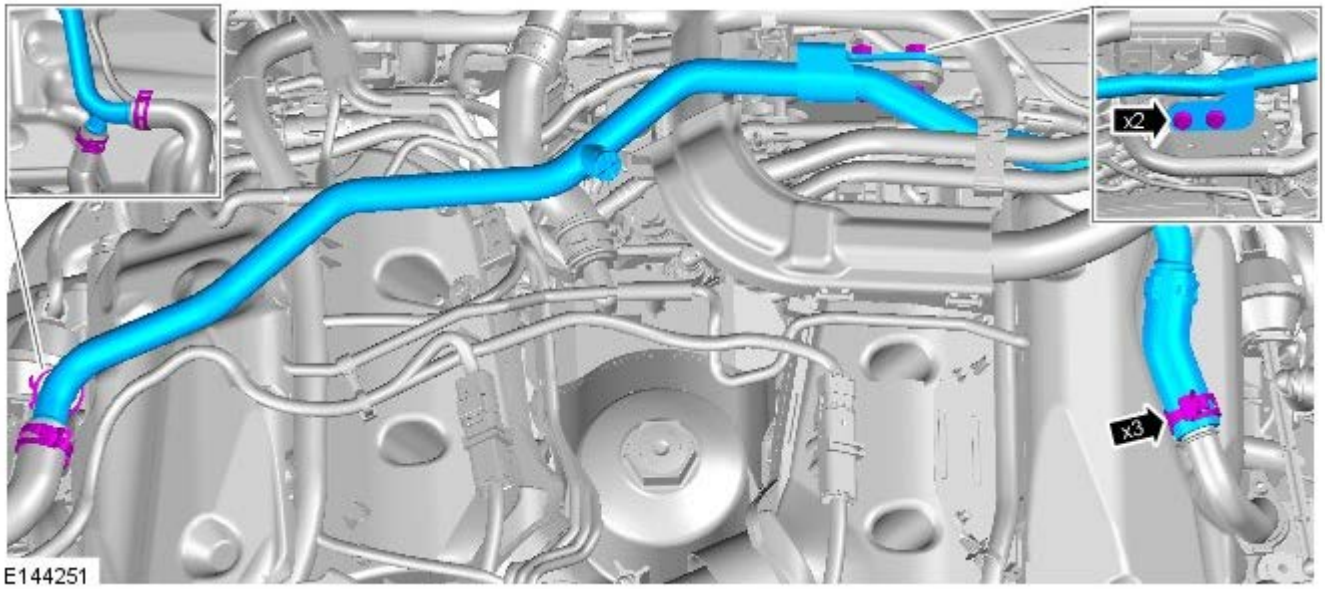
Fuel Charging and Controls - TDV6 3.0L Diesel - Fuel Rail LH

Removal and Installation

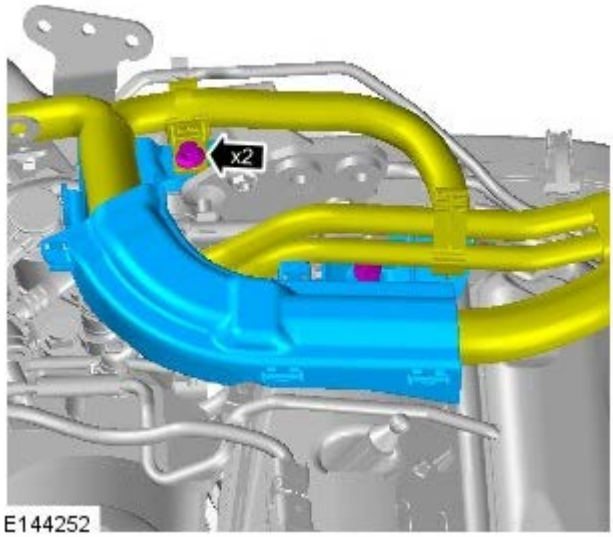
Removal

NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. Refer to: Specifications (414-00, Specifications).
2. Refer to: Secondary Bulkhead Center Panel - TDV6 3.0L Diesel (501-02 Front End Body Panels, Removal and Installation).
3. Refer to: Cooling System Partial Draining, Filling and Bleeding (303-03A Engine Cooling - TDV6 3.0L Diesel, General Procedures).
4. Refer to: Exhaust Gas Recirculation (EGR) Valve Outlet Tube LH (303-08A Engine Emission Control - TDV6 3.0L Diesel, Removal and Installation).
5. Refer to: Fuel Injection Component Cleaning (303-04A Fuel Charging and Controls - TDV6 3.0L Diesel, General Procedures).
6.



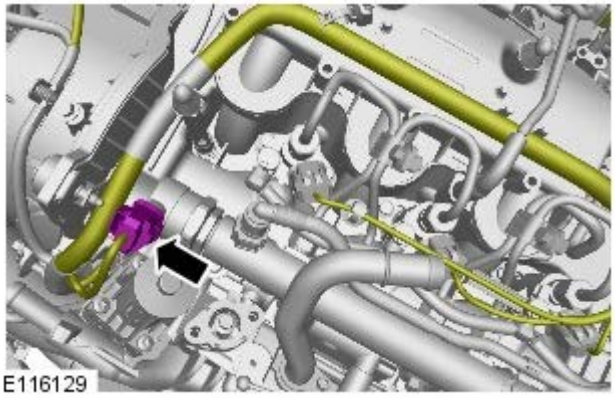
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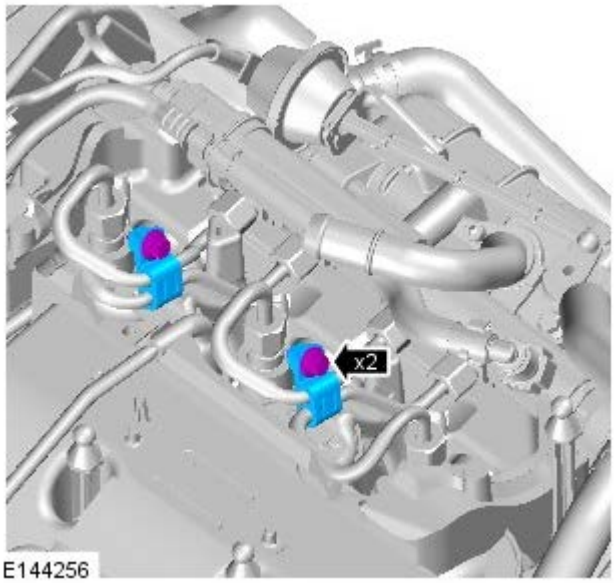
8.


E144253

9.


E116129

10.

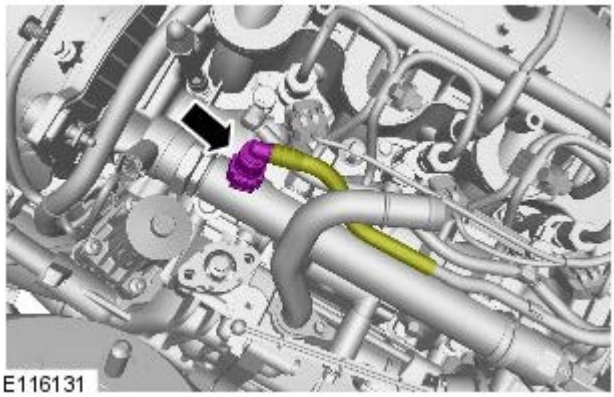


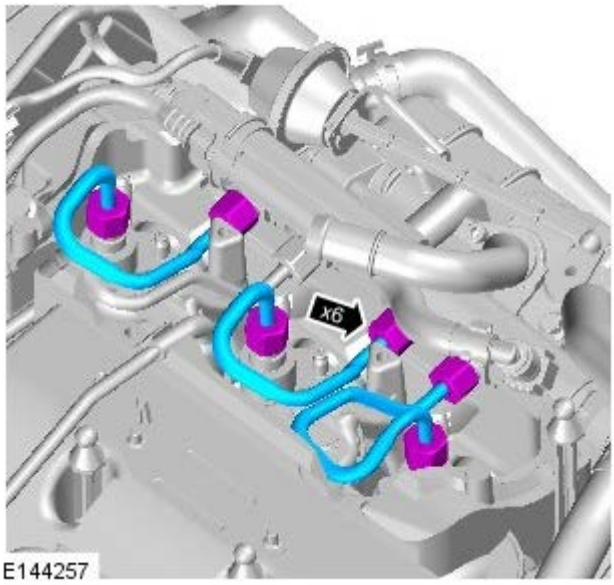
E144256

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.



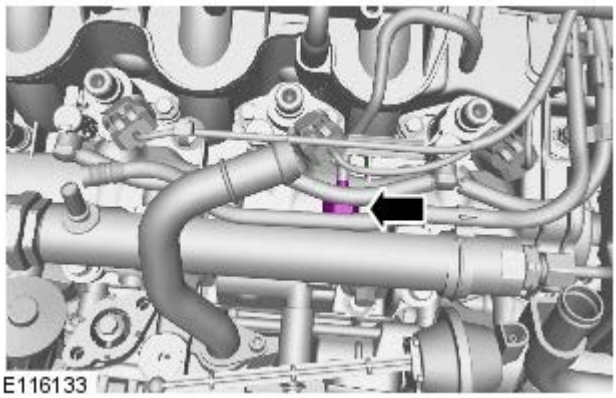


12. CAUTIONS:

    Be prepared to collect escaping fuel.

    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.

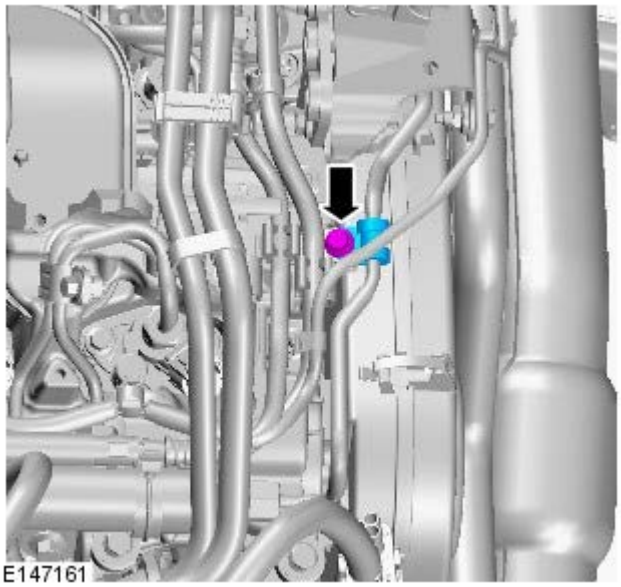


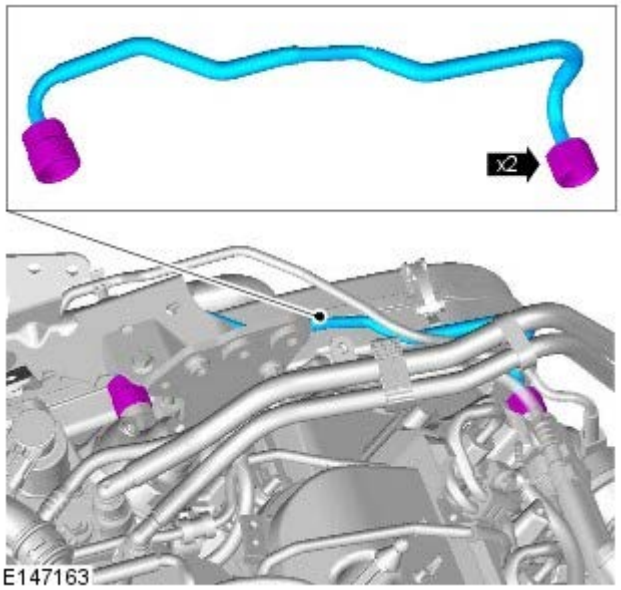
13. CAUTIONS:

    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.

14.


E147161



E147163

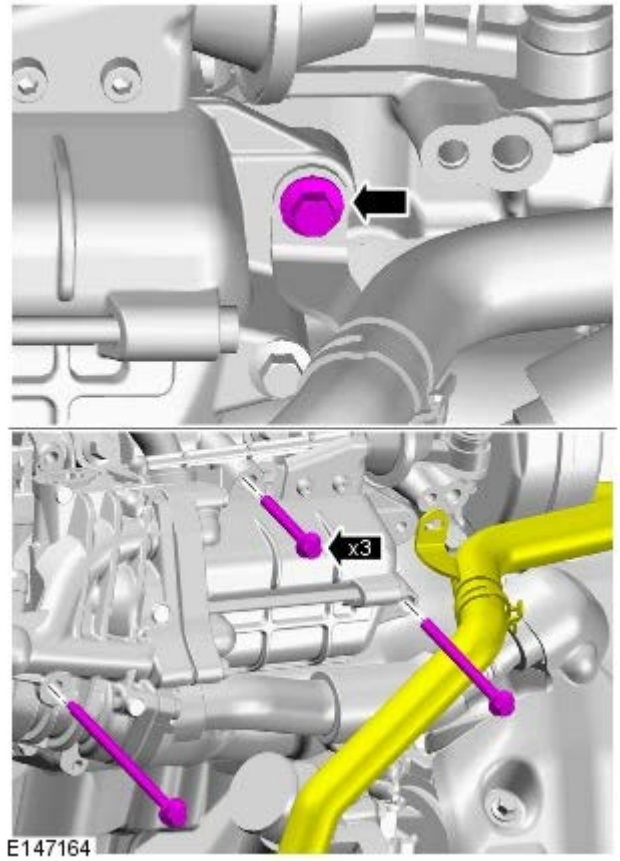
15. CAUTIONS:

Be prepared to collect escaping fuel.

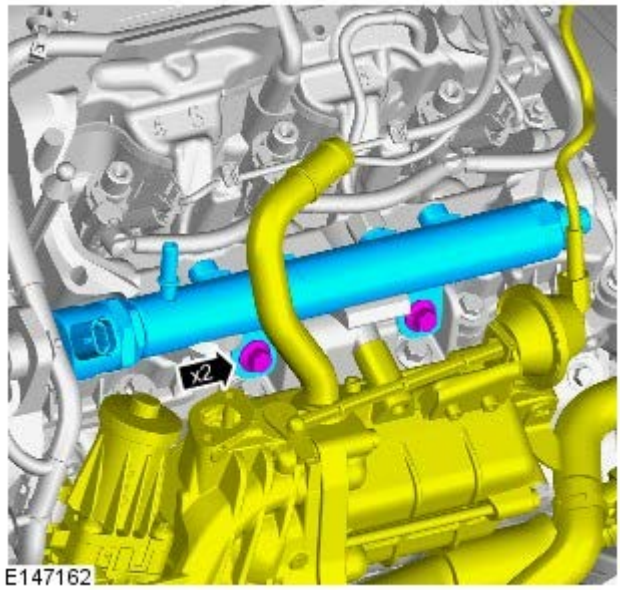
Discard the component.

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.

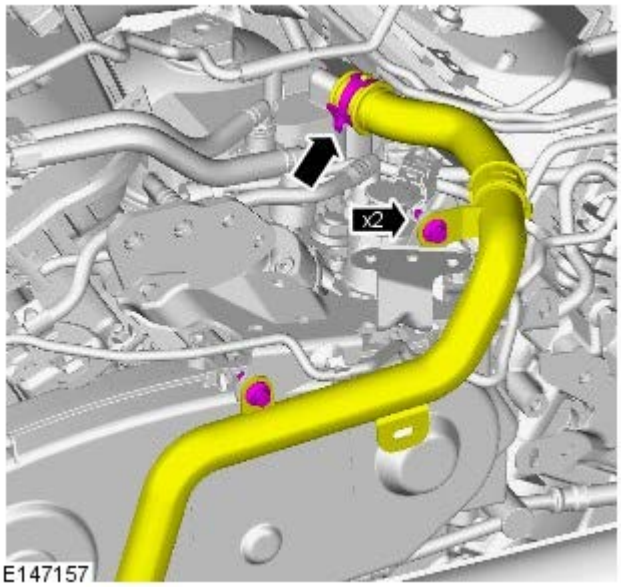
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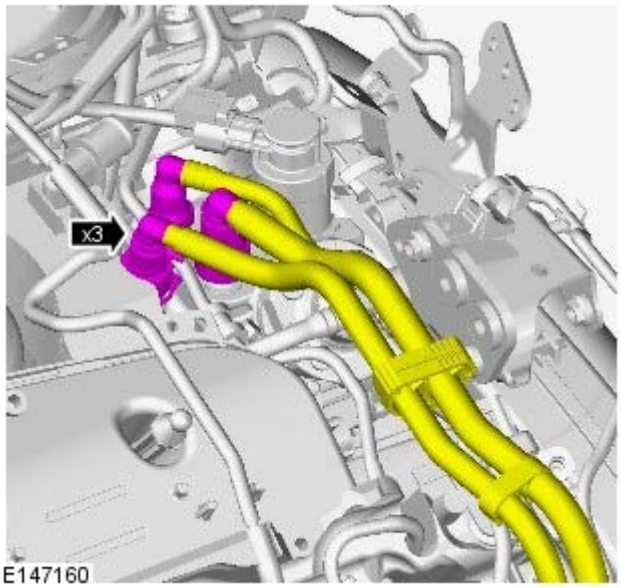
17.



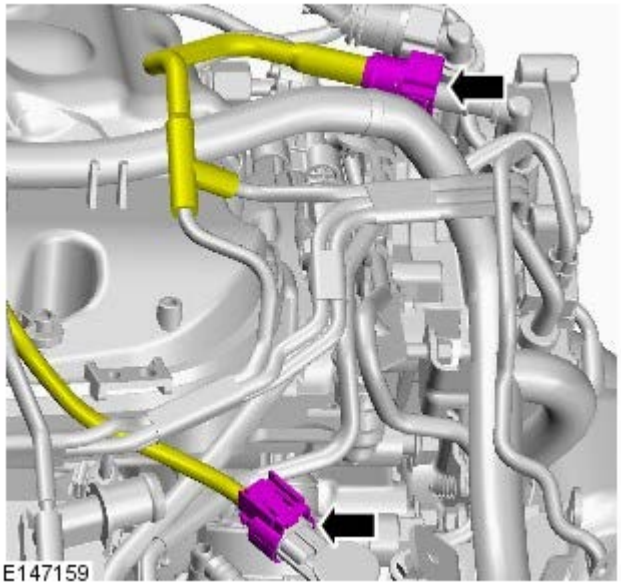
18.



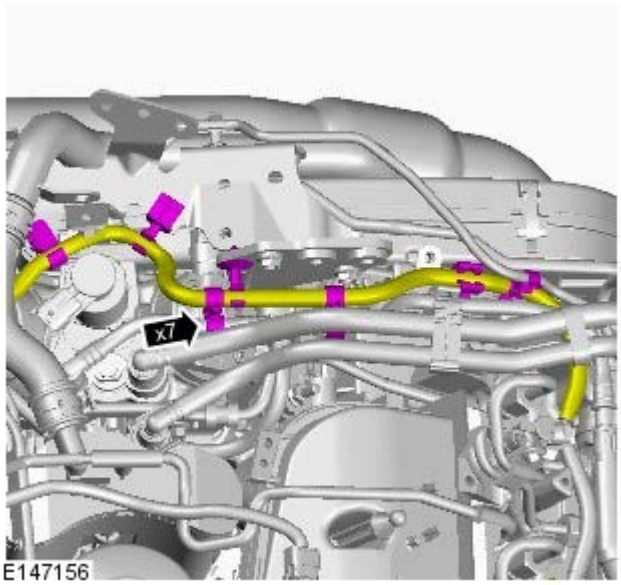
19. CAUTION: Be prepared to collect escaping fuel.



20.



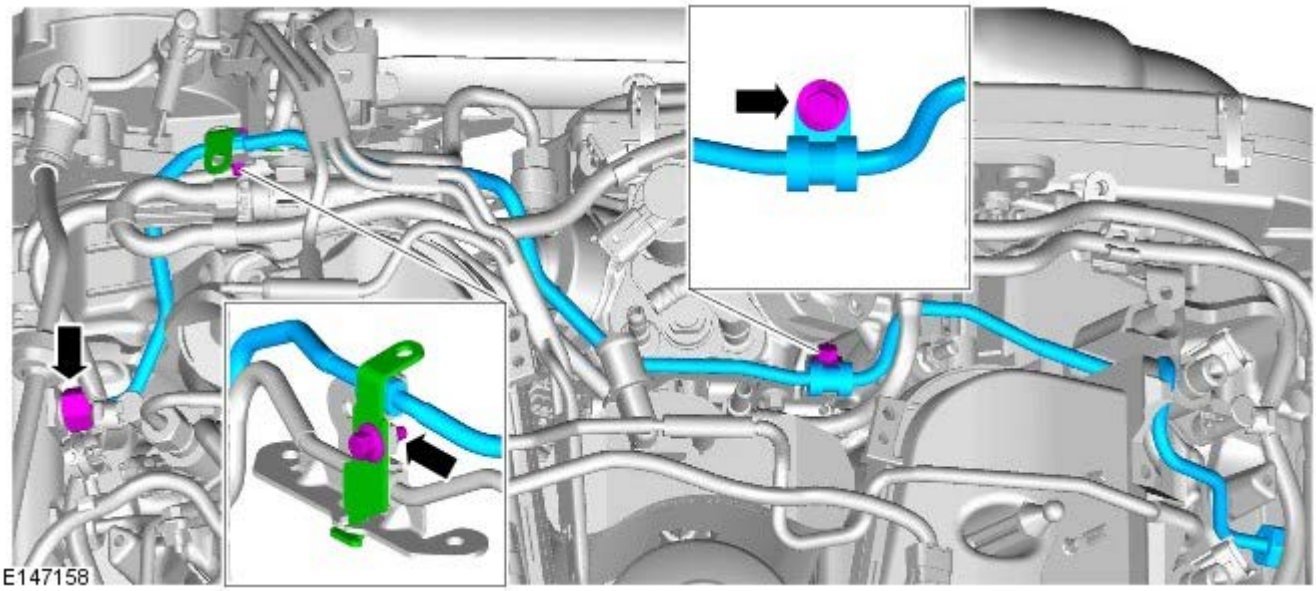
21.



22. CAUTIONS:

Be prepared to collect escaping fuel.

Discard the component.



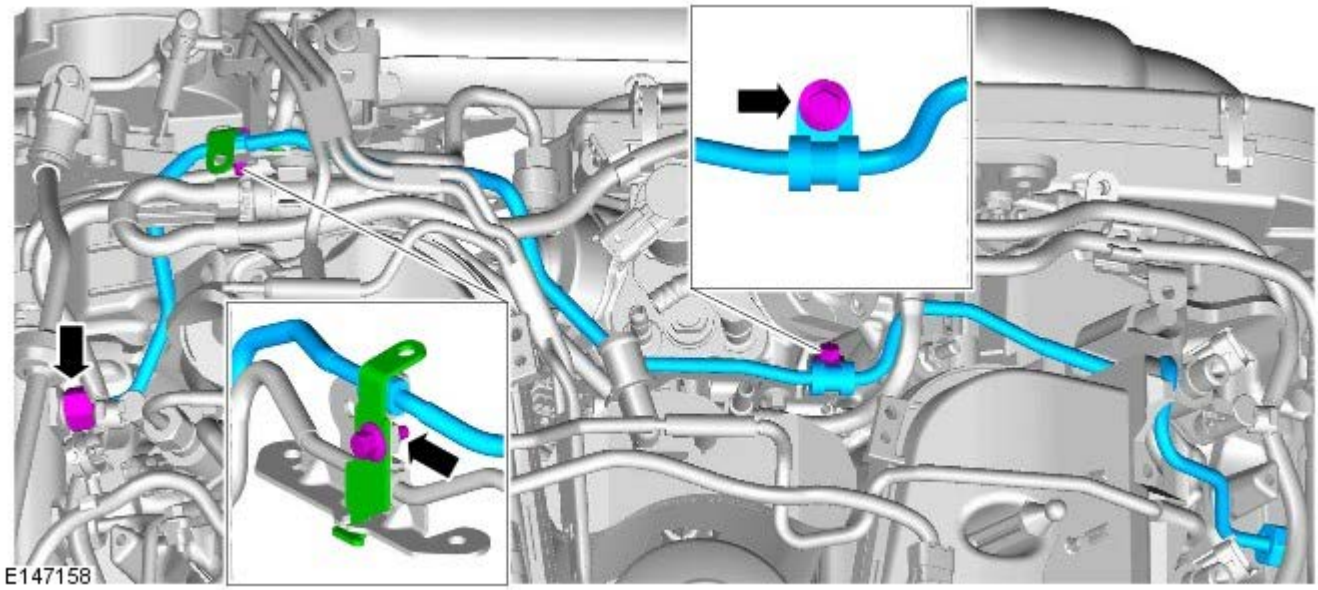
Installation

1. CAUTIONS:

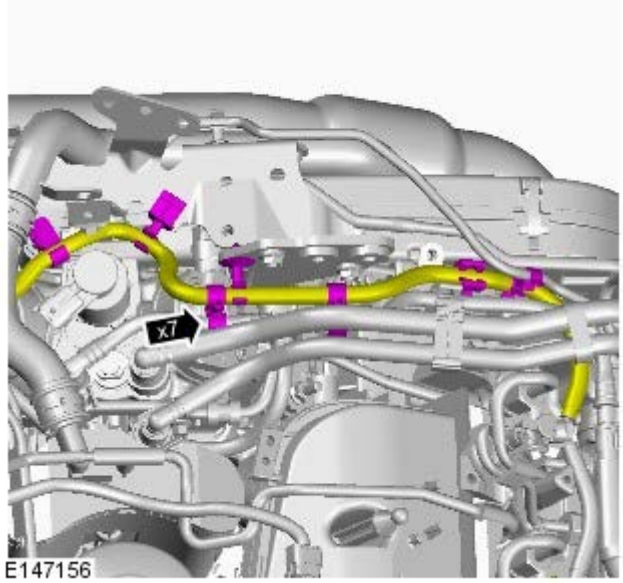
Make sure that a new component is installed.

Tighten the fuel supply line unions finger tight.

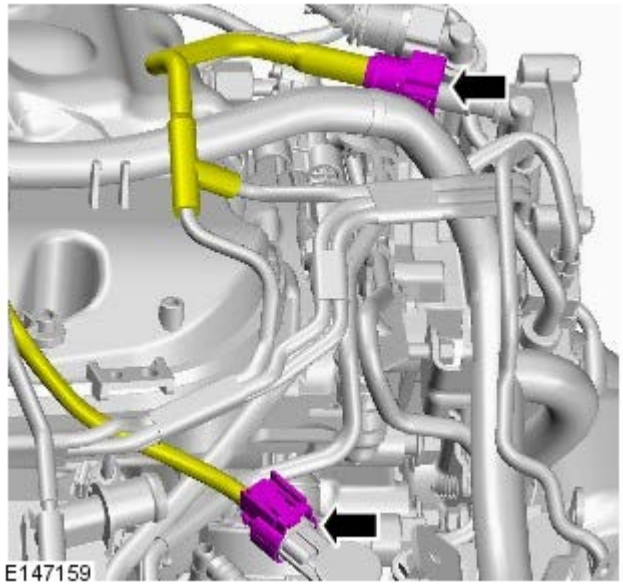
Only tighten the bolts finger-tight at this stage.



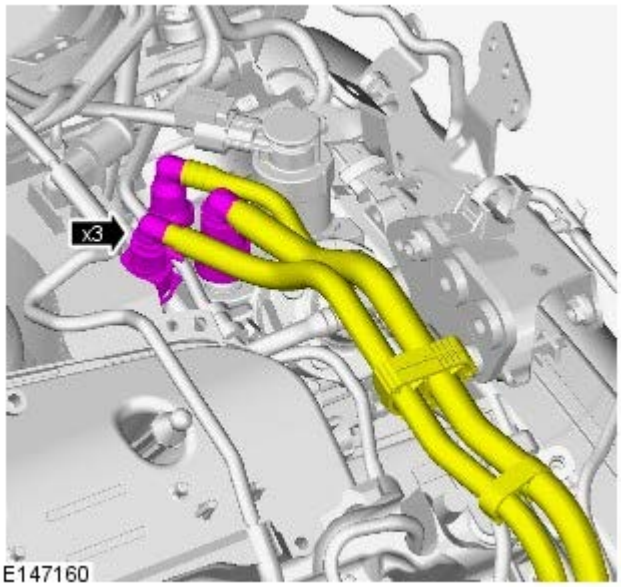
2.



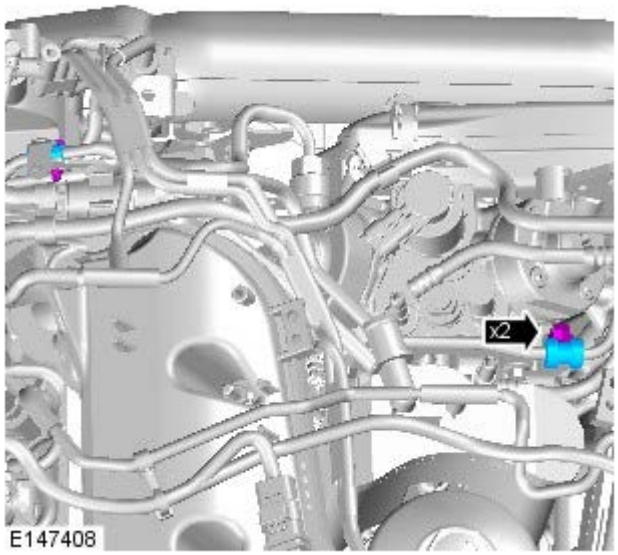
3.



4.



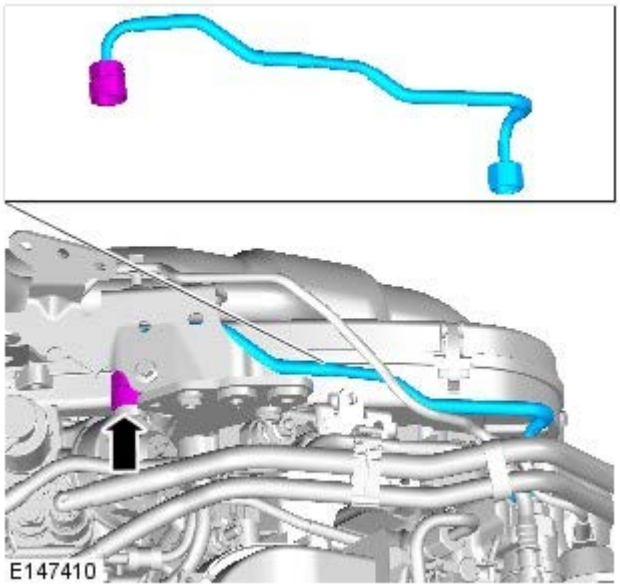
5. CAUTION: Only tighten the bolts finger-tight at this stage.



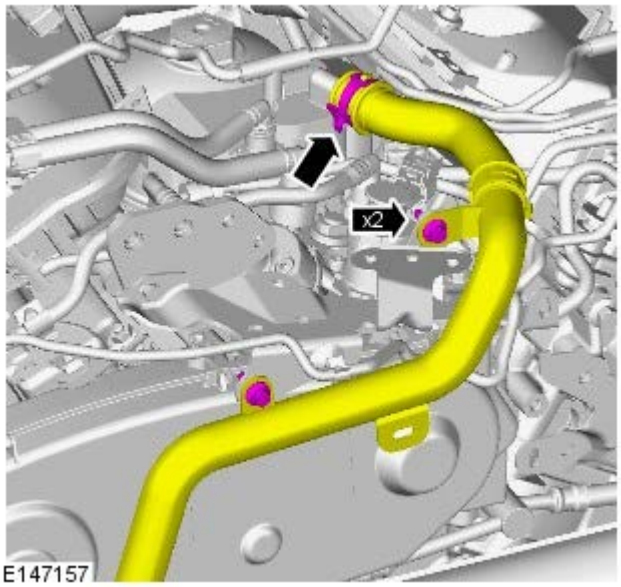
6. CAUTIONS:

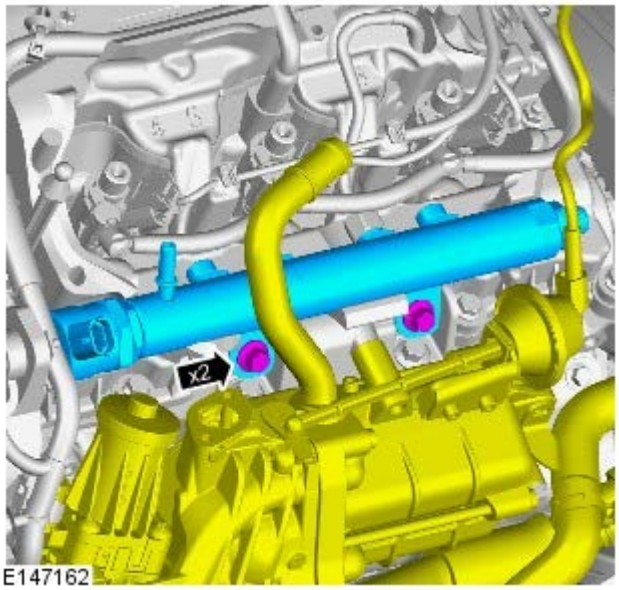
   Make sure that a new component is installed.

   Tighten the fuel supply line unions finger tight.

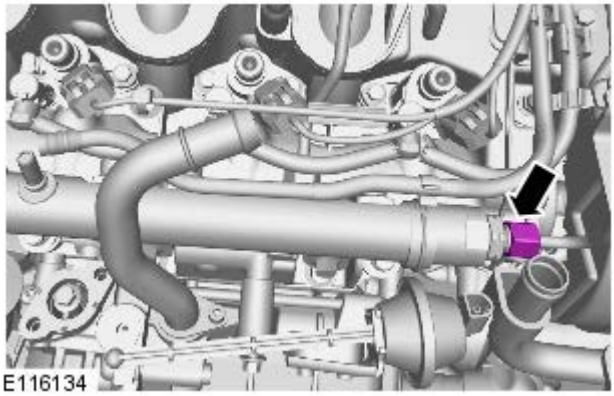


7. *Torque:* 10 Nm



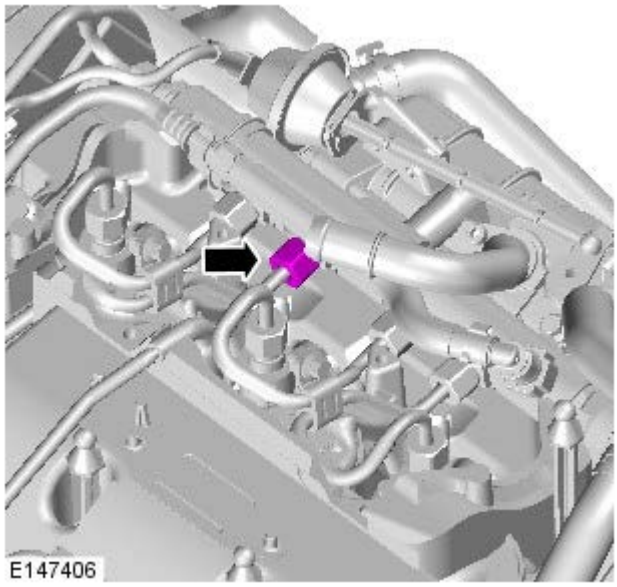


8. CAUTION: Only tighten the bolts finger-tight at this stage.

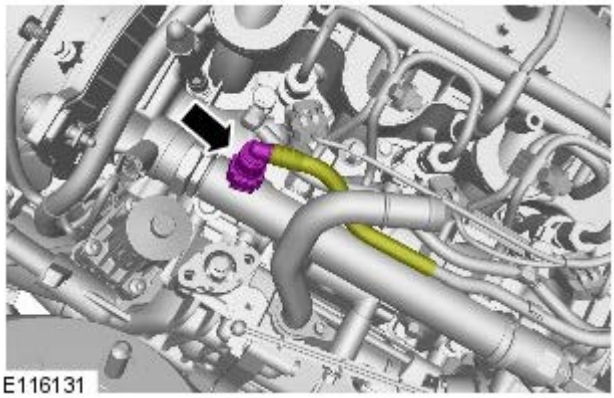


9. CAUTION: Tighten the fuel supply line unions finger tight.

10. CAUTION: Tighten the fuel supply line unions finger tight.



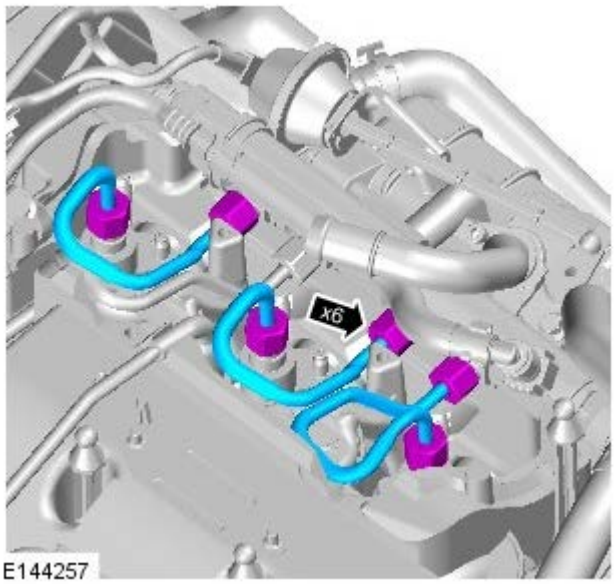
11.



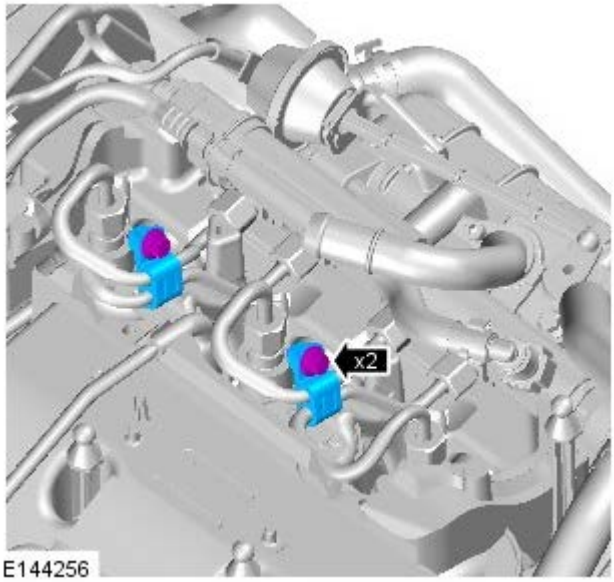
12. CAUTIONS:

Make sure that a new component is installed.

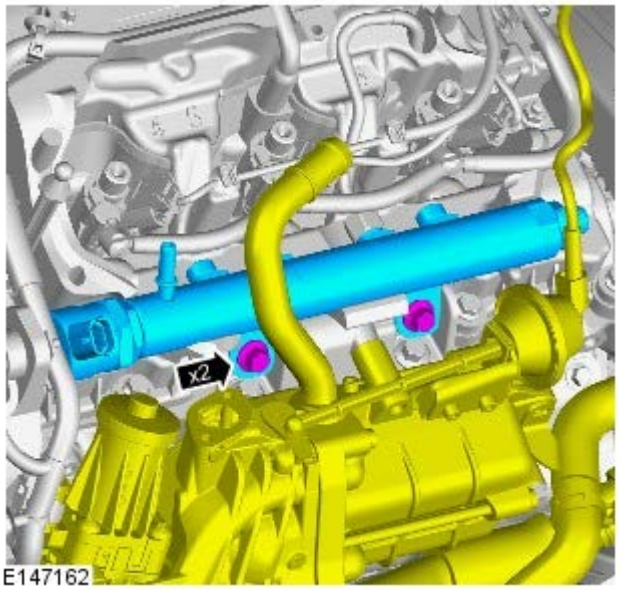
Tighten the fuel supply line unions finger tight.



13. *Torque:* 9 Nm

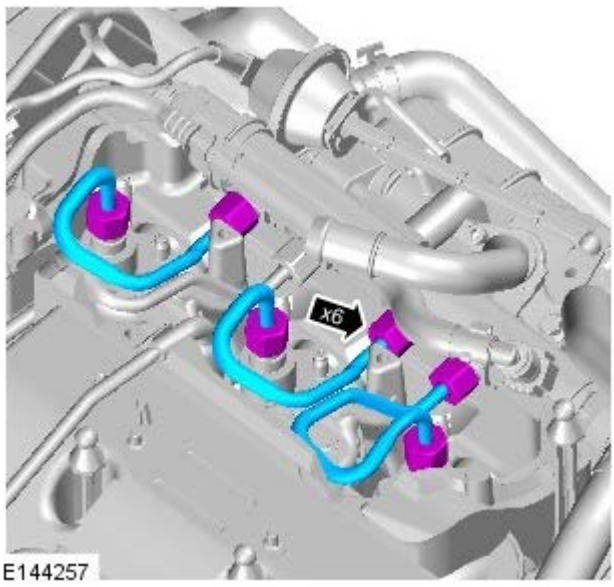


14. *Torque:* 24 Nm



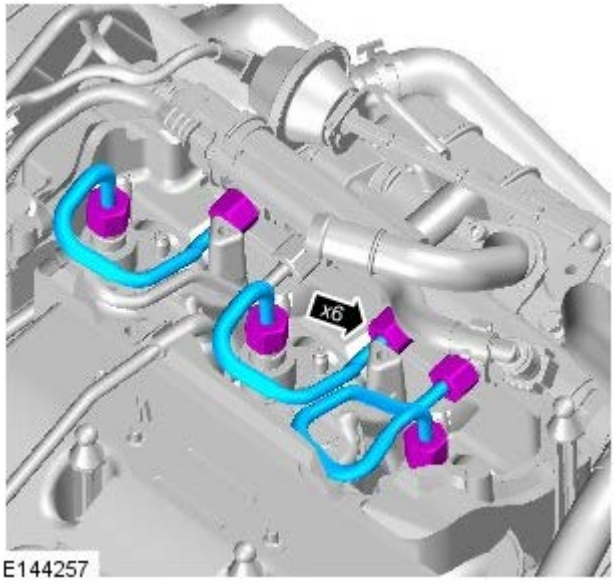
15.

- 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.

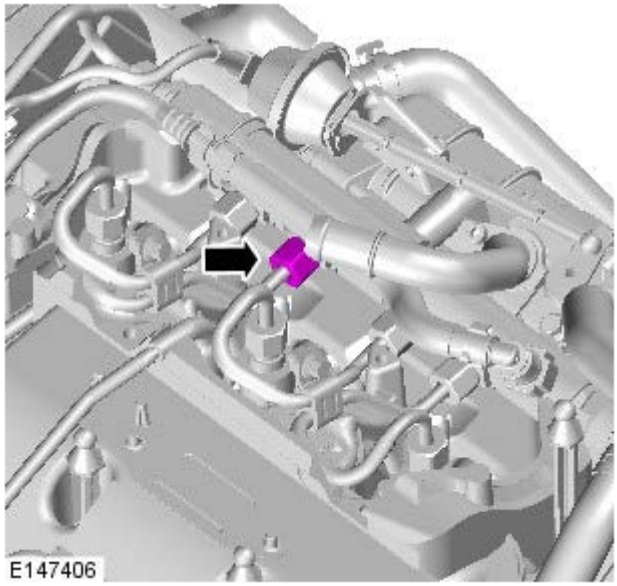


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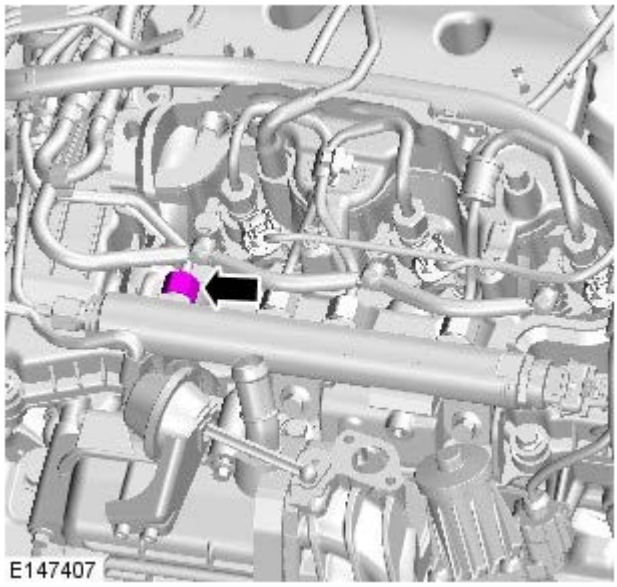
- Stage 1: Tighten the high-pressure fuel supply line unions at the fuel rail to 35Nm.
- Stage 2: Tighten the high-pressure fuel supply line unions at the injector to 35Nm.



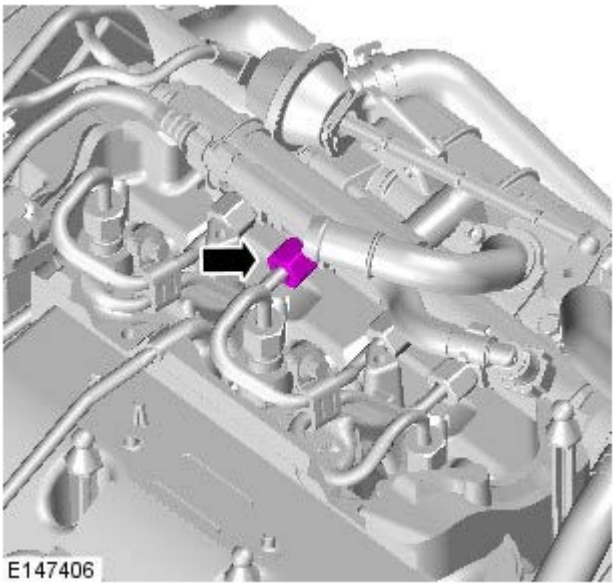
17. Tighten the high-pressure fuel lines union to 15Nm.



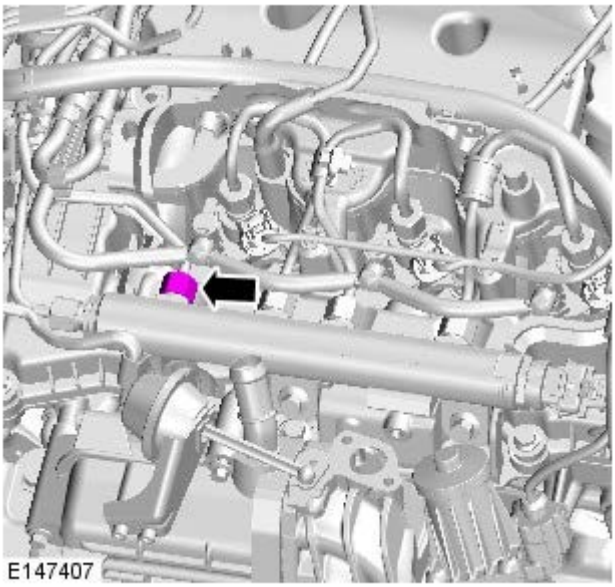
18. Tighten the high-pressure fuel lines union to 15Nm.



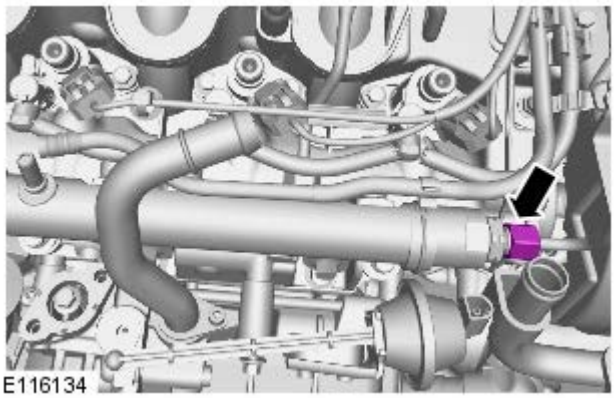
19. Tighten the high-pressure fuel line union to 35 Nm.



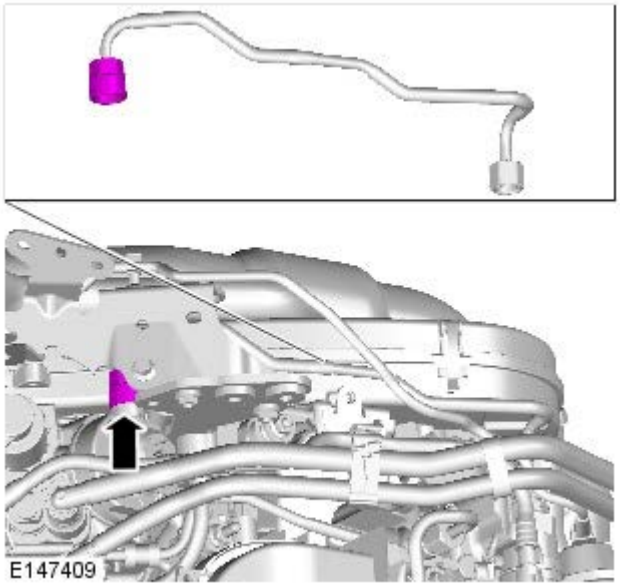
20. Tighten the high-pressure fuel line union to 35 Nm.



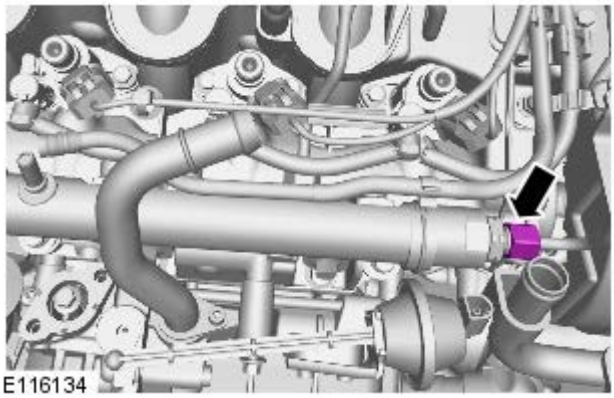
21. Tighten the high-pressure fuel lines union to 15Nm.



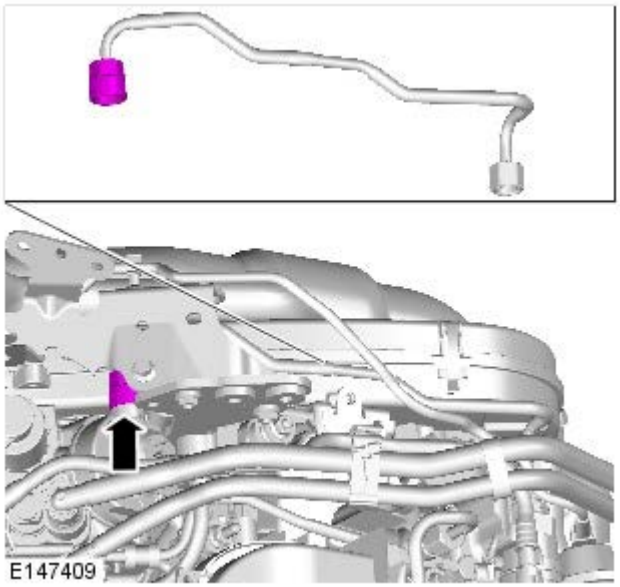
22. Tighten the high-pressure fuel lines union to 15Nm.



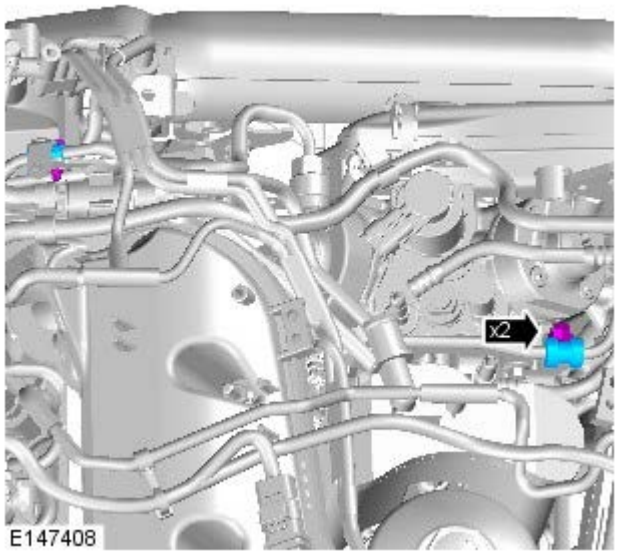
23. Tighten the high-pressure fuel line union to 35 Nm.



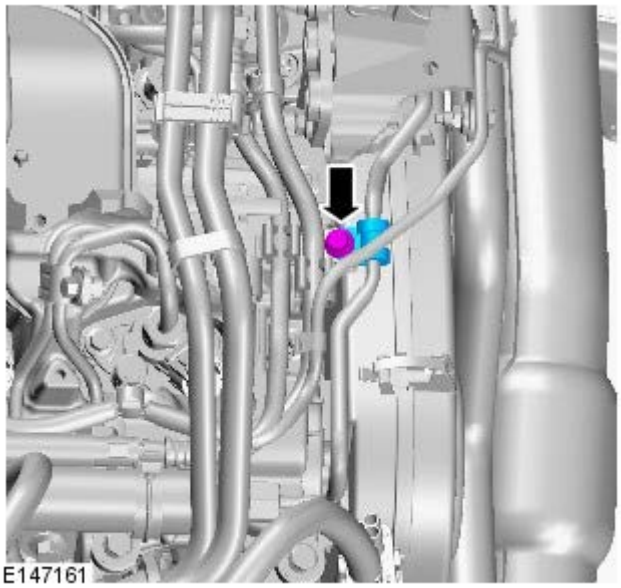
24. Tighten the high-pressure fuel line union to 35 Nm.



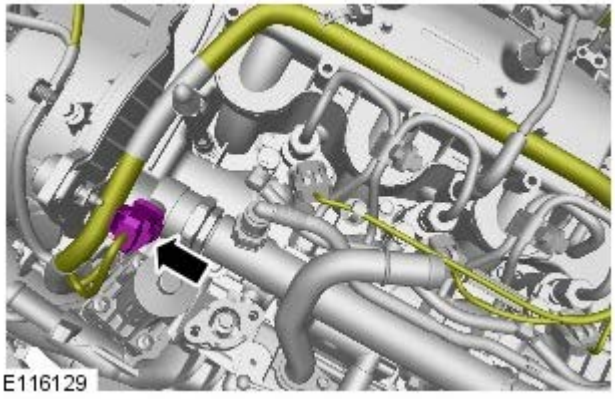
25. *Torque:* 10 Nm



26. *Torque:* 10 Nm



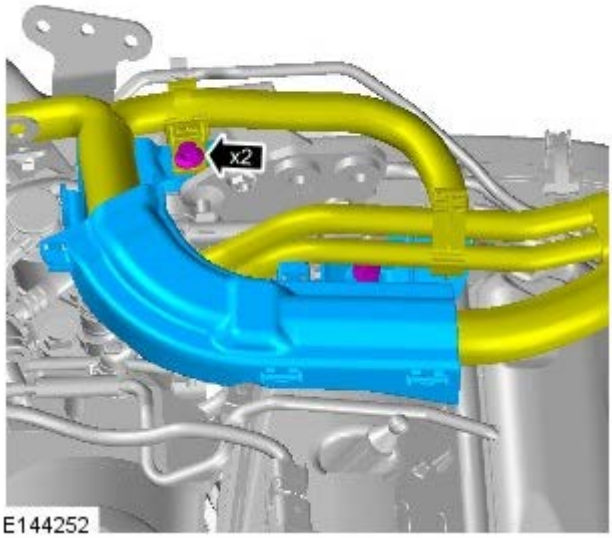
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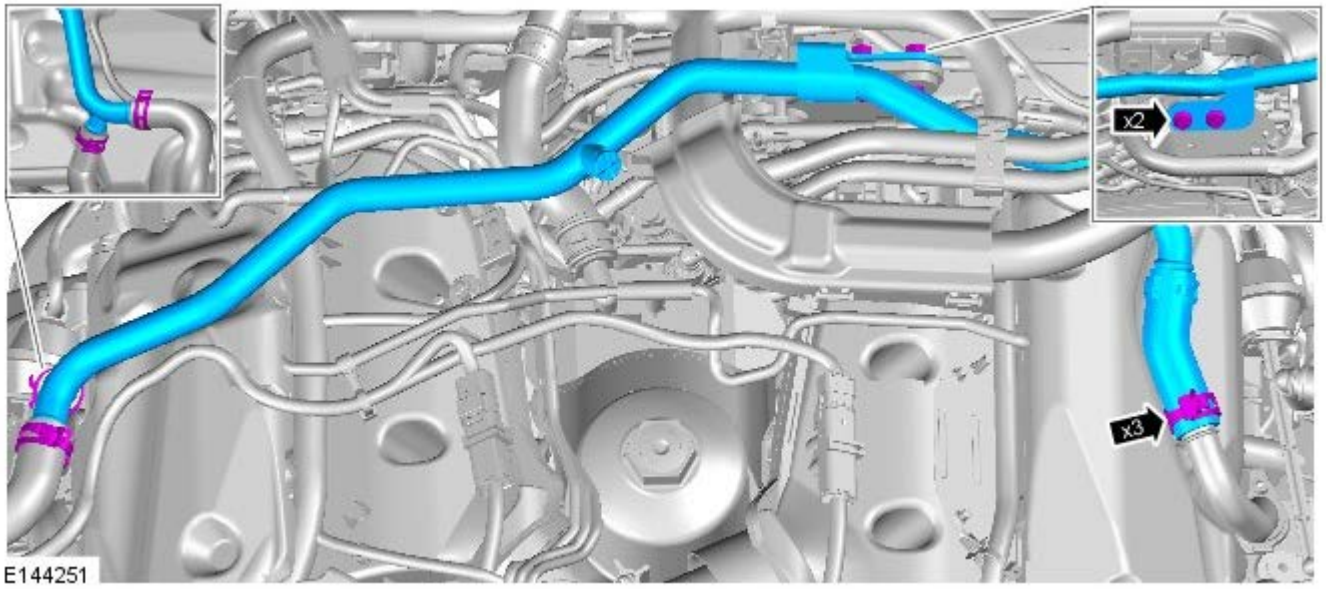
28.



29. *Torque:* 10 Nm



30. *Torque:* 10 Nm



31. Refer to: Exhaust Gas Recirculation (EGR) Valve Outlet Tube LH (303-08A Engine Emission Control - TDV6 3.0L Diesel, Removal and Installation).

32. Refer to: Cooling System Partial Draining, Filling and Bleeding (303-03A Engine Cooling - TDV6 3.0L Diesel, General Procedures).

33. Refer to: Secondary Bulkhead Center Panel - TDV6 3.0L Diesel (501-02 Front End Body Panels, Removal and Installation).

34. Refer to: Specifications (414-00, Specifications).

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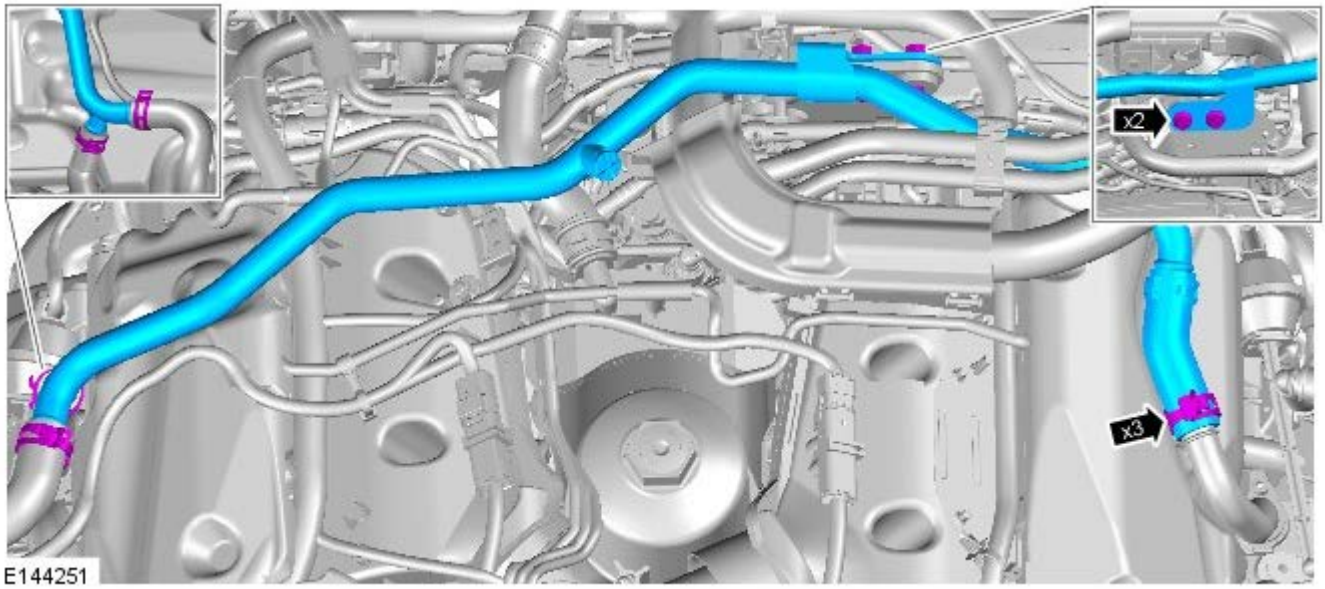
Fuel Charging and Controls - TDV6 3.0L Diesel - Fuel Rail RH

Removal and Installation

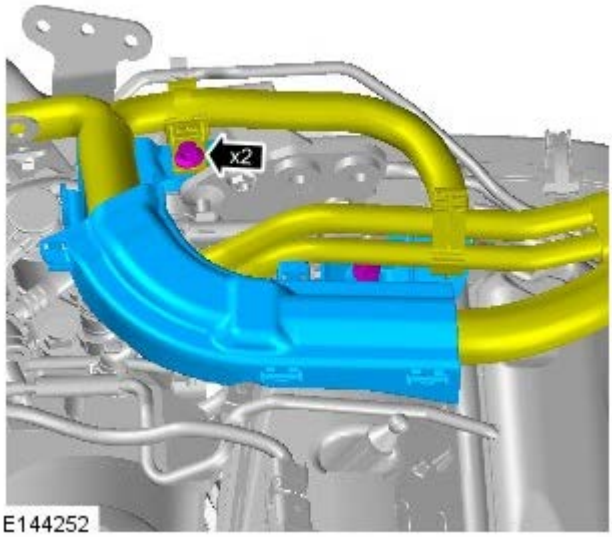
Removal

NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

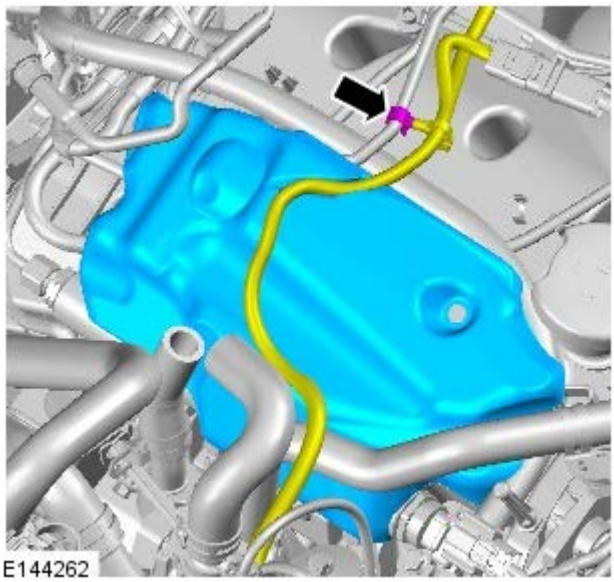
1. Refer to: Specifications (414-00, Specifications).
2. Refer to: Secondary Bulkhead Center Panel - TDV6 3.0L Diesel (501-02 Front End Body Panels, Removal and Installation).
3. Refer to: Cooling System Partial Draining, Filling and Bleeding (303-03A Engine Cooling - TDV6 3.0L Diesel, General Procedures).
4. Refer to: Exhaust Gas Recirculation (EGR) Valve Outlet Tube LH (303-08A Engine Emission Control - TDV6 3.0L Diesel, Removal and Installation).
5. Refer to: Fuel Injection Component Cleaning (303-04A Fuel Charging and Controls - TDV6 3.0L Diesel, General Procedures).
6.



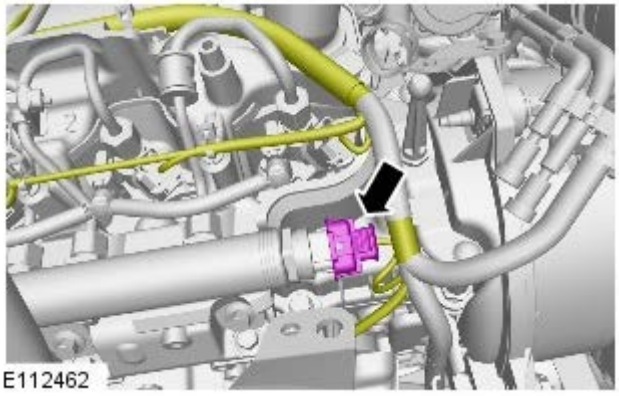
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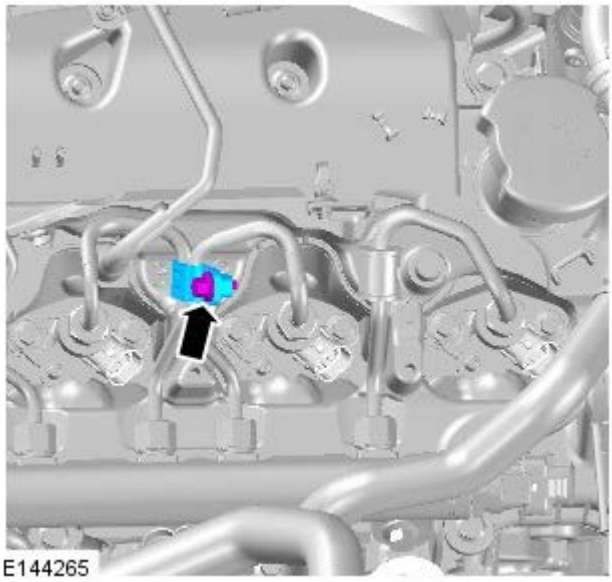
8.


E144262

9.


E112462

10.

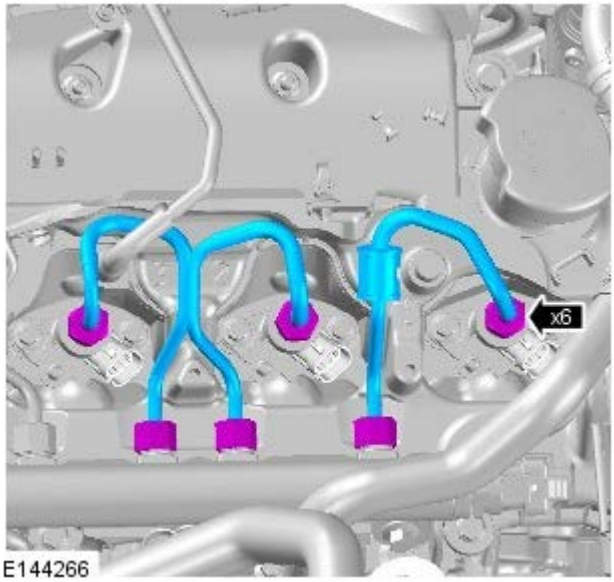

E144265

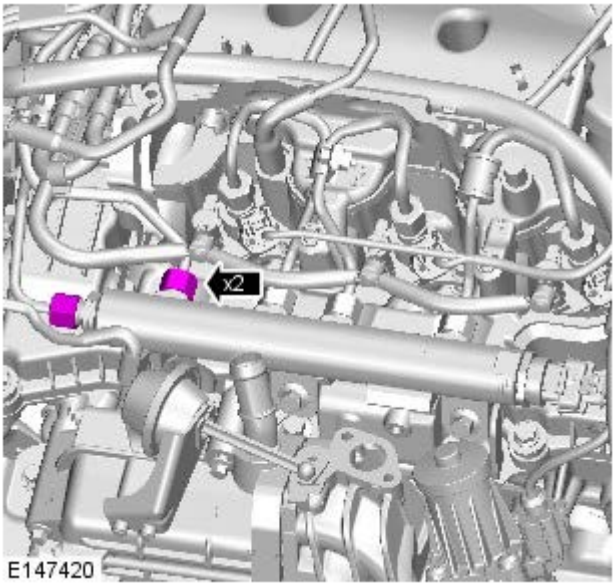
11. CAUTIONS:

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.

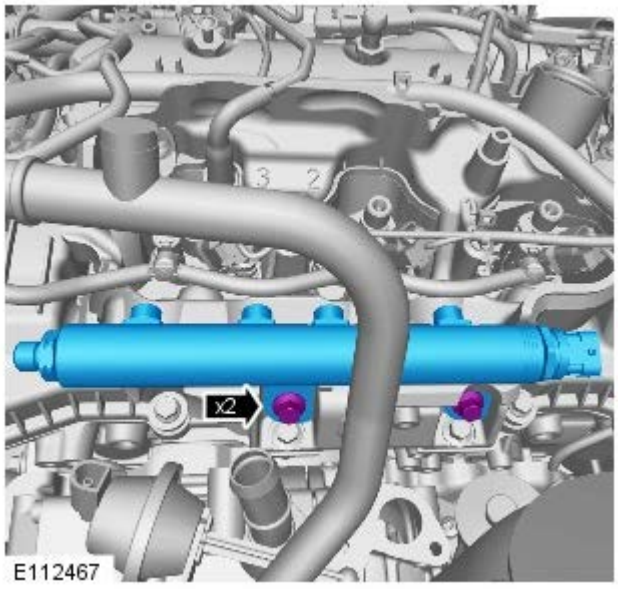




12. CAUTIONS:

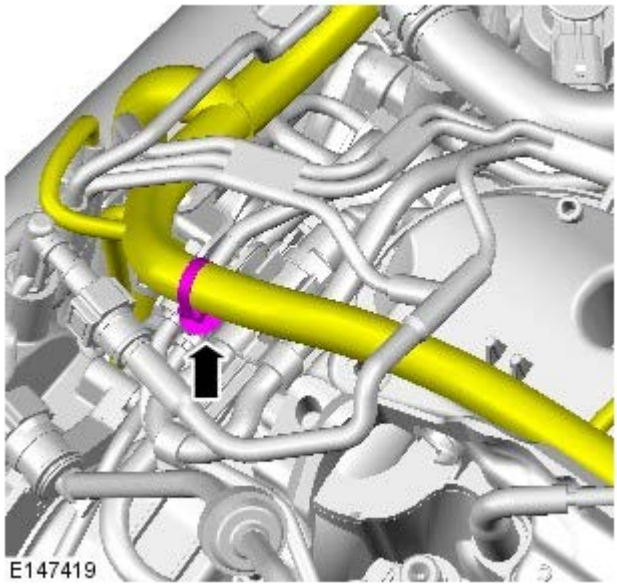
    Be prepared to collect escaping fuel.

    Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

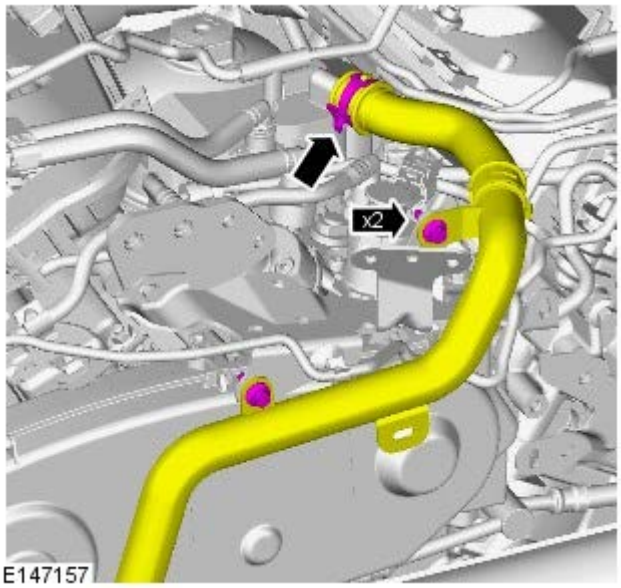


13. CAUTION: Be prepared to collect escaping fuel.

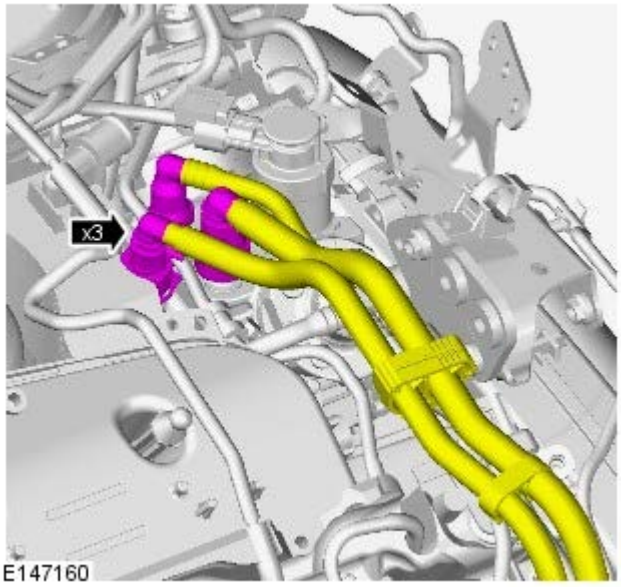
14.



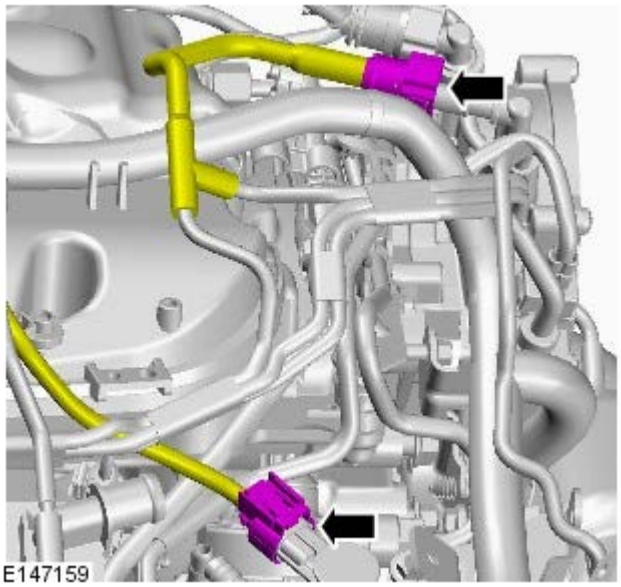
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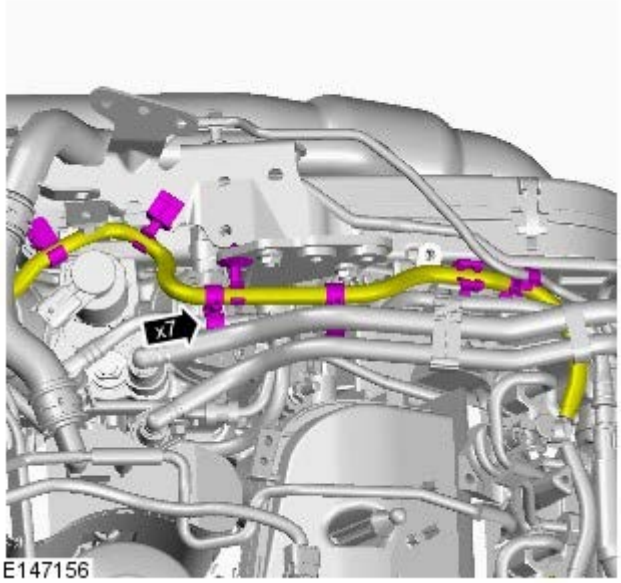
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17.



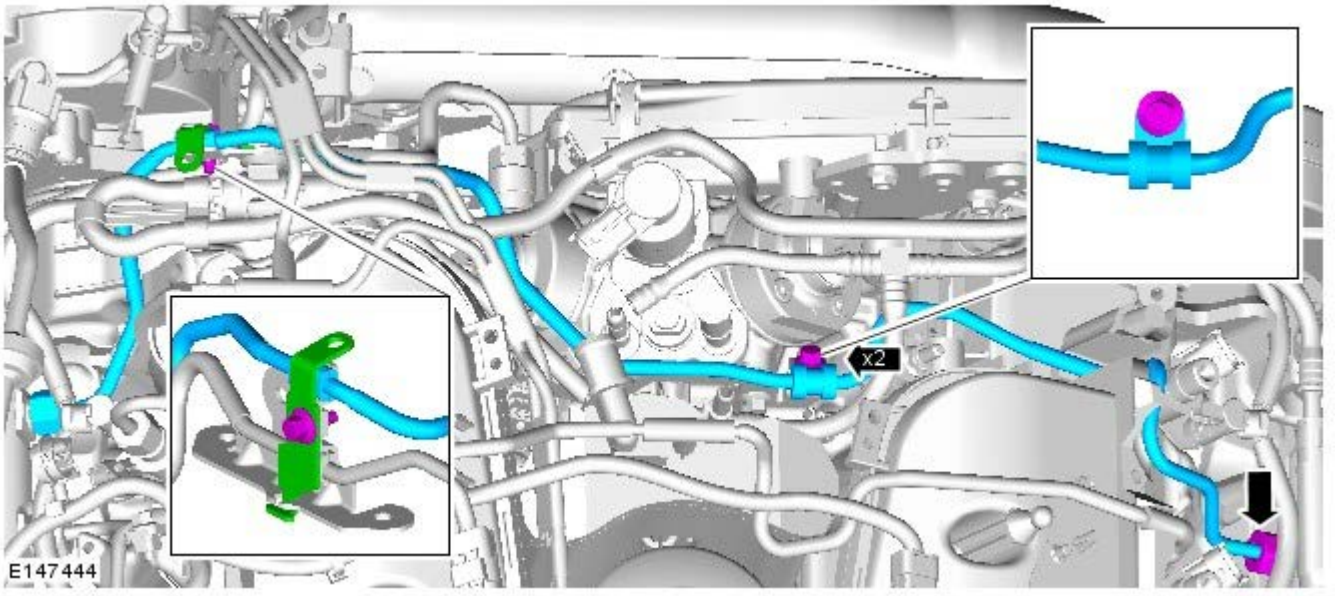
18. CAUTION: Be prepared to collect escaping fuel.



19. CAUTIONS:

Be prepared to collect escaping fuel.

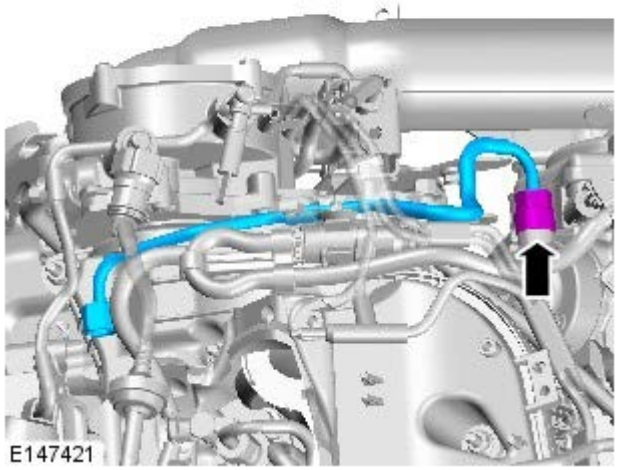
Discard the component.



20. CAUTIONS:

Be prepared to collect escaping fuel.

Discard the component.

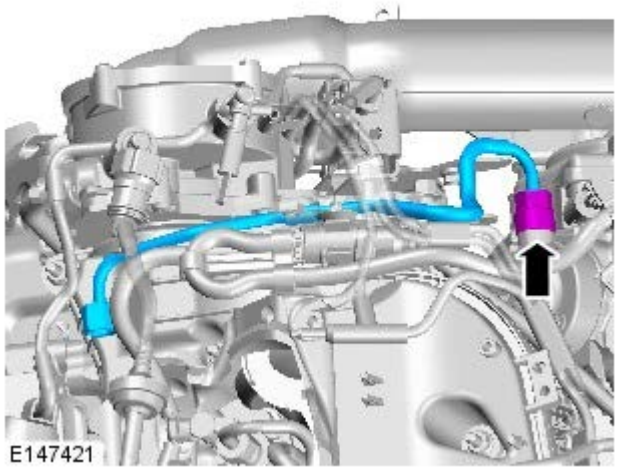


Installation

1. CAUTIONS:

Make sure that a new component is installed.

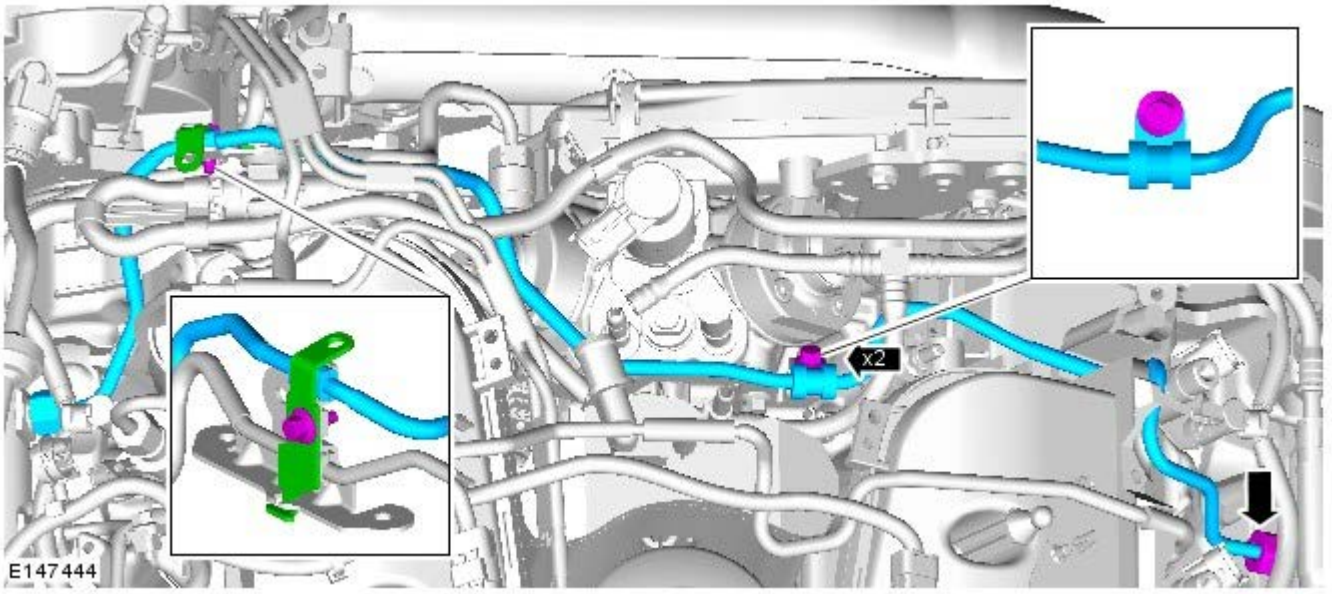
Tighten the fuel supply line unions finger tight.



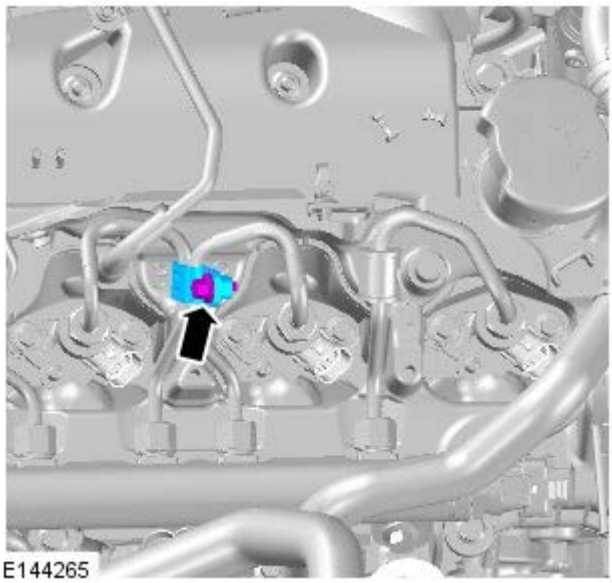
2. CAUTIONS:

Only tighten the unions finger-tight at this stage.

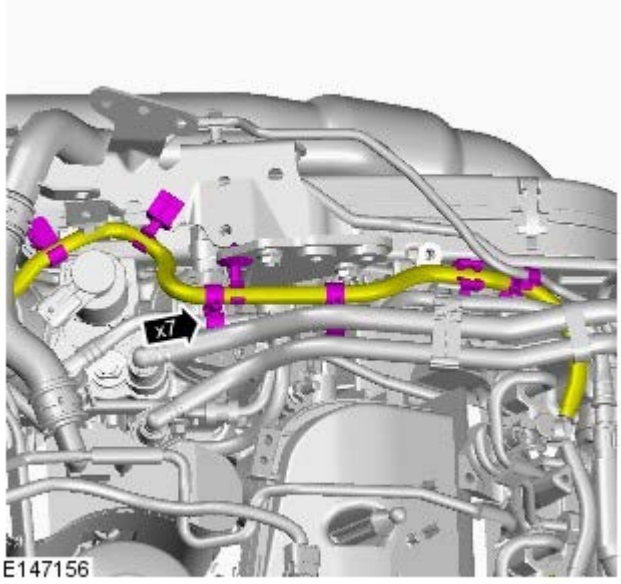
Make sure that a new component is installed.



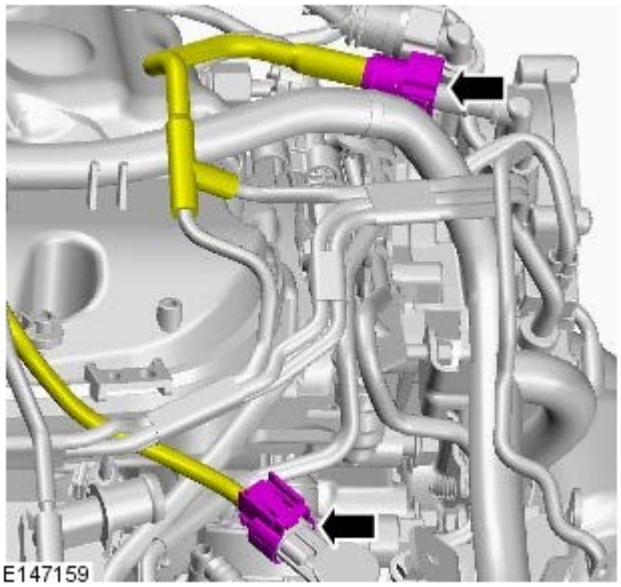
3. *Torque:* 9 Nm



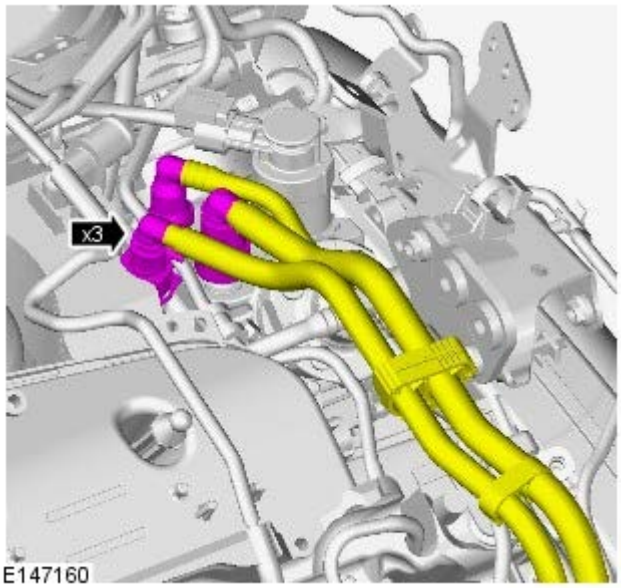
4.



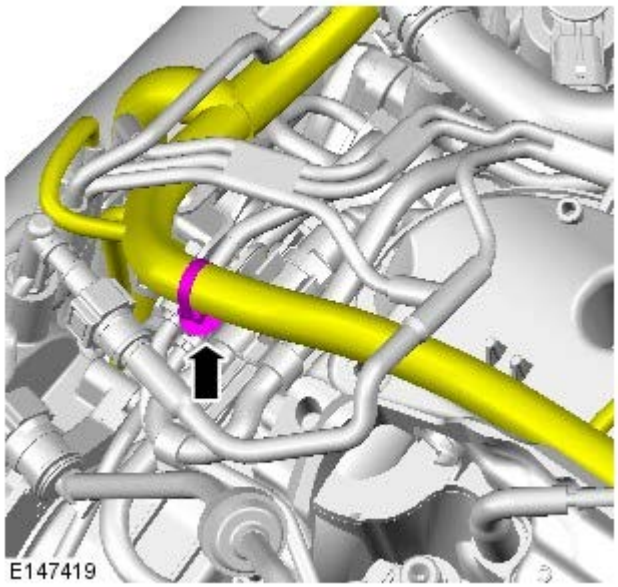
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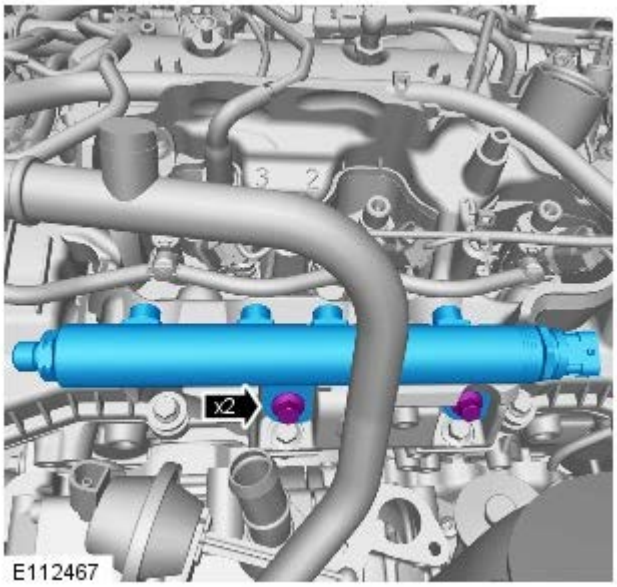
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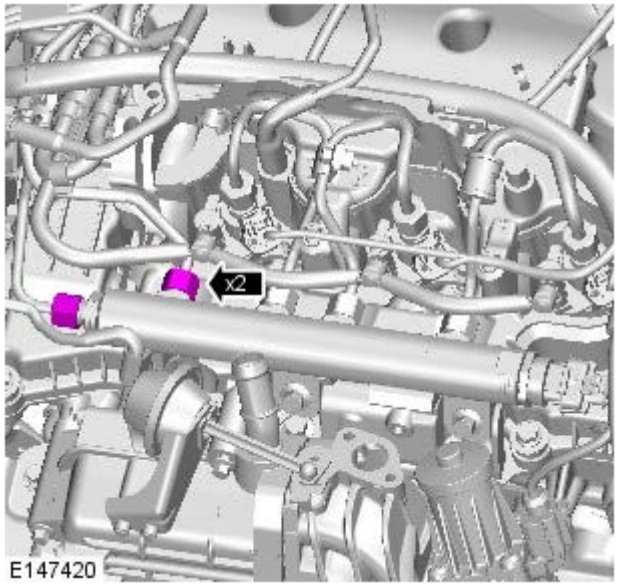


7.

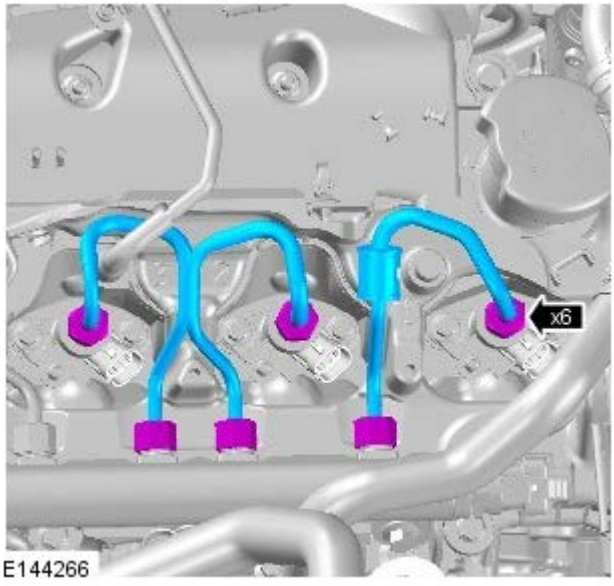


8. CAUTION: Only tighten the bolts finger-tight at this stage.





9. CAUTION: Only tighten the unions finger-tight at this stage.

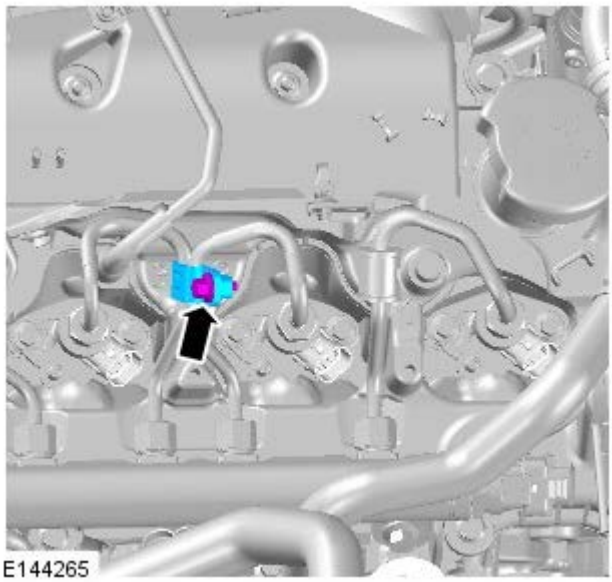


10. CAUTIONS:

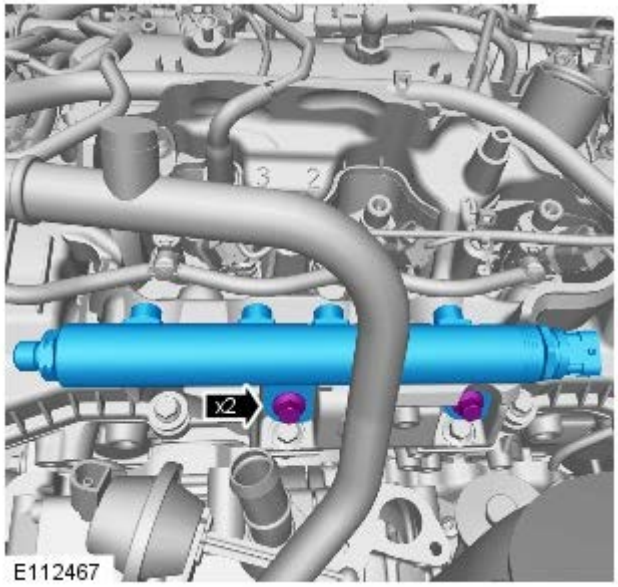
Make sure that new components are installed.

Only tighten the unions finger-tight at this stage.

11. *Torque:* 9 Nm

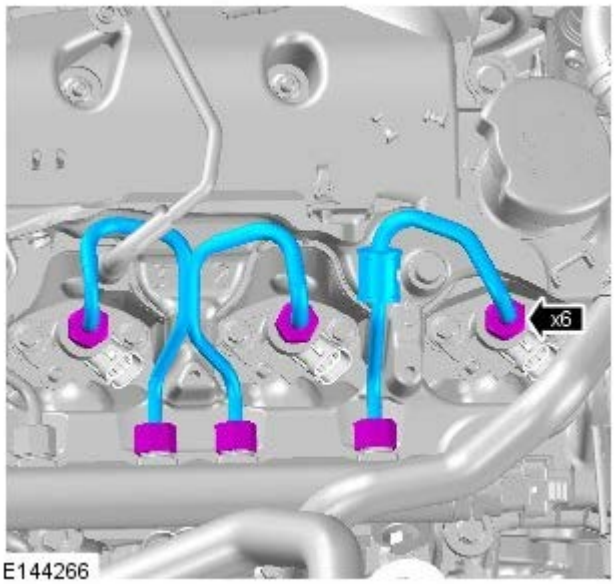


12. *Torque:* 24 Nm



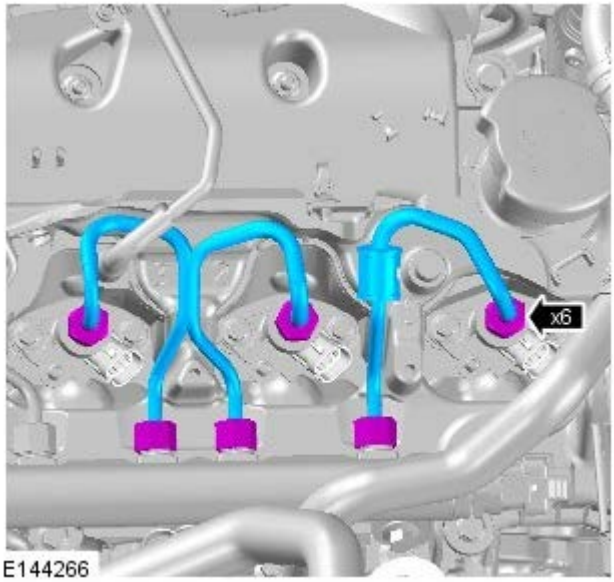
13. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

- 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.



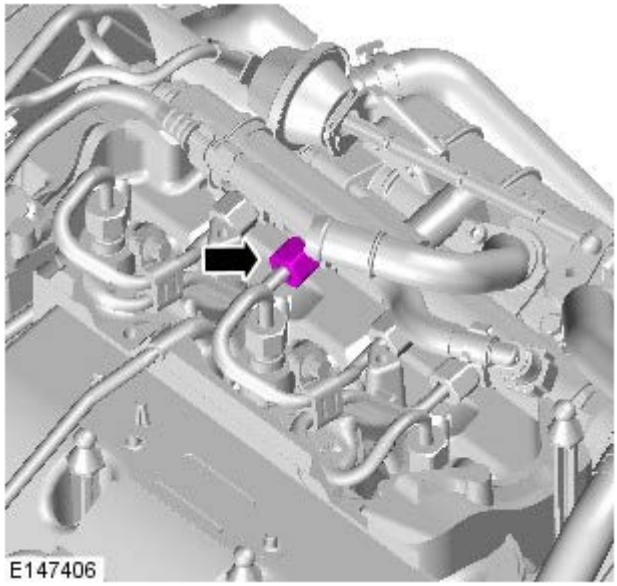
14. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

- Stage 1: Tighten the high-pressure fuel supply line unions at the fuel rail to 35Nm.
- Stage 2: Tighten the high-pressure fuel supply

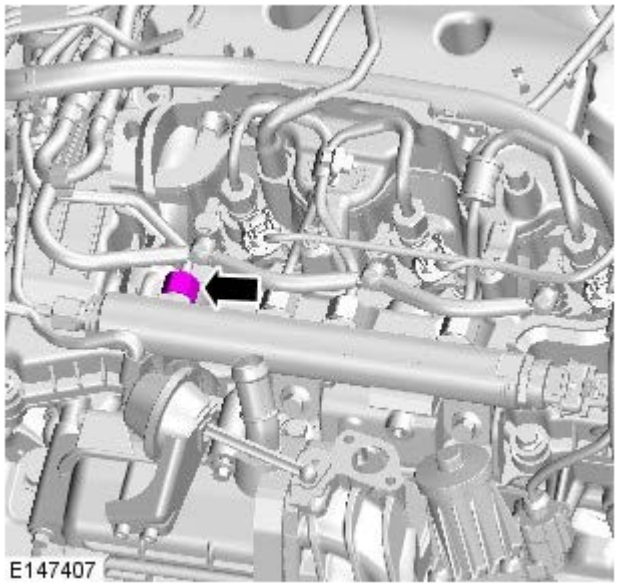


line unions at the injector to 35Nm.

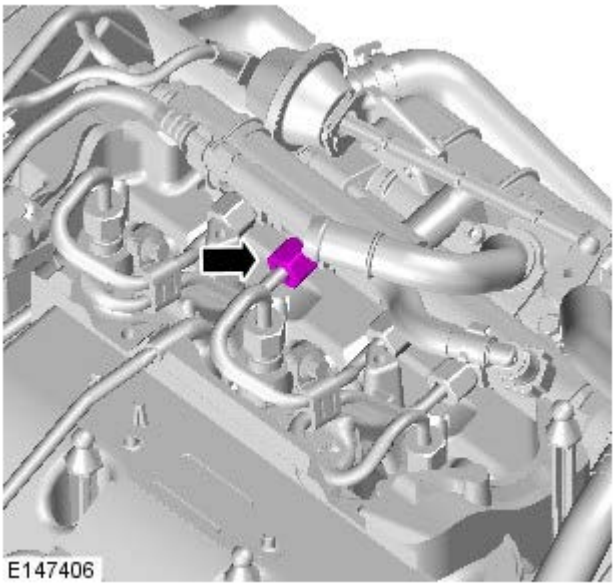
15. Tighten the high-pressure fuel lines union to 15Nm.



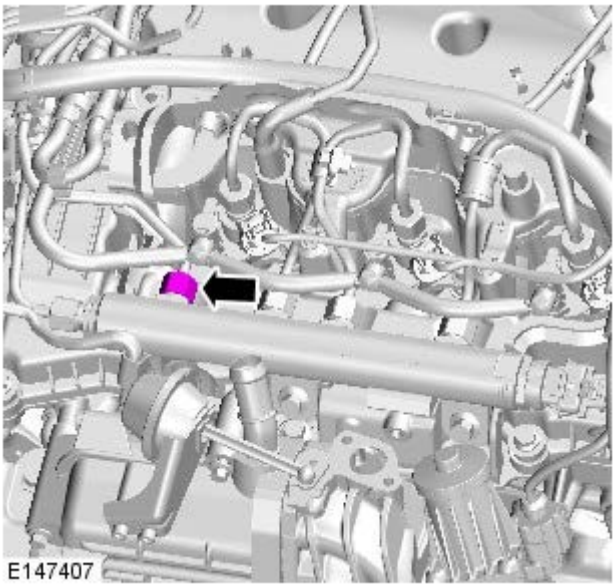
16. Tighten the high-pressure fuel lines union to 15Nm.



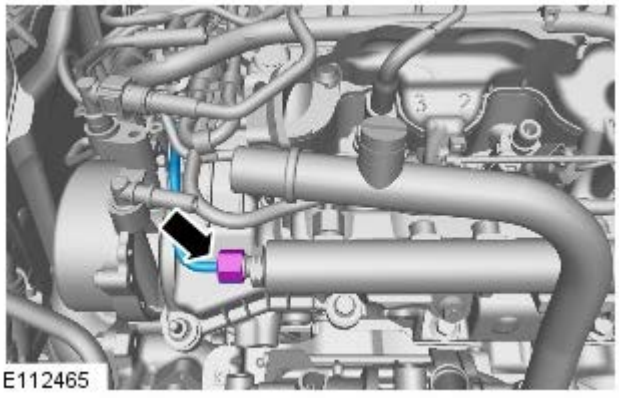
17. Tighten the high-pressure fuel lines union to 35Nm.



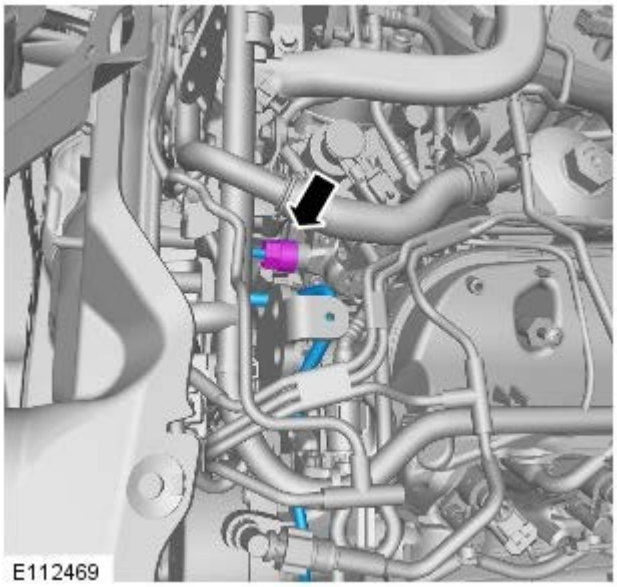
18. Tighten the high-pressure fuel lines union to 35Nm.



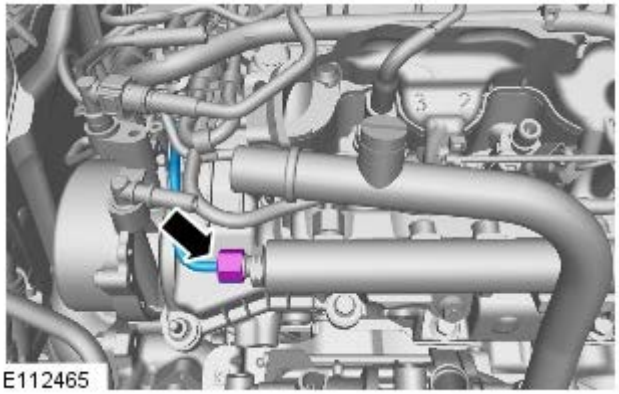
19. Tighten the high-pressure fuel lines union to 15Nm.



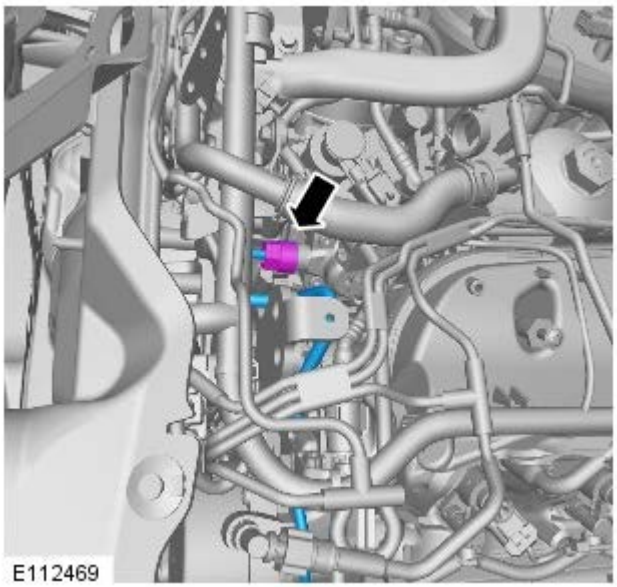
20. Tighten the high-pressure fuel lines union to 15Nm.



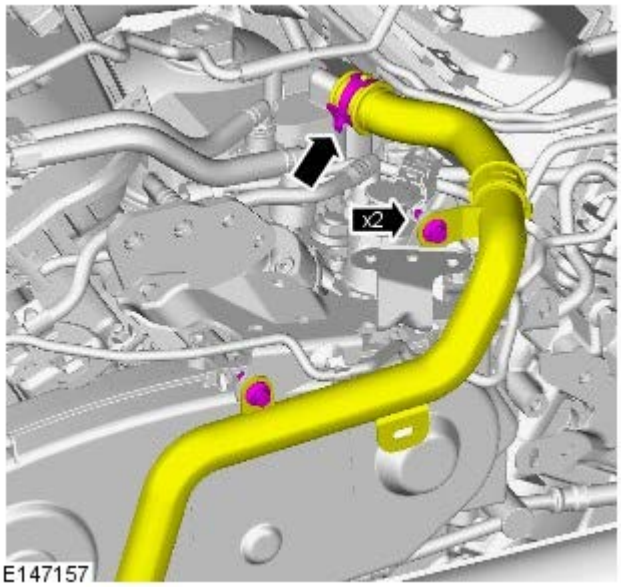
21. Tighten the high-pressure fuel line union to 35 Nm.



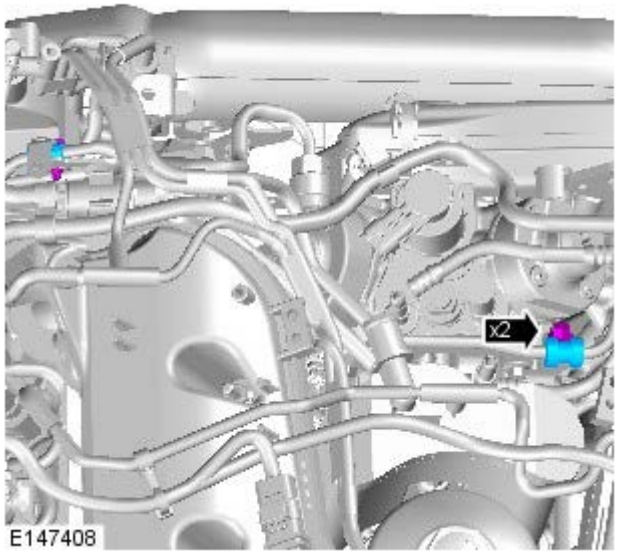
22. Tighten the high-pressure fuel line union to 35 Nm.



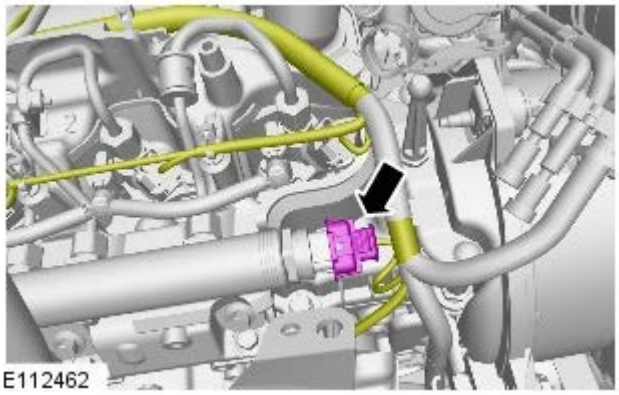
23. *Torque:* 10 Nm



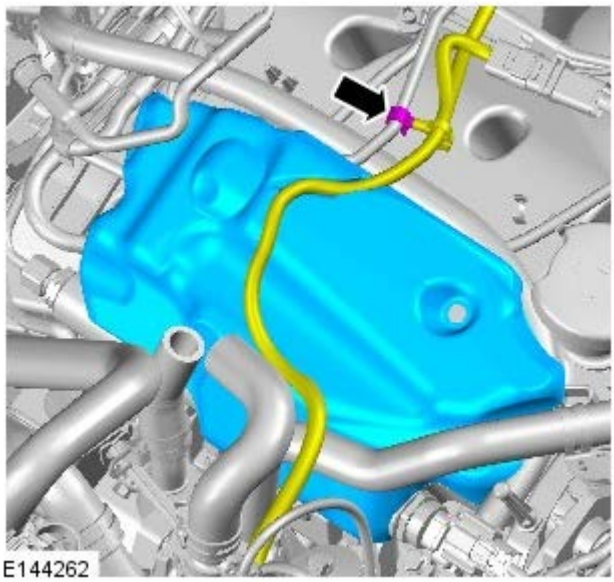
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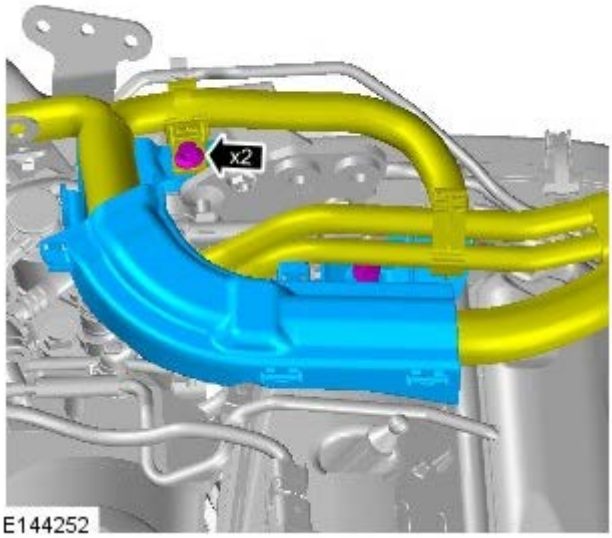
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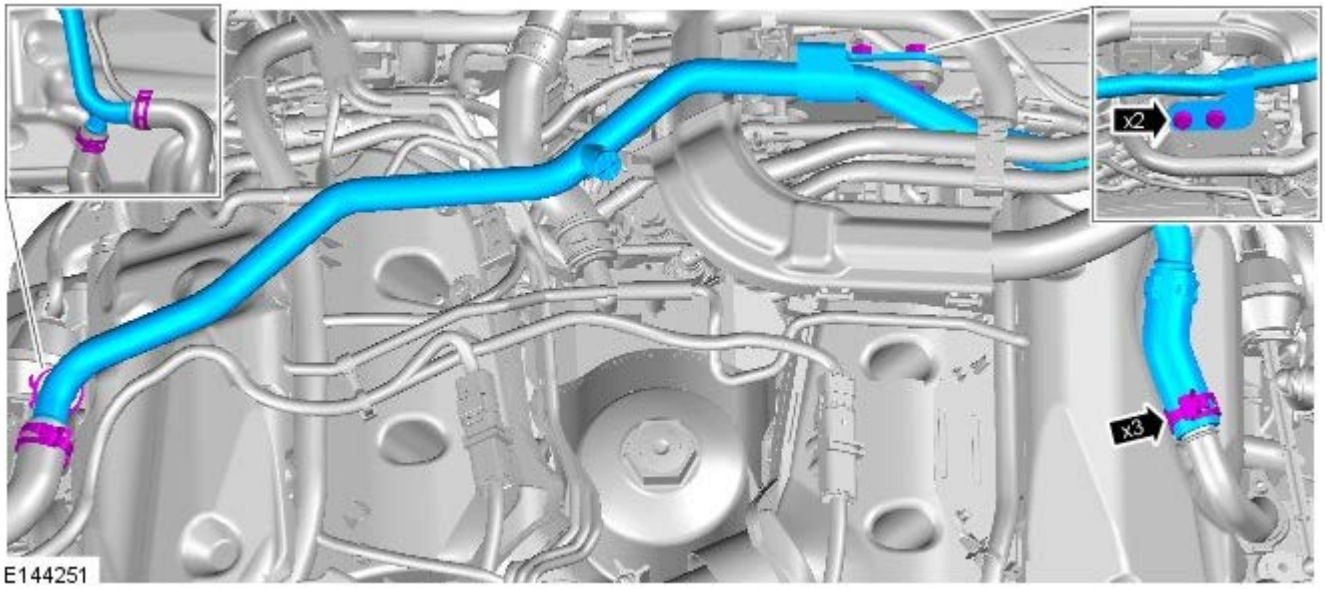
26.



27. *Torque:* 10 Nm



28. *Torque:* 10 Nm



29. Refer to: Exhaust Gas Recirculation (EGR) Valve Outlet Tube RH (303-08A Engine Emission Control - TDV6 3.0L Diesel, Removal and Installation).

30. Refer to: Cooling System Partial Draining, Filling and Bleeding (303-03A Engine Cooling - TDV6 3.0L Diesel, General Procedures).

31. Refer to: Secondary Bulkhead Center Panel - TDV6 3.0L Diesel (501-02 Front End Body Panels, Removal and Installation).

32. Refer to: Specifications (414-00, Specifications).

Published: 31-Jul-2012

Fuel Charging and Controls - TDV6 3.0L Diesel - Intake Air Shutoff Throttle

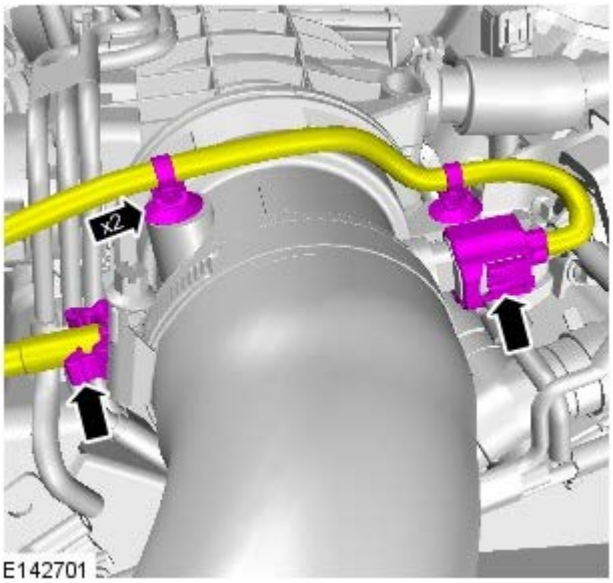
Removal and Installation

Removal

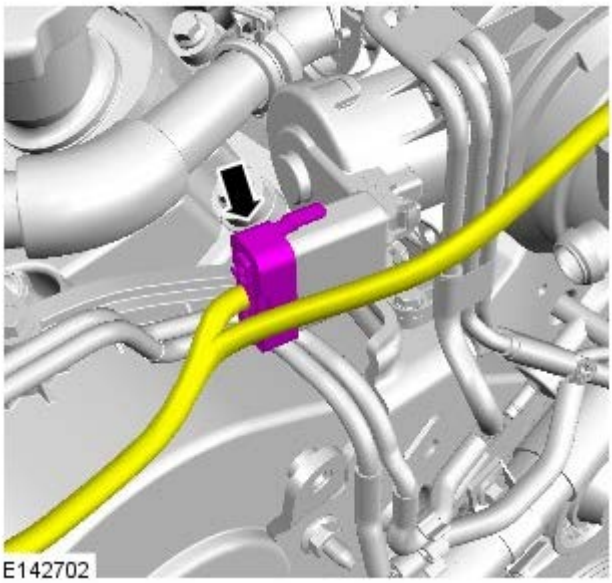
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05, Removal and Installation).

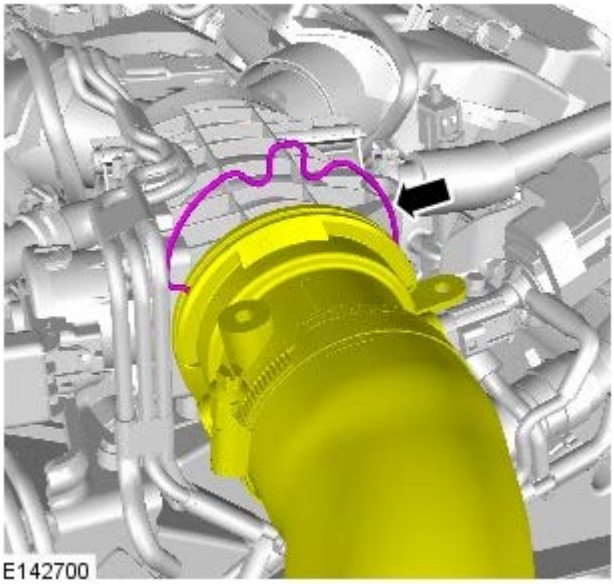
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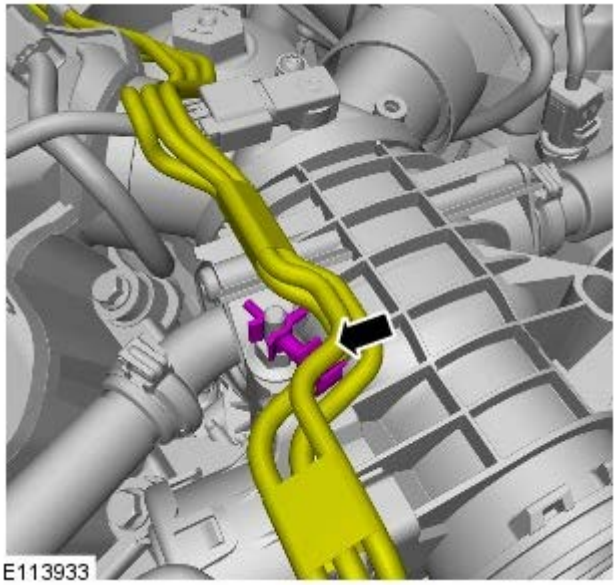
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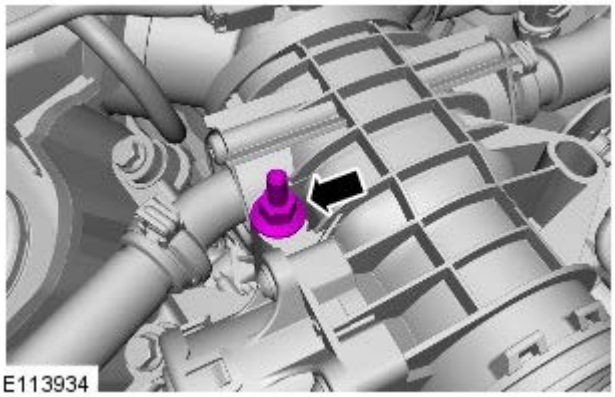
4.



5.



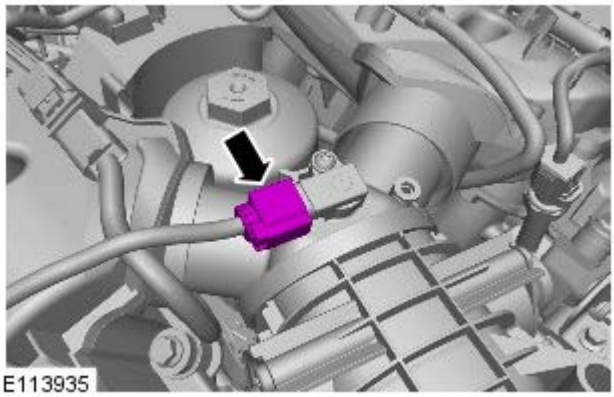
6. *Torque:* 10 Nm



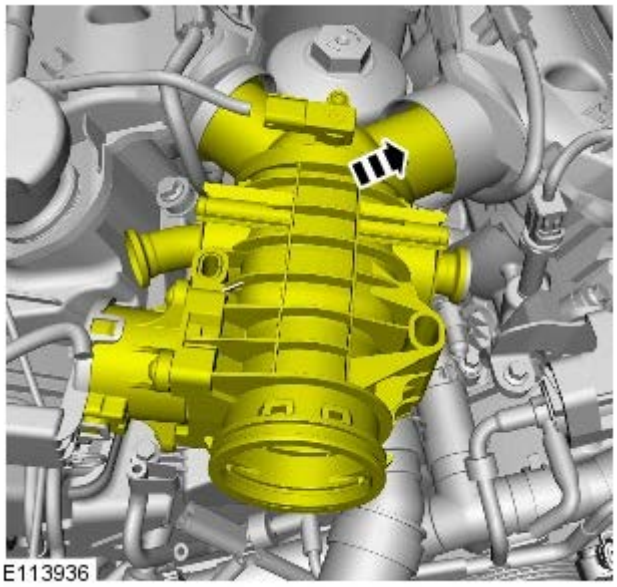
7. Refer to: Exhaust Gas Recirculation (EGR) Valve Outlet Tube LH (303-08A Engine Emission Control - TDV6 3.0L Diesel, Removal and Installation).

8. Refer to: Exhaust Gas Recirculation (EGR) Valve Outlet Tube RH (303-08A Engine Emission Control - TDV6 3.0L Diesel, Removal and Installation).

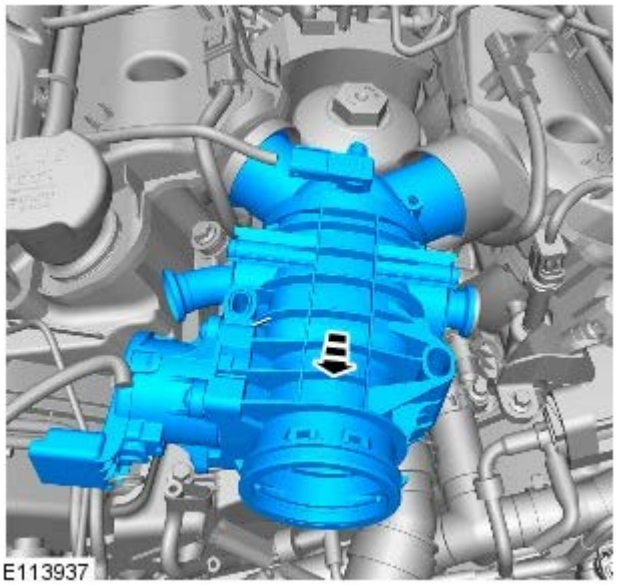
9.


E113935

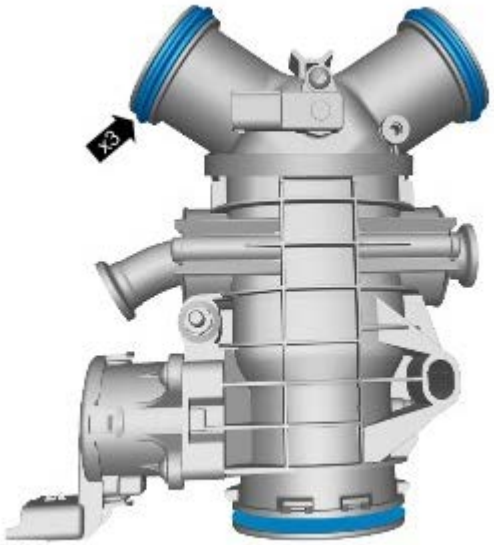
10.


E113936

11.


E113937

12. CAUTION: Install the new seals.



E116356

Installation

1. To install, reverse the removal procedure.
2. If a new unit is installed, configure using the approved diagnostic tool.

Published: 24-Oct-2012

Fuel Charging and Controls - Turbocharger - SDV6 3.0L Diesel - Hybrid Electric Vehicle / TDV6 3.0L Diesel -

Torque Specification

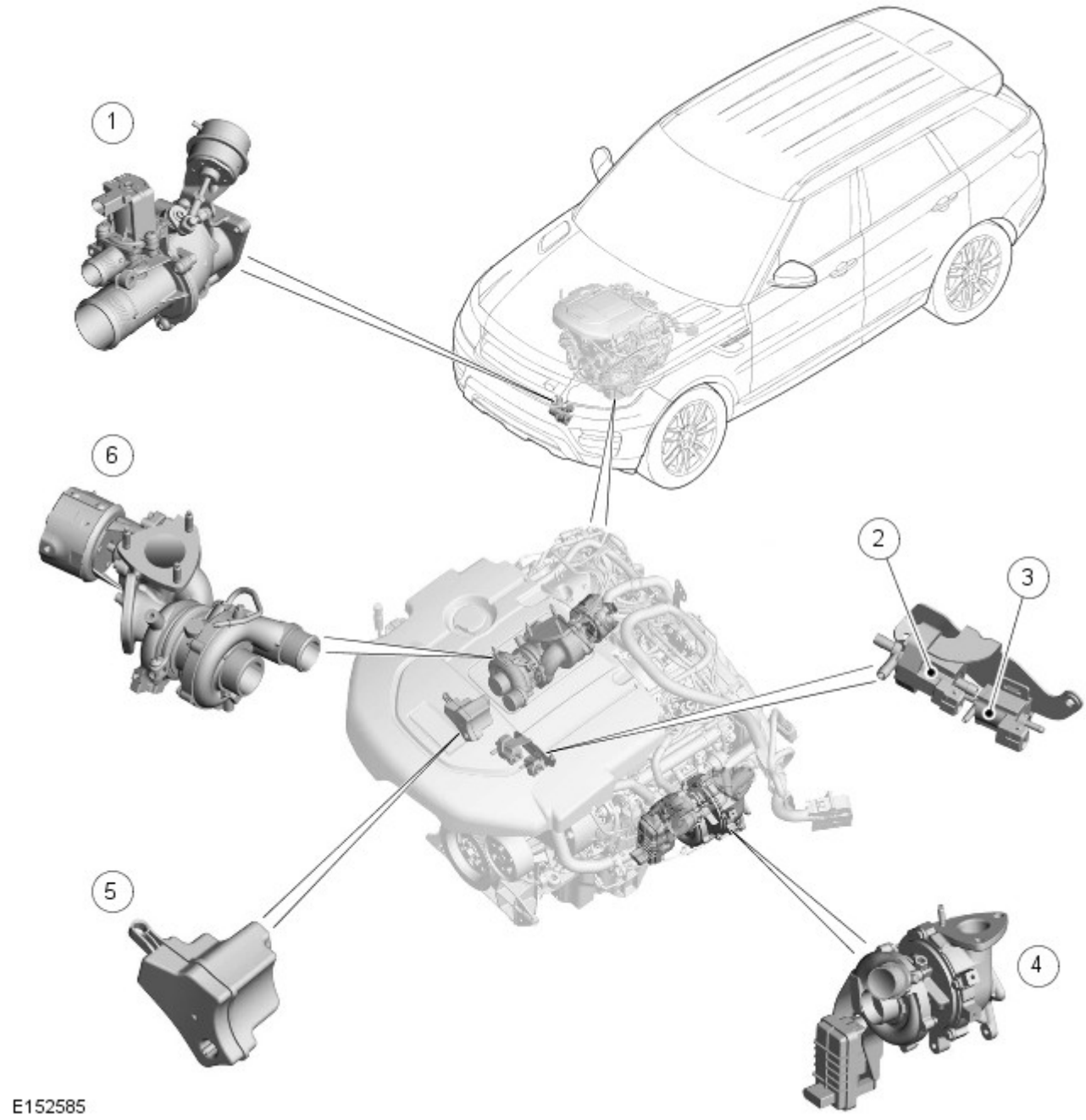
Description	Nm	lb-ft	lb-in
Exhaust manifold retaining nuts	28	21	-
Turbocharger oil return tube to turbocharger retaining bolt	9	-	80
Turbocharger oil return tube to engine retaining bolt	9	-	80
Turbocharger bracket retaining bolts	32	24	-
Turbocharger to exhaust manifold retaining nuts	24	18	-
Exhaust manifold heatshield retaining bolt	11	8	-
Exhaust heatshield retaining bolt	9	-	80
Turbocharger oil supply tube union bolt	30	22	-
Exhaust gas recirculation (EGR) tube to EGR valve retaining bolts	10	-	88
EGR valve tube to exhaust manifold retaining bolts	10	-	88
Turbocharger bypass valve retaining bolts	9		80
Turbocharger bypass valve to cross section duct bolts	10		88

Published: 31-May-2013

Fuel Charging and Controls - Turbocharger - SDV6 3.0L Diesel - Hybrid Electric Vehicle / TDV6 3.0L Diesel - Turbocharger

Description and Operation

COMPONENT LOCATION



E152585

Item	Part Number	Description
1	-	Charge air intake valve
2	-	Turbine intake shut-off valve solenoid
3	-	Charge air solenoid
4	-	Primary turbocharger
5	-	Vacuum reservoir
6	-	Secondary turbocharger

OVERVIEW

The 3.0L V6 diesel engine uses two turbochargers, a VGT (Variable Geometry Turbine) type (the primary turbocharger) and a fixed vane type (the secondary turbocharger).

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 primary turbocharger operates through the entire engine speed range, but is at its most efficient at engine speeds of up to 2800 rev/min, running in a mono turbocharger mode. At engine speeds above 2800 rev/min under load, the secondary

turbocharger comes into operation, with both of the turbochargers running in a parallel bi-turbocharger mode.

The parallel sequential turbocharging system comprises the two turbochargers, a charge air intake valve, a turbine intake shut-off valve solenoid and a charge air solenoid. Operation of the system is controlled by the ECM (Engine Control Module).

The turbochargers and the charge air intake valve are interconnected by the charge air ducts of the intake air distribution and filtering system.
For additional information, refer to: Intake Air Distribution and Filtering (303-12A Intake Air Distribution and Filtering - TDV6 3.0L Diesel, Description and Operation).

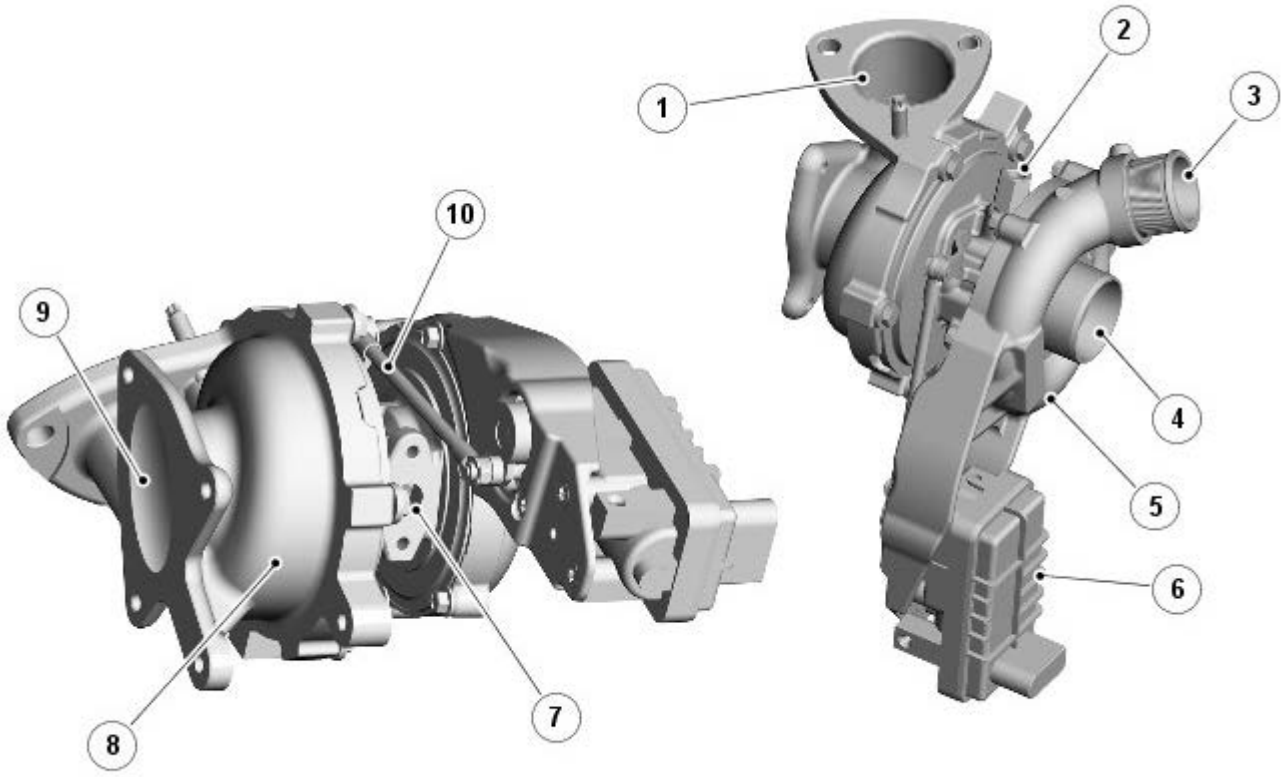
DESCRIPTION

Turbochargers

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.

The turbocharger bearings are lubricated and cooled by an oil supply from the cylinder block. The primary turbocharger return oil drains into a dedicated area of the oil pan, assisted by an oil scavenge element in the vacuum pump. The secondary turbocharger return oil drains into a dedicated area of the crankcase directly via drain tube.
For additional information, refer to: Engine (303-01A Engine - TDV6 3.0L Diesel, Description and Operation).

PRIMARY TURBOCHARGER



E144803

Item	Part Number	Description
1	-	Exhaust intake
2	-	Oil feed connection
3	-	Charge air outlet
4	-	Clean air intake
5	-	Compressor housing
6	-	VGT vane actuator
7	-	Oil return connection
8	-	Turbine housing
9	-	Exhaust outlet
10	-	Actuator rod

The primary turbocharger is attached to the left 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 provides for the attachment of the left down pipe of the exhaust system. Three screws secure the down pipe to the flange and a gasket seals the joint.

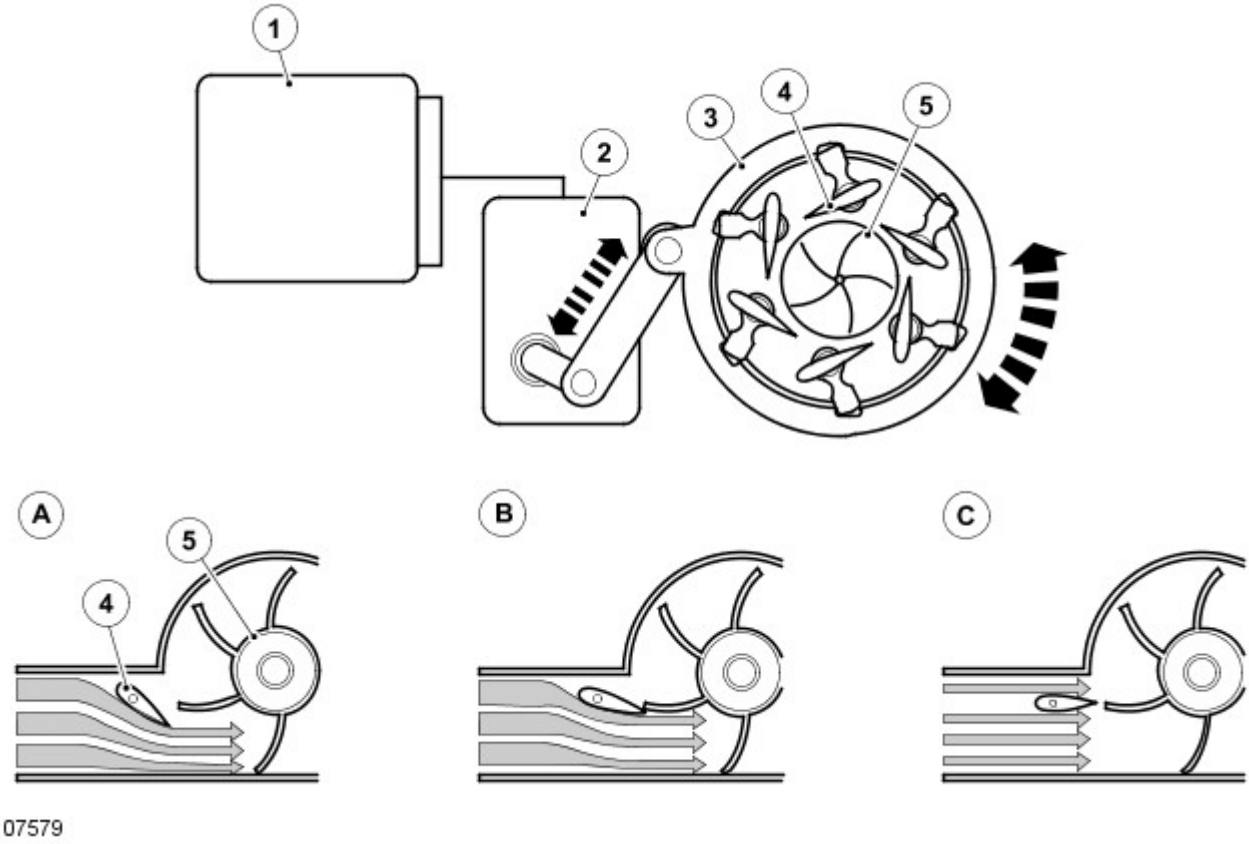
The compressor end of the turbocharger has two hose connections. The central hose connection provides a clean air supply from the air cleaner to the compressor. The second connection on the outside of the housing provides for the attachment of the charge air ducts.

An integral bracket houses the VGT vane actuator. The actuator is connected to an eccentric lever which moves the turbine housing to adjust the position of the vanes. When the actuator operates a boss is rotated, which in turn moves the lever and changes rotary motion into linear motion. The lever is connected to a rod attached to the outside of the turbine housing and the linear motion is converted back to rotary motion of the housing.

Operation of the VGT vane actuator is controlled by the ECM. The VGT vane actuator also provides the ECM with a feedback signal to determine the pitch angle of the vanes.

The variable vanes in the 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 charge air pressure.

Principles of Variable Vane Operation



E107579

A = Low engine speed; B = Intermediate engine speed; C = Maximum engine speed.

Item	Part Number	Description
1	-	Engine control module
2	-	VGT vane actuator
3	-	Turbine housing
4	-	Variable vanes
5	-	Compressor wheel

Low Engine Speed. At low engine speeds the volume of exhaust gas is low so the vanes are moved towards the closed position to reduce the turbine inlet area. This reduction causes an increase in the gas velocity into the turbine wheel thereby increasing wheel speed and charge air pressure.

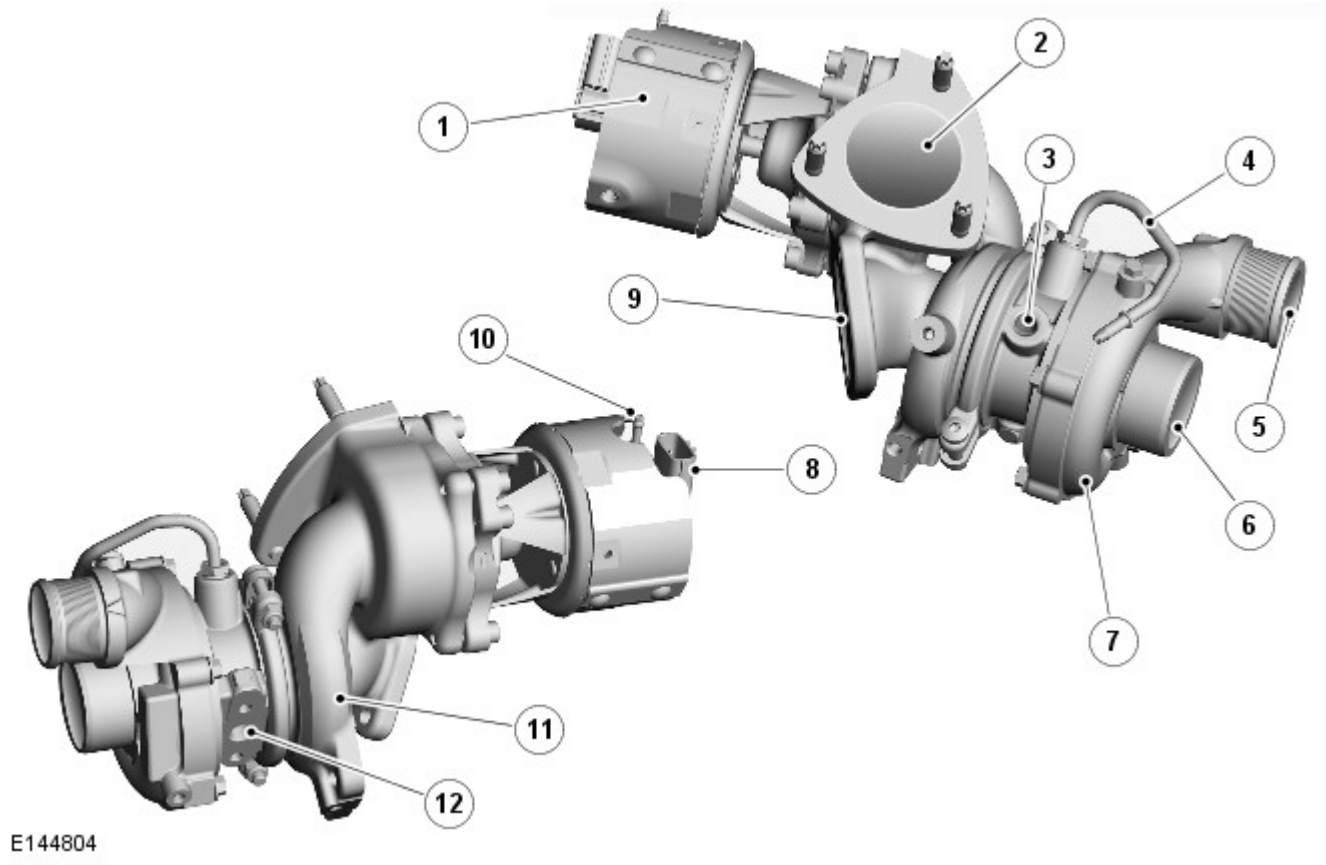
Intermediate Engine Speed. As the engine speed increases and the volume of exhaust gas increases the vanes are moved towards the open position to increase the turbine inlet area and maintain the gas velocity.

Maximum Engine Speed. At maximum engine speed the vanes are almost fully open maintaining the gas velocity into the turbine wheel.

When the vehicle is driven at high altitudes the ambient pressure reduces causing the compressor wheel to rotate faster to achieve the same charge air pressure. To prevent the turbine wheel from over-speeding under these conditions, the ECM protects the turbocharger by opening the vanes further to reduce the turbine wheel speed. This is known as the altitude margin of the turbocharger, which occurs at altitudes above 2000 meters. Below 2000 meters altitude compensation is not necessary. The ECM uses an internal barometric pressure sensor to monitor altitude.

The maximum position of the turbocharger vanes (fully open) is also an emergency default position in the event of an electrical fault. This lowers the chance of engine damage due to excessive charge air pressure.

SECONDARY TURBOCHARGER



Item	Part Number	Description
1	-	Turbine shut-off valve
2	-	Exhaust intake
3	-	Oil feed connection
4	-	Seal pressurizing air pipe
5	-	Charge air outlet
6	-	Clean air intake
7	-	Compressor housing
8	-	Position sensor electrical connector
9	-	Exhaust outlet
10	-	Vacuum connection
11	-	Turbine housing
12	-	Oil return connection

The secondary turbocharger is attached to the right 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.

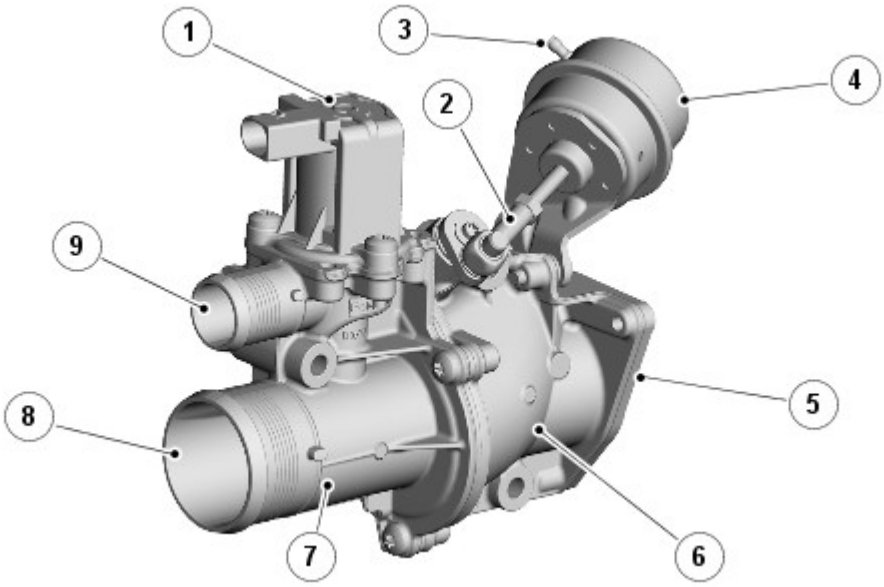
A second flange on the turbocharger provides for the attachment of the right down pipe of the exhaust system. Two screws secure the down pipe to the flange and a gasket seals the joint.

The compressor end of the turbocharger has two hose connections. The central connection provides a clean air supply from the air cleaner to the compressor. The second connection on the outside of the housing provides for the attachment of the charge air ducts.

A pipe on the center housing of the turbocharger provides for the connection of a bleed air pipe from the charge air duct connection with the electric throttle. The bleed air is used to pressurize the seals of the compressor stage to prevent oil leaking into the compressor housing when the turbocharger is not running.

Attached to the rear of the turbocharger is a turbine shut-off valve operated by a vacuum actuator. The ECM operates the turbine intake shut-off valve solenoid to apply and release the vacuum in the actuator, which opens the turbine shut-off valve when a vacuum is present. The turbine shut-off valve is closed when the system is operating in mono-turbocharger mode, diverting exhaust gasses from the right exhaust manifold, via the exhaust cross-over duct to the left exhaust manifold. A position sensor in the turbine shut-off valve allows the ECM to monitor the shut-off valve for correct operation.

Charge Air Intake Valve



E144805

Item	Part Number	Description
1	-	Recirculation solenoid
2	-	Shut-off valve connecting rod
3	-	Vacuum connection
4	-	Vacuum actuator
5	-	Shut-off valve charge air outlet (to charge air coolers)
6	-	Shut-off valve body
7	-	Recirculation solenoid valve body
8	-	Charge air intake (from secondary turbocharger)
9	-	Recirculation solenoid charge air outlet (to primary turbocharger clean air duct)

The charge air intake valve is attached to a bracket on the front subframe and the cooling pack protector. The ECM uses the valve to control the bi-turbocharger operation of the turbochargers.

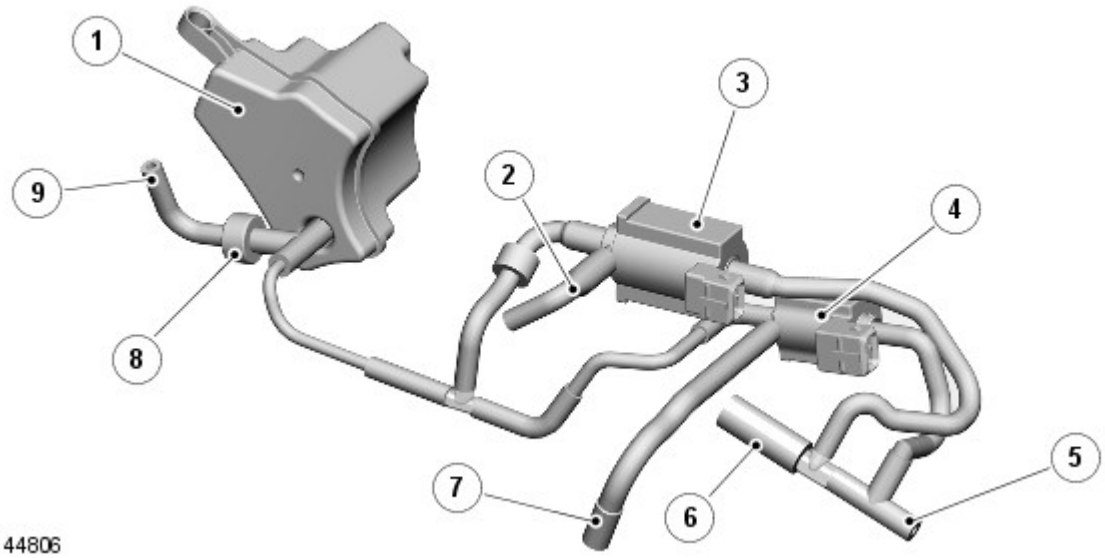
The charge air intake valve consists of a recirculation solenoid and a shut-off valve that are connected together by four screws and a gasket. The recirculation solenoid controls the flow of air from the compressor of the secondary turbocharger to the clean air duct of the primary turbocharger. The shut-off valve controls the flow of air from the compressor of the secondary turbocharger to the charge air coolers.

The recirculation solenoid is operated by a power feed from the EJB (Engine Junction Box) and a ground connection with the ECM. When it is de-energized, the recirculation solenoid is closed.

If the recirculation solenoid develops a fault it will default to the closed position. In this position an overspeed of the primary turbocharger will occur. This overspeed is sensed by the MAP (Manifold Absolute Pressure) sensor which detects the increase in pressure. The ECM registers the signals from the MAP sensor and operates the turbochargers in mono-turbo mode with restricted engine torque and DTC (Diagnostic Trouble Code)'s recorded.

The shut-off valve is a flap valve operated by a vacuum actuator. The ECM operates the charge air solenoid to apply and release the vacuum in the actuator, which opens the valve when a vacuum is present. When the shut-off valve is open charge air from the secondary turbocharger flows through the valve to the charge air coolers.

Vacuum Control Solenoids



Item	Part Number	Description
1	-	Vacuum reservoir
2	-	Pipe to turbine shut-off valve (secondary turbocharger)
3	-	Turbine intake shut-off valve solenoid
4	-	Charge air solenoid
5	-	Pipe from left air cleaner
6	-	Pipe to cooling bypass solenoid of exhaust gas recirculation system
7	-	Pipe to vacuum actuator of charge air shut-off valve
8	-	Non return valve
9	-	Pipe from vacuum pump

The turbine intake and charge air solenoids are installed on a bracket attached to the front of the left cylinder head. The ECM operates the solenoids to apply and release the vacuum in the vacuum actuators of the turbine shut-off valve (of the secondary turbocharger) and the charge air shut-off valve.

The vacuum for the actuators is produced by the vacuum pump on the rear of the right cylinder head.
For additional information, refer to: Engine (303-01A Engine - TDV6 3.0L Diesel, Description and Operation).

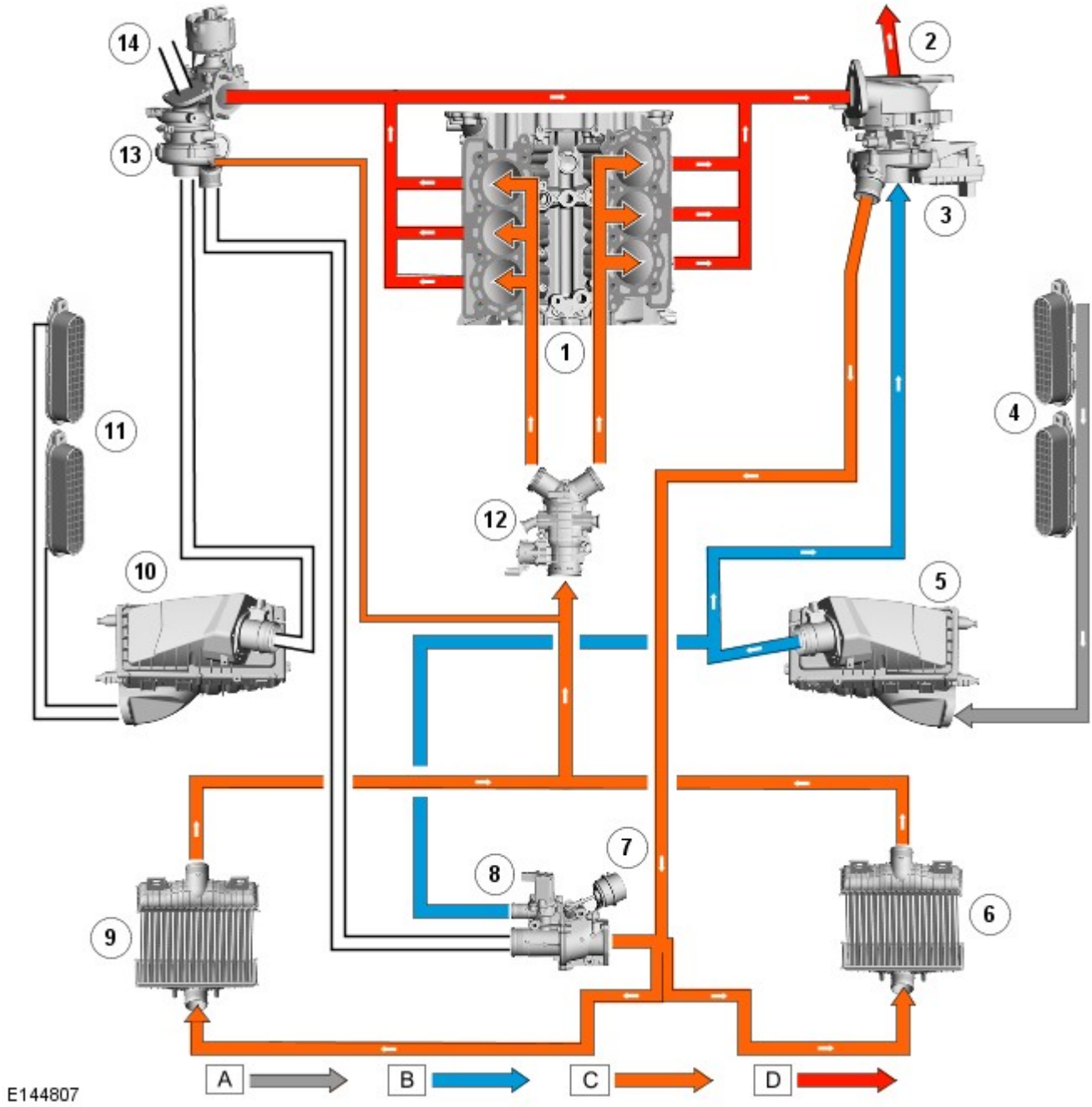
The solenoids are normally-closed valves installed in the vacuum line between the vacuum reservoir and their related vacuum actuator. Each solenoid is also connected to a line from the left air cleaner, which allows air into the vacuum lines to the actuators when the solenoids are de-energized.

OPERATION

The turbine wheel of each turbocharger uses the engine exhaust gasses to drive the compressor wheel. The compressor wheel draws in clean air, which is supplied to the engine cylinders in a compressed form.

The turbochargers can operate in two modes; mono turbocharger operation or bi-turbocharger operation.

Mono Turbocharger Operation



A = Dirty air; B = Clean air; C = Charge air; D = Exhaust gasses.

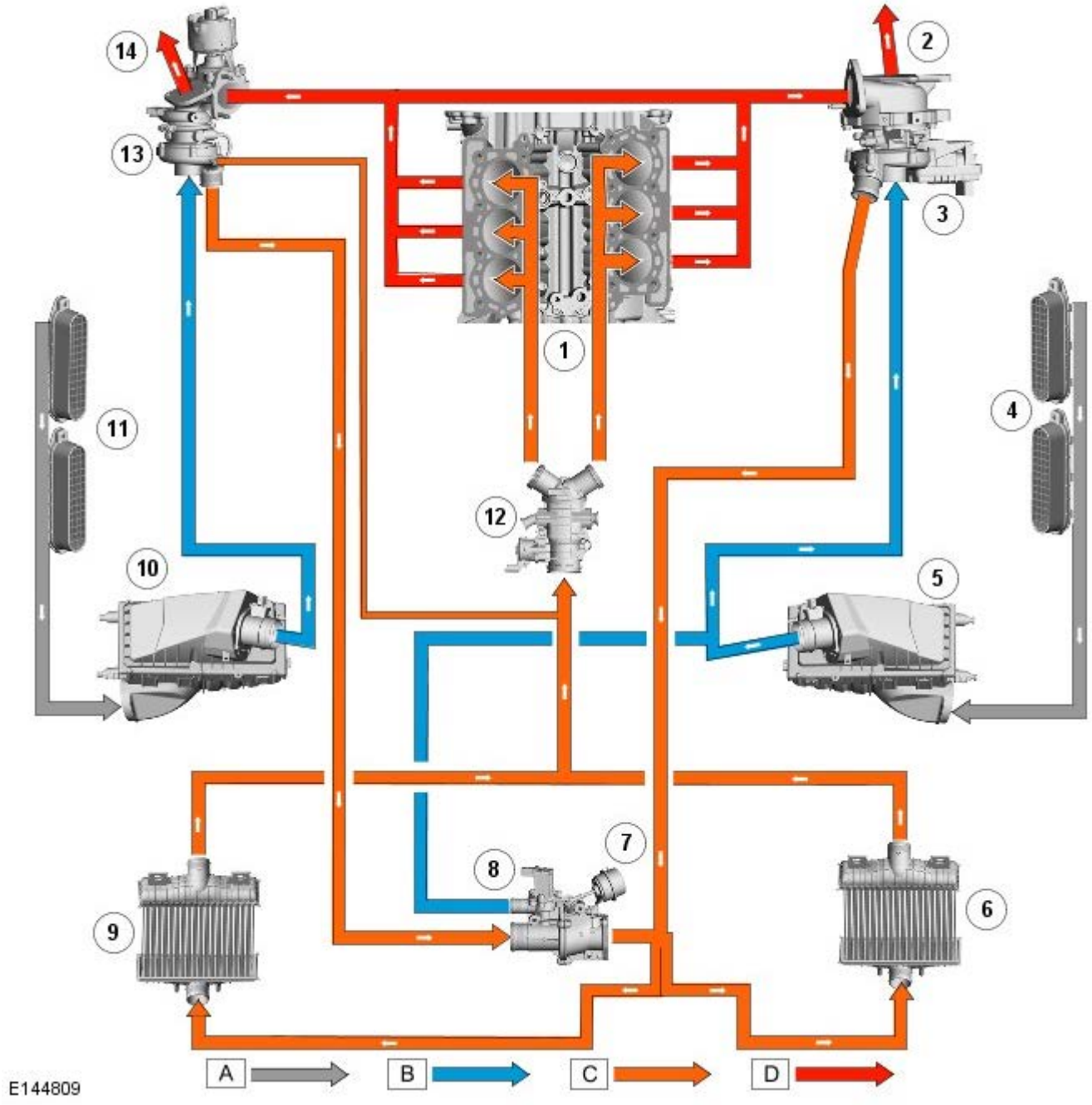
Item	Part Number	Description
1	-	Engine
2	-	Exhaust system left intake pipe
3	-	Primary turbocharger
4	-	Left intake grills
5	-	Left air cleaner
6	-	Left charge air cooler
7	-	Charge air shut-off valve
8	-	Charge air recirculation solenoid
9	-	Right charge air cooler
10	-	Right air cleaner
11	-	Right intake grills
12	-	Electric throttle
13	-	Secondary turbocharger
14	-	Exhaust system right intake pipe

Fresh air is drawn through the left air cleaner and the MAF (Mass Air Flow) sensor to the primary turbocharger compressor. The compressed air then passes through the charge air coolers and electric throttle to the intake manifolds.

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 charge air pressure is produced by the primary turbocharger using the exhaust gasses from all six cylinders.

If the engine idles for more than 3 minutes, the secondary turbocharger is actuated to keep the turbocharger shaft rotating, to prevent oil from leaking into the turbine housing. This is achieved by periodically opening the turbine shut-off valve to operate the turbocharger.

Bi-Turbocharger Switching



A = Dirty air; B = Clean air; C = Charge air; D = Exhaust gasses.

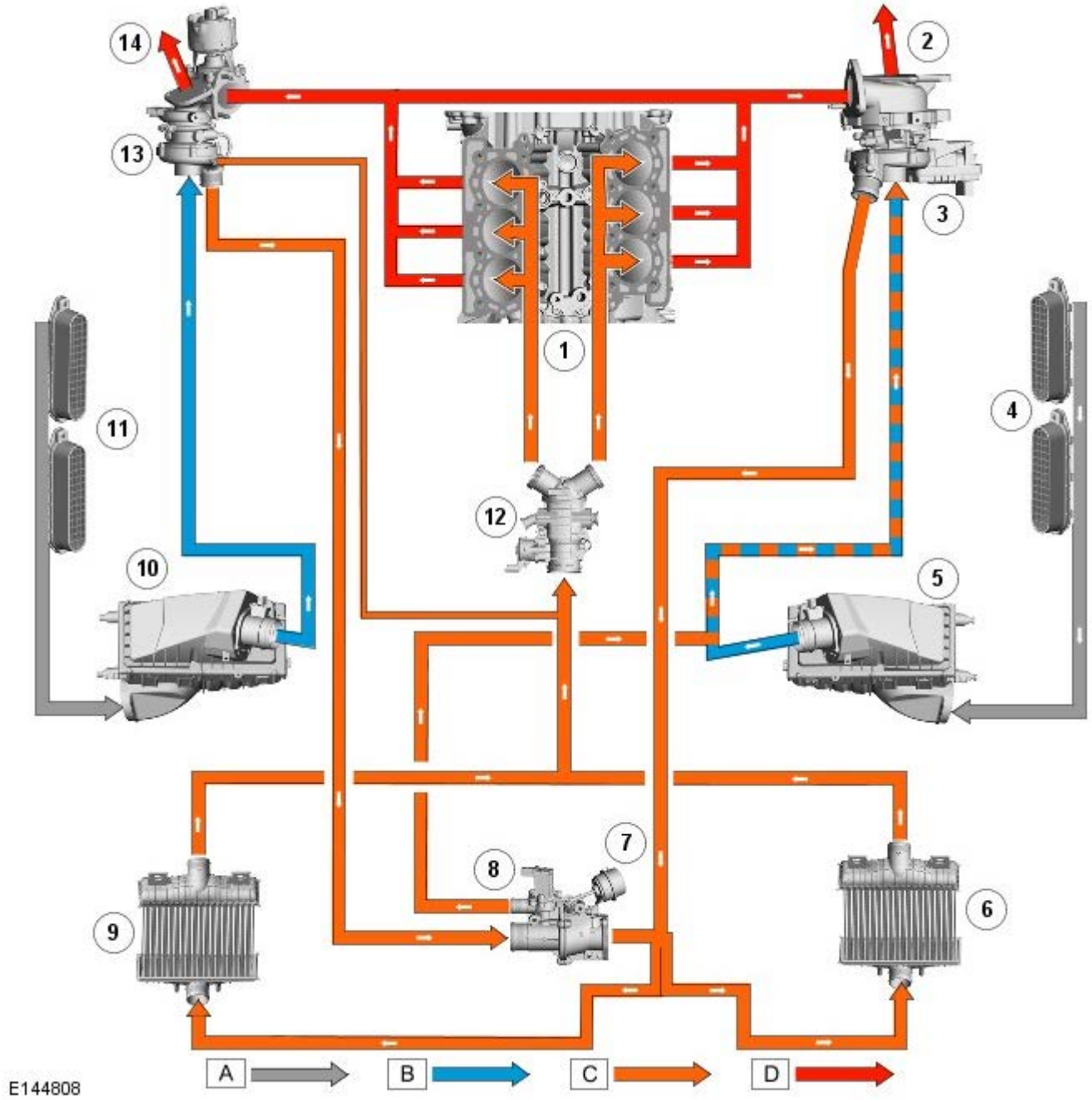
Item	Part Number	Description
1	-	Engine
2	-	Exhaust system left intake pipe
3	-	Primary turbocharger
4	-	Left intake grills
5	-	Left air cleaner
6	-	Left charge air cooler
7	-	Charge air shut-off valve
8	-	Charge air recirculation solenoid
9	-	Right charge air cooler
10	-	Right air cleaner
11	-	Right intake grills
12	-	Electric throttle
13	-	Secondary turbocharger
14	-	Exhaust system right intake pipe

As the secondary turbocharger charge air pressure increases, the recirculation solenoid is closed and the charge air shut-

off valve opened. This increases the charge air pressure from the secondary turbocharger and combines it with the charge air from the primary turbocharger.

The ECM maintains the turbochargers in bi-turbocharger mode until it determines that the engine operating parameters no longer require it. The ECM then switches the turbochargers back to mono turbocharger operation.

Bi-Turbocharger Operation



A = Dirty air; B = Clean air; C = Charge air; D = Exhaust gasses.

Item	Part Number	Description
1	-	Engine
2	-	Exhaust system left intake pipe
3	-	Primary turbocharger
4	-	Left intake grills
5	-	Left air cleaner
6	-	Left charge air cooler
7	-	Charge air shut-off valve
8	-	Charge air recirculation solenoid
9	-	Right charge air cooler
10	-	Right air cleaner
11	-	Right intake grills
12	-	Electric throttle
13	-	Secondary turbocharger

14	-	Exhaust system right intake pipe

When the engine operating parameters approach the limits (approximately 2800 rev/min under load) of the primary turbocharger, 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. Fresh air is then drawn through the right air cleaner and the MAFT (Mass Air Flow and Temperature) sensor to the secondary turbocharger compressor.

Initially, the secondary turbocharger does not produce a charge air pressure to equal that of the primary turbocharger. Therefore, the charge air from the secondary turbocharger is fed via the recirculation solenoid into the clean air duct of the primary turbocharger.

Shut-off Valve Control

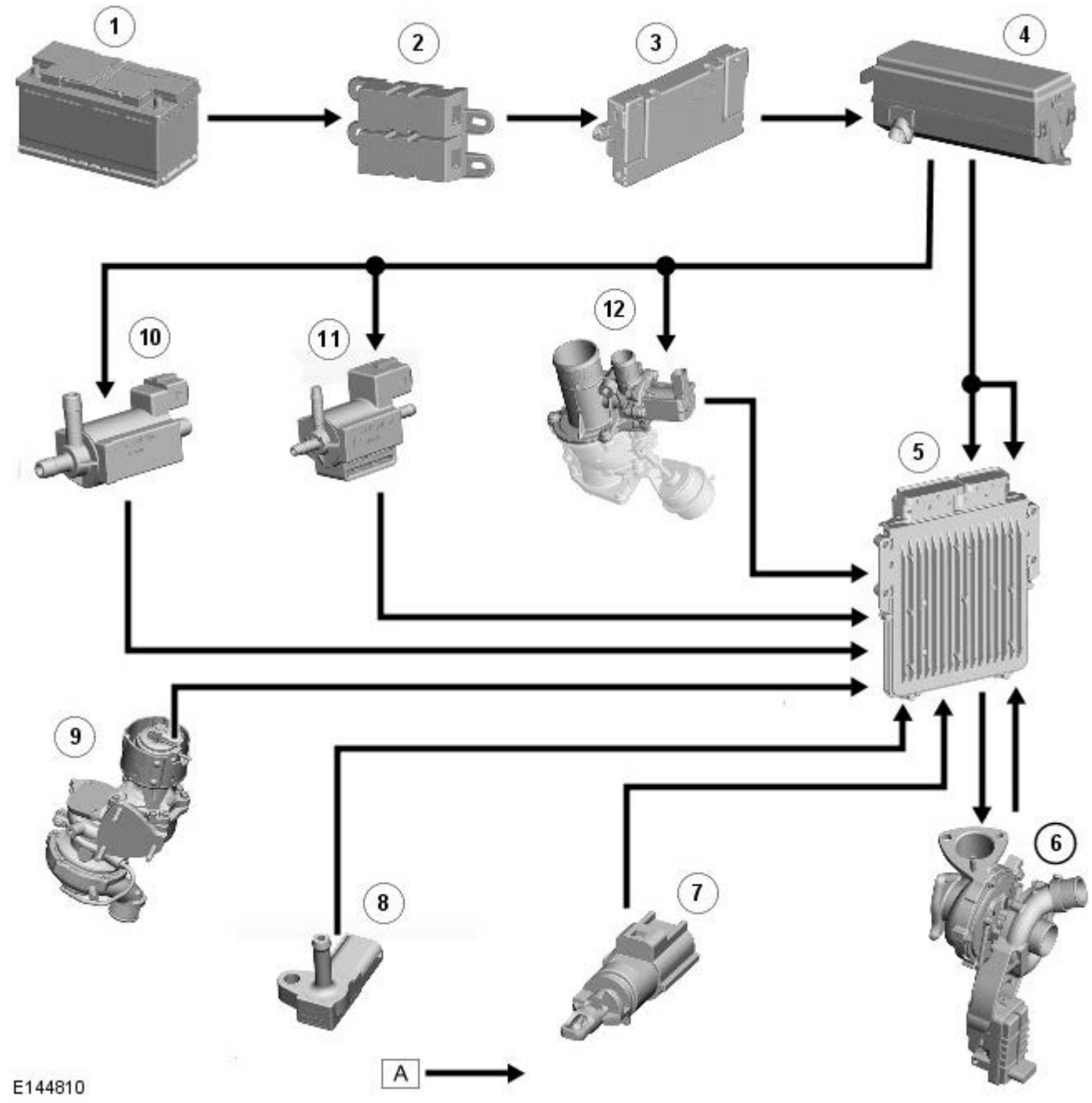
SECONDARY TURBOCHARGER TURBINE INTAKE SHUT-OFF VALVE

If vacuum is lost to the shut-off valve it will default to the closed position. The turbine intake valve position sensor will inform the ECM, which will initiate mono-turbo mode, restrict engine performance and record a DTC.

CHARGE AIR SHUT-OFF VALVE

If vacuum is lost to the shut-off valve it will default to the closed position. In the default position, the ECM initiates mono-turbo operation and restricts engine torque. A DTC will also be recorded in the ECM.

Control Diagram



A = Hardwired.

Item	Part Number	Description
1	-	Battery

2	-	Battery Junction Box 2 (BJB2)
3	-	Battery Junction Box (BJB)
4	-	Engine Junction Box (EJB)
5	-	Engine Control Module (ECM)
6	-	VGT vane actuator
7	-	Charge air temperature sensor
8	-	Charge air pressure sensor
9	-	Turbine shut-off valve position sensor
10	-	Turbine intake shut-off valve solenoid
11	-	Charge air solenoid
12	-	Charge air recirculation solenoid

Published: 31-Jul-2012

Fuel Charging and Controls - Turbocharger - SDV6 3.0L Diesel - Hybrid Electric Vehicle/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: Turbocharger (303-04B Fuel Charging and Controls - Turbocharger - SDV6 3.0L Diesel - Hybrid Electric Vehicle/TDV6 3.0L Diesel, 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 • 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	• Low/Contaminated fuel • Restricted intake air system • General engine condition • Engine control module 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. Check for DTCs indicating a module fault. Refer to the warranty policy and procedures manual if an engine control module is suspect.
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 failure	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. Refer to the warranty policy and procedures manual if an engine control module is suspect.
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: 24-Aug-2012

Fuel Charging and Controls - Turbocharger - SDV6 3.0L Diesel - Hybrid Electric Vehicle / TDV6 3.0L Diesel - Turbocharger LH TDV6 3.0L Diesel

Removal and Installation

Removal

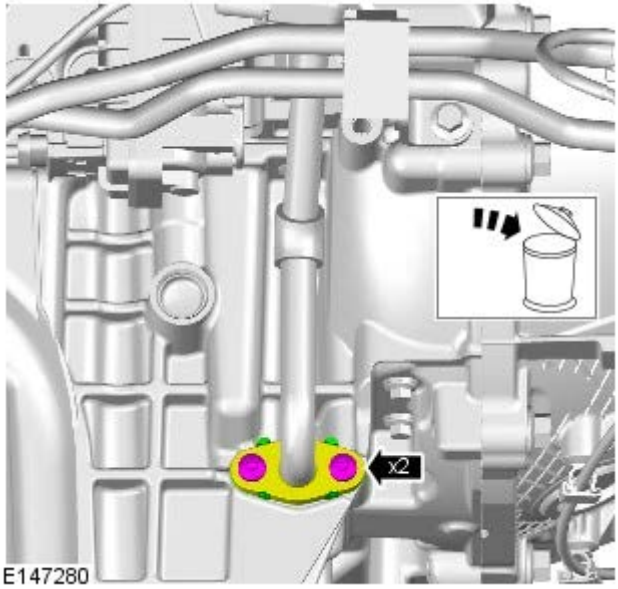
CAUTION: Make sure that all openings are sealed. Use new blanking caps.

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: Engine Oil Draining and Filling (303-01A Engine - TDV6 3.0L Diesel, General Procedures).
2. Refer to: Exhaust System - Vehicles With: Diesel Particulate Filter (DPF) (309-00A Exhaust System - TDV6 3.0L Diesel, Removal and Installation).
3. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).
4. Refer to: Transmission Fluid Cooler Tubes - TDV6 3.0L Diesel (307-02A Transmission/Transaxle Cooling - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, Removal and Installation).



5. CAUTION: Make sure that the area around the component is clean and free of foreign material.

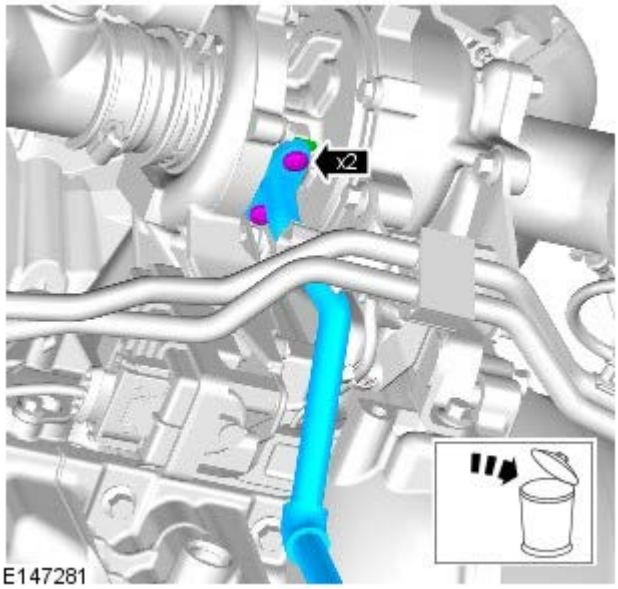
   NOTE: Install a new gasket.

   Torque: 9 Nm

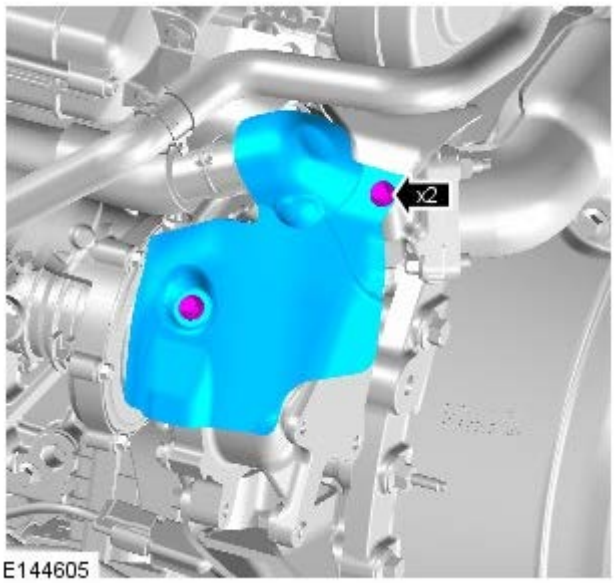
6. CAUTION: Make sure that the area around the component is clean and free of foreign material.

   NOTE: Install new gaskets.

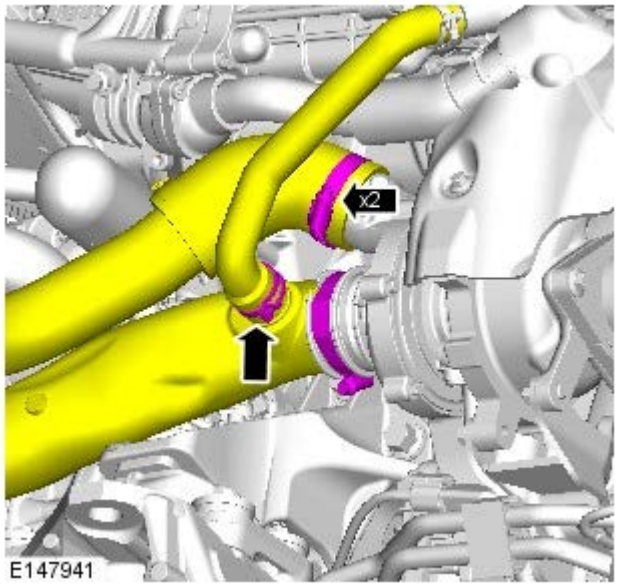
   Torque: 9 Nm



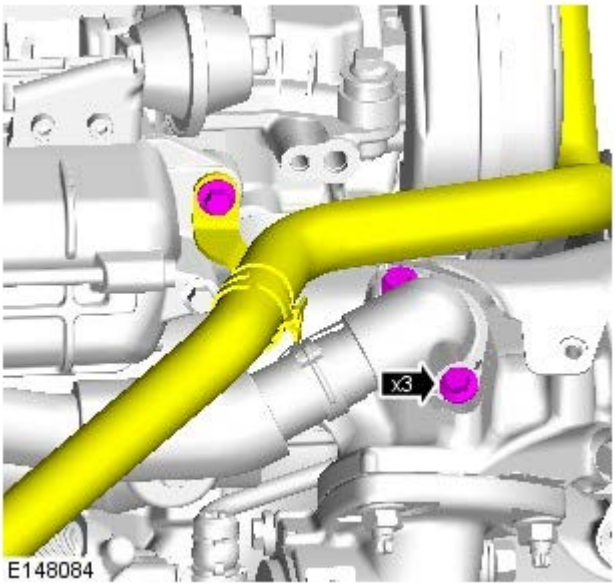
7. *Torque:* 9 Nm



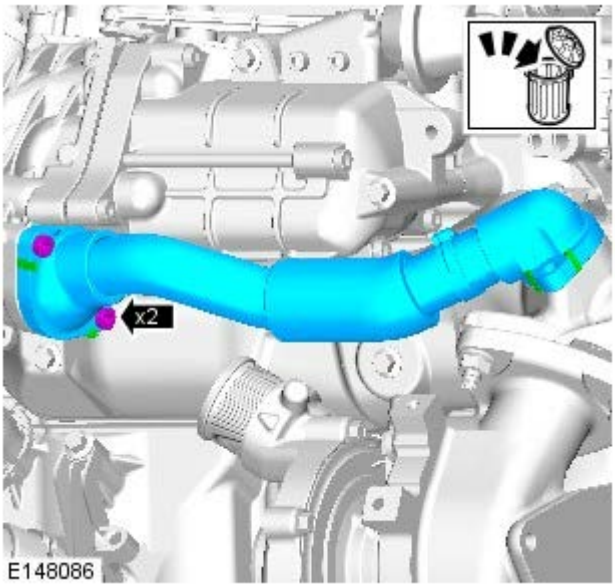
8.



9. *Torque:* 10 Nm

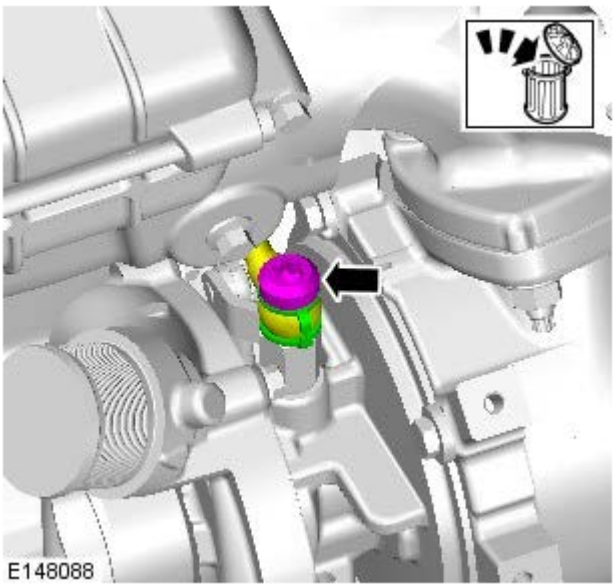


10. *Torque:* 6 Nm

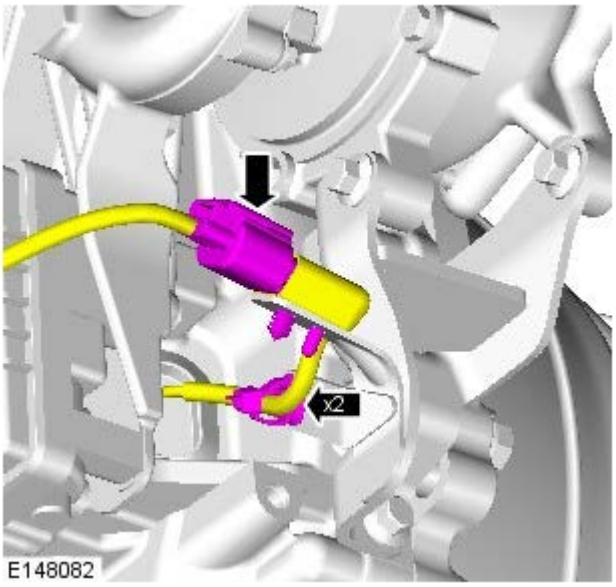


11. CAUTION: Make sure that new sealing washers are installed.

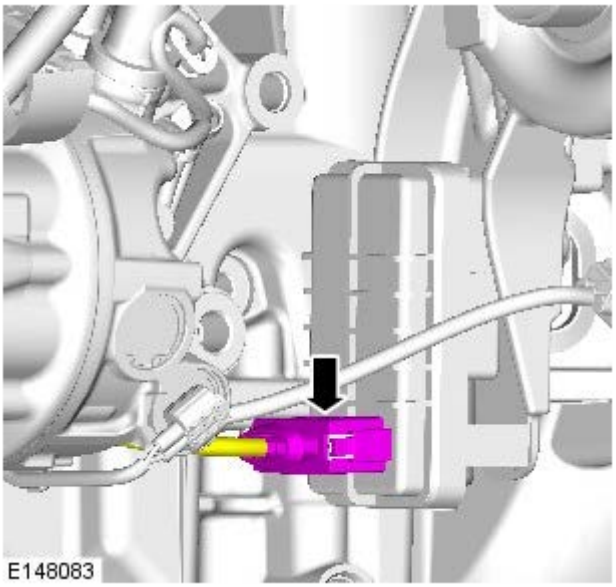
Torque: 30 Nm

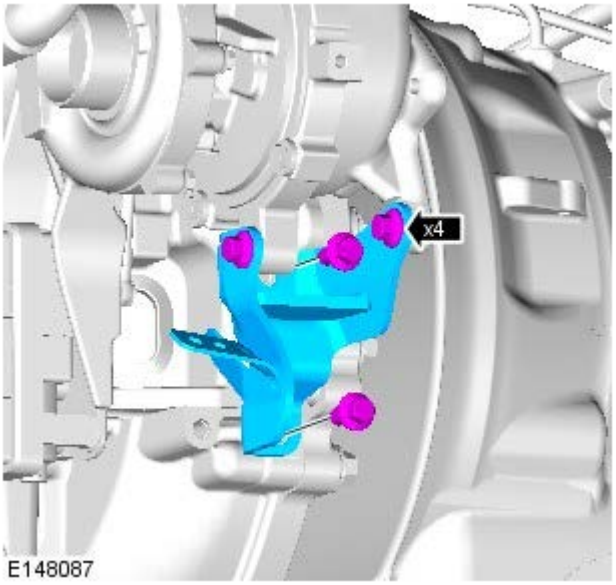


12.



13.





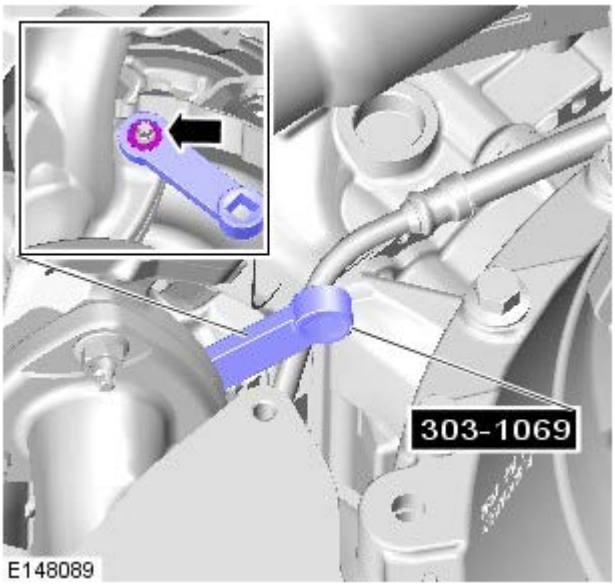
14. CAUTION: Apply Loctite 243 to the bolts.

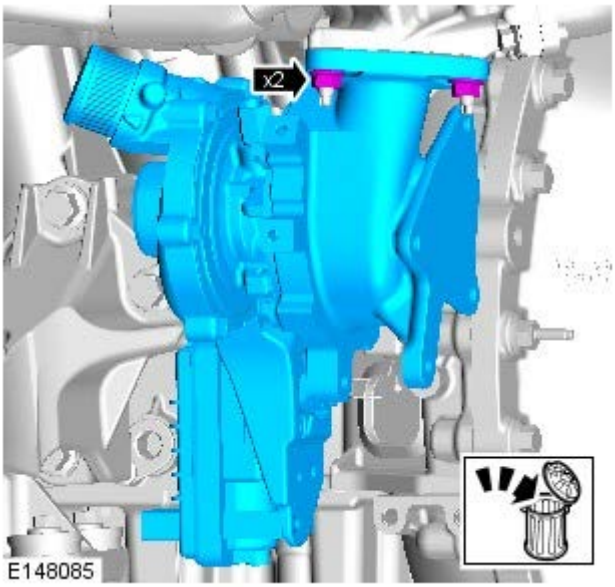
NOTE: Make sure to clean the threads prior to installation.

Torque: 32 Nm

15. WARNING: Make sure that a new nut is installed.

Torque: 24 Nm





16. NOTE: Install a new gasket.

    Torque: 24 Nm

Installation

1. To install reverse the removal procedure.

Published: 20-Aug-2013

Fuel Charging and Controls - Turbocharger - SDV6 3.0L Diesel - Hybrid Electric Vehicle / 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.

Make sure that all openings are sealed. Use new blanking caps.

1. Disconnect the battery ground cable.

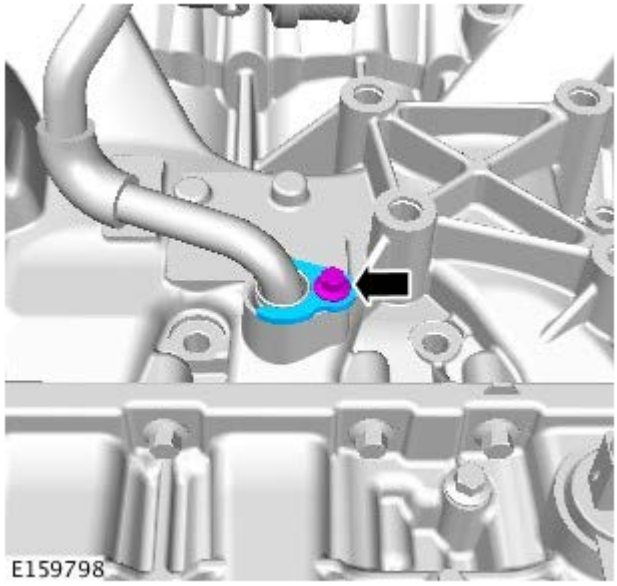
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

2. Refer to: Engine Oil Draining and Filling (303-01A Engine - TDV6 3.0L Diesel, General Procedures).

3. Refer to: Exhaust System - Vehicles With: Diesel Particulate Filter (DPF) (309-00 Exhaust System - TDV6 3.0L Diesel, Removal and Installation).

4. Refer to: Exhaust Gas Recirculation (EGR) Valve RH (303-08A Engine Emission Control - TDV6 3.0L Diesel, Removal and Installation).

5. Refer to: Starter Motor (303-06A Starting System - TDV6 3.0L Diesel, Removal and Installation).



6. CAUTION: Make sure that the area around the component is clean and free of foreign material.

   Torque: 9 Nm

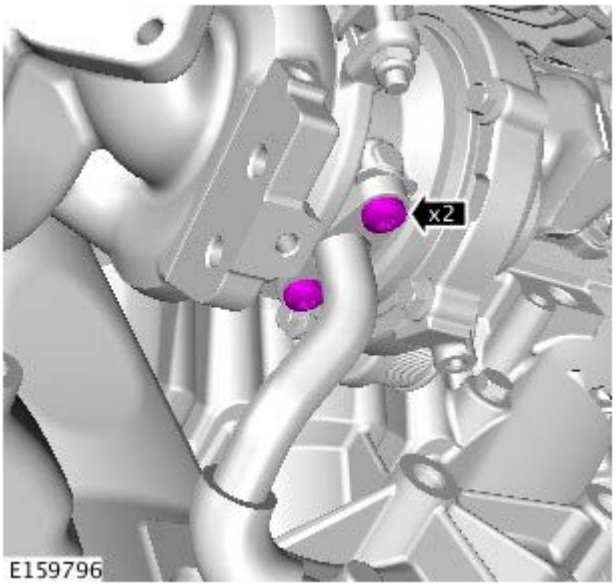
7. CAUTIONS:

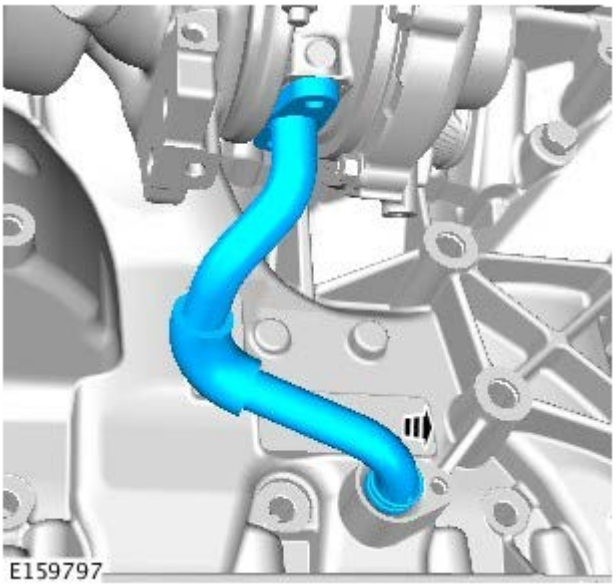
   Make sure that a new gasket is installed.

   Make sure that the area around the component is clean and free of foreign material.

   NOTE: Discard the gasket.

   Torque: 9 Nm





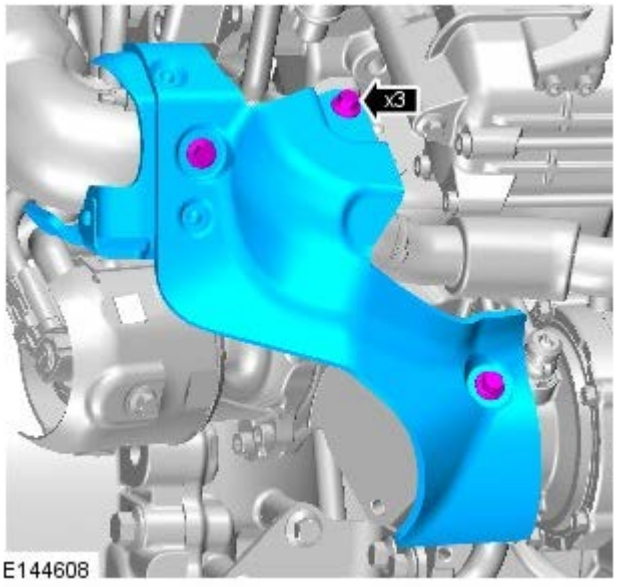
8. CAUTIONS:

   Make sure that a new seal is installed.

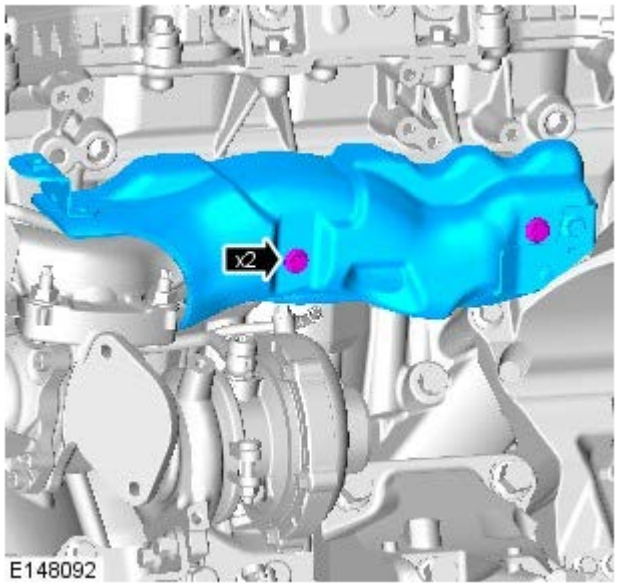
   Make sure that the area around the component is clean and free of foreign material.

   NOTE: Discard the seal.

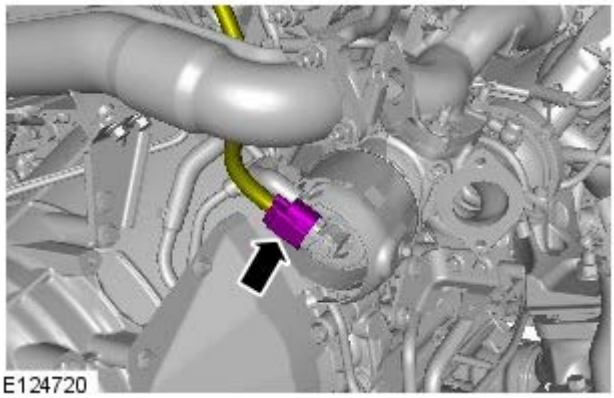
9. *Torque:* 9 Nm



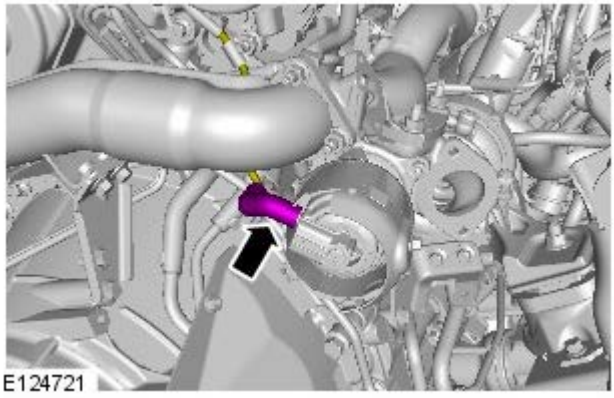
10. *Torque:* 11 Nm

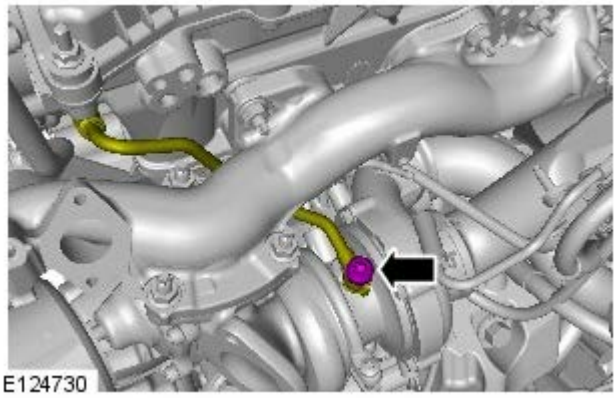


11.



12.





13. CAUTIONS:

Be prepared to collect escaping oil.

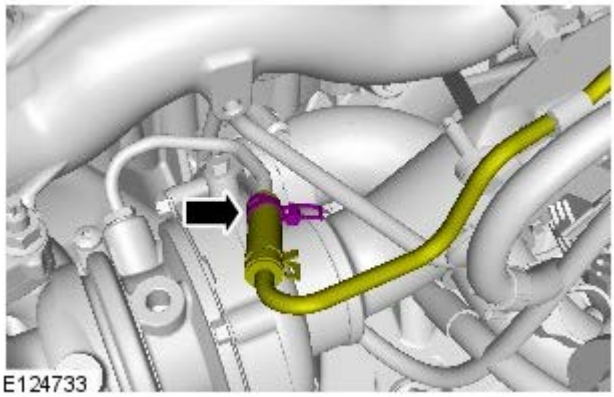
Make sure that the area around the component is clean and free of foreign material.

Make sure that new sealing washers are installed.

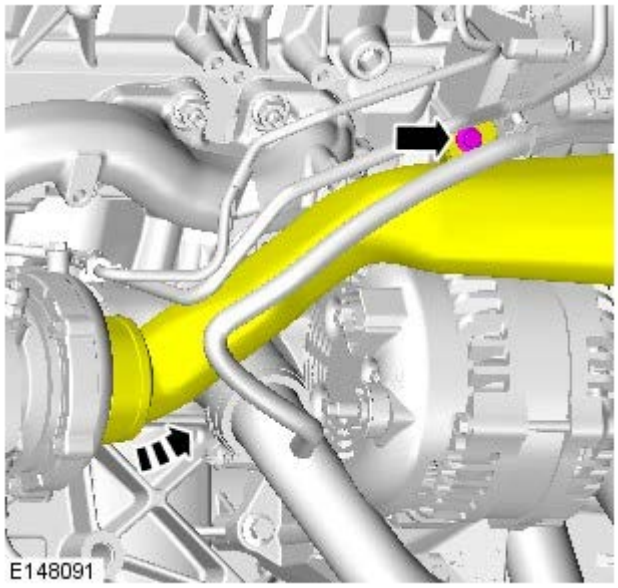
Make sure that a new bolt is installed.

Torque: 30 Nm

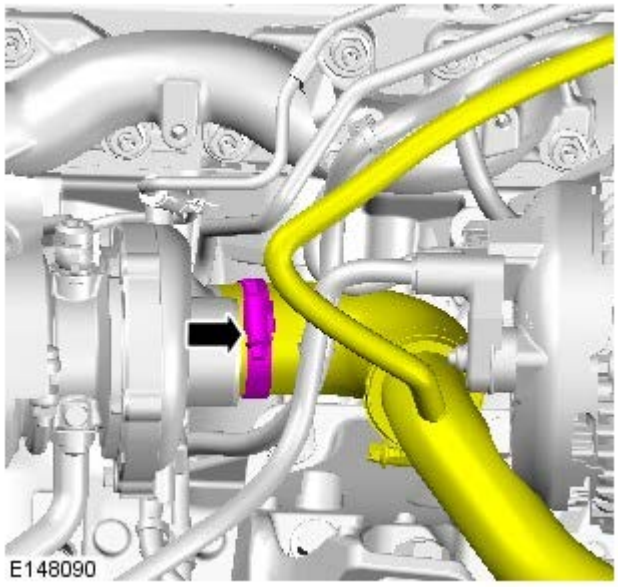
14.



15. *Torque:* 10 Nm



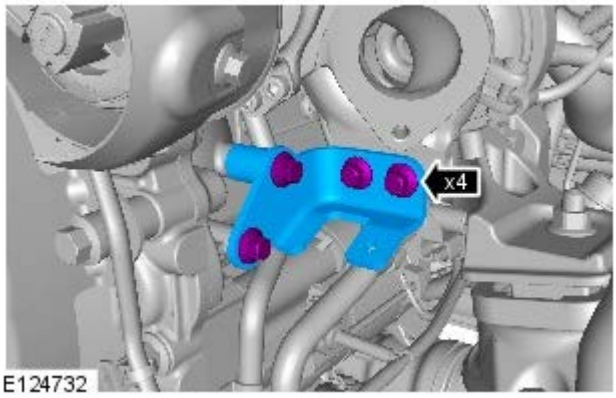
16.

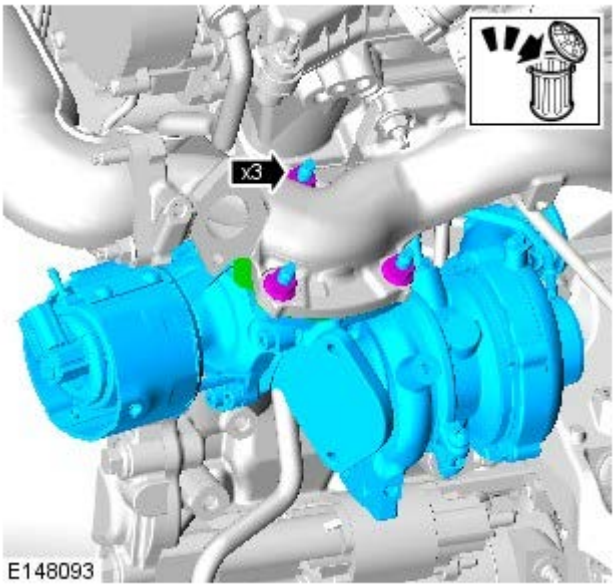


17. CAUTION: Apply Loctite 243 to the bolts.

NOTE: Make sure to clean the threads prior to installation.

Torque: 32 Nm





18. WARNING: Make sure that new nuts are installed.

    CAUTIONS:

    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.

    Torque: 24 Nm

Installation

1. To install, reverse the removal procedure.
2. If a new unit is installed, configure using the approved diagnostic tool.

Published: 04-Aug-2012

Fuel Charging and Controls - Turbocharger - SDV6 3.0L Diesel - Hybrid Electric Vehicle / TDV6 3.0L Diesel - Turbocharger Bypass Valve

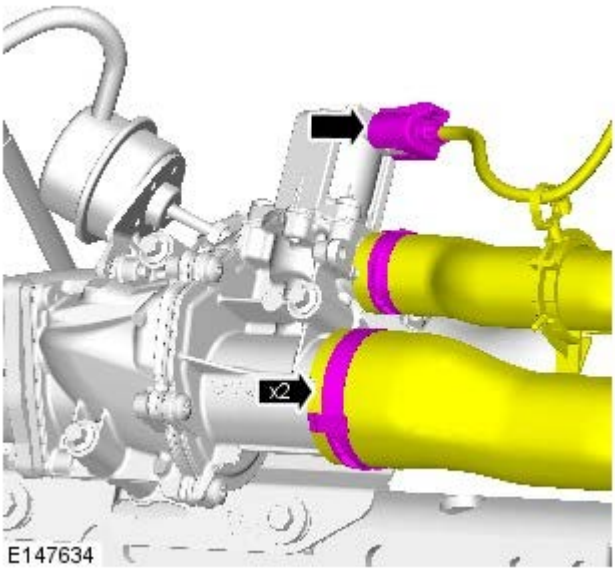
Removal and Installation

Removal

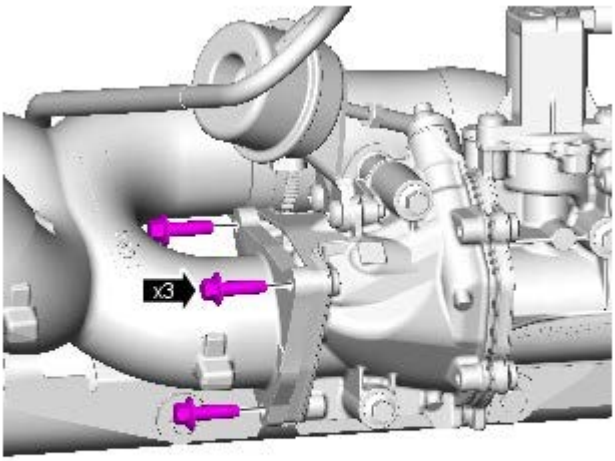
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

2.

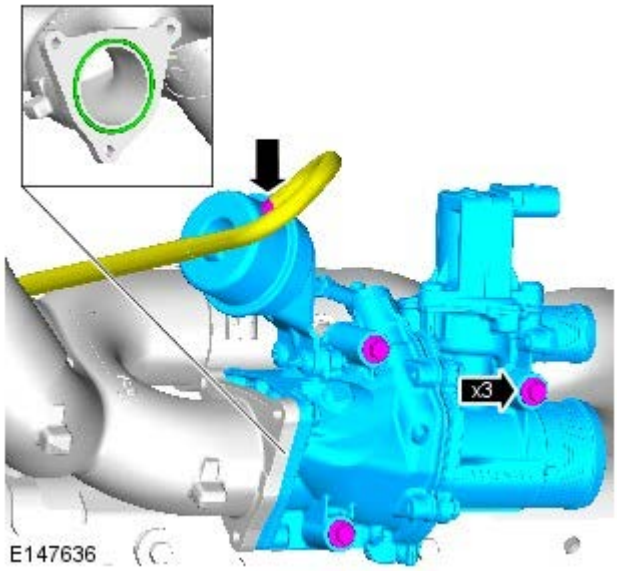


3. *Torque:* 10 Nm



4. NOTE: Discard the seal.

   Torque: 9 Nm



Installation

1. To install, reverse the removal procedure.

Published: 02-May-2013

Fuel Charging and Controls - Turbocharger - SDV6 3.0L Diesel - Hybrid Electric Vehicle / TDV6 3.0L Diesel - Fixed Vane Turbocharger Actuator

Removal and Installation

Removal

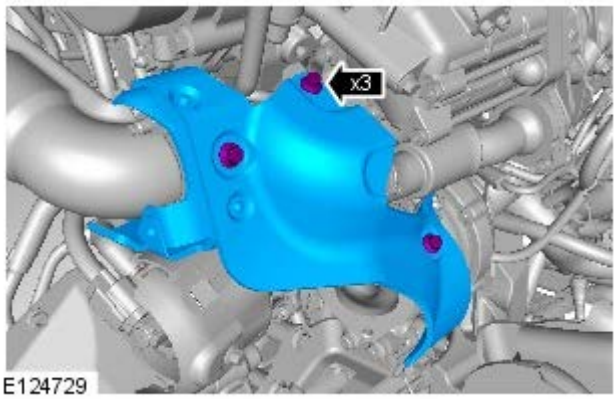
NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. WARNING: Make sure to support the vehicle with axle stands.

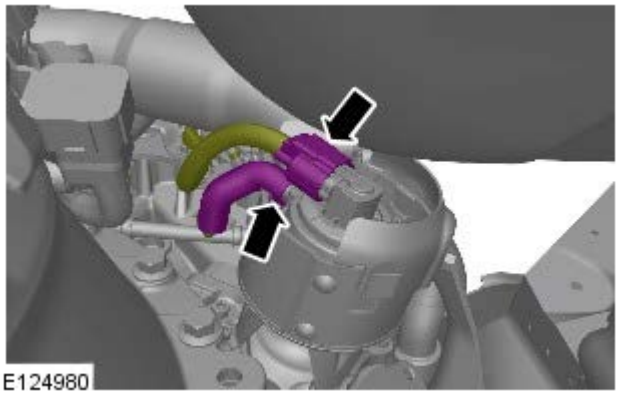
   Raise and support the vehicle.

2. Refer to: Exhaust System - Vehicles With: Diesel Particulate Filter (DPF) (309-00A Exhaust System - TDV6 3.0L Diesel, Removal and Installation).
   Refer to: Exhaust System - Vehicles Without: Diesel Particulate Filter (DPF) (309-00A Exhaust System - TDV6 3.0L Diesel, Removal and Installation).

3. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

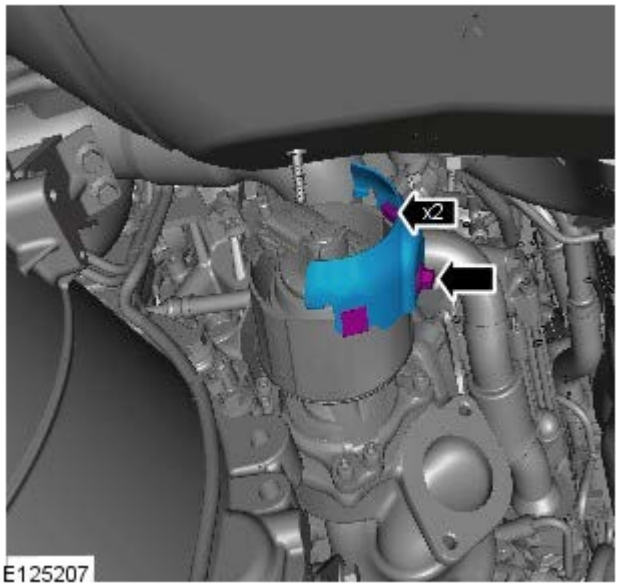


4. NOTE: Engine shown removed for clarity.

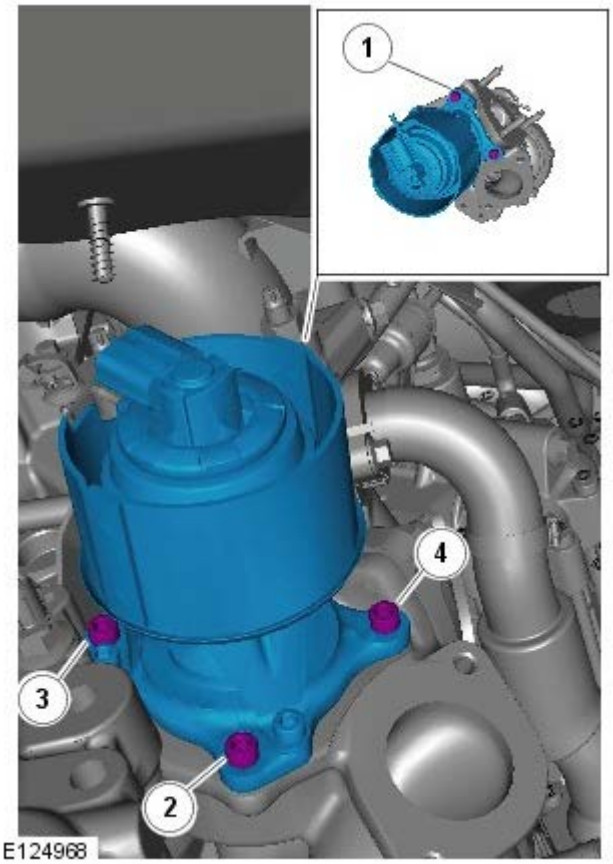


5.

6.



E125207



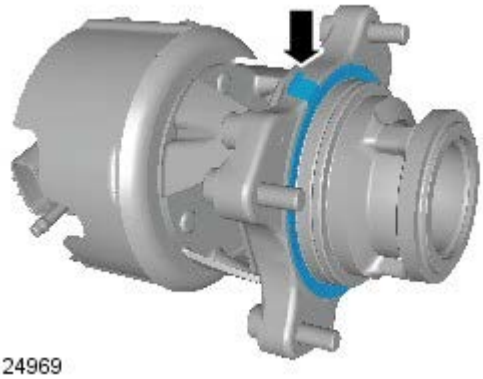
E124968

7. 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

8. NOTES:

Make a note of the orientation of the gasket tang.

Remove and discard the gasket using the gasket tang.

9. NOTES:

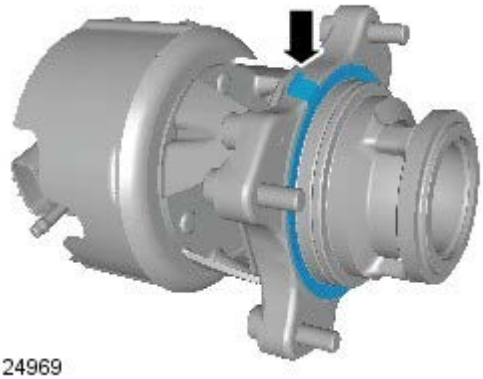


E124972

Remove and discard the gasket.

Turbocharger shown removed for clarity.

Installation



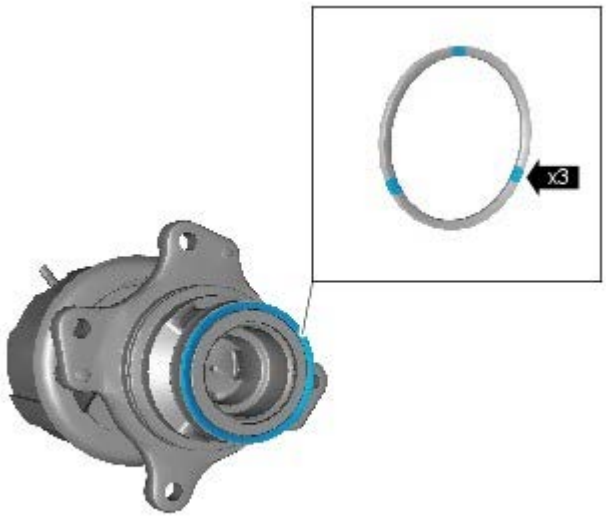
E124969

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.

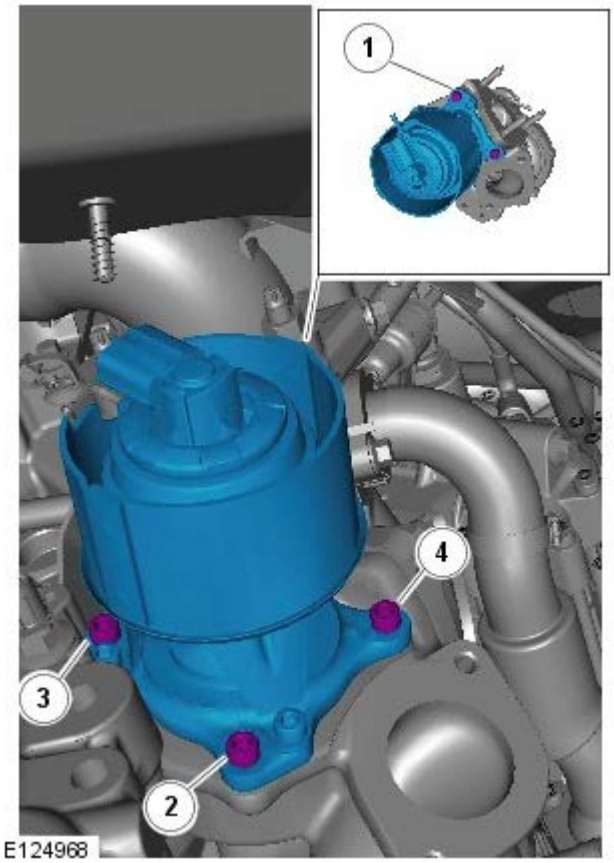
   Apply a small amount of grease in the areas indicated to allow the gasket to remain in the position for installation.

3. CAUTIONS:

   Install all the bolts finger tight before final tightening.

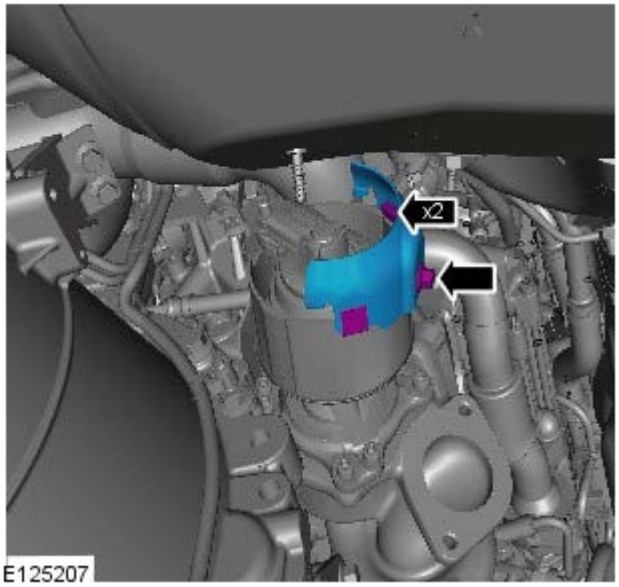
   Tighten the Torx screws evenly and progressively.

   - Using a suitable 130mm T30 Torx socket, remove the retaining bolts.

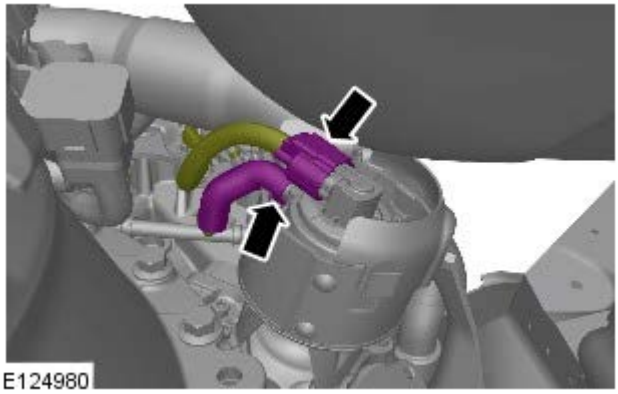


Torque: 12 Nm

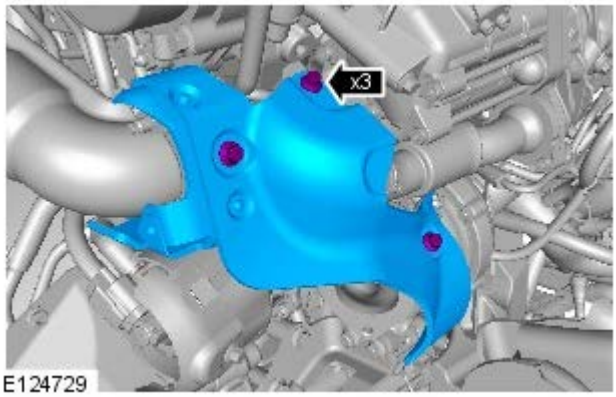
4. *Torque:* 9 Nm



5.



6. *Torque:* 9 Nm



7. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

8. Refer to: Exhaust System - Vehicles With: Diesel Particulate Filter (DPF) (309-00A Exhaust System - TDV6 3.0L Diesel, Removal and Installation).
   Refer to: Exhaust System - Vehicles Without: Diesel Particulate Filter (DPF) (309-00A Exhaust System - TDV6 3.0L Diesel, Removal and Installation).

9. If a new fixed vane turbocharger actuator is installed, carry out the reset procedure for the fixed vane turbocharger actuator using approved diagnostic tool.

Published: 06-Sep-2013

Fuel Charging and Controls - Turbocharger - SDV6 3.0L Diesel - Hybrid Electric Vehicle / TDV6 3.0L Diesel - Turbocharger LH SDV6 3.0L Diesel - Hybrid Electric Vehicle

Removal and Installation

Removal

WARNING: This procedure can only be carried out after the vehicle has been decommissioned, by an approved person.

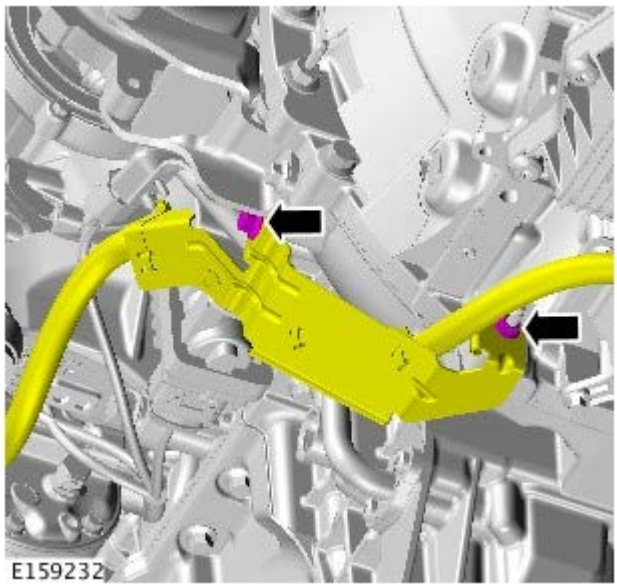
CAUTION: Make sure that all openings are sealed. Use new blanking caps.

NOTES:

Some variation in the illustrations may occur, but the essential information is always correct.

Removal steps in this procedure may contain installation details.

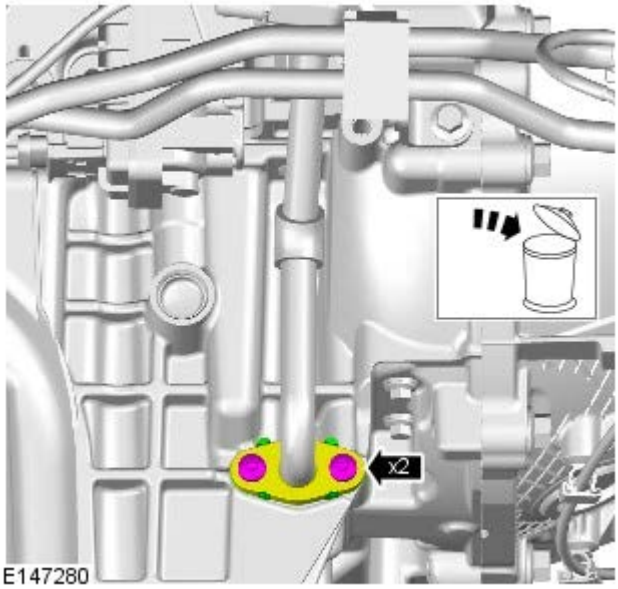
1. Refer to: Hybrid Electric Vehicle (HEV) Decommission (414-01, General Procedures).
2. Refer to: Engine Oil Draining and Filling (303-01E Engine - SDV6 3.0L Diesel - Hybrid Electric Vehicle, General Procedures).
3. Refer to: Exhaust System - Vehicles With: Diesel Particulate Filter (DPF) (309-00 Exhaust System - TDV6 3.0L Diesel, Removal and Installation).
4. Refer to: Transmission Fluid Cooler Tubes - TDV6 3.0L Diesel (307-02B Transmission/Transaxle Cooling - Vehicles With: 8HP70 8-Speed - Hybrid Electric Vehicle - Automatic Transmission – AWD, Removal and Installation).
5.

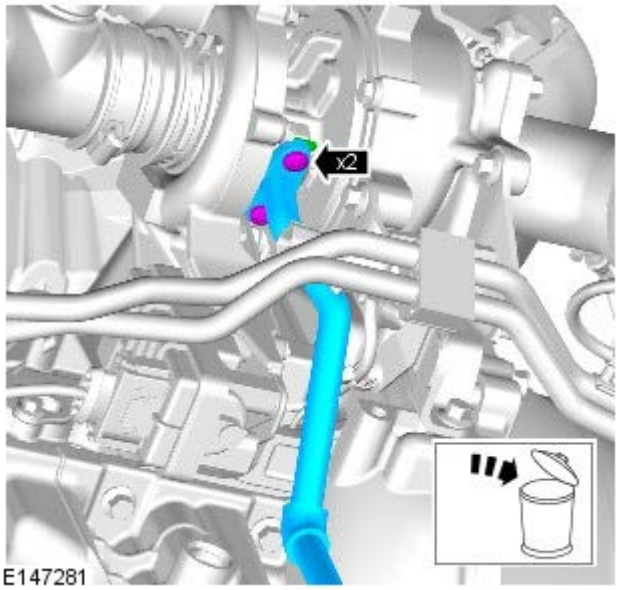


6. CAUTION: Make sure that the area around the component is clean and free of foreign material.

   NOTE: Install a new gasket.

   Torque: 9 Nm



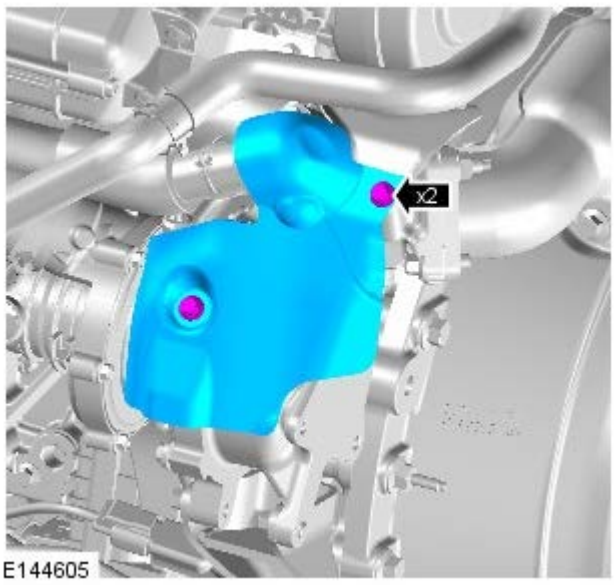


7. CAUTION: Make sure that the area around the component is clean and free of foreign material.

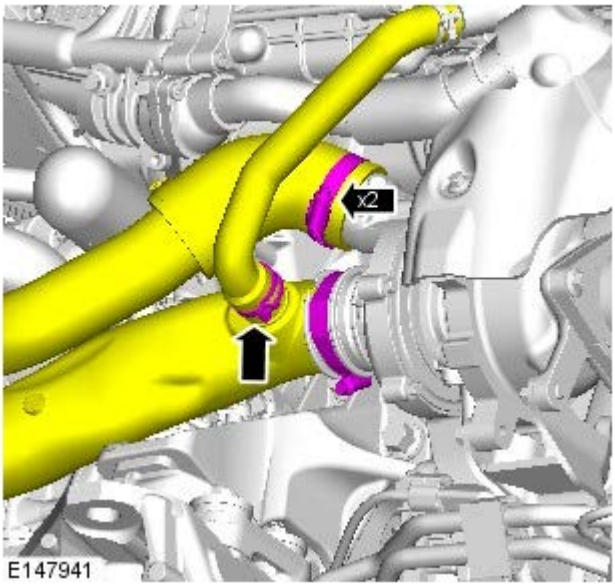
   NOTE: Install new gaskets.

   Torque: 9 Nm

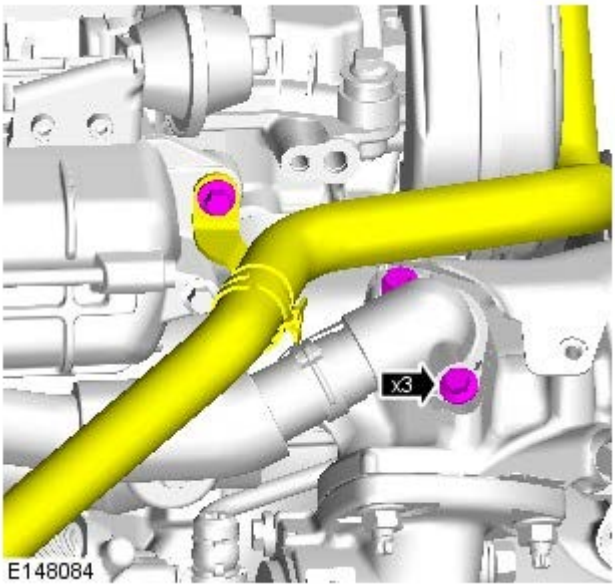
8. *Torque:* 9 Nm



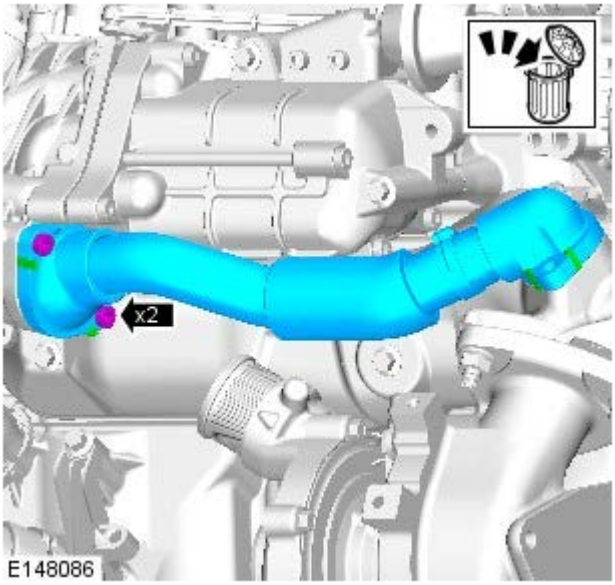
9.



10. *Torque:* 10 Nm

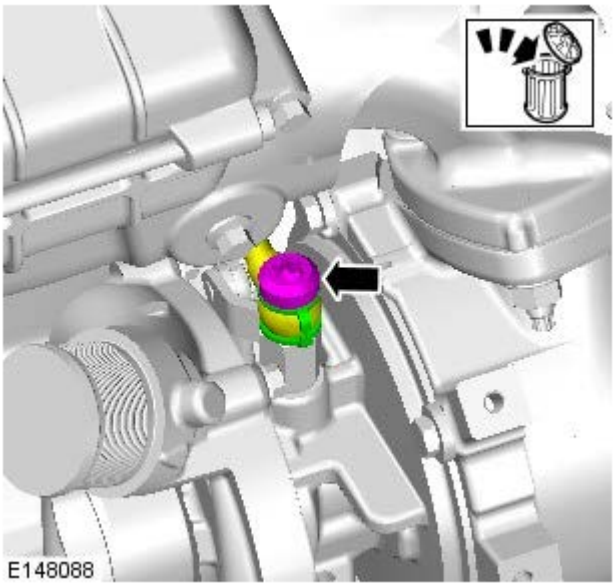


11. *Torque:* 6 Nm

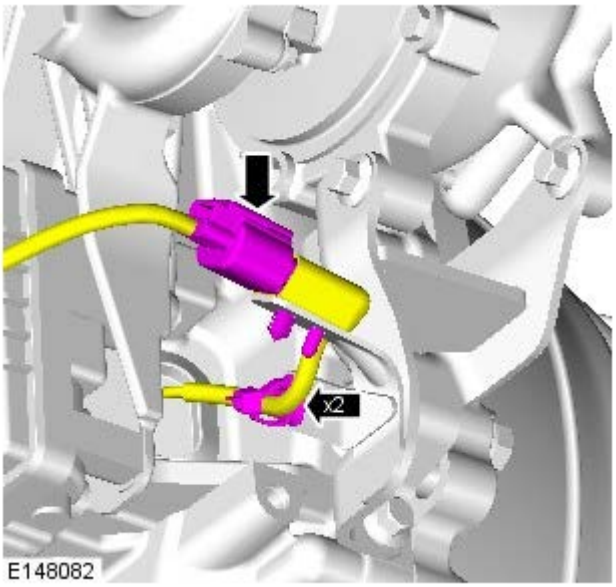


12. CAUTION: Make sure that new sealing washers are installed.

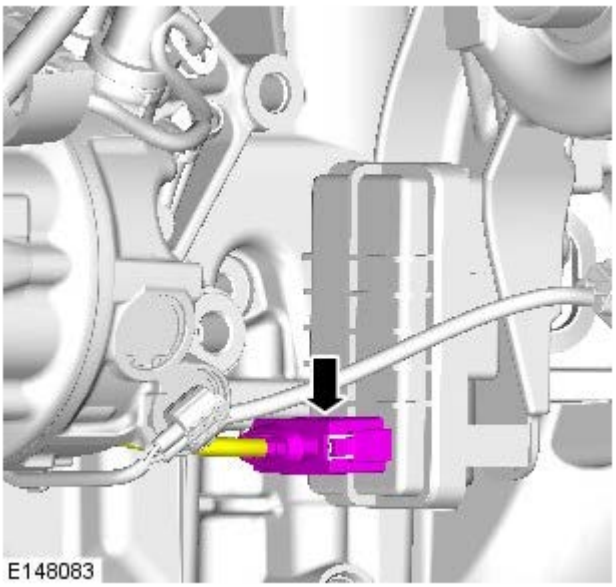
    Torque: 30 Nm



13.

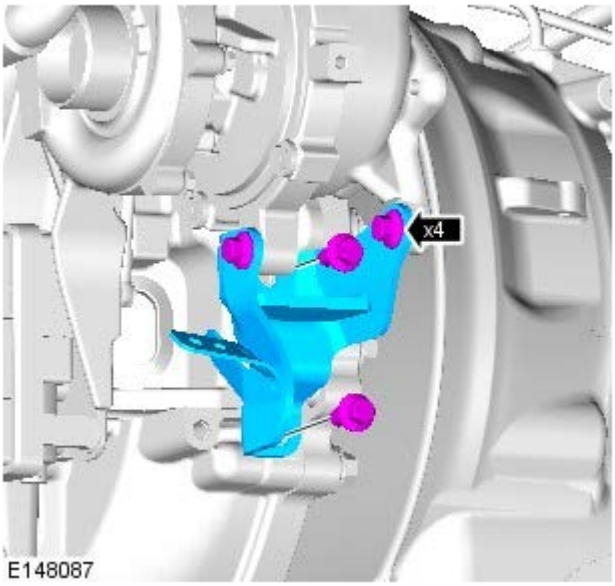


14.

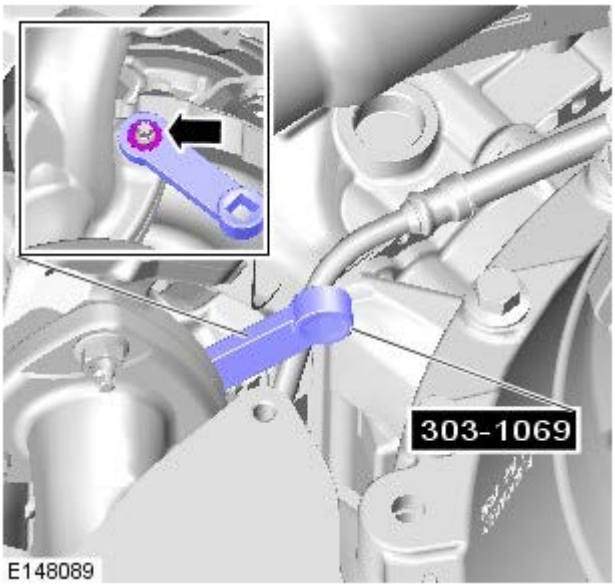


15. CAUTION: Apply Loctite 243 to the bolts.

NOTE: Make sure to clean the threads prior to installation.

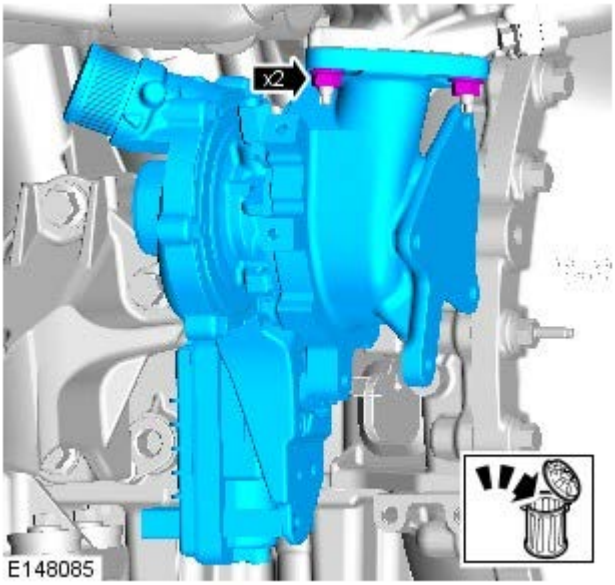


Torque: 32 Nm



16. WARNING: Make sure that a new nut is installed.

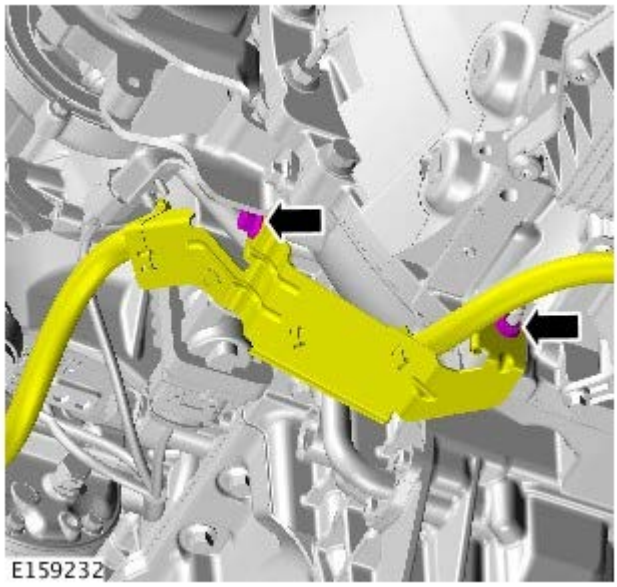
Torque: 24 Nm



17. NOTE: Install a new gasket.

Torque: 24 Nm

18. *Torque:* 10 Nm



Installation

1. To install reverse the removal procedure.
2. Refer to: Hybrid Electric Vehicle (HEV) Decommission (414-01, General Procedures).

Published: 22-Oct-2012

Fuel Charging and Controls - V6 S/C 3.0L Petrol -

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.

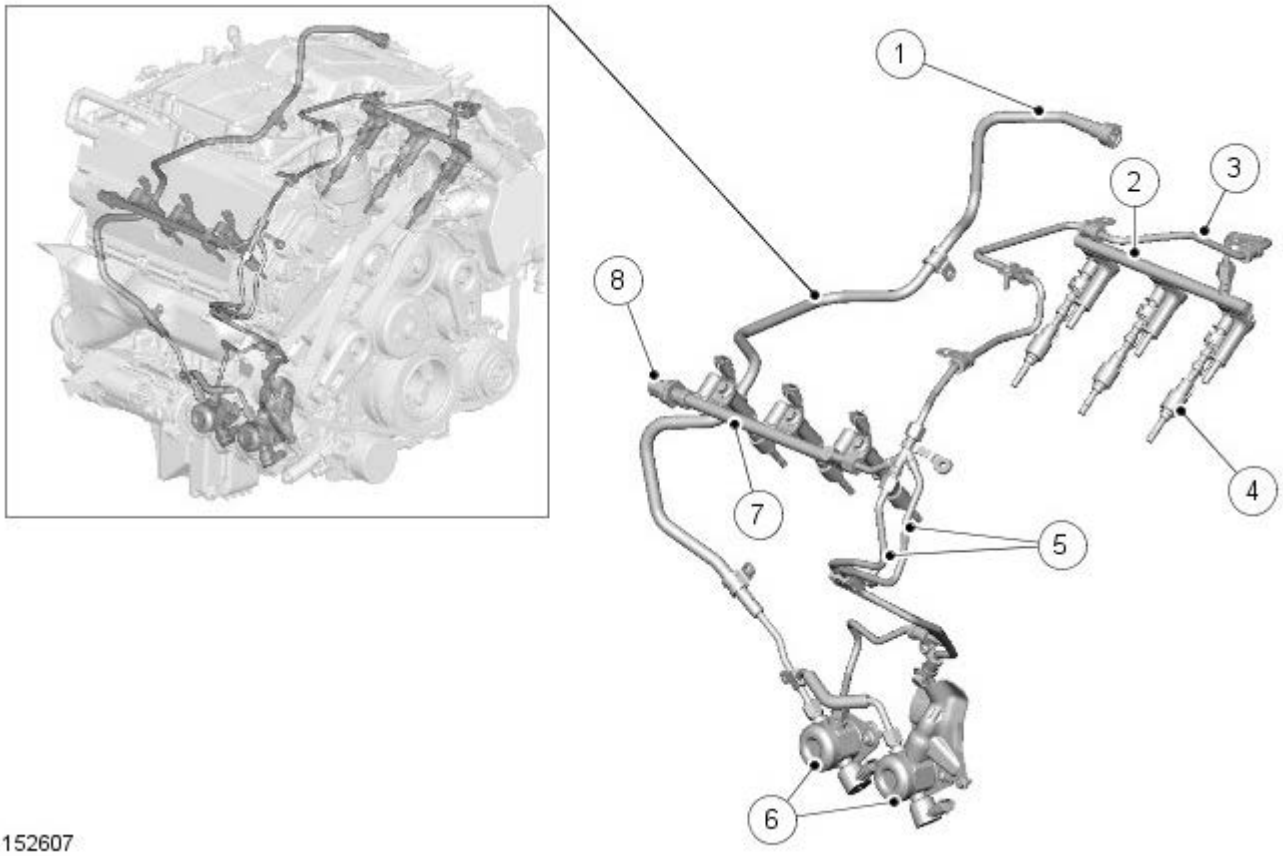
Description	Nm	lb-ft	lb-in
Ignition coil-on-plugs retaining bolts	7	-	62
Spark plugs	20	15	-
Fuel rail retaining bolt	Stage 1 - 20 Stage 2 - 30	Stage 1 - 15 Stage 2 - 22	-
Fuel rail crossover pipe unions	21	15	-
Fuel rail crossover pipe retaining bolts	8	6	-
Fuel pressure regulator	33	24	-
Fuel rail 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	11	8	-
Throttle body retaining bolts	10	7	-
Steering gear retaining bolts	100	74	-
Steering column lower universal joint assembly bolts	35	26	-
Thermostat housing to cylinder head coolant pipe retaining bolt	10	7	-
Accessory drive belt idler pulley bracket retaining bolts	25	18	

Published: 02-May-2013

Fuel Charging and Controls - V6 S/C 3.0L Petrol - Fuel Charging and Controls

Description and Operation

COMPONENT LOCATION



E152607

Item	Part Number	Description
1	-	Low Pressure (LP) fuel lines
2	-	Left fuel rail
3	-	Crossover tube
4	-	Fuel injector (6 off)
5	-	High Pressure (HP) fuel lines
6	-	HP fuel pumps
7	-	Right fuel rail
8	-	Fuel Rail Pressure and Temperature (FRPT) sensor

OVERVIEW

The fuel charging and controls system is a petrol 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 Fuel Rail Pressure and Temperature (FRPT) sensor.
- • Six 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.

SYSTEM OPERATION

GENERAL

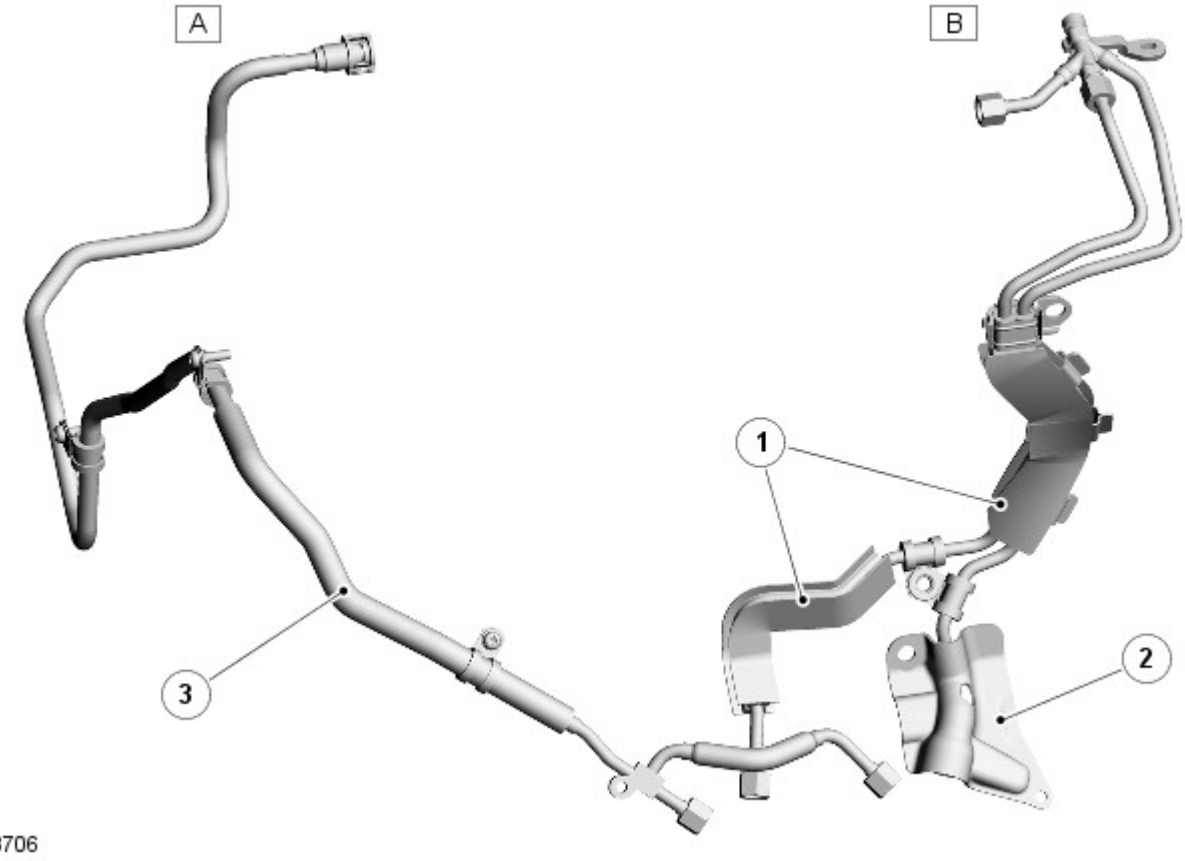
The ECM controls the output from the HP fuel pumps to deliver the required volume of fuel at pressures up to 200 bar (2900 lbf/in2).

The ECM uses the signal from the FRPT (Fuel Rail Pressure and Temperature) sensor to calculate the time the fuel

injectors need to be energized to deliver the correct mass of fuel to the combustion chambers.

COMPONENT DESCRIPTION

Low and High Pressure Fuel Lines



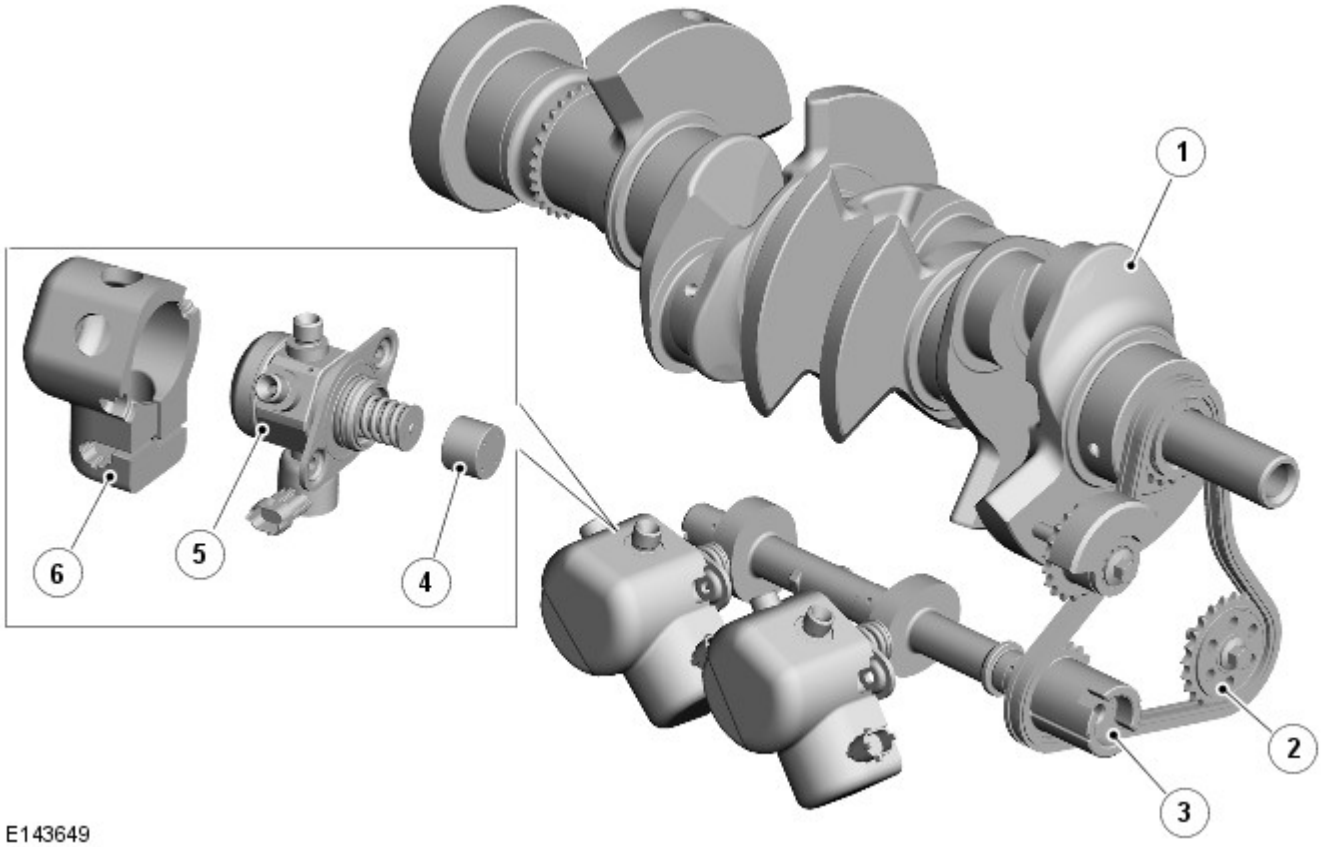
A = LP fuel lines, B = HP fuel lines.

Item	Part Number	Description
1	-	Acoustic covers
2	-	Fuel pipe cover
3	-	Heat reflective and insulation sleeve

The LP fuel line connects the HP fuel pumps to the fuel delivery line from the fuel tank and lines system. A double latch quick release connector at the start of the LP fuel line connects with the fuel line from the fuel tank mounted fuel pump module. The connector is secured to a bracket on the charge air cooler. P-clips secure the LP fuel line to the rear of each cylinder head and to the right side of the cylinder block. A heat reflective and insulation sleeve is installed on the LP fuel line where it runs behind the right exhaust manifold.

The HP fuel lines connect the HP fuel pumps to the right fuel rail and the crossover tube. Two P-clips and a pipe clamp attach the HP fuel lines to the cylinder block and the right cylinder head respectively. An integral bracket on the front HP fuel line is attached to a stud on the front-upper right camshaft cover. A pipe cover is installed on the bottom of the front HP fuel line and acoustic covers are fitted to both HP fuel lines.

High Pressure Fuel Pumps



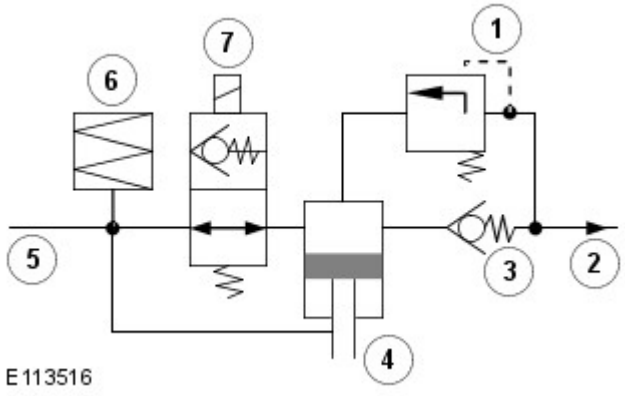
E143649

Item	Part Number	Description
1	-	Crankshaft
2	-	Auxiliary drive chain
3	-	Auxiliary shaft
4	-	Tappet
5	-	HP fuel pump
6	-	Acoustic cover

The two HP fuel pumps are identical mechanically-driven pumps installed on the right side of the oil pan body, behind the generator. An O-ring seal, seals each of the HP fuel pumps in the oil pan. The front HP fuel pump is identified as No. 1 pump; the rear 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 shaft. A tappet on the end each plunger is operated by a two-lobe cam on the auxiliary shaft. A spring installed on the outside of the plunger ensures the plunger and tappet remain in contact with the cam.

The auxiliary shaft is driven by the crankshaft, via the auxiliary drive chain, at engine speed. The auxiliary shaft is timed to match the pump delivery strokes with crankshaft position.



E113516

Item	Part Number	Description
1	-	Pressure Relief Valve (PRV)
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.

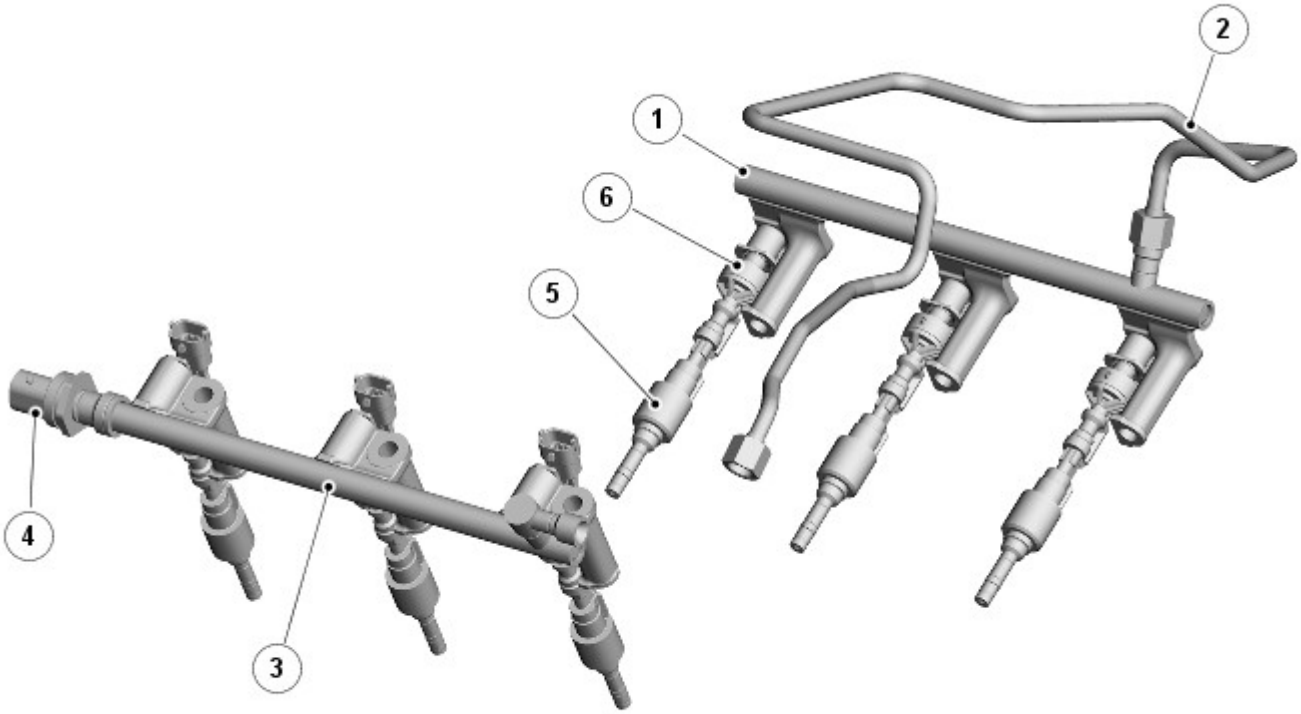
The damper absorbs pressure pulses from the LP fuel system.

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 250 bar (3625 lbf/in2), the PRV opens and returns fuel to the inlet side of the plunger.

Fuel Rails and Crossover Tube



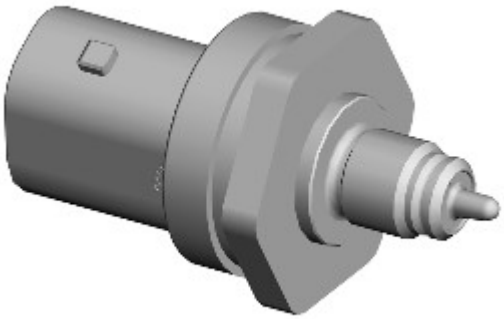
E143650

Item	Part Number	Description
1	-	Left fuel rail
2	-	Crossover tube
3	-	Right fuel rail
4	-	Fuel Rail Pressure and Temperature (FRPT) sensor
5	-	Fuel injector (6 off)
6	-	Hold down spring (6 off)

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 left fuel rail, which ensures there is equal pressure in the two fuel rails. Four P-clips attach the crossover tube to the top of the charge air cooler.

The rear of the right fuel rail incorporates a threaded boss for installation of the FRPT sensor.

Fuel Rail Pressure and Temperature Sensor

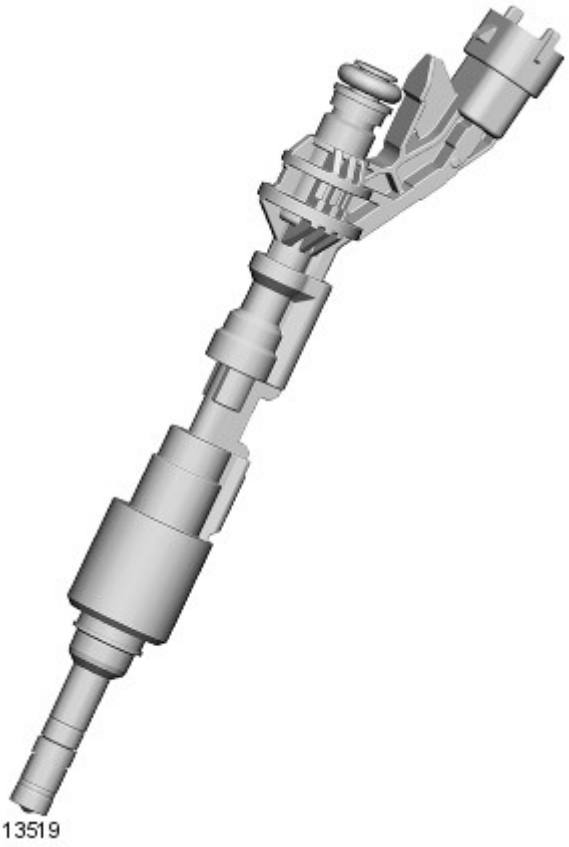


E143651

The FRPT sensor provides the ECM with a continuous signal of fuel rail pressure. The FRPT sensor is installed in the rear of the right fuel rail. The FRPT sensor is screwed into a threaded boss in the fuel rail.

The FRPT 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 determine a pressure value and NTC (negative temperature coefficient) temperature.

Fuel Injectors



E113519

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, an O-ring seal, 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.

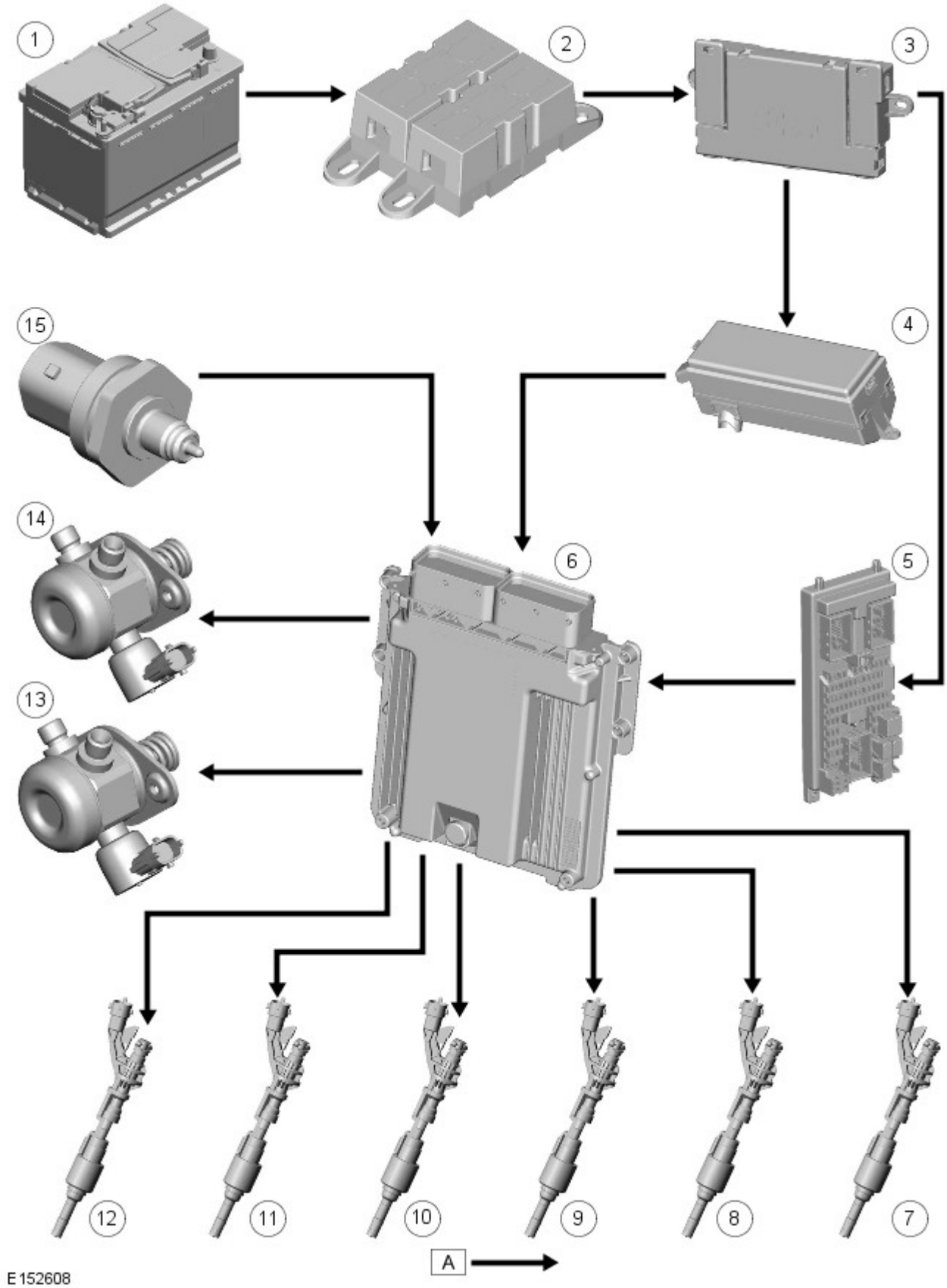
Each fuel injector contains a solenoid-operated needle valve, which opens when the solenoid winding is energized. While the needle valve is open, fuel is sprayed into the combustion chamber. The solenoid winding is connected to a power feed and a ground from the ECM, which operates the fuel injectors 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	-	Battery Junction Box 2 (BJB2)
3	-	Battery Junction Box (BJB)
4	-	Engine Junction Box (EJB)
5	-	Central Junction Box (CJB)

6	-	Engine Control Module (ECM)
7	-	No. 1 Fuel injector
8	-	No. 2 Fuel injector
9	-	No. 3 Fuel injector
10	-	No. 4 Fuel injector
11	-	No. 5 Fuel injector
12	-	No. 6 Fuel injector
13	-	No. 1 HP fuel pump
14	-	No. 2 HP fuel pump
15	-	Fuel Rail Pressure and Temperature (FRPT) sensor

Published: 05-Nov-2012

Fuel Charging and Controls - V6 S/C 3.0L 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 - V6 S/C 3.0L Petrol, Description and Operation),
Fuel Charging and Controls (303-04E, Description and Operation),
Fuel Charging and Controls (303-04E, 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. Check for ignition system, fuel system and electronic engine control DTCs and refer to the relevant DTC Index
Engine cranks and fires, but will not start	• 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. Check for electronic engine controls, engine emissions, fuel system and evaporative emissions system related DTCs and refer to the relevant DTC Index
Difficult hot start	• Injector leak • Electronic engine control	Check for injector leak, install new injector as required. Check for electronic engine controls, evaporative emissions, fuel system, ignition system and engine emission system related DTCs and

	• Purge valve • Fuel pump • Ignition system	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. Check for electronic engine controls, evaporative emissions, fuel system, ignition system and engine emission system 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. Check for electronic engine control, ignition system and fuel system related DTCs and refer to the relevant DTC Index. Check for blockage in air filter element and air intake system. Check for air leakage in air intake system
Engine hesitates/poor acceleration	• 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	Check for fuel system related DTCs and refer to the relevant DTC Index. Check for injector leak, install new injector as required. Check for air leakage in air intake system. Ensure accelerator pedal is free from restriction. Check for electronic engine controls, ignition, engine emission system and transmission related DTCs and refer to the relevant DTC Index
Engine backfires	• Fuel pump/lines • Air leakage • Electronic engine controls • Ignition system • Sticking variable camshaft timing (VCT) unit	Check for fuel system failures. Check for air leakage in intake air system. Check for electronic engine controls, ignition system and VCT system 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. Check for electronic engine controls, throttle system and ignition system related DTCs and refer to the relevant DTC Index
Engine detonates/knocks	• Fuel pump/lines • Air leakage • Electronic engine controls • Sticking VCT unit	Check for fuel system failures. Check for air leakage in intake air system. Check for electronic engine controls and VCT system related DTCs and refer to the relevant DTC Index
No throttle response	• Electronic engine controls • Throttle motor	Check for electronic engine controls and throttle system related DTCs and refer to the relevant DTC Index
Poor throttle response	• Breather system disconnected/restricted • Electronic engine control • Transmission malfunction • Traction control event • Air leakage	Ensure the engine breather system is free from restriction and is correctly installed. Check for electronic engine controls, transmission and traction control related DTCs and refer to the related DTC Index. Check for air leakage in intake air system

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.
REFER to: Diagnostic Trouble Code (DTC) Index - V6 S/C 3.0L Petrol , DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation).

Published: 11-May-2011

Fuel Charging and Controls - V6 S/C 3.0L 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 - V6 S/C 3.0L 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:

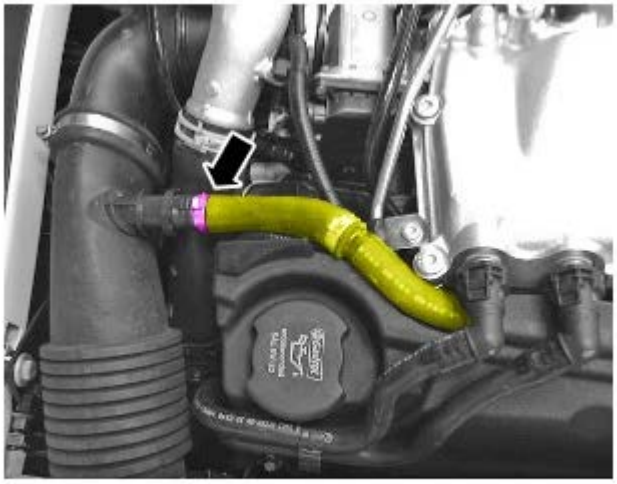
Make sure that any protective clothing worn is clean and made from lint-free non-flocking material.

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

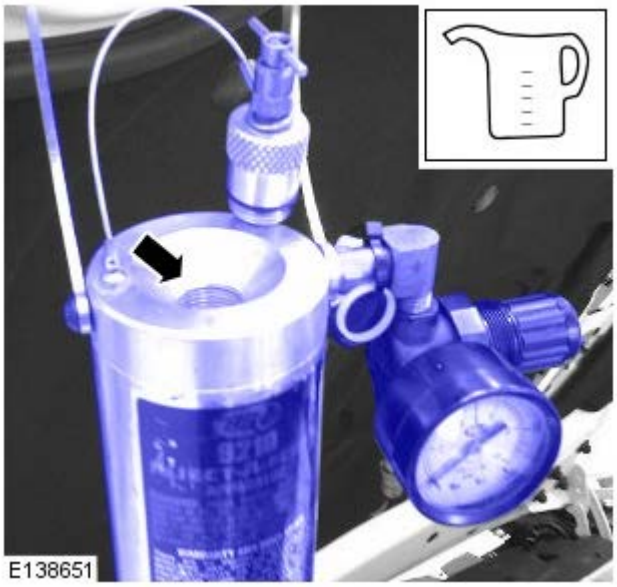


E138649

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.

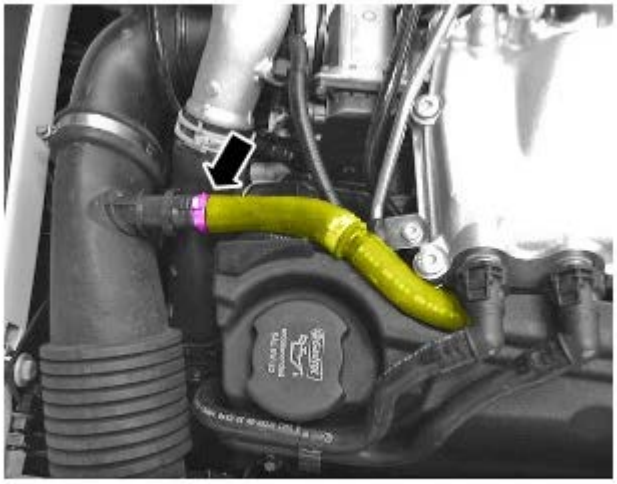


E138653

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: 02-May-2013

Fuel Charging and Controls - V6 S/C 3.0L Petrol - Fuel Injectors

Removal and Installation

Removal

1. Refer to: Fuel Rail RH (303-04C Fuel Charging and Controls - V6 S/C 3.0L Petrol, Removal and Installation).
   Refer to: Fuel Rail LH (303-04C Fuel Charging and Controls - V6 S/C 3.0L Petrol, Removal and Installation).

Installation

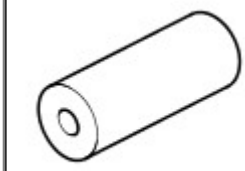
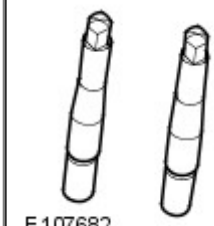
1. To install, reverse the removal procedure.

Published: 02-May-2013

Fuel Charging and Controls - V6 S/C 3.0L Petrol - Fuel Rail LH

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

Removal

CAUTIONS:

Make sure that tools and equipment are clean and free of foreign material and lubricant.

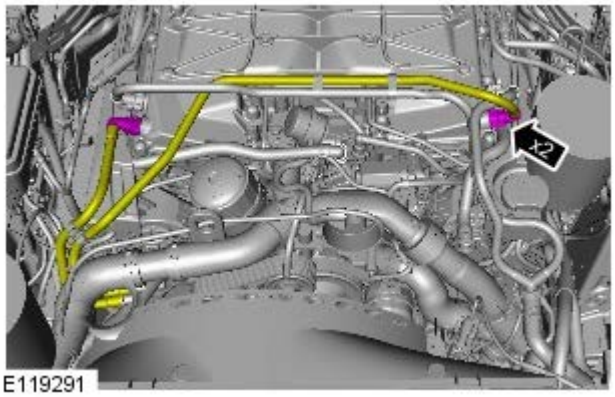
Always carry out the cleaning process before carrying out any repairs to the fuel injection system components. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

NOTE: 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 - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (310-00 Fuel System - General Information, General Procedures).
3. Disconnect the battery ground cable.

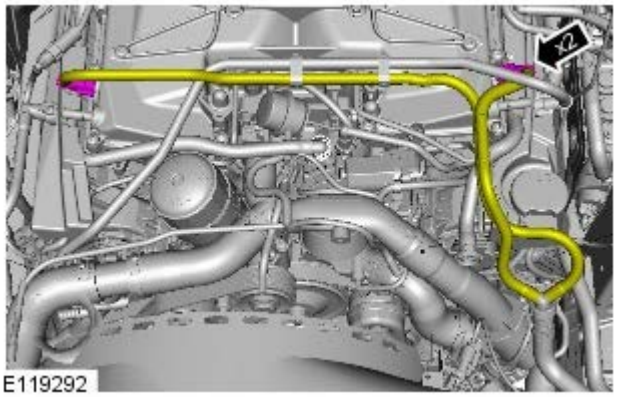
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).
4. Refer to: Fuel Injection Component Cleaning (303-04C Fuel Charging and Controls - V6 S/C 3.0L Petrol, General Procedures).

5. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12B Intake Air Distribution and Filtering - V6 S/C 3.0L Petrol, Removal and Installation).



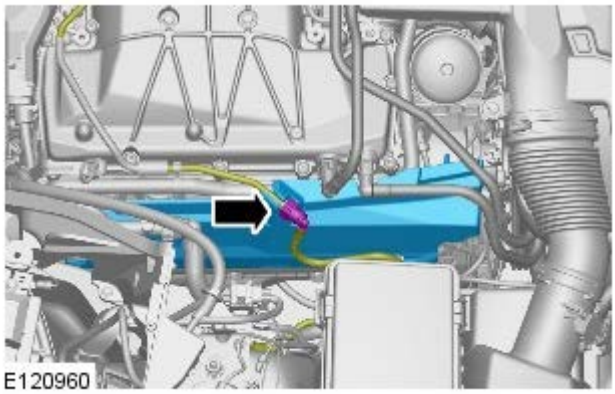
E119291

6. CAUTION: Be prepared to collect escaping fluids.

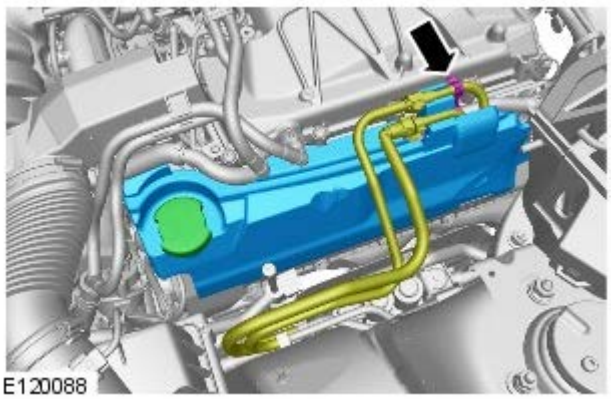


E119292

7. CAUTION: Be prepared to collect escaping fluids.

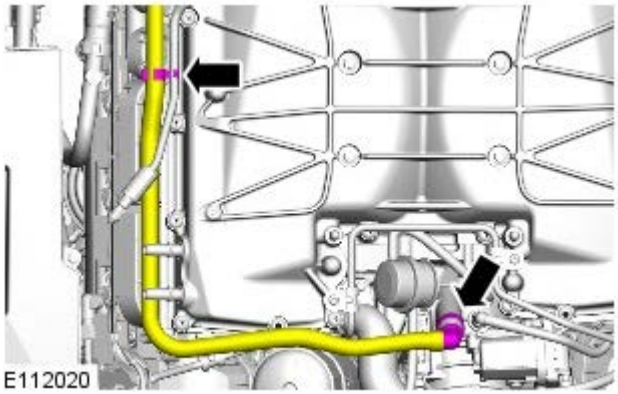

E120960

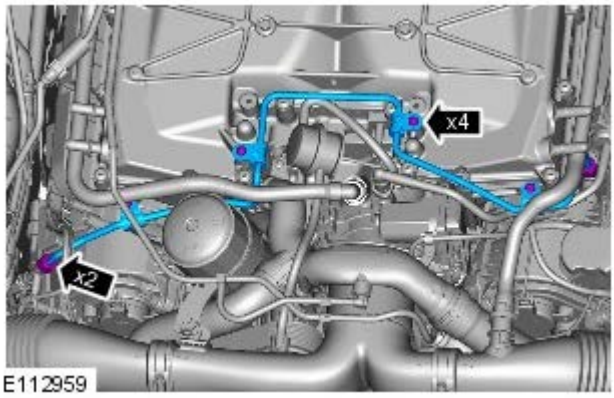
8. CAUTION: Be prepared to collect escaping fluids.


E120088

9. CAUTION: Be prepared to collect escaping fluids.

10.



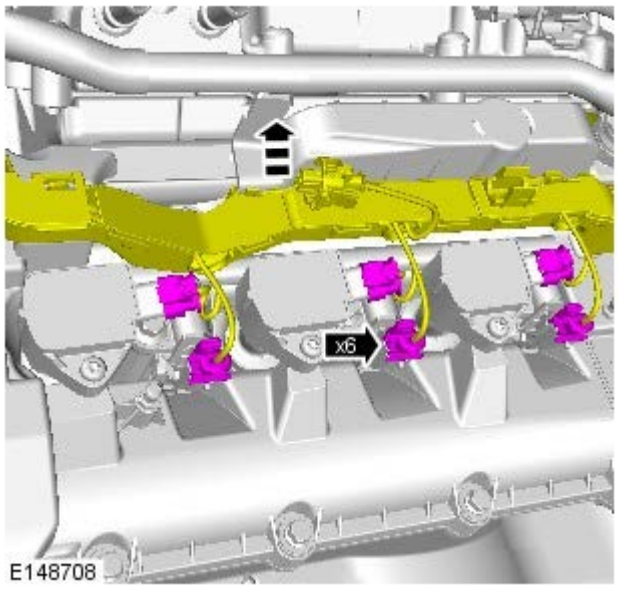


11. CAUTIONS:

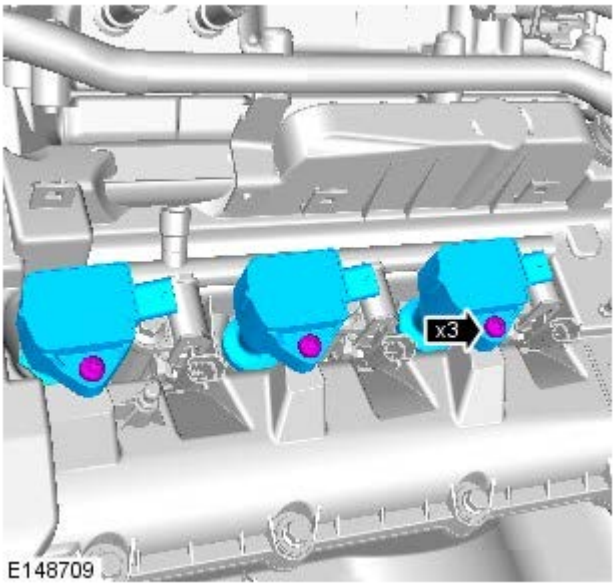
    Make sure that all openings are sealed. Use new blanking caps.

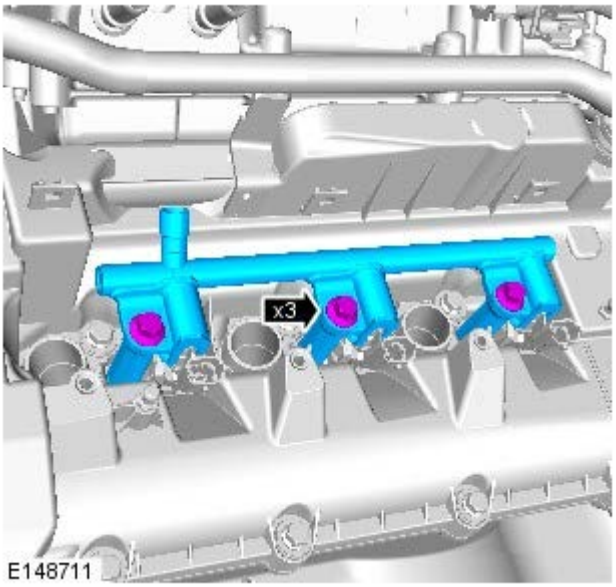
    Be prepared to collect escaping fluids.

12.

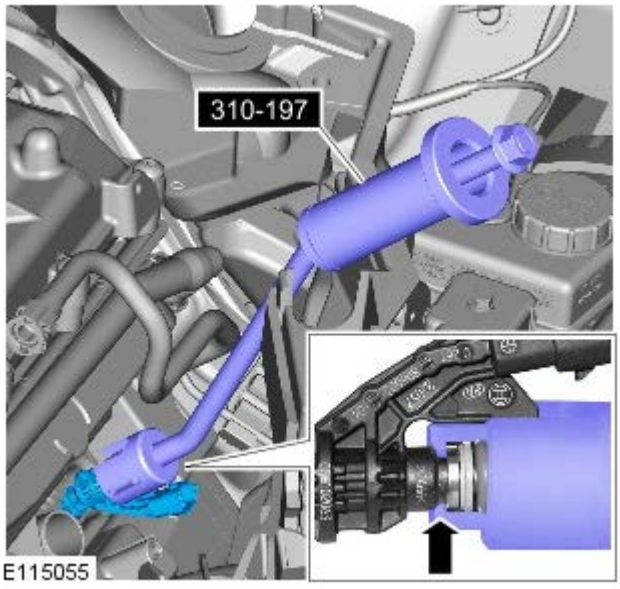


13.





14. CAUTION: Make a note of the fuel injector clamp alignment to the fuel rail prior to removal.



15. 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.

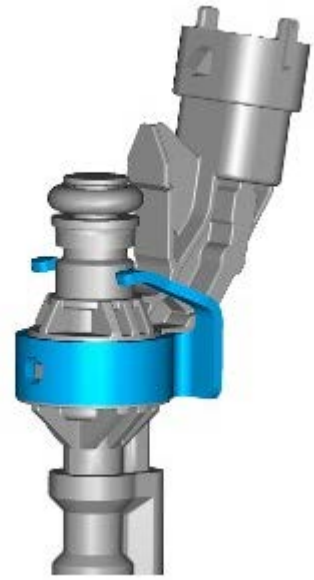
Make sure that all open ports are covered to prevent any foreign material ingress.

NOTE: RH illustration shown, LH is similar.

Special Tool(s): 310-197

16. CAUTIONS:

If new fuel injectors are installed, a new injector clamp must be installed.



E115057

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.

17. CAUTIONS:

Do not use a knife to remove the Teflon seal as damage could occur to the fuel injector.

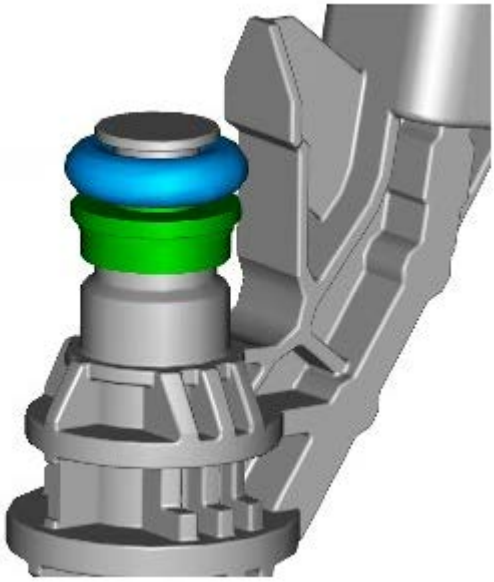
Do not cut the Teflon seal to deep as damage could occur to the fuel injector.

Pinch the Teflon seal to allow the tool to cut the Teflon seal without damaging the fuel injector.



E115058

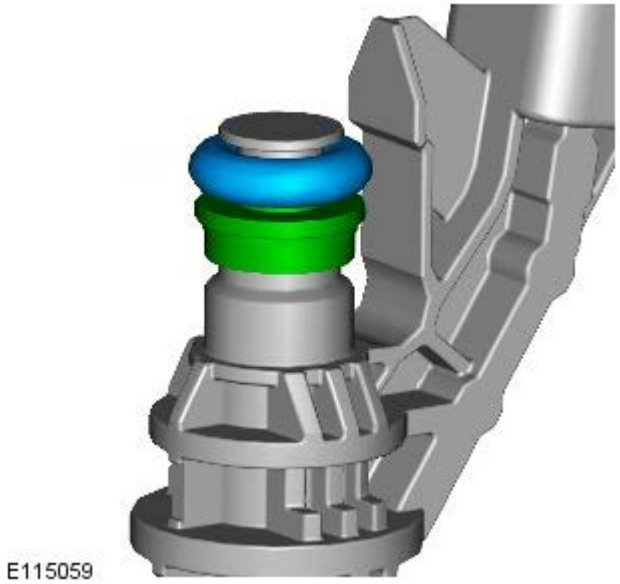
18. CAUTION: Do not use any sharp tools to remove the O-ring seal as damage could occur to the fuel injector.



E115059

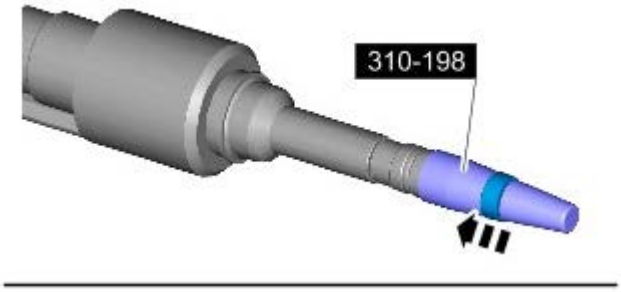
Installation

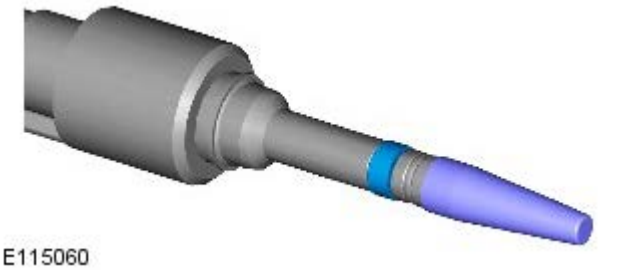
1.



E115059

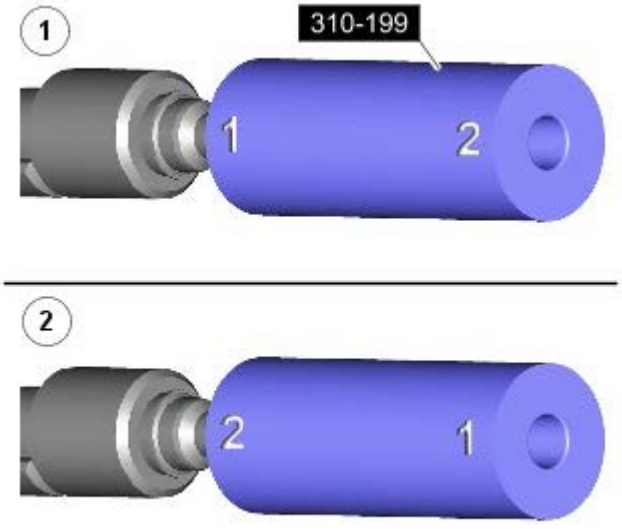
2. *Special Tool(s):* 310-198





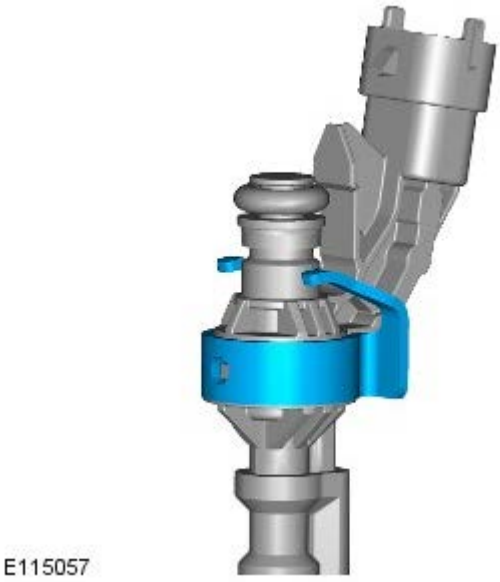
E115060

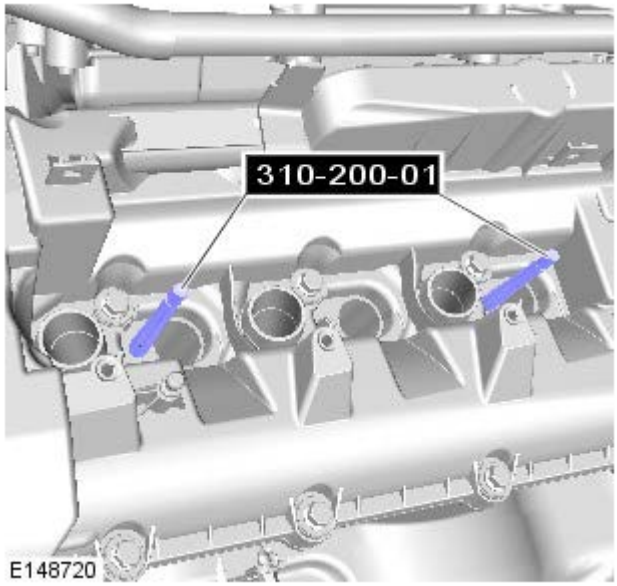
3. *Special Tool(s):* 310-199



E115062

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.

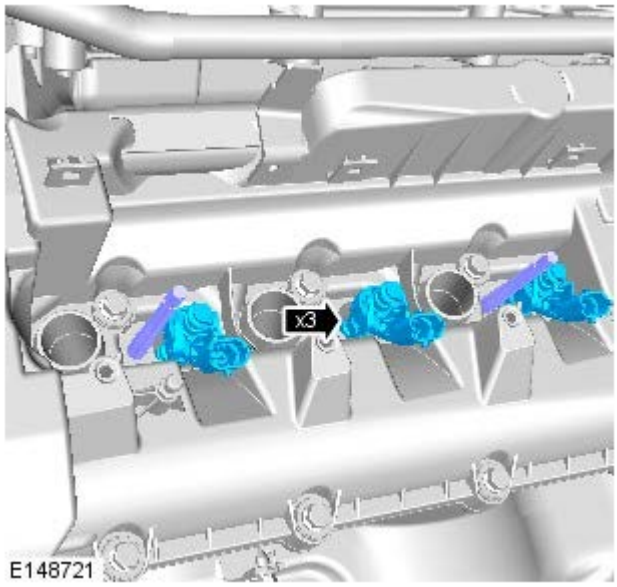

E115057



E148720

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



E148721

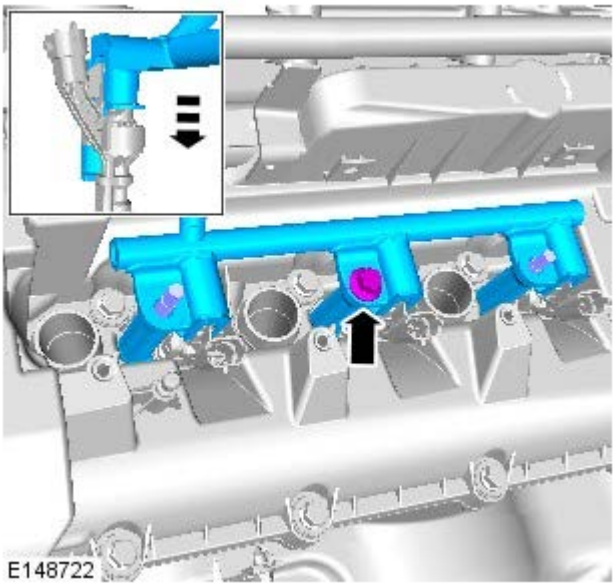
6. CAUTIONS:

   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.



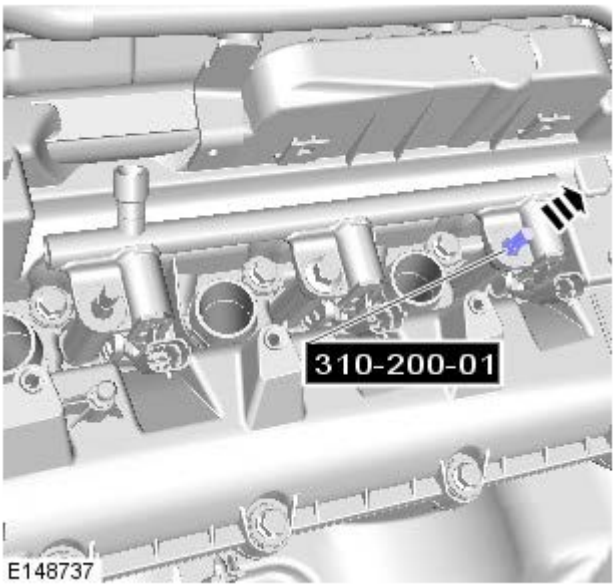
Make sure that the fuel injector is aligned and installed into the fuel rail correctly, as noted in the removal step.

Tighten the fuel rail retaining bolts a turn at a time until the correct torque is achieved.

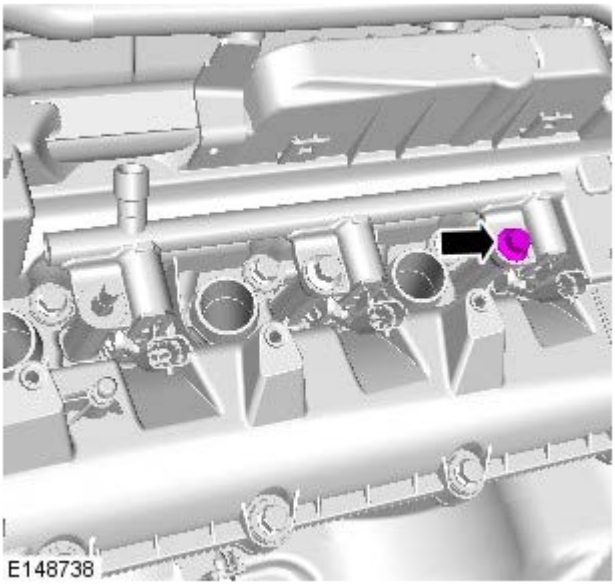
NOTE: Lubricate the fuel injector O-ring seals with clean engine oil.

Torque: 20 Nm

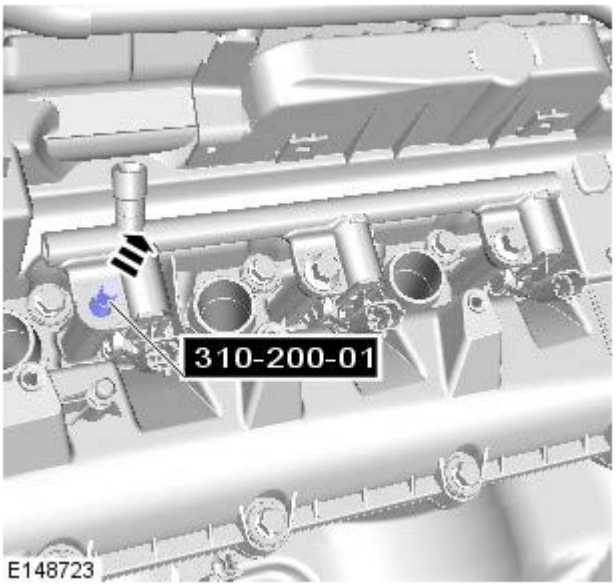
8. *Special Tool(s):* 310-200-01



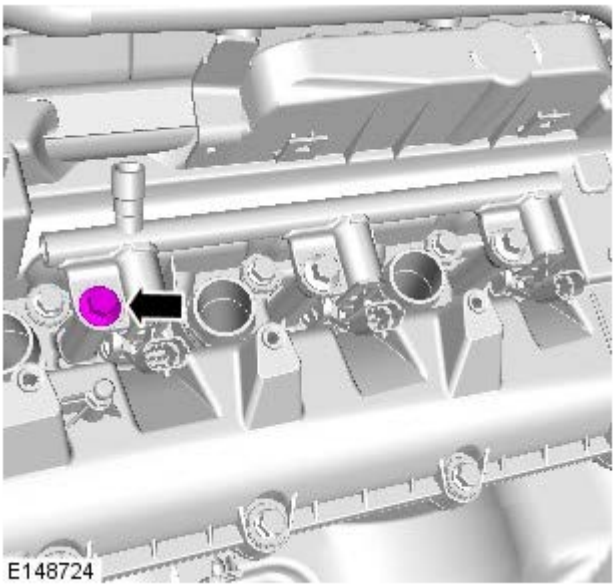
9. *Torque:* 20 Nm



10. *Special Tool(s):* 310-200-01

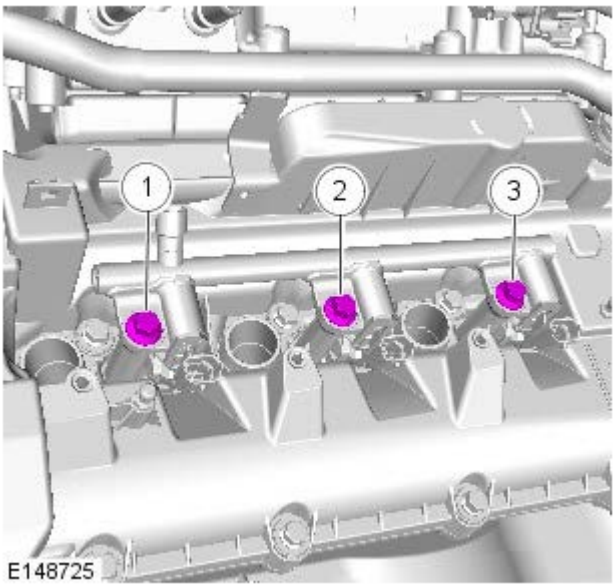


11. *Torque:* 20 Nm

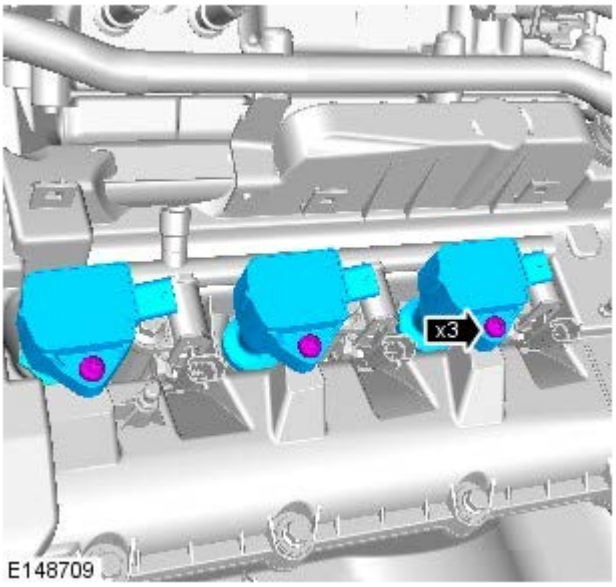


12. NOTE: Tighten the bolts in the indicated sequence.

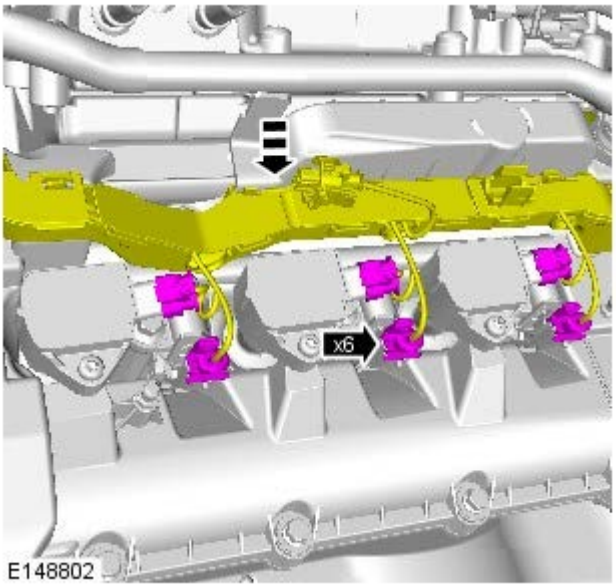
Torque:
Bolt 2 30 Nm
Bolt 3 30 Nm
Bolt 1 30 Nm

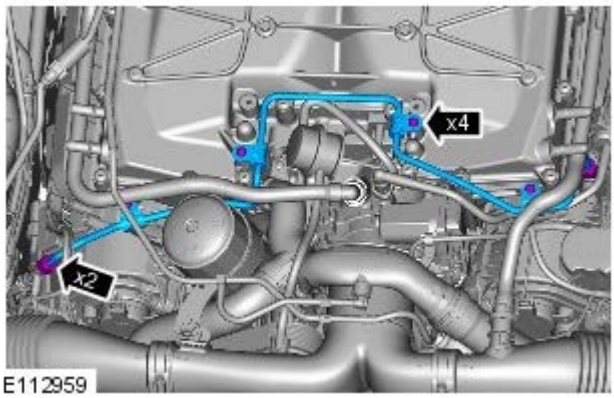


13. *Torque:* 7 Nm



14.





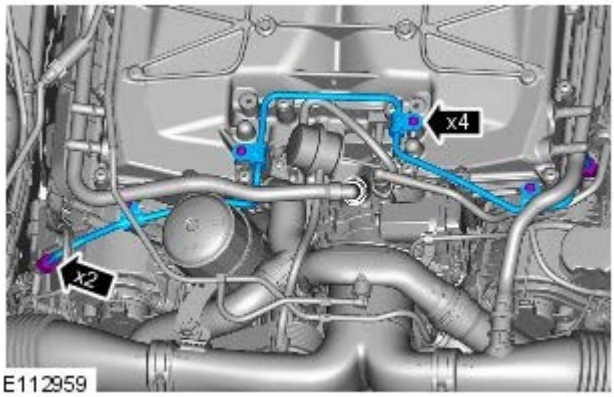
15. CAUTION: Lubricate only the union threads with clean engine oil.

NOTES:

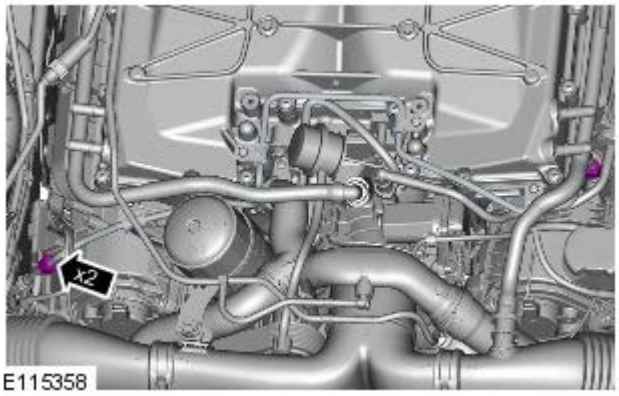
Do not tighten at this stage.

Remove and discard the blanking caps.

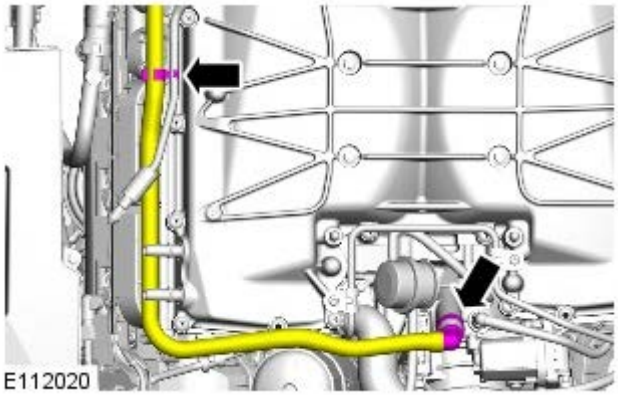
16. *Torque:*
Unions 21 Nm
Bolts 8 Nm



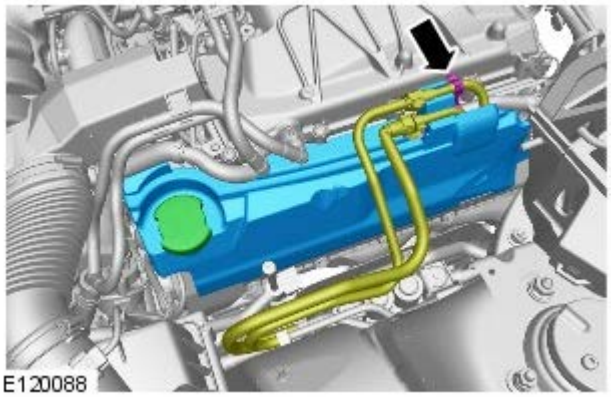
17. *Torque:* 21 Nm



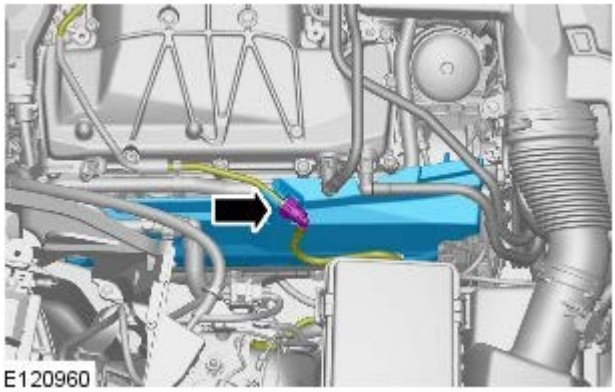
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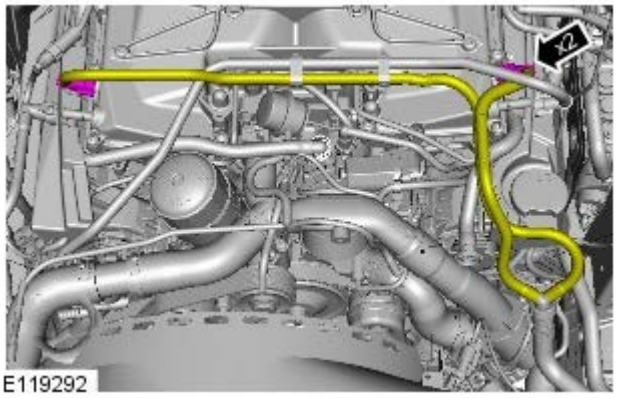
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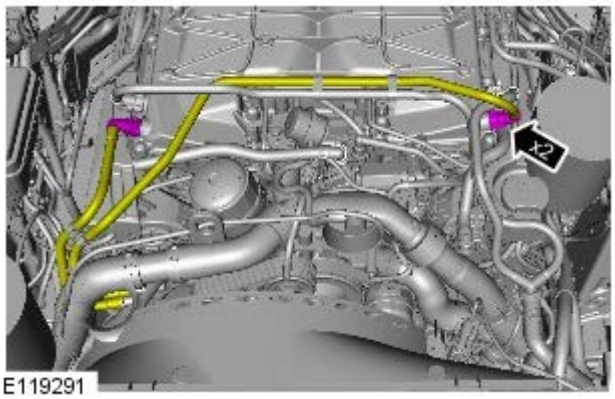
20.



21.



22.



23. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12B Intake Air Distribution and Filtering - V6 S/C 3.0L Petrol, Removal and Installation).

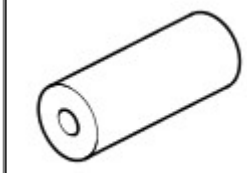
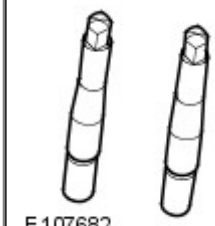
24. Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 03-Dec-2013

Fuel Charging and Controls - V6 S/C 3.0L 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

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:

Some variation in the illustrations may occur, but the essential information is always correct.

Some components shown removed for clarity.

Removal steps in this procedure may contain installation details.

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 - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (310-00 Fuel System - General Information, General Procedures).
3. Refer to: Engine Cover - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol

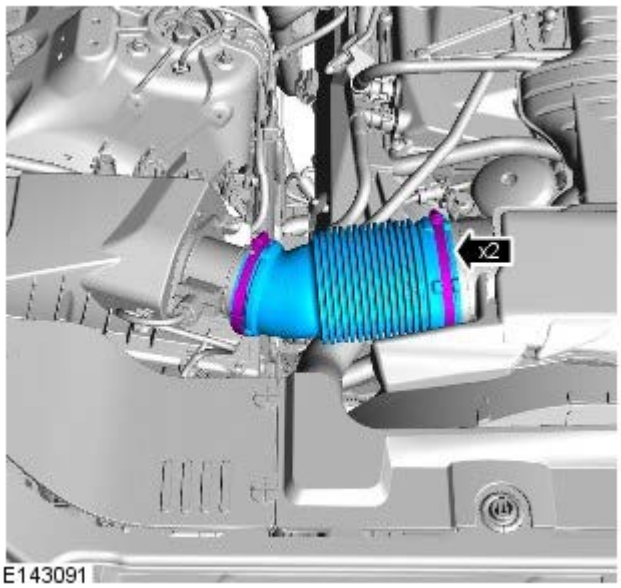
(501-05 Interior Trim and Ornamentation, Removal and Installation).

4. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

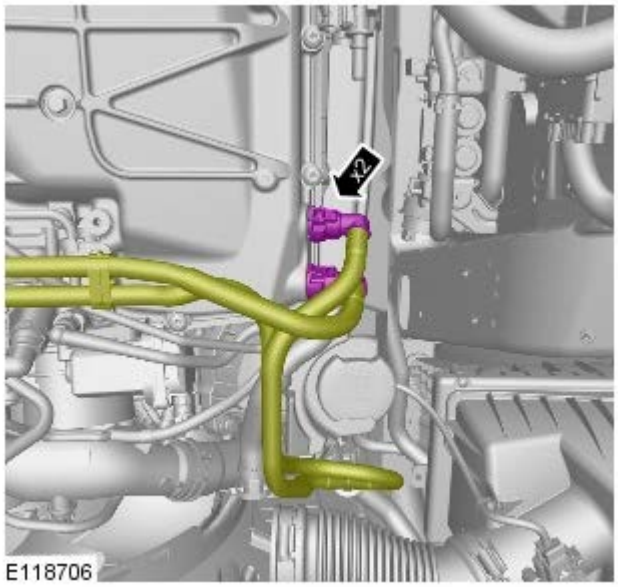
5. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12B Intake Air Distribution and Filtering - V6 S/C 3.0L Petrol, Removal and Installation).

6.

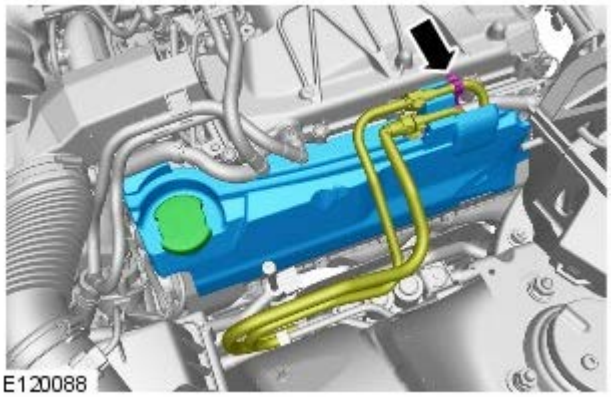


7. Refer to: Air Cleaner RH (303-12B Intake Air Distribution and Filtering - V6 S/C 3.0L Petrol, Removal and Installation).

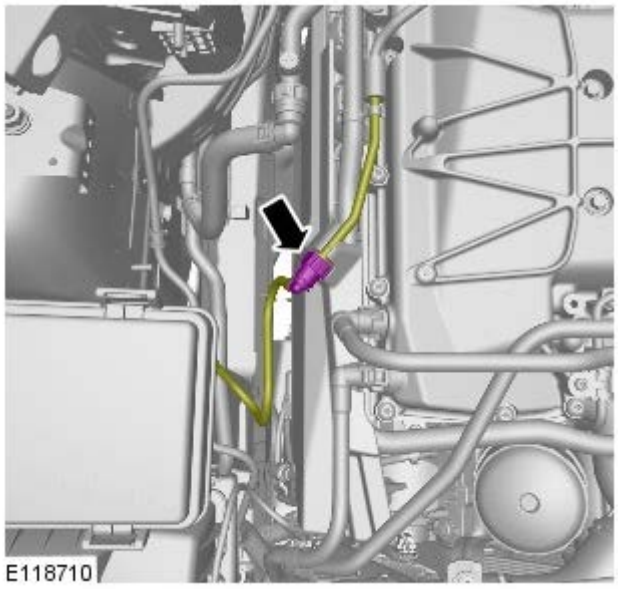
8. CAUTION: Be prepared to collect escaping coolant.



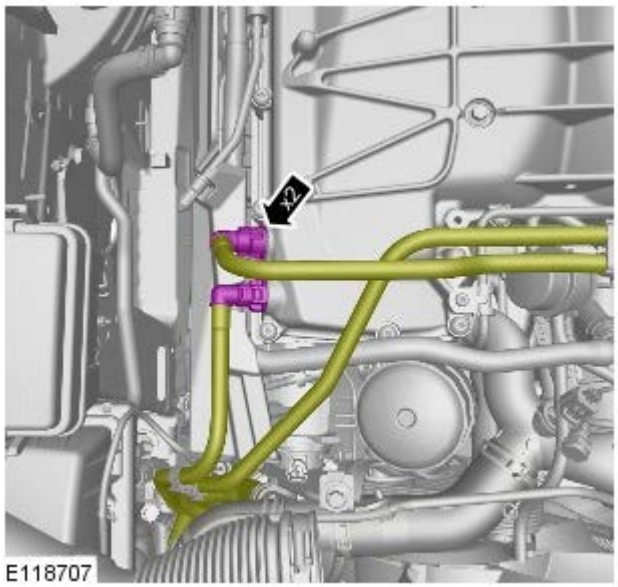
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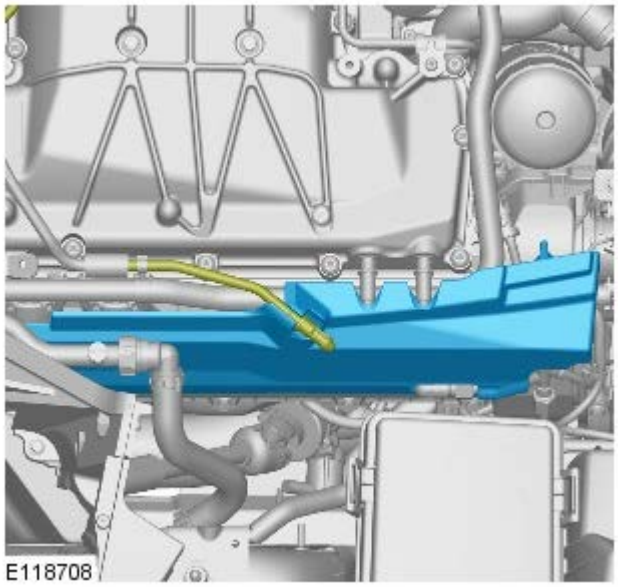
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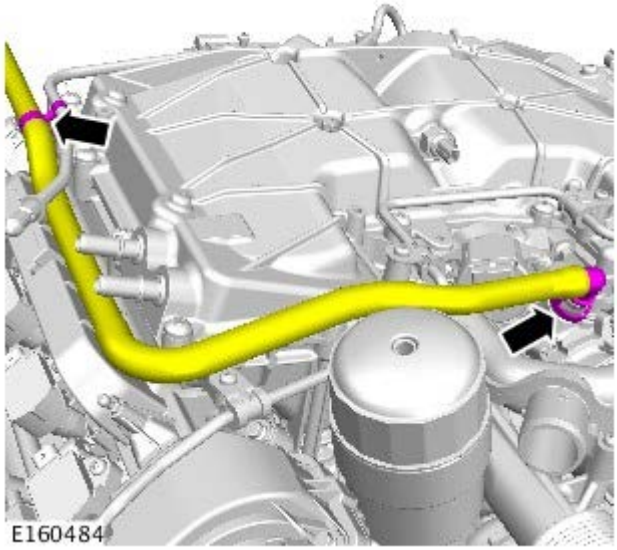
11. CAUTION: Be prepared to collect escaping coolant.



12.



13.



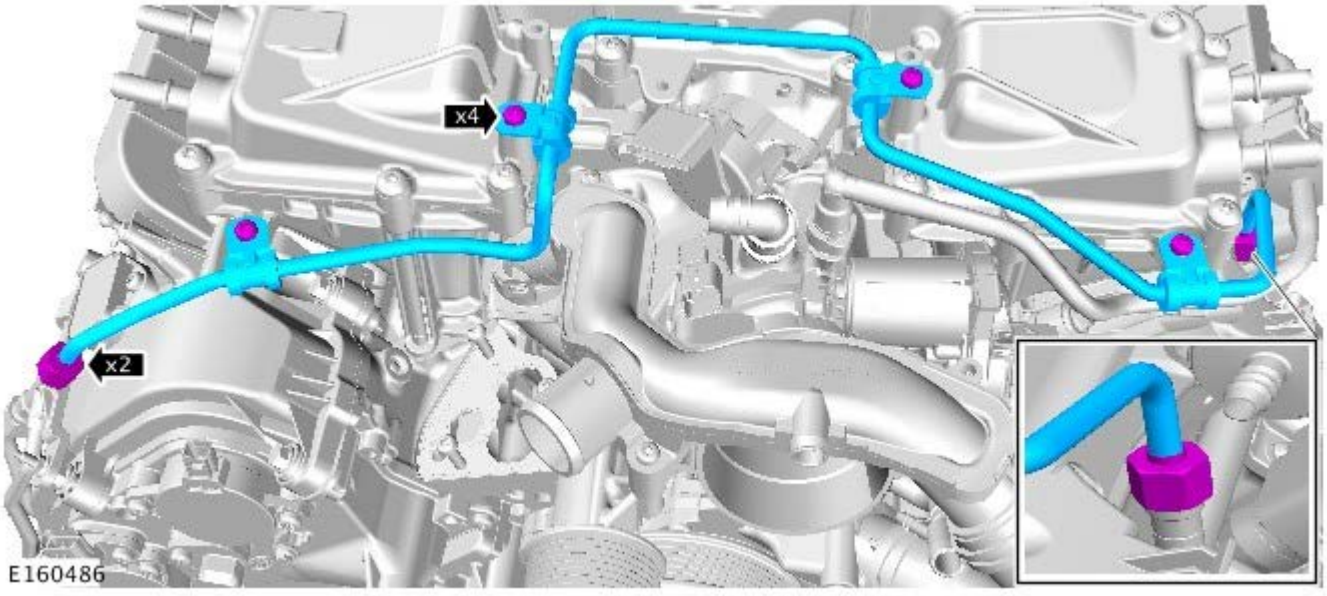
14. WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

CAUTIONS:

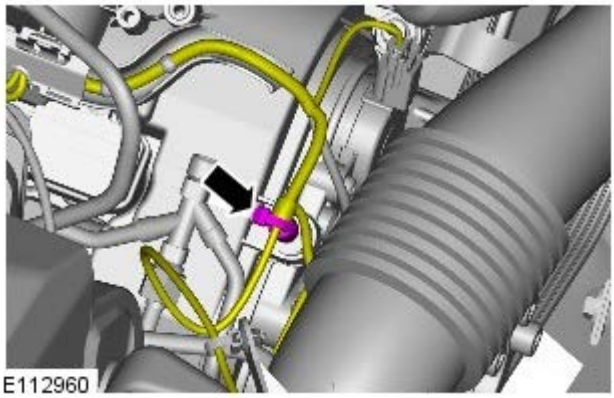
Make sure that the fuel line union does not rotate.

Be prepared to collect escaping fluids.

Make sure that all openings are sealed. Use new blanking caps.



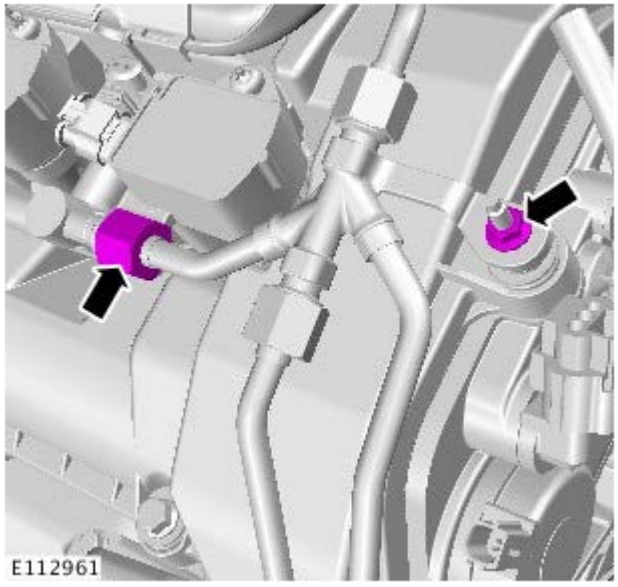
15.



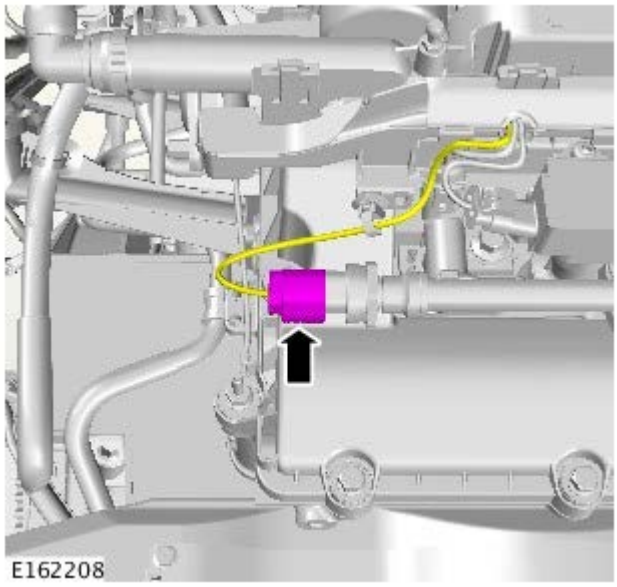
16. CAUTIONS:

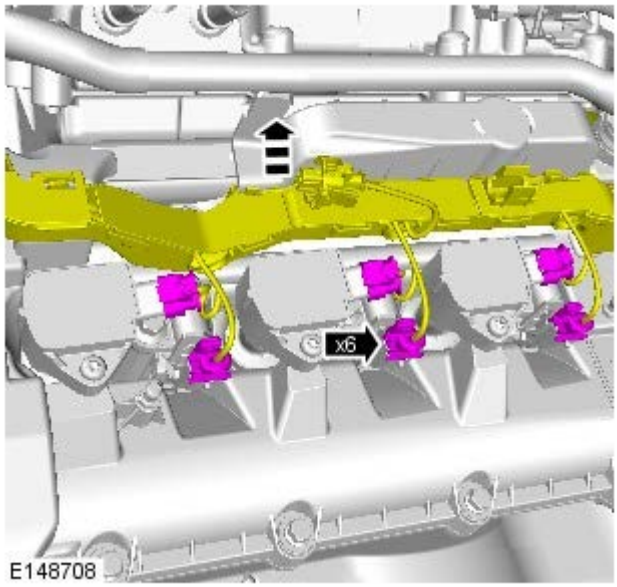
Be prepared to collect escaping fluids.

Make sure that all openings are sealed. Use new blanking caps.



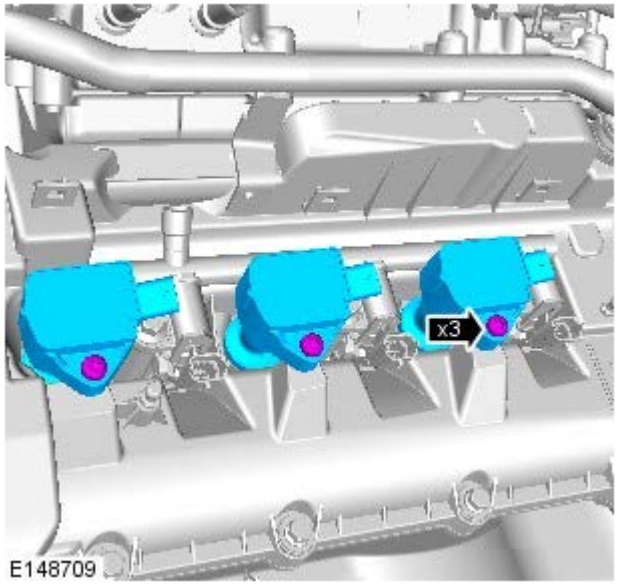
17.





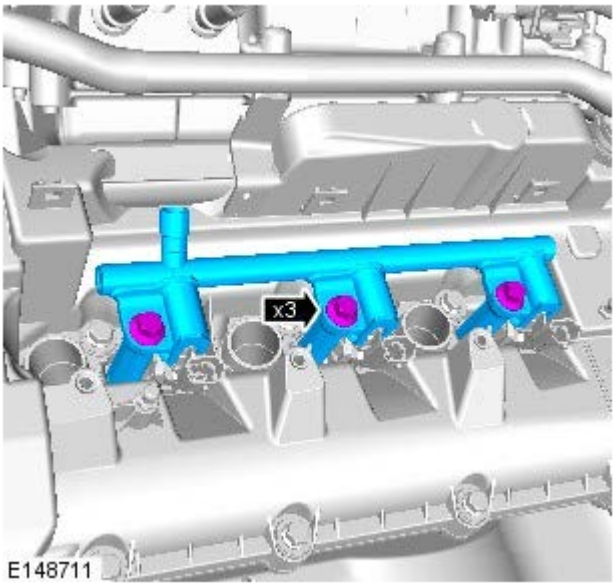
18. NOTE: LH illustration shown, RH is similar.

19. Refer to: Fuel Injection Component Cleaning (303-04C Fuel Charging and Controls - V6 S/C 3.0L Petrol, General Procedures).



20. NOTE: LH illustration shown, RH is similar.

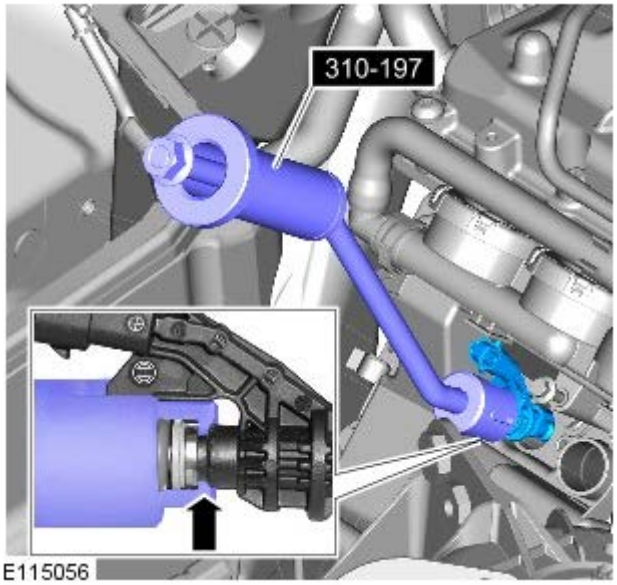
21. CAUTION: Make a note of the fuel injector clamp alignment to the fuel rail prior to removal.



NOTE: LH illustration shown, RH is similar.

22. 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 - V6 S/C 3.0L Petrol, Removal and Installation).



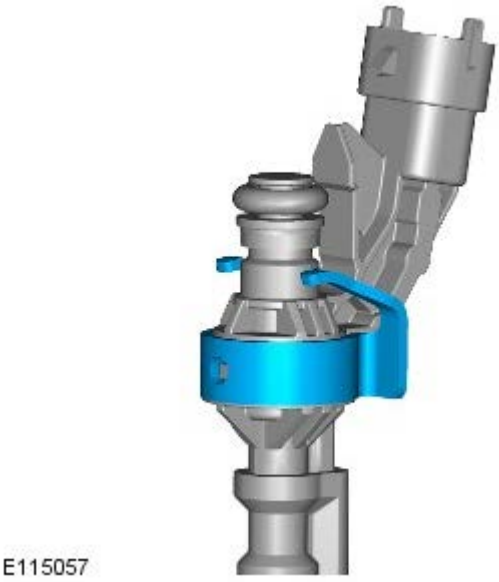
23. CAUTIONS:

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



24. 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.

25. CAUTIONS:

⚠ Do not use a knife to remove the Teflon seal as damage could occur to the fuel injector.

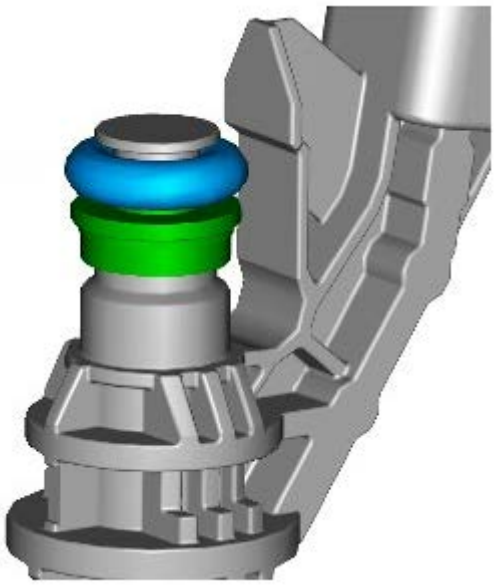
⚠ Do not cut the Teflon seal to deep as damage could occur to the fuel injector.

⚠ Pinch the Teflon seal to allow the tool to cut the Teflon seal without damaging the fuel injector.



E115058

26. ⚠ CAUTION: Do not use any sharp tools to remove the O-ring seal as damage could occur to the fuel injector.



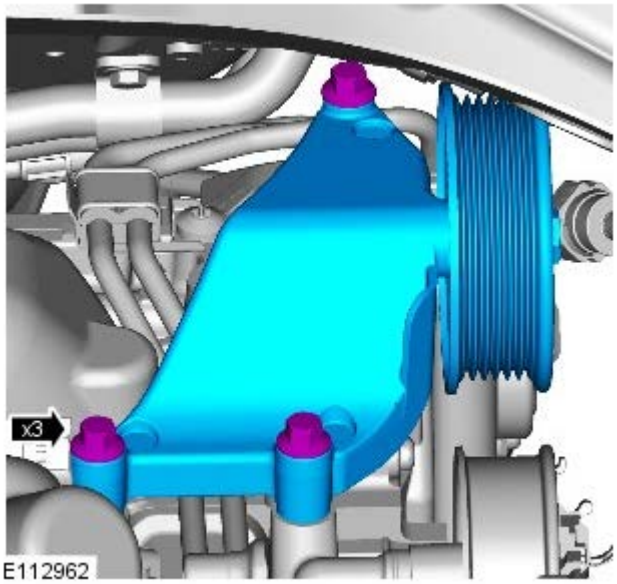
E115059

27. ⚠ WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

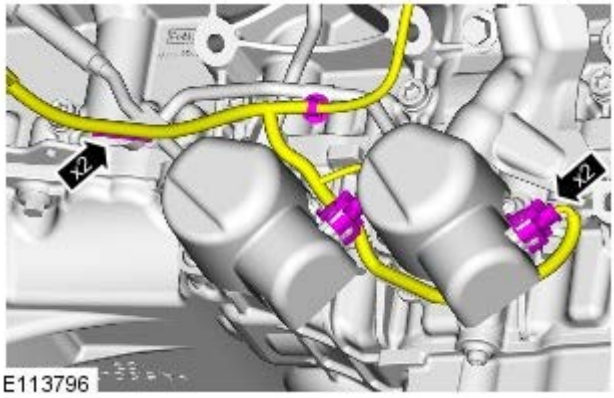
Raise and support the vehicle.

28. Refer to: Generator (414-02C Generator and Regulator - V8 S/C 5.0L Petrol, Removal and Installation).

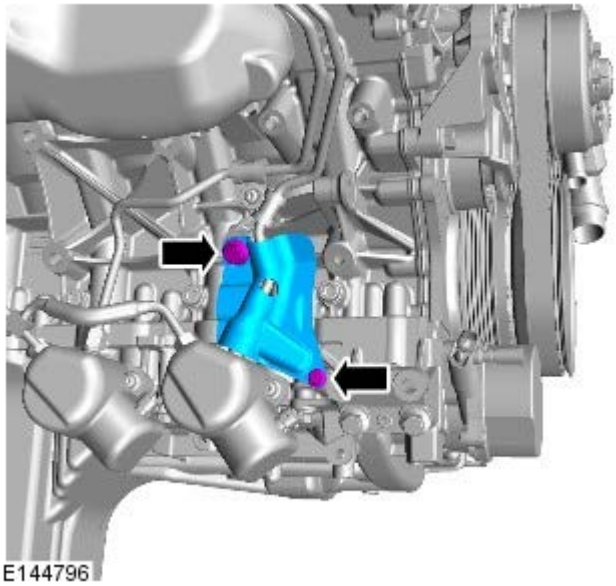
29.



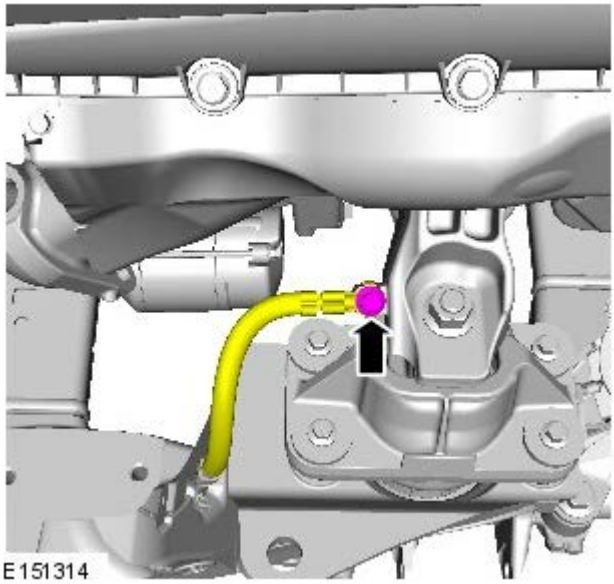
30.



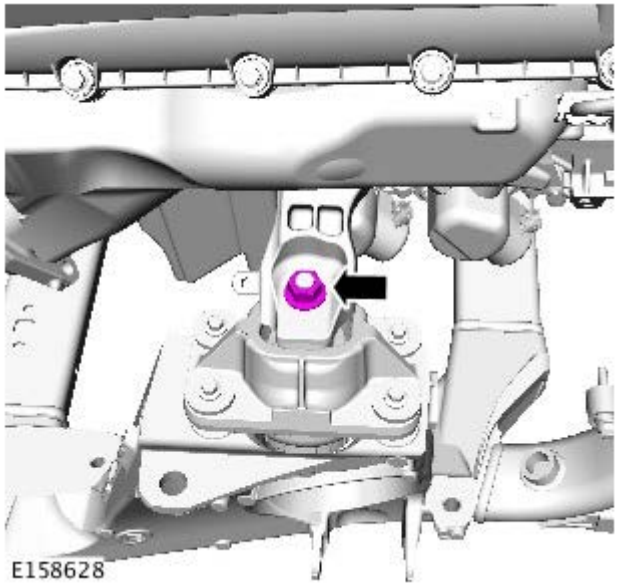
31.



32.

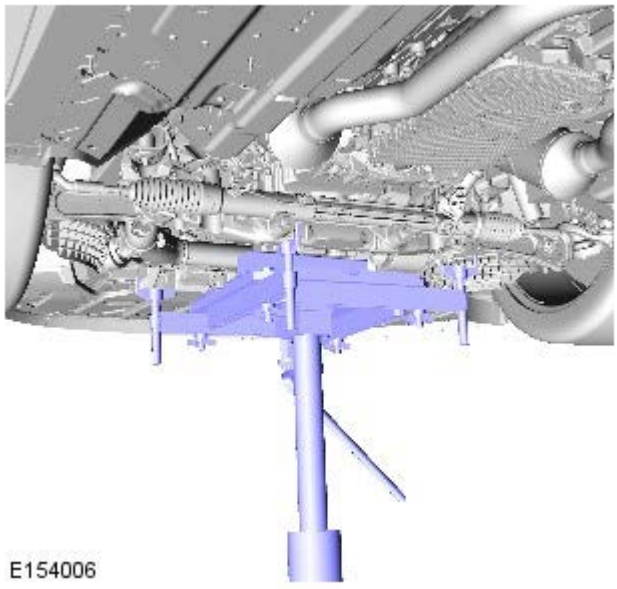


33.

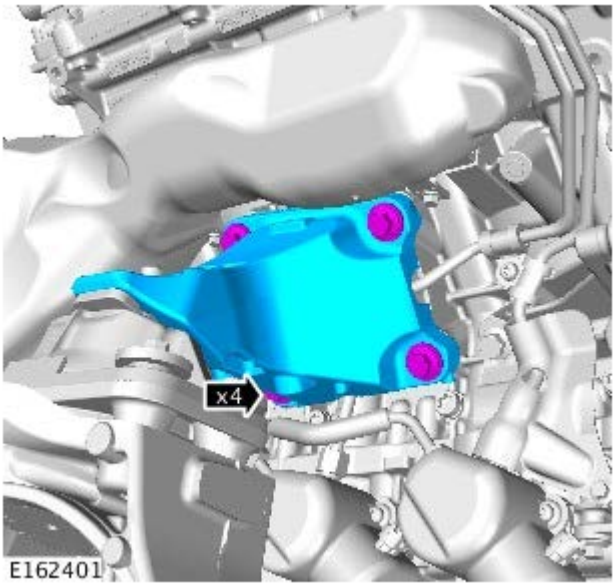


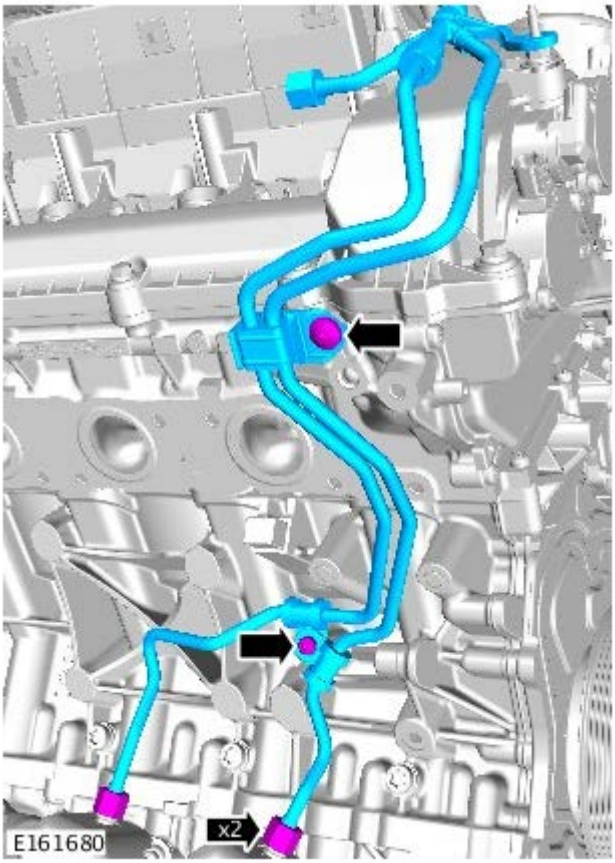
34. CAUTION: Use a wooden block to protect the oil pan when supporting the engine.

Using a suitable hydraulic jack, support the engine.



35.





36. 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

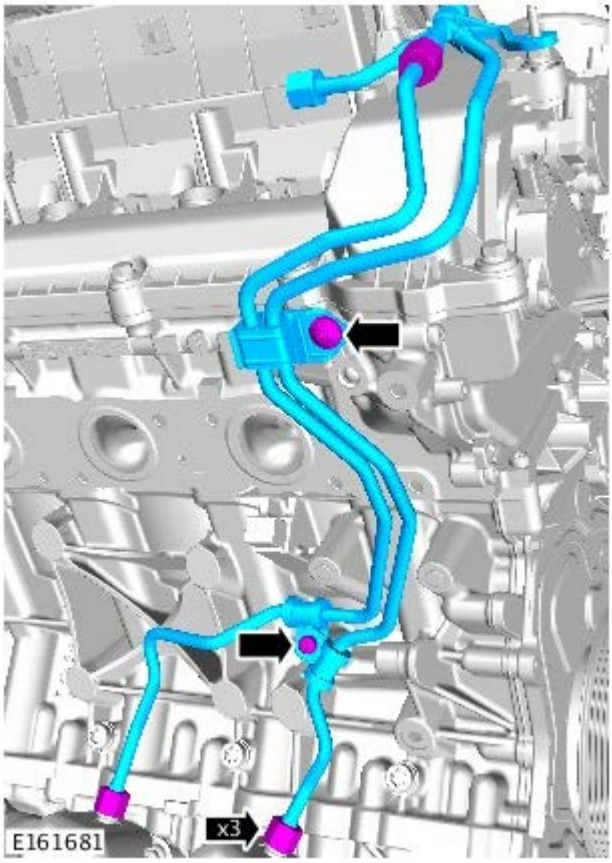
1. CAUTION: Lubricate only the union threads with clean engine oil.

   NOTES:

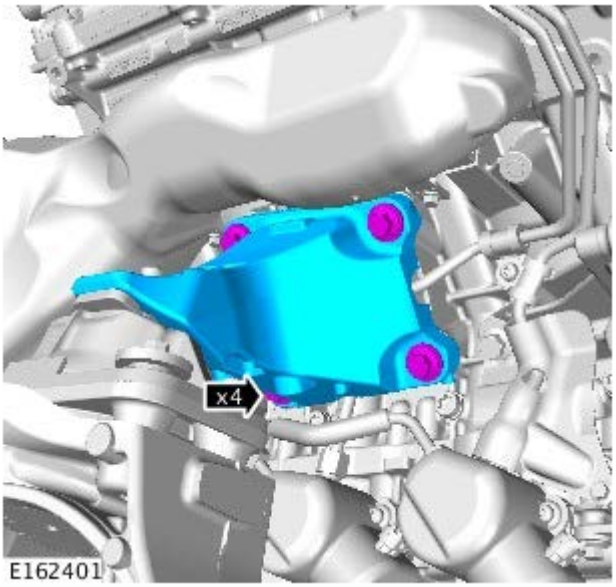
   Engine shown removed for clarity.

   Install the bolts and unions finger tight before final tightening.

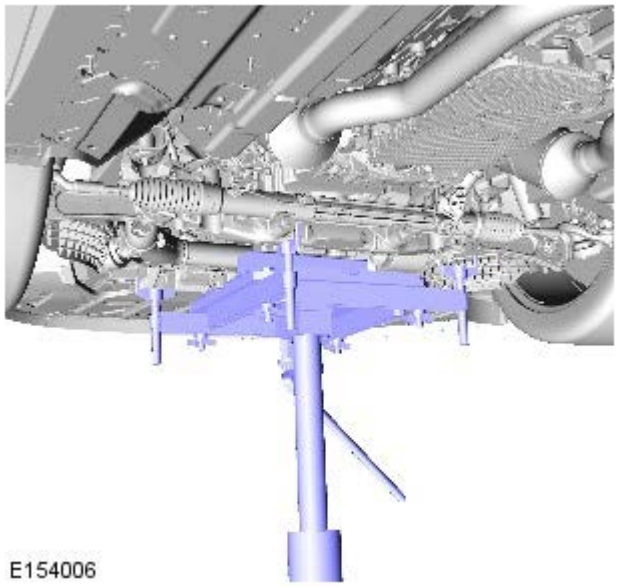
   Remove and discard the blanking caps.



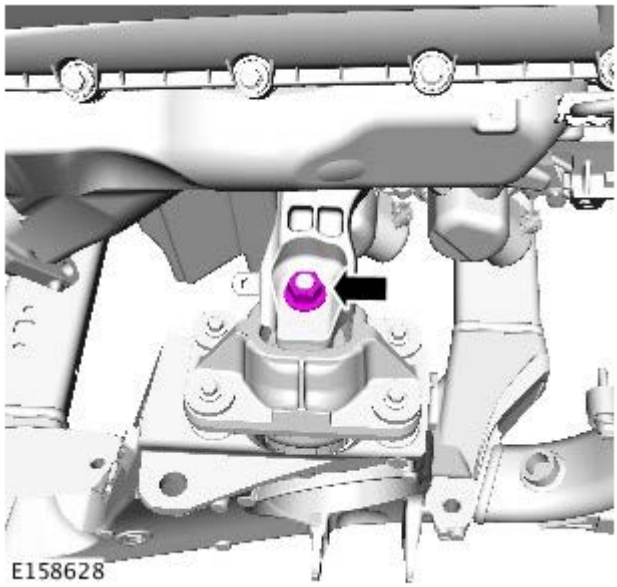
2. *Torque:*
   Stage 1:45 Nm
   Stage 2:60°



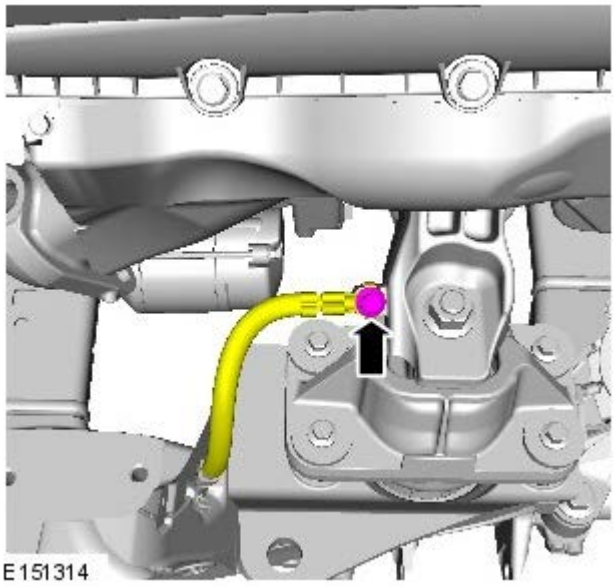
3. Remove the special tool.



4. *Torque:* 130 Nm

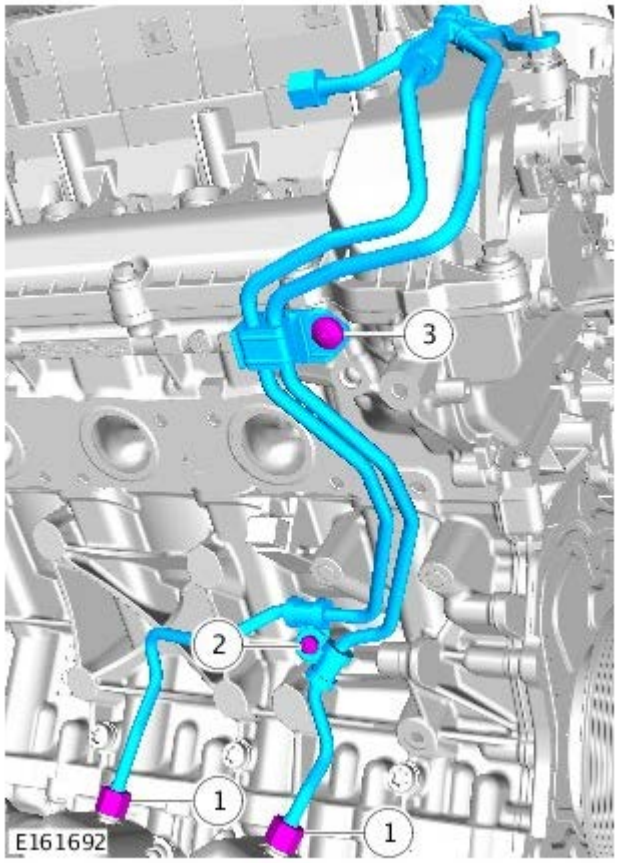


5. *Torque:* 10 Nm



6. NOTE: Some components shown removed for clarity.

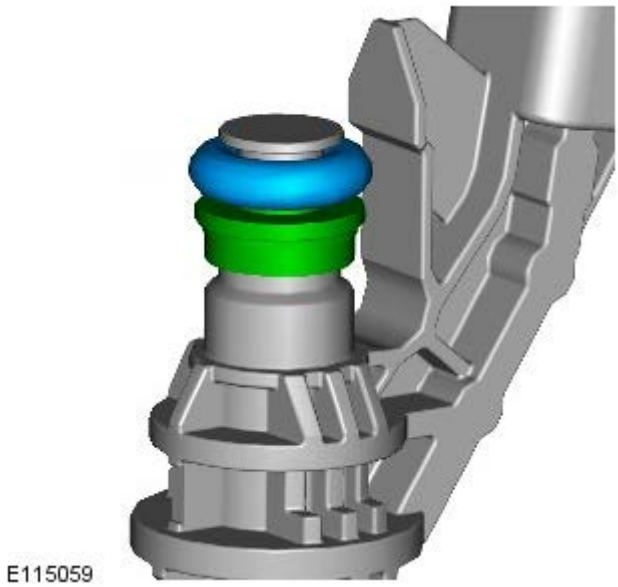
Torque:
Unions (1) 21 Nm
M6 (2) 11 Nm



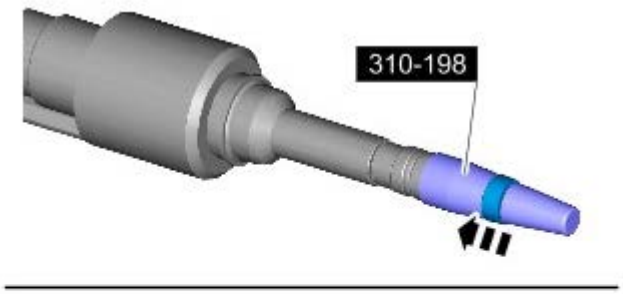
M8 (3) 25 Nm

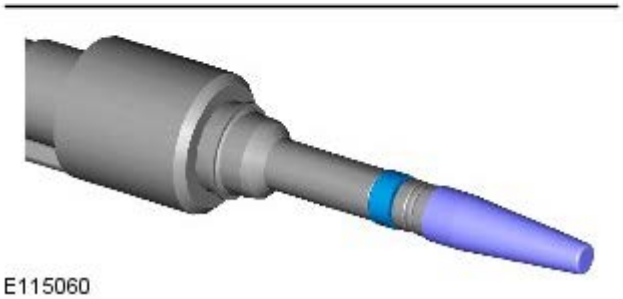
7. Lower the vehicle.

8.



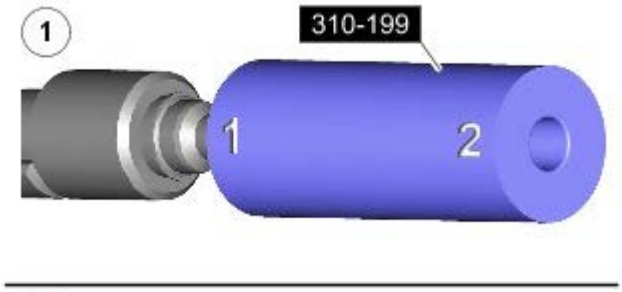
9. *Special Tool(s):* 310-198

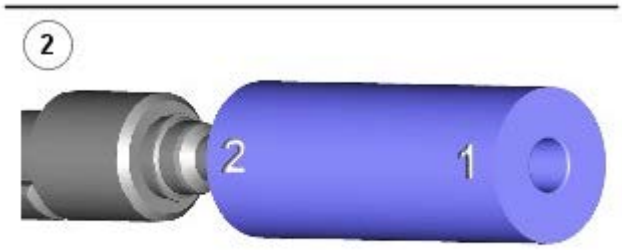




E115060

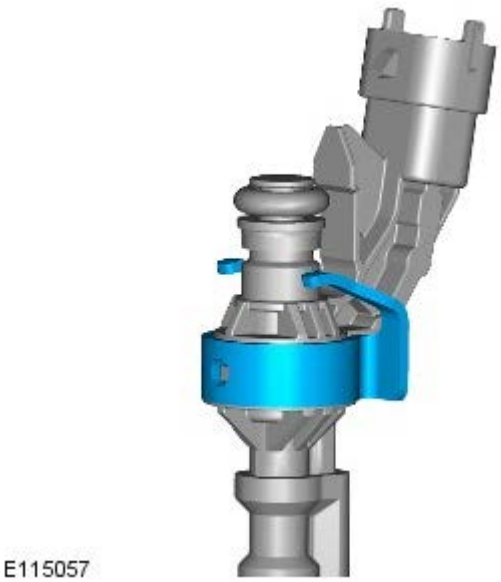
10. *Special Tool(s):* 310-199





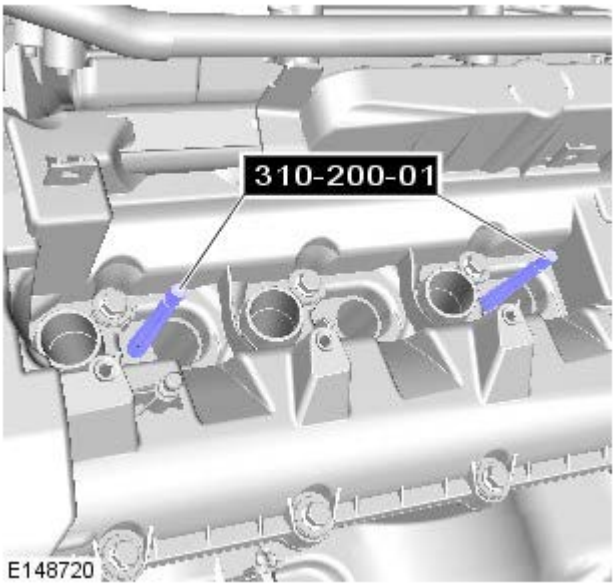
E115062

11. CAUTION: If the original fuel injector is being installed, the original fuel injector clamp must installed with the fuel injector it was removed with.



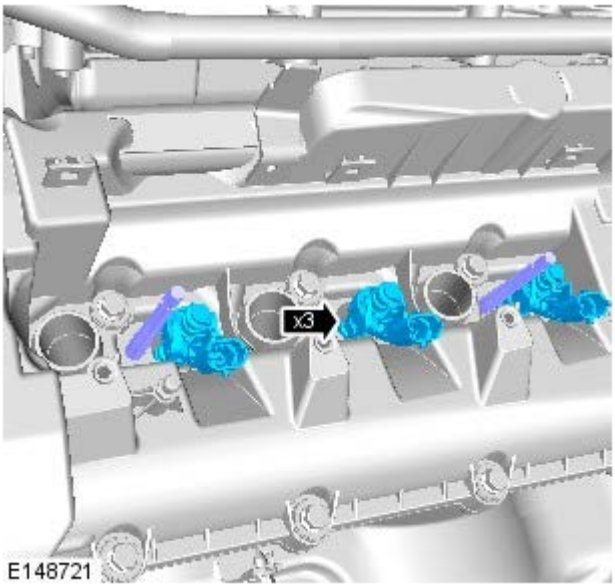
E115057

12. 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



13. CAUTIONS:

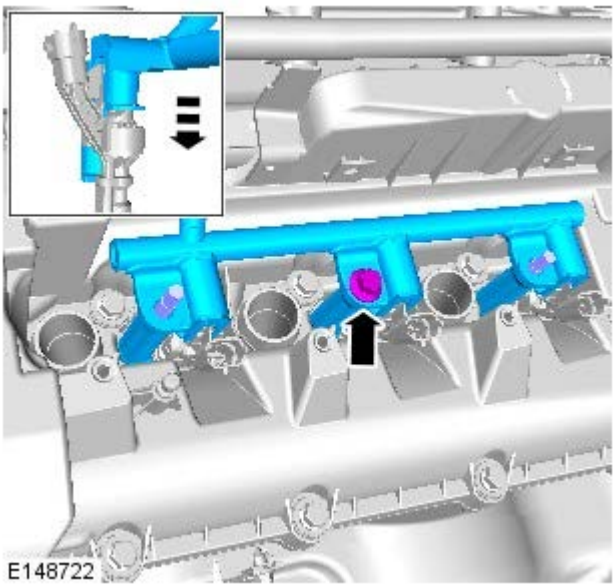
Make sure that the area around the open fuel injector ports are clean and free of foreign material and lubricant prior to installing the fuel injector.

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.

14. 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 - V6 S/C 3.0L Petrol, Removal and Installation).



15. 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.

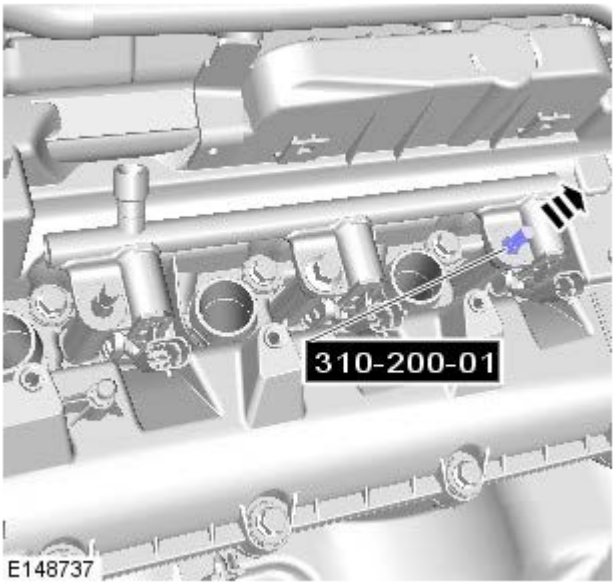
Tighten the fuel rail retaining bolts a turn at a time until the correct torque is achieved.

NOTES:

Lubricate the fuel injector O-ring seals with clean engine oil.

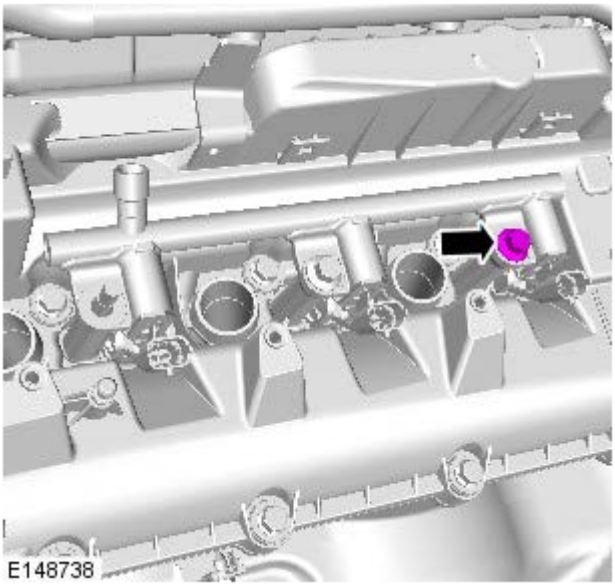
LH illustration shown, RH is similar.

Torque: 20 Nm



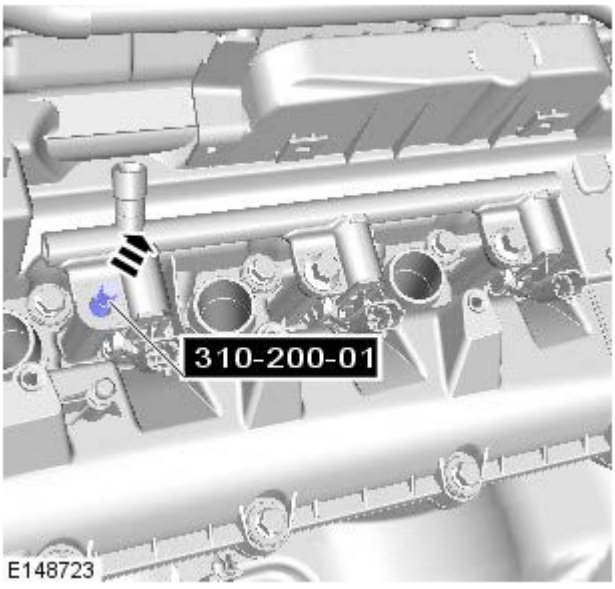
16. NOTE: LH illustration shown, RH is similar.

Special Tool(s): 310-200-01



17. NOTE: LH illustration shown, RH is similar.

Torque: 20 Nm

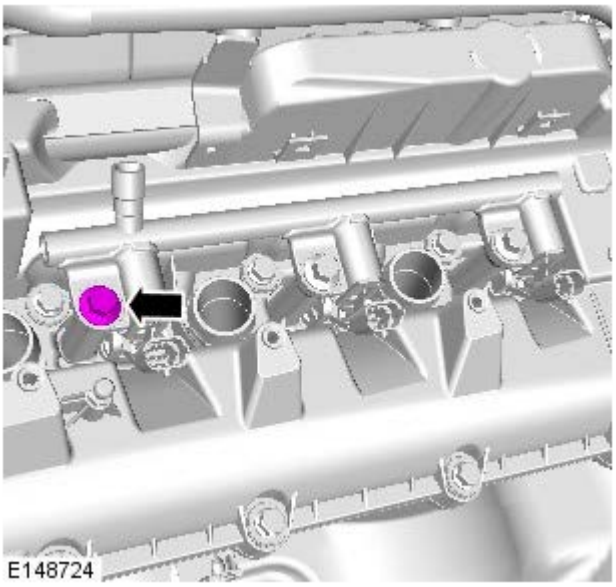


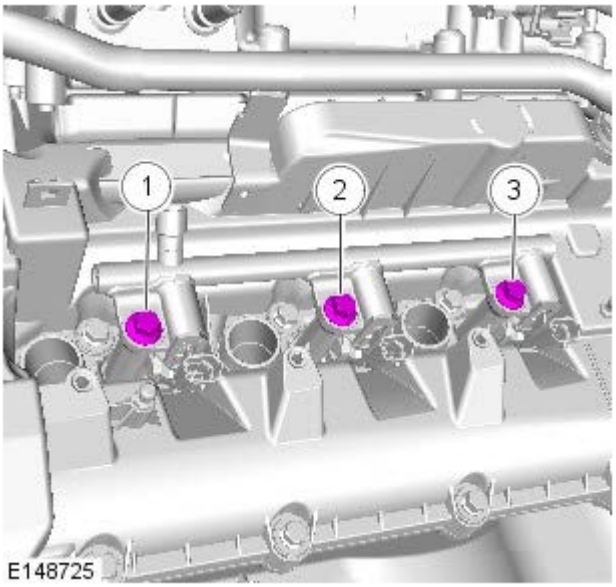
18. NOTE: LH illustration shown, RH is similar.

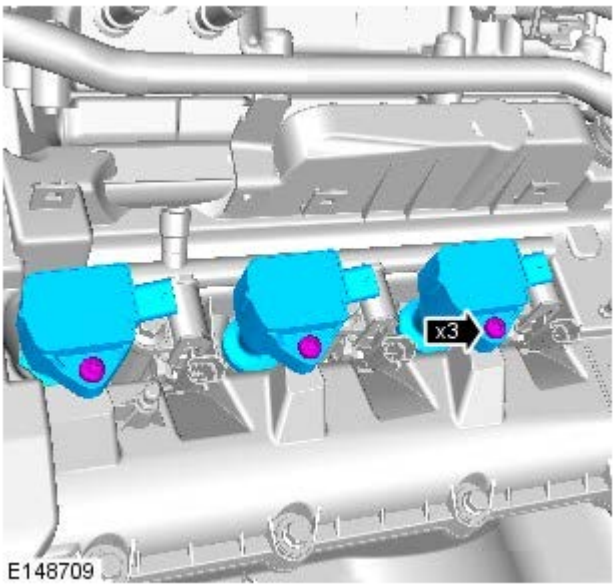
Special Tool(s): 310-200-01

19. NOTE: LH illustration shown, RH is similar.

Torque: 20 Nm







20. NOTES:

Tighten the bolts in the indicated sequence.

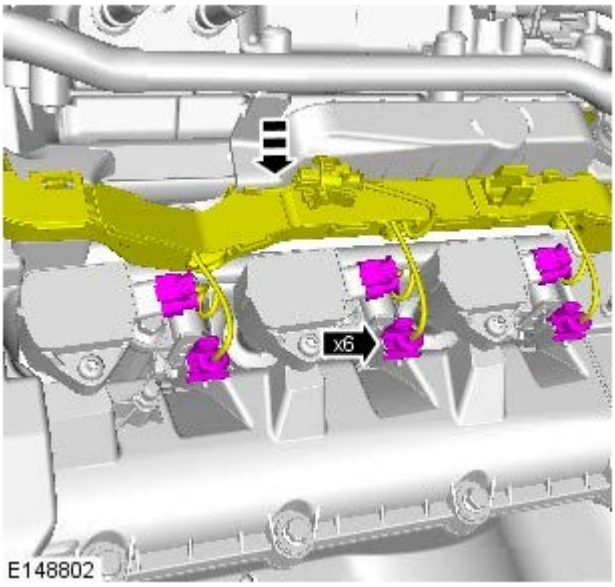
LH illustration shown, RH is similar.

Torque:
Bolt 2 30 Nm
Bolt 3 30 Nm
Bolt 1 30 Nm

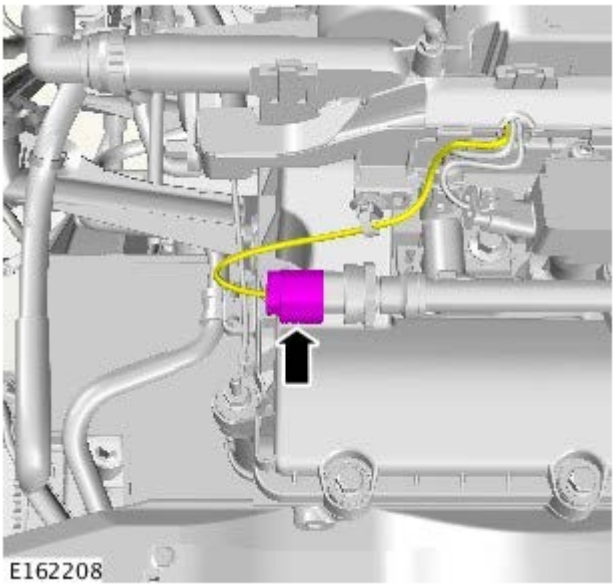
21. NOTE: LH illustration shown, RH is similar.

Torque: 8 Nm

22. NOTE: LH illustration shown, RH is similar.

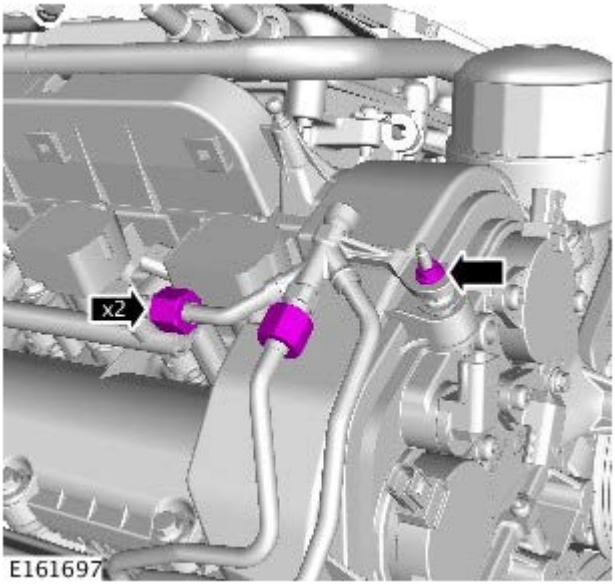


23.



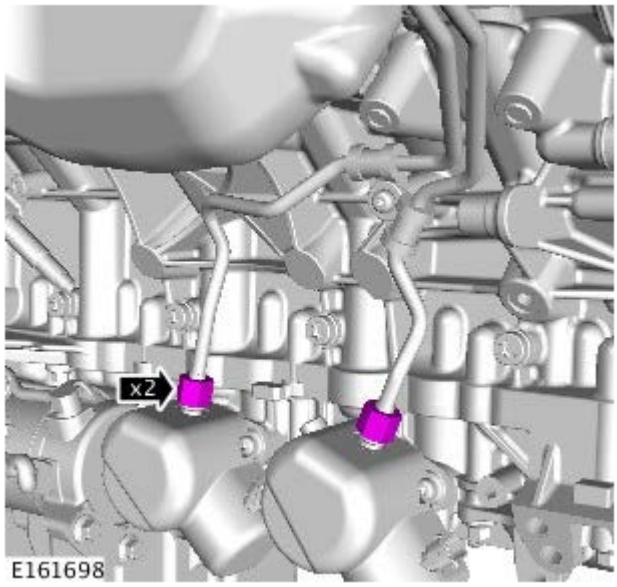
24. NOTE: Remove and discard the blanking caps.

Torque:
Unions 21 Nm
Nut 6 Nm



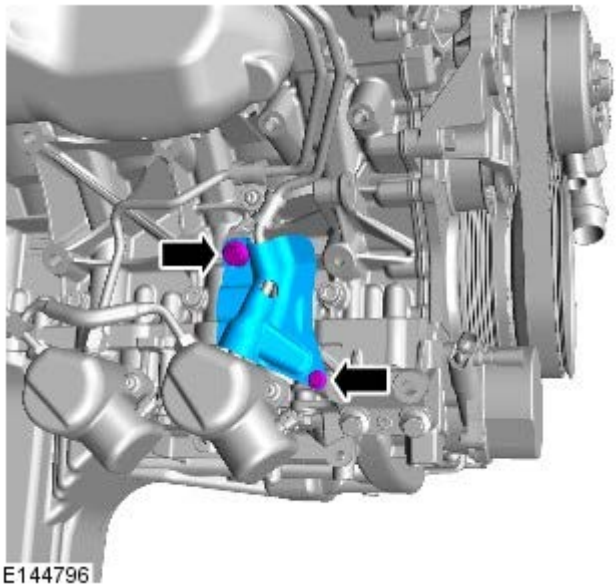
25. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.



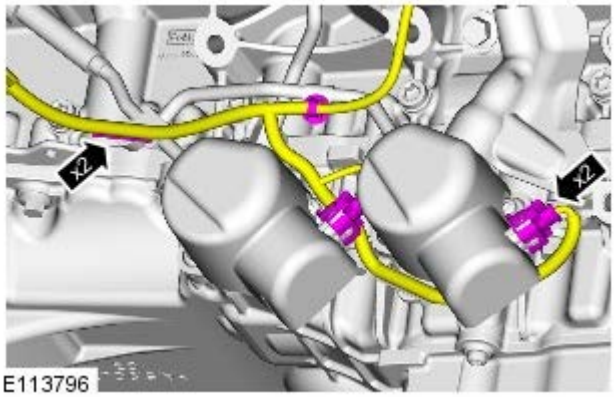
26. NOTE: Some components shown removed for clarity.

Torque: 21 Nm

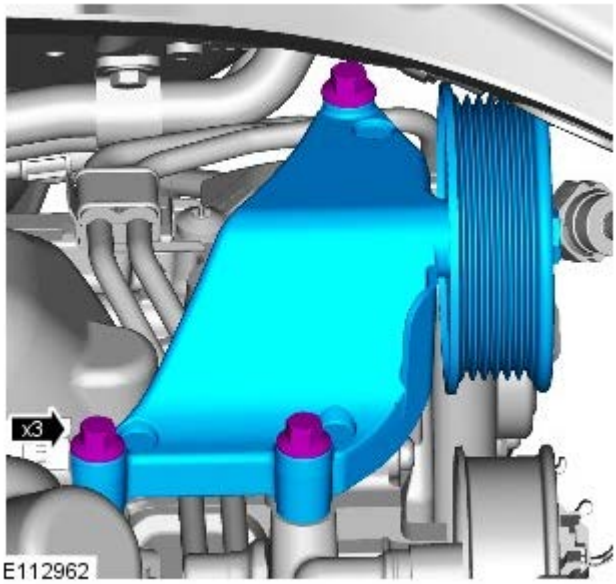


27. *Torque:*
M6 12 Nm
M10 29 Nm

28.



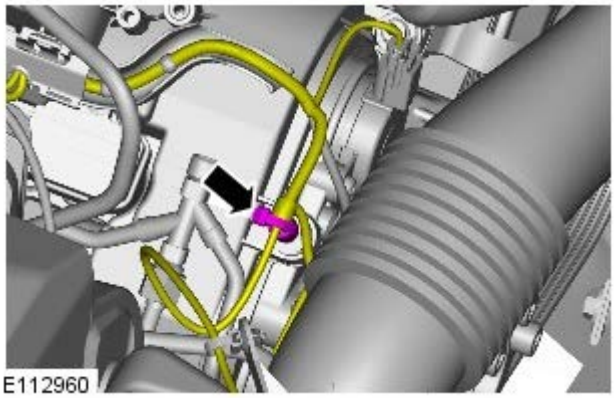
29. *Torque:* 25 Nm



30. Refer to: Generator (414-02C Generator and Regulator - V8 S/C 5.0L Petrol, Removal and Installation).

31. Lower the vehicle.

32.

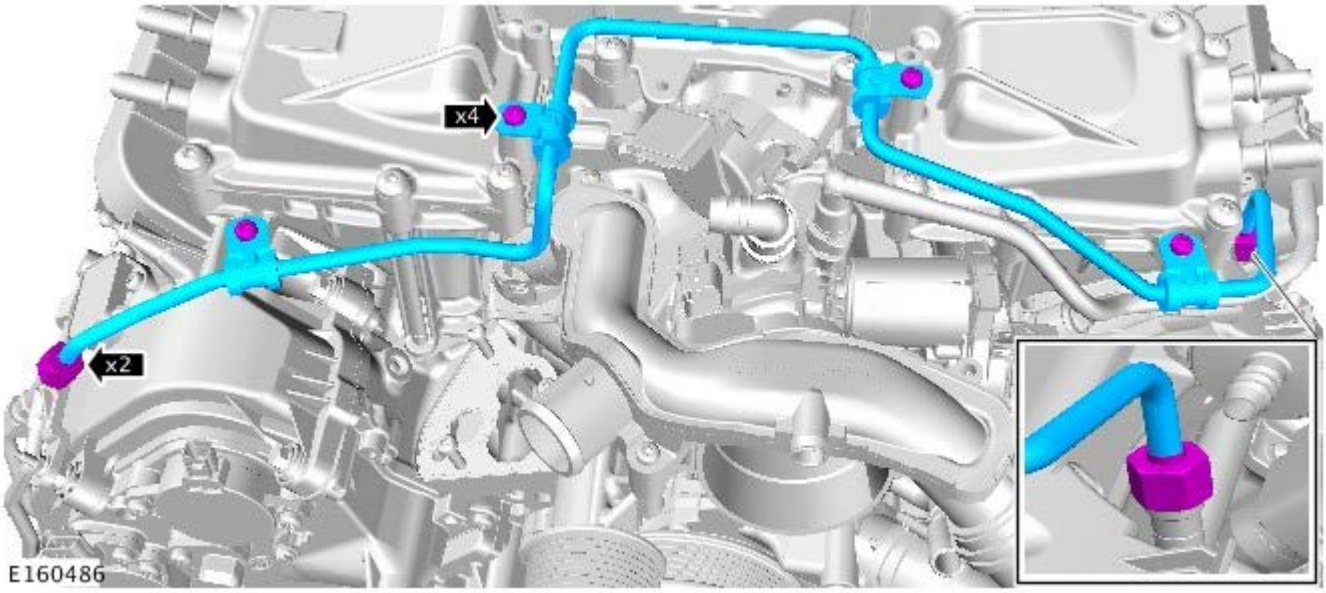


33. CAUTION: Lubricate only the union threads with clean engine oil.

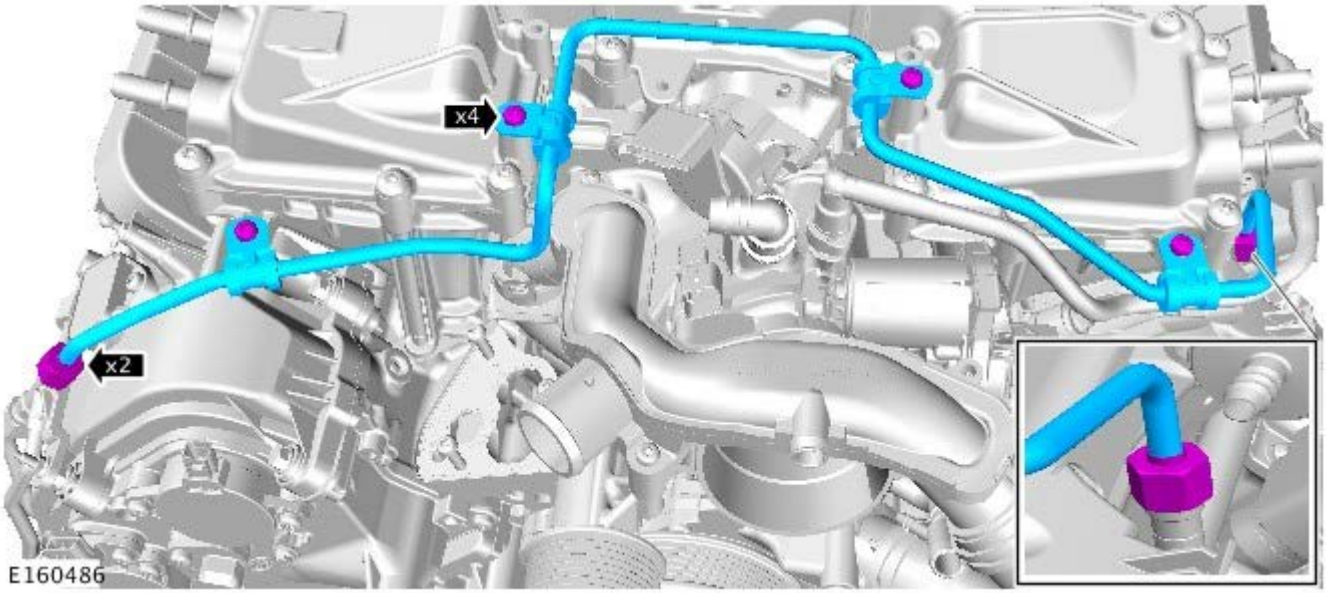
NOTES:

Install the bolts and unions finger tight before final tightening.

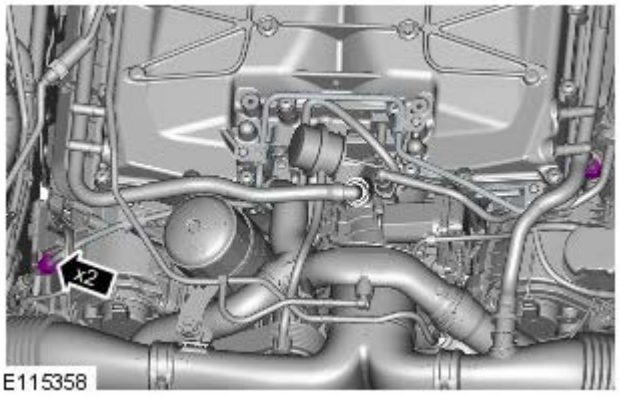
Remove and discard the blanking caps.



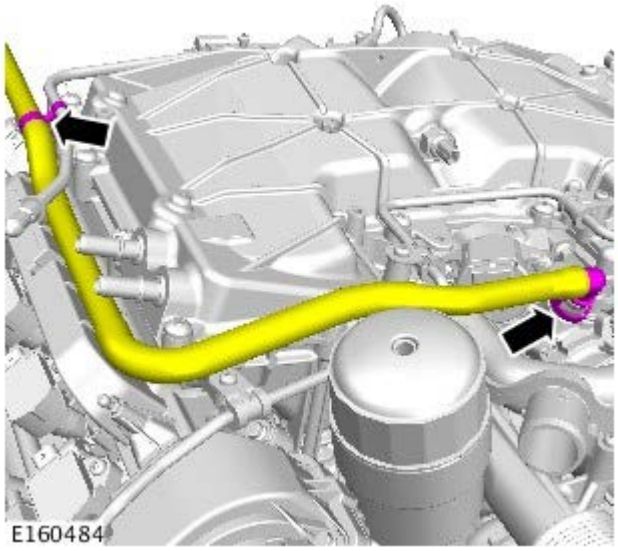
34. *Torque:*
Unions 21 Nm
Bolts 12 Nm



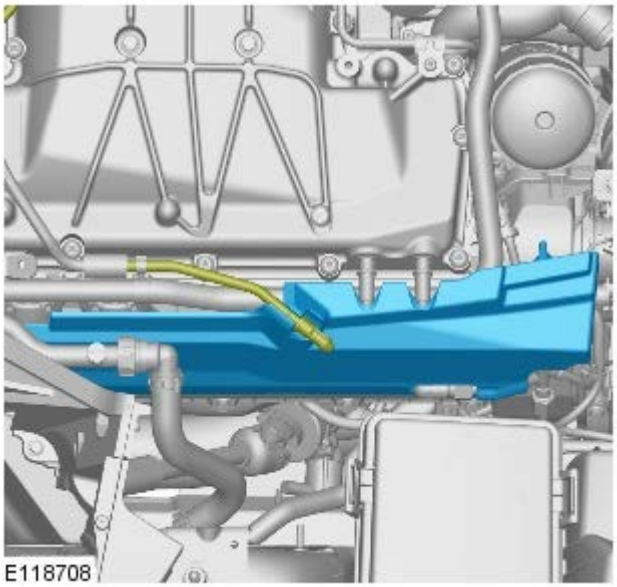
35. *Torque:* 21 Nm



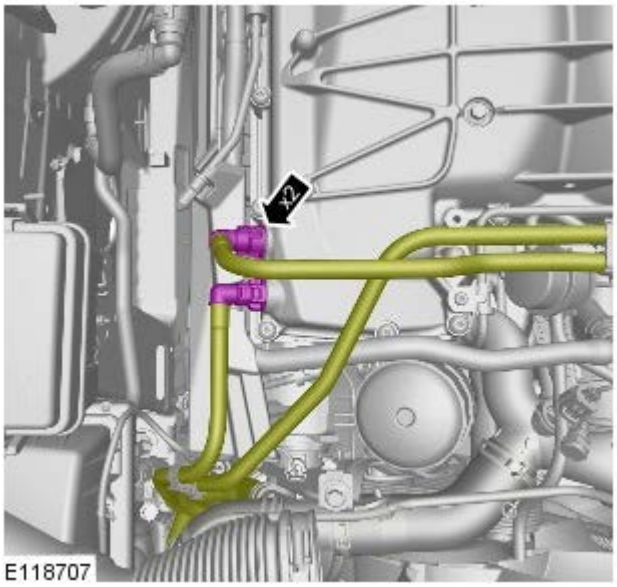
36.



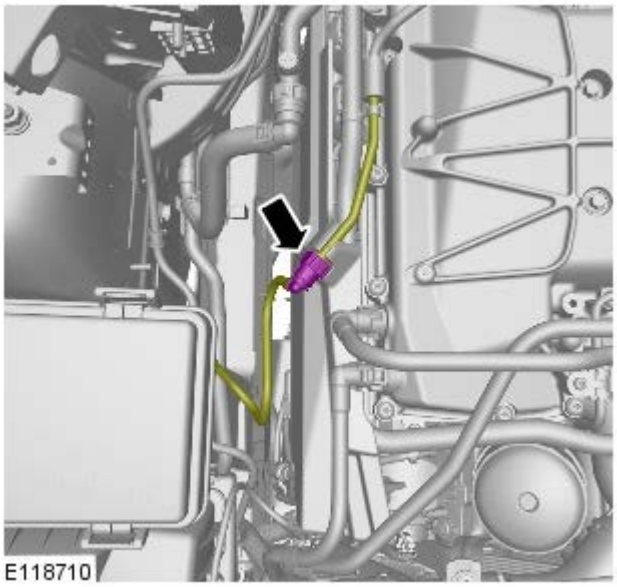
37.



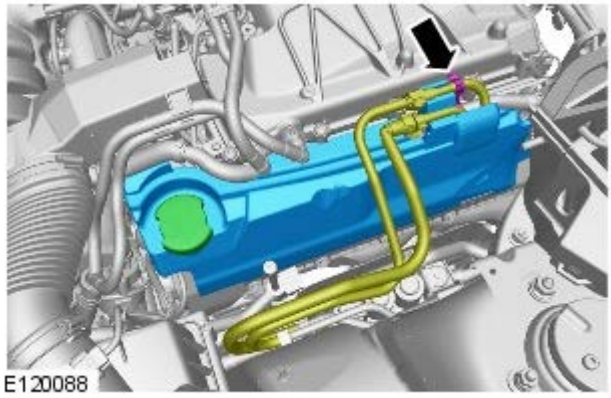
38.



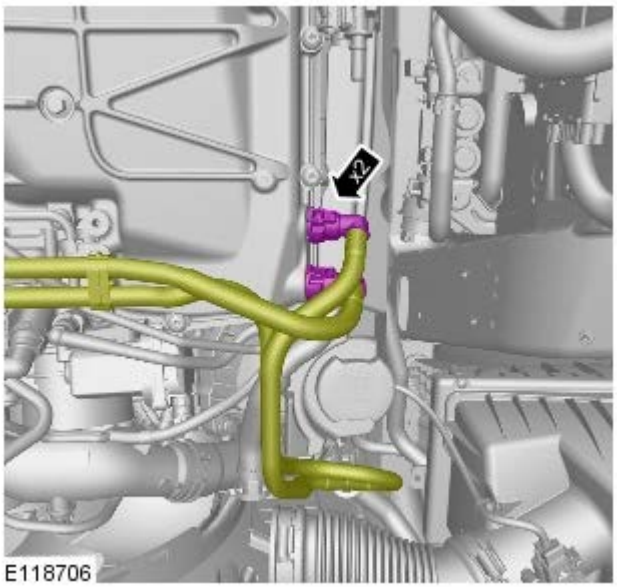
39.



40.

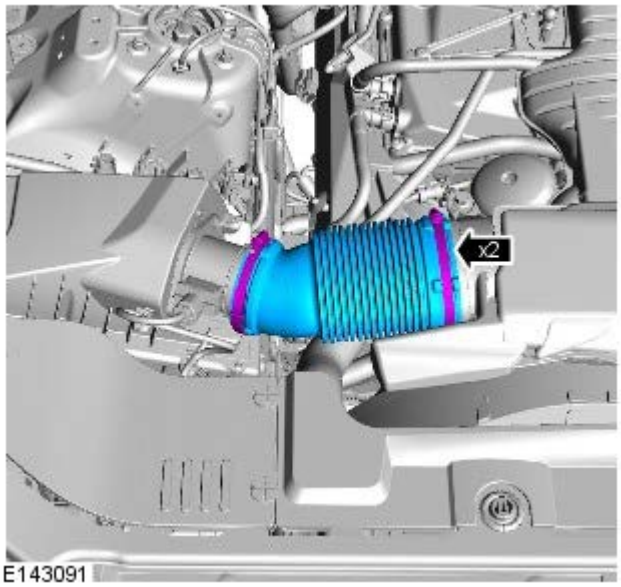


41.



42. Refer to: Air Cleaner RH (303-12B Intake Air Distribution and Filtering - V6 S/C 3.0L Petrol, Removal and Installation).

43. *Torque:* 3.5 Nm



E143091

44. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12B Intake Air Distribution and Filtering - V6 S/C 3.0L Petrol, Removal and Installation).

45. Connect the battery ground cable.

    Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

46. Refer to: Engine Cover - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (501-05 Interior Trim and Ornamentation, Removal and Installation).

Published: 02-May-2013

Fuel Charging and Controls - V6 S/C 3.0L Petrol - High Pressure Fuel Pump 1

Removal and Installation

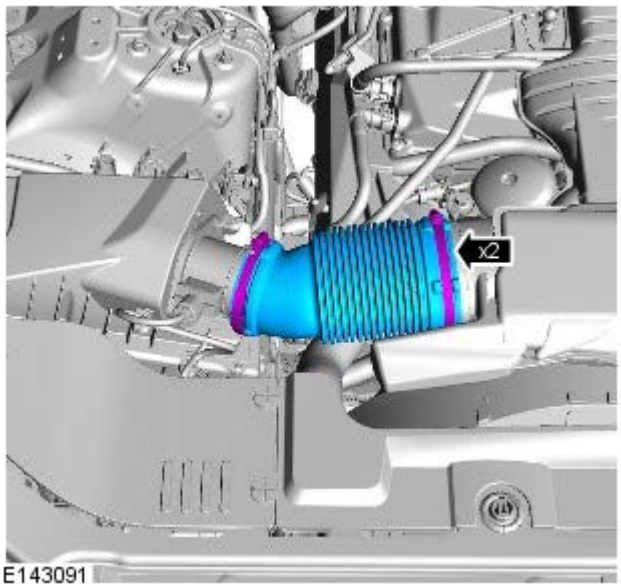
Removal

CAUTION: 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.

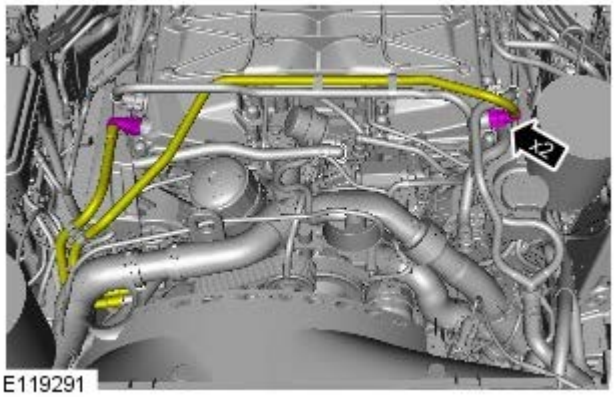
NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

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 - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (310-00 Fuel System - General Information, General Procedures).
3. Disconnect the battery ground cable.

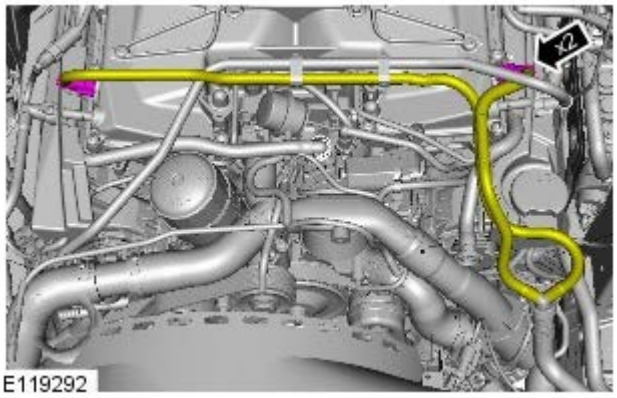
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).
4. Refer to: Engine Oil Draining and Filling (303-01B Engine - V6 S/C 3.0L Petrol, General Procedures).
5. Refer to: Fuel Injection Component Cleaning (303-04C Fuel Charging and Controls - V6 S/C 3.0L Petrol, General Procedures).
6. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12B Intake Air Distribution and Filtering - V6 S/C 3.0L Petrol, Removal and Installation).
7. *Torque:* 3.5 Nm



8. CAUTION: Be prepared to collect escaping coolant.



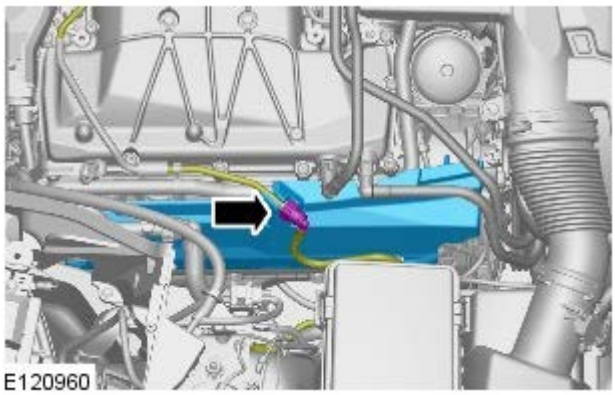
E119291



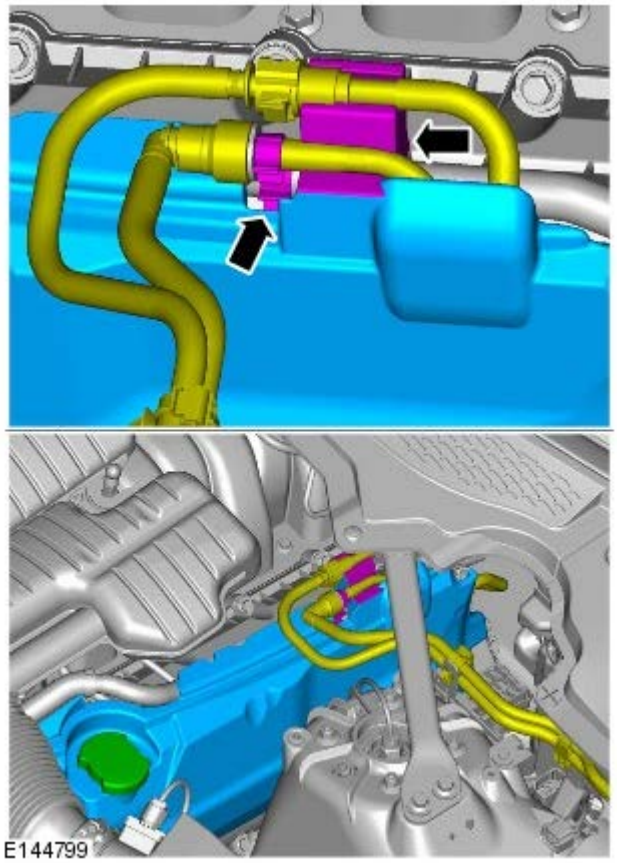
E119292

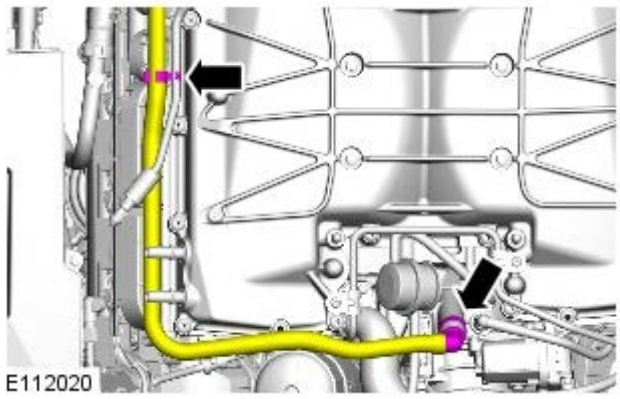
9. WARNING: Be prepared to collect escaping fluids.

10.

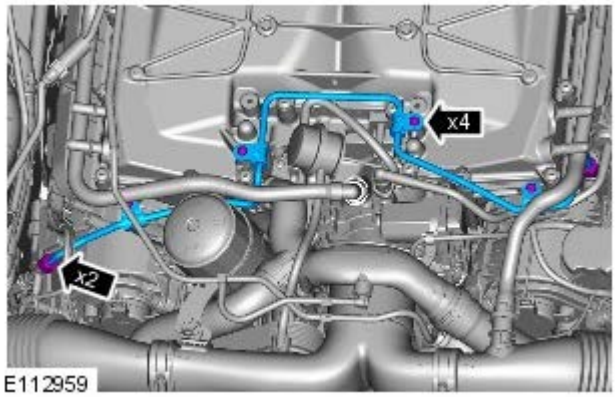

E120960

11.





12. CAUTION: Be prepared to collect escaping fluids.

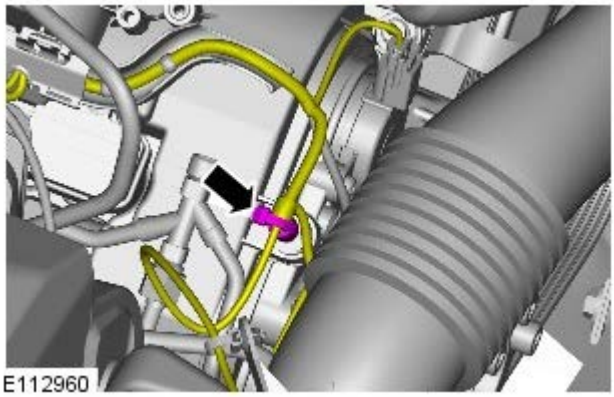


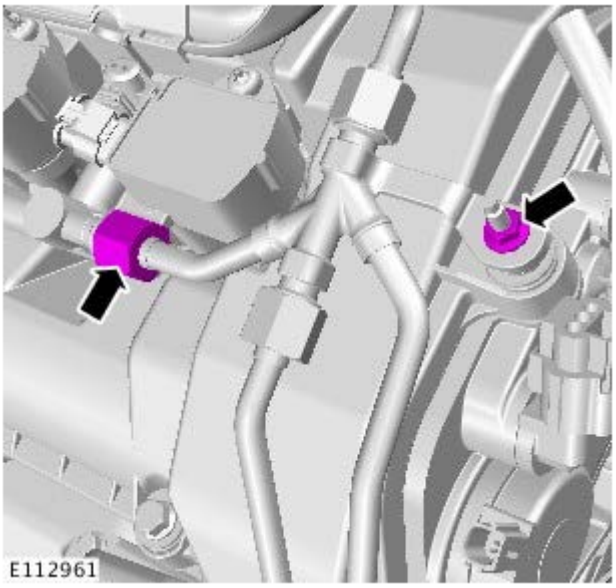
13. CAUTIONS:

Be prepared to collect escaping fluids.

Make sure that all openings are sealed. Use new blanking caps.

14.





15. CAUTIONS:

    Be prepared to collect escaping fluids.

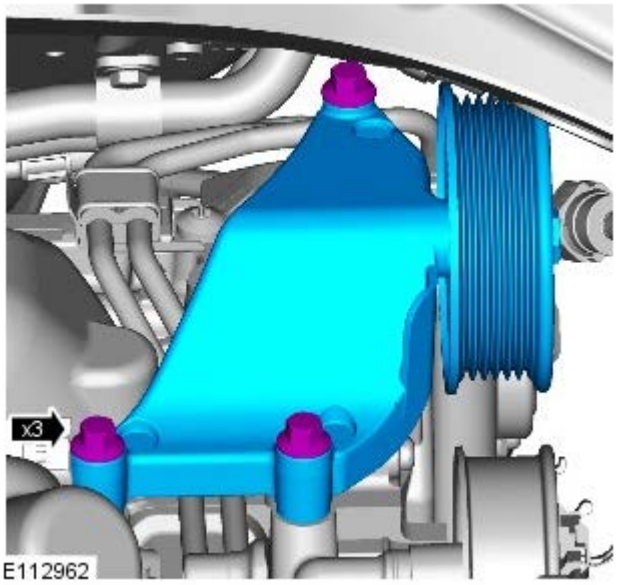
    Make sure that all openings are sealed. Use new blanking caps.

16. WARNING: Make sure to support the vehicle with axle stands.

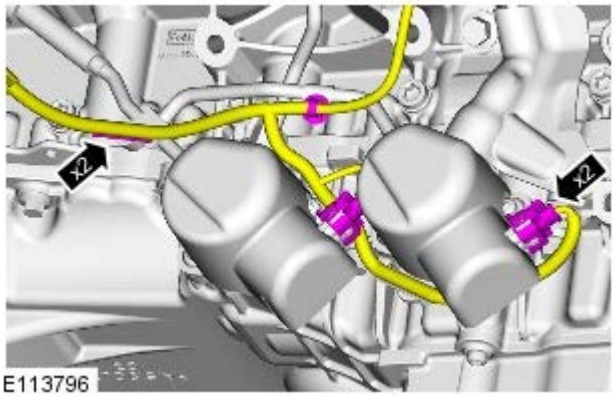
    Raise and support the vehicle.

17. Refer to: Generator (414-02B Generator and Regulator - V6 S/C 3.0L Petrol, Removal and Installation).

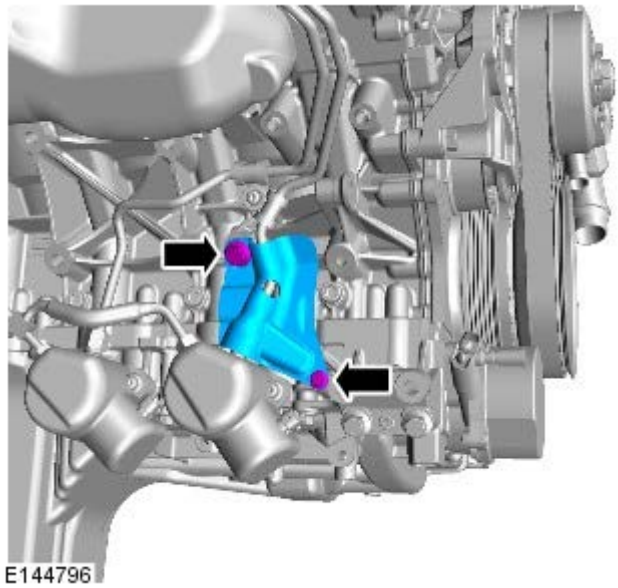
18.



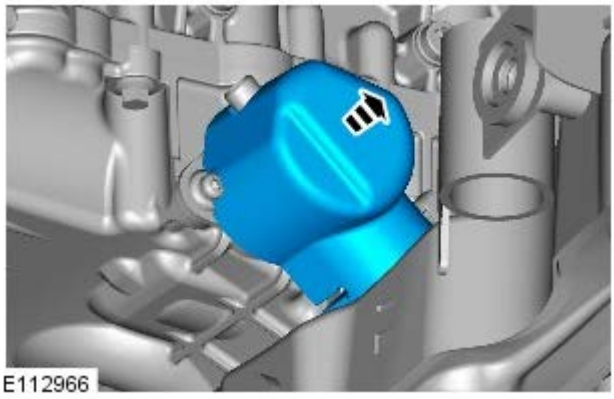
19. NOTE: Engine shown removed for clarity.



20.



21.



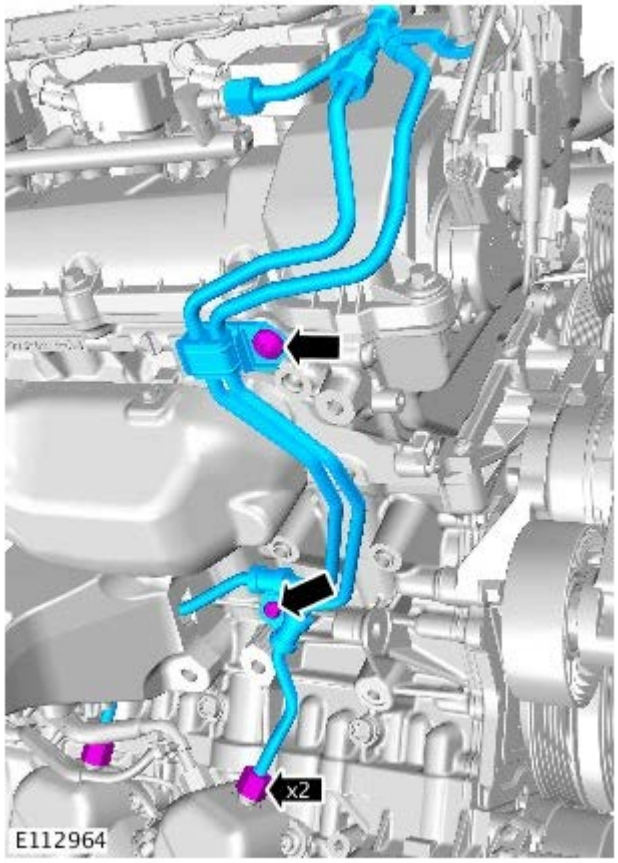
22. CAUTIONS:

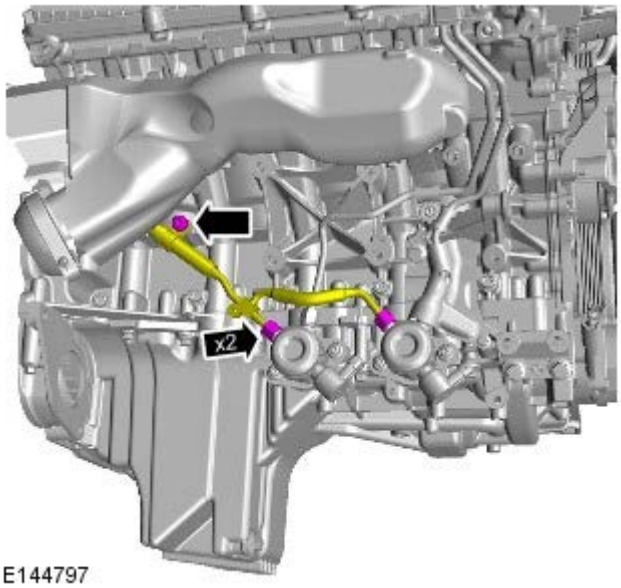
Be prepared to collect escaping fluids.

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.





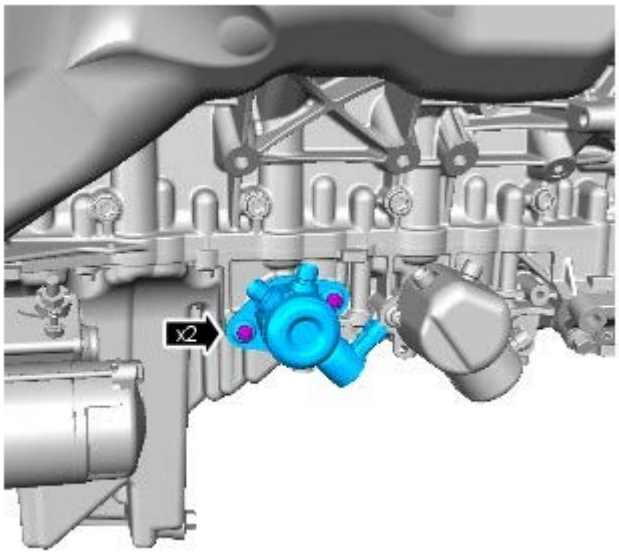
23. CAUTIONS:

    Be prepared to collect escaping fluids.

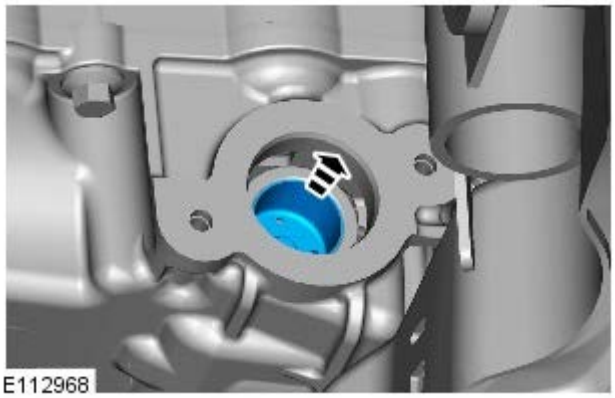
    Make sure that all openings are sealed. Use new blanking caps.

24. CAUTION: Be prepared to collect escaping fluids.

    Loosen the Torx screws a turn each at a time.

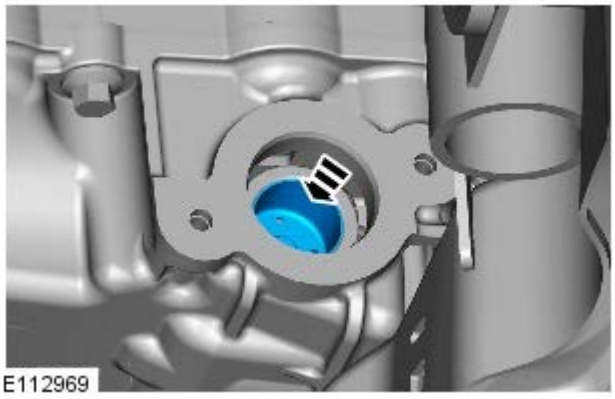


E144831


E112968

25. CAUTION: Be prepared to collect escaping fluids.

Installation

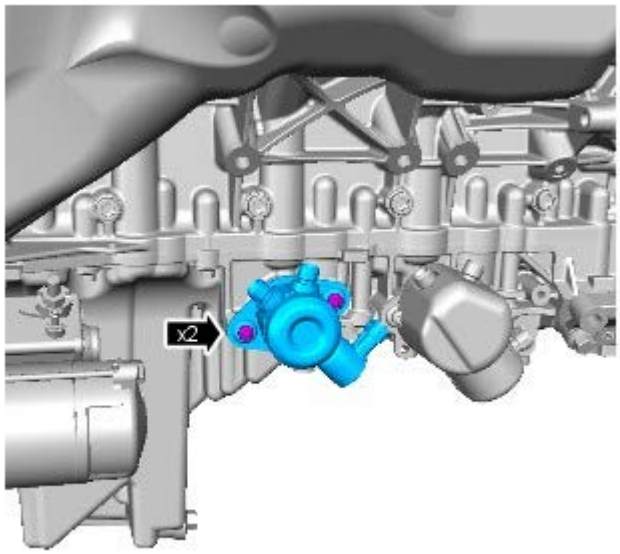

E112969

1. NOTE: Lubricate the fuel rail high-pressure fuel pump bucket with clean engine oil.

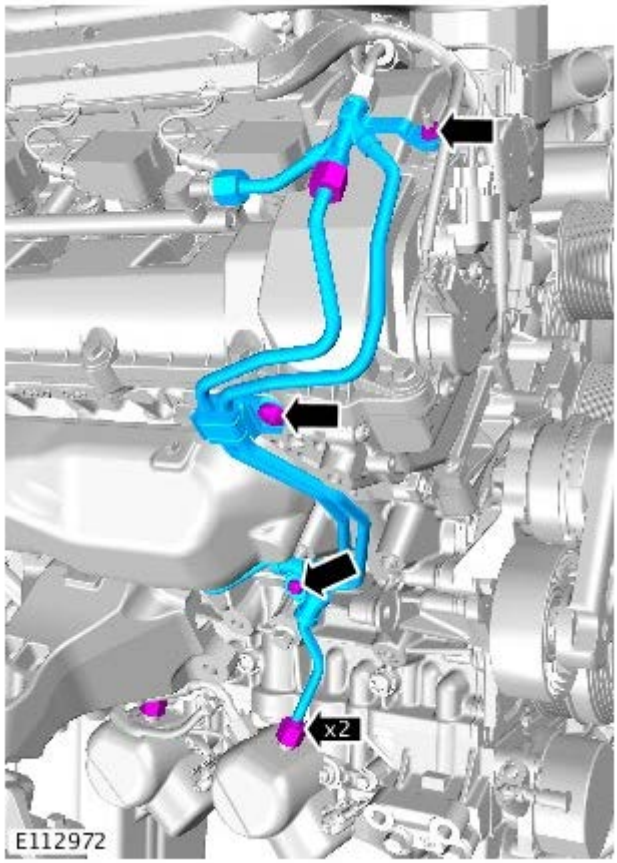
2. CAUTION: Tighten the Torx screws a turn at a time until the correct torque is achieved.

NOTE: Lubricate the fuel rail high-pressure fuel pump O-ring seal with clean engine oil.

Torque: 12 Nm



E144831



E112972

3. CAUTIONS:

Install new high-pressure fuel supply lines.

Lubricate only the union threads with clean engine oil.

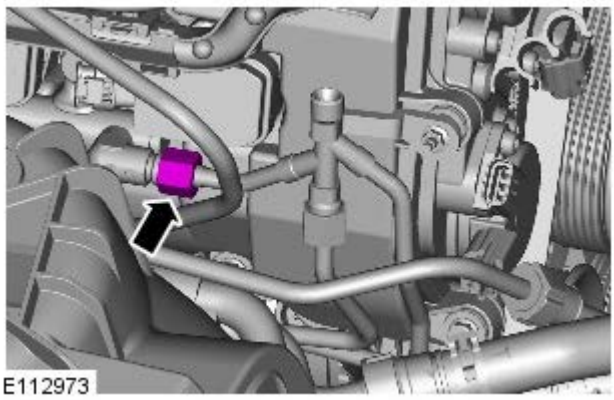
NOTES:

Remove and discard the blanking caps.

Engine shown removed for clarity.

Install the bolt and unions fully finger tight before final tightening.

4. Lower the vehicle.


E112973

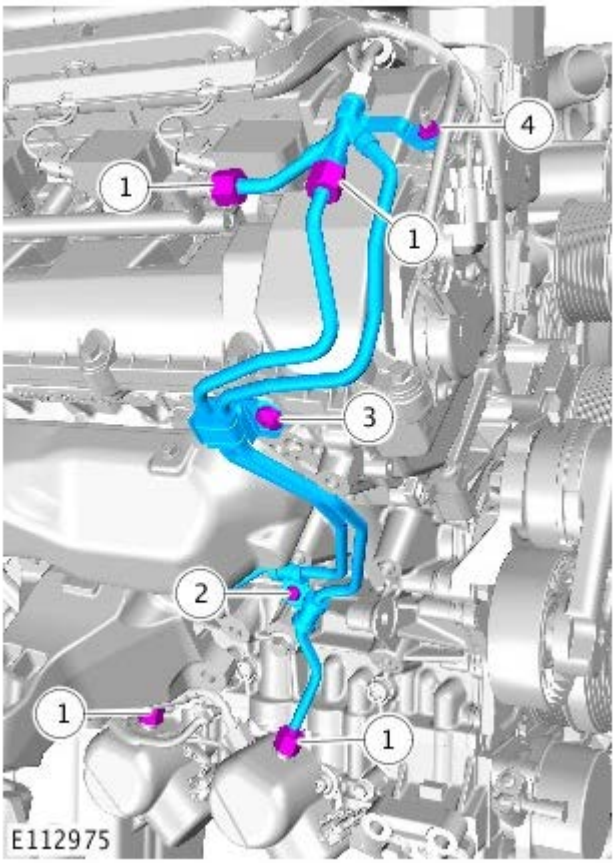
5. NOTES:

Do not tighten at this stage.

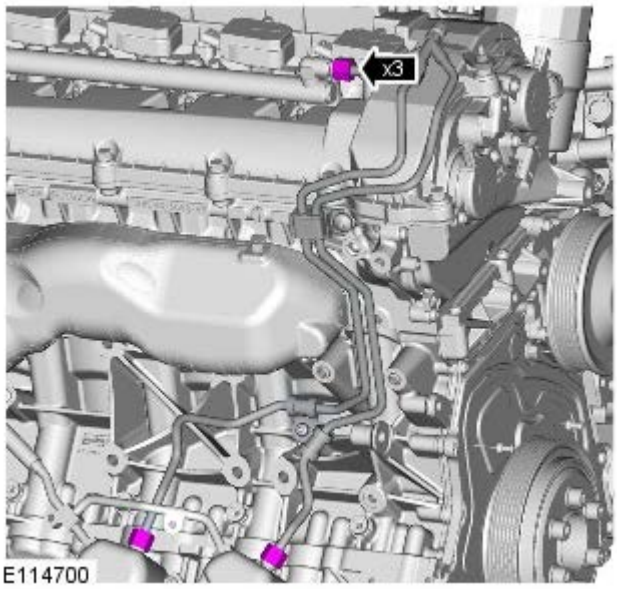
Remove and discard the blanking caps.

6. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.



7. *Torque:*
   Unions (1) 20 Nm
   M6 (2) 12 Nm
   M8 (3) 25 Nm
   M5 nut (4) 6 Nm



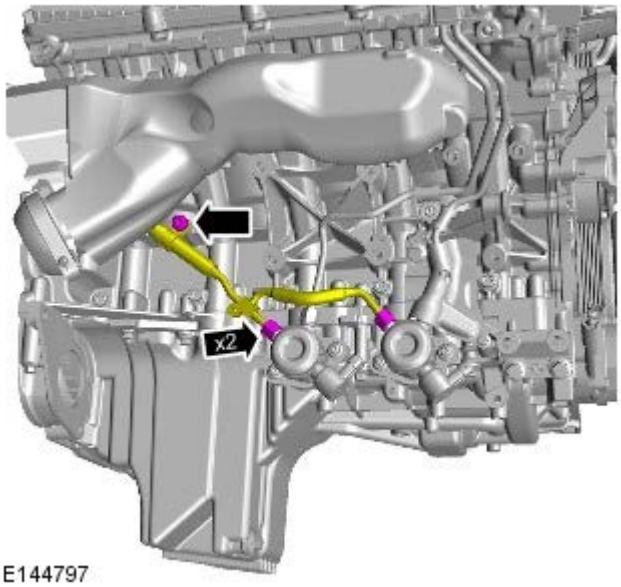
8. *Torque:* 21 Nm

9. NOTES:

   Install the bolt and unions finger tight before final tightening.

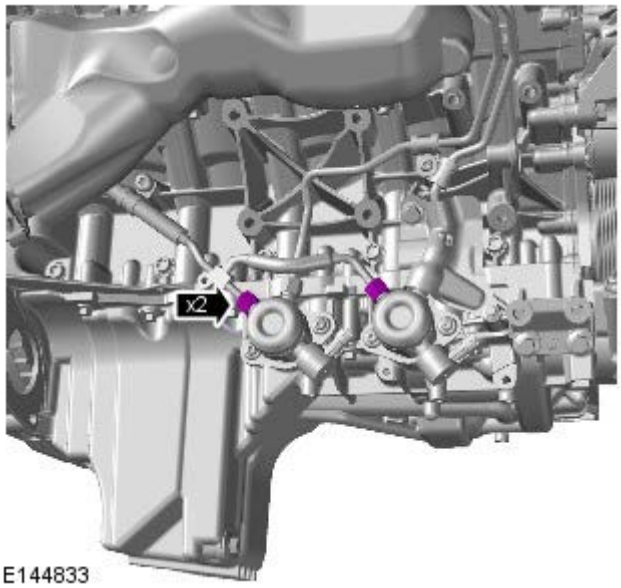
   Remove and discard the blanking caps.

   Torque:
   Unions 20 Nm
   M6 12 Nm



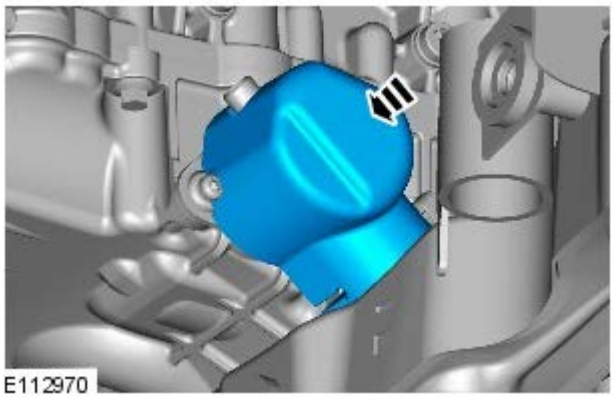
E144797

10. *Torque:* 21 Nm

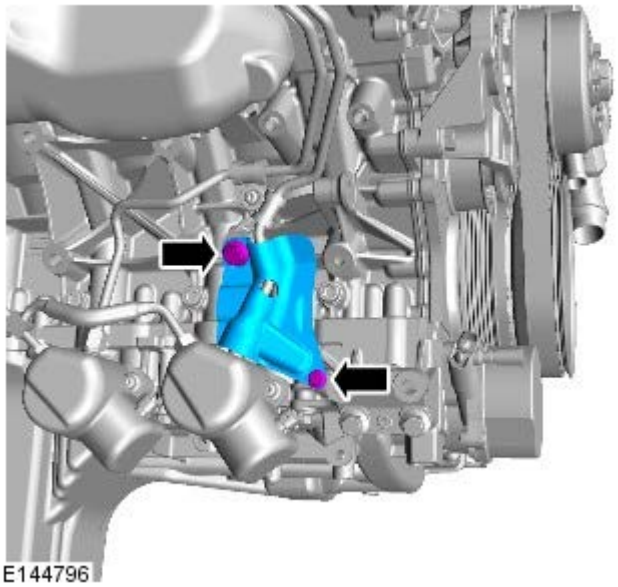


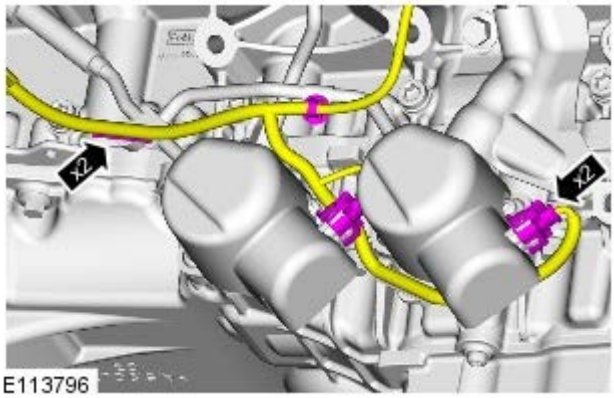
E144833

11.


E112970

12. *Torque:*
M6 12 Nm
M10 29 Nm

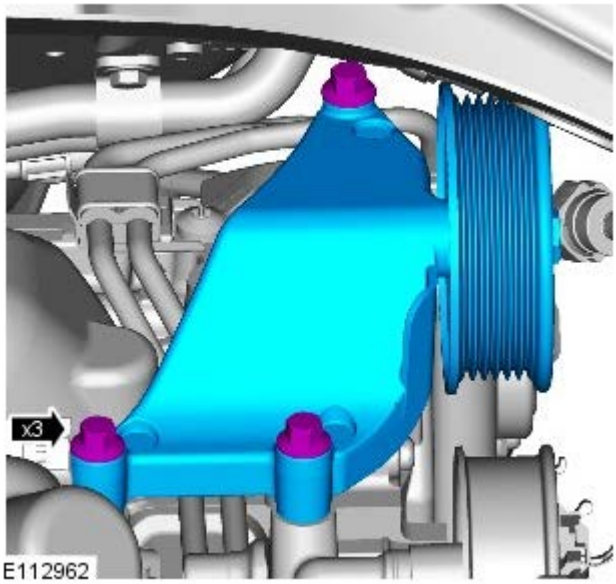

E144796



E113796

13. NOTE: Engine shown removed for clarity.

14. *Torque:* 25 Nm

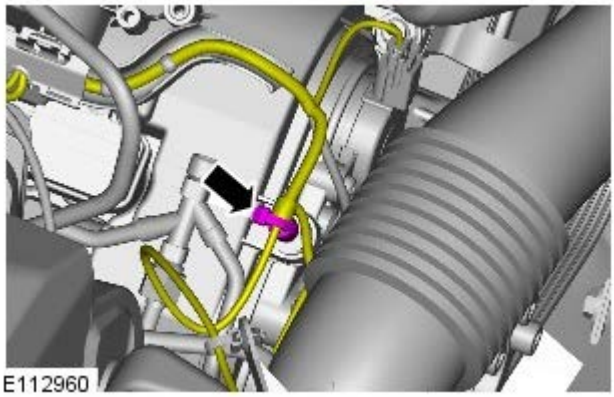


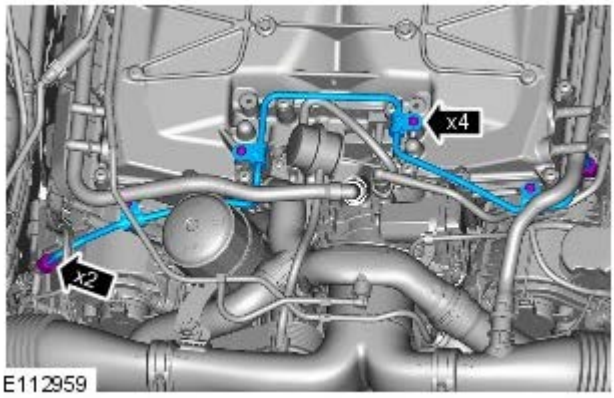
E112962

15. Refer to: Generator (414-02B Generator and Regulator - V6 S/C 3.0L Petrol, Removal and Installation).

16. Lower the vehicle.

17.


E112960



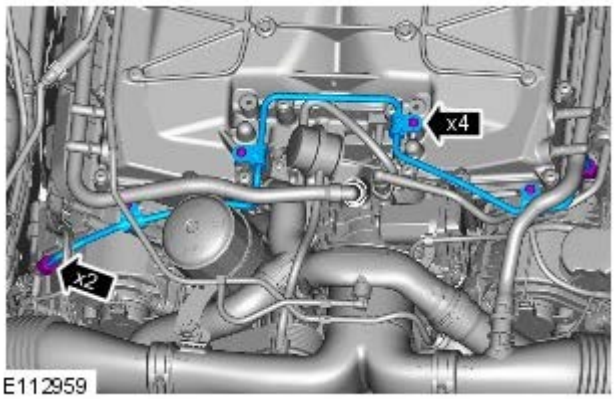
E112959

18. CAUTION: Lubricate only the union threads with clean engine oil.

    NOTES:

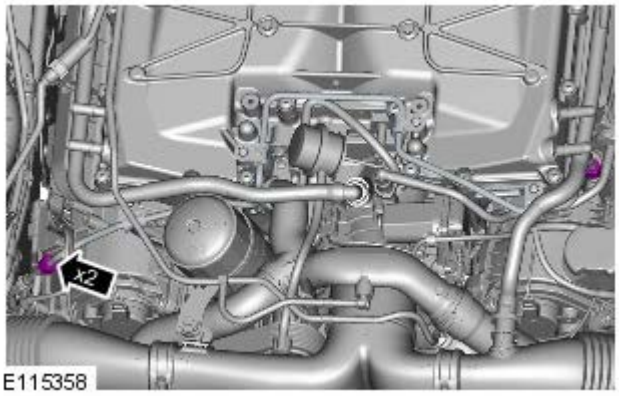
    Do not tighten at this stage.

    Remove and discard the blanking caps.



E112959

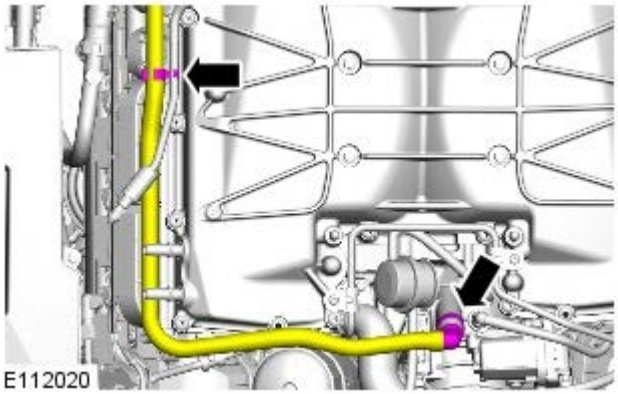
19. *Torque:*
    Unions 20 Nm
    Bolts 8 Nm



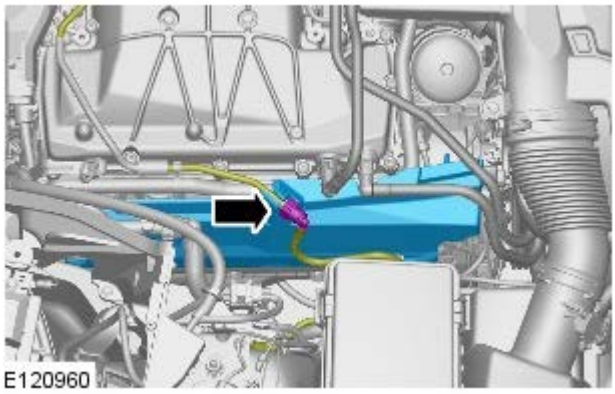
E115358

20. *Torque:* 21 Nm

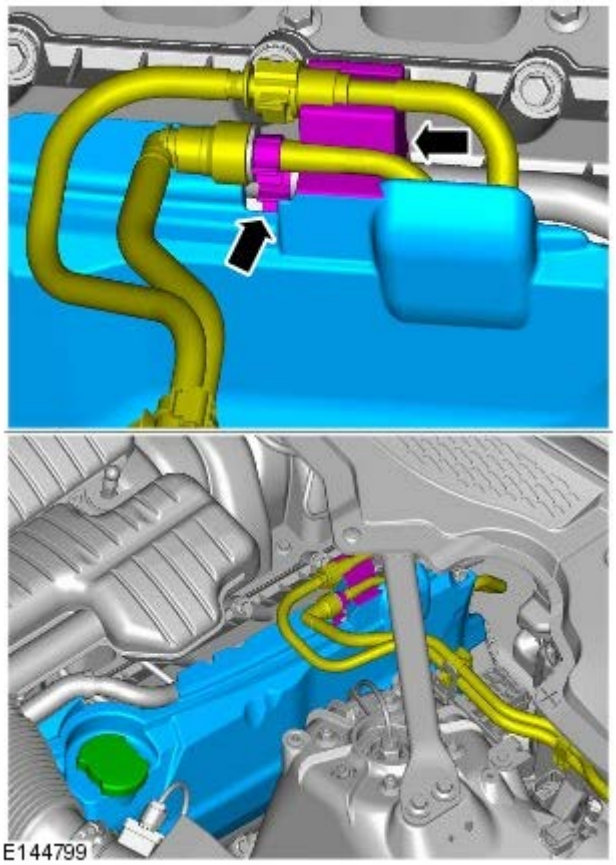
21.



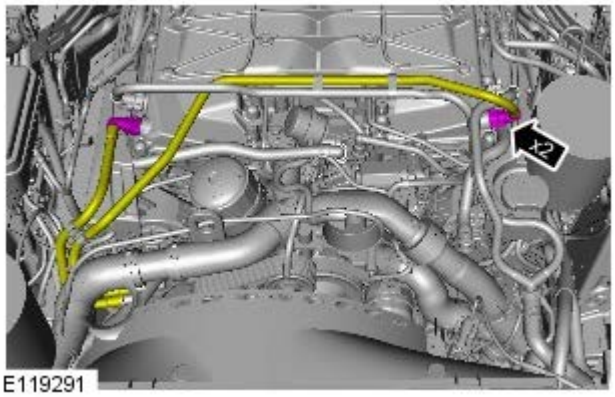
22.



23.

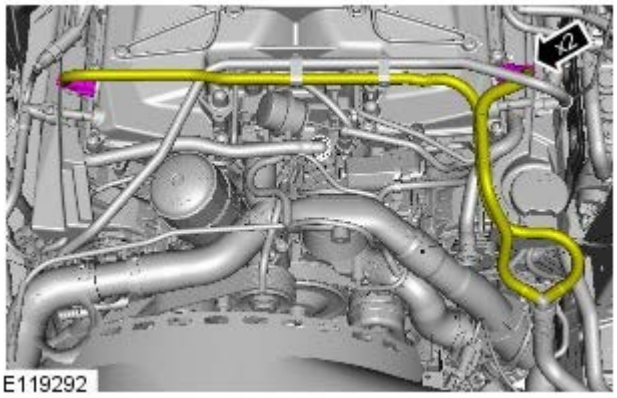


24. CAUTION: Be prepared to collect escaping coolant.



E119291

25.



E119292

26. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12B Intake Air Distribution and Filtering - V6 S/C 3.0L Petrol, Removal and Installation).

27. Refer to: Engine Oil Draining and Filling (303-01B Engine - V6 S/C 3.0L Petrol, General Procedures).

28. Connect the battery ground cable.

    Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 02-May-2013

Fuel Charging and Controls - V6 S/C 3.0L Petrol - High Pressure Fuel Pump 2

Removal and Installation

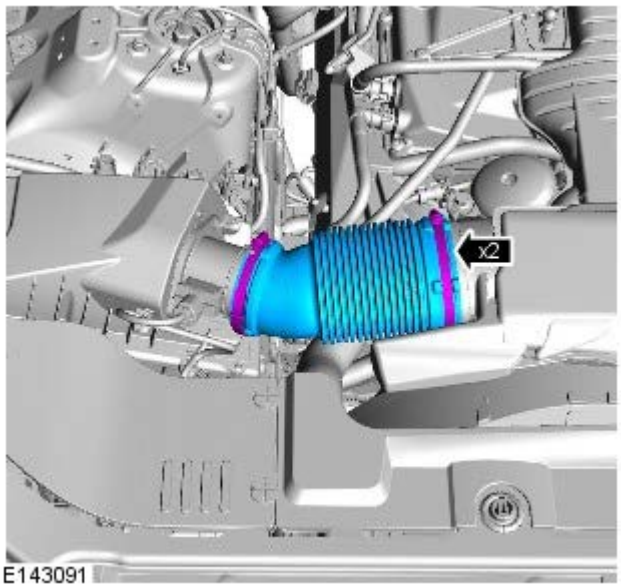
Removal

CAUTION: 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.

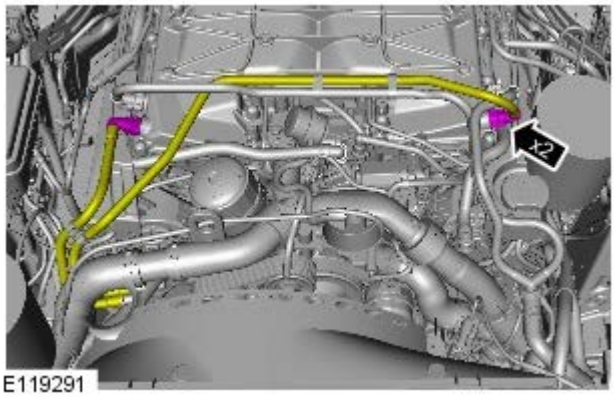
NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

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 - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (310-00 Fuel System - General Information, General Procedures).
3. Disconnect the battery ground cable.

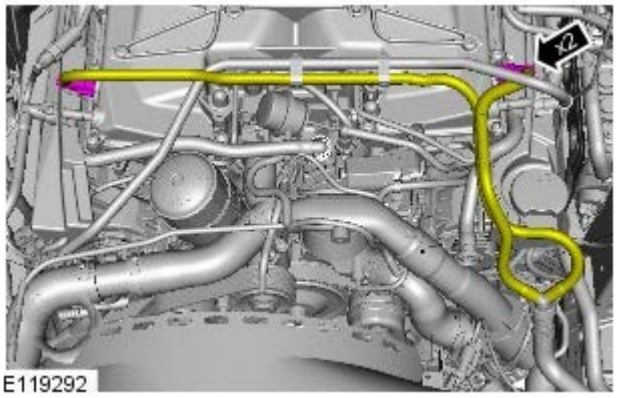
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).
4. Refer to: Engine Oil Draining and Filling (303-01B Engine - V6 S/C 3.0L Petrol, General Procedures).
5. Refer to: Fuel Injection Component Cleaning (303-04C Fuel Charging and Controls - V6 S/C 3.0L Petrol, General Procedures).
6. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12B Intake Air Distribution and Filtering - V6 S/C 3.0L Petrol, Removal and Installation).
7. *Torque:* 3.5 Nm



8. CAUTION: Be prepared to collect escaping coolant.

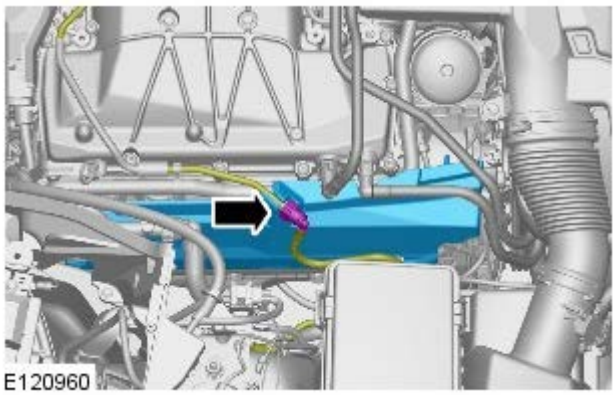


E119291



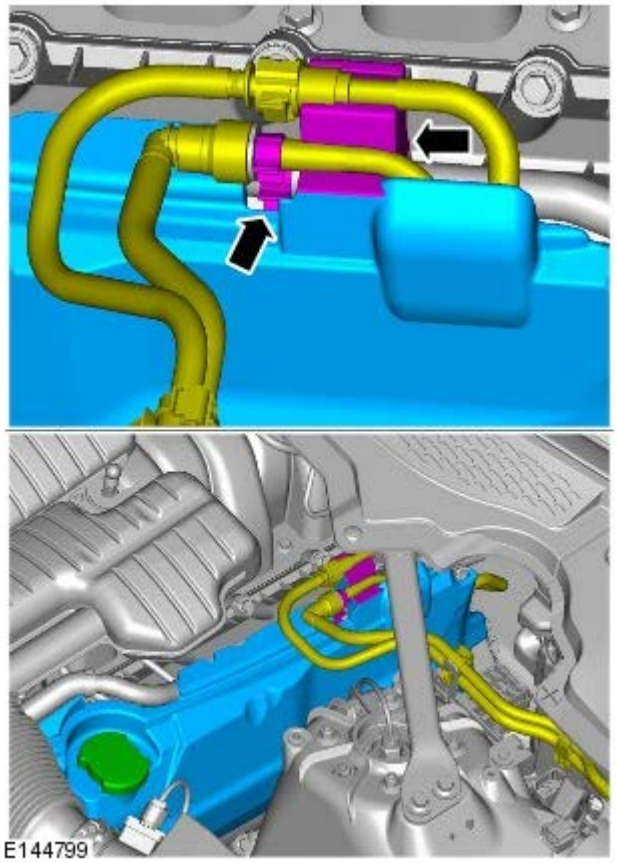
E119292

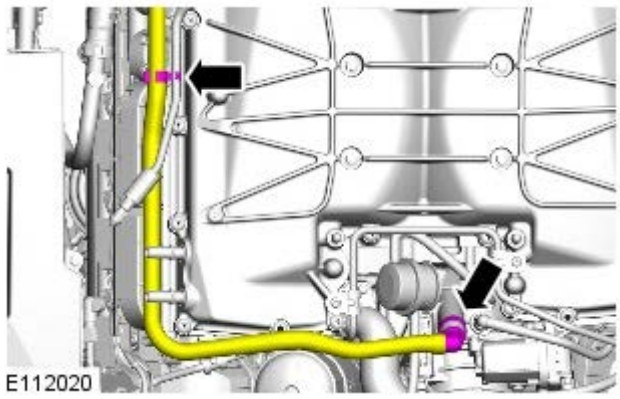
9. WARNING: Be prepared to collect escaping fluids.


E120960

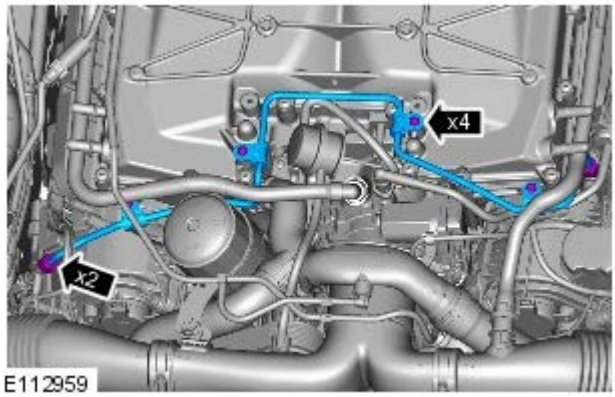
10. CAUTION: Be prepared to collect escaping fluids.

11.





12. CAUTION: Be prepared to collect escaping fluids.

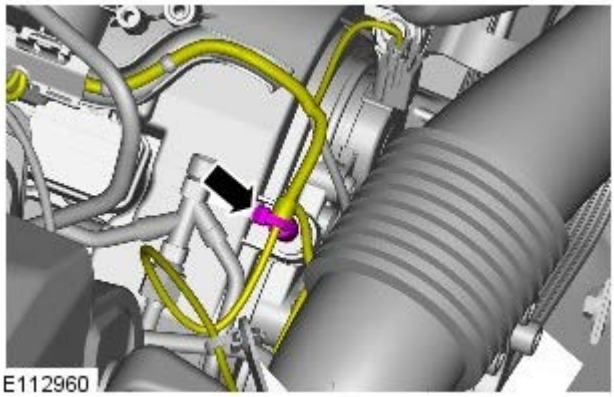


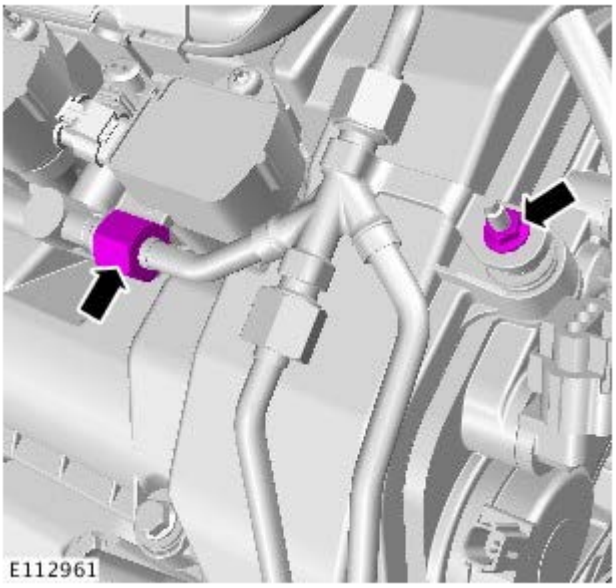
13. CAUTIONS:

Be prepared to collect escaping fluids.

Make sure that all openings are sealed. Use new blanking caps.

14.





15. CAUTIONS:

    Be prepared to collect escaping fluids.

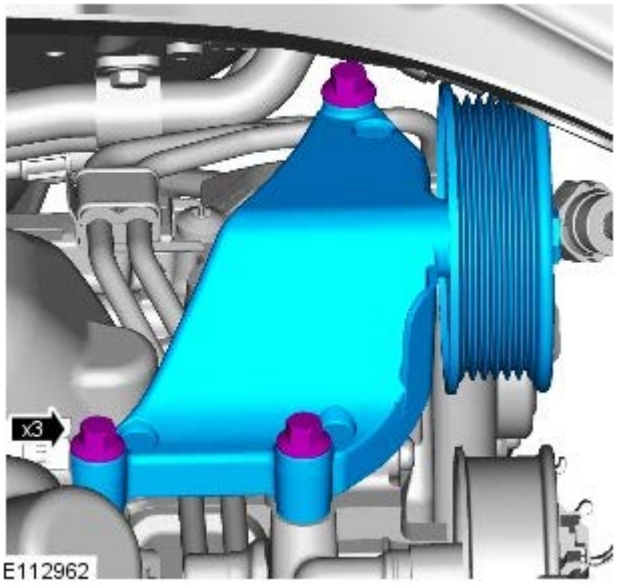
    Make sure that all openings are sealed. Use new blanking caps.

16. WARNING: Make sure to support the vehicle with axle stands.

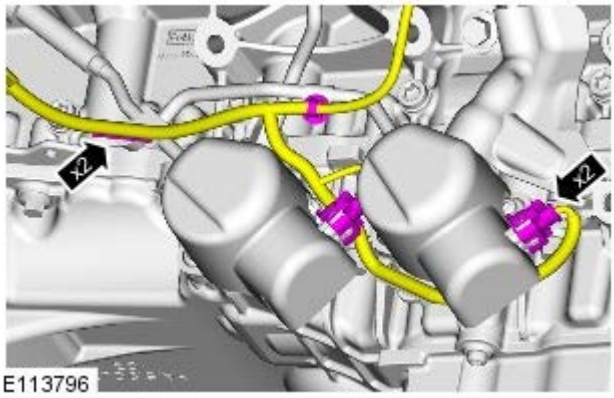
    Raise and support the vehicle.

17. Refer to: Generator (414-02B Generator and Regulator - V6 S/C 3.0L Petrol, Removal and Installation).

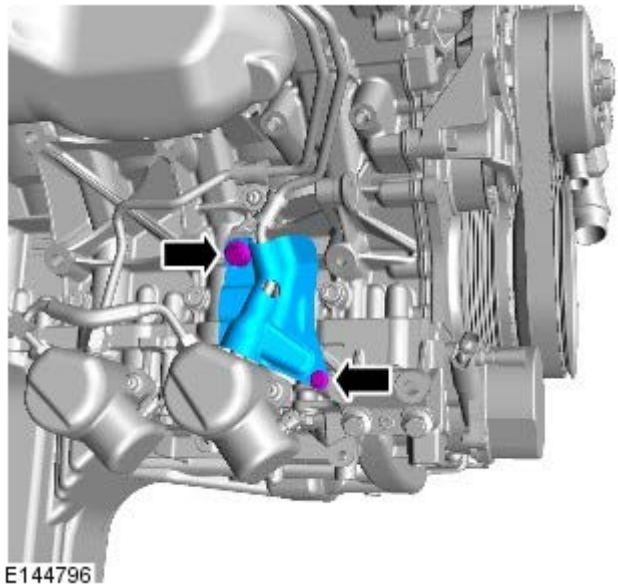
18.



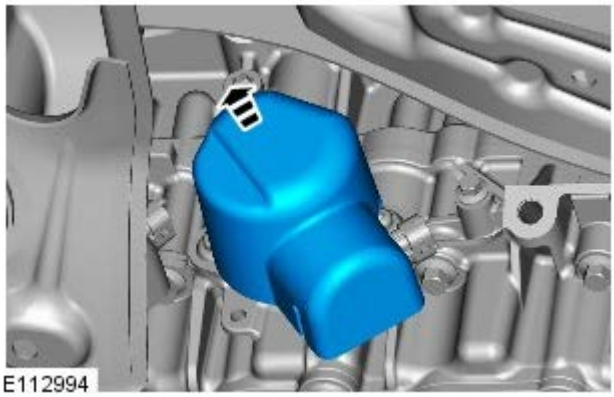
19. NOTE: Engine shown removed for clarity.



20.



21.



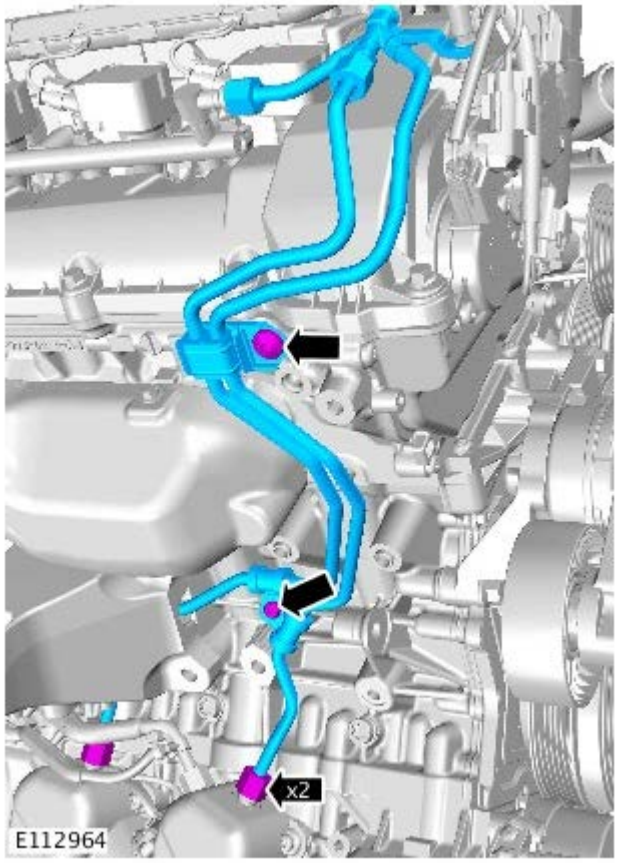
22. CAUTIONS:

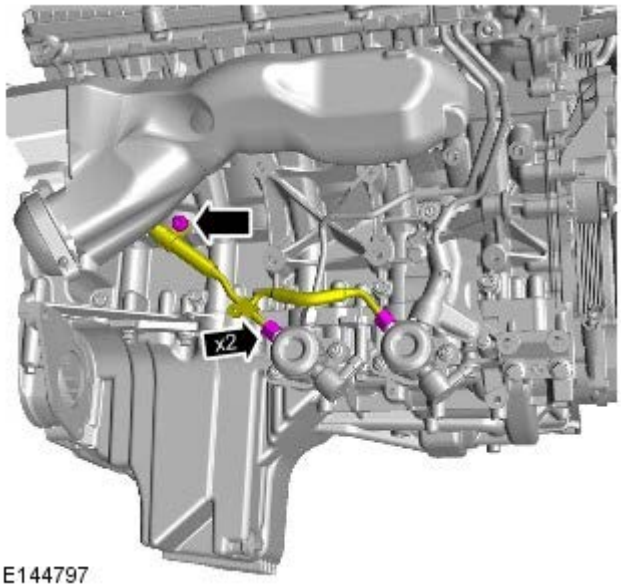
Be prepared to collect escaping fluids.

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.





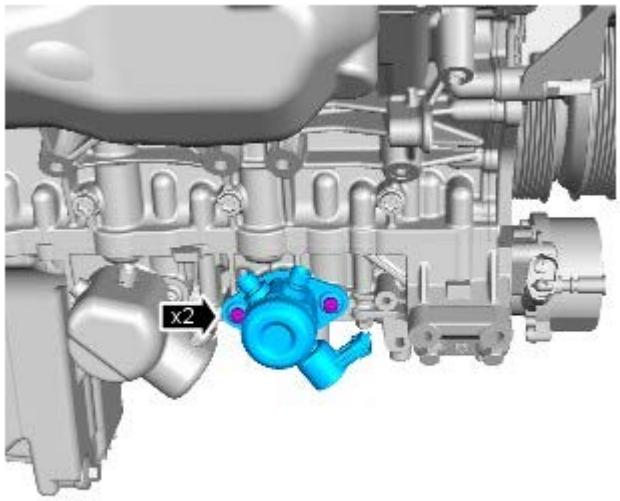
23. CAUTIONS:

    Be prepared to collect escaping fluids.

    Make sure that all openings are sealed. Use new blanking caps.

24. CAUTION: Be prepared to collect escaping fluids.

    Loosen the Torx screws a turn each at a time.



E144830



E112996

25. CAUTION: Be prepared to collect escaping fluids.

Installation

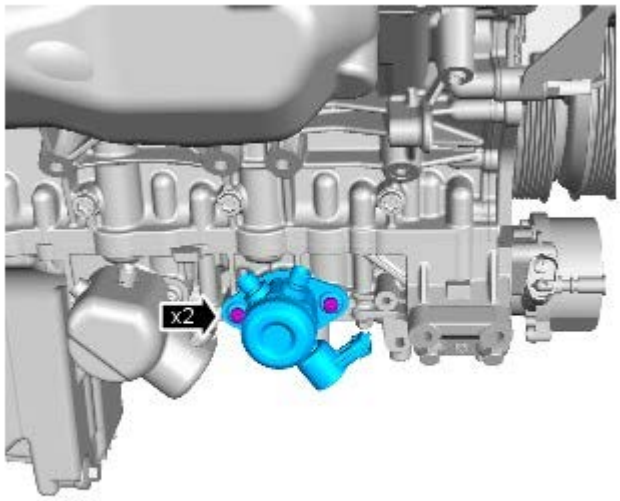


E112997

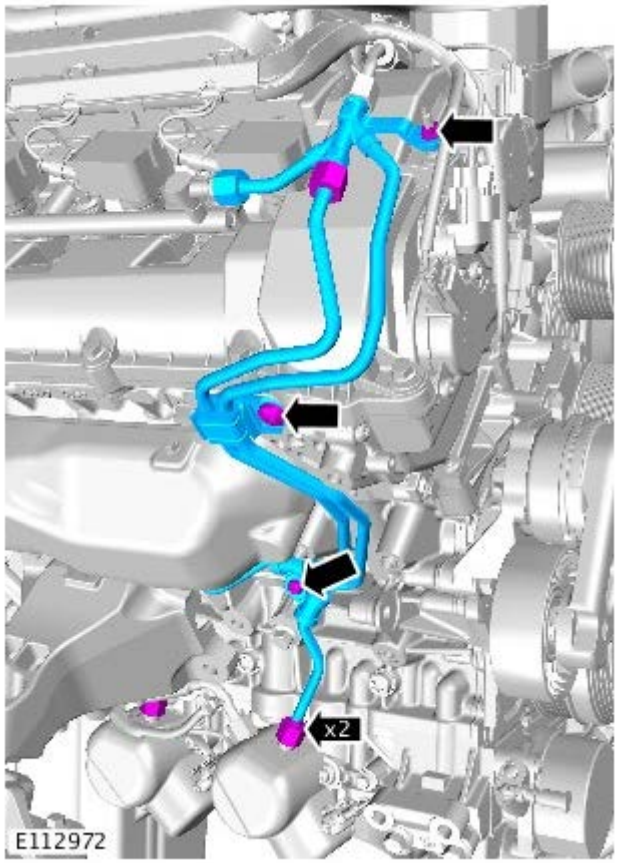
1. NOTE: Lubricate the fuel rail high-pressure fuel pump bucket with clean engine oil.

2. CAUTION: Be prepared to collect escaping fluids.

   Torque: 12 Nm



E144830



3. CAUTIONS:

Install new high-pressure fuel supply lines.

Lubricate only the union threads with clean engine oil.

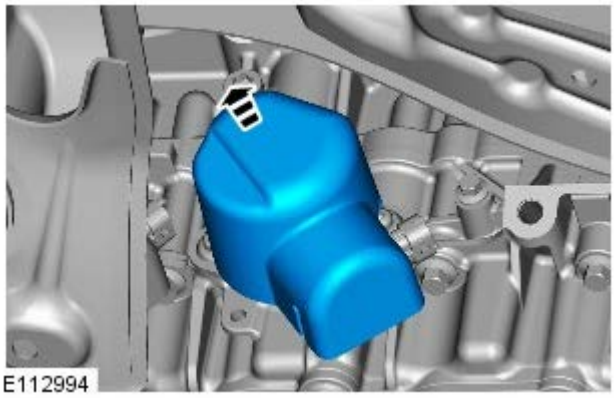
NOTES:

Remove and discard the blanking caps.

Engine shown removed for clarity.

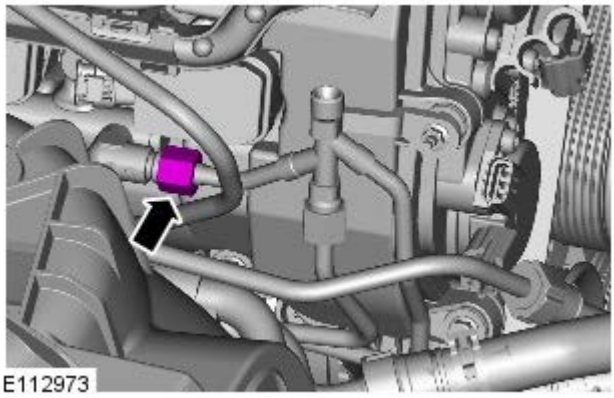
Install the bolt and unions fully finger tight before final tightening.

4.



5. Lower the vehicle.

6. NOTES:

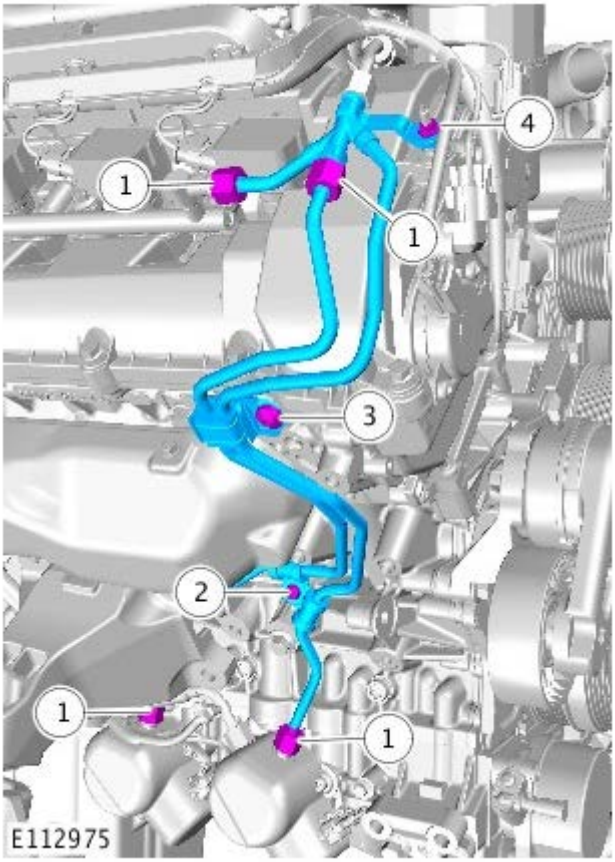


Do not tighten at this stage.

Remove and discard the blanking caps.

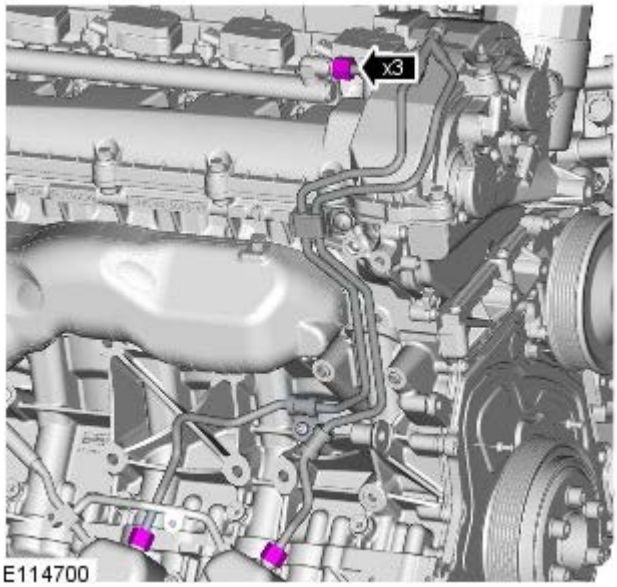
7. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

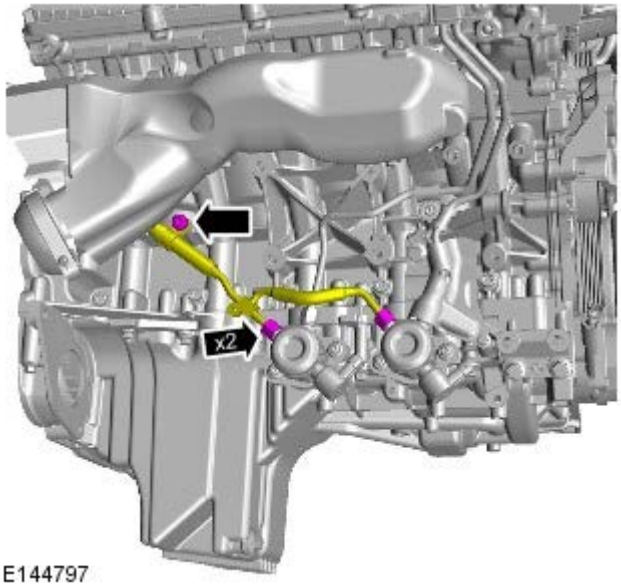


8. *Torque:*
   Unions (1) 20 Nm
   M6 (2) 12 Nm
   M8 (3) 25 Nm
   M5 nut (4) 6 Nm

9. *Torque:* 21 Nm



E114700



E144797

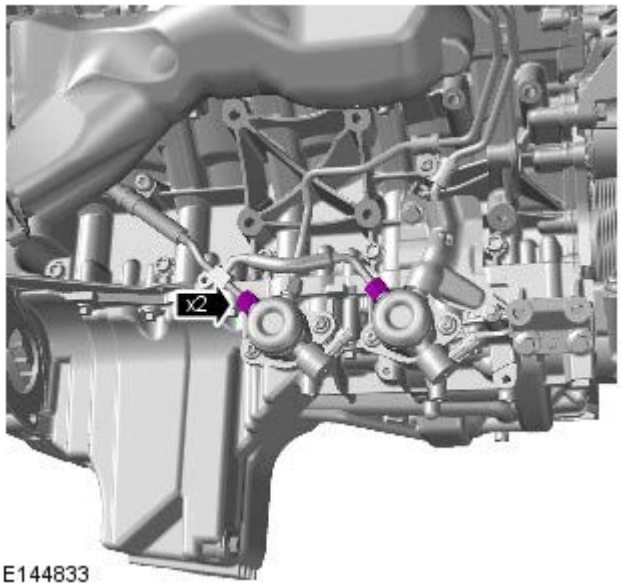
10. NOTES:

⚠ Install the bolt and unions finger tight before final tightening.

⚠ Remove and discard the blanking caps.

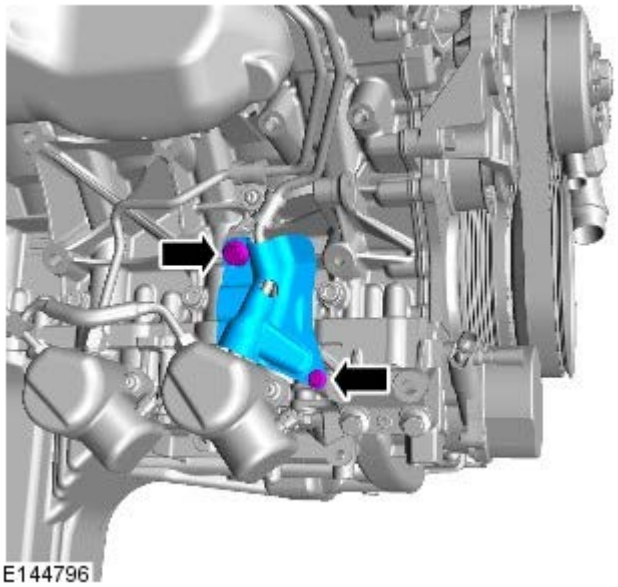
Torque:
Unions 20 Nm
M6 12 Nm

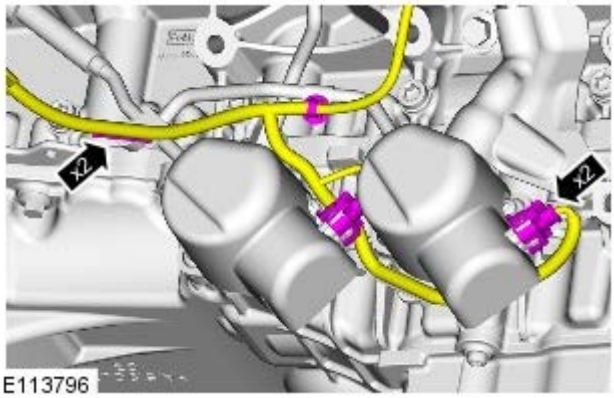
11. *Torque:* 21 Nm



E144833

12. *Torque:*
M6 12 Nm
M10 29 Nm

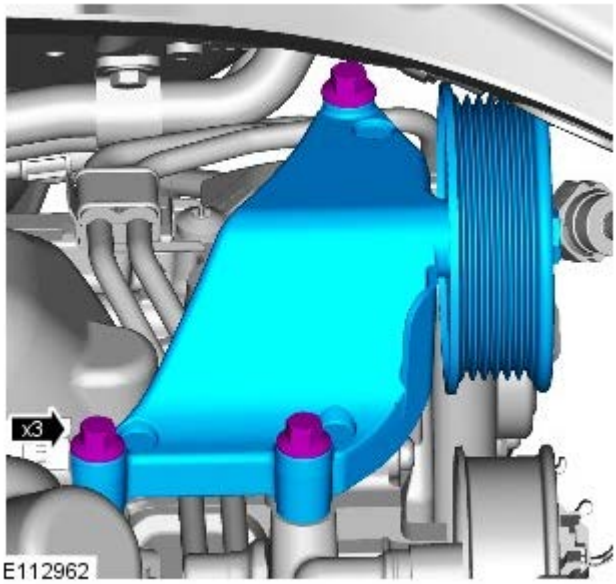

E144796



E113796

13. NOTE: Engine shown removed for clarity.

14. *Torque:* 25 Nm

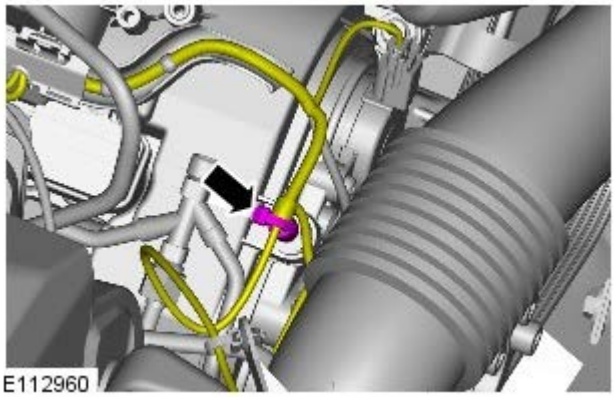


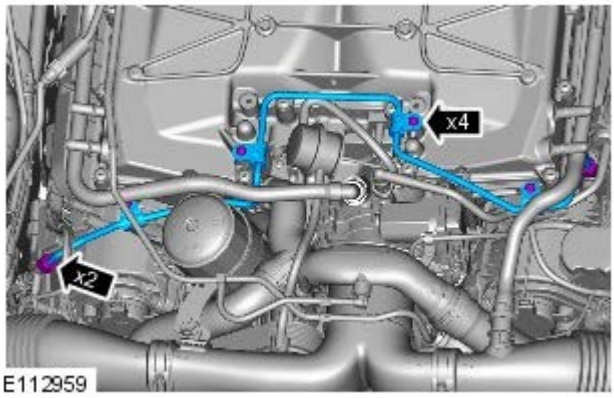
E112962

15. Refer to: Generator (414-02B Generator and Regulator - V6 S/C 3.0L Petrol, Removal and Installation).

16. Lower the vehicle.

17.


E112960



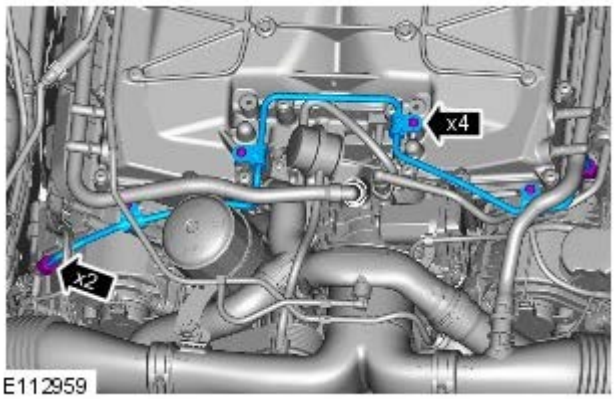
E112959

18. CAUTION: Lubricate only the union threads with clean engine oil.

    NOTES:

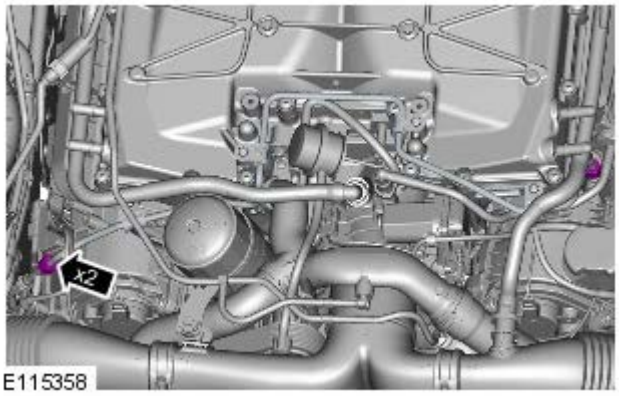
    Do not tighten at this stage.

    Remove and discard the blanking caps.



E112959

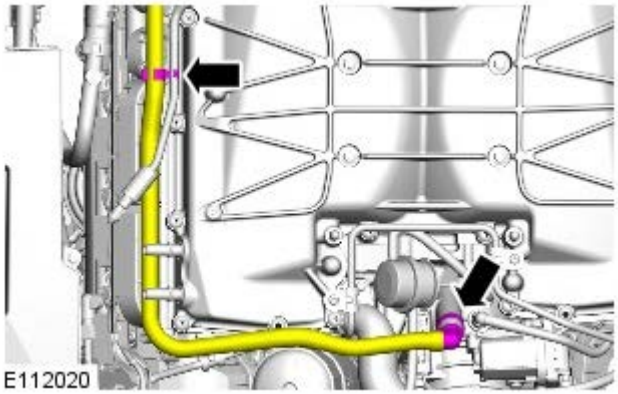
19. *Torque:*
    Unions 20 Nm
    Bolts 8 Nm



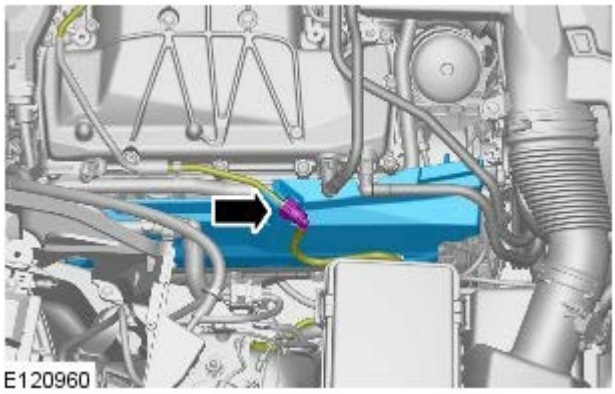
E115358

20. *Torque:* 21 Nm

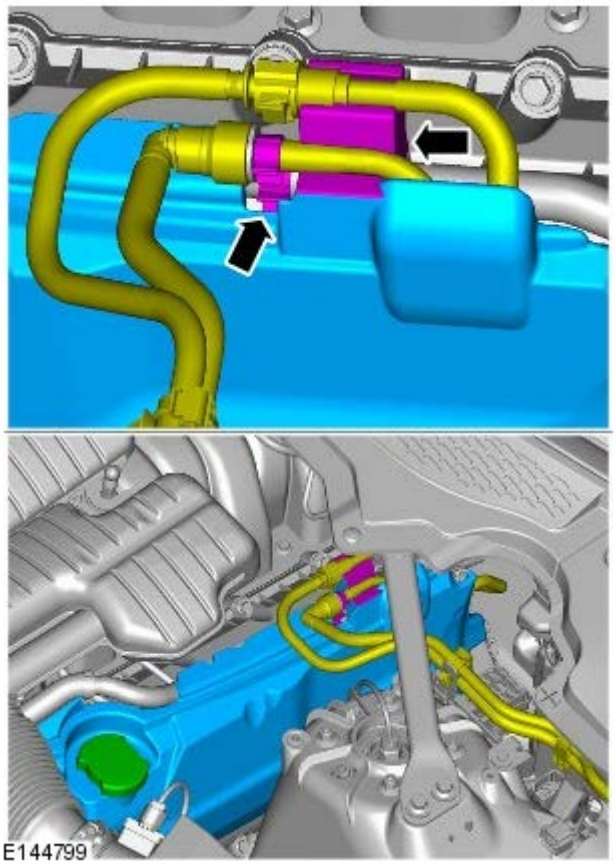
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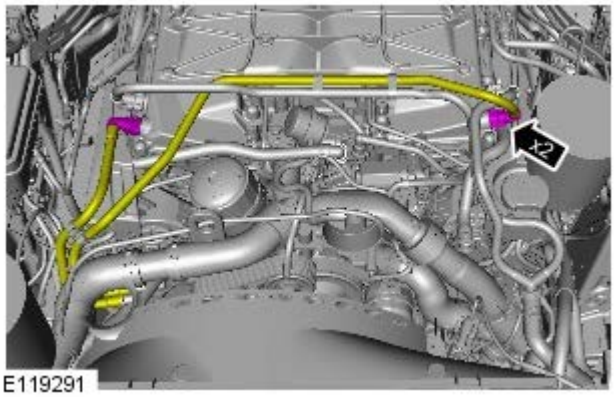
22.



23.

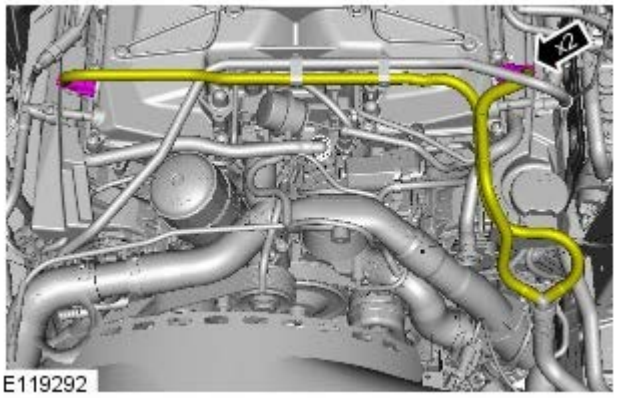


24. CAUTION: Be prepared to collect escaping coolant.



E119291

25.



E119292

26. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12B Intake Air Distribution and Filtering - V6 S/C 3.0L Petrol, Removal and Installation).

27. Refer to: Engine Oil Draining and Filling (303-01B Engine - V6 S/C 3.0L Petrol, General Procedures).

28. Connect the battery ground cable.

    Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 02-May-2013

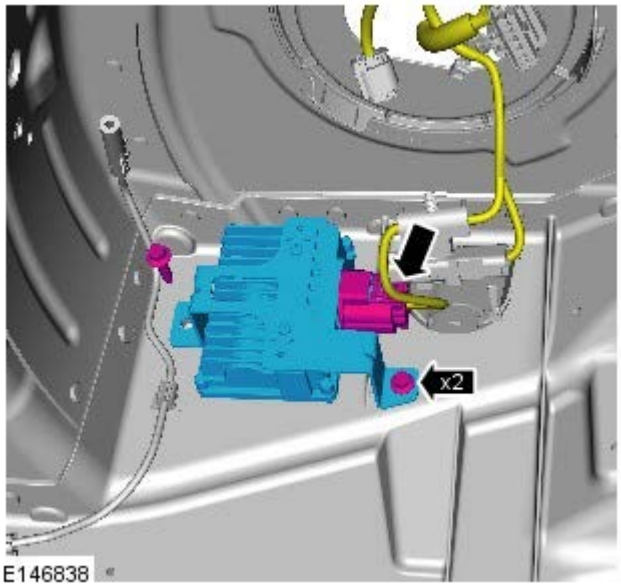
Fuel Charging and Controls - V6 S/C 3.0L Petrol - Fuel Pump Driver Module (FPDM)

Removal and Installation

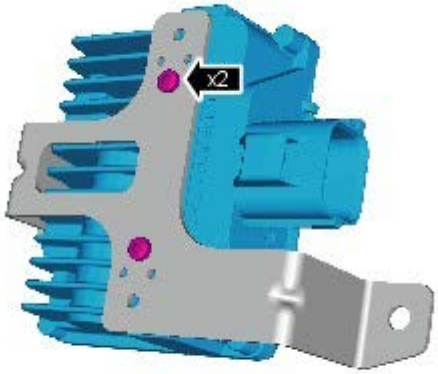
Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Fuel Tank (310-01B, Removal and Installation).
2. *Torque:* 10 Nm



3. *Torque:* 3 Nm



Installation

1. NOTE: If a new component has been installed, configure using Land Rover approved diagnostic equipment.

   To install, reverse the removal procedure.

Published: 02-May-2013

Fuel Charging and Controls - V6 S/C 3.0L Petrol - Throttle Body

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

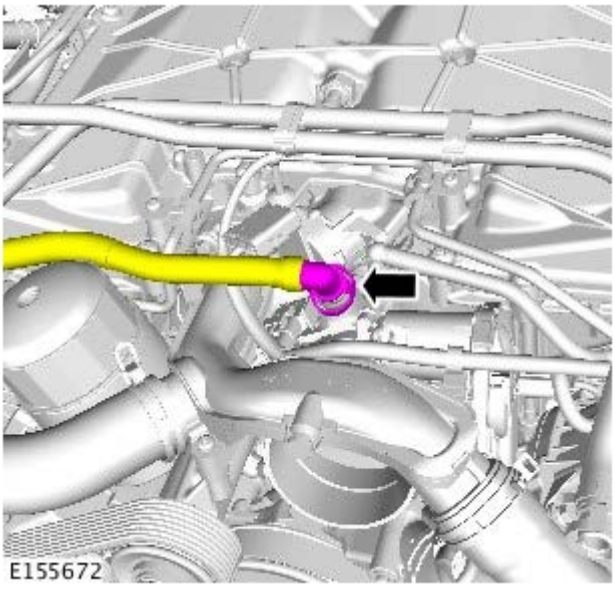
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

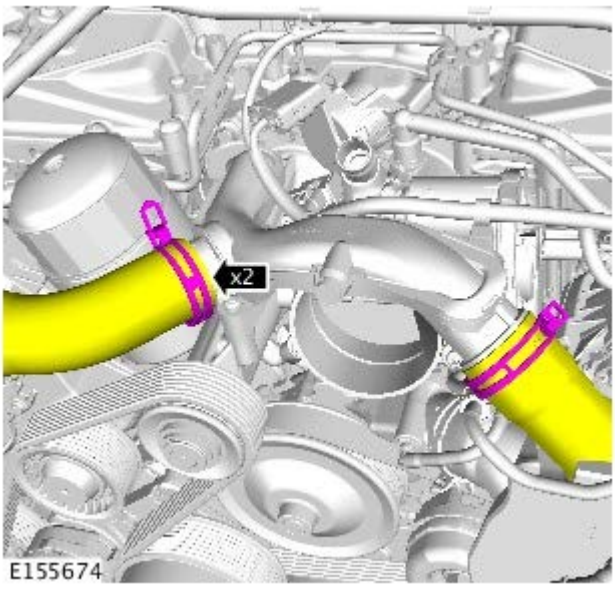
   Raise and support the vehicle.

3. Refer to: Cooling System Partial Draining, Filling and Bleeding - V8 S/C 5.0L Petrol (303-03C Engine Cooling - V8 S/C 5.0L Petrol, General Procedures).
   Refer to: Cooling System Partial Draining, Filling and Bleeding - V8 S/C 5.0L Petrol (303-03C Engine Cooling - V8 S/C 5.0L Petrol, General Procedures).

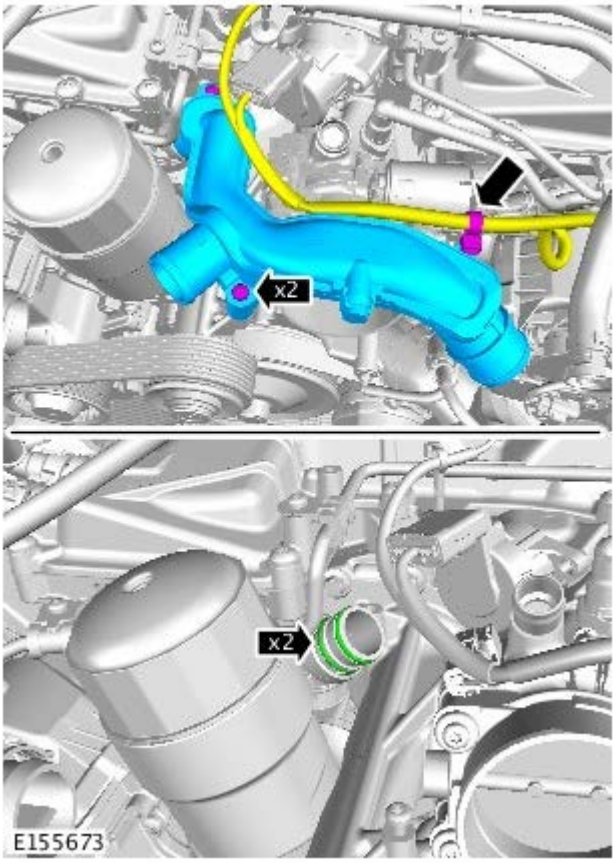
4.



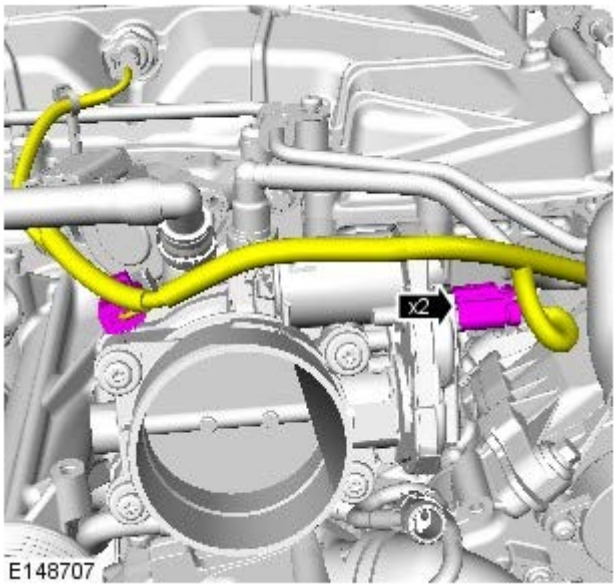
5.



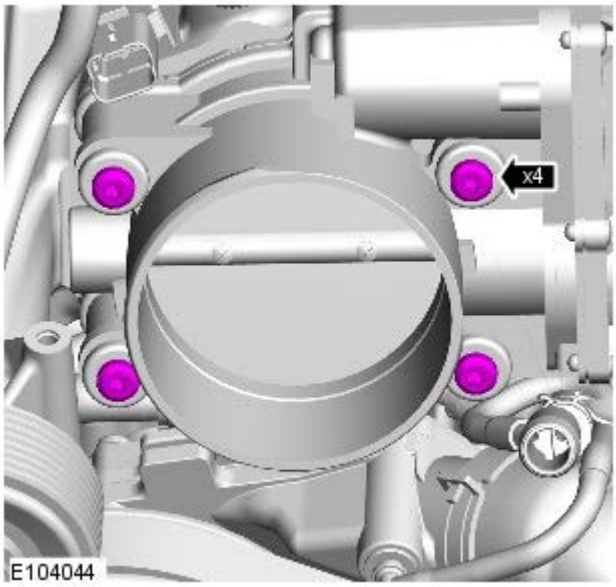
6. *Torque:* 10 Nm

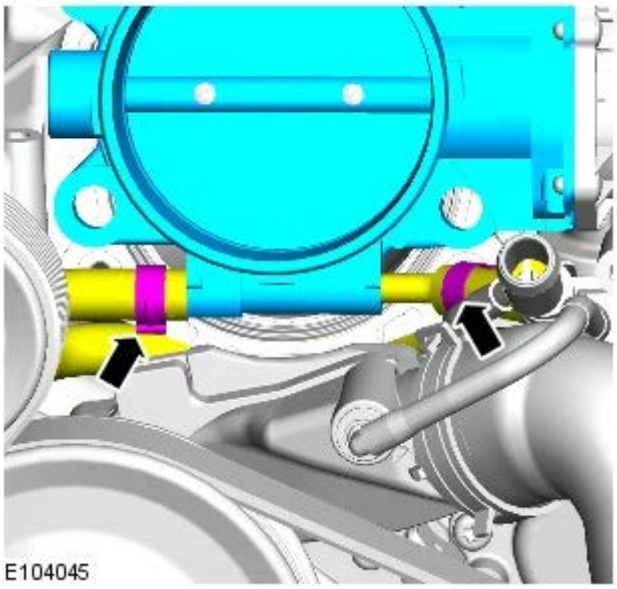


7.



8. *Torque:* 10 Nm





9. 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: 23-Aug-2012

Fuel Charging and Controls - V8 S/C 5.0L Petrol -

Torque Specifications

 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.

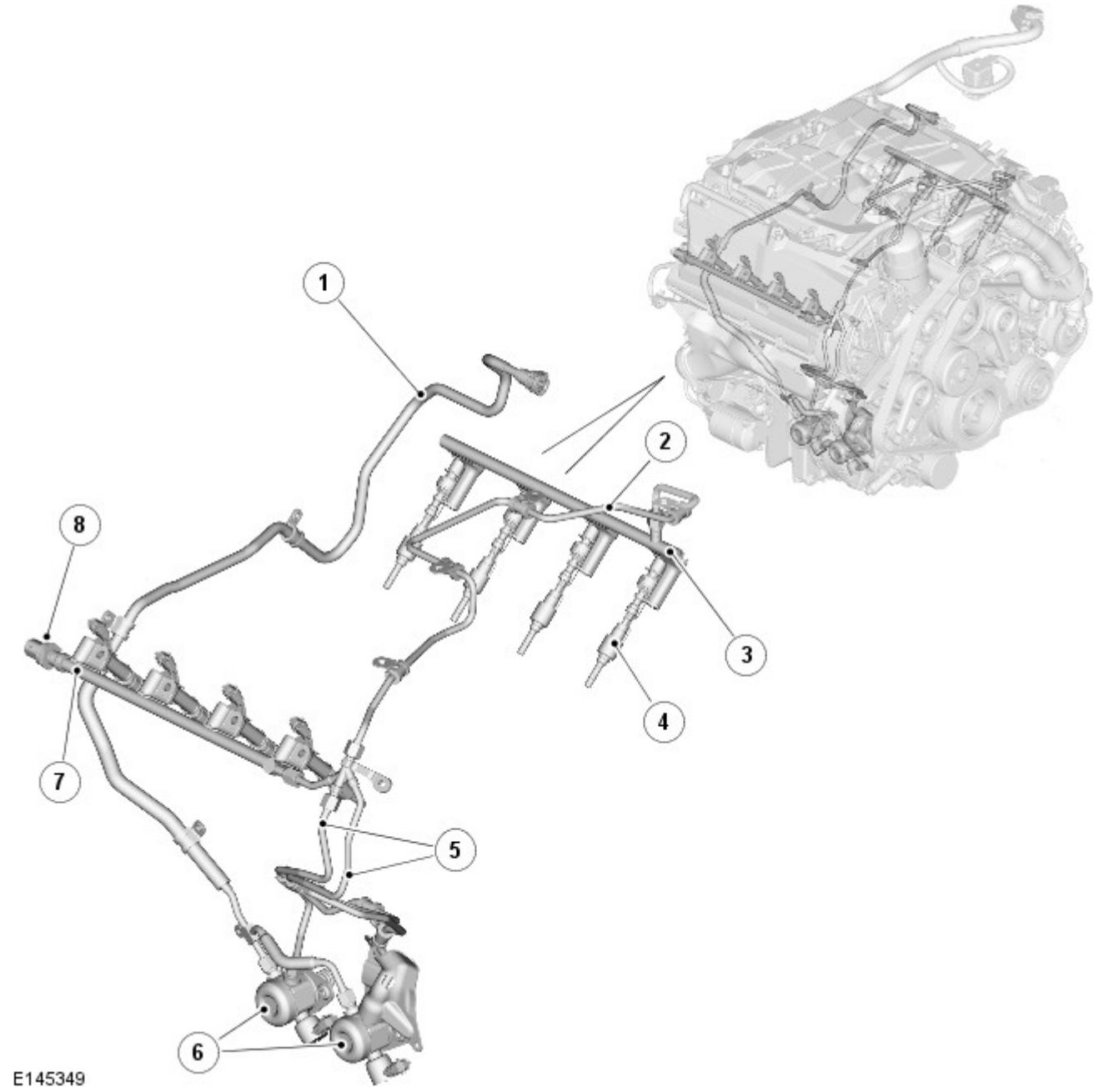
Description	Nm	lb-ft	lb-in
Ignition coil-on-plugs retaining bolts	8	-	71
Fuel rail retaining bolt	Stage 1 - 20 Stage 2 - 30	Stage 1 - 15 Stage 2 - 22	-
Fuel rail crossover pipe unions	21	15	-
Fuel rail crossover pipe retaining bolts	8	-	71
Fuel rail pressure sensor	33	24	-
Fuel rail pressure and temperature sensor	37	27	-
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	12	9	-
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	12	9	-
Fuel rail high pressure fuel pump torx bolts	12	9	-
Throttle body retaining bolts	17	13	-
Accessory drive belt idler pulley bracket bolts	25	18	-
Fuel pump driver modul (FPDM) bracket to body bolt	10	7	-
FPDM to bracket bolts	3	-	27

Published: 02-May-2013

Fuel Charging and Controls - V8 S/C 5.0L Petrol - Fuel Charging and Controls

Description and Operation

COMPONENT LOCATION



Item	Part Number	Description
1	-	Low pressure fuel lines
2	-	Crossover tube
3	-	Left fuel rail
4	-	Fuel injector (8 off)
5	-	High pressure fuel lines
6	-	High pressure fuel pumps
7	-	Right fuel rail
8	-	Fuel rail pressure and temperature (FRPT) sensor

OVERVIEW

The fuel charging and controls system is a petrol DI (direct injection) system controlled by the ECM (Engine Control Module).

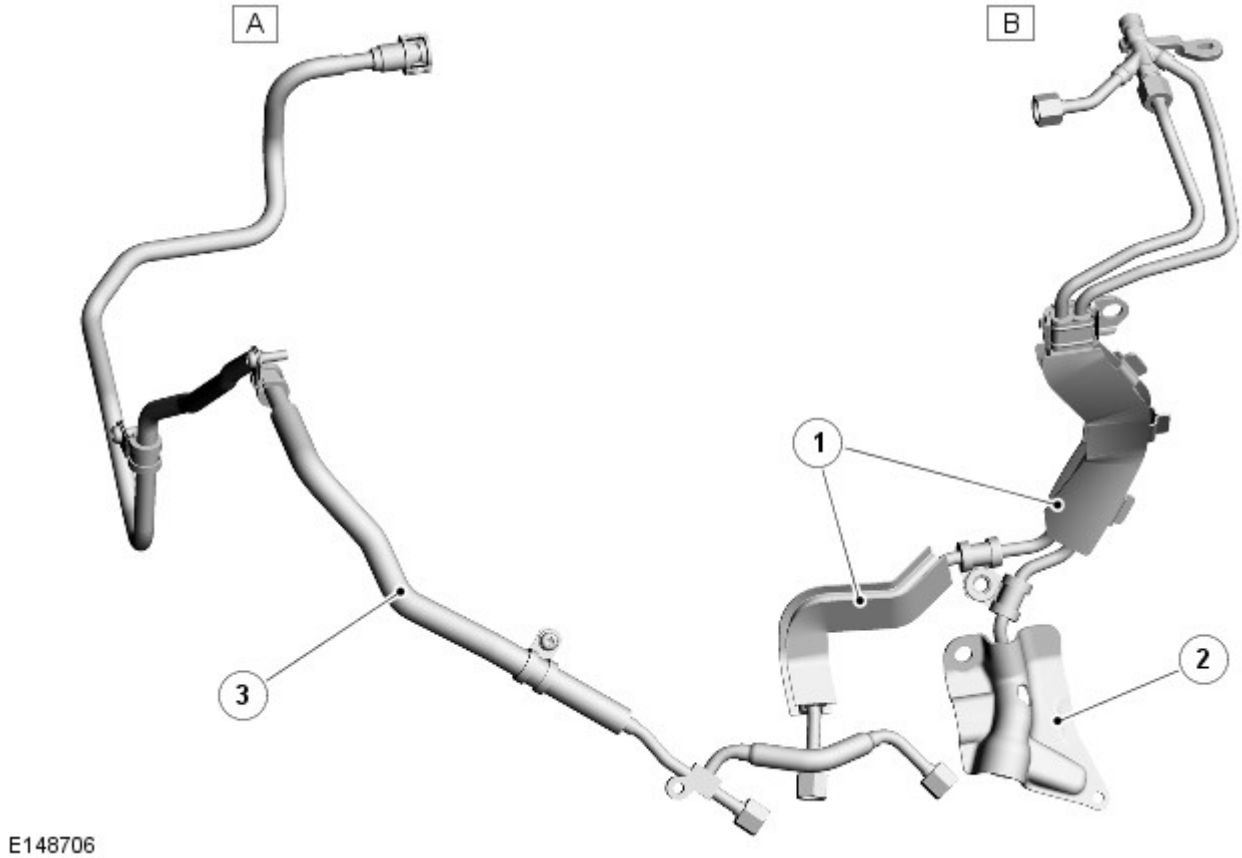
The fuel charging and controls system consists of:

- LP (low pressure) and HP (high pressure) fuel lines.
- Two HP fuel pumps.
- Two fuel rails and a crossover tube.
- A FRPT (fuel rail pressure and temperature) 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.

DESCRIPTION

Low and High Pressure Fuel Lines



E148706

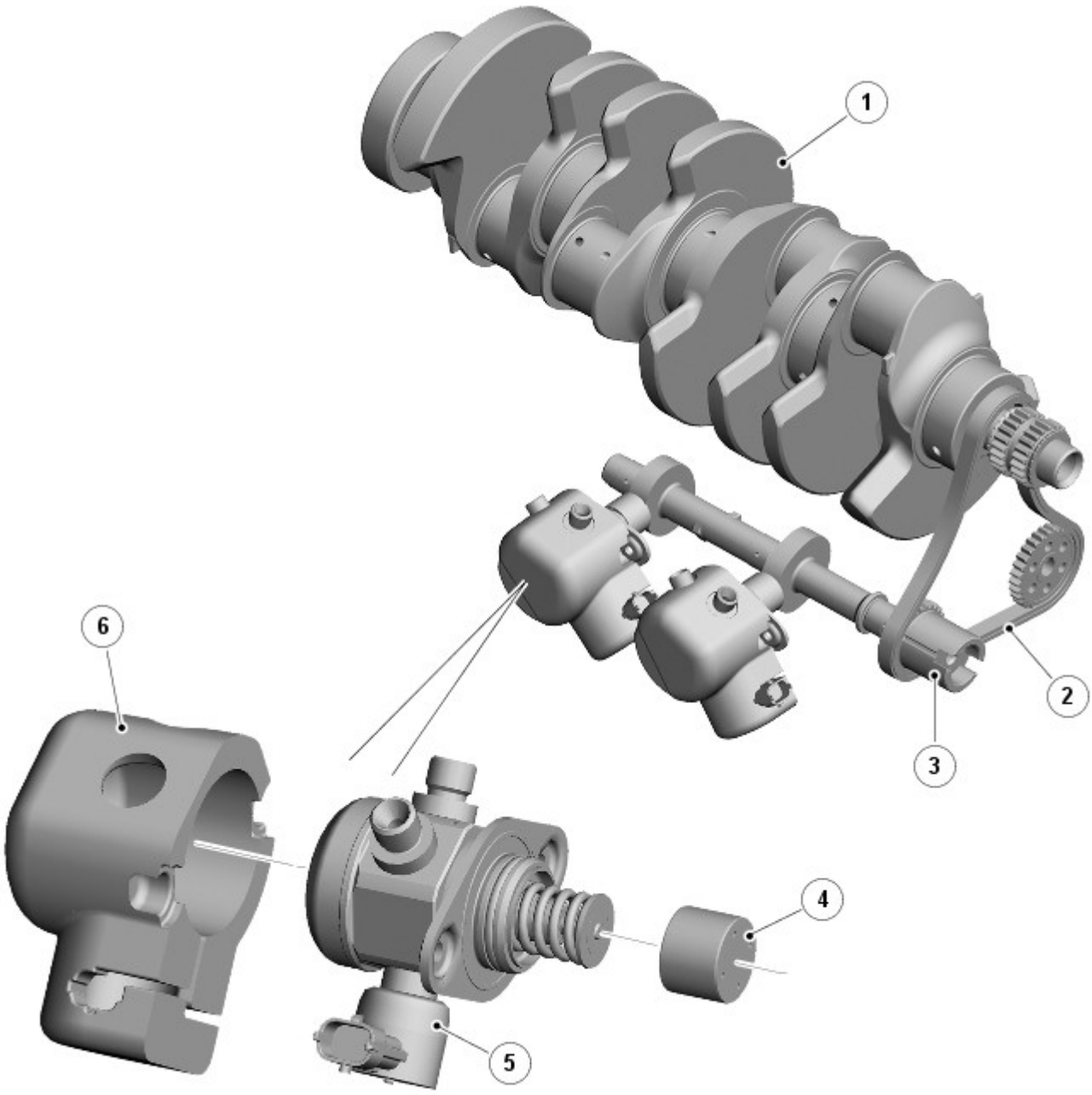
A = LP fuel lines; B = HP fuel lines.

Item	Part Number	Description
1	-	Acoustic covers
2	-	Fuel pipe cover
3	-	Heat reflective and insulation sleeve

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 left ignition coils cover. P-clips secure the LP fuel line to the rear of each cylinder head and to the right side of the cylinder block. A heat reflective and insulation sleeve is installed on the LP fuel line where it runs behind the right exhaust manifold.

The HP fuel lines connect the HP fuel pumps to the right fuel rail and the crossover tube. Two P-clips and a pipe clamp attach the HP fuel lines to the cylinder block and the right cylinder head respectively. An integral bracket on the front HP fuel line is attached to a stud on the front-upper right timing cover. Covers are installed over the lower areas of the HP fuel lines to absorb noise.

High Pressure Fuel Pumps



E114701

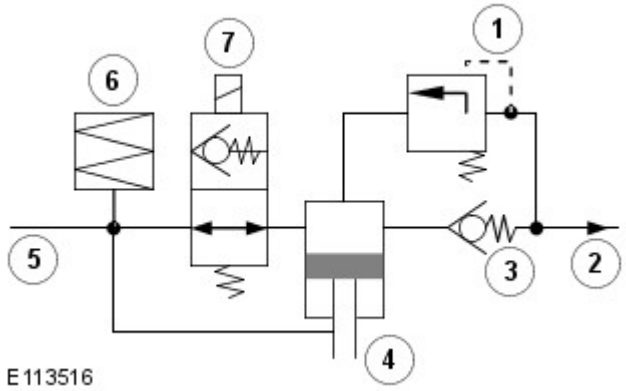
Item	Part Number	Description
1	-	Crankshaft
2	-	Auxiliary drive chain
3	-	Auxiliary camshaft
4	-	Tappet
5	-	HP fuel pump
6	-	Acoustic cover

The two HP fuel pumps are identical mechanically-driven pumps installed on the right side of the sump body, behind the generator. An O-ring seals each of the HP fuel pumps in the sump body. The front HP fuel pump is identified as No. 1 pump; the rear 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 of 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	-	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:

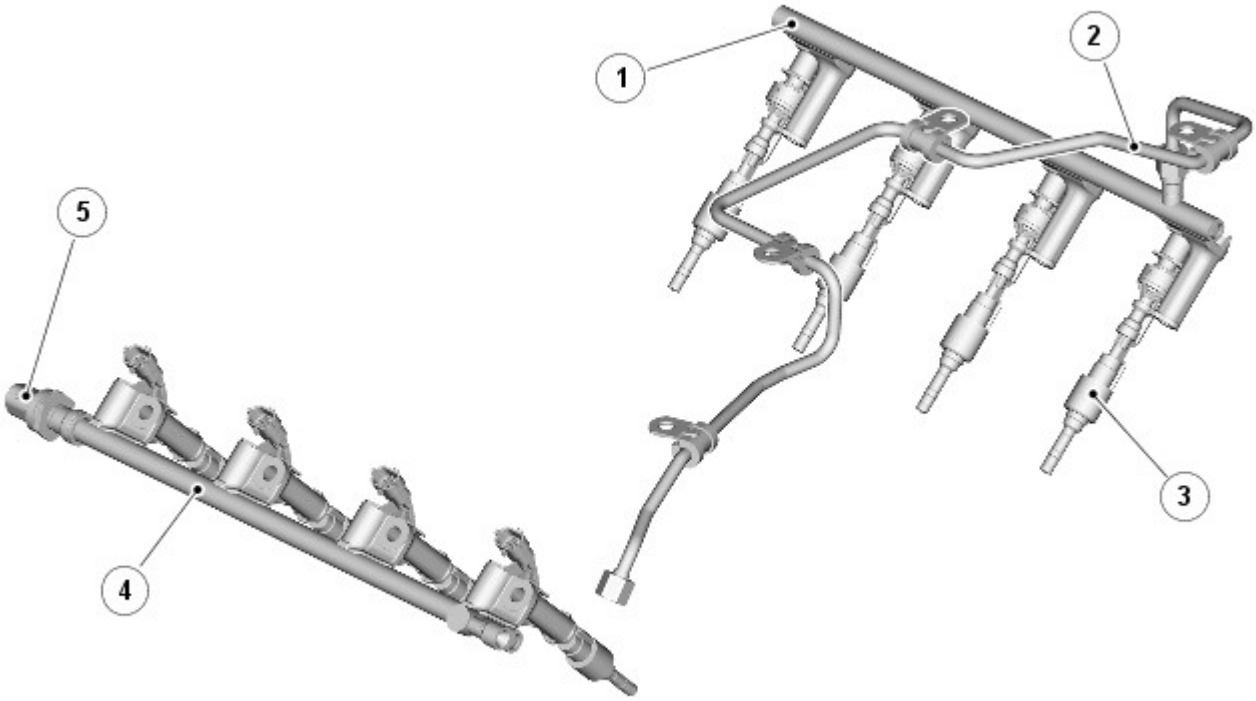
- A damper chamber.
- A fuel metering valve.
- A check valve.
- A PRV (pressure relief valve).

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 check valve. If the pump delivery pressure is excessive, the PRV opens and returns fuel to the inlet side of the plunger.

Fuel Rails and Crossover Tube



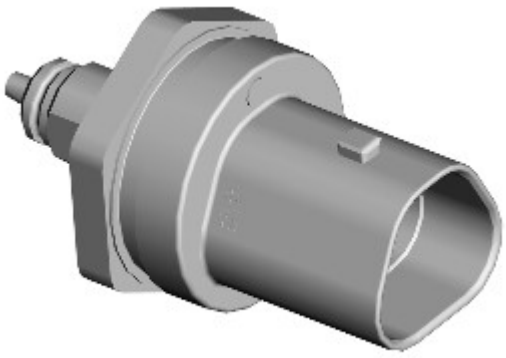
E145350

Item	Part Number	Description
1	-	Left fuel rail
2	-	Crossover tube
3	-	Fuel injector (8 off)
4	-	Right fuel rail
5	-	Fuel rail pressure and temperature (FRPT) 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 left fuel rail, which ensures there is equal pressure in the two fuel rails. Four P-clips attach the crossover tube to the charge air cooler tank top.

The rear of the right fuel rail incorporates a threaded boss for installation of the FRPT sensor.

Fuel Rail Pressure and Temperature Sensor

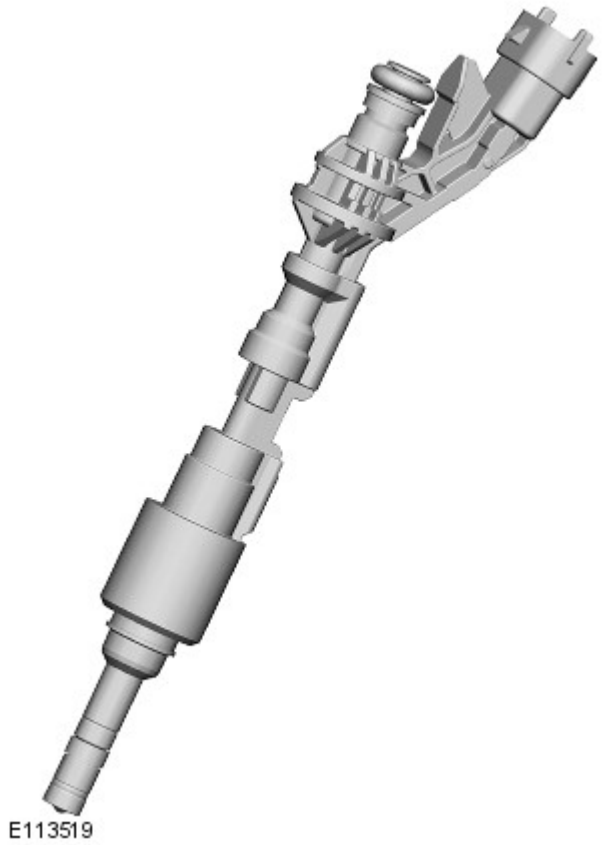


E145342

The FRPT sensor provides the ECM with a continuous signal of fuel rail pressure and temperature. The FRPT sensor is installed in the rear of the right fuel rail. The FRPT sensor is screwed into a threaded boss in the fuel rail.

The FRPT 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


E113519

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, an 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.

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 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.

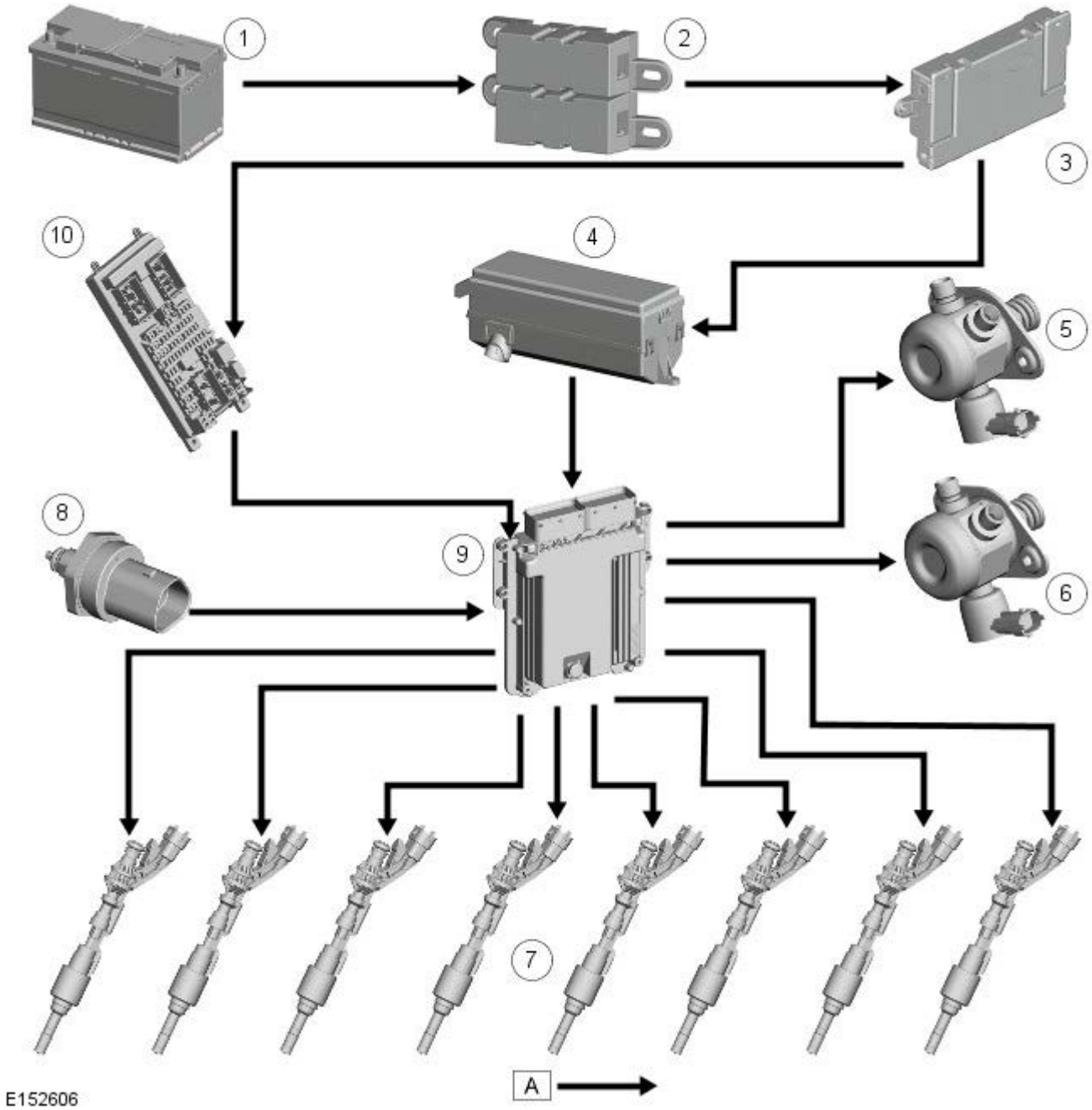
OPERATION

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/in²).

The ECM uses the signal from the FRPT sensor to calculate the time the fuel injectors need to be energized to deliver the correct mass of fuel to the combustion chambers.

CONTROL DIAGRAM

NOTE: A = Hardwired



Item	Part Number	Description
1	-	Battery
2	-	Battery Junction Box 2 (BJB2)
3	-	Battery Junction Box (BJB)
4	-	Engine Junction Box (EJB)
5	-	No. 1 HP fuel pump
6	-	No. 2 HP fuel pump
7	-	Fuel injector (8 off)
8	-	Fuel rail pressure and temperature (FRPT) sensor
9	-	Engine Control Module (EJB)
10	-	Central Junction Box (CJB)

Published: 06-Mar-2013

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. Check for ignition system, fuel system and electronic engine control DTCs and refer to the relevant DTC Index
Engine cranks and fires, but will not start	• 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. Check for electronic engine controls, engine emissions, fuel system and evaporative emissions system related DTCs and refer to the relevant DTC Index
Difficult hot start	• Injector leak • Electronic engine control • Purge valve • Fuel pump • Ignition system	Check for injector leak, install new injector as required. Check for electronic engine controls, evaporative emissions, fuel system, ignition system and engine emission system related DTCs and refer to the relevant DTC Index

Difficult to start after hot soak (vehicle standing, engine off, after engine has reached operating temperature)	• Injector leak • Electronic engine control • Purge valve • Fuel pump • Ignition system	Check for injector leak, install new injector as required. Check for electronic engine controls, evaporative emissions, fuel system, ignition system and engine emission system related DTCs and refer to the relevant DTC Index
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. Check for electronic engine control, ignition system and fuel system related DTCs and refer to the relevant DTC Index. Check for blockage in air filter element and air intake system. Check for air leakage in air intake system
Engine hesitates/poor acceleration	• 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	Check for fuel system related DTCs and refer to the relevant DTC Index. Check for injector leak, install new injector as required. Check for air leakage in air intake system. Ensure accelerator pedal is free from restriction. Check for electronic engine controls, ignition, engine emission system and transmission related DTCs and refer to the relevant DTC Index
Engine backfires	• 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. Check for electronic engine controls, ignition system and VCT system 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. Check for electronic engine controls, throttle system and ignition system 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. Check for electronic engine controls and VCT system related DTCs and refer to the relevant DTC Index
No throttle response	• Electronic engine controls • Throttle motor	Check for electronic engine controls and throttle system related DTCs and refer to the relevant DTC Index
Poor throttle response	• Breather system disconnected/restricted • Electronic engine control • Transmission malfunction • Traction control event • Air leakage	Ensure the engine breather system is free from restriction and is correctly installed. Check for electronic engine controls, transmission and traction control related DTCs and refer to the related DTC Index. Check for air leakage in intake air system

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.

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: 04-Aug-2012

Fuel Charging and Controls - V8 S/C 5.0L Petrol - Fuel Injectors

Removal and Installation

Removal

1. Refer to: Fuel Rail LH (303-04 Fuel Charging and Controls - V8 S/C 5.0L Petrol, Removal and Installation).
   Refer to: Fuel Rail RH (303-04F, Removal and Installation).

Installation

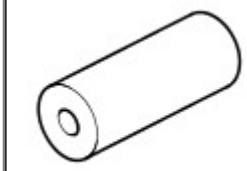
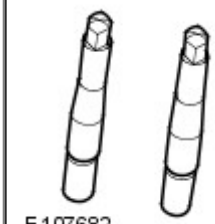
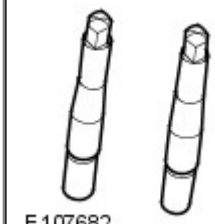
1. To install, reverse the removal procedure.

Published: 06-Sep-2012

Fuel Charging and Controls - V8 S/C 5.0L Petrol - Fuel Rail LH

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.

NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

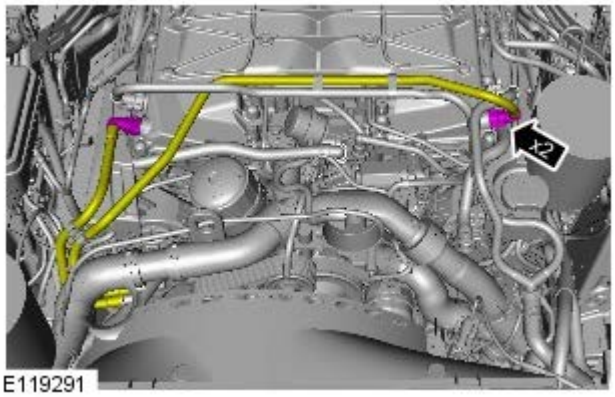
1. Refer to: Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions (100-00 General Information, Description and Operation).
2. Refer to: Fuel System Pressure Release - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (310-00 Fuel System - General Information, General Procedures).

3. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

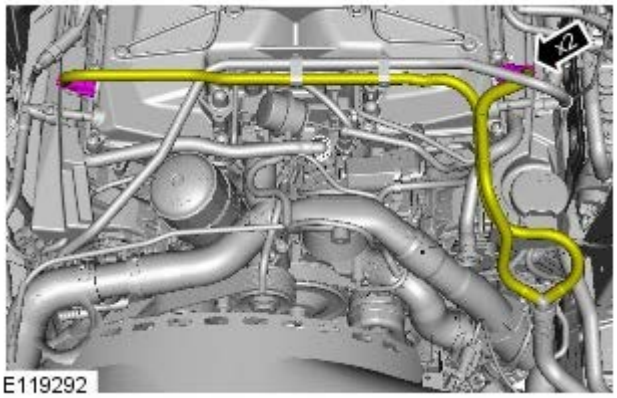
4. Refer to: Fuel Injection Component Cleaning (303-04C Fuel Charging and Controls - V6 S/C 3.0L Petrol, General Procedures).

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).



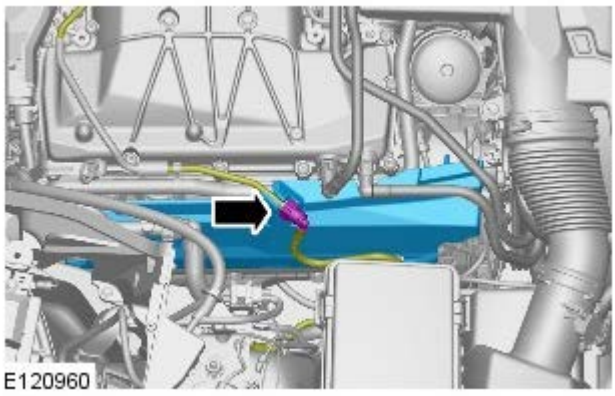
E119291

6. CAUTION: Be prepared to collect escaping fluids.



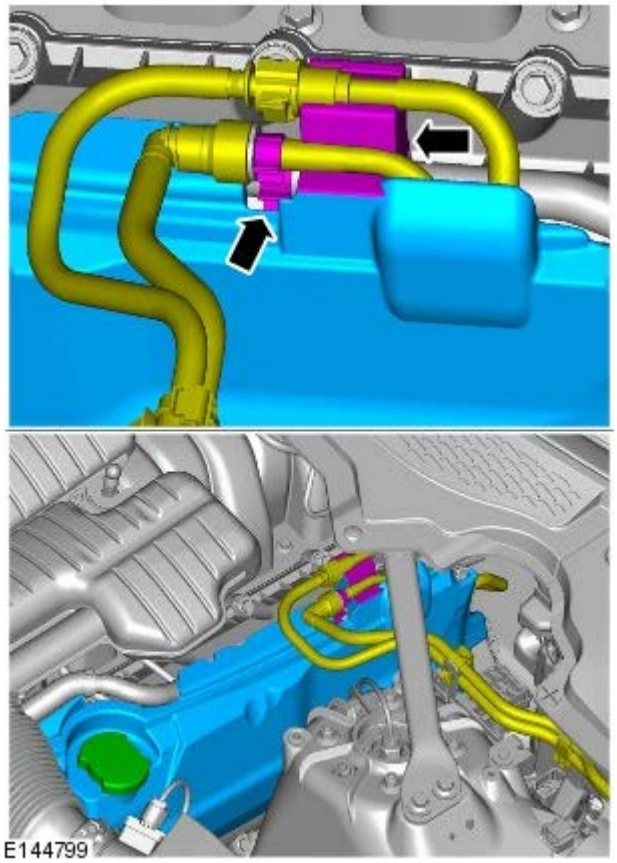
E119292

7. CAUTION: Be prepared to collect escaping fluids.

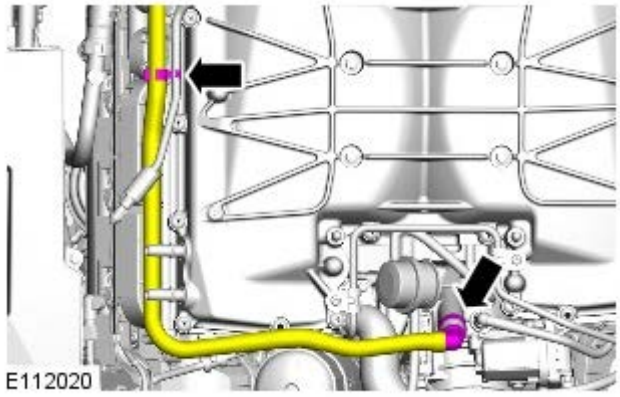

E120960

8. CAUTION: Be prepared to collect escaping fluids.

9.



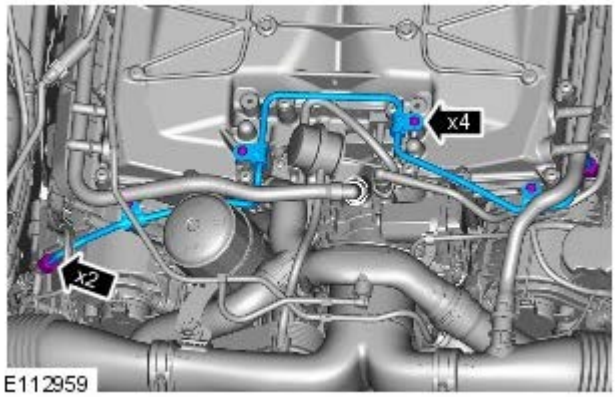
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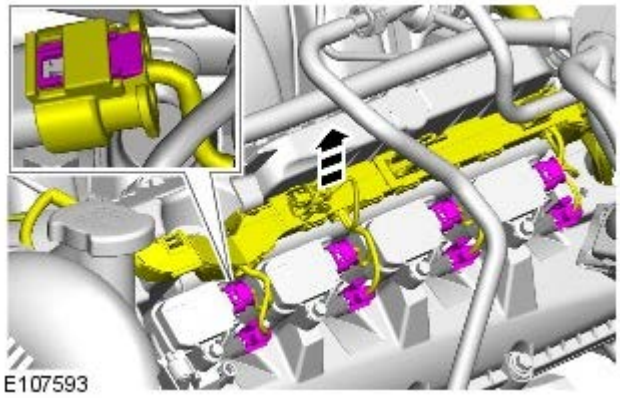
11. CAUTIONS:

Make sure that all openings are sealed. Use new blanking caps.

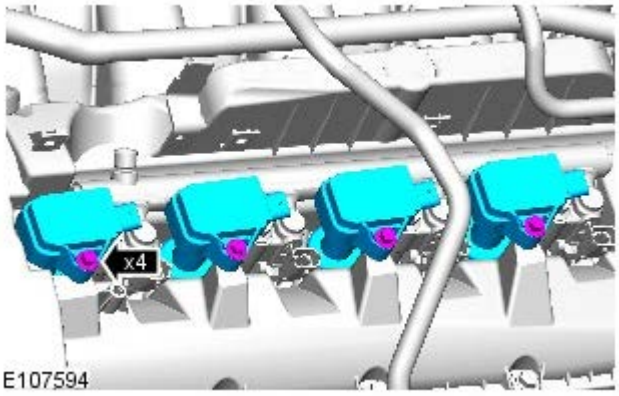
Be prepared to collect escaping fluids.



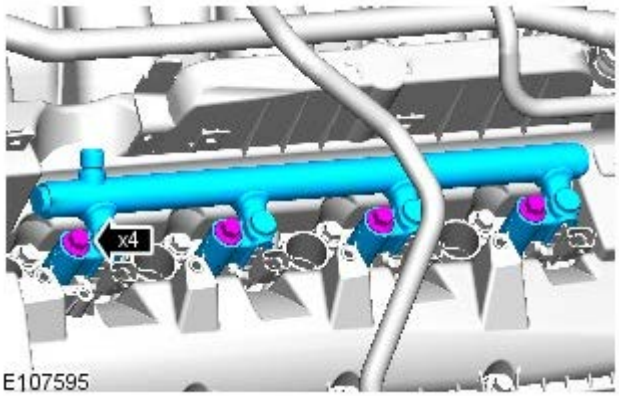
12.



13.



14. CAUTION: Make a note of the fuel injector clamp alignment to the fuel rail prior to removal.



15. CAUTIONS:

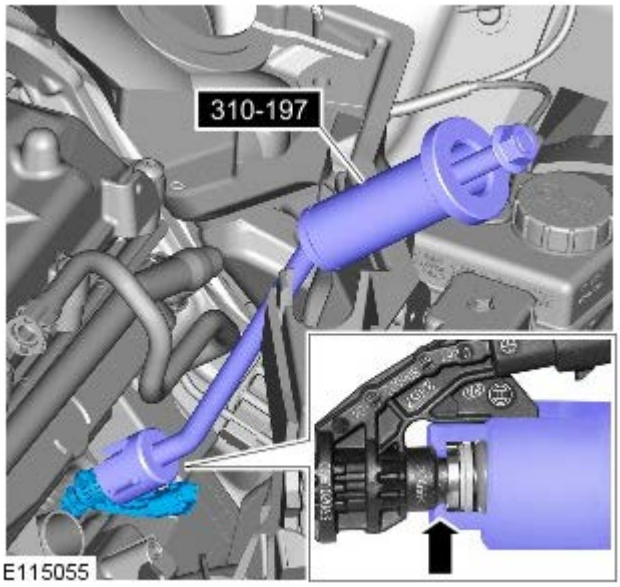
Make sure that the special tool is located correctly to the fuel injector prior to removing the fuel injector.

Make sure that the special tool is held square to the fuel injector during removal.

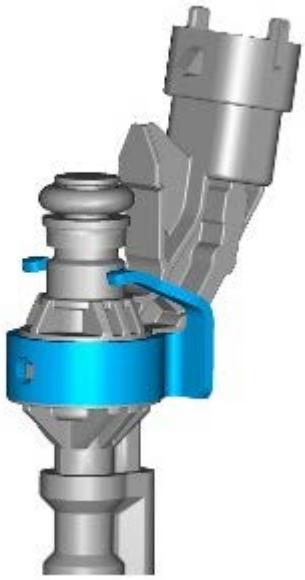
Make sure that all open ports are covered to prevent any foreign material ingress.

NOTE: RH illustration shown, LH is similar.

Special Tool(s): 310-197



16. CAUTIONS:



E115057

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.

17. CAUTIONS:

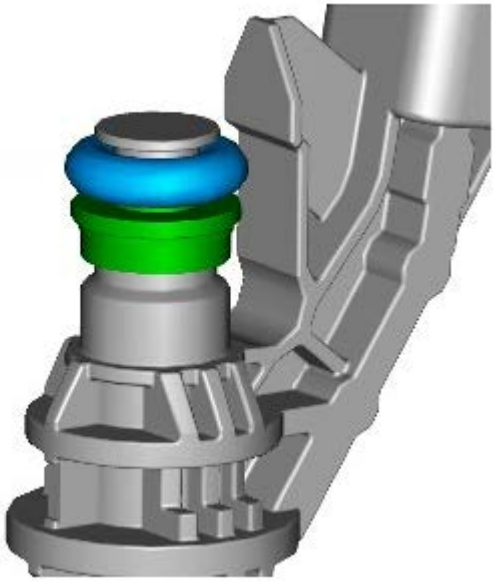


E115058

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.

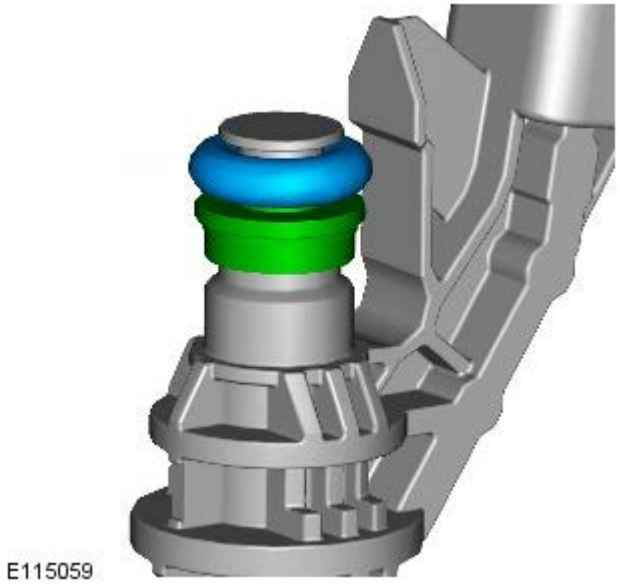


E115059

18. CAUTION: Do not use any sharp tools to remove the O-ring seal as damage could occur to the fuel injector.

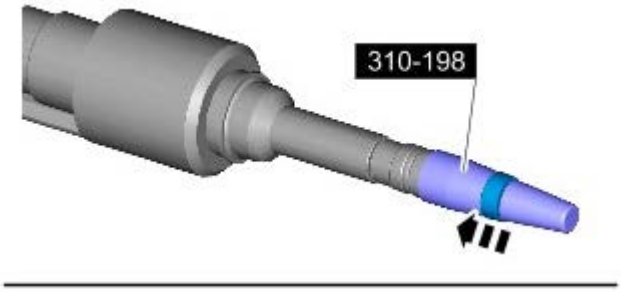
Installation

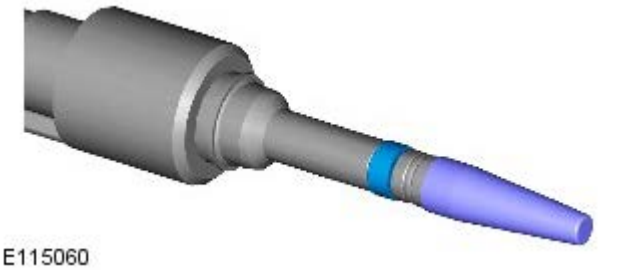
1.



E115059

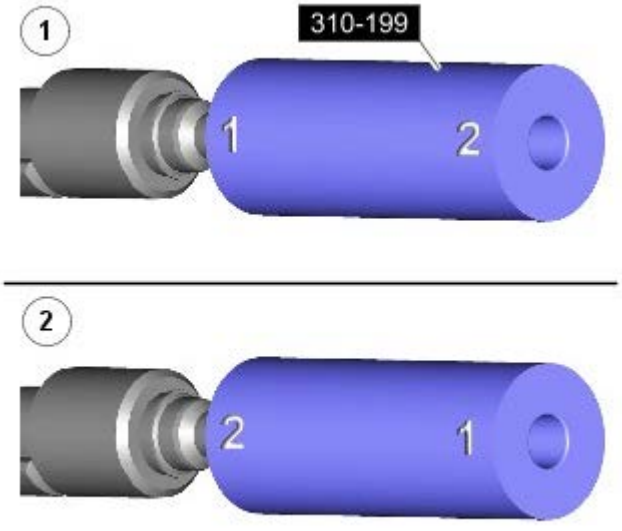
2. *Special Tool(s):* 310-198





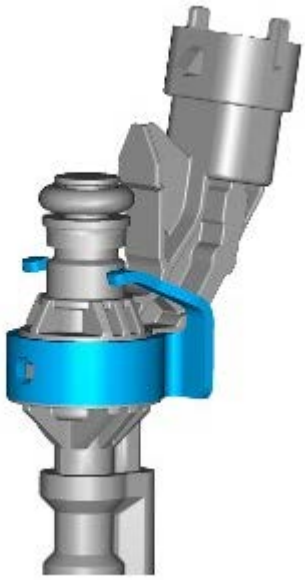
E115060

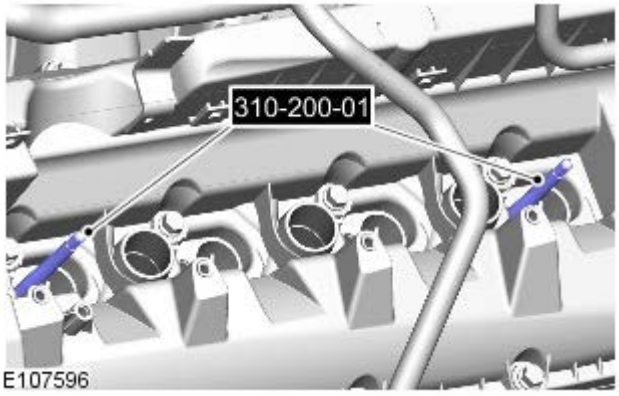
3. *Special Tool(s):* 310-199



E115062

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.

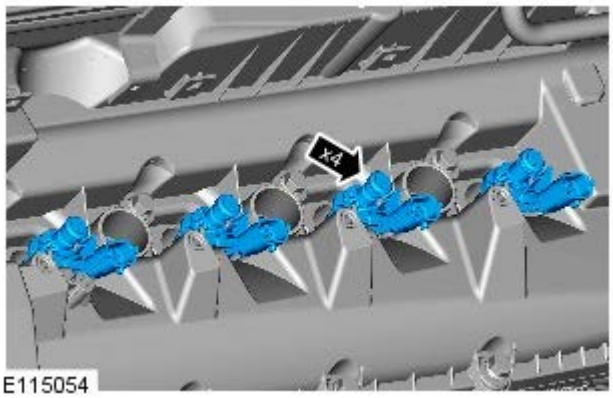

E115057



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



E115054

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:

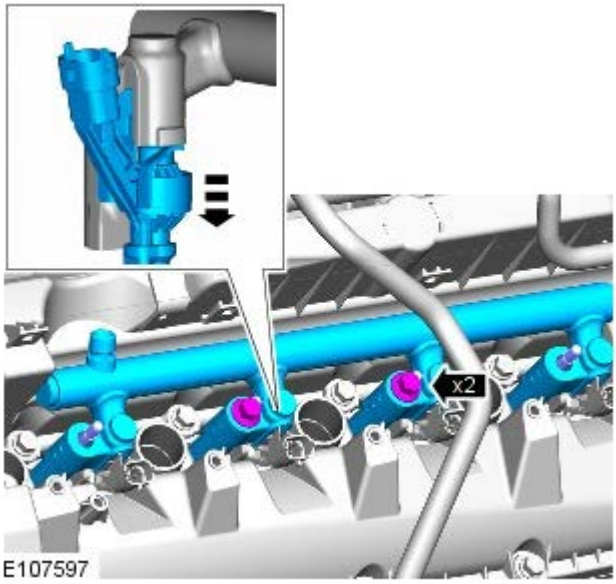
If new fuel injectors are installed, a new injector clamp must be installed.

Make sure that the fuel injector is aligned and installed into the fuel rail correctly, as noted in the removal step.

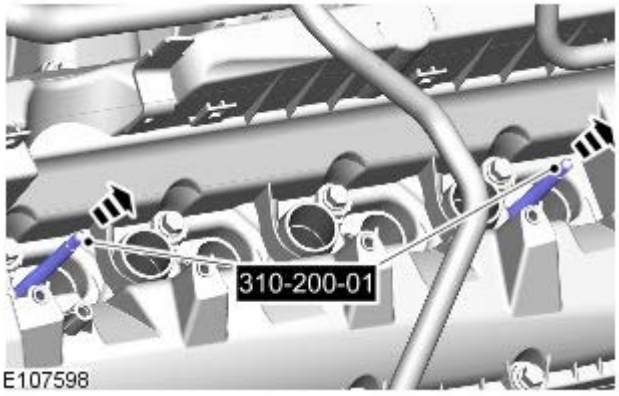
Tighten the fuel rail retaining bolts a turn at a time until the correct torque is achieved.

NOTE: Lubricate the fuel injector O-ring seals with clean engine oil.

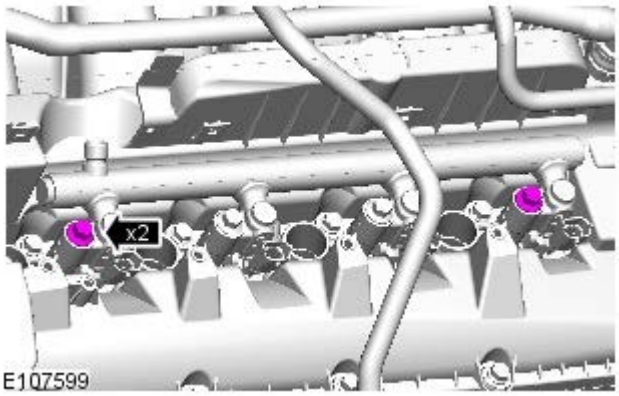
Torque: 20 Nm

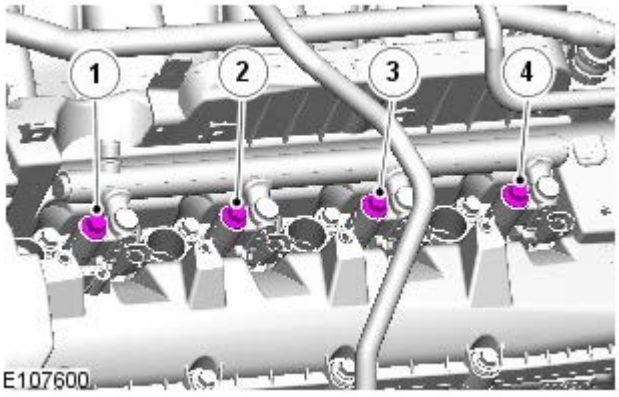


8. *Special Tool(s):* 310-200-01, 310-200-02



9. *Torque:* 20 Nm

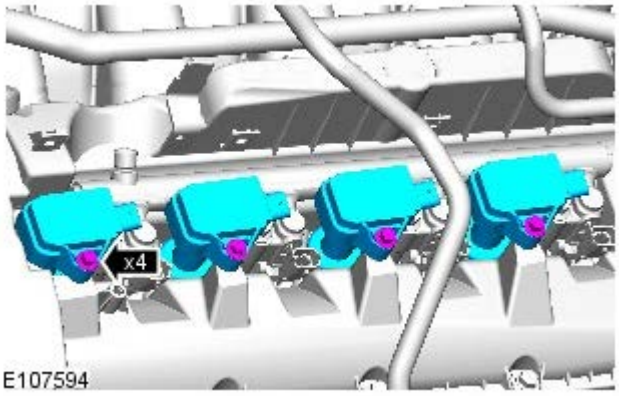




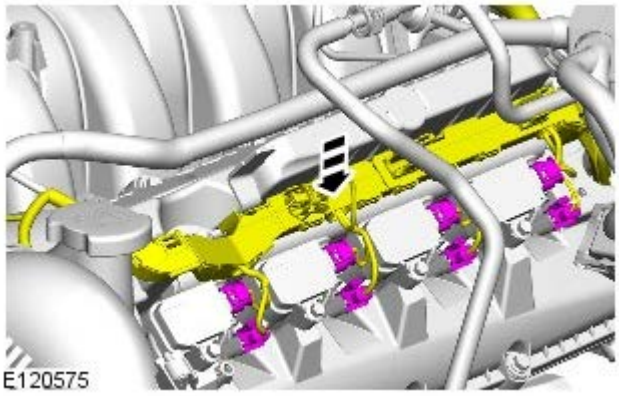
10. NOTE: Tighten the bolts in the indicated sequence.

    Torque:
    Bolt 2 30 Nm
    Bolt 3 30 Nm
    Bolt 1 30 Nm
    Bolt 4 30 Nm

11. *Torque:* 8 Nm



12.

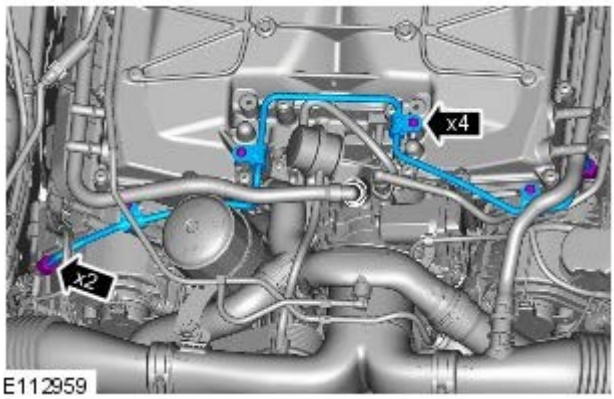


13. CAUTION: Lubricate only the union threads with clean engine oil.

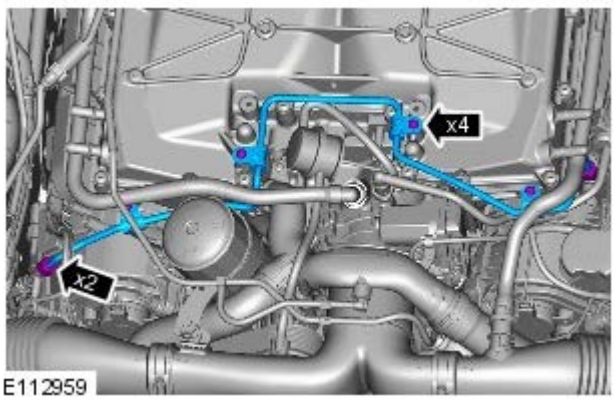
NOTES:

Do not tighten at this stage.

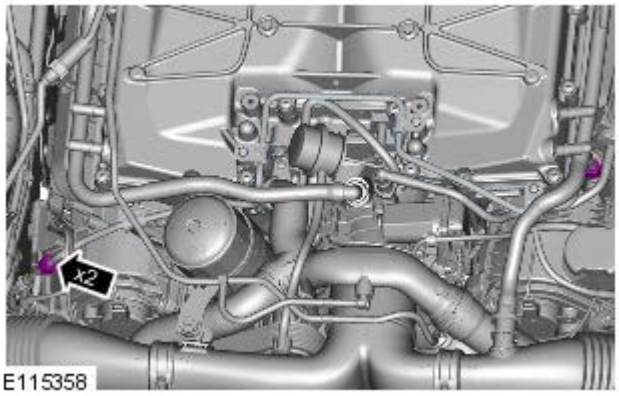
Remove and discard the blanking caps.



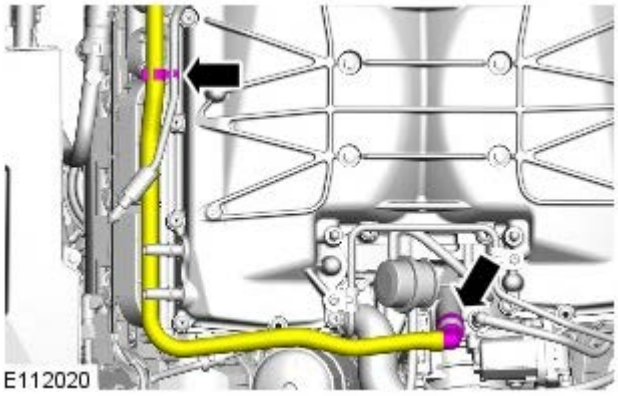
14. *Torque:*
Unions 20 Nm
Bolts 8 Nm



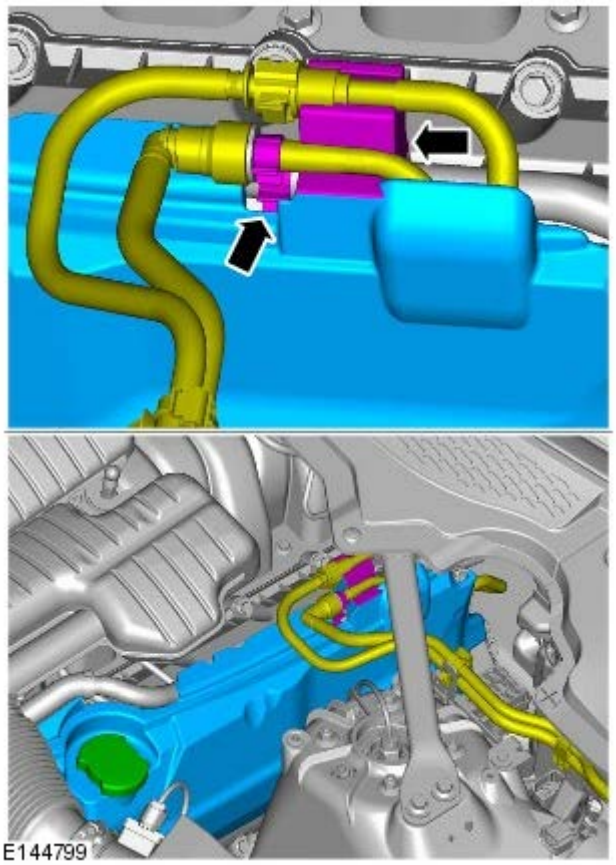
15. *Torque:* 21 Nm



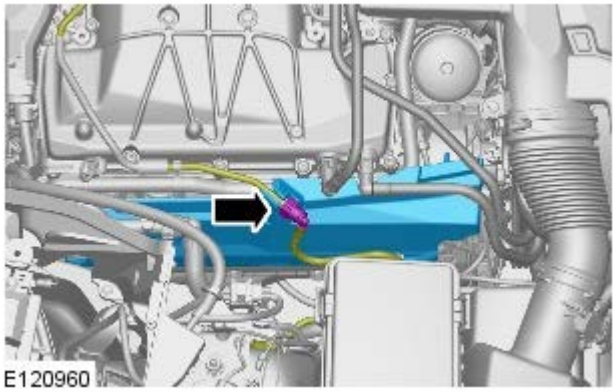
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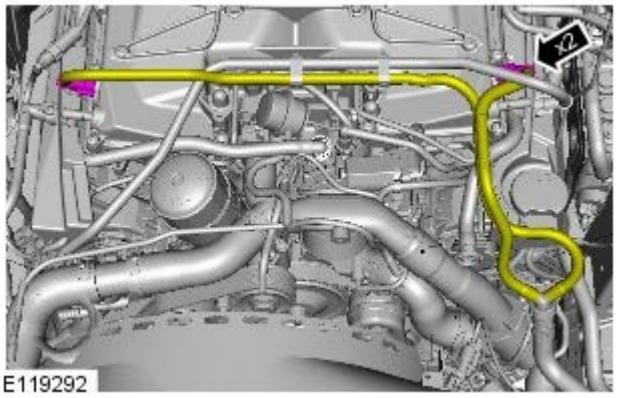
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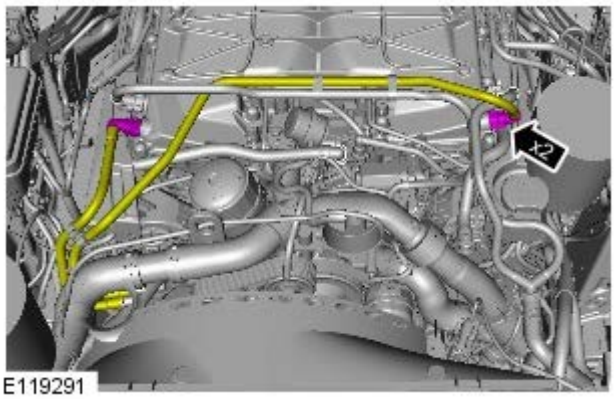
18.



19.



20.



21. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).

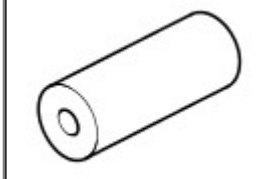
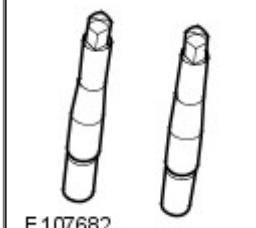
22. Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 03-Dec-2013

Fuel Charging and Controls - V8 S/C 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

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:

Some variation in the illustrations may occur, but the essential information is always correct.

Some components shown removed for clarity.

Removal steps in this procedure may contain installation details.

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 - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (310-00 Fuel System - General Information, General Procedures).
3. Refer to: Engine Cover - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol

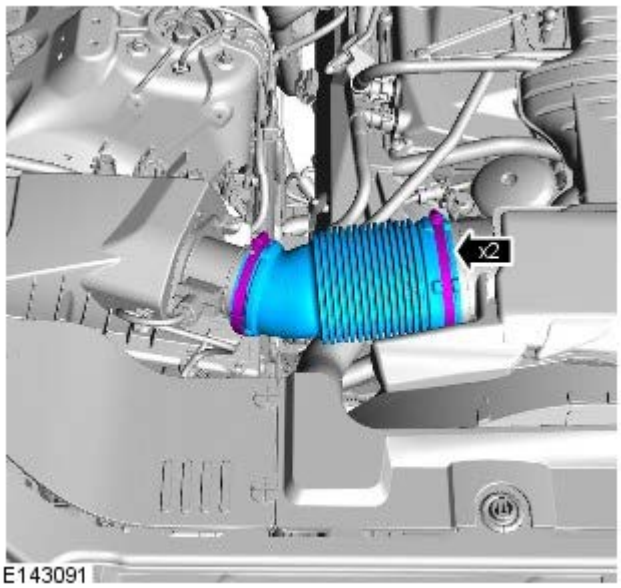
(501-05 Interior Trim and Ornamentation, Removal and Installation).

4. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

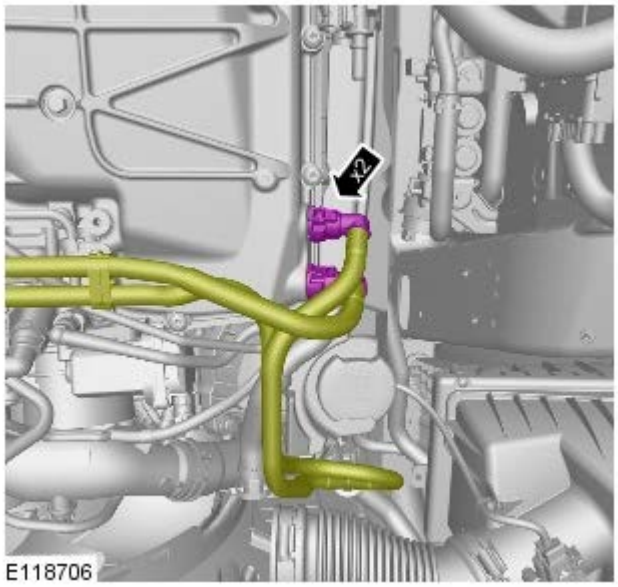
5. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).

6.

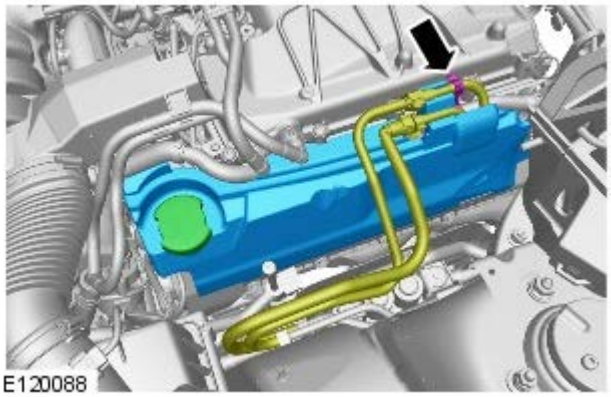


7. Refer to: Air Cleaner RH (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).

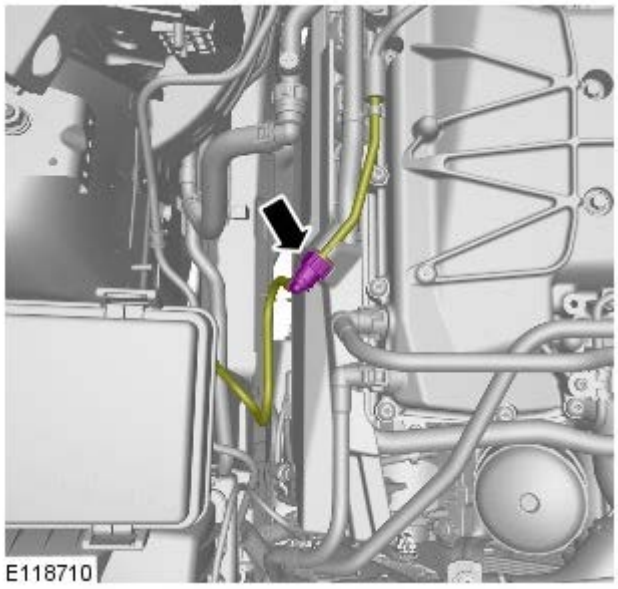
8. CAUTION: Be prepared to collect escaping coolant.



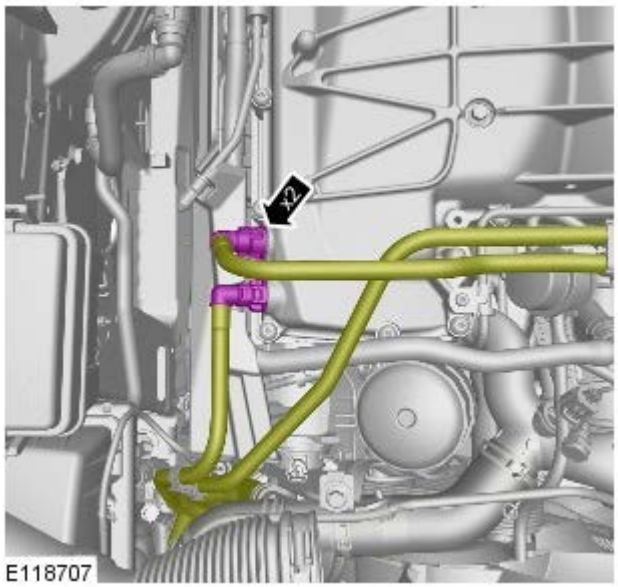
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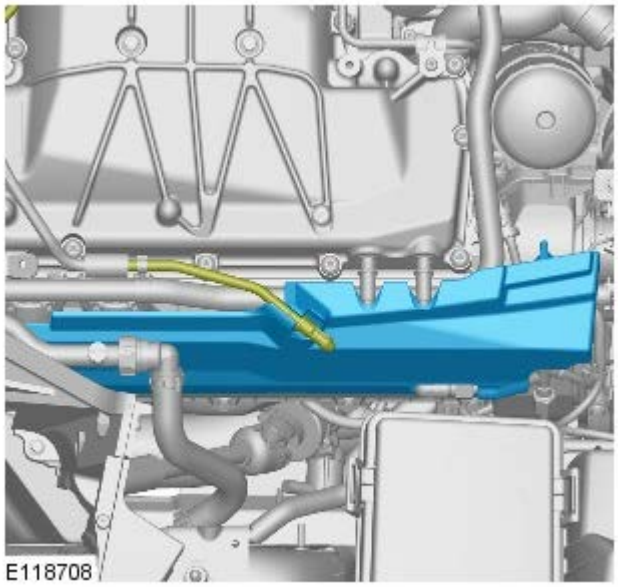
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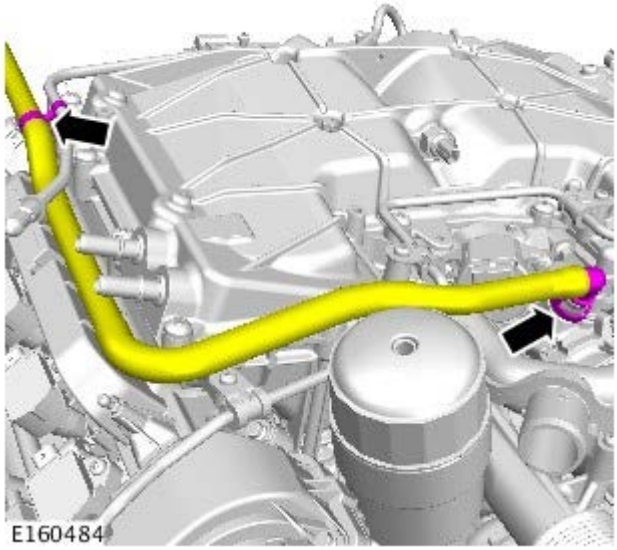
11. CAUTION: Be prepared to collect escaping coolant.



12.



13.



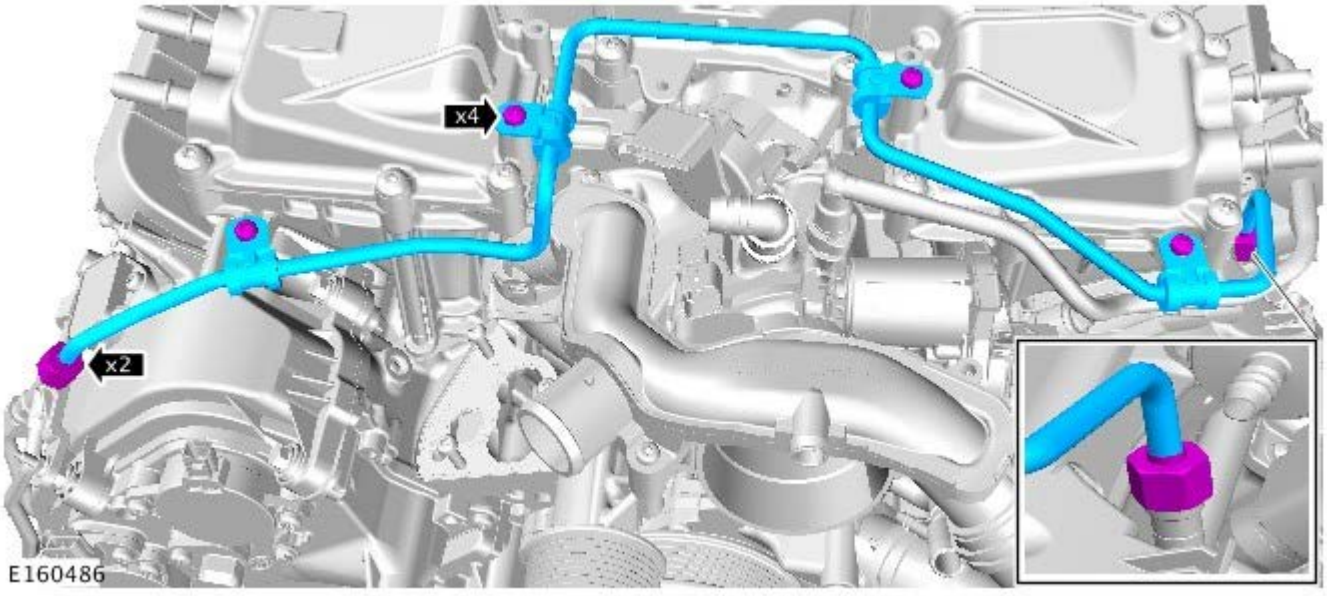
14. WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

CAUTIONS:

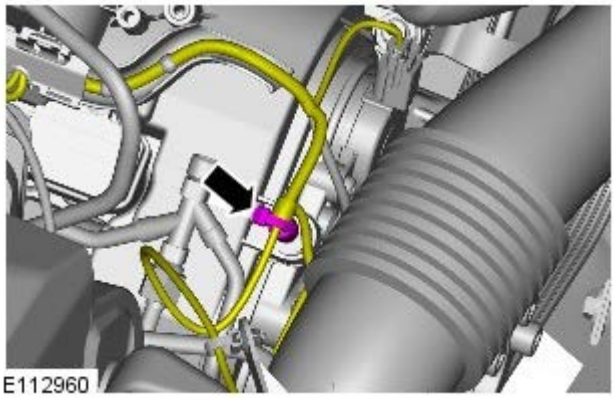
Make sure that the fuel line union does not rotate.

Be prepared to collect escaping fluids.

Make sure that all openings are sealed. Use new blanking caps.



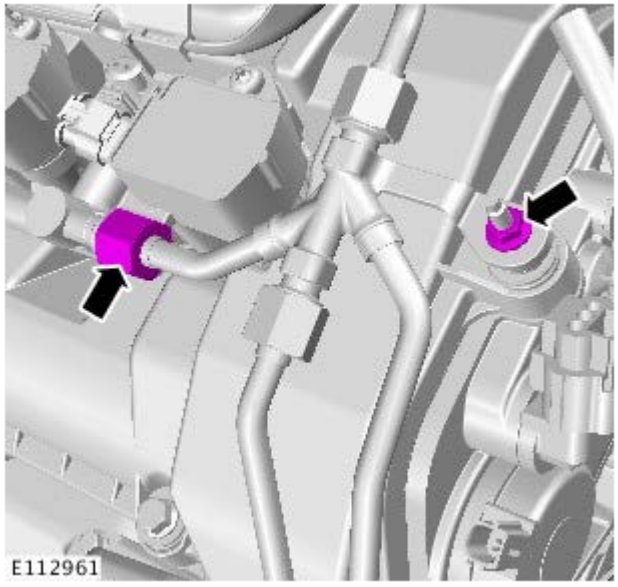
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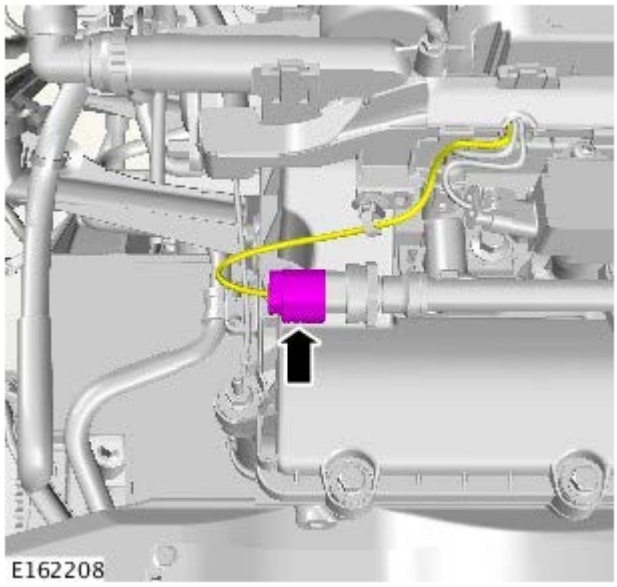
16. CAUTIONS:

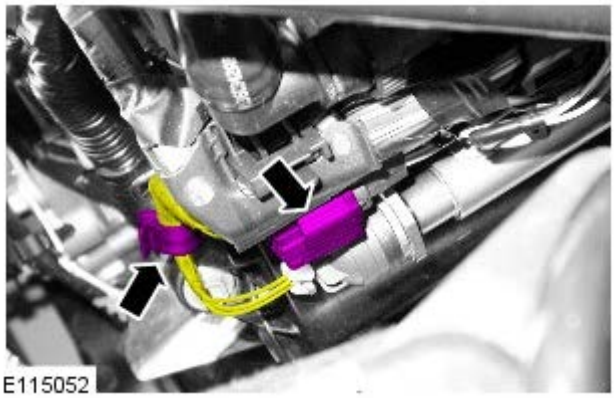
Be prepared to collect escaping fluids.

Make sure that all openings are sealed. Use new blanking caps.

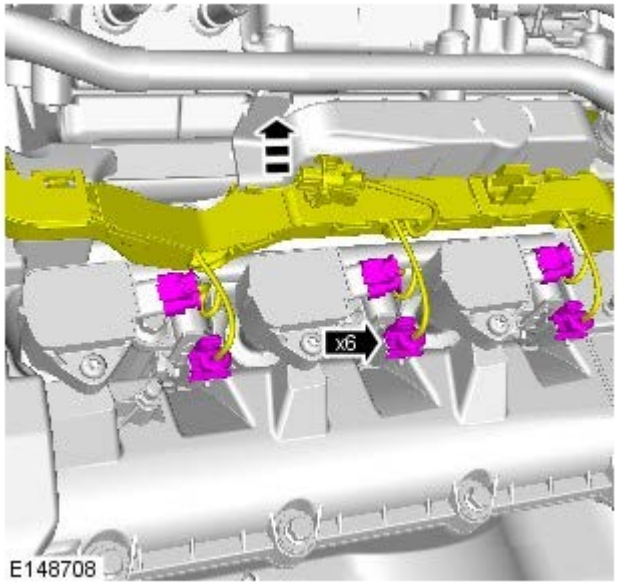


17.





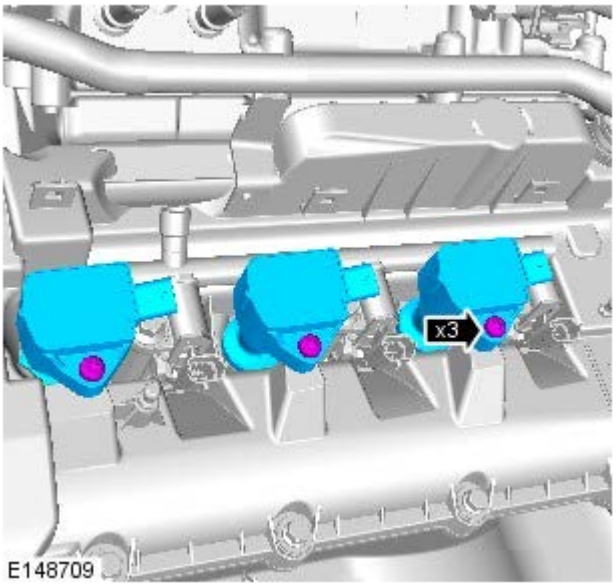
18. NOTE: If equipped.

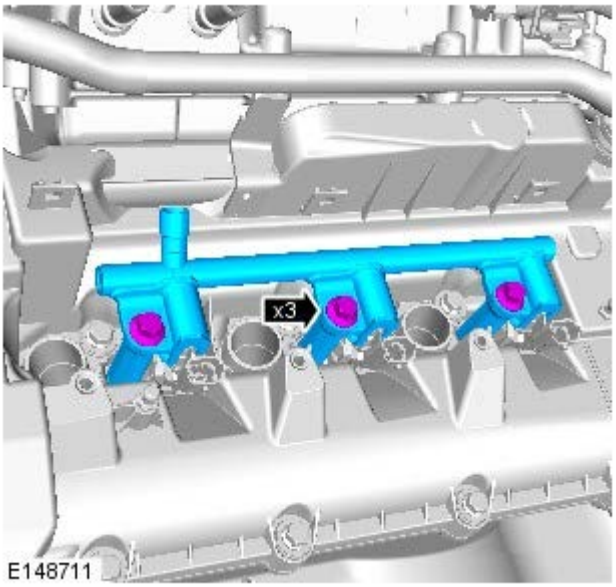


19. NOTE: LH illustration shown, RH is similar.

20. Refer to: Fuel Injection Component Cleaning (303-04C Fuel Charging and Controls - V6 S/C 3.0L Petrol, General Procedures).

21. NOTE: LH illustration shown, RH is similar.



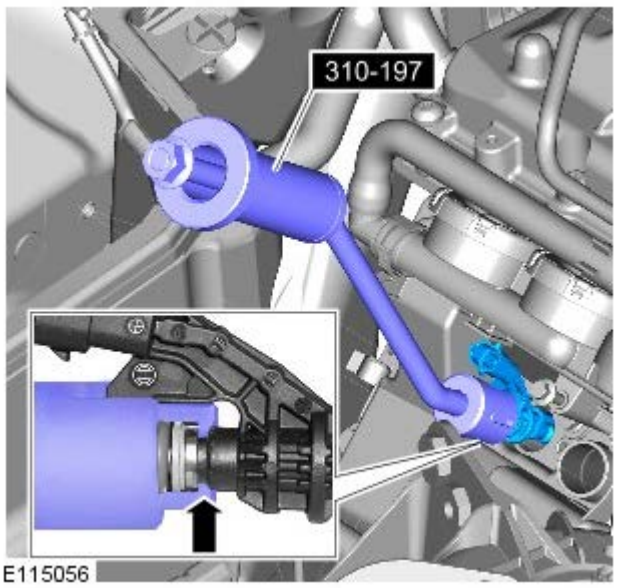


22. CAUTION: Make a note of the fuel injector clamp alignment to the fuel rail prior to removal.

NOTE: LH illustration shown, RH is similar.

23. NOTE: This step is only required if a new fuel rail is installed.

Refer to: Fuel Rail Pressure (FRP) Sensor (303-14D, Removal and Installation).



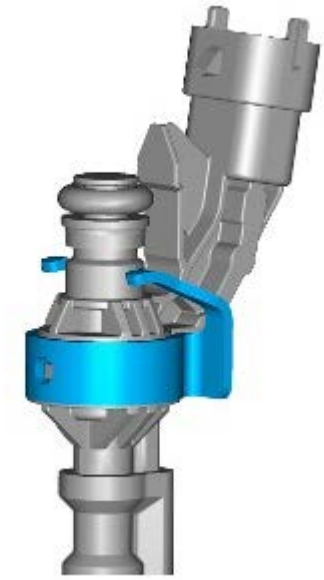
24. CAUTIONS:

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.

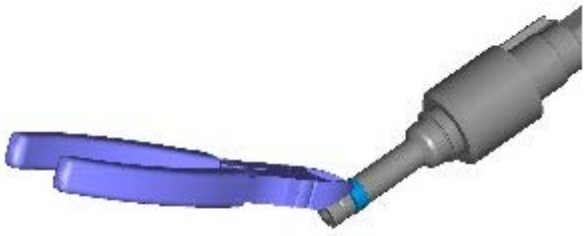
Special Tool(s): 310-197



E115057

25. 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.

26. CAUTIONS:

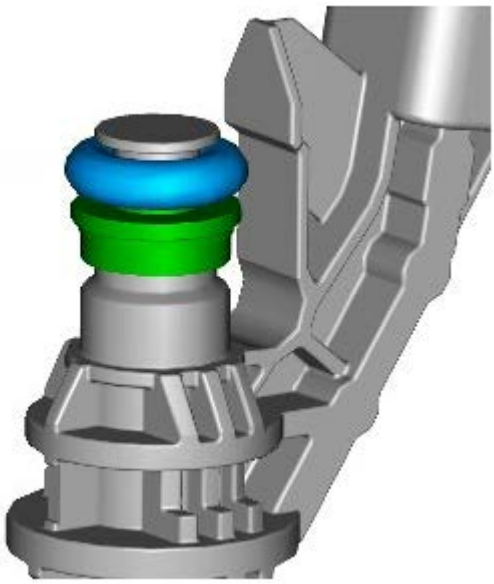


E115058

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.



E115059

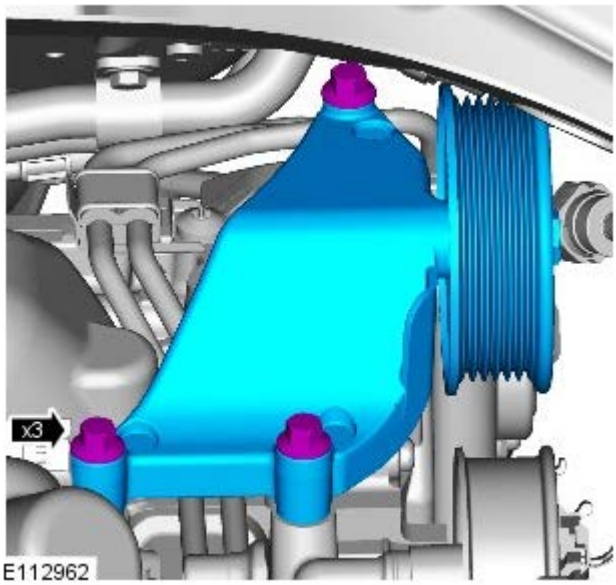
27. CAUTION: Do not use any sharp tools to remove the O-ring seal as damage could occur to the fuel injector.

28. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

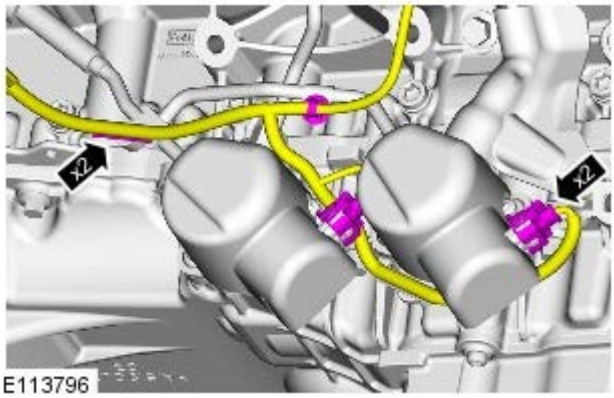
Raise and support the vehicle.

29. Refer to: Generator (414-02C Generator and Regulator - V8 S/C 5.0L Petrol, Removal and Installation).

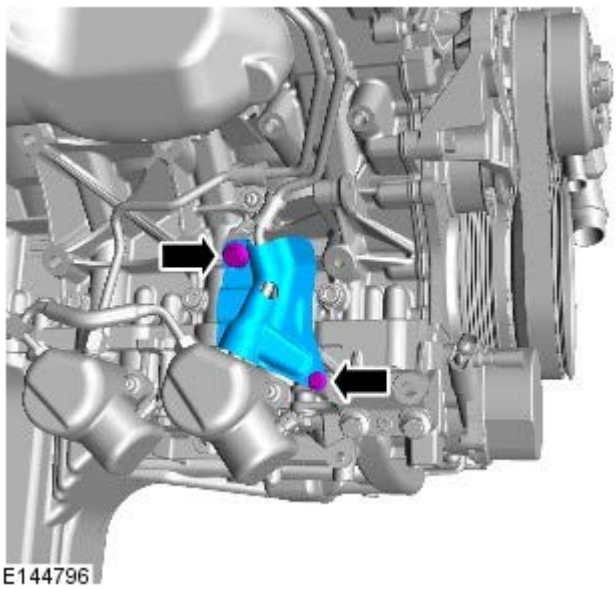
30.



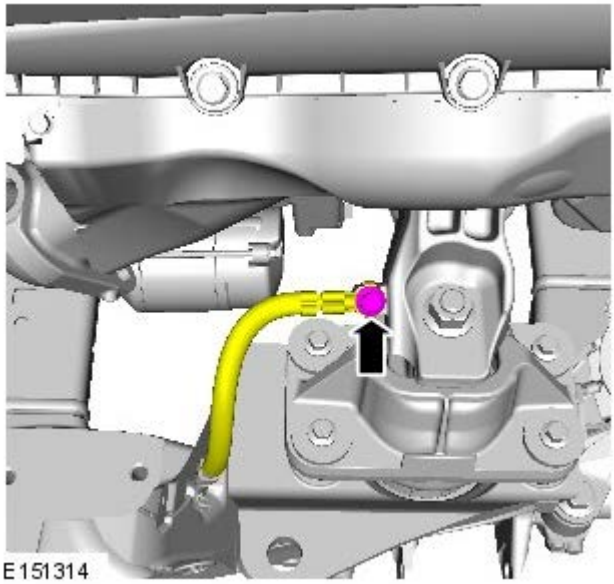
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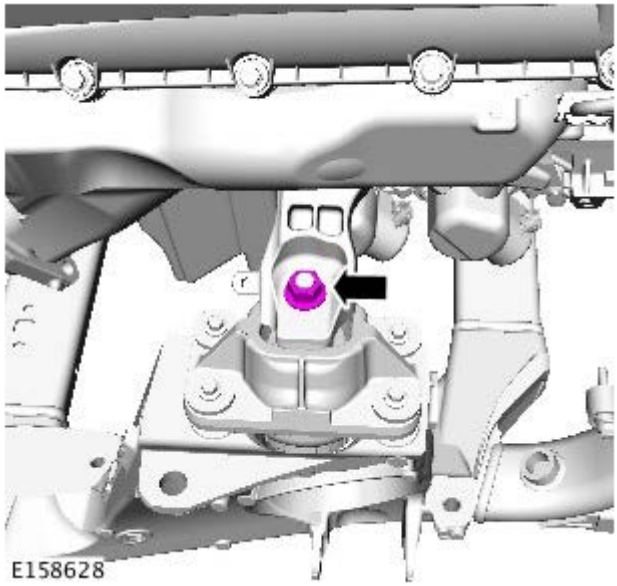
32.



33.

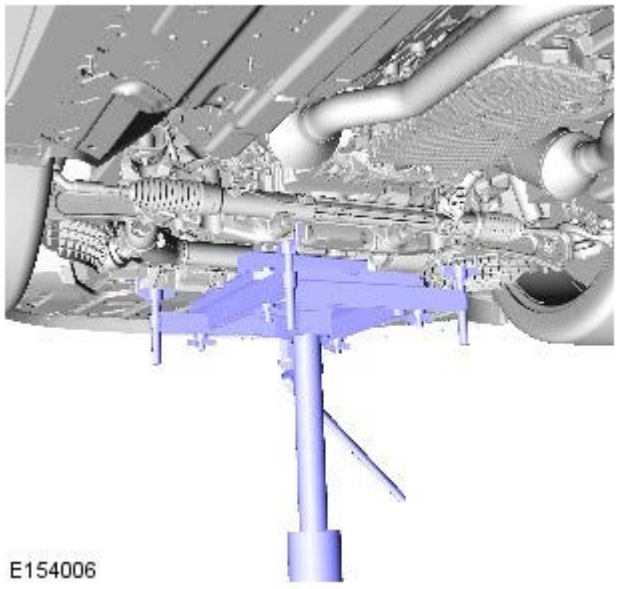


34.

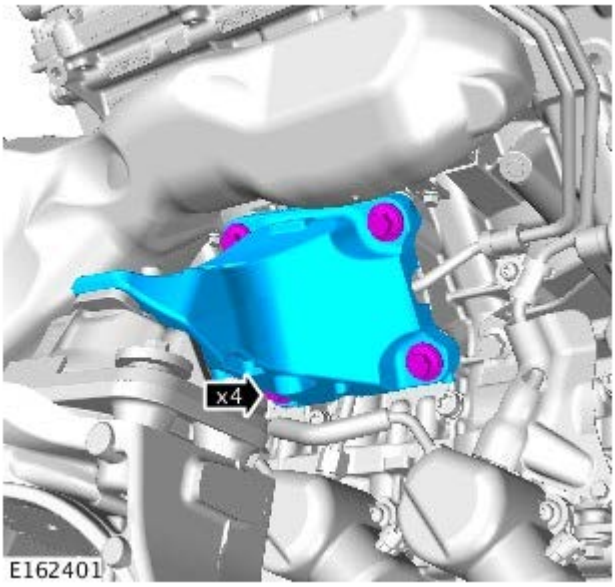


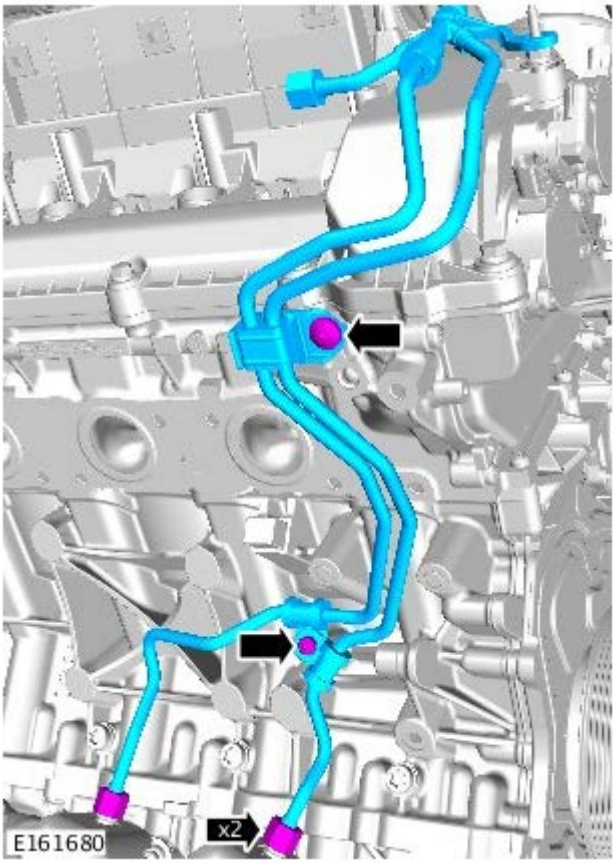
35. CAUTION: Use a wooden block to protect the oil pan when supporting the engine.

Using a suitable hydraulic jack, support the engine.



36.





37. 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

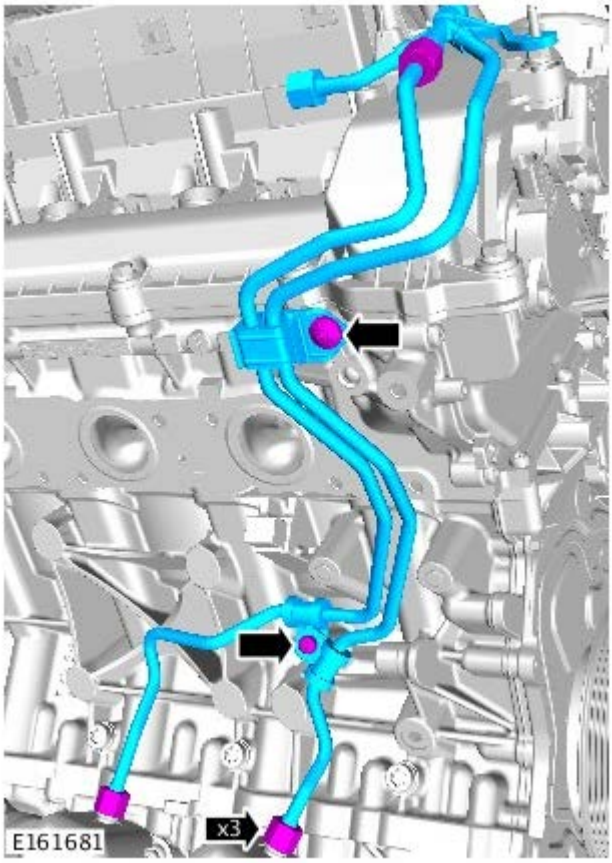
1. CAUTION: Lubricate only the union threads with clean engine oil.

   NOTES:

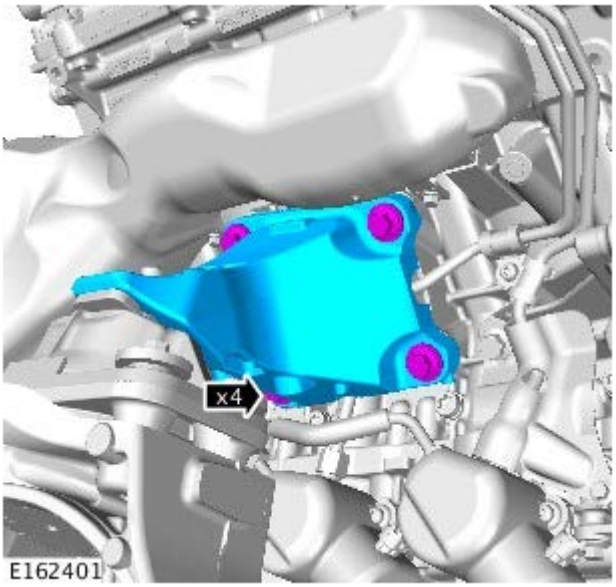
   Engine shown removed for clarity.

   Install the bolts and unions finger tight before final tightening.

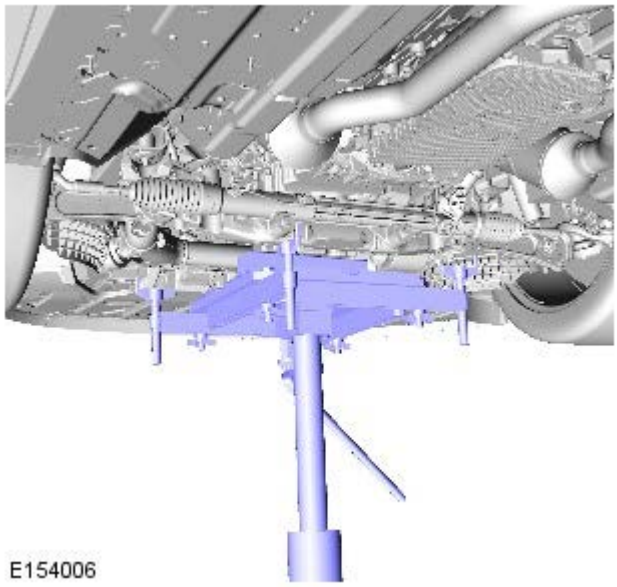
   Remove and discard the blanking caps.



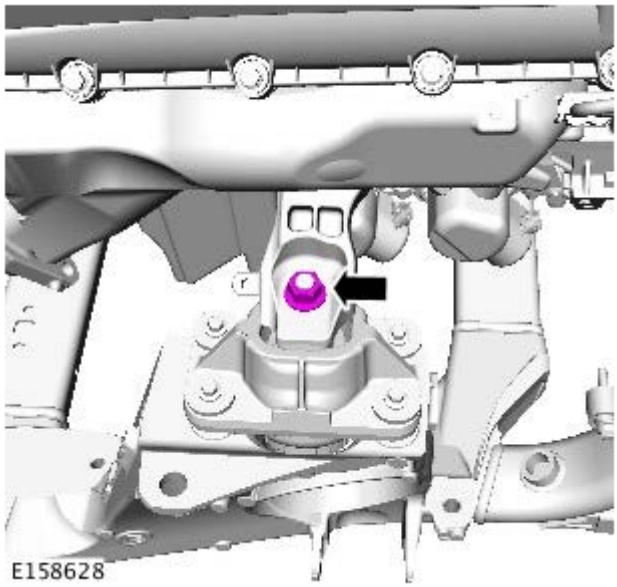
2. *Torque:*
   Stage 1:45 Nm
   Stage 2:60°



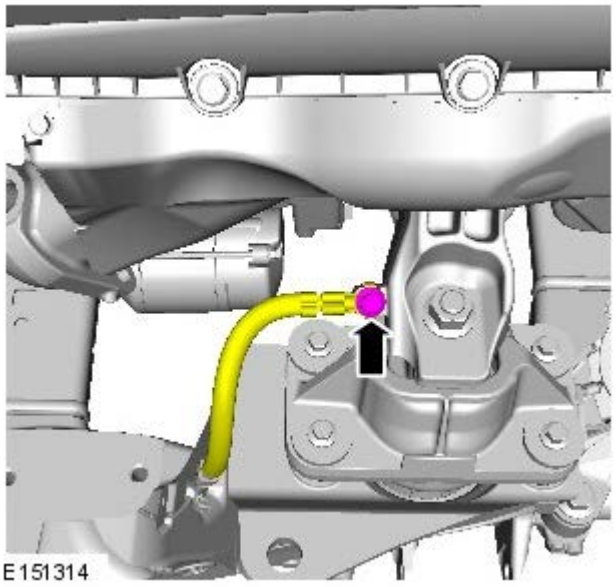
3. Remove the special tool.



4. *Torque:* 130 Nm

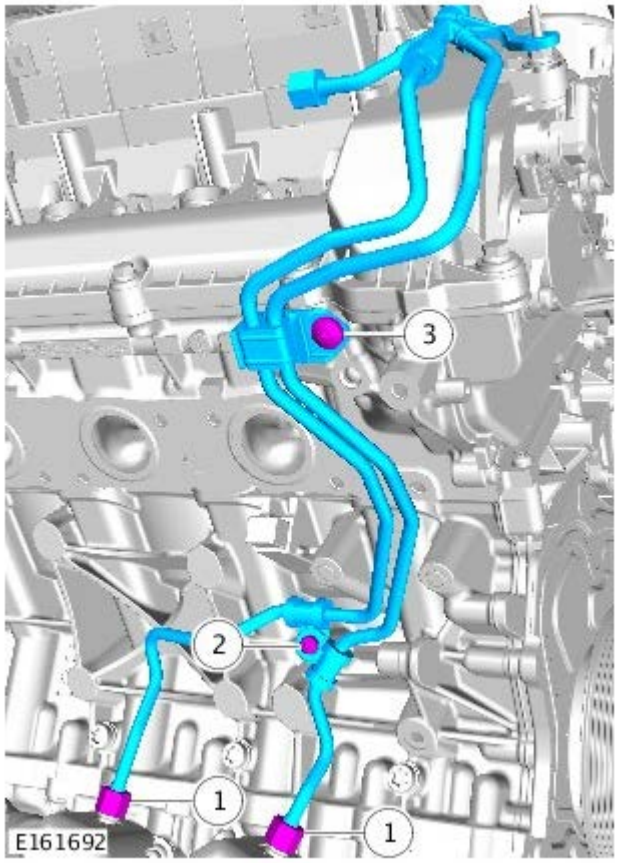


5. *Torque:* 10 Nm



6. NOTE: Some components shown removed for clarity.

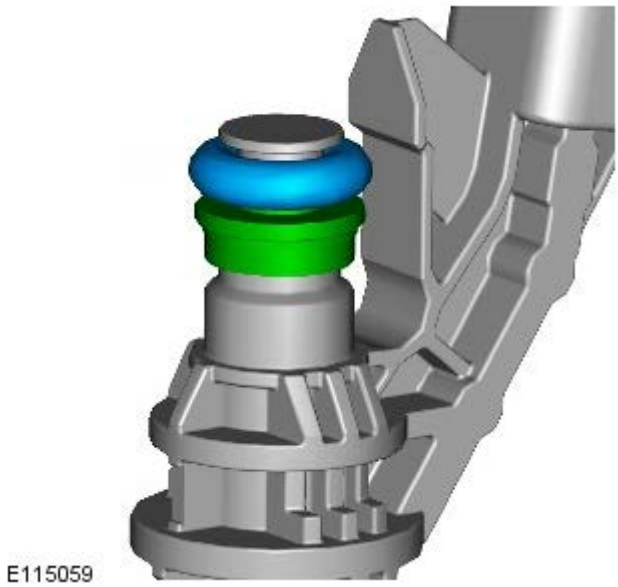
Torque:
Unions (1) 21 Nm
M6 (2) 11 Nm



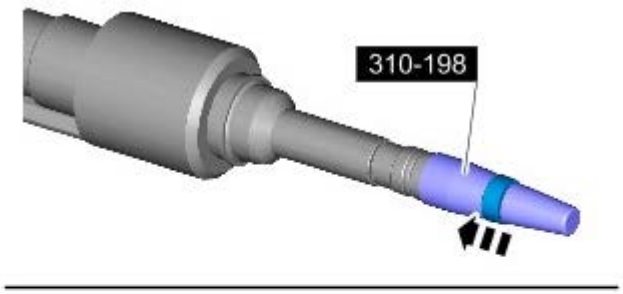
M8 (3) 25 Nm

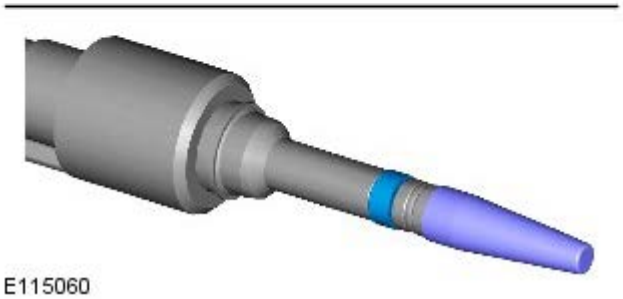
7. Lower the vehicle.

8.



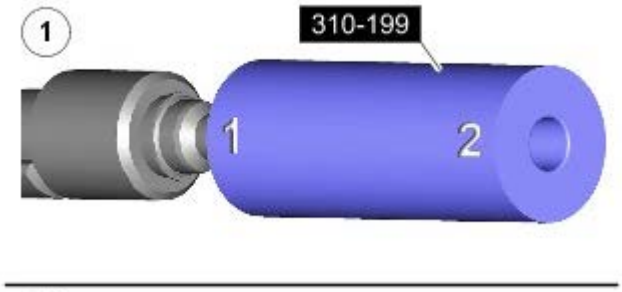
9. *Special Tool(s):* 310-198

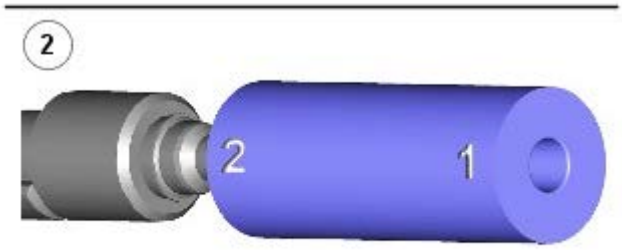




E115060

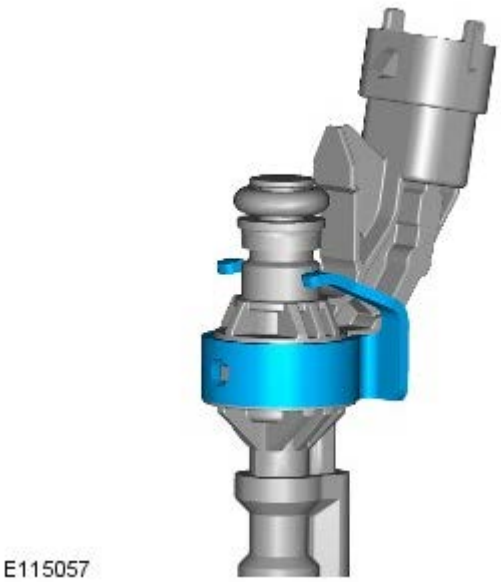
10. *Special Tool(s):* 310-199





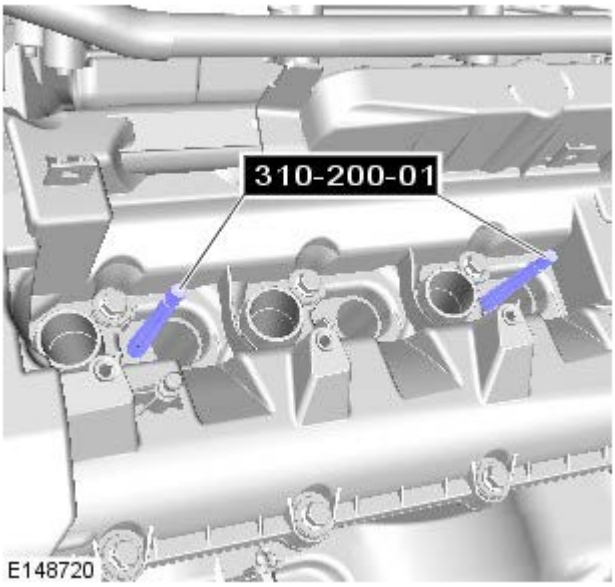
E115062

11. CAUTION: If the original fuel injector is being installed, the original fuel injector clamp must installed with the fuel injector it was removed with.



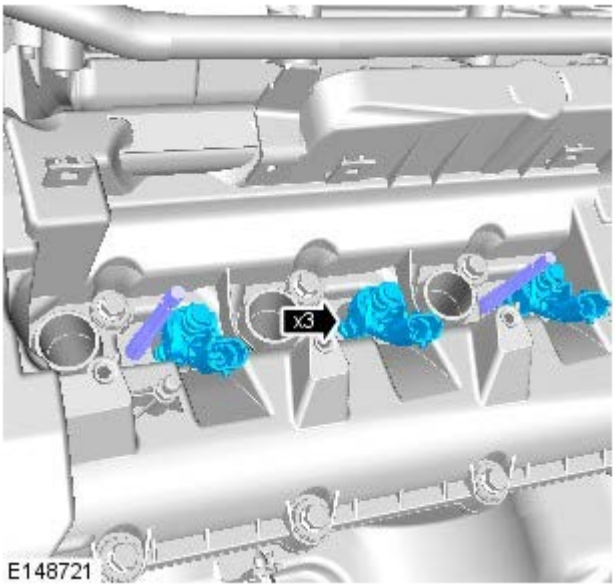
E115057

12. 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



13. CAUTIONS:

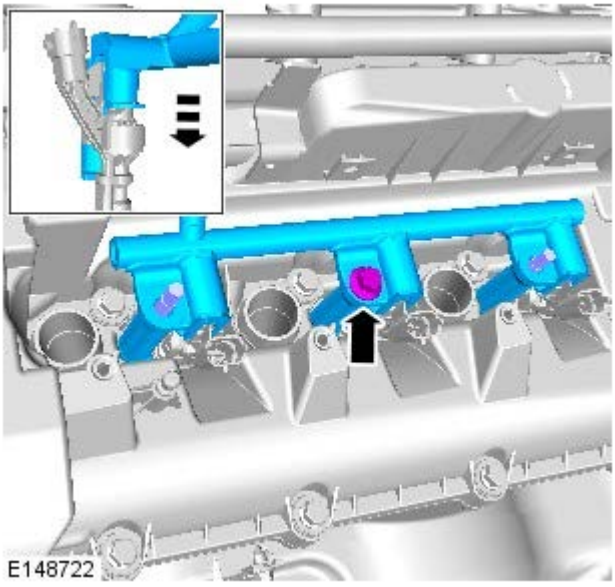
Make sure that the area around the open fuel injector ports are clean and free of foreign material and lubricant prior to installing the fuel injector.

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.

14. NOTE: This step is only required if a new fuel rail is installed.

Refer to: Fuel Rail Pressure (FRP) Sensor (303-14D, Removal and Installation).



15. 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.

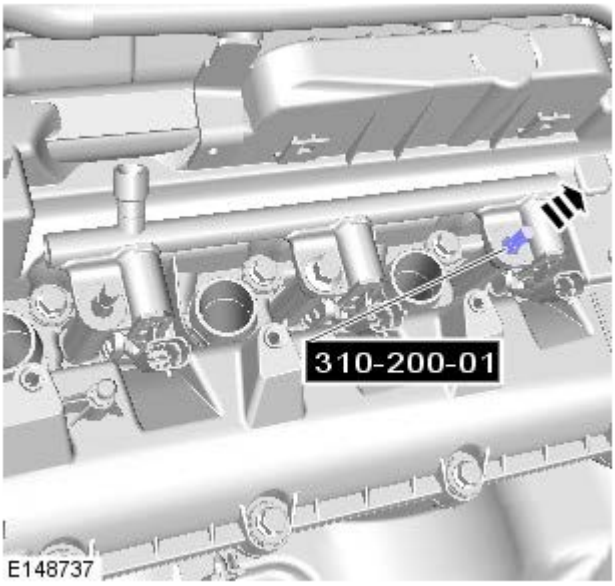
Tighten the fuel rail retaining bolts a turn at a time until the correct torque is achieved.

NOTES:

Lubricate the fuel injector O-ring seals with clean engine oil.

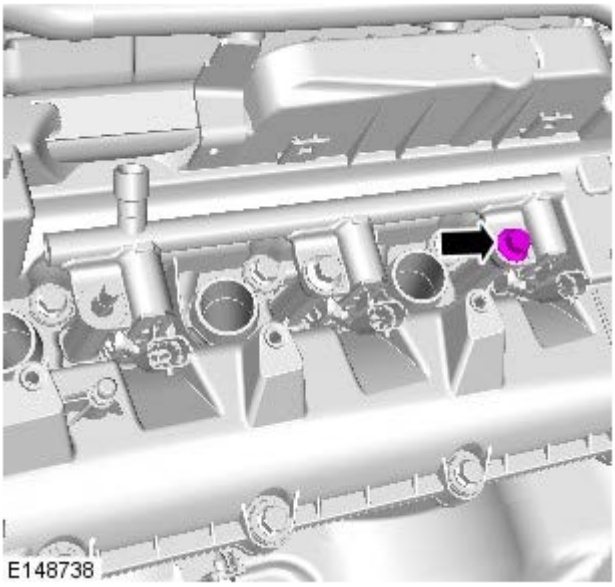
LH illustration shown, RH is similar.

Torque: 20 Nm



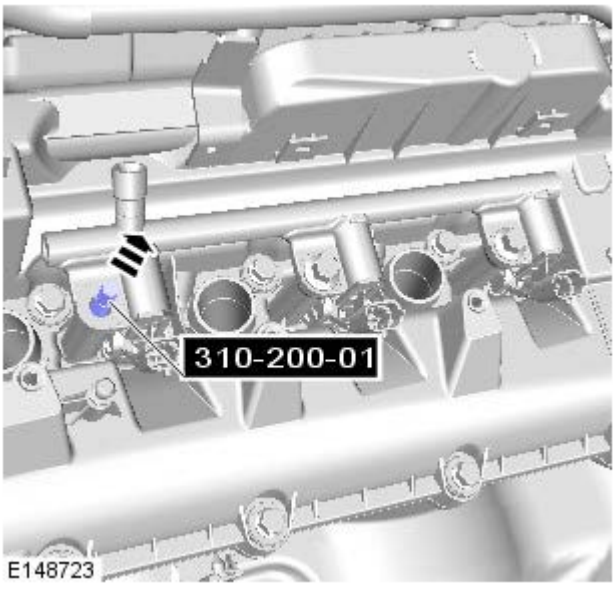
16. NOTE: LH illustration shown, RH is similar.

Special Tool(s): 310-200-01



17. NOTE: LH illustration shown, RH is similar.

Torque: 20 Nm

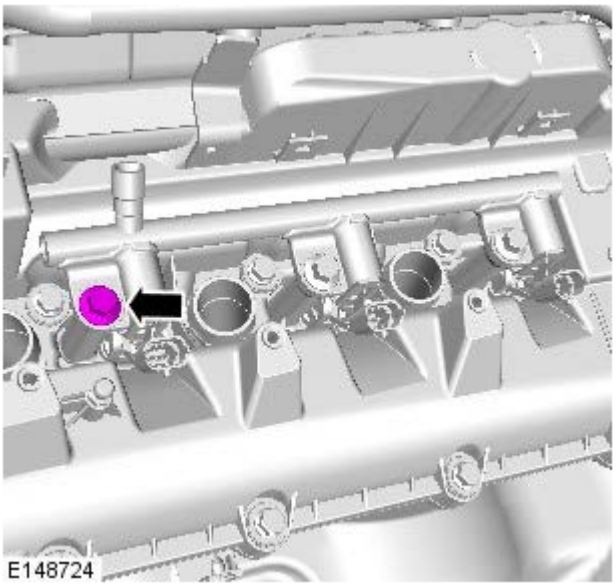


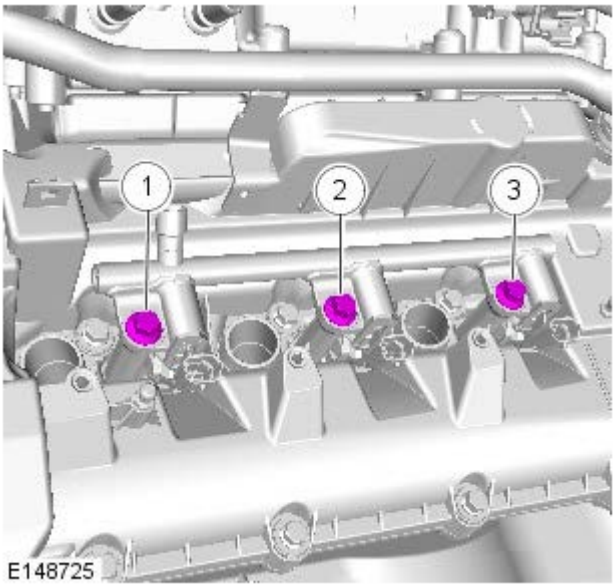
18. NOTE: LH illustration shown, RH is similar.

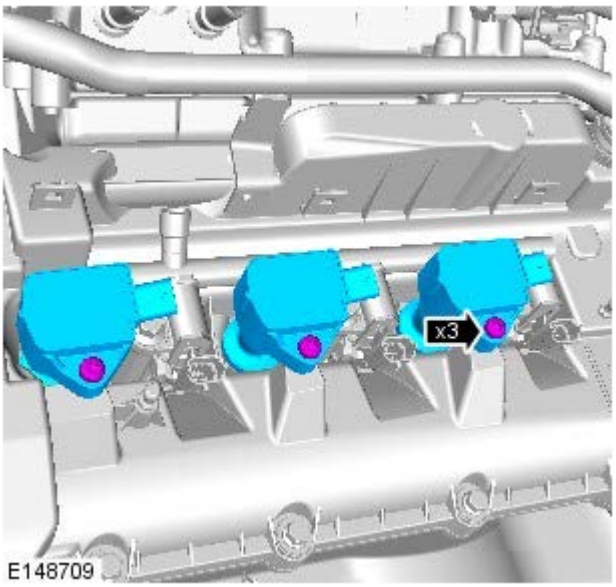
Special Tool(s): 310-200-01

19. NOTE: LH illustration shown, RH is similar.

Torque: 20 Nm







20. NOTES:

Tighten the bolts in the indicated sequence.

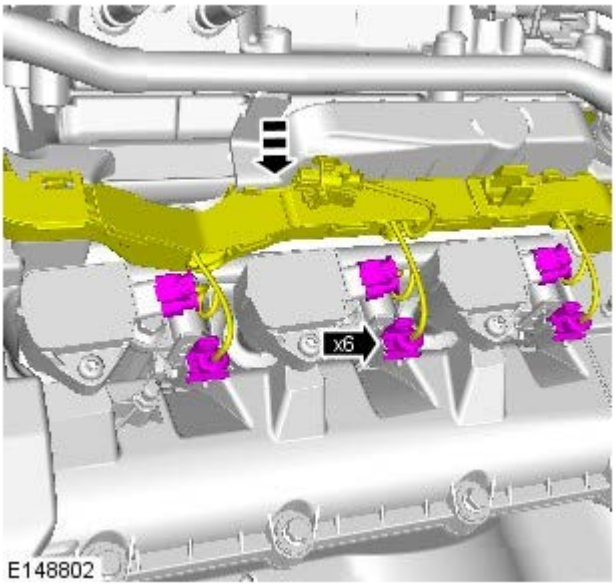
LH illustration shown, RH is similar.

Torque:
Bolt 2 30 Nm
Bolt 3 30 Nm
Bolt 1 30 Nm

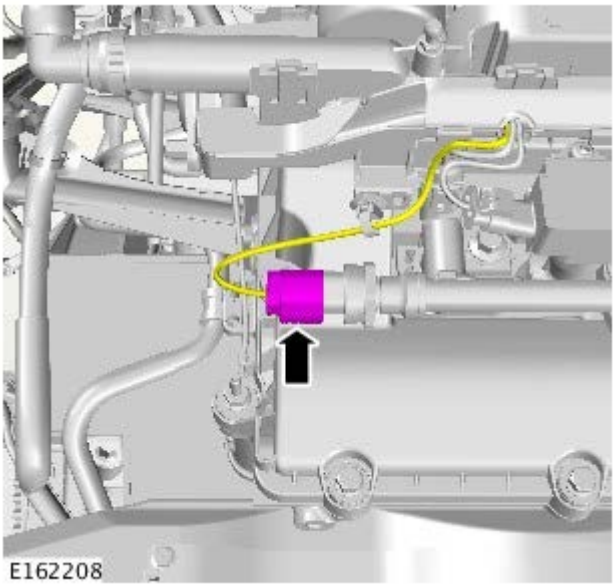
21. NOTE: LH illustration shown, RH is similar.

Torque: 8 Nm

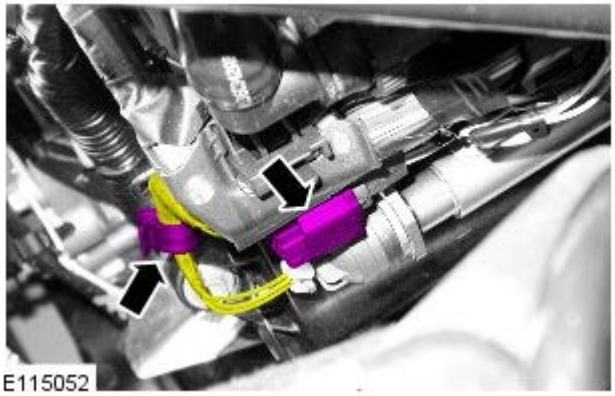
22. NOTE: LH illustration shown, RH is similar.



23.

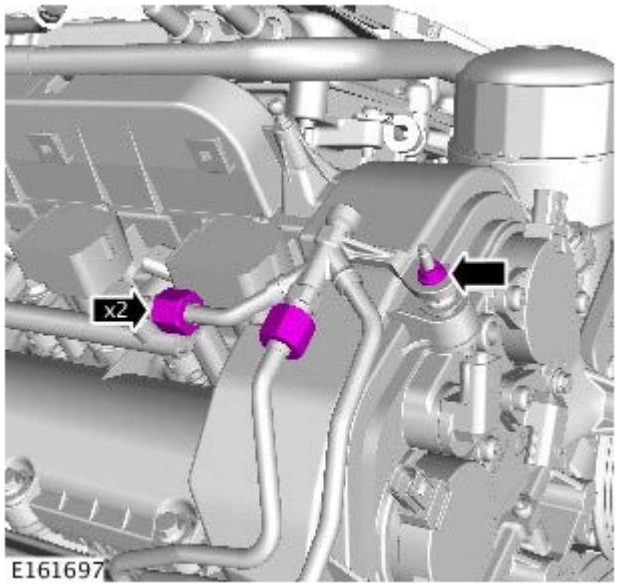


24. NOTE: If equipped.



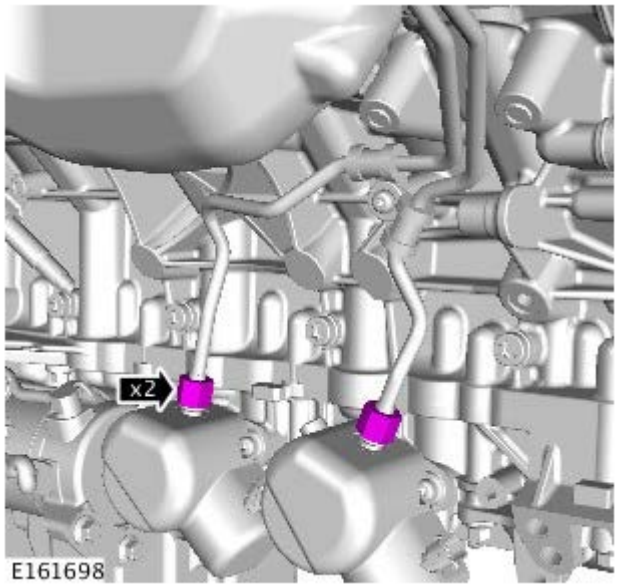
25. NOTE: Remove and discard the blanking caps.

Torque:
Unions 21 Nm
Nut 6 Nm



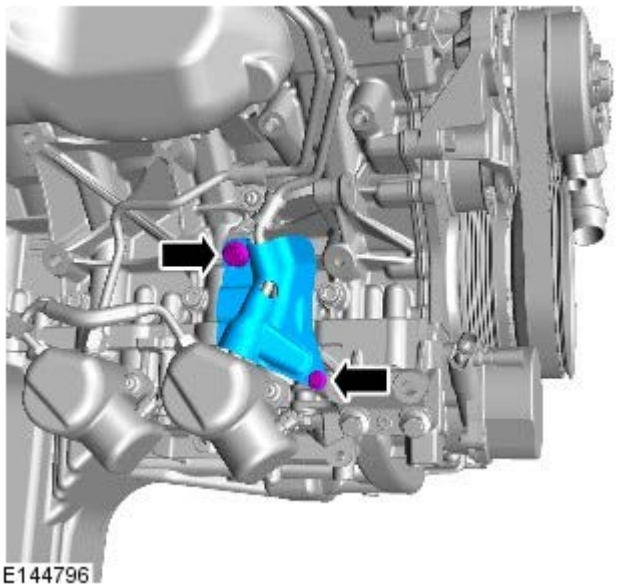
26. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

    Raise and support the vehicle.



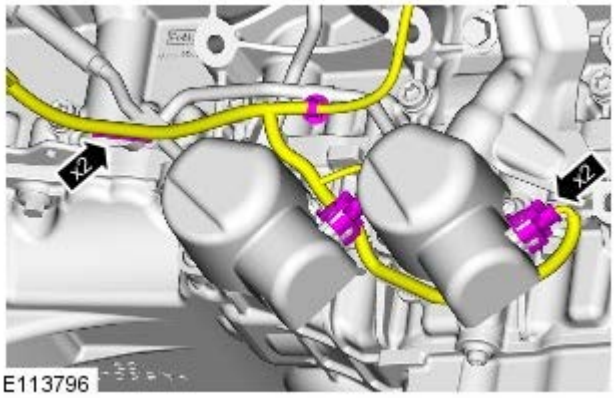
27. NOTE: Some components shown removed for clarity.

    Torque: 21 Nm

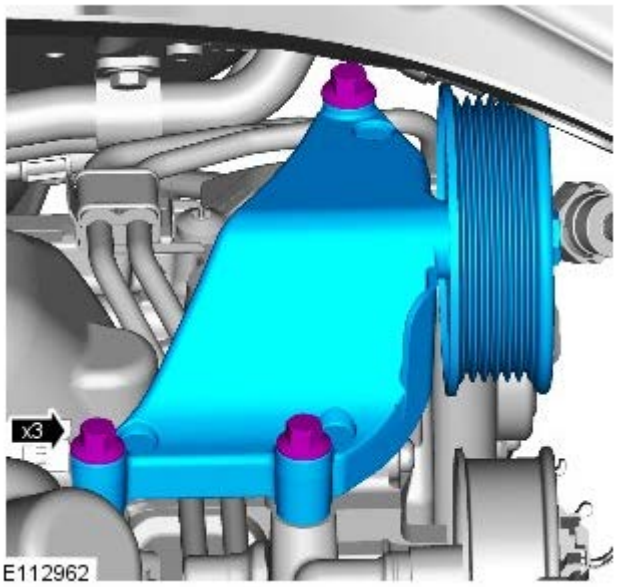


28. *Torque:*
    M6 12 Nm
    M10 29 Nm

29.



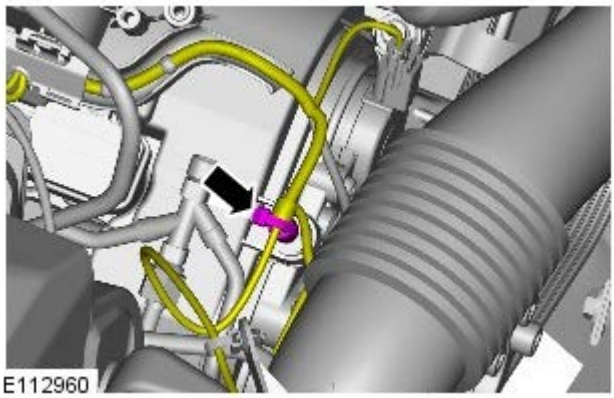
30. *Torque:* 25 Nm



31. Refer to: Generator (414-02C Generator and Regulator - V8 S/C 5.0L Petrol, Removal and Installation).

32. Lower the vehicle.

33.

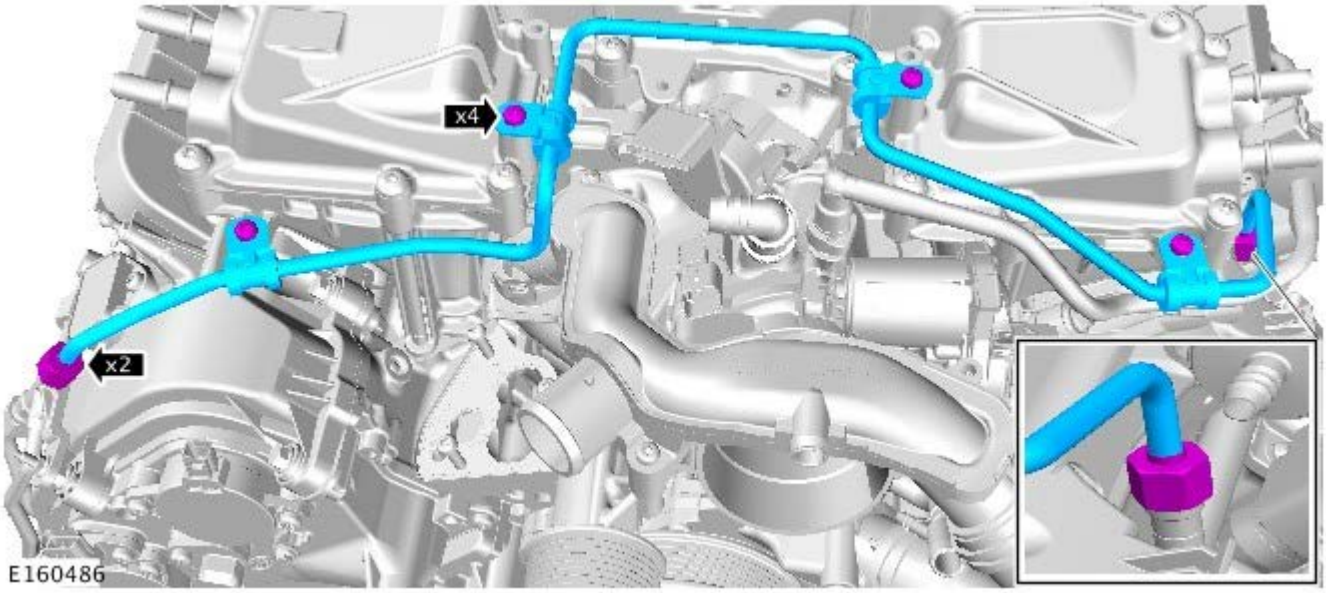


34. CAUTION: Lubricate only the union threads with clean engine oil.

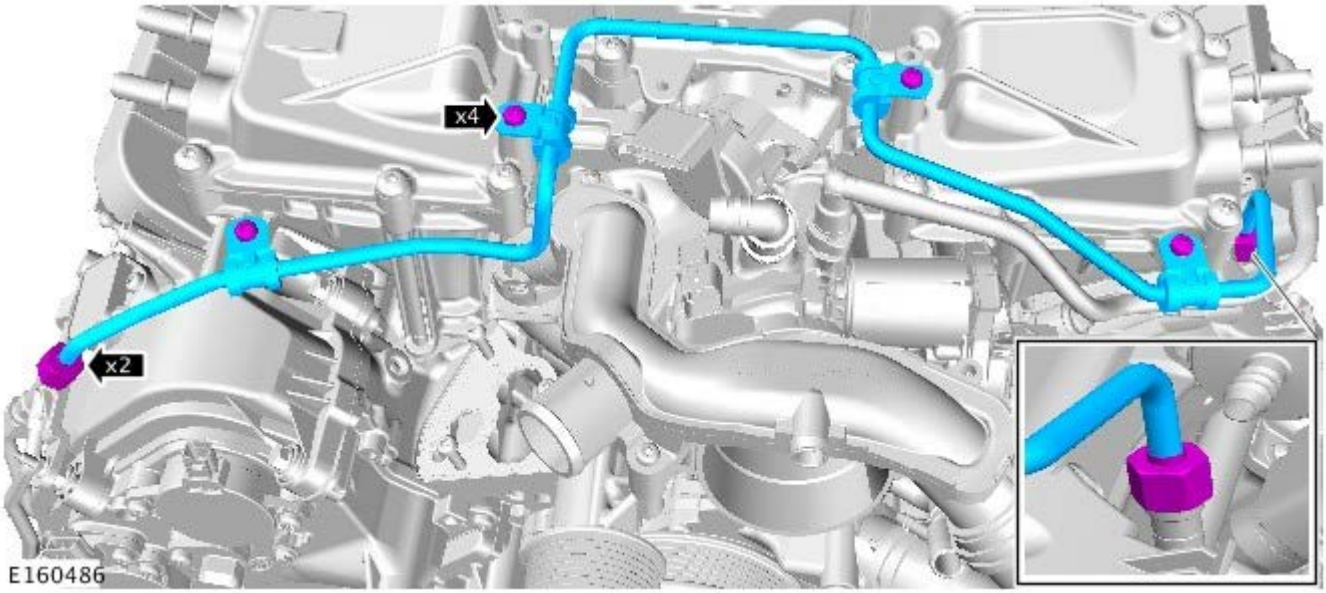
NOTES:

Install the bolts and unions finger tight before final tightening.

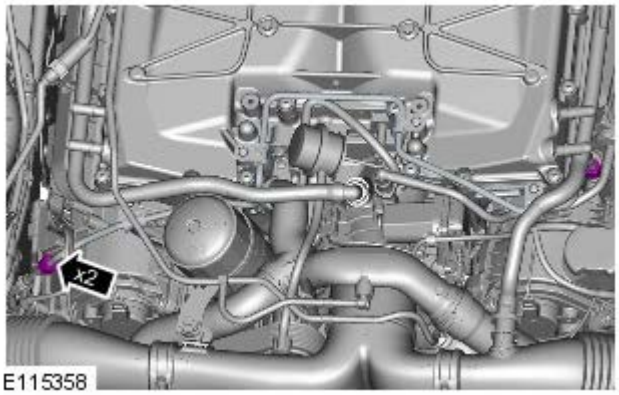
Remove and discard the blanking caps.



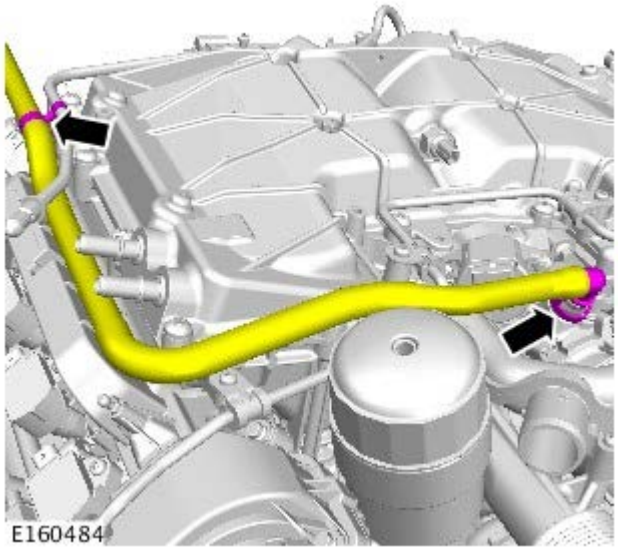
35. *Torque:*
Unions 21 Nm
Bolts 12 Nm



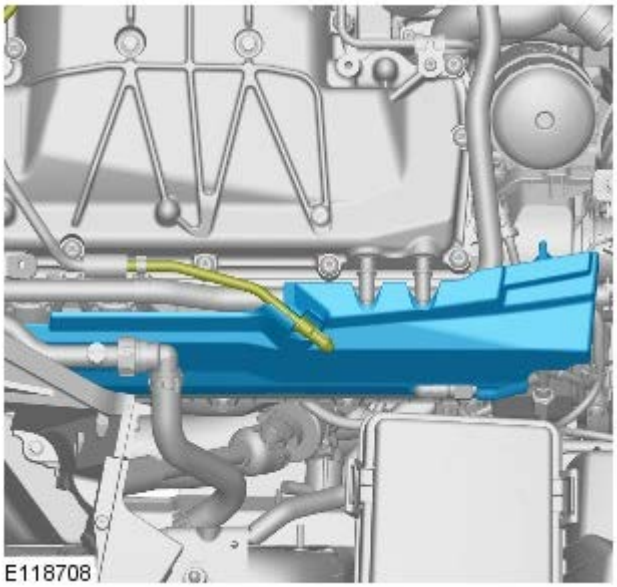
36. *Torque:* 21 Nm



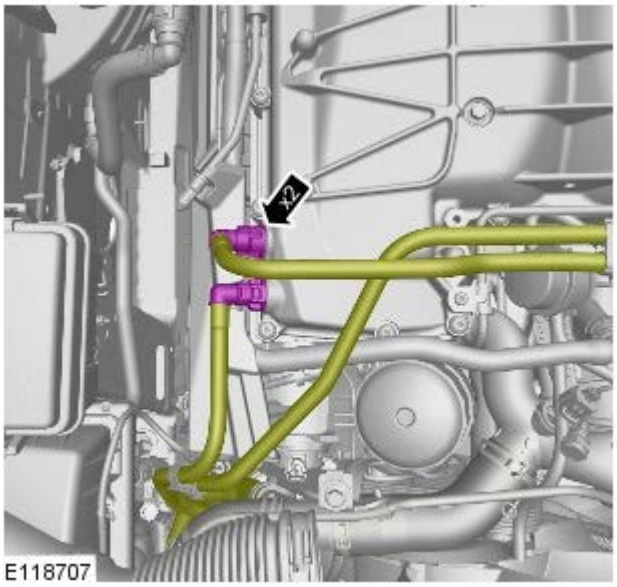
37.



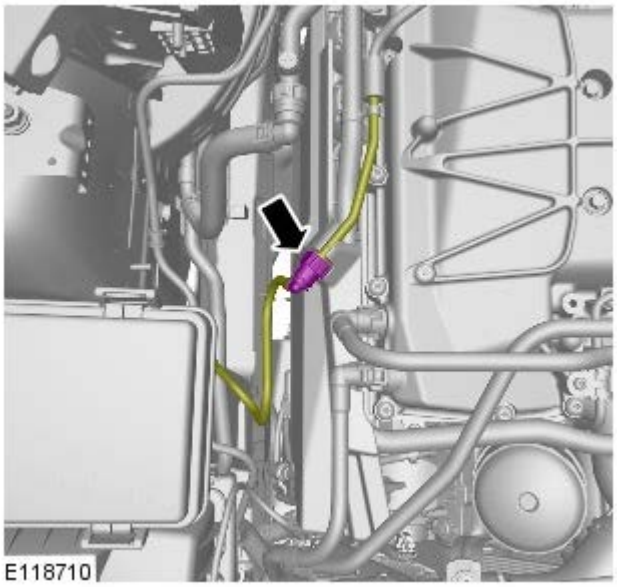
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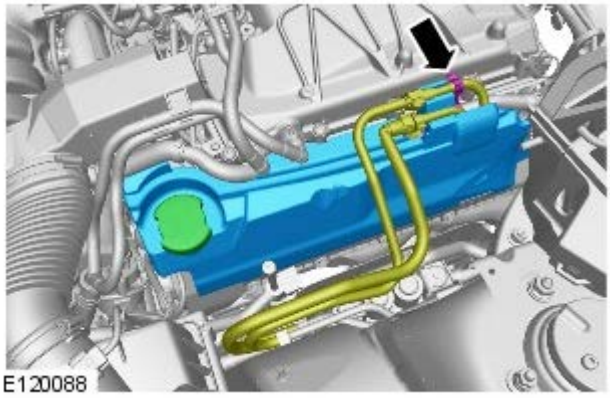
39.



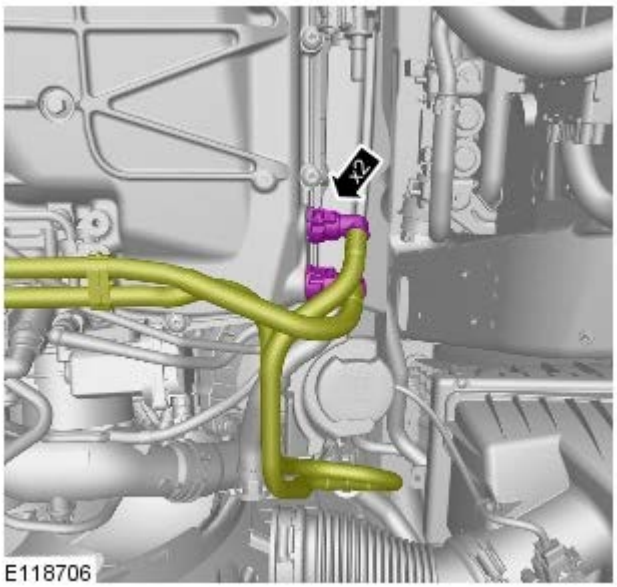
40.



41.

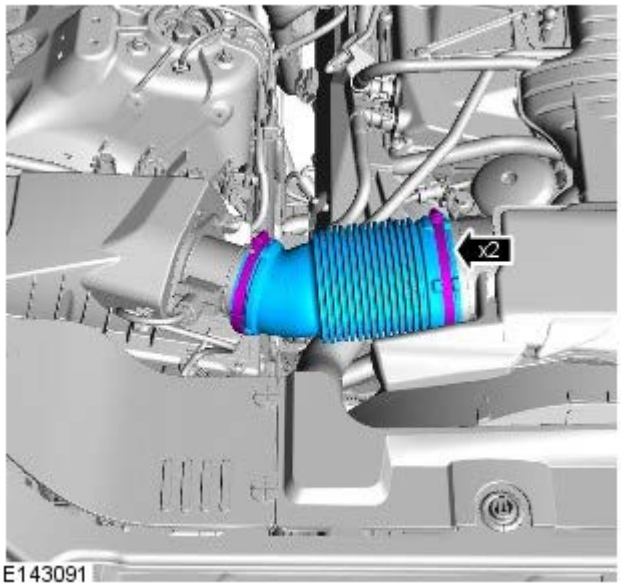


42.



43. Refer to: Air Cleaner RH (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).

44. *Torque:* 3.5 Nm



E143091

45. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).

46. Connect the battery ground cable.

    Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

47. Refer to: Engine Cover - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (501-05 Interior Trim and Ornamentation, Removal and Installation).

Published: 06-Sep-2012

Fuel Charging and Controls - V8 S/C 5.0L Petrol - High Pressure Fuel Pump 1

Removal and Installation

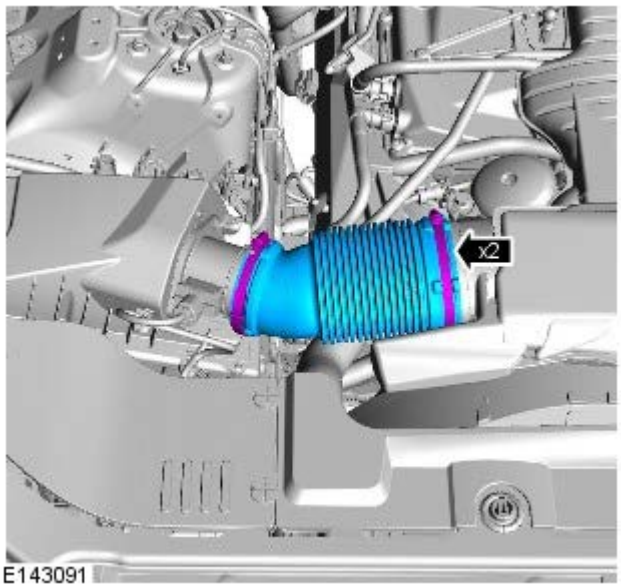
Removal

CAUTION: 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.

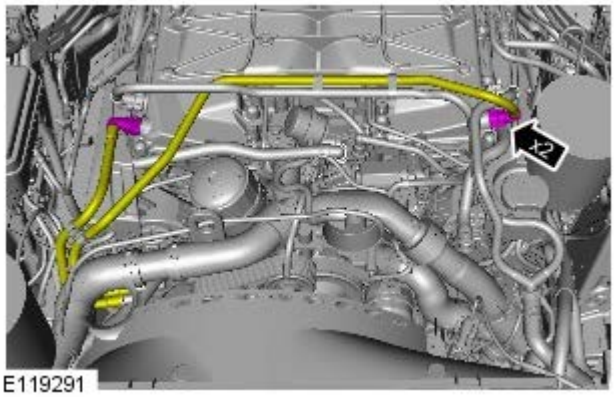
NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

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 - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (310-00 Fuel System - General Information, General Procedures).
3. Disconnect the battery ground cable.

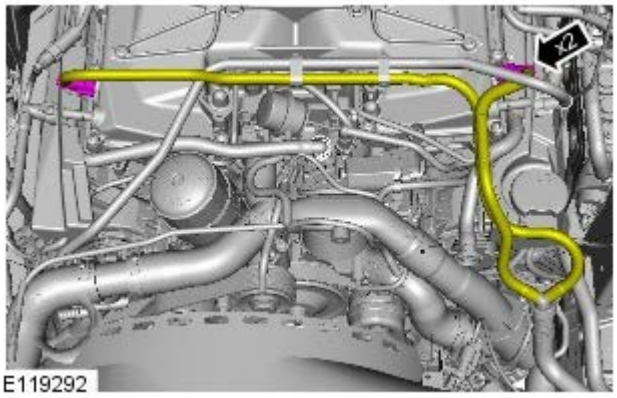
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).
4. Refer to: Engine Oil Draining and Filling (303-01C Engine - V8 S/C 5.0L Petrol, General Procedures).
5. Refer to: Fuel Injection Component Cleaning (303-04C Fuel Charging and Controls - V6 S/C 3.0L Petrol, General Procedures).
6. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).
7. *Torque:* 3.5 Nm



8. CAUTION: Be prepared to collect escaping coolant.



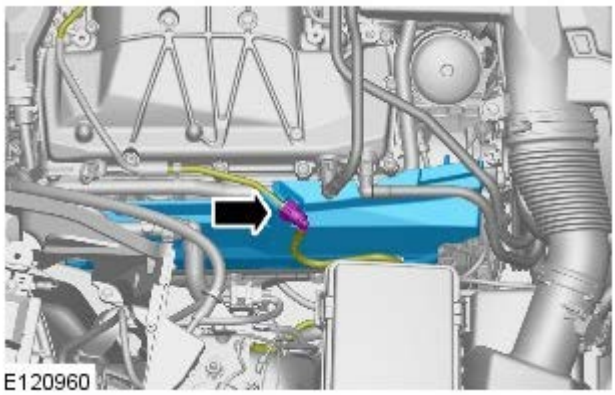
E119291



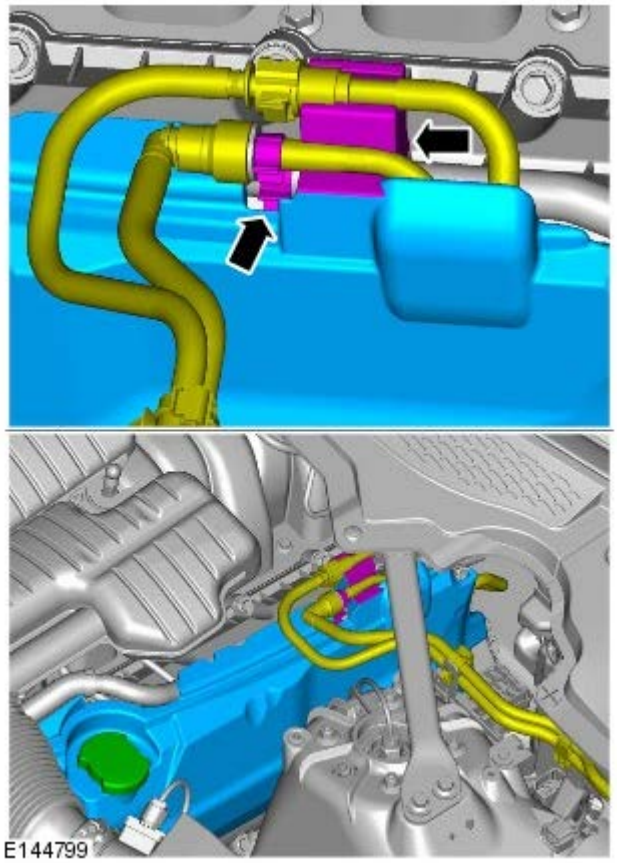
E119292

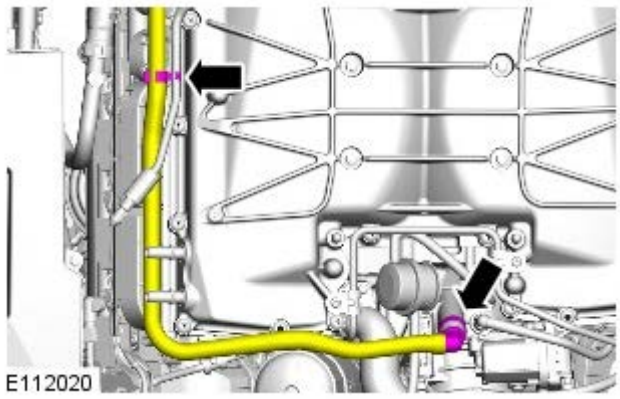
9. WARNING: Be prepared to collect escaping fluids.

10.

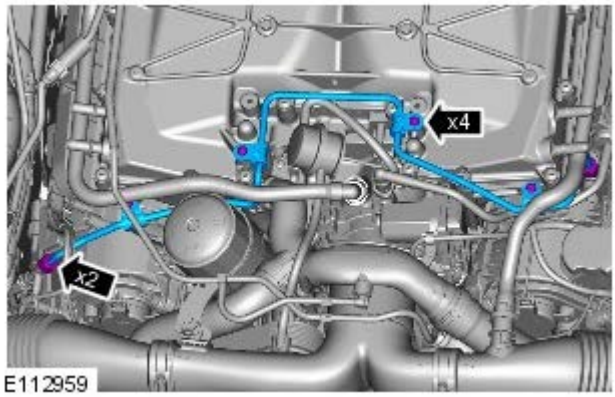

E120960

11.





12. CAUTION: Be prepared to collect escaping fluids.

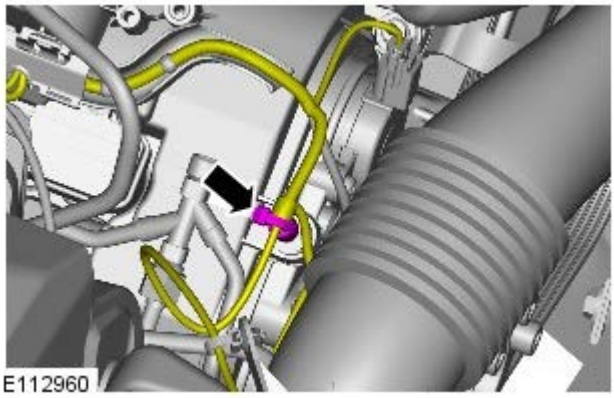


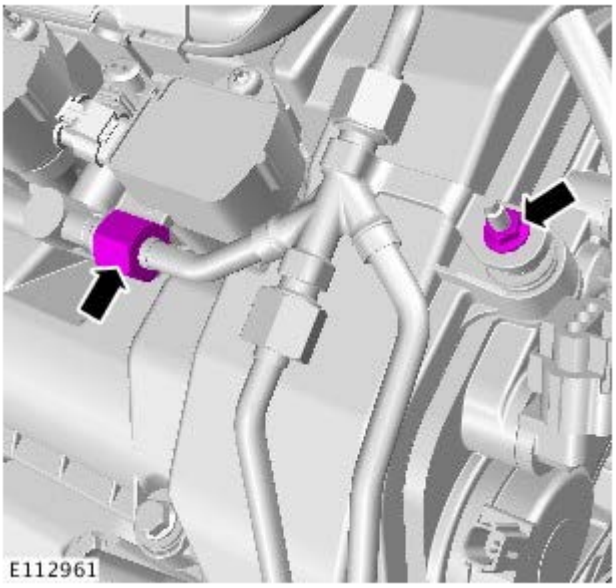
13. CAUTIONS:

Be prepared to collect escaping fluids.

Make sure that all openings are sealed. Use new blanking caps.

14.





15. CAUTIONS:

    Be prepared to collect escaping fluids.

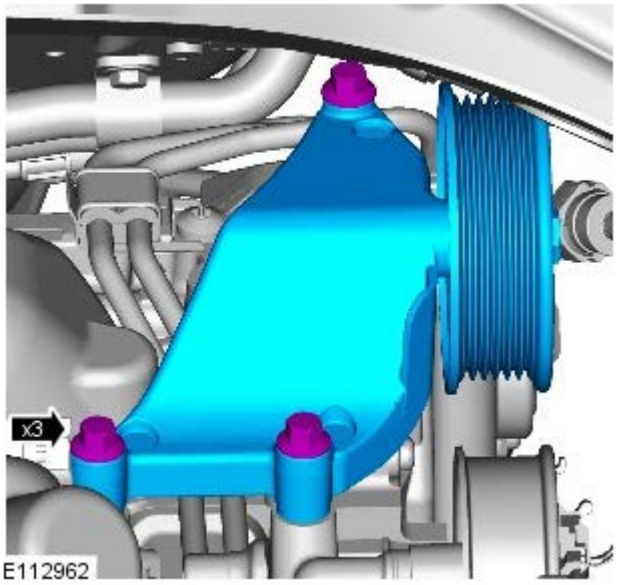
    Make sure that all openings are sealed. Use new blanking caps.

16. WARNING: Make sure to support the vehicle with axle stands.

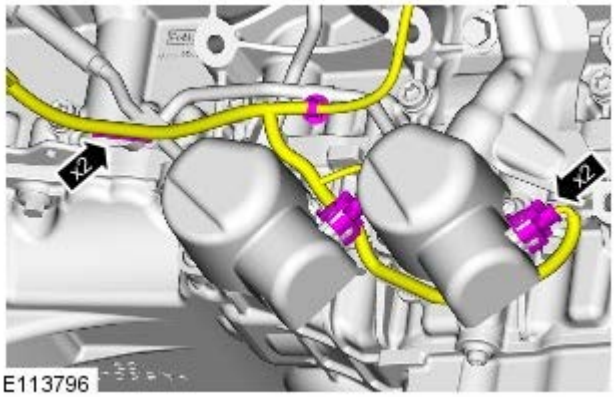
    Raise and support the vehicle.

17. Refer to: Generator (414-02C Generator and Regulator - V8 S/C 5.0L Petrol, Removal and Installation).

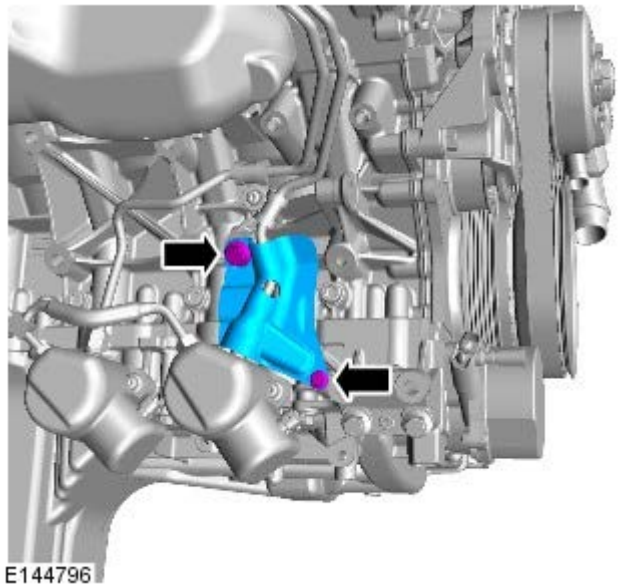
18.



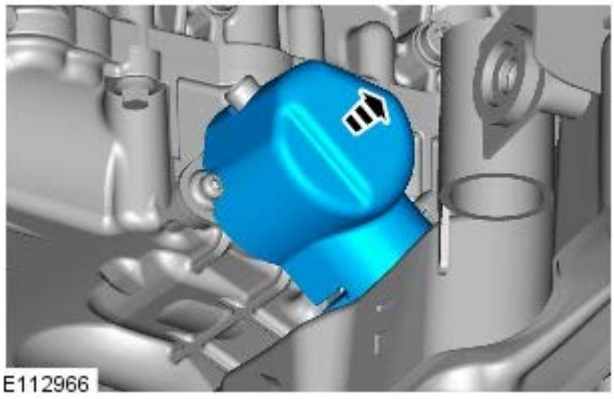
19. NOTE: Engine shown removed for clarity.



20.



21.



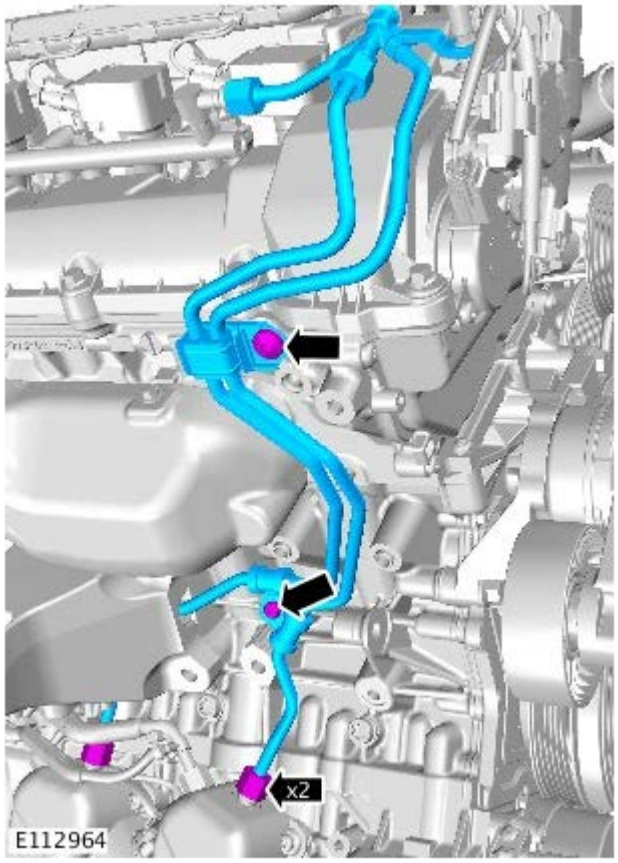
22. CAUTIONS:

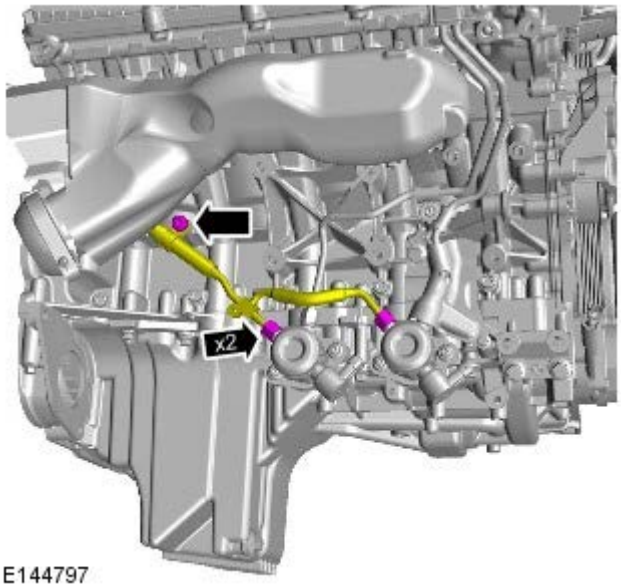
Be prepared to collect escaping fluids.

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.





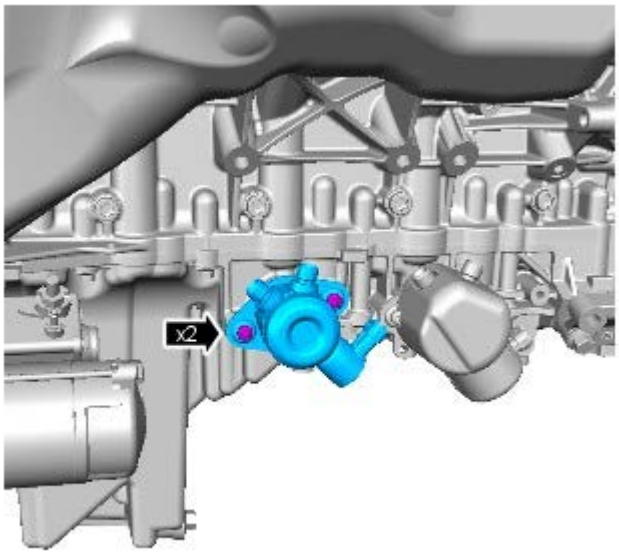
23. CAUTIONS:

    Be prepared to collect escaping fluids.

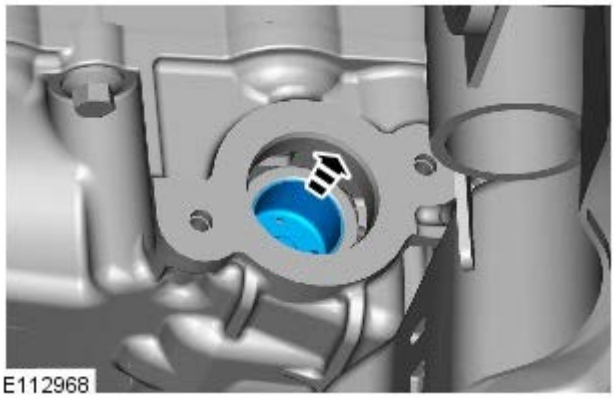
    Make sure that all openings are sealed. Use new blanking caps.

24. CAUTION: Be prepared to collect escaping fluids.

    Loosen the Torx screws a turn each at a time.

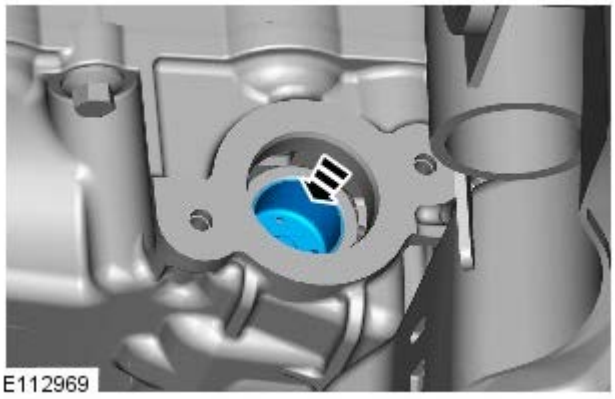


E144831


E112968

25. CAUTION: Be prepared to collect escaping fluids.

Installation

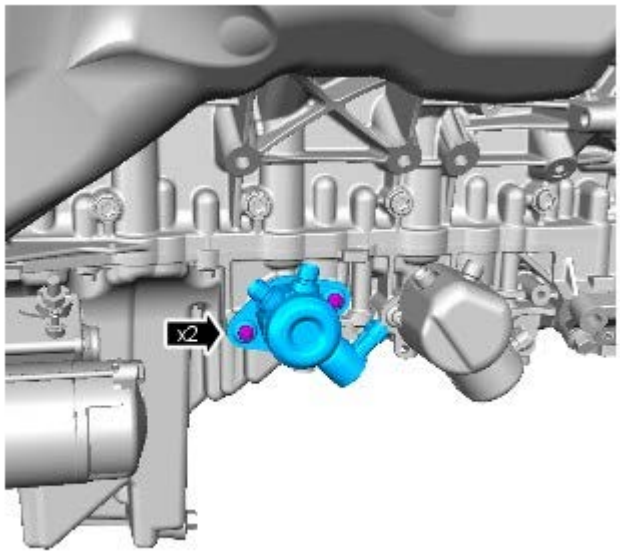

E112969

1. NOTE: Lubricate the fuel rail high-pressure fuel pump bucket with clean engine oil.

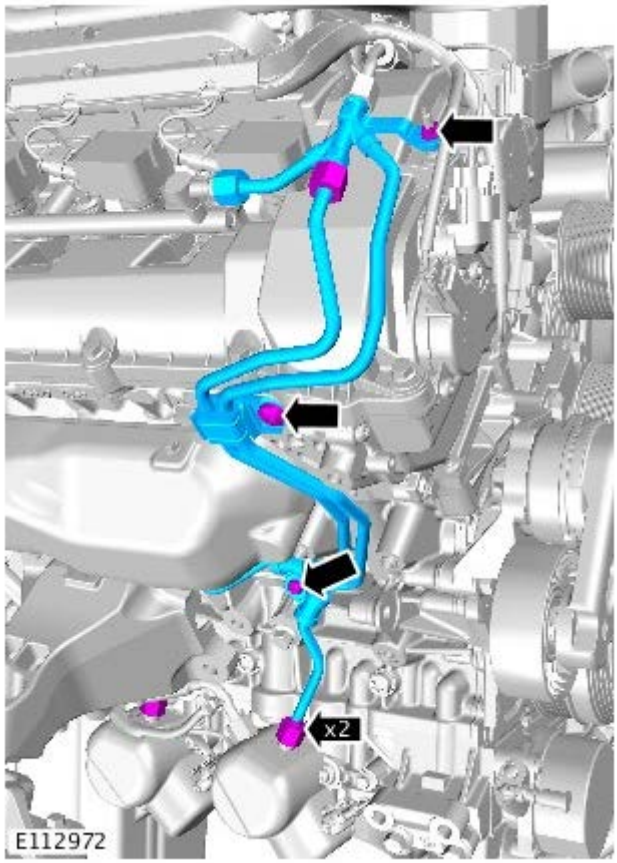
2. CAUTION: Tighten the Torx screws a turn at a time until the correct torque is achieved.

NOTE: Lubricate the fuel rail high-pressure fuel pump O-ring seal with clean engine oil.

Torque: 12 Nm



E144831



E112972

3. CAUTIONS:

Install new high-pressure fuel supply lines.

Lubricate only the union threads with clean engine oil.

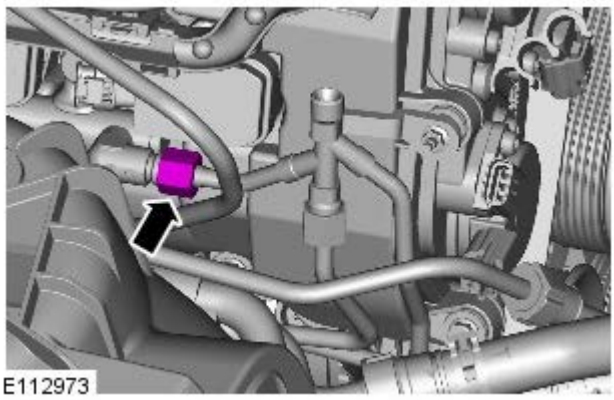
NOTES:

Remove and discard the blanking caps.

Engine shown removed for clarity.

Install the bolt and unions fully finger tight before final tightening.

4. Lower the vehicle.


E112973

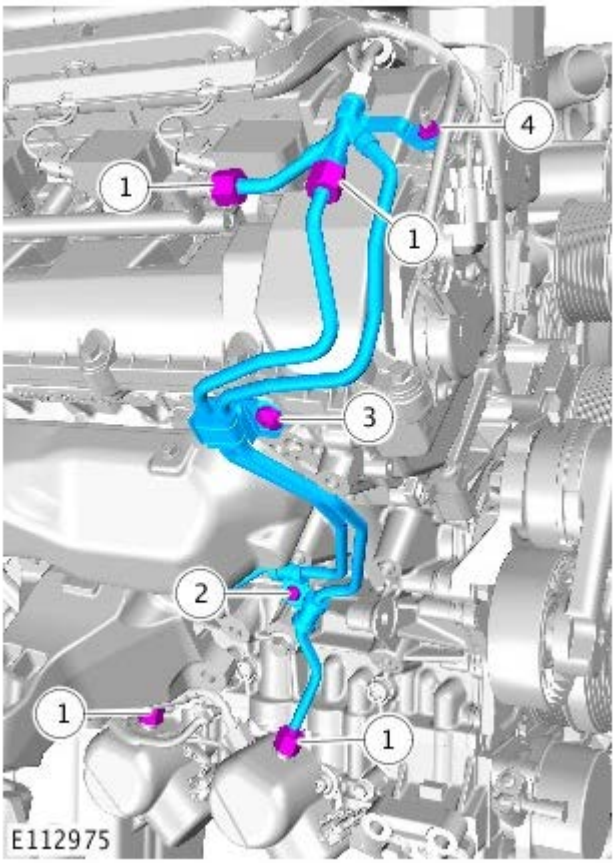
5. NOTES:

Do not tighten at this stage.

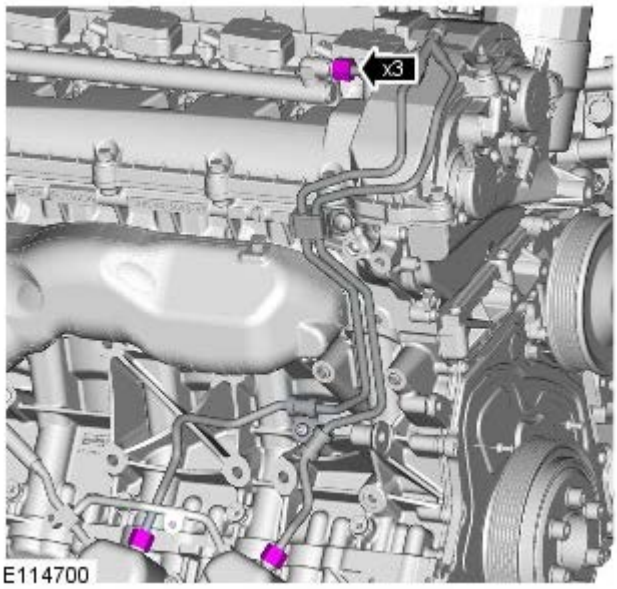
Remove and discard the blanking caps.

6. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.



7. *Torque:*
   Unions (1) 20 Nm
   M6 (2) 12 Nm
   M8 (3) 25 Nm
   M5 nut (4) 6 Nm



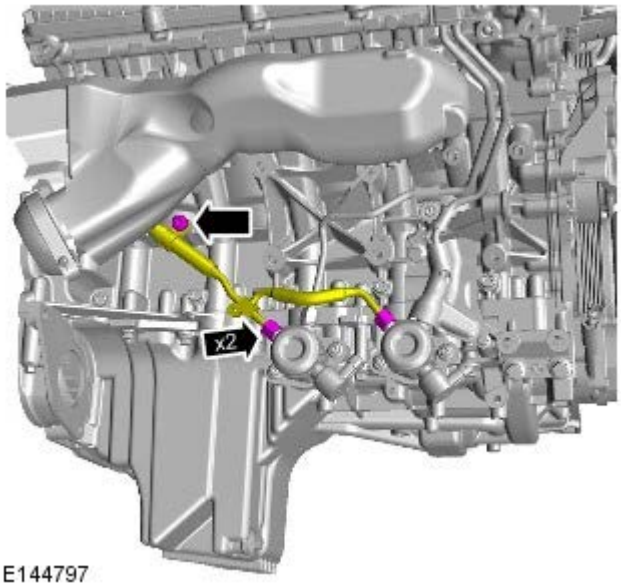
8. *Torque:* 21 Nm

9. NOTES:

   Install the bolt and unions finger tight before final tightening.

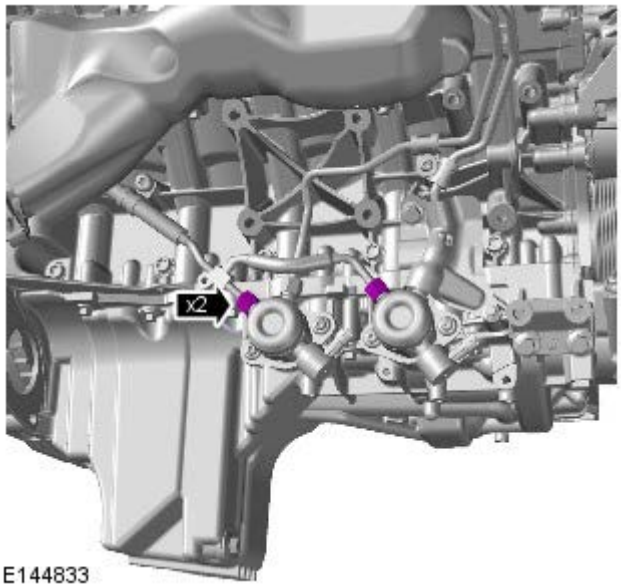
   Remove and discard the blanking caps.

   Torque:
   Unions 20 Nm
   M6 12 Nm



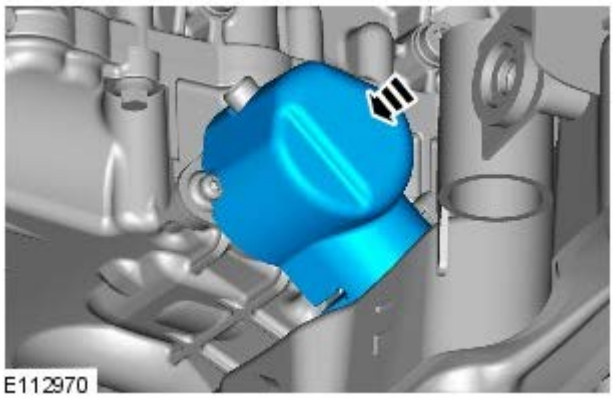
E144797

10. *Torque:* 21 Nm

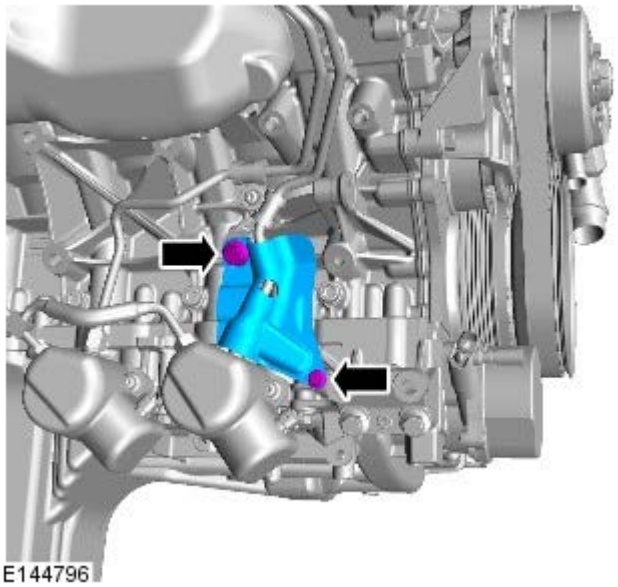


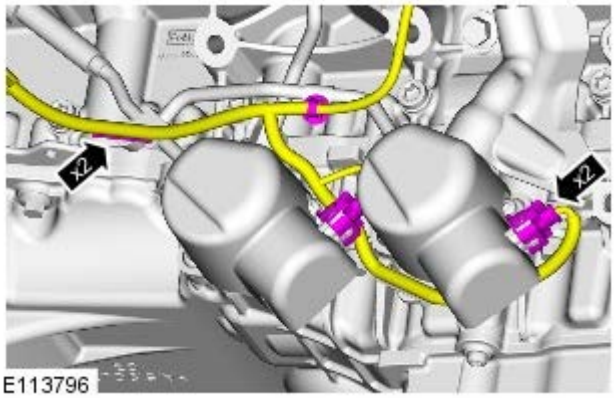
E144833

11.


E112970

12. *Torque:*
M6 12 Nm
M10 29 Nm

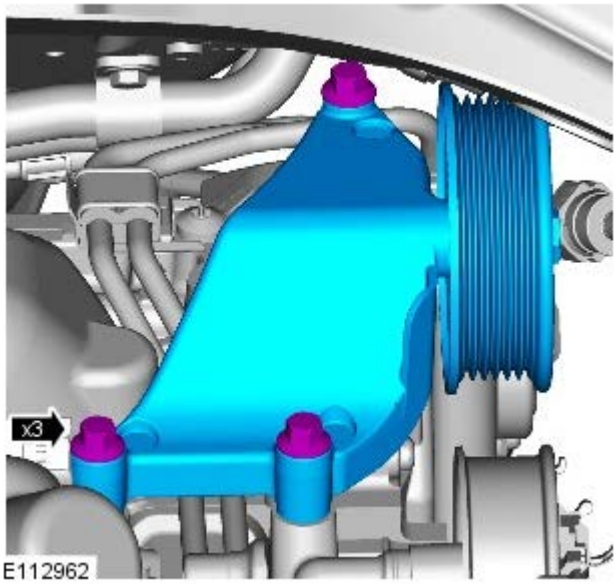

E144796



E113796

13. NOTE: Engine shown removed for clarity.

14. *Torque:* 25 Nm

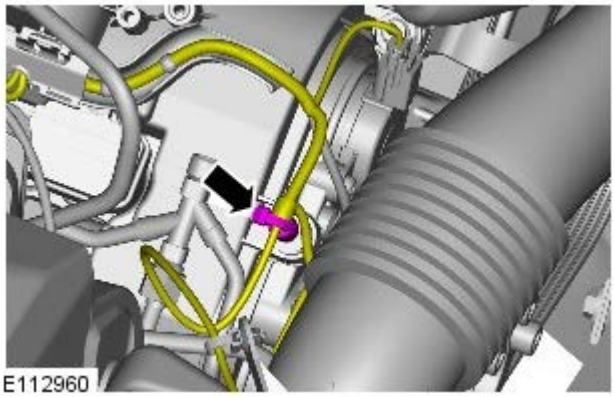


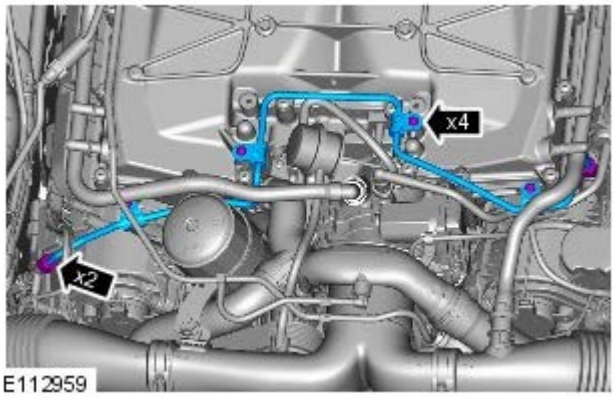
E112962

15. Refer to: Generator (414-02C Generator and Regulator - V8 S/C 5.0L Petrol, Removal and Installation).

16. Lower the vehicle.

17.


E112960



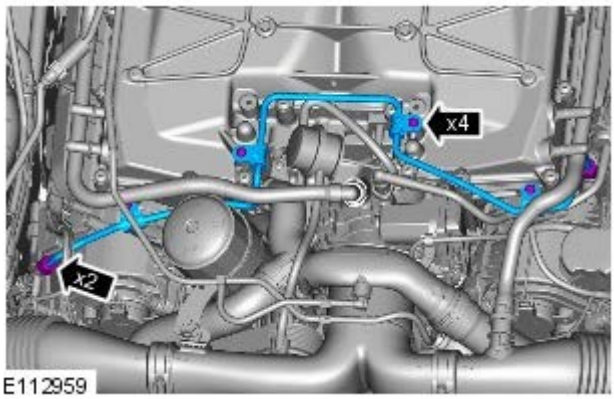
E112959

18. CAUTION: Lubricate only the union threads with clean engine oil.

    NOTES:

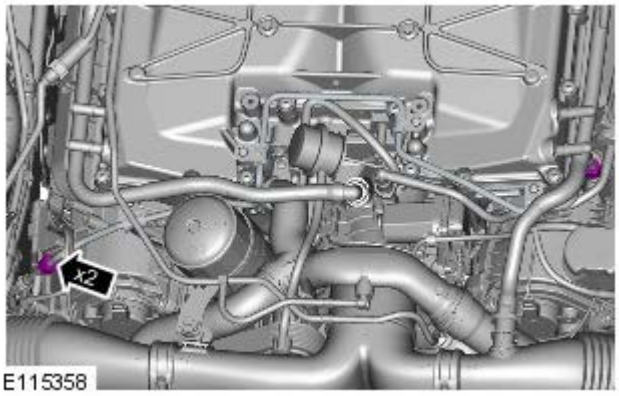
    Do not tighten at this stage.

    Remove and discard the blanking caps.



E112959

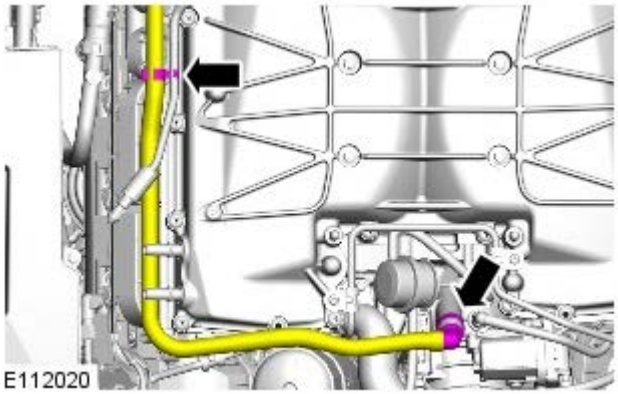
19. *Torque:*
    Unions 20 Nm
    Bolts 8 Nm



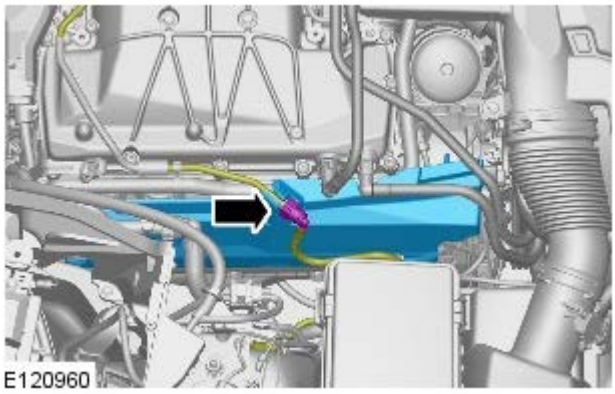
E115358

20. *Torque:* 21 Nm

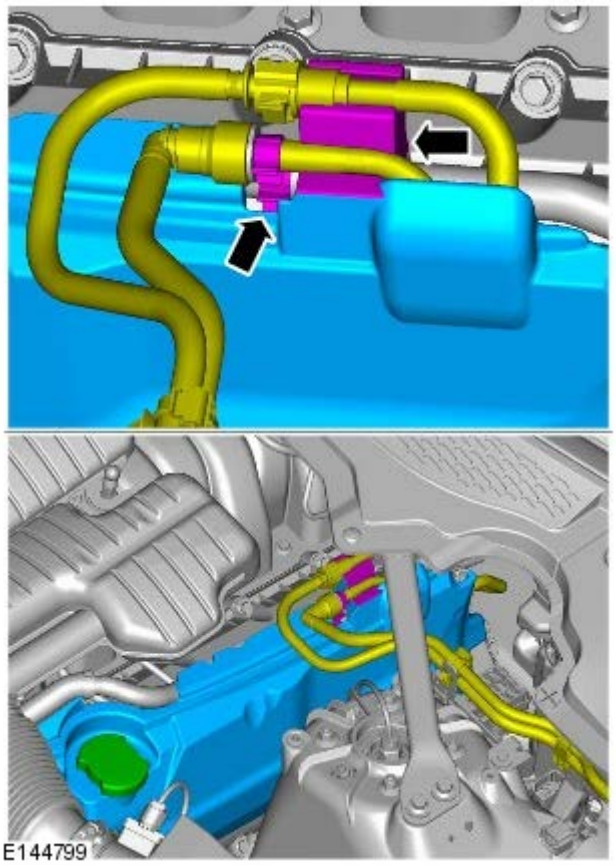
21.



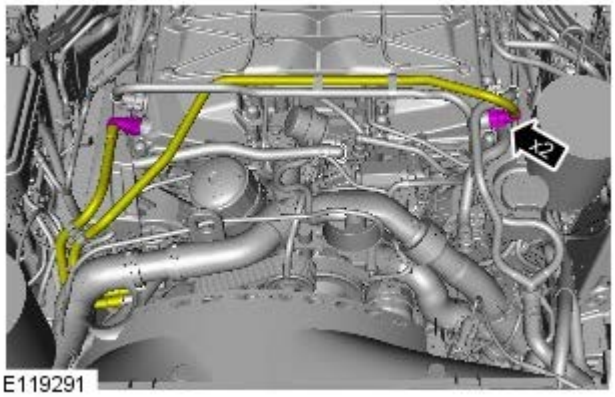
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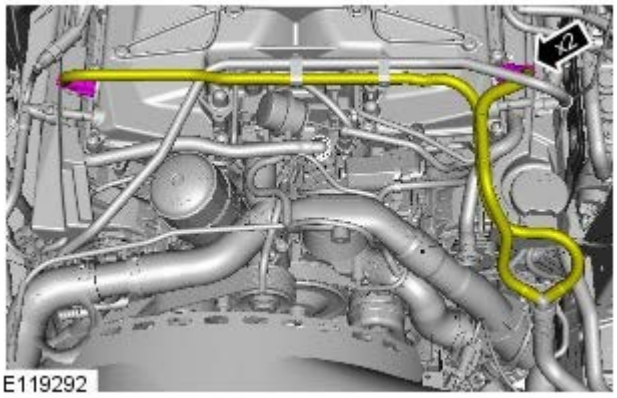


24. CAUTION: Be prepared to collect escaping coolant.



E119291

25.



E119292

26. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).

27. Refer to: Engine Oil Draining and Filling (303-01C Engine - V8 S/C 5.0L Petrol, General Procedures).

28. Connect the battery ground cable.

    Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 06-Sep-2012

Fuel Charging and Controls - V8 S/C 5.0L Petrol - High Pressure Fuel Pump 2

Removal and Installation

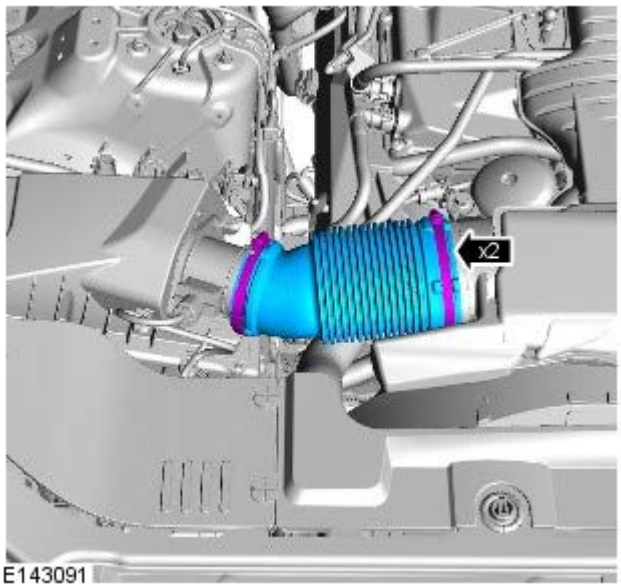
Removal

CAUTION: 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.

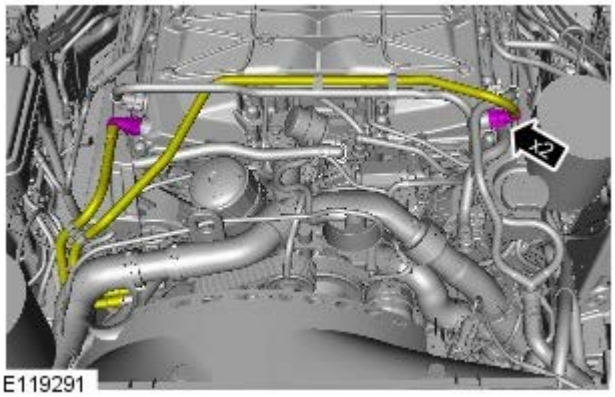
NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

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 - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (310-00 Fuel System - General Information, General Procedures).
3. Disconnect the battery ground cable.

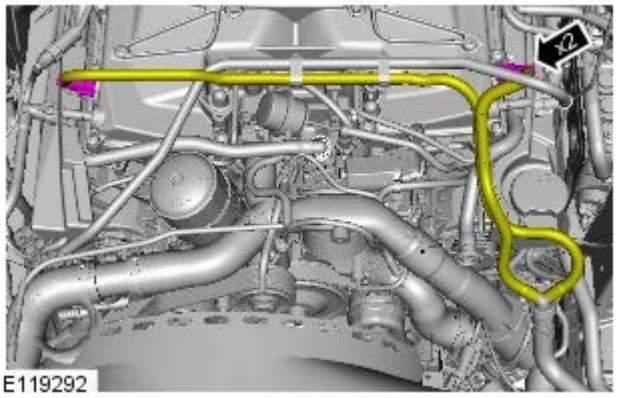
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).
4. Refer to: Engine Oil Draining and Filling (303-01C Engine - V8 S/C 5.0L Petrol, General Procedures).
5. Refer to: Fuel Injection Component Cleaning (303-04C Fuel Charging and Controls - V6 S/C 3.0L Petrol, General Procedures).
6. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).
7. *Torque:* 3.5 Nm



8. CAUTION: Be prepared to collect escaping coolant.

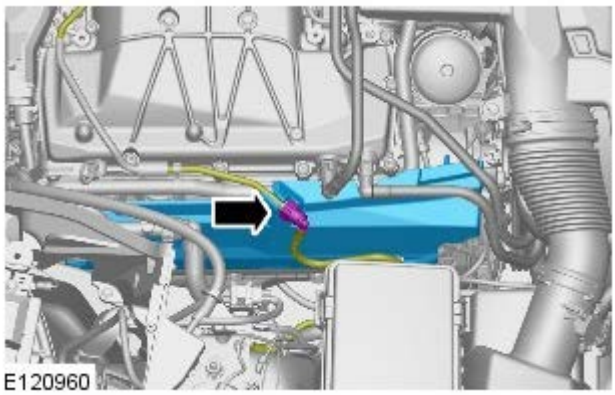


E119291



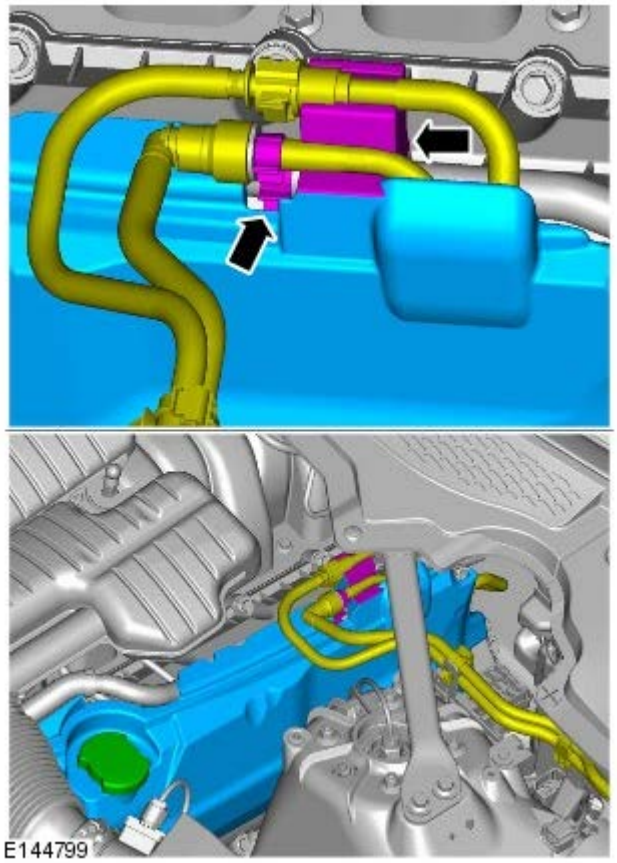
E119292

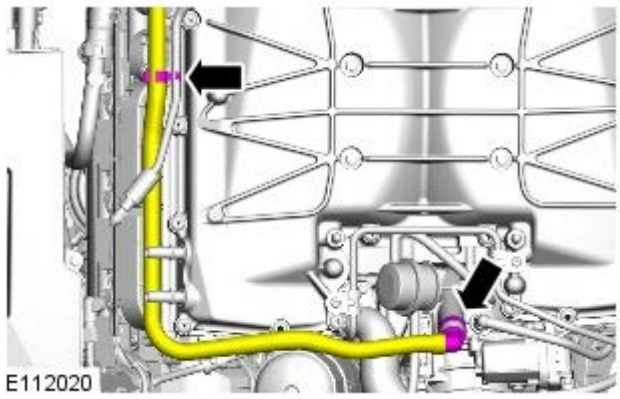
9. WARNING: Be prepared to collect escaping fluids.


E120960

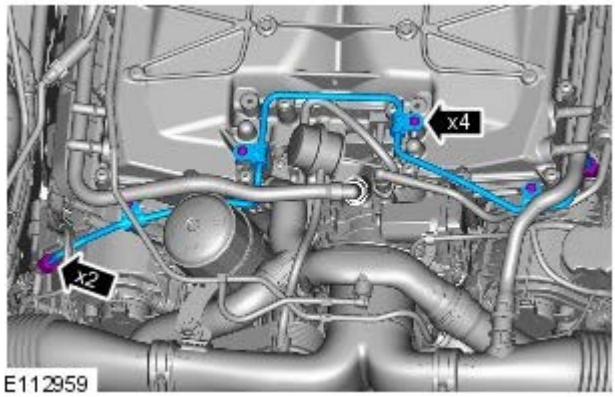
10. CAUTION: Be prepared to collect escaping fluids.

11.





12. CAUTION: Be prepared to collect escaping fluids.

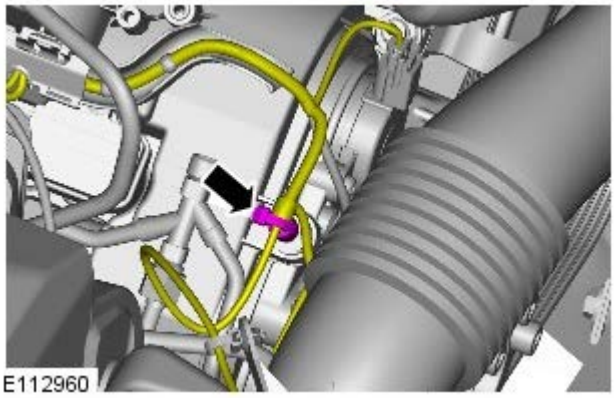


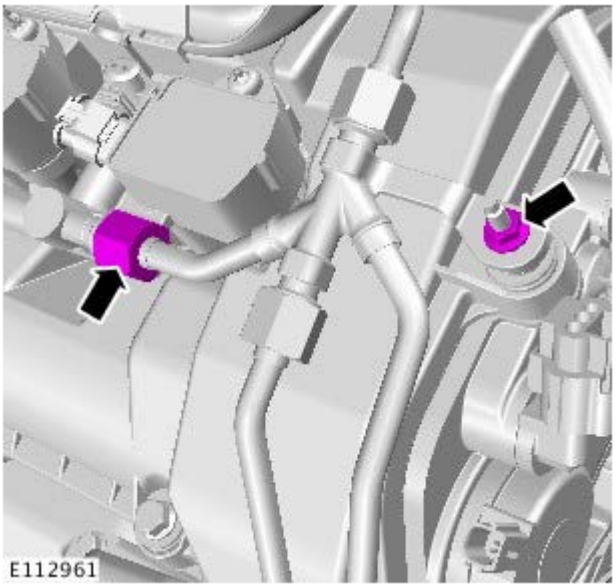
13. CAUTIONS:

Be prepared to collect escaping fluids.

Make sure that all openings are sealed. Use new blanking caps.

14.





15. CAUTIONS:

    Be prepared to collect escaping fluids.

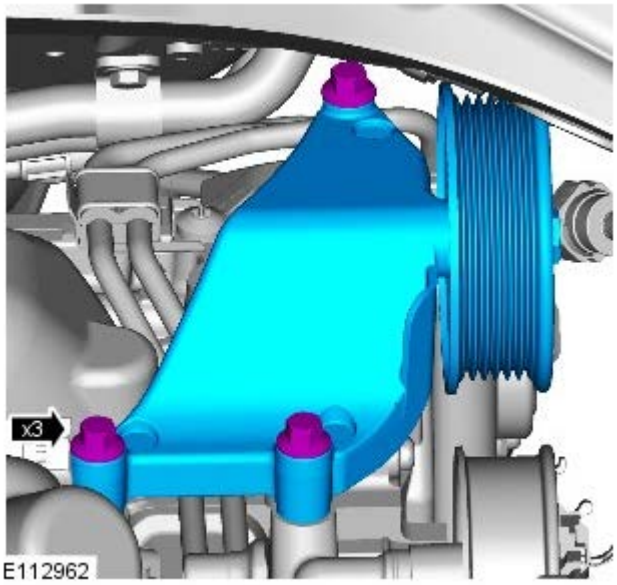
    Make sure that all openings are sealed. Use new blanking caps.

16. WARNING: Make sure to support the vehicle with axle stands.

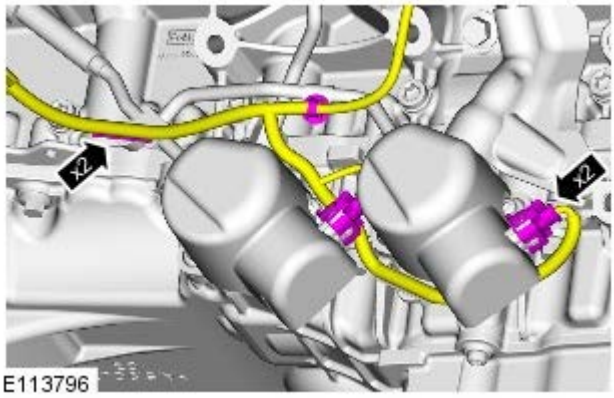
    Raise and support the vehicle.

17. Refer to: Generator (414-02C Generator and Regulator - V8 S/C 5.0L Petrol, Removal and Installation).

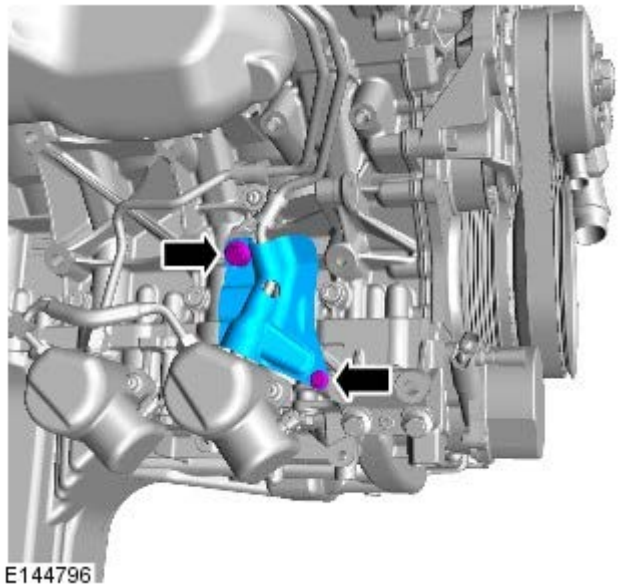
18.



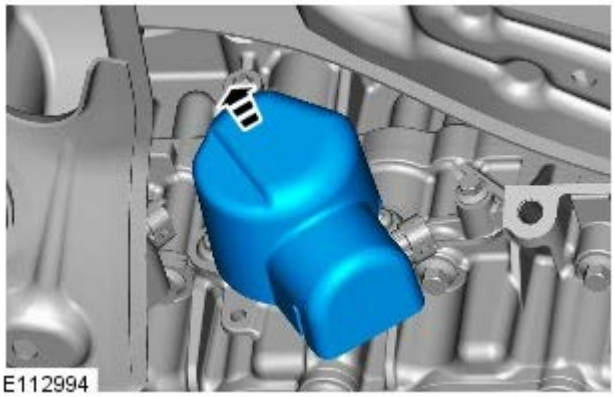
19. NOTE: Engine shown removed for clarity.



20.



21.



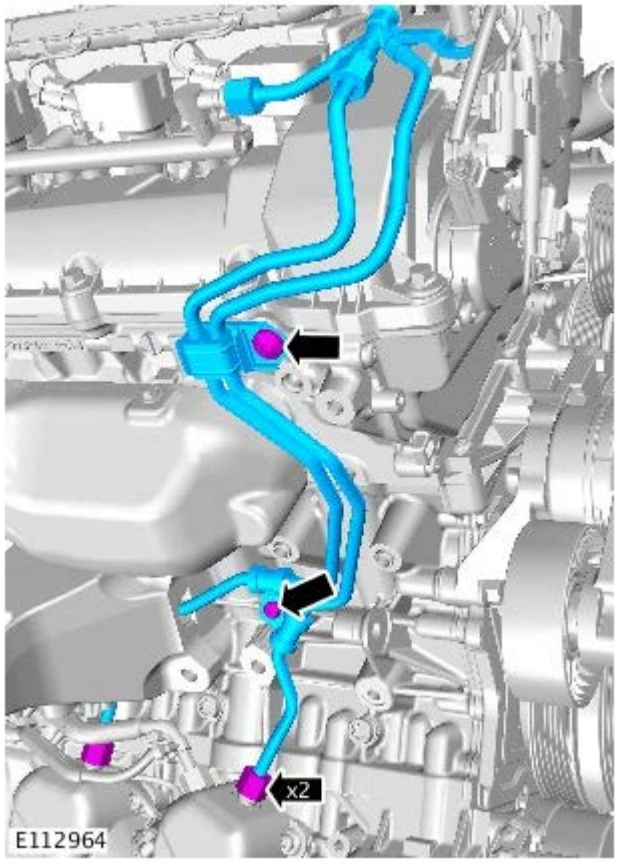
22. CAUTIONS:

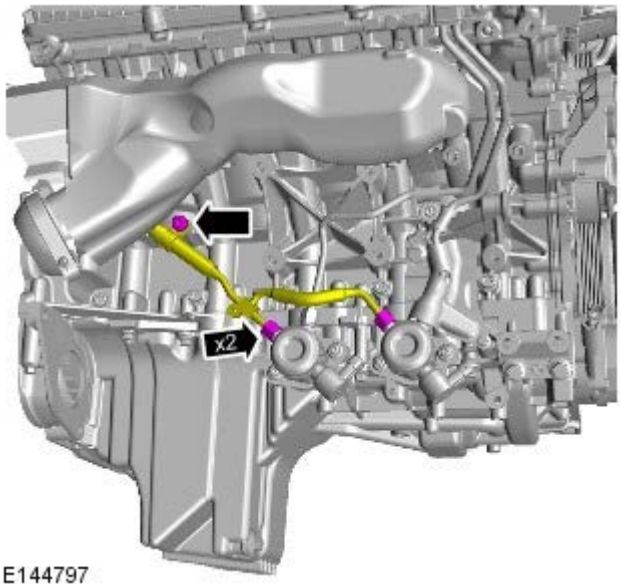
Be prepared to collect escaping fluids.

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.





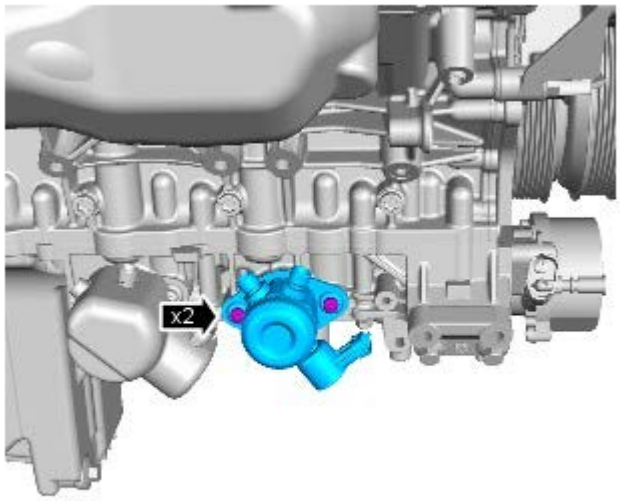
23. CAUTIONS:

    Be prepared to collect escaping fluids.

    Make sure that all openings are sealed. Use new blanking caps.

24. CAUTION: Be prepared to collect escaping fluids.

    Loosen the Torx screws a turn each at a time.



E144830



E112996

25. CAUTION: Be prepared to collect escaping fluids.

Installation

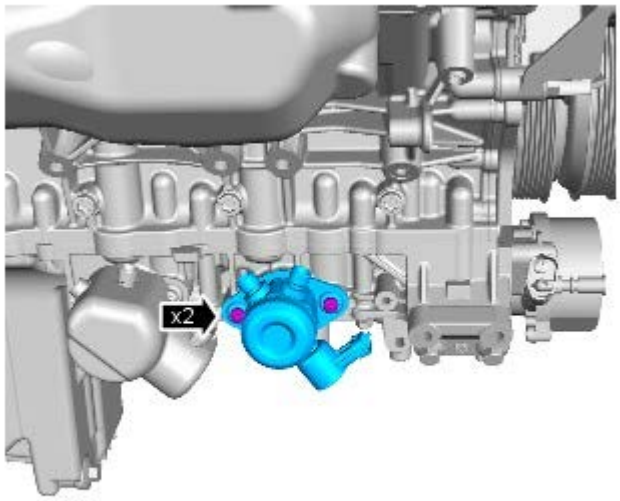


E112997

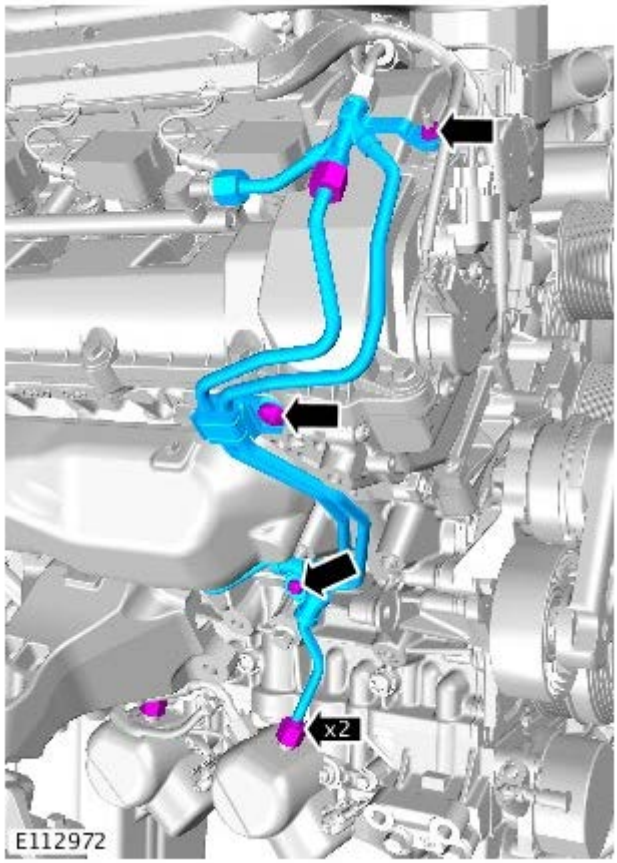
1. NOTE: Lubricate the fuel rail high-pressure fuel pump bucket with clean engine oil.

2. CAUTION: Be prepared to collect escaping fluids.

   Torque: 12 Nm



E144830



3. CAUTIONS:

Install new high-pressure fuel supply lines.

Lubricate only the union threads with clean engine oil.

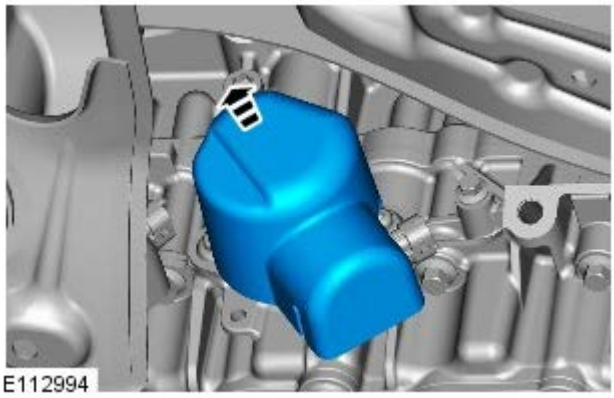
NOTES:

Remove and discard the blanking caps.

Engine shown removed for clarity.

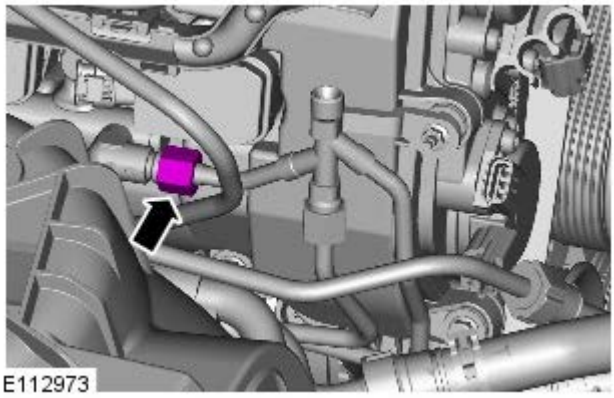
Install the bolt and unions fully finger tight before final tightening.

4.



5. Lower the vehicle.

6. NOTES:

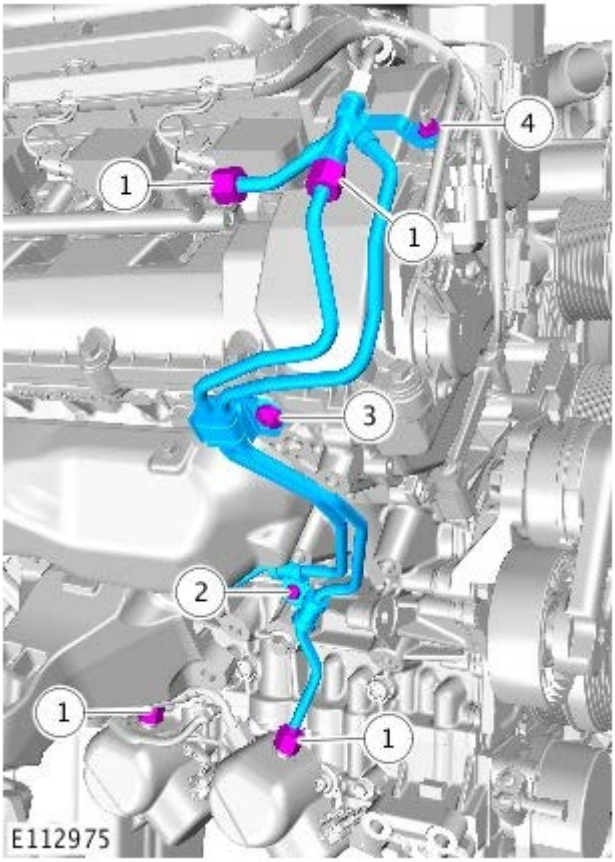


Do not tighten at this stage.

Remove and discard the blanking caps.

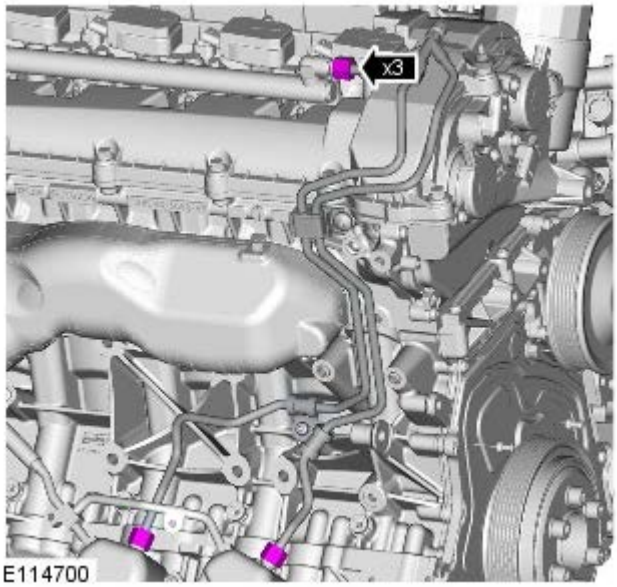
7. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

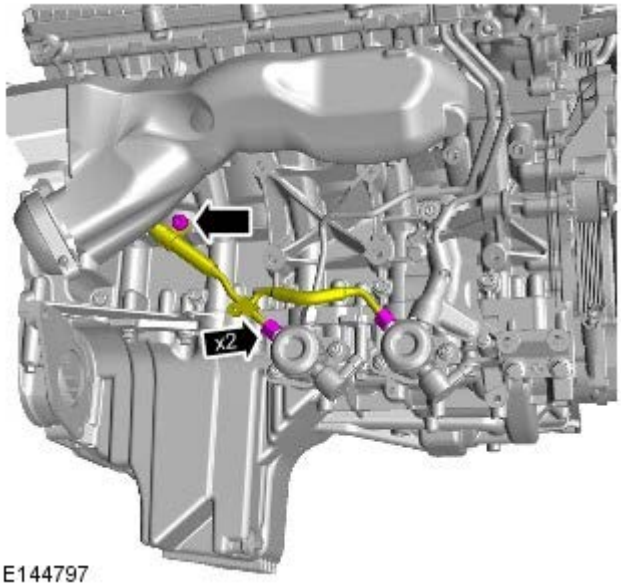


8. *Torque:*
   Unions (1) 20 Nm
   M6 (2) 12 Nm
   M8 (3) 25 Nm
   M5 nut (4) 6 Nm

9. *Torque:* 21 Nm



E114700



E144797

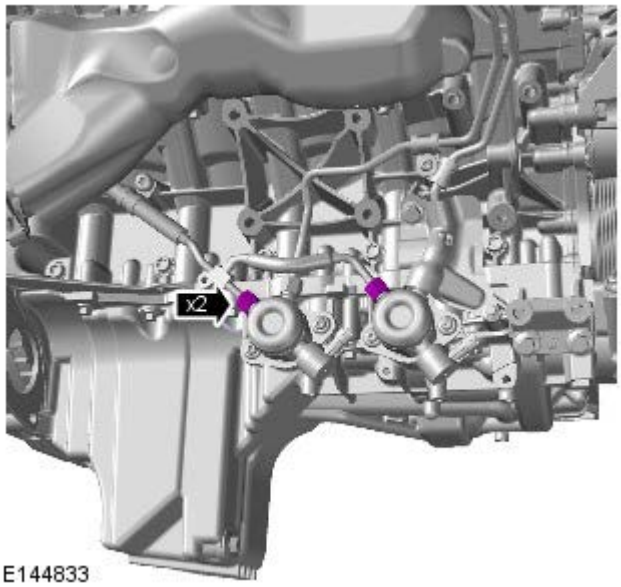
10. NOTES:

⚠ Install the bolt and unions finger tight before final tightening.

⚠ Remove and discard the blanking caps.

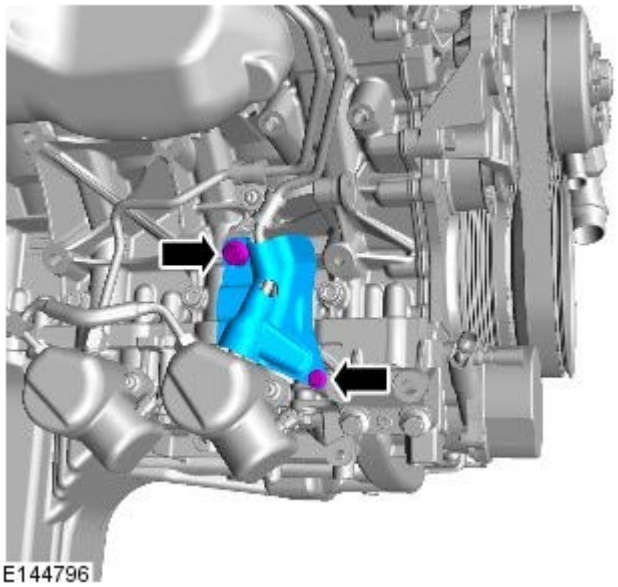
Torque:
Unions 20 Nm
M6 12 Nm

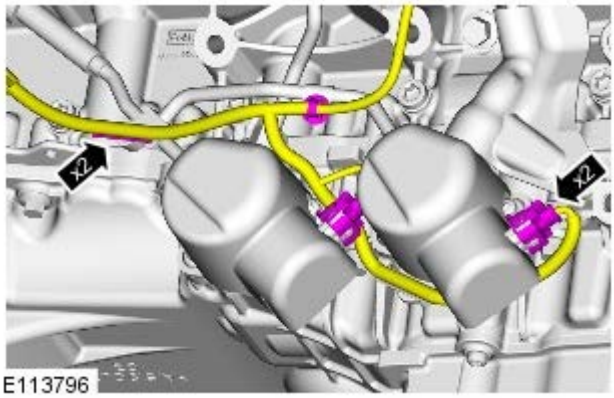
11. *Torque:* 21 Nm



E144833

12. *Torque:*
M6 12 Nm
M10 29 Nm

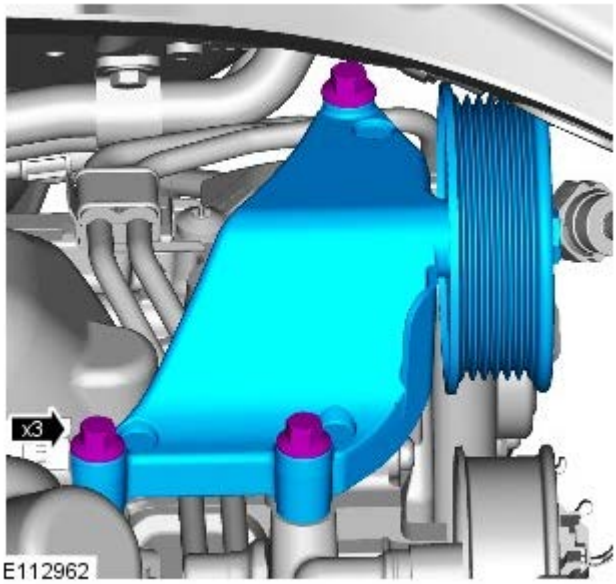

E144796



E113796

13. NOTE: Engine shown removed for clarity.

14. *Torque:* 25 Nm

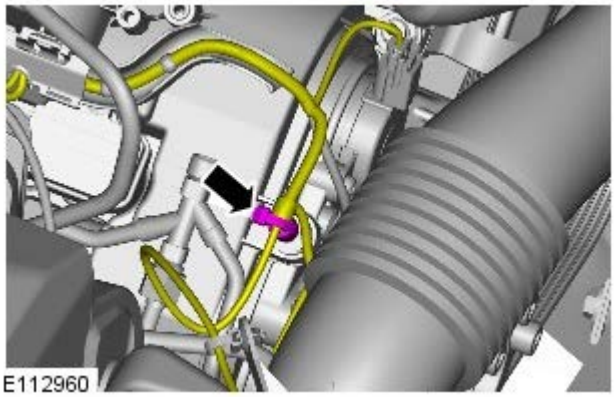


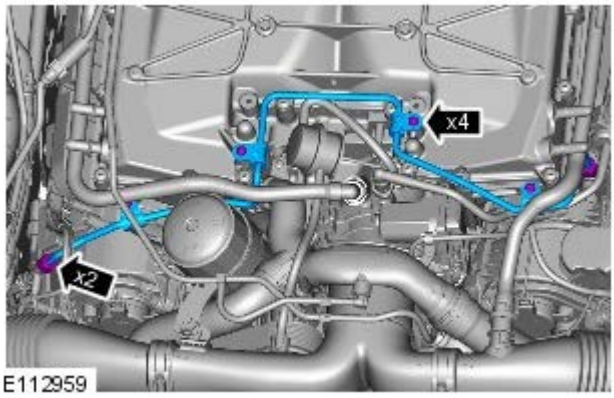
E112962

15. Refer to: Generator (414-02C Generator and Regulator - V8 S/C 5.0L Petrol, Removal and Installation).

16. Lower the vehicle.

17.


E112960



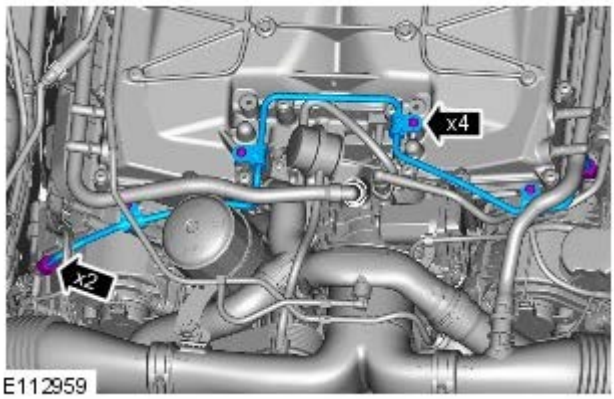
E112959

18. CAUTION: Lubricate only the union threads with clean engine oil.

    NOTES:

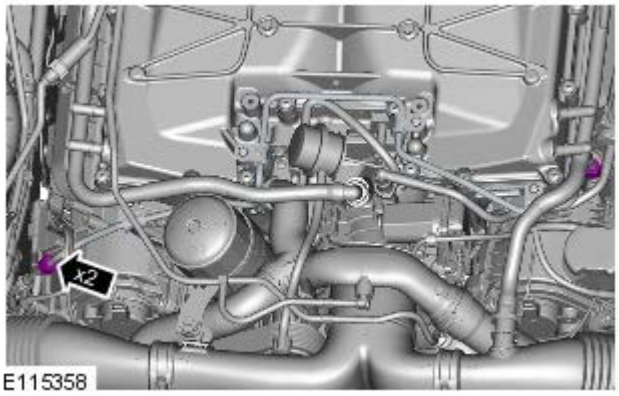
    Do not tighten at this stage.

    Remove and discard the blanking caps.



E112959

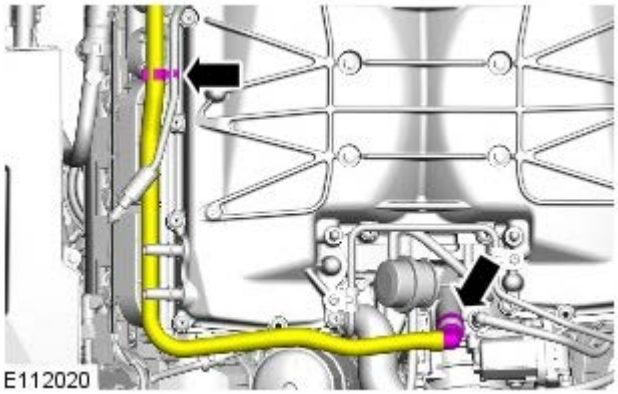
19. *Torque:*
    Unions 20 Nm
    Bolts 8 Nm



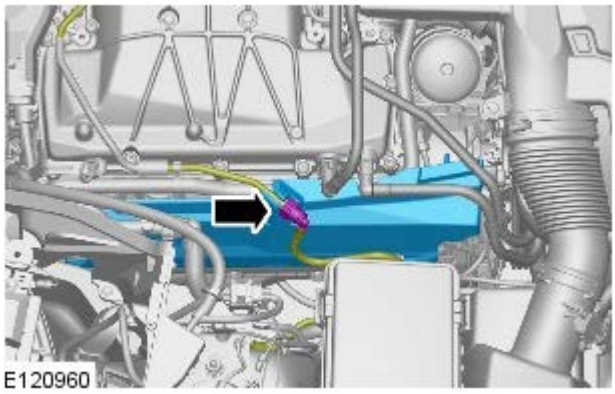
E115358

20. *Torque:* 21 Nm

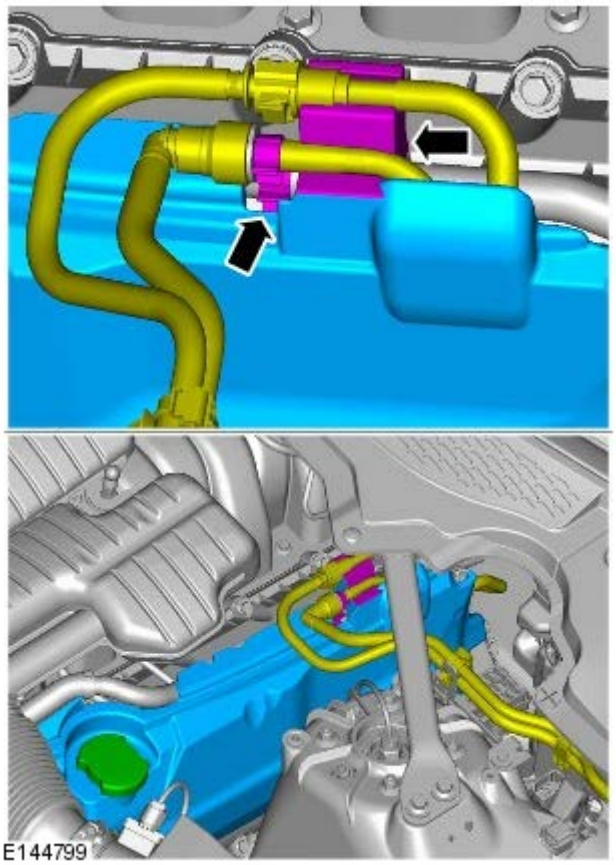
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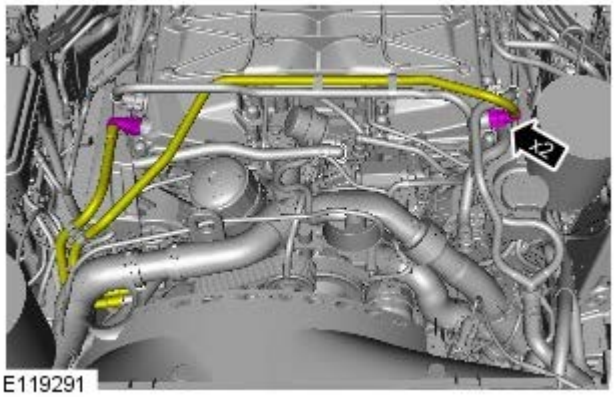
22.



23.

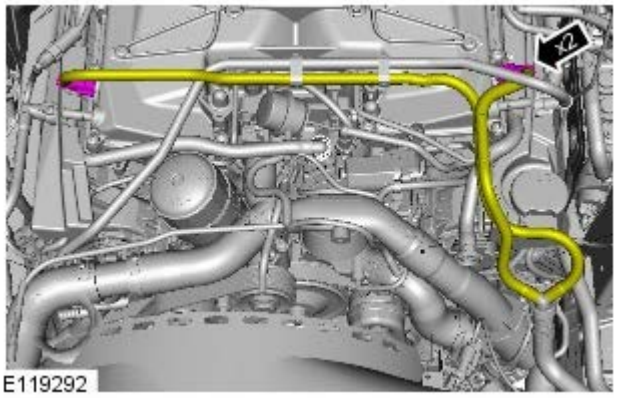


24. CAUTION: Be prepared to collect escaping coolant.



E119291

25.



E119292

26. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).

27. Refer to: Engine Oil Draining and Filling (303-01C Engine - V8 S/C 5.0L Petrol, General Procedures).

28. Connect the battery ground cable.

    Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 16-Apr-2013

Fuel Charging and Controls - V8 S/C 5.0L Petrol - Fuel Pump Driver Module (FPDM)

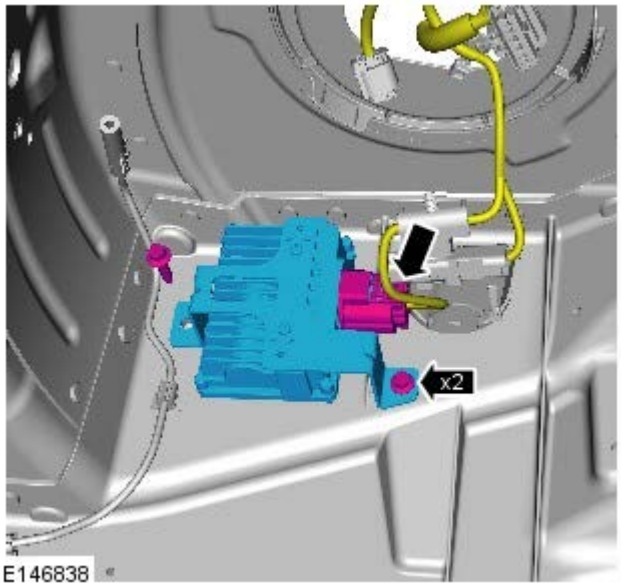
Removal and Installation

Removal

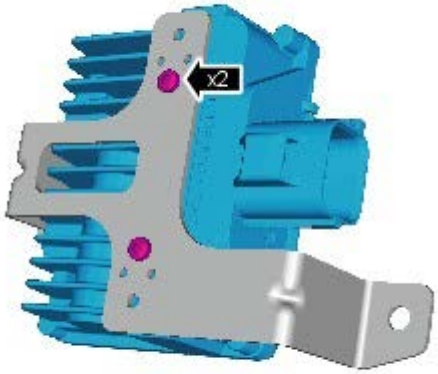
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Fuel Tank (310-01C, Removal and Installation).

2. *Torque:* 10 Nm



3. *Torque:* 3 Nm



Installation

1. NOTE: If a new component has been installed, configure using Land Rover approved diagnostic equipment.

   To install, reverse the removal procedure.

Published: 02-May-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. Disconnect the battery ground cable.

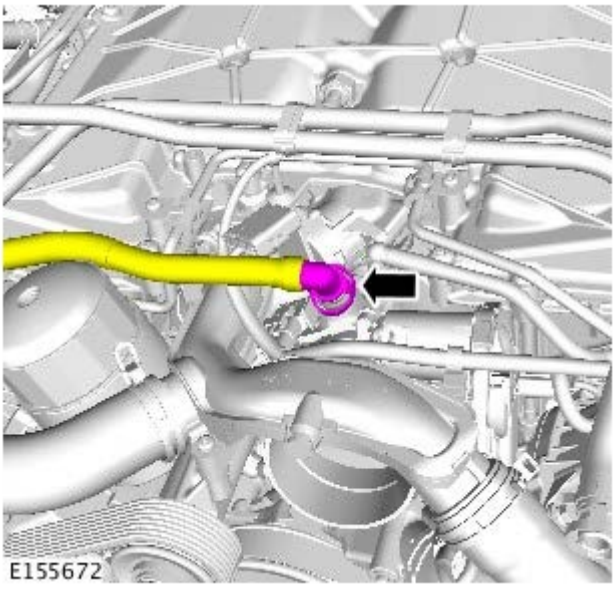
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

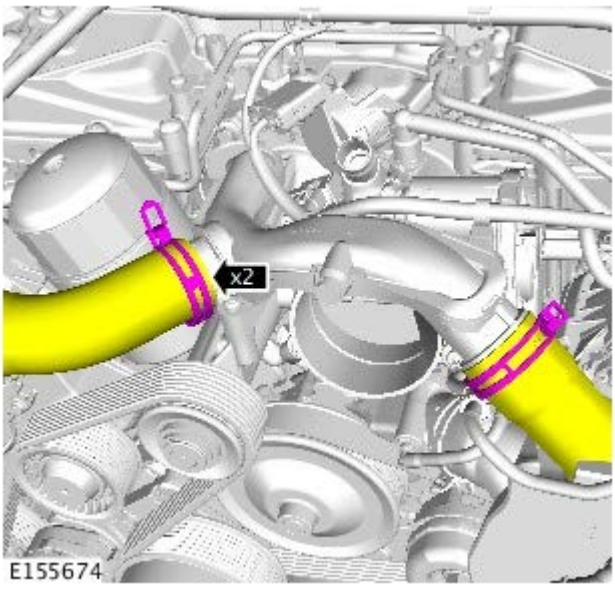
   Raise and support the vehicle.

3. Refer to: Cooling System Partial Draining, Filling and Bleeding - V8 S/C 5.0L Petrol (303-03C Engine Cooling - V8 S/C 5.0L Petrol, General Procedures).
   Refer to: Cooling System Partial Draining, Filling and Bleeding - V8 S/C 5.0L Petrol (303-03C Engine Cooling - V8 S/C 5.0L Petrol, General Procedures).

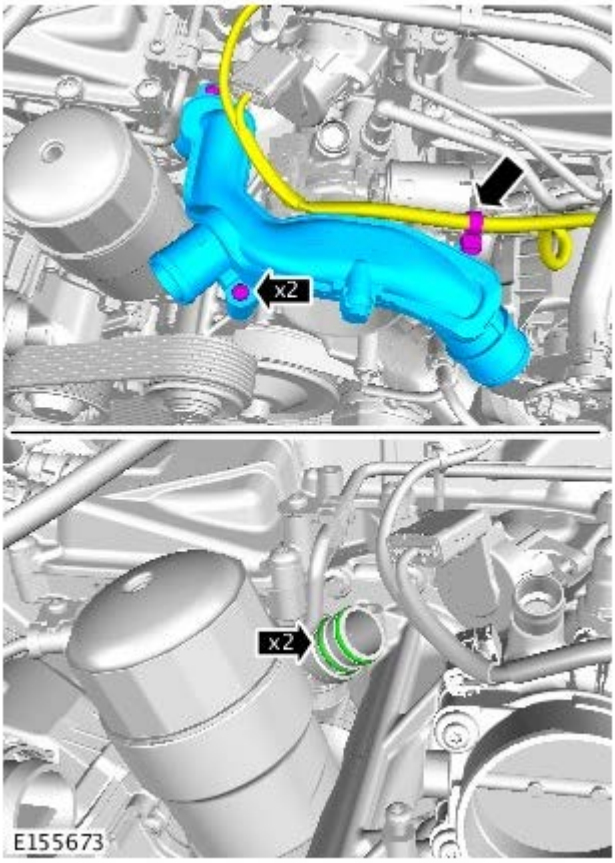
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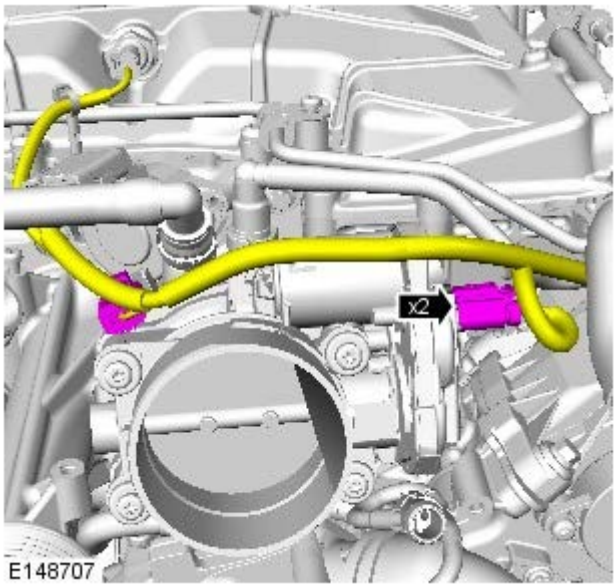
5.



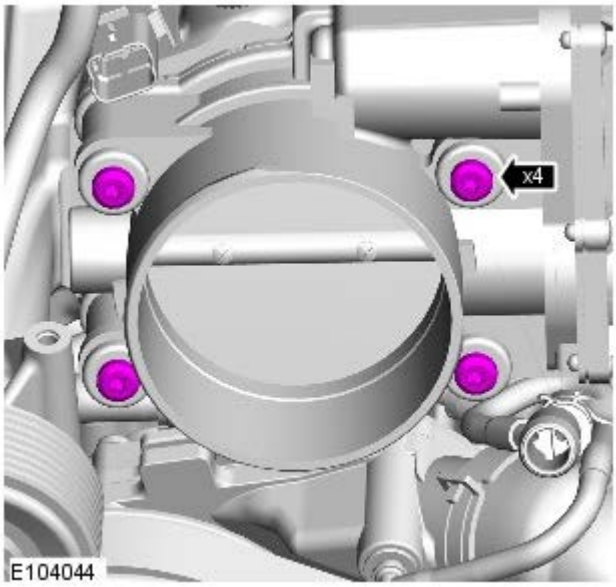
6. *Torque:* 10 Nm

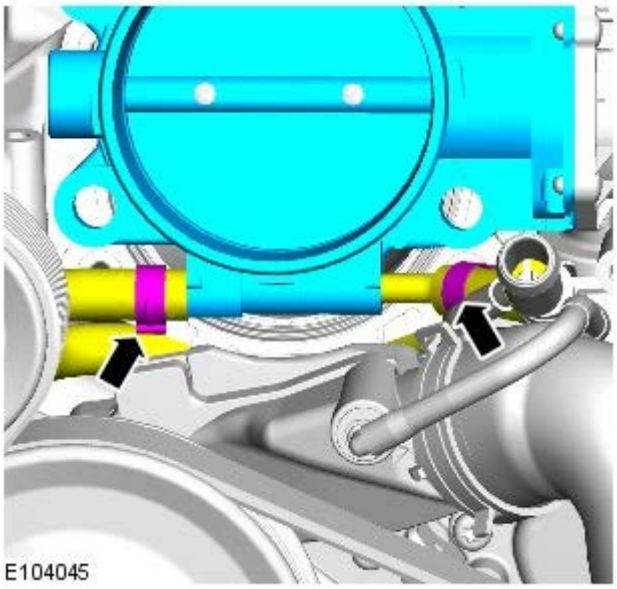


7.



8. *Torque:* 10 Nm





9. 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: 28-Oct-2013

Fuel Charging and Controls - TDV8 4.4L Diesel -

Torque Specifications

Item	Nm	lb-ft	lb-in
LH Turbocharger boost pressure pipe bolts	10	7	89
Injector heat shield nuts	6	-	53
Injector retaining clamp bolts	10	7	89
++ Fuel injection high-pressure fuel supply line, fuel rail and injector unions			
Stage 1	Finger tight	Finger tight	Finger tight
Stage 2	10	7	89
Stage 3	73°	73°	73°
++ Fuel injection high-pressure fuel supply line, fuel pump unions			
Stage 1	Finger tight	Finger tight	Finger tight
Stage 2	10	7	89
Stage 3	80°	80°	80°
High-pressure fuel pipe clamp bolts	10	7	89
High-pressure fuel pump bolts	24	18	212
High-pressure fuel pump shield bolts	10	7	89
Fuel rail retaining bolts	23	17	204
Throttle body retaining bolts	11	8	97
Dynamic response fluid reservoir bolt	9	-	78
High-pressure fuel pump timing gear bolt	60	42	531

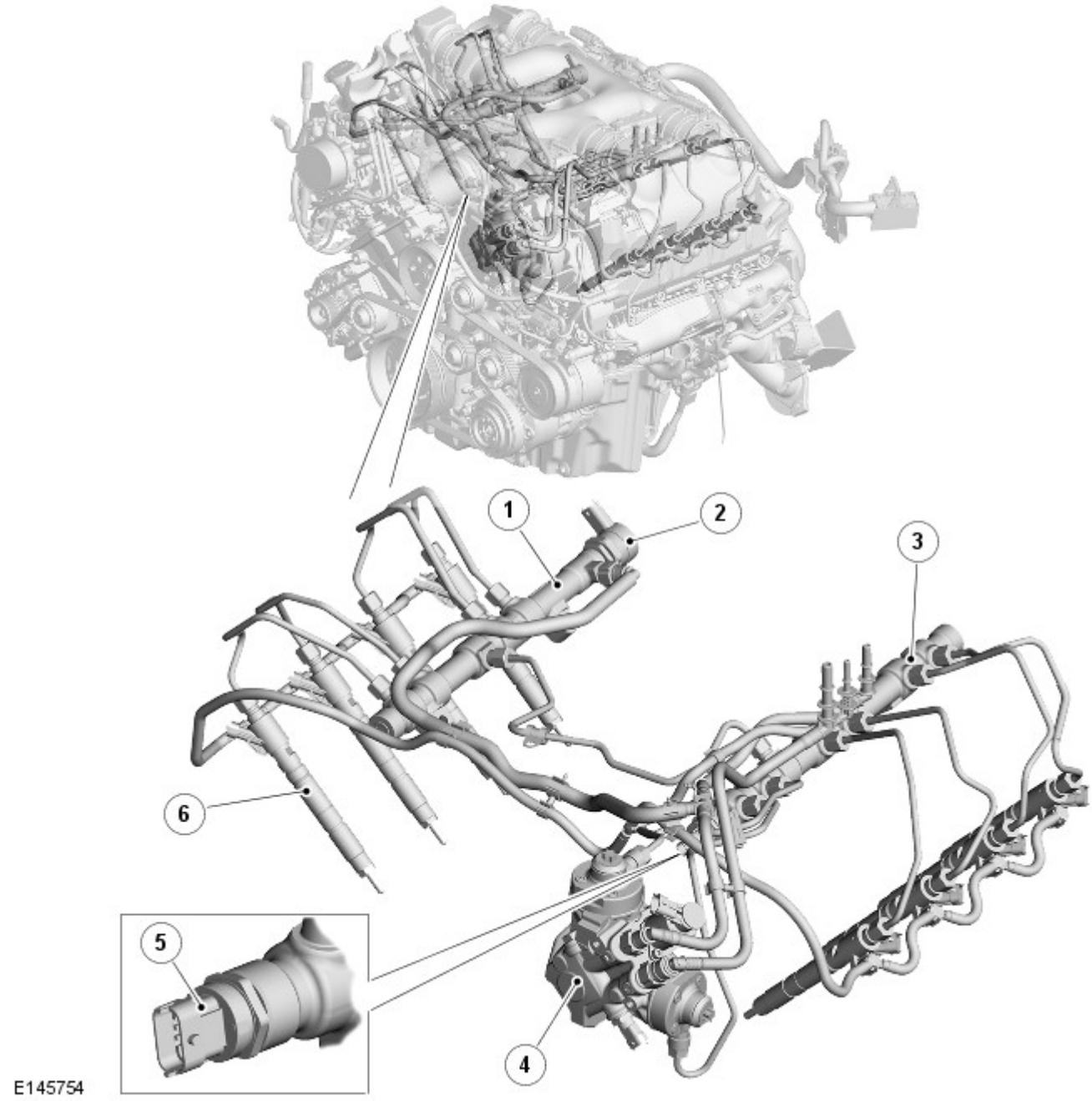
++ New pipes must be installed

Published: 02-Dec-2013

Fuel Charging and Controls - TDV8 4.4L Diesel - Fuel Charging and Controls

Description and Operation

COMPONENT LOCATION



Item	Part Number	Description
1	-	Right fuel rail
2	-	Fuel pressure control valve
3	-	Left fuel rail
4	-	High Pressure (HP) fuel pump
5	-	Fuel Rail Pressure (FRP) sensor
6	-	Fuel injector (8 off)

OVERVIEW

The TDV8 4.4L diesel engine is equipped with a HP (high pressure) common rail fuel injection system. With this fuel injection process, a HP fuel pump delivers a uniform level of pressure to the shared fuel lines (the common rails), which serve all 8 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:

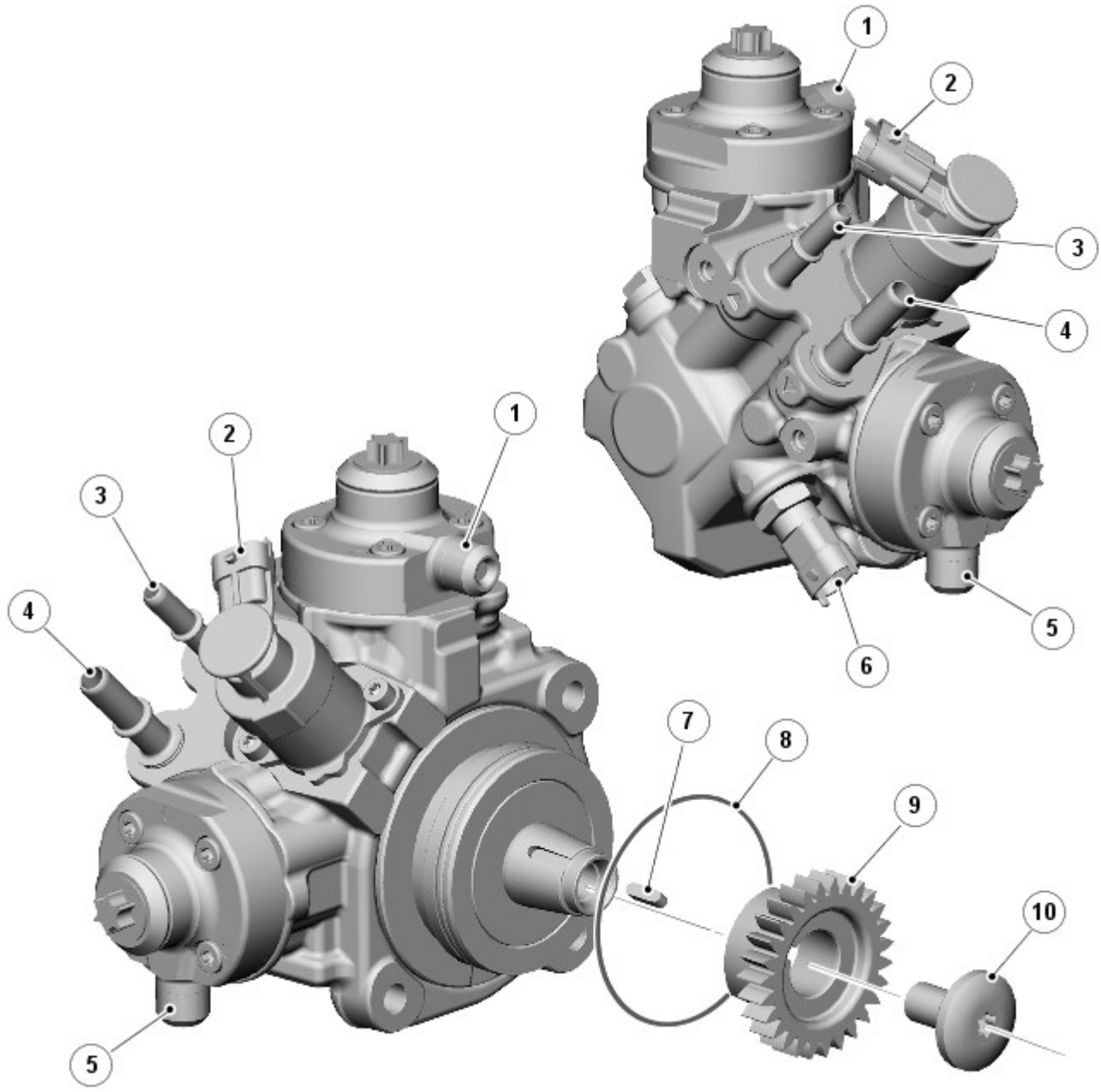
- High fuel injection pressures of up to 2000 bar (29007 lbf/in²) for greater atomisation of fuel (increasing performance and lowering emissions)
- Variable injection to optimize combustion in all engine operating conditions
- Low tolerances and high precision throughout the life of the system.

The system features the following components:

- HP fuel pump
- Fuel rails
- HP and LP (low pressure) fuel pipes
- Fuel injectors.

DESCRIPTION

High Pressure Fuel Pump



E130477

Item	Part Number	Description
1	-	High pressure fuel outlet to left fuel rail
2	-	Fuel metering valve
3	-	Low pressure fuel return connection
4	-	Low pressure fuel supply connection
5	-	High pressure fuel outlet to left fuel rail

6	-	Fuel temperature sensor
7	-	Woodruff key
8	-	O-ring seal
9	-	Fuel injection pump drive gear
10	-	Drive flange bolt

The HP fuel pump is a 2-piston (90 degree apart) radial plunger pump with a HP displacement of 1.0 cc and the ability to produce a maximum pressure of 2000 bar (29007 lbf/in²).

The pump is driven from the left intake camshaft via a drive gear and must be timed to the engine.
For additional information, refer to: Fuel Pump (303-04E Fuel Charging and Controls - TDV8 4.4L Diesel, Removal and Installation).

The required supply pressure to the pump is 4.5 bar (65.3 lbf/in²) to 7.0 bar (101.5 lbf/in²). The return pressure is -0.3 bar to +0.8 bar.

The pump is sized to deliver sufficient fuel to the fuel rails for all engine operating conditions.

The HP fuel pump consists of the following components:

- Fuel metering valve
- HP pumping elements (2 off)
- Fuel temperature sensor.

The fuel metering valve is a variable position solenoid valve electronically controlled by the ECM. The fuel metering valve is located between the fuel inlet and the HP pumping elements. The fuel metering valve regulates the amount of fuel that is delivered to the fuel rails via the pumping elements. When there is no signal to the fuel metering valve the valve is closed, therefore there is no fuel delivery.

The 2 HP pumping elements each have a HP outlet that connects to the left fuel rail via HP pipes.

The HP fuel pump can supply up to 2000 bar fuel pressure continuously with a pump speed which is the same as engine speed. It is calibrated to deliver fuel pressure dependant upon engine speed and load and is always under full control.

When the HP fuel pump is rotated, fuel pressure is created when the fuel metering valve is open and the fuel pressure control valve in the right common rail is closed. The fuel metering valve and fuel pressure control valve are variable position to allow variable fuel delivery and pressure control.

When the ECM actuates the fuel injectors, the pressure drop in the fuel rails is offset by additional fuel being delivered by the HP fuel pump.

FUEL METERING VALVE

The fuel metering valve is fixed directly to the HP fuel pump.

The fuel metering valve regulates the fuel supply (and hence the quantity of fuel) from the internal transfer pump to the HP pumping elements, depending on the fuel pressure required in the fuel rails. This makes it possible to match the delivery of the HP fuel pump to the requirements of the engine from the LP side. The quantity of fuel flowing back to the main fuel supply line is kept to a minimum. In addition, this adjustment reduces the power consumption of the HP fuel pump, improving the efficiency of the engine.

NOTE: The fuel metering valve default is closed without electrical supply. An open circuit connector will prevent the engine from running.

The fuel metering valve forms part of the HP fuel pump and cannot be replaced as a separate component in service.

FUEL PRESSURE CONTROL VALVE

The fuel pressure control valve is located on the right fuel rail. It governs the fuel pressure at the HP outlets of the HP fuel pump and thus the fuel pressure within the rails. In addition, the fuel pressure control valve dampens any fluctuations in pressure, which occur during the delivery of fuel through the HP fuel pump and through the injection process.

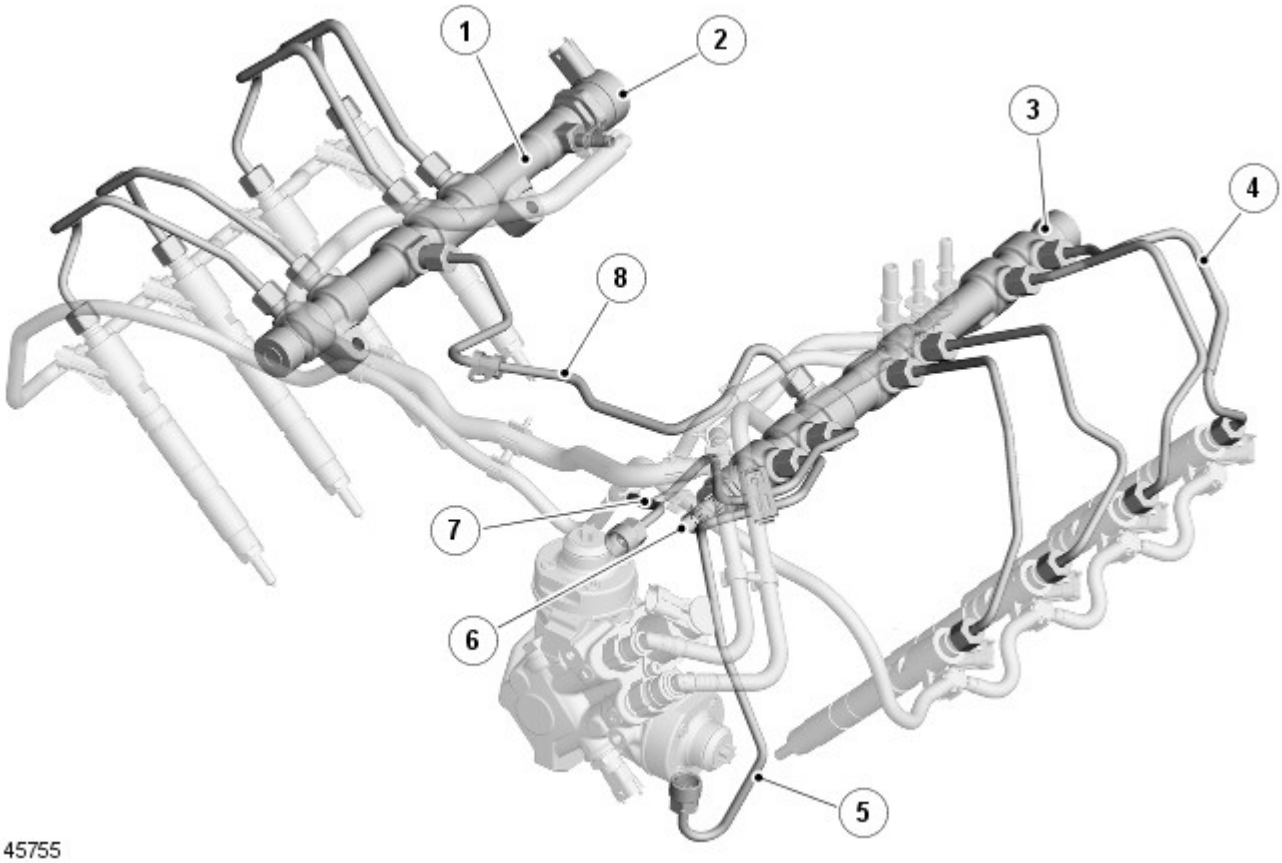
The fuel pressure control valve ensures that optimum pressure exists in the fuel rails for every operating condition of the engine.

The fuel pressure control valve is an electro-magnetically operated valve with spring support.

The electrical current supplied by the ECM through the solenoid attracts the armature to the coil. This forces the ball valve onto its seat via the control pin. The entire armature is coated with fuel for lubrication and cooling.

Fuel Rails

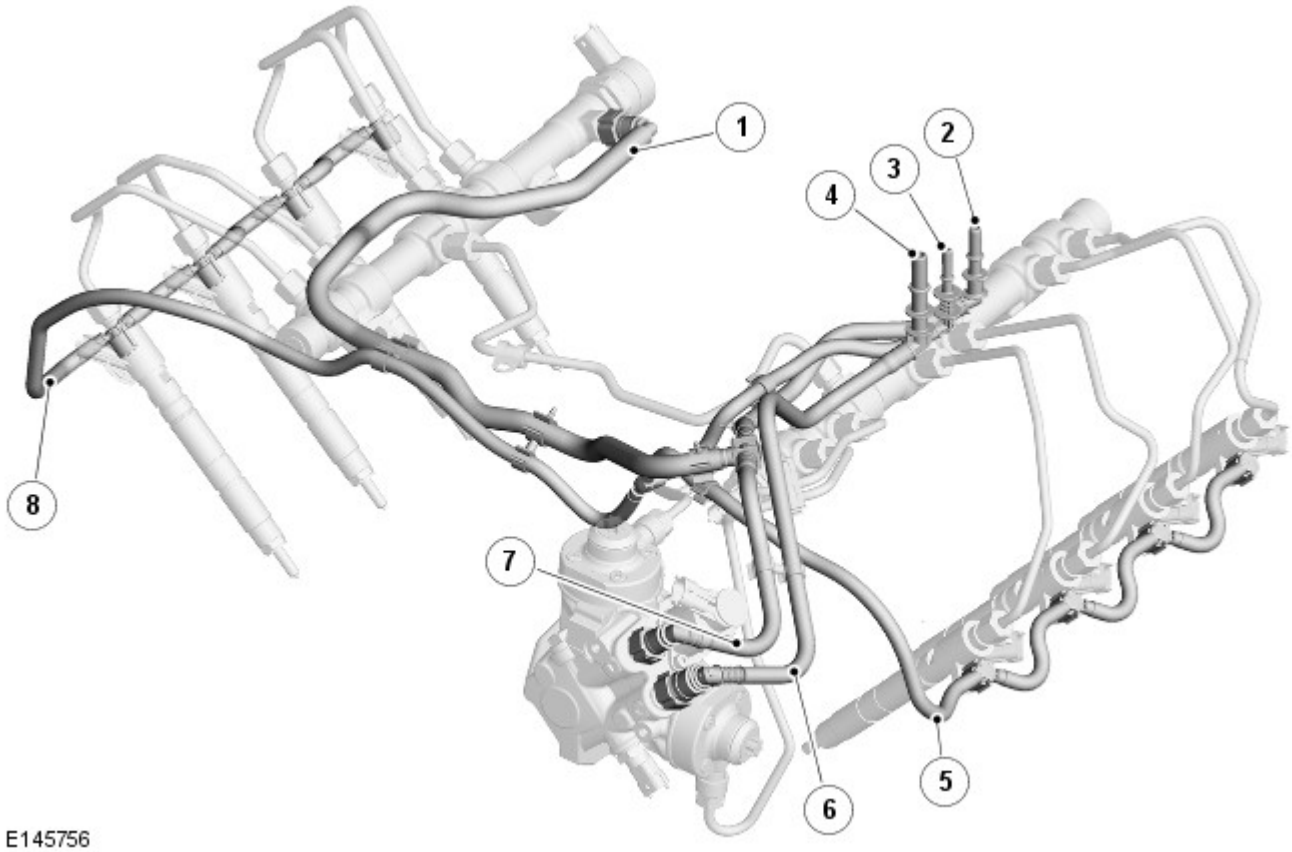
Fuel Rails and High Pressure Fuel Lines



E145755

Item	Part Number	Description
1	-	Right fuel rail
2	-	Fuel pressure control valve
3	-	Left fuel rail
4	-	Supply pipe to fuel injector (8 off)
5	-	Supply pipe to left fuel rail
6	-	Fuel rail pressure sensor
7	-	Supply pipe to left fuel rail
8	-	Fuel rail balance pipe

Low Pressure Fuel Lines



E145756

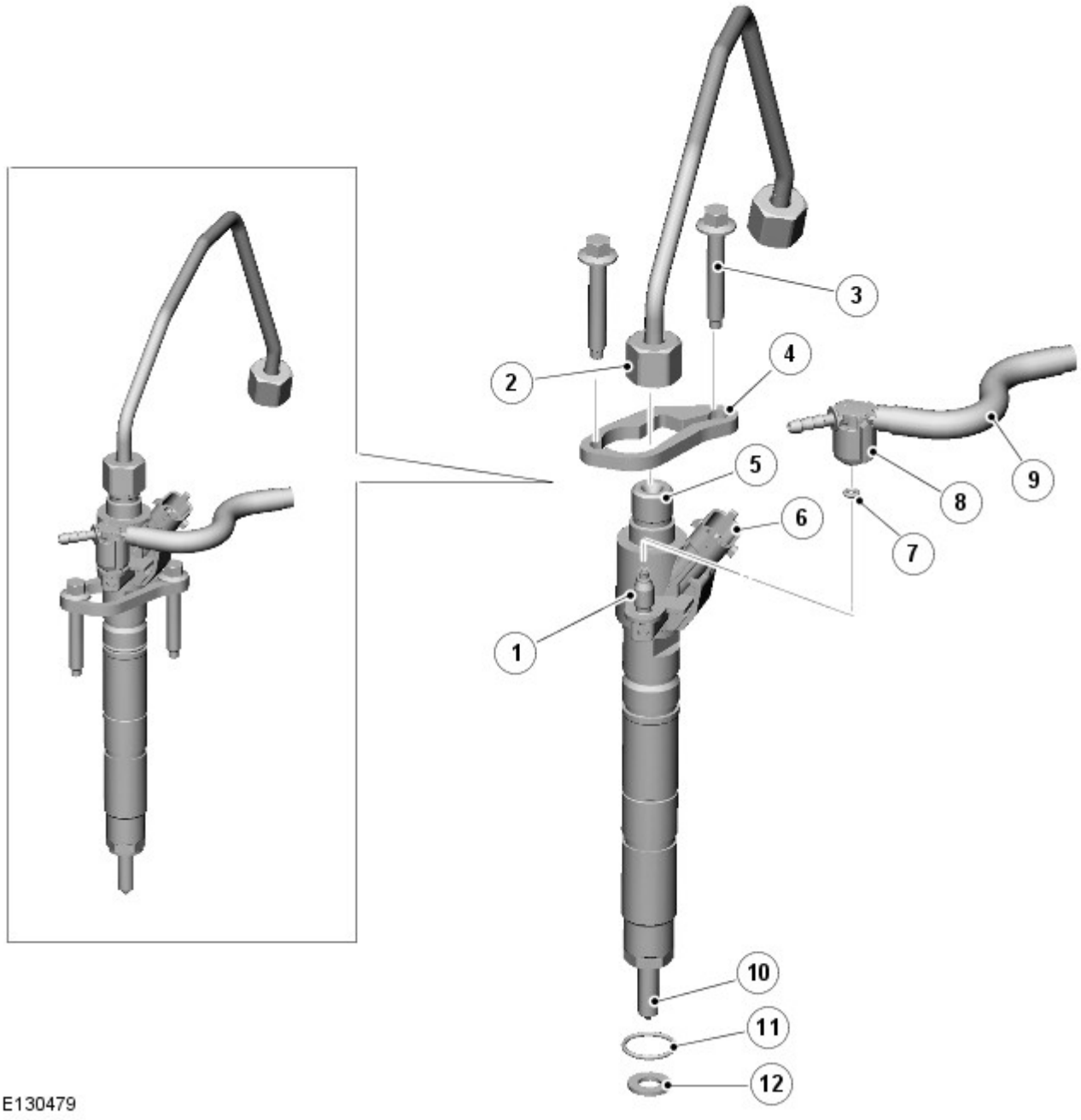
Item	Part Number	Description
1	-	Fuel pressure control valve fuel return tube
2	-	Fuel return connection - fuel pressure control valve and high pressure fuel pump to fuel cooler
3	-	Fuel return connection - fuel injector leak-back to fuel filter inlet tube
4	-	Fuel supply connection - fuel filter to high pressure fuel pump
5	-	Left bank fuel injector leak-back tube
6	-	High pressure fuel pump fuel supply tube
7	-	High pressure fuel pump fuel return tube
8	-	Right bank fuel injector leak-back tube

The fuel rails store the fuel at high pressure and prevent pressure fluctuations in the HP system.

All HP pipes have an internal diameter of 3.0 mm. Total rail volume is 33 cc.

The left rail is fitted with a fuel pressure sensor and the right rail is fitted with a fuel pressure control valve. Both the pressure sensor and the fuel pressure control valve are connected to and controlled by the ECM.

Fuel Injectors



E130479

Item	Part Number	Description
1	-	Leak-back connection
2	-	High pressure supply pipe from fuel rail
3	-	Bolt (2 off per injector)
4	-	Injector clamp
5	-	High pressure connection
6	-	Electrical harness connection
7	-	O-ring seal - leak back coupling
8	-	Injector leak-back coupling
9	-	Fuel leak-back tube
10	-	Nozzle spray holes
11	-	O-ring seal
12	-	Injector nozzle washer

CAUTION: Each injection event is controlled by a charge and discharge cycle allowing energy to dissipate in, and recover from, the injector. Never disconnect the wiring connector when the vehicle is running. The injector may remain open thus causing engine damage.

The fuel injectors are operated directly by the ECM for fuel metering (start of injection and quantity of fuel injected).

The operating components of the piezo fuel injectors are:

- The piezo actuator
- The injector body containing the hydraulic servo system

- The fuel injector nozzle.

Each injector has a code which must be programmed into the ECM to identify which cylinder it is associated with. Therefore it is important that the injectors must be replaced into the correct cylinders.

OPERATION

Engine Starting

During starting, the fuel rail pressure must be at least 150 bar (2175 lbf/in²). Should the pressure be below this figure, the injectors will not operate, resulting in the vehicle not starting.

Engine Stopping

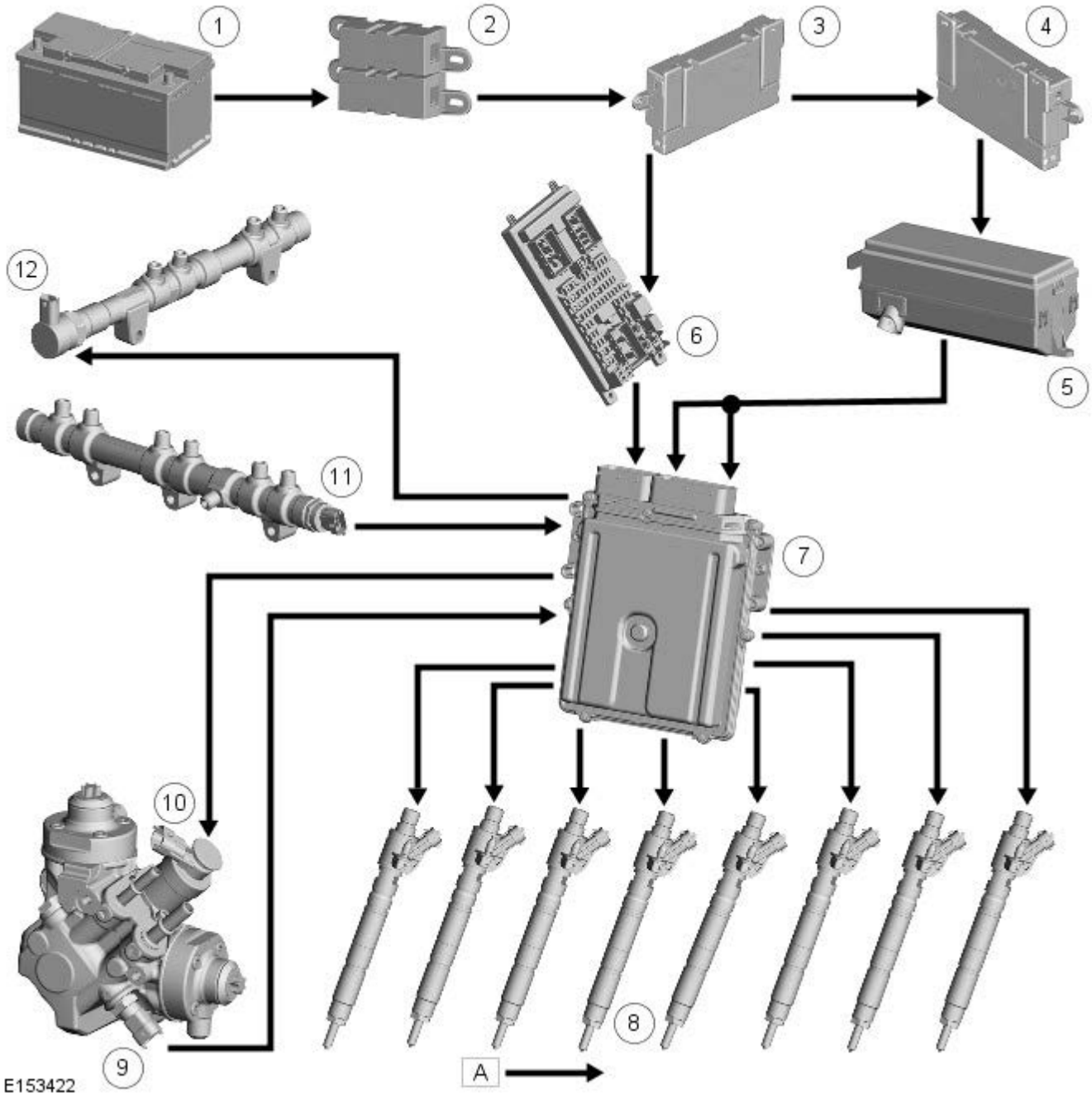
To stop the engine the ECM stops energizing the actuators in the fuel injectors, therefore, no fuel is injected and the engine speed drops to zero.
For additional information, refer to: Electronic Engine Controls (303-14D Electronic Engine Controls - TDV8 4.4L Diesel, Description and Operation).

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 fuel injectors, 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 released into the LP fuel return line through the open pressure control valve.

Control Diagram

 NOTE: A = Hardwired.



Item	Part Number	Description
1	-	Battery
2	-	Battery Junction Box 2 (BJB2)
3	-	Battery Junction Box (BJB)
4	-	Auxiliary Junction Box (AJB)
5	-	Engine Junction Box (EJB)
6	-	Central Junction Box (CJB)
7	-	Engine Control Module (ECM)
8	-	Fuel injector (8 off)
9	-	Fuel temperature sensor
10	-	Fuel metering valve
11	-	Fuel Rail Pressure (FRP) sensor
12	-	Fuel pressure control valve

Published: 26-Feb-2013

Fuel Charging and Controls - TDV8 4.4L Diesel - Fuel Charging and Controls

Diagnosis and Testing

Principle of Operation

For a detailed description of the fuel charging and controls system and operation, refer to the relevant Description and Operation section in the Workshop Manual.
REFER to: Fuel Charging and Controls (303-04E Fuel Charging and Controls - TDV8 4.4L Diesel, 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:

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.

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.

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 • 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) • 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	• 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 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, check for DTCs indicating a fuel volume or pressure control valve fault. Check the fuel pump. Check the CKP sensor circuits. Refer to the electrical guides.
Difficult to start	• Glow plug system fault (very cold conditions) • Low/Contaminated fuel • Air leakage	Check the glow plug circuits. Refer to the electrical guides. 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, check for DTCs indicating a fuel volume

	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	or pressure control valve fault. 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 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 low-pressure fuel system for leaks/damage. Check the fuel filter, check for DTCs indicating a fuel volume or pressure control valve fault. 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. Check for DTCs indicating a fuel pressure fault. 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: Check for DTCs indicating a fuel volume or pressure control valve fault. 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. Check the intake air system for leaks. Check the low-pressure fuel system for leaks/damage. Check the high pressure fuel system for leaks, check for DTCs indicating a fuel volume or pressure control valve fault. Check the fuel pump.
Excessive fuel consumption	• Low-pressure fuel system fault • Fuel volume control valve	Check the low-pressure fuel system for leaks/damage. Check for DTCs indicating a fuel volume or pressure control valve fault. Check the fuel temperature sensor, fuel pump, etc for leaks. Check for injector DTCs. Check the EGR system.

	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	

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 - TDV8 4.4L Diesel, DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation).

Published: 22-Oct-2013

Fuel Charging and Controls - TDV8 4.4L 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

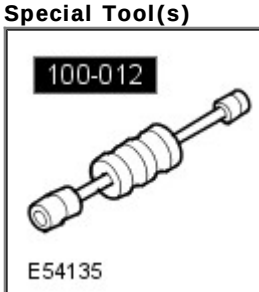
1. Using a new brush that will not lose its bristles, brush cleaning fluid onto the components being removed and onto the surrounding area.
2. Using a pneumatic vacuum gun, remove all traces of cleaning fluid and foreign material.
3. Dispose of any used cleaning fluid and the brush after completing the repair.

Published: 10-Dec-2013

Fuel Charging and Controls - TDV8 4.4L 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
	JLR-310-242 Remover/Installer, Fuel Injector Leak Off Pipe

Removal

CAUTIONS:

Make sure the wings and trim panels are covered and protected, failure to follow this instruction may result in damage to the vehicle.

The use of an electronic torque and angle gauge is recommended during the high pressure fuel pipe tightening procedure.

NOTES:

Some variation in the illustrations may occur, but the essential information is always correct.

Engine shown removed for clarity.

1. Disconnect the battery ground cable.

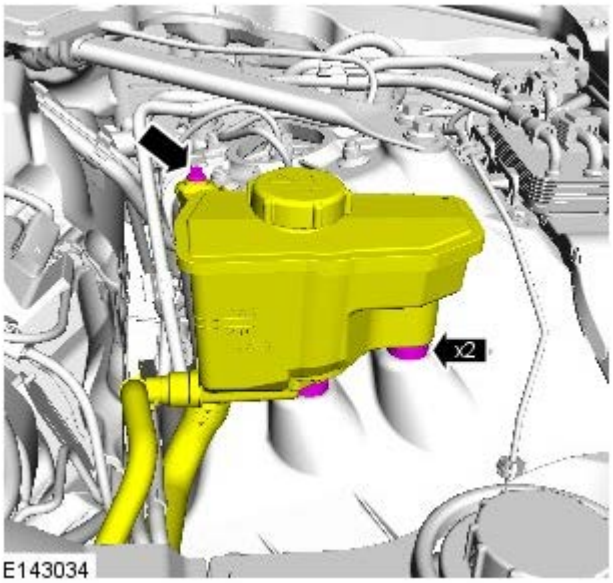
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

2. Refer to: Secondary Bulkhead Center Panel - TDV8 4.4L Diesel (501-02 Front End Body Panels, Removal and Installation).

3. Refer to: Air Cleaner LH (303-12D Intake Air Distribution and Filtering - TDV8 4.4L Diesel, Removal and Installation).

4. Refer to: Fuel Filter Element (310-01D Fuel Tank and Lines - TDV8 4.4L Diesel, Removal and Installation).

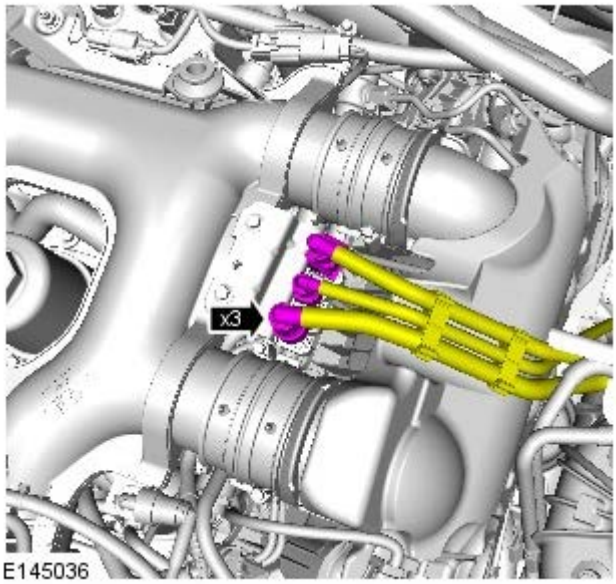
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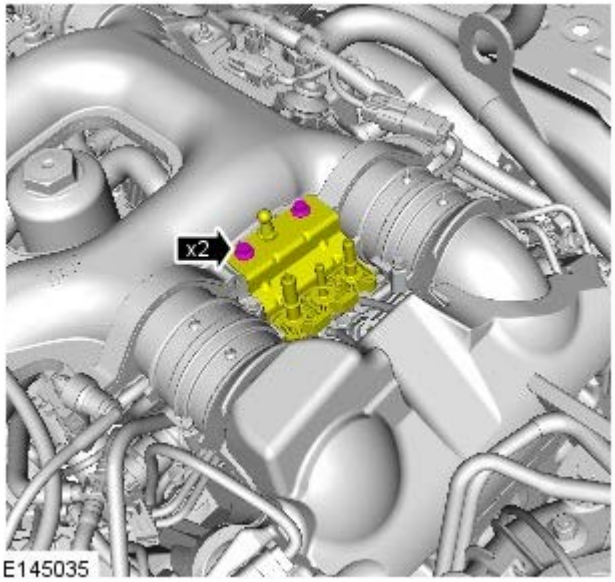
6. Refer to: Diesel Fuel System Health and Safety Precautions (100-00 General Information, Description and Operation).

7. Refer to: Fuel Injection Component Cleaning (303-04A Fuel Charging and Controls - TDV6 3.0L Diesel, General Procedures).

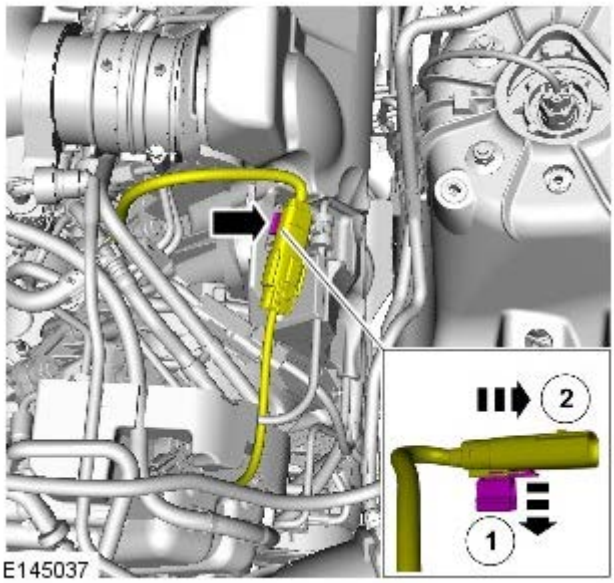
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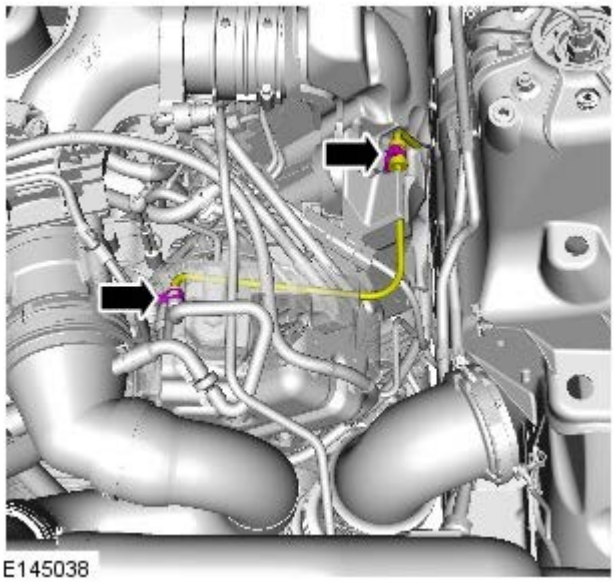
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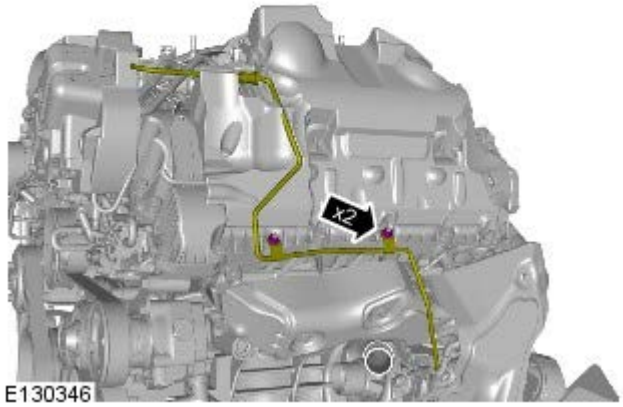
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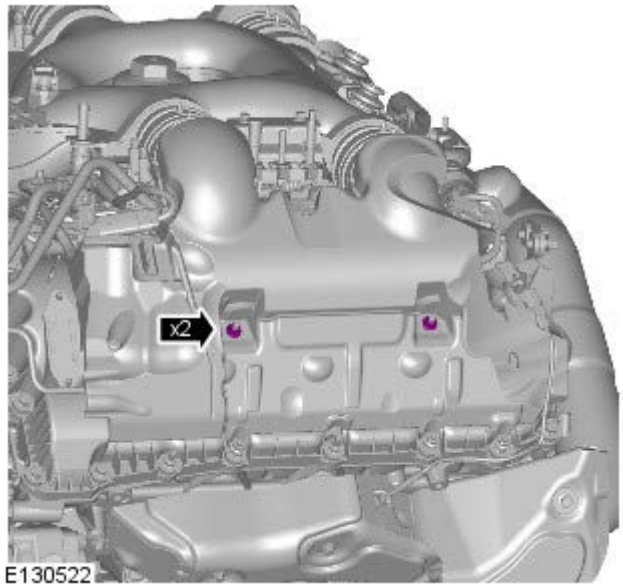
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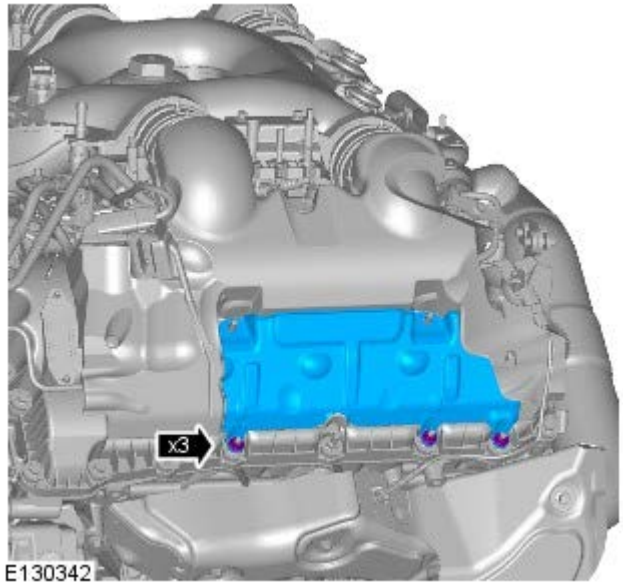
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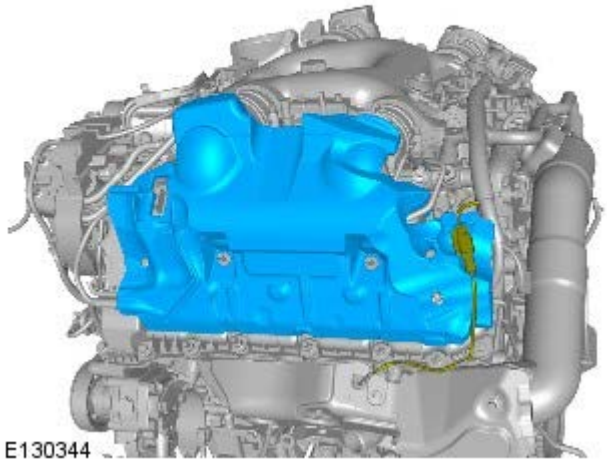
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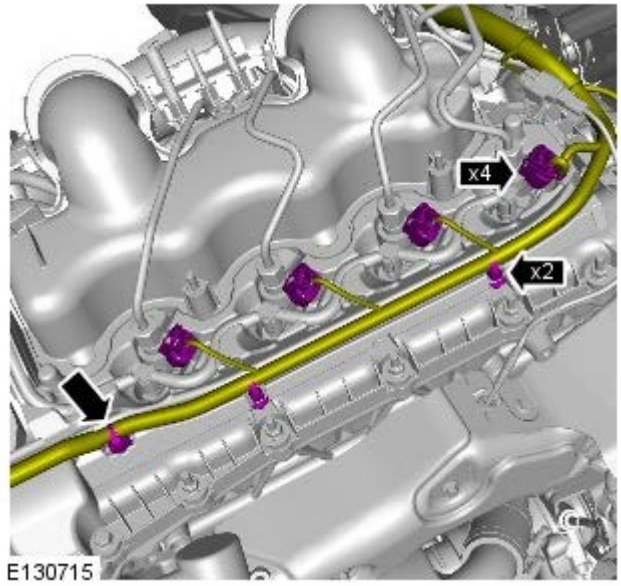
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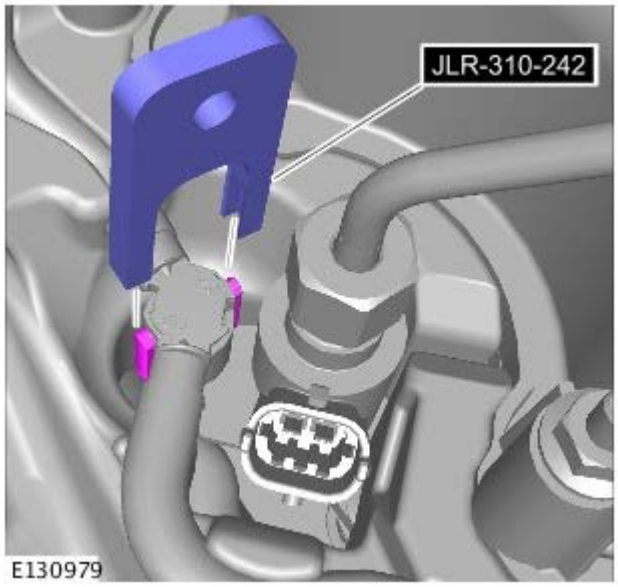
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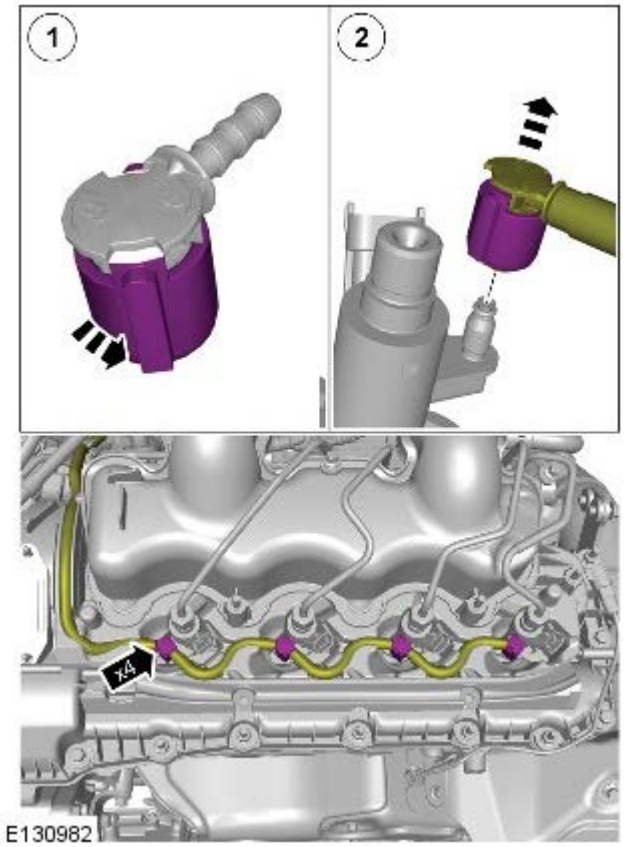
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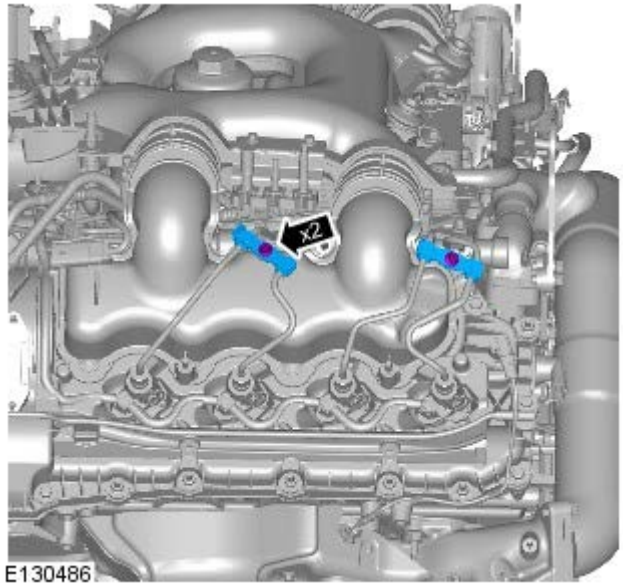
17. *Special Tool(s):* JLR-310-242



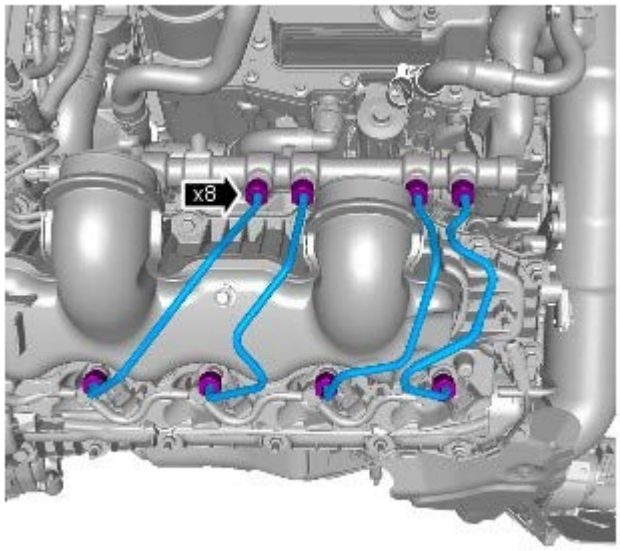
18. CAUTION: To remove the fuel injector leak off connector, rotate the connector anti clockwise until the white indicator becomes black.



19.

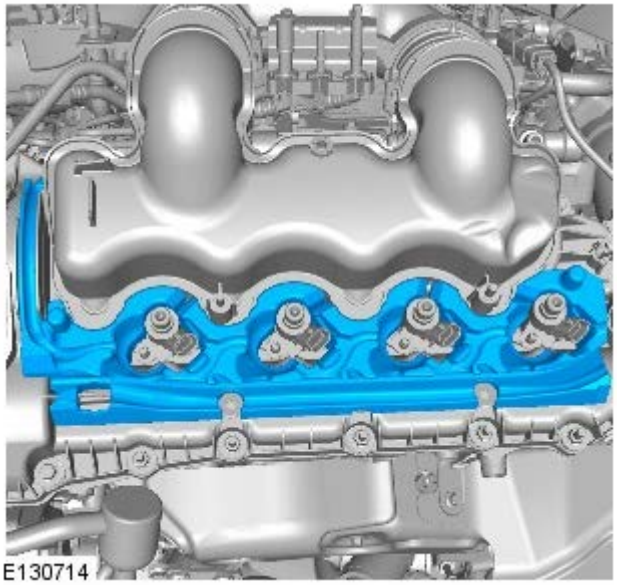


20. CAUTION: Discard the fuel pipes.



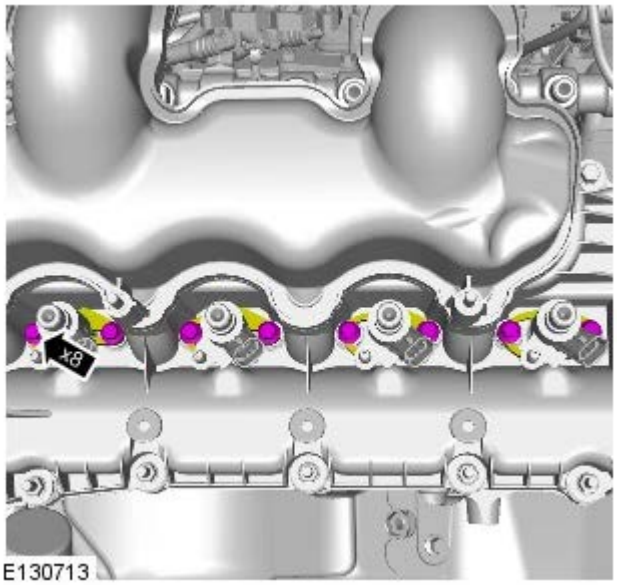
E130377

21.



E130714

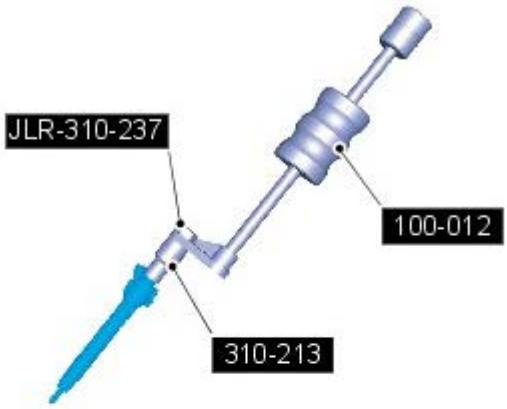
22. CAUTION: Discard the bolts.

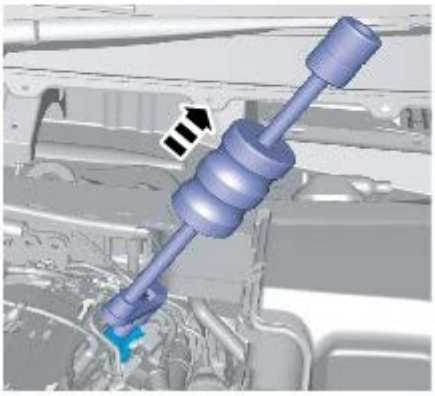


E130713

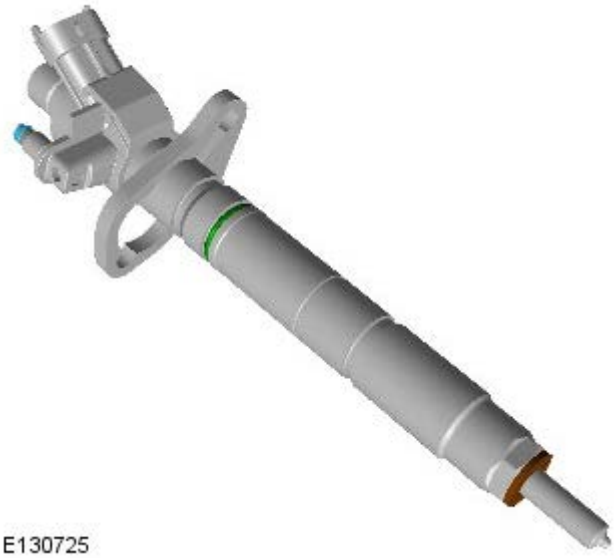
23. NOTE: Repeat this step for each of the fuel injectors.

- *Special Tool(s):* 100-012
- *Special Tool(s):* 310-213
- *Special Tool(s):* JLR-310-237





E130711



E130725

24. NOTES:

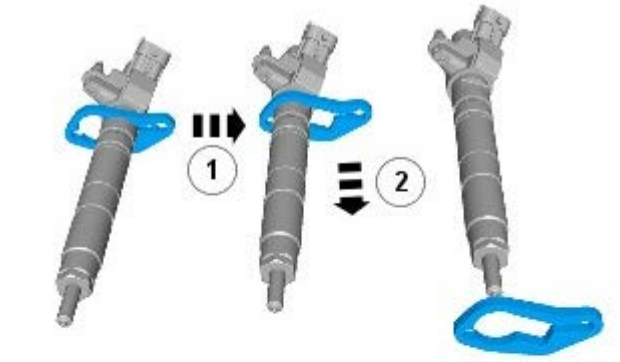
This step is only required if new components are not installed.

Remove and discard the O-ring seals.

Discard the sealing washers.

Repeat this step for each of the fuel injectors.

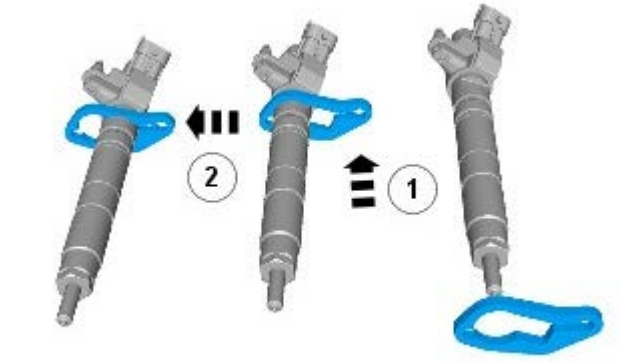
25. NOTE: This step is only required if new components are not installed.





E130766

Installation



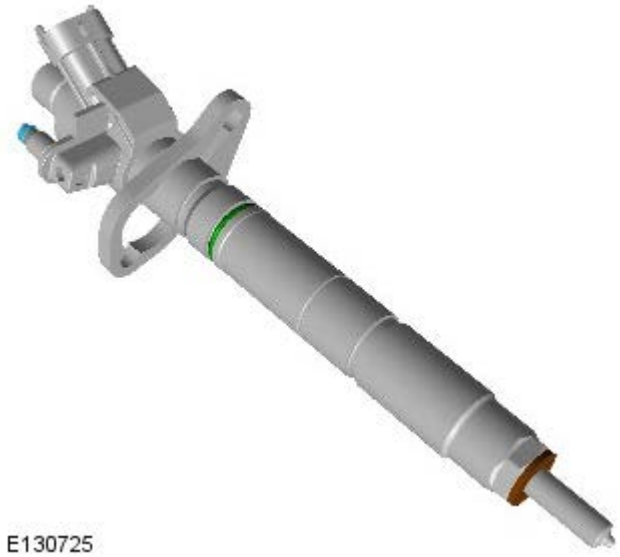


E130767

1. NOTE: This step is only required if previously removed.

2. CAUTION: Make sure that new sealing washers are installed.

   NOTES:



E130725

This step is only required if previously removed.

Install new O-ring seals.

Repeat this step for each of the fuel injectors.

3. 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.

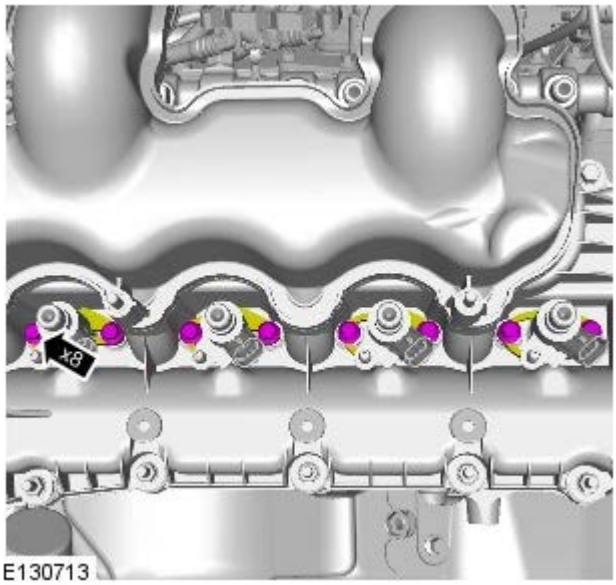


E130650

4. CAUTION: Make sure that new bolts are installed.

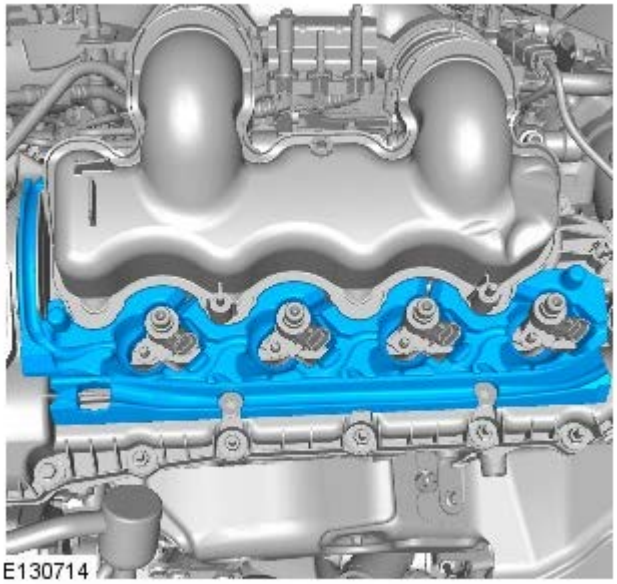
NOTE: Tighten the retaining bolts evenly and progressively.

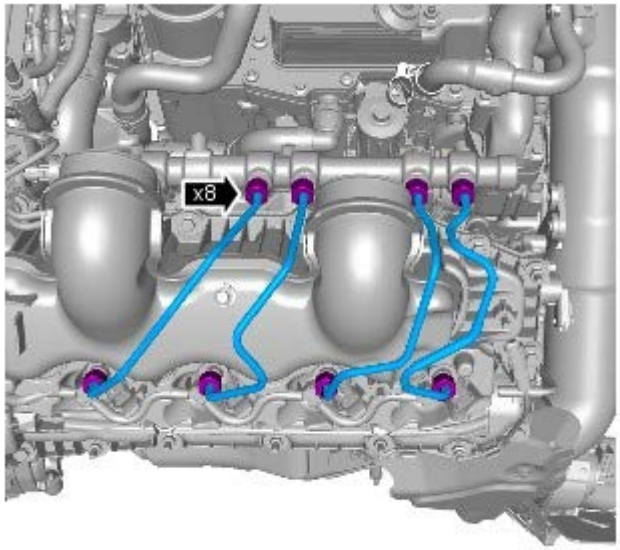
Torque: 10 Nm



E130713

5.

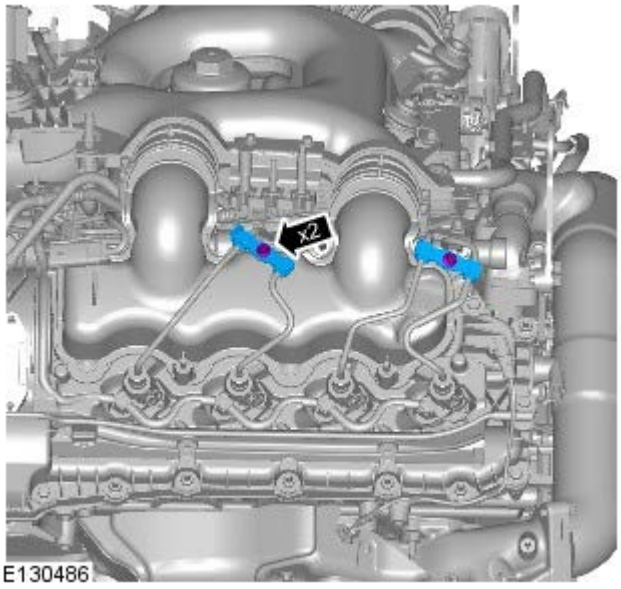




6. CAUTIONS:

   Install new fuel pipes.

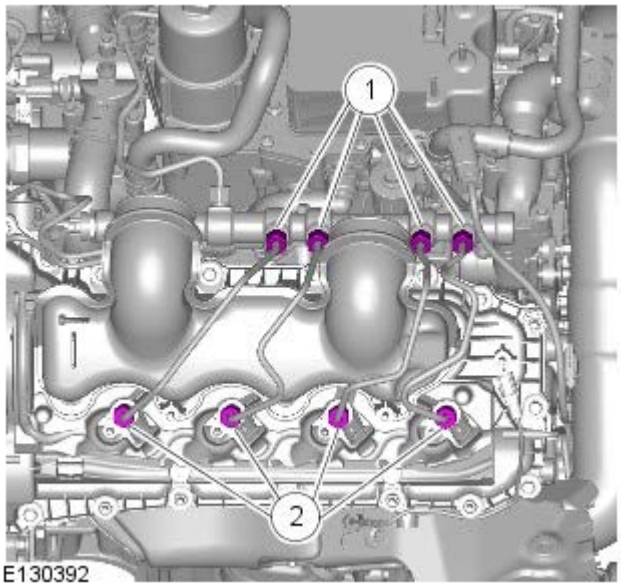
   Only tighten the unions finger-tight at this stage.



7. CAUTION: Only tighten the bolts finger-tight at this stage.

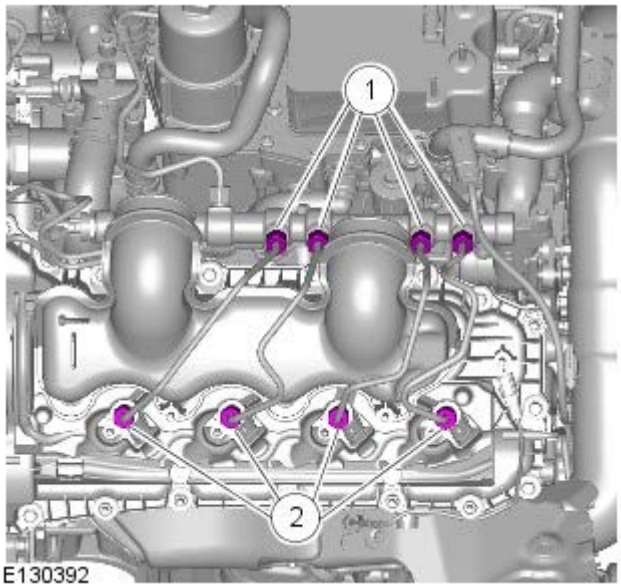
8. Tighten all.

   Torque: 10 Nm

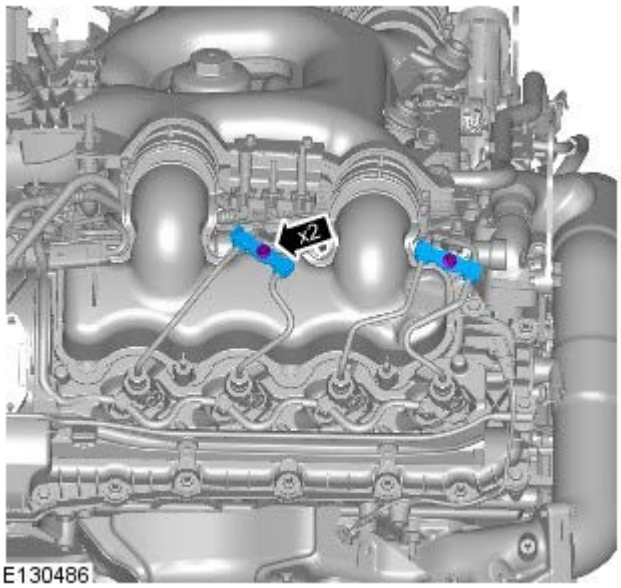


9. Tighten all.

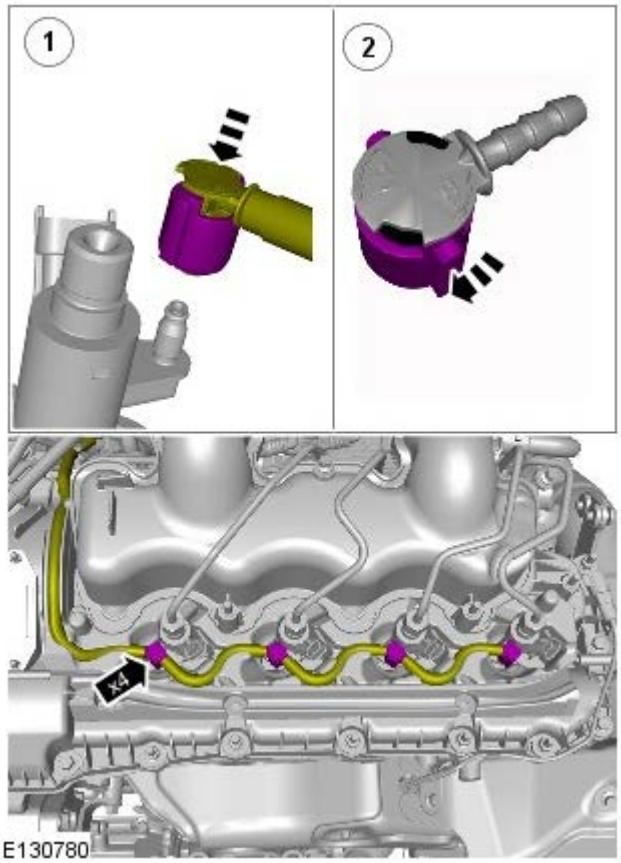
   Torque: 73°



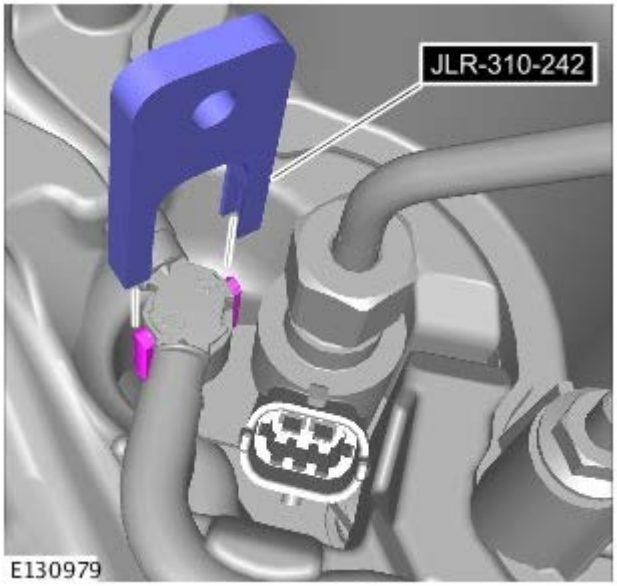
10. *Torque:* 10 Nm



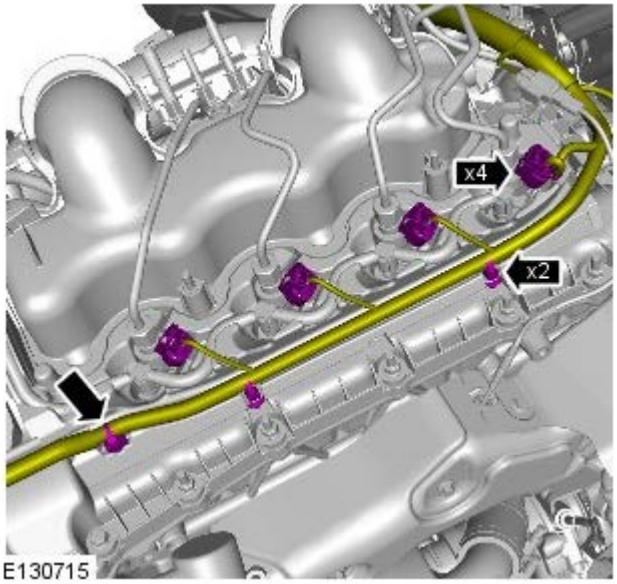
11. CAUTION: To install the fuel injector leak off connector, rotate the connector clockwise until the black indicator becomes white.



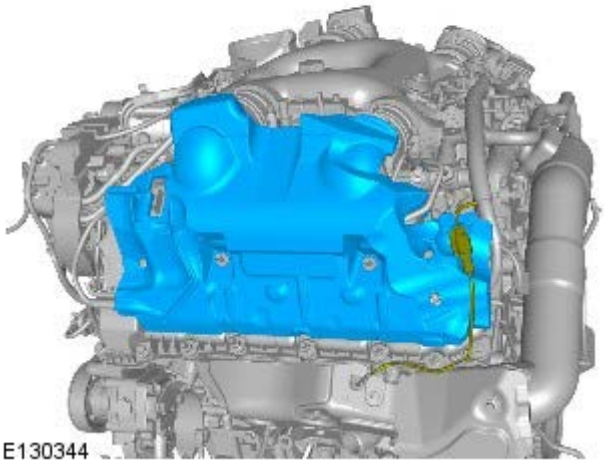
12. *Special Tool(s):* JLR-310-242



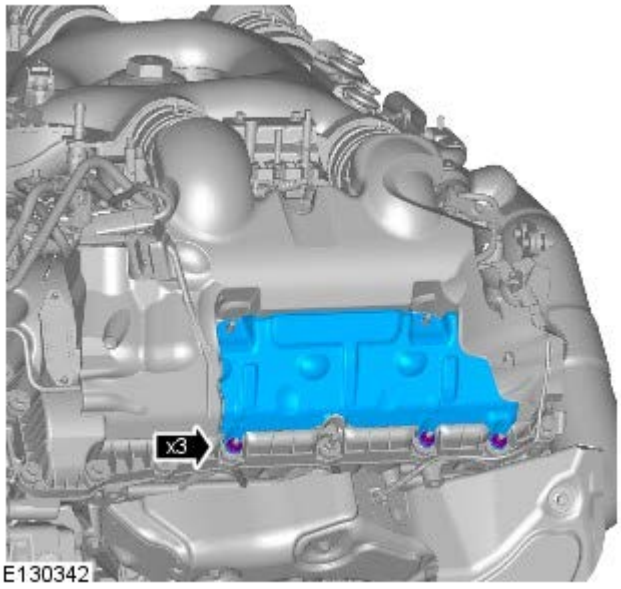
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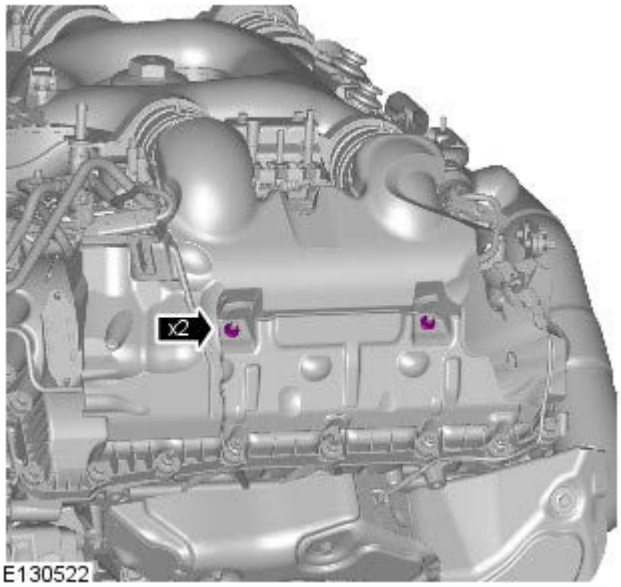
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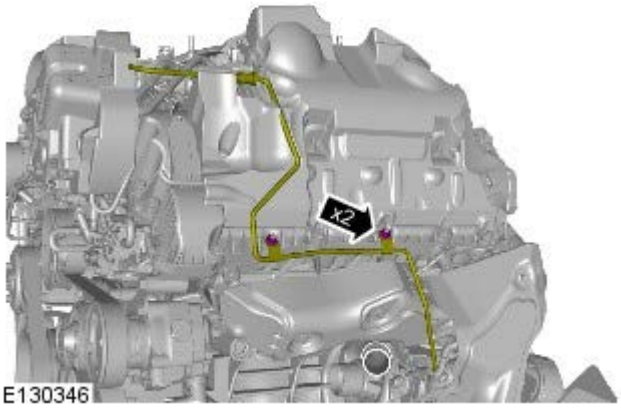
15. *Torque:* 10 Nm



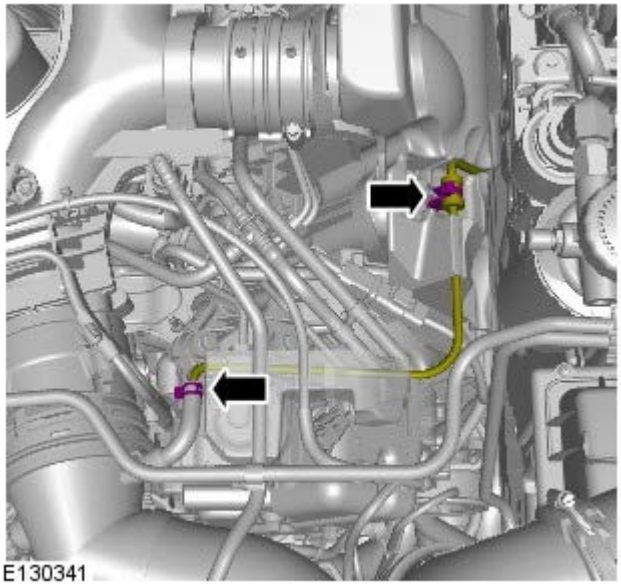
16. *Torque:* 6 Nm



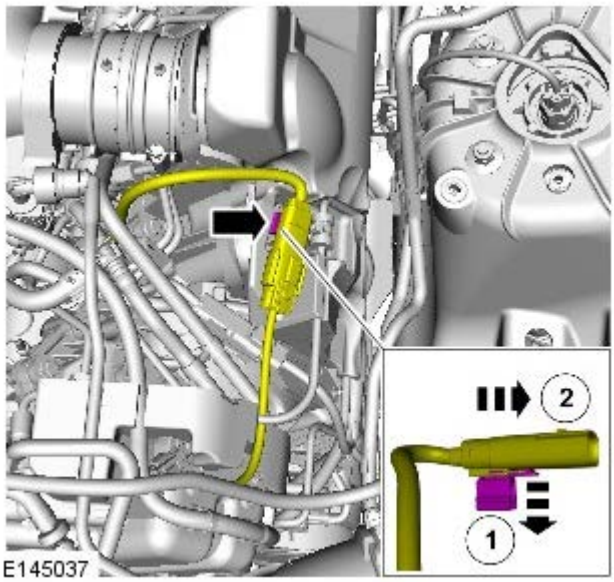
17. *Torque:* 10 Nm



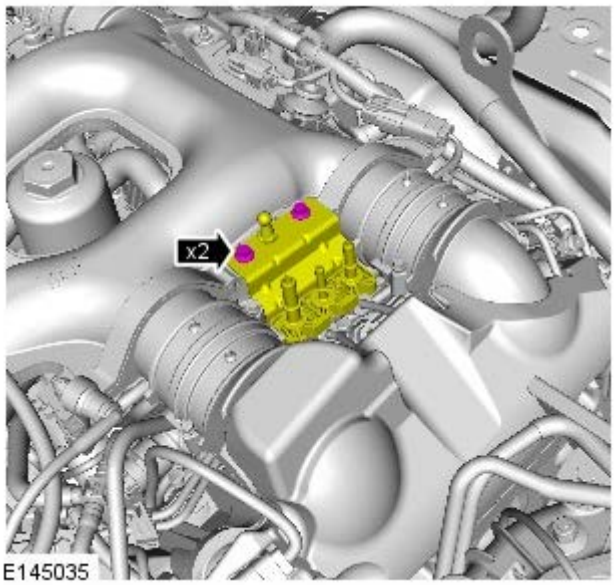
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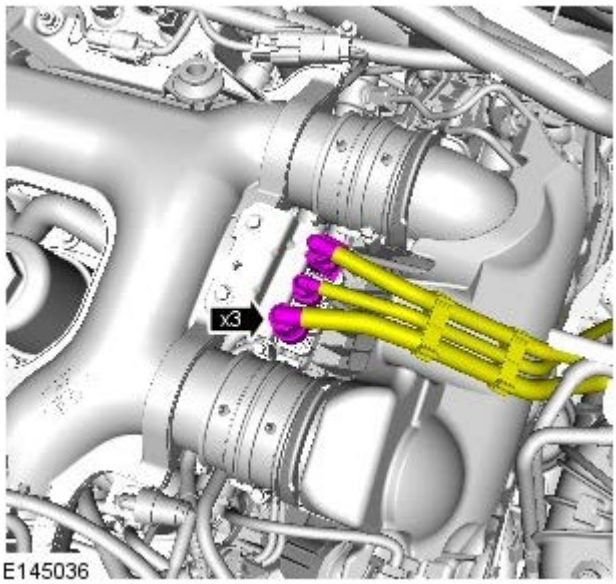
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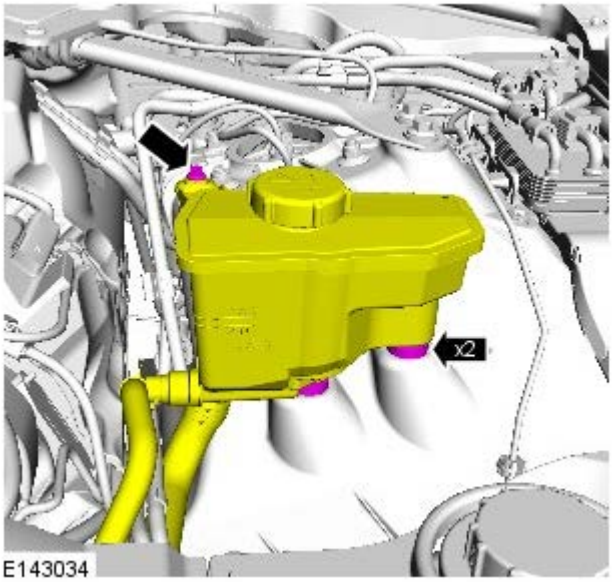
20. *Torque:* 10 Nm



21.



22. *Torque:* 9 Nm



23. Refer to: Fuel Filter Element (310-01D Fuel Tank and Lines - TDV8 4.4L Diesel, Removal and Installation).

24. Refer to: Air Cleaner LH (303-12D Intake Air Distribution and Filtering - TDV8 4.4L Diesel, Removal and Installation).

25. Refer to: Secondary Bulkhead Center Panel - TDV8 4.4L Diesel (501-02 Front End Body Panels, Removal and Installation).

26. Connect the battery ground cable.

    Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

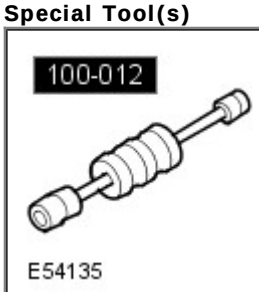
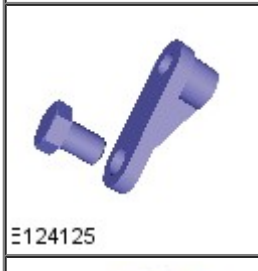
27. Refer to: High-Pressure Fuel System Bleeding (310-00 Fuel System - General Information, General Procedures).

Published: 10-Dec-2013

Fuel Charging and Controls - TDV8 4.4L Diesel - Fuel Injectors RH

Removal and Installation

Special Tool(s)

	100-012 Slide Hammer
	310-213 Fuel Injector Removal Adapter
	JLR-310-237 Remover, Fuel Injector
	JLR-310-242 Remover/Installer, Fuel Injector Leak Off Pipe

Removal

CAUTIONS:

Make sure the wings and trim panels are covered and protected, failure to follow this instruction may result in damage to the vehicle.

The use of an electronic torque and angle gauge is recommended during the high pressure fuel pipe tightening procedure.

NOTES:

Some variation in the illustrations may occur, but the essential information is always correct.

Engine shown removed for clarity.

1. Disconnect the battery ground cable.

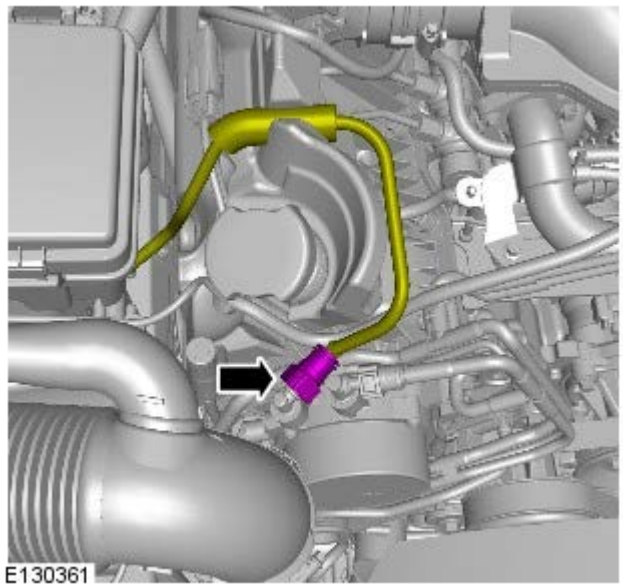
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

2. Refer to: Air Cleaner RH (303-12D Intake Air Distribution and Filtering - TDV8 4.4L Diesel, Removal and Installation).

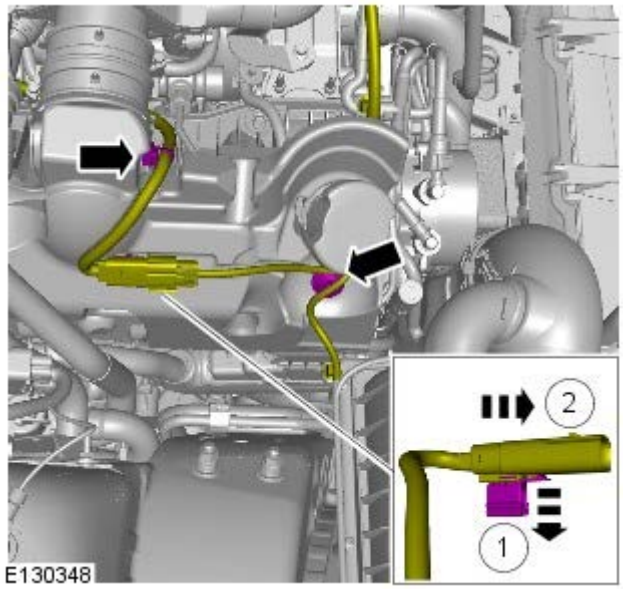
3. Refer to: Secondary Bulkhead Center Panel - TDV8 4.4L Diesel (501-02 Front End Body Panels, Removal and Installation).

4. Refer to: Fuel Fired Booster Heater (412-02A Auxiliary Climate Control, Removal and Installation).

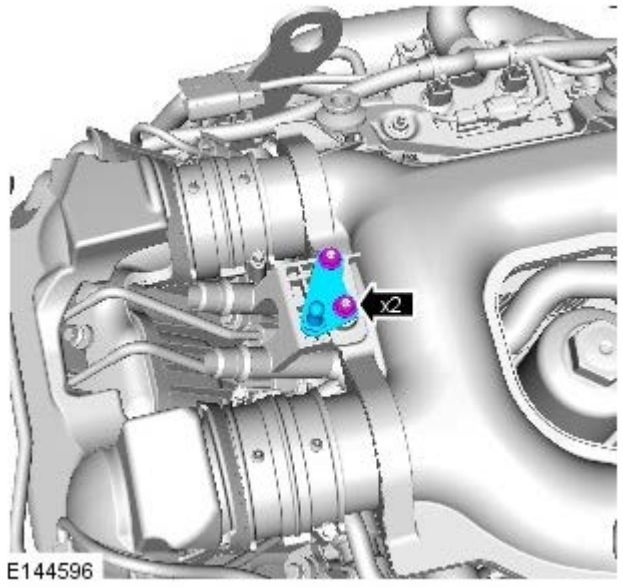
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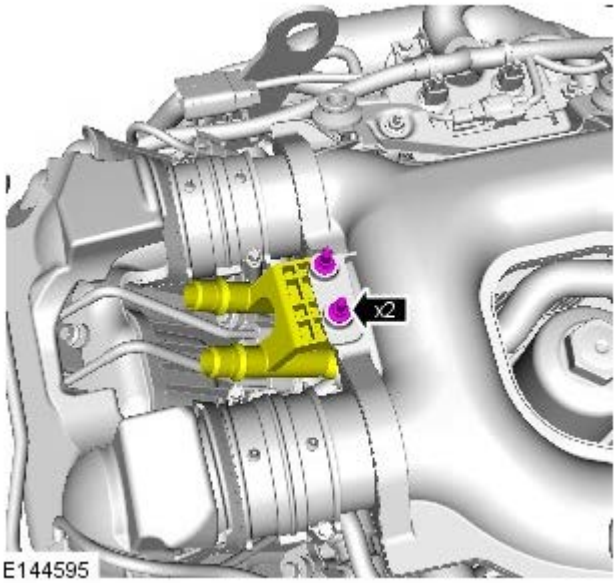
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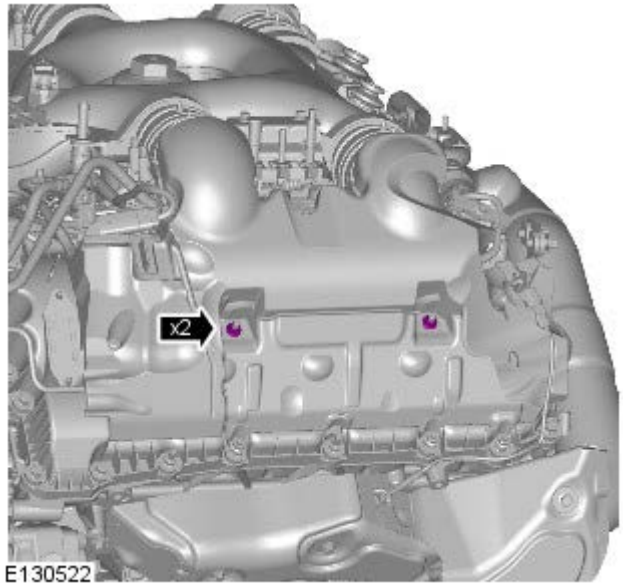
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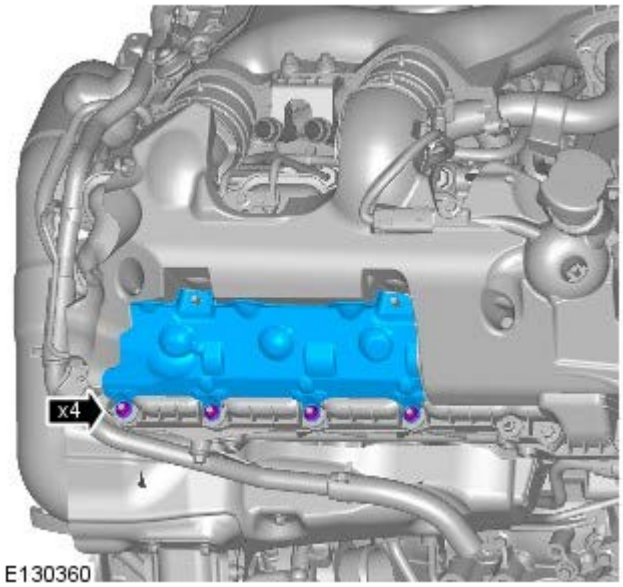
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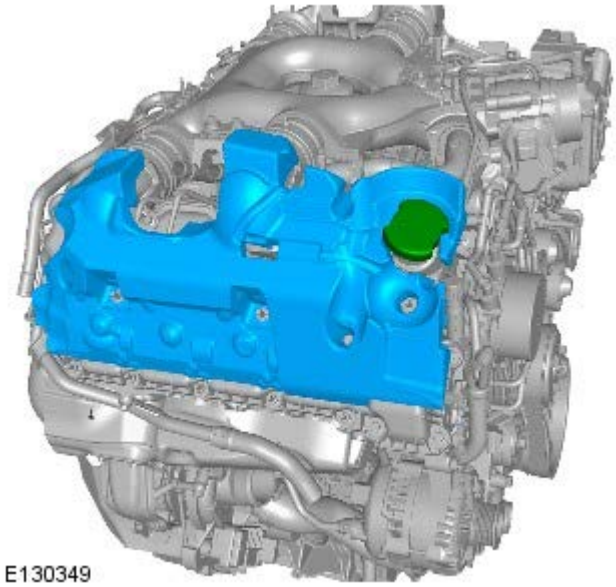
9. CAUTION: LH illustration shown, RH is similar.



10.



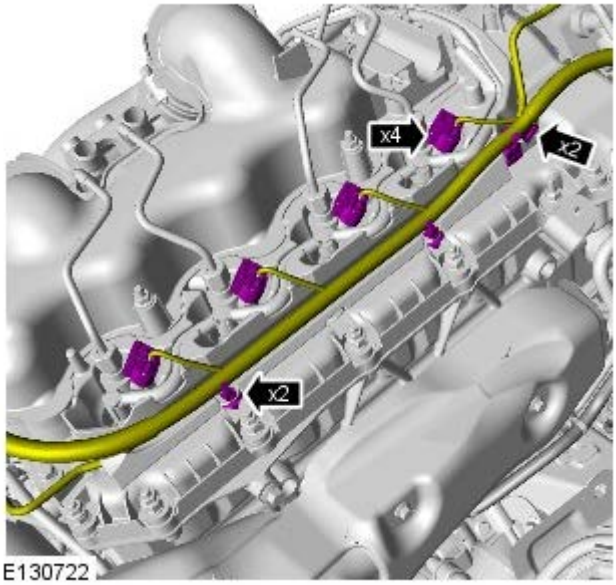
11.


E130349

12. Refer to: Diesel Fuel System Health and Safety Precautions (100-00 General Information, Description and Operation).

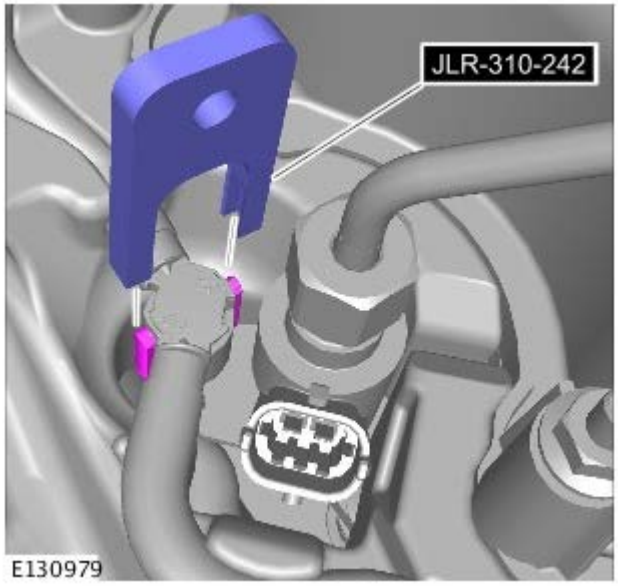
13. Refer to: Fuel Injection Component Cleaning (303-04A Fuel Charging and Controls - TDV6 3.0L Diesel, General Procedures).

14.

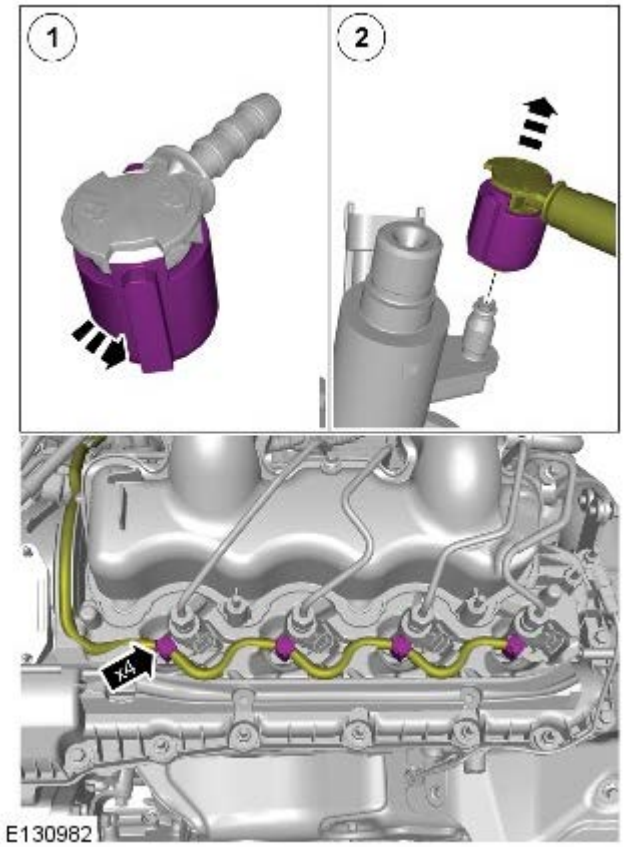


E130722

15. *Special Tool(s):* JLR-310-242



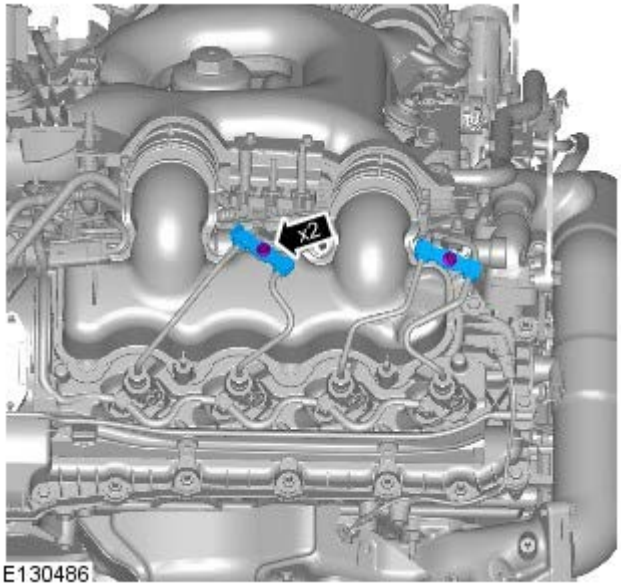
E130979



16. CAUTIONS:

LH illustration shown, RH is similar.

To remove the fuel injector leak off connector, rotate the connector anti clockwise until the white indicator becomes black.

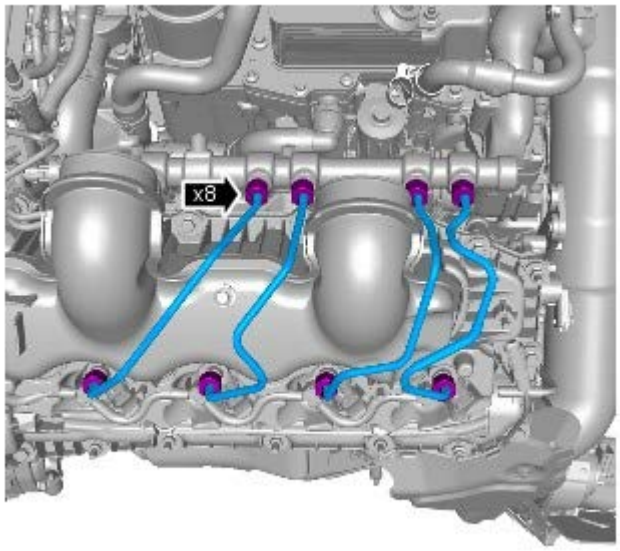


17. CAUTION: LH illustration shown, RH is similar.

18. CAUTIONS:

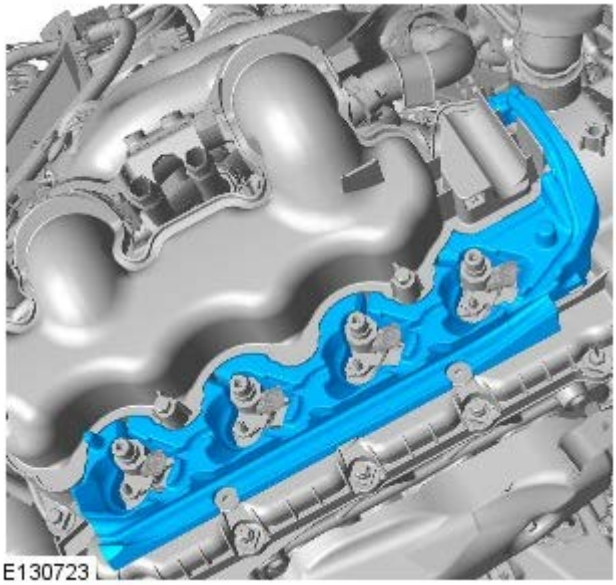
Discard the fuel pipes.

LH illustration shown, RH is similar.



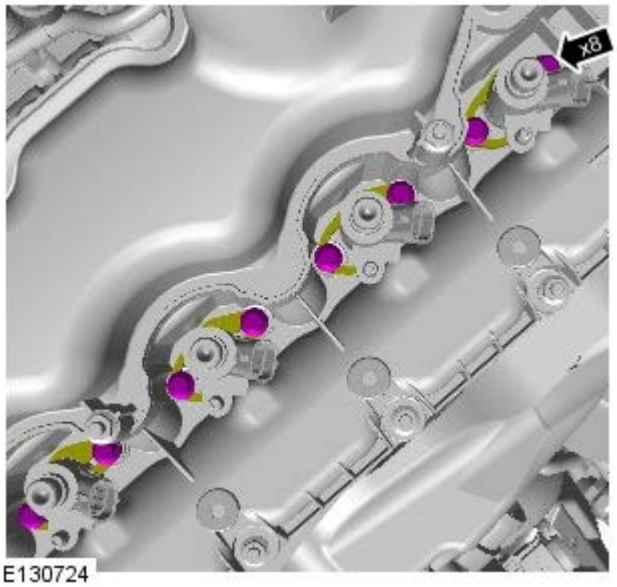
E130377

19.



E130723

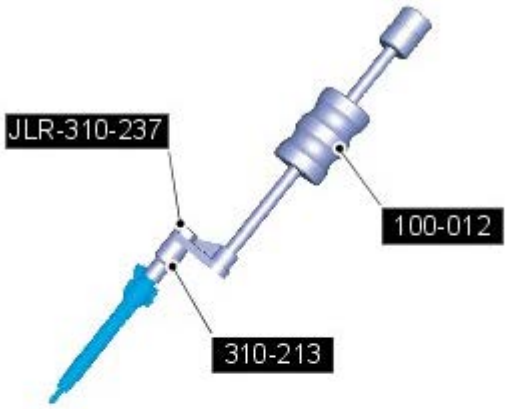
20. CAUTION: Discard the bolts.

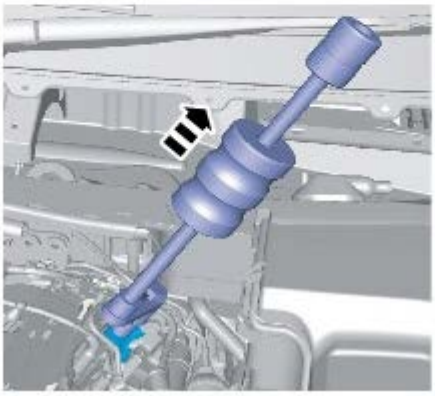


E130724

21. CAUTIONS:

Make sure that the area around the component is clean and free of foreign material.





E130711

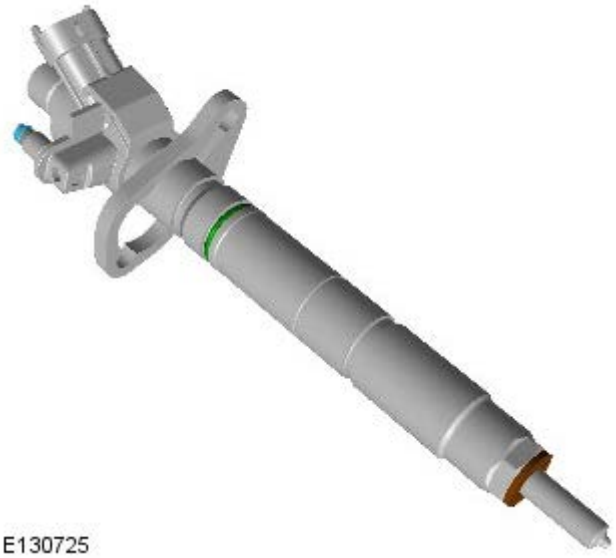
Make sure that all openings are sealed. Use new blanking caps.

LH illustration shown, RH is similar.

NOTE: Repeat this step for each of the fuel injectors.

- *Special Tool(s):* 100-012
- *Special Tool(s):* 310-213
- *Special Tool(s):* JLR-310-237

22. NOTES:



E130725

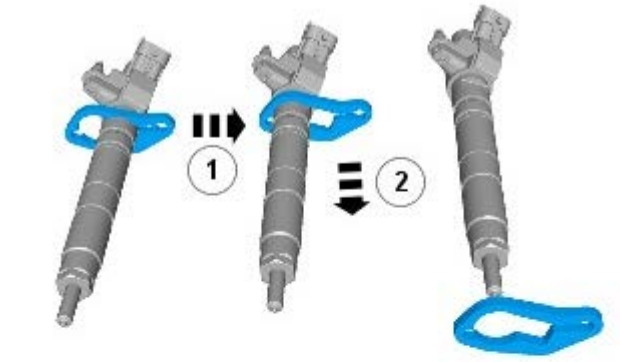
This step is only required if new components are not installed.

Remove and discard the O-ring seals.

Discard the sealing washers.

Repeat this step for each of the fuel injectors.

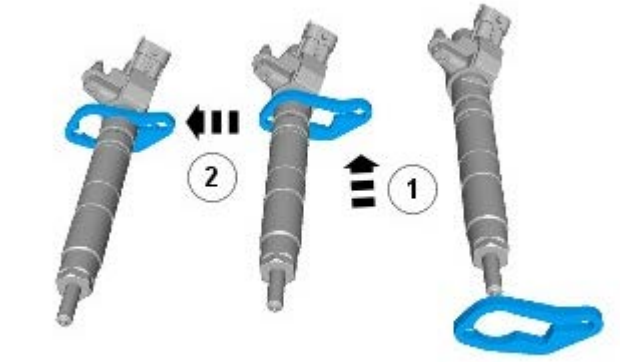
23. NOTE: This step is only required if new components are not installed.





E130766

Installation



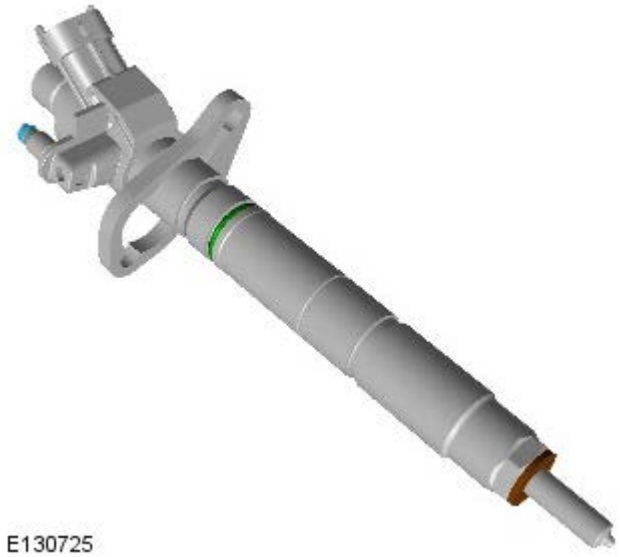


E130767

1. NOTE: This step is only required if previously removed.

2. CAUTION: Make sure that new sealing washers are installed.

   NOTES:



E130725

This step is only required if previously removed.

Install new O-ring seals.

Repeat this step for each of the fuel injectors.

3. 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.

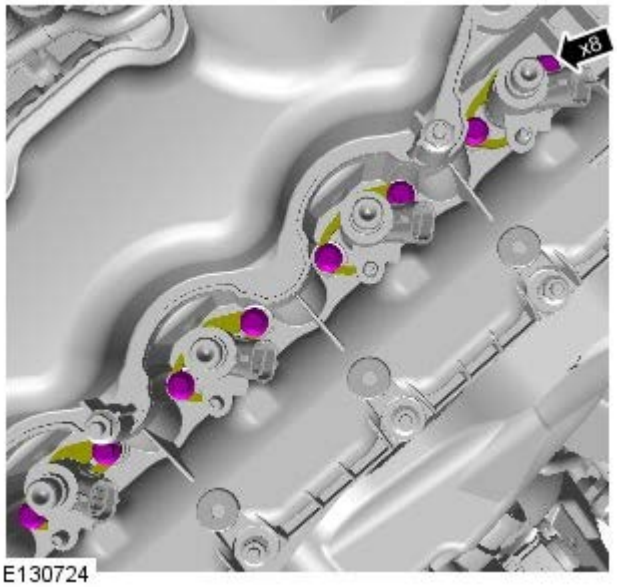


E130650

4. CAUTION: Make sure that new bolts are installed.

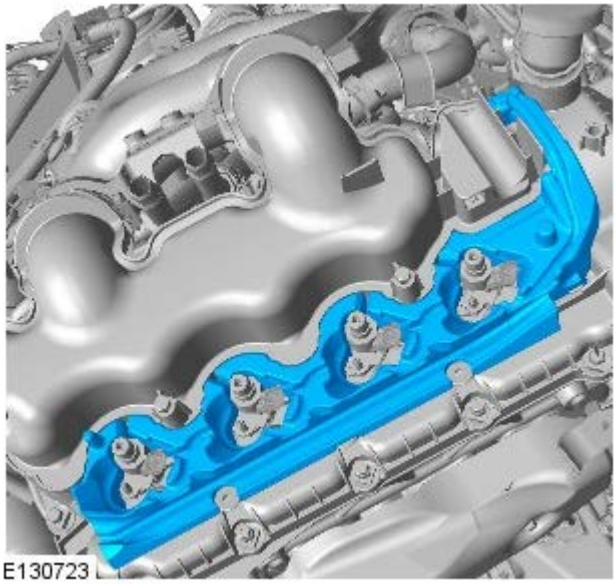
NOTE: Tighten the retaining bolts evenly and progressively.

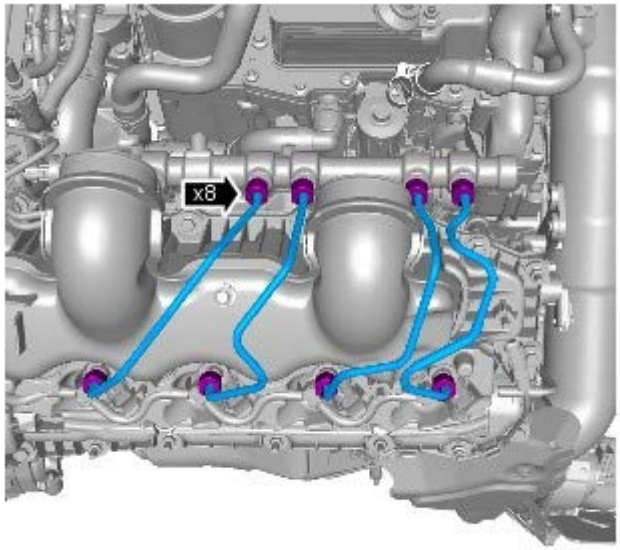
Torque: 10 Nm



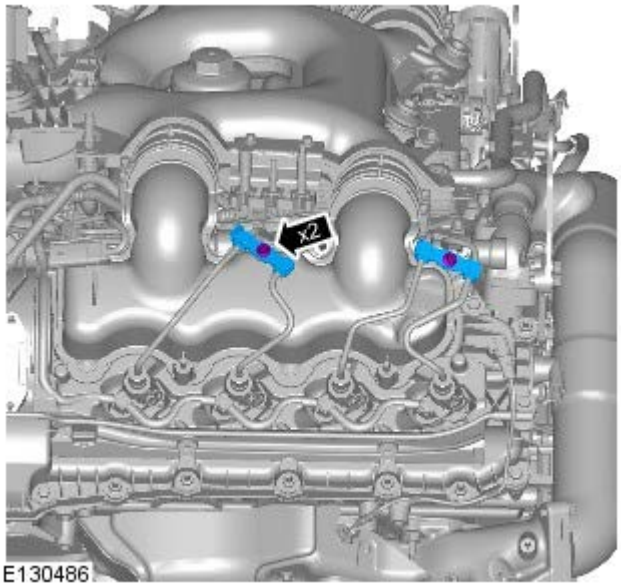
E130724

5.


E130723



E130377



E130486

6. CAUTIONS:

   Install new fuel pipes.

   Only tighten the unions finger-tight at this stage.

   LH illustration shown, RH is similar.

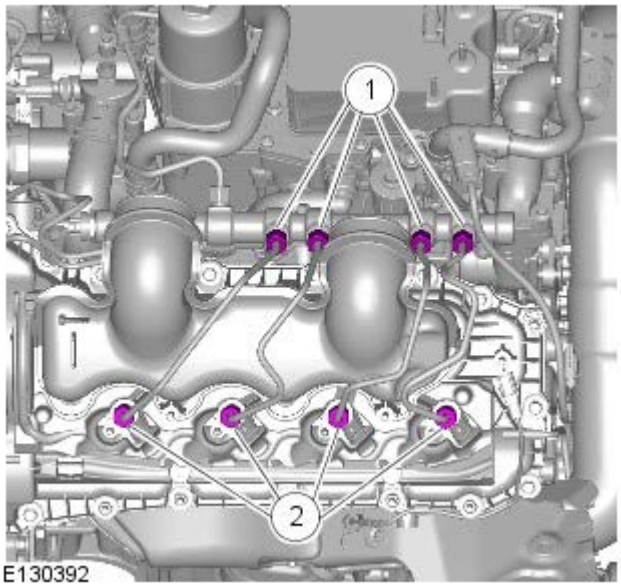
7. CAUTIONS:

   Only tighten the bolts finger-tight at this stage.

   LH illustration shown, RH is similar.

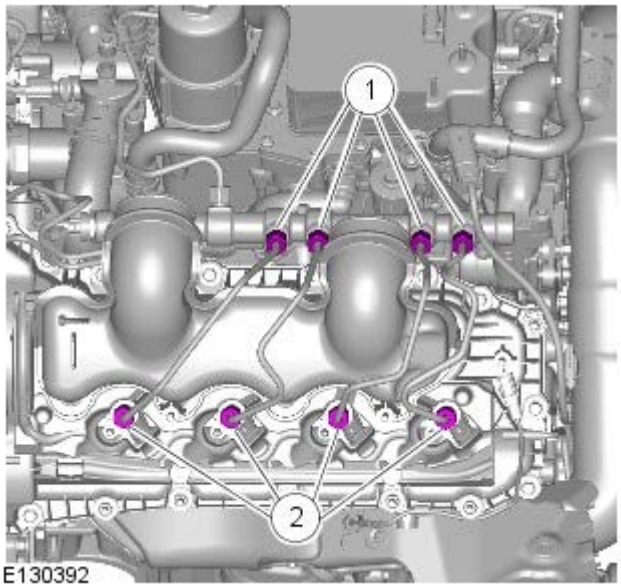
8. Tighten all.

   Torque: 10 Nm



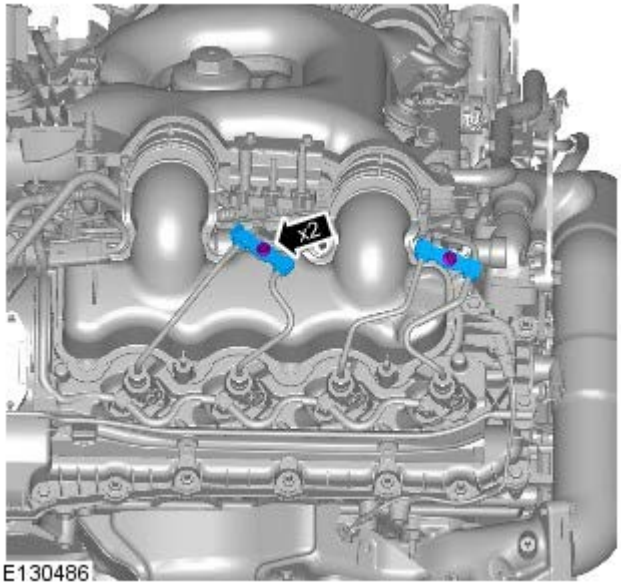
9. Tighten all.

   Torque: 73°

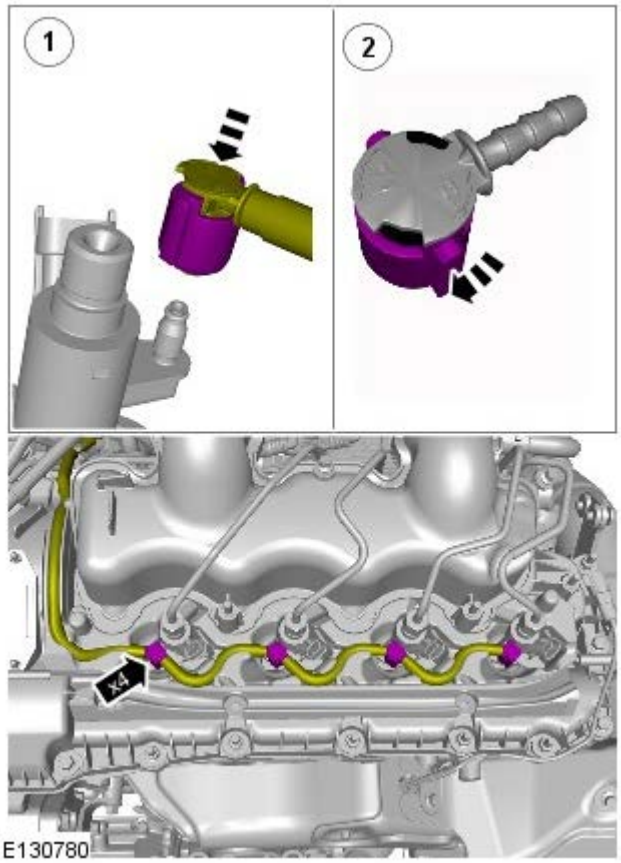


10. CAUTION: LH illustration shown, RH is similar.

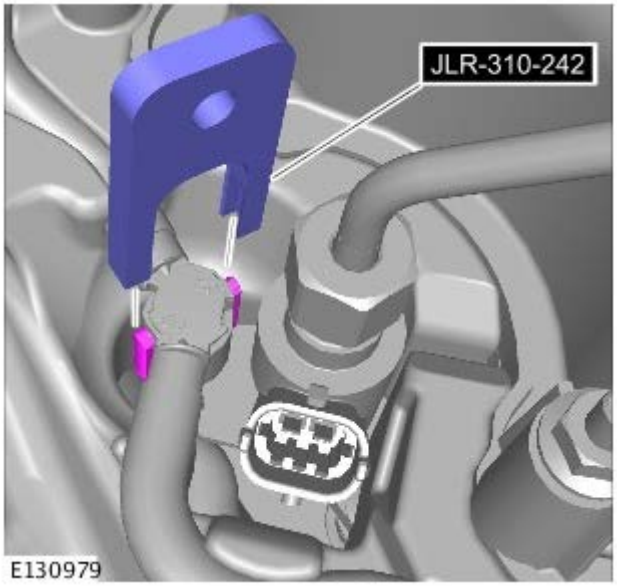
    Torque: 10 Nm



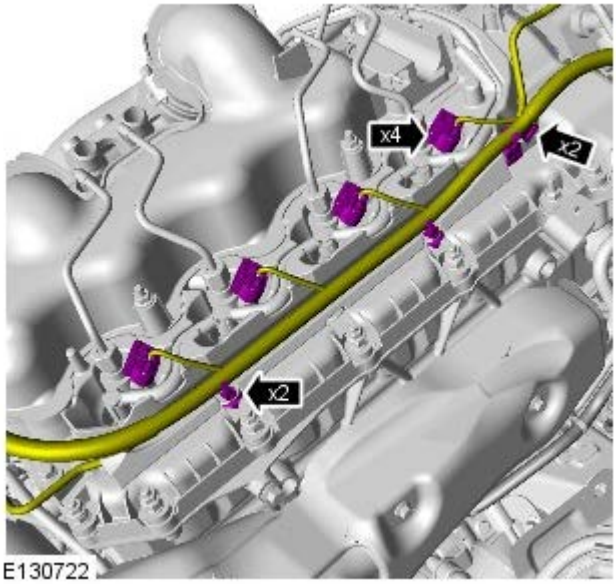
11. CAUTION: To install the fuel injector leak off connector, rotate the connector clockwise until the black indicator becomes white.



12. *Special Tool(s):* JLR-310-242

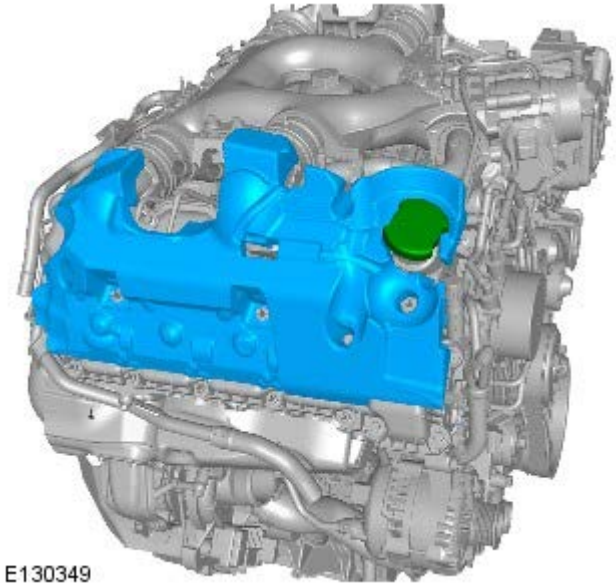


13.

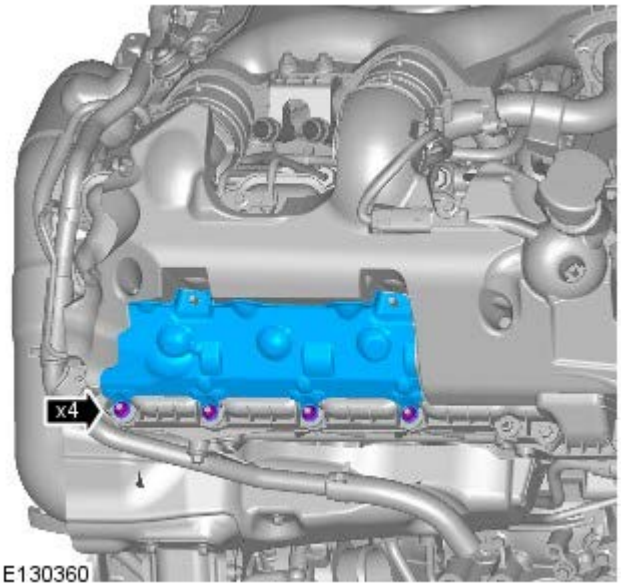


E130722

14.

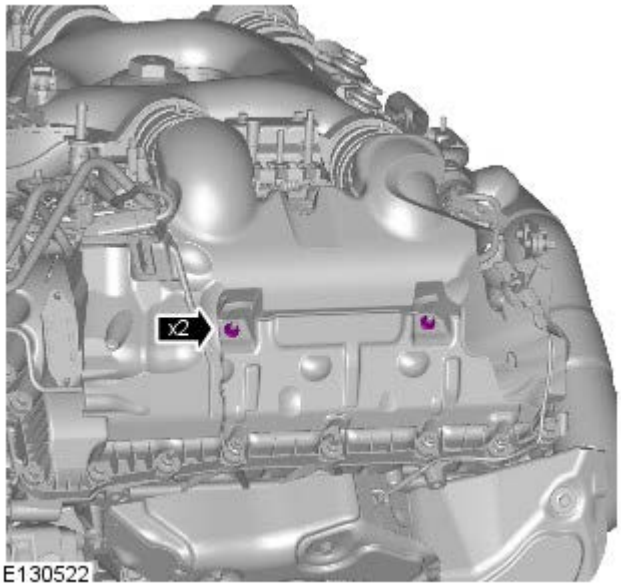

E130349

15. *Torque:* 10 Nm

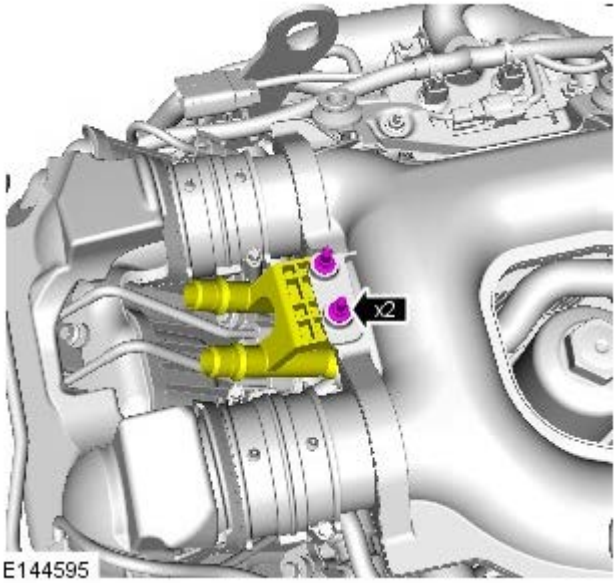


E130360

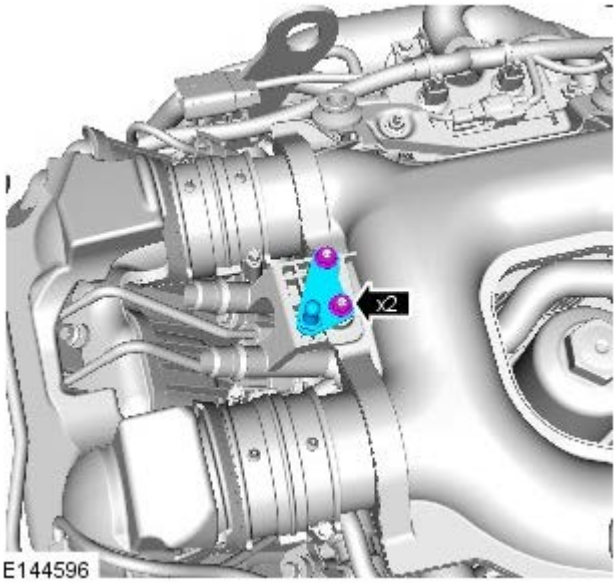
16. *Torque:* 6 Nm



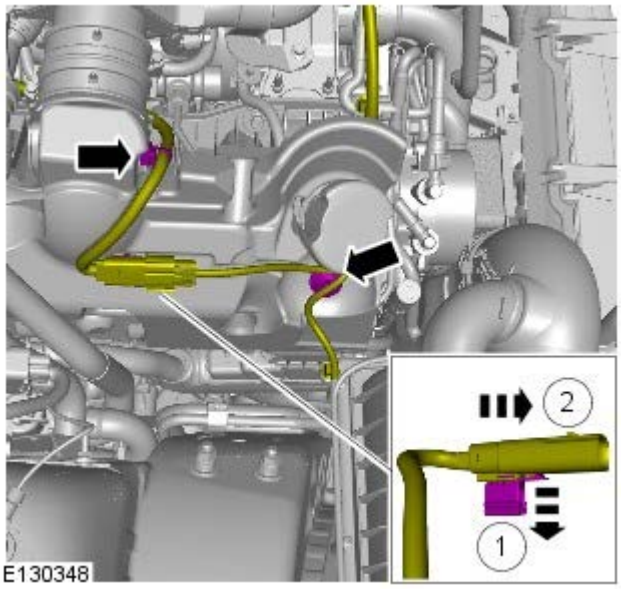
17. *Torque:* 10 Nm



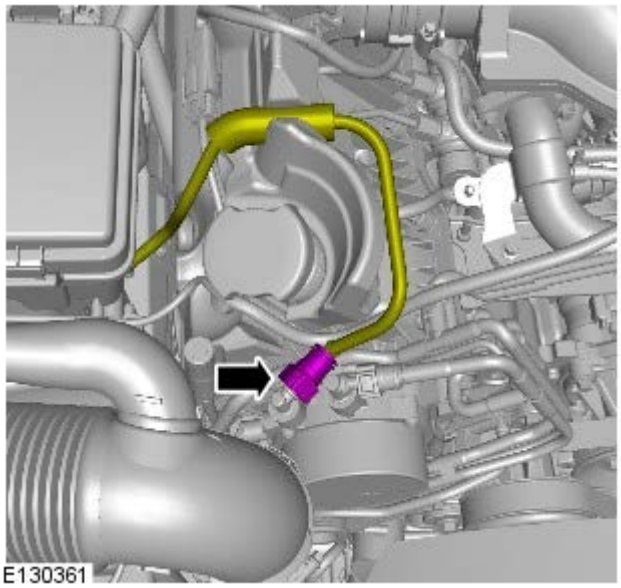
18. *Torque:* 10 Nm



19.



20.



21. Refer to: Fuel Fired Booster Heater (412-02A Auxiliary Climate Control, Removal and Installation).

22. Refer to: Secondary Bulkhead Center Panel - TDV8 4.4L Diesel (501-02 Front End Body Panels, Removal and Installation).

23. Refer to: Air Cleaner RH (303-12D Intake Air Distribution and Filtering - TDV8 4.4L Diesel, Removal and Installation).

24. Refer to: High-Pressure Fuel System Bleeding (310-00 Fuel System - General Information, General Procedures).

25. Connect the battery ground cable.

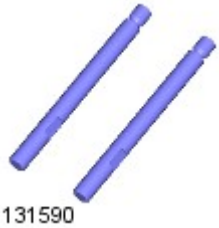
    Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 24-Oct-2013

Fuel Charging and Controls - TDV8 4.4L Diesel - Fuel Pump

Removal and Installation

Special Tool(s)

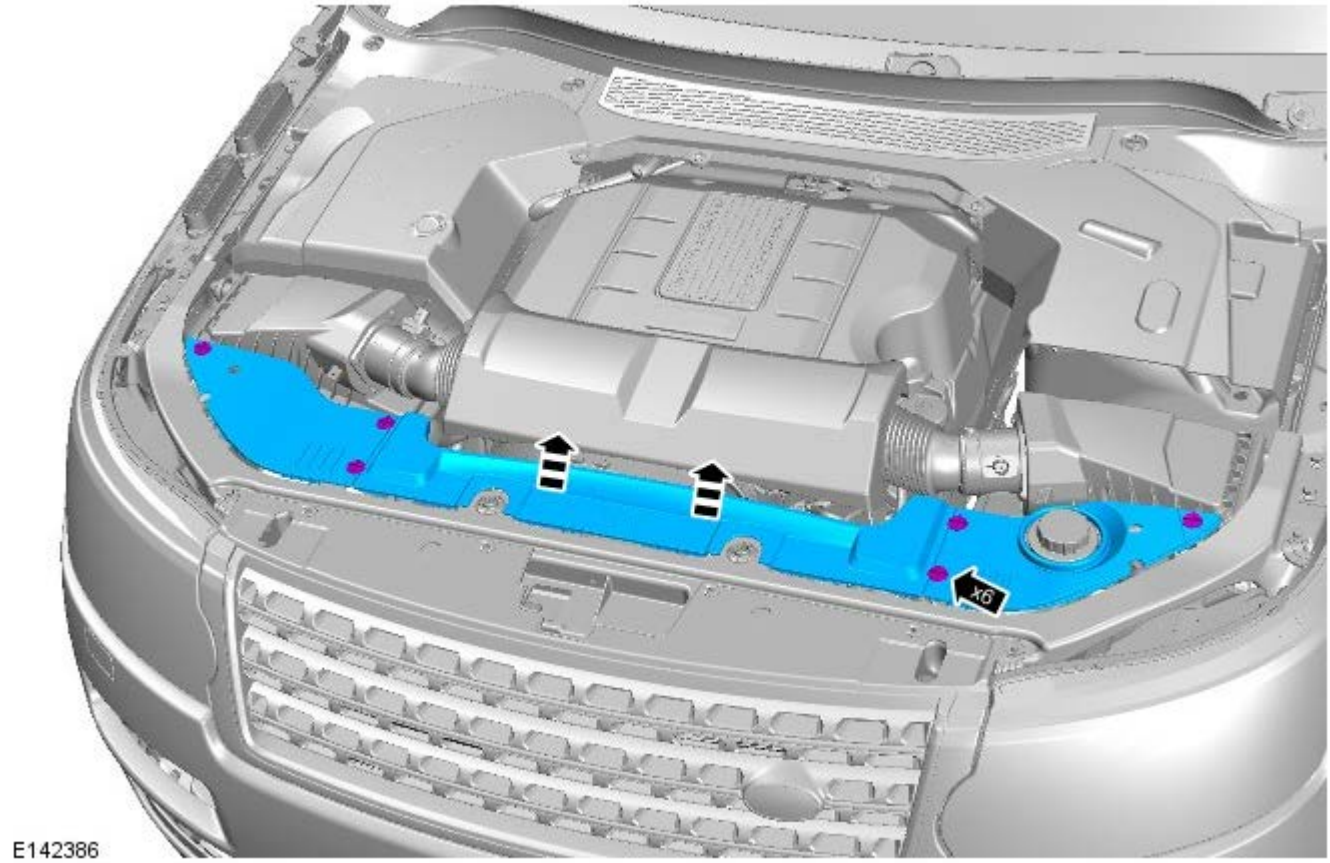
 E131587	JLR-303-1571 Locking Tool, Crankshaft Damper
 E131589	JLR-310-246 Locking Tool, Fuel Injection Pump
 E131590	JLR-310-248 Aligner, Fuel Pump

Removal

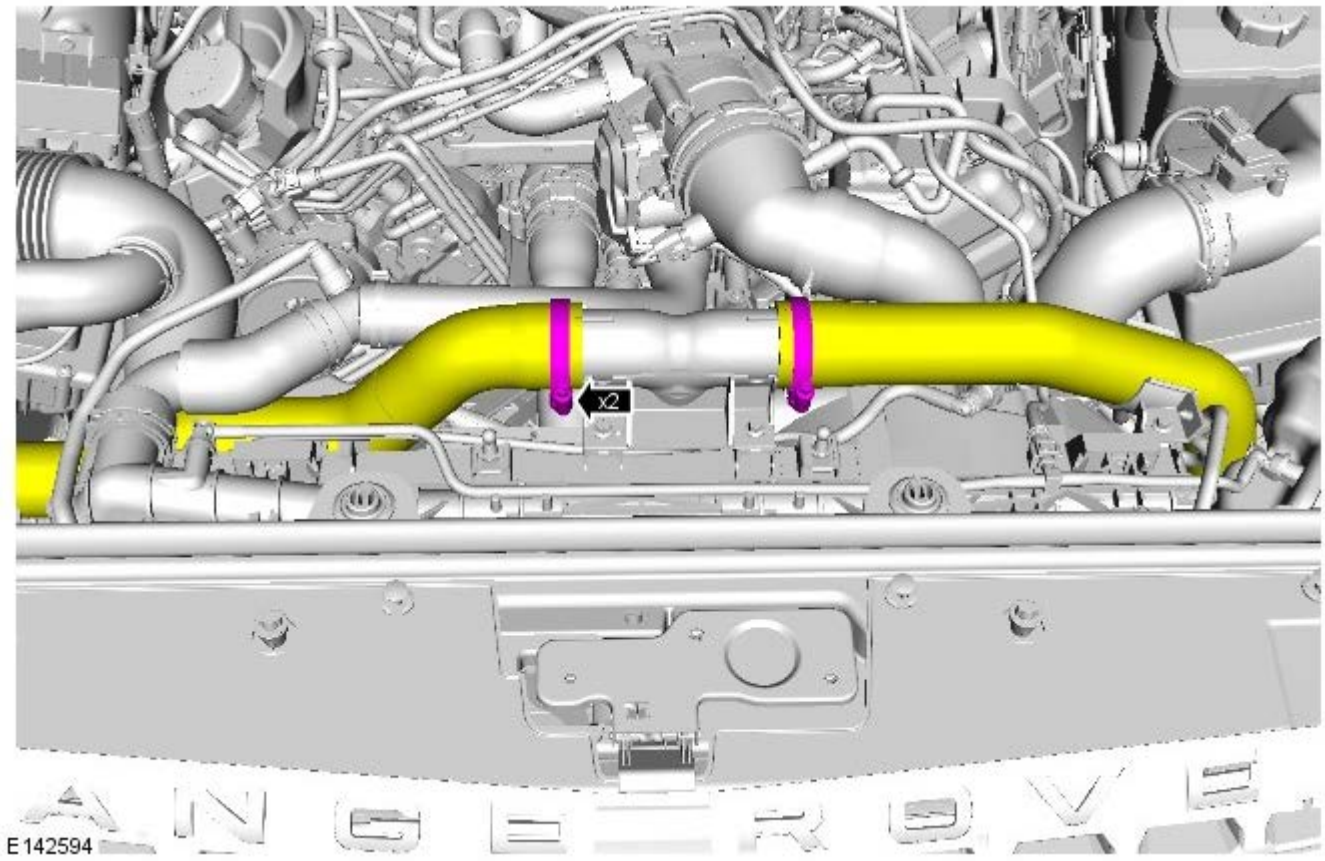
CAUTION: Make sure that all openings are sealed. Use new blanking caps.

1. Refer to: Diesel Fuel System Health and Safety Precautions (100-00 General Information, Description and Operation).
2. Disconnect the battery ground cable.

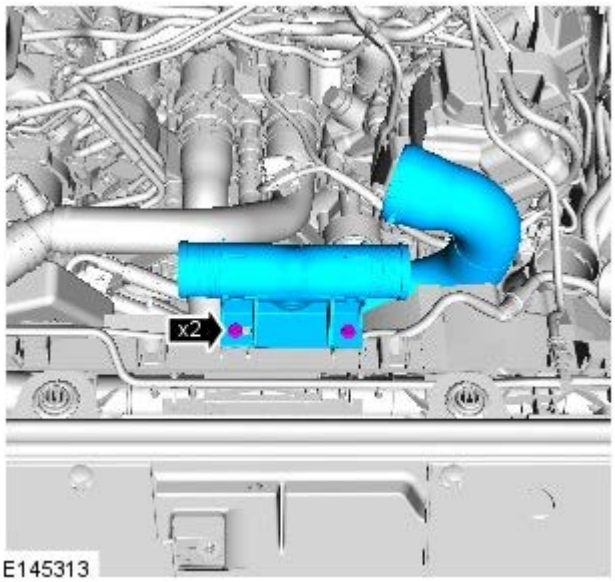
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).
3. Refer to: Cooling System Partial Draining, Filling and Bleeding (303-03F Engine Cooling - TDV8 4.4L Diesel, General Procedures).
4. Refer to: Air Cleaner LH (303-12D Intake Air Distribution and Filtering - TDV8 4.4L Diesel, Removal and Installation).
5. Refer to: Intake Manifold Plenum Chamber (303-01D Engine - TDV8 4.4L Diesel, Removal and Installation).
6. Refer to: Fuel Injection Component Cleaning (303-04A Fuel Charging and Controls - TDV6 3.0L Diesel, General Procedures).
7.



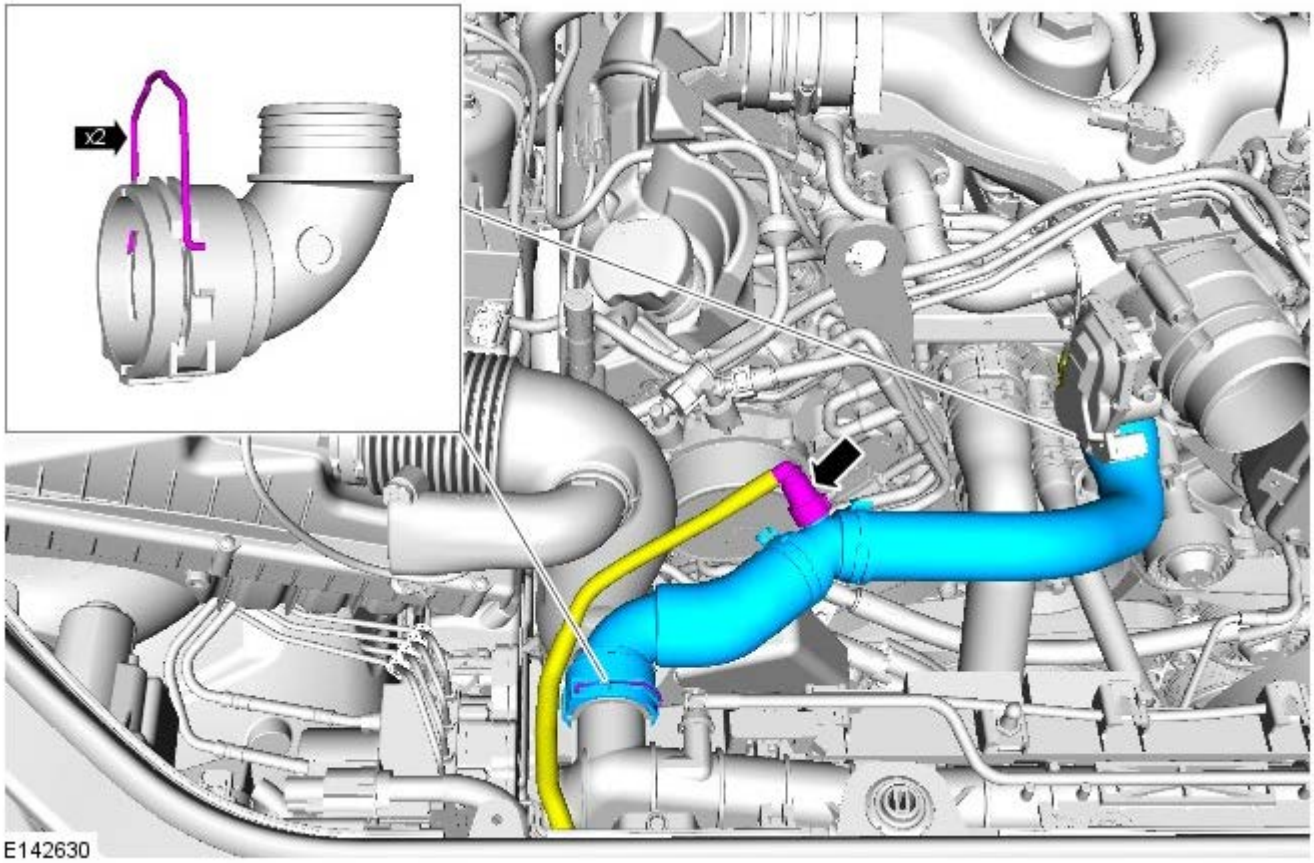
8.



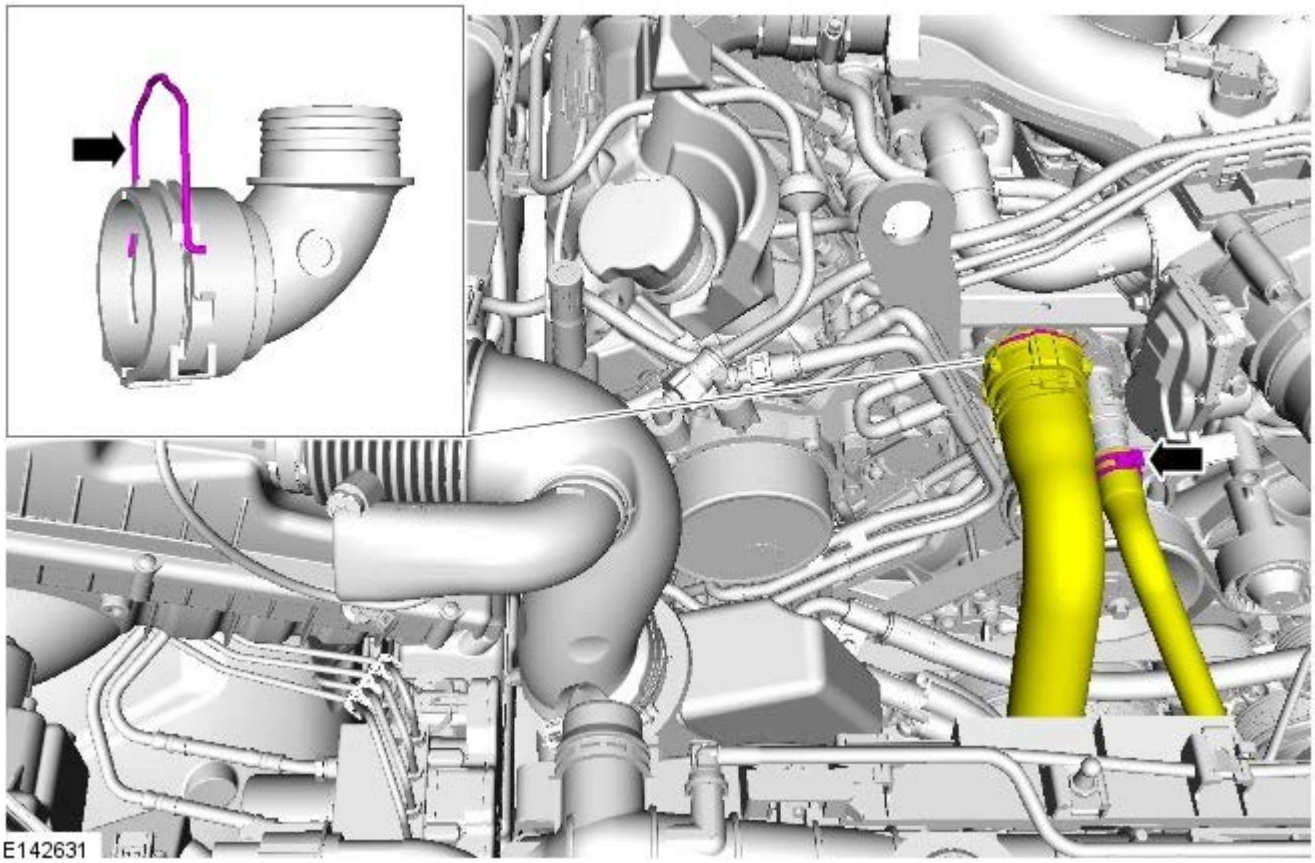
9.



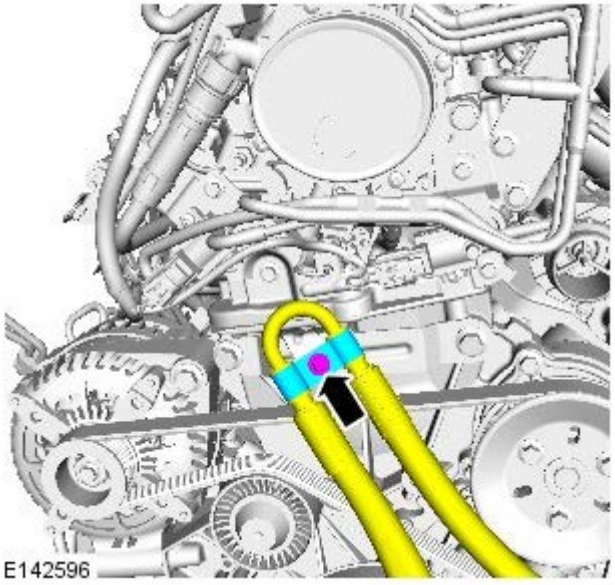
10.



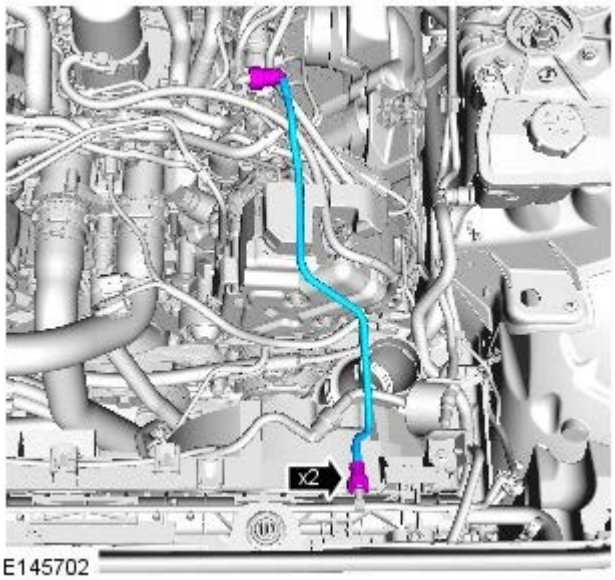
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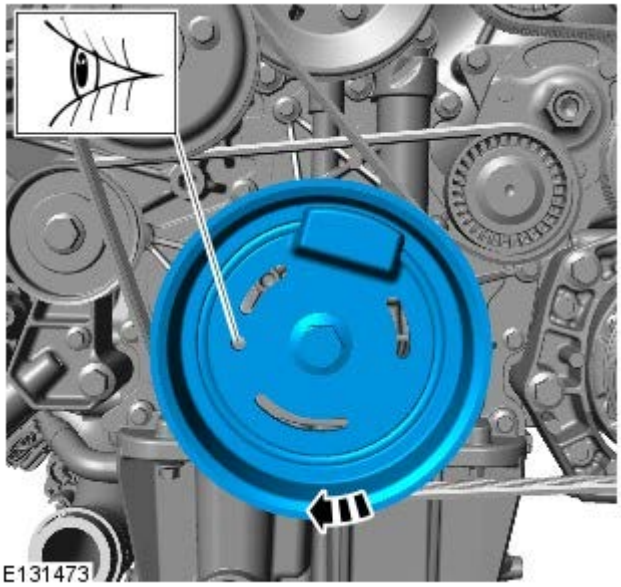
12.



13.



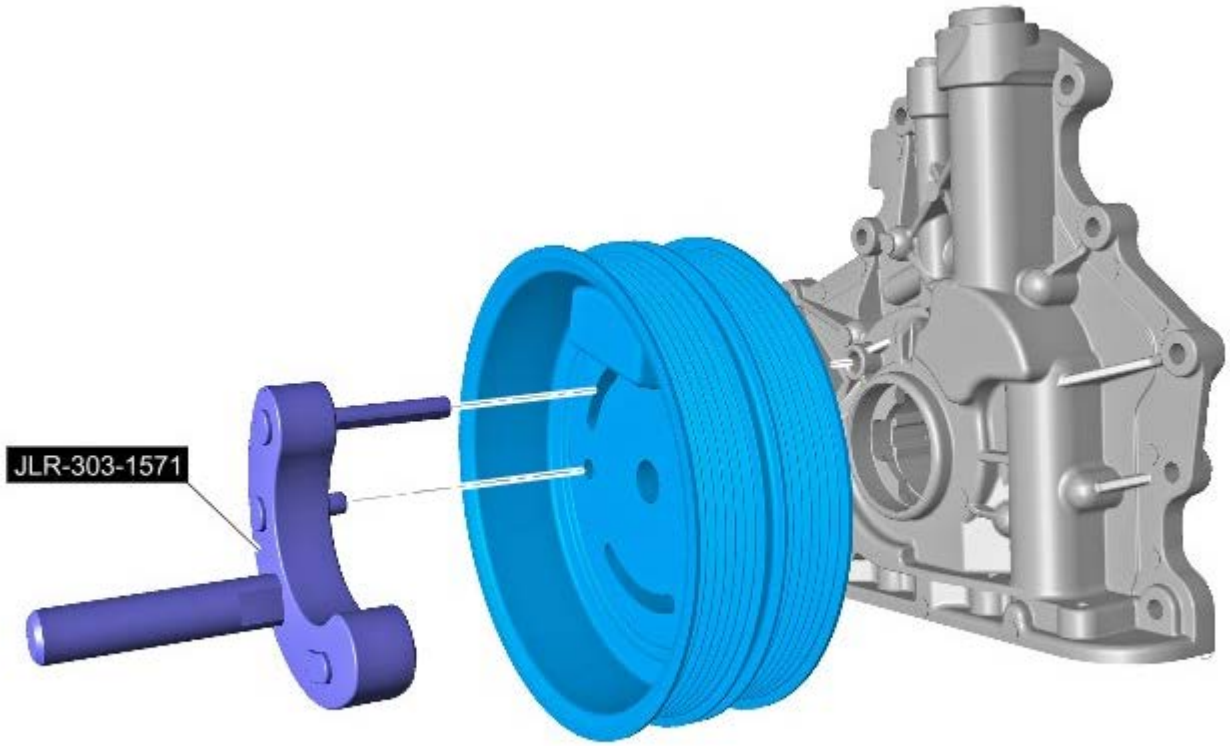
E145702


E131473

14. NOTE: Make sure that the singular round hole in the crankshaft pulley is in the 9 o'clock position.

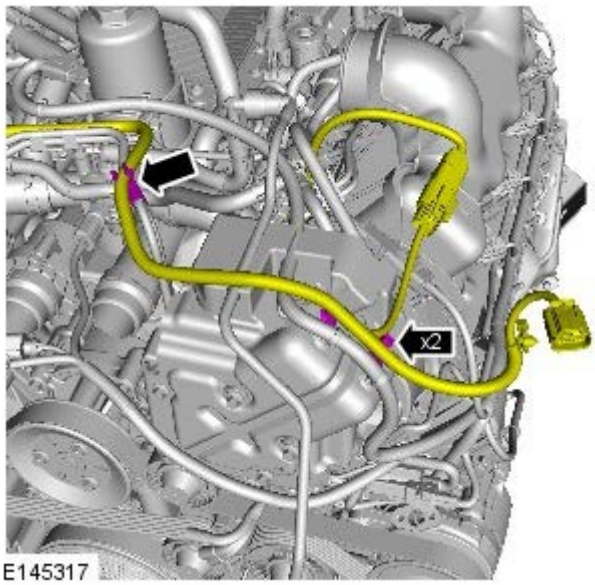
15. Install special tool.

Special Tool(s): JLR-303-1571



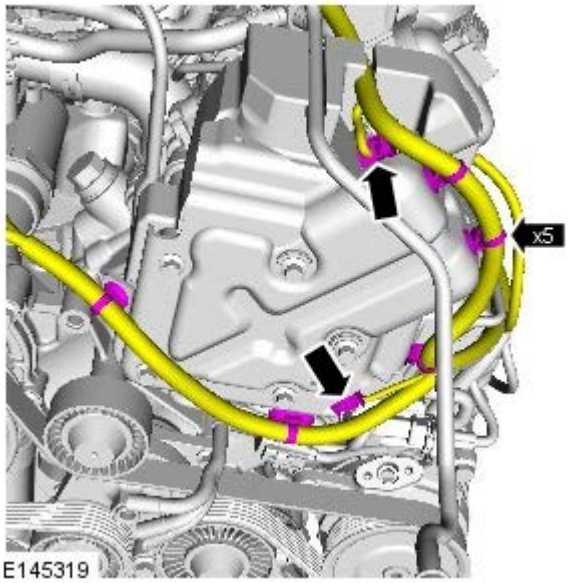
E131508

16.

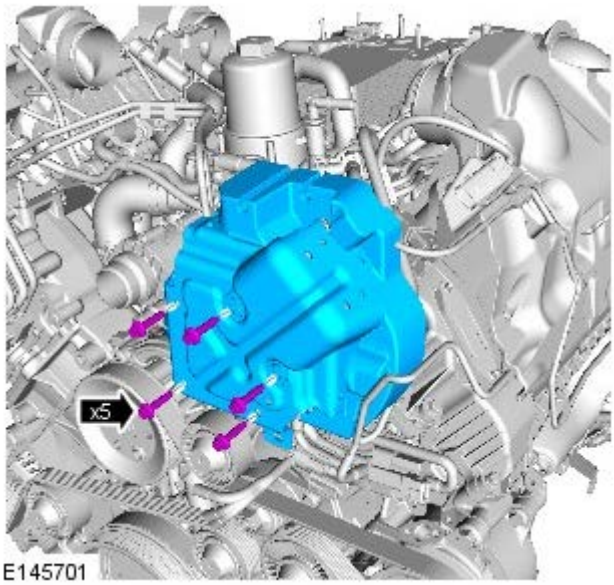


E145317

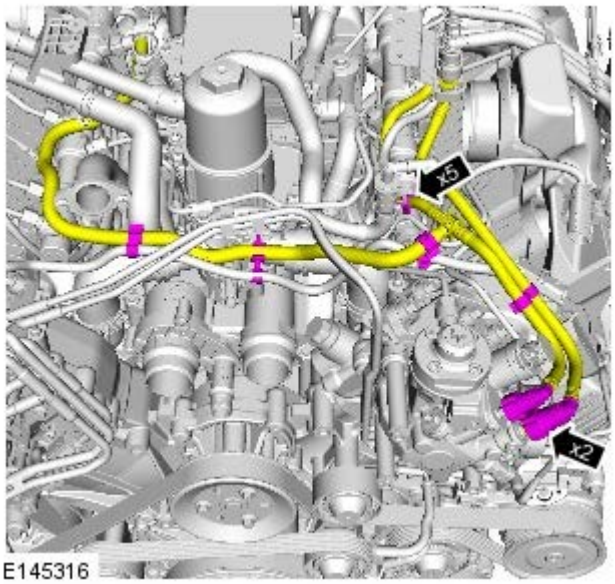
17.



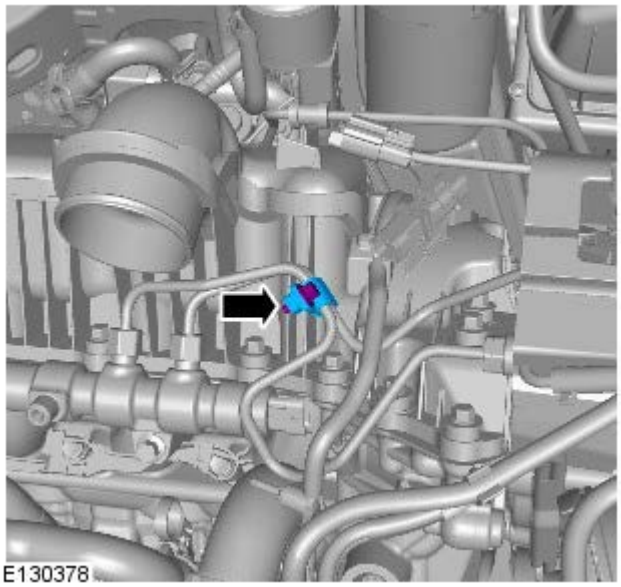
18.

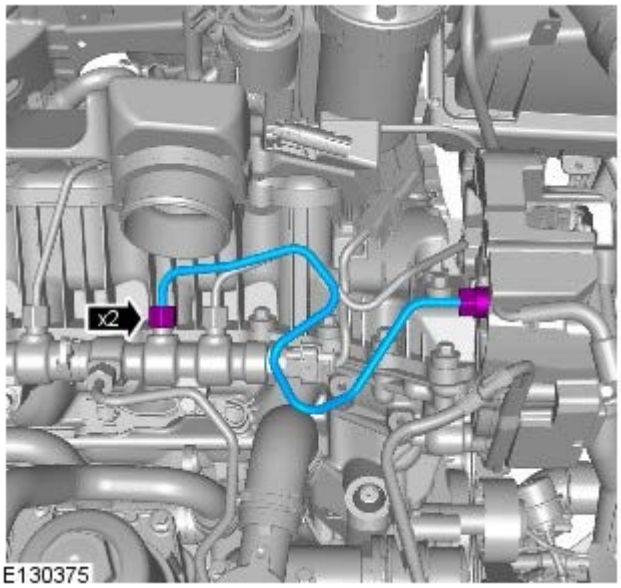


19. CAUTION: Be prepared to collect escaping fuel.

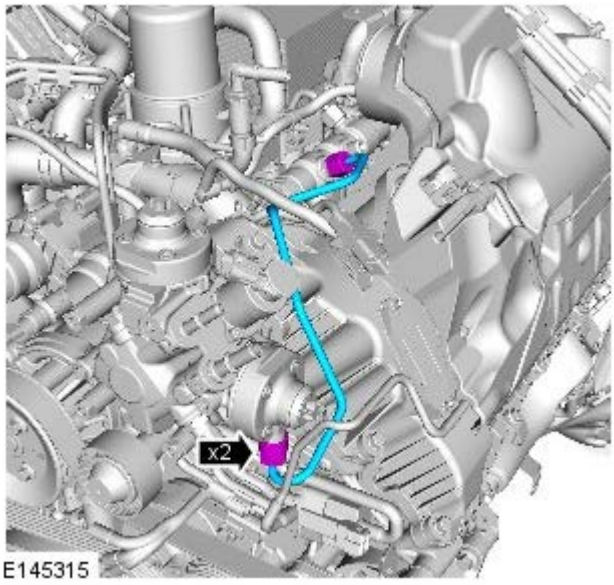


20.


E130378



E130375



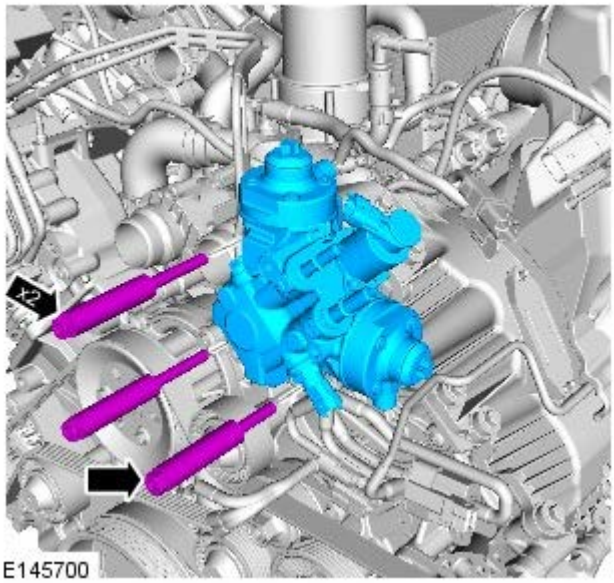
E145315

21. NOTE: Discard the fuel pipes.

22. NOTE: Discard the fuel pipes.

23. CAUTION: Discard the bolts.

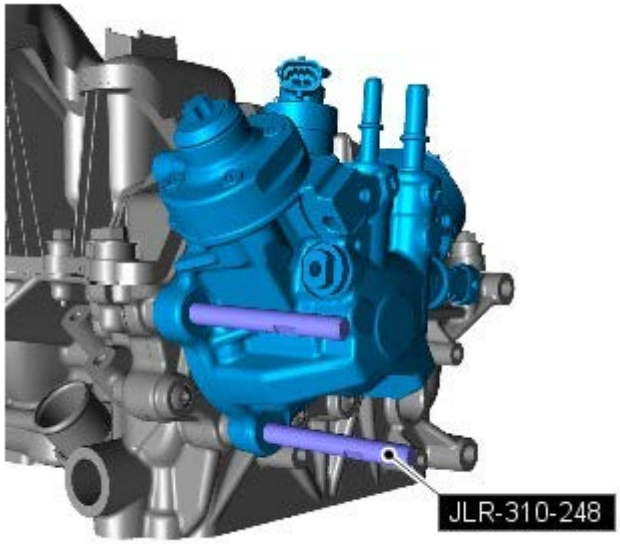
NOTE: Note the different lengths of the bolts.



E145700

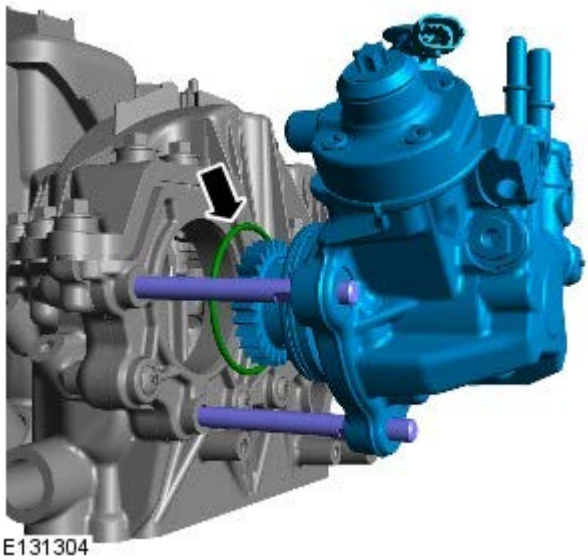
24. Install the 2 guide pins in the original location of the 2 bolts.

    Special Tool(s): JLR-310-248



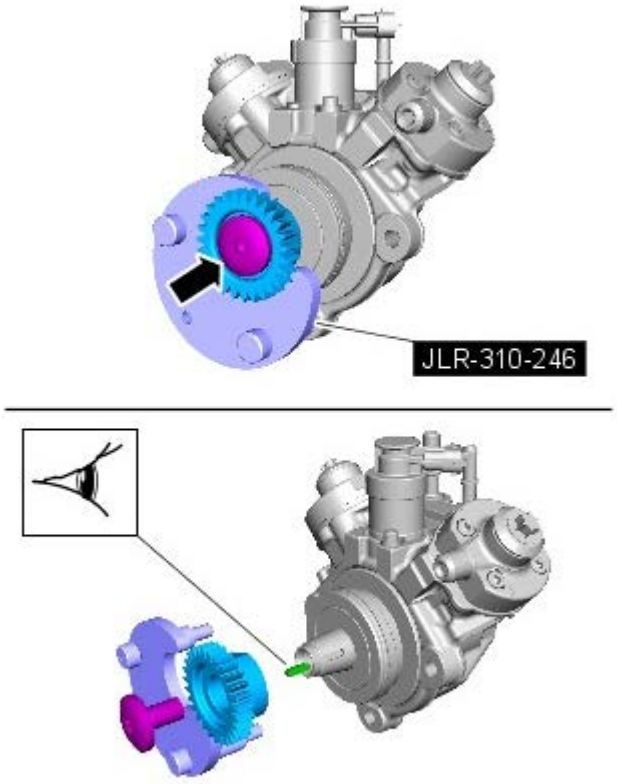
E131307

25. CAUTION: Ensure that the fuel pump gear does not rotate during removal.


E131304

26. CAUTION: Note position of the woodruff key prior to removal.

    NOTE: Do not disturb the fuel pump gear.

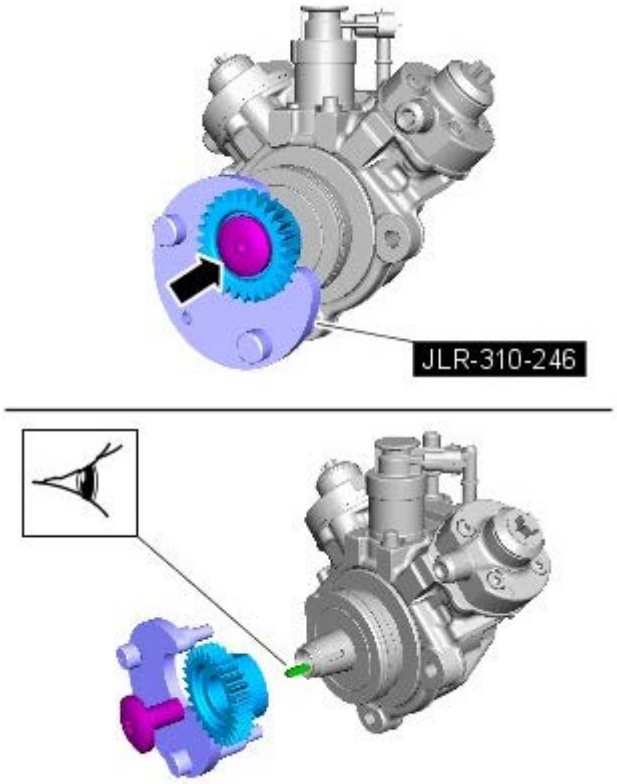


E139045

Install special tool.

Special Tool(s): JLR-310-246

Installation



E139045

1. CAUTION: Make sure the woodruff key is installed to the noted removal position.

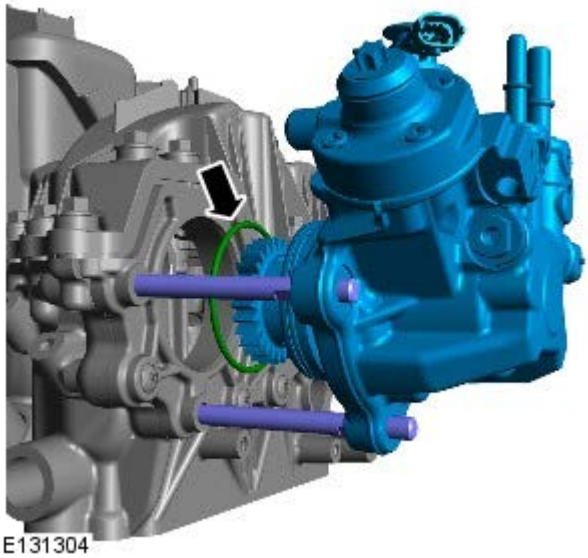
   NOTE: Make sure that the fuel pump shaft is in the correct orientation before installation.

   Remove the special tool.

   Torque: 60 Nm

2. CAUTION: Ensure that the fuel pump gear does not rotate during installation.

   NOTE: Lubricate the O-ring seal with clean engine oil.

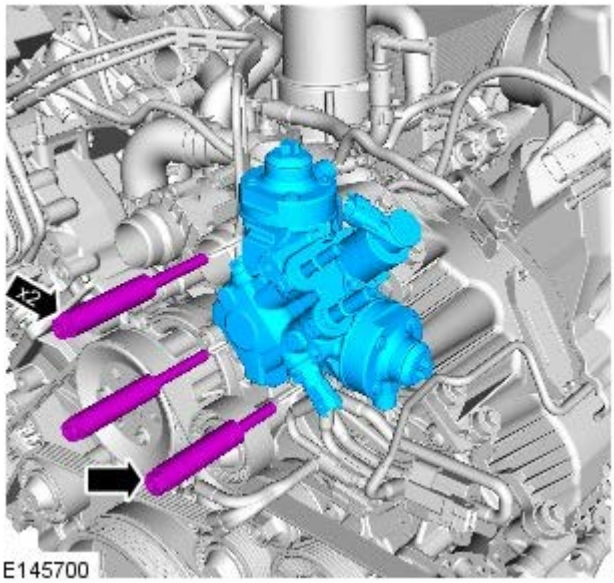


E131304

3. Remove the guide pins.



E131307



E145700

4. CAUTIONS:

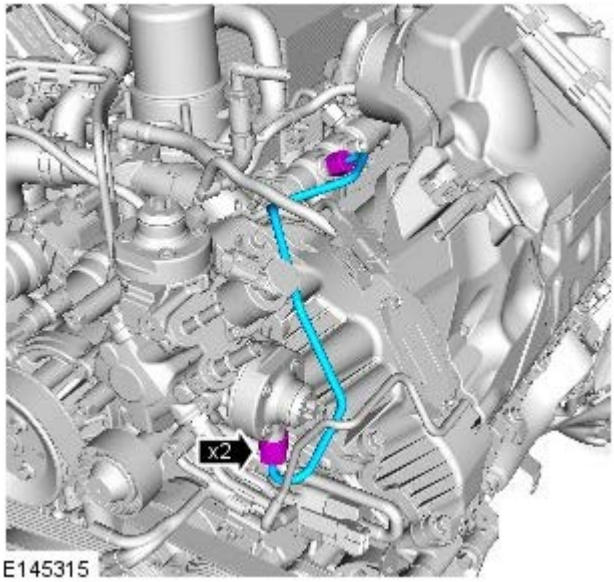
⚠ Make sure that new bolts are installed.

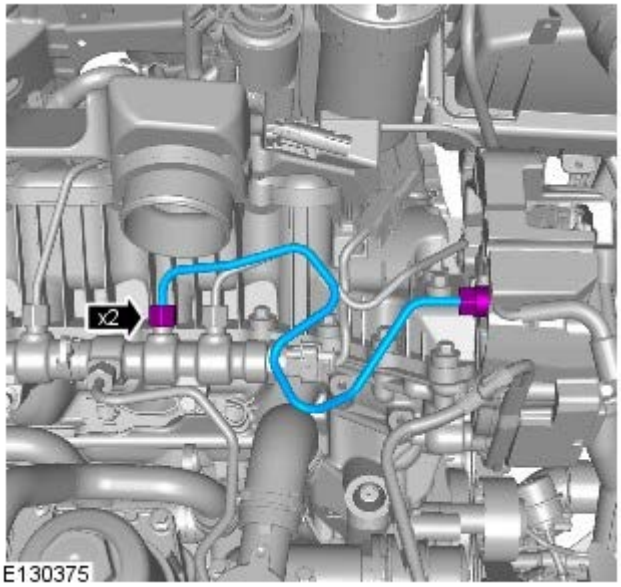
⚠ Install the bolts in the noted position.

Torque: 24 Nm

5. ⚠ CAUTION: Install new fuel pipes.

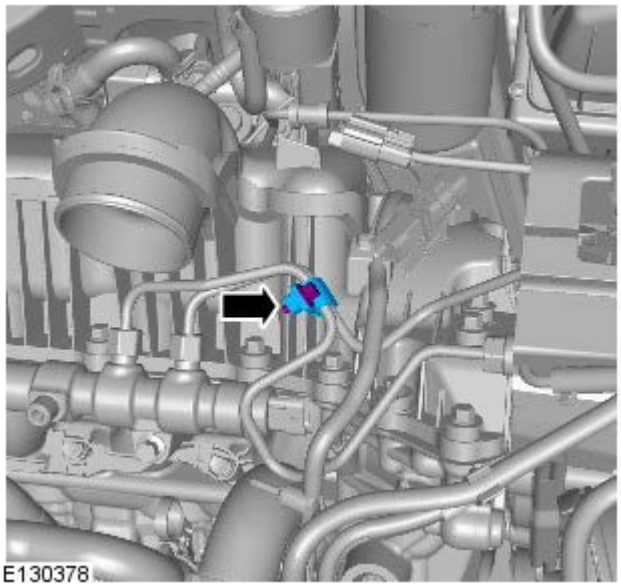
NOTE: Only tighten the unions finger-tight at this stage.





6. CAUTION: Install new fuel pipes.

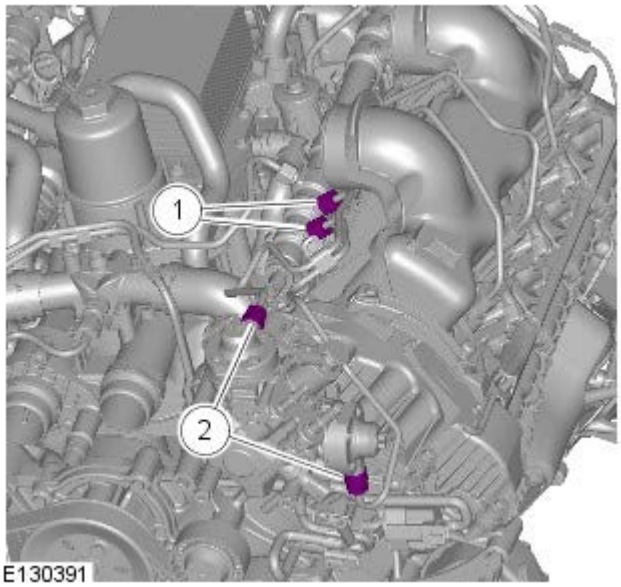
   NOTE: Only tighten the unions finger-tight at this stage.



7. NOTE: Only tighten the bolt finger-tight at this stage.

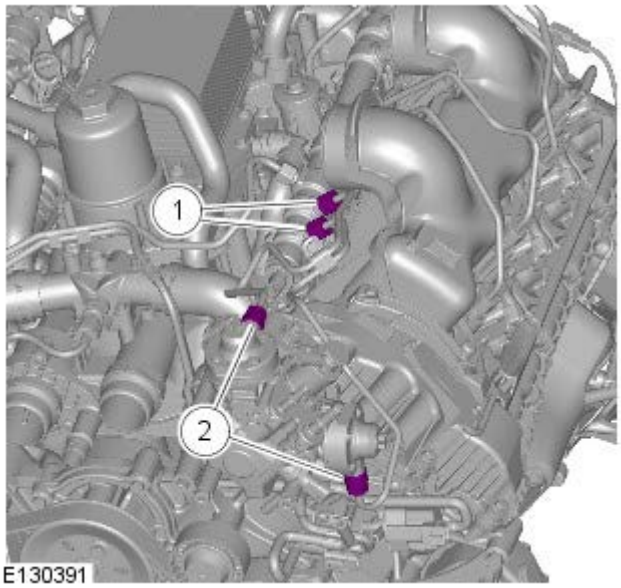
8. Tighten all.

   Torque: 10 Nm



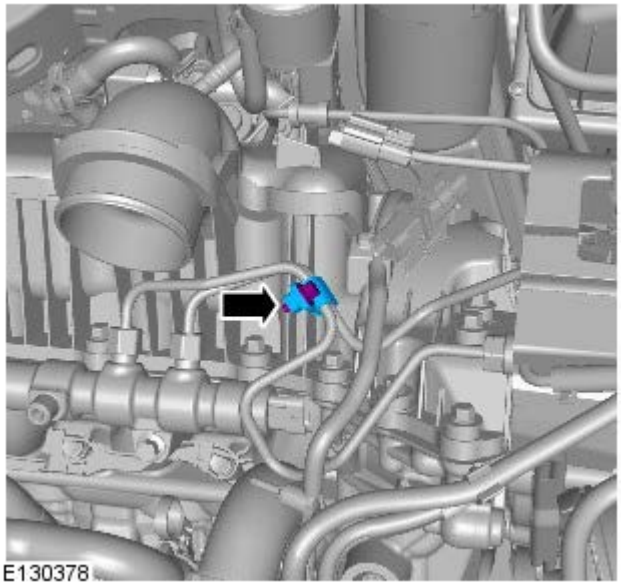
E130391

9. *Torque:*
   1 73°
   2 80°

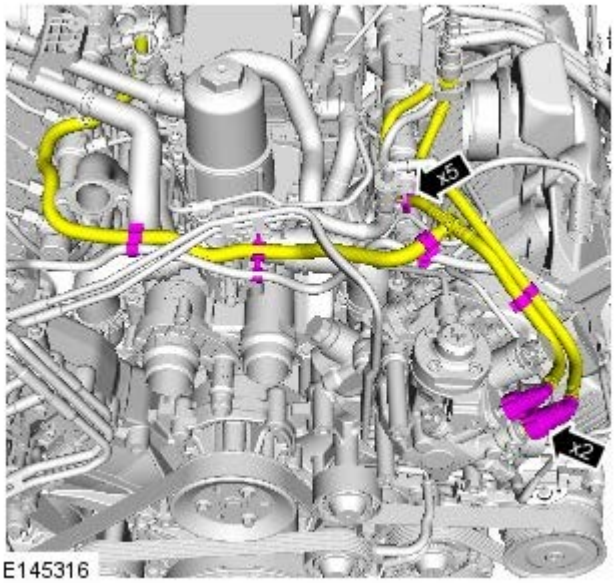


E130391

10. *Torque:* 10 Nm

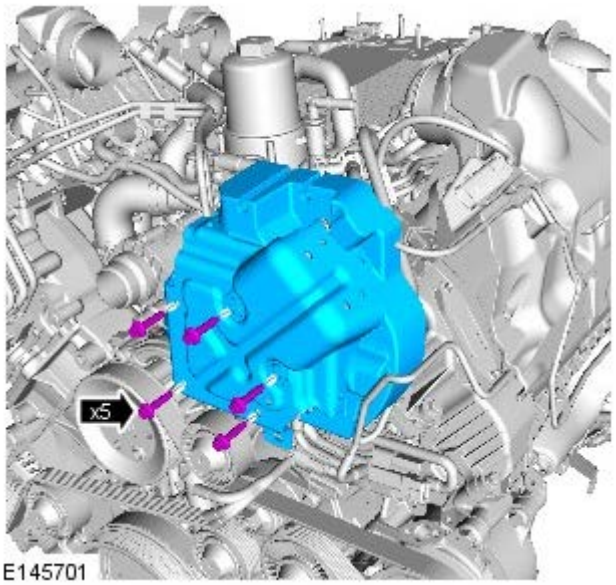

E130378

11. NOTE: Remove and discard all blanking caps.



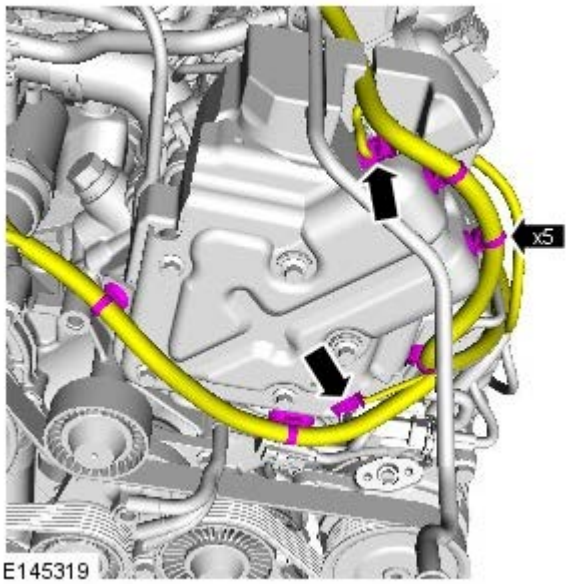
E145316

12. *Torque:* 10 Nm



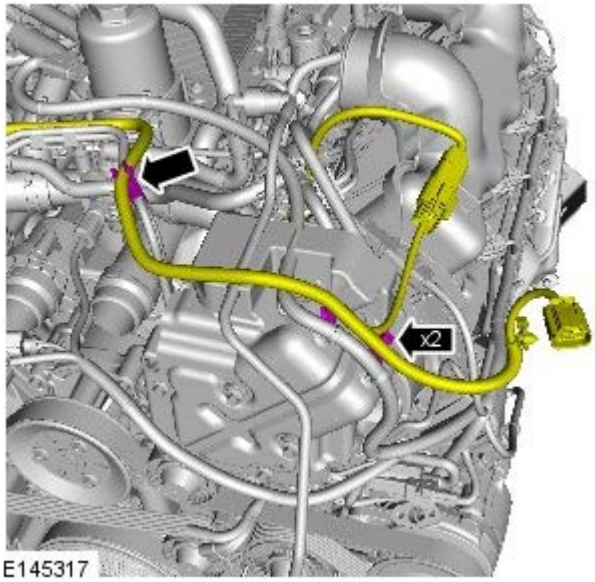
E145701

13.



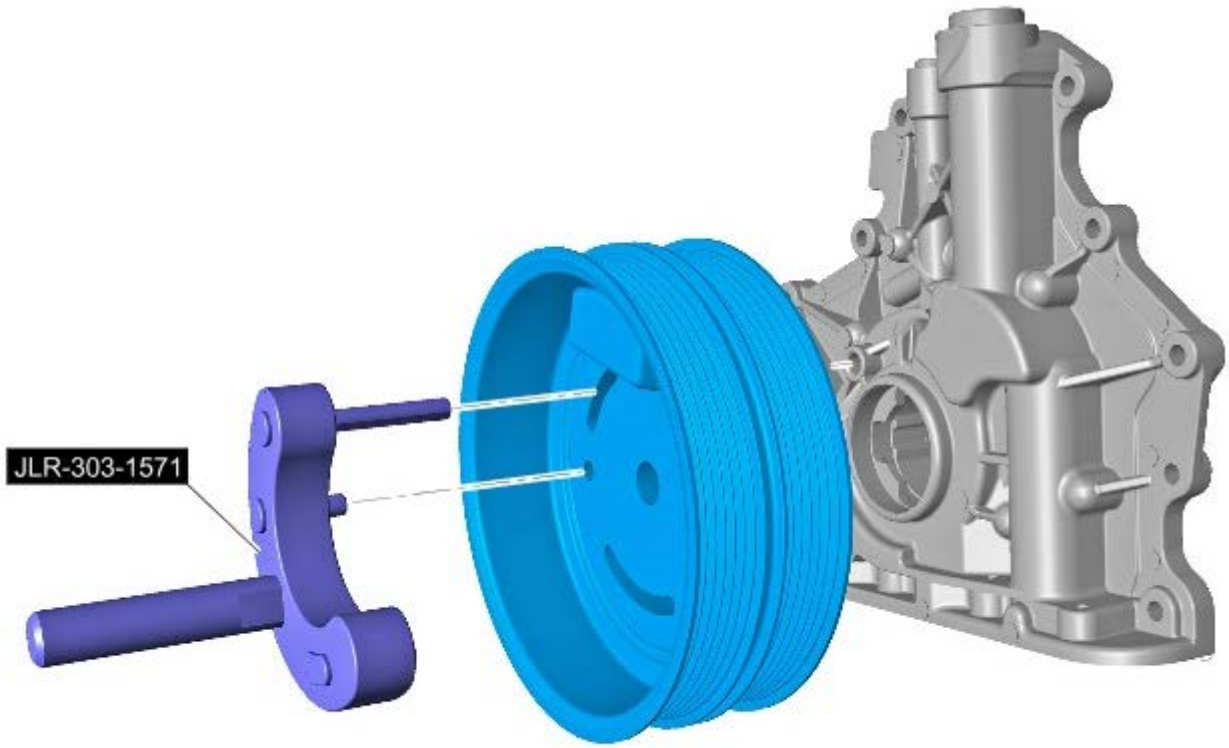
E145319

14.



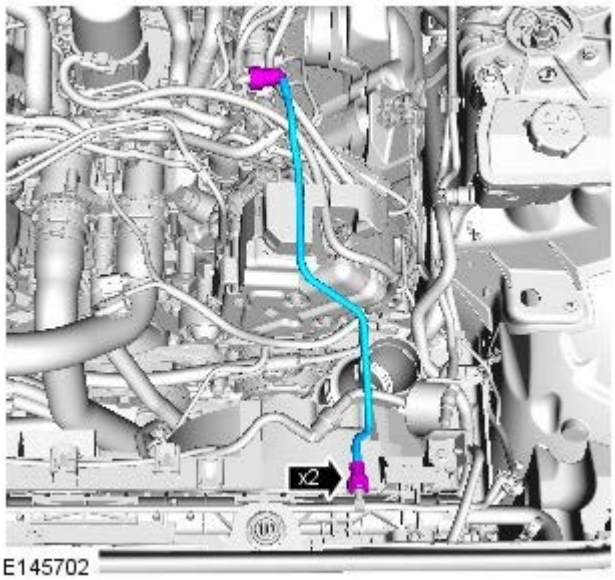
E145317

15. Remove the special tool.

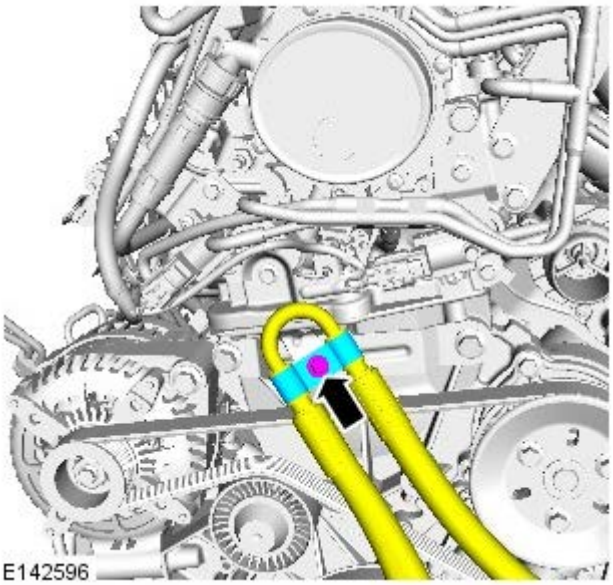


E131508

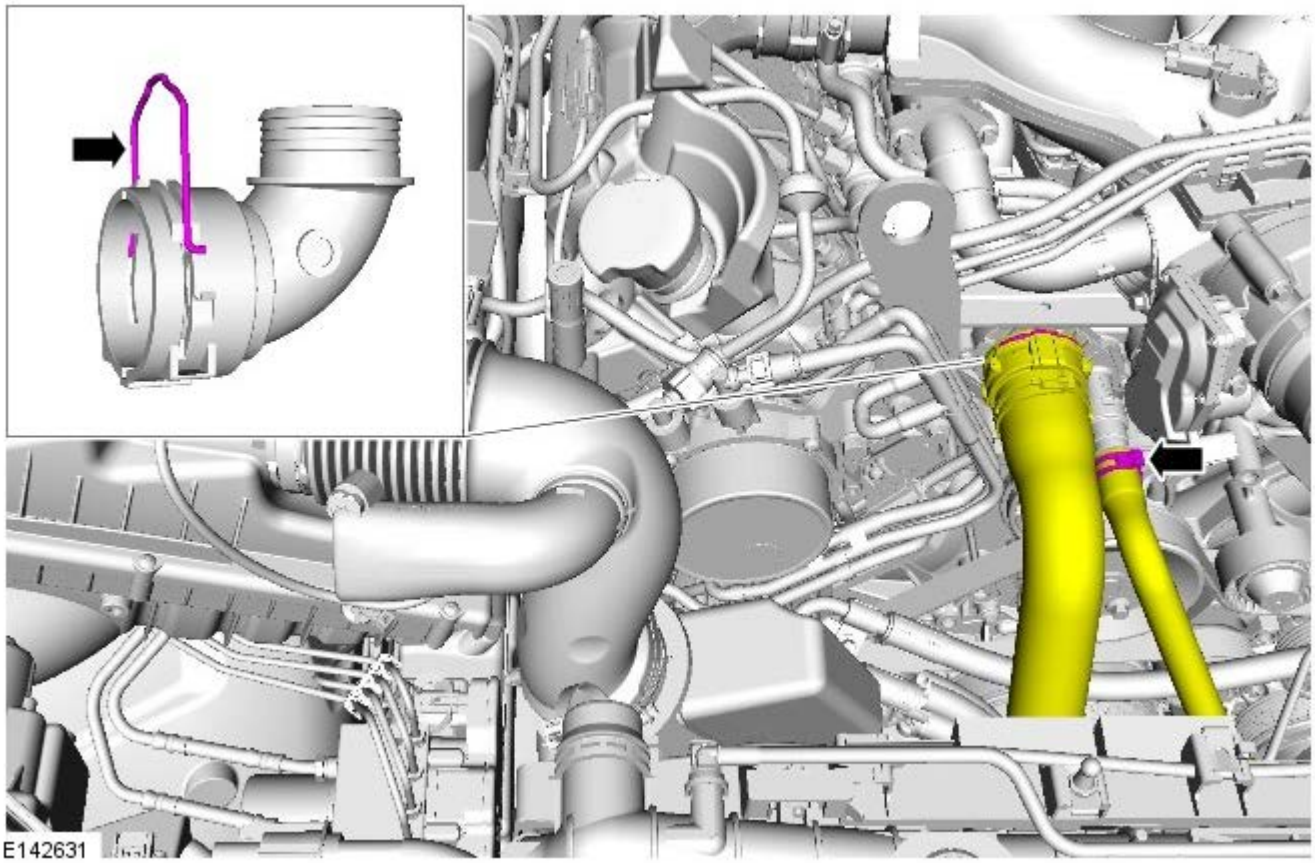
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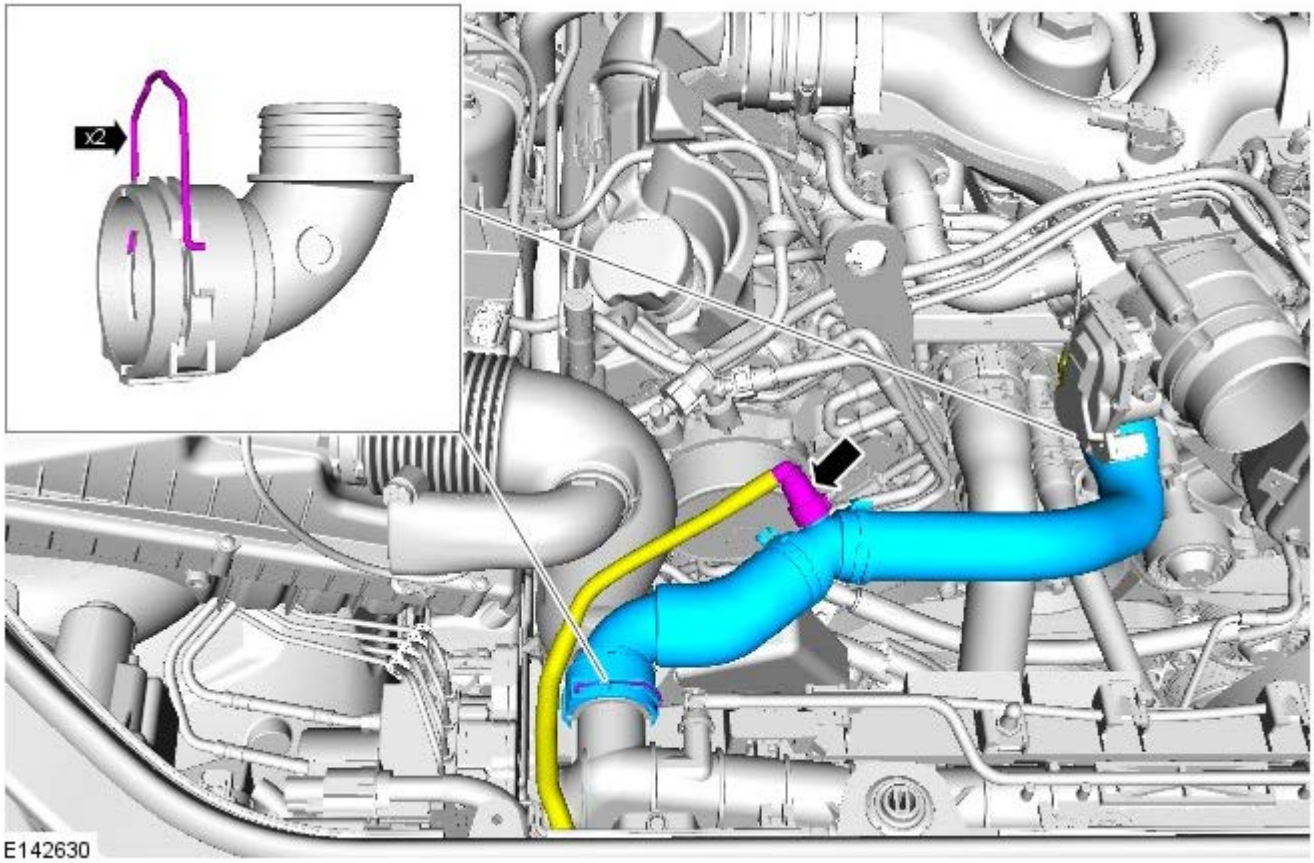
17. *Torque:* 10 Nm



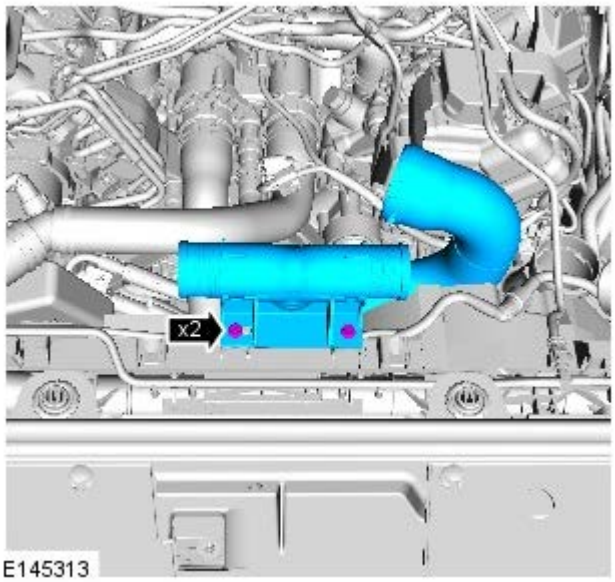
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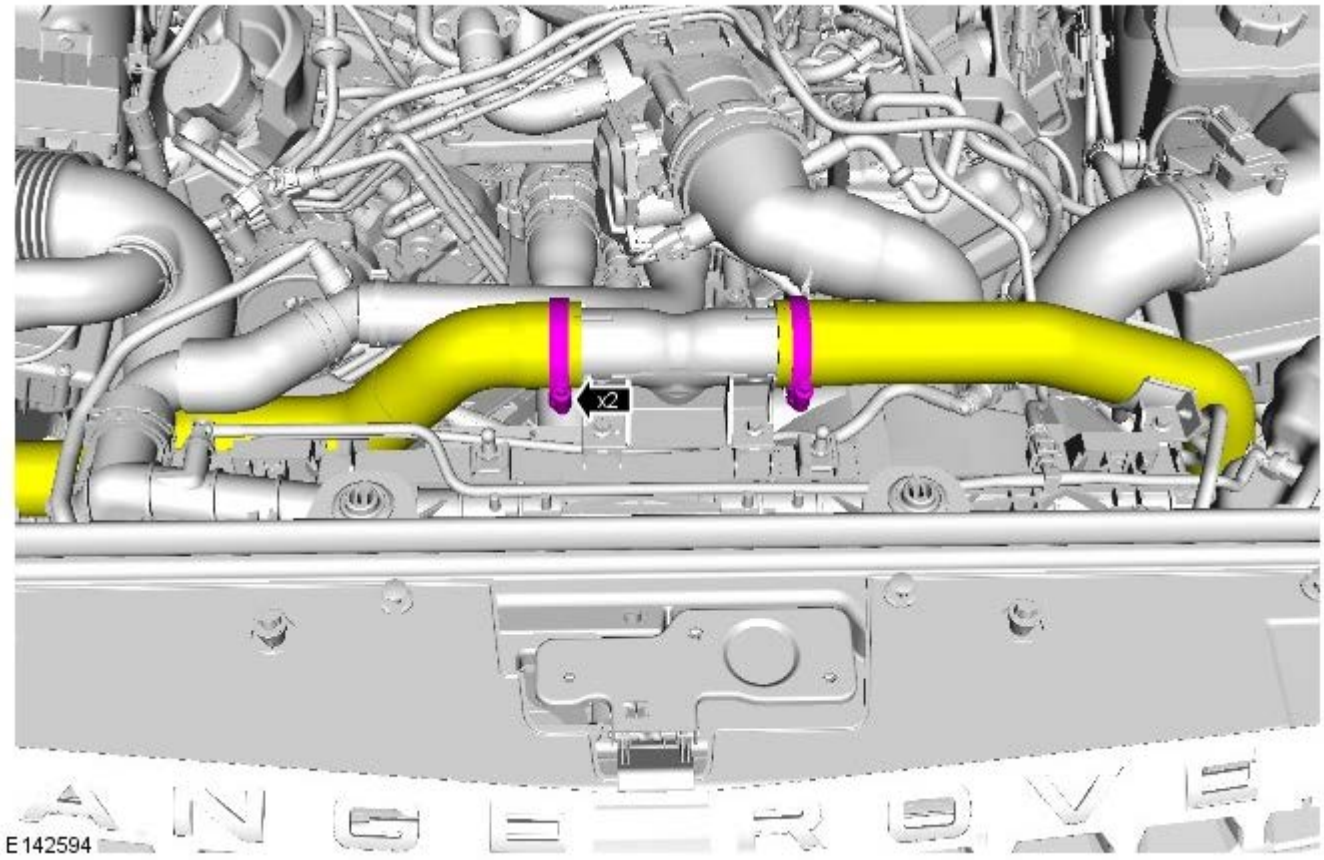
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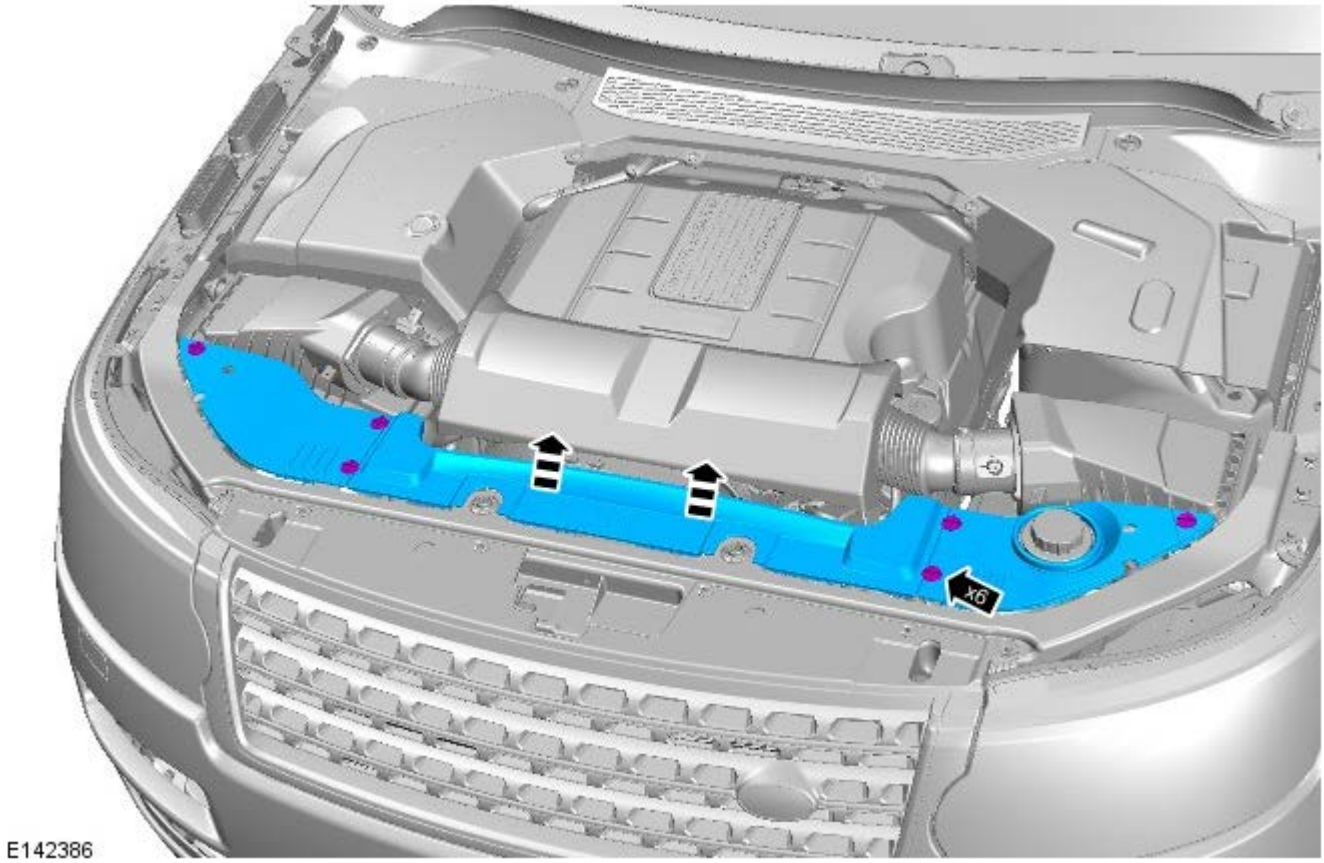
20.



21.



22.



23. Refer to: Intake Manifold Plenum Chamber (303-01D Engine - TDV8 4.4L Diesel, Removal and Installation).

24. Refer to: Air Cleaner LH (303-12D Intake Air Distribution and Filtering - TDV8 4.4L Diesel, Removal and Installation).

25. Connect the battery ground cable.

    Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

26. Refer to: Cooling System Partial Draining, Filling and Bleeding (303-03F Engine Cooling - TDV8 4.4L Diesel, General Procedures).

27. Refer to: High-Pressure Fuel System Bleeding (310-00 Fuel System - General Information, General Procedures).

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Fuel Charging and Controls - TDV8 4.4L Diesel - Fuel Rail LH

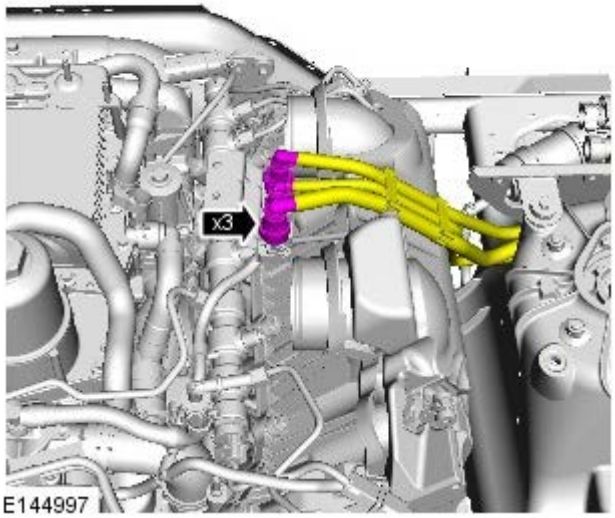
Removal and Installation

Removal

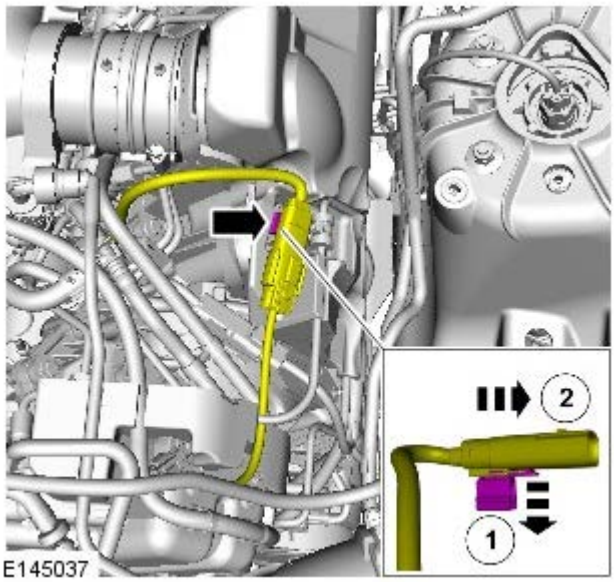
CAUTION: Make sure that all openings are sealed. Use new blanking caps.

1. Refer to: Diesel Fuel System Health and Safety Precautions (100-00 General Information, Description and Operation).
2. Disconnect the battery ground cable.

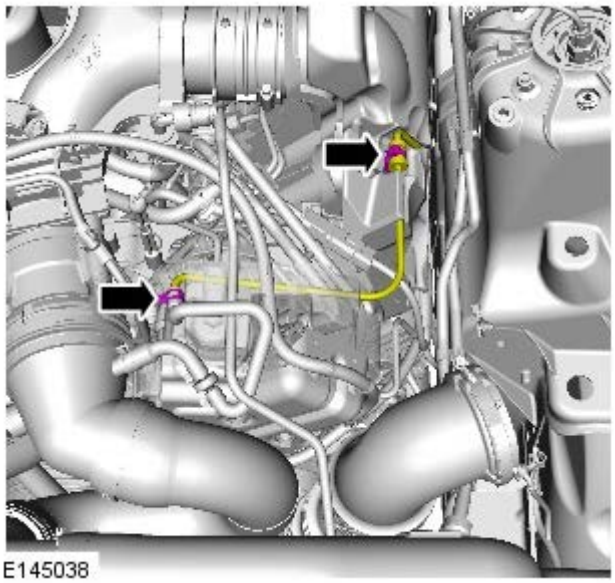
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).
3. Refer to: Air Cleaner LH (303-12D Intake Air Distribution and Filtering - TDV8 4.4L Diesel, Removal and Installation).
4. Refer to: Fuel Filter Element (310-01D Fuel Tank and Lines - TDV8 4.4L Diesel, Removal and Installation).
5. Refer to: Intake Manifold Plenum Chamber (303-01D Engine - TDV8 4.4L Diesel, Removal and Installation).
6. Refer to: Fuel Injection Component Cleaning (303-04A Fuel Charging and Controls - TDV6 3.0L Diesel, General Procedures).
7.



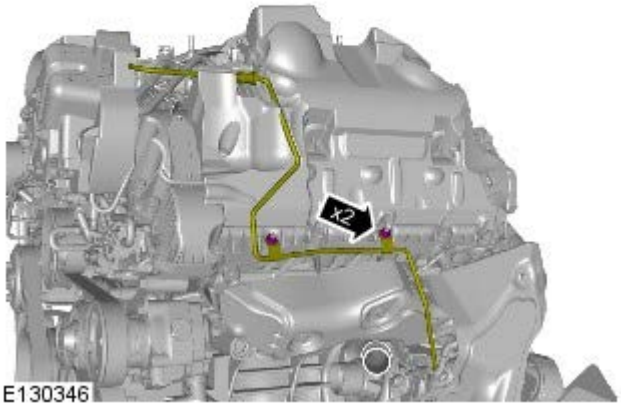
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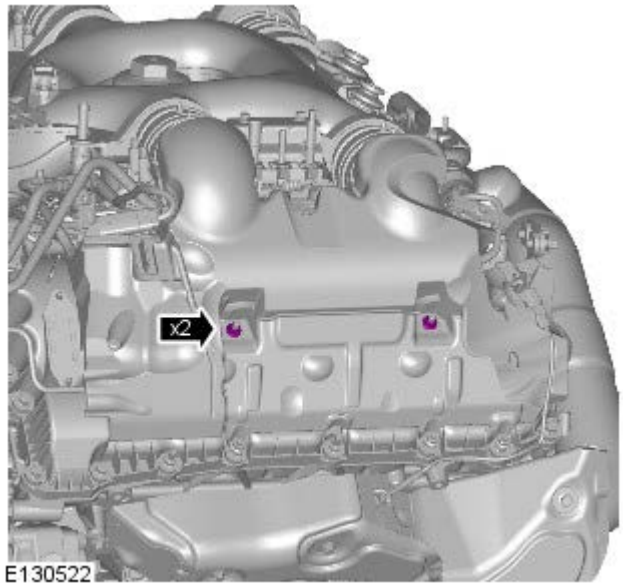
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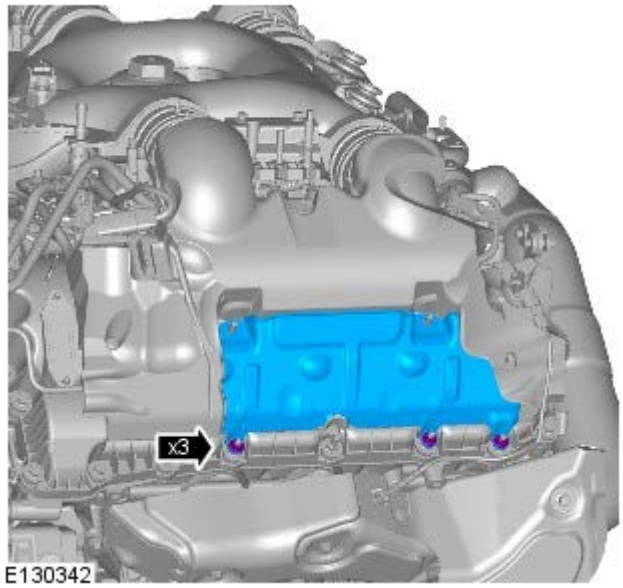
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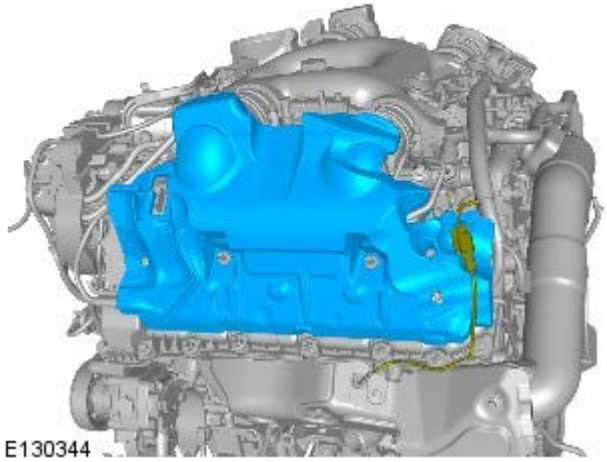
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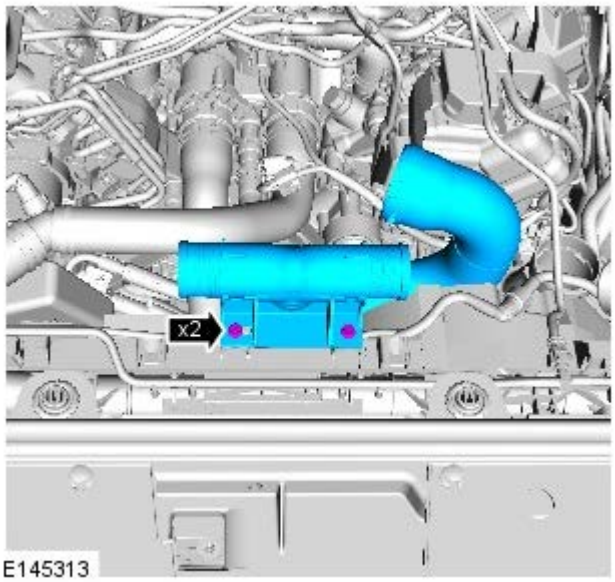
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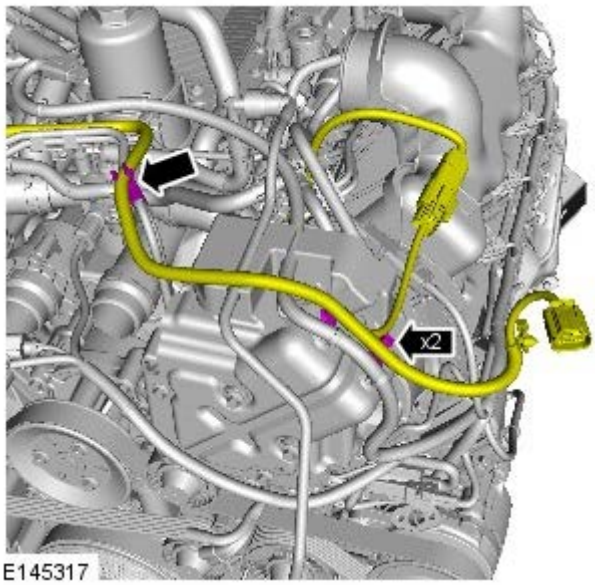
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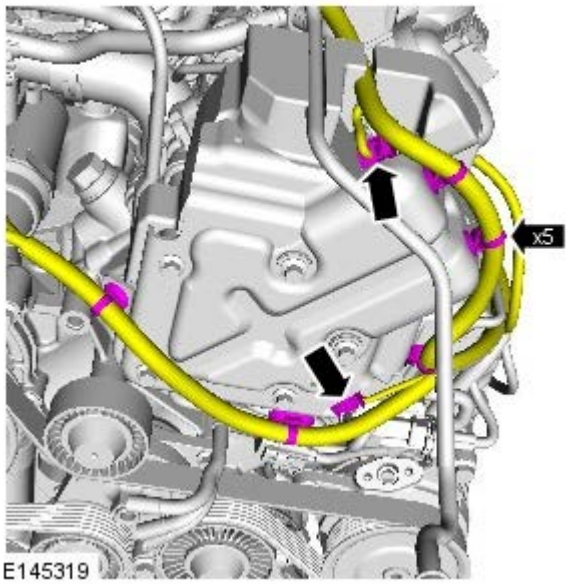
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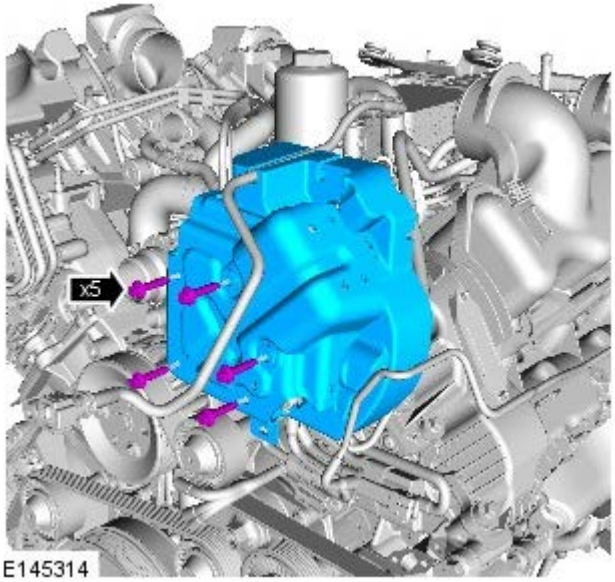
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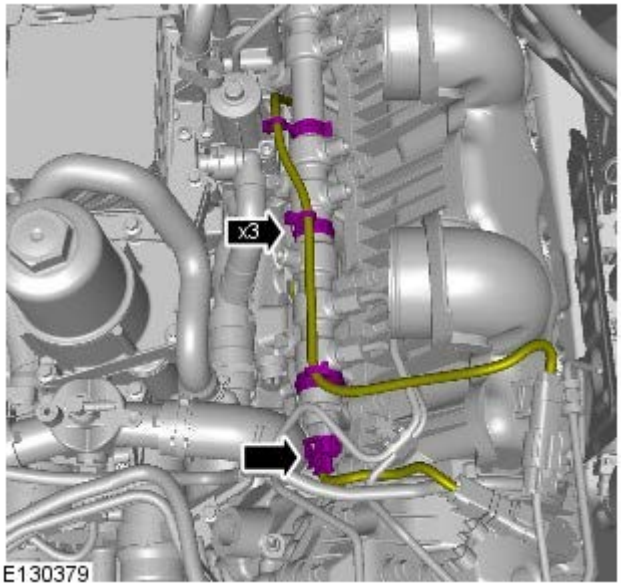
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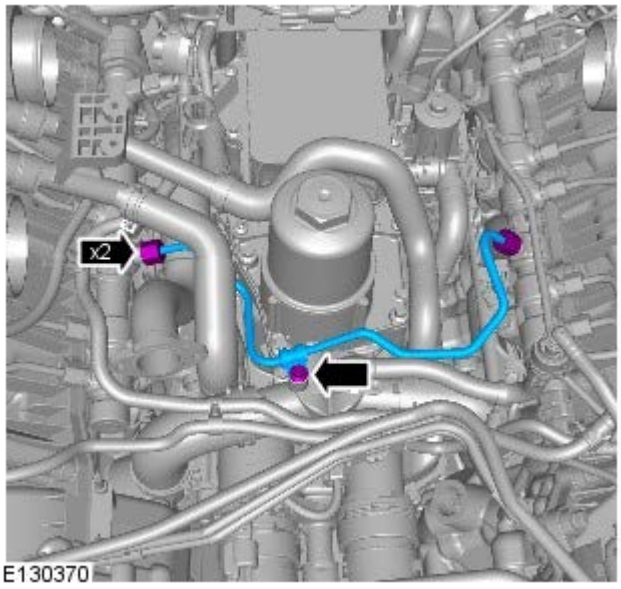
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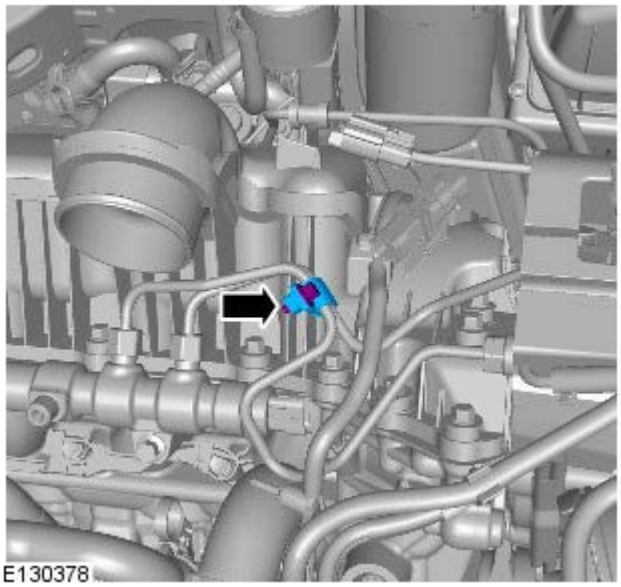
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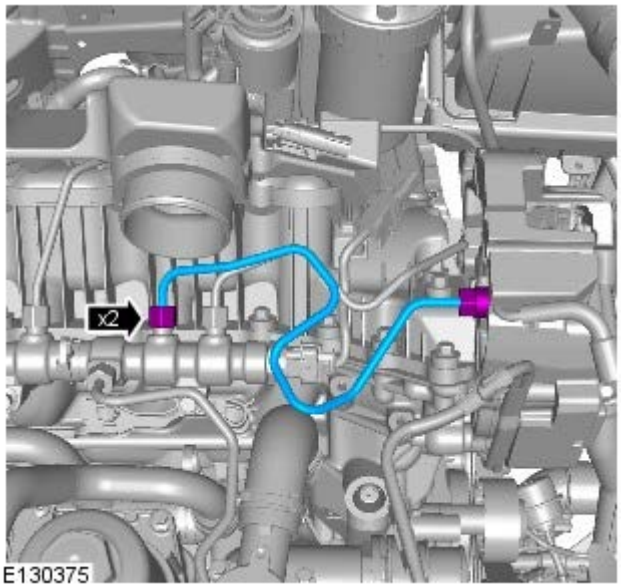
19. CAUTION: Discard the fuel pipe.



20.

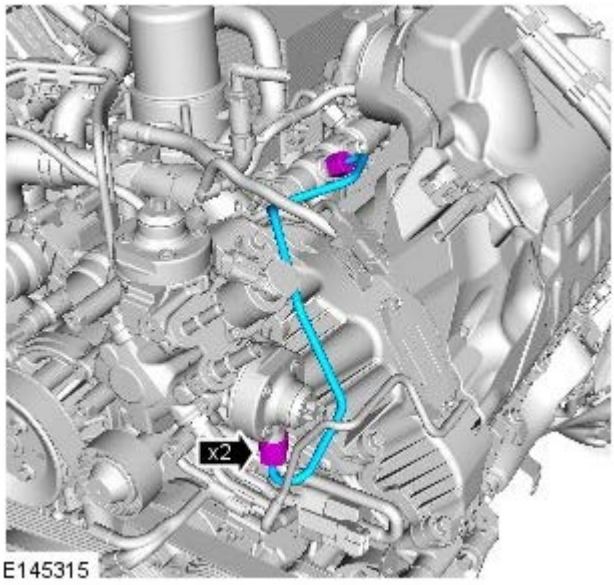

E130378

21. CAUTION: Discard the fuel pipe.



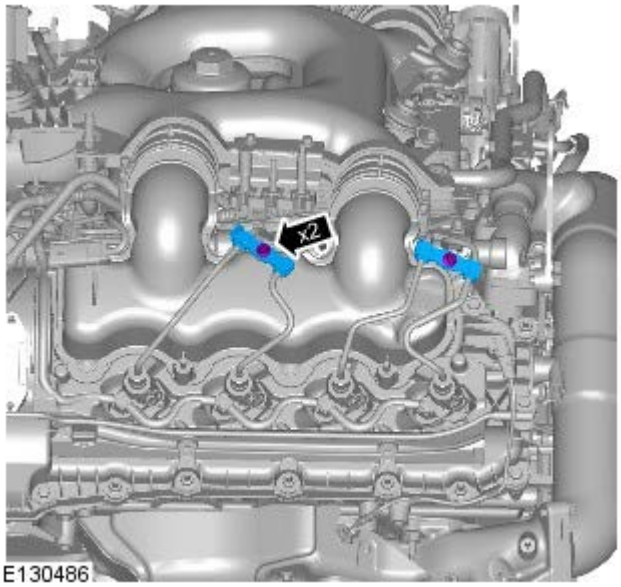
E130375

22. CAUTION: Discard the fuel pipe.

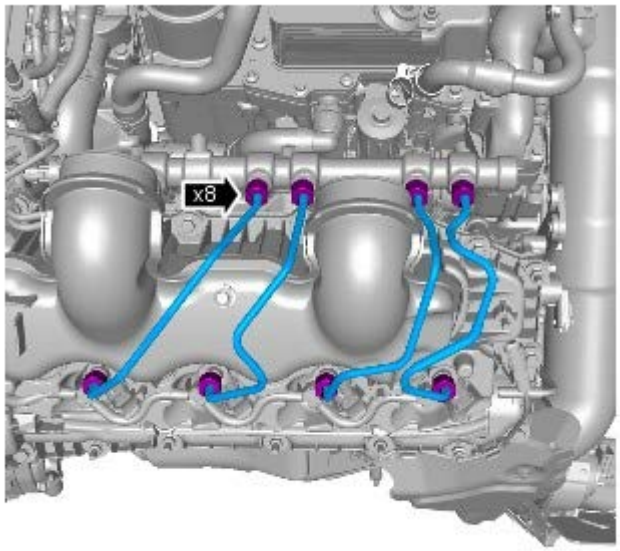


E145315

23.



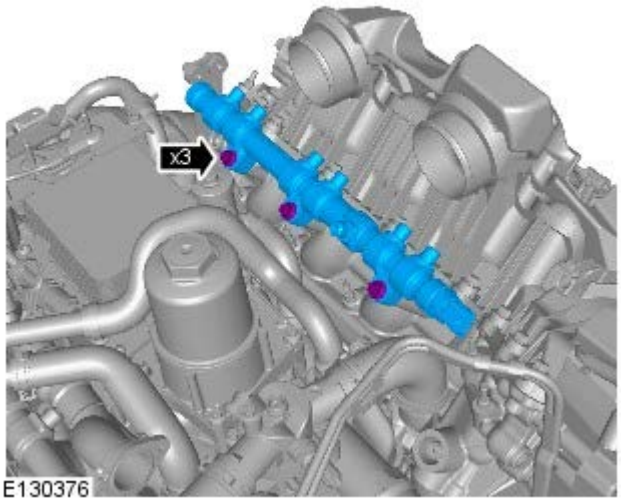
E130486



E130377

24. CAUTION: Discard the fuel pipes.

25.

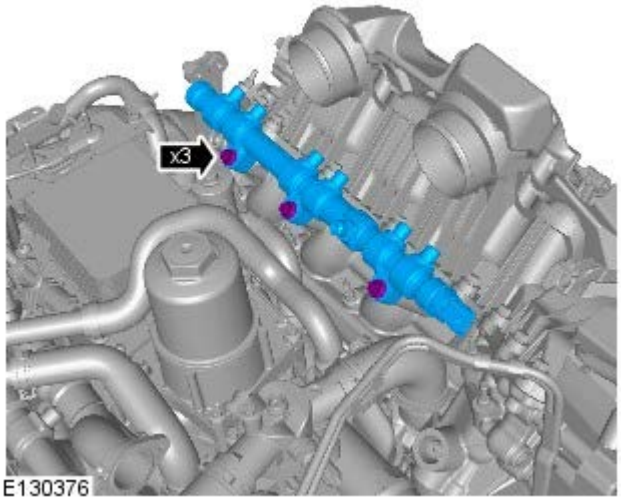


E130376

Installation

NOTE: Remove and discard all blanking caps.

1. CAUTION: Do not tighten at this stage.

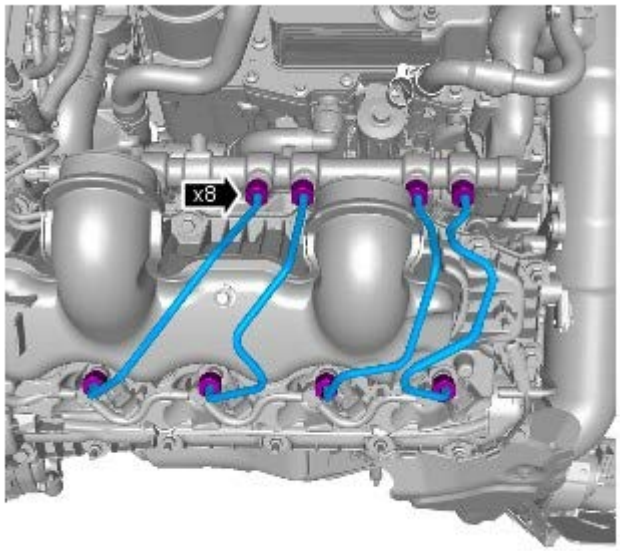


E130376

2. CAUTIONS:

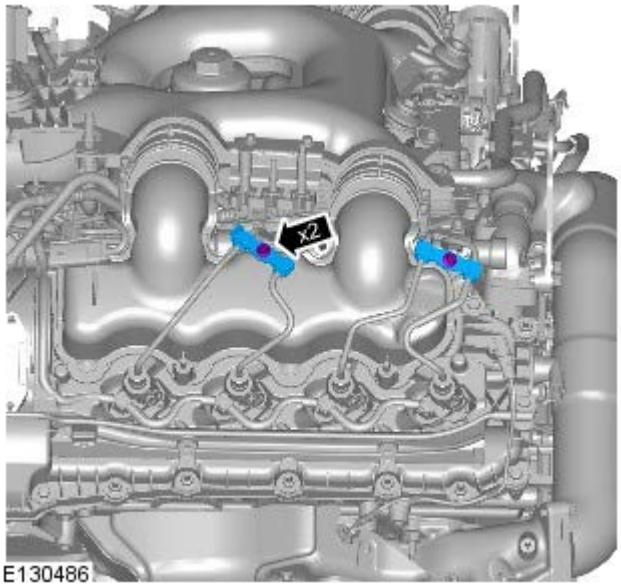
   Install new fuel pipes.

   Only tighten the unions finger-tight at this stage.



E130377

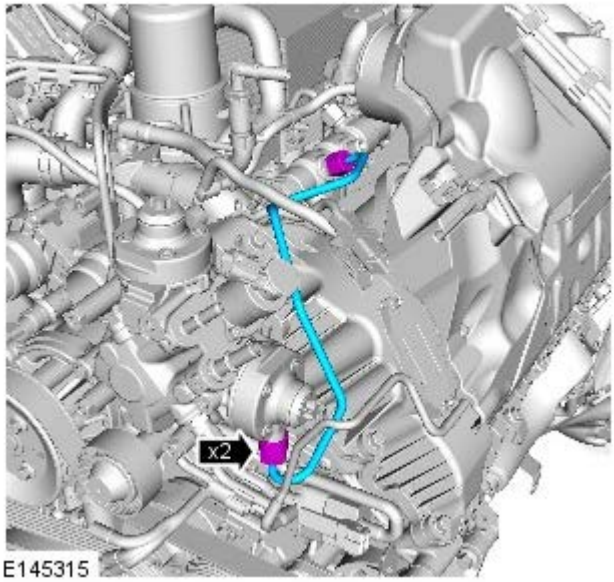
3. CAUTION: Only tighten the bolts finger-tight at this stage.



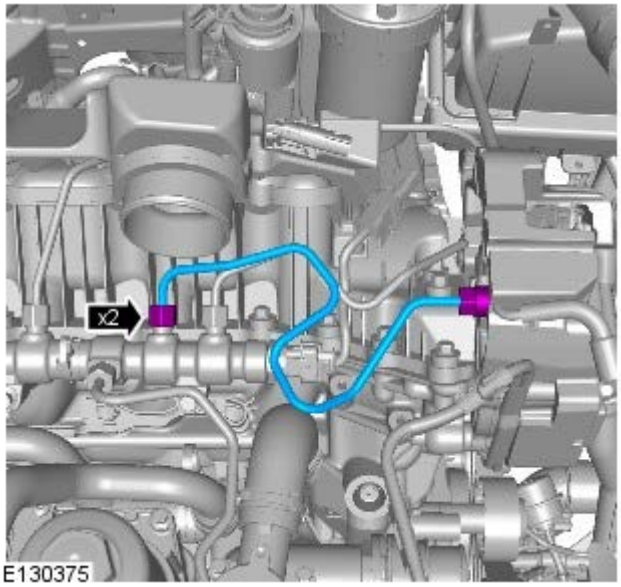
E130486

4. CAUTIONS:

   Install new fuel pipes.



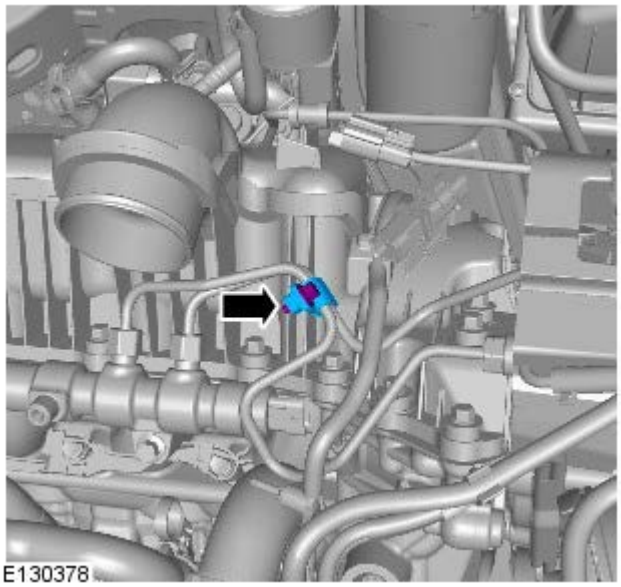
Only tighten the unions finger-tight at this stage.



5. CAUTIONS:

Install new fuel pipes.

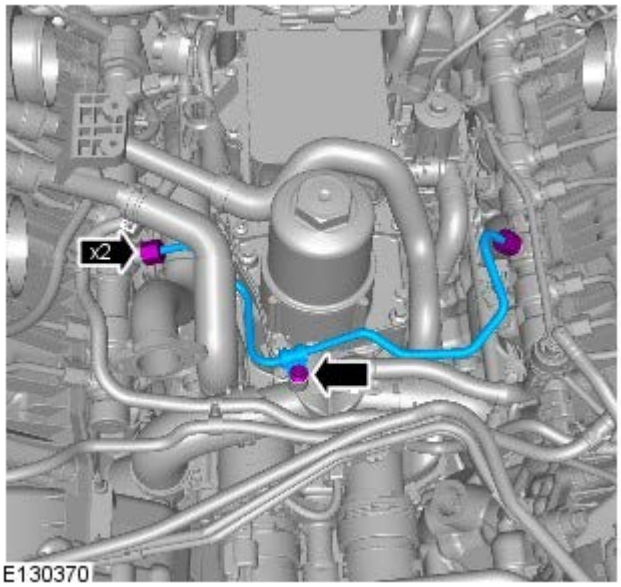
Only tighten the unions finger-tight at this stage.



6. CAUTION: Only tighten the bolt finger-tight at this stage.

7. CAUTIONS:

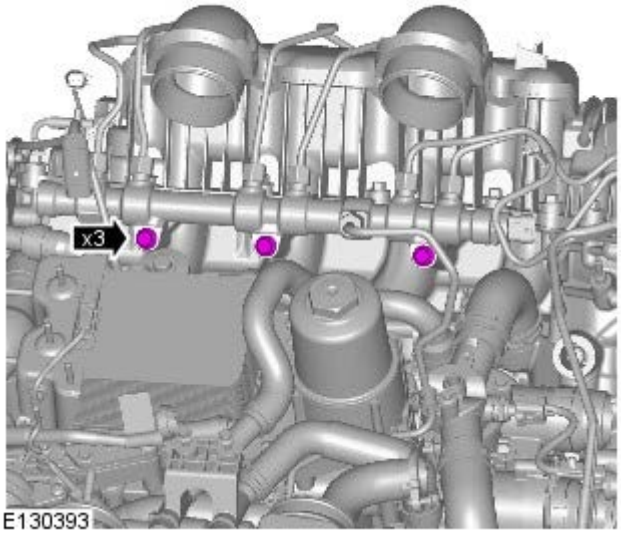
Install new fuel pipes.



⚠ Only tighten the bolt finger-tight at this stage.

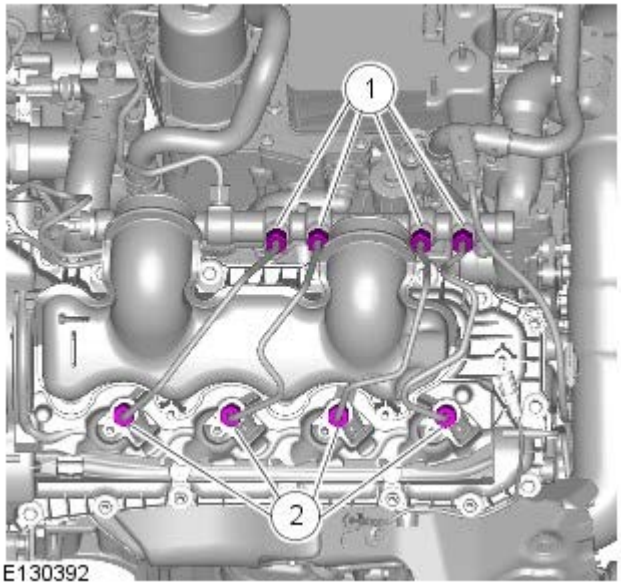
⚠ Only tighten the unions finger-tight at this stage.

8. *Torque:* 23 Nm

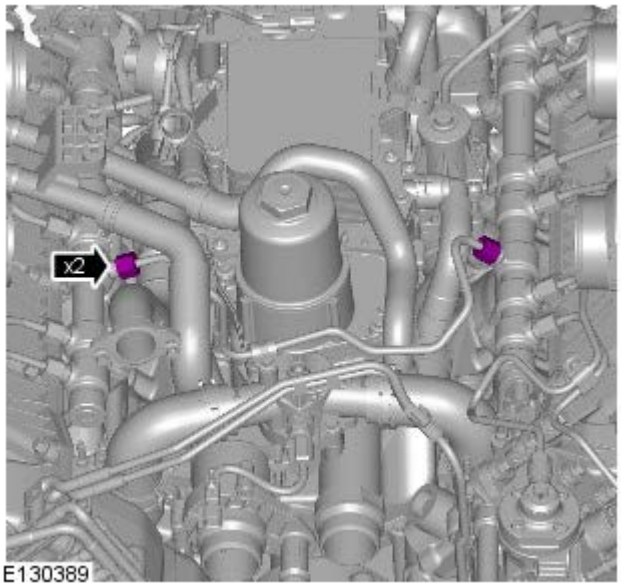


9. Tighten all.

   Torque: 10 Nm

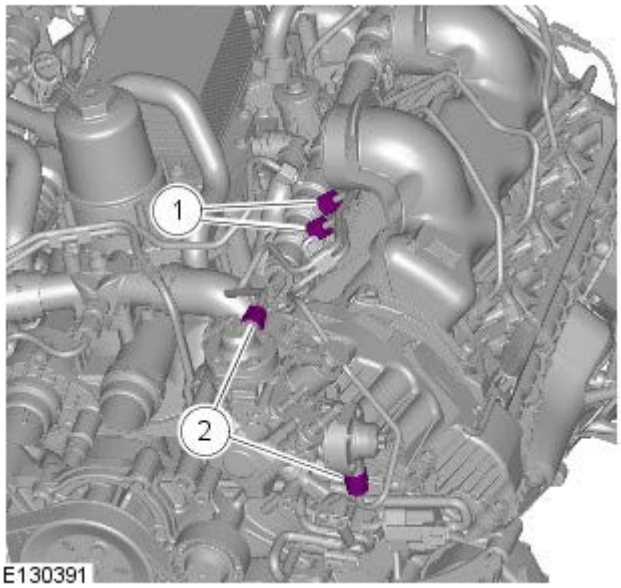


10. *Torque:* 10 Nm



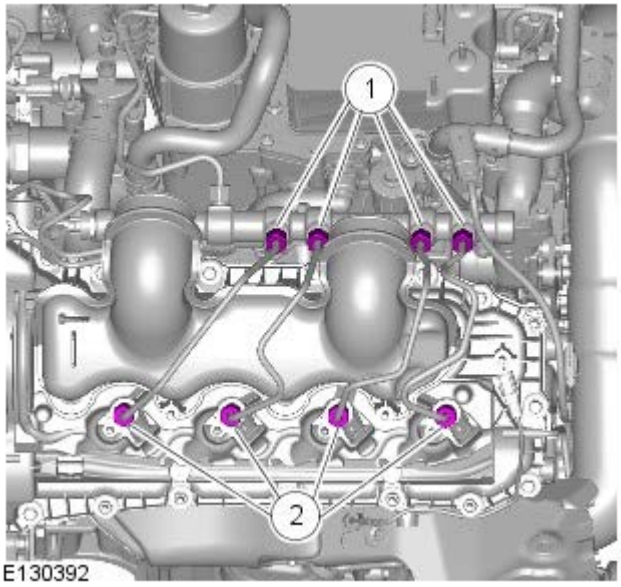
11. Tighten all.

    Torque: 10 Nm

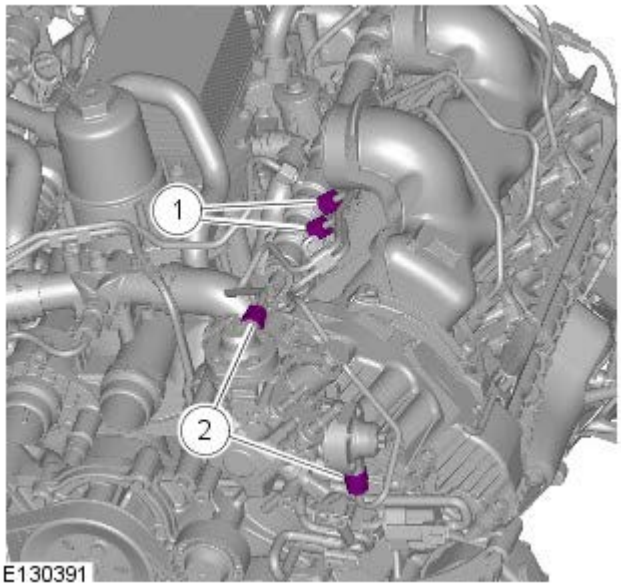


12. Tighten all.

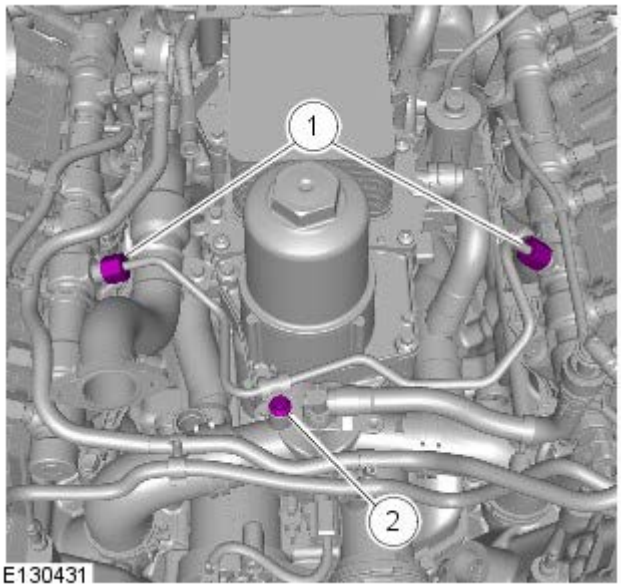
    Torque: 73°



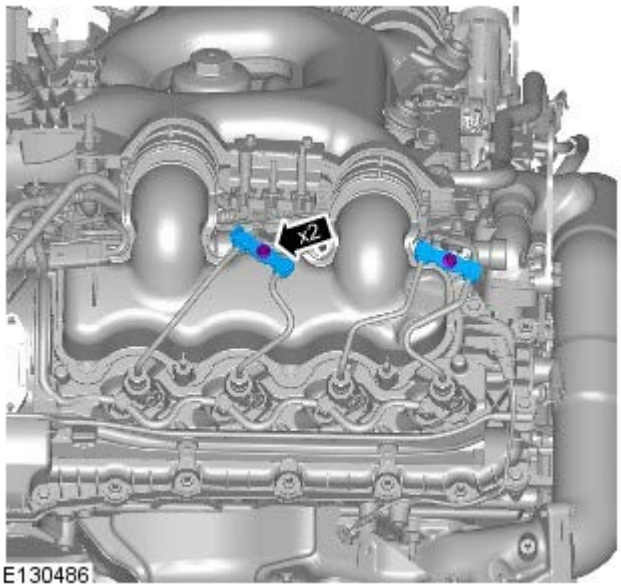
13. *Torque:*
    73°
    80°



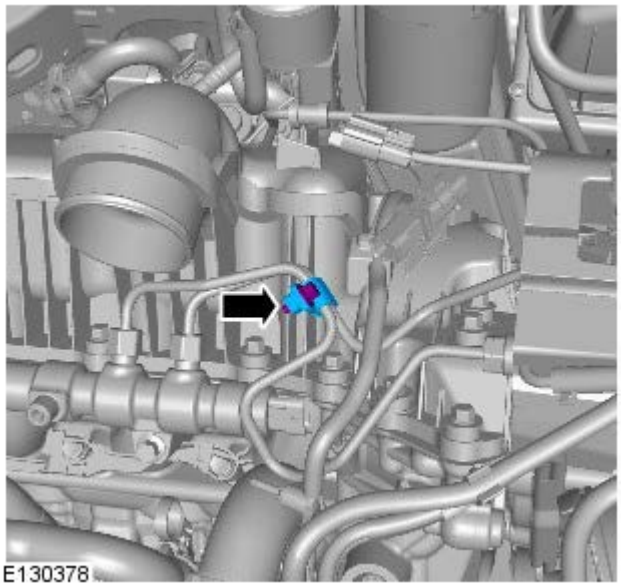
14. *Torque:*
    Unions 73°
    M6 10 Nm



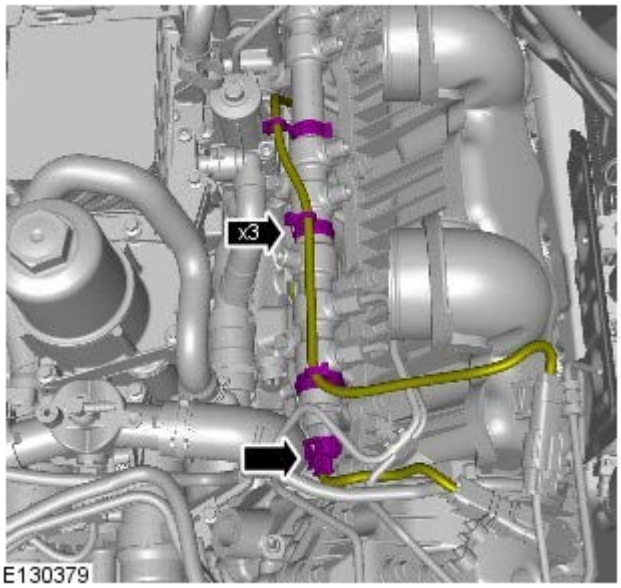
15. *Torque:* 10 Nm



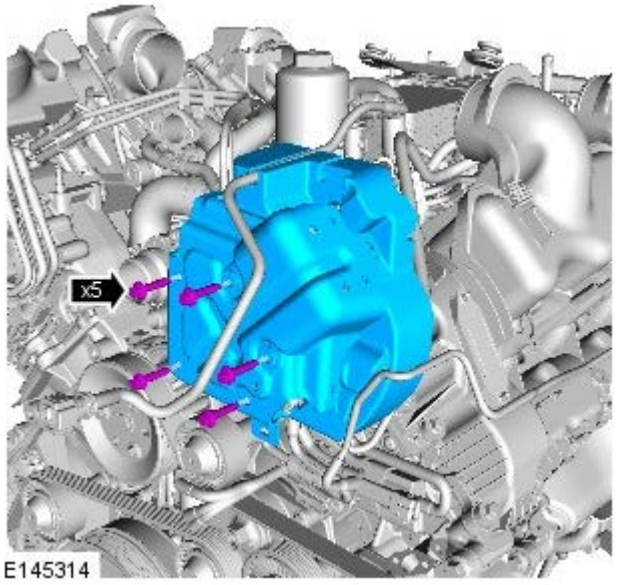
16. *Torque:* 10 Nm



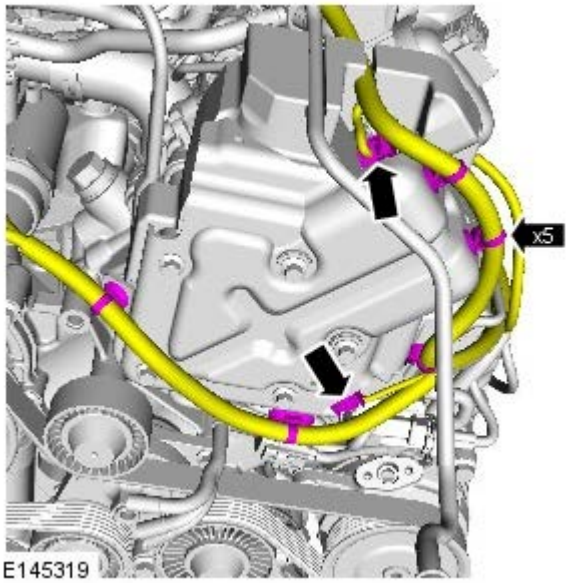
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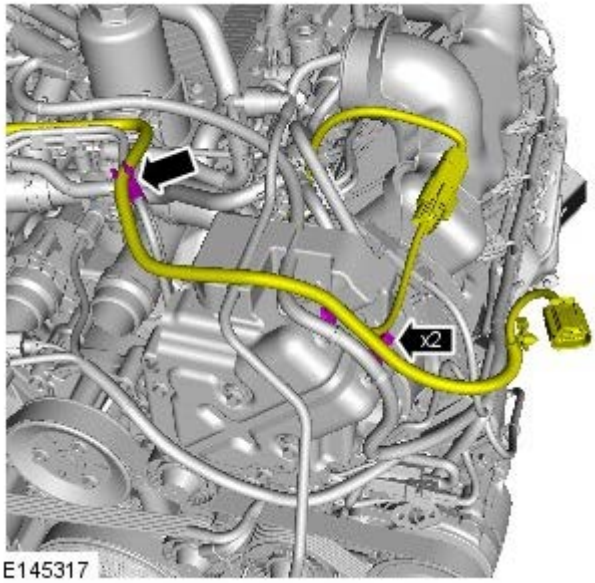
18. *Torque:* 10 Nm



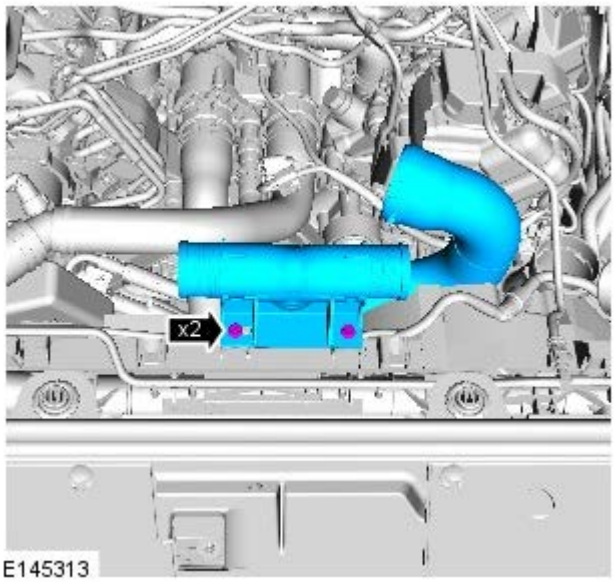
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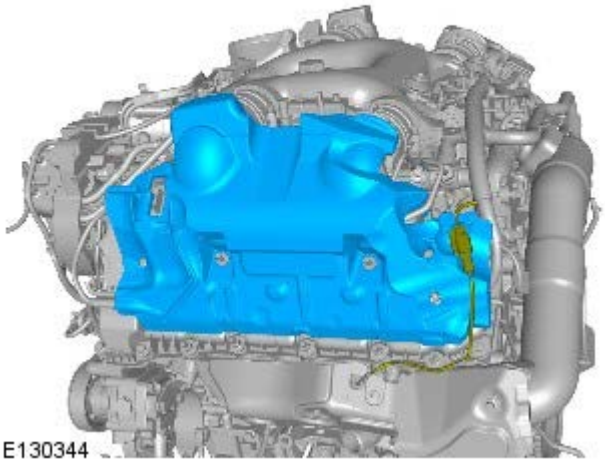
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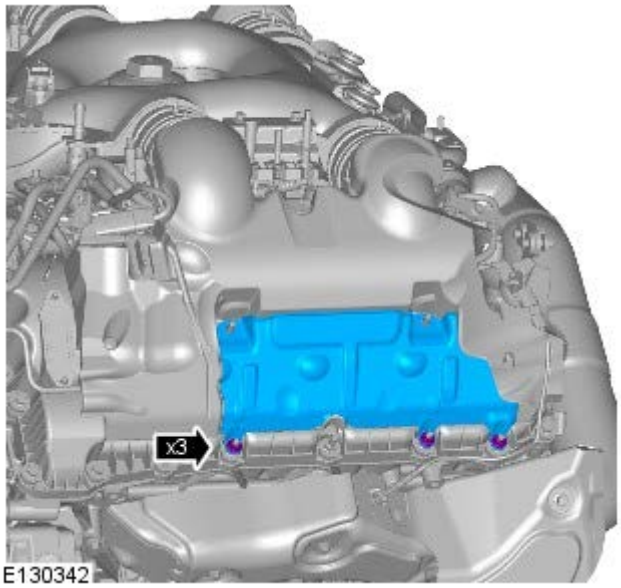
21. *Torque:* 10 Nm



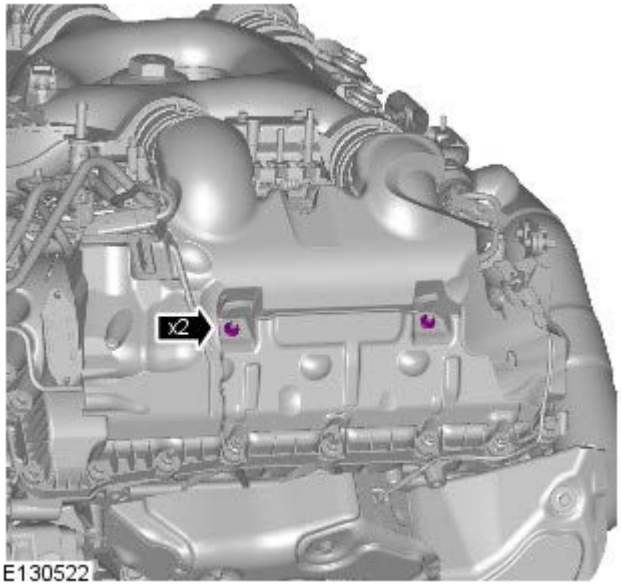
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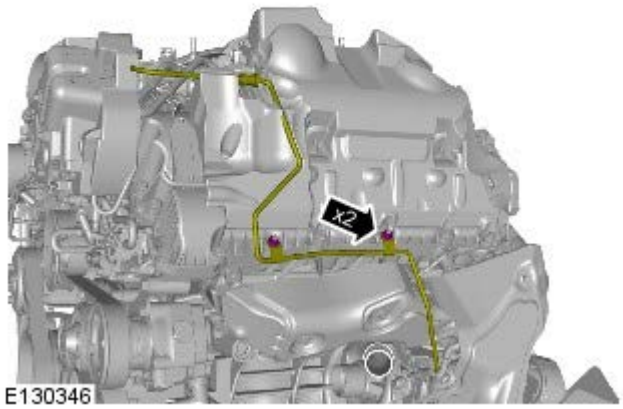
23. *Torque:* 10 Nm



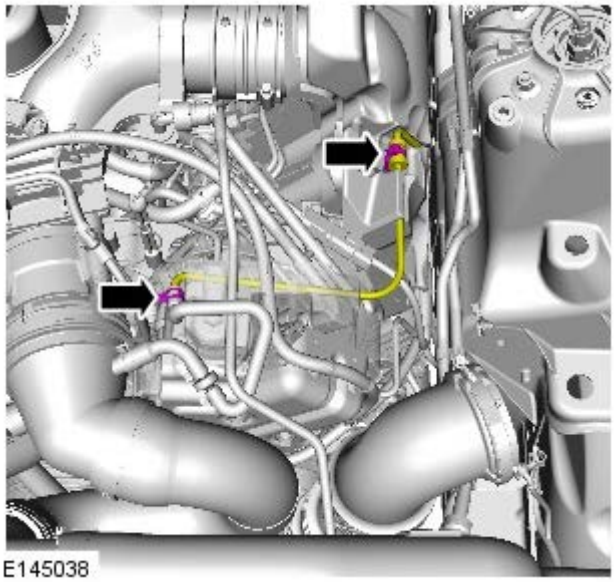
24. *Torque:* 6 Nm



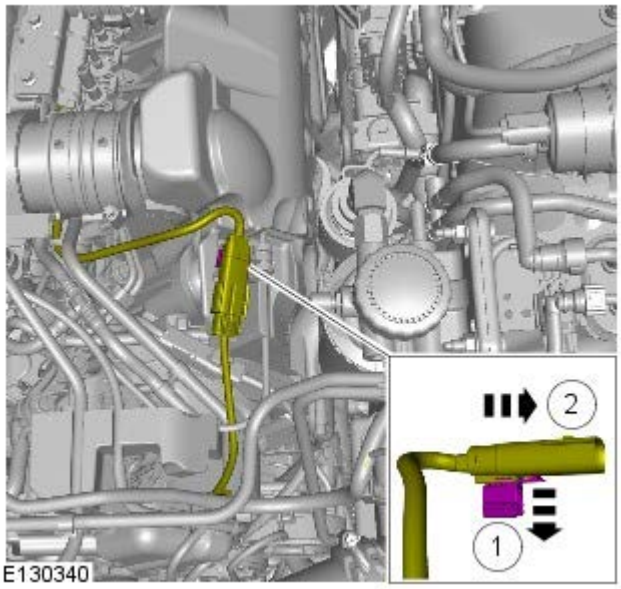
25. *Torque:* 10 Nm



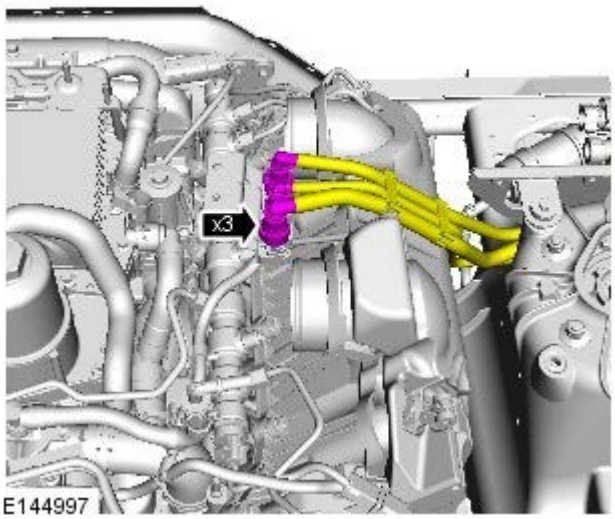
26.



27.



28.



29. Refer to: Intake Manifold Plenum Chamber (303-01D Engine - TDV8 4.4L Diesel, Removal and Installation).

30. Refer to: Fuel Filter Element (310-01D Fuel Tank and Lines - TDV8 4.4L Diesel, Removal and Installation).

31. Refer to: Air Cleaner LH (303-12D Intake Air Distribution and Filtering - TDV8 4.4L Diesel, Removal and Installation).

32. Connect the battery ground cable.

    Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

33. Refer to: High-Pressure Fuel System Bleeding (310-00 Fuel System - General Information, General Procedures).

Published: 23-Oct-2013

Fuel Charging and Controls - TDV8 4.4L Diesel - Fuel Rail RH

Removal and Installation

Removal

CAUTION: Make sure that all openings are sealed. Use new blanking caps.

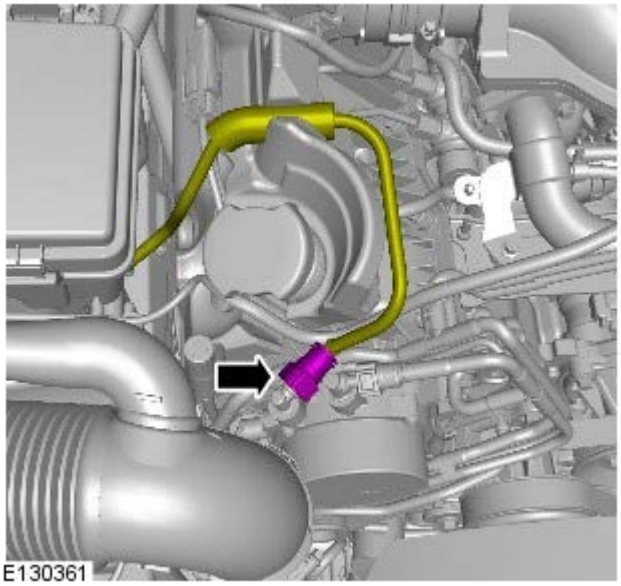
NOTES:

Some variation in the illustrations may occur, but the essential information is always correct.

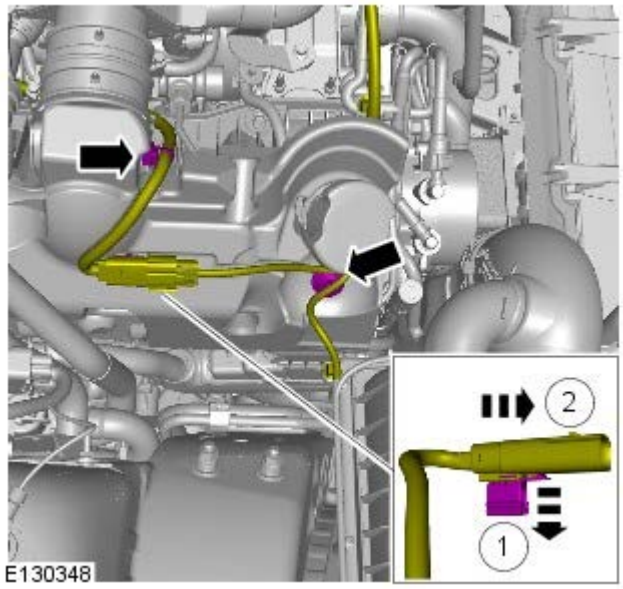
Engine shown removed for clarity.

1. Refer to: Diesel Fuel System Health and Safety Precautions (100-00 General Information, Description and Operation).
2. Disconnect the battery ground cable.

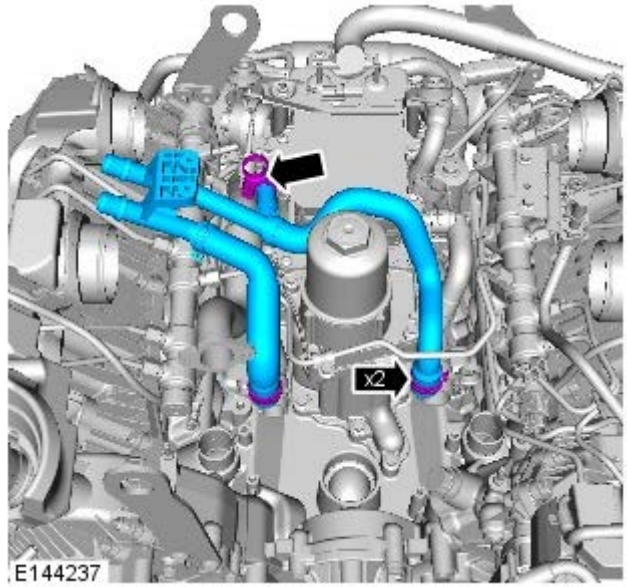
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).
3. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.
4. Refer to: Fuel Fired Booster Heater (412-02A Auxiliary Climate Control, Removal and Installation).
5. Refer to: Intake Manifold Plenum Chamber (303-01D Engine - TDV8 4.4L Diesel, Removal and Installation).
6. Refer to: Fuel Injection Component Cleaning (303-04E Fuel Charging and Controls - TDV8 4.4L Diesel, General Procedures).
7. 

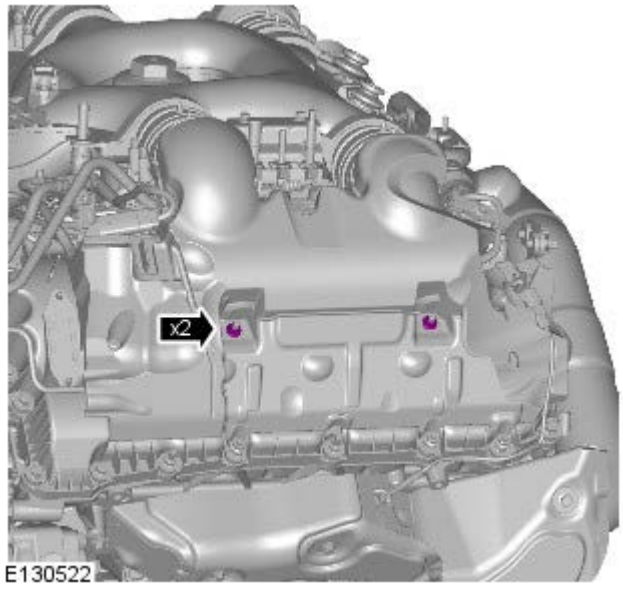
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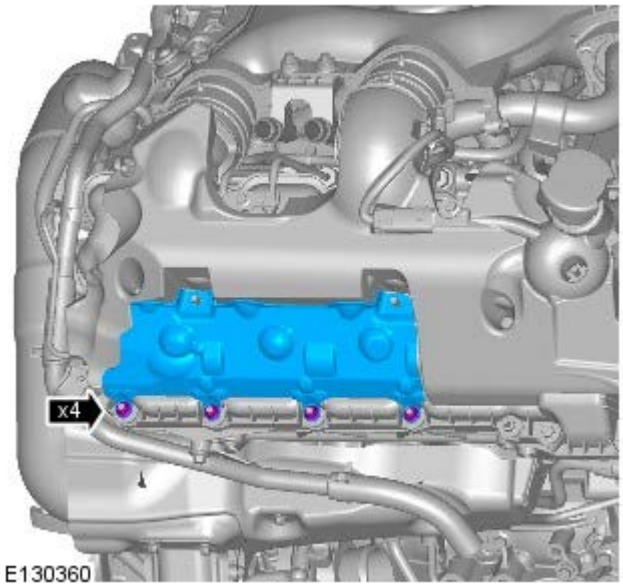
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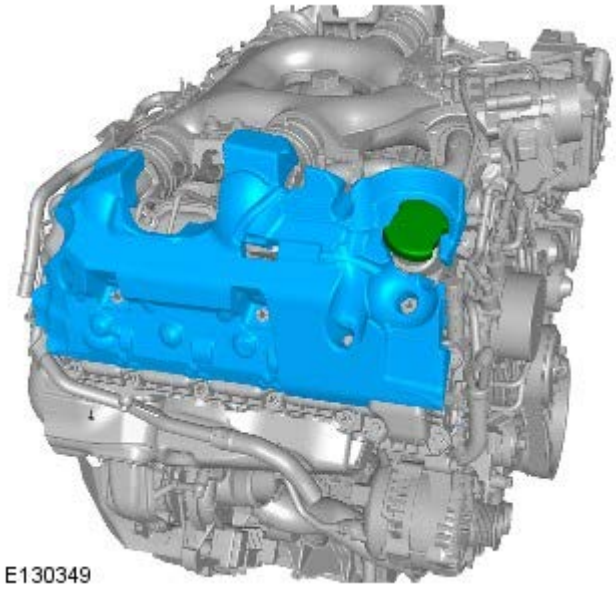
10. CAUTION: LH illustration shown, RH is similar.



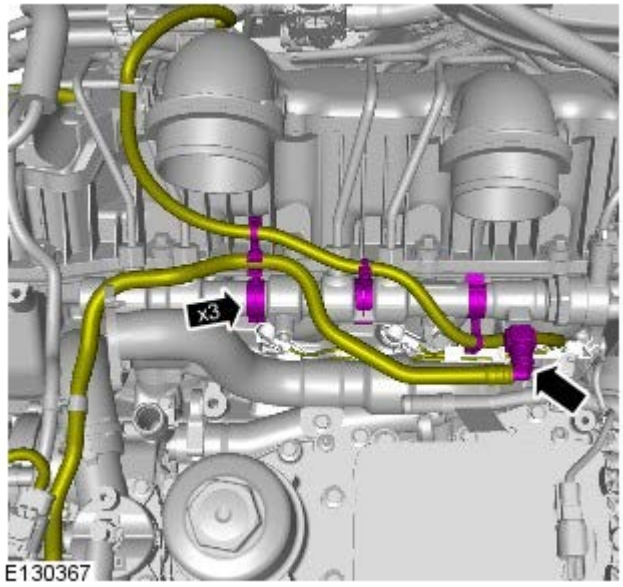
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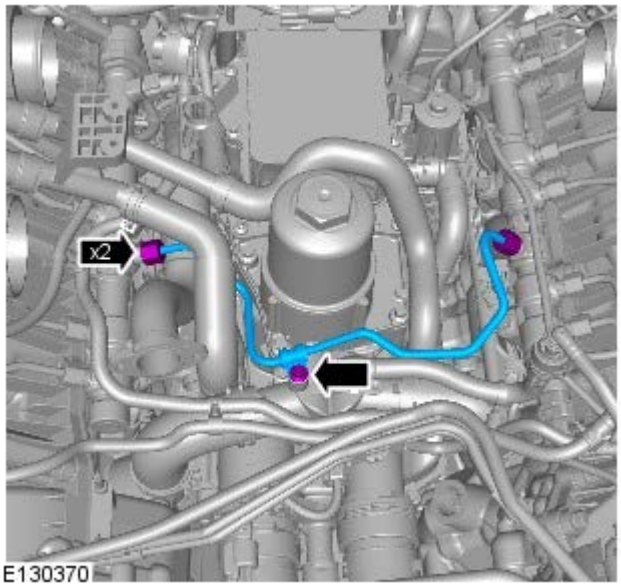
12.



13.

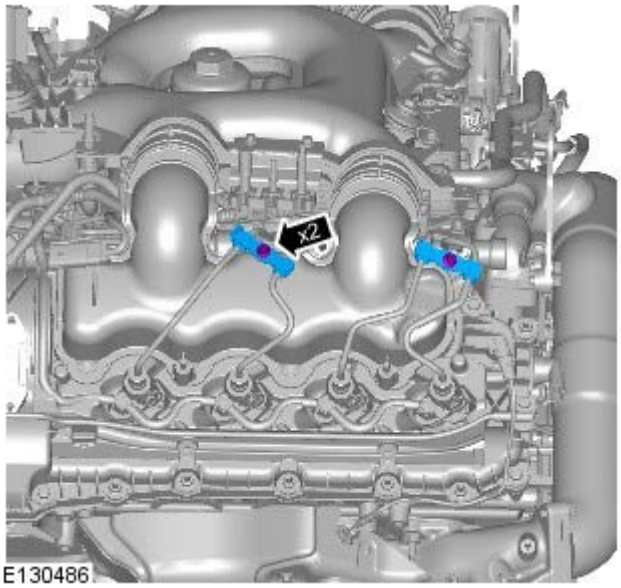


14. CAUTION: Discard the fuel pipes.



E130370

15. CAUTION: LH illustration shown, RH is similar.

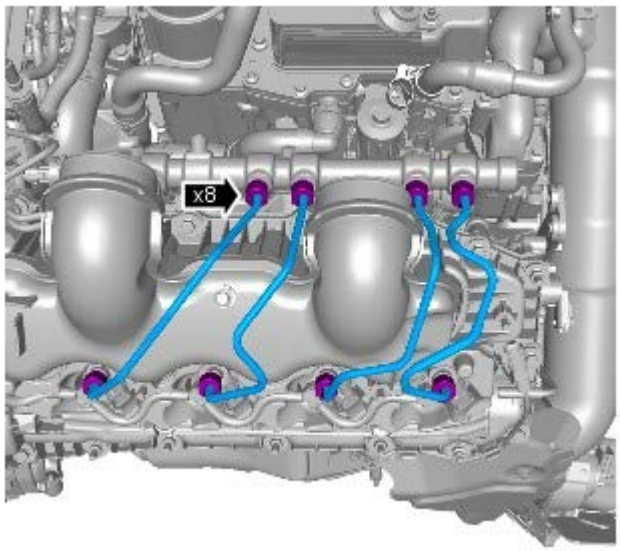


E130486

16. CAUTIONS:

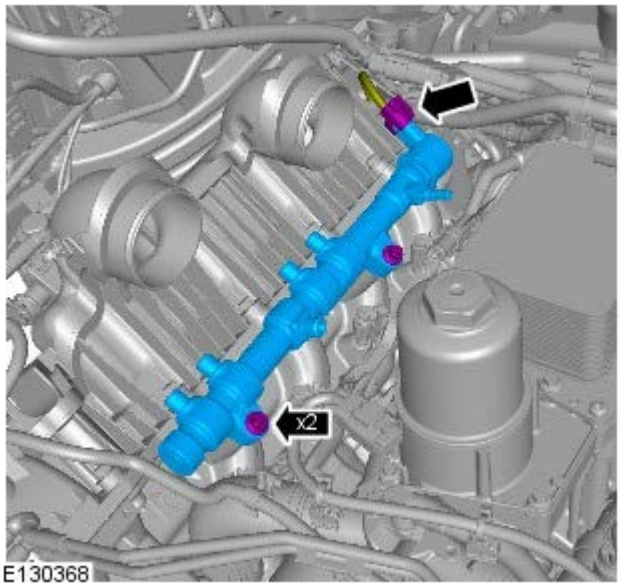
LH illustration shown, RH is similar.

Discard the fuel pipes.



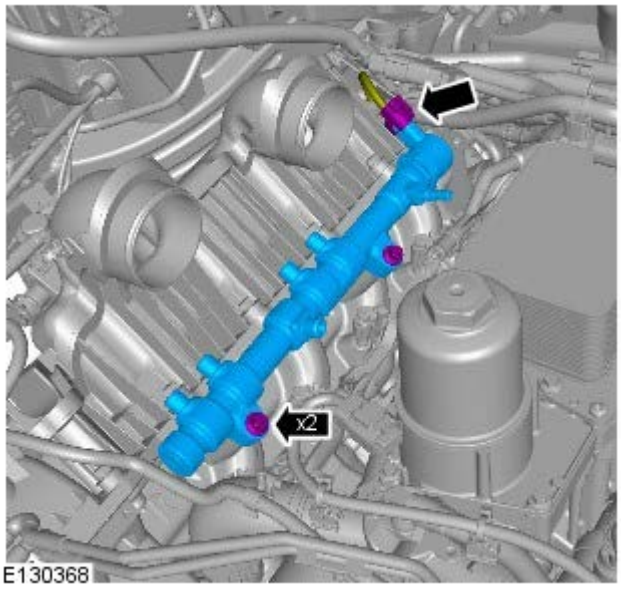
E130377

17.



E130368

Installation

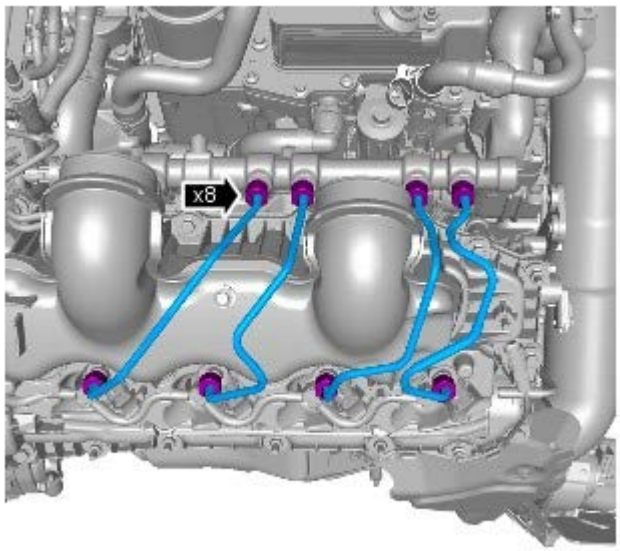


E130368

1. NOTES:

   Remove and discard all blanking caps.

   Do not tighten at this stage.



E130377

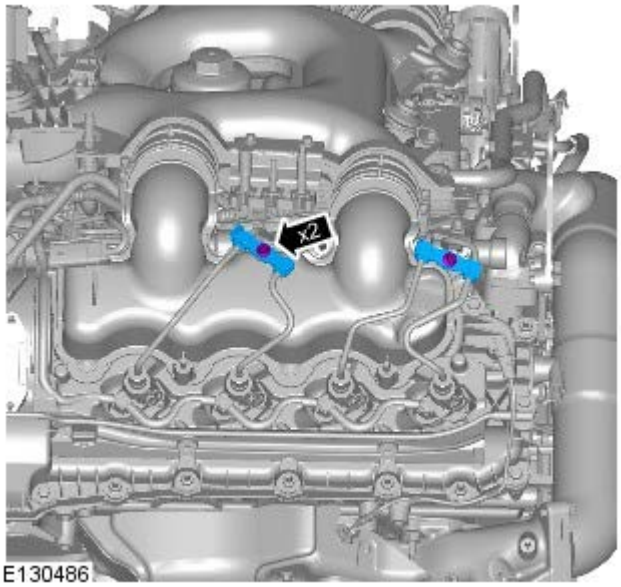
2. CAUTIONS:

   LH illustration shown, RH is similar.

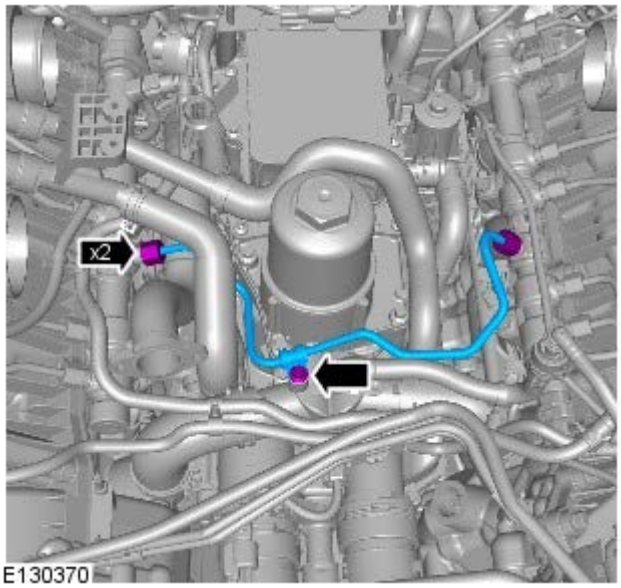
   Install new fuel pipes.

   NOTE: Do not tighten at this stage.

3. CAUTION: LH illustration shown, RH is similar.



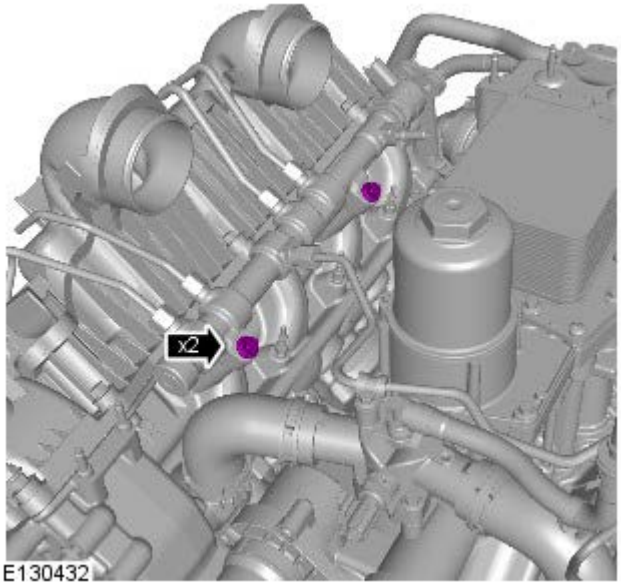
NOTE: Do not tighten at this stage.



4. CAUTION: Install new fuel pipes.

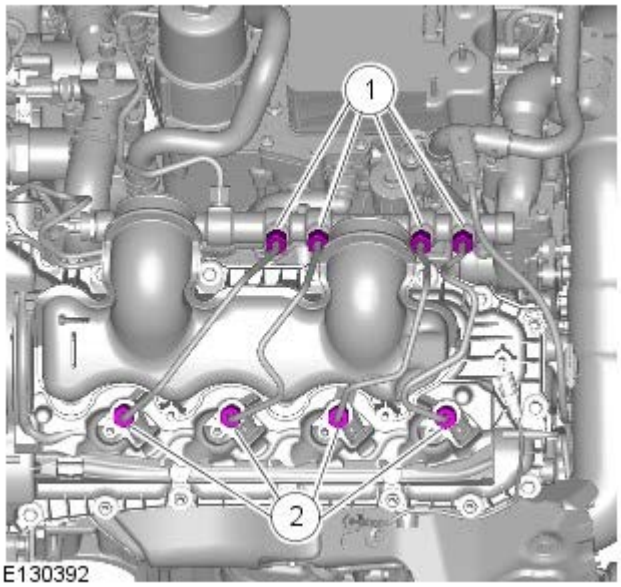
NOTE: Do not tighten at this stage.

5. *Torque:* 23 Nm

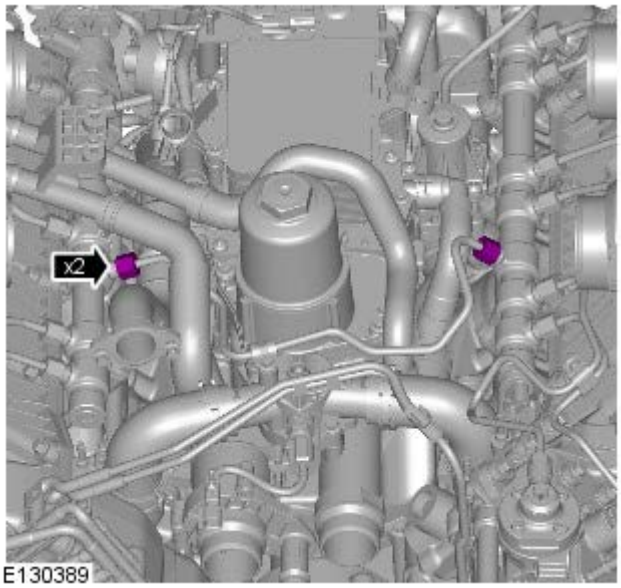


6. CAUTION: LH illustration shown, RH is similar.

Torque: 15 Nm

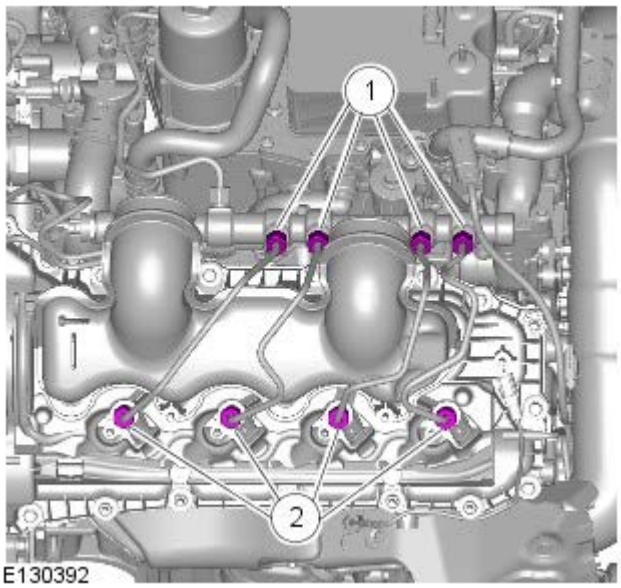


7. *Torque:* 15 Nm

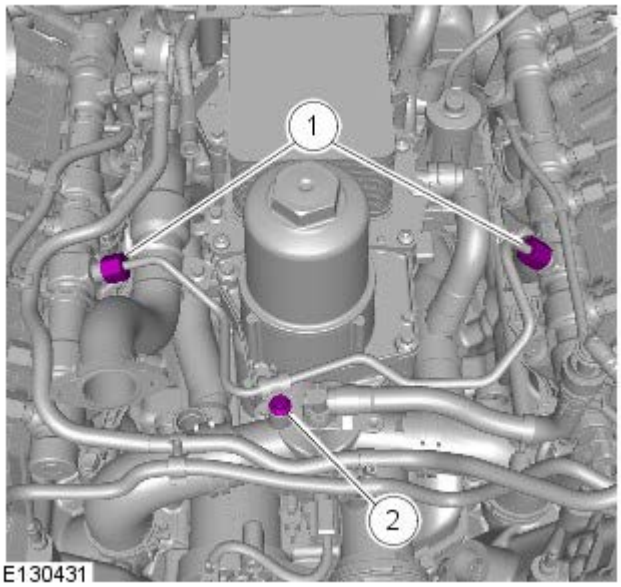


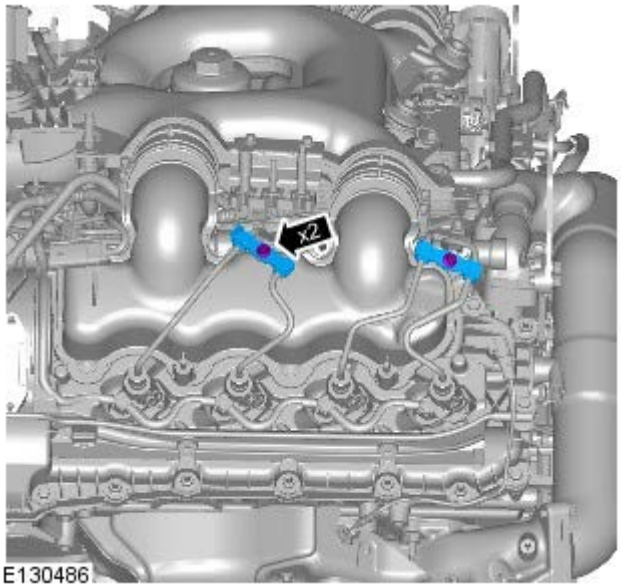
8. CAUTION: LH illustration shown, RH is similar.

Torque: 35 Nm



9. *Torque:*
   Unions 35 Nm
   M6 10 Nm

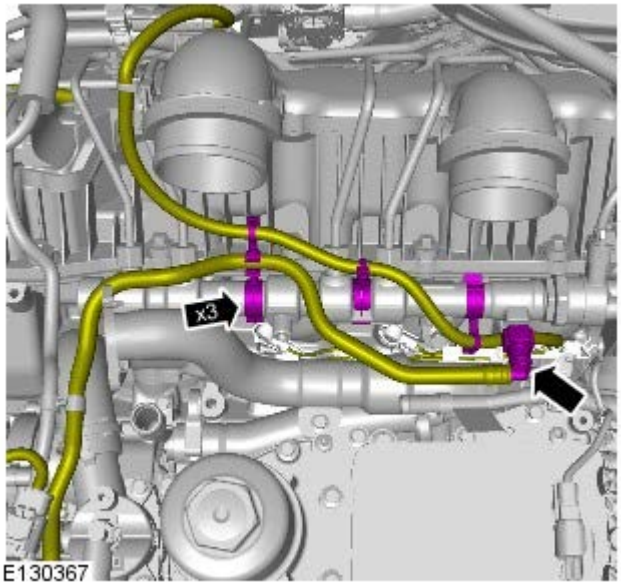




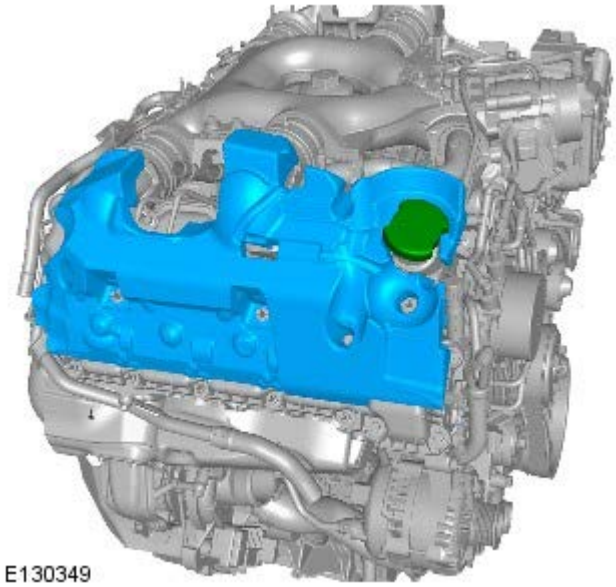
10. CAUTION: LH illustration shown, RH is similar.

Torque: 10 Nm

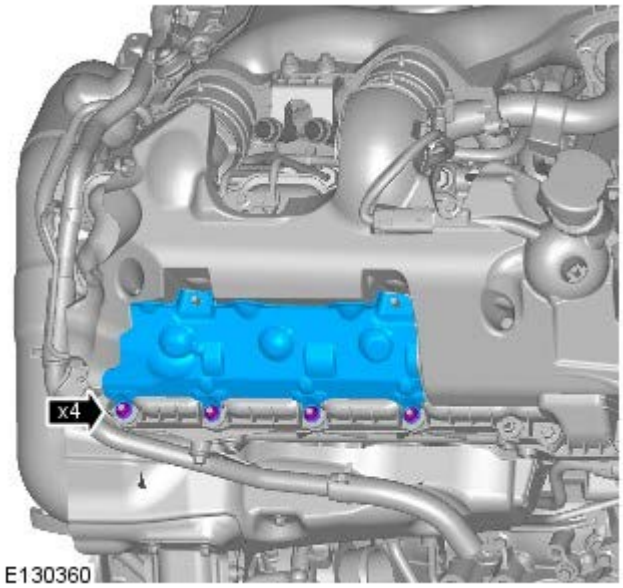
11.



12.


E130349

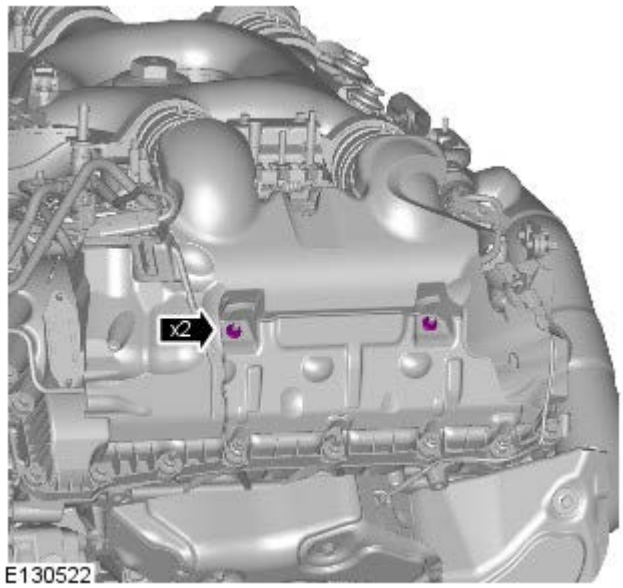
13. *Torque:* 10 Nm



E130360

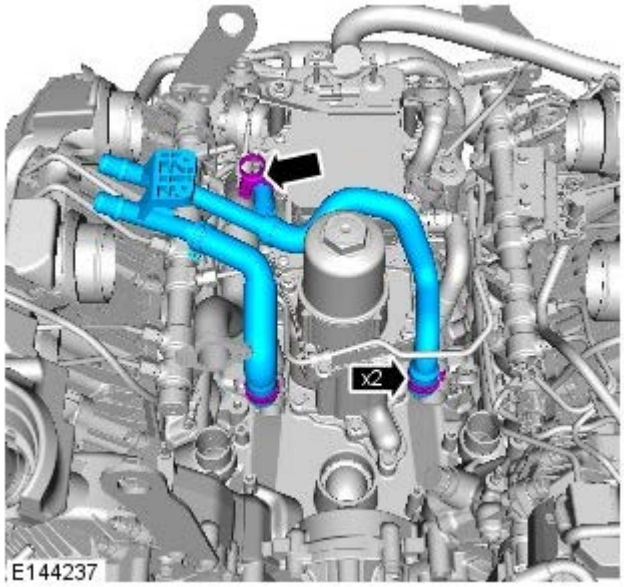
14. CAUTION: LH illustration shown, RH is similar.

Torque: 6 Nm

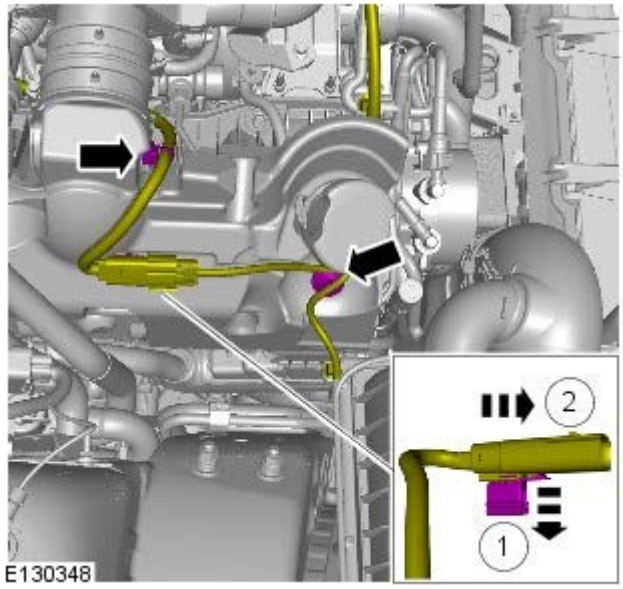


E130522

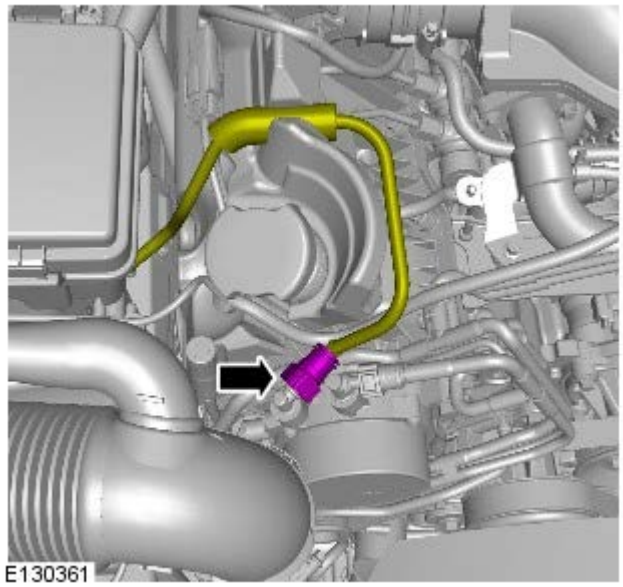
15.



16.



17.



18. Refer to: Intake Manifold Plenum Chamber (303-01D Engine - TDV8 4.4L Diesel, Removal and Installation).

19. Refer to: Fuel Fired Booster Heater (412-02A Auxiliary Climate Control, Removal and Installation).

20. Connect the battery ground cable.

    Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

21. Refer to: High-Pressure Fuel System Bleeding (310-00 Fuel System - General Information, General Procedures).

Published: 22-Oct-2013

Fuel Charging and Controls - TDV8 4.4L Diesel - Throttle Body

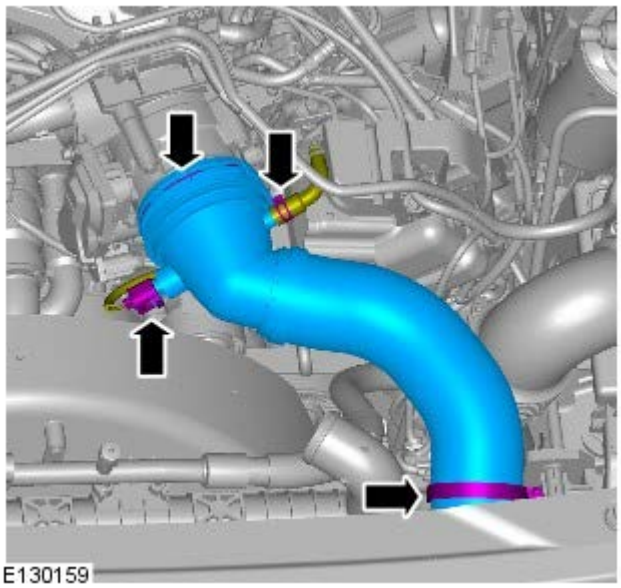
Removal and Installation

Removal

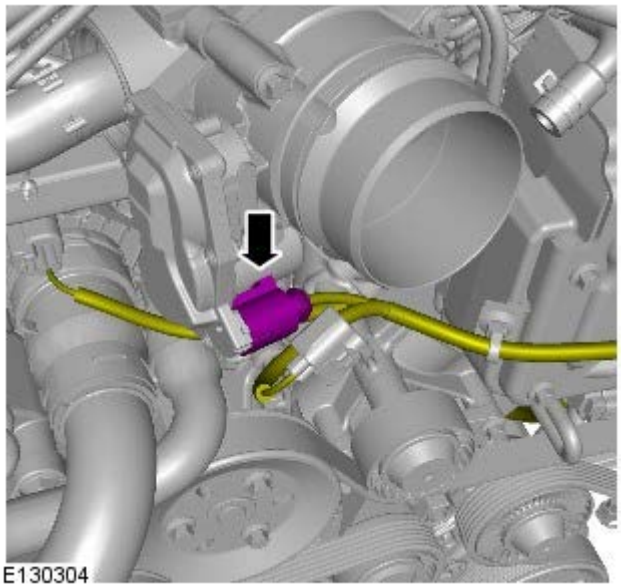
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Engine Cover - 4.4L V8 - TdV8 (501-05 Interior Trim and Ornamentation, Removal and Installation).

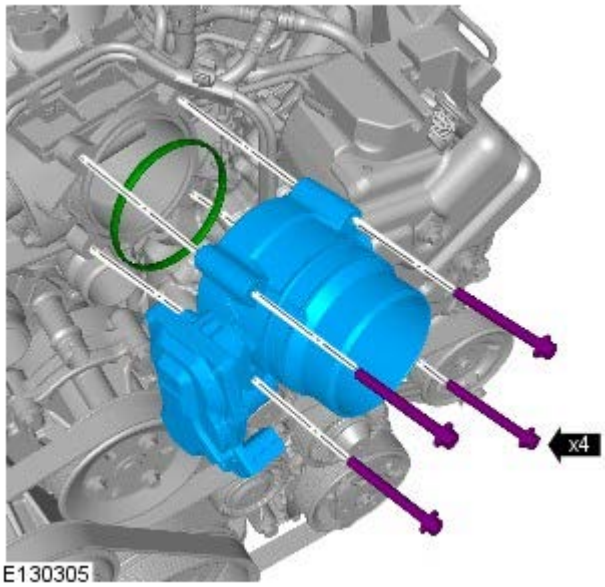
2.



3.



4. *Torque:* 10 Nm



Installation

1. To install, reverse the removal procedure.
2. Using the approved diagnostic equipment, clear the powertrain control module (PCM) adaptions.

Published: 19-Oct-2012

Fuel Charging and Controls - Turbocharger - TDV8 4.4L Diesel -

Description	Nm	lb-ft
Oil supply pipe to turbocharger banjo bolts	24	18
Oil supply pipe to turbocharger bracket bolts	7	5
Oil supply pipe to cylinder block bolts	10	7
Turbocharger oil return tube bolts	10	7
*+ Turbocharger to exhaust manifold nuts	23	17
Turbocharger to exhaust manifold studs	13	10
Turbocharger heatshield bolts	9	7
*+ Exhaust manifold nuts	24	18
Exhaust manifold heatshield bolts	9	7
LH turbocharger to exhaust bolts	33	24
+ Turbocharger support bracket bolts	23	17

*** New nuts must be installed**

+ Nuts must be tightened in sequence

This section contains no data

Published: 11-May-2011

Fuel Charging and Controls - Turbocharger - TDV8 4.4L Diesel - Turbocharger

Diagnosis and Testing

Principles of Operation

For a detailed description of the turbocharger and operation, refer to the relevant Description and Operation section of the Workshop Manual.

Inspection and Verification

WARNINGS:

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.

The turbocharger can continue to rotate after the engine has stopped. Do not attempt to check the turbocharger until one minute has elapsed since the engine was switched off. 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 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
• Intake air system • Hose(s)/hose connections • Turbochargers • General engine condition.	• Circuit(s) • Electrical connections and harnesses • Turbocharger actuators • 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 performance (off-boost)	• Low/Contaminated fuel • Restricted intake air system • General engine condition • 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. Check for DTCs indicating a module fault. Refer to the warranty policy and procedures manual if an ECM is suspect.
No boost	• Electrical connections and harnesses • Restricted intake air system • Charge air cooler restricted/leaking • Turbocharger actuator failure(s) • Turbocharger failure(s) • ECM failure	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. Refer to the warranty policy and procedures manual if an ECM is suspect.
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 - 3.6L (TdV8) Diesel, DTC: Module Name: Engine Control Module (100-00,

Description and Operation).

Published: 22-Oct-2013

Fuel Charging and Controls - Turbocharger - TDV8 4.4L Diesel - Turbocharger Bypass Valve

Removal and Installation

Removal

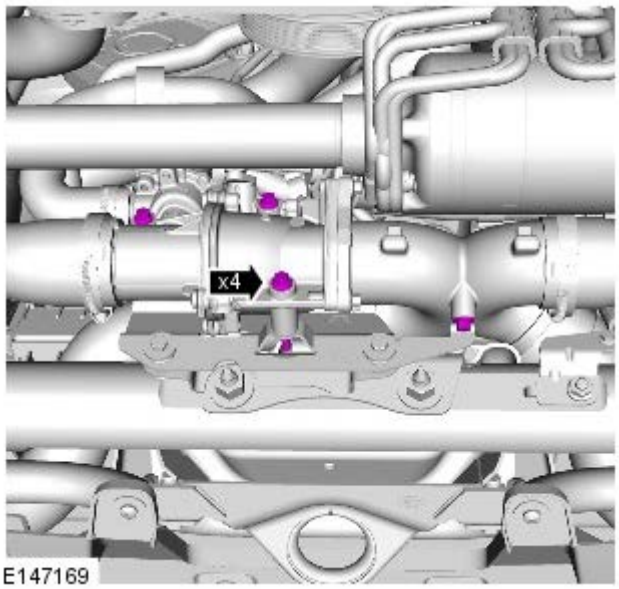
NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

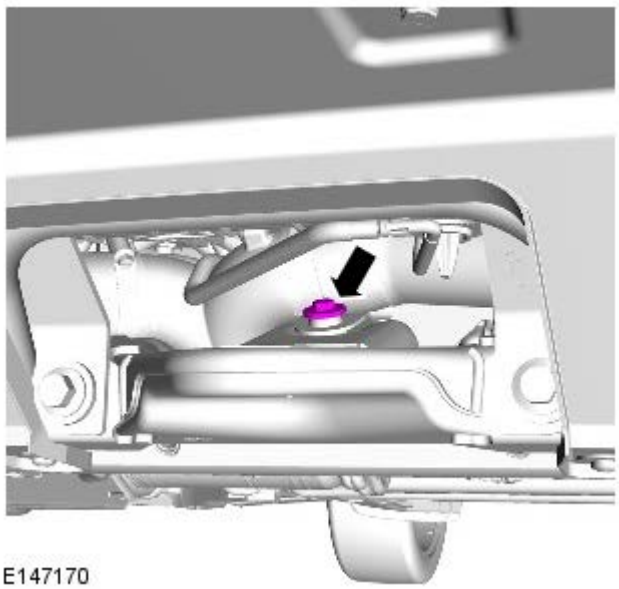
2. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

3. *Torque:* 10 Nm



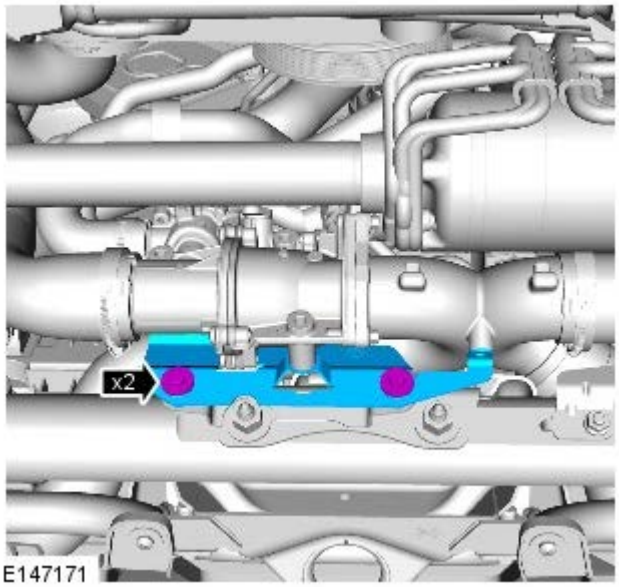
E147169

4. *Torque:* 10 Nm

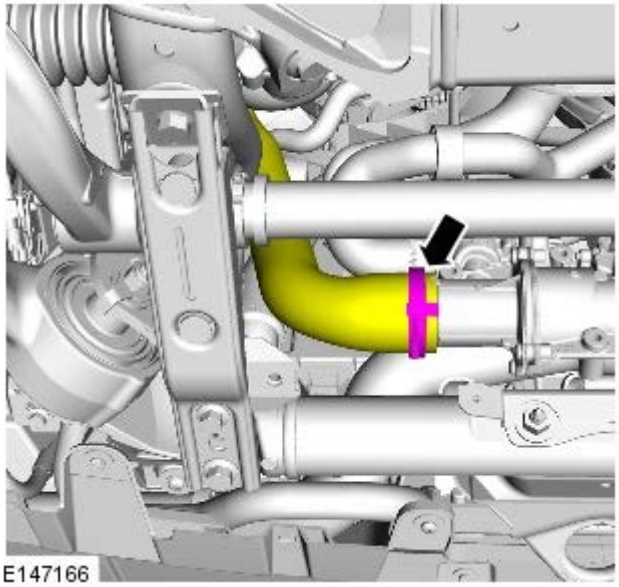


E147170

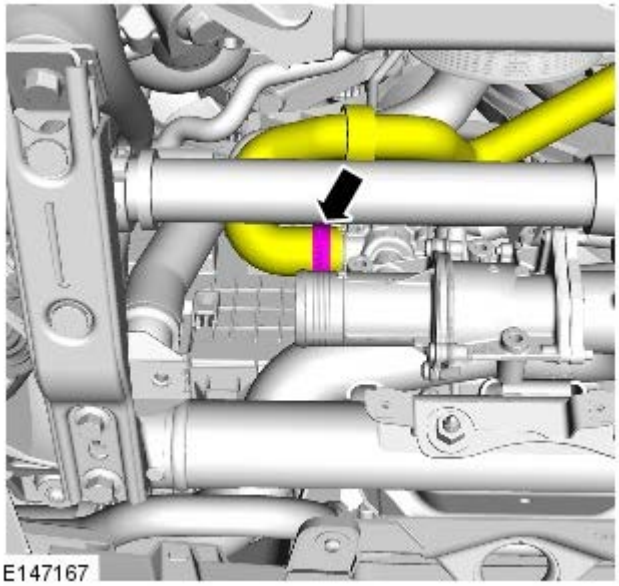
5. *Torque:* 10 Nm



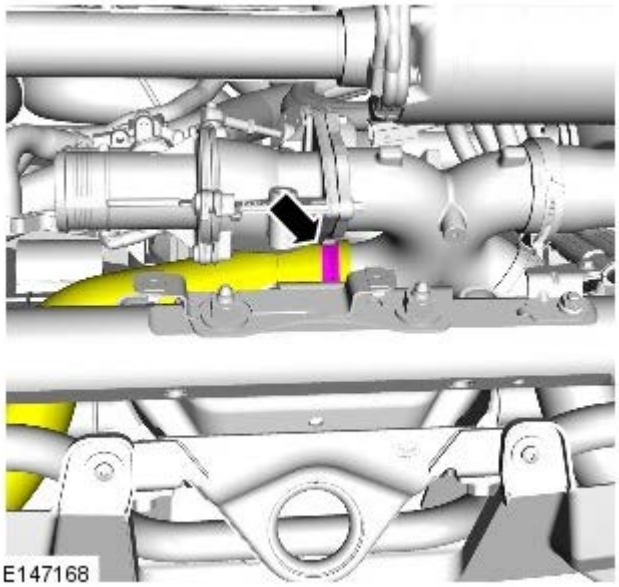
6. *Torque:* 3.5 Nm



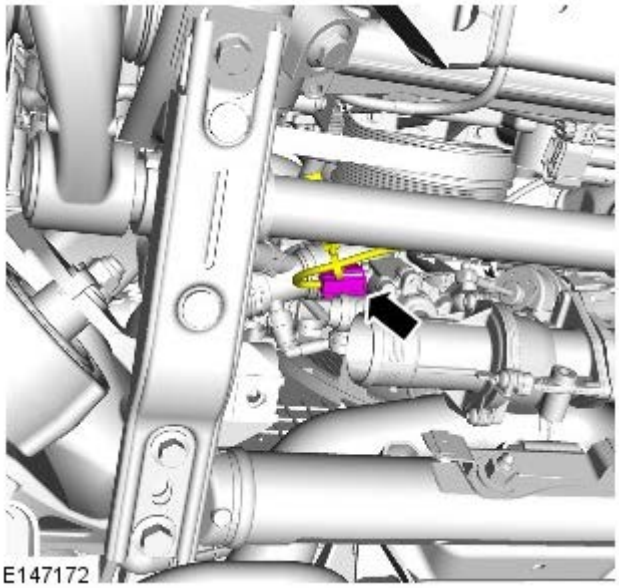
7. *Torque:* 3.5 Nm



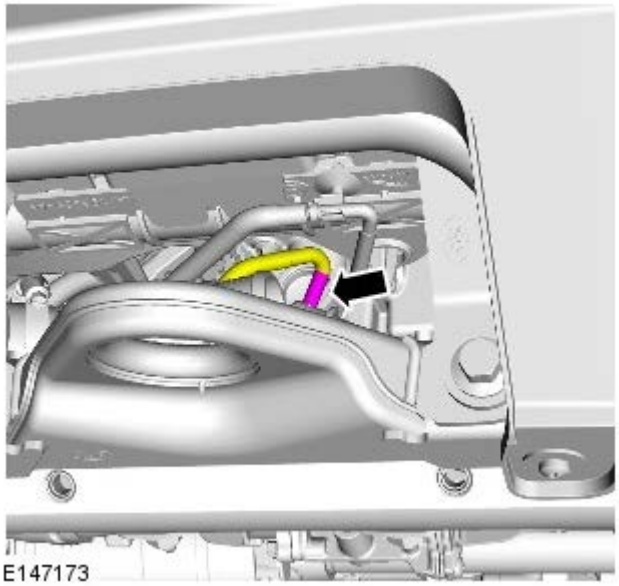
8. *Torque:* 3.5 Nm



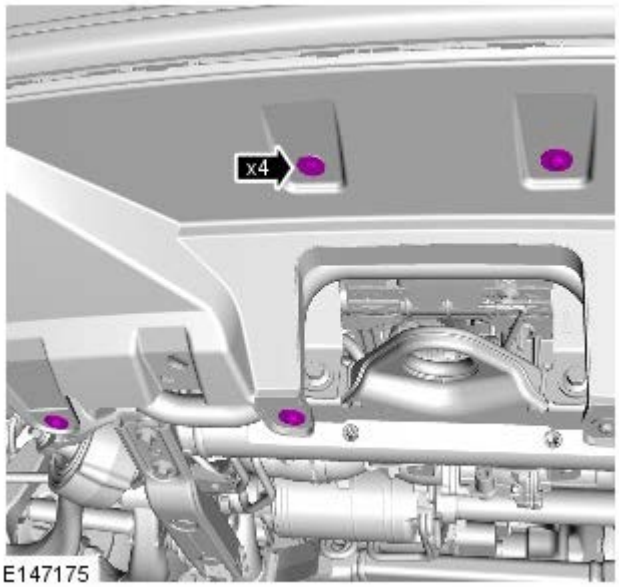
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10.

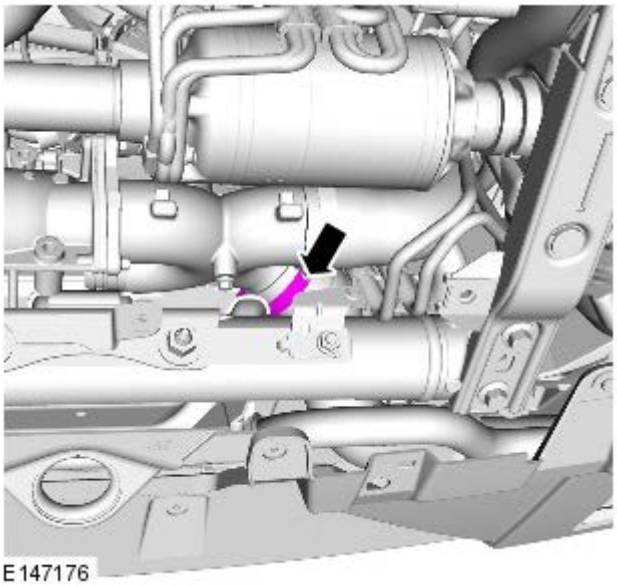


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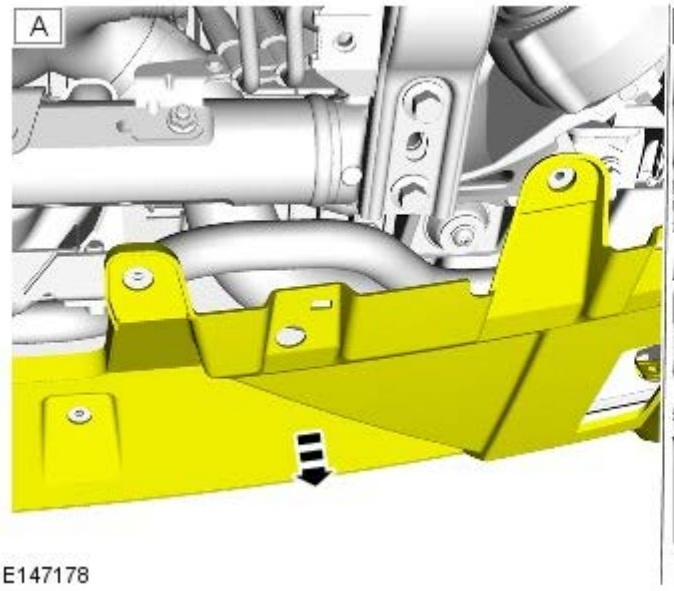


E147175

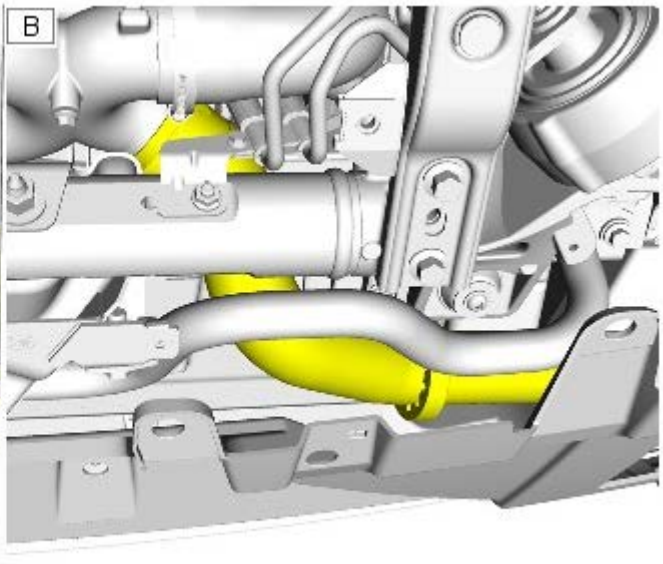
12. *Torque:* 3.5 Nm


E147176

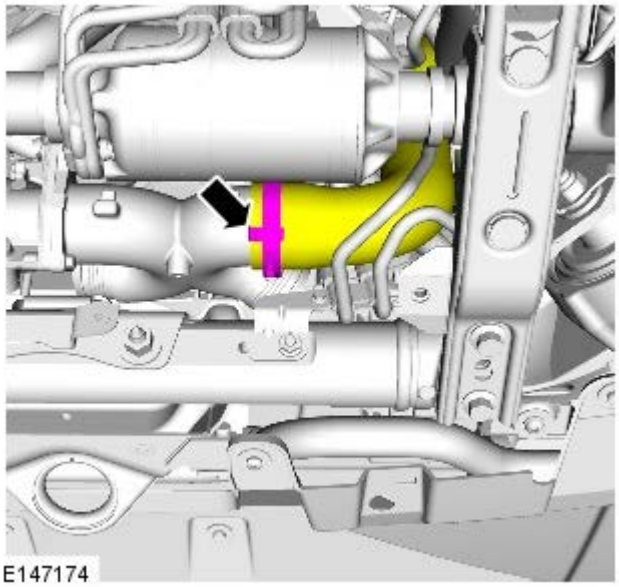
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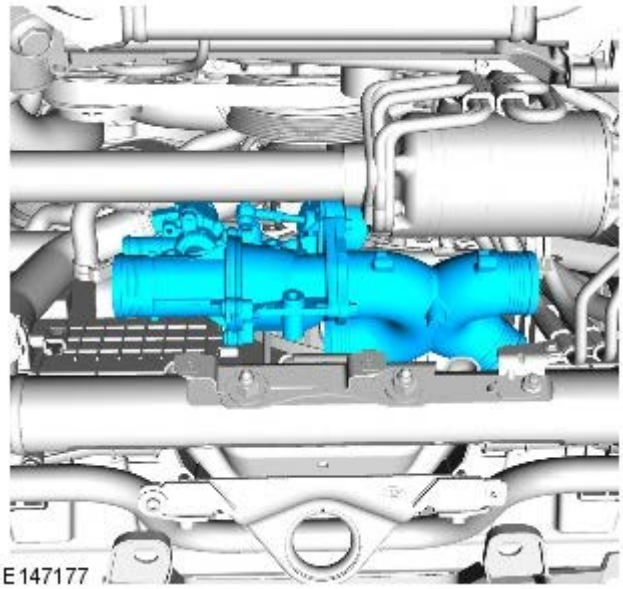
E147178



14. *Torque:* 3.5 Nm



15.



Installation

1. To install, reverse the removal procedure.

Published: 28-Oct-2013

Fuel Charging and Controls - Turbocharger - TDV8 4.4L Diesel - Turbocharger LH

Removal and Installation

Removal

CAUTION: Make sure that all openings are sealed. Use new blanking caps.

NOTES:

Some variation in the illustrations may occur, but the essential information is always correct.

Engine shown removed for clarity.

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 Battery and Charging System - General Information, Specifications).

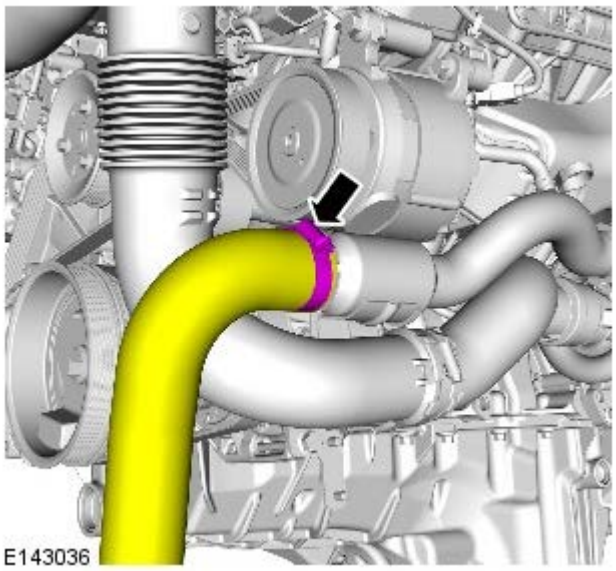
3. Refer to: Air Cleaner LH (303-12D Intake Air Distribution and Filtering - TDV8 4.4L Diesel, Removal and Installation).

4. Refer to: Fuel Filter Element (310-01D Fuel Tank and Lines - TDV8 4.4L Diesel, Removal and Installation).

5. Refer to: Fender Splash Shield (501-02 Front End Body Panels, Removal and Installation).

6. Refer to: Exhaust System - Vehicles With: Diesel Particulate Filter (DPF) (309-00D Exhaust System - TDV8 4.4L Diesel, Removal and Installation).
   Refer to: Exhaust System - Vehicles Without: Diesel Particulate Filter (DPF) (309-00D Exhaust System - TDV8 4.4L Diesel, Removal and Installation).

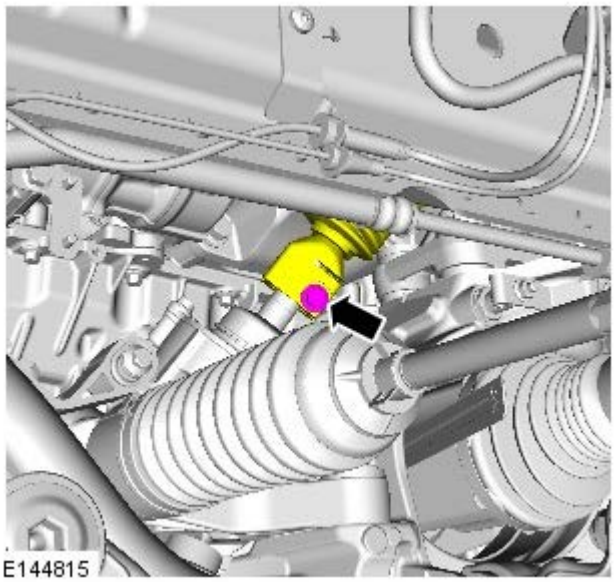
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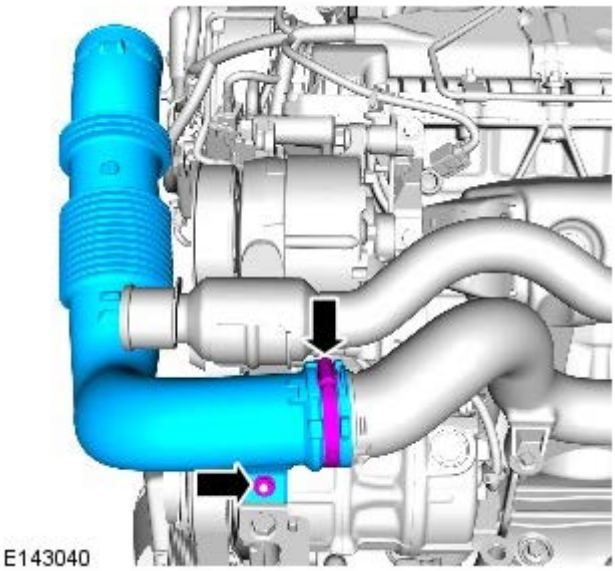
8. CAUTION: Discard the bolt.

   NOTE: Left hand drive only.

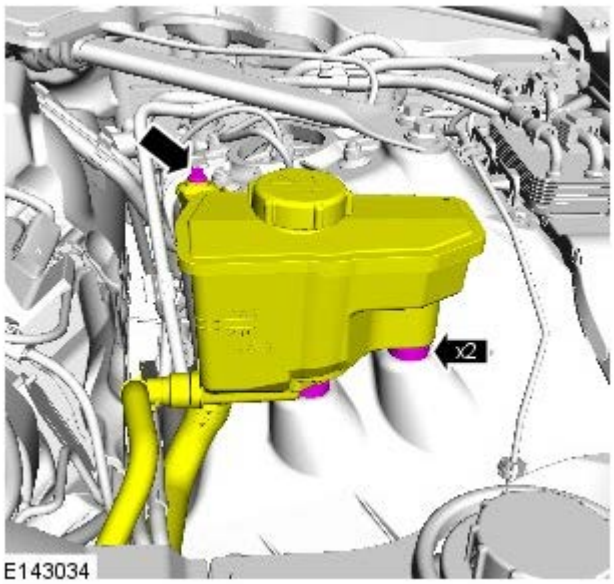
   Align the steering wheel to straight ahead.



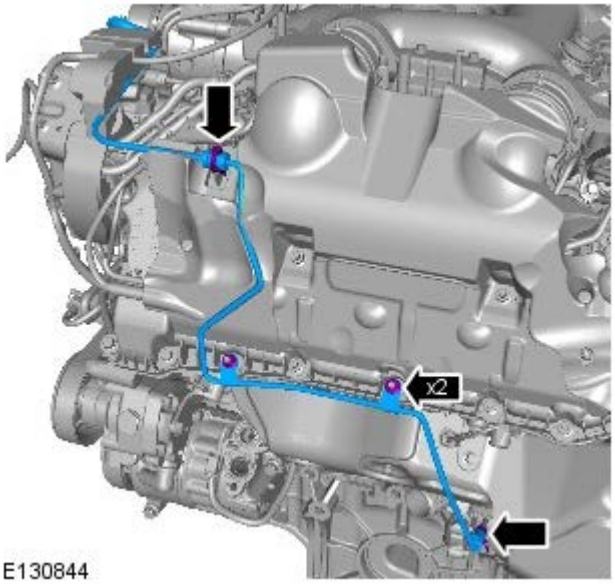
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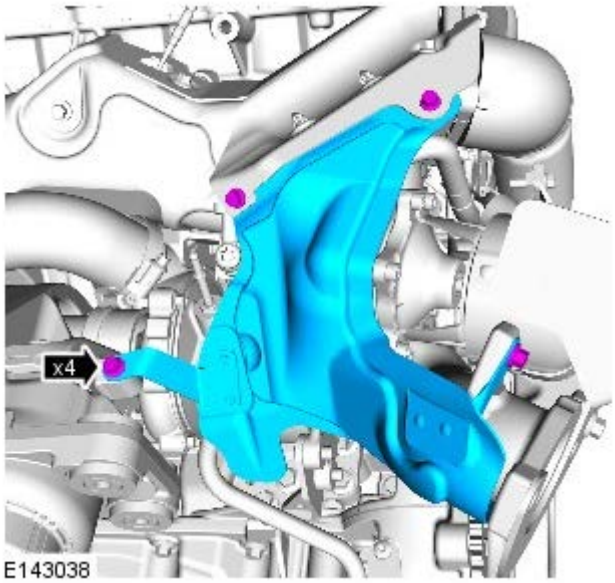
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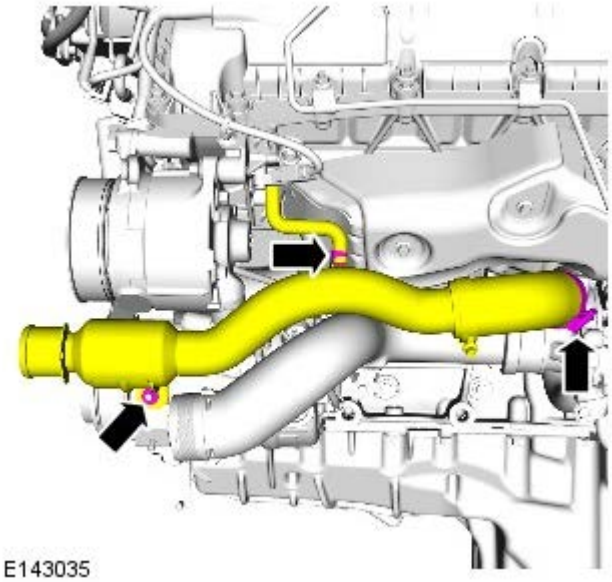
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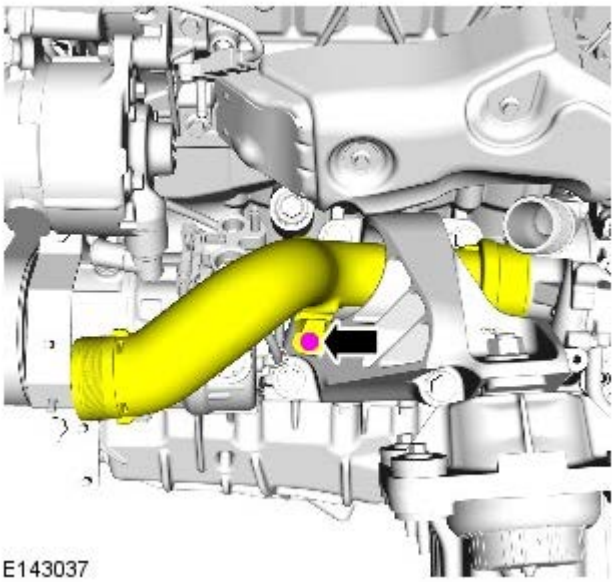
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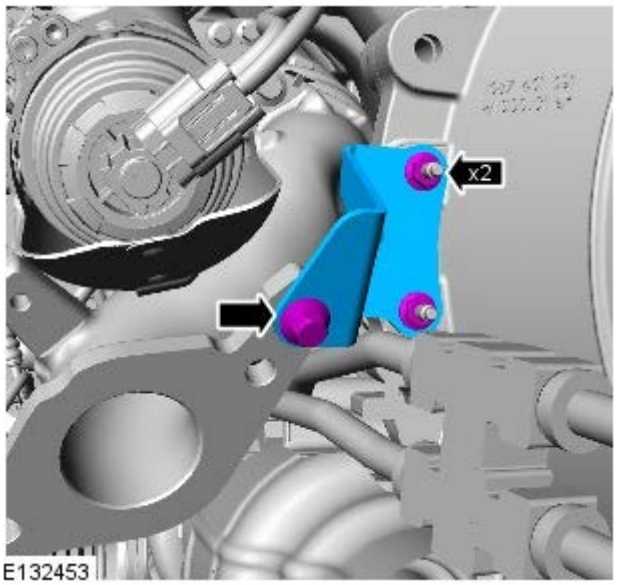
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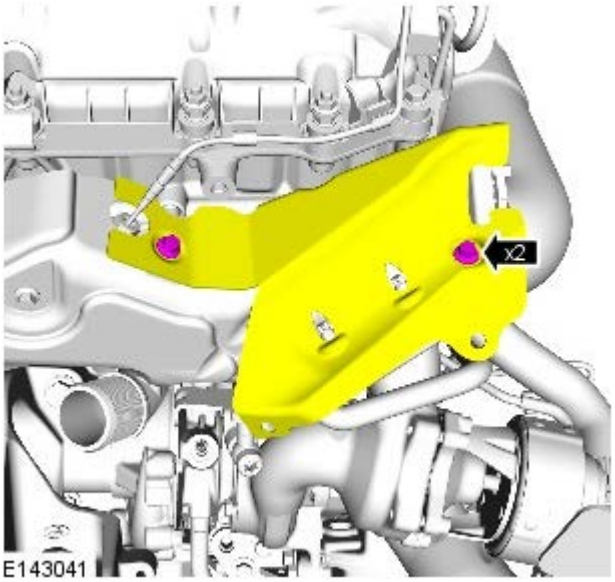
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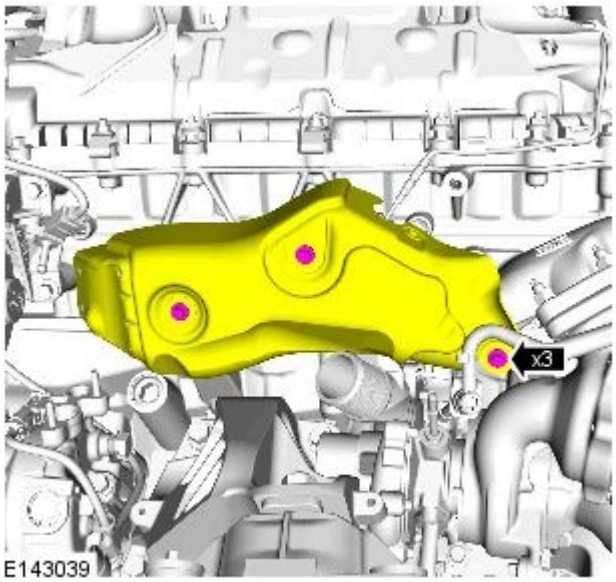
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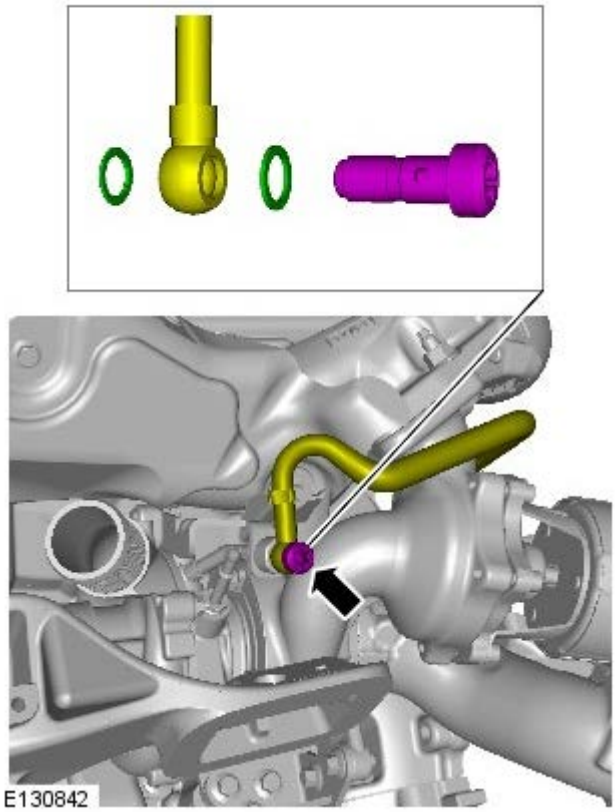
16. Move the shield aside.



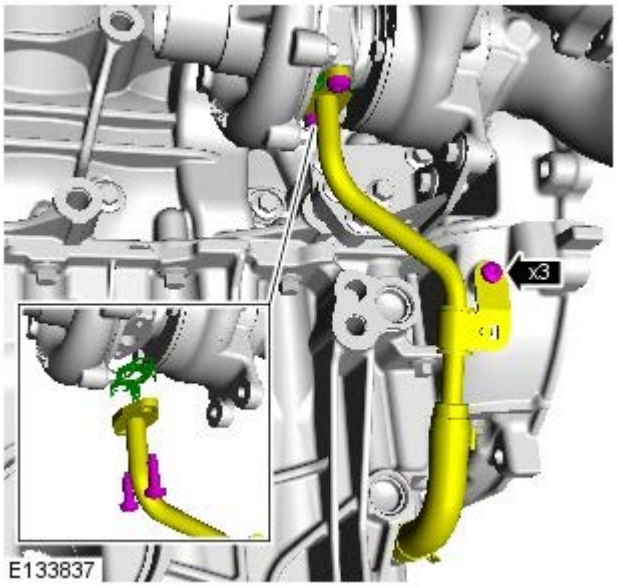
17. Move the shield aside.



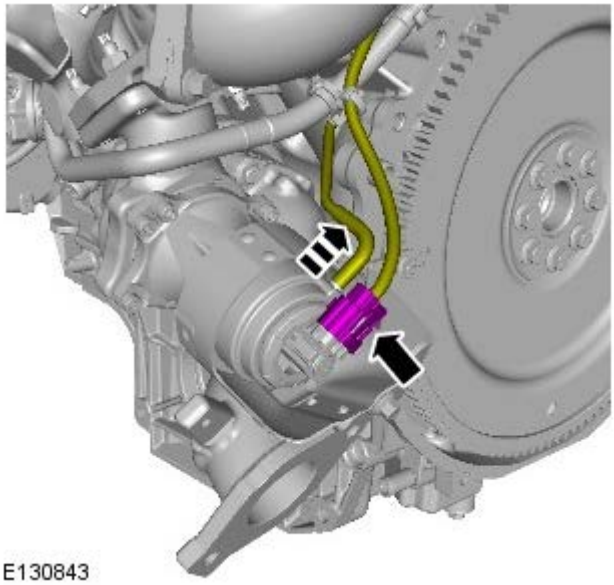
18. CAUTION: Be prepared to collect escaping oil.



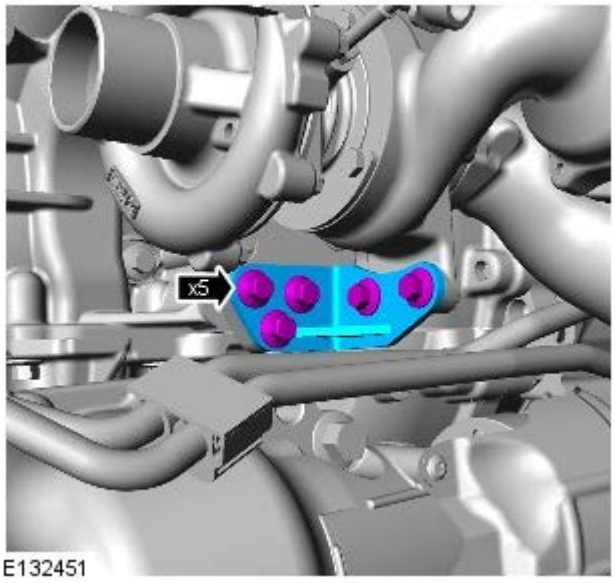
19. CAUTION: Be prepared to collect escaping oil.



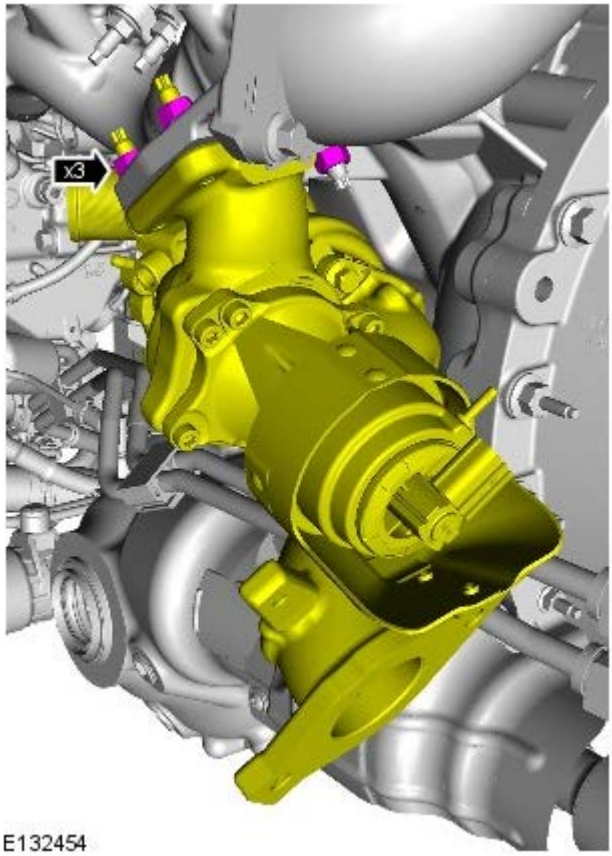
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21.

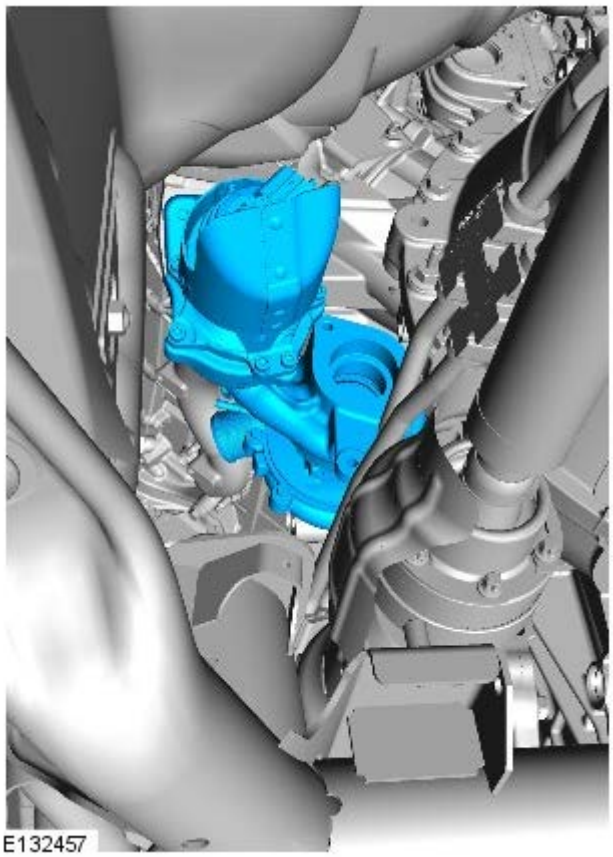


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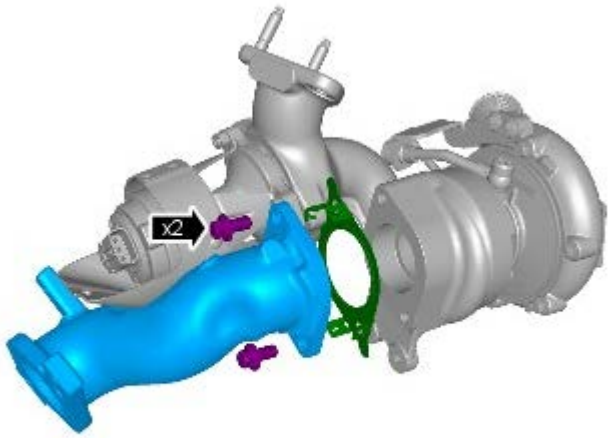


E132454

23.

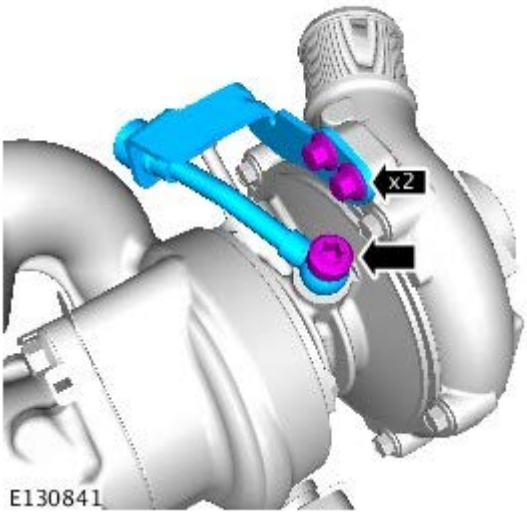

E132457

24. NOTE: Do not disassemble further if the component is removed for access only.



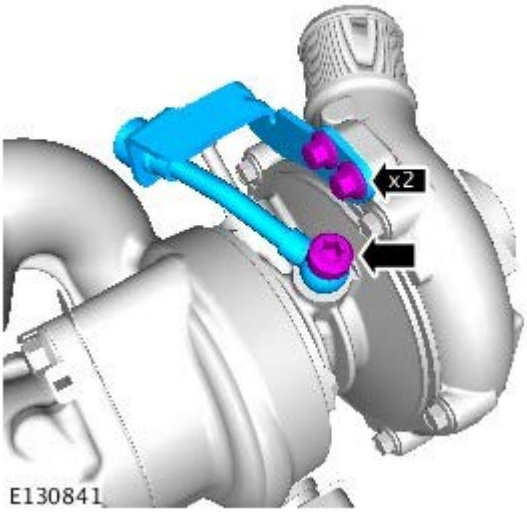
E130839

25. NOTE: Discard the component.



E130841

Installation

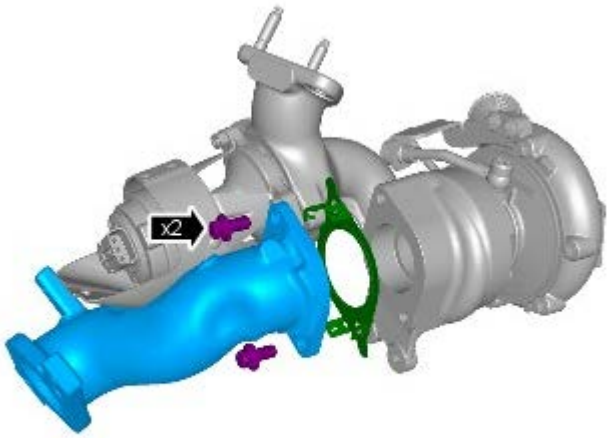


E130841

1. CAUTION: Make sure that a new component is installed.

   Torque:
   M6 7 Nm
   Union Bolt 24 Nm

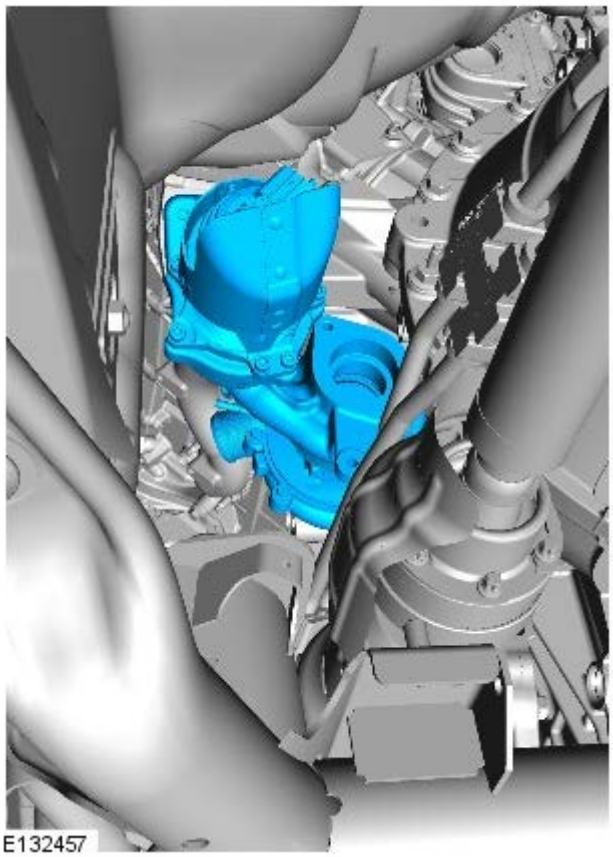
2. CAUTION: Make sure that the mating faces are clean and free of foreign material.



E130839

Torque: 33 Nm

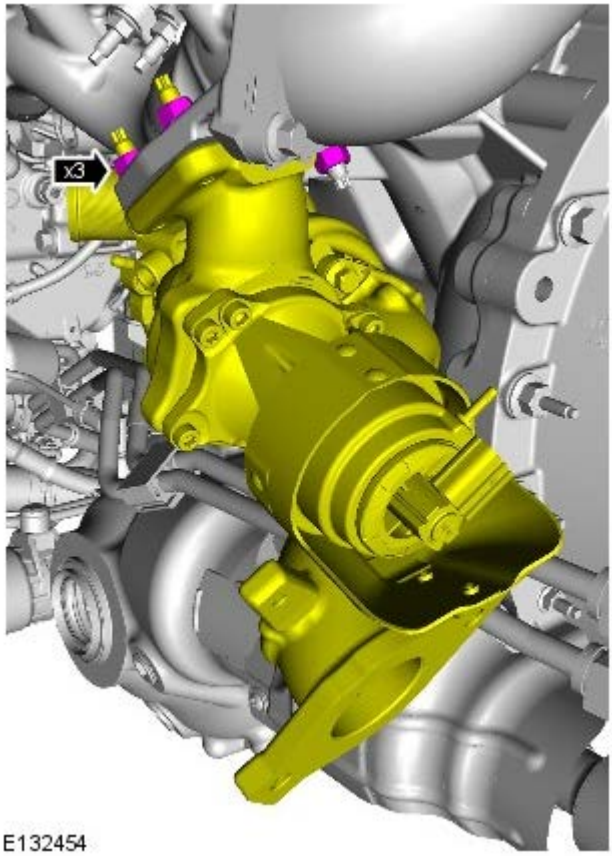
3.



E132457

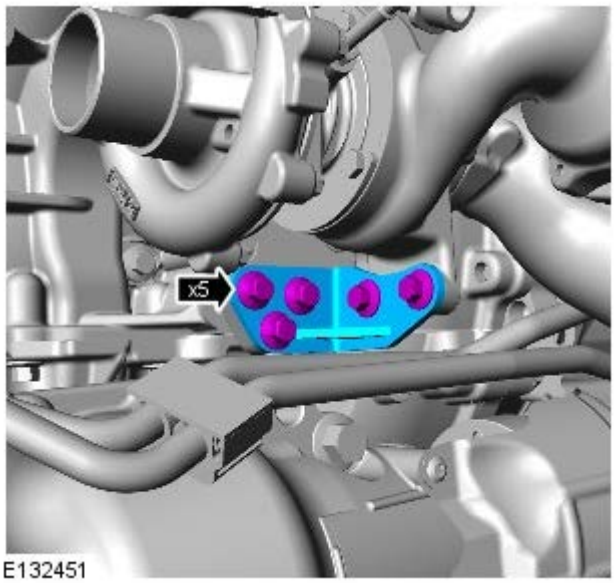
4. CAUTION: Make sure that the mating faces are clean and free of foreign material.

Torque: 23 Nm



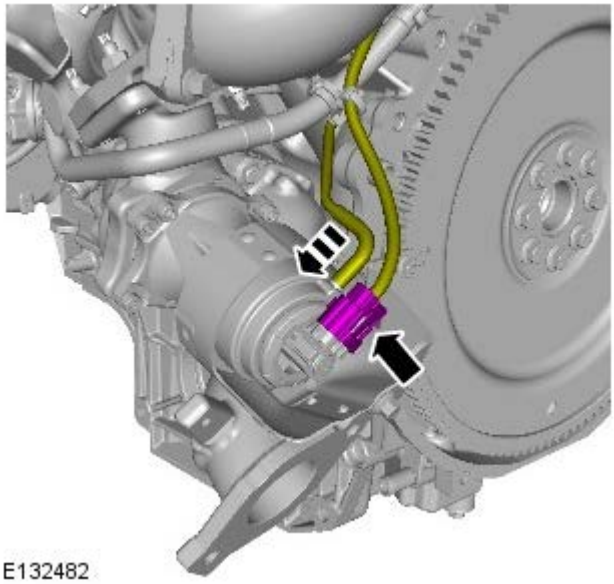
E132454

5. *Torque:* 23 Nm



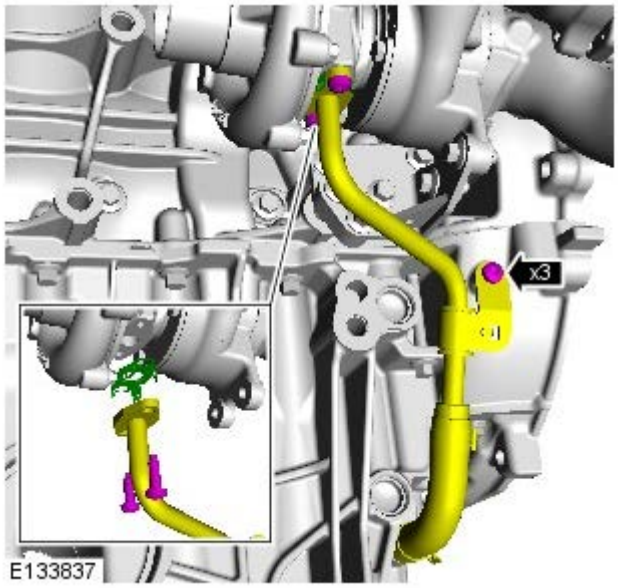
E132451

6.



E132482

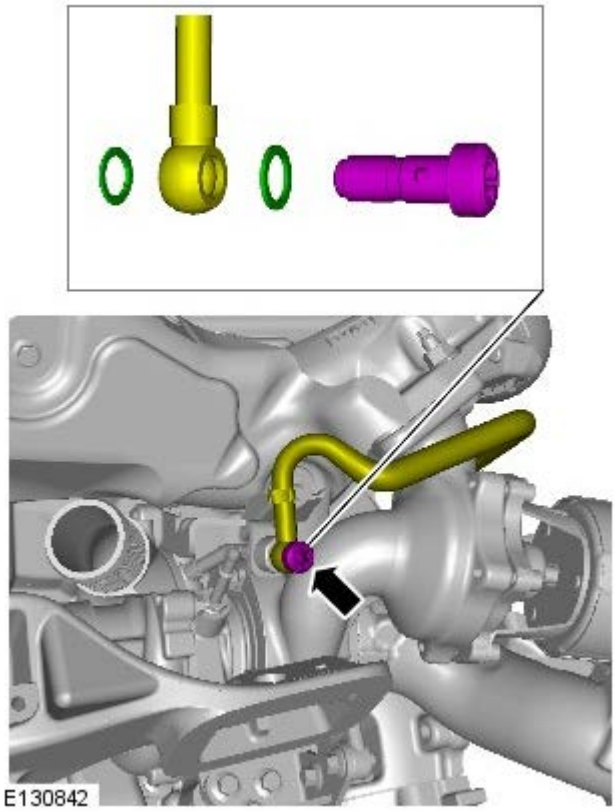
7. *Torque:* 10 Nm



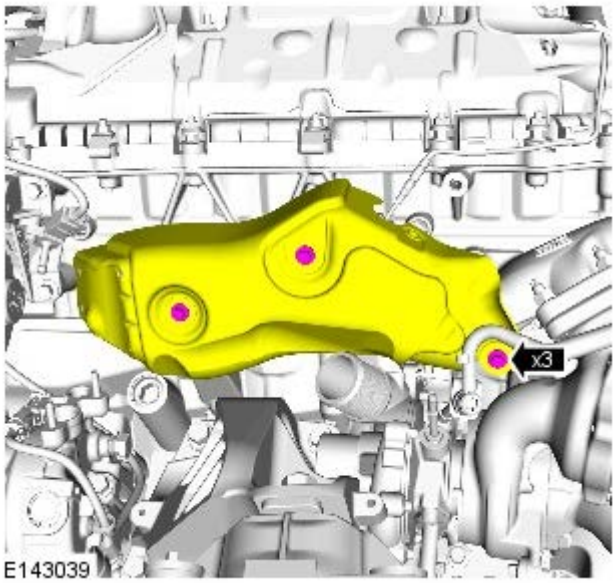
E133837

8. CAUTION: Make sure that new sealing washers are installed.

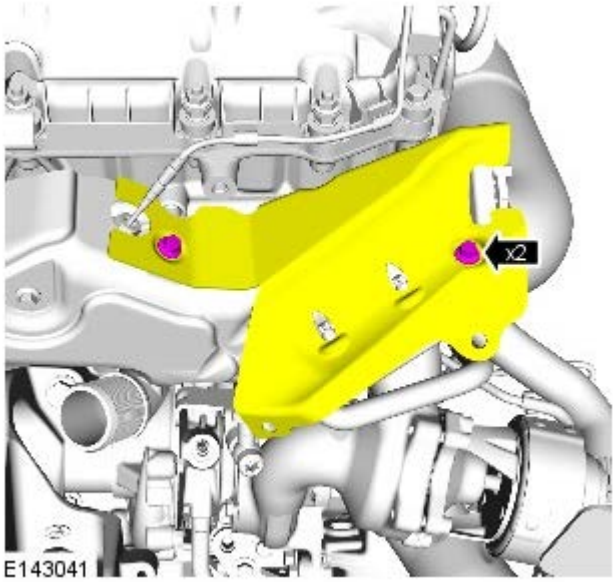
   Torque: 22 Nm



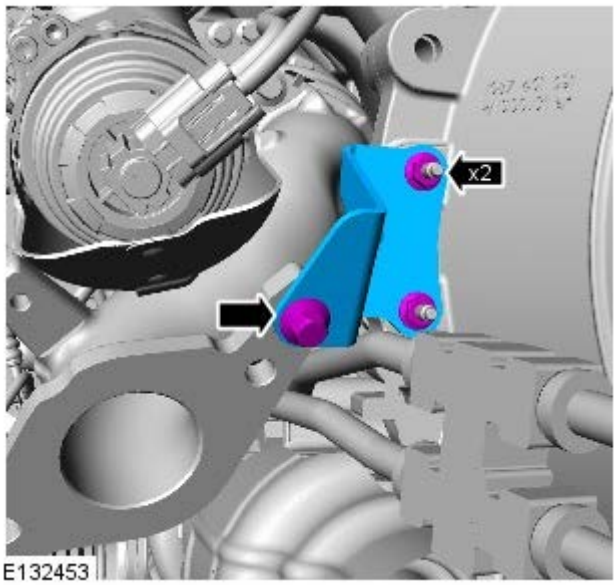
9. *Torque:* 9 Nm



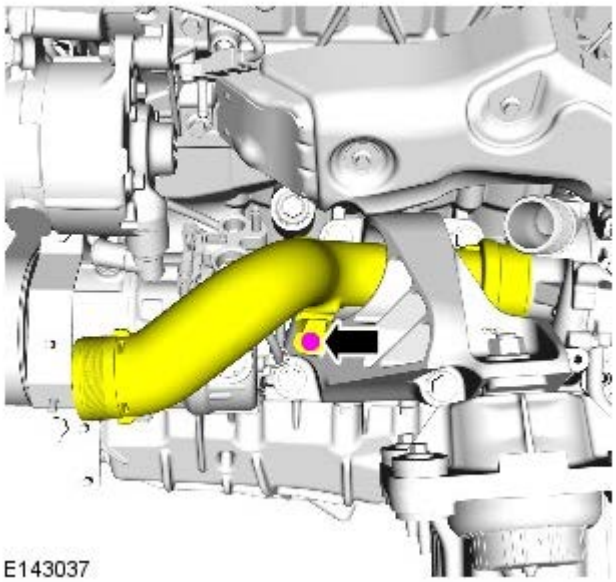
10. *Torque:* 9 Nm



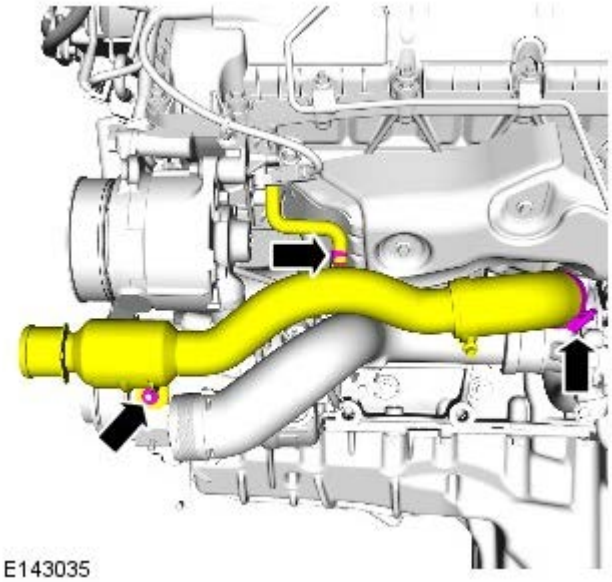
11. *Torque:*
    M8 20 Nm
    M6 10 Nm



12. *Torque:* 12 Nm

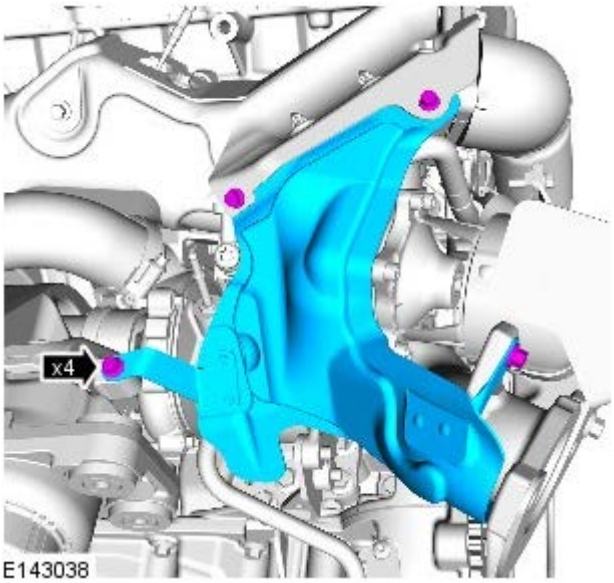


13. *Torque:* 10 Nm



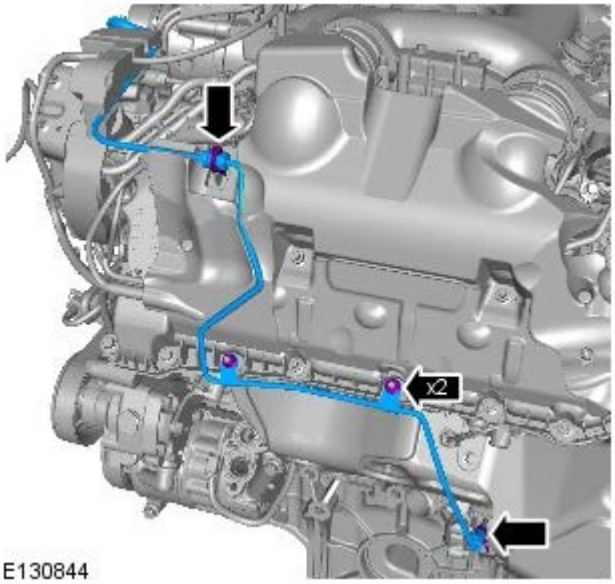
E143035

14. *Torque:* 9 Nm



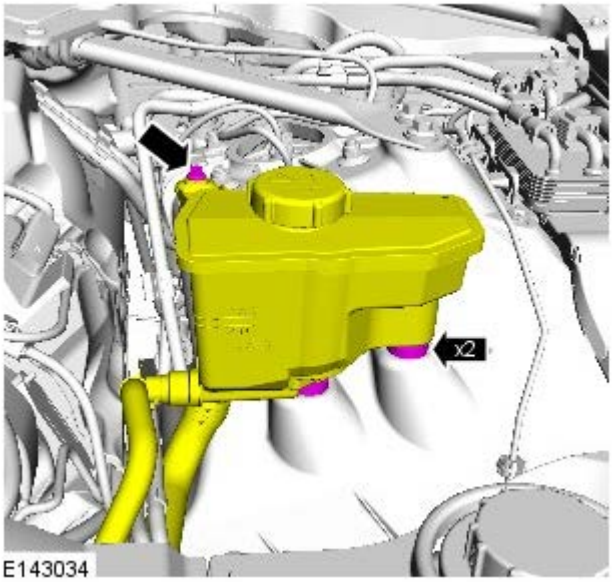
E143038

15. *Torque:* 9 Nm

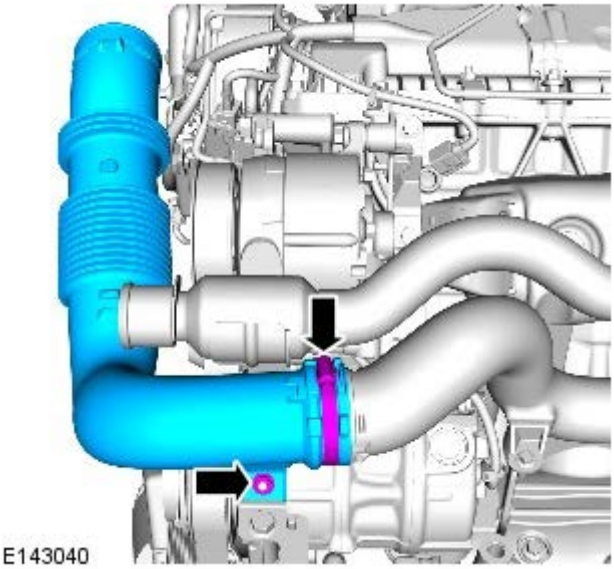


E130844

16. *Torque:* 9 Nm



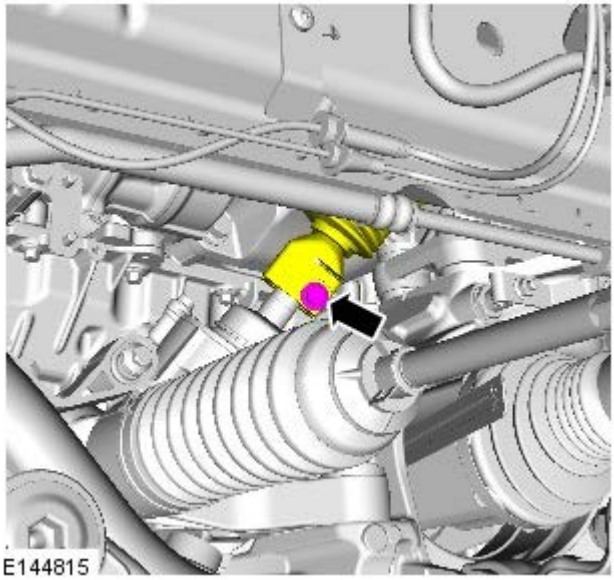
17. *Torque:*
    M6 12 Nm
    Clamp 3.5 Nm



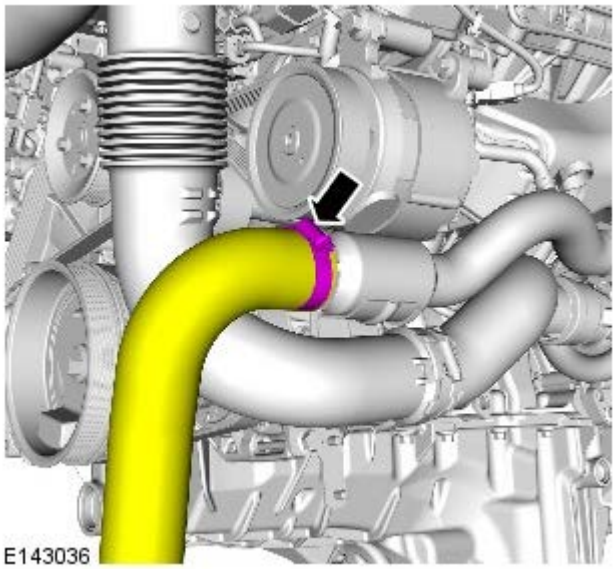
18. CAUTION: Make sure that a new bolt is installed.

    NOTE: Left hand drive only.

    Torque: 30 Nm



19. *Torque:* 3.5 Nm



20. Refer to: Exhaust System - Vehicles With: Diesel Particulate Filter (DPF) (309-00D Exhaust System - TDV8 4.4L Diesel, Removal and Installation).
    Refer to: Exhaust System - Vehicles Without: Diesel Particulate Filter (DPF) (309-00D Exhaust System - TDV8 4.4L Diesel, Removal and Installation).

21. Refer to: Fender Splash Shield (501-02 Front End Body Panels, Removal and Installation).

22. Refer to: Fuel Filter Element (310-01D Fuel Tank and Lines - TDV8 4.4L Diesel, Removal and Installation).

23. Refer to: Air Cleaner LH (303-12D Intake Air Distribution and Filtering - TDV8 4.4L Diesel, Removal and Installation).

24. Connect the battery ground cable.

    Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 28-Oct-2013

Fuel Charging and Controls - Turbocharger - TDV8 4.4L Diesel - Turbocharger RH

Removal and Installation

Removal

CAUTION: Make sure that all openings are sealed. Use new blanking caps.

NOTES:

Some variation in the illustrations may occur, but the essential information is always correct.

Removal steps in this procedure may contain installation details.

Engine shown removed for clarity.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

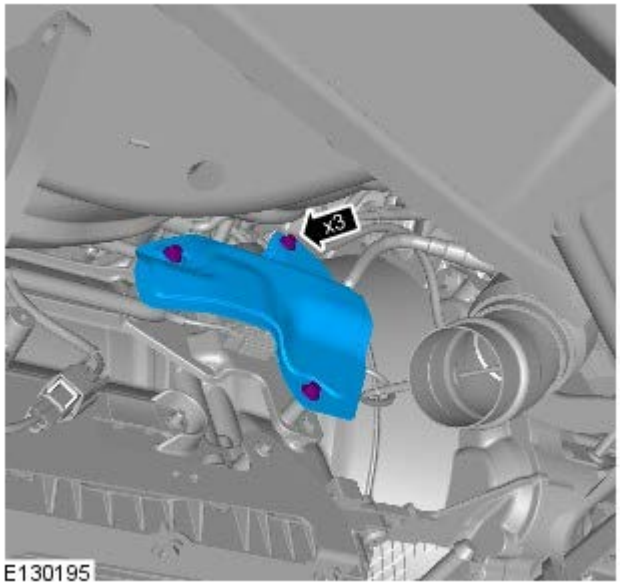
2. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

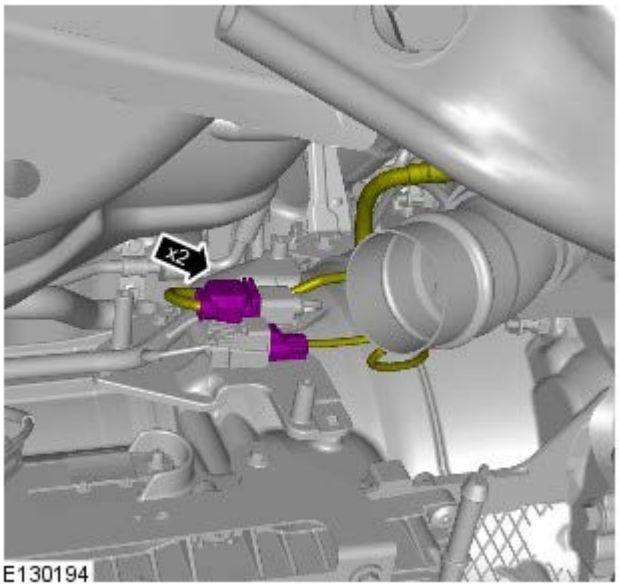
3. Refer to: Generator (414-02D Generator and Regulator - TDV8 4.4L Diesel, Removal and Installation).

4. Refer to: Exhaust System - Vehicles With: Diesel Particulate Filter (DPF) (309-00D Exhaust System - TDV8 4.4L Diesel, Removal and Installation).
   Refer to: Exhaust System - Vehicles Without: Diesel Particulate Filter (DPF) (309-00D Exhaust System - TDV8 4.4L Diesel, Removal and Installation).

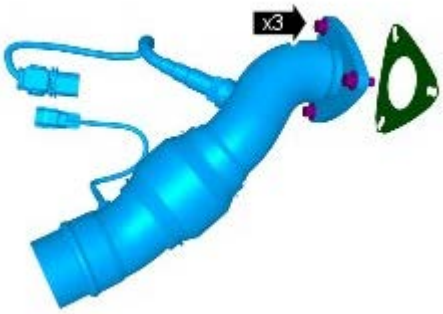
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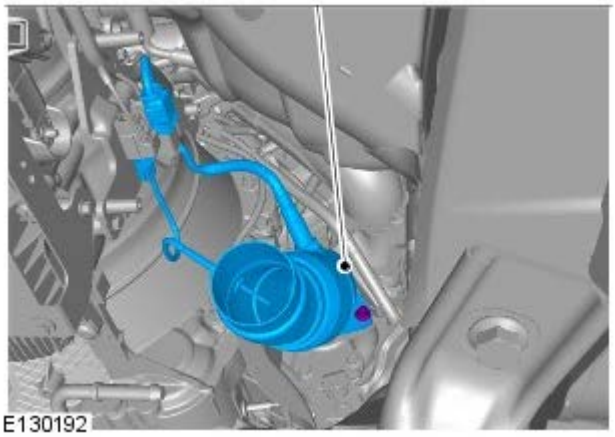


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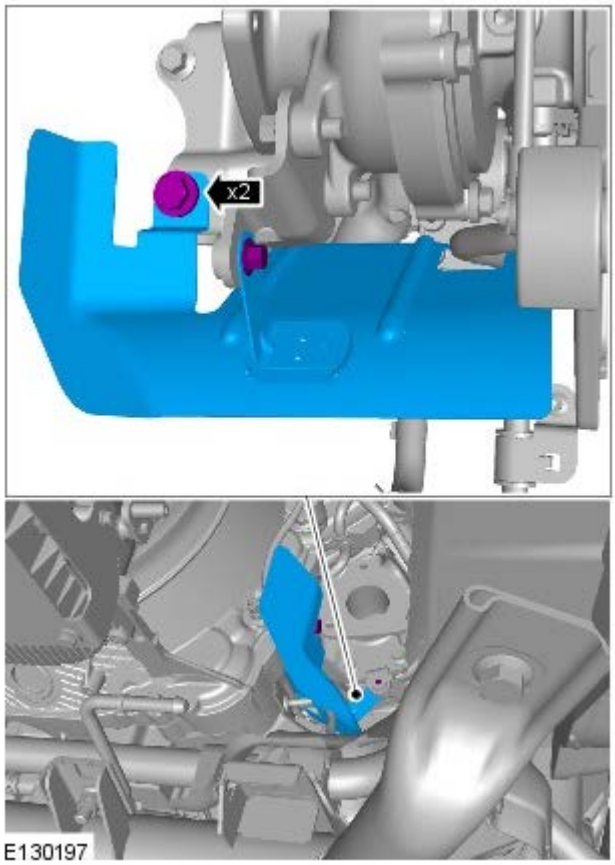


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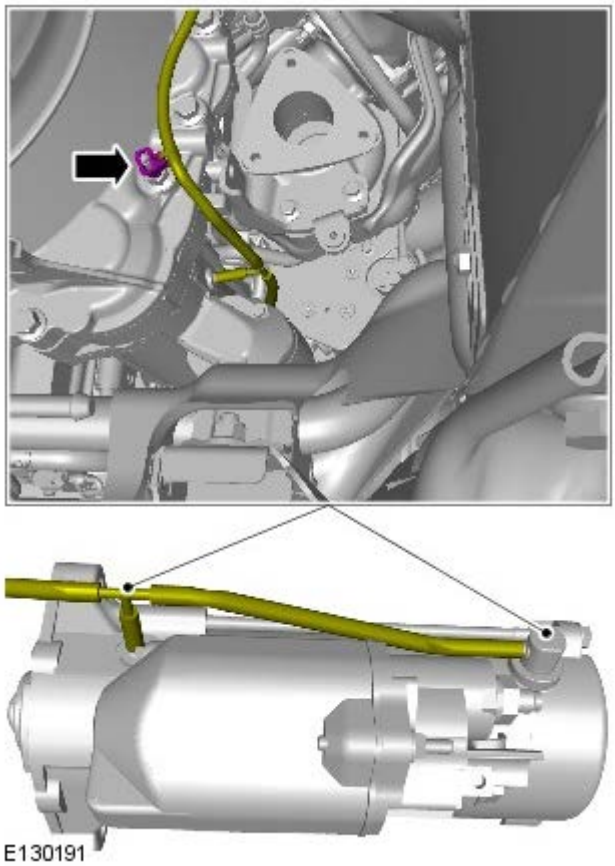




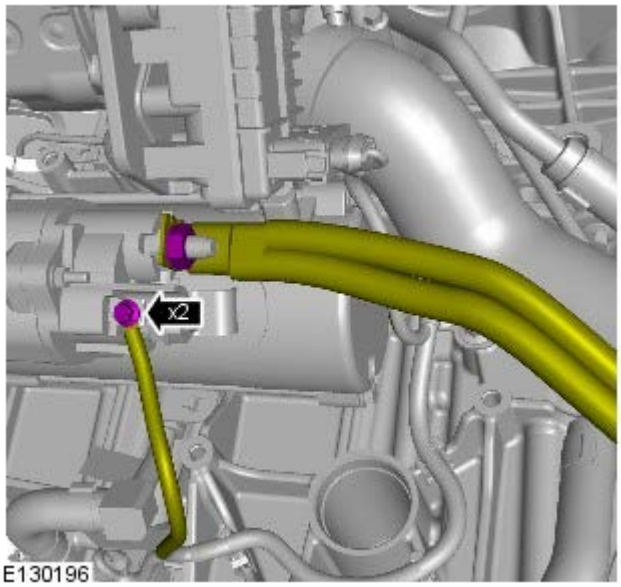
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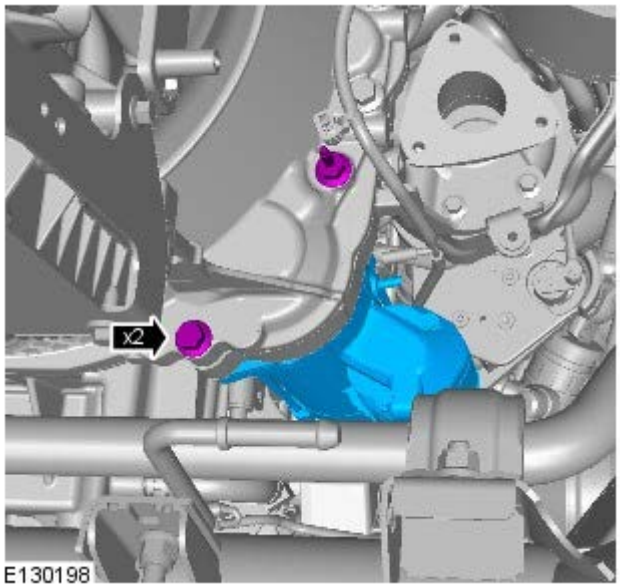
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10.



11.

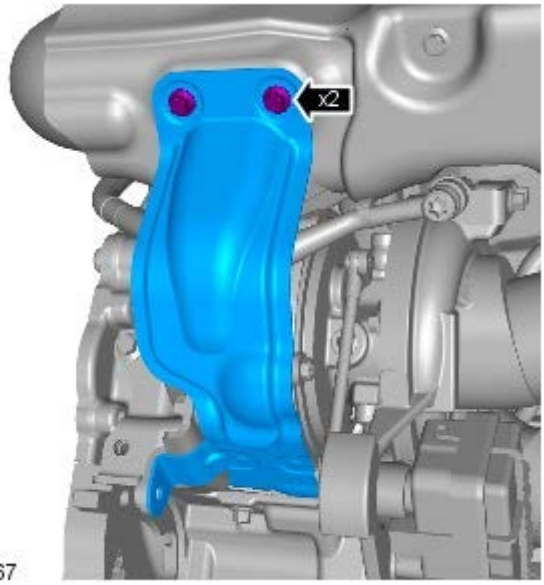


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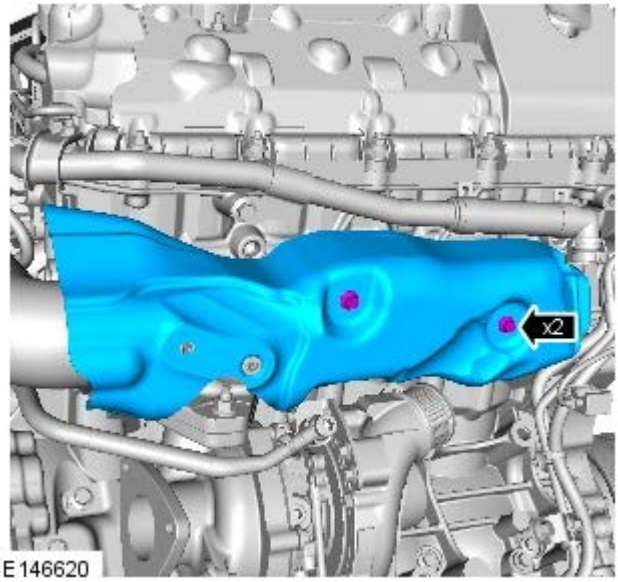
E146622

13.



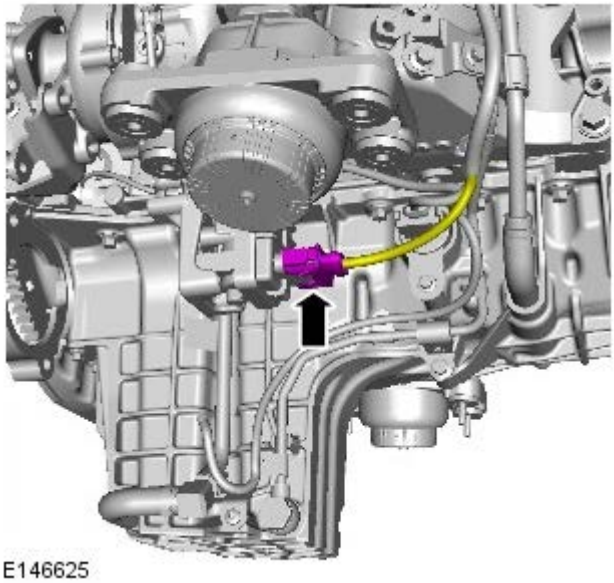
E130867

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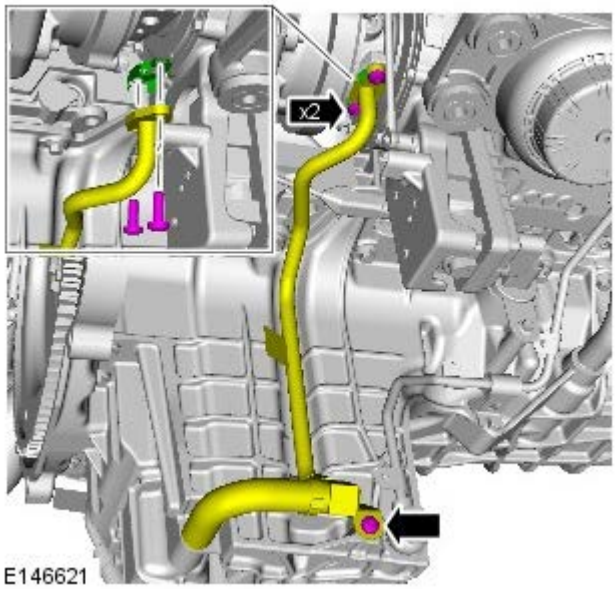


E146620

15.


E146625

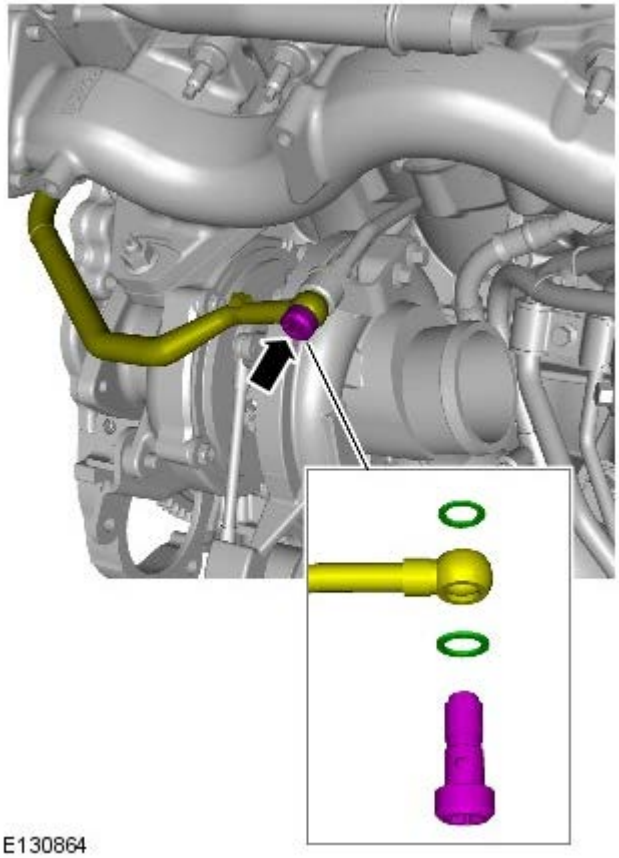
16. CAUTION: Be prepared to collect escaping oil.



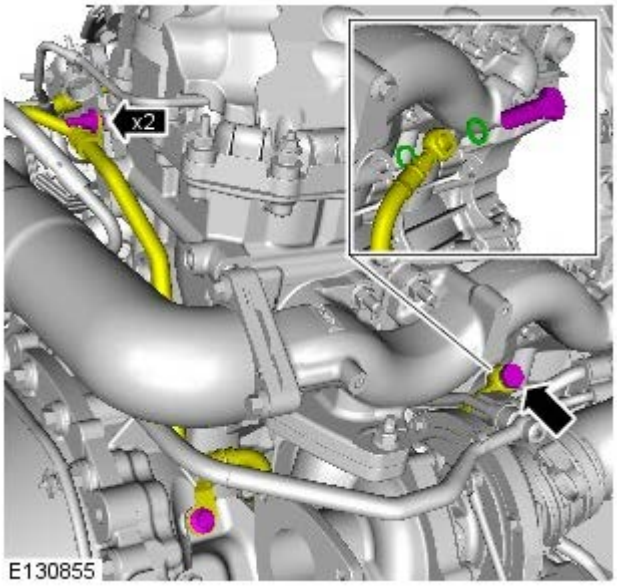
E146621

17. CAUTION: Be prepared to collect escaping oil.

NOTE: Discard the sealing washers.



E130864

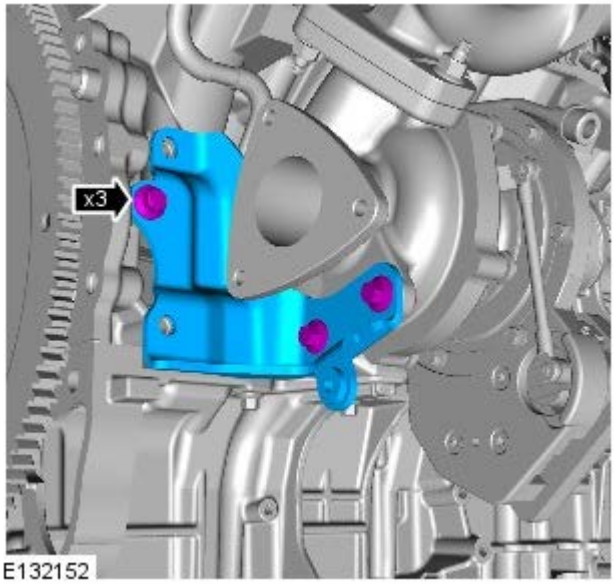


E130855

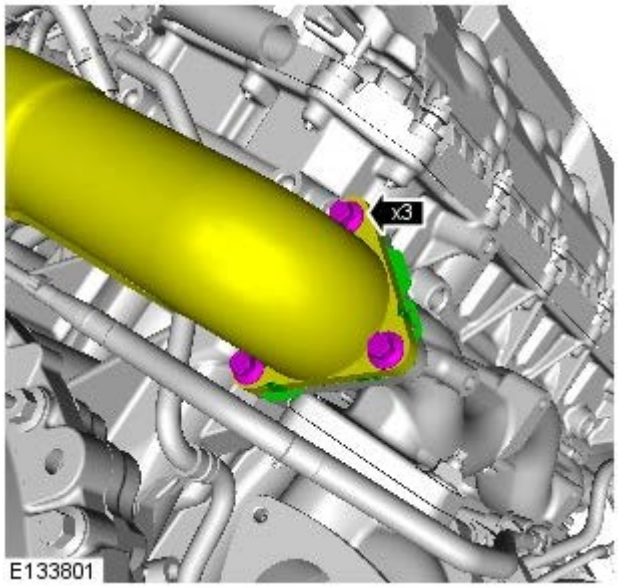
18. CAUTION: Be prepared to collect escaping coolant.

NOTE: Discard the sealing washers.

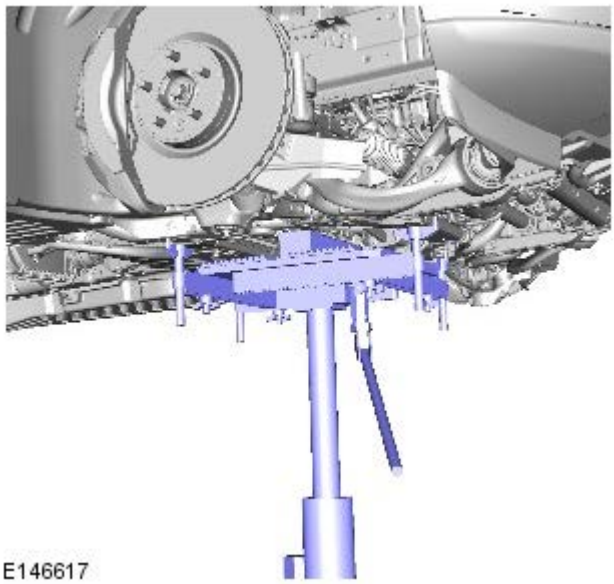
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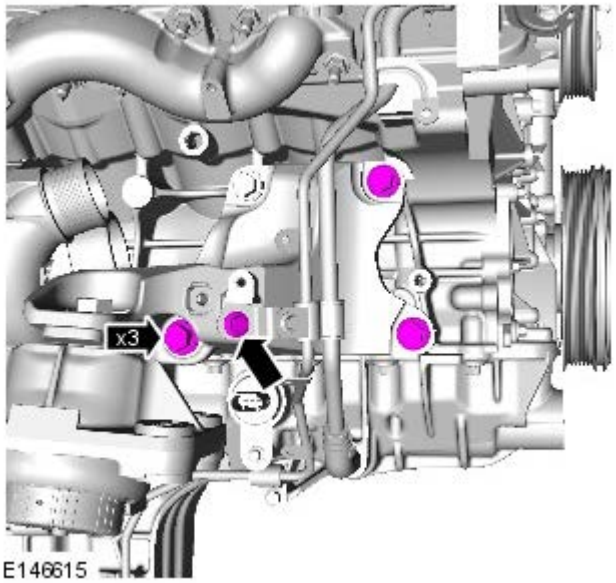
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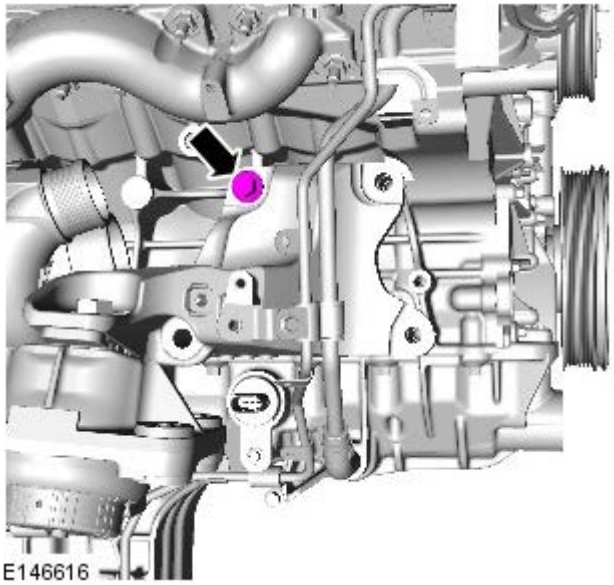


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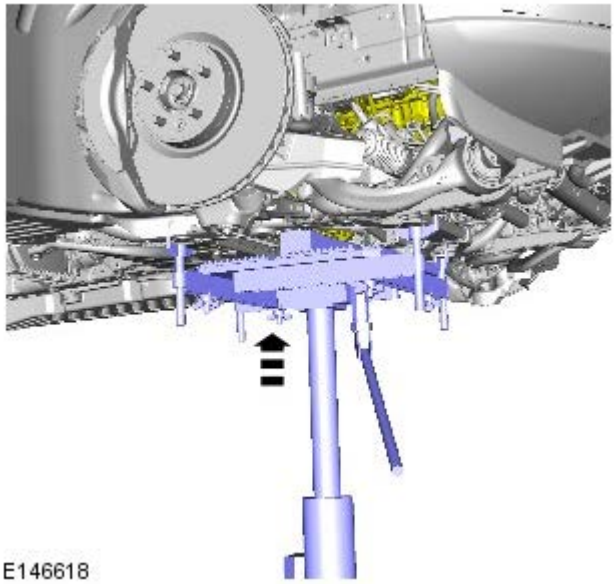


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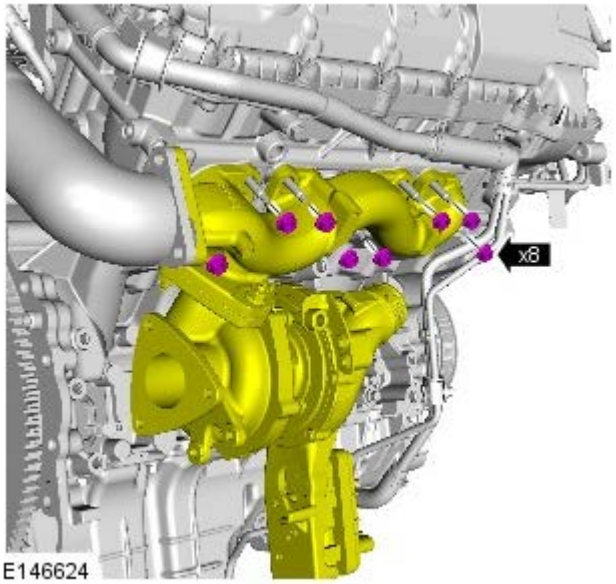
23. NOTE: Loosen the bolt, but do not fully remove.


E146616

24.

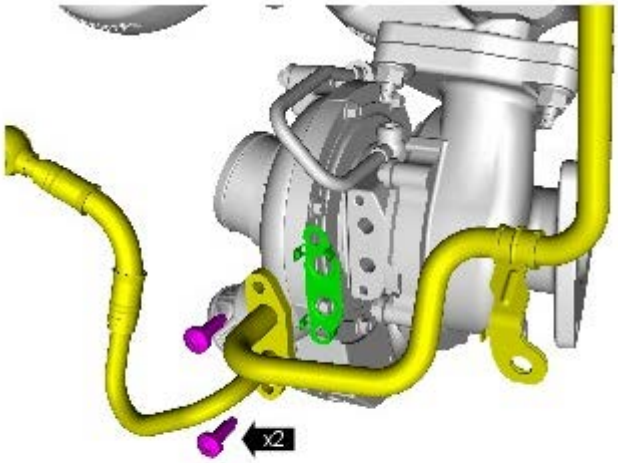

E146618

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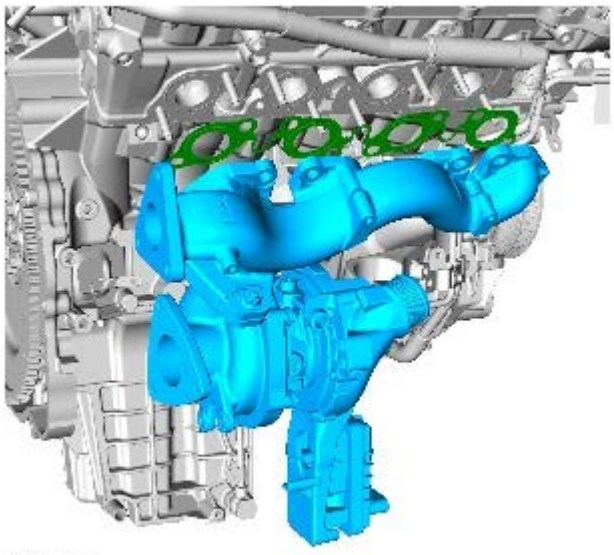
E146624

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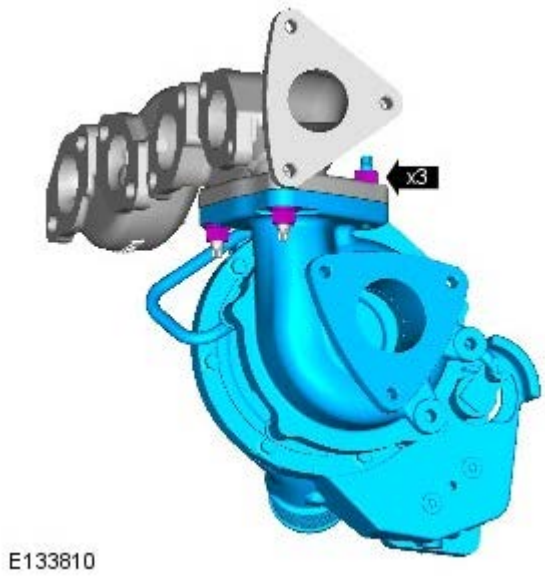


E133807

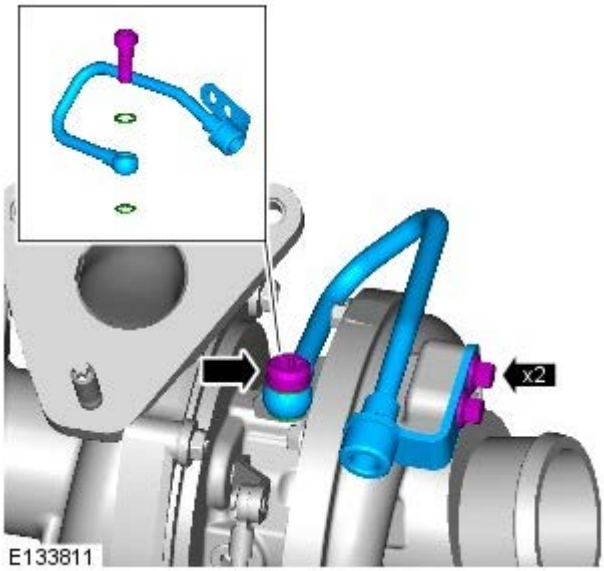
27.


E146626

28.



E133810



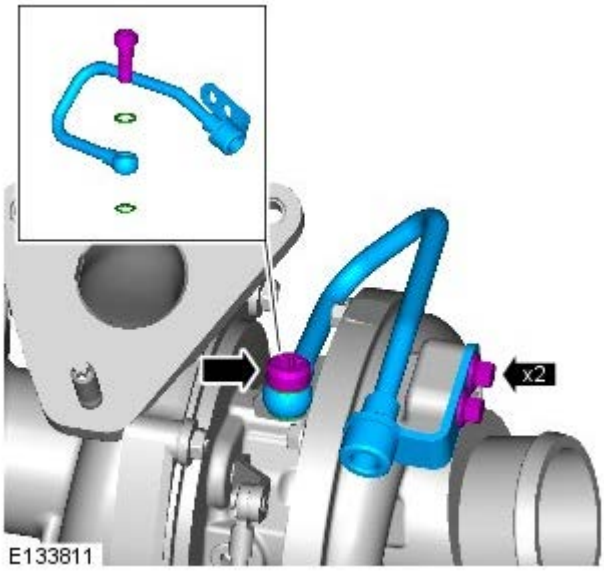
E133811

29. NOTES:

    Do not disassemble further if the component is removed for access only.

    Discard the sealing washers.

Installation

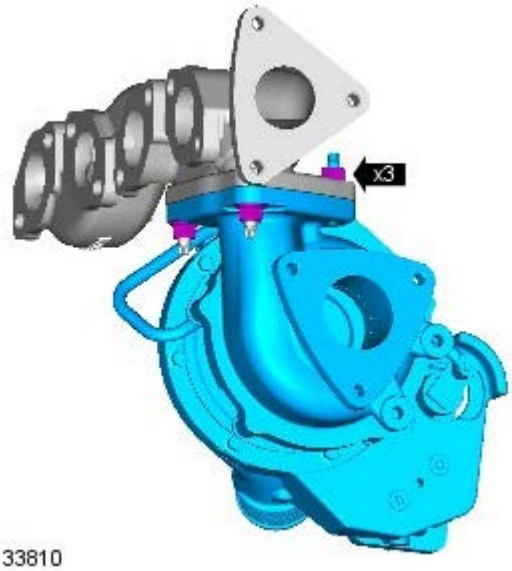


E133811

1. CAUTION: Make sure that new sealing washers are installed.

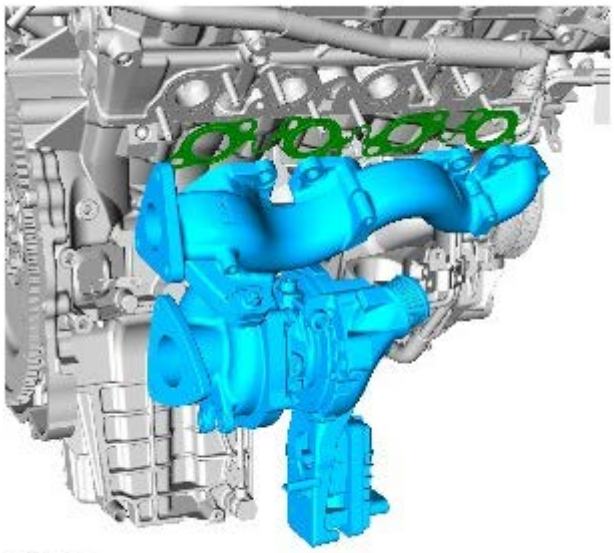
   Torque:
   M6 7 Nm
   Union Bolt 24 Nm

2. *Torque:* 23 Nm



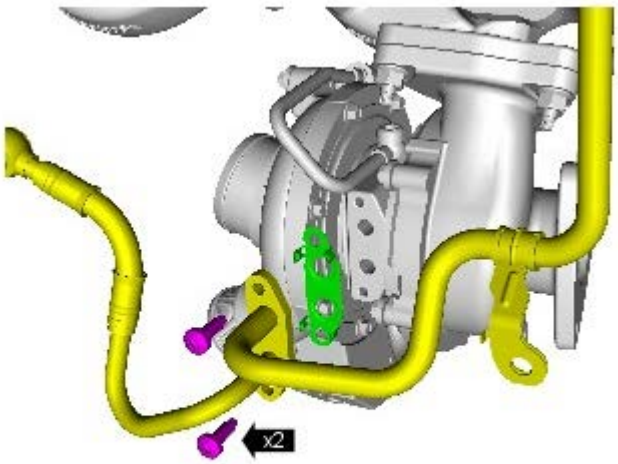
E133810

3.



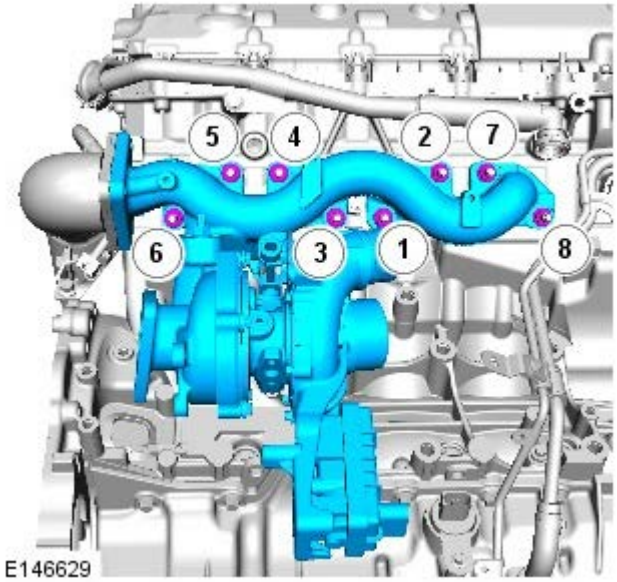
E146626

4. *Torque:* 10 Nm

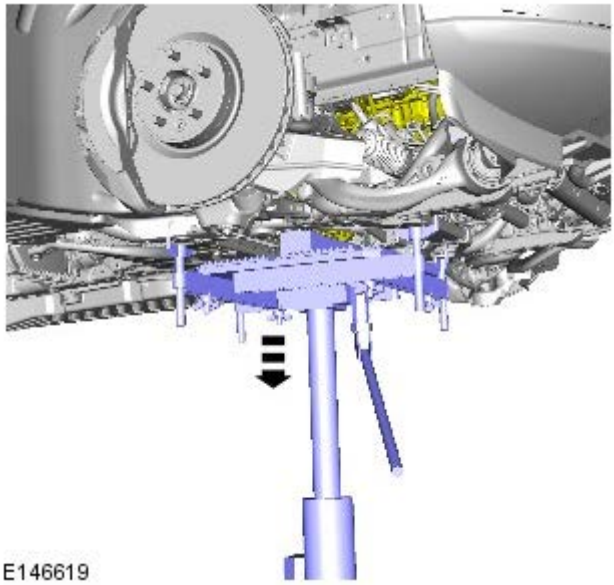


E133807

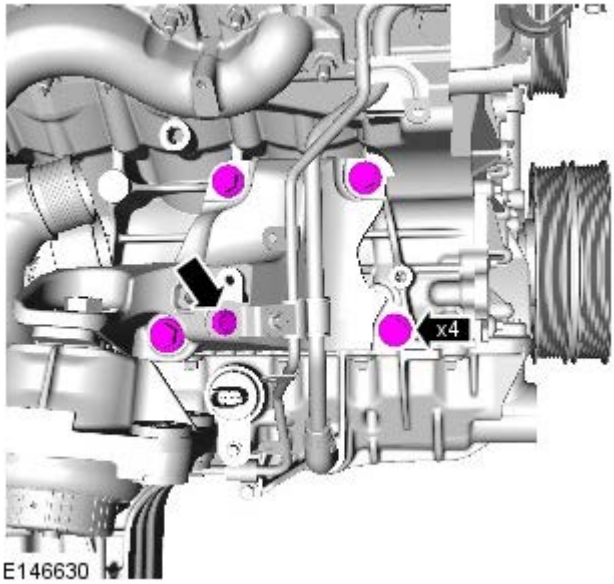
5. *Torque:* 24 Nm



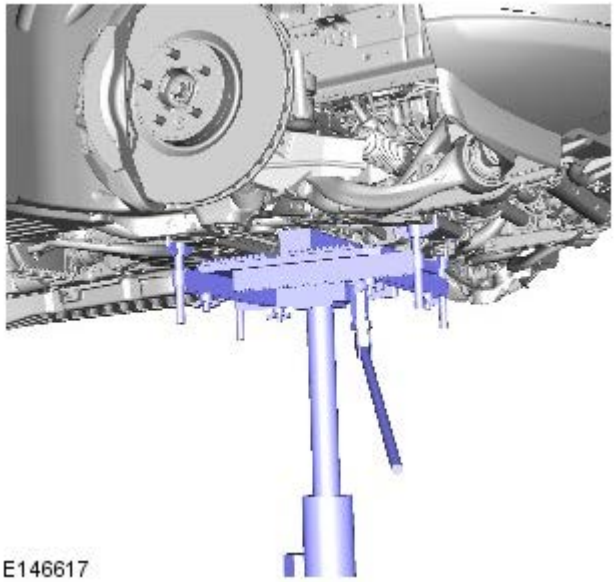
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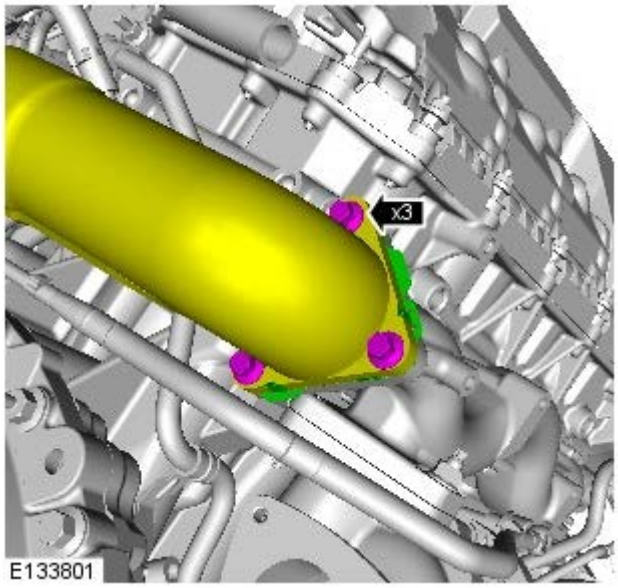
7. *Torque:*
   M12 bolts 115 Nm
   M8 bolt 25 Nm



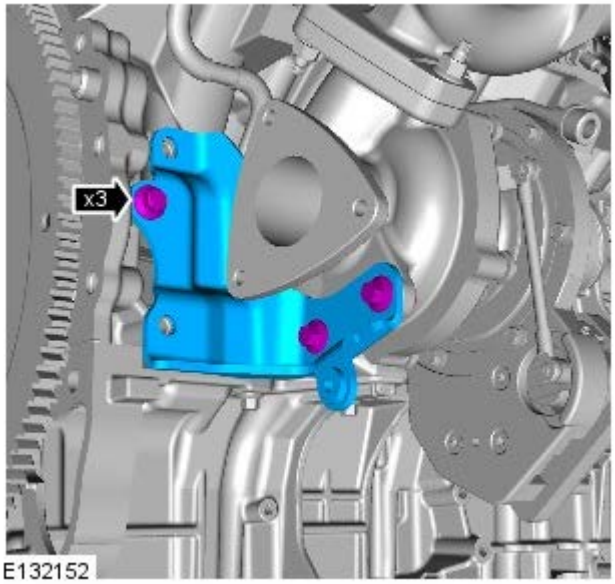
8.



9. *Torque:* 23 Nm

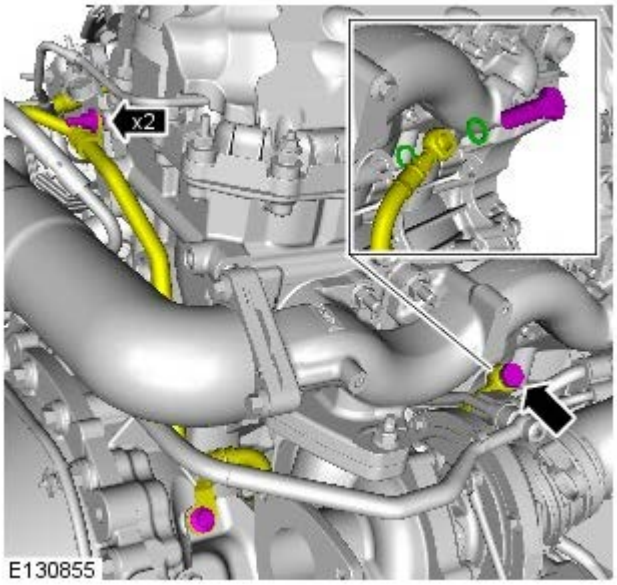


10. *Torque:* 23 Nm

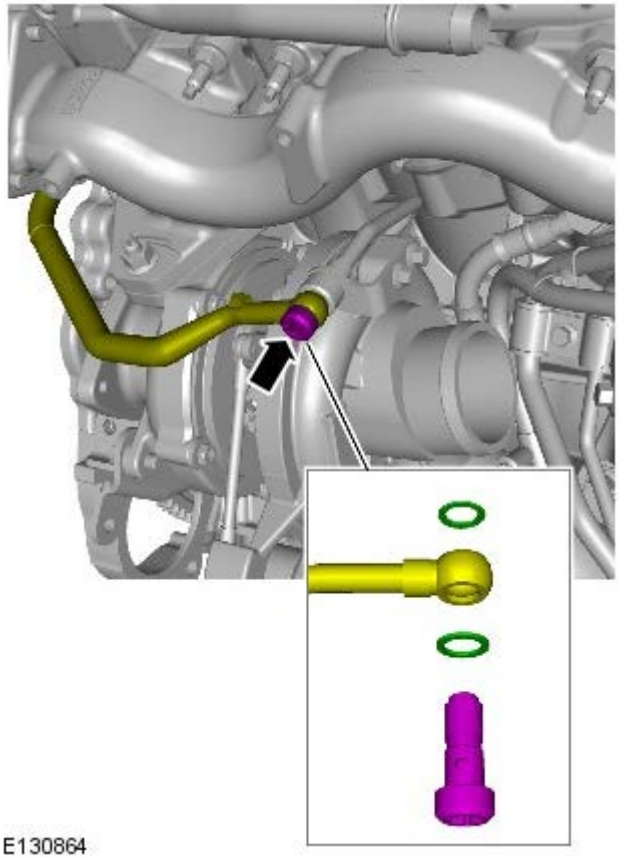


11. CAUTION: Make sure that new sealing washers are installed.

Torque:
M8 Bolt 23 Nm
Union Bolt 24 Nm



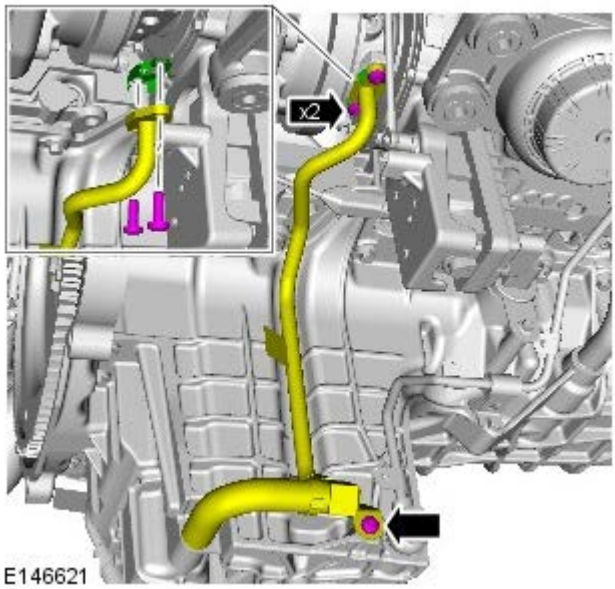
Nut 10 Nm



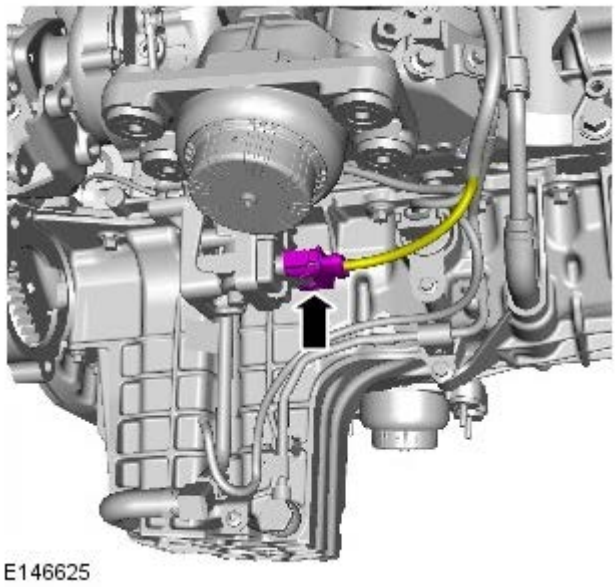
12. CAUTION: Make sure that new sealing washers are installed.

Torque: 22 Nm

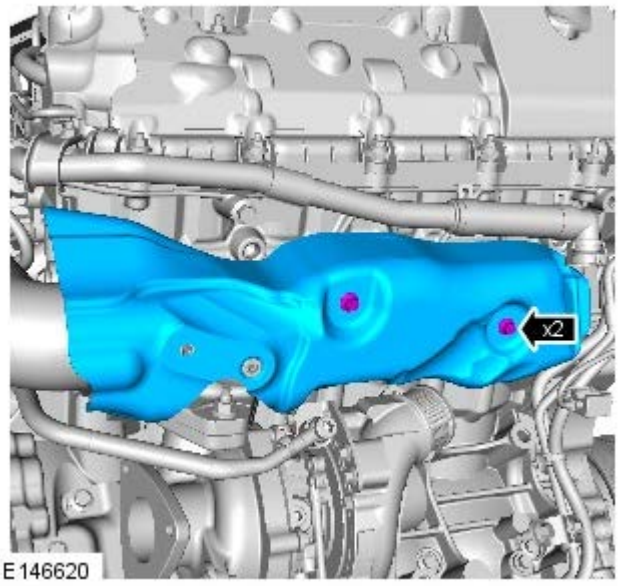
13. *Torque:* 10 Nm



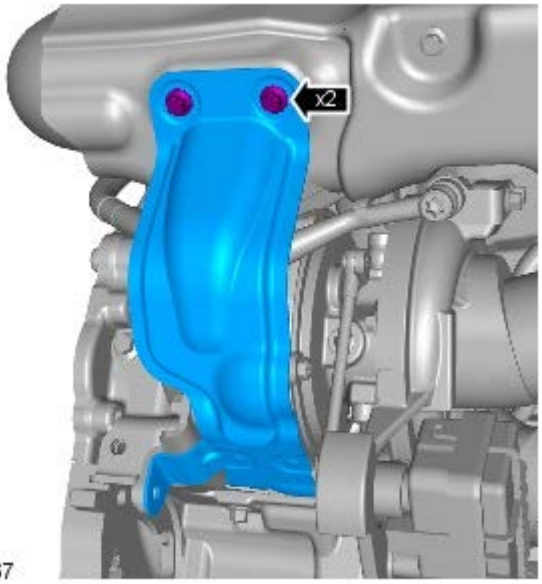
14.



15. *Torque:* 9 Nm



16. *Torque:* 9 Nm



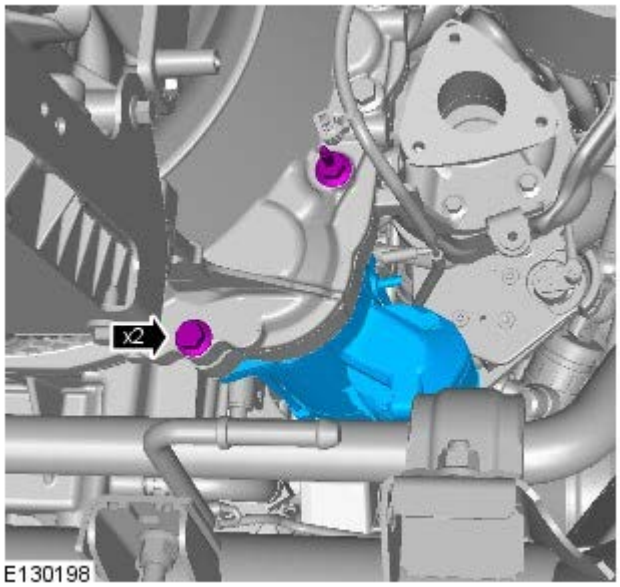
E130867

17.

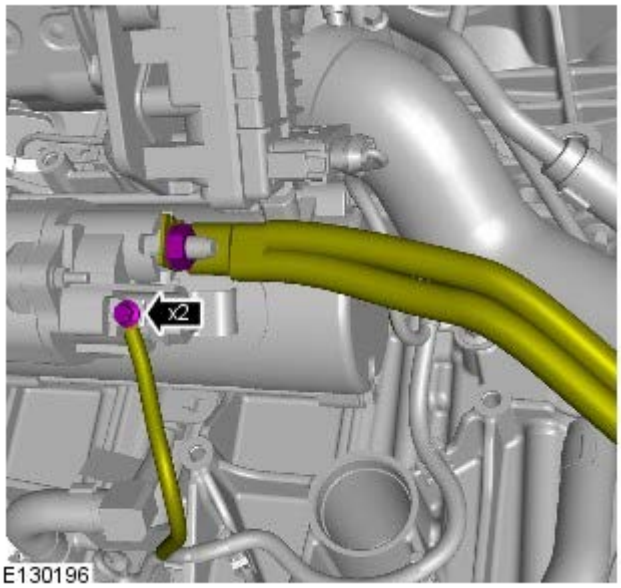


E146622

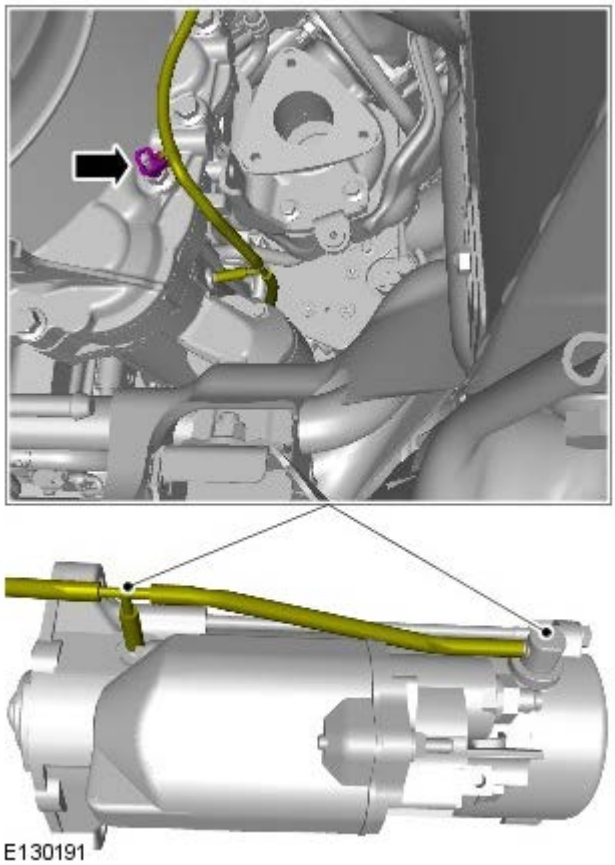
18. *Torque:* 45 Nm



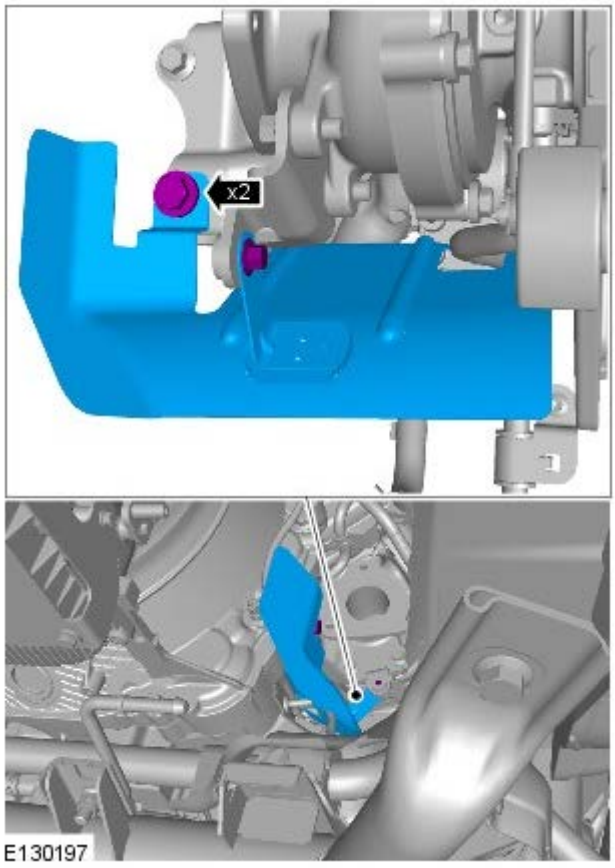
19. *Torque:*
    M8 nut 22 Nm
    M6 bolt 4 Nm



20.

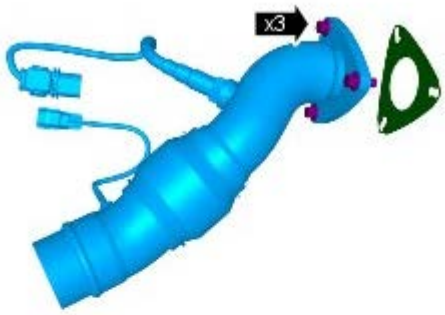


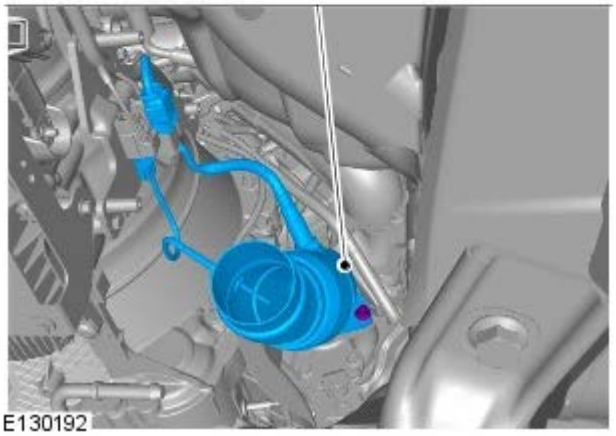
21. *Torque:* 10 Nm



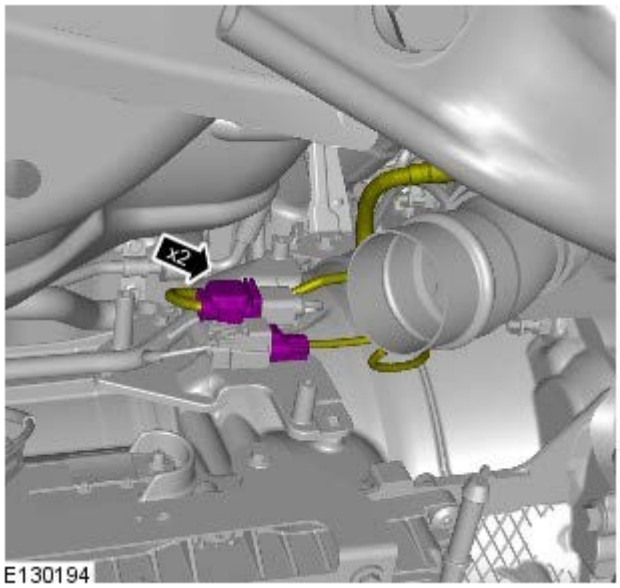
22. NOTE: Install a new gasket.

Torque: 21 Nm



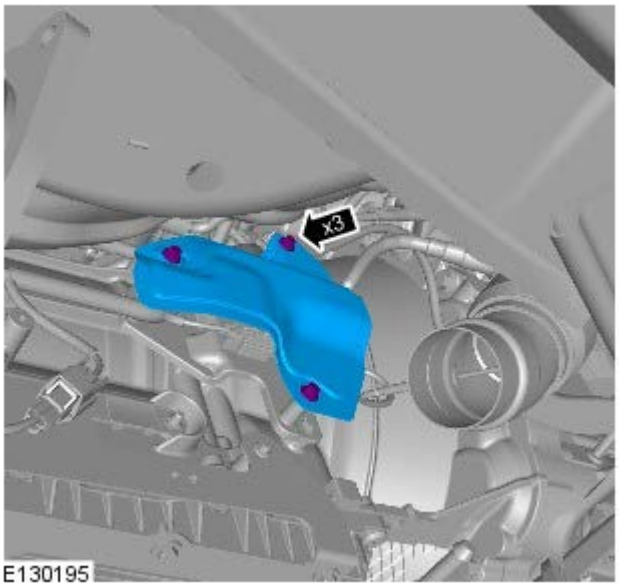

E130192

23.



E130194

24. *Torque:* 10 Nm



25. Refer to: Exhaust System - Vehicles With: Diesel Particulate Filter (DPF) (309-00D Exhaust System - TDV8 4.4L Diesel, Removal and Installation).
    Refer to: Exhaust System - Vehicles Without: Diesel Particulate Filter (DPF) (309-00D Exhaust System - TDV8 4.4L Diesel, Removal and Installation).

26. Refer to: Generator (414-02D Generator and Regulator - TDV8 4.4L Diesel, Removal and Installation).

27. Connect the battery ground cable.

    Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 31-Jul-2012

Accessory Drive - TDV6 3.0L Diesel -

Torque Specification

NOTE: **A = refer to procedure for correct torque sequence**

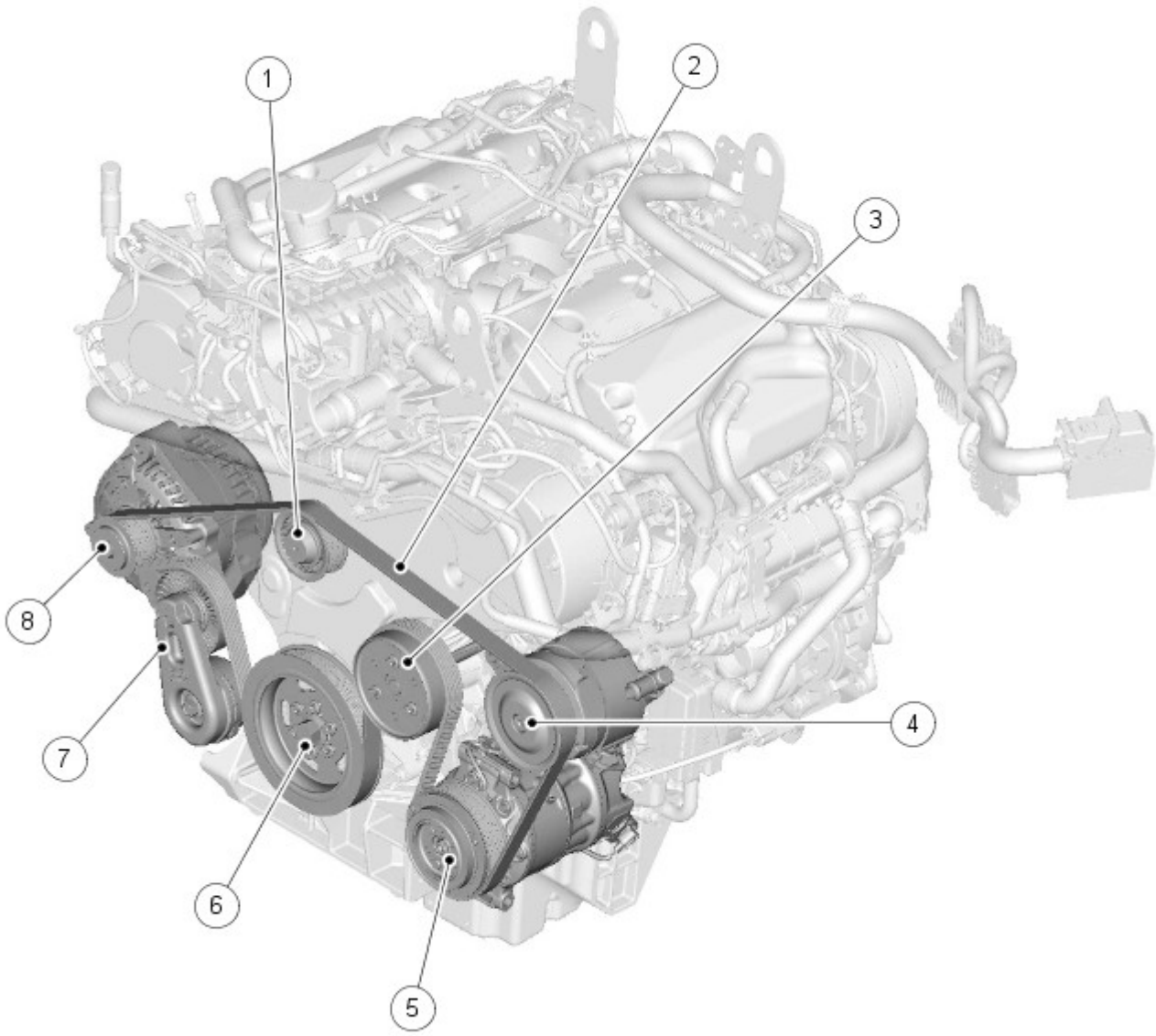
Description	Nm	lb-ft
Accessory drive belt tensioner retaining bolt	48	35
Accessory drive belt idler pulley retaining bolt	48	35
Fuel injection pump sprocket retaining nut	**A**	-
Camshaft rear hub bolt	Stage 1 - 80 Stage 2 - 80 degrees	Stage 1 - 59 Stage 2 - 80 degrees
Camshaft rear pulley retaining bolts	23	17
Rear end accessory drive belt (READ) belt tensioner retaining bolt	23	17

Published: 02-May-2013

Accessory Drive - TDV6 3.0L Diesel - Accessory Drive

Description and Operation

COMPONENT LOCATION



E152895

Item	Part Number	Description
1	-	Idler pulley
2	-	Accessory drive belt
3	-	Coolant pump
4	-	Dynamic response hydraulic pump
5	-	Air conditioning compressor
6	-	Crankshaft pulley/torsional vibrtation damper
7	-	Belt tensioner
8	-	Generator

OVERVIEW

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 a single drive belt. An automatic belt tensioner maintains the drive belt at the correct tension. Together with the idler pulley, the belt tensioner also guides the drive belt clear of obstructions and sets the correct 'wrap-around' of the accessory component drive pulleys to ensure a slip-free drive.

The drive belt is a six-ribbed poly-V belt that drives the:

- Coolant pump.
- A/C (Air Conditioning) compressor.
- Generator.
- Dynamic response hydraulic pump

The belt tensioner consists of an idler pulley on the end of a spring loaded pivot arm. The pivot arm can be turned manually for removal and installation of the drive belt. The belt tensioner is calibrated to automatically maintain the correct tension in the drive belt.

Published: 15-Aug-2012

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:

Accessory Drive (303-05A Accessory Drive - TDV6 3.0L Diesel, Description and Operation),
Accessory Drive (303-05 Accessory Drive - TDV6 3.0L Diesel, Description and Operation),
Accessory Drive (303-05 Accessory Drive - 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 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: 09-Aug-2012

Accessory Drive - TDV6 3.0L Diesel - Accessory Drive Belt Vehicles Without: Dynamic Suspension

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

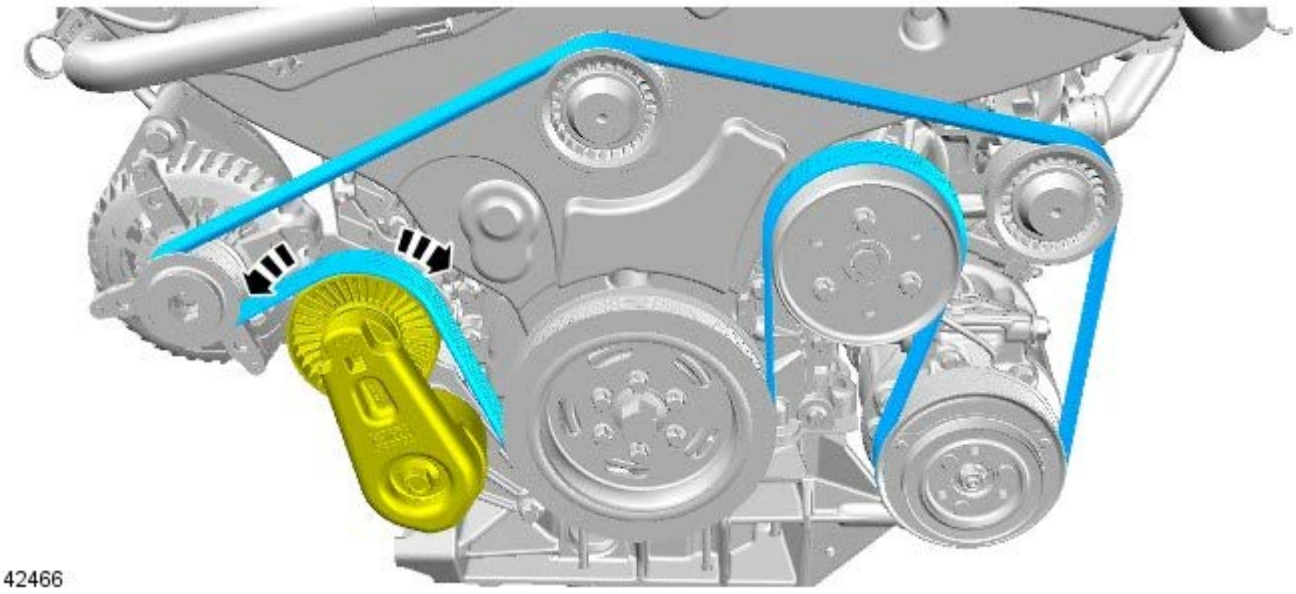
   Refer to: Specifications (414-00, Specifications).

2. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05, Removal and Installation).

3. NOTES:

   Note the fitted position of the accessory drive belt.

   Engine shown removed for clarity.



E142466

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: 15-May-2013

Accessory Drive - TDV6 3.0L Diesel - Accessory Drive Belt Vehicles With: Dynamic Suspension

Removal and Installation

Removal

CAUTION: Dynamic Response system components are manufactured to very precise tolerances. 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 dynamic response system.

NOTES:

Removal steps in this procedure may contain installation details.

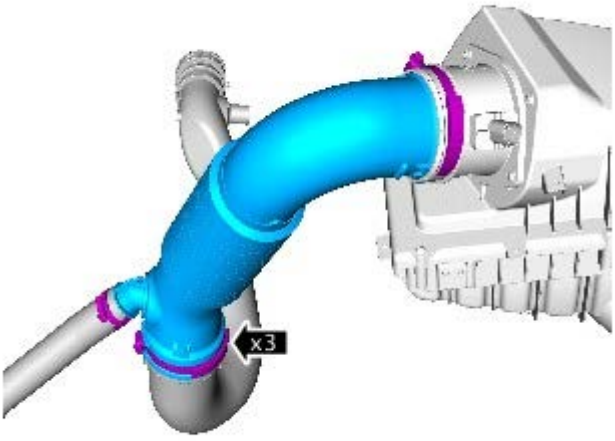
Some components shown removed for clarity.

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

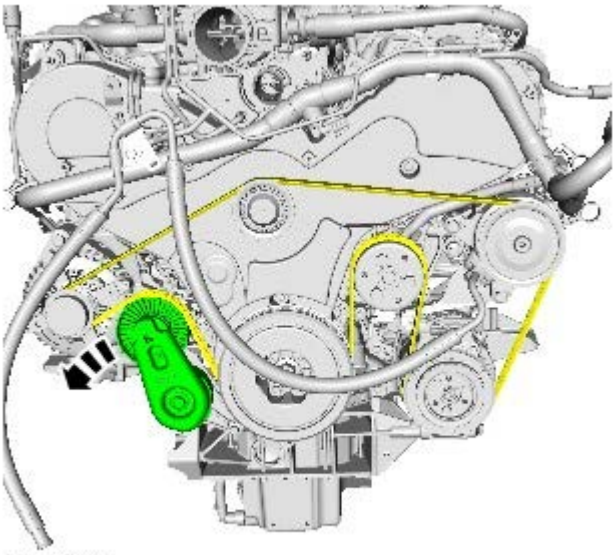
2. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05 Interior Trim and Ornamentation, Removal and Installation).

3.



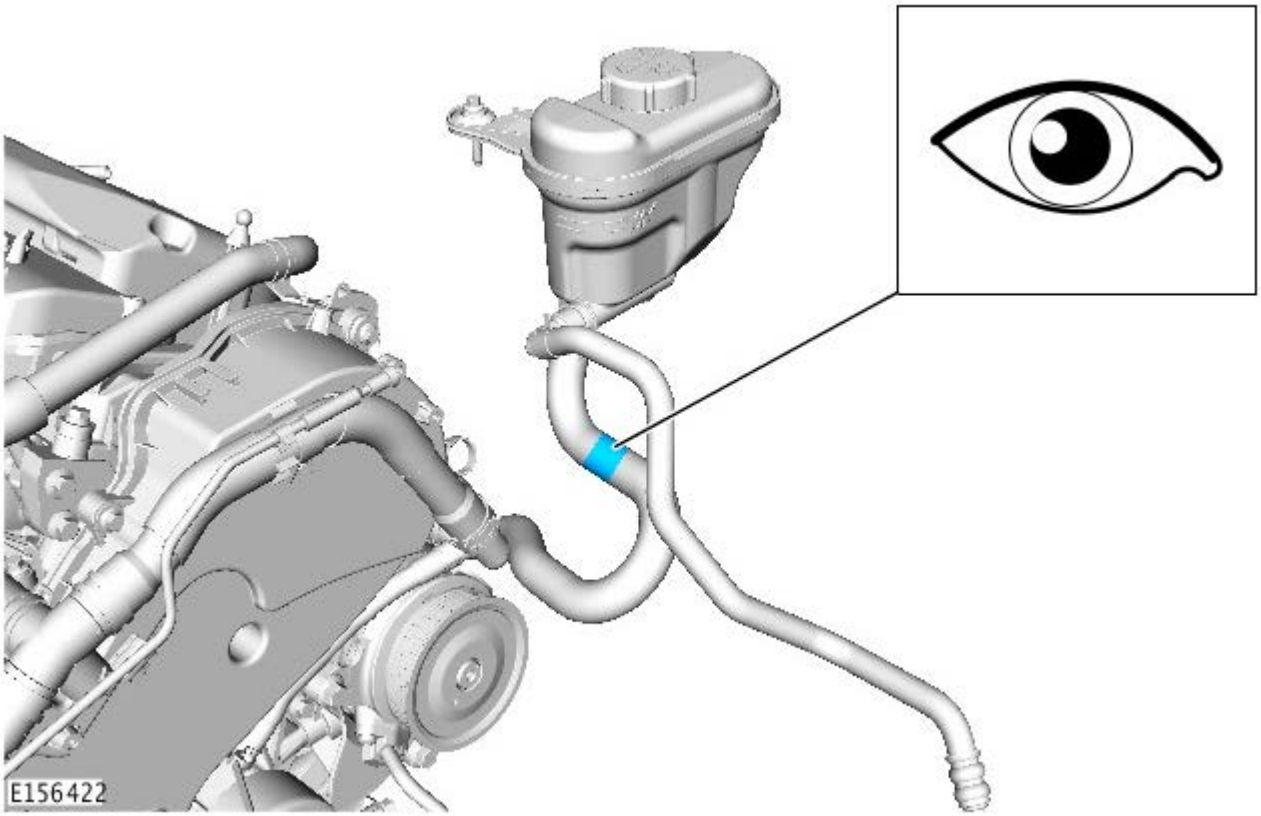
E156586

4.

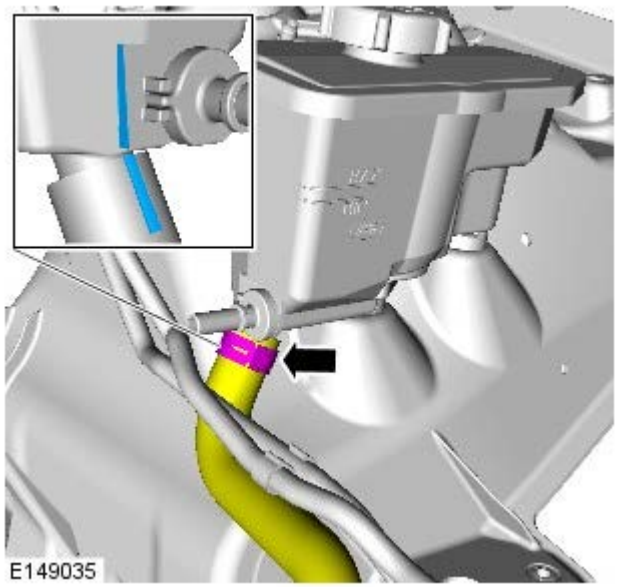


E156818

5. Clamp the suction pipe in the area shown.



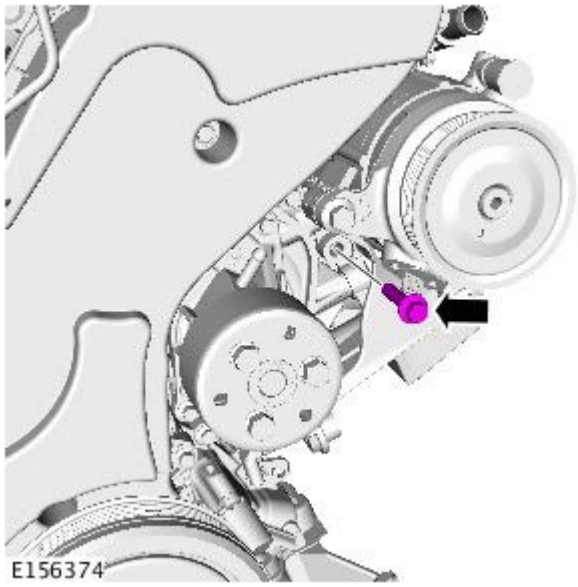
6. Using a suitable suction device drain the fluid reservoir.



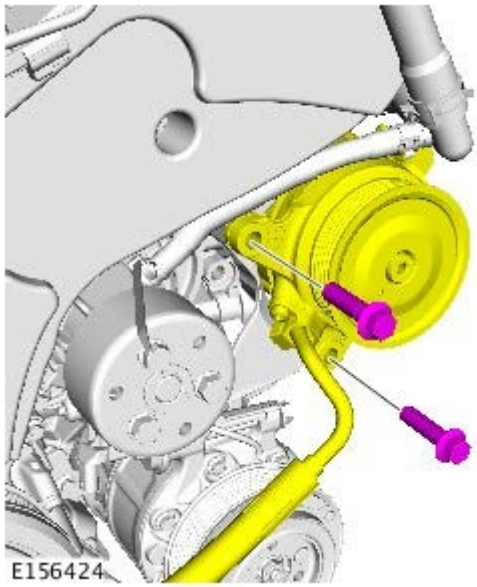
7. CAUTION: Be prepared to collect escaping fluids.

NOTE: Note the orientation of the component prior to removal.

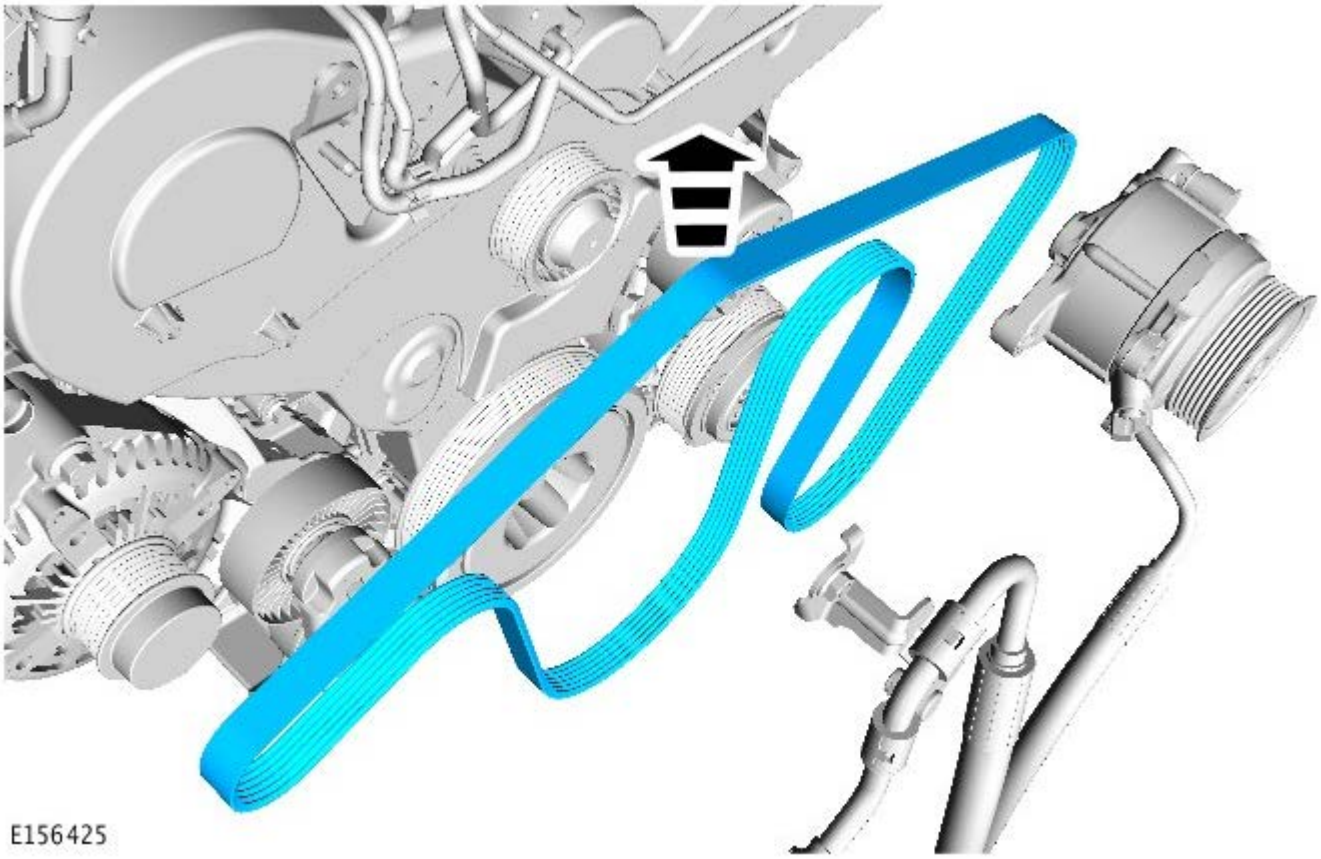
8. *Torque:* 25 Nm



9. *Torque:* 48 Nm



10.



Installation

1. To install, reverse the removal procedure.

2.
   - Check and top up the fluid reservoir.
   - Squeeze the suction pipe several times to expel the all the air.

Published: 06-Aug-2012

Accessory Drive - TDV6 3.0L Diesel - Accessory Drive Belt Idler Pulley

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

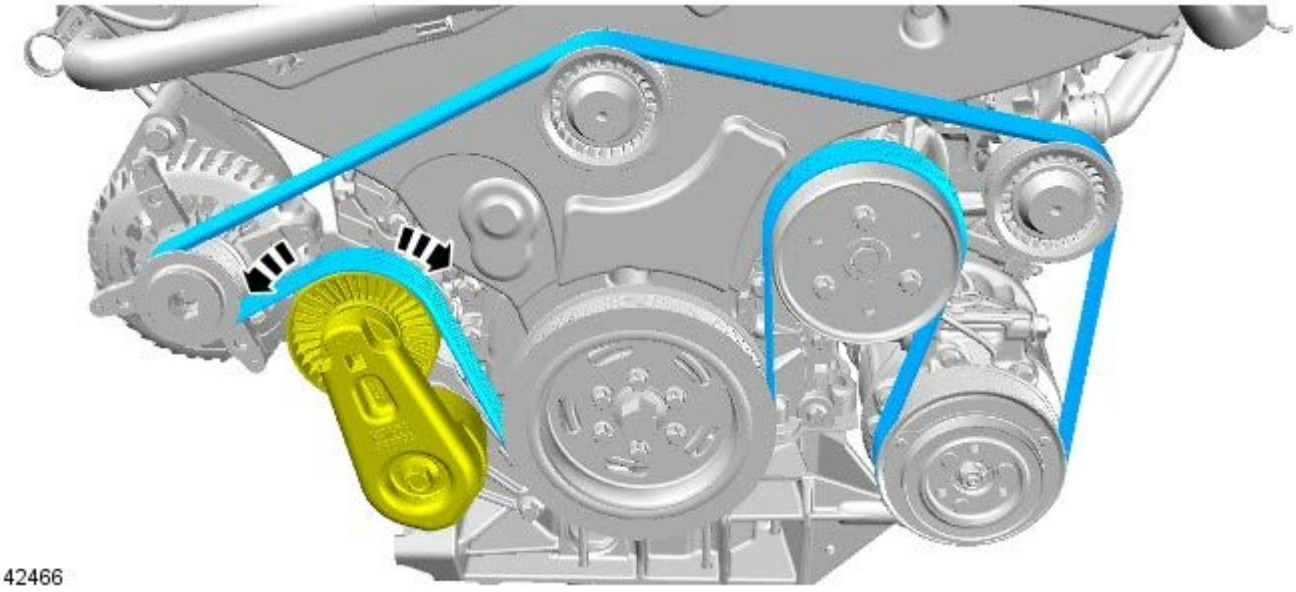
   Refer to: Specifications (414-00, Specifications).

2. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05, Removal and Installation).

3. NOTES:

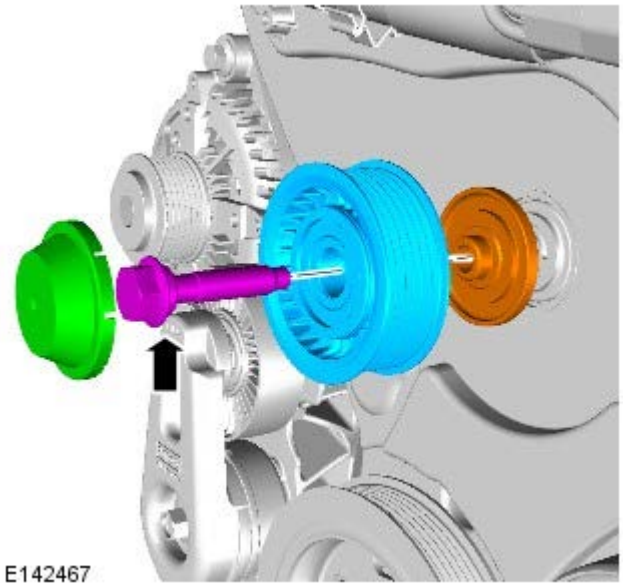
   Note the fitted position of the accessory drive belt.

   Engine shown removed for clarity.



E142466

4. *Torque:* 50 Nm



E142467

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: 09-Aug-2012

Accessory Drive - TDV6 3.0L Diesel - Accessory Drive Belt Tensioner

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

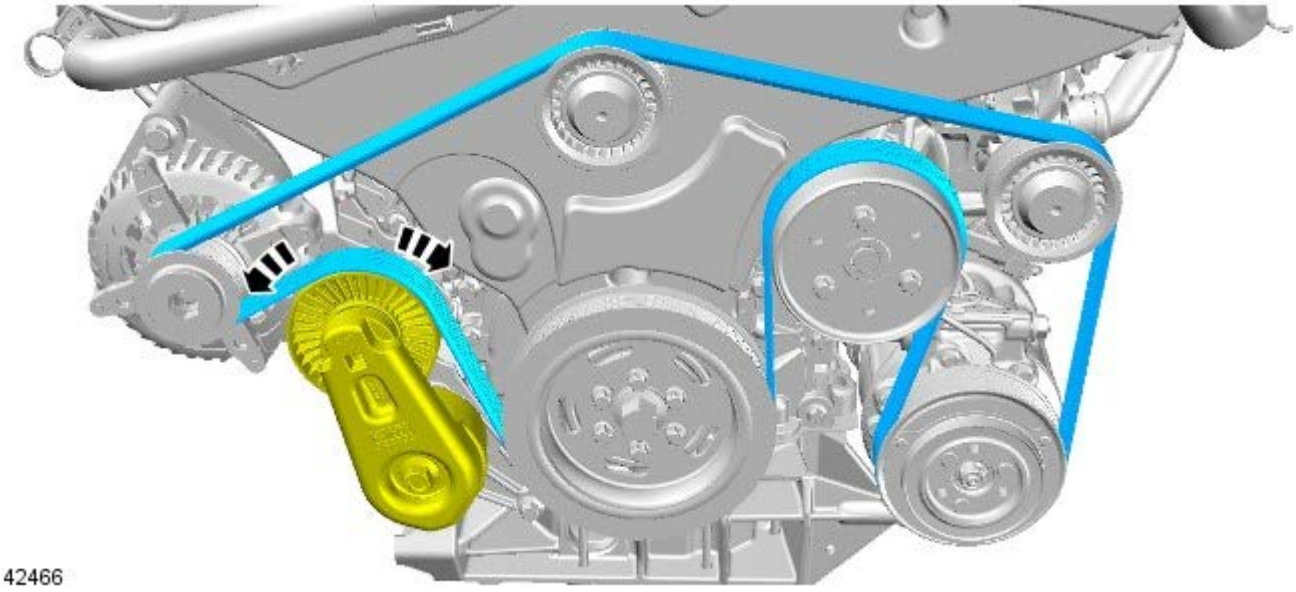
   Refer to: Specifications (414-00, Specifications).

2. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05, Removal and Installation).

3. NOTES:

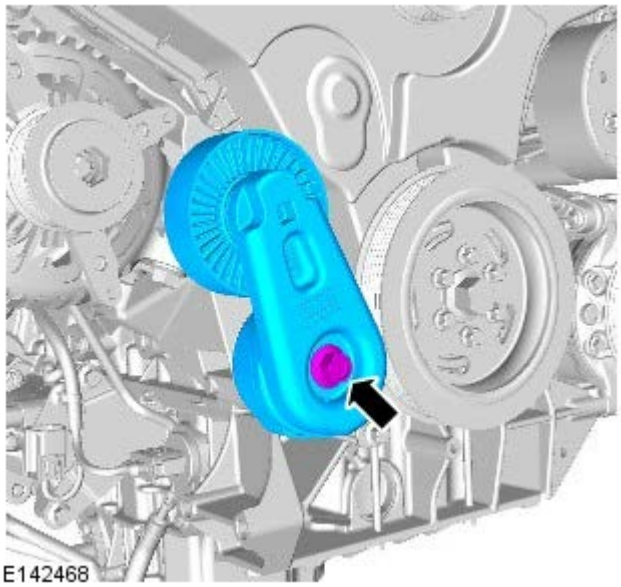
   Note the fitted position of the accessory drive belt.

   Engine shown removed for clarity.



E142466

4. *Torque:* 47 Nm



E142468

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: 05-Sep-2012

Accessory Drive - TDV6 3.0L Diesel - Fuel Injection Pump Pulley

Removal and Installation

Removal

1. Refer to: Fuel Pump (303-04A Fuel Charging and Controls - TDV6 3.0L Diesel, Removal and Installation).

Installation

1. To install, reverse the removal procedure.

Published: 10-Sep-2012

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.

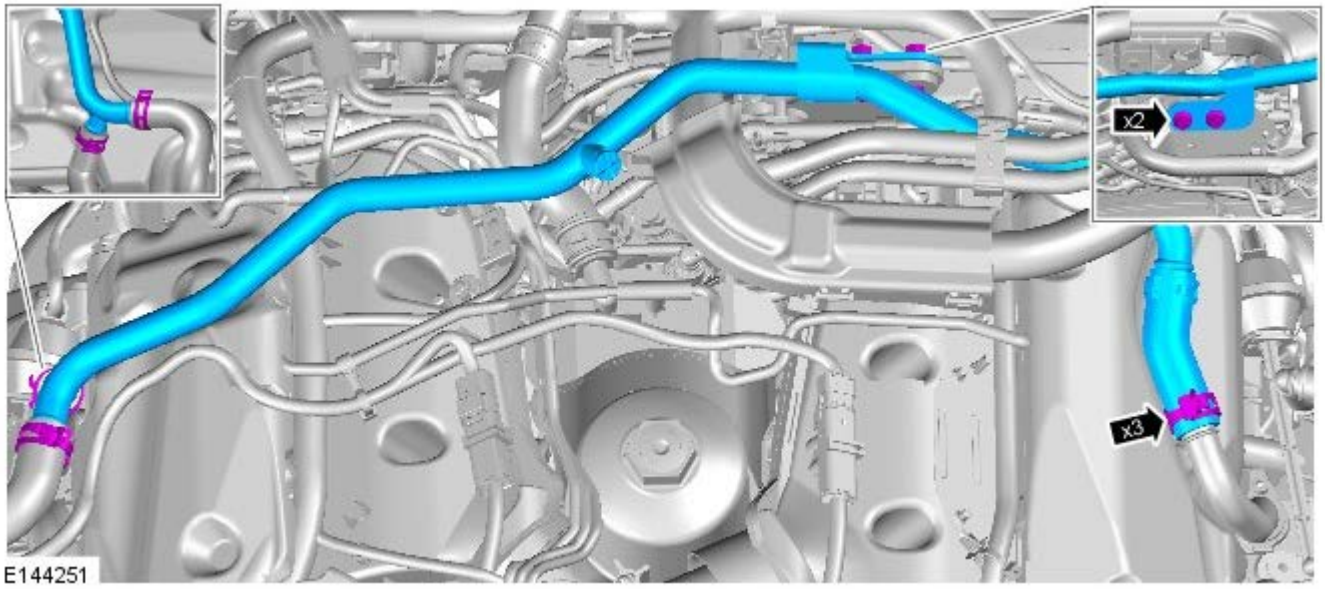
Do not disassemble or clean inside the fuel pump, even with an ultrasonic cleaner. Always install a new fuel pump when required.

1. Refer to: Specifications (414-00, Specifications).
2. Refer to: Secondary Bulkhead Center Panel - TDV6 3.0L Diesel (501-02, Removal and Installation).
3. WARNING: Make sure to support the vehicle with axle stands.

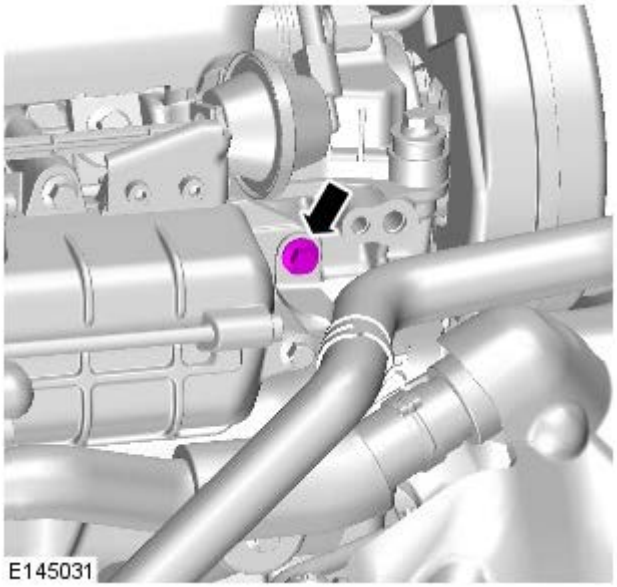
   Raise and support the vehicle.
4. Refer to: Starter Motor (303-06A Starting System - TDV6 3.0L

Diesel, Removal and Installation).

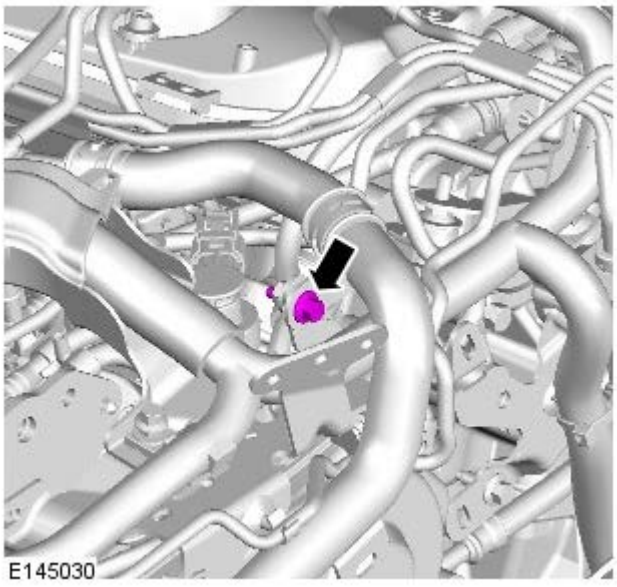
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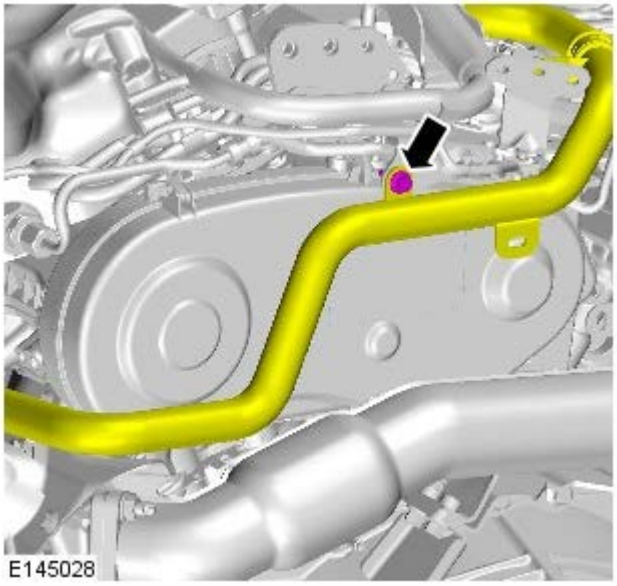


6.

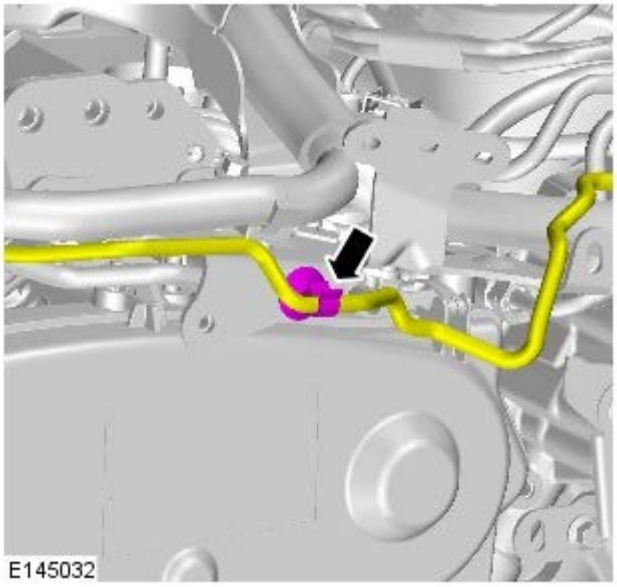


7.



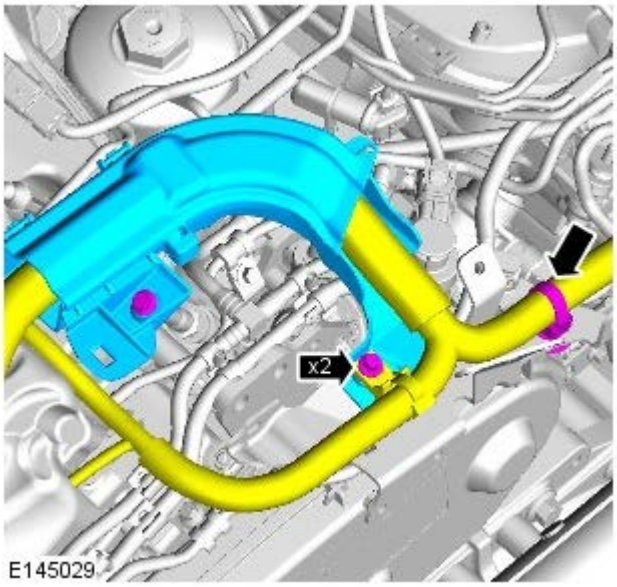


8. NOTE: Engine shown removed for clarity.

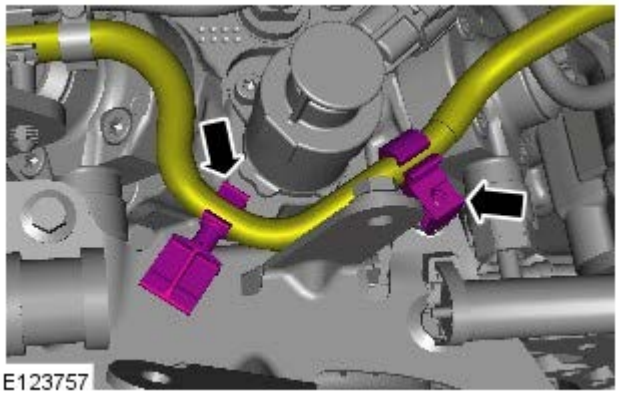


9. NOTE: Engine shown removed for clarity.

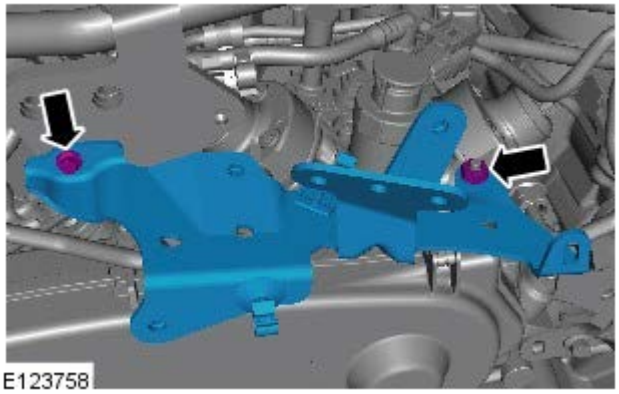
10.



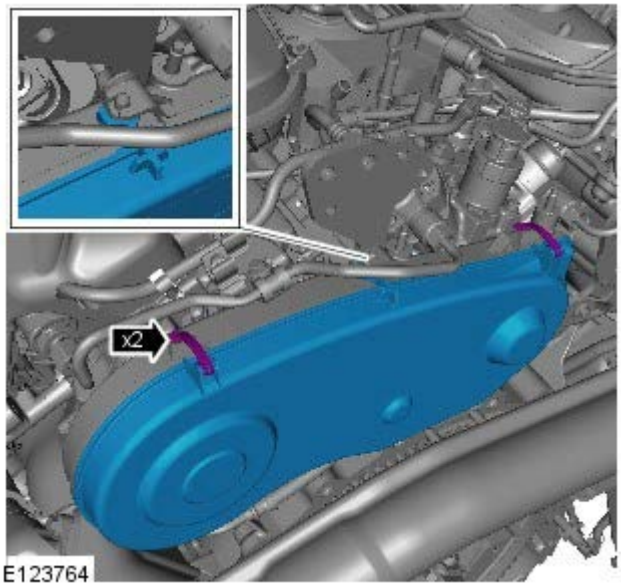
11. NOTE: Engine shown removed for clarity.



12. NOTE: Engine shown removed for clarity.



13.



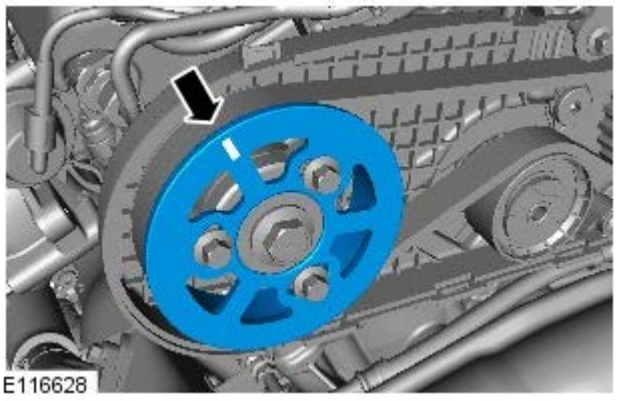
14. CAUTION: Only rotate the crankshaft clockwise.

NOTES:

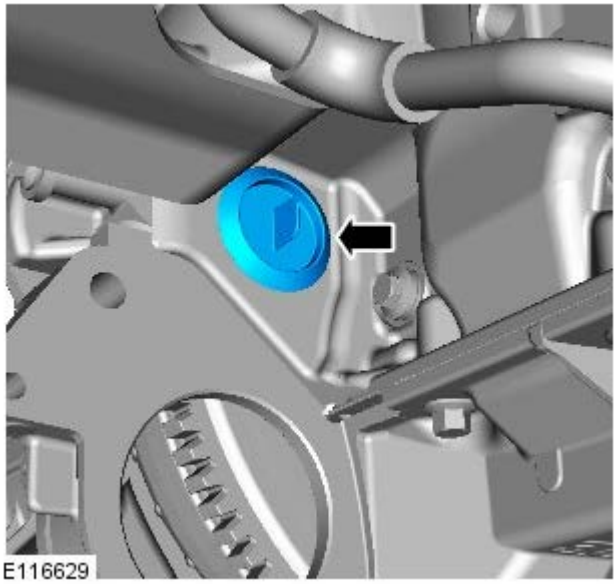
This step requires the aid of another technician.

Engine shown removed for clarity.

Rotate the crankshaft until the mark on the rear camshaft pulley is in the illustrated position.

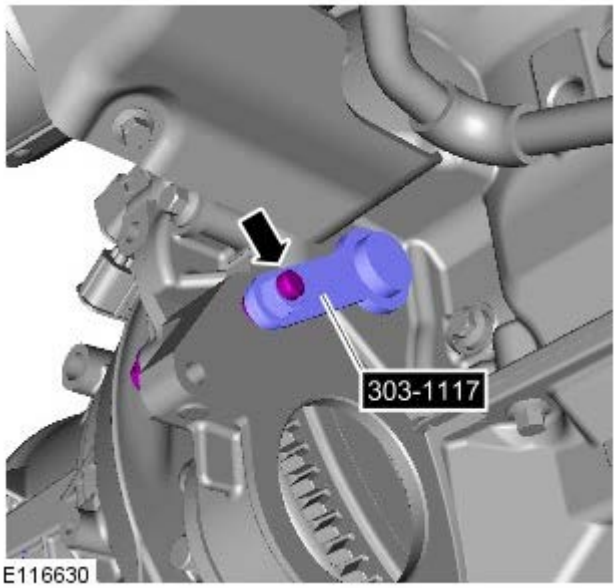


15.


E116629

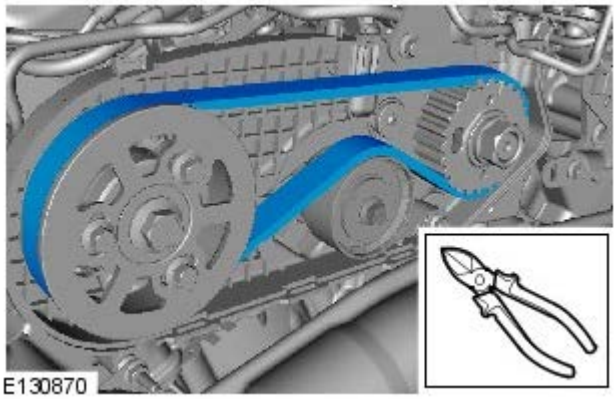
16.

- Install the special tool.
- *Special Tool(s):* 303-1117

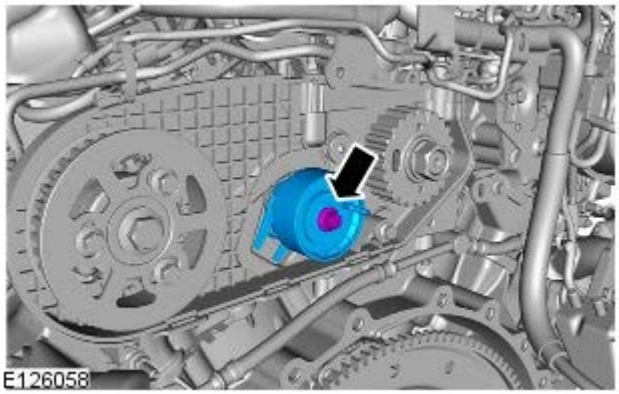


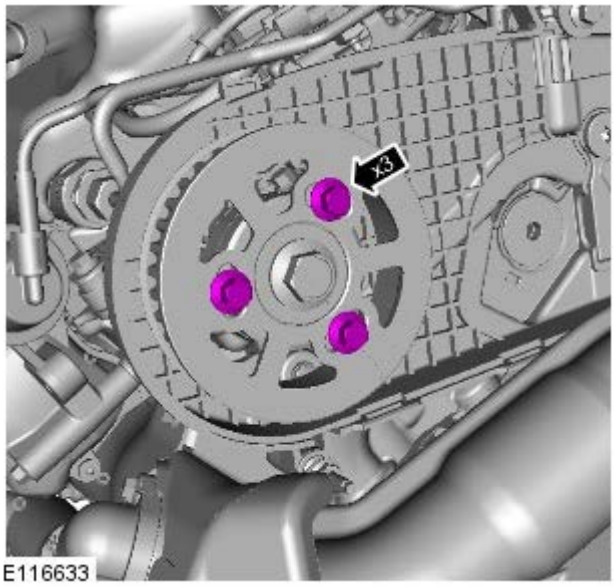
E116630

17.


E130870

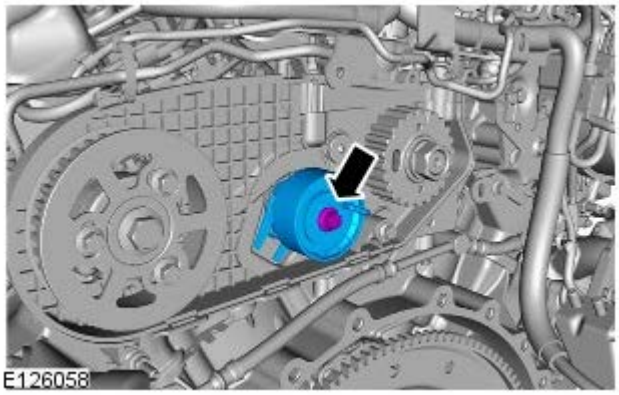
18. CAUTION: Discard the component.





19. NOTE: Do not loosen the bolts more than 2 turns.

Installation

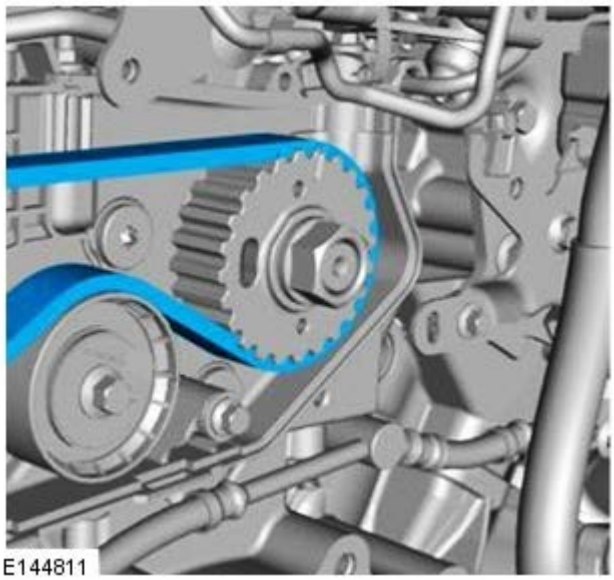


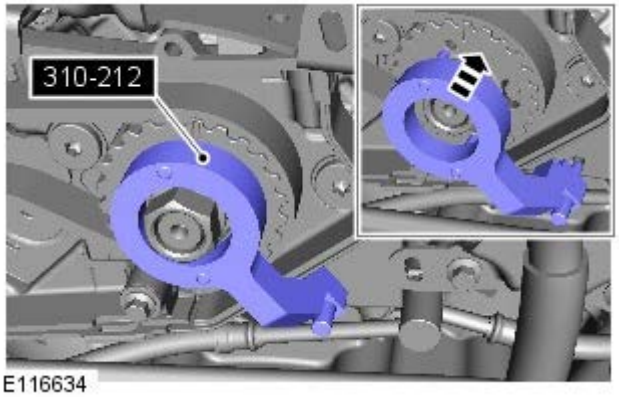
1. CAUTION: Make sure that the READ belt tensioner tang is correctly located to the READ belt rear cover. Failure to follow this instruction may result in damage to the engine.

   NOTE: Make sure that the READ belt tensioner locking pin is not removed until the READ belt is fully installed.

   Torque: 23 Nm

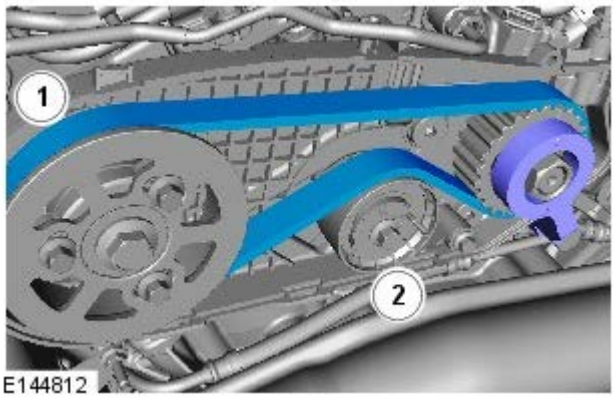
2. NOTE: Make sure the new READ belt is correctly seated onto the fuel pump pulley.


E144811



E116634

3.
- Install the special tool.
- *Special Tool(s):* 310-212



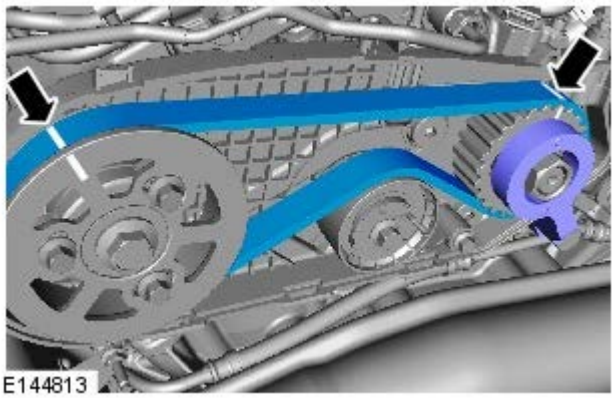
E144812

4. 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.

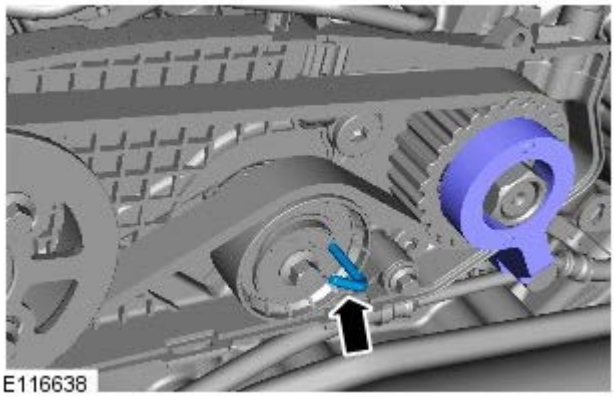
Install the READ belt onto the camshaft pulley (1) and on to the tensioner (2).

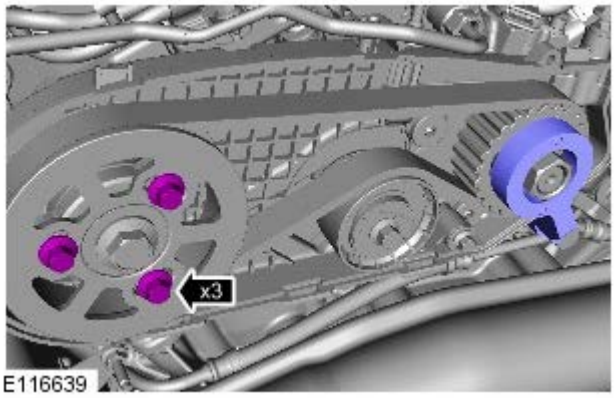

E144813

5. NOTE: Make sure that the READ belt tensioner locking pin is not removed until the READ belt is fully installed.

Make sure that the rear end accessory drive (READ) belt is aligned with the marks on the rear camshaft pulley and fuel injection pump pulley as illustrated.

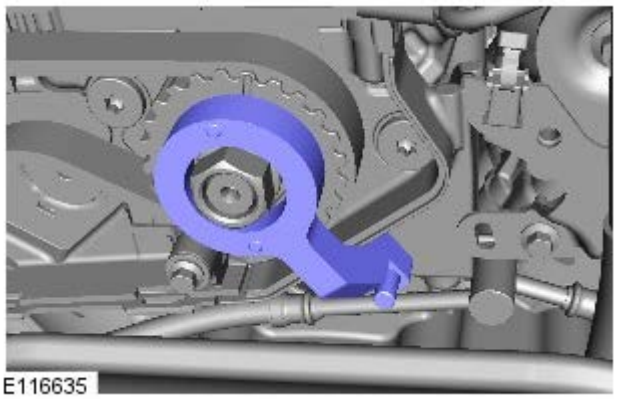
6. NOTE: Engine shown removed for clarity.





7. NOTE: Engine shown removed for clarity.

   Torque: 23 Nm

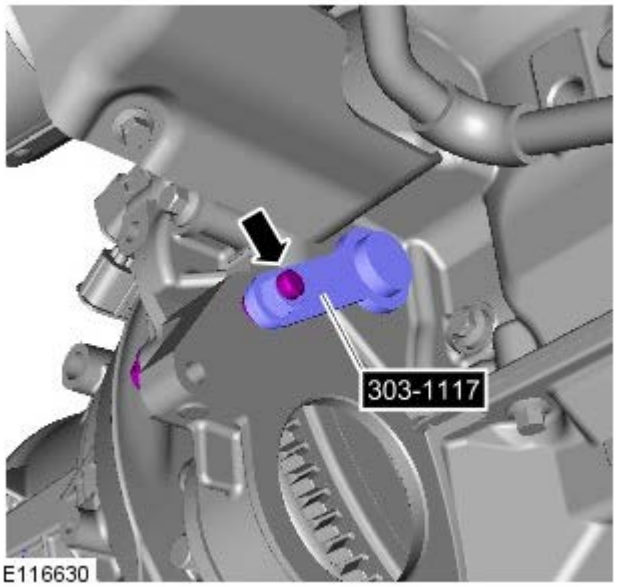


8. NOTE: Engine shown removed for clarity.

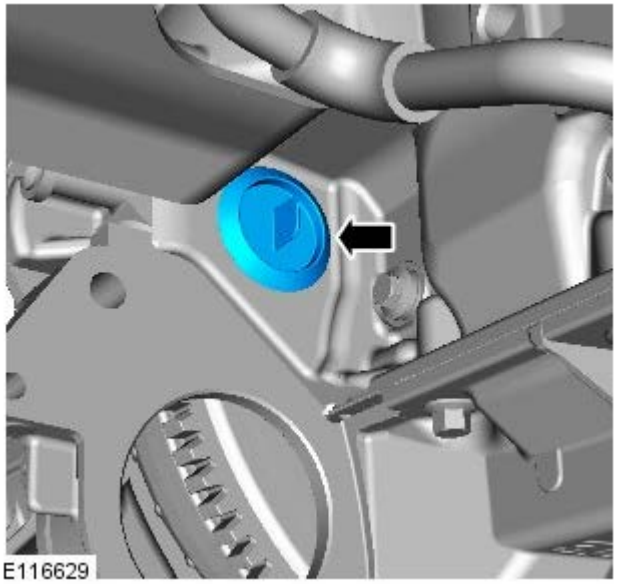
   - Remove the special tool.
   - *Special Tool(s):* 310-212

9. Remove the special tool.

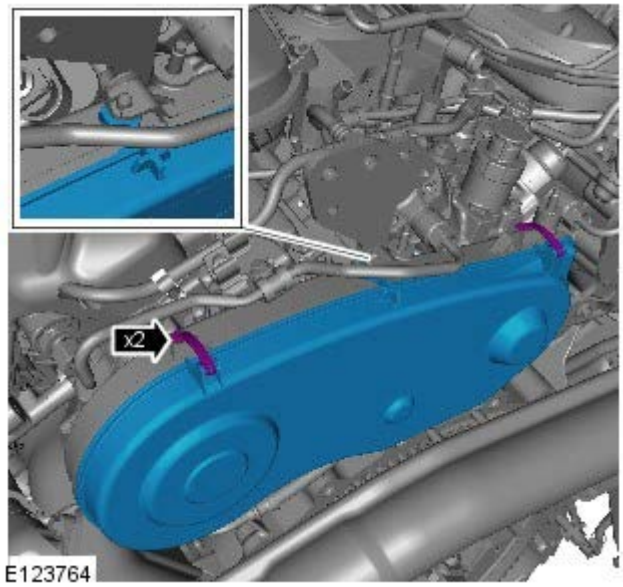
   Special Tool(s): 303-1117



10.

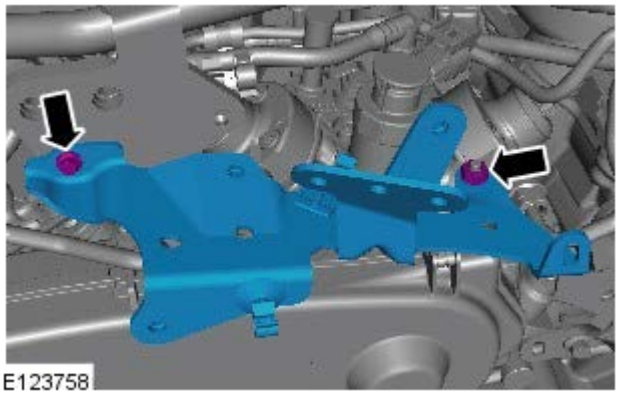


11.

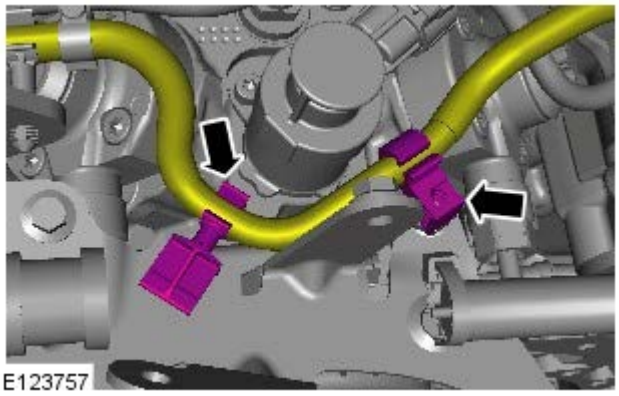


12. NOTE: Engine shown removed for clarity.

- *Torque:* 10 Nm

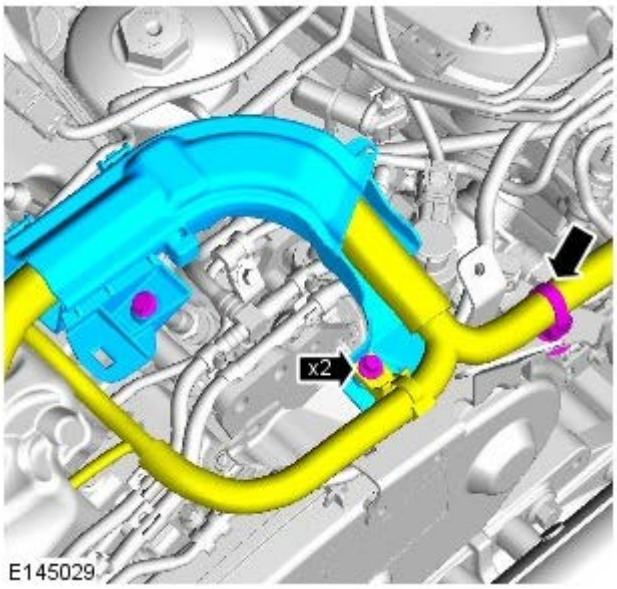


13. NOTE: Engine shown removed for clarity.

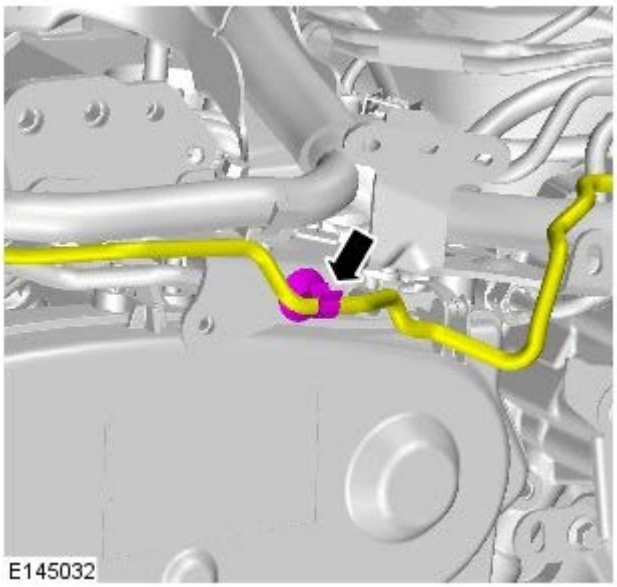


14.

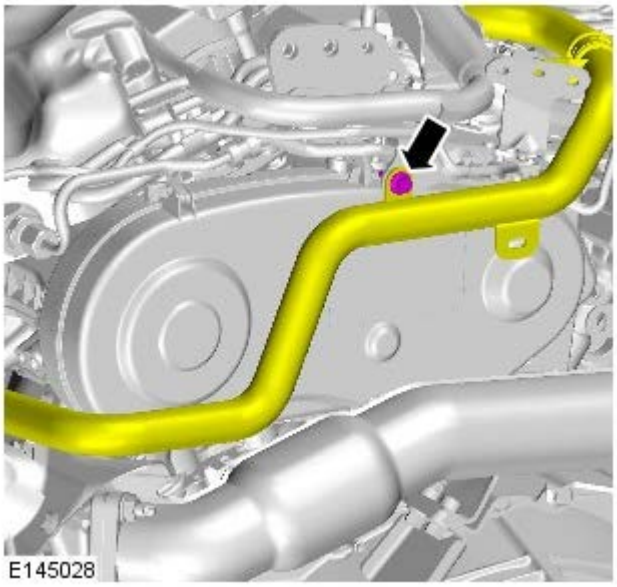
- *Torque:* 5 Nm



15. NOTE: Engine shown removed for clarity.

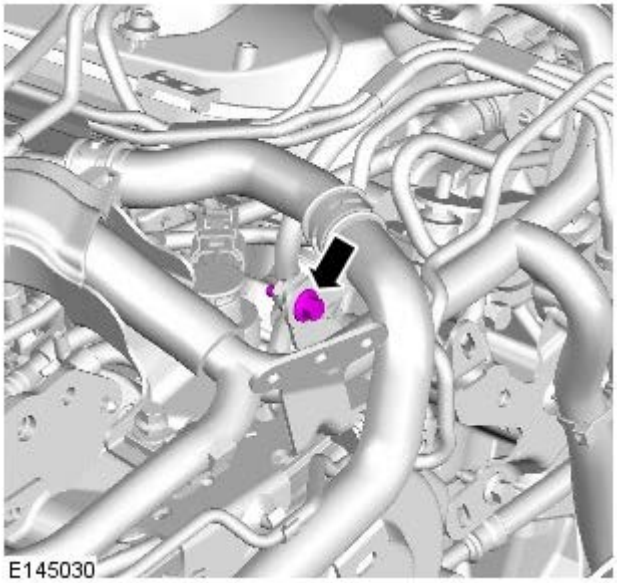


16.



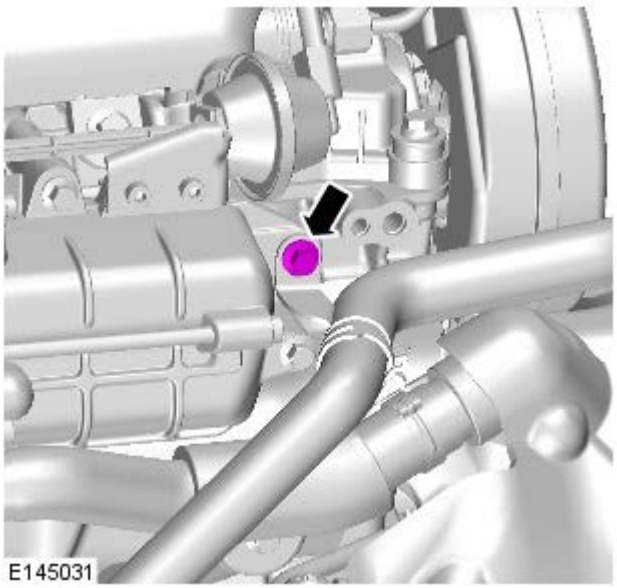
17.

- *Torque:* 10 Nm



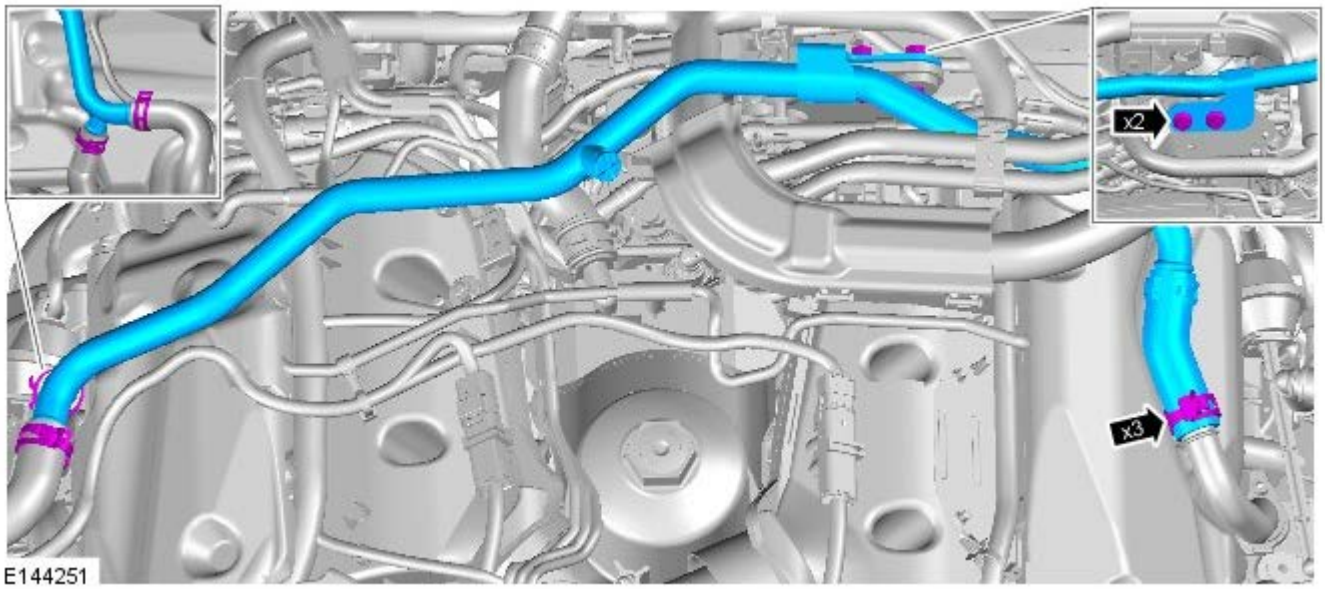
18.

- *Torque:* 10 Nm



19.

- *Torque:* 10 Nm



20. Refer to: Starter Motor (303-06A Starting System - TDV6 3.0L Diesel, Removal and Installation).

21. Refer to: Secondary Bulkhead Center Panel - TDV6 3.0L Diesel (501-02, Removal and Installation).

22. Refer to: Specifications (414-00, Specifications).

Published: 22-Oct-2012

Accessory Drive - V6 S/C 3.0L Petrol -

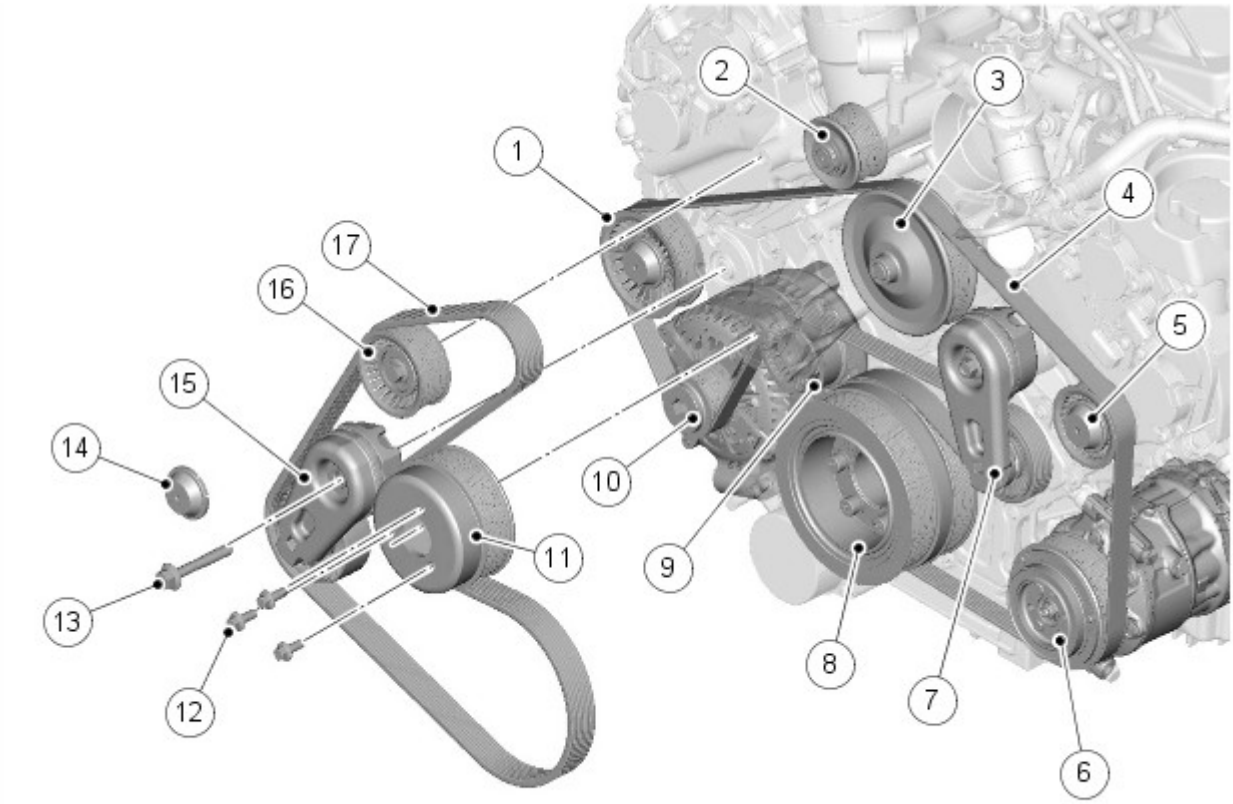
Description	Nm	lb-ft	lb-in
Accessory drive belt tensioner retaining bolt	47	35	-
Accessory drive belt idler pulley retaining bolt to tensioner bracket - vehicles with supercharger	40	30	-
Supercharger belt tensioner bracket retaining bolt	25	19	-
Supercharger belt tensioner retaining bolt	40	30	-
Supercharger belt idler pulley retaining bolt to tensioner bracket	40	30	-

Published: 02-May-2013

Accessory Drive - V6 S/C 3.0L Petrol - Accessory Drive

Description and Operation

COMPONENT LOCATION



E152896

Item	Part Number	Description
1	-	Idler pulley
2	-	Supercharger (SC)
3	-	Coolant pump
4	-	Primary drive belt
5	-	Idler pulley
6	-	Air conditioning compressor
7	-	Primary drive belt tensioner
8	-	Crankshaft pulley/torsional vibration damper
9	-	Idler pulley
10	-	Generator
11	-	Viscous cooling fan pulley
12	-	M8 bolt (3 off)
13	-	M10 bolt
14	-	Cover
15	-	Secondary drive belt tensioner
16	-	Idler pulley
17	-	Secondary drive belt

OVERVIEW

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. A belt tensioner is incorporated into each belt run to maintain 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:

- • Coolant pump.
- • A/C Air conditioning compressor.

- • Generator.

Secondary Drive Belt

The secondary drive belt is an eight-ribbed poly-V belt that drives the pulley of the viscous cooling fan. In addition, the secondary drive belt also drives the SC (Supercharger).

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: 02-May-2013

Accessory Drive - V6 S/C 3.0L Petrol - Accessory Drive

Diagnosis and Testing

Principles of Operation

For a detailed description of the accessory drive belts and operation, refer to the relevant Description and Operation section in the Workshop Manual. REFER to:

Accessory Drive (303-05B Accessory Drive - V6 S/C 3.0L Petrol, Description and Operation), Accessory Drive (303-05B, 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 damage.

Visual Inspection

Mechanical
• Drive belt condition (cracking/damage/contamination) • Idler assembly • Generator • Engine cooling fan • Tensioner assembly • Engine coolant pump • Air conditioning (A/C) compressor • Torsional vibration damper • Dynamic response pump • Tensioner assembly • Accessory drive 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.
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

CAUTION: If the engine is run without the accessory drive belts connected to eliminate driven components, diagnostic trouble codes, (DTCs) may be set which must be cleared before the vehicle is returned to the owner. The engine should not be run for more than 2-3 minutes with the belts disconnected. Failure to follow this instruction may result in damage to the vehicle.

Symptom	Possible Causes	Action
Noise	• Belt condition • Belt tension • Pulleys misaligned • Driven components (including tensioners)	Check the belt condition (see visual inspection). Check the tensioner function. Check the pulley alignment. Check the driven components for excessive resistance to rotation. Rectify as necessary.
Drive belt does not hold tension	• Belt condition • Tensioner fault	Check the belt condition (see visual inspection). Check the tensioner function. Rectify as necessary.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - V6 S/C 3.0L Petrol , DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation).

Published: 24-Jul-2012

Accessory Drive - V6 S/C 3.0L Petrol - Accessory Drive Belt

Removal and Installation

Removal

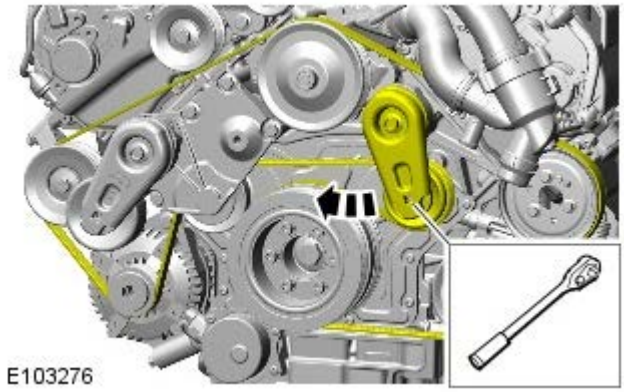
NOTES:

Removal steps in this procedure may contain installation details.

Engine shown removed for clarity.

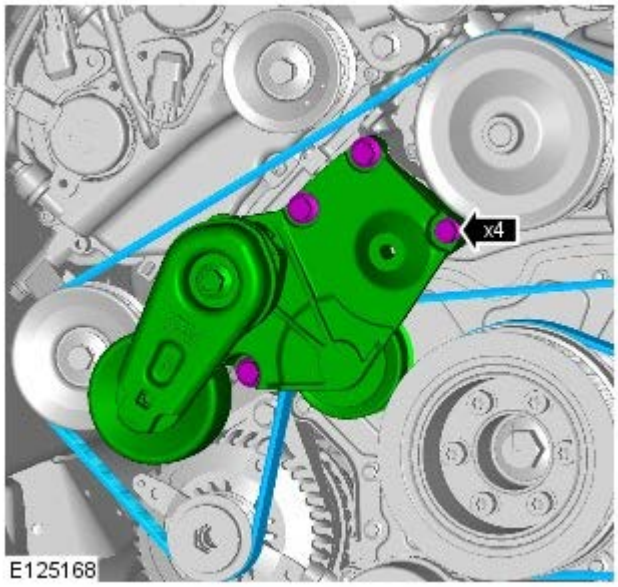
1. Refer to: Air Cleaner Outlet Pipe LH (303-12B Intake Air Distribution and Filtering - V6 S/C 3.0L Petrol, Removal and Installation).

2. Refer to: Supercharger Belt Idler Pulley (303-05B Accessory Drive - V6 S/C 3.0L Petrol, Removal and Installation).



3. NOTE: Note the fitted position of the accessory drive belt.

4. *Torque:* 25 Nm



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: 24-Jul-2012

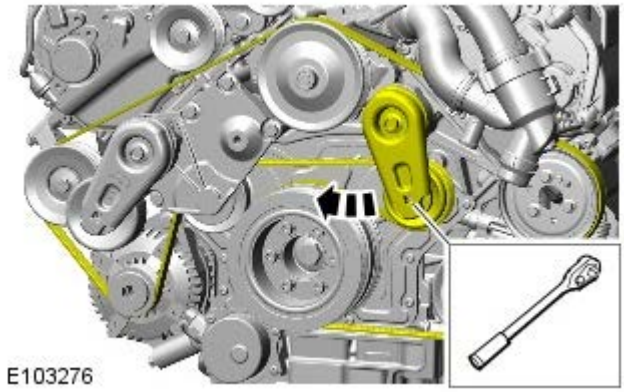
Accessory Drive - V6 S/C 3.0L Petrol - Accessory Drive Belt Idler Pulley

Removal and Installation

Removal

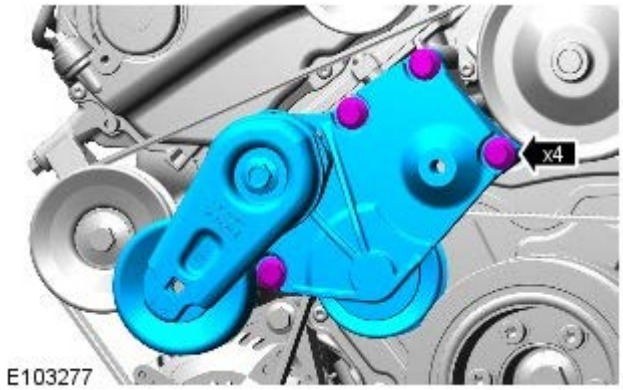
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Supercharger Belt Idler Pulley (303-05B Accessory Drive - V6 S/C 3.0L Petrol, Removal and Installation).



2. NOTE: Note the fitted position of the accessory drive belt.

3. *Torque:* 25 Nm



4. *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: 24-Jul-2012

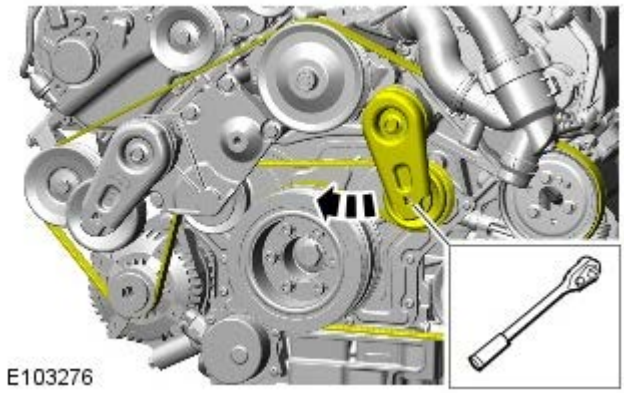
Accessory Drive - V6 S/C 3.0L Petrol - Accessory Drive Belt Tensioner

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

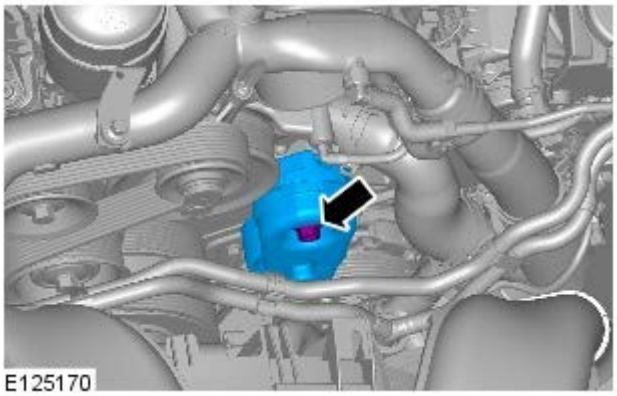
1. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12B Intake Air Distribution and Filtering - V6 S/C 3.0L Petrol, Removal and Installation).
2. Refer to: Air Cleaner Outlet Pipe LH (303-12B Intake Air Distribution and Filtering - V6 S/C 3.0L Petrol, Removal and Installation).



3. NOTES:

   Engine shown removed for clarity.

   Note the fitted position.



4. NOTE: Install the bolt finger tight before final tightening.

   Torque: 47 Nm

Installation

1. CAUTION: Make sure that the accessory drive belt is correctly located on each pulley.

   To install, reverse the removal procedure.

Published: 25-Jul-2013

Accessory Drive - V6 S/C 3.0L Petrol - Supercharger Belt Idler Pulley

Removal and Installation

Removal

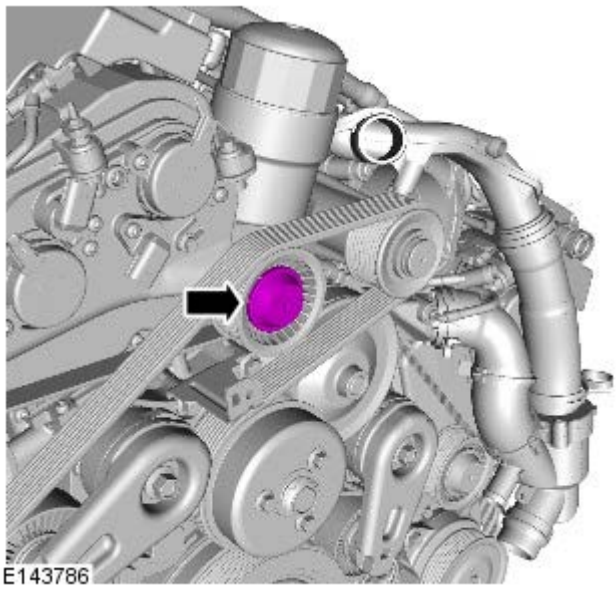
NOTES:

Removal steps in this procedure may contain installation details.

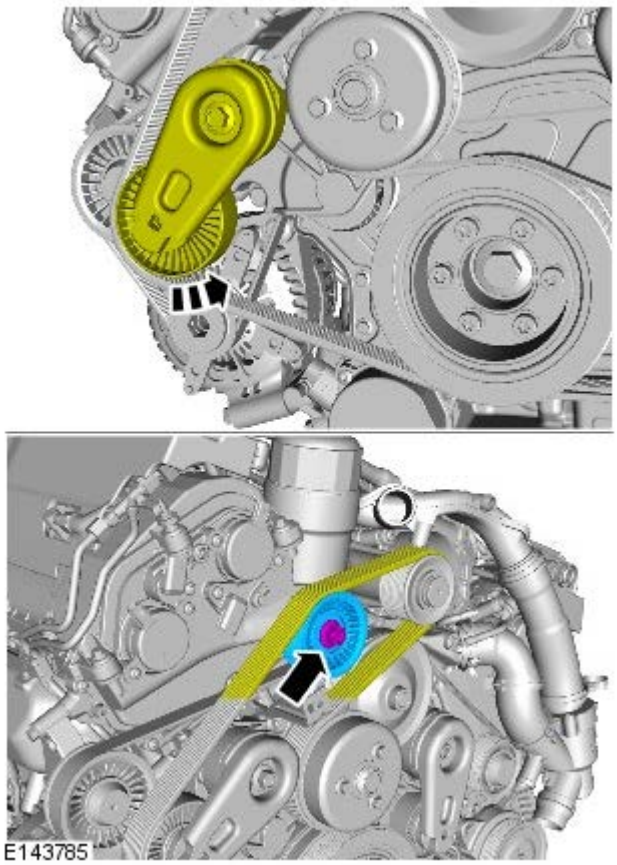
Some variation in the illustrations may occur, but the essential information is always correct.

1. Refer to: Cooling Fan (303-03B Engine Cooling - V6 S/C 3.0L Petrol, Removal and Installation).

2.



3. *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: 25-Jul-2013

Accessory Drive - V6 S/C 3.0L Petrol - Supercharger Belt Tensioner

Removal and Installation

Removal

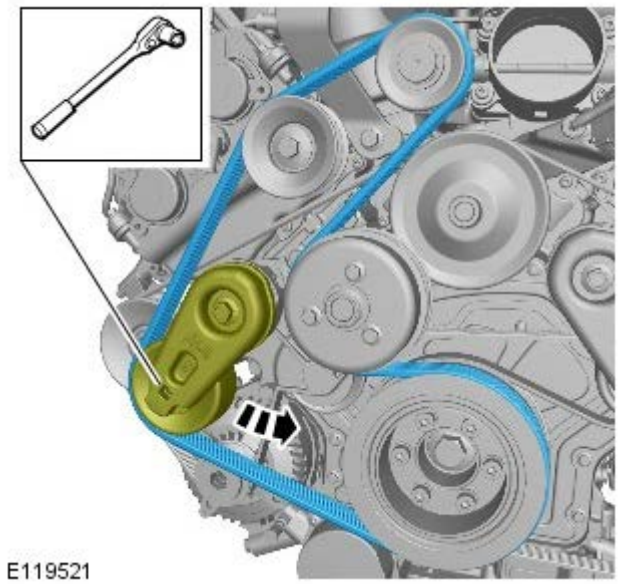
NOTES:

Removal steps in this procedure may contain installation details.

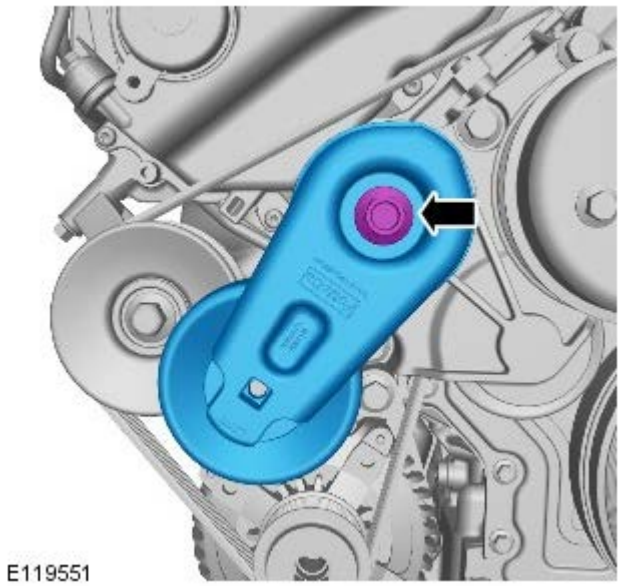
Some variation in the illustrations may occur, but the essential information is always correct.

1. Refer to: Cooling Fan (303-03B Engine Cooling - V6 S/C 3.0L Petrol, Removal and Installation).

2.



3. *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: 25-Jul-2013

Accessory Drive - V6 S/C 3.0L Petrol - Supercharger Belt

Removal and Installation

Removal

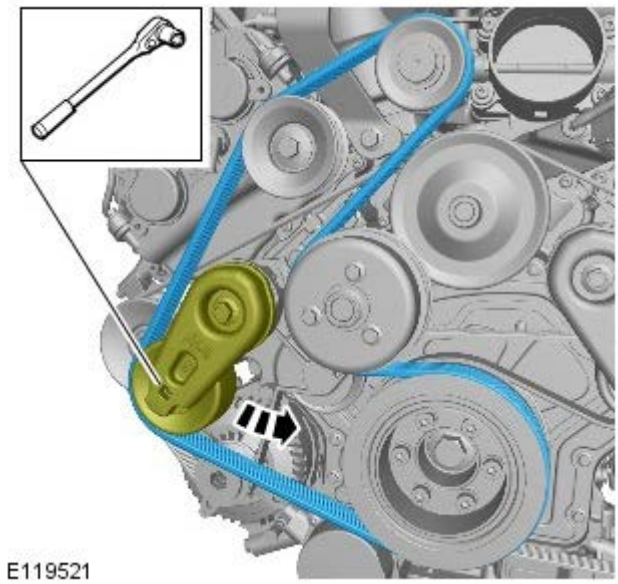
NOTES:

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: Cooling Fan (303-03B Engine Cooling - V6 S/C 3.0L Petrol, Removal and Installation).

2.



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: 02-Aug-2012

Accessory Drive - V8 S/C 5.0L Petrol -

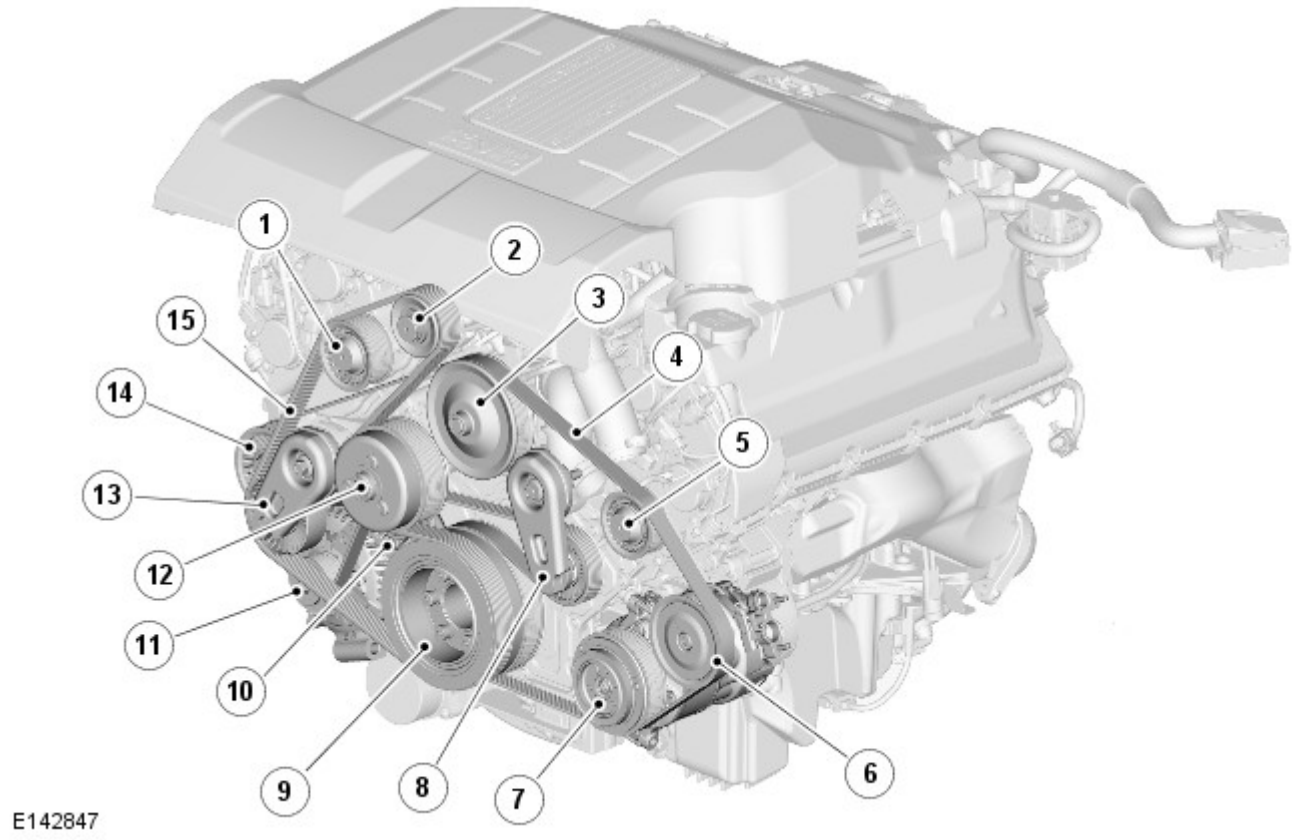
Description	Nm	lb-ft	lb-in
Accessory drive belt tensioner retaining bolt	48	35	-
Accessory drive belt idler pulley retaining bolt - all vehicles	48	35	-
Accessory drive belt center idler pulley retaining bolt - vehicles without supercharger	52	19	-
Accessory drive belt idler pulley retaining bolt to 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: 02-May-2013

Accessory Drive - V8 S/C 5.0L Petrol - Accessory Drive

Description and Operation

COMPONENT LOCATION



Item	Part Number	Description
1	-	Idler pulley
2	-	Supercharger
3	-	Coolant pump
4	-	Primary drive belt
5	-	Idler pulley
6	-	Dynamic response hydraulic pump
7	-	Air conditioning compressor
8	-	Primary belt tensioner
9	-	Crankshaft pulley/torsional vibration damper
10	-	Idler pulley
11	-	Generator
12	-	Viscous cooling fan pulley
13	-	Secondary belt tensioner
14	-	Idler pulley
15	-	Secondary drive belt

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. A belt tensioner is incorporated into each belt run to maintain 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:

- Coolant pump.
- Dynamic response hydraulic pump.
- A/C Air conditioning compressor.
- Generator.

Secondary Drive Belt

The secondary drive belt is an eight-ribbed poly-V belt that drives the pulley of the viscous cooling fan. In addition, the secondary drive belt also drives the SC (Supercharger).

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: 18-Jun-2013

Accessory Drive - V8 S/C 5.0L Petrol - Accessory Drive

Diagnosis and Testing

Principles of Operation

For a detailed description of the drive belts and operation, refer to the relevant Description and Operation section in the Workshop Manual. REFER to:

Accessory Drive (303-05C, Description and Operation),
Accessory Drive (303-05C, Description and Operation),
Accessory Drive (303-05C Accessory Drive - V8 S/C 5.0L Petrol, Diagnosis and Testing).

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 damage.

Visual Inspection

Mechanical
• 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 • Primary and secondary front drive belts

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

CAUTION: If the engine is run without the drive belt(s) 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

Symptom	Possible Causes	Action
Noise	• Belt condition • Belt tension • Pulleys misaligned • Driven components (including tensioners)	Check the belt condition (see visual inspection). Check the tensioner function. Check the pulley alignment. Check the driven components for excessive resistance to rotation. Rectify as necessary
Drive belt does not hold tension	• Belt condition • Tensioner fault	Check the belt condition (see visual inspection). Check the tensioner function. Rectify as necessary

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - V8 S/C 5.0L Petrol, DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation).

Published: 04-Aug-2012

Accessory Drive - V8 S/C 5.0L Petrol - Accessory Drive Belt

Removal and Installation

Removal

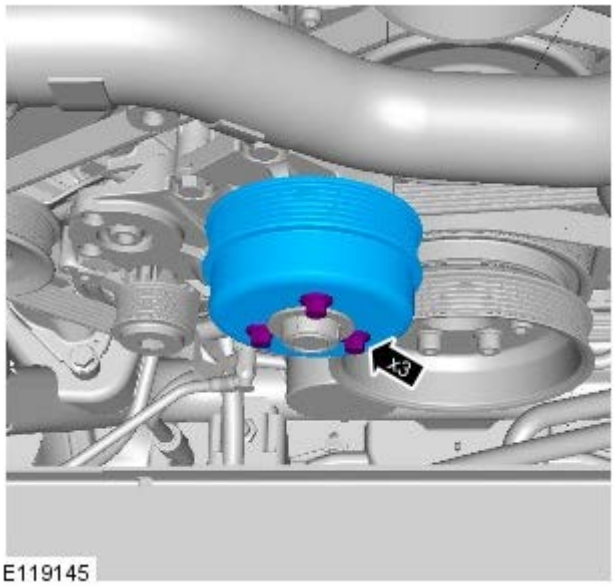
NOTES:

Some variation in the illustrations may occur, but the essential information is always correct.

Removal steps in this procedure may contain installation details.

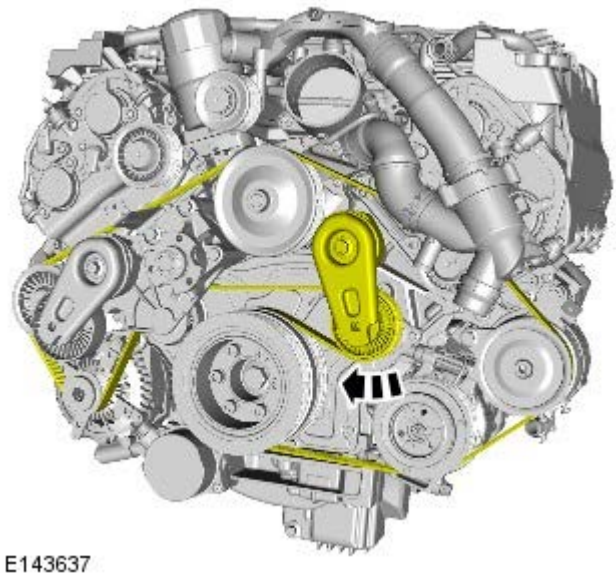
1. Refer to: Supercharger Belt (303-05C Accessory Drive - V8 S/C 5.0L Petrol, Removal and Installation).

2. *Torque:* 25 Nm



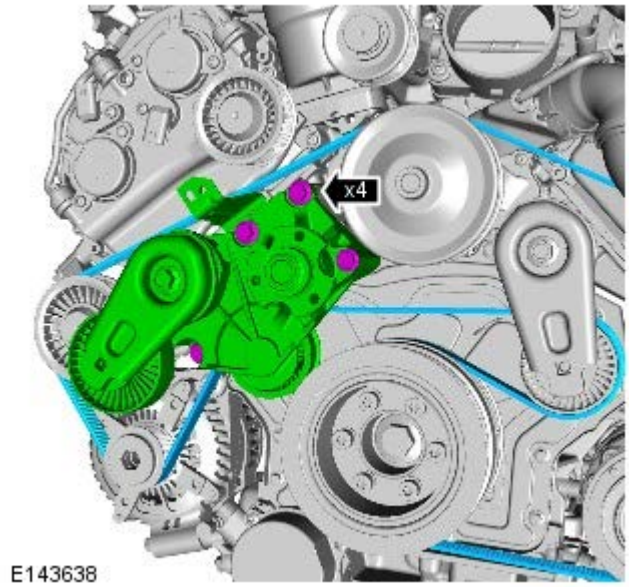
E119145

3. NOTE: Note the fitted position.



E143637

4. *Torque:* 25 Nm



Installation

1. To install, reverse the removal procedure.

Published: 22-Jan-2014

Accessory Drive - V8 S/C 5.0L Petrol - Accessory Drive Belt Idler Pulley

Removal and Installation

Removal

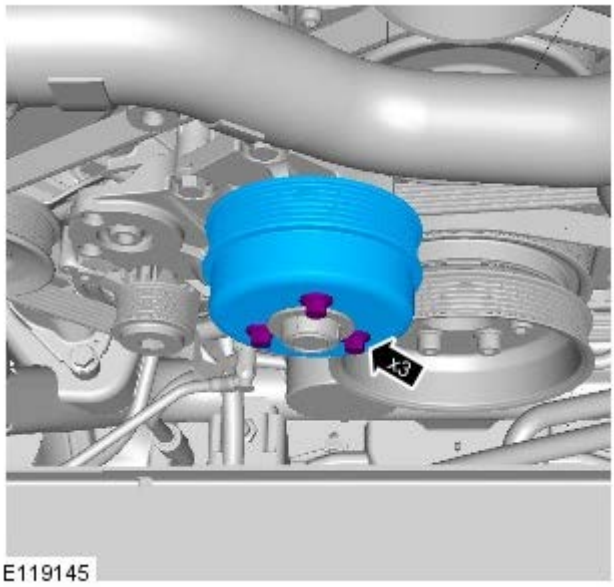
NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect battery ground cable.

   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

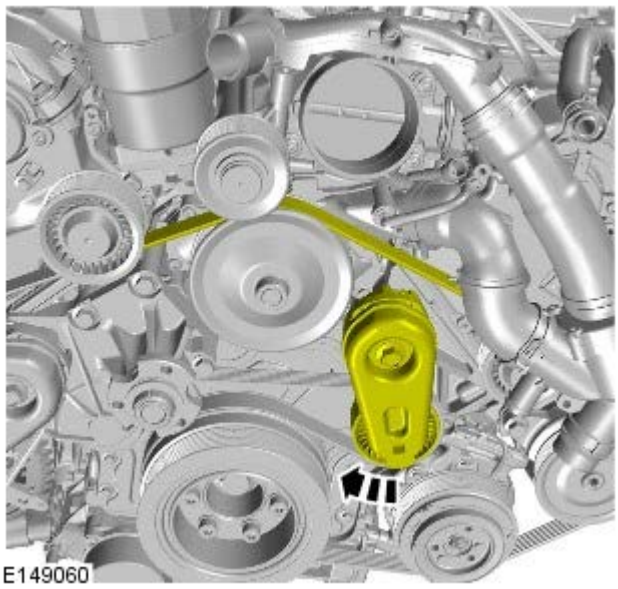
2. Refer to: Accessory Drive Belt (303-05C Accessory Drive - V8 S/C 5.0L Petrol, Removal and Installation).

3. *Torque:* 25 Nm

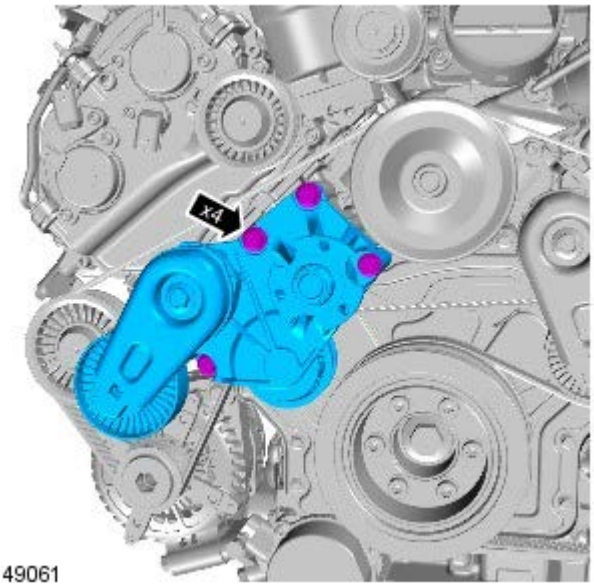


E119145

4. NOTE: Note the fitted position.


E149060

5. *Torque:* 25 Nm



E149061

6. *Torque:* 48 Nm



E149058

Installation

1. To install, reverse the removal procedure.

Published: 02-Aug-2012

Accessory Drive - V8 S/C 5.0L Petrol - Accessory Drive Belt Tensioner

Removal and Installation

Removal

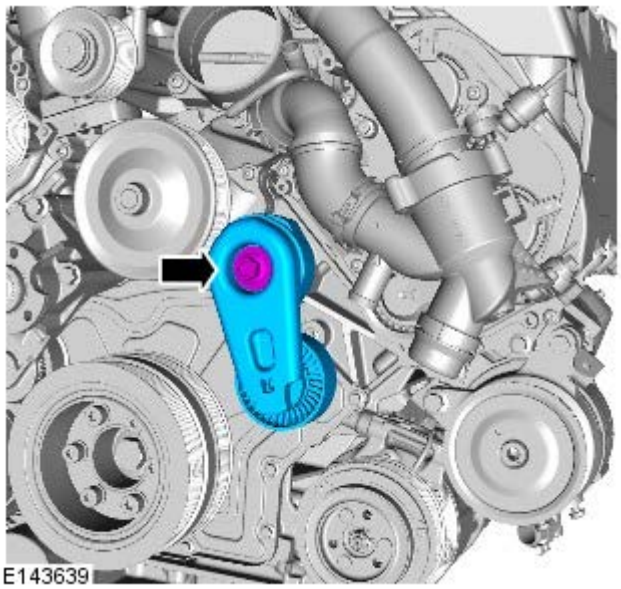
NOTES:

Some variation in the illustrations may occur, but the essential information is always correct.

Removal steps in this procedure may contain installation details.

1. Refer to: Accessory Drive Belt (303-05C Accessory Drive - V8 S/C 5.0L Petrol, Removal and Installation).

2. *Torque:* 48 Nm



Installation

1. To install, reverse the removal procedure.

Published: 24-Aug-2012

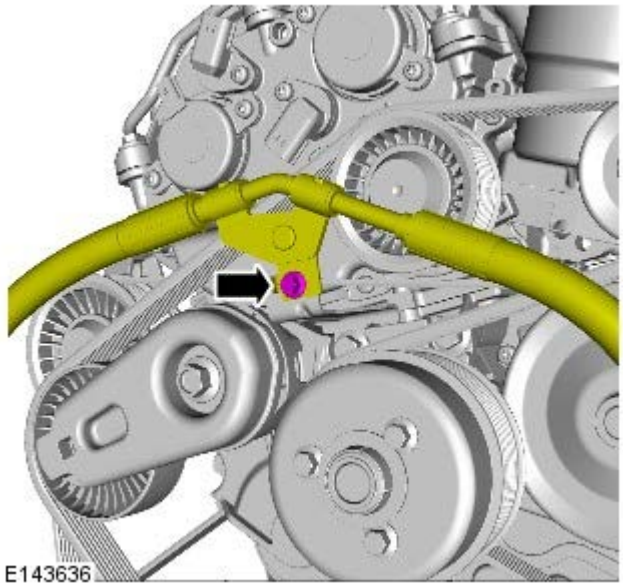
Accessory Drive - V8 S/C 5.0L Petrol - Supercharger Belt

Removal and Installation

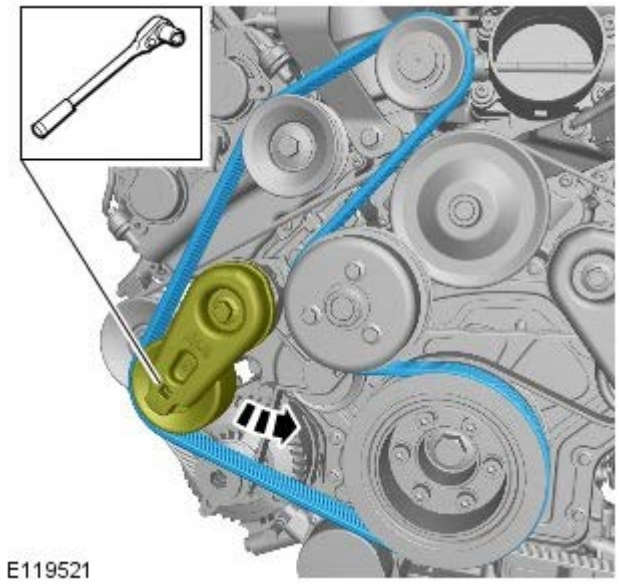
Removal

1. Refer to: Cooling Fan (303-03C, Removal and Installation).

2.



3.



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: 08-Aug-2012

Accessory Drive - V8 S/C 5.0L Petrol - Supercharger Belt Idler Pulley

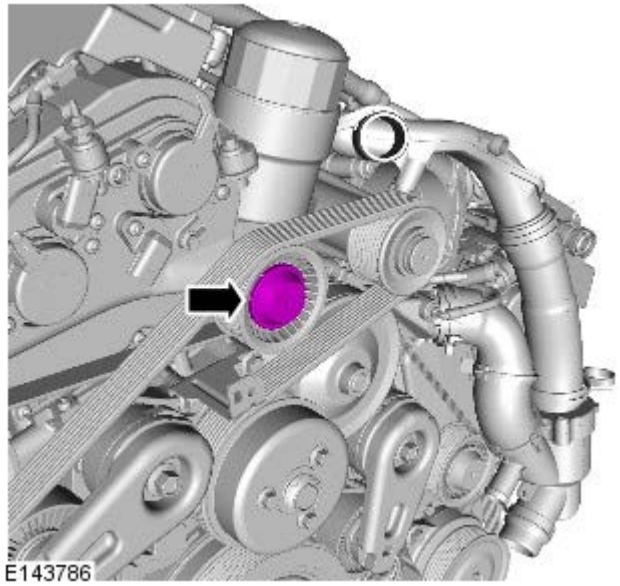
Removal and Installation

Removal

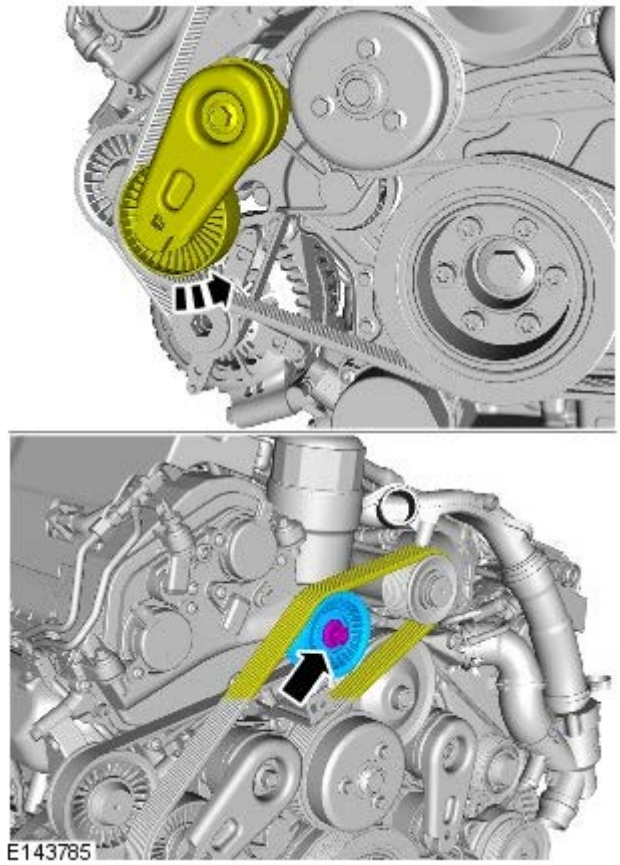
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Cooling Fan (303-03C, Removal and Installation).

2.



3. *Torque:* 48 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: 31-Jul-2012

Accessory Drive - V8 S/C 5.0L Petrol - Supercharger Belt Tensioner

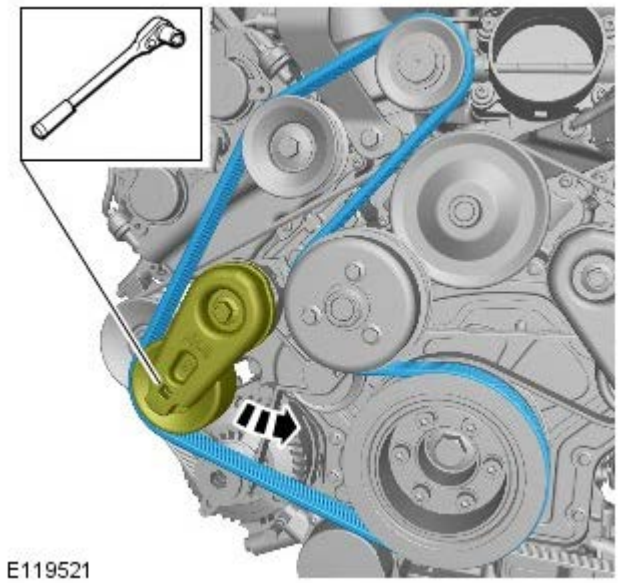
Removal and Installation

Removal

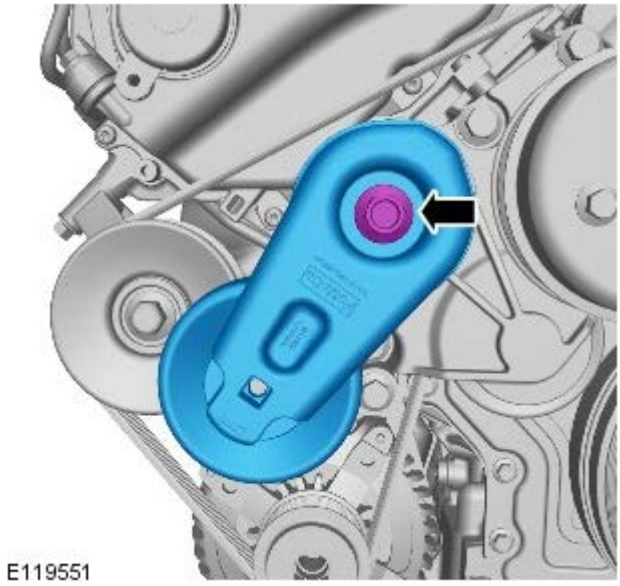
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Cooling Fan - V8 S/C 5.0L Petrol (303-03, Removal and Installation).

2.



3. *Torque:* 48 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: 31-Jul-2012

Accessory Drive - TDV8 4.4L Diesel -

Torque Specifications

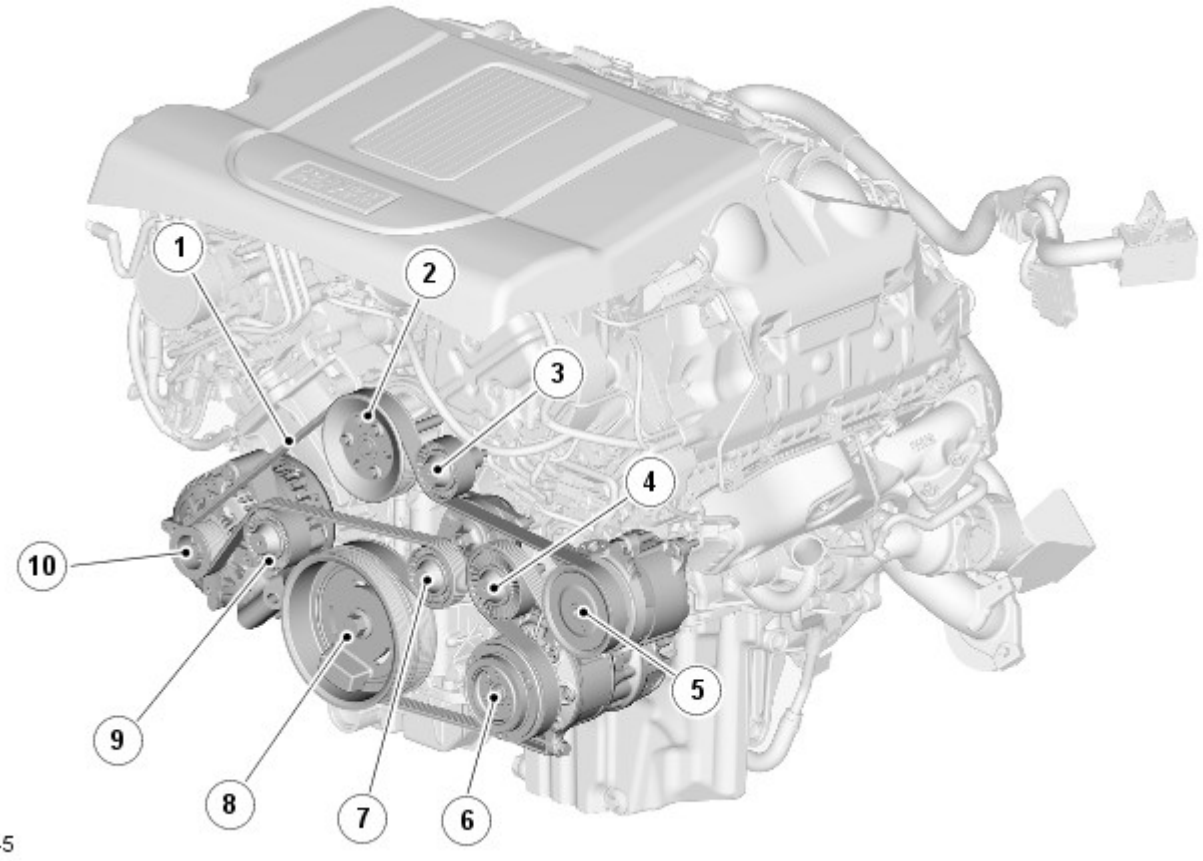
Item	Nm	lb-ft	lb-in
65 mm accessory drive belt idler pulley bolt	32	24	-
80 mm accessory drive belt idler pulley bolt	62	46	-
Accessory drive belt tensioner bolts	25	18	-

Published: 02-Dec-2013

Accessory Drive - TDV8 4.4L Diesel - Accessory Drive

Description and Operation

COMPONENT LOCATION



Item	Part Number	Description
1	-	Accessory drive belt
2	-	Coolant pump
3	-	Idler pulley
4	-	Idler pulley
5	-	Dynamic response hydraulic pump
6	-	Air conditioning compressor
7	-	Belt tensioner
8	-	Crankshaft pulley/torsional vibration damper
9	-	Idler pulley
10	-	Generator

OVERVIEW

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 a single drive belt. An automatic belt tensioner maintains the drive belt at the correct tension. Together with idler pulleys, the belt tensioner also guides the drive belt clear of obstructions and sets the correct 'wrap-around' of the accessory component drive pulleys to ensure a slip-free drive.

The drive belt is a six-ribbed poly-V belt that drives the:

- Coolant pump.
- Dynamic response hydraulic pump.
- A/C (Air Conditioning) compressor.
- Generator.

The belt tensioner consists of an idler pulley on the end of a spring loaded pivot arm. The pivot arm can be turned manually for removal and installation of the drive belt. The belt tensioner is calibrated to automatically maintain the correct tension in the drive belt.

Published: 31-Jul-2012

Accessory Drive - TDV8 4.4L Diesel - Accessory Drive

Diagnosis and Testing

Principles of Operation

For a detailed description of the accessory drive belts and operation, refer to the relevant Description and Operation section in the Workshop Manual.
REFER to: Accessory Drive (303-05B, 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 damage.

Visual Inspection

Mechanical
• Drive belt condition (cracking/damage/contamination) • Idler assembly • Generator • Tensioner assembly • Engine coolant pump • Air conditioning compressor • Torsional vibration damper • Tensioner assembly

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 (Accessory Drive Belt)

CAUTION: If the engine is run without the accessory drive belts connected to eliminate driven components, diagnostic trouble codes, (DTCs) may be set which must be cleared before the vehicle is returned to the owner. The engine should not be run for more than 2-3 minutes with the belts disconnected. Failure to follow this instruction may result in damage to the vehicle.

Symptom	Possible Causes	Action
Noise	• Belt condition • Belt tension • Pulleys misaligned • Driven components (including tensioners)	Check the belt condition (see visual inspection). Check the tensioner function. Check the pulley alignment. Check the driven components for excessive resistance to rotation. Rectify as necessary
Drive belt does not hold tension	• Belt condition • Tensioner fault	Check the belt condition (see visual inspection). Check the tensioner function. Rectify as necessary

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.
REFER to: Diagnostic Trouble Code (DTC) Index - TDV8 4.4L Diesel, DTC: Module Name: Engine Control Module (100-00, Description and Operation).

Published: 22-Oct-2013

Accessory Drive - TDV8 4.4L Diesel - Accessory Drive Belt

Removal and Installation

Removal

NOTES:

Removal steps in this procedure may contain installation details.

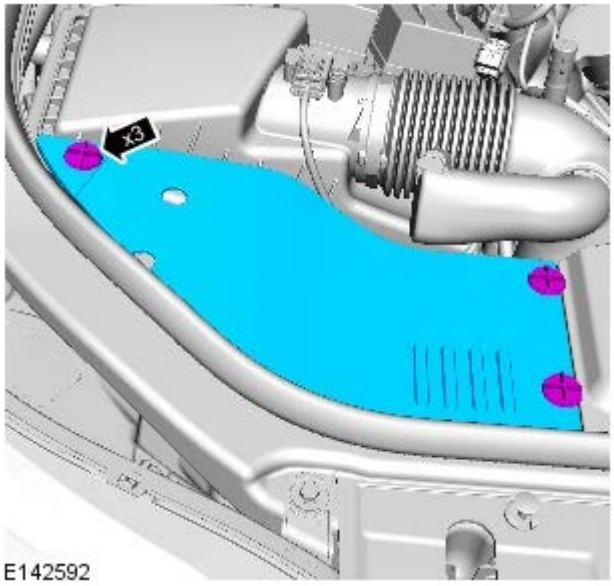
Some variation in the illustrations may occur, but the essential information is always correct.

1. Disconnect the battery ground cable.

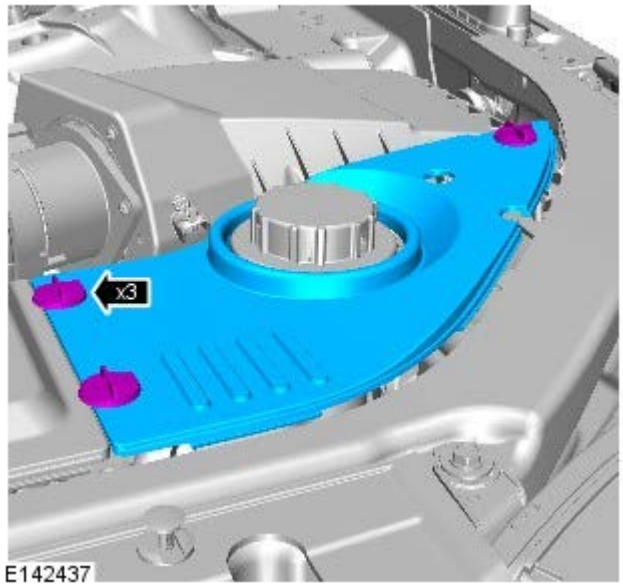
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

2. Refer to: Air Cleaner Outlet Pipe LH (303-12D Intake Air Distribution and Filtering - TDV8 4.4L Diesel, Removal and Installation).

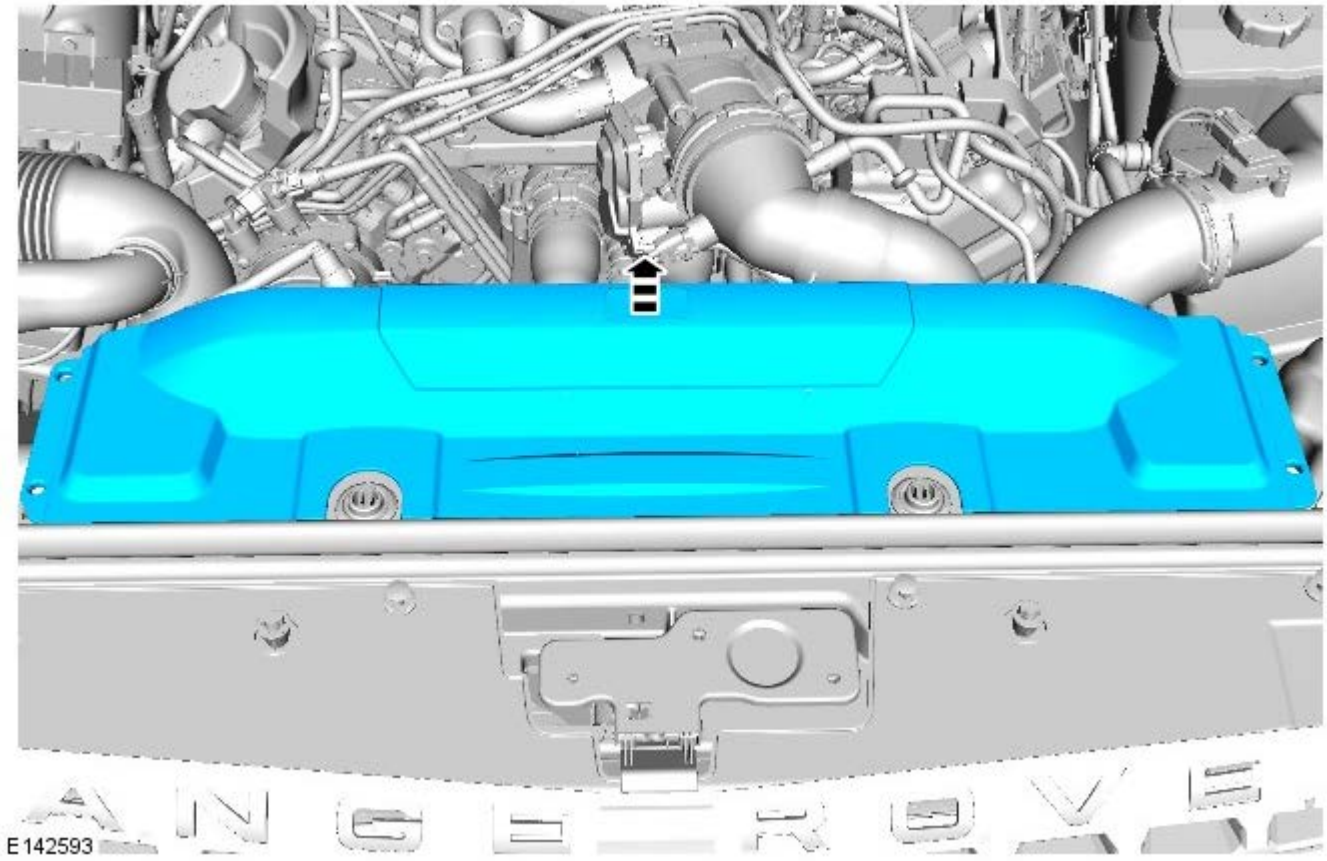
3.



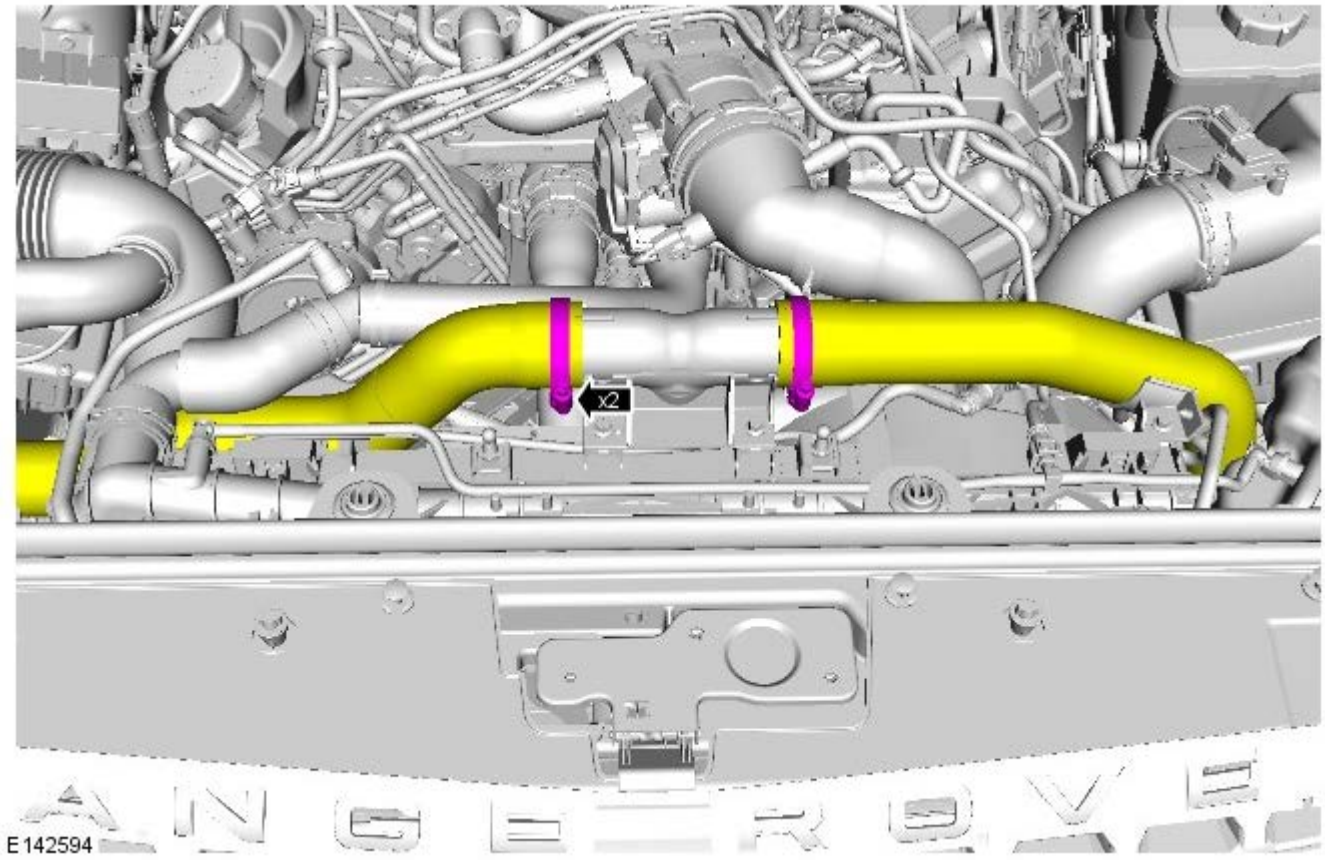
4.



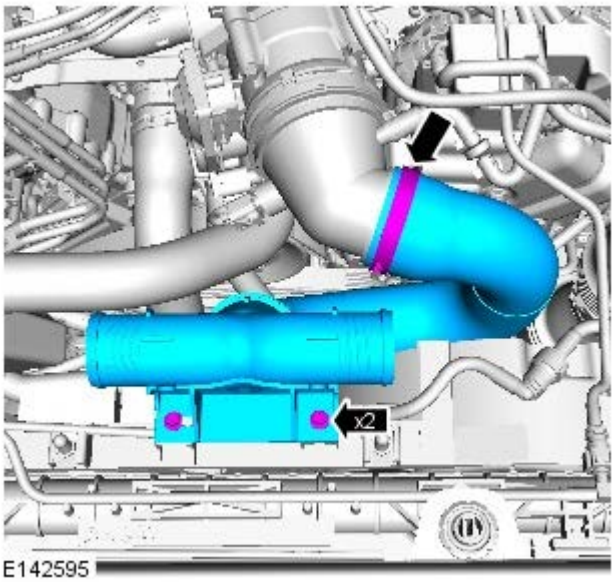
5.



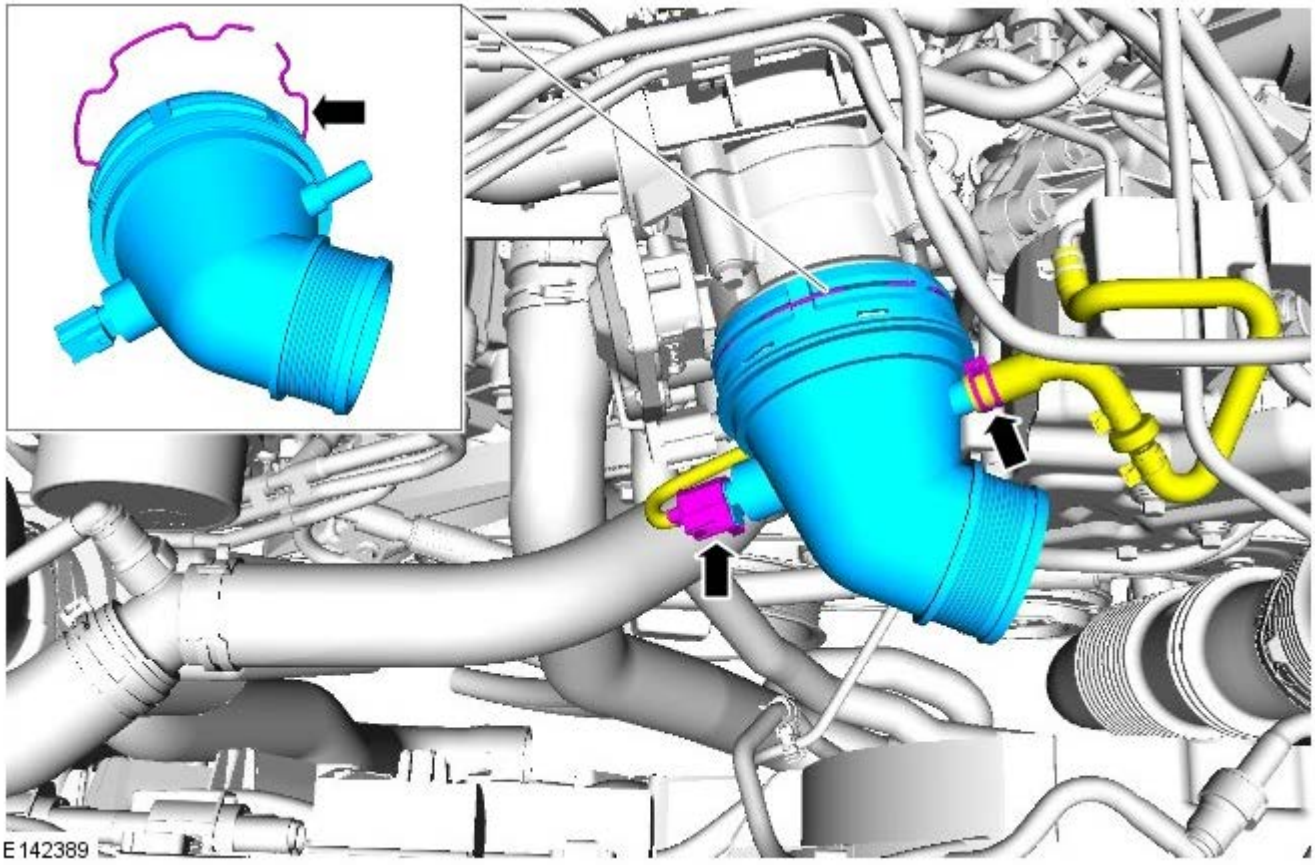
6.



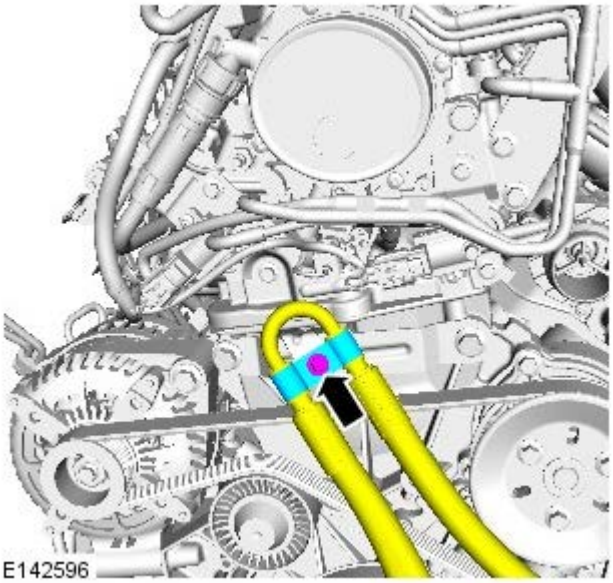
7. *Torque:* 10 Nm

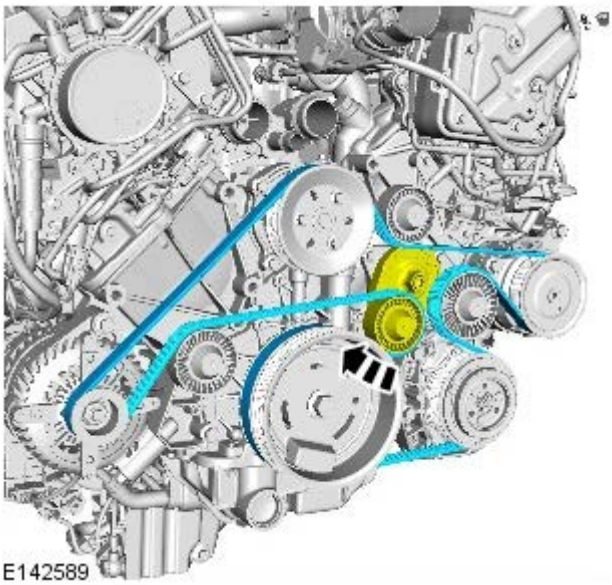


8.



9. *Torque:* 10 Nm





10. CAUTIONS:

    Make sure that the accessory drive belt is correctly seated in all of the pulley grooves.

    Make sure that the accessory drive belt is correctly routed around all of the pulleys.

Installation

1. CAUTIONS:

   Clean and inspect the accessory drive belt pulleys for damage.

   Ensure the drive belt is correctly seated in all the pulley grooves.

   To install, reverse the removal procedure.

Published: 22-Oct-2013

Accessory Drive - TDV8 4.4L Diesel - Accessory Drive Belt Tensioner

Removal and Installation

Removal

NOTES:

Removal steps in this procedure may contain installation details.

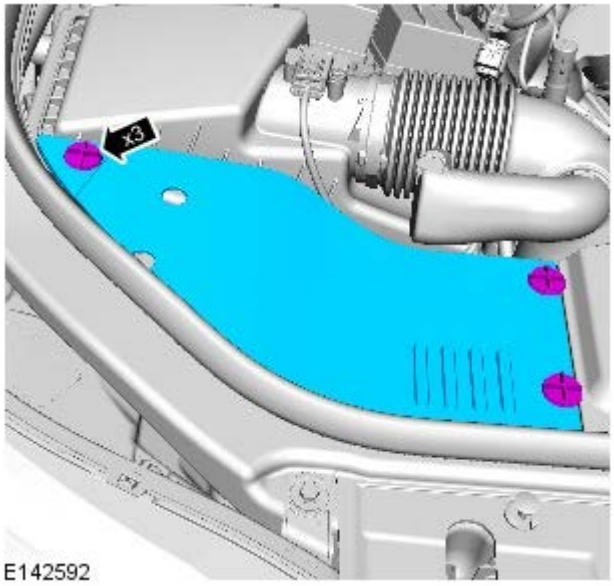
Some variation in the illustrations may occur, but the essential information is always correct.

1. Disconnect the battery ground cable.

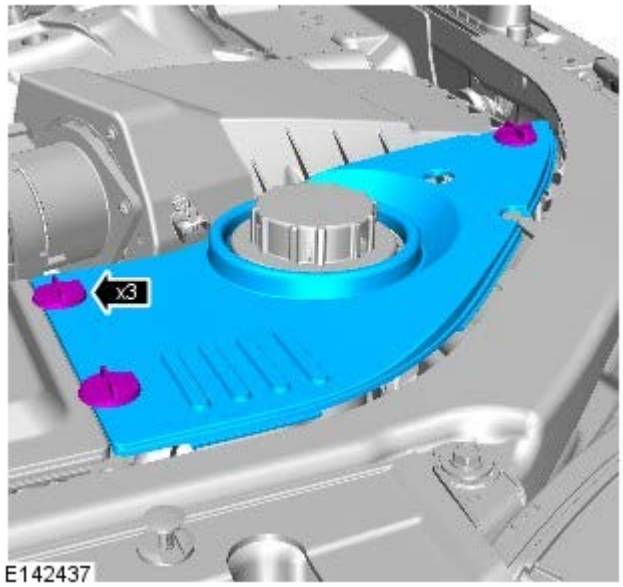
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

2. Refer to: Air Cleaner Outlet Pipe LH (303-12D Intake Air Distribution and Filtering - TDV8 4.4L Diesel, Removal and Installation).

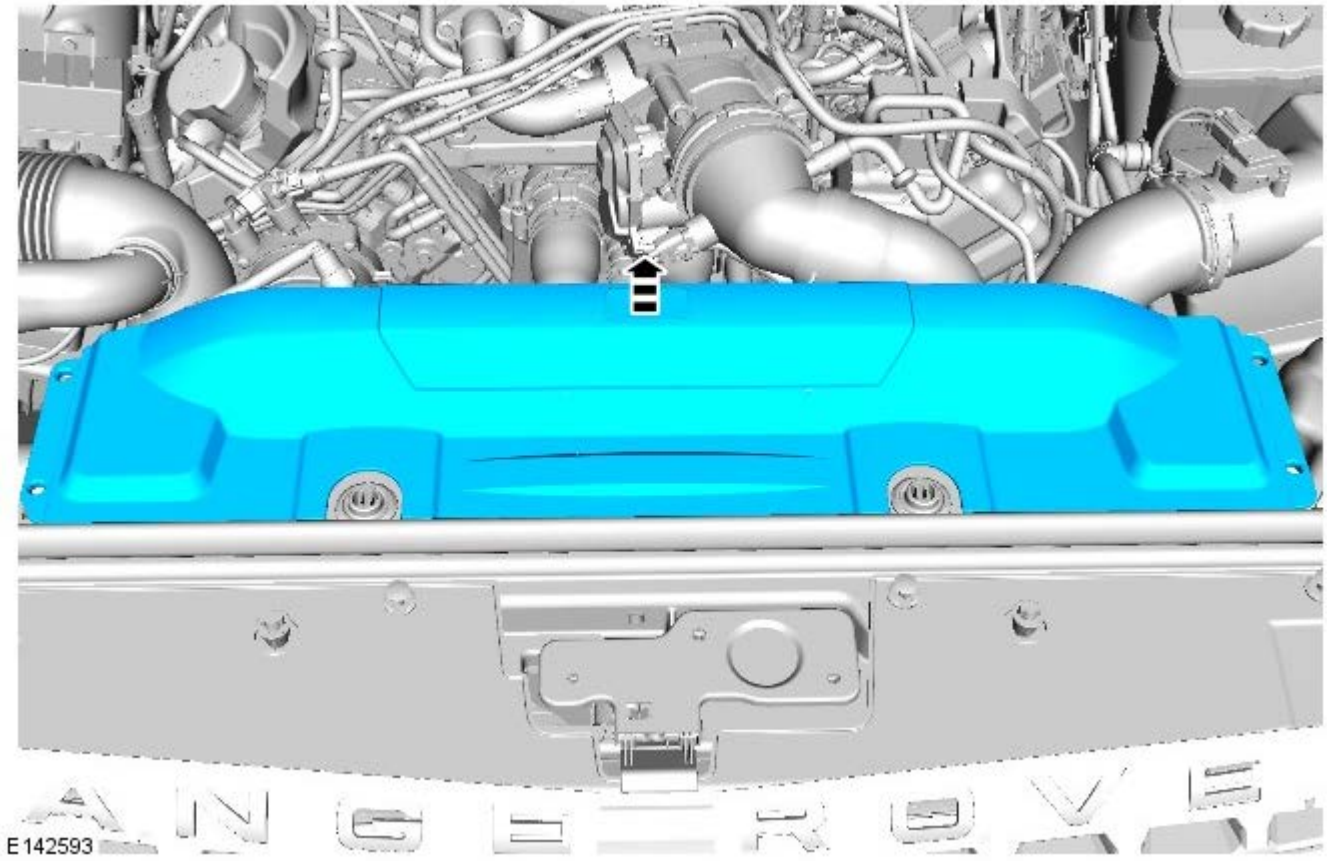
3.



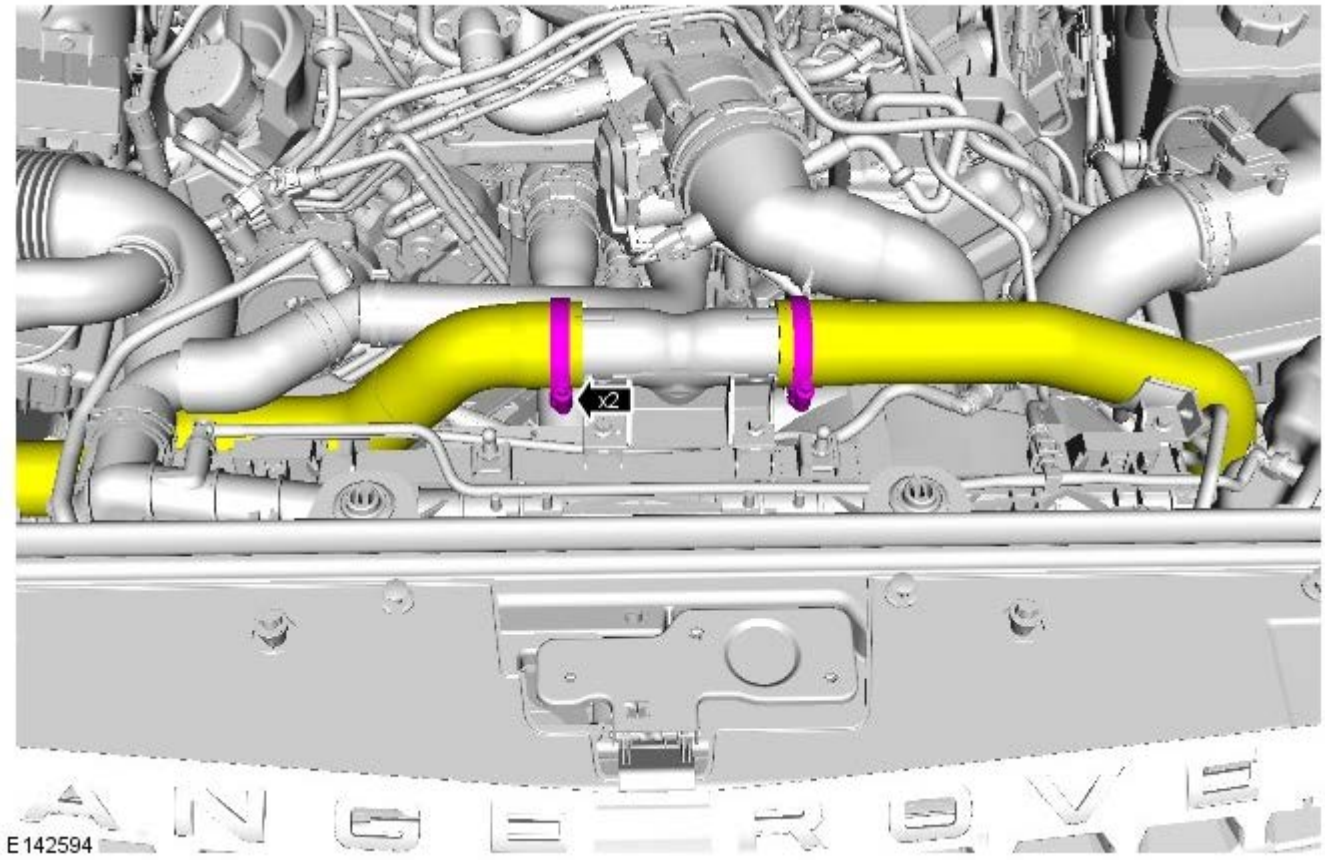
4.



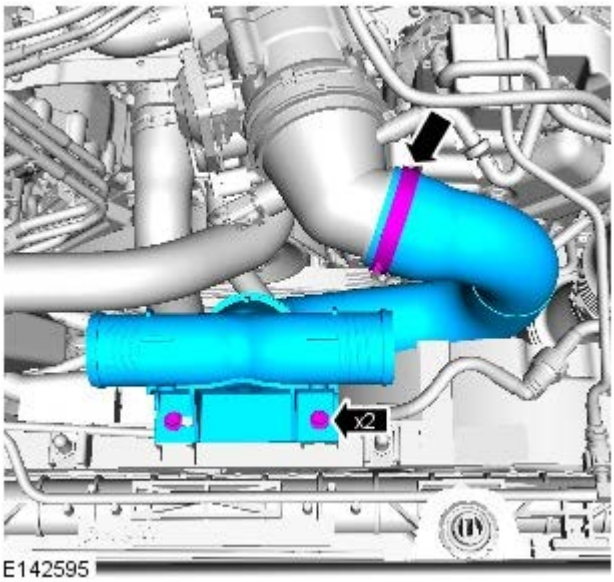
5.



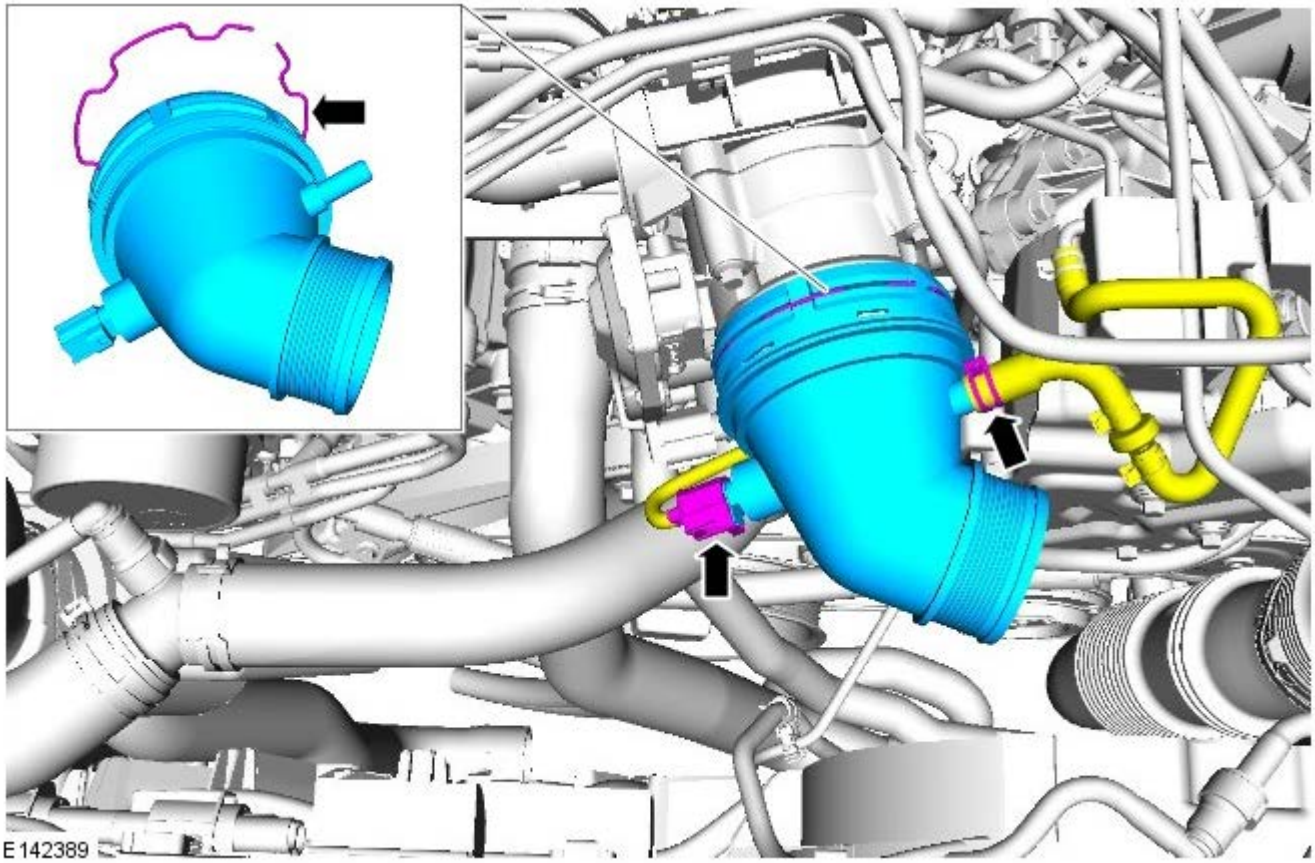
6.



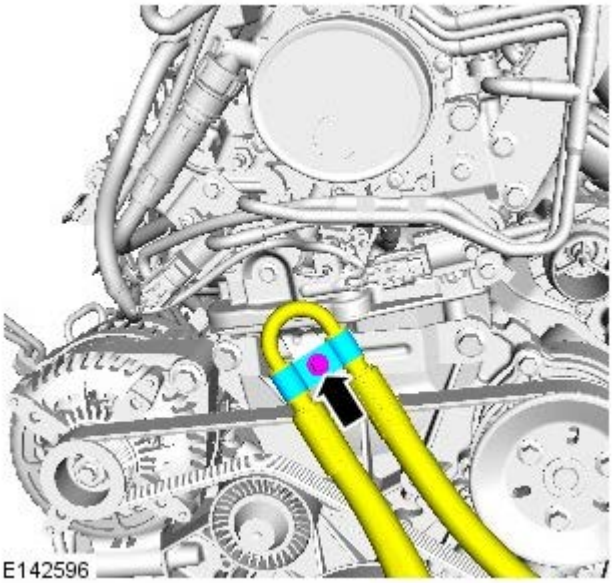
7.

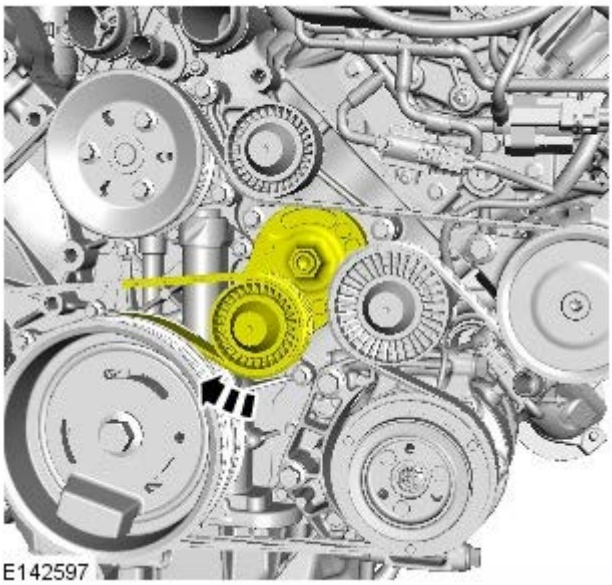


8.



9.

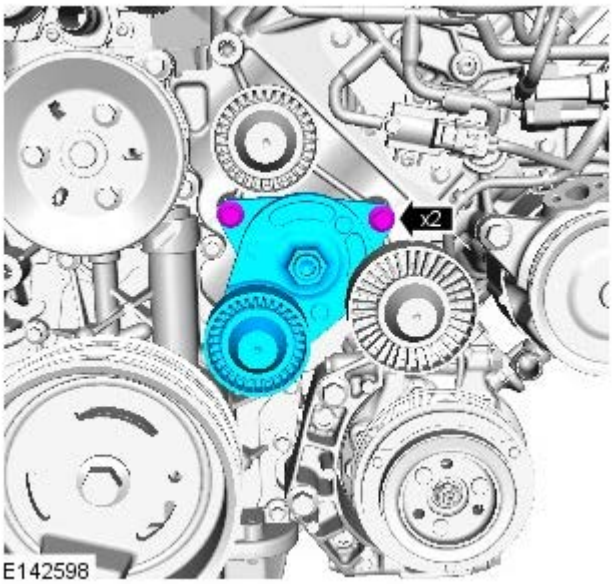




10. CAUTIONS:

    Make sure that the accessory drive belt is correctly located on each pulley.

    Make sure that the accessory drive belt is correctly routed around all of the pulleys.



11. *Torque:* 25 Nm

Installation

1. To install, reverse the removal procedure.

Published: 04-Aug-2012

Accessory Drive - TDV8 4.4L Diesel - Accessory Drive Belt Idler Pulley

Removal and Installation

Removal

NOTES:

Removal steps in this procedure may contain installation details.

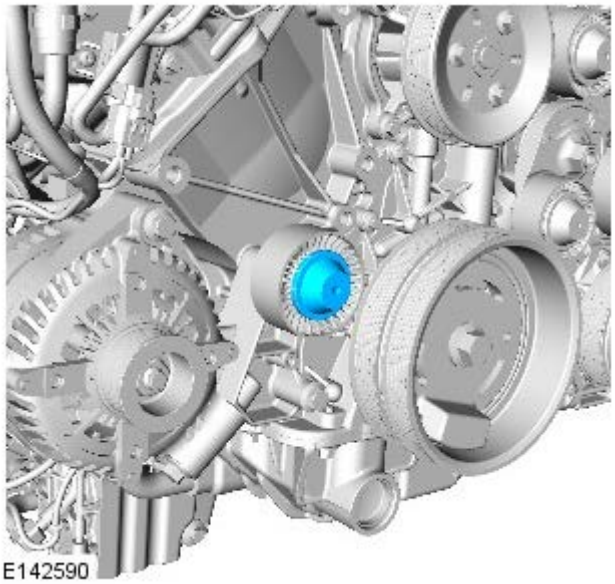
Some variation in the illustrations may occur, but the essential information is always correct.

1. Disconnect the battery ground cable.

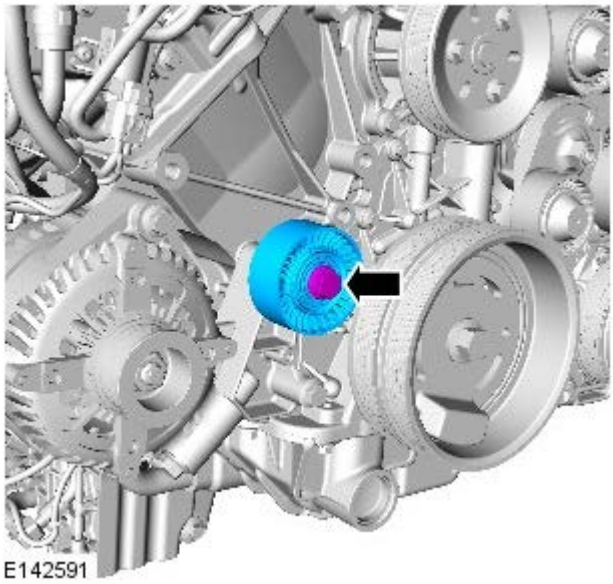
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

2. Refer to: Accessory Drive Belt (303-05 Accessory Drive - TDV8 4.4L Diesel, Removal and Installation).

3.



4. *Torque:* 62 Nm



Installation

1. To install, reverse the removal procedure.

Published: 31-Jul-2012

Accessory Drive - SDV6 3.0L Diesel - Hybrid Electric Vehicle -

Torque Specification

NOTE: **A = refer to procedure for correct torque sequence**

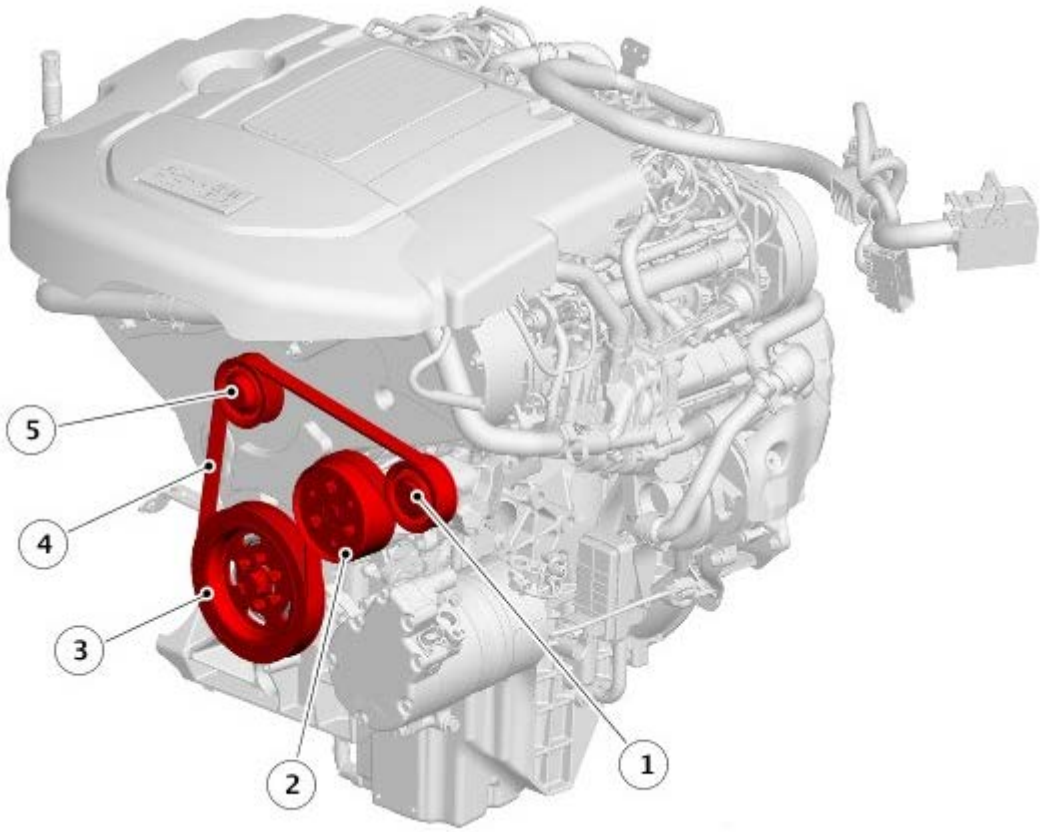
Description	Nm	lb-ft
Accessory drive belt tensioner retaining bolt	48	35
Accessory drive belt idler pulley retaining bolt	48	35
Fuel injection pump sprocket retaining nut	**A**	-
Camshaft rear hub bolt	Stage 1 - 80 Stage 2 - 80 degrees	Stage 1 - 59 Stage 2 - 80 degrees
Camshaft rear pulley retaining bolts	23	17
Rear end accessory drive belt (READ) belt tensioner retaining bolt	23	17

Published: 14-Jun-2013

Accessory Drive - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Accessory Drive

Description and Operation

COMPONENT LOCATION



E157258

Item	Part Number	Description
1	-	Idler pulley
2	-	Coolant pump pulley
3	-	Crankshaft pulley/torsional vibration damper
4	-	Accessory drive belt
5	-	Idler pulley

OVERVIEW

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 the engine coolant pump via a six-ribbed poly-V belt. Two idler pulleys guide the drive belt clear of obstructions and sets the correct 'wrap-around' of the coolant pump pulley to ensure a slip-free drive.

Published: 06-Sep-2013

Accessory Drive - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Accessory Drive Belt

Removal and Installation

Removal

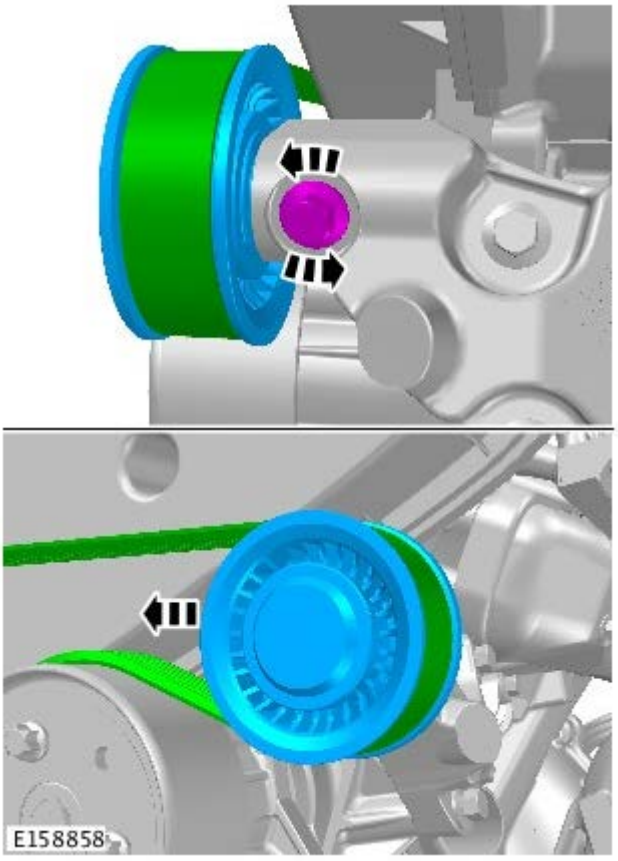
NOTES:

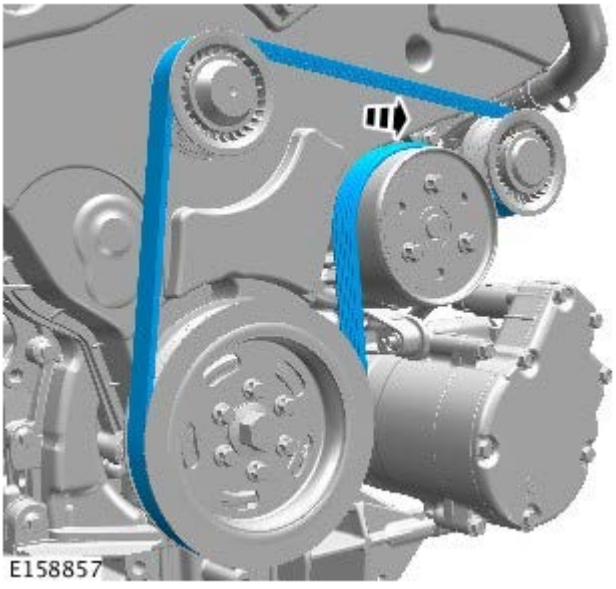
Removal steps in this procedure may contain installation details.

Some variation in the illustrations may occur, but the essential information is always correct.

1. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05 Interior Trim and Ornamentation, Removal and Installation).

2.





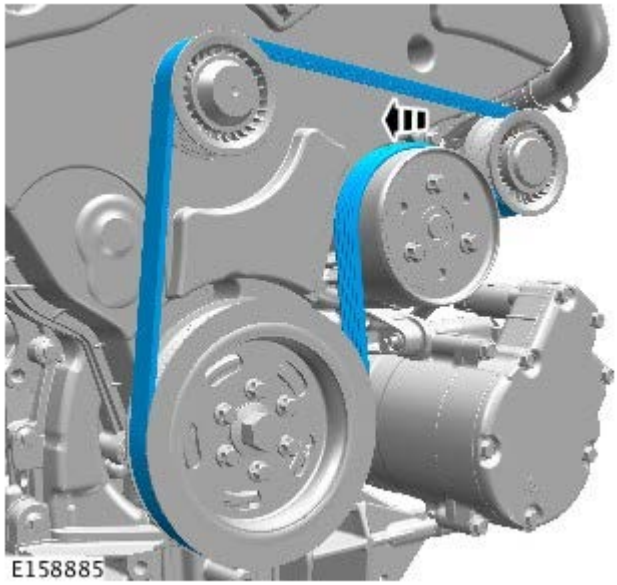
3. NOTES:

Note the fitted position of the accessory drive belt.

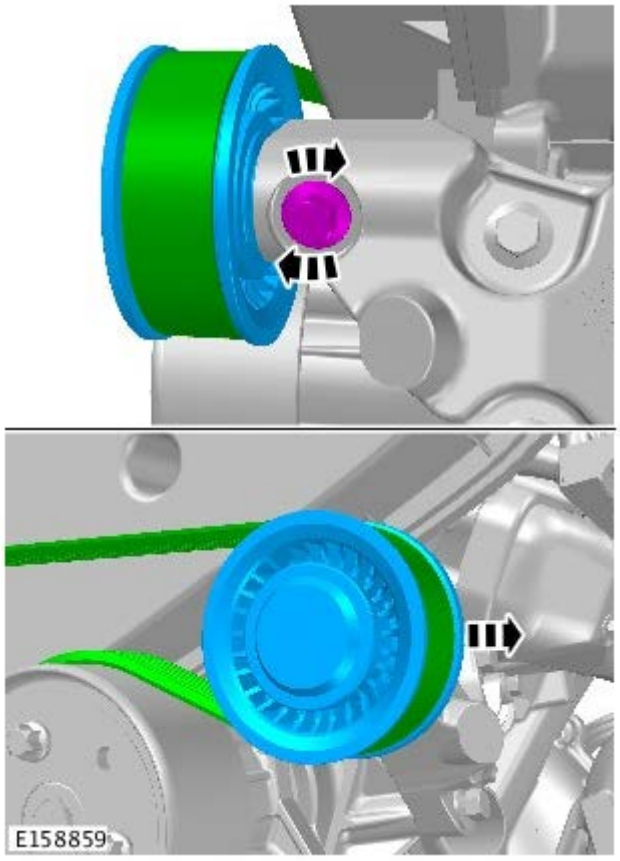
Engine shown removed for clarity.

Installation

1.



2. *Torque:* 32 Nm



3. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05 Interior Trim and Ornamentation, Removal and Installation).

Published: 06-Sep-2013

Accessory Drive - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Accessory Drive Belt Idler Pulley

Removal and Installation

Removal

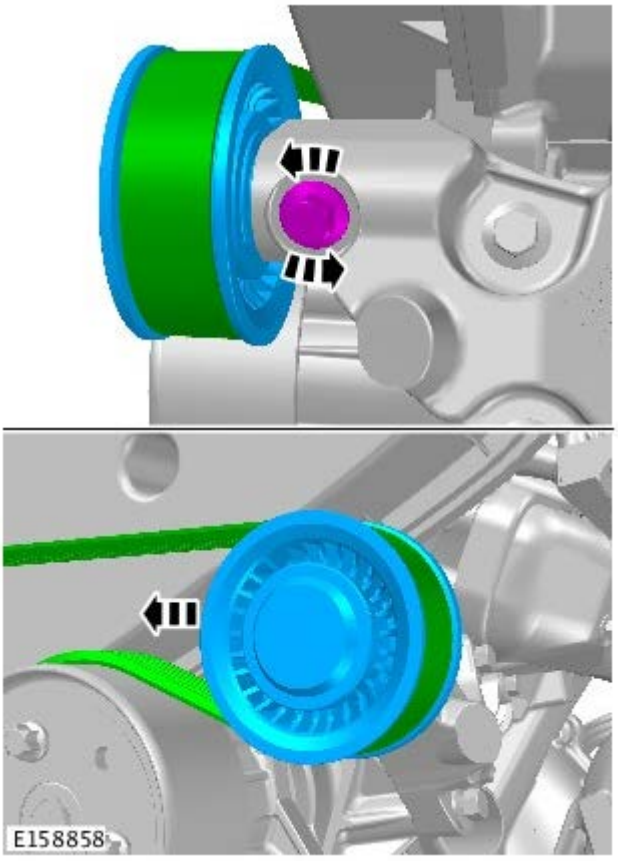
NOTES:

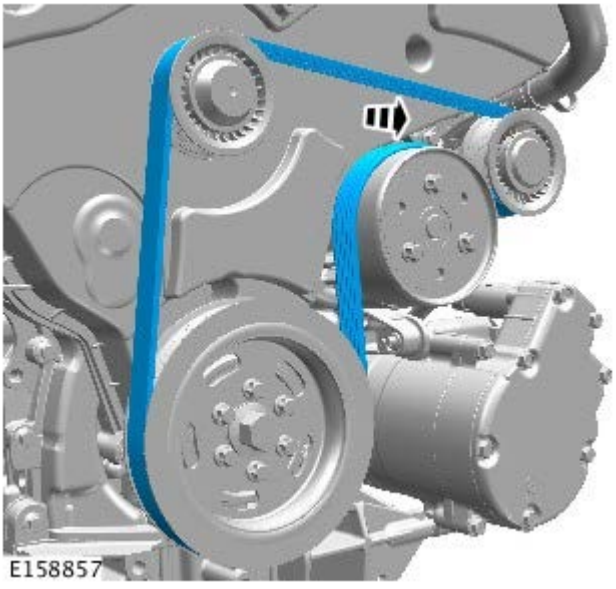
Removal steps in this procedure may contain installation details.

Some variation in the illustrations may occur, but the essential information is always correct.

1. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05 Interior Trim and Ornamentation, Removal and Installation).

2.



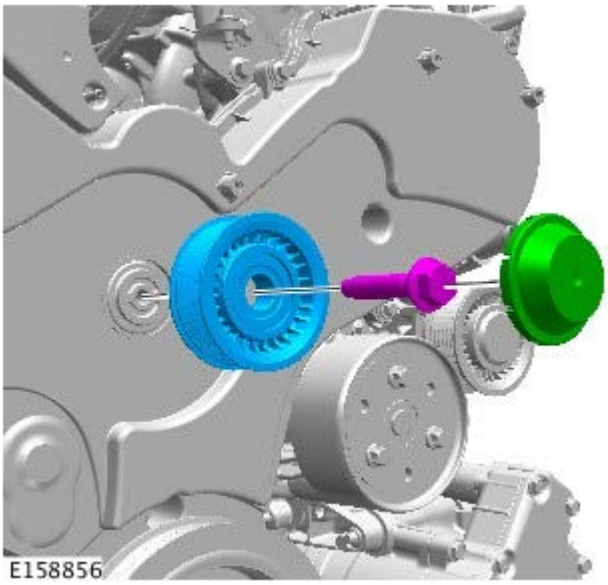


3. NOTES:

Engine shown removed for clarity.

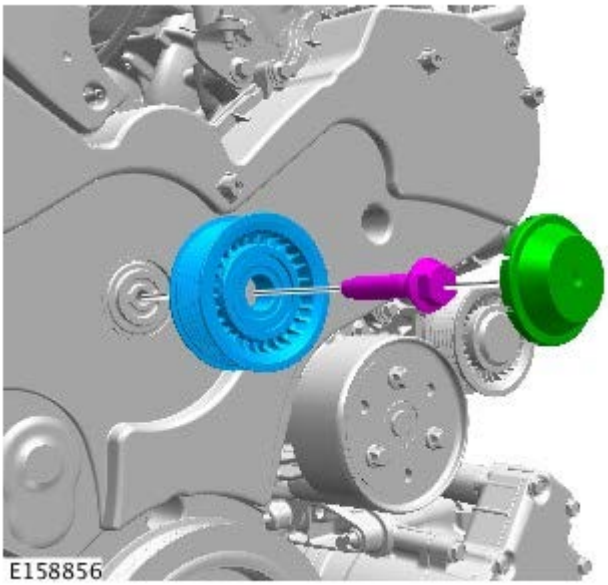
Note the fitted position of the accessory drive belt.

4.

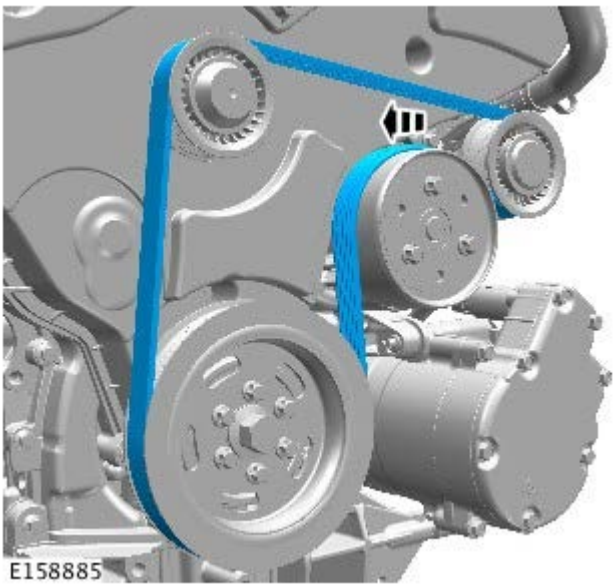


Installation

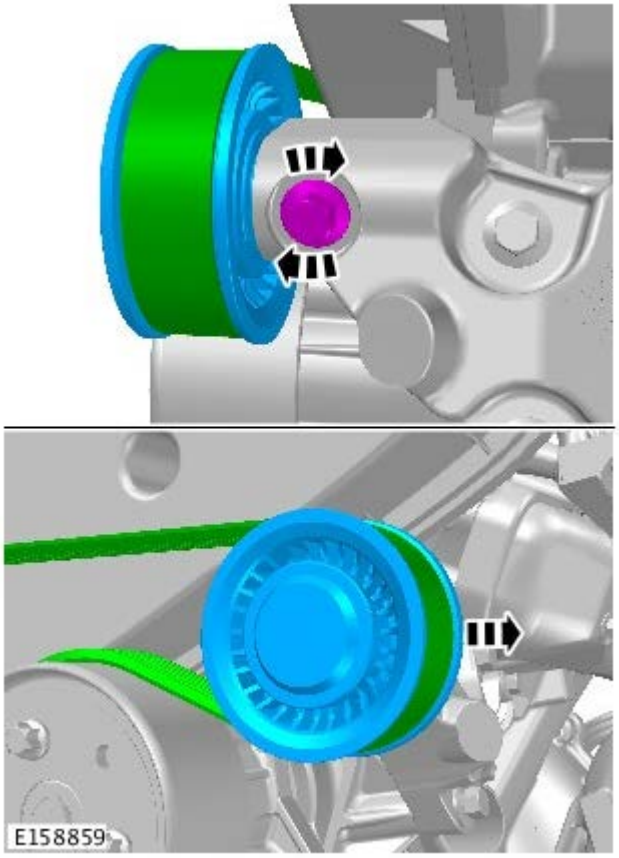
1. *Torque:* 50 Nm



2.



3. *Torque:* 32 Nm



4. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05 Interior Trim and Ornamentation, Removal and Installation).

Published: 06-Sep-2013

Accessory Drive - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Accessory Drive Belt Tensioner

Removal and Installation

Removal

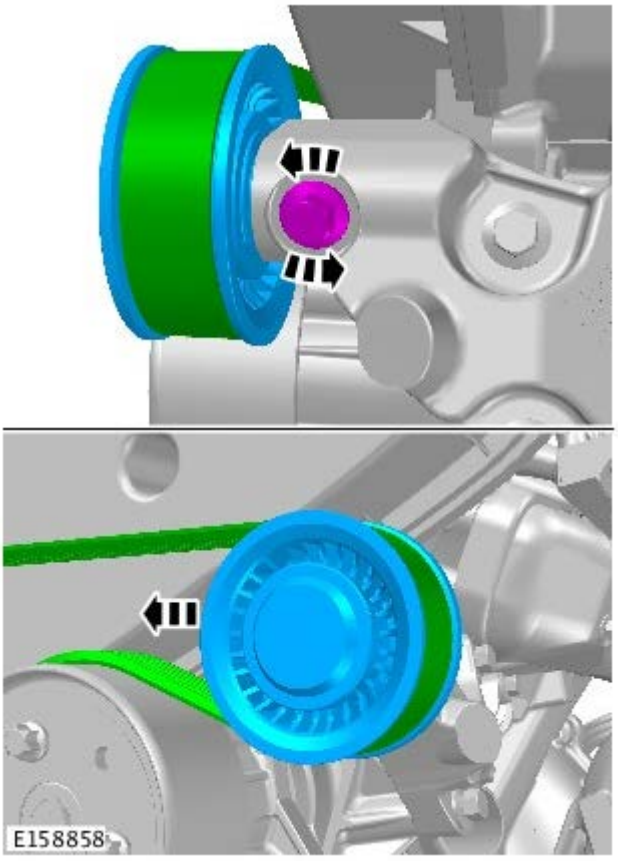
NOTES:

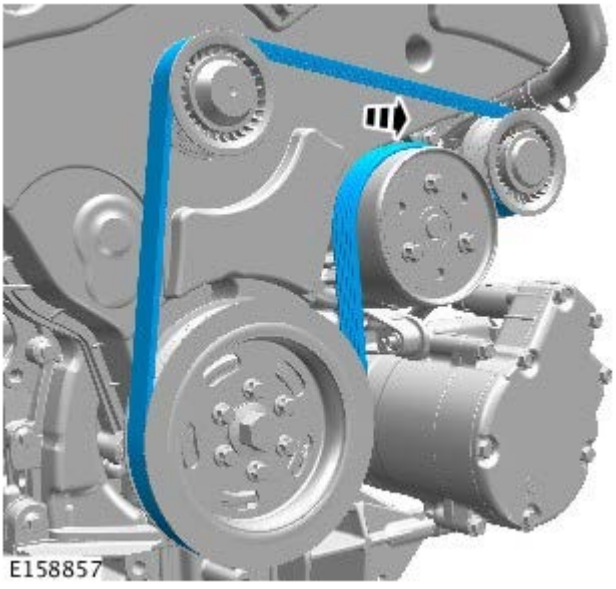
Removal steps in this procedure may contain installation details.

Some variation in the illustrations may occur, but the essential information is always correct.

1. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05 Interior Trim and Ornamentation, Removal and Installation).

2.



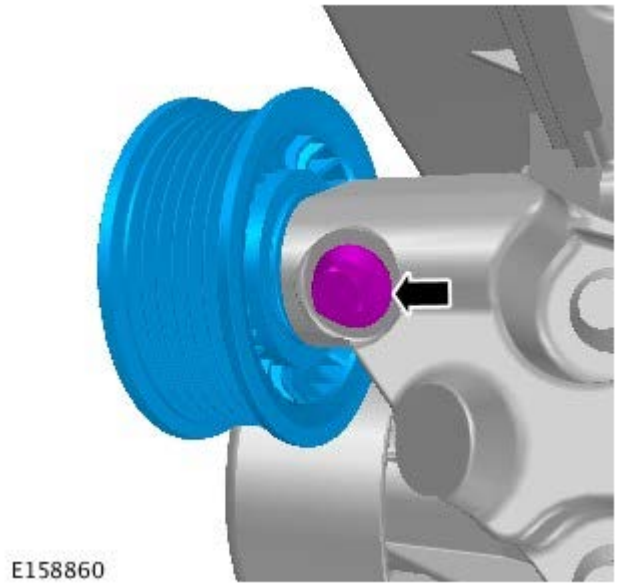


3. NOTES:

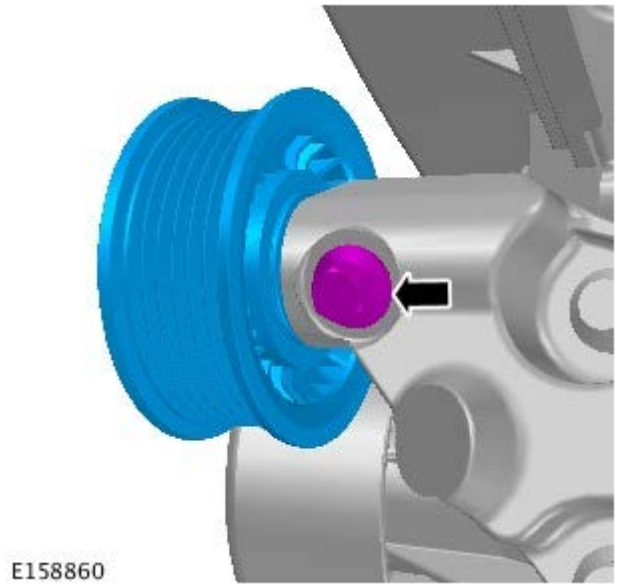
Engine shown removed for clarity.

Note the fitted position of the accessory drive belt.

4.

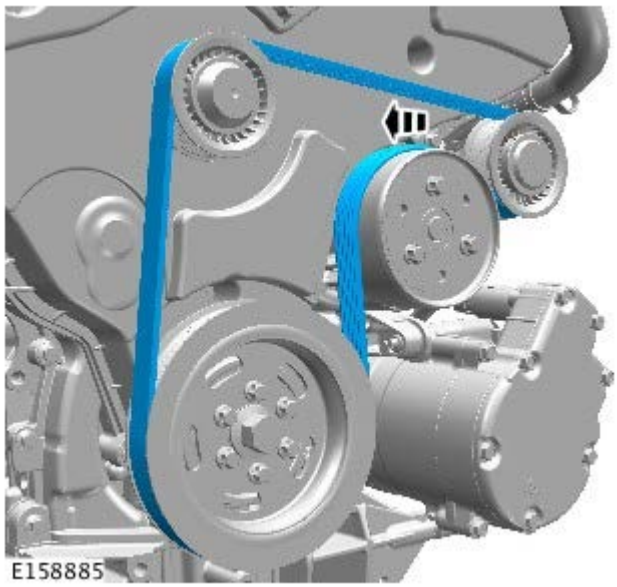


Installation

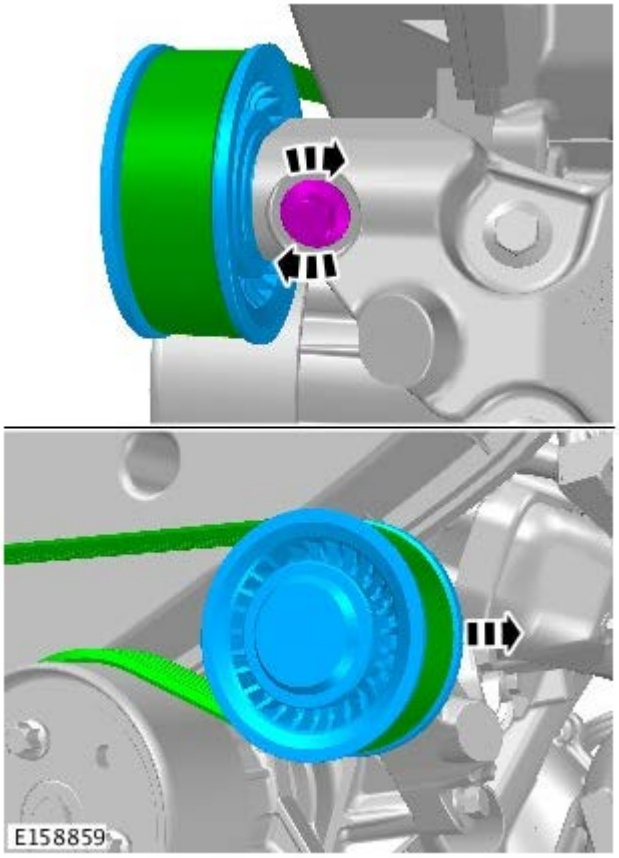


1. NOTE: Only tighten the bolt finger tight at this stage.

2.



3. *Torque:* 32 Nm



4. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05 Interior Trim and Ornamentation, Removal and Installation).

Published: 05-Sep-2012

Accessory Drive - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Fuel Injection Pump Pulley

Removal and Installation

Removal

1. Refer to: Fuel Pump (303-04A Fuel Charging and Controls - TDV6 3.0L Diesel, Removal and Installation).

Installation

1. To install, reverse the removal procedure.

Published: 10-Sep-2012

Accessory Drive - SDV6 3.0L Diesel - Hybrid Electric Vehicle - 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.

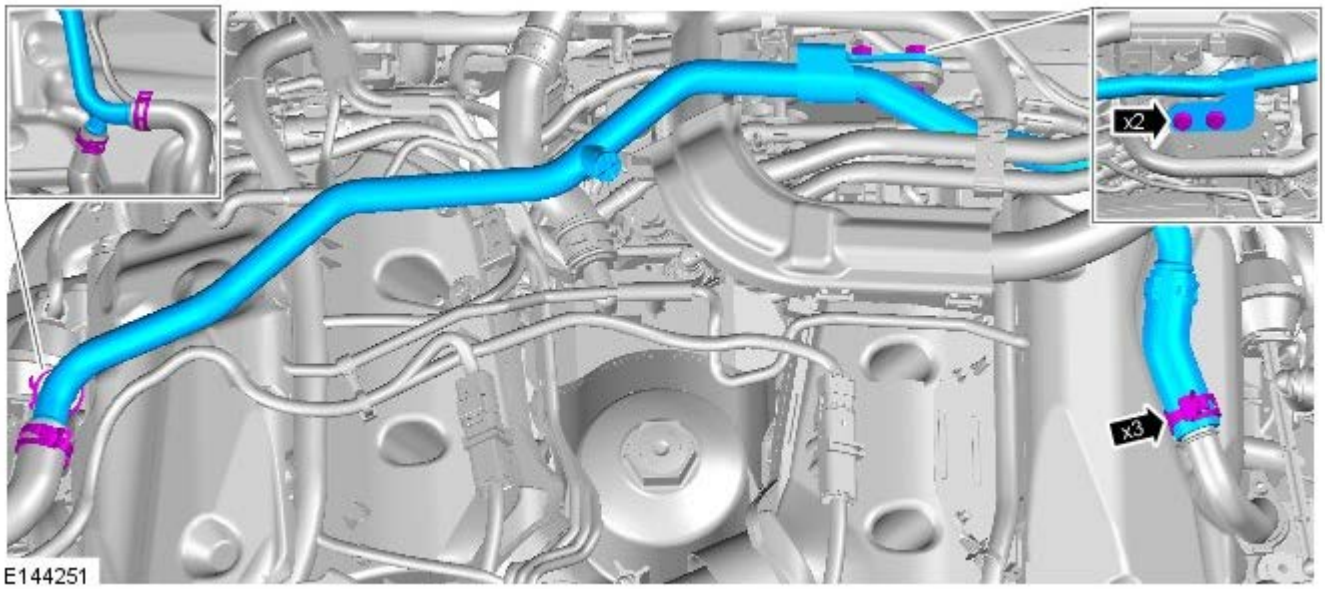
Do not disassemble or clean inside the fuel pump, even with an ultrasonic cleaner. Always install a new fuel pump when required.

1. Refer to: Specifications (414-00, Specifications).
2. Refer to: Secondary Bulkhead Center Panel - TDV6 3.0L Diesel (501-02, Removal and Installation).
3. WARNING: Make sure to support the vehicle with axle stands.

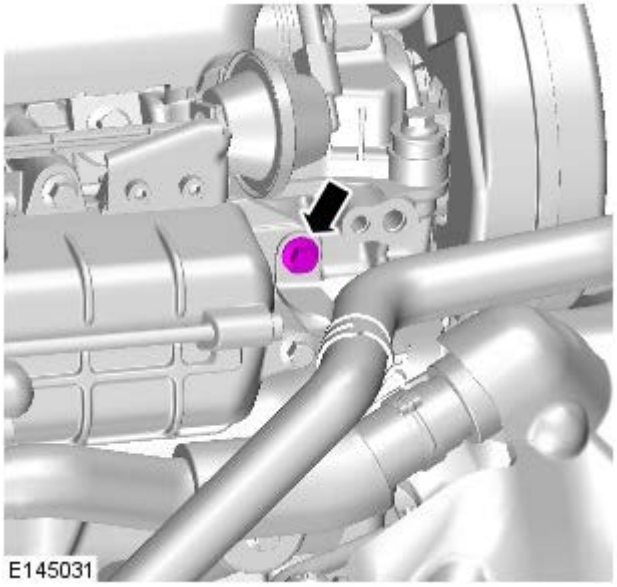
   Raise and support the vehicle.

4. Refer to: Starter Motor (303-06A Starting System - TDV6 3.0L Diesel, Removal and Installation).

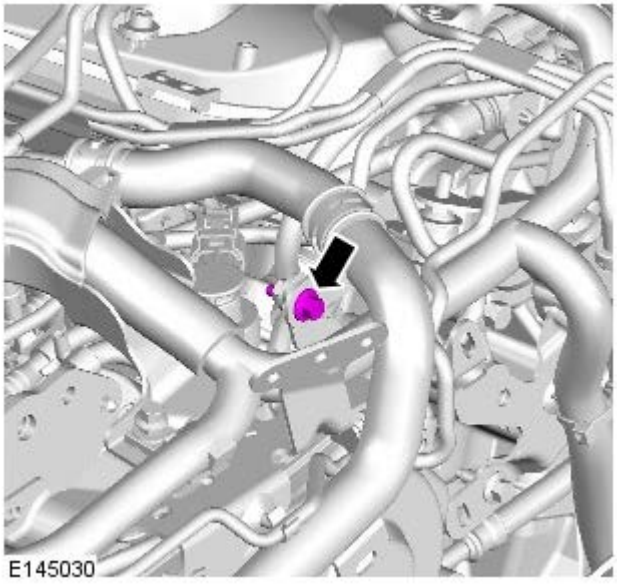
5.

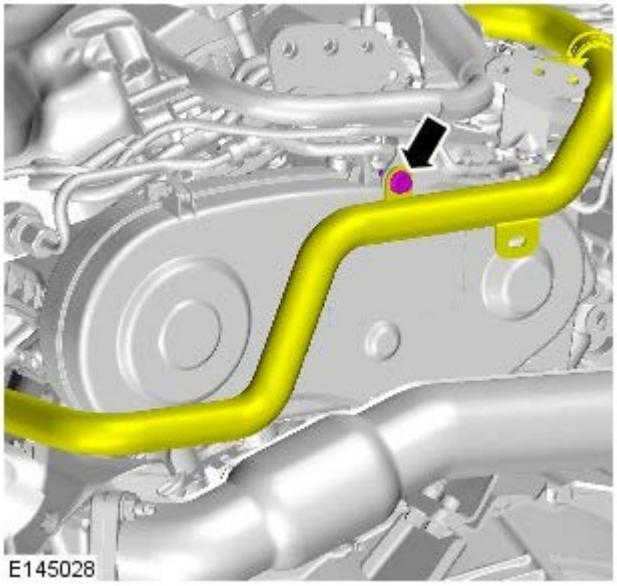


6.

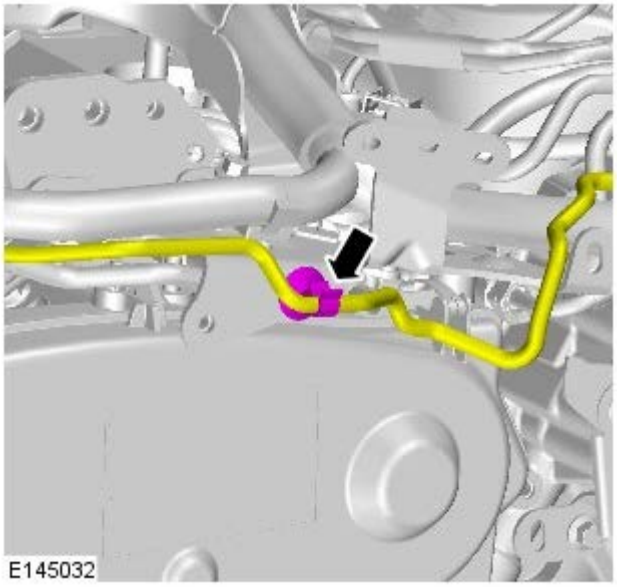


7.



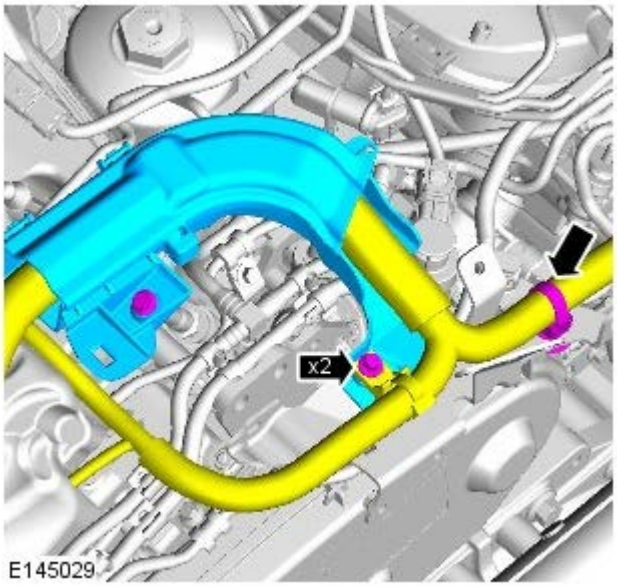


8. NOTE: Engine shown removed for clarity.

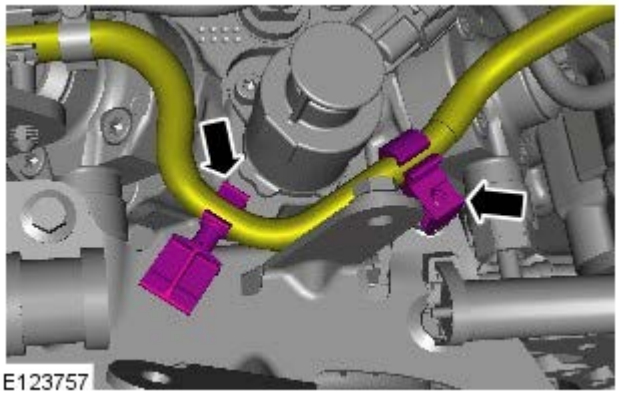


9. NOTE: Engine shown removed for clarity.

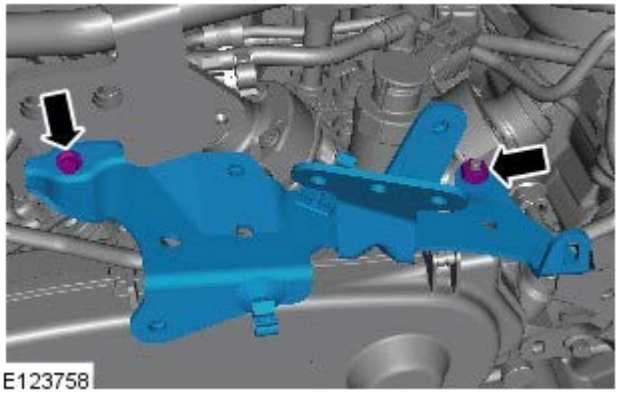
10.



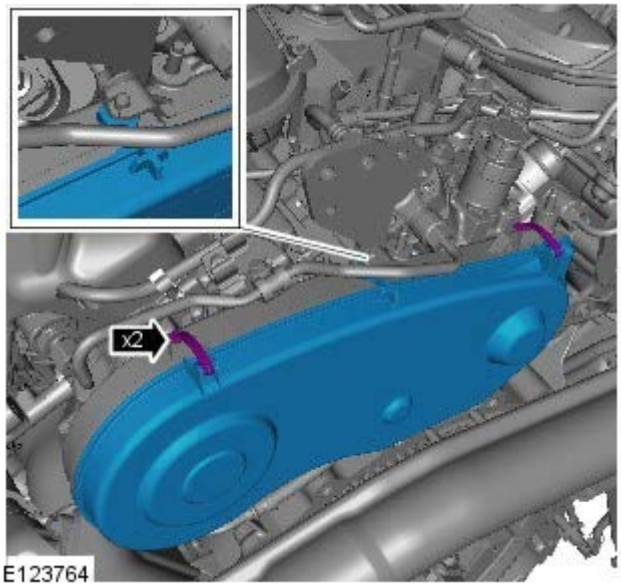
11. NOTE: Engine shown removed for clarity.



12. NOTE: Engine shown removed for clarity.



13.



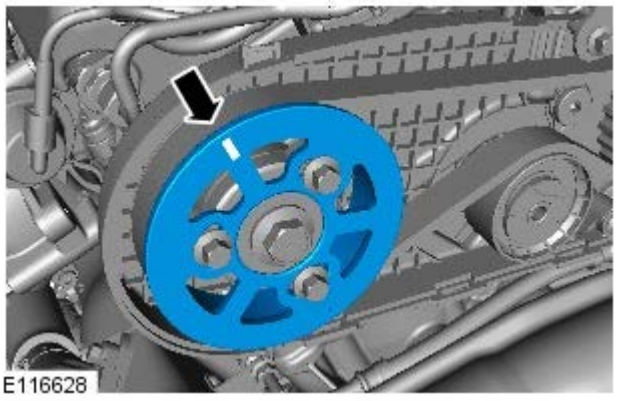
14. CAUTION: Only rotate the crankshaft clockwise.

NOTES:

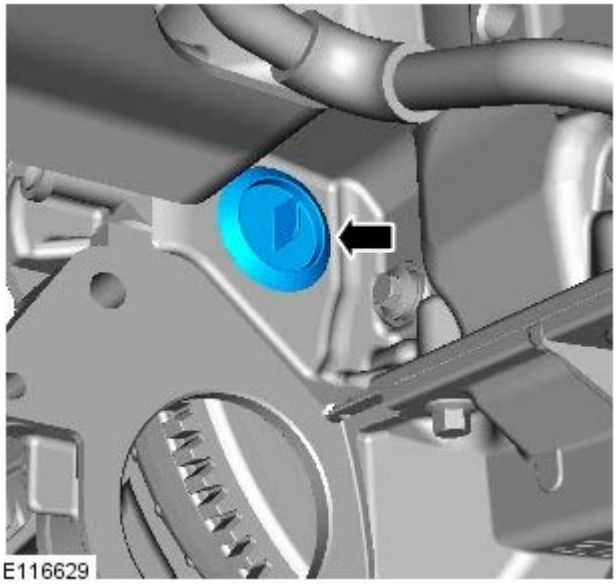
This step requires the aid of another technician.

Engine shown removed for clarity.

Rotate the crankshaft until the mark on the rear camshaft pulley is in the illustrated position.

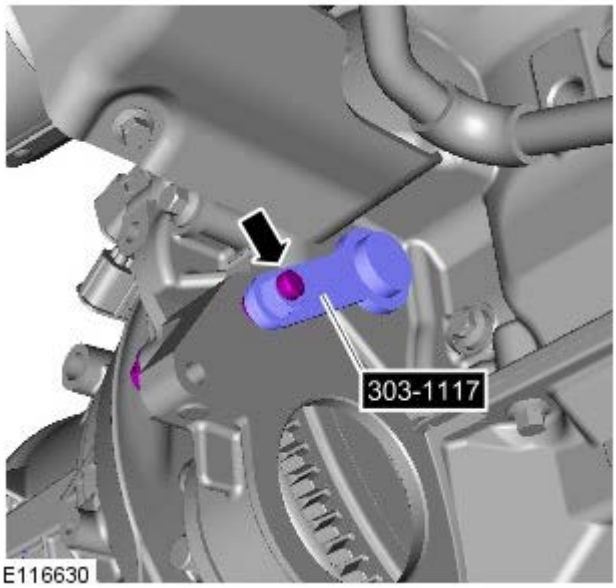


15.


E116629

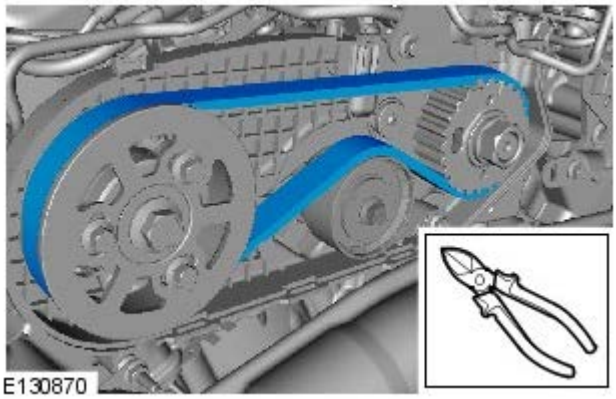
16.

- Install the special tool.
- *Special Tool(s):* 303-1117

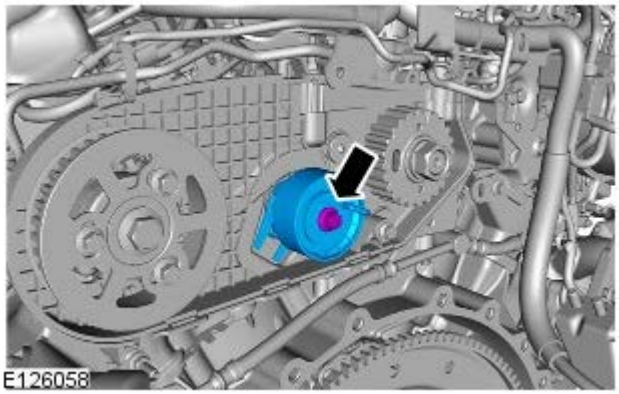


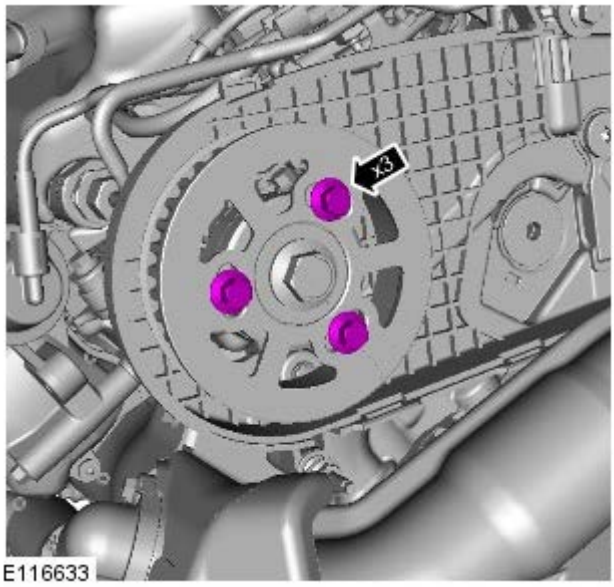
E116630

17.


E130870

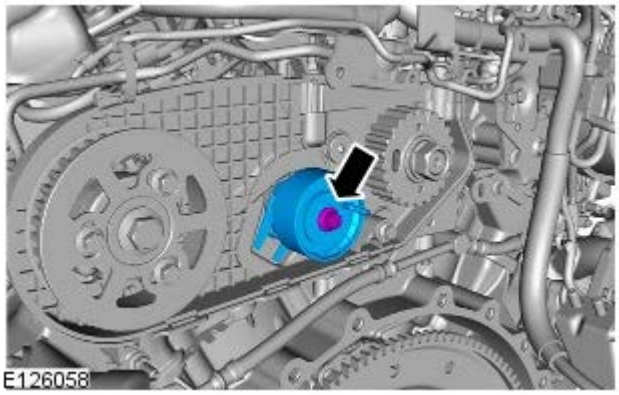
18. CAUTION: Discard the component.





19. NOTE: Do not loosen the bolts more than 2 turns.

Installation

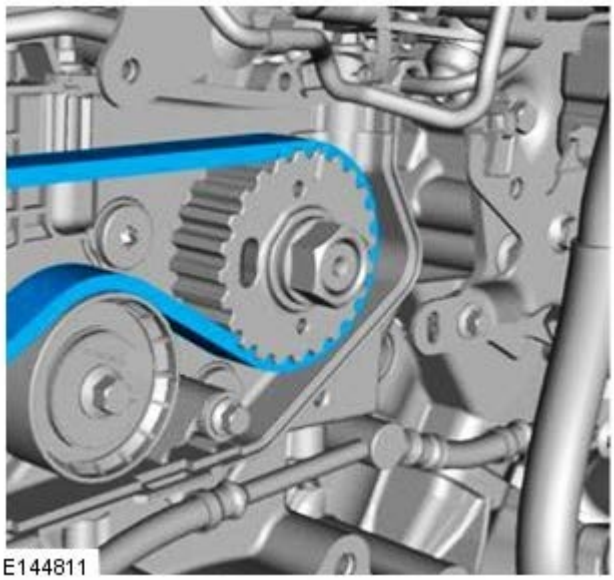


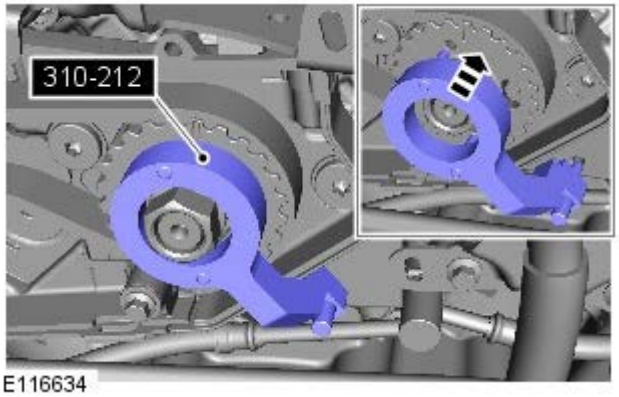
1. CAUTION: Make sure that the READ belt tensioner tang is correctly located to the READ belt rear cover. Failure to follow this instruction may result in damage to the engine.

   NOTE: Make sure that the READ belt tensioner locking pin is not removed until the READ belt is fully installed.

   Torque: 23 Nm

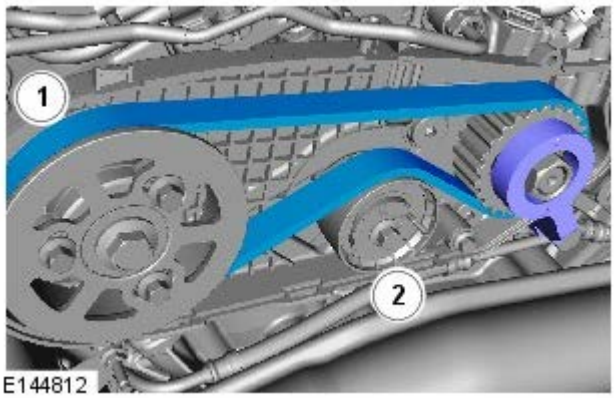
2. NOTE: Make sure the new READ belt is correctly seated onto the fuel pump pulley.


E144811



E116634

3.
- Install the special tool.
- *Special Tool(s):* 310-212



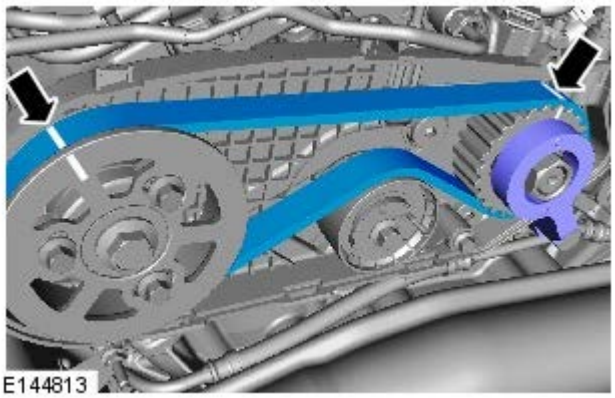
E144812

4. 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.

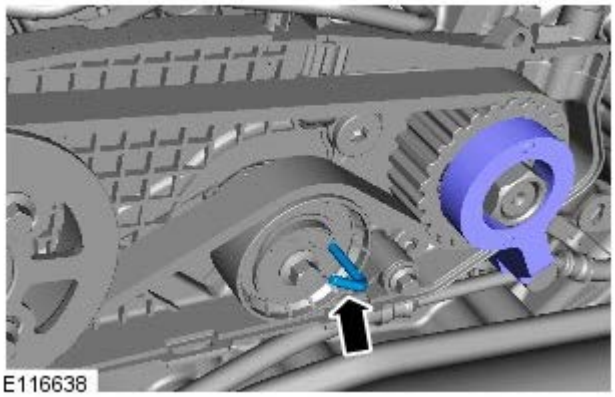
Install the READ belt onto the camshaft pulley (1) and on to the tensioner (2).

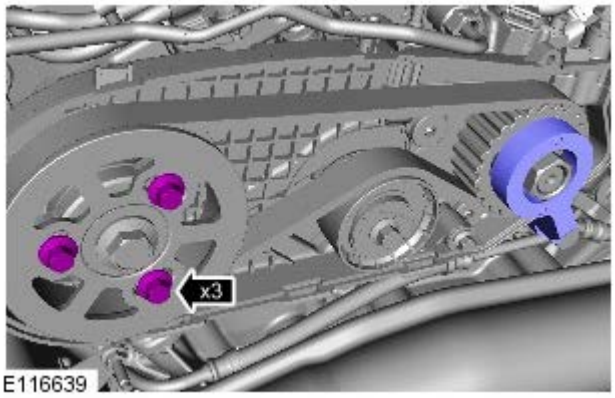

E144813

5. NOTE: Make sure that the READ belt tensioner locking pin is not removed until the READ belt is fully installed.

Make sure that the rear end accessory drive (READ) belt is aligned with the marks on the rear camshaft pulley and fuel injection pump pulley as illustrated.

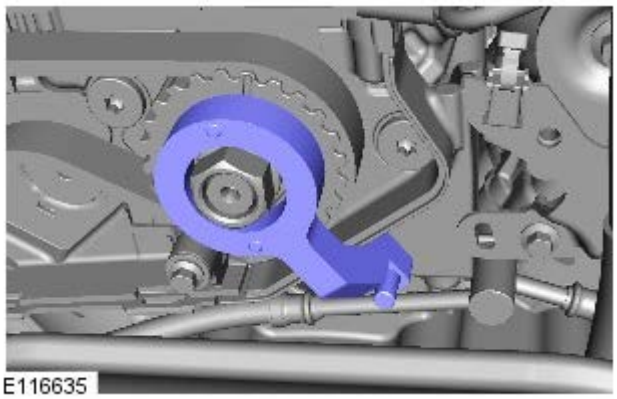
6. NOTE: Engine shown removed for clarity.





7. NOTE: Engine shown removed for clarity.

   Torque: 23 Nm

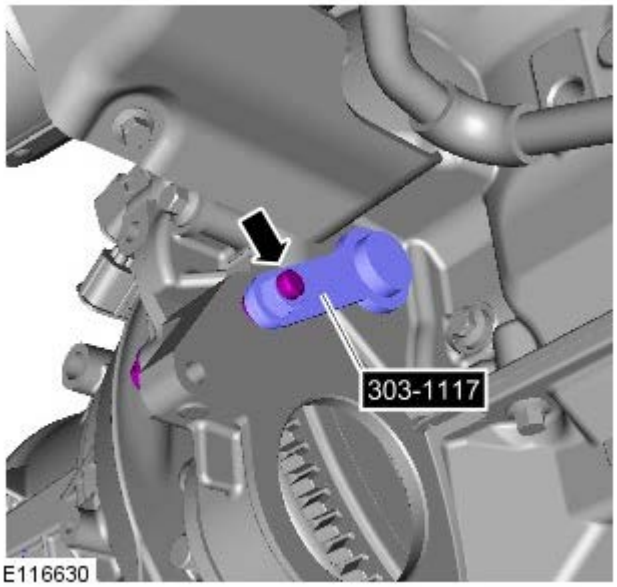


8. NOTE: Engine shown removed for clarity.

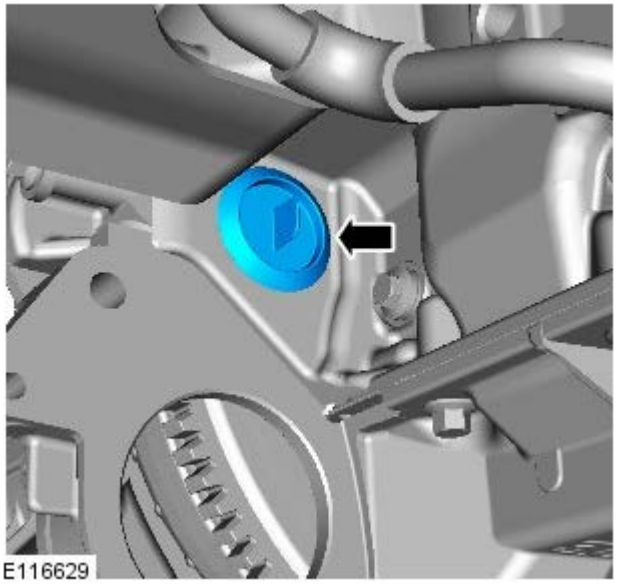
   - Remove the special tool.
   - *Special Tool(s):* 310-212

9. Remove the special tool.

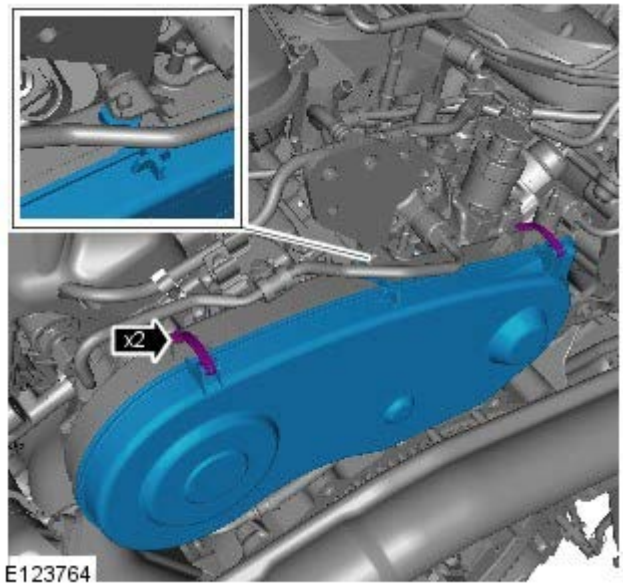
   Special Tool(s): 303-1117



10.

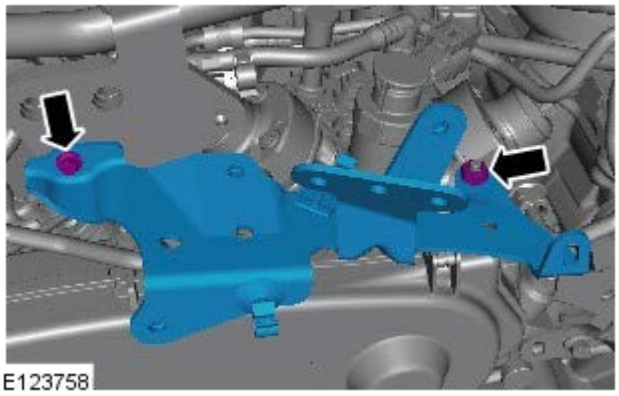


11.

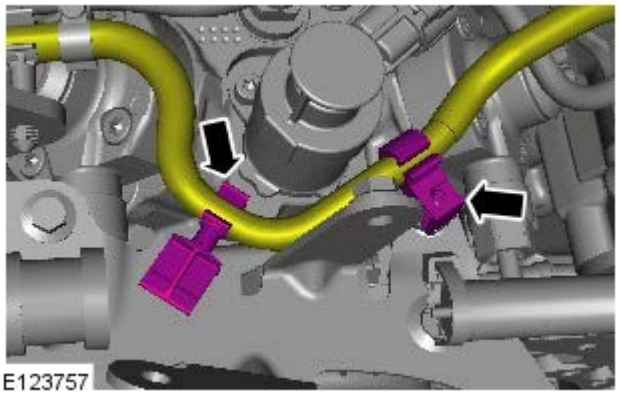


12. NOTE: Engine shown removed for clarity.

- *Torque:* 10 Nm

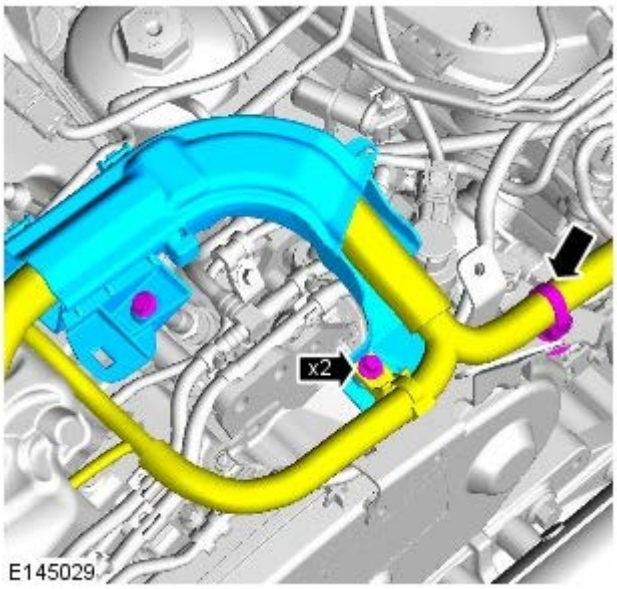


13. NOTE: Engine shown removed for clarity.

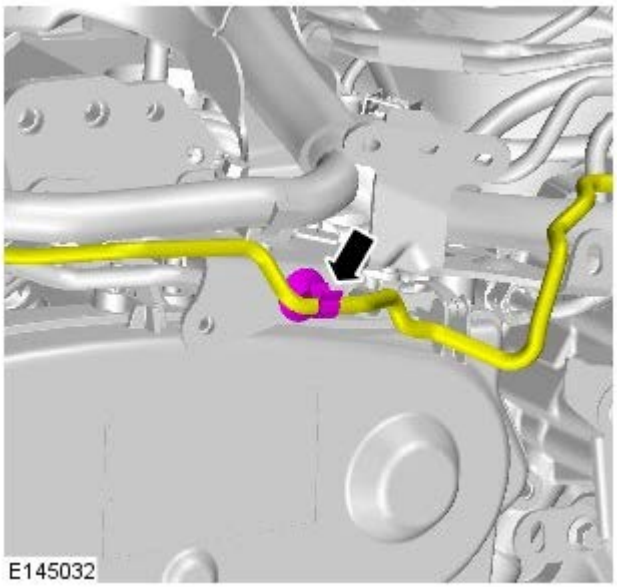


14.

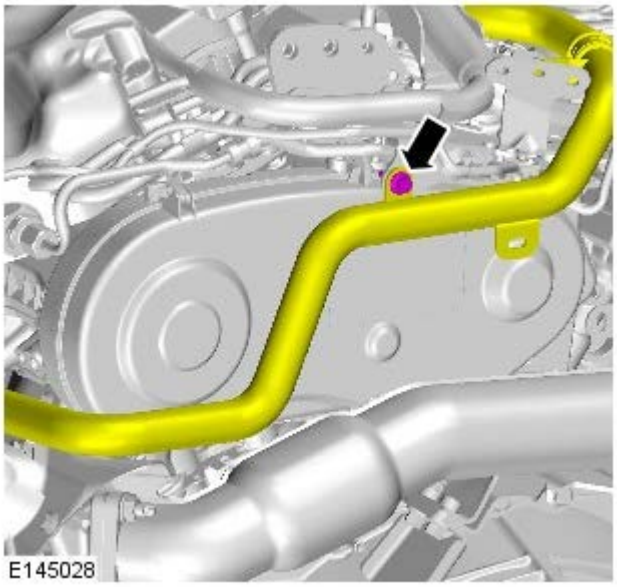
- *Torque:* 5 Nm



15. NOTE: Engine shown removed for clarity.

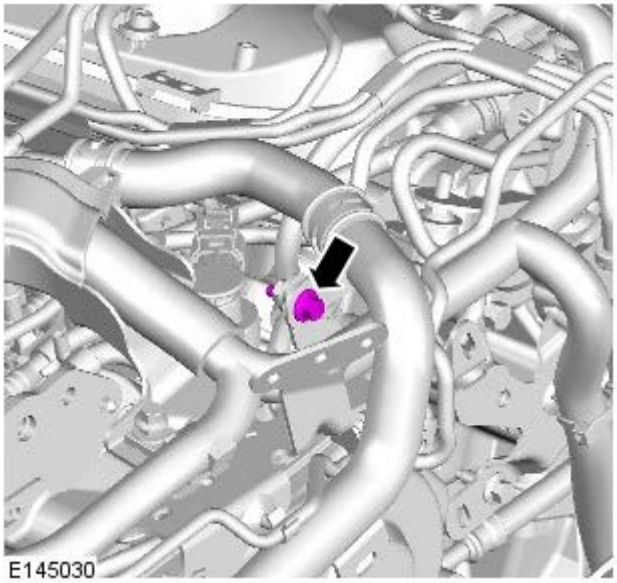


16.



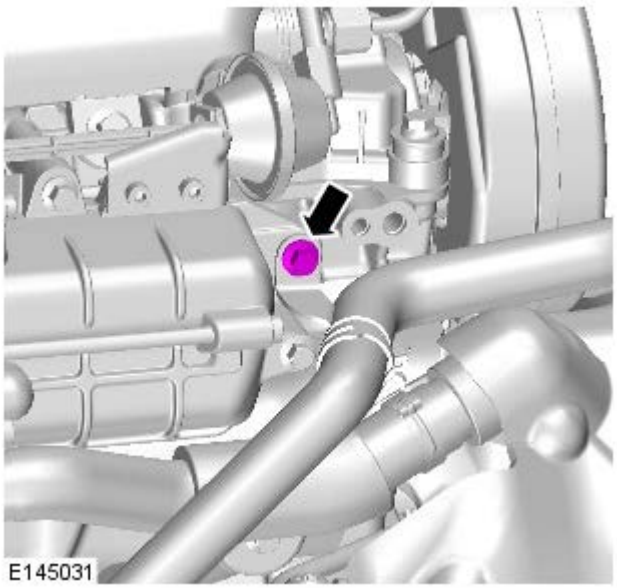
17.

- *Torque:* 10 Nm



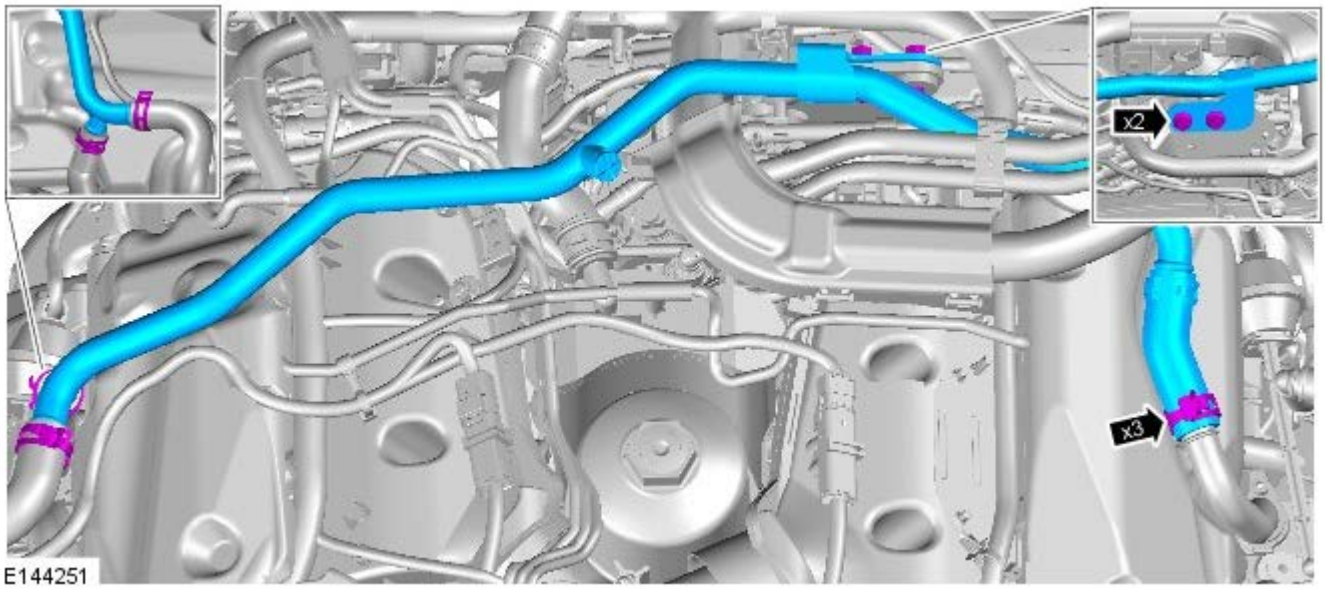
18.

- *Torque:* 10 Nm



19.

- *Torque:* 10 Nm



20. Refer to: Starter Motor (303-06A Starting System - TDV6 3.0L Diesel, Removal and Installation).

21. Refer to: Secondary Bulkhead Center Panel - TDV6 3.0L Diesel (501-02, Removal and Installation).

22. Refer to: Specifications (414-00, Specifications).

Published: 22-Oct-2012

Starting System - TDV6 3.0L Diesel -

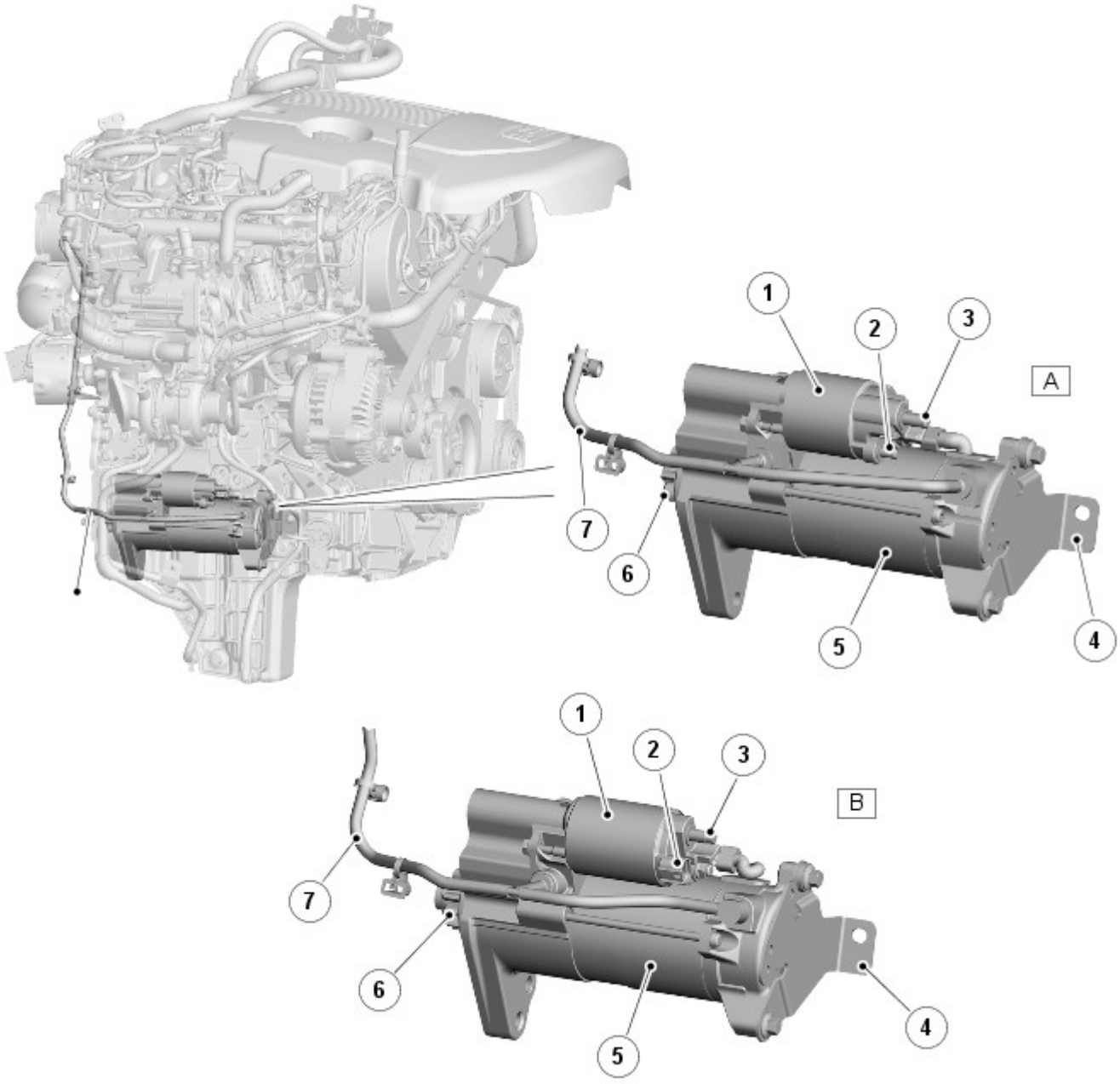
Description	Nm	lb-ft	lb-in
Starter motor to oil pan bolts	47	35	-
Battery positive terminal integral connector retaining nut	10	7	-
Solenoid terminal integral connector nut	7	-	62

Published: 14-May-2013

Starting System - TDV6 3.0L Diesel - Starting System

Description and Operation

COMPONENT LOCATION - STARTER MOTOR

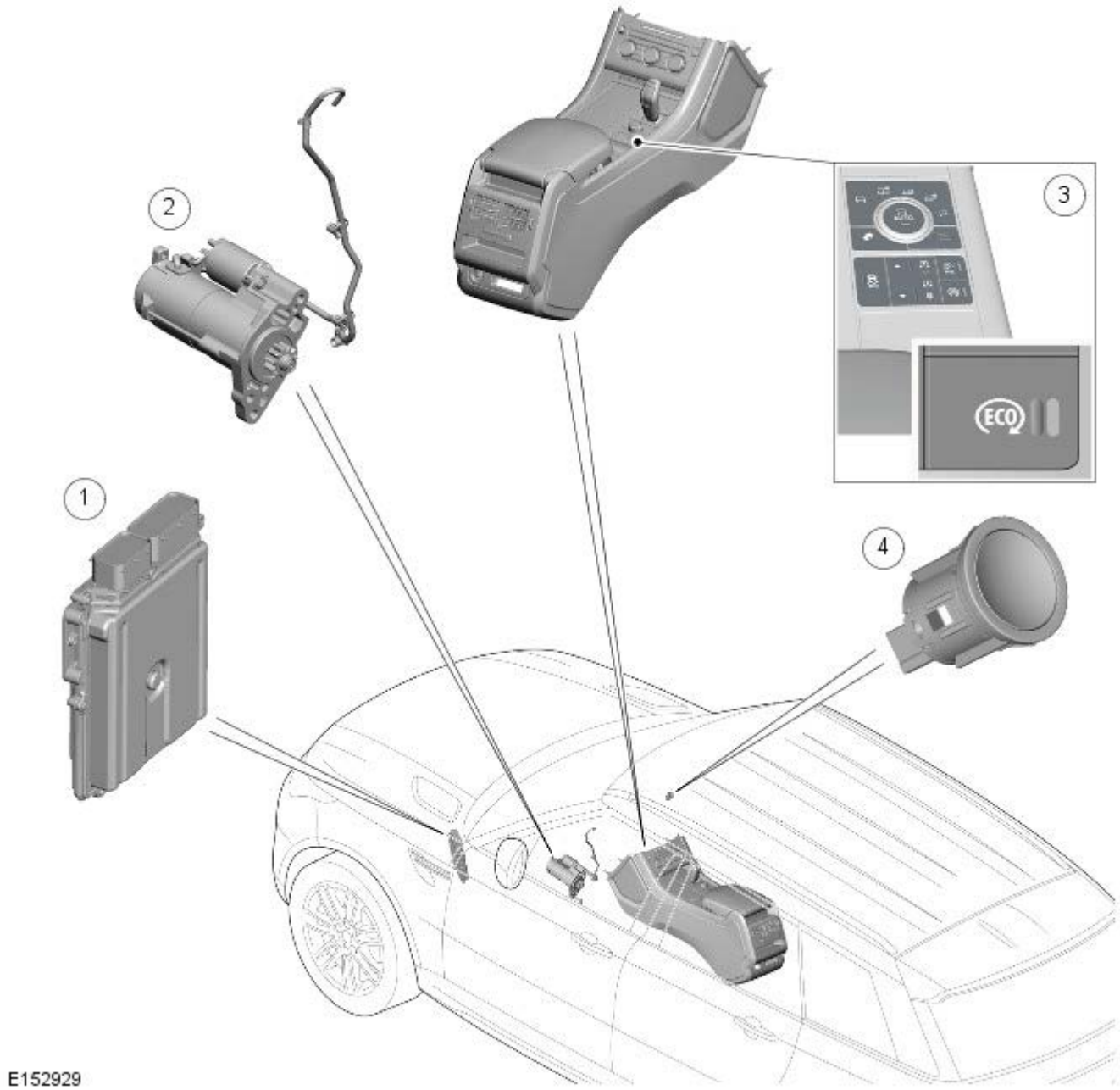


E147781

A = Non TSS motor; B = TSS motor.

Item	Part Number	Description
1	-	Solenoid
2	-	Solenoid electrical connection
3	-	Motor electrical connection
4	-	Support bracket
5	-	Motor
6	-	Pinion gear
7	-	Breather tube

COMPONENT LOCATION - STOP/START SYSTEM



E152929

Item	Part Number	Description
1	-	Engine Control module (ECM)
2	-	TSS motor
3	-	ECO switch
4	-	Stop/start switch

OVERVIEW

The starting system consists of an electric starter motor that engages with the ring gear on the crankshaft drive plate. Operation of the starter motor is controlled by the ECM (Engine Control Module).

In some markets the starting system incorporates a stop/start system. The system is controlled by the ECM using CAN (Controller Area Network) messages and signals from other system components and modules to determine the correct conditions for system operation. The stop/start system automatically stops and re-starts the engine when appropriate conditions are met. This reduces the amount of time the engine is running at idle speed which improves economy and reduces engine emissions.

The stop/start system is automatically enabled each time the ignition is switched on. The driver can disable the system using an ECO switch.

The stop/start system stops the engine when it is not needed, this is known as ECO stop. The engine will restart automatically when vehicle parameters are met and the driver releases the brake pedal, this is known as ECO start.

To accommodate the increased electrical loads, vehicles fitted with the stop/start system are equipped with two batteries.
For additional information, refer to: Battery and Cables (414-01 Battery, Mounting and Cables, Description and Operation).

DESCRIPTION

Starter Motor

Vehicles without the stop/start system use a conventional starter motor. Vehicles with the stop/start system use a TSS (Tandem Solenoid Starter) motor. The TSS motor can restart the engine if it is still rotating, allowing the engine to be started quickly in any situation.

The starter motor is located on the rear right side of the oil pan. The rear of the starter motor is attached to a support bracket on the oil pan. The starter motor incorporates a snorkel breather pipe tp assist with ventilation and sealing, during water submergence.

VEHICLES WITHOUT STOP/START

The starter motor is rated at 2.0 kW and comprises a series wound motor, an overrunning clutch and pinion, and a solenoid.

Power to operate the motor is supplied from BJB2 (Battery Junction Box 2). Power to operate the solenoid is supplied from the starter relay in the EJB (Engine Junction Box).

VEHICLES WITH STOP/START

The TSS motor is rated at 2.0 kW and comprises a series wound motor, an overrunning clutch and pinion, a pinion gear shift solenoid and a motor rotation solenoid.

Power to operate the motor is supplied from the BJB2. Power to operate the solenoids is supplied from the starter motor relay and the starter pinion relay in the EJB.

ECO Switch

On vehicles with stop/start, the ECO switch is integrated into the Terrain Response® switchpack in the floor console. An amber LED (Light Emitting Diode) in the ECO switch remains illuminated while the stop/start system is active. Selection of the ECO switch is transmitted from the Terrain Response® switchpack to the ECM on the high speed CAN Chassis, and high speed CAN Powertrain bus via the GWM (Gateway Module).

Warning Indicator



E147783

On vehicles with stop/start, an ECO warning indicator is located in the IC (Instrument Cluster). The warning indicator comes on when the engine stops during a stop/start cycle, then goes off when the engine restarts. The warning indicator is controlled by a high speed CAN Powertrain bus message from the ECM.

OPERATION

Vehicles Without Stop/Start

When the engine stop/start switch is pressed, if the keyless vehicle module detects a valid smart key in the vehicle the CJB (Central Junction Box) transmits a hardwired crank request to the ECM.
For additional information, refer to: Anti-Theft - Passive (419-01B Anti-Theft - Passive, Diagnosis and Testing).

When the ECM receives a crank request from the CJB it energizes the starter relay, provided the TCS (Transmission Control Switch) is in P (park) or N (neutral) and the brake pedal is pressed. The energized starter relay supplies battery power to the starter solenoid, which energizes and causes the pinion gear to engage with the ring gear. When the starter solenoid is energized it also closes high-current contacts, which connects battery power from BJB2 to the motor to turn the engine.

Vehicles With Stop/Start

At the beginning of a drive cycle, when the engine stop/start switch is pressed the starting system operates in the same

way as on vehicles without stop/start, up to the point that the ECM energizes the starter relay. At that point, on the stop/start system, the ECM energizes both the starter pinion relay and the starter motor relay. The energized starter motor relay supplies battery power to the pinion gear shift solenoid in the starter, which energizes and causes the pinion gear to engage with the ring gear. The energized starter pinion relay supplies battery power to the motor rotation solenoid in the starter, which energizes and closes high-current contacts, which connects battery power from BJB2 to the motor to turn the engine.

During a drive cycle, with the stop/start system enabled and the TCS in D (drive) or S (sport), the ECM performs an ECO stop when one of the following occurs:

- The vehicle stops from a speed greater than 4 km/h (2.5 mph) and sufficient brake pressure is applied to the brake pedal to ensure the vehicle is stationary
- The vehicle is stationary and N is selected on the TCS.

 NOTE: On a gradient an ECO stop will only occur if the driver applies a minimum of 7 bar (101.5 lbf/in²)+ / - 3 bar (43.5 lbf/in²) brake pressure and will not occur at all on gradients about in excess of 1 in 4.34 (23%).

The green ECO warning indicator in the IC illuminates to advise that the engine has shut down. Other warning indicators normally associated with an engine shut down, for example the ignition and low oil pressure warning indicators, are suppressed so will not illuminate during an ECO stop.

During an ECO stop, the ECM operates the fuel pressure control valve to maintain a fuel rail pressure of 250 bar (3625 lbf/in²), instead of releasing the fuel pressure as normally occurs at engine shut down. This ensures there is adequate fuel volume and pressure for an instant ECO restart.

The following conditions will prevent an ECO stop:

- A steering wheel paddle switch has been used to select a gear (transmission Commandshift mode)
- The ambient air temperature is outside the range of 0 to 40 °C (32 to 104 °F)
- The engine coolant temperature is outside the range of 20 to 110 °C (68 to 230 °F)
- Brake vacuum is less than the threshold value
- The pressure altitude derived from the barometric pressure sensor in the ECM is more than approximately 2800 m (9150 feet)
- The hood is open
- The driver door is open
- The driver seatbelt is not fastened
- High demand from the climate control system requires the engine to be running, for example windshield demist selected
- The battery charge is low
- A Terrain Response® special program is active
- Hill descent control is active
- The level in the fuel tank is too low
- Active regeneration of the DPF (Diesel Particulate Filter) is required or in progress
- ECO stop/start is disabled using the ECO switch.

While the vehicle is stationary, if a condition that prevented an ECO stop is removed the ECM automatically performs an ECO stop. The ECM automatically restarts the engine when one of the following occurs:

- The brake pedal is released with D or S selected on the TCS.
- The accelerator pedal is pressed
- A paddle switch is used to select a gear
- R (reverse) is selected on the TCS
- Climate control system demand increases
- The vehicle speed exceeds approximately 1 km/h (0.5 mph)
- The battery charge becomes low
- Brake vacuum reduces below the threshold value
- ECO stop/start is disabled using the ECO switch.

 NOTE: When the brake pedal is released during an ECO restart the ABS (anti-lock brake system) control module briefly applies the brakes to hold the vehicle stationary until the engine has restarted.

The following will prevent an ECO restart, and require use of the engine stop/start switch to restart the engine:

- The hood is open
- The driver door is open
- The driver seatbelt is not fastened.

STOP/START STRATEGY

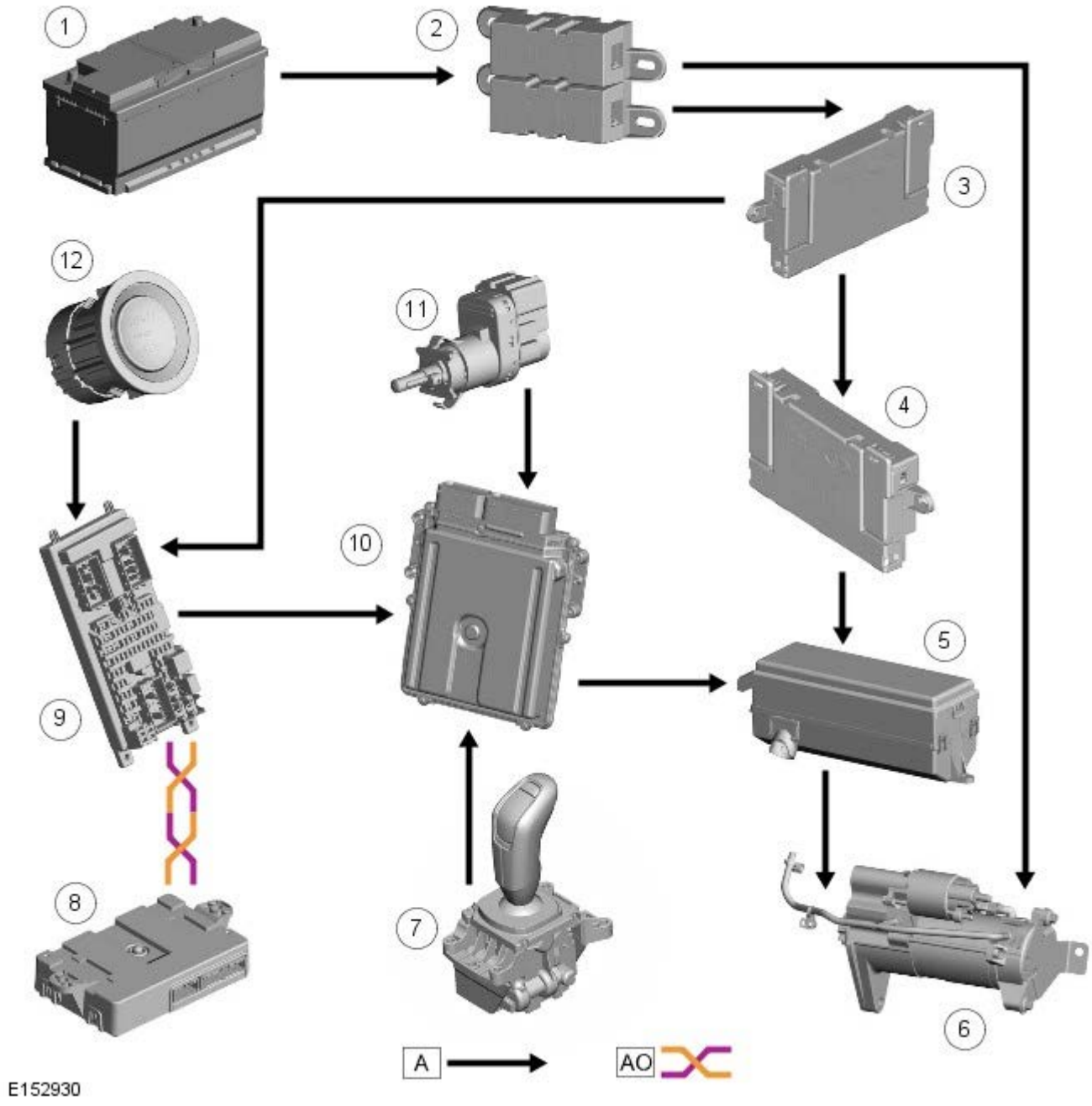
Operating the motor and the pinion gear individually allows meshing of the pinion gear with the drive plate ring gear, even if the engine is still turning. This allows instant restarts under all conditions.

Engine speed 250 rev/min or more: When an ECO stop is initiated and the ECM then detects an engine restart parameter, it operates the starter motor to first accelerate the pinion gear up to the ring gear speed, then engages the pinion gear with the ring gear and energizes the motor to rotate the engine up to starting speed. The ECM also activates the fueling and engine systems to restart the engine.

Engine speed less than 250 rev/min: When an ECO stop is initiated and the ECM then detects an engine restart parameter, it operates the starter motor to first engage the pinion gear with the ring gear, then energizes the motor to rotate the engine up to starting speed. The ECM also activates the fueling and engine systems to restart the engine.

Control Diagram - Vehicles Without Stop/Start

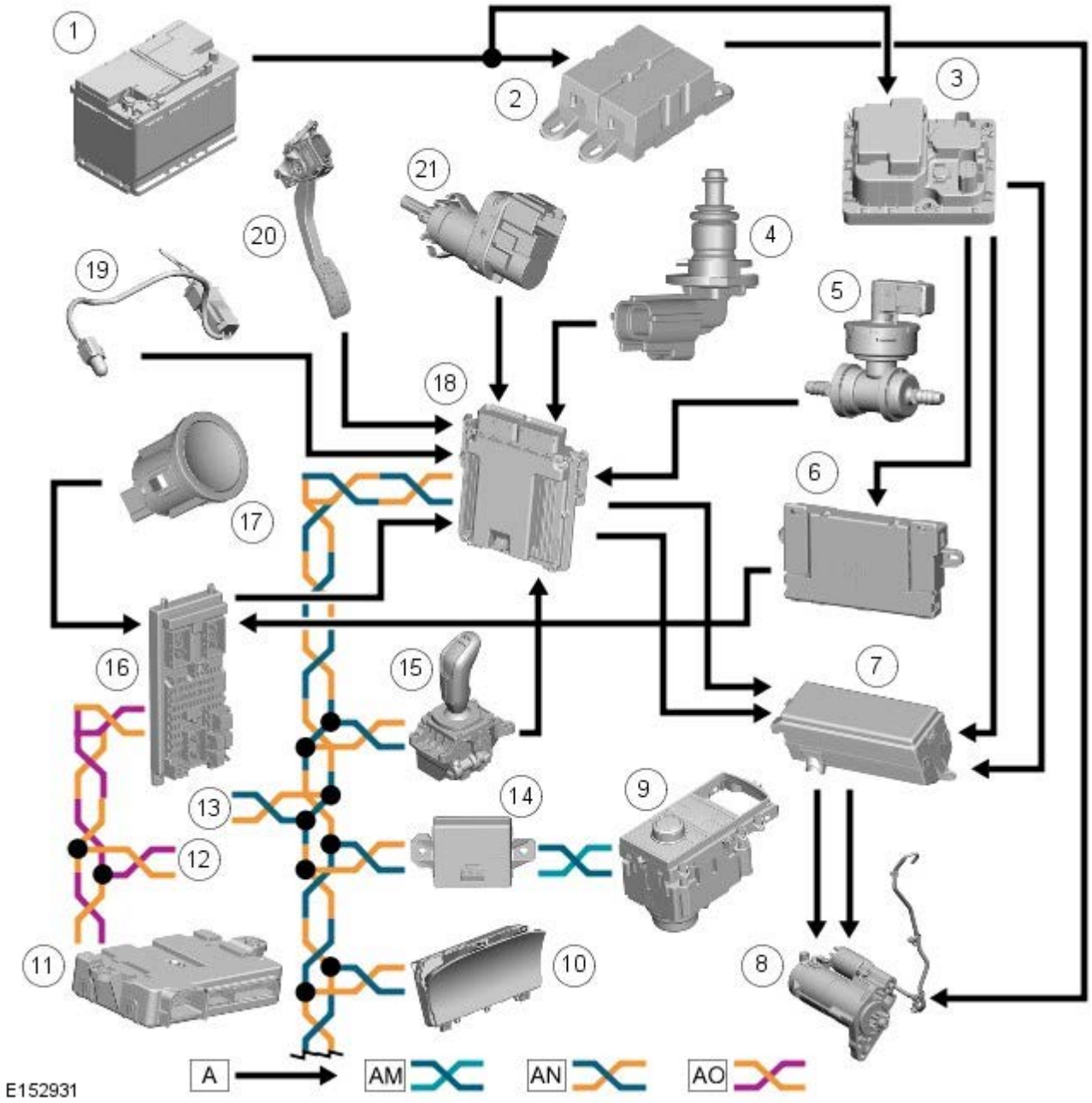
NOTE: A = Hardwired, AO = Medium speed CAN (Controller Area Network) Body bus.



Item	Part Number	Description
1	-	Battery
2	-	Battery Junction Box 2 (BJB2)
3	-	Battery Junction Box (BJB)
4	-	Auxiliary Junction Box (AJB)
5	-	Engine Junction Box (EJB)
6	-	Starter motor
7	-	Transmission control switch
8	-	Keyless vehicle module (KVM)
9	-	Central Junction Box (CJB)
10	-	Engine Control Module (ECM)
11	-	Brake pedal switch
12	-	Stop/start switch

Control Diagram - Vehicles With Stop/Start

NOTE: A = Hardwired, AM = High speed CAN (Controller Area Network) Chassis bus, AN = High speed CAN Powertrain bus, AO = Medium speed CAN Body bus.



Item	Part Number	Description
1	-	Battery
2	-	Battery Junction Box (BJB2)
3	-	Power Supply Distribution Box
4	-	Engine Coolant Temperature (ECT) sensor
5	-	Brake vacuum sensor
6	-	Battery Junction Box (BJB)
7	-	Engine Junction Box (EJB)
8	-	TSS motor
9	-	Terrain Response® switchpack
10	-	Instrument Cluster (IC)
11	-	Keyless Vehicle Module (KVM)
12	-	Connection to other control modules on medium speed CAN Body bus
13	-	Connection to other control modules on high speed CAN Powertrain bus
14	-	Gateway Module (GWM)
15	-	Transmission Control Switch (TCS)
16	-	Central Junction Box (CJB)
17	-	Stop/start switch
18	-	Engine Control Module (ECM)
19	-	Ambient Air Temperature (AAT) sensor
20	-	Accelerator pedal

21	-	Brake pedal switch

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: Starting System (303-06A Starting 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 and electrical damage.

Visual Inspection

Mechanical	Electrical
• Starter motor • Engine (turns freely)	• Battery • Fuses • Starter relay • Wiring harness(es) • 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

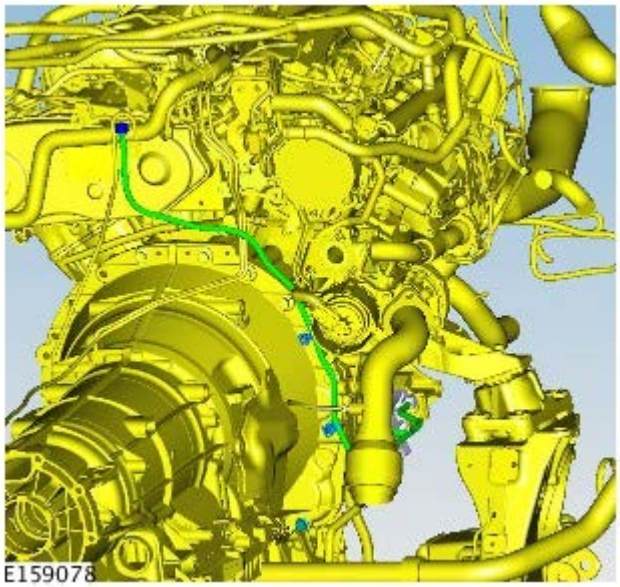
Symptom	Possible Causes	Action
The engine does not crank (starter motor does **not** turn)	• Gear selector not in **P** or **N** position (vehicles with automatic transmission) • Battery • Starter relay • Invalid key code received by central junction box • Harness/connectors • Starter motor • Ignition 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 fault. Check the starter motor relay, ignition switch and generator circuits. Refer to the electrical guides. Check for TCM and ECM DTCs. Check that the engine turns freely
The engine does not crank (starter motor **does** turn)	• 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 • Starter motor • Oil grade	Check the battery condition and state of charge. Check the starter motor circuits. Refer to the electrical guides. Check the engine oil grade and condition

Engine cranks too fast	• 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 - 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	
	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

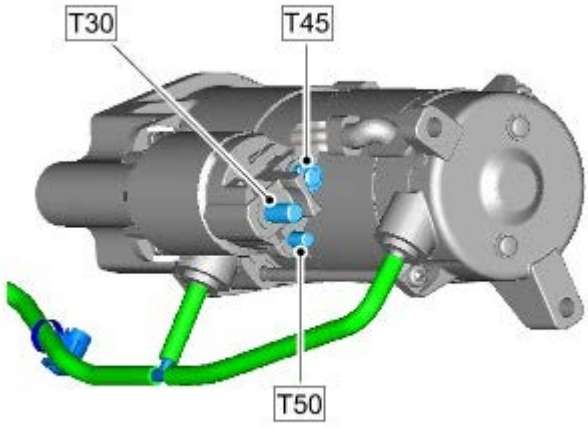
Install the breather tube and route it correctlyAttempt 10 starts to the vehicle. If the vehicle does **NOT** start during any of the 10 attempts. Install new starter motorIf the vehicle **DOES** start during all of the 10 attemptsProceed to next step

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

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: 29-Apr-2013

Starting System - TDV6 3.0L Diesel - Starter Motor

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.

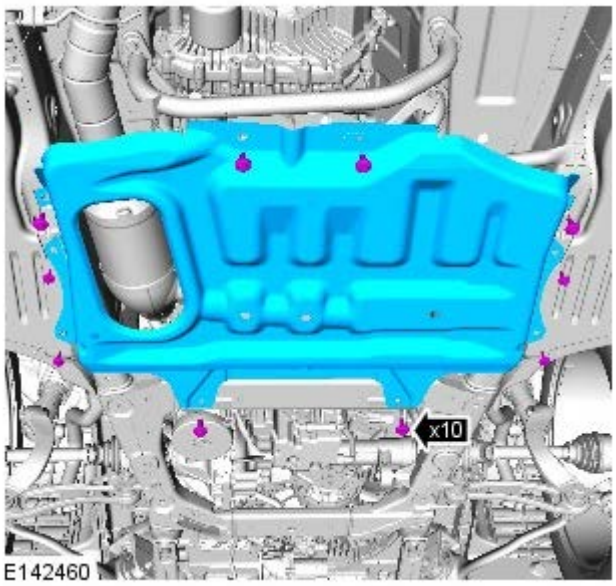
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

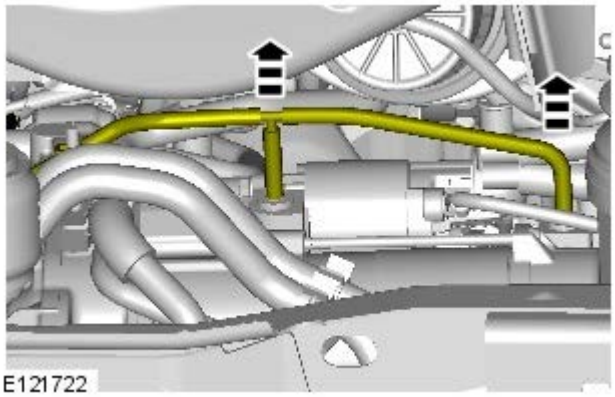
2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

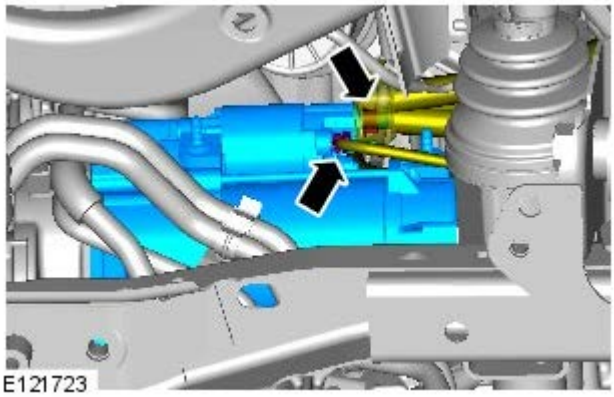


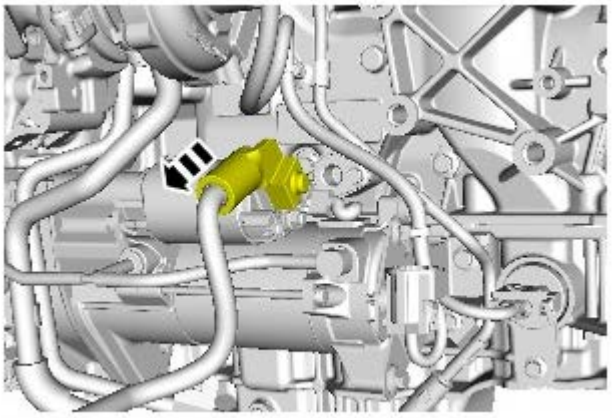
4. *Torque:*
   M10 60 Nm
   M6 10 Nm



5.

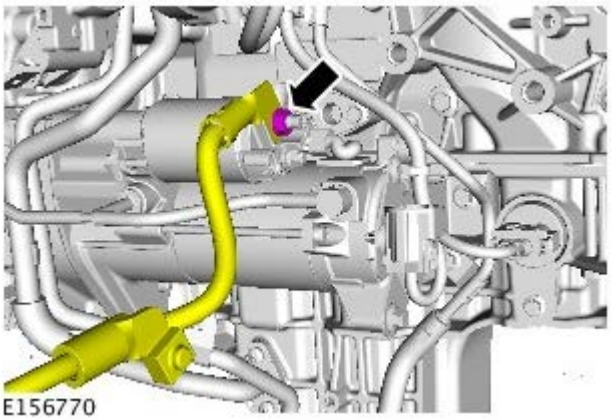
6. *Torque:*
   M8 10 Nm
   M6 7 Nm

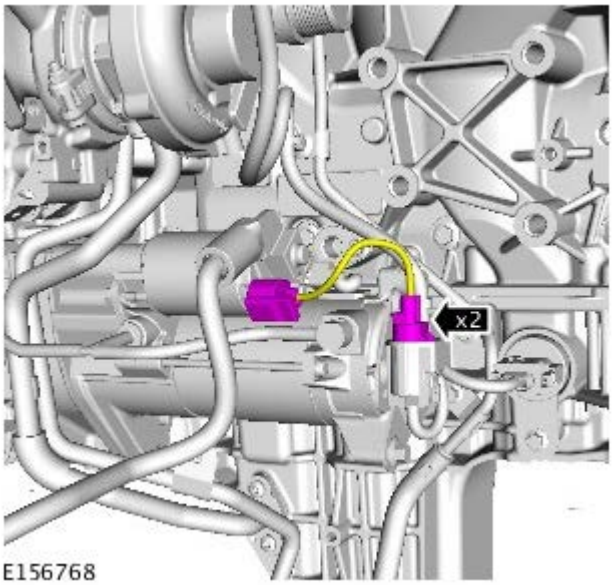




7. NOTE: If equipped with TSS.

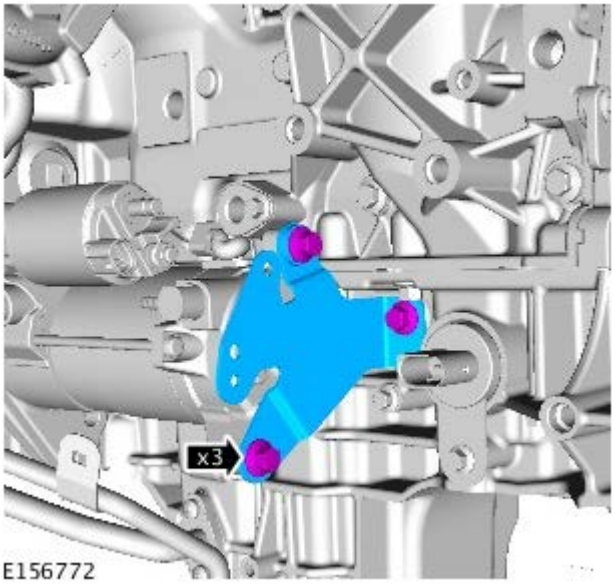
   Torque: 10 Nm

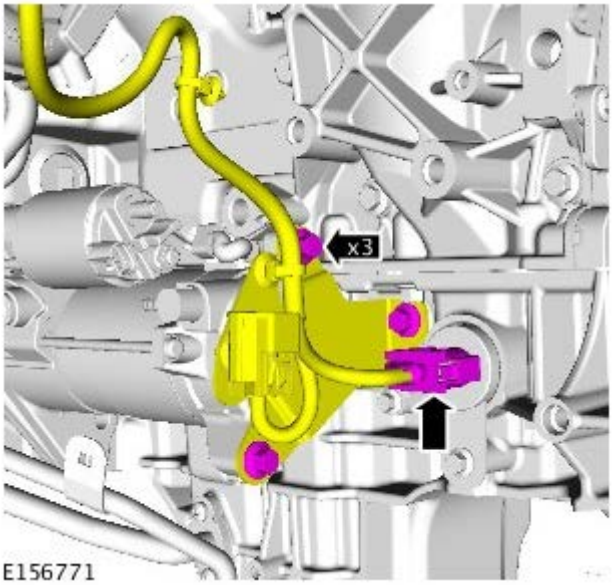




8. NOTE: If equipped with TSS.

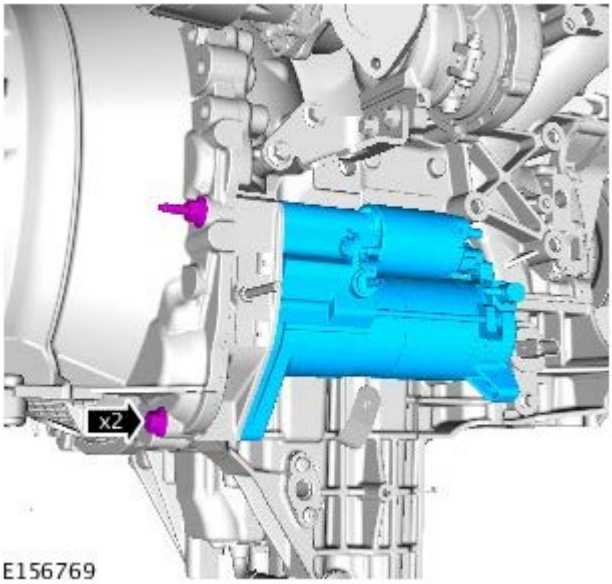
9. *Torque:* 47 Nm





10. NOTE: If equipped with TSS.

    Torque: 47 Nm



11. NOTE: Components removed for clarity.

    Torque: 47 Nm

Installation

1. To install, reverse the removal procedure.

Published: 29-Apr-2013

Starting System - V6 S/C 3.0L Petrol -

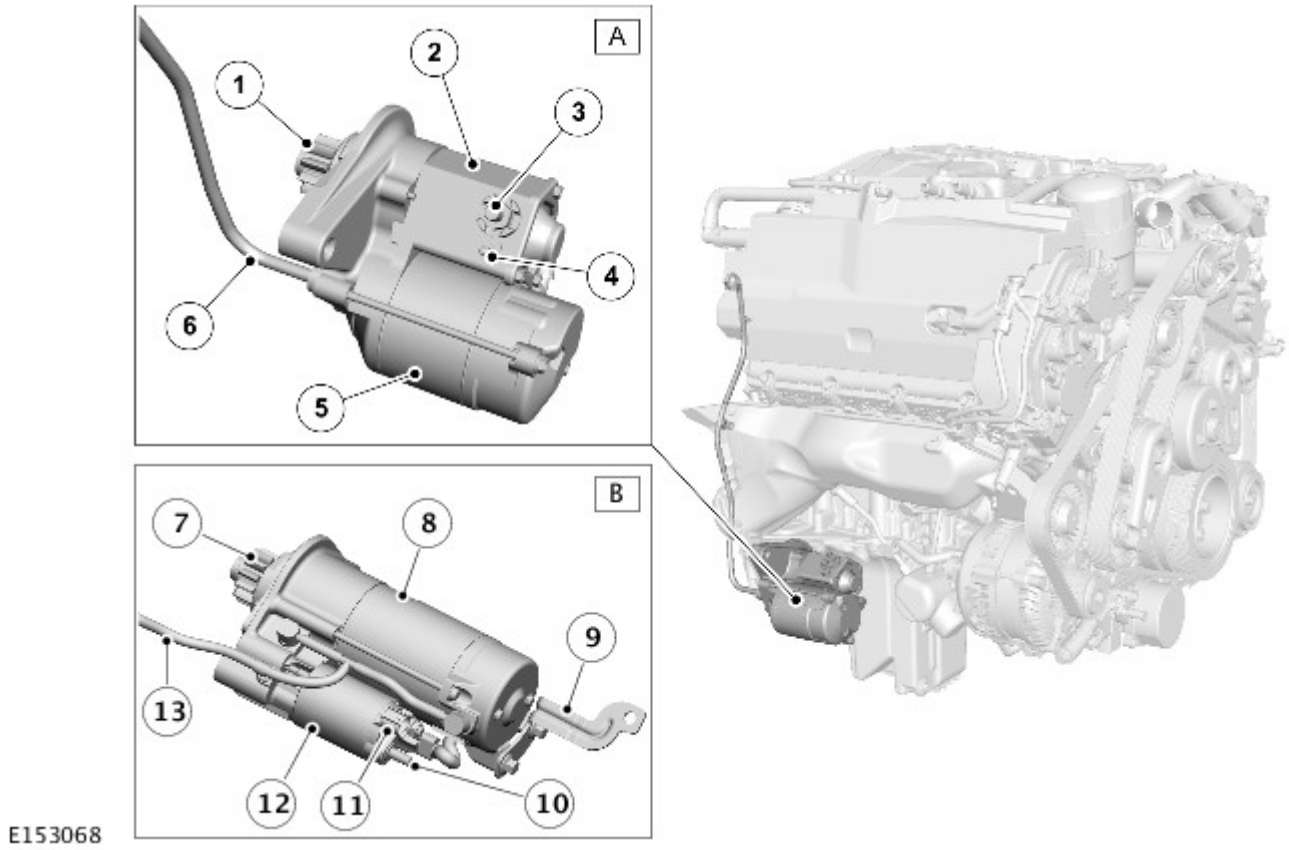
Description	Nm	lb-ft	lb-in
Starter motor retaining bolts	47	-	416
Battery positive terminal connector retaining nuts	10	-	89
Heat shield retaining bolts	4	-	35
Solenoid terminal connector retaining nut	4	-	35
Starter motor mounting bracket bolts	47		416

Published: 14-May-2013

Starting System - V6 S/C 3.0L Petrol - Starting System

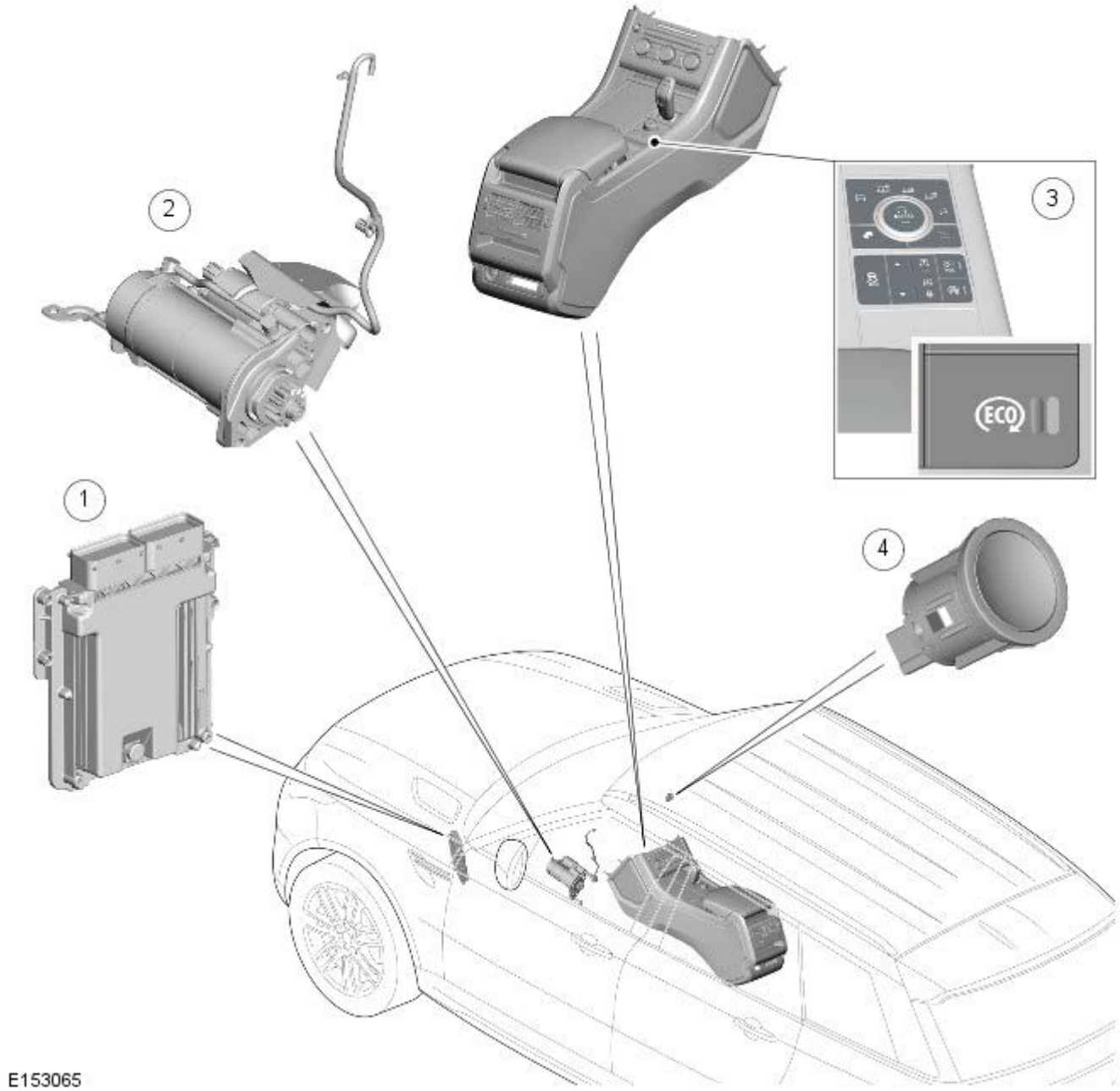
Description and Operation

COMPONENT LOCATION - STARTER MOTOR



Item	Part Number	Description
A	-	Non TSS motor
B	-	TSS motor
1	-	Pinion gear
2	-	Solenoid
3	-	Motor electrical connection
4	-	Solenoid electrical connection
5	-	Motor
6	-	Breather tube
7	-	Pinion gear
8	-	Motor
9	-	Support bracket
10	-	Motor electrical connection
11	-	Solenoid electrical connection
12	-	Solenoid
13	-	Heatshield
14	-	Breather tube

COMPONENT LOCATION - STOP/START SYSTEM



E153065

Item	Part Number	Description
1	-	Engine Control Module (ECM)
2	-	TSS motor
3	-	ECO switch
4	-	Stop/start switch

OVERVIEW

The starting system consists of an electric starter motor that engages with the ring gear on the crankshaft drive plate. Operation of the starter motor is controlled by the ECM (Engine Control Module).

In some markets the starting system incorporates a stop/start system. The system is controlled by the ECM using CAN (Controller Area Network) messages and signals from other system components and modules to determine the correct conditions for system operation. The stop/start system automatically stops and re-starts the engine when appropriate conditions are met. This reduces the amount of time the engine is running at idle speed which improves economy and reduces engine emissions.

The stop/start system is automatically enabled each time the ignition is switched on. The driver can disable the system using an ECO switch.

The stop/start system stops the engine when it is not needed, this is known as ECO stop. The engine will restart automatically when vehicle parameters are met and the driver releases the brake pedal, this is known as ECO start.

To accommodate the increased electrical loads, vehicles fitted with the stop/start system are equipped with two batteries.
For additional information, refer to: Battery and Cables (414-01 Battery, Mounting and Cables, Description and Operation).

DESCRIPTION

Vehicles without the stop/start system use a conventional starter motor. Vehicles with the stop/start system use a TSS (Tandem Solenoid Starter) motor. The TSS motor can restart the engine if it is still rotating, allowing the engine to be started quickly in any situation.

The starter motor is located on the rear right side of the oil pan. The rear of the starter motor is attached to a support bracket on the oil pan. The starter motor incorporates a snorkel breather pipe to assist with ventilation and sealing, during water submergence.

VEHICLES WITHOUT STOP/START

The starter motor is rated at 1.4 kW and comprises a series wound motor, an overrunning clutch and pinion, and a solenoid.

Power to operate the motor is supplied from the 450 A megafuse in BJB2 (Battery Junction Box 2). Power to operate the solenoid is supplied from the starter relay in the EJB (Engine Junction Box).

VEHICLES WITH STOP/START

The TSS motor is rated at 2.0 kW and comprises a series wound motor, an overrunning clutch and pinion, a pinion gear shift solenoid and a motor rotation solenoid.

Power to operate the motor is supplied from the 450A megafuse in BJB2. Power to operate the solenoids is supplied from the starter motor relay and the starter pinion relay in the EJB.

ECO Switch

On vehicles with stop/start, the ECO switch is integrated into the Terrain Response® switchpack in the floor console. An amber LED (Light Emitting Diode) in the ECO switch remains illuminated while the stop/start system is active. Selection of the ECO switch is transmitted from the Terrain Response® switchpack to the ECM on the high speed CAN Chassis, and high speed CAN Powertrain bus via the GWM (Gateway Module).

Warning Indicator



E147783

On vehicles with stop/start, an ECO warning indicator is located in the IC (Instrument Cluster). The warning indicator comes on when the engine stops during a stop/start cycle, then goes off when the engine restarts. The warning indicator is controlled by a high speed CAN Powertrain bus message from the ECM.

OPERATION

Vehicles Without Stop/Start

When the engine stop/start switch is pressed, if the keyless vehicle module detects a valid smart key in the vehicle the CJB (central junction box) transmits a hardwired crank request to the ECM.
For additional information, refer to: Anti-Theft - Passive (419-01B Anti-Theft - Passive, Description and Operation).

When the ECM receives a crank request from the CJB it energizes the starter relay, provided the TCS (Transmission Control Switch) is in P (park) or N (neutral) and the brake pedal is pressed. The energized starter relay supplies battery power to the starter solenoid, which energizes and causes the pinion gear to engage with the ring gear. When the starter solenoid is energized it also closes high-current contacts, which connects battery power from BJB2 to the motor to turn the engine.

Vehicles With Stop/Start

At the beginning of a drive cycle, when the engine stop/start switch is pressed the starting system operates in the same way as on vehicles without stop/start, up to the point that the ECM energizes the starter relay. At that point, on the stop/start system, the ECM energizes both the starter pinion relay and the starter motor relay. The energized starter

motor relay supplies battery power to the pinion gear shift solenoid in the starter, which energizes and causes the pinion gear to engage with the ring gear. The energized starter pinion relay supplies battery power to the motor rotation solenoid in the starter, which energizes and closes high-current contacts, which connects battery power from BJB2 to the motor to turn the engine.

During a drive cycle, with the stop/start system enabled and the TCS in D (drive) or S (sport), the ECM performs an ECO stop when one of the following occurs:

- The vehicle stops from a speed greater than 4 km/h (2.5 mph) and sufficient brake pressure is applied to the brake pedal to ensure the vehicle is stationary
- The vehicle is stationary and N is selected on the TCS.

 NOTE: On a gradient an ECO stop will only occur if the driver applies a minimum of 7 bar (101.5 lbf/in²)+ / - 3 bar (43.5 lbf/in²) brake pressure and will not occur at all on gradients about in excess of 1 in 4.34 (23%).

The green ECO warning indicator in the IC illuminates to advise that the engine has shut down. Other warning indicators normally associated with an engine shut down, for example the ignition and low oil pressure warning indicators, are suppressed so will not illuminate during an ECO stop.

The following conditions will prevent an ECO stop:

- A steering wheel paddle switch has been used to select a gear (transmission Commandshift mode)
- The ambient air temperature is outside the range of 0 to 40 °C (32 to 104 °F)
- The engine coolant temperature is outside the range of 20 to 110 °C (68 to 230 °F)
- Brake vacuum is less than the threshold value
- The pressure altitude derived from the barometric pressure sensor in the ECM is more than approximately 2800 m (9150 feet)
- The hood is open
- The driver door is open
- The driver seatbelt is not fastened
- High demand from the climate control system requires the engine to be running, for example windshield demist selected
- The battery charge is low
- A Terrain Response® special program is active
- Hill descent control is active
- The level in the fuel tank is too low
- ECO stop/start is disabled using the ECO switch.

While the vehicle is stationary, if a condition that prevented an ECO stop is removed the ECM automatically performs an ECO stop. The ECM automatically restarts the engine when one of the following occurs:

 NOTE: When the brake pedal is released during an ECO restart the ABS (anti-lock brake system) control module briefly applies the brakes to hold the vehicle stationary until the engine has restarted.

- The brake pedal is released with D or S selected on the TCS.
- The accelerator pedal is pressed
- A paddle switch is used to select a gear
- R (reverse) is selected on the TCS
- Climate control system demand increases
- The vehicle speed exceeds approximately 1 km/h (0.5 mph)
- The battery charge becomes low
- Brake vacuum reduces below the threshold value
- ECO stop/start is disabled using the ECO switch.

The following will prevent an ECO restart, and require use of the engine stop/start switch to restart the engine:

- The hood is open
- The driver door is open
- The driver seatbelt is not fastened.

STOP/START STRATEGY

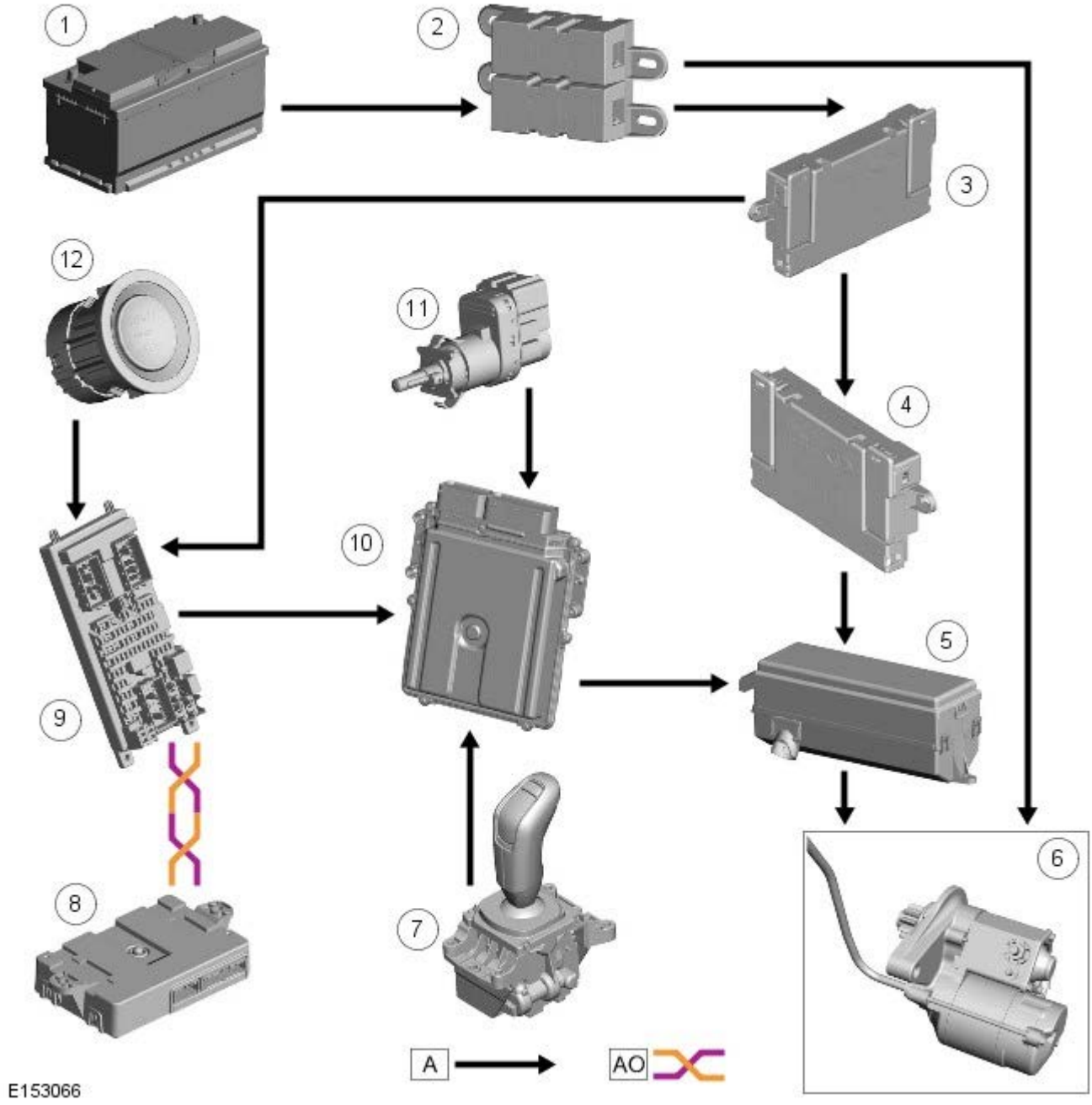
Operating the motor and the pinion gear individually allows meshing of the pinion gear with the drive plate ring gear, even if the engine is still turning. This allows instant restarts under all conditions.

Engine speed 250 rev/min or more: When an ECO stop is initiated and the ECM then detects an engine restart parameter, it operates the starter motor to first accelerate the pinion gear up to the ring gear speed, then engages the pinion gear with the ring gear and energizes the motor to rotate the engine up to starting speed. The ECM also activates the fueling and engine systems to restart the engine.

Engine speed less than 250 rev/min: When an ECO stop is initiated and the ECM then detects an engine restart parameter, it operates the starter motor to first engage the pinion gear with the ring gear, then energizes the motor to rotate the engine up to starting speed. The ECM also activates the fueling and engine systems to restart the engine.

CONTROL DIAGRAM - VEHICLES WITHOUT STOP/START

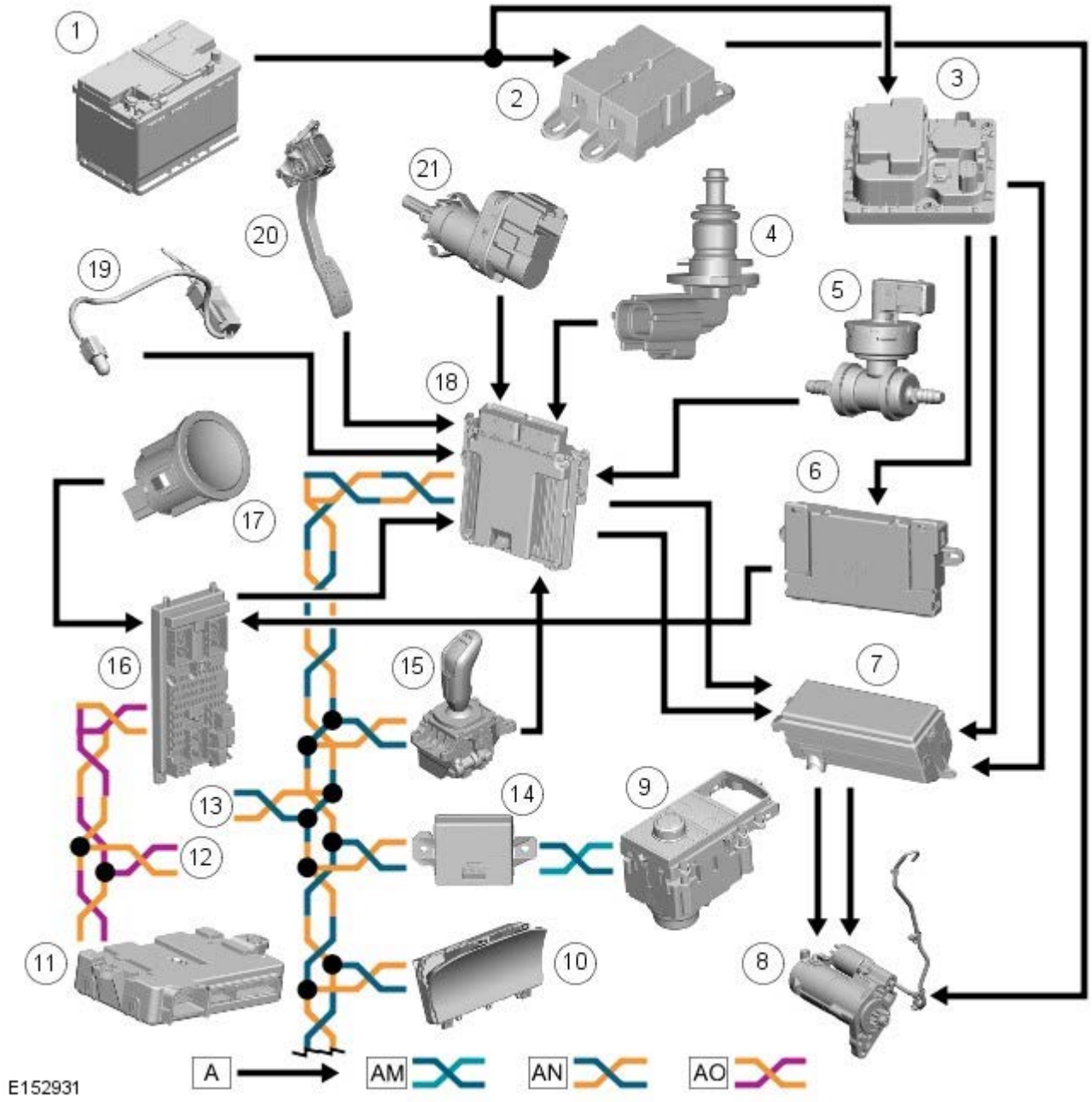
 NOTE: A = Hardwired, AO = Medium speed CAN (Controller Area Network) Body bus.



Item	Part Number	Description
1	-	Battery
2	-	Battery Junction Box 2 (BJB2)
3	-	Battery Junction Box (BJB)
4	-	Auxiliary Junction Box (AJB)
5	-	Engine Junction Box (EJB)
6	-	Starter motor
7	-	Transmission Control Switch (TCS)
8	-	Keyless Vehicle Module (KVM)
9	-	Central Junction Box (CJB)
10	-	Engine Control Module (ECM)
11	-	Brake pedal switch
12	-	Stop/start switch

CONTROL DIAGRAM - VEHICLES WITH STOP/START

NOTE: A = Hardwired, AM = High speed CAN (Controller Area Network) Chassis bus, AN = High speed CAN Powertrain bus, AO = Medium speed CAN Body bus.



Item	Part Number	Description
1	-	Battery
2	-	Battery Junction Box (BJB2)
3	-	Power Supply Distribution Box
4	-	Engine Coolant Temperature (ECT) sensor
5	-	Brake vacuum sensor
6	-	Battery Junction Box (BJB)
7	-	Engine Junction Box (EJB)
8	-	TSS motor
9	-	Terrain Response® switchpack
10	-	Instrument Cluster (IC)
11	-	Keyless Vehicle Module (KVM)
12	-	Connection to other control modules on medium speed CAN Body bus
13	-	Connection to other control modules on high speed CAN Powertrain bus
14	-	Gateway Module (GWM)
15	-	Transmission Control Switch (TCS)
16	-	Central Junction Box (CJB)
17	-	Stop/start switch
18	-	Engine Control Module (ECM)
19	-	Ambient Air Temperature (AAT) sensor
20	-	Accelerator pedal

21	-	Brake pedal switch

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Starting System - V6 S/C 3.0L 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 in the workshop manual. REFER to:

Starting System (303-06B Starting System - V6 S/C 3.0L Petrol, Description and Operation),
Starting System (303-06 Starting System - V6 S/C 3.0L Petrol, Description and Operation),
Starting System (303-06 Starting System - V6 S/C 3.0L 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	Electrical
• Starter motor • Engine (turns freely) • Drive plate ring gear	• Battery • Fuse(s) • Wiring harness(es) • Damaged, loose or corroded connectors • Ignition switch • Starter relay • Transmission Control Module (TCM) • Engine Control Module (ECM) • Eco Switch

3. If an obvious cause for an observed or reported condition is found, correct the cause (if possible) before proceeding to the symptom chart.
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. Check for DTCs indicating an immobilizer fault. Check the starter motor relay, ignition switch and generator circuits. Refer to the electrical guides. Check for TCM and ECM DTCs. Check that the engine turns freely.
The engine does not crank (starter motor **does** turn)	• Starter motor installation • Starter motor • Drive plate ring gear	Check the starter motor installation (fasteners tight, starter motor square to engine, etc). Check the drive plate ring gear teeth for damage, foreign objects.
Engine cranks	• Battery	Check the battery condition and state of charge. Check the starter motor

too slowly	• Harness/Connectors • Starter motor • Oil grade	circuits. Refer to the electrical guides. 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 drive plate ring gear teeth for damage, foreign objects.

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 - V6 S/C 3.0L Petrol , DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation).

Published: 29-Apr-2013

Starting System - V6 S/C 3.0L Petrol - Starter Motor

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.

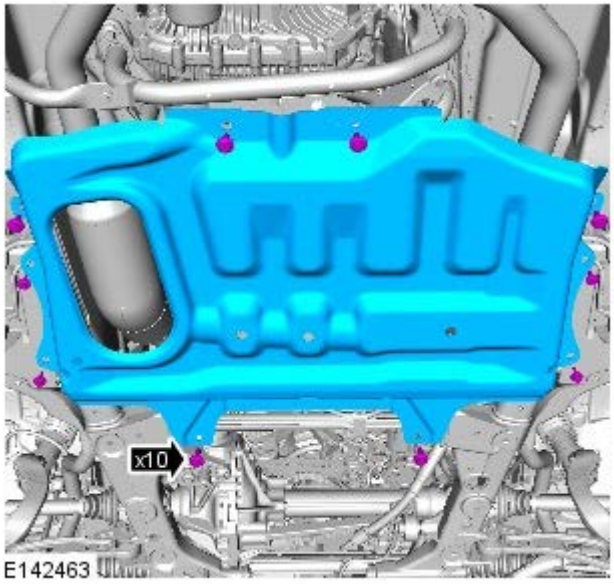
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

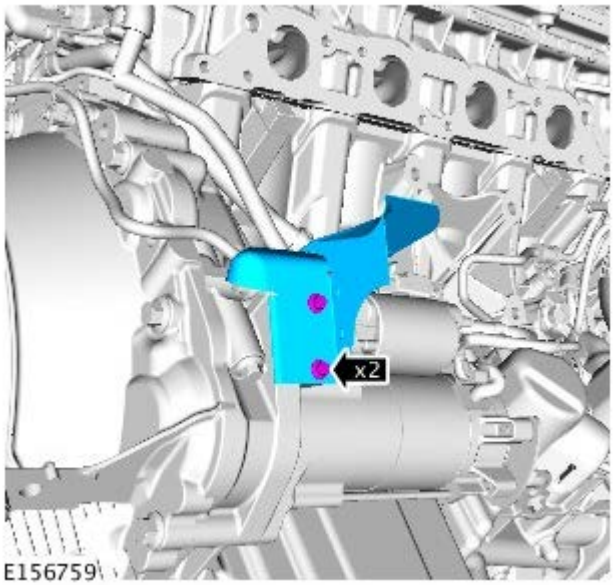
3. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

4. *Torque:*
   M10 60 Nm
   M6 10 Nm

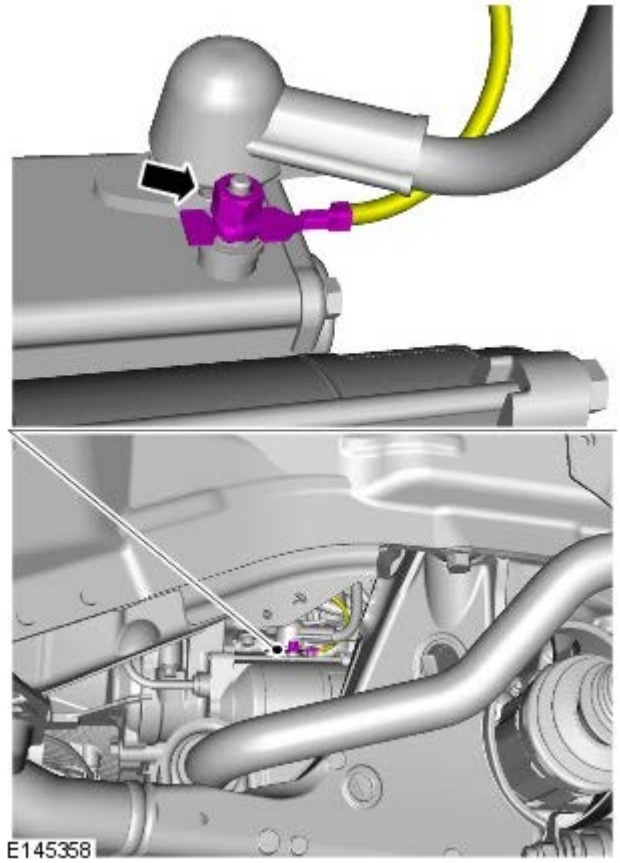


5. NOTE: If equipped with TSS.

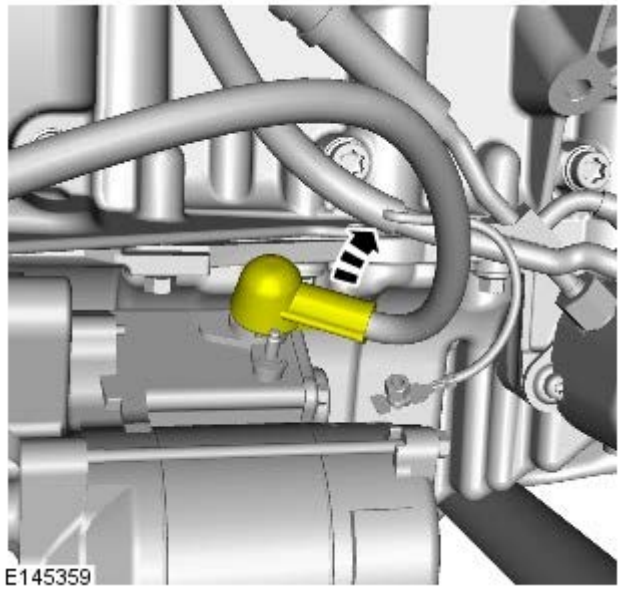
   Torque: 6 Nm



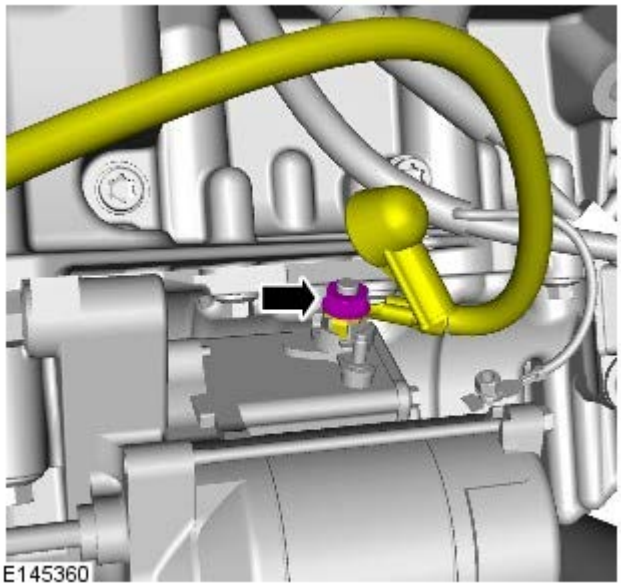
6. *Torque:* 7 Nm

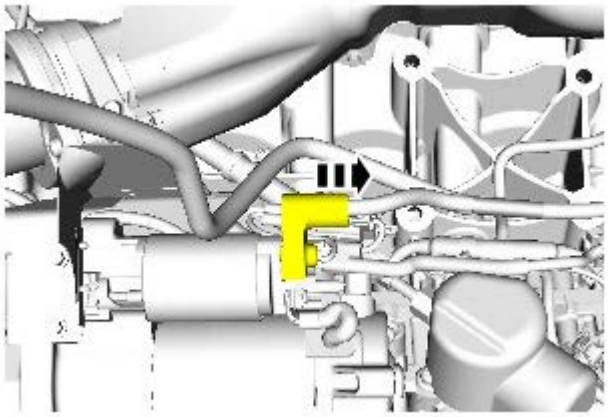


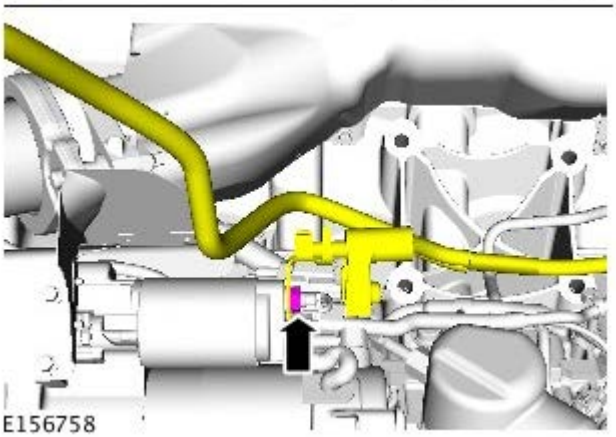
7.



8. *Torque:* 10 Nm



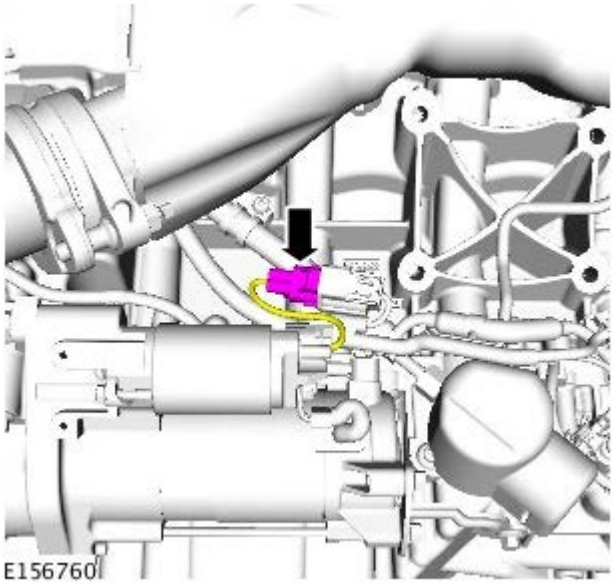




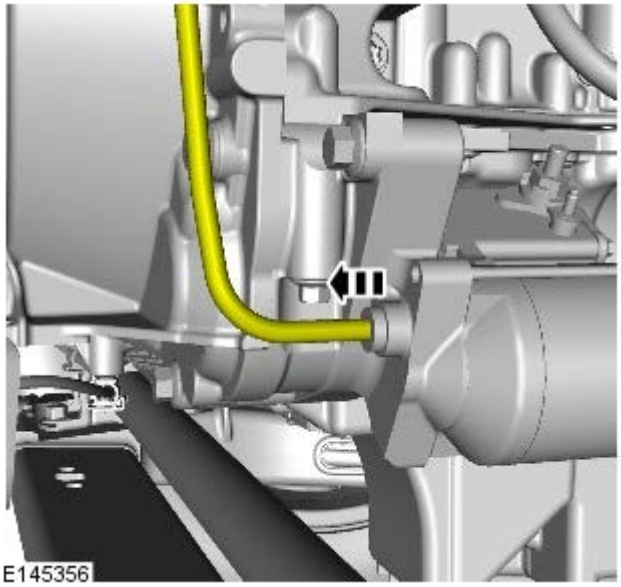
9. NOTE: If equipped with TSS.

Torque: 10 Nm

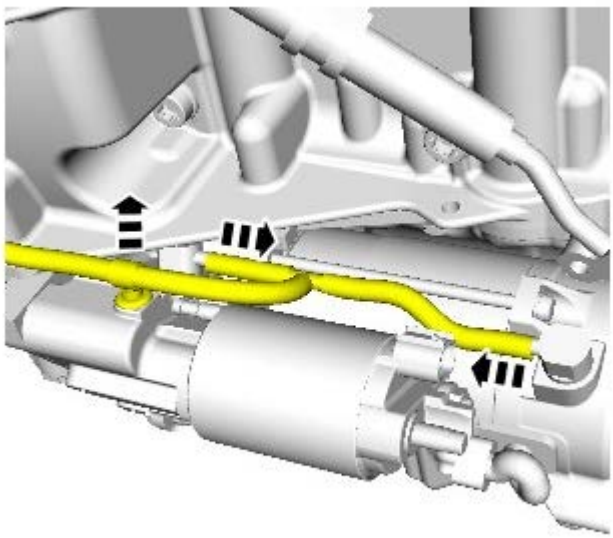
10. NOTE: If equipped with TSS.



11.

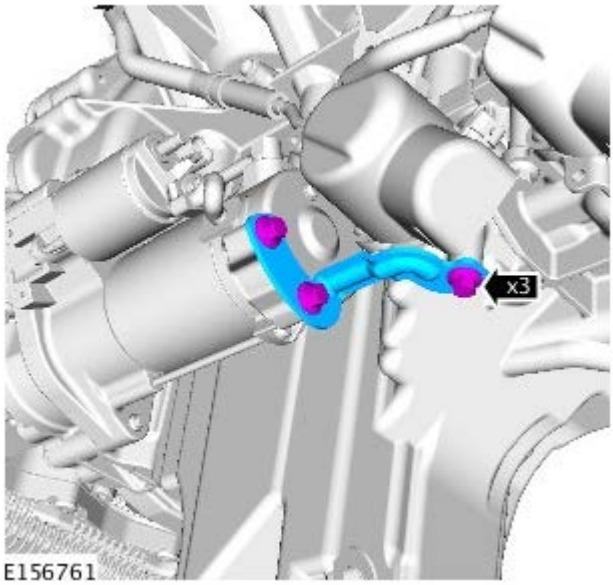


12. NOTE: If equipped with TSS.

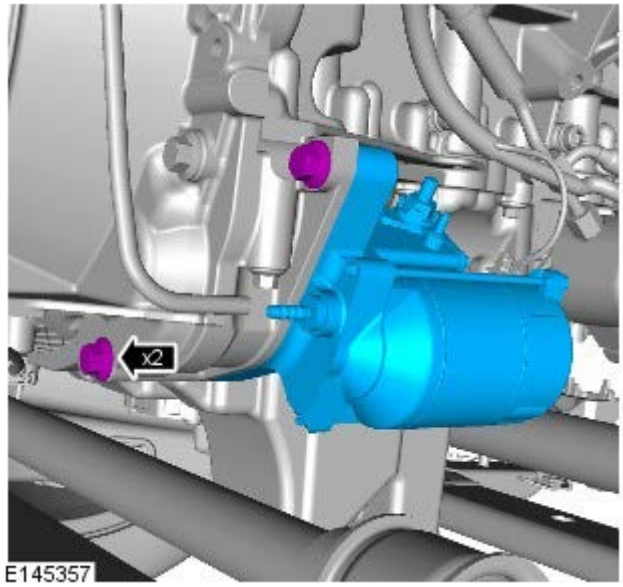


13. NOTE: If equipped with TSS.

Torque: 47 Nm



14. *Torque:* 47 Nm



Installation

1. To install, reverse the removal procedure.

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Starting System - V8 S/C 5.0L Petrol -

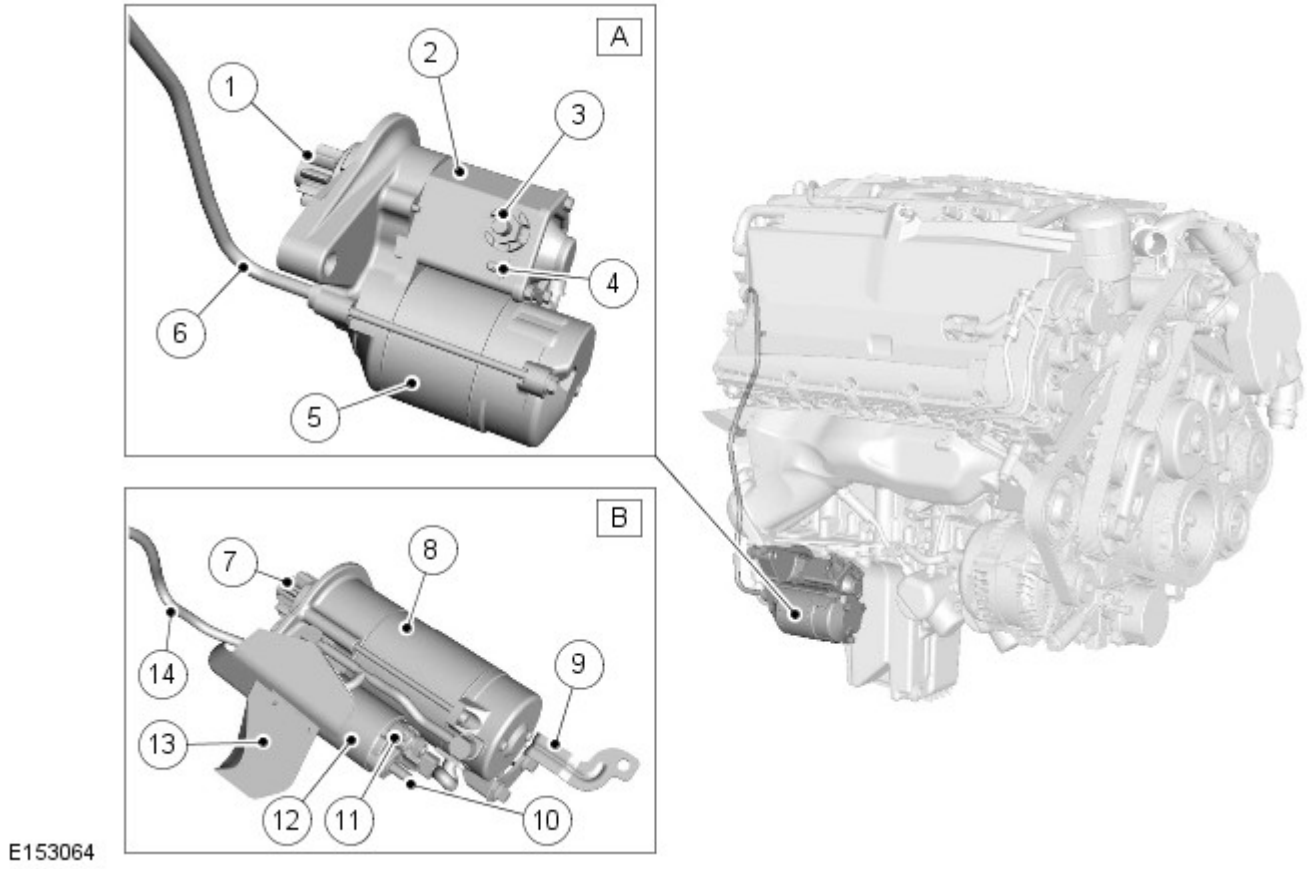
Description	Nm	lb-ft	lb-in
Starter motor retaining bolts	47	36	416
Battery positive terminal connector retaining nut	10	7	89
Solenoid terminal connector retaining nut	4	-	35
Starter motor mounting bracket bolts	47		416
Solenoid heat shield bolts	4		35

Published: 14-May-2013

Starting System - V8 S/C 5.0L Petrol - Starting System

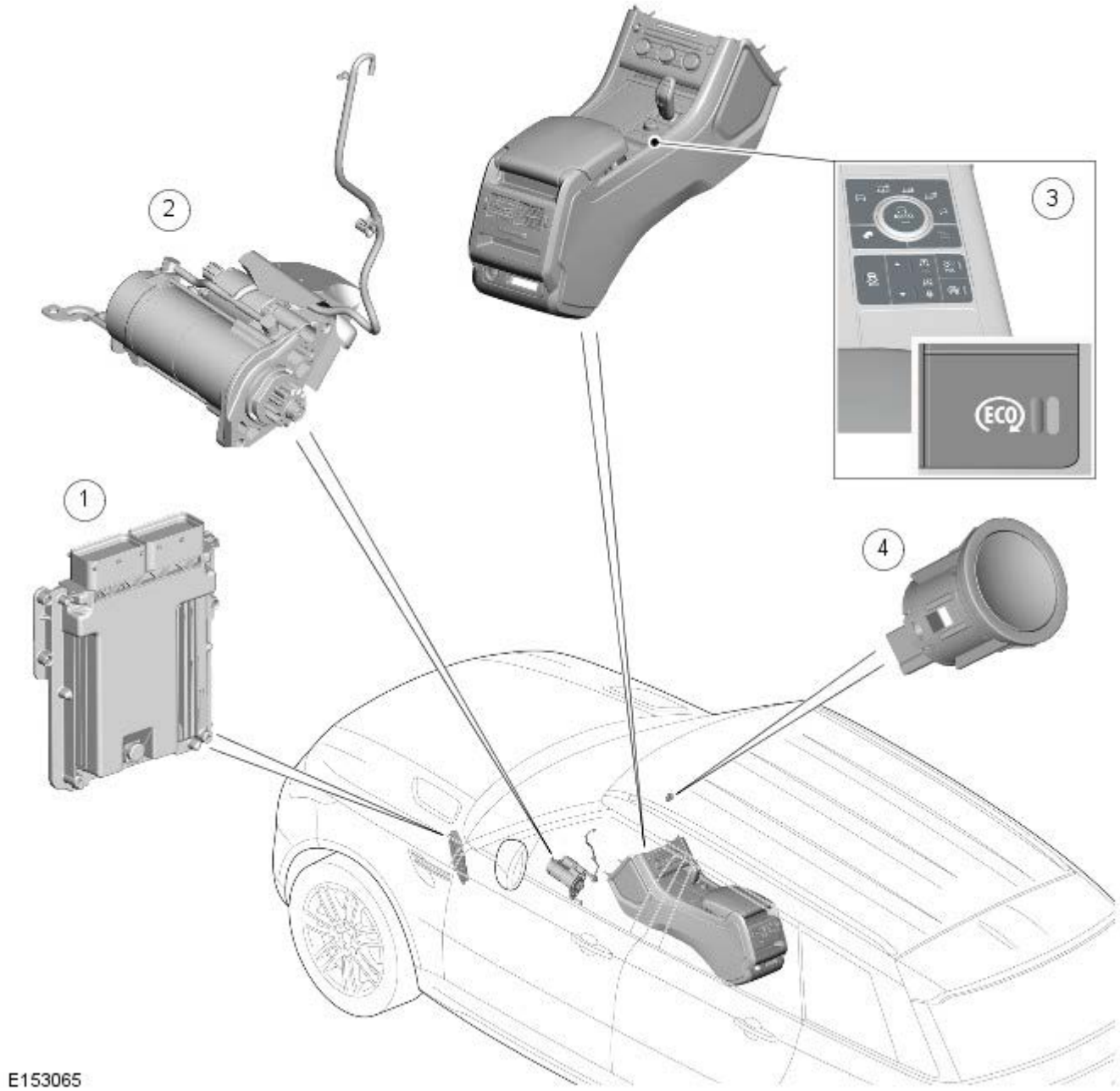
Description and Operation

COMPONENT LOCATION - STARTER MOTOR



Item	Part Number	Description
A	-	Non TSS motor
B	-	TSS motor
1	-	Pinion gear
2	-	Solenoid
3	-	Motor electrical connection
4	-	Solenoid electrical connection
5	-	Motor
6	-	Breather tube
7	-	Pinion gear
8	-	Motor
9	-	Support bracket
10	-	Motor electrical connection
11	-	Solenoid electrical connection
12	-	Solenoid
13	-	Heatshield
14	-	Breather tube

COMPONENT LOCATION - START/STOP SYSTEM



E153065

Item	Part Number	Description
1	-	Engine Control Module (ECM)
2	-	TSS motor
3	-	ECO switch
4	-	Stop/start switch

OVERVIEW

The starting system consists of an electric starter motor that engages with the ring gear on the crankshaft drive plate. Operation of the starter motor is controlled by the ECM (Engine Control Module).

In some markets the starting system incorporates a stop/start system. The system is controlled by the ECM using CAN (Controller Area Network) messages and signals from other system components and modules to determine the correct conditions for system operation. The stop/start system automatically stops and re-starts the engine when appropriate conditions are met. This reduces the amount of time the engine is running at idle speed which improves economy and reduces engine emissions.

The stop/start system is automatically enabled each time the ignition is switched on. The driver can disable the system using an ECO switch.

The stop/start system stops the engine when it is not needed, this is known as ECO stop. The engine will restart automatically when vehicle parameters are met and the driver releases the brake pedal, this is known as ECO start.

To accommodate the increased electrical loads, vehicles fitted with the stop/start system are equipped with two batteries.
For additional information, refer to: Battery and Cables (414-01 Battery, Mounting and Cables, Description and Operation).

DESCRIPTION

Vehicles without the stop/start system use a conventional starter motor. Vehicles with the stop/start system use a TSS (Tandem Solenoid Starter) motor. The TSS motor can restart the engine if it is still rotating, allowing the engine to be started quickly in any situation.

The starter motor is located on the rear right side of the oil pan. The rear of the starter motor is attached to a support bracket on the oil pan. The starter motor incorporates a snorkel breather pipe to assist with ventilation and sealing, during water submergence.

VEHICLES WITHOUT STOP/START

The starter motor is rated at 1.4 kW and comprises a series wound motor, an overrunning clutch and pinion, and a solenoid.

Power to operate the motor is supplied from the 450 A megafuse in BJB2 (Battery Junction Box 2). Power to operate the solenoid is supplied from the starter relay in the EJB (Engine Junction Box).

VEHICLES WITH STOP/START

The TSS motor is rated at 2.0 kW and comprises a series wound motor, an overrunning clutch and pinion, a pinion gear shift solenoid and a motor rotation solenoid.

Power to operate the motor is supplied from the 450A megafuse in BJB2. Power to operate the solenoids is supplied from the starter motor relay and the starter pinion relay in the EJB.

ECO Switch

On vehicles with stop/start, the ECO switch is integrated into the Terrain Response® switchpack in the floor console. An amber LED (Light Emitting Diode) in the ECO switch remains illuminated while the stop/start system is active. Selection of the ECO switch is transmitted from the Terrain Response® switchpack to the ECM on the high speed CAN Chassis, and high speed CAN Powertrain bus via the GWM (Gateway Module).

Warning Indicator



E147783

On vehicles with stop/start, an ECO warning indicator is located in the IC (Instrument Cluster). The warning indicator comes on when the engine stops during a stop/start cycle, then goes off when the engine restarts. The warning indicator is controlled by a high speed CAN Powertrain bus message from the ECM.

OPERATION

Vehicles Without Stop/Start

When the engine stop/start switch is pressed, if the keyless vehicle module detects a valid smart key in the vehicle the CJB (central junction box) transmits a hardwired crank request to the ECM.
For additional information, refer to: Anti-Theft - Passive (419-01B Anti-Theft - Passive, Description and Operation).

When the ECM receives a crank request from the CJB it energizes the starter relay, provided the TCS (Transmission Control Switch) is in P (park) or N (neutral) and the brake pedal is pressed. The energized starter relay supplies battery power to the starter solenoid, which energizes and causes the pinion gear to engage with the ring gear. When the starter solenoid is energized it also closes high-current contacts, which connects battery power from BJB2 to the motor to turn the engine.

Vehicles With Stop/Start

At the beginning of a drive cycle, when the engine stop/start switch is pressed the starting system operates in the same way as on vehicles without stop/start, up to the point that the ECM energizes the starter relay. At that point, on the stop/start system, the ECM energizes both the starter pinion relay and the starter motor relay. The energized starter

pinion relay supplies battery power to the pinion gear shift solenoid in the starter, which energizes and causes the pinion gear to engage with the ring gear. The energized starter motor relay supplies battery power to the motor rotation solenoid in the starter, which energizes and closes high-current contacts, which connects battery power from BJB2 to the motor to turn the engine.

During a drive cycle, with the stop/start system enabled and the TCS in D (drive) or S (sport), the ECM performs an ECO stop when one of the following occurs:

- The vehicle stops from a speed greater than 4 km/h (2.5 mph) and sufficient brake pressure is applied to the brake pedal to ensure the vehicle is stationary
- The vehicle is stationary and N is selected on the TCS.

NOTE: On a gradient an ECO stop will only occur if the driver applies a minimum of 7 bar (101.5 lbf/in²)+ / - 3 bar (43.5 lbf/in²) brake pressure and will not occur at all on gradients about in excess of 1 in 4.34 (23%).

The green ECO warning indicator in the IC illuminates to advise that the engine has shut down. Other warning indicators normally associated with an engine shut down, for example the ignition and low oil pressure warning indicators, are suppressed so will not illuminate during an ECO stop.

The following conditions will prevent an ECO stop:

- A steering wheel paddle switch has been used to select a gear (transmission Commandshift mode)
- The ambient air temperature is outside the range of 0 to 40 °C (32 to 104 °F)
- The engine coolant temperature is outside the range of 20 to 110 °C (68 to 230 °F)
- Brake vacuum is less than the threshold value
- The pressure altitude derived from the barometric pressure sensor in the ECM is more than approximately 2800 m (9150 feet)
- The hood is open
- The driver door is open
- The driver seatbelt is not fastened
- High demand from the climate control system requires the engine to be running, for example windshield demist selected
- The battery charge is low
- A Terrain Response® special program is active
- Hill descent control is active
- The level in the fuel tank is too low
- ECO stop/start is disabled using the ECO switch.

While the vehicle is stationary, if a condition that prevented an ECO stop is removed the ECM automatically performs an ECO stop. The ECM automatically restarts the engine when one of the following occurs:

NOTE: When the brake pedal is released during an ECO restart the ABS (anti-lock brake system) control module briefly applies the brakes to hold the vehicle stationary until the engine has restarted.

- The brake pedal is released with D or S selected on the TCS.
- The accelerator pedal is pressed
- A paddle switch is used to select a gear
- R (reverse) is selected on the TCS
- Climate control system demand increases
- The vehicle speed exceeds approximately 1 km/h (0.5 mph)
- The battery charge becomes low
- Brake vacuum reduces below the threshold value
- ECO stop/start is disabled using the ECO switch.

The following will prevent an ECO restart, and require use of the engine stop/start switch to restart the engine:

- The hood is open
- The driver door is open
- The driver seatbelt is not fastened.

STOP/START STRATEGY

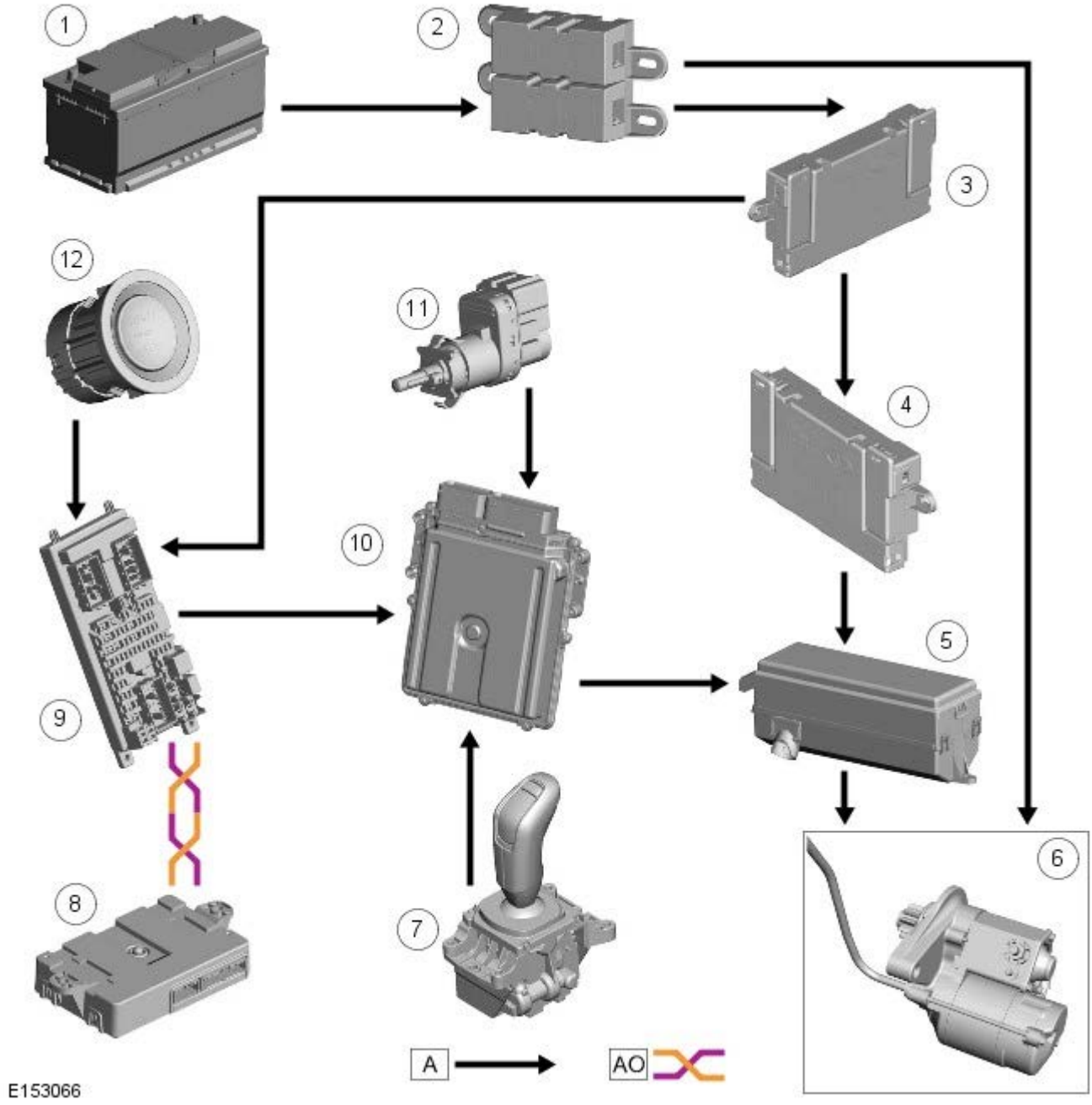
Operating the motor and the pinion gear individually allows meshing of the pinion gear with the drive plate ring gear, even if the engine is still turning. This allows instant restarts under all conditions.

Engine speed 250 rev/min or more: When an ECO stop is initiated and the ECM then detects an engine restart parameter, it operates the starter motor to first accelerate the pinion gear up to the ring gear speed, then engages the pinion gear with the ring gear and energizes the motor to rotate the engine up to starting speed. The ECM also activates the fueling and engine systems to restart the engine.

Engine speed less than 250 rev/min: When an ECO stop is initiated and the ECM then detects an engine restart parameter, it operates the starter motor to first engage the pinion gear with the ring gear, then energizes the motor to rotate the engine up to starting speed. The ECM also activates the fueling and engine systems to restart the engine.

CONTROL DIAGRAM - VEHICLES WITHOUT STOP/START

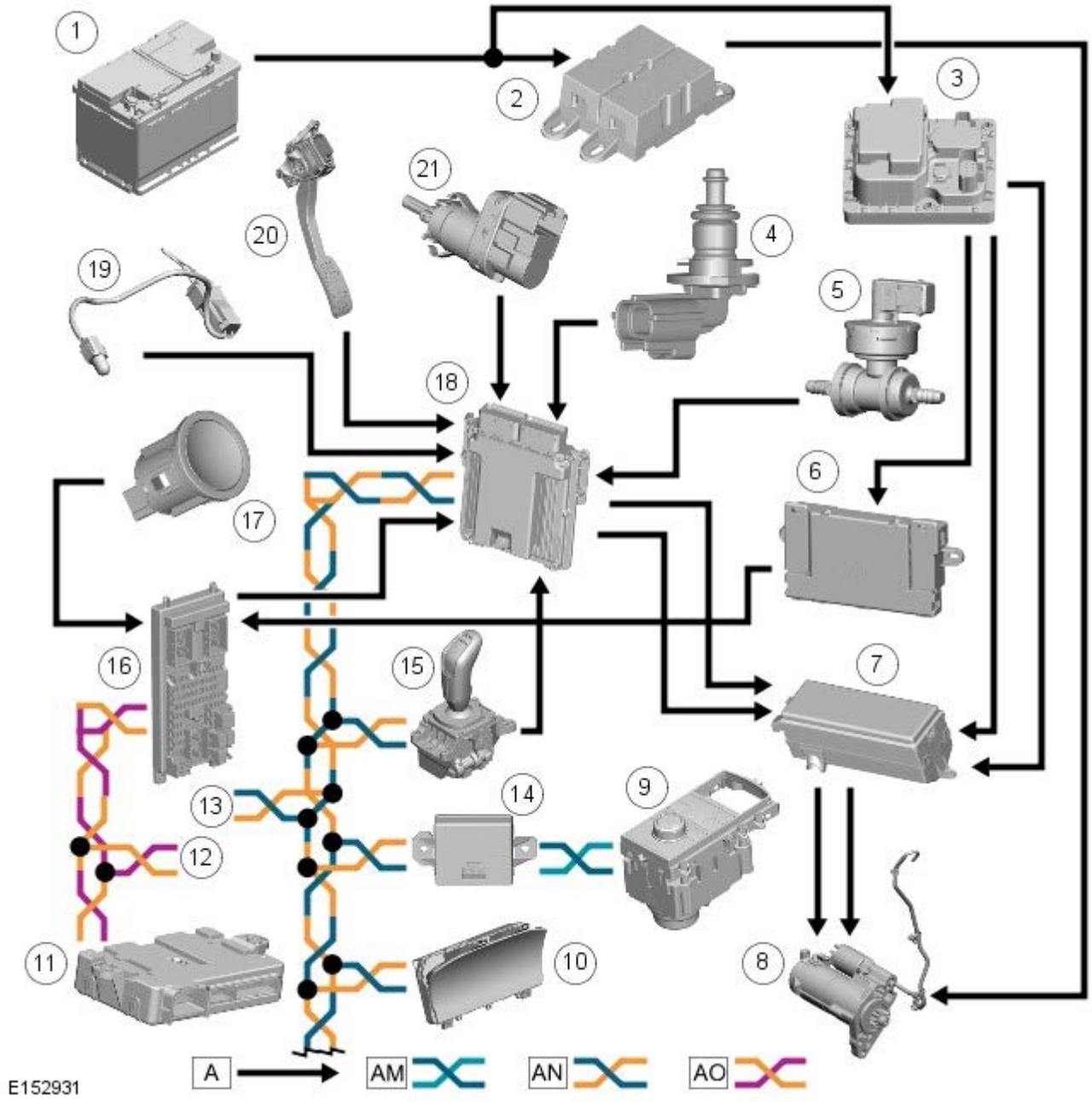
NOTE: A = Hardwired, AO = Medium speed CAN (Controller Area Network) Body bus.



Item	Part Number	Description
1	-	Battery
2	-	Battery Junction Box 2 (BJB2)
3	-	Battery Junction Box
4	-	Auxiliary Junction Box (AJB)
5	-	Engine Junction Box(EJB)
6	-	Starter motor
7	-	Transmission Control Switch (TCS)
8	-	Keyless Vehicle Module (KVM)
9	-	Central Junction Box (CJB)
10	-	Engine Control Module (ECM)
11	-	Brake pedal switch
12	-	Stop/start switch

CONTROL DIAGRAM - VEHICLES WITH STOP/START

NOTE: A = Hardwired, AM = High speed CAN (Controller Area Network) Chassis bus, AN = High speed CAN Powertrain bus, AO = Medium speed CAN Body bus.



Item	Part Number	Description
1	-	Battery
2	-	Battery Junction Box (BJB2)
3	-	Power Supply Distribution Box
4	-	Engine Coolant Temperature (ECT) sensor
5	-	Brake vacuum sensor
6	-	Battery Junction Box (BJB)
7	-	Engine Junction Box (EJB)
8	-	TSS motor
9	-	Terrain Response® switchpack
10	-	Instrument Cluster (IC)
11	-	Keyless Vehicle Module (KVM)
12	-	Connection to other control modules on medium speed CAN Body bus
13	-	Connection to other control modules on high speed CAN Powertrain bus
14	-	Gateway Module (GWM)
15	-	Transmission Control Switch (TCS)
16	-	Central Junction Box (CJB)
17	-	Stop/start switch
18	-	Engine Control Module (ECM)
19	-	Ambient Air Temperature (AAT) sensor
20	-	Accelerator pedal

21	-	Brake pedal switch

Published: 06-Apr-2013

Starting System - 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 in 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.

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or 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 • 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.
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 - Output circuit: high resistance - Output circuit: short circuit to power • Invalid key code received by Central Junction Box (CJB) • Harness/Connectors • Starter motor • Ignition switch • Generator • Engine seized	Make sure the gear selector is in the **P** or **N** position and correctly adjusted. REFER to: Selector Lever Cable Adjustment (307-05 Automatic Transmission/Transaxle External Controls - TDV8 3.6L Diesel, General Procedures). Check the battery condition and state of charge. Check for DTCs indicating an immobilizer fault. Check the starter motor relay, ignition switch and generator circuits. Refer to the electrical guides. Check that the engine turns freely.
The engine does not crank (starter motor **does** turn)	• Starter motor fitment • Starter motor • Flywheel/Drive plate ring gear	Check the starter motor fitment (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 • Starter motor • Oil grade	Check the battery condition and state of charge. Check the starter motor circuits. Refer to the electrical guides. Check the engine oil grade and condition.

Engine cranks too fast	• Low engine compression	Check the engine condition and compressions.
Excessive starter motor noise	• Starter motor • Flywheel/Drive plate ring gear • Starter motor installation/casing	Check the starter motor fitment (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 S/C 5.0L Petrol, DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation).

Published: 29-Apr-2013

Starting System - V8 S/C 5.0L Petrol - Starter Motor

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.

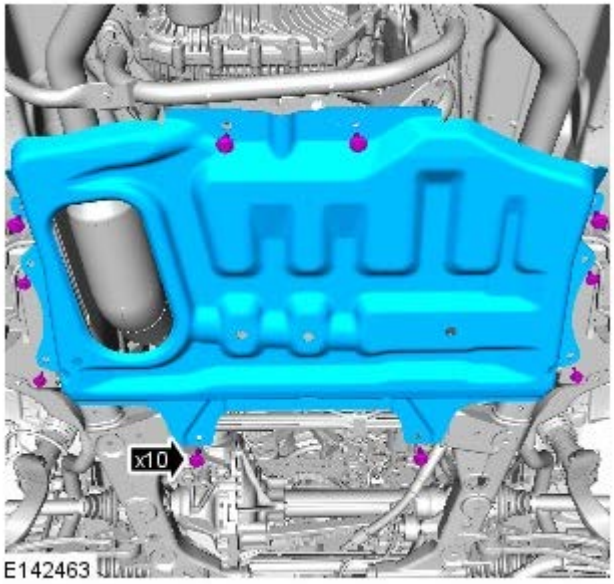
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

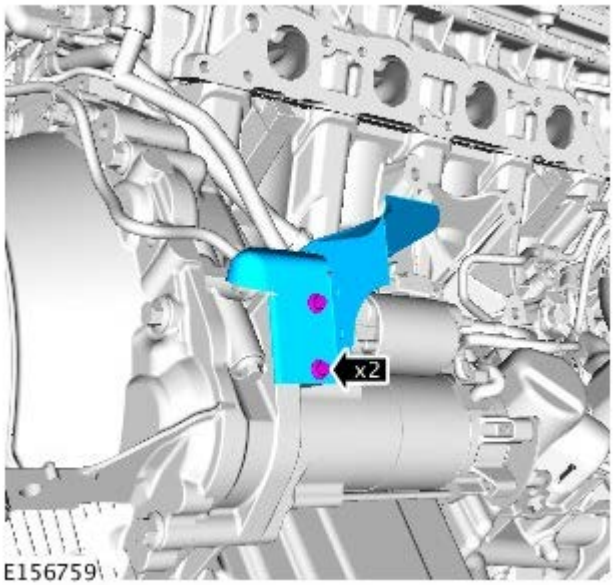
3. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

4. *Torque:*
   M10 60 Nm
   M6 10 Nm

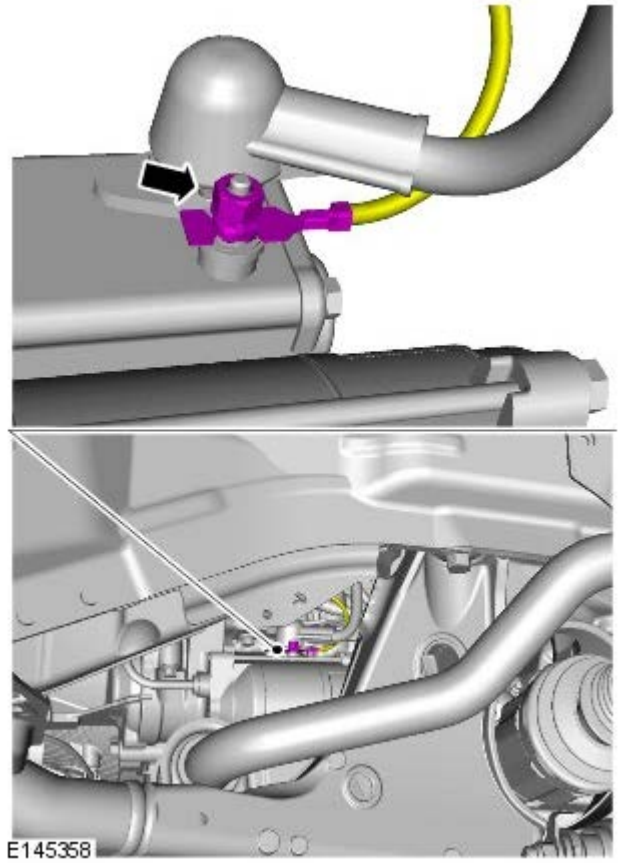


5. NOTE: If equipped with TSS.

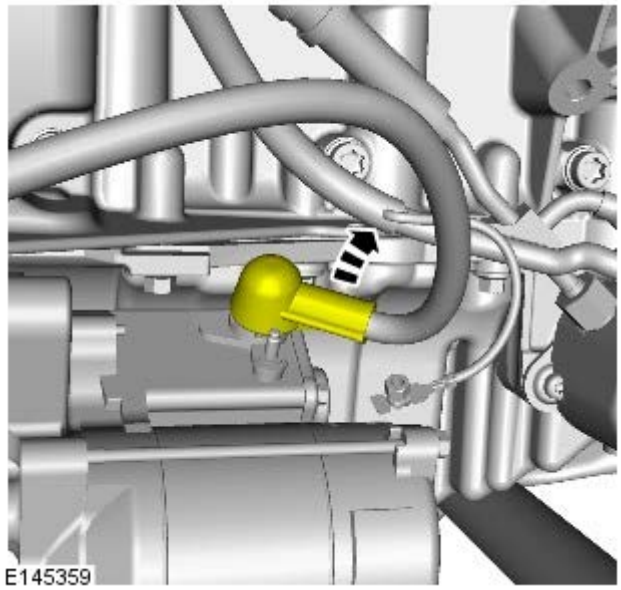
   Torque: 6 Nm



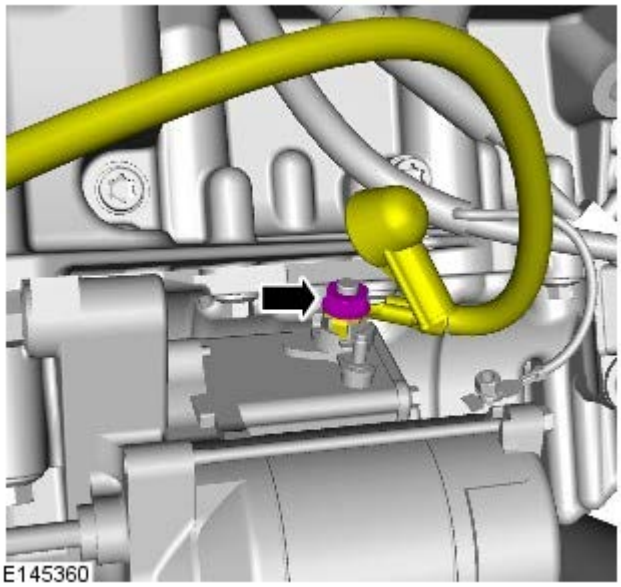
6. *Torque:* 7 Nm

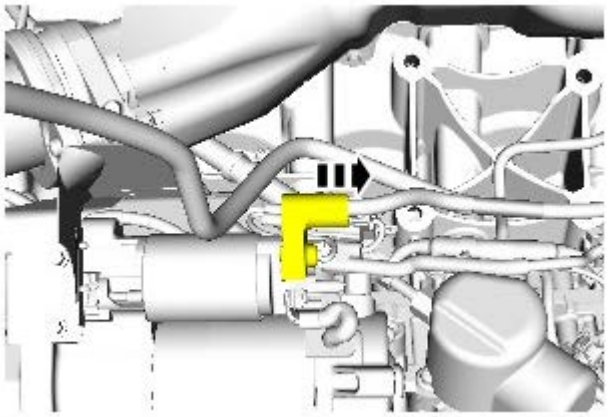


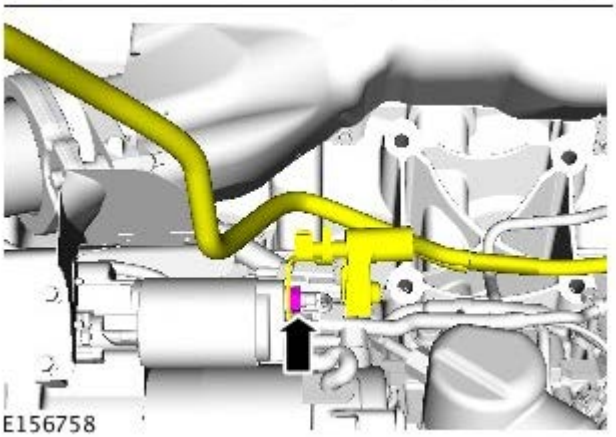
7.



8. *Torque:* 10 Nm



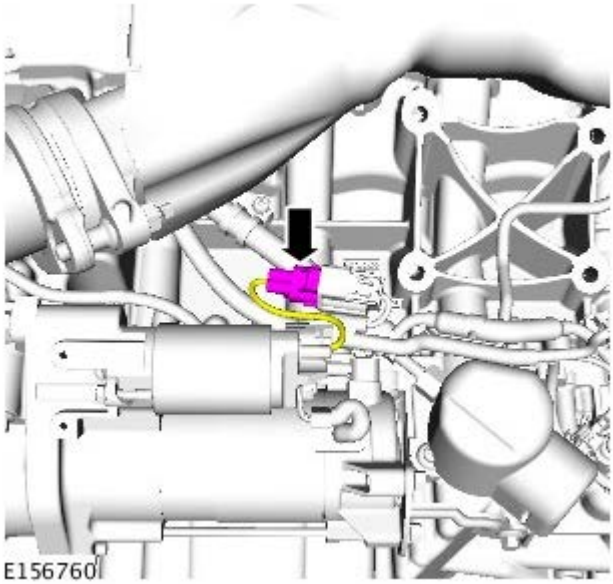




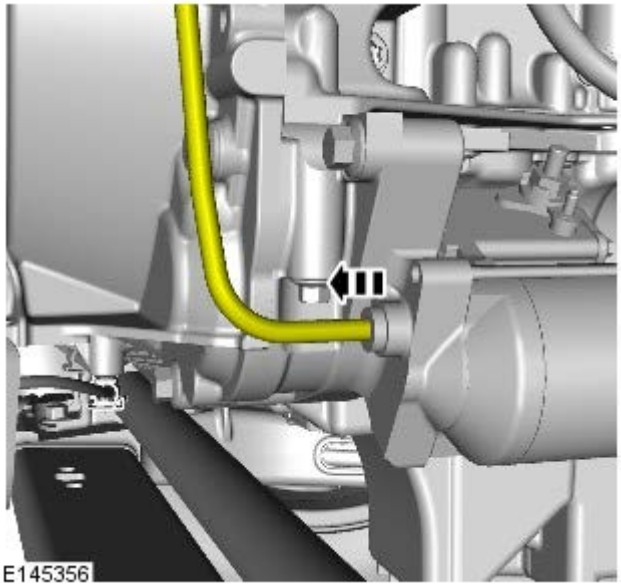
9. NOTE: If equipped with TSS.

Torque: 10 Nm

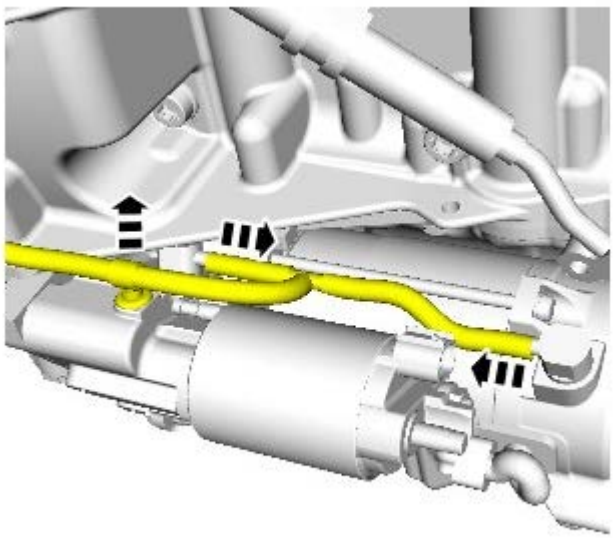
10. NOTE: If equipped with TSS.



11.

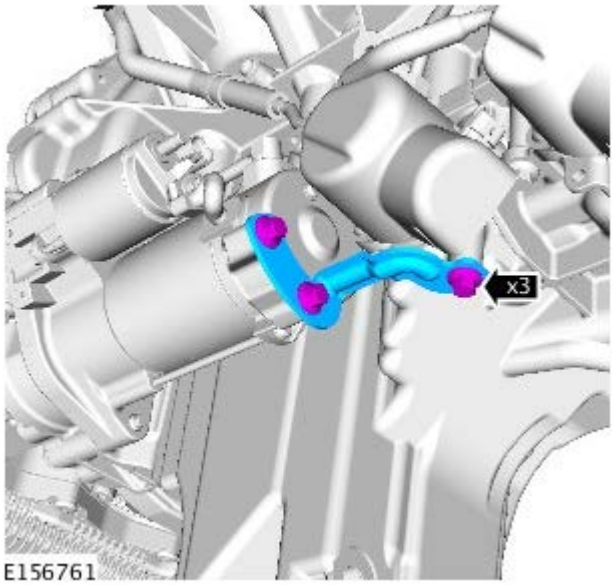


12. NOTE: If equipped with TSS.

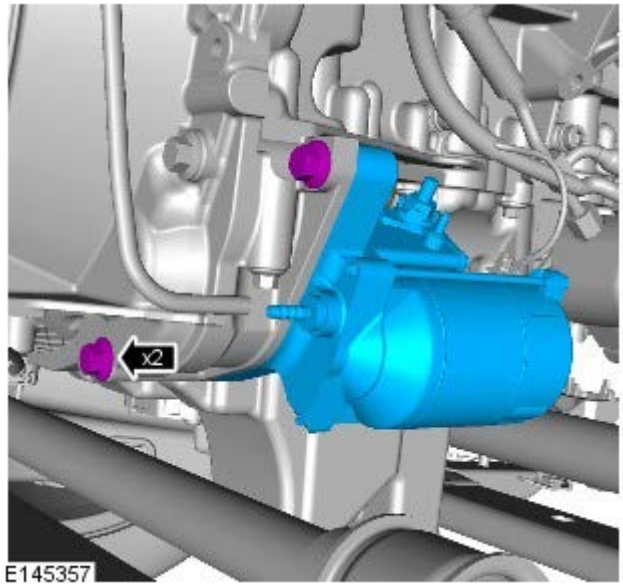


13. NOTE: If equipped with TSS.

Torque: 47 Nm



14. *Torque:* 47 Nm



Installation

1. To install, reverse the removal procedure.

Published: 31-Jul-2012

Starting System - TDV8 4.4L Diesel -

Torque Specifications

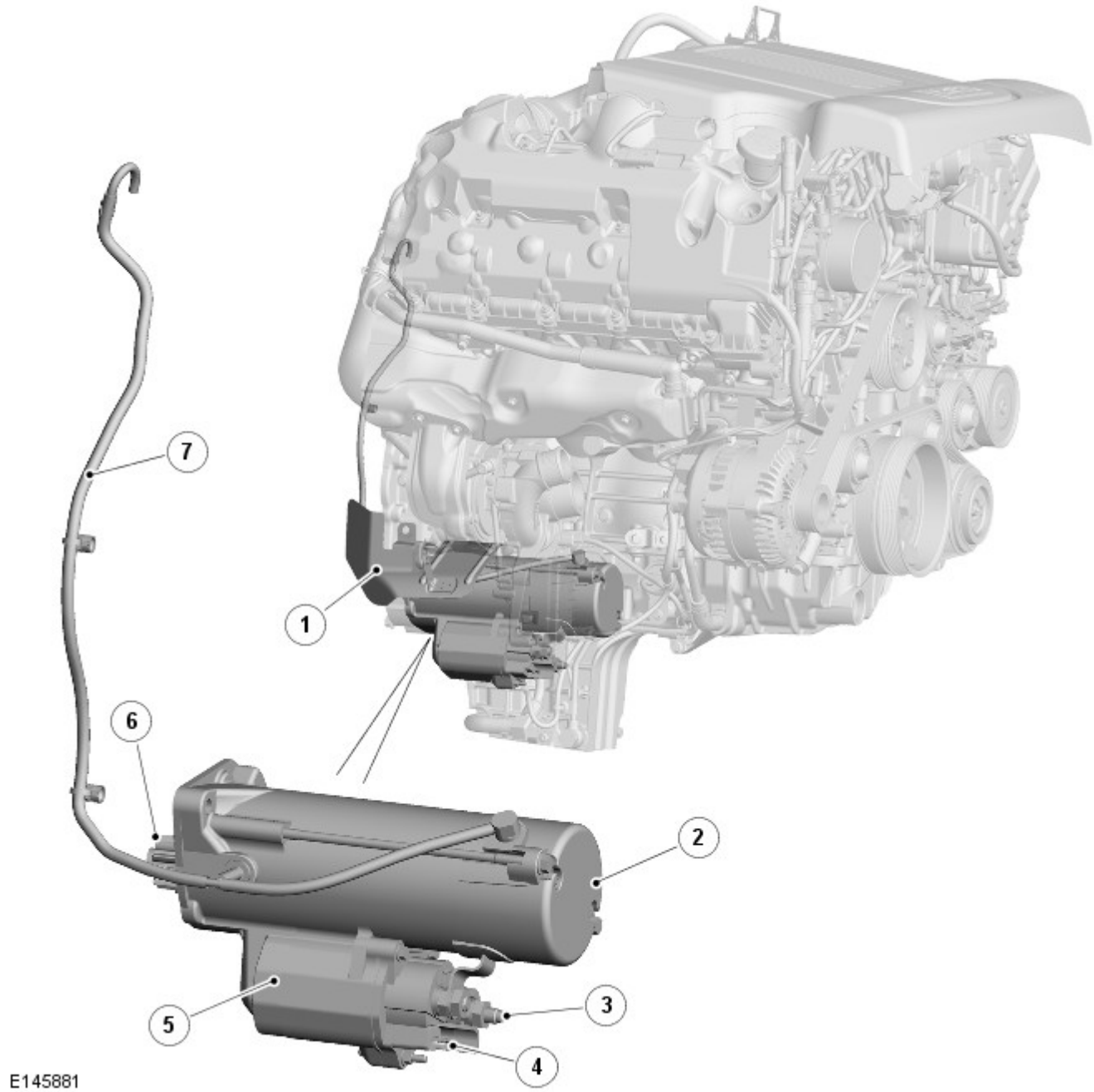
Item	Nm	lb-ft	lb-in
Battery positive cable nut	22	16	-
Starter motor bolts	45	33	-
Starter motor heat shield bolts	10	-	89
Switch lead to the starter motor solenoid nut	4	-	35

Published: 02-Dec-2013

Starting System - TDV8 4.4L Diesel - Starting System

Description and Operation

COMPONENT LOCATION



Item	Part Number	Description
1	-	Heat shield
2	-	Motor
3	-	Motor electrical connection
4	-	Solenoid electrical connection
5	-	Solenoid
6	-	Pinion gear
7	-	Breather tube

OVERVIEW

The starting system consists of an electric starter motor that engages with the ring gear on the crankshaft drive plate. Operation of the starter motor is controlled by the ECM (Engine Control Module).

DESCRIPTION

Starter Motor

The starter motor is located on the rear right side of the oil pan and secured with two bolts. A heat shield is positioned above the starter motor to protect it from heat emitted from the variable turbocharger. The starter motor incorporates a snorkel breather pipe to assist with ventilation and sealing during water submergence.

The starter motor is rated at 3.0 kW and comprises a series wound motor, an overrunning clutch and pinion, and a solenoid.

Power to operate the motor is supplied from the 450 A megafuse in BJB 2 (Battery Junction Box 2). Power to operate the solenoid is supplied from the starter relay in the EJB (Engine Junction Box).

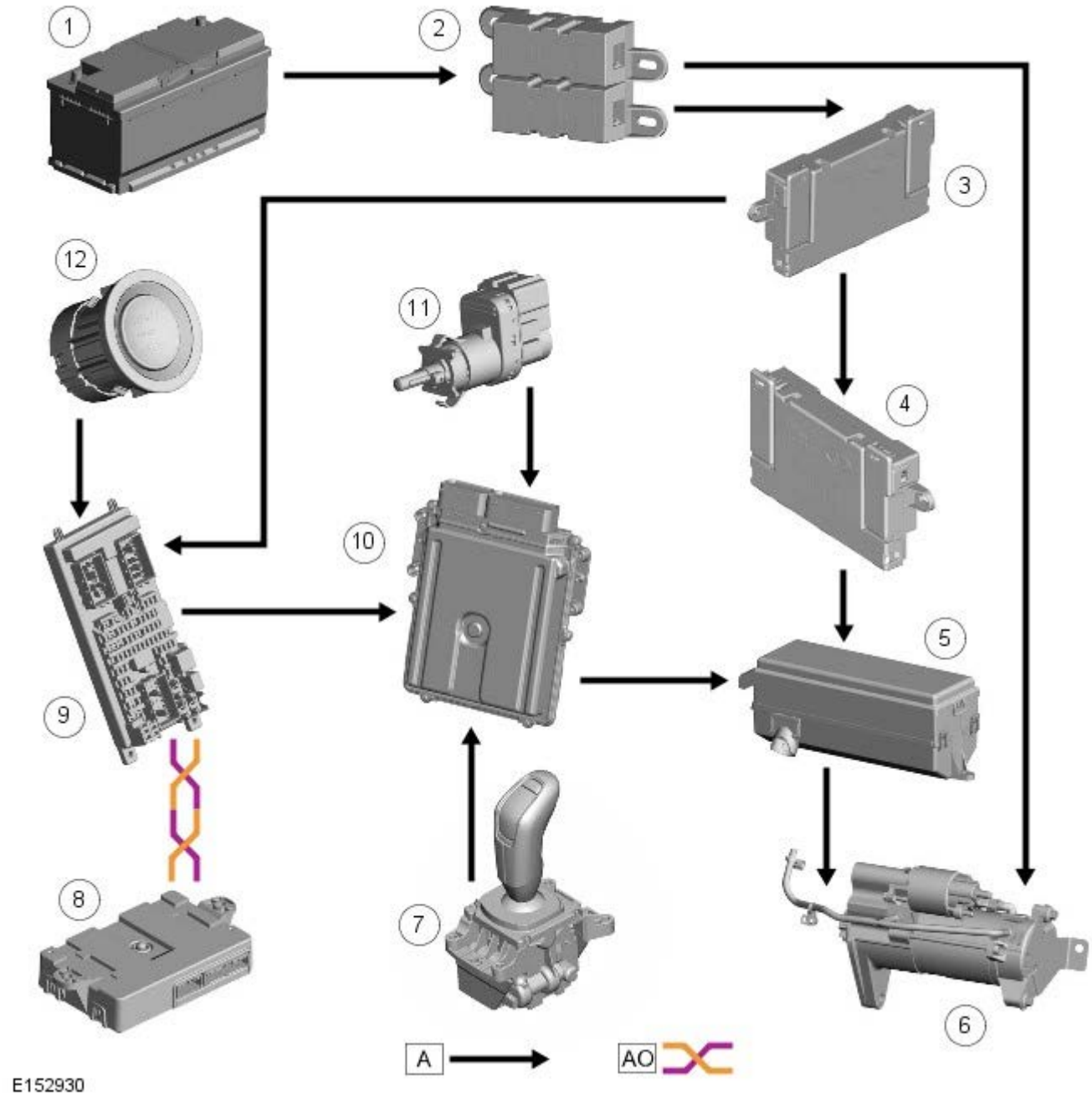
OPERATION

When the stop/start switch is pressed, if the keyless vehicle module detects a valid smart key in the vehicle the CJB (Central Junction Box) transmits a hardwired crank request to the ECM.
For additional information, refer to: Anti-Theft - Passive (419-01B Anti-Theft - Passive, Description and Operation).

When the ECM receives a crank request from the CJB, provided the transmission control switch is in P (park) or N (neutral) and the brake pedal is pressed, it energizes the starter relay. The energized starter relay supplies battery power to the starter solenoid, which energizes and causes the pinion gear to engage with the ring gear. When the starter solenoid is energized it also closes high-current contacts for the motor, which connects battery power from BJB 2 to the motor to turn the engine.

Control Diagram

NOTE: A = Hardwired, AO = Medium speed CAN (Controller Area Network) Body bus.



E152930

Item	Part Number	Description

1	-	Battery
2	-	Battery Junction Box 2 (BJB2)
3	-	Battery Junction Box (BJB)
4	-	Auxiliary Junction Box (AJB)
5	-	Engine Junction Box (EJB)
6	-	Starter motor
7	-	Transmission control switch (TCS)
8	-	Keyless vehicle module (KVM)
9	-	Central Junction Box (CJB)
10	-	Engine Control Module (ECM)
11	-	Brake pedal switch
12	-	Stop/start switch

Published: 06-Apr-2013

Starting System - TDV8 4.4L 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: Starting System (303-06E Starting System - SDV6 3.0L Diesel - Hybrid Electric Vehicle, 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 slowly	• Battery • Harness/connectors • Starter motor • Oil grade	Check the battery condition and state of charge. Check the starter motor circuits. Refer to the electrical guides. Check the engine oil grade and condition

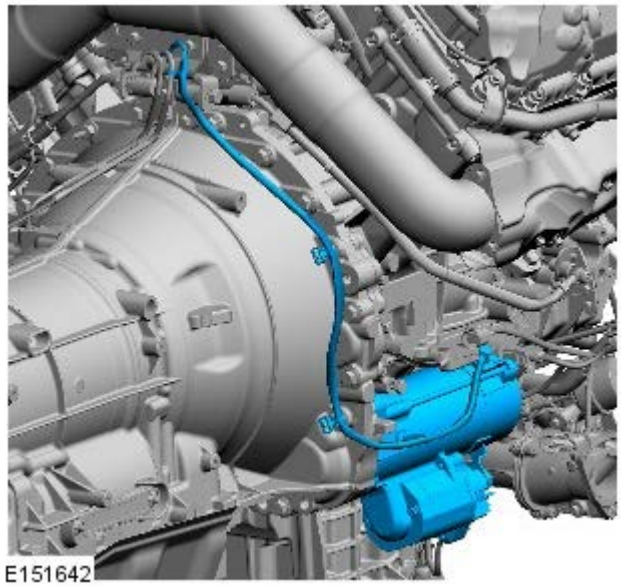
Engine cranks too fast	• Low engine compression	Check the engine compressions
Excessive starter motor noise	• Starter motor • Flywheel/drive plate ring gear • Starter motor installation/casing	Check the starter motor installation (fasteners tight, motor square to engine, etc). Check the starter motor 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 - TDV8 4.4L 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



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

 E151641	
	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 0.6 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 - TDV8 4.4L Diesel, DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation).

Published: 28-Oct-2013

Starting System - TDV8 4.4L Diesel - Starter Motor

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.

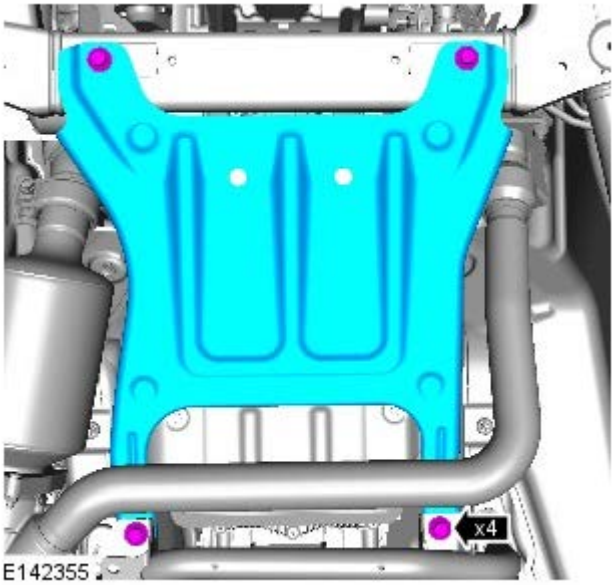
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

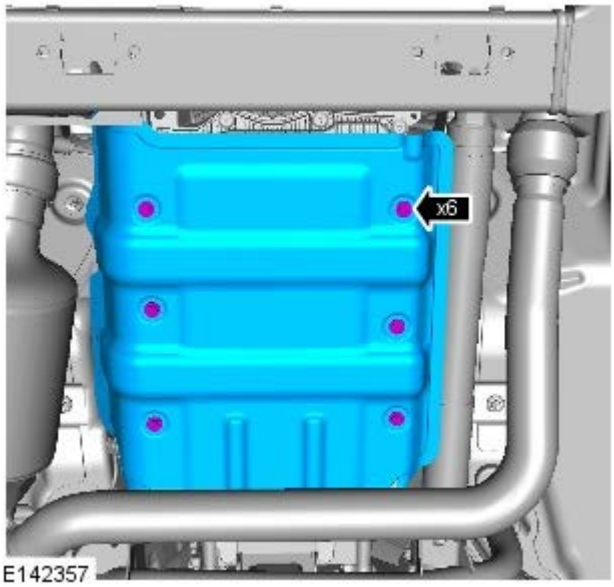
   Raise and support the vehicle.

3. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

4. *Torque:* 60 Nm



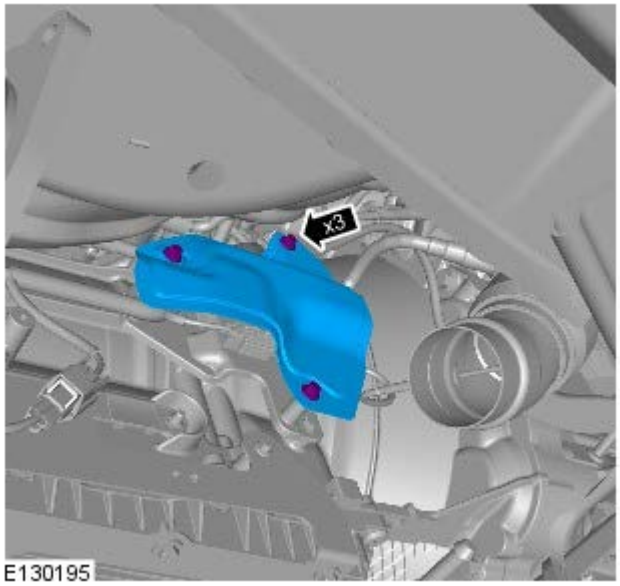
5. *Torque:* 10 Nm



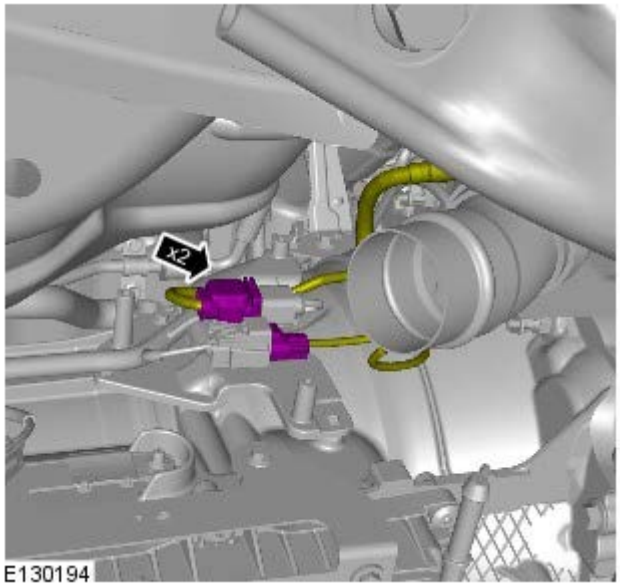
6. Refer to: Catalytic Converter (309-00D Exhaust System - TDV8

4.4L Diesel, Removal and Installation).

7. *Torque:* 10 Nm

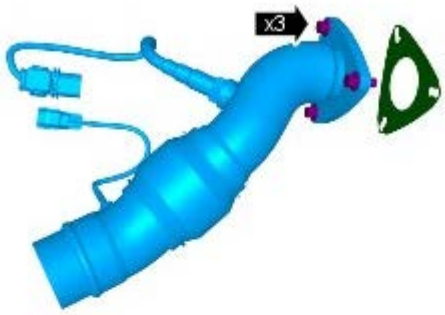


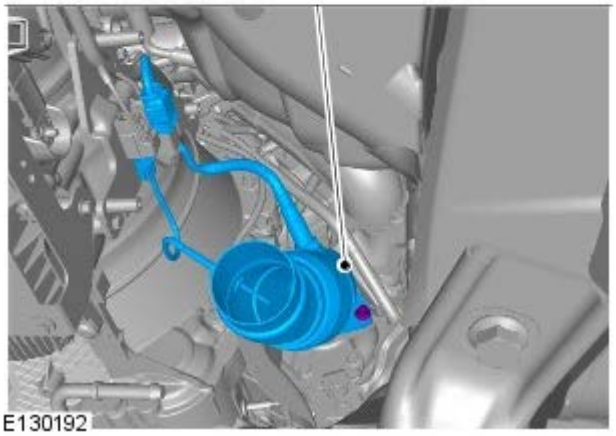
8.



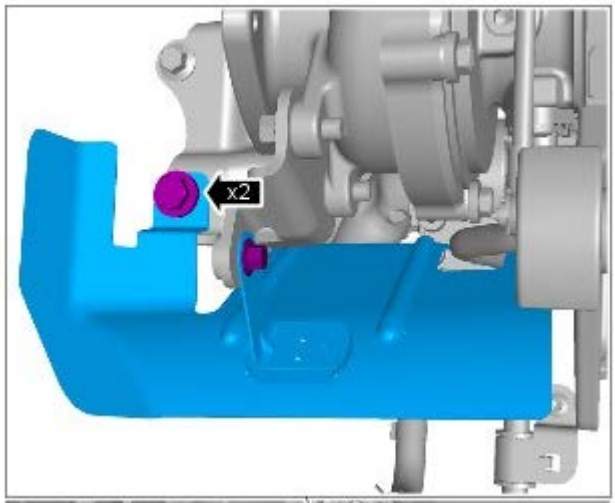
9. NOTE: Install a new gasket.

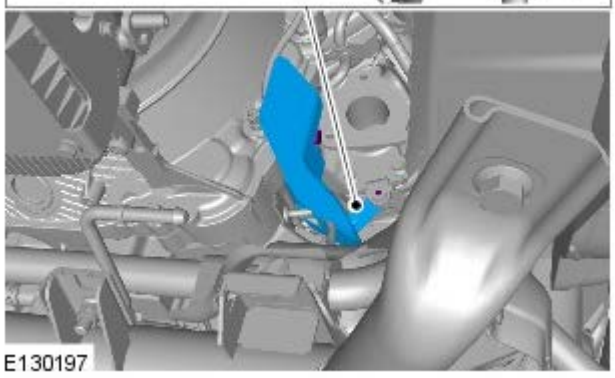
Torque: 21 Nm



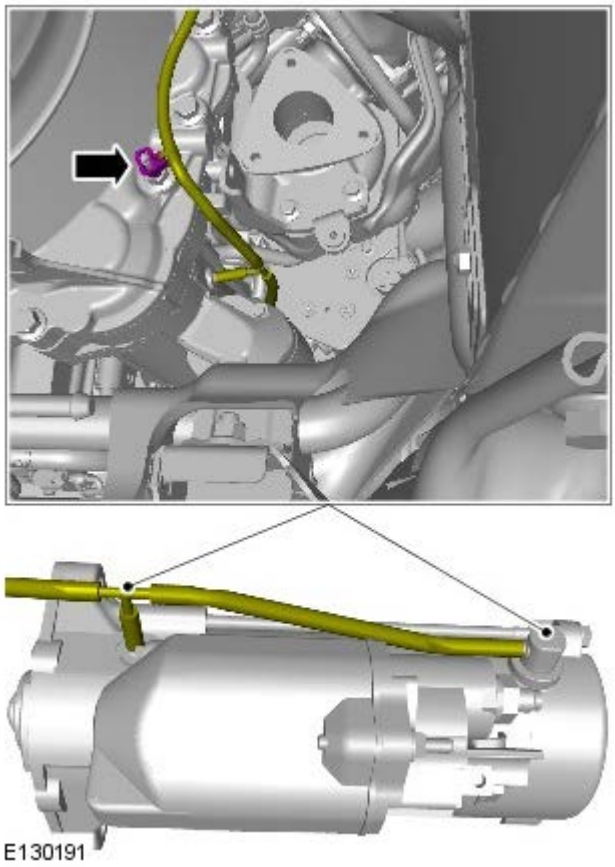


10. *Torque:* 10 Nm

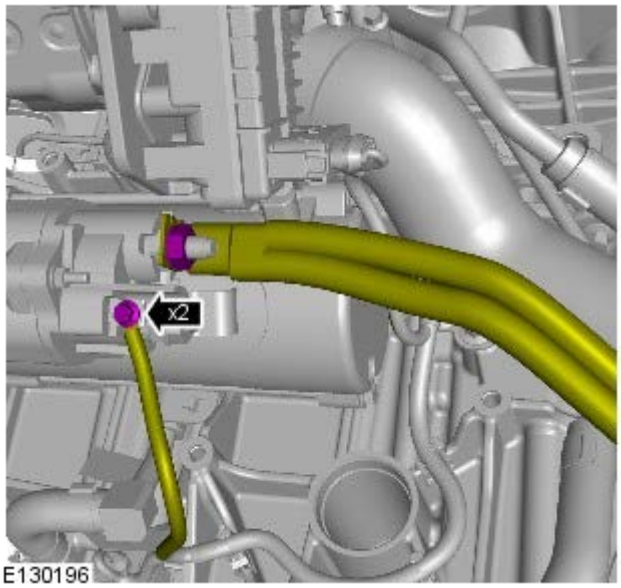




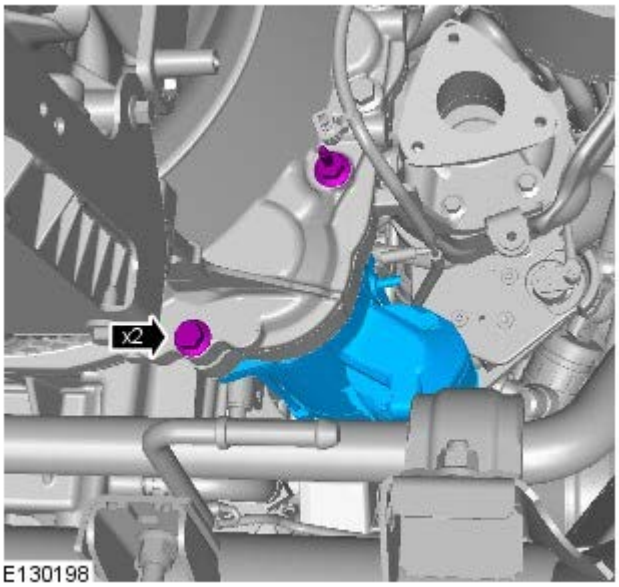
11.



12. *Torque:*
    M8 nut 22 Nm
    M6 bolt 4 Nm



13. *Torque:* 45 Nm



Installation

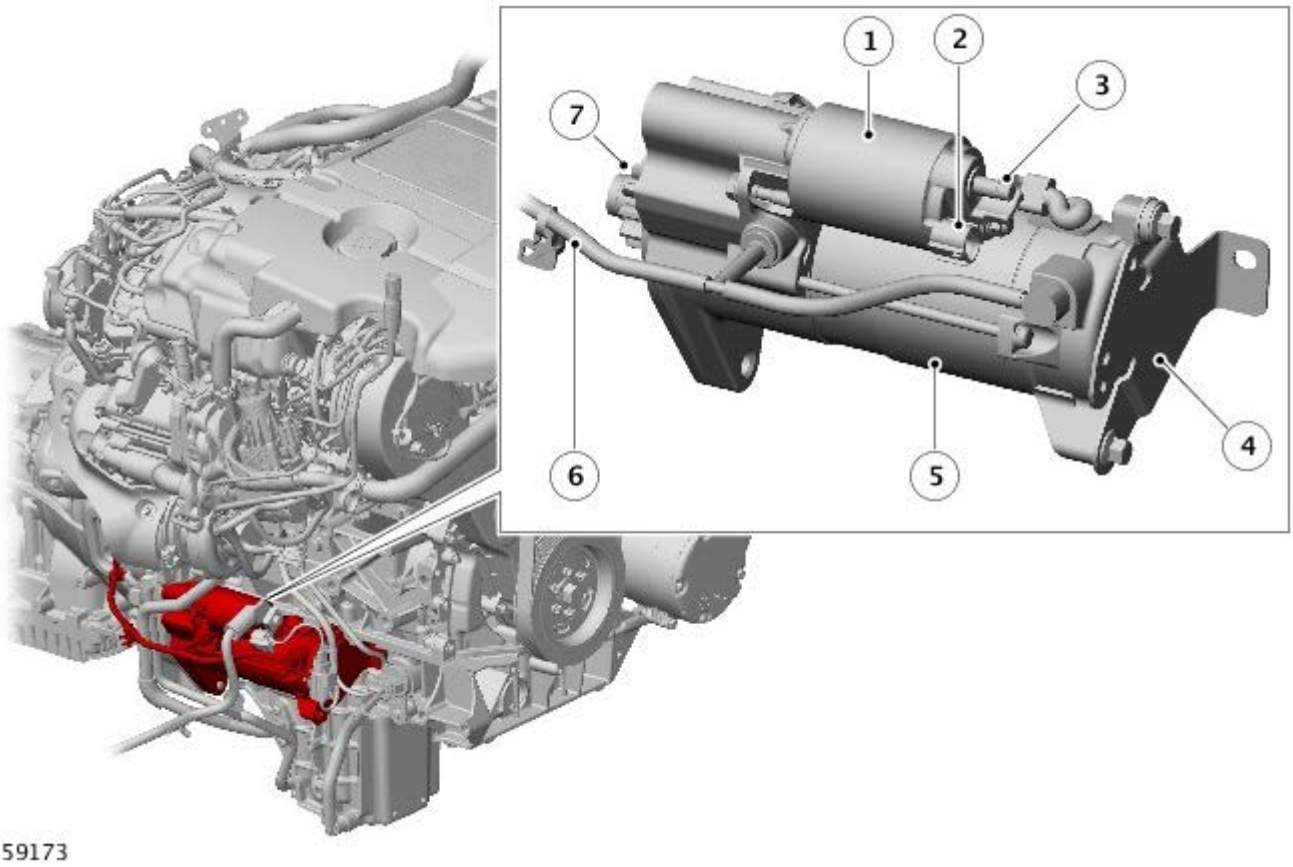
1. To install, reverse the removal procedure.

Published: 06-Sep-2013

Starting System - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Starting System

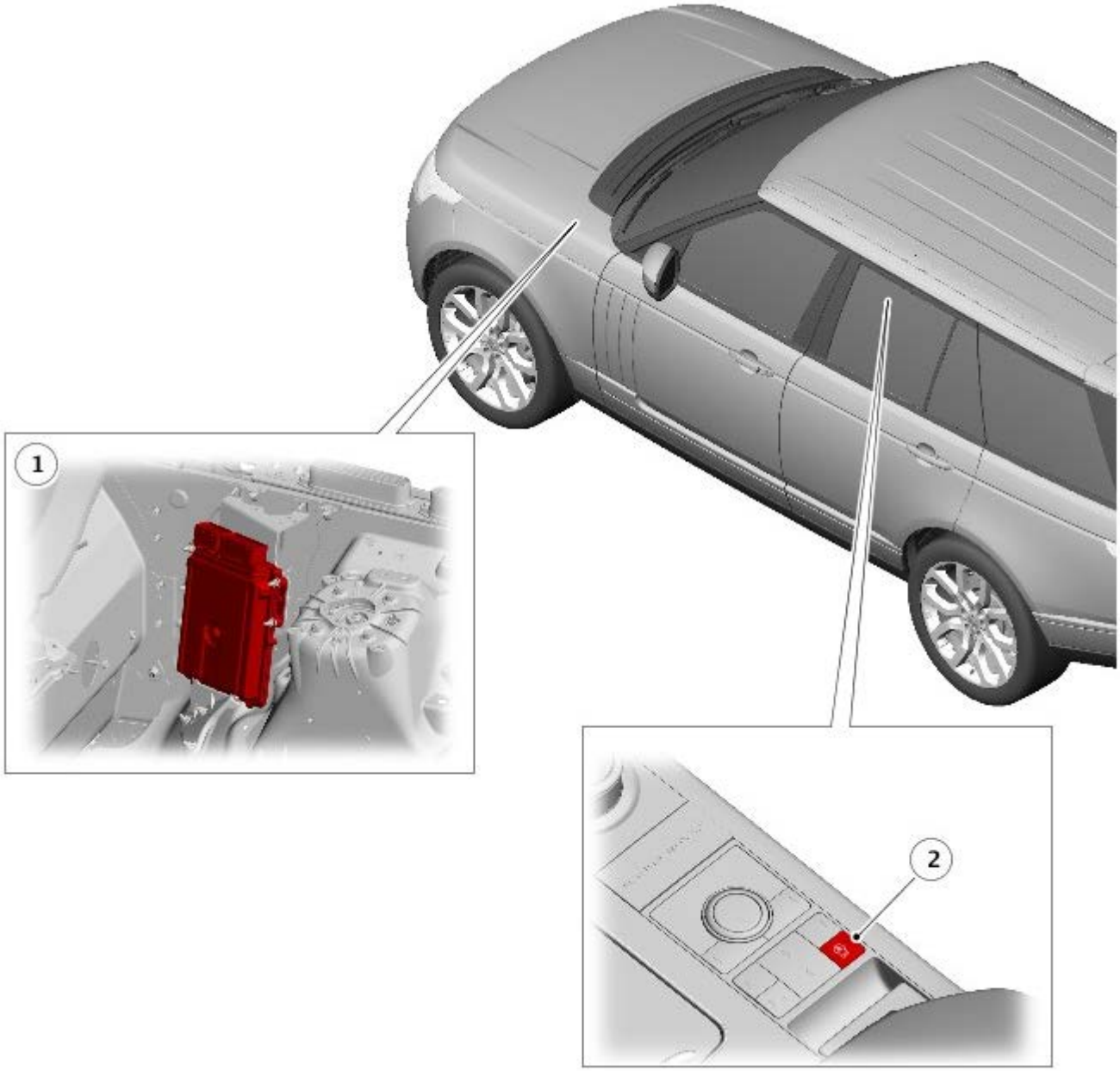
Description and Operation

COMPONENT LOCATION - SHEET 1 OF 2



Item	Part Number	Description
1	-	Solenoids
2	-	Solenoid electrical connection
3	-	Motor electrical connection
4	-	Support bracket
5	-	Motor
6	-	Breather tube
7	-	Pinion gear

COMPONENT LOCATION - SHEET 2 OF 2



E159174

Item	Part Number	Description
1	-	Engine control module
2	-	Auto stop/start switch

OVERVIEW

The starting system consists of an electric starter motor that engages with the ring gear on the crankshaft drive plate. Operation of the starter motor is controlled by the ECM (engine control module).

The vehicle includes a hybrid system. The system is controlled by the ECM using CAN (controller area network) messages and signals from other system components and modules to determine the correct conditions for system operation. The hybrid system has an auto stop/start feature which automatically stops and restarts the engine according to the vehicle operating condition. This feature is active both when the vehicle is stationary and when moving. Turning the engine off when it is not needed improves fuel economy and reduces engine emissions. The hybrid system auto stop/start feature is automatically enabled each time the ignition is switched on. The driver can disable the feature using an auto stop/start switch.

The hybrid system stops the engine when it is not needed, this is known as auto stop. The engine will restart automatically when vehicle operating conditions change, this is known as an auto start.

To ensure robustness of engine starts, the 12 V electrical system incorporates a secondary battery.
For additional information, refer to: Battery and Cables - TDV6 3.0L Diesel - Hybrid Electric Vehicle (414-01, Description and Operation).

DESCRIPTION

Starter Motor

The starter motor is a TSS (tandem solenoid starter) motor. The TSS motor can restart the engine if it is still rotating, allowing the engine to be started quickly in any situation.

The starter motor is located on the rear right side of the oil pan. The rear of the starter motor is attached to a support bracket on the oil pan. The starter motor incorporates labyrinth-breathing tubes to help with sealing and drainage.

The starter motor is rated at 2.2 kW and comprises a series wound motor, an overrunning clutch and pinion, a pinion gear shift solenoid and a motor rotation solenoid.

Power to operate the motor is supplied from the BJB (battery junction box) 2. Power to operate the solenoids is supplied from the starter motor relay and the starter pinion relay in the EJB (engine junction box).

Auto Stop/Start Switch



E159175

The auto stop/start feature of the hybrid system can be turned off with the auto stop/start switch integrated into the Terrain Response® switchpack in the floor console. An amber LED (light emitting diode) in the switch remains illuminated while the auto stop/start feature is off. Selection of the switch is transmitted from the Terrain Response® switchpack to the ECM on the high speed CAN systems via the gateway module.

Warning Indicator



E159177

An auto stop/start warning indicator is located in the instrument cluster. The warning indicator is illuminated when the auto stop/start feature of the hybrid system is selected off. The warning indicator is controlled by a high speed CAN bus message from the ECM.

OPERATION

When the hybrid stop/start ignition switch is pressed, if the keyless vehicle module detects a valid smart key in the vehicle the CJB (central junction box) transmits a hardwired powertrain running request to the ECM.
For additional information, refer to: Anti-Theft - Passive (419-01B, Description and Operation).

On receipt of a powertrain running request, the ECM signals the BECM (battery energy control module) and the EPIC (electric power inverter converter), on the high speed CAN hybrid systems, to enable the HEV (hybrid electric vehicle) system.
For additional information, refer to: Battery and Cables - TDV6 3.0L Diesel - Hybrid Electric Vehicle (414-01, Description and Operation).

When the engine is required to run, the ECM energizes the starter pinion relay and the starter motor relay in the EJB. The energized starter pinion relay supplies battery power to the pinion gear shift solenoid in the starter, which energizes and causes the pinion gear to engage with the ring gear. The energized starter pinion relay supplies battery power to the motor rotation solenoid in the starter, which energizes and closes high-current contacts, which connects battery power from BJB 2 to the motor to turn the engine.

During a drive cycle, with the auto stop/start feature enabled and the TCS (transmission control switch) in D (drive), the ECM performs an auto stop when one of the following occurs:

- While the vehicle is moving, the 12 V and HEV batteries have a satisfactory state of charge and the power demand from the accelerator pedal is low

When the vehicle stops from a speed greater than 4 km/h (2.5 mph) and sufficient brake pressure is applied to the brake pedal to ensure the vehicle is stationary
- The vehicle is stationary and N is selected on the TCS.

NOTE: When the vehicle stops on a gradient, an auto stop will only occur if the driver applies a minimum of 6 bar (87 lbf/in²) brake pressure and will not occur at all on gradients in excess of 1 in 5 (20%).

During an auto stop the warning indicators normally associated with an engine shut down, for example the ignition and low oil pressure warning indicators, are suppressed so will not illuminate.

During an auto stop, the ECM operates the fuel pressure control valve to maintain a fuel rail pressure of 250 bar (3625 lbf/in²), instead of releasing the fuel pressure as normally occurs at engine shut down. This ensures there is adequate fuel volume and pressure for an instant auto start.

The following conditions will prevent an auto stop:

- A steering wheel paddle switch has been used to select a gear (transmission Commandshift mode)
- The pressure altitude derived from the barometric pressure sensor in the ECM is more than approximately 2800 m (9150 feet)
- The hood is open
- A 12 V or HEV battery state of charge is low
- The level in the fuel tank is too low
- Active regeneration of the DPF (diesel particulate filter) is required or in progress
- The auto stop/start feature is disabled using the auto stop/start switch
- The transfer case is in low range
- The suspension is set to off-road height
- The wade sensing system has detected that the vehicle is wading
- The 12 V battery temperature is below -5°C (23°F).

If a condition that prevented an auto stop is removed the ECM performs an auto stop if there are no other conditions preventing an auto stop. The ECM automatically restarts the engine when one of the following occurs:

- A paddle switch is used to select a gear
- Either the HEV battery or 12 V battery charge becomes low
- Brake vacuum reduces below the threshold value
- The auto stop/start feature is disabled using the auto stop/start switch.

NOTE: The engine may or may not re-start when R (reverse) is selected.

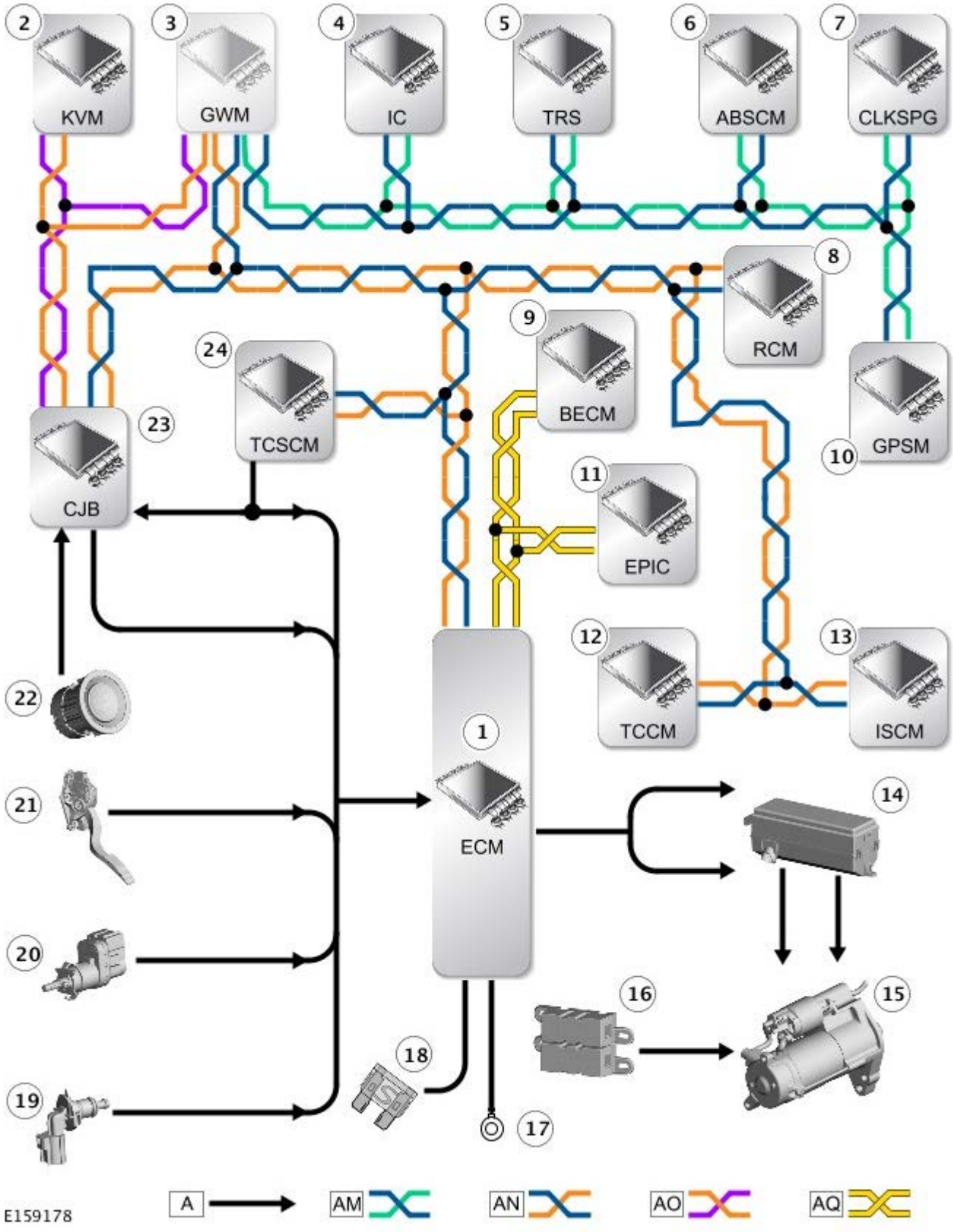
STARTER MOTOR OPERATING STRATEGY

Operating the motor and the pinion gear individually allows meshing of the pinion gear with the drive plate ring gear, even if the engine is still turning. This allows instant restarts under all conditions.

Engine speed 250 rev/min or more: When an auto stop is initiated and the ECM then detects an engine restart parameter, it operates the starter motor to first accelerate the pinion gear up to the ring gear speed, then engages the pinion gear with the ring gear and energizes the motor to rotate the engine up to starting speed. The ECM also activates the fueling and engine systems to restart the engine.

Engine speed less than 250 rev/min: When an auto stop is initiated and the ECM then detects an engine restart parameter, it operates the starter motor to first engage the pinion gear with the ring gear, then energizes the motor to rotate the engine up to starting speed. The ECM also activates the fueling and engine systems to restart the engine.

Control Diagram



A = Hardwired; AM = High speed CAN chassis systems; AN = High speed CAN powertrain systems; AO = Medium speed CAN body systems; AQ = High speed CAN HEV systems.

Item	Part Number	Description
1	-	Engine control module
2	-	Keyless vehicle module
3	-	Gateway module
4	-	Instrument cluster
5	-	Terrain Response® switchpack
6	-	Anti-lock brake system control module
7	-	Clockspring
8	-	Restraints control module

9	-	Battery energy control module
10	-	General proximity sensor module
11	-	Electric power inverter converter
12	-	Transfer case control module
13	-	Integrated suspension control module
14	-	Engine junction box
15	-	Starter motor
16	-	Battery junction box 2
17	-	Ground
18	-	Power supply
19	-	Engine coolant temperature sensor
20	-	Brake pedal switch
21	-	Accelerator pedal position sensor
22	-	Stop/Start switch
23	-	Central junction box
24	-	Transmission control switch control module

Published: 18-Jan-2013

Engine Ignition - V6 S/C 3.0L Petrol -

Item	Specification
Firing order	1:2:3:4:5:6
Spark plug type	SILZKAR7C10S
Spark plug gap	0.9 - 1.0 mm (0.035 - 0.039 inches)

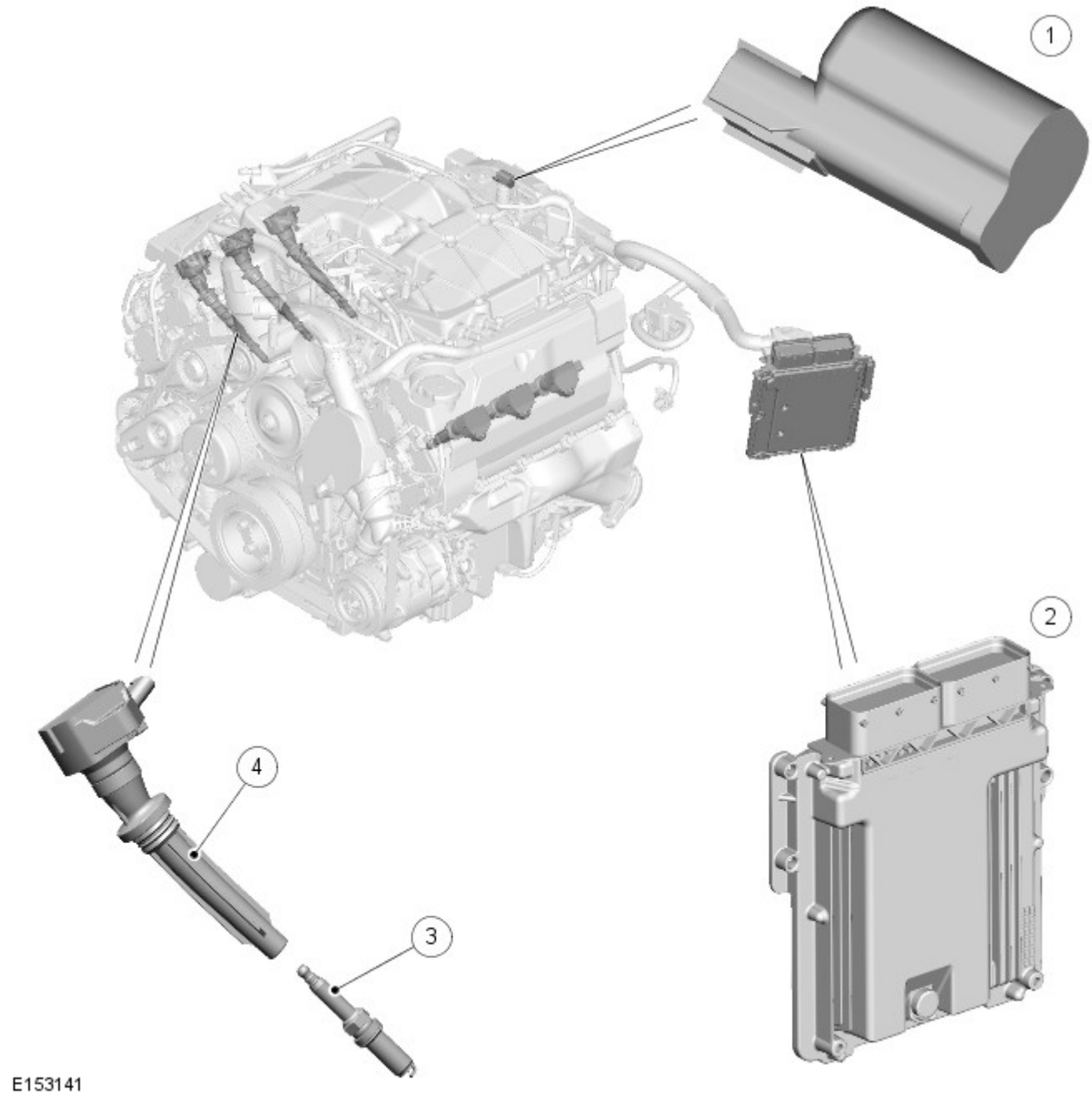
Description	Nm	lb-ft	lb-in
Spark plugs	22	16	-
Ignition coil-on-plug retaining bolts	8	6	-

Published: 04-Nov-2013

Engine Ignition - V6 S/C 3.0L Petrol - Engine Ignition

Description and Operation

COMPONENT LOCATION



Item	Part Number	Description
1	-	Radio Frequency Interference (RFI) suppressor
2	-	Engine Control Module (ECM)
3	-	Spark plug (6 off)
4	-	Ignition coil (6 off)

OVERVIEW

The engine ignition system is a coil-on-plug, single spark system controlled by the ECM (engine control module). The spark plugs are installed one per cylinder, between the inlet and exhaust valves. The spark plugs feature an iridium-tripped (IR) centre electrode (CE), and a platinum-tripped (PT) ground electrode (GE). The energy stored in the ignition coil, manifests itself on the spark plug in terms of a voltage differential between the electrodes. When the voltage differential equals the required voltage, then the spark plugs and the stored energy is dissipated. 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.

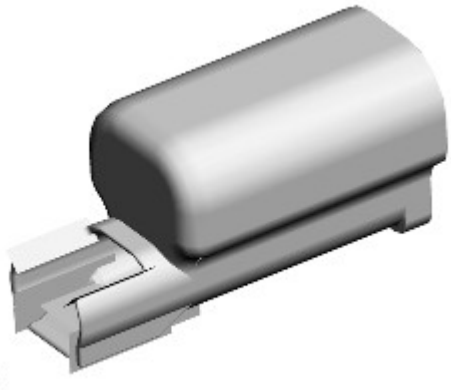
DESCRIPTION

Ignition Coils

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 EJB (engine junction 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



The RFI suppressor is installed on the engine harness carrier at the rear of the engine.

OPERATION

The ignition coils are supplied with electrical power from the ECM relay in the EJB. The ECM controls the operation of the ECM relay.

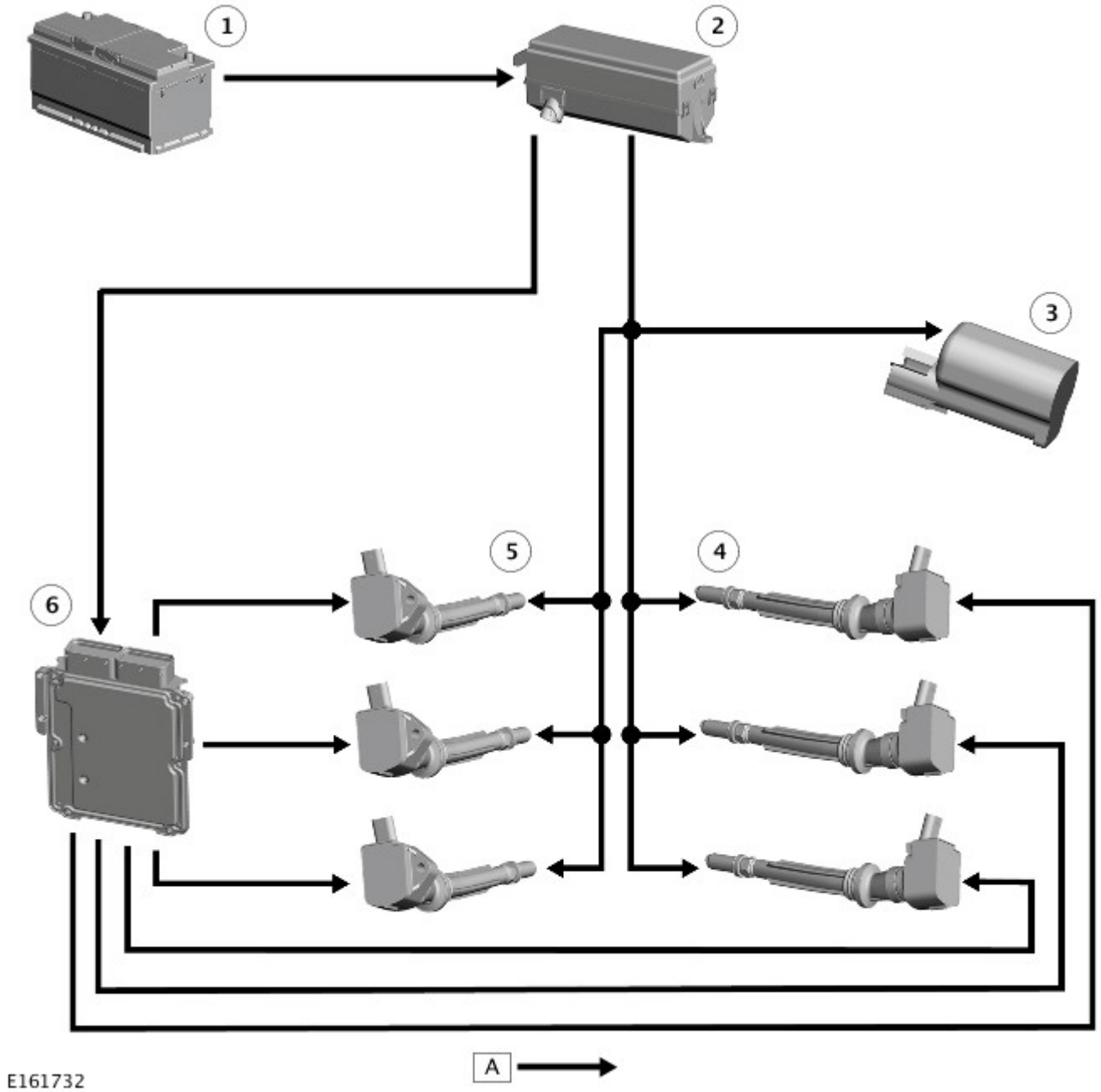
The ECM sends a separate signal to each ignition coil to trigger the power stage switching. The ECM calculates the dwell time from the battery voltage and engine speed, to ensure a constant energy level is produced in the secondary coil each time the power stage is switched. This ensures sufficient spark 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

CONTROL DIAGRAM

NOTE: A = Hardwired.



Item	Part Number	Description
1	-	Battery
2	-	Engine Junction Box (EJB)
3	-	RFI suppressor
4	-	Left cylinder bank ignition coils (3 off)
5	-	Right cylinder bank ignition coils (3 off)
6	-	Engine Control Module (ECM)

Published: 05-Nov-2012

Engine Ignition - V6 S/C 3.0L 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 in the workshop manual. REFER to:

Engine Ignition (303-07A Engine Ignition - V6 S/C 3.0L Petrol, Description and Operation),
Engine Ignition (303-07C, Description and Operation),
Engine Ignition (303-07C, 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	Electrical
• Spark Plug(s) • Fuel level • Fuel contamination/grade/quality	• Fuses • Wiring harness • Loose or corroded electrical connectors • Ignition coil(s) • Engine Control Module (ECM)

3. If an obvious cause for an observed or reported condition is found, correct the cause (if possible) before proceeding to the symptom chart.
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 • Spark plug(s) • Fuel system • Electronic engine control	Ensure the engine breather system is free from restriction and is correctly installed. Check for ignition system, fuel system and electronic engine control DTCs and refer to the relevant DTC Index
Engine cranks and fires, but will not start	• 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	• Spark plug(s) • 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. Check for electronic engine controls, engine emissions, fuel system and evaporative emissions system related DTCs and refer to the relevant DTC Index
Difficult hot start	• Injector leak • Electronic engine control • Purge valve • Fuel pump • Ignition system	Check for injector leak, install new injector as required. Check for electronic engine controls, evaporative emissions, fuel system, ignition system and engine emission system related DTCs and refer to the relevant DTC Index
Difficult to start after hot soak (vehicle	• Injector leak • Electronic engine	Check for injector leak, install new injector as required. Check for electronic engine controls, evaporative emissions, fuel system,

standing, engine off, after engine has reached operating temperature)	control • Purge valve • Fuel pump • Ignition system	ignition system and engine emission system 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. Check for electronic engine control, ignition system and fuel system related DTCs and refer to the relevant DTC Index. Check for blockage in air filter element and air intake system. Check for air leakage in air intake system
Engine hesitates/poor acceleration	• 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	Check for fuel system related DTCs and refer to the relevant DTC Index. Check for injector leak, install new injector as required. Check for air leakage in air intake system. Ensure accelerator pedal is free from restriction. Check for electronic engine controls, ignition, engine emission system and transmission related DTCs and refer to the relevant DTC Index
Engine backfires	• Fuel pump/lines • Air leakage • Electronic engine controls • Ignition system • Sticking variable camshaft timing (VCT) unit	Check for fuel system failures. Check for air leakage in intake air system. Check for electronic engine controls, ignition system and VCT system 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. Check for electronic engine controls, throttle system and ignition system related DTCs and refer to the relevant DTC Index
Engine detonates/knocks	• Fuel pump/lines • Air leakage • Electronic engine controls • Sticking VCT unit	Check for fuel system failures. Check for air leakage in intake air system. Check for electronic engine controls and VCT system related DTCs and refer to the relevant DTC Index
No throttle response	• Electronic engine controls • Throttle motor	Check for electronic engine controls and throttle system related DTCs and refer to the relevant DTC Index
Poor throttle response	• Breather system disconnected/restricted • Electronic engine control • Transmission malfunction • Traction control event • Air leakage	Ensure the engine breather system is free from restriction and is correctly installed. Check for electronic engine controls, transmission and traction control related DTCs and refer to the related DTC Index. Check for air leakage in intake air system

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - V6 S/C 3.0L Petrol , DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation).

Published: 02-May-2013

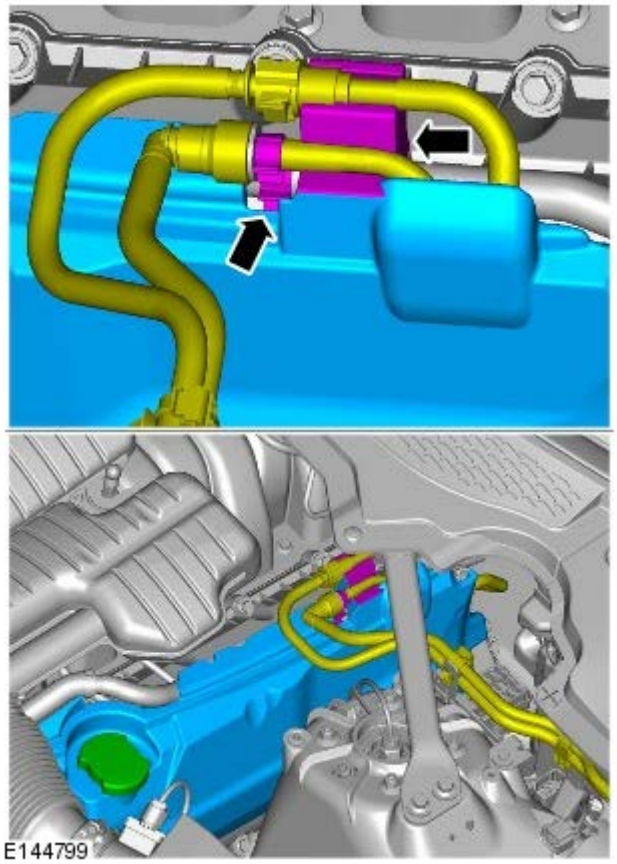
Engine Ignition - V6 S/C 3.0L Petrol - Ignition Coil-On-Plug

Removal and Installation

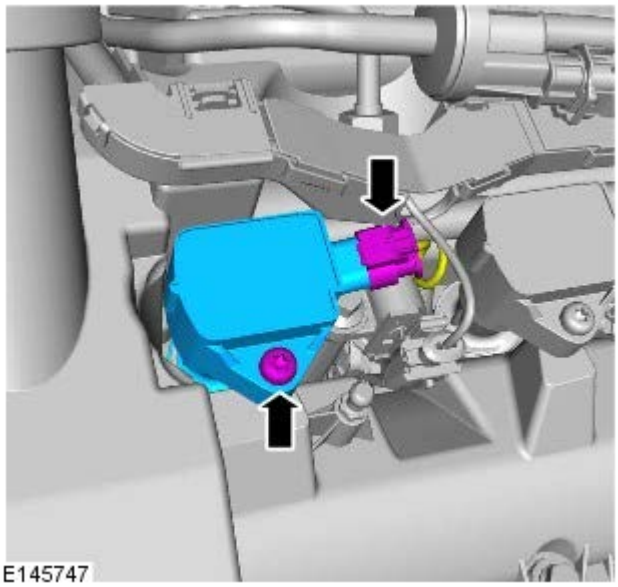
Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.
2. Refer to: Engine Cover - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (501-05 Interior Trim and Ornamentation, Removal and Installation).
3.



4. *Torque:* 7 Nm



Installation

1. To install, reverse the removal procedure.

Published: 02-May-2013

Engine Ignition - V6 S/C 3.0L Petrol - Spark Plugs

Removal and Installation

Removal

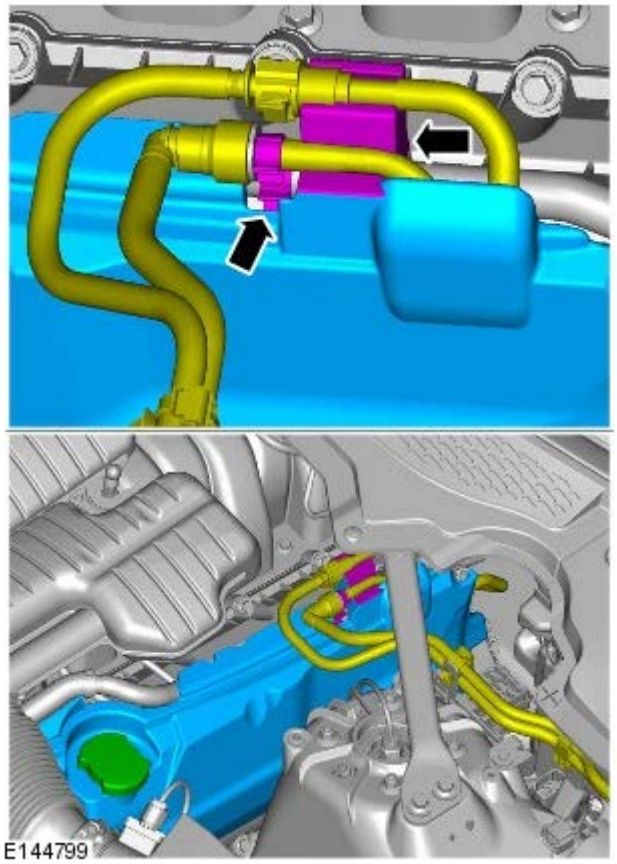
NOTES:

Removal steps in this procedure may contain installation details.

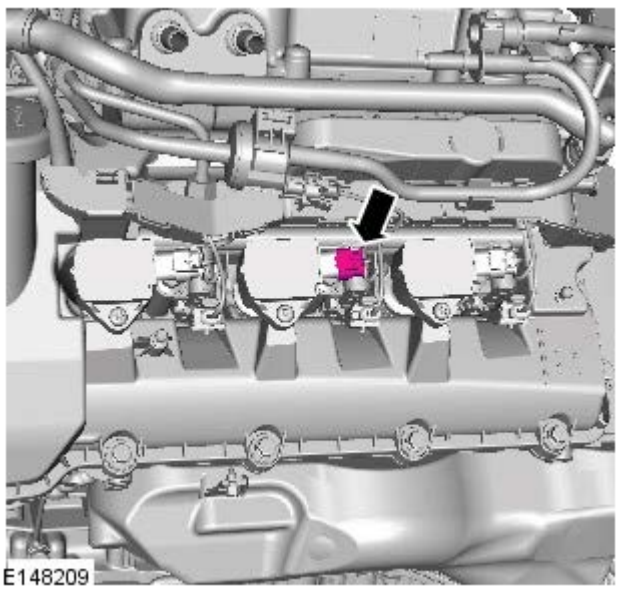
Some variation in the illustrations may occur, but the essential information is always correct.

1. Refer to: Engine Cover - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (501-05 Interior Trim and Ornamentation, Removal and Installation).

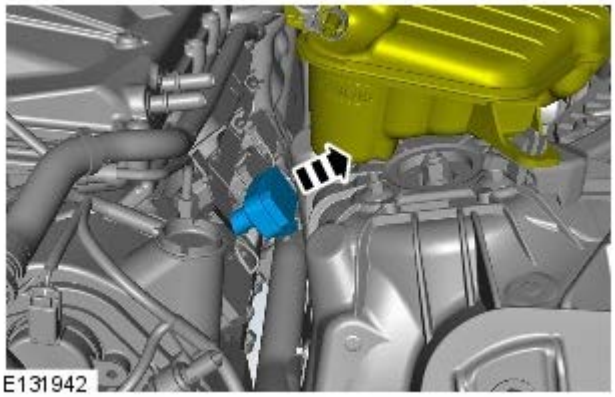
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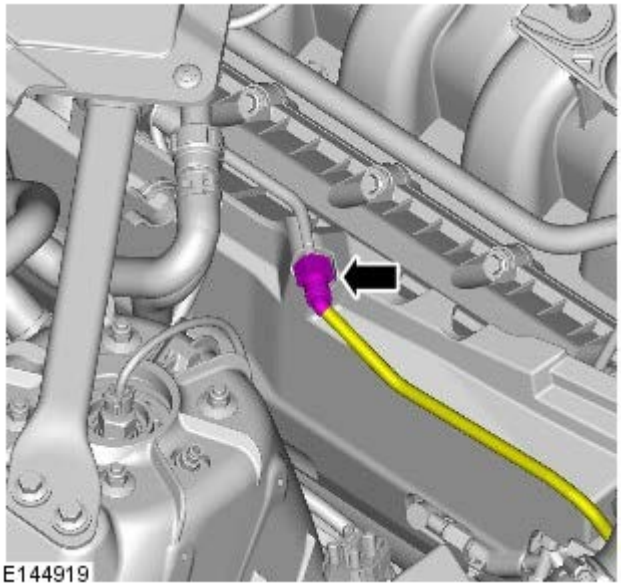
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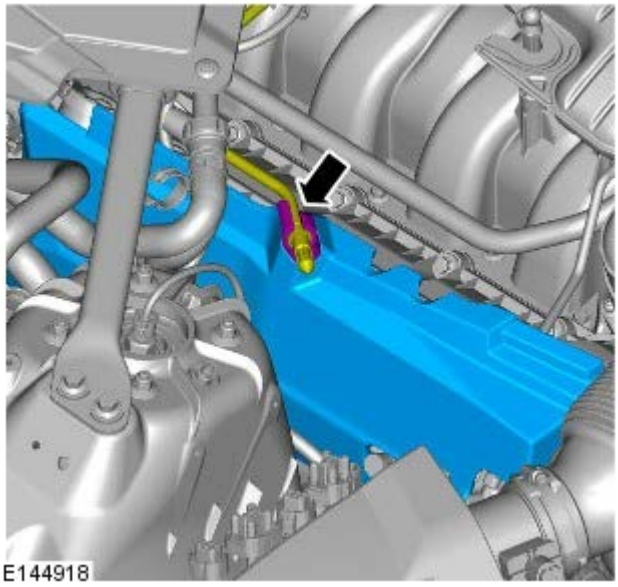
4. *Torque:* 7 Nm



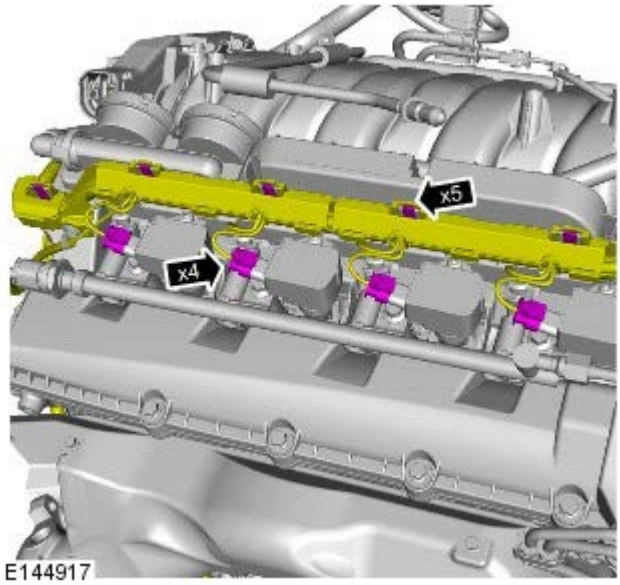
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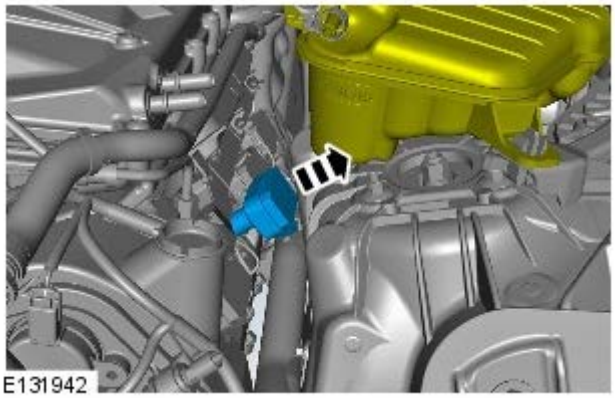


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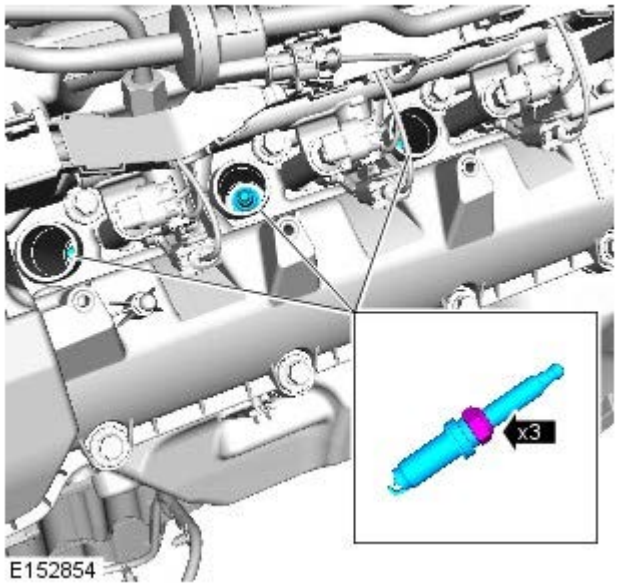
7.





8. NOTE: LH illustration shown, RH is similar.

Torque: 7 Nm



9. NOTES:

The step must be carried out on both sides.

LH illustration shown, RH is similar.

Torque: 20 Nm

Installation

1. To install, reverse the removal procedure.

Published: 12-Sep-2012

Engine Ignition - V8 S/C 5.0L Petrol -

Item	Specification
Firing order	1:5:4:2:6:3:7:8
Spark plug type	ILKAR7C10

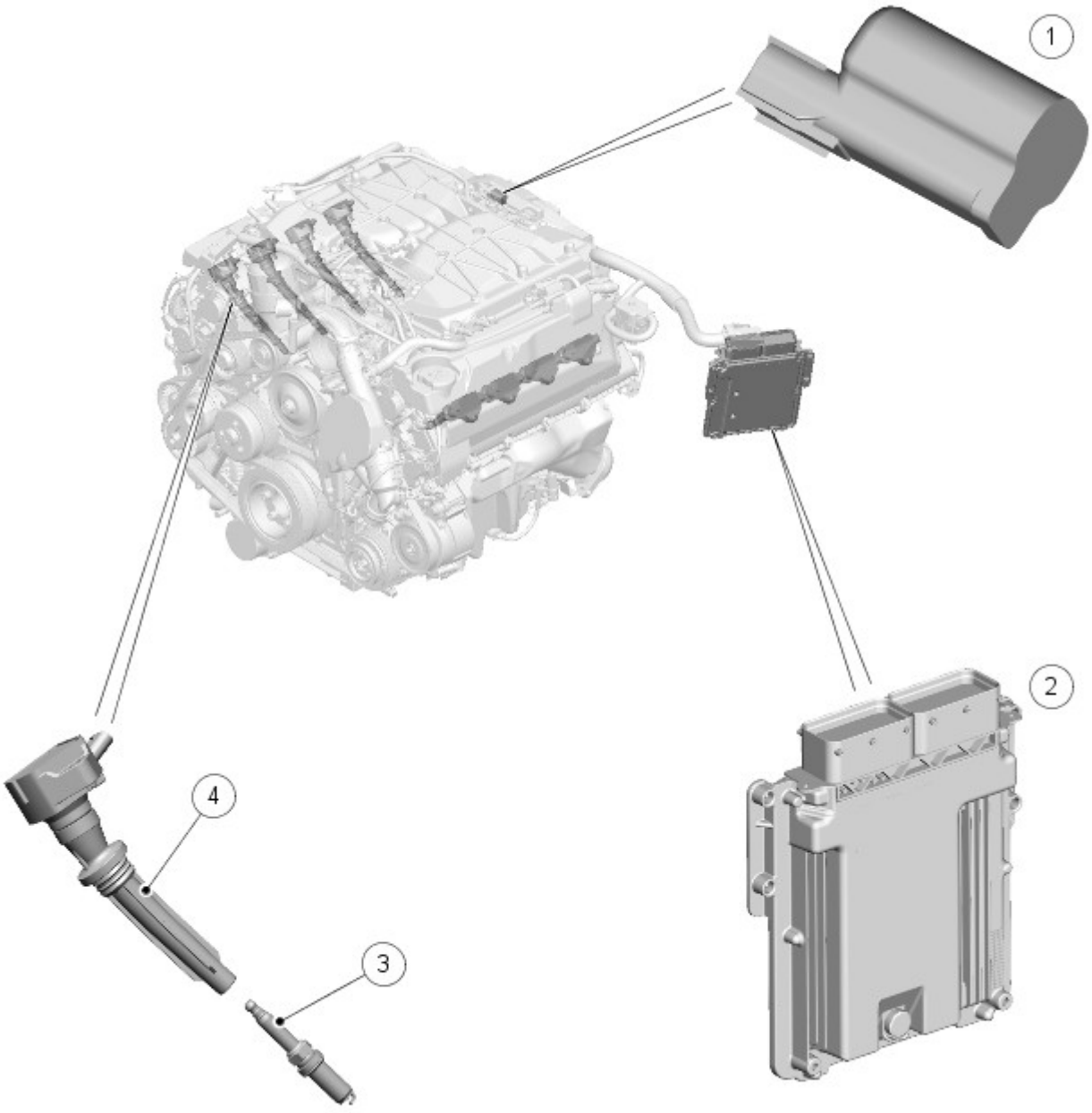
Description	Nm	lb-ft	lb-in
Spark plugs	20	15	-
Ignition coil-on-plug retaining bolts	7	5	-

Published: 02-May-2013

Engine Ignition - V8 S/C 5.0L Petrol - Engine Ignition

Description and Operation

COMPONENT LOCATION



E153131

Item	Part Number	Description
1	-	Radio Frequency Interference (RFI) suppressor
2	-	Engine Control Module (ECM)
3	-	Spark plug (8 off)
4	-	Ignition coil (8 off)

OVERVIEW

The engine ignition system is a coil-on-plug, single spark system controlled by the ECM (Engine Control Module). The spark plugs are installed one per cylinder, between the inlet and exhaust valves. The spark plugs feature an iridium-tripped (IR) centre electrode (CE), and a platinum-tripped (PT) ground electrode (GE). The energy stored in the ignition coil, manifests itself on the spark plug in terms of a voltage differential between the electrodes. When the voltage differential equals the required voltage, then the spark plugs and the stored energy is dissipated. 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.

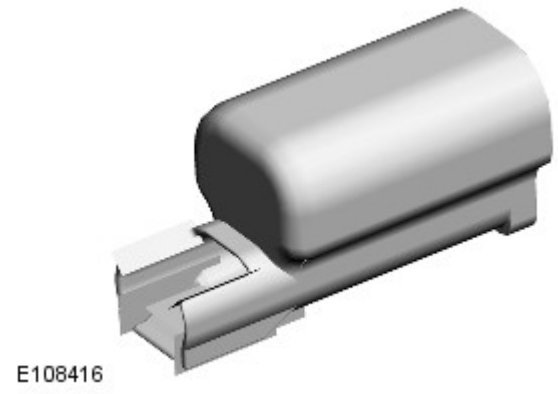
DESCRIPTION

Ignition Coils

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 EJB (Engine Junction 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



The RFI suppressor is installed on the engine harness carrier at the rear of the engine.

OPERATION

The ignition coils are supplied with electrical power from the ECM relay in the EJB. The ECM controls the operation of the ECM relay.

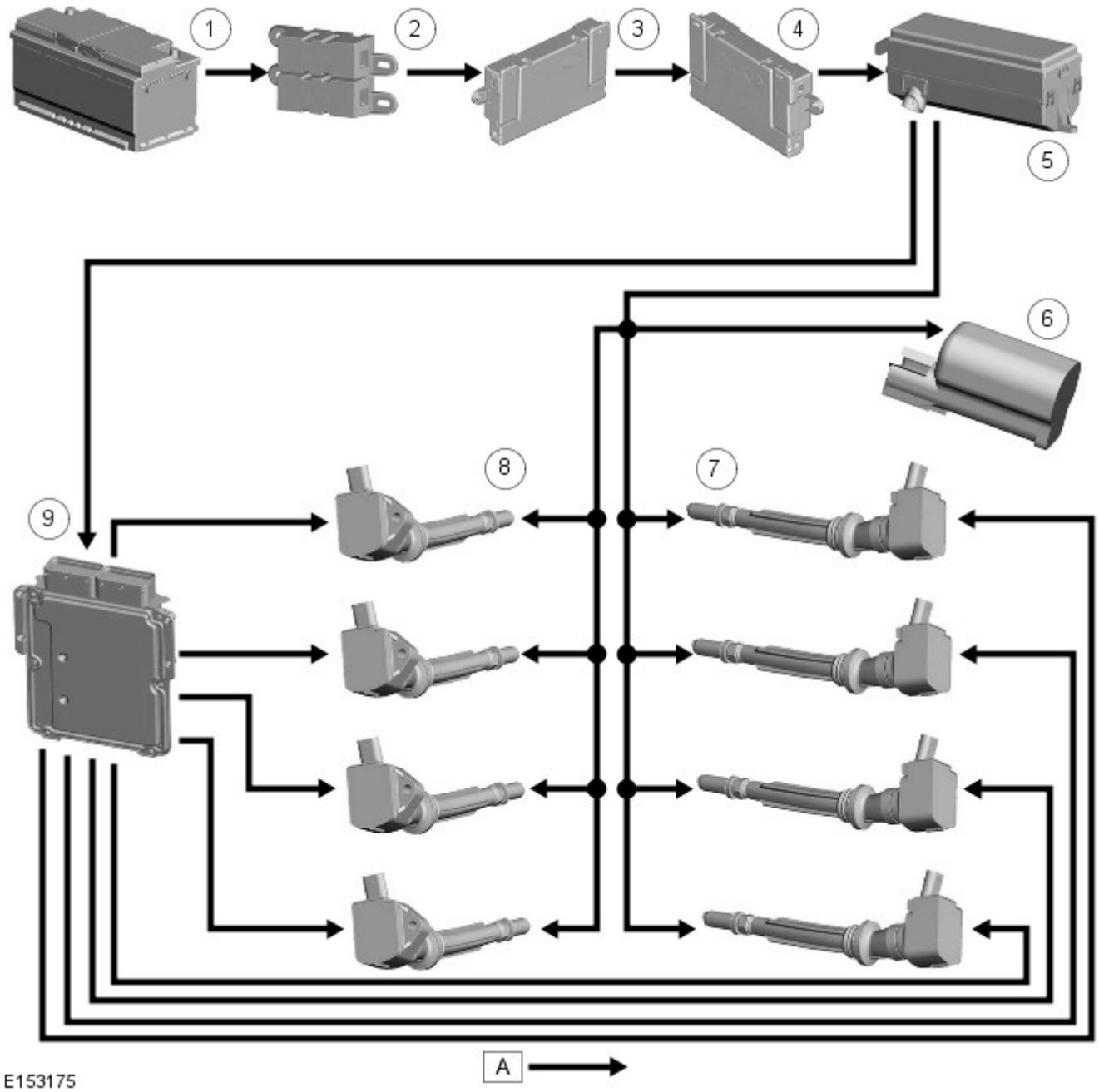
The ECM sends a separate signal to each ignition coil to trigger the power stage switching. The ECM calculates the dwell time from the battery voltage and engine speed, to ensure a constant energy level is produced in the secondary coil each time the power stage is switched. This ensures sufficient spark 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.

Control Diagram

NOTE: A = Hardwired.



Item	Part Number	Description
1	-	Battery
2	-	Battery Junction Box 2 (BJB2)
3	-	Battery Junction Box (BJB)
4	-	Auxiliary Junction Box (AJB)
5	-	Engine Junction Box (EJB) (ECM relay)
6	-	RFI suppressor
7	-	Left cylinder bank ignition coils (4 off)
8	-	Right cylinder bank ignition coils (4 off)
9	-	Engine Control Module (ECM)

Published: 27-Feb-2013

Engine Ignition - 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 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	• 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. Check for ignition system, fuel system and electronic engine control DTCs and refer to the relevant DTC Index
Engine cranks and fires, but will not start	• 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. Check for electronic engine controls, engine emissions, fuel system and evaporative emissions system related DTCs and refer to the relevant DTC Index
Difficult hot start	• Injector leak • Electronic engine control • Purge valve • Fuel pump • Ignition system	Check for injector leak, install new injector as required. Check for electronic engine controls, evaporative emissions, fuel system, ignition system and engine emission system related DTCs and refer to the relevant DTC Index
Difficult to start after	• Injector leak	Check for injector leak, install new injector as required. Check for

hot soak (vehicle standing, engine off, after engine has reached operating temperature)	Electronic engine control • Purge valve • Fuel pump • Ignition system	electronic engine controls, evaporative emissions, fuel system, ignition system and engine emission system 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. Check for electronic engine control, ignition system and fuel system related DTCs and refer to the relevant DTC Index. Check for blockage in air filter element and air intake system. Check for air leakage in air intake system
Engine hesitates/poor acceleration	• 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	Check for fuel system related DTCs and refer to the relevant DTC Index. Check for injector leak, install new injector as required. Check for air leakage in air intake system. Ensure accelerator pedal is free from restriction. Check for electronic engine controls, ignition, engine emission system and transmission related DTCs and refer to the relevant DTC Index
Engine backfires	• 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. Check for electronic engine controls, ignition system and VCT system 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. Check for electronic engine controls, throttle system and ignition system 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. Check for electronic engine controls and VCT system related DTCs and refer to the relevant DTC Index
No throttle response	• Electronic engine controls • Throttle motor	Check for electronic engine controls and throttle system related DTCs and refer to the relevant DTC Index
Poor throttle response	• Breather system disconnected/restricted • Electronic engine control • Transmission malfunction • Traction control event • Air leakage	Ensure the engine breather system is free from restriction and is correctly installed. Check for electronic engine controls, transmission and traction control related DTCs and refer to the related DTC Index. Check for air leakage in intake air system

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - V8 S/C 5.0L Petrol, DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation).

Published: 01-Aug-2012

Engine Ignition - V8 S/C 5.0L Petrol - Ignition Coil-On-Plug

Removal and Installation

Removal

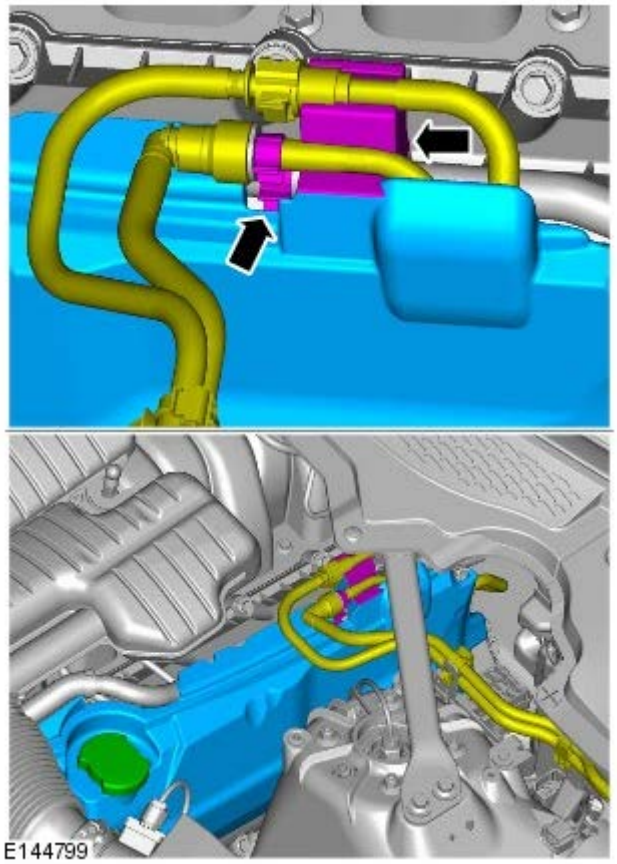
NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

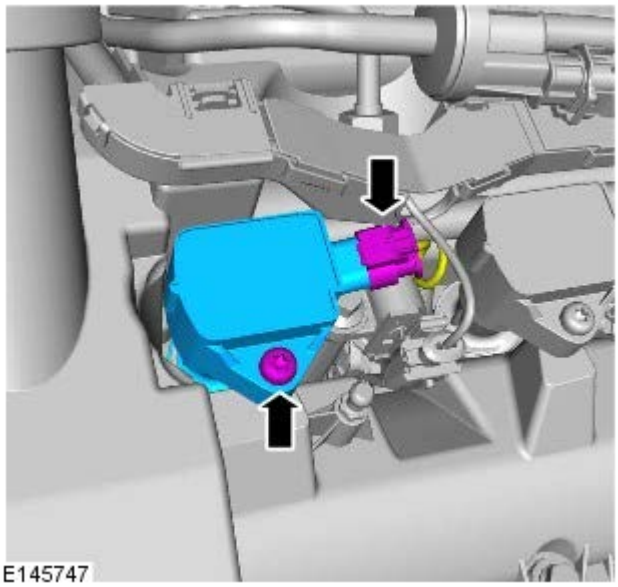
   Refer to: Specifications (414-00, Specifications).

2. Refer to: Engine Cover - V8 5.0L Petrol/V8 S/C 5.0L Petrol (501-05, Removal and Installation).

3.



4. *Torque:* 7 Nm



Installation

1. To install, reverse the removal procedure.

Published: 10-Sep-2012

Engine Ignition - V8 S/C 5.0L Petrol - Spark Plugs

Removal and Installation

Special Tool(s)

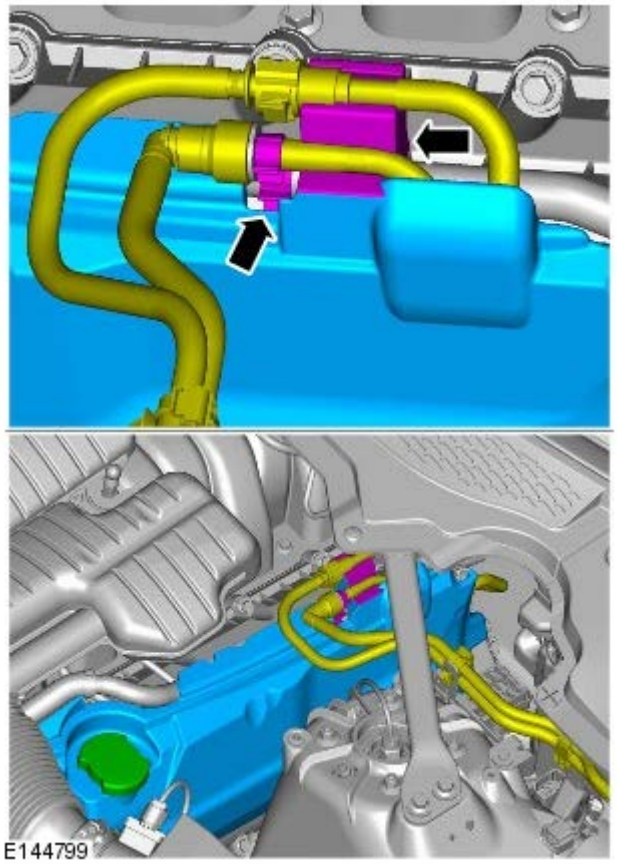
 E115268	303-1450 Spark Plug Remover/Installer

Removal

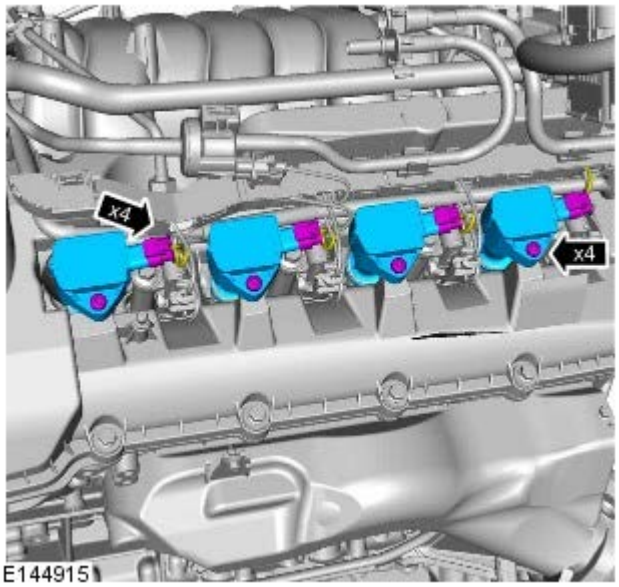
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Engine Cover - V8 5.0L Petrol/V8 S/C 5.0L Petrol (501-05, Removal and Installation).

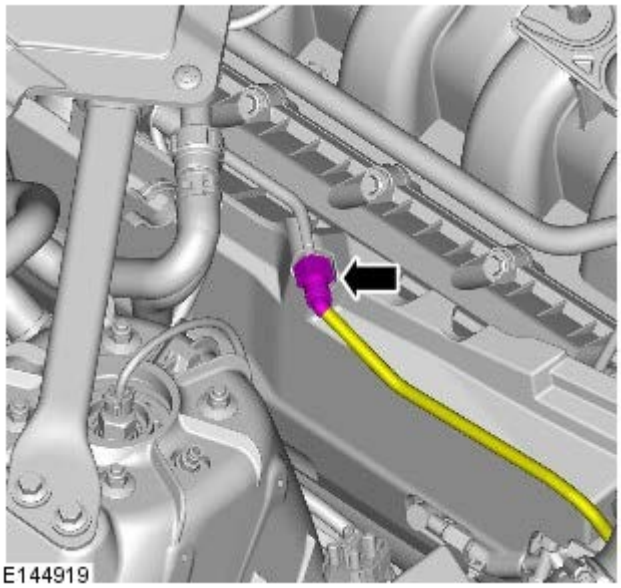
2.


E144799

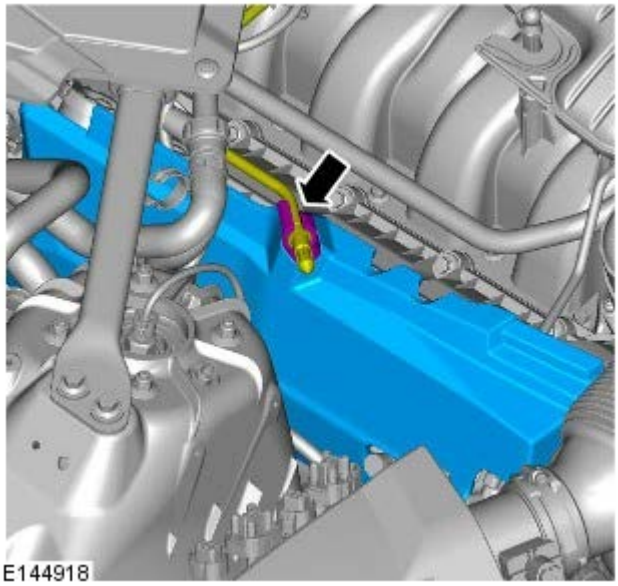
3. *Torque:* 7 Nm



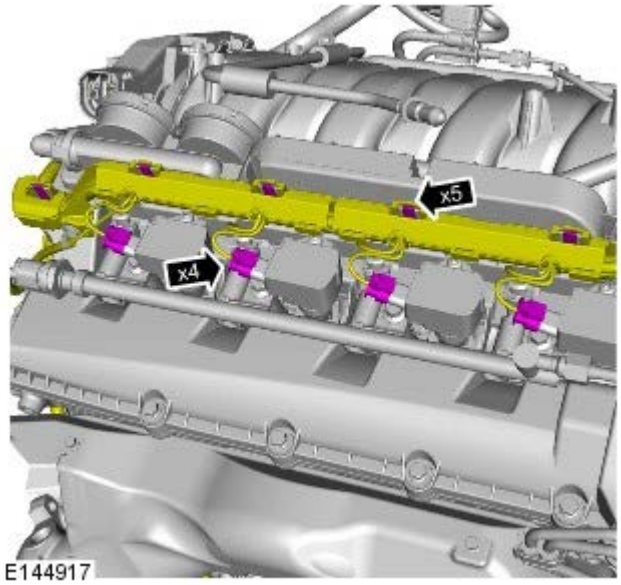
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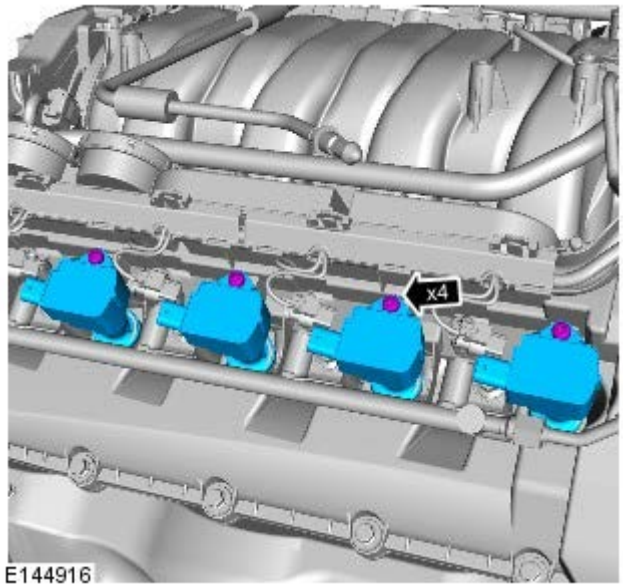
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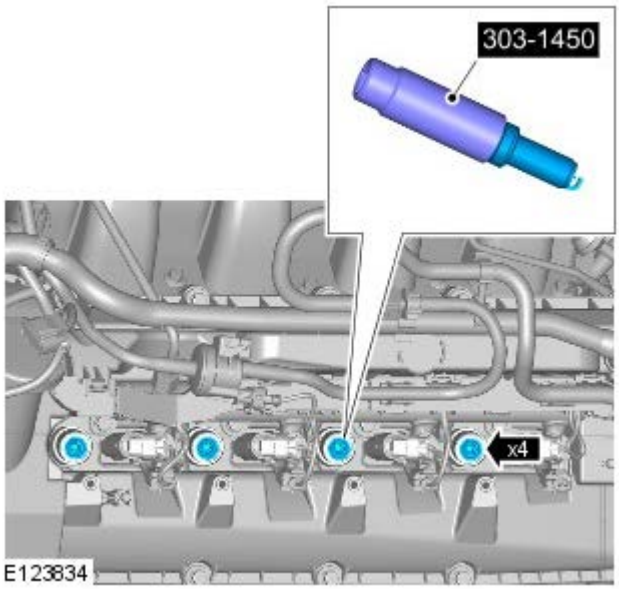


7. *Torque:* 7 Nm



8. NOTE: The step must be carried out on both sides.

Special Tool(s): 303-1450
Torque: 20 Nm



Installation

1. To install, reverse the removal procedure.

Published: 24-Oct-2012

Glow Plug System - TDV6 3.0L Diesel -

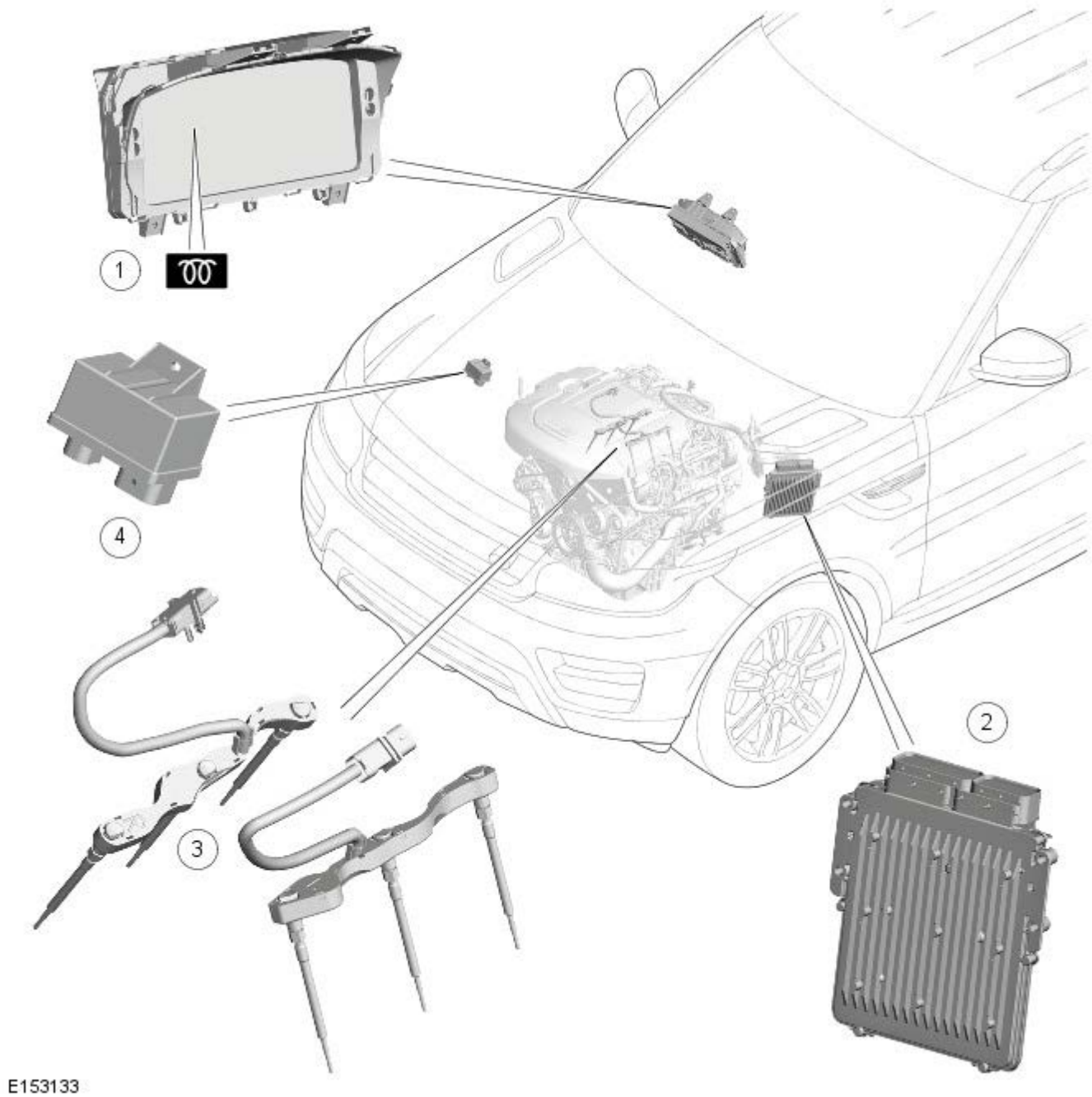
Description	Nm	lb-ft	lb-in
Glow plug	10	-	89
Glow plug module	10	-	89

Published: 02-May-2013

Glow Plug System - TDV6 3.0L Diesel - Glow Plug System

Description and Operation

COMPONENT LOCATION



Item	Part Number	Description
1	-	Glow plug warning indicator
2	-	Engine Control Module (ECM)
3	-	Glow plugs (6 off)
4	-	Glow plug control module

OVERVIEW

The glow plug system includes a glow plug installed in the inlet side of each cylinder and a glow plug control 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 control module, which is controlled by glow plug software contained within the ECM (Engine Control Module).

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 control module receives a battery voltage feed from the AJB (Auxiliary Junction Box) and an ignition feed from the ECM relay in the EJB (Engine Junction Box). Operation of the glow plug control module is controlled by the ECM, which also controls the illumination of the glow plug warning indicator in the IC (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 control 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.

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) sensor. The lower temperature signal from ECT sensor means a longer heating times. If the ECT sensor fails, the ECM will use a predefined temperature as a default value.

The ECM monitors the feedback from the glow plug control module. If a fault is detected, the ECM stores a related fault code and permanently illuminates the glow plug warning indicator while the ignition is on.

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. The pre-heat duration is extended if the coolant temperature is low.

When the stop/start switch is pressed while the brake pedal is being pressed, the ECM calculates any required glow plug heating times and, if heating is required, signals the glow plug control module, which supplies power to the glow plugs. When pre heating is required the ECM also sends a message to the IC, on the high speed CAN (Controller Area Network) Powertrain bus, to request illumination of the glow plug warning indicator. The glow plug warning indicator remains illuminated for the duration of the pre heating phase, until the ECM cranks the engine. If required, the glow plug control module supplies power to the glow plugs during cranking and for the duration of any post heating phase.

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 rev/min for longer than 50 milliseconds, or the starter is active for longer than 4 seconds. If the ECT sensor is defective, a default temperature of 0°C is used.

Post Heating

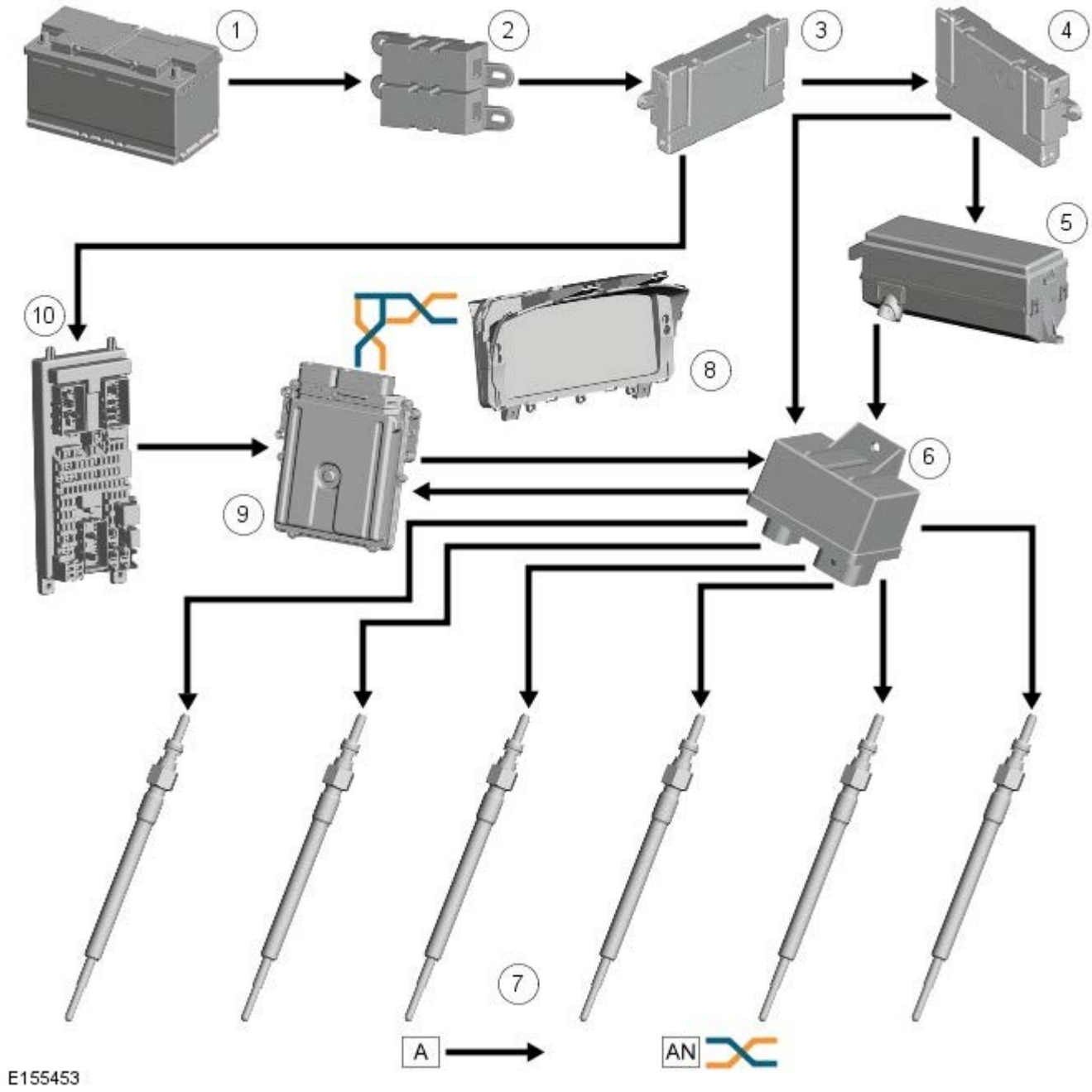
Post heat is the length of time the glow plugs operate after the engine starts. The ECM controls the post heating time based on ECT sensor output. The post heat phase reduces engine noise, improves idle quality and reduces hydrocarbon emissions.

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.

Control Diagram

 NOTE: A = Hardwired, AN = High speed CAN (Controller Area Network) Powertrain bus.



Item	Part Number	Description
1	-	Battery
2	-	Battery Junction Box 2 (BJB2)
3	-	Battery Junction Box (BJB)
4	-	Auxiliary Junction Box (AJB)
5	-	Engine Junction Box (EJB)
6	-	Glow plug (6 off)
7	-	Glow plug control module
8	-	Instrument Cluster (IC)
9	-	Central Junction Box (CJB)
10	-	Engine Control Module (ECM)

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:

Glow Plug System (303-07C Glow Plug System - TDV6 3.0L Diesel, Description and Operation),
Glow Plug System (303-07 Glow Plug System - TDV6 3.0L Diesel, Description and Operation),
Glow Plug System (303-07 Glow Plug 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 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: 06-Sep-2012

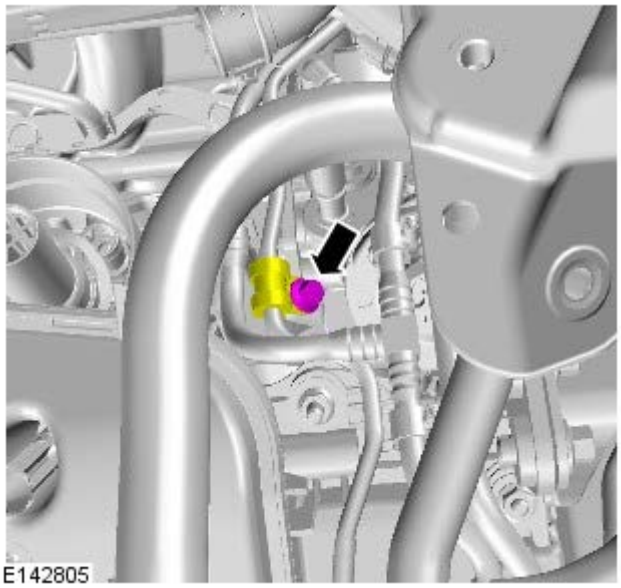
Glow Plug System - TDV6 3.0L Diesel - Glow Plugs

Removal and Installation

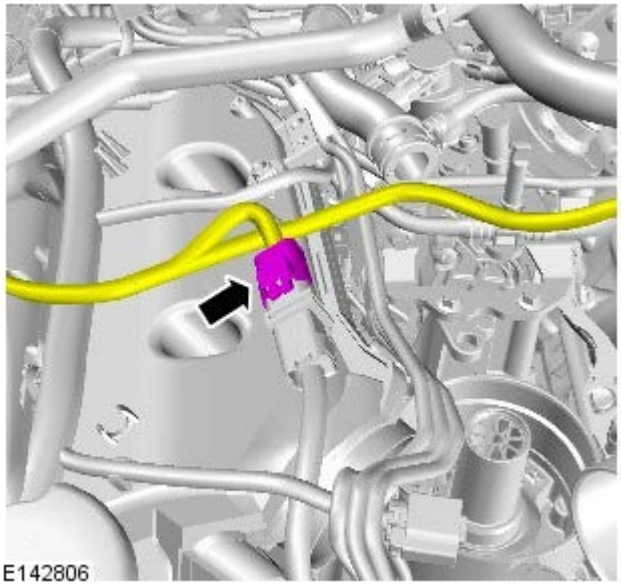
Removal

NOTE: Removal steps in this procedure may contain installation details.

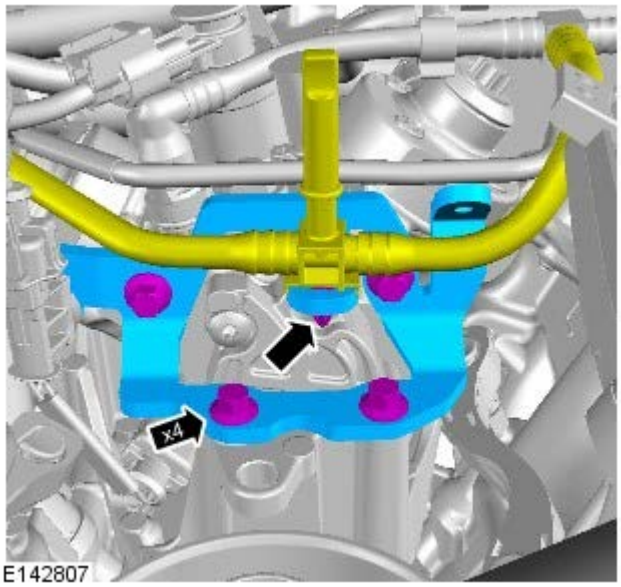
1. Refer to: Intake Air Shutoff Throttle (303-04A Fuel Charging and Controls - TDV6 3.0L Diesel, Removal and Installation).
2. Refer to: Crankcase Vent Oil Separator (303-08A Engine Emission Control - TDV6 3.0L Diesel, Removal and Installation).
3. Refer to: Oil Filter Element (303-01A Engine - TDV6 3.0L Diesel, Removal and Installation).
4. *Torque:* 10 Nm

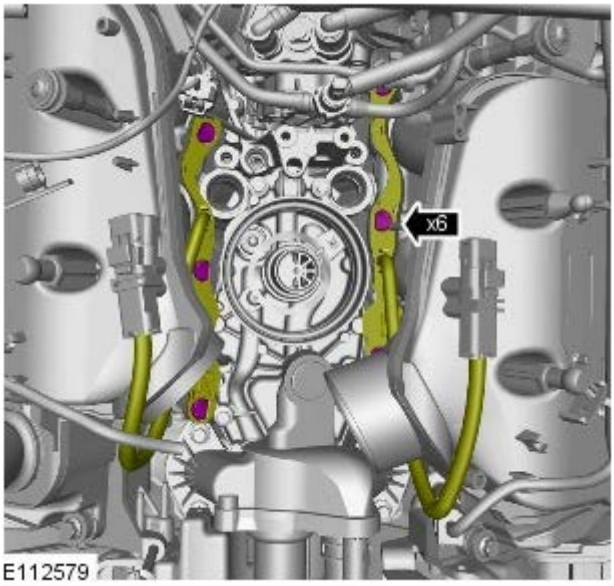


5.

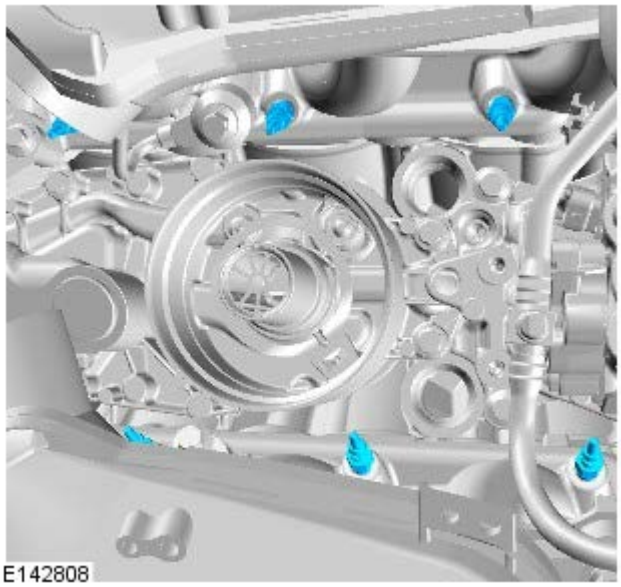


6. *Torque:* 10 Nm





7. CAUTION: Take extra care not to damage the component.



8. CAUTIONS:

   Take extra care not to damage 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

   Torque: 10 Nm

Installation

1. To install, reverse the removal procedure.

Published: 04-Aug-2012

Glow Plug System - TDV6 3.0L Diesel - Glow Plug Module

Removal and Installation

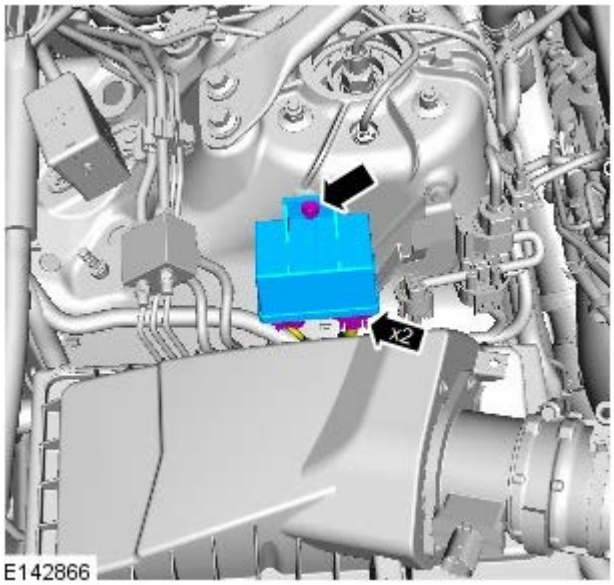
Removal

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:* 10 Nm



Installation

1. To install reverse the removal procedure.

Published: 31-Jul-2012

Glow Plug System - TDV8 4.4L Diesel -

Torque Specifications

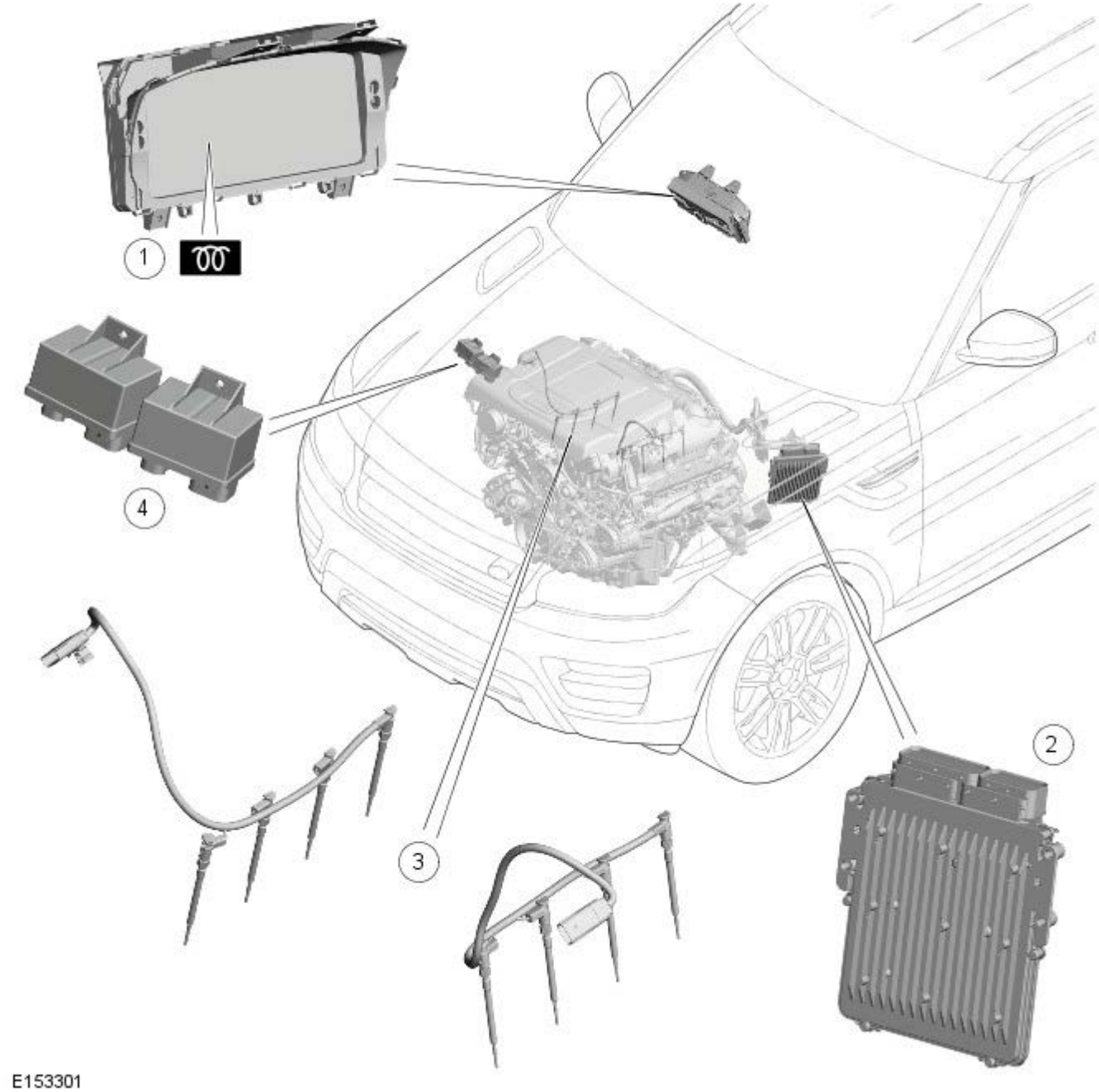
Item	Nm	lb-ft	lb-in
Glow plugs	11	8	-
Glow plug module(s) retaining nut(s)	10	7	-
Exhaust gas recirculation (EGR) assembly outlet pipe clamp bolt	10	7	-

Published: 02-Dec-2013

Glow Plug System - TDV8 4.4L Diesel - Glow Plug System

Description and Operation

COMPONENT LOCATION



E153301

Item	Part Number	Description
1	-	Glow plug warning indicator
2	-	Engine Control Module (ECM)
3	-	Glow plugs (8 off)
4	-	Glow plug control modules (2 off)

OVERVIEW

The glow plug system has a glow plug installed in the inlet side of each cylinder. 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. Glow plug operation is controlled by two glow plug control modules and the ECM (Engine Control Module).

Each bank of glow plugs is connected via a separate harness to its respective glow plug control module. Each glow plug control module is controlled by glow plug software contained within the ECM.

DESCRIPTION

Glow Plugs

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 control 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.

Each cylinder bank has a separate harness connecting the 4 glow plugs. The harness connects into the respective glow plug control module for that bank.

The glow plug control modules receive a battery voltage feed from the BJB (Battery Junction Box) and an ignition feed from the ECM relay in the EJB (Engine Junction Box). Operation of the glow plug control modules is controlled by the ECM, which also controls the illumination of the glow plug warning indicator in the IC (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 control modules match the voltage to the sheathed-element glow plugs and control 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 at ambient temperatures of -5°C (23°F) or below.

OPERATION

There are three phases of glow plug heating:

- Pre heating
- Crank heating
- Post heating.

The ECM determines the heating times from the signal of ECT (Engine Coolant Temperature) sensor. The lower engine coolant temperature means a longer heating times. If the ECT sensor fails, the ECM will use a predefined temperature as a default value.

The ECM monitors the feedback from the glow plug control modules. If a fault is detected, the ECM stores a related fault code and permanently illuminates the glow plug warning indicator while the ignition is on.

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. The pre-heat duration is extended if the coolant temperature is low.

When the stop/start switch is pressed while the brake pedal is being pressed, the ECM calculates any required glow plug heating times and, if heating is required, signals the glow plug control modules, which supply power to the glow plugs. When pre heating is required the ECM also sends a message to the IC, on the high speed CAN (Controller Area Network) Powertrain bus, to request illumination of the glow plug warning indicator. The glow plug warning indicator remains illuminated for the duration of the pre heating phase, until the ECM cranks the engine. If required, the glow plug control module supplies power to the glow plugs during cranking and for the duration of any post heating phase.

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 42 rev/min for longer than 50 milliseconds, or the starter is active for longer than 4 seconds. If the coolant temperature sensor is defective, a default temperature of 0° C is used.

Post Heating

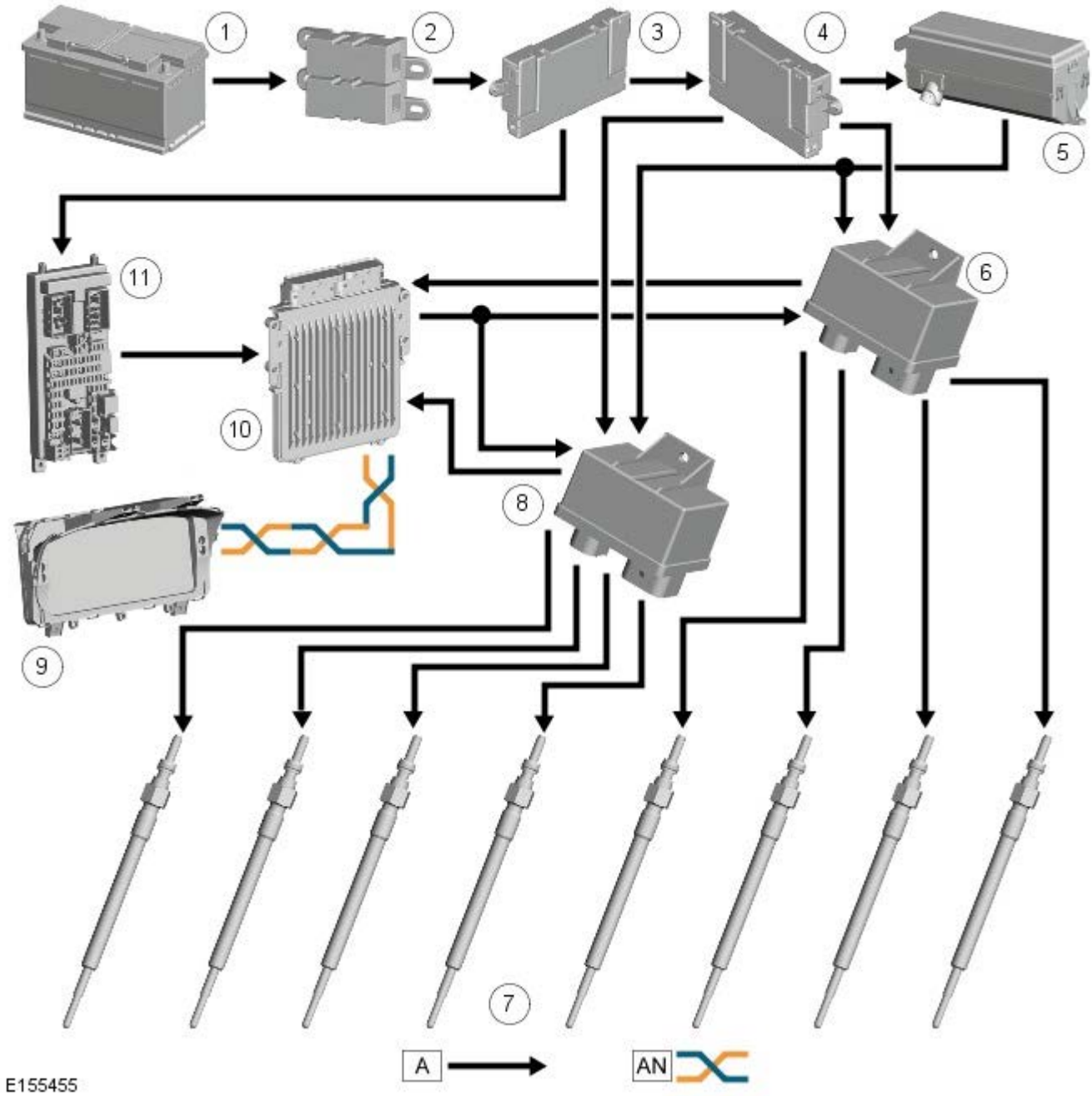
Post heat is the length of time the glow plugs operate after the engine starts. The ECM controls the post heating time based on ECT sensor output. The post heat phase reduces engine noise, improves idle quality and reduces hydrocarbon emissions.

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.

Control Diagram

NOTE: A = Hardwired, AN = High speed CAN (Controller Area Network) Powertrain bus.



Item	Part Number	Description
1	-	Battery
2	-	Battery Junction Box 2 (BJB2)
3	-	Battery Junction Box (BJB)
4	-	Auxiliary Junction Box (AJB)
5	-	Engine Junction Box (EJB)
6	-	Glow plug control module
7	-	Glow plugs (8 off)
8	-	Glow plug control module
9	-	Instrument Cluster (IC)
10	-	Engine Control Module (ECM)
11	-	Central Junction Box (CJB)

Published: 11-May-2011

Glow Plug System - TDV8 4.4L 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.

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

Electrical
• Glow plug lamp • Fuses • Glow plug relays • Engine management relay • Wiring harness(es)/connectors • Glow plugs • 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 - The fuel system recycles fuel until operating temperature is reached to reduce this possibility	Check the glow plug harnesses at the glow plugs and at the connections to the main harness. Refer to the electrical guides. Check for DTCs indicating a glow plug fault. Rectify as necessary. Clear the DTCs and check for normal operation.
High cold-engine emissions	• After-glow phase inoperative	Check the glow plug harnesses at the glow plugs and at the connections to the main harness. Refer to the electrical guides. Check for DTCs indicating a glow plug fault. Rectify as necessary. Clear the DTCs and check for normal operation. After-glow is designed to function at engine temperatures below 50° C (122° F) and below 2,500 rpm.
High cold-engine noise, vibration or harshness	• After-glow phase inoperative	Check the glow plug harnesses at the glow plugs and at the connections to the main harness. Refer to the electrical guides. Check for DTCs indicating a glow plug fault. Rectify as necessary. Clear the DTCs and check for normal operation. After-glow is designed to function at engine temperatures below 50° C (122° F) and below 2,500 rpm.

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 - TDV8 4.4L Diesel, DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation).

Published: 08-Aug-2012

Glow Plug System - TDV8 4.4L Diesel - Glow Plugs

Removal and Installation

Removal

CAUTION: Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

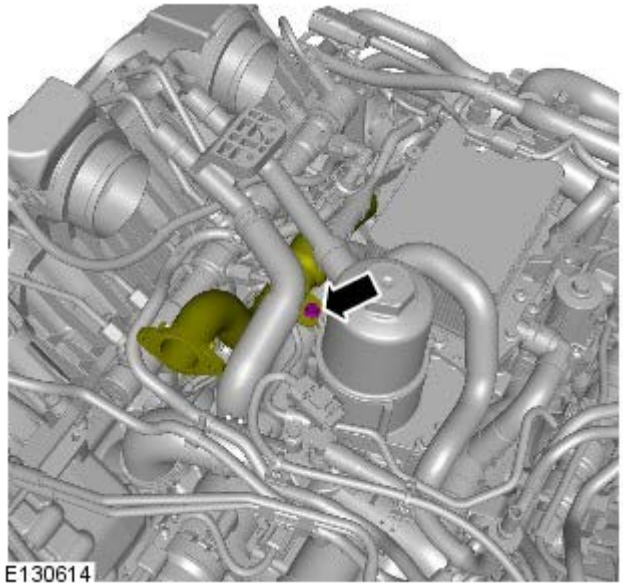
NOTES:

Removal steps in this procedure may contain installation details.

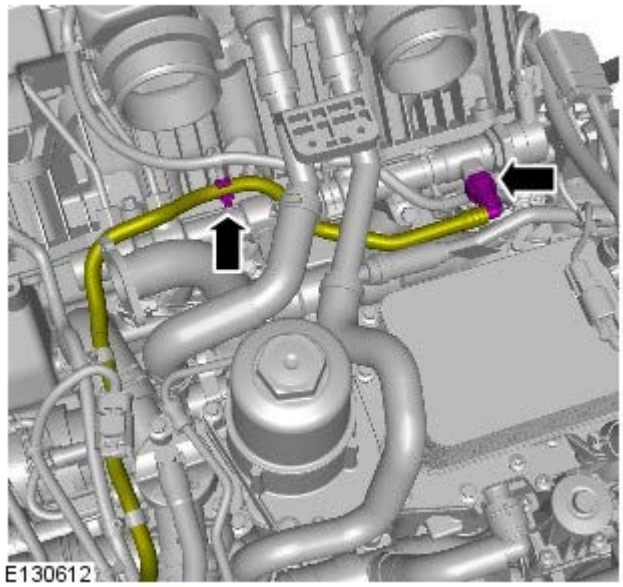
Some variation in the illustrations may occur, but the essential information is always correct.

Engine shown removed for clarity.

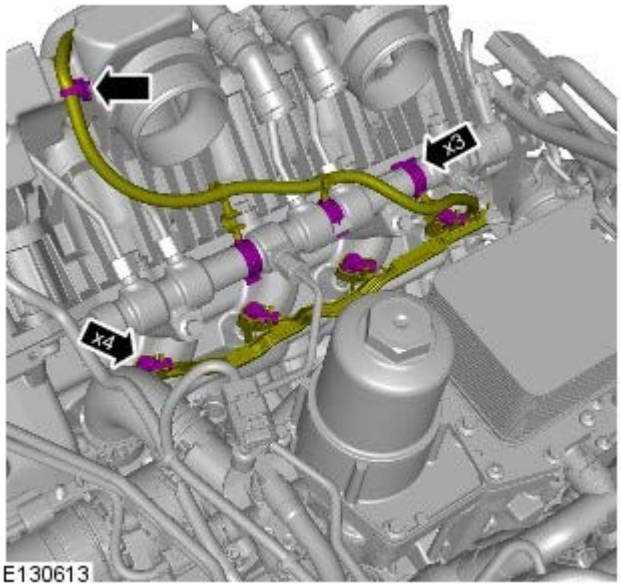
1. Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).
2. Refer to: Intake Manifold Plenum Chamber (303-01, Removal and Installation).
3. *Torque:* 10 Nm



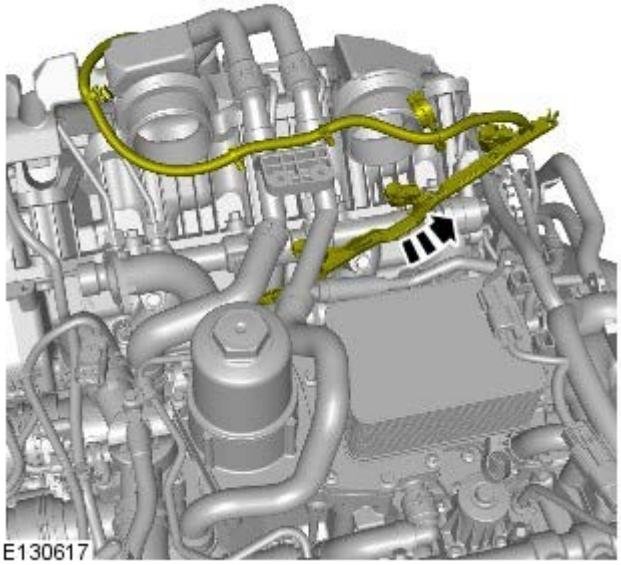
4.



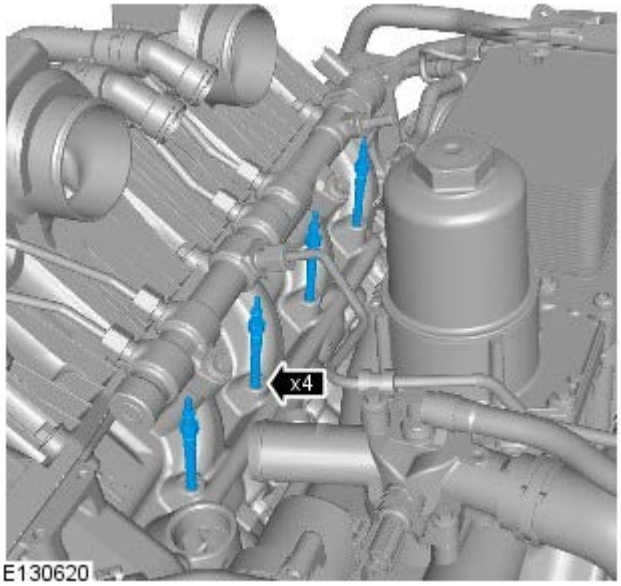
5.



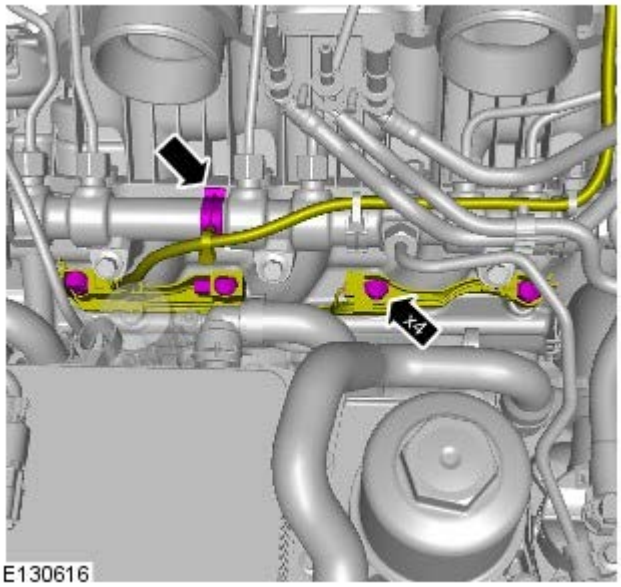
6.



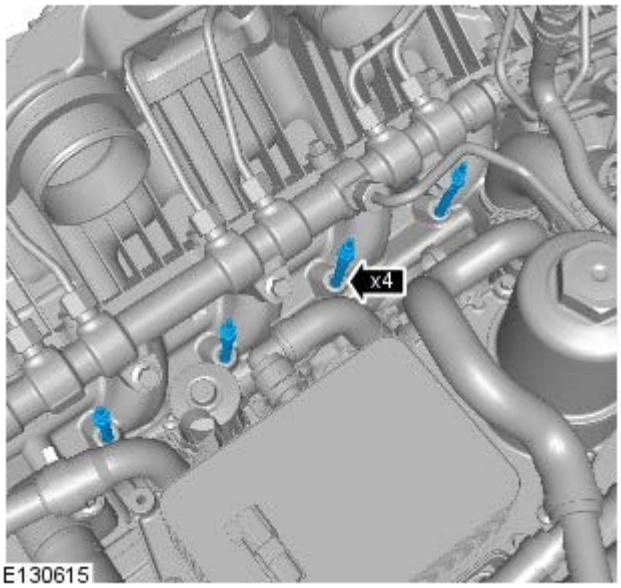
7. *Torque:* 11 Nm



8.



9. *Torque:* 11 Nm



Installation

1. NOTE: Remove and discard all blanking caps.

   To install, reverse the removal procedure.

Published: 04-Aug-2012

Glow Plug System - TDV8 4.4L Diesel - Glow Plug Module

Removal and Installation

Removal

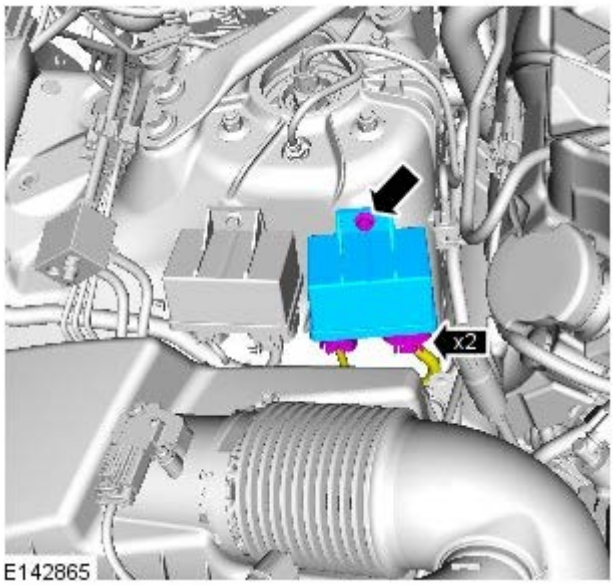
CAUTION: LH illustration shown, RH is similar.

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:* 10 Nm



Installation

1. To install reverse the removal procedure.

Published: 22-Oct-2012

Engine Emission Control - TDV6 3.0L Diesel -

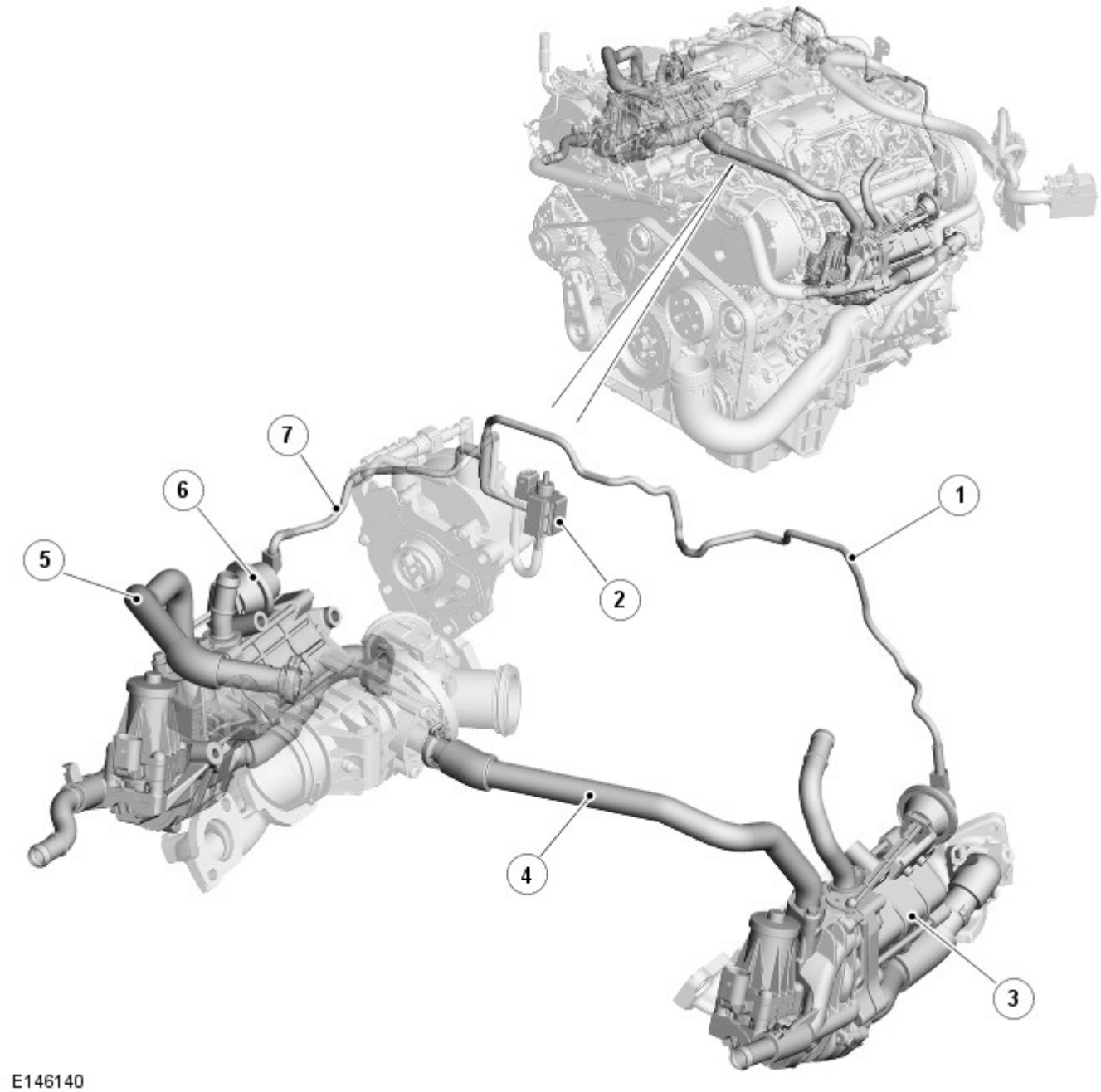
Description	Nm	lb-ft	lb-in
Exhaust gas recirculation (EGR) valve to cylinder head retaining bolts	10	7	89
EGR valve to EGR cooler retaining bolts	10	7	89
EGR valve tube to exhaust manifold retaining bolts	10	7	89
EGR valve cooler mounting bracket retaining bolt	10	7	89
EGR valve outlet tube to EGR valve retaining bolts	10	7	89
EGR valve outlet tube to timing cover retaining bolt	5	4	35

Published: 30-May-2013

Engine Emission Control - TDV6 3.0L Diesel - Engine Emission Control

Description and Operation

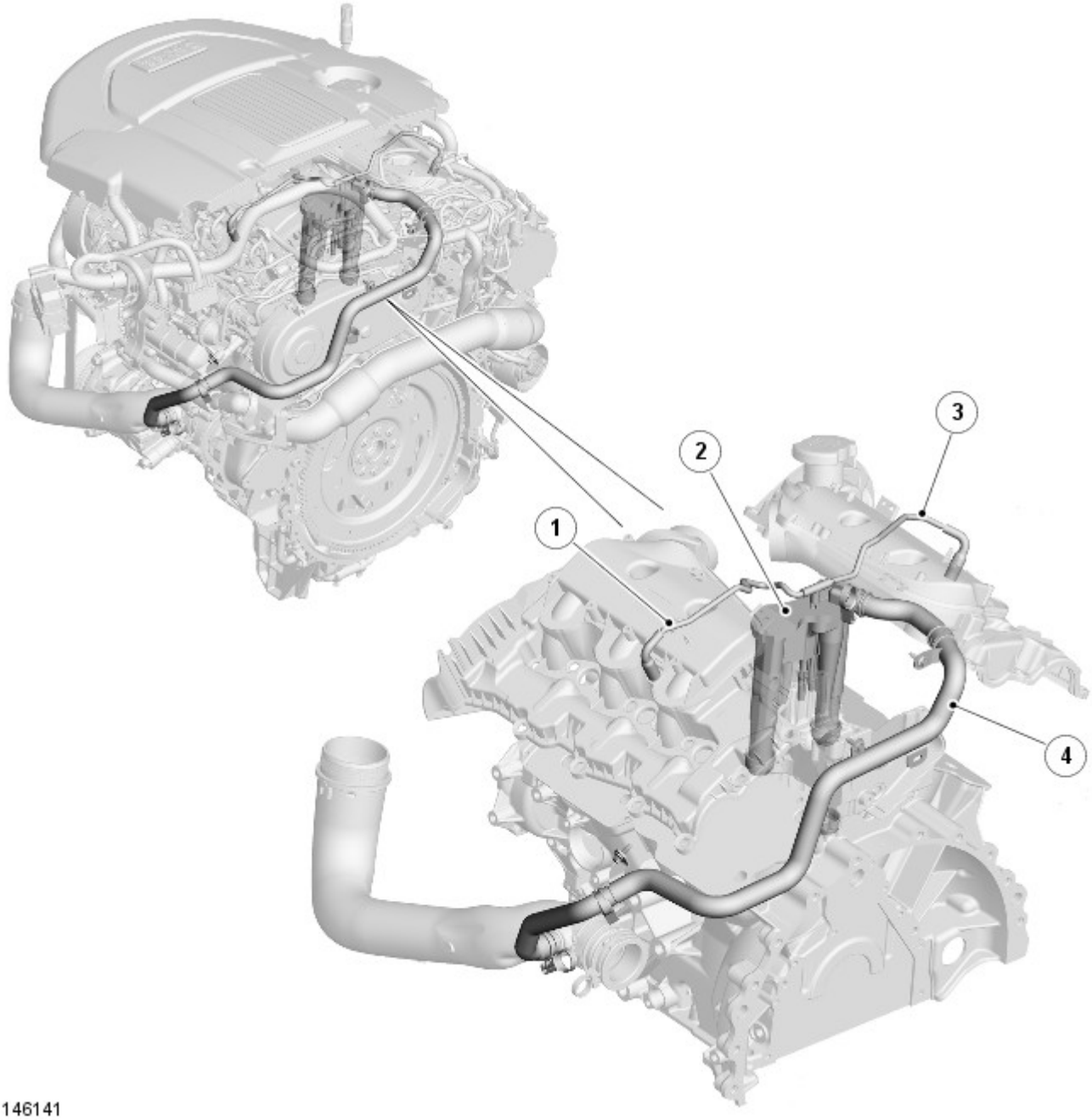
COMPONENT LOCATION - EXHAUST GAS RECIRCULATION



E146140

Item	Part Number	Description
1	-	Left vacuum tube
2	-	EGR cooler bypass valve solenoid
3	-	Left EGR cooler and valve housing
4	-	Left EGR outlet tube
5	-	Right EGR outlet tube
6	-	Right EGR cooler and valve housing
7	-	Right vacuum tube

COMPONENT LOCATION - CRANKCASE VENTILATION



E146141

Item	Part Number	Description
1	-	Left camshaft cover ventilation tube
2	-	Oil separator
3	-	Right camshaft cover ventilation tube
4	-	Crankcase ventilation hose and tube assembly

OVERVIEW

Exhaust Gas Recirculation System

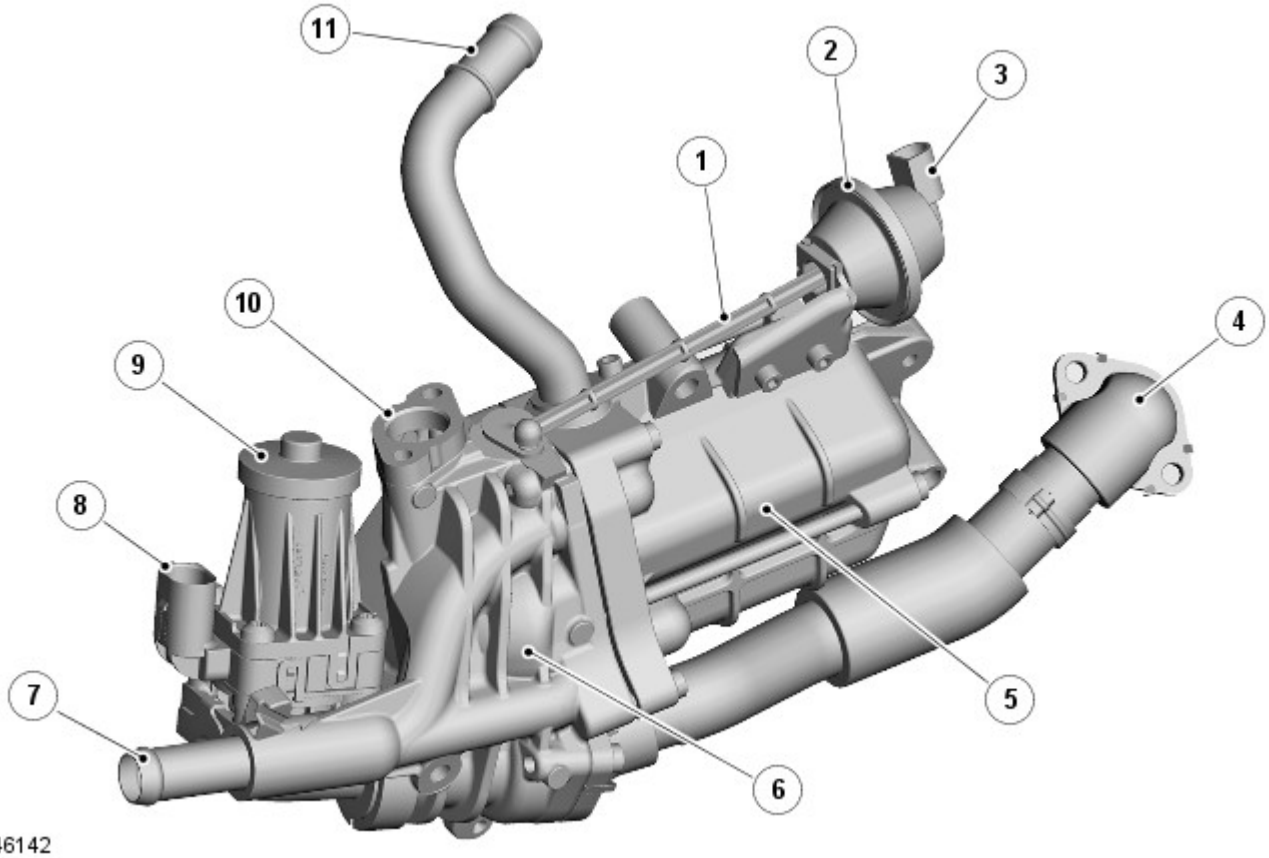
The EGR (Exhaust Gas Recirculation) system is used to control the amount of exhaust gas being recirculated in order to reduce exhaust emissions and combustion noise. EGR is enabled when the engine is at normal operating temperature and under cruising conditions.

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 recirculated via the clean air induction system.

DESCRIPTION

Exhaust Gas Recirculation System



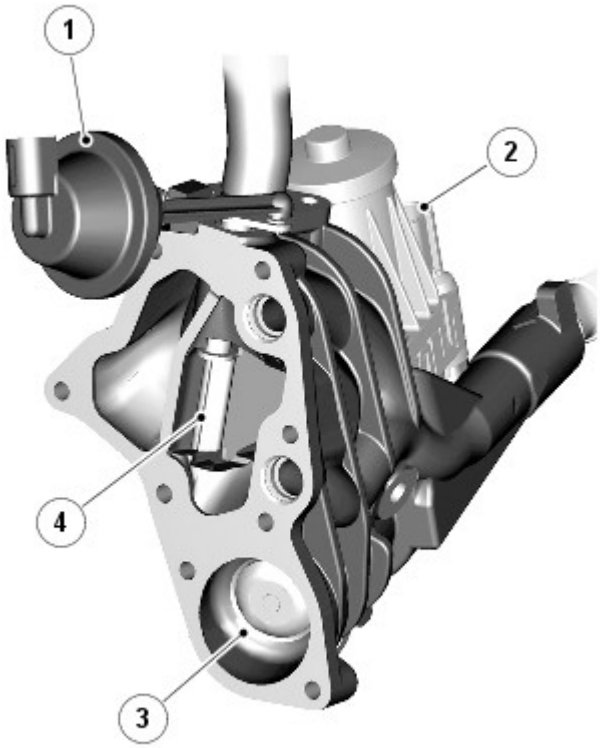
Item	Part Number	Description
1	-	Actuator rod
2	-	Cooler bypass valve vacuum actuator
3	-	Vacuum connection
4	-	EGR intake tube
5	-	Cooler
6	-	Valve housing
7	-	Coolant intake connection
8	-	Electrical connector
9	-	EGR valve motor
10	-	EGR outlet tube connection
11	-	Coolant outlet connection

The EGR system comprises an EGR cooler and valve housing assembly bolted to each cylinder head, above the exhaust manifolds. Each EGR cooler and valve housing assembly incorporates an EGR valve and motor, an EGR cooler, and a cooler bypass valve and actuator.

On each valve housing, an EGR intake tube is connected to the exhaust manifold and directs exhaust gasses into the valve housing. A second pipe from the valve housing connects to the electric throttle and passes the exhaust gasses into the electric throttle to mix with the clean air entering the engine from the turbochargers.

The EGR cooler is attached to the valve housing with a gasket and five screws. The valve housing has an engine coolant connection which allows coolant to flow into a water jacket within the cooler, which cools the exhaust gasses. The coolant returns to the engine cooling system through an outlet pipe on the cooler.

COOLER BYPASS VALVE



E107585

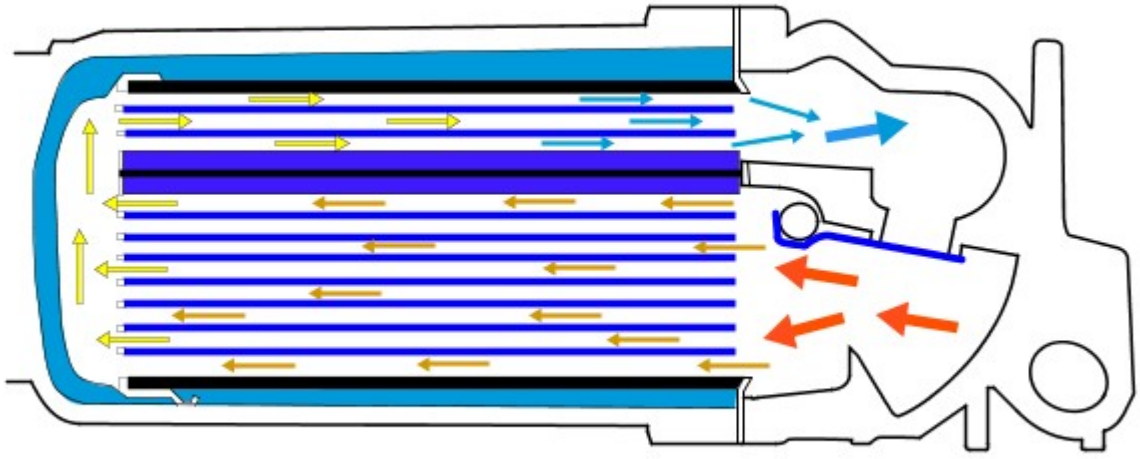
Item	Part Number	Description
1	-	Cooler bypass valve vacuum actuator
2	-	EGR valve motor
3	-	EGR valve
4	-	Cooler bypass valve

Each valve housing contains a cooler bypass valve, which either allows the exhaust gasses to flow direct to the electric throttle or diverts them through the EGR cooler.

A vacuum actuator is located on a bracket attached to each EGR cooler to operate the cooler bypass valves. The actuators receive a vacuum which is produced by the vacuum pump located at the rear of the engine. Each vacuum actuator is connected to its related bypass valve by an actuator rod.

The vacuum supply to the actuators is controlled by the ECM (Engine Control Module). When bypass control is required, the ECM energizes a cooler bypass valve solenoid, 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 rods is transferred to rotary movement of the cooler bypass valves within the valve housings.

Cooler Bypass Valve Closed

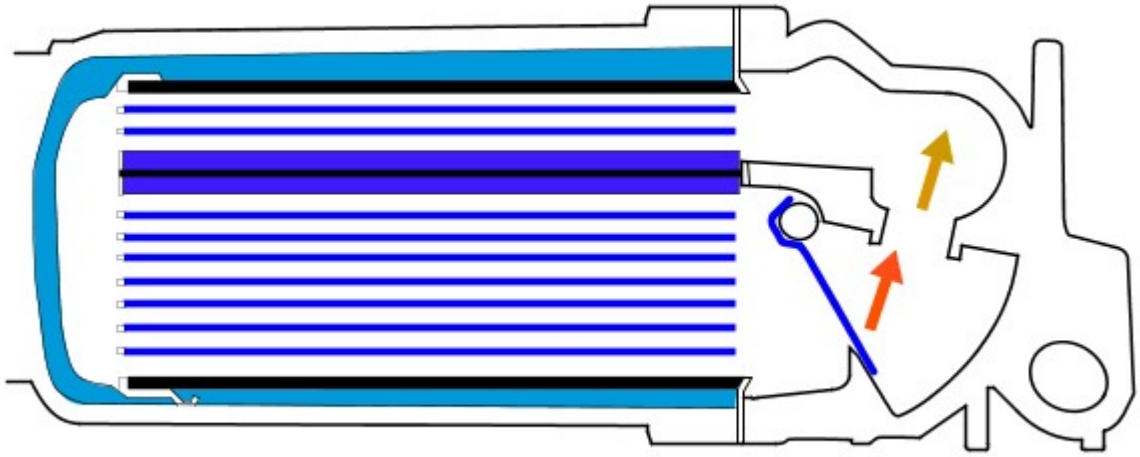


E112407

When the cooler bypass valve is closed, exhaust gasses are directed through the cooler before being passed to the

electric throttle.

Cooler By-Pass Valve Open



E112408

When the cooler bypass valve is open, exhaust gasses are passed directly through the valve housing into the electric throttle with no cooling applied to the gasses.

EXHAUST GAS RECIRCULATION VALVE

The EGR valve motor is located on the valve housing. A five pin connector provides the power, ground and ECM signal and feedback connections for the motor.

The motor is secured to the valve housing with four thorx screws. A pinion gear on the motor spindle drives a geared rack which is connected to the EGR valve in the valve housing.

The motor is controlled by the ECM which provides power 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 System

The crankcase ventilation system comprises an oil separator and associated ventilation hoses and tubes.

The oil separator is connected to the top of the cylinder block with two seals. An oil outlet connection locates in the high pressure fuel pump mounting bracket. Two ventilation tubes connect the top of the oil separator to the camshaft covers. A ventilation tube and hose assembly connects the top of the oil separator to the intake duct of the primary turbocharger.

OPERATION

Exhaust Gas Recirculation System

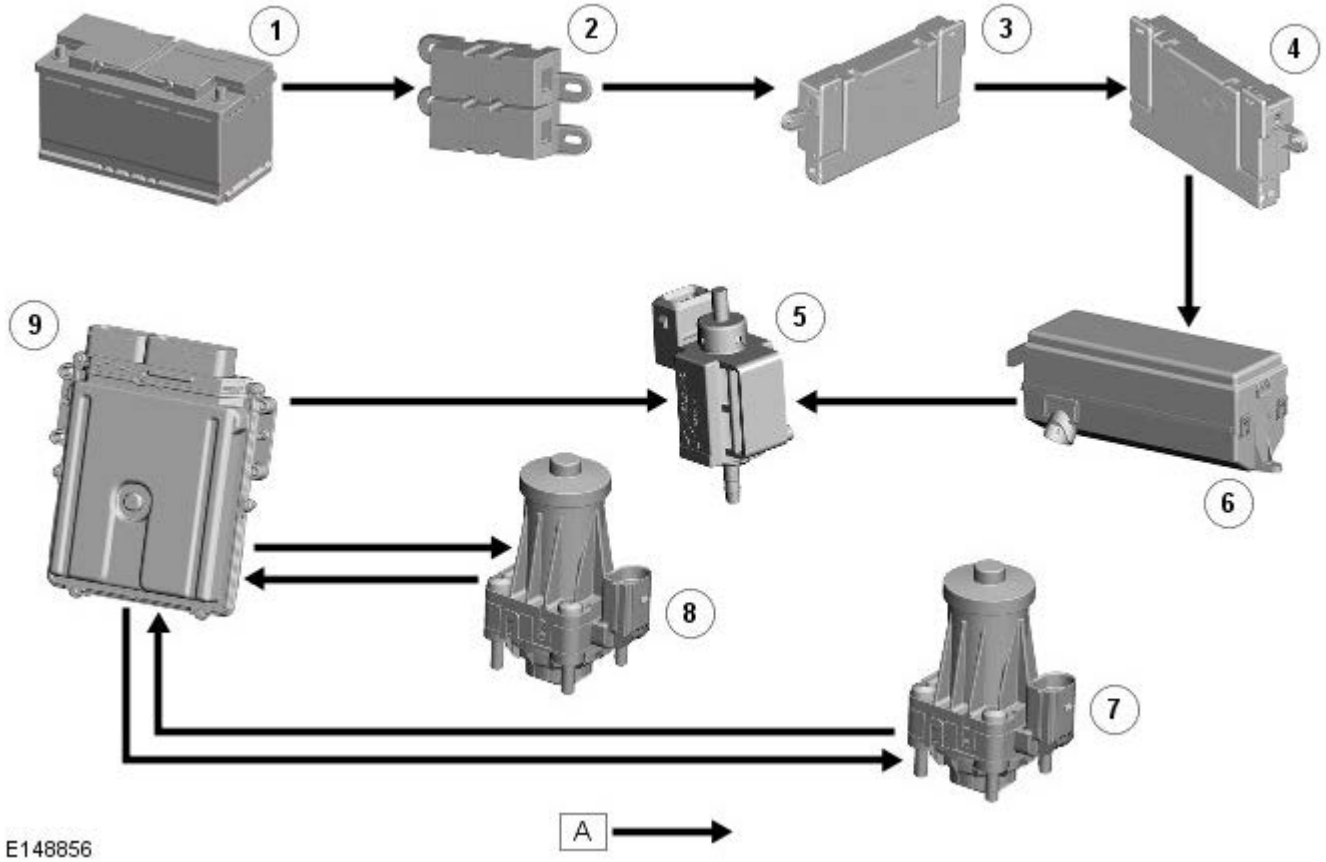
If small volumes of fuel are injected into a combustion chamber full of pure air, the effect is to create a very lean mixture. This burns at a high temperature, which in turn causes the excess oxygen in the mixture to combine with the naturally occurring nitrogen in the air to create NOx (oxides of nitrogen), a noxious class of pollutants associated with acid rain. This is a particular problem for diesel engines at low to medium loads. 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 from the exhaust manifolds through the EGR coolers before being supplied to the electric throttle. The volume of exhaust gas added to the intake charge is regulated by the EGR valves, actuated according to precise engine speed and load maps by the ECM.

Crankcase Ventilation System

Clean air being drawn into the primary turbocharger when the engine is running creates a vacuum in the ventilation tube and hose assembly. This vacuum in turn creates a vacuum in the oil separator and draws gasses from the crankcase and camshaft covers into the separator. The gasses are circulated around the oil separator, allowing oil particles to be separated from the gas. The gasses are drawn into the ventilation tube and hose assembly and are mixed with the clean air being drawn into the turbocharger. The oil drains out of the oil separator, and down through the high pressure fuel pump mounting bracket and cylinder block into the oil pan.

Control Diagram



A = Hardwired.

Item	Part Number	Description
1	-	Battery
2	-	Battery Junction Box 2 (BJB2)
3	-	Battery Junction Box (BJB)
4	-	Auxiliary Junction Box (AJB)
5	-	EGR cooler bypass valve solenoid
6	-	Engine Junction Box (EJB)
7	-	Left EGR valve motor
8	-	Right EGR valve motor
9	-	Engine Control Module (ECM)

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:

Engine Emission Control (303-08A Engine Emission Control - TDV6 3.0L Diesel, Description and Operation),
Engine Emission Control (303-08 Engine Emission Control - TDV6 3.0L Diesel, Description and Operation),
Engine Emission Control (303-08 Engine Emission Control - 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
• 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: 04-Aug-2012

Engine Emission Control - TDV6 3.0L Diesel - Crankcase Vent Oil Separator

Removal and Installation

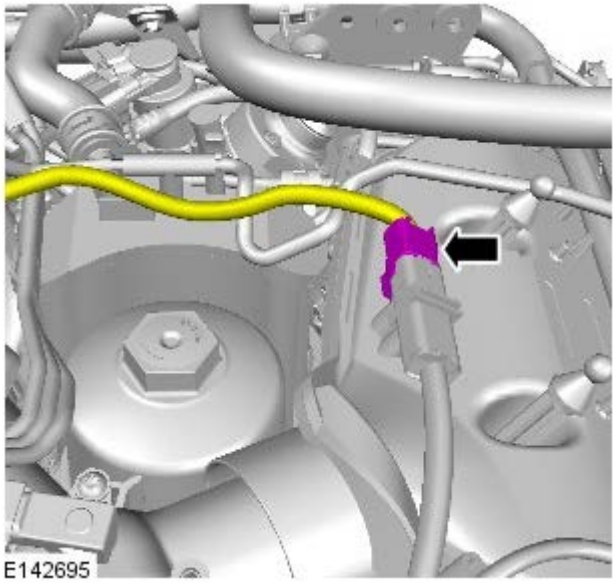
Removal

NOTES:

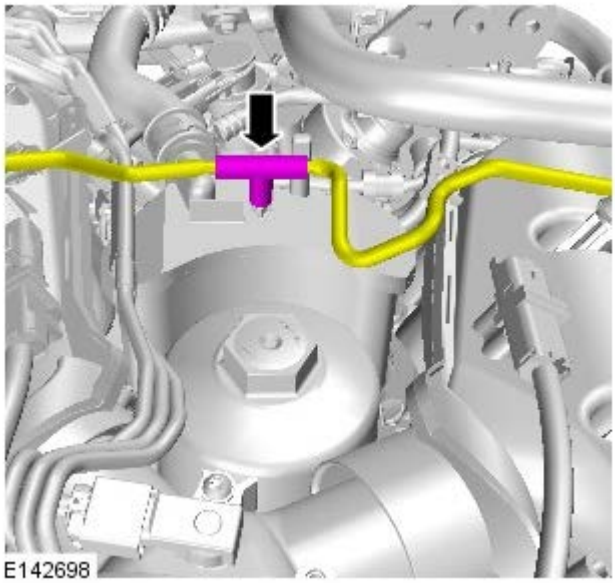
Some variation in the illustrations may occur, but the essential information is always correct.

Removal steps in this procedure may contain installation details.

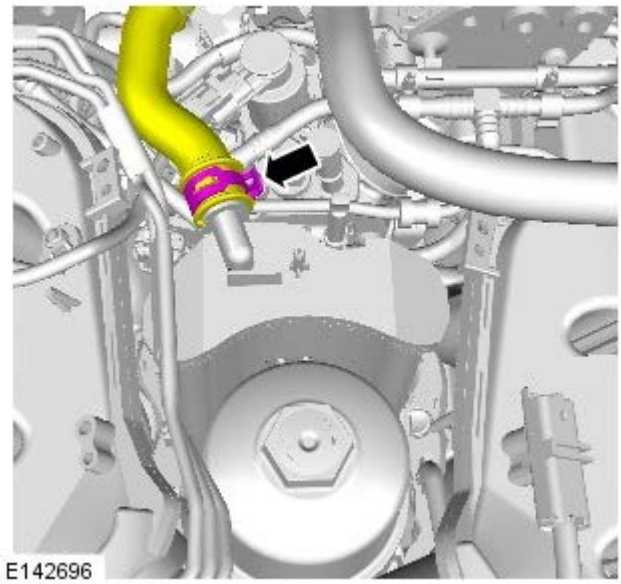
1. Refer to: Specifications (414-00, Specifications).
2. Refer to: Cowl Panel Grille (501-02, Removal and Installation).
3. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05, Removal and Installation).
4.

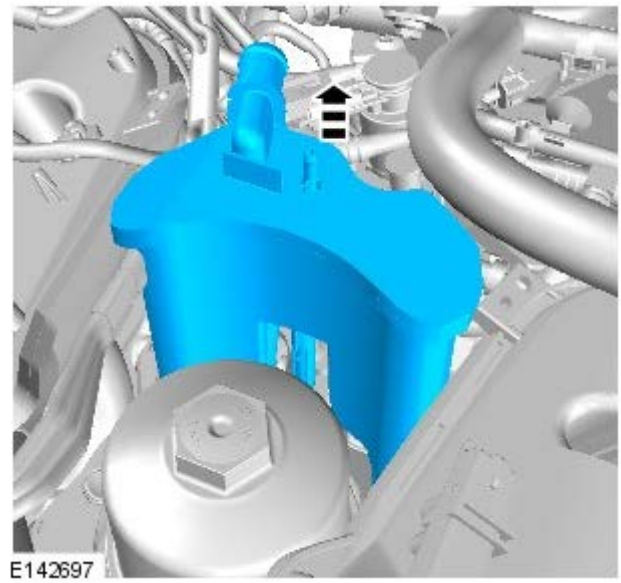


5.



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: 24-Oct-2012

Engine Emission Control - TDV6 3.0L Diesel - Exhaust Gas Recirculation (EGR) Valve LH

Removal and Installation

Removal

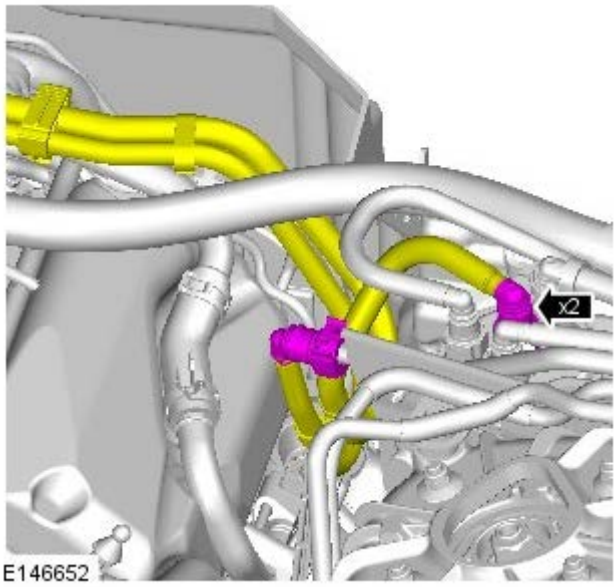
NOTES:

Removal steps in this procedure may contain installation details.

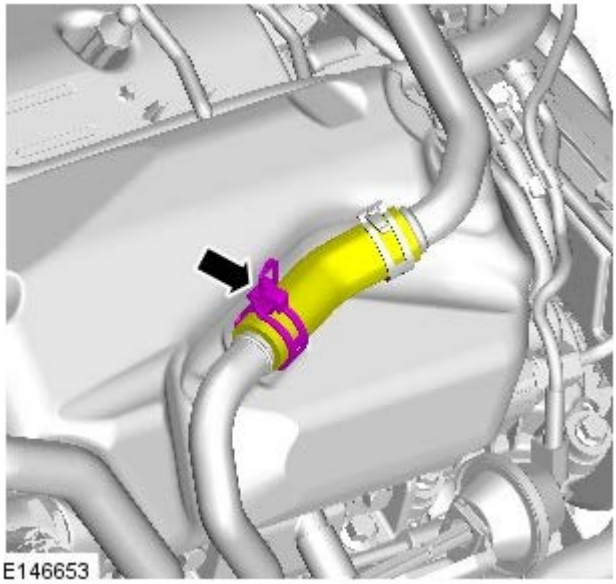
Some illustrations may show the engine removed for clarity.

Make sure that all openings are sealed.

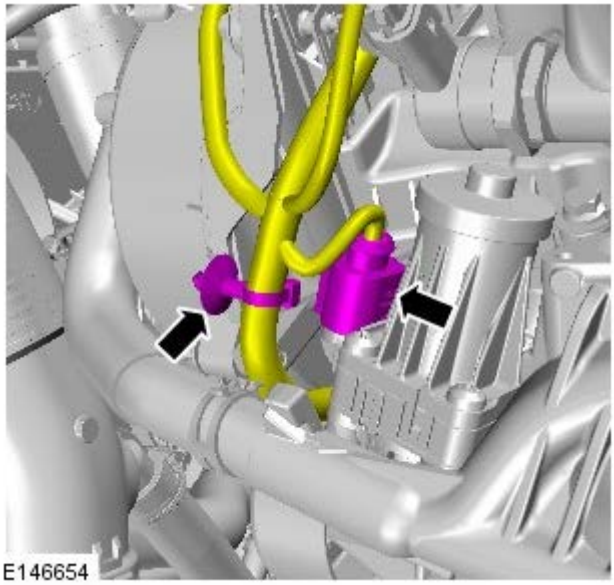
1. Refer to: Specifications (414-00, Specifications).
2. Refer to: Cooling System Partial Draining, Filling and Bleeding (303-03A Engine Cooling - TDV6 3.0L Diesel, General Procedures).
3. Refer to: Secondary Bulkhead Center Panel - TDV6 3.0L Diesel (501-02 Front End Body Panels, Removal and Installation).
4. Refer to: Exhaust Gas Recirculation (EGR) Valve Outlet Tube LH (303-08A Engine Emission Control - TDV6 3.0L Diesel, Removal and Installation).
5.



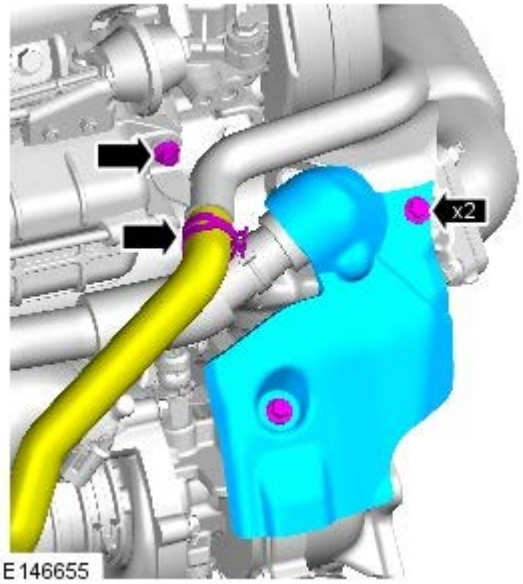
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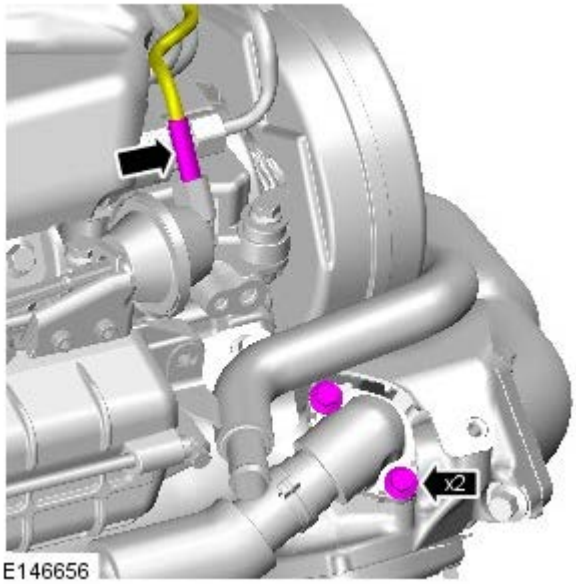
7.



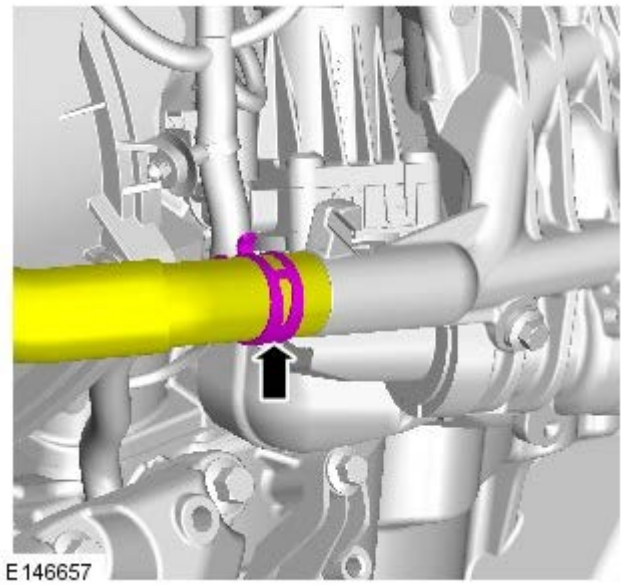
8. *Torque:* 10 Nm



9. *Torque:* 10 Nm

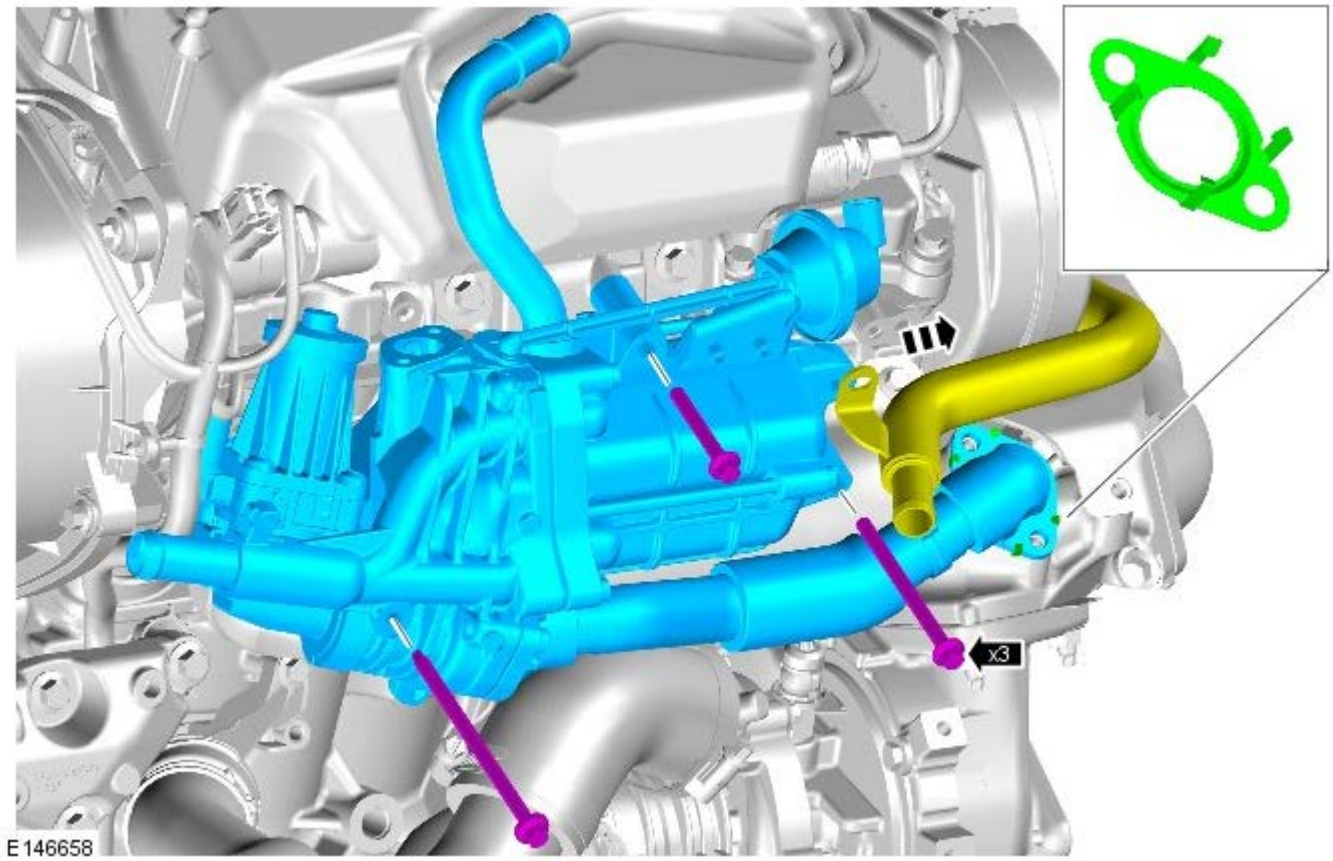


10.



11. 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: 24-Oct-2012

Engine Emission Control - TDV6 3.0L Diesel - Exhaust Gas Recirculation (EGR) Valve RH

Removal and Installation

Removal

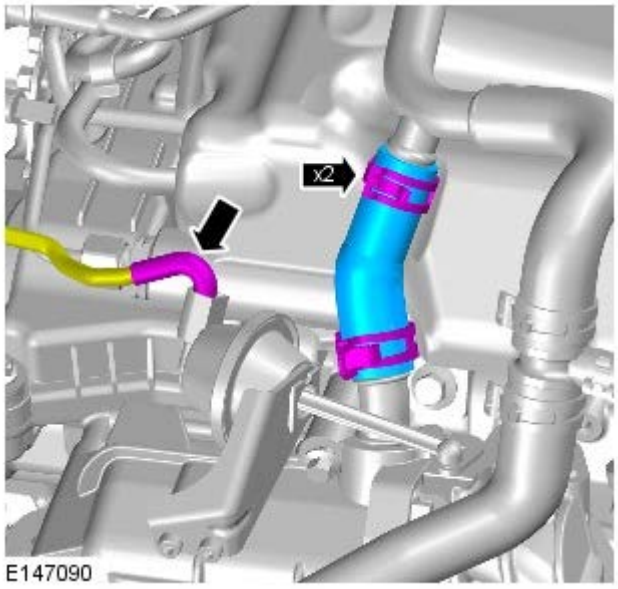
NOTES:

Removal steps in this procedure may contain installation details.

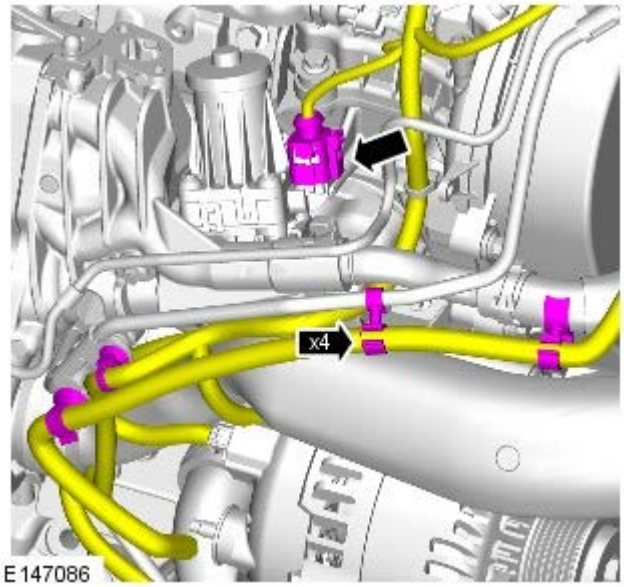
Some illustrations may show the engine removed for clarity.

Make sure that all openings are sealed.

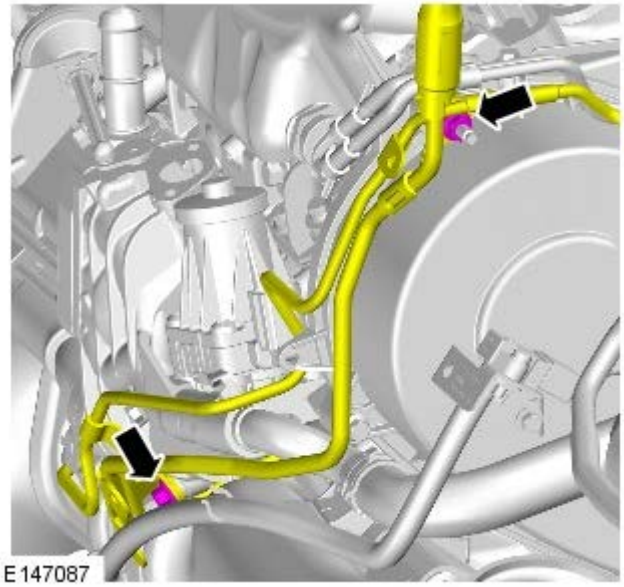
1. Refer to: Specifications (414-00, Specifications).
2. Refer to: Cooling System Partial Draining, Filling and Bleeding (303-03A Engine Cooling - TDV6 3.0L Diesel, General Procedures).
3. Refer to: Secondary Bulkhead Center Panel - TDV6 3.0L Diesel (501-02 Front End Body Panels, Removal and Installation).
4. Refer to: Exhaust Gas Recirculation (EGR) Valve Outlet Tube RH (303-08A Engine Emission Control - TDV6 3.0L Diesel, Removal and Installation).
5.



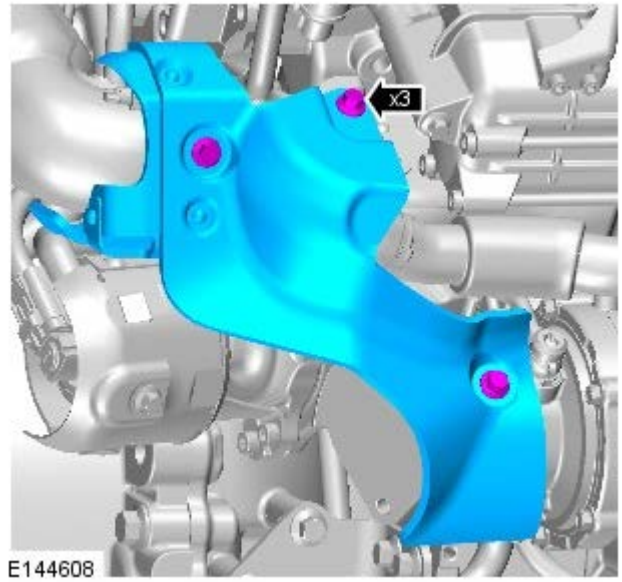
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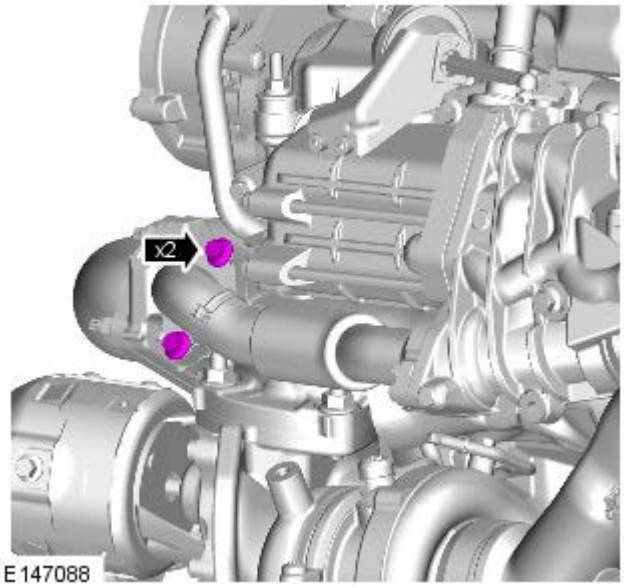
7. *Torque:* 8 Nm



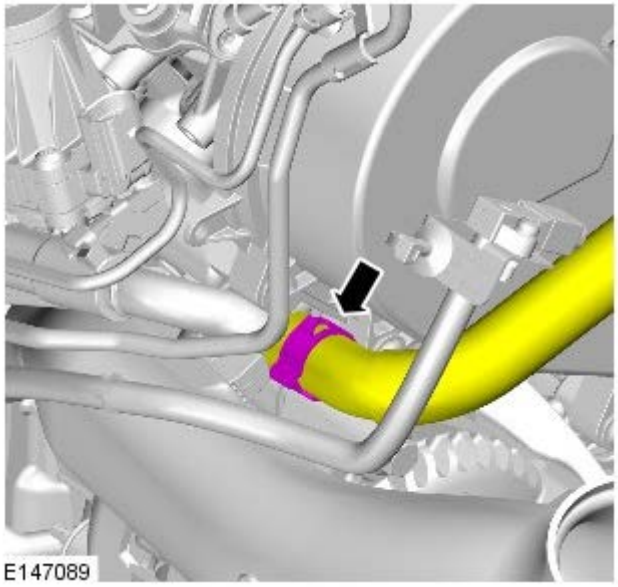
8. *Torque:* 10 Nm



9. *Torque:* 10 Nm

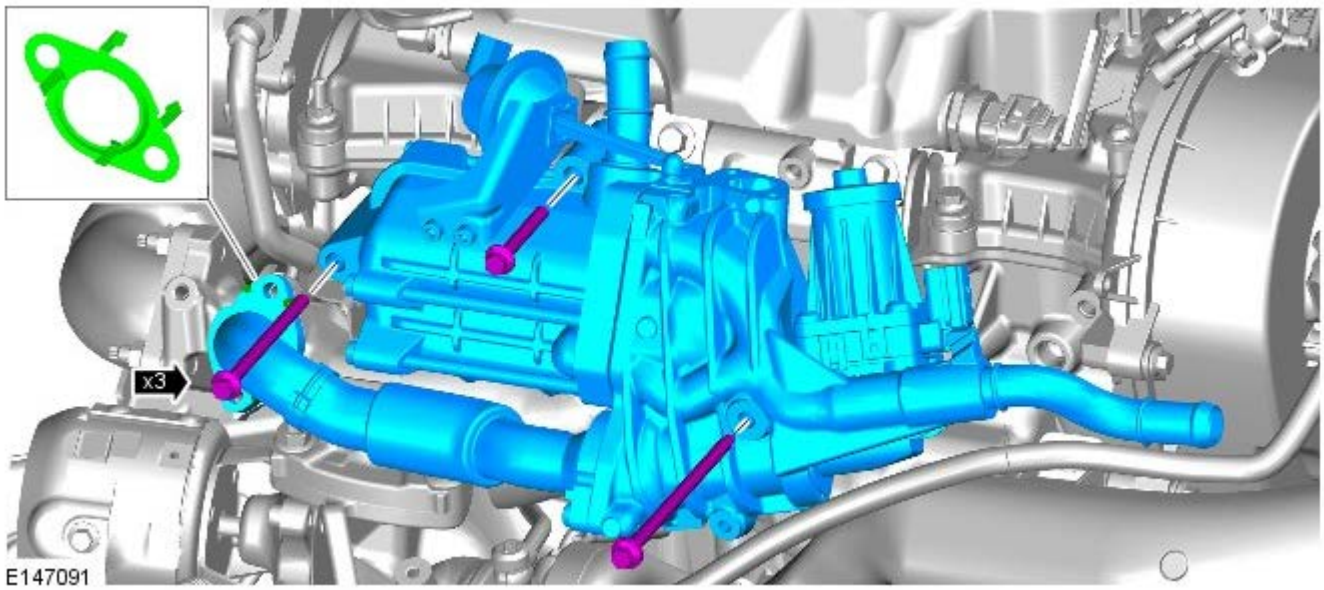


10.



11. 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: 31-Jul-2012

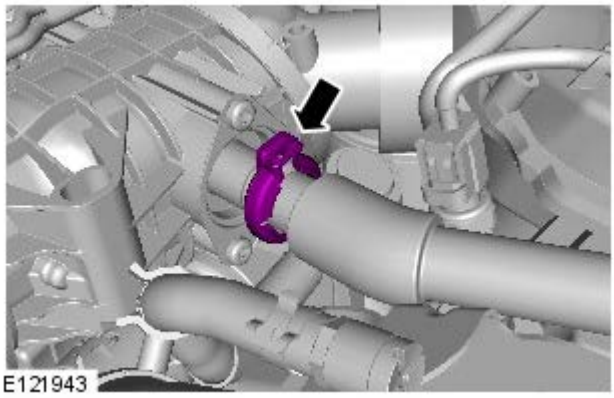
Engine Emission Control - TDV6 3.0L Diesel - Exhaust Gas Recirculation (EGR) Valve Outlet Tube LH

Removal and Installation

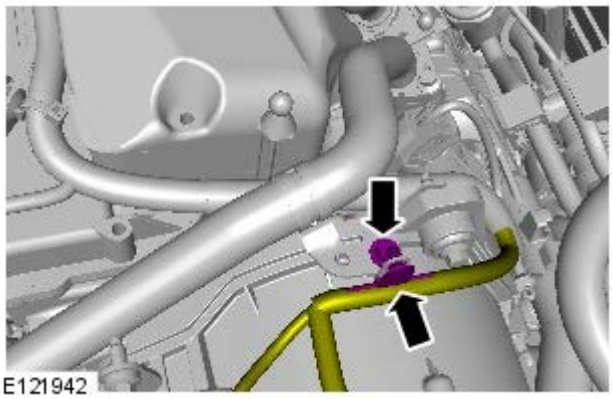
Removal

NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

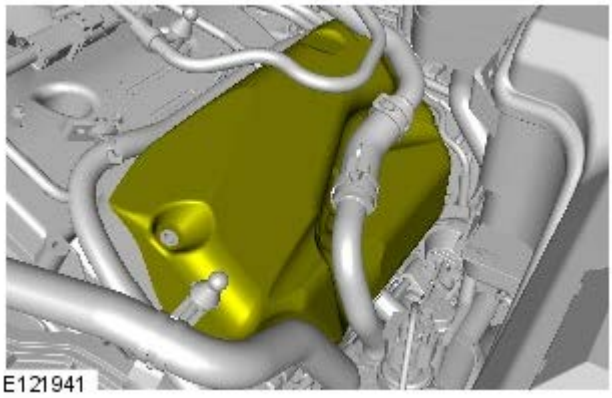
1. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05, Removal and Installation).


E121943

2. NOTE: Discard the retaining clips.


E121942

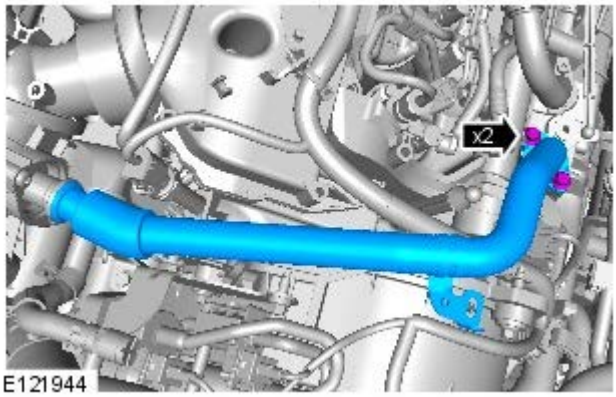
3.


E121941

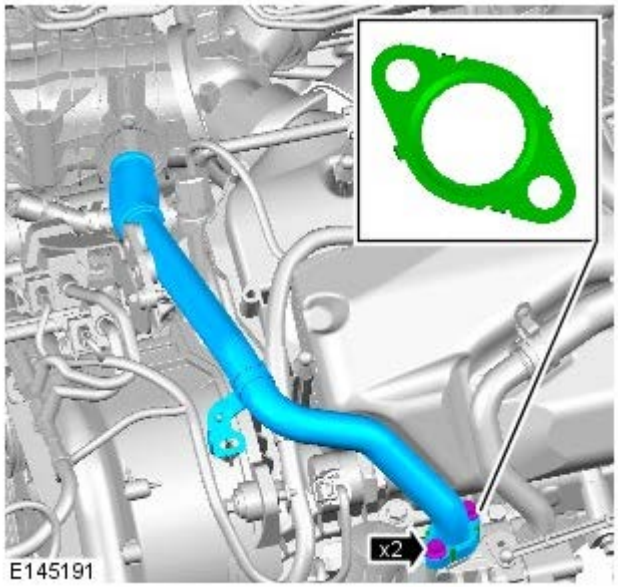
4.

5. CAUTION: Make sure that all openings are sealed.

NOTE: Discard the gasket.

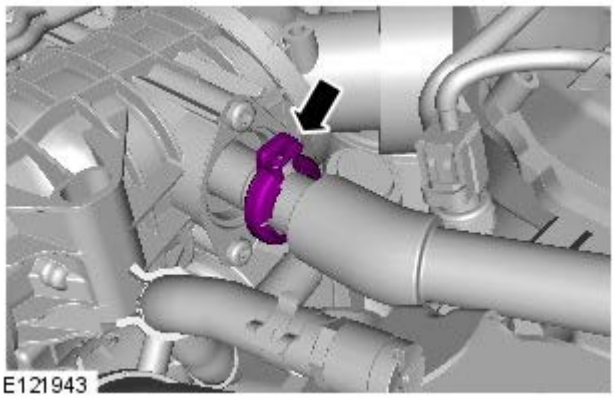


Installation



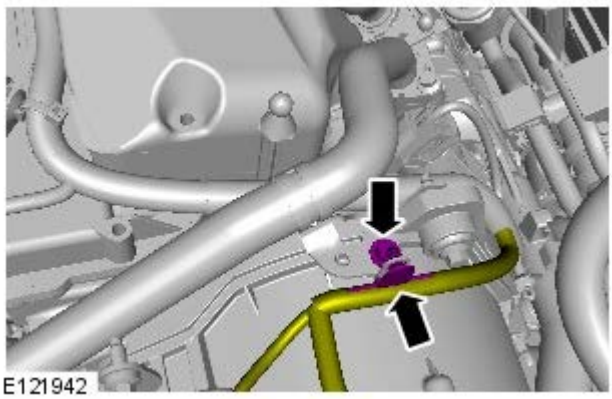
1. CAUTION: Only tighten the bolts finger-tight at this stage.

   NOTE: Install a new gasket.

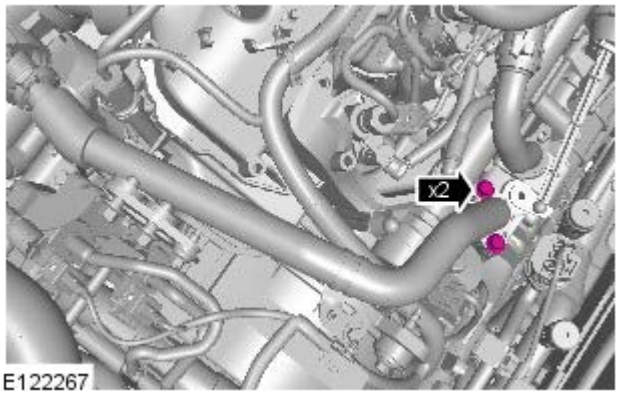


2. CAUTION: Install a new clamp. Close the clamp to the first audible click by hand. Making sure that the clamp is in a central position to the joint, close to the second audible click using a suitable tool.

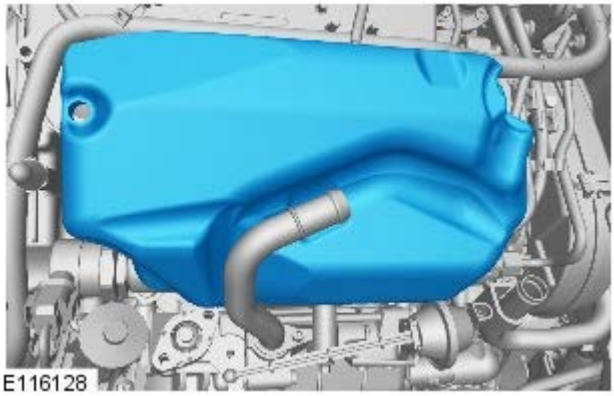
3. *Torque:* 5 Nm



4. *Torque:* 10 Nm



5.



6. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05, Removal and Installation).

Published: 06-Sep-2012

Engine Emission Control - TDV6 3.0L Diesel - Exhaust Gas Recirculation (EGR) Valve Outlet Tube RH

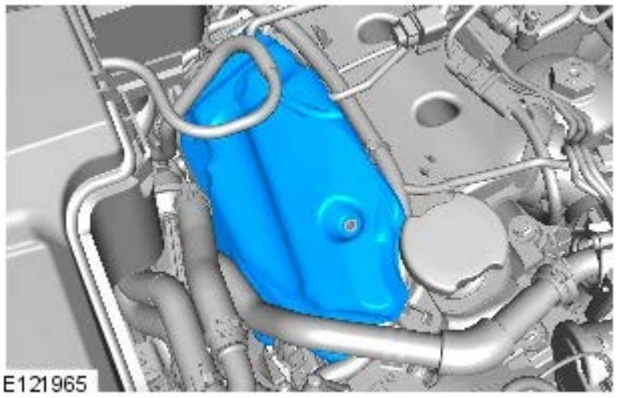
Removal and Installation

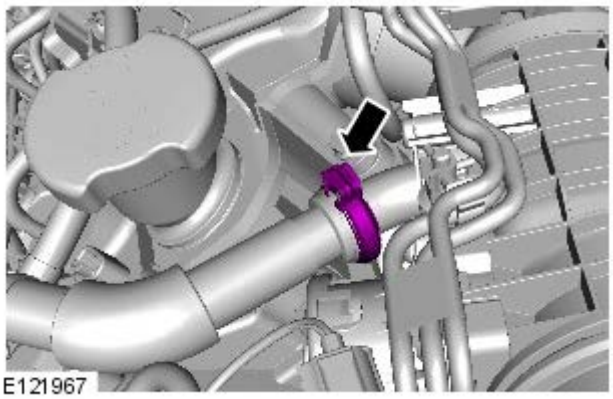
Removal

NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05, Removal and Installation).

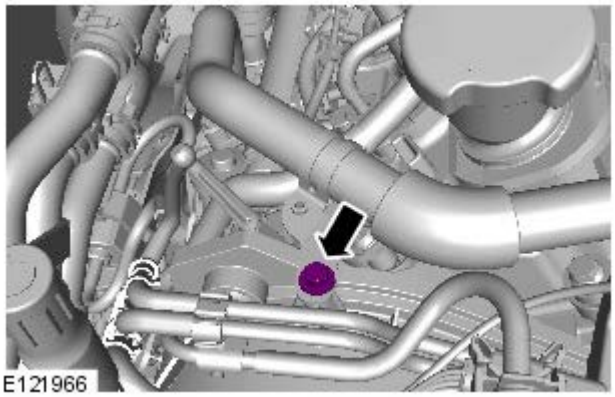
2.





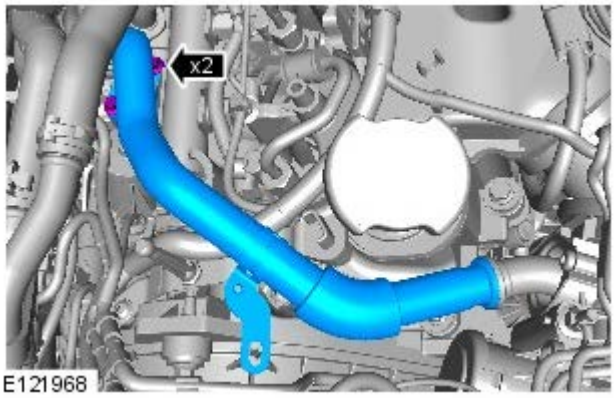
3. NOTE: Discard the retaining clips.

4.

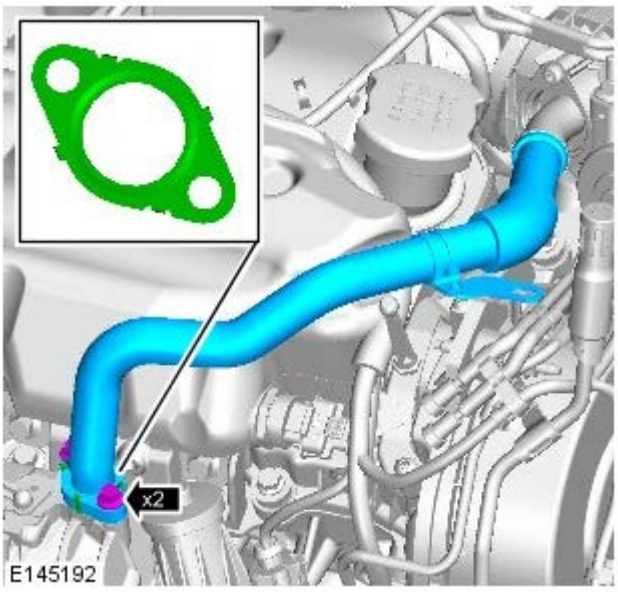


5. CAUTION: Make sure that all openings are sealed.

NOTE: Discard the gasket.

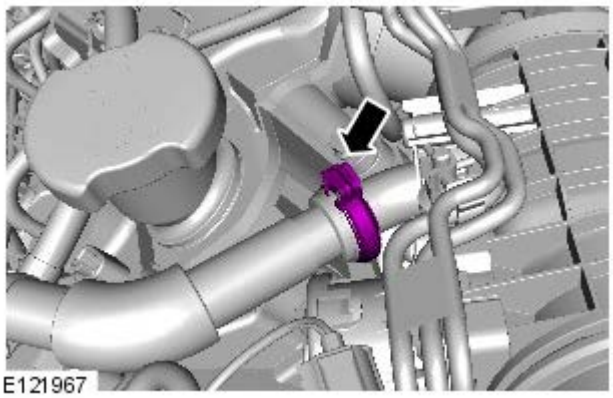


Installation



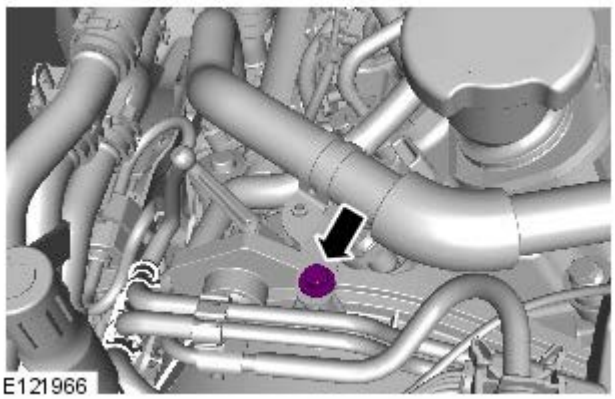
1. CAUTION: Only tighten the bolts finger-tight at this stage.

   NOTE: Install a new gasket.

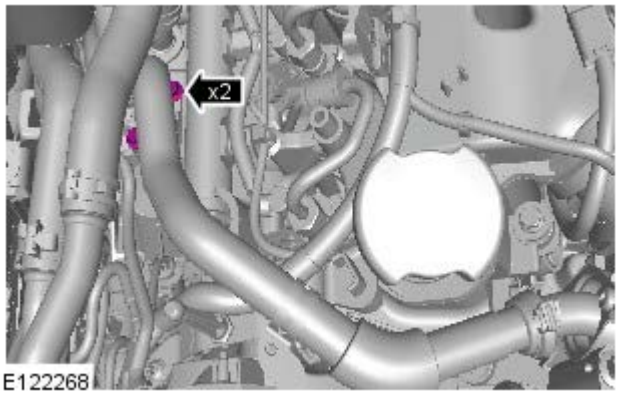


2. CAUTION: Install a new clamp. Close the clamp to the first audible click by hand. Making sure that the clamp is in a central position to the joint, close to the second audible click using a suitable tool.

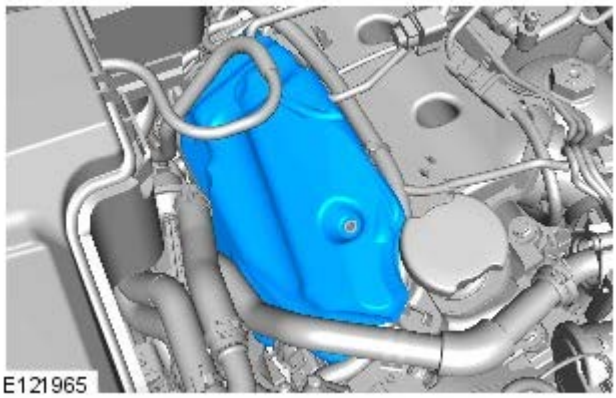
3. *Torque:* 5 Nm



4. *Torque:* 10 Nm



5.



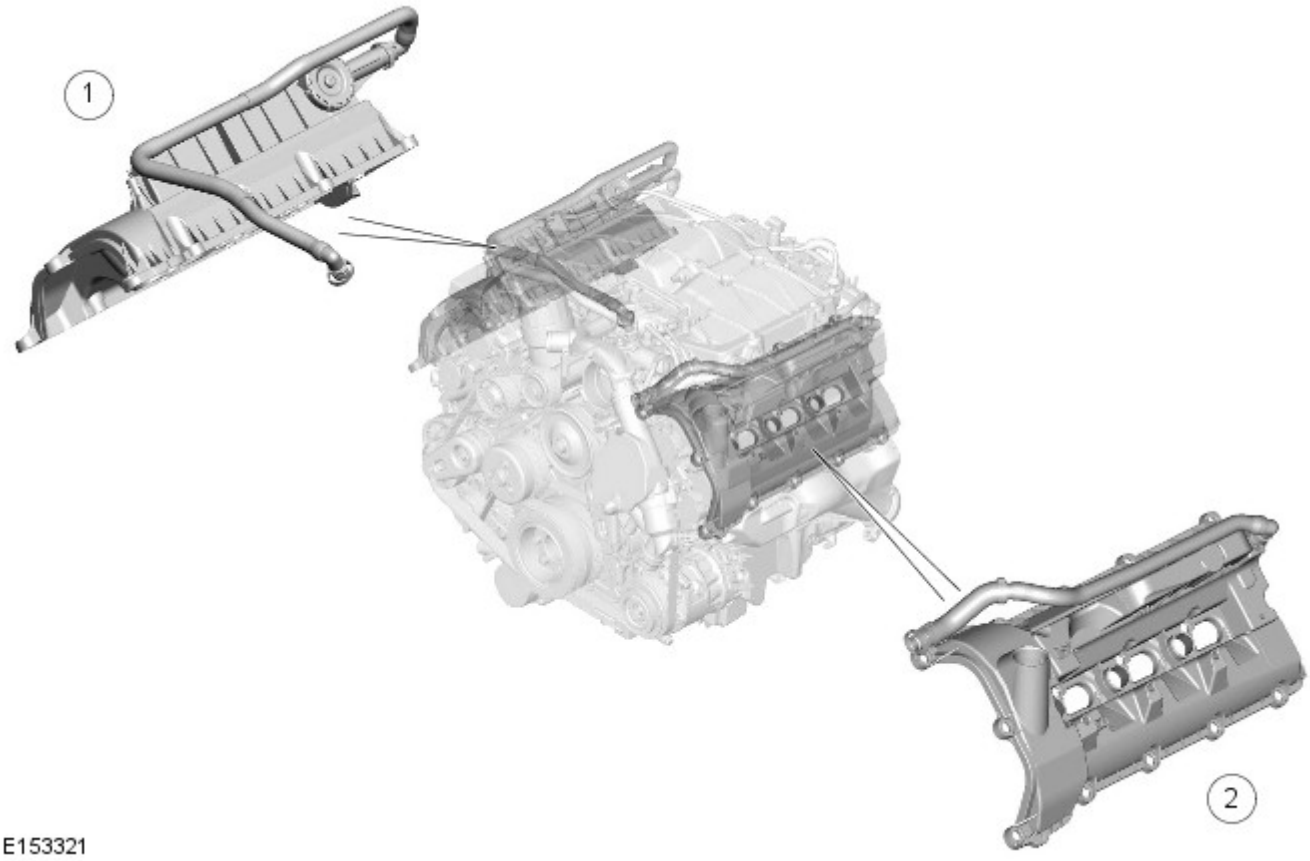
6. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05, Removal and Installation).

Published: 28-Oct-2013

Engine Emission Control - V6 S/C 3.0L Petrol - Engine Emission Control

Description and Operation

COMPONENT LOCATION



E153321

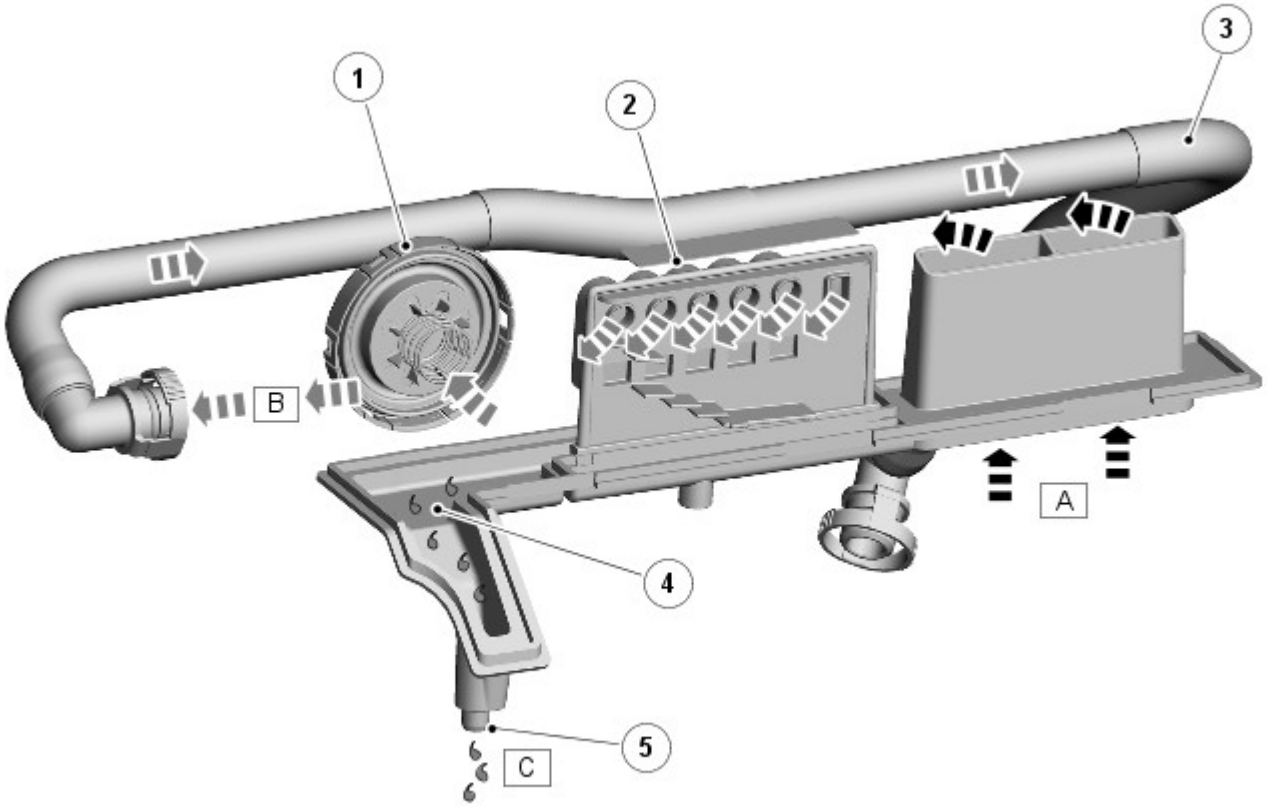
Item	Part Number	Description
1	-	Part load breather
2	-	Full load breather

OVERVIEW

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 and metered fresh air 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.

DESCRIPTION

Part Load Breather



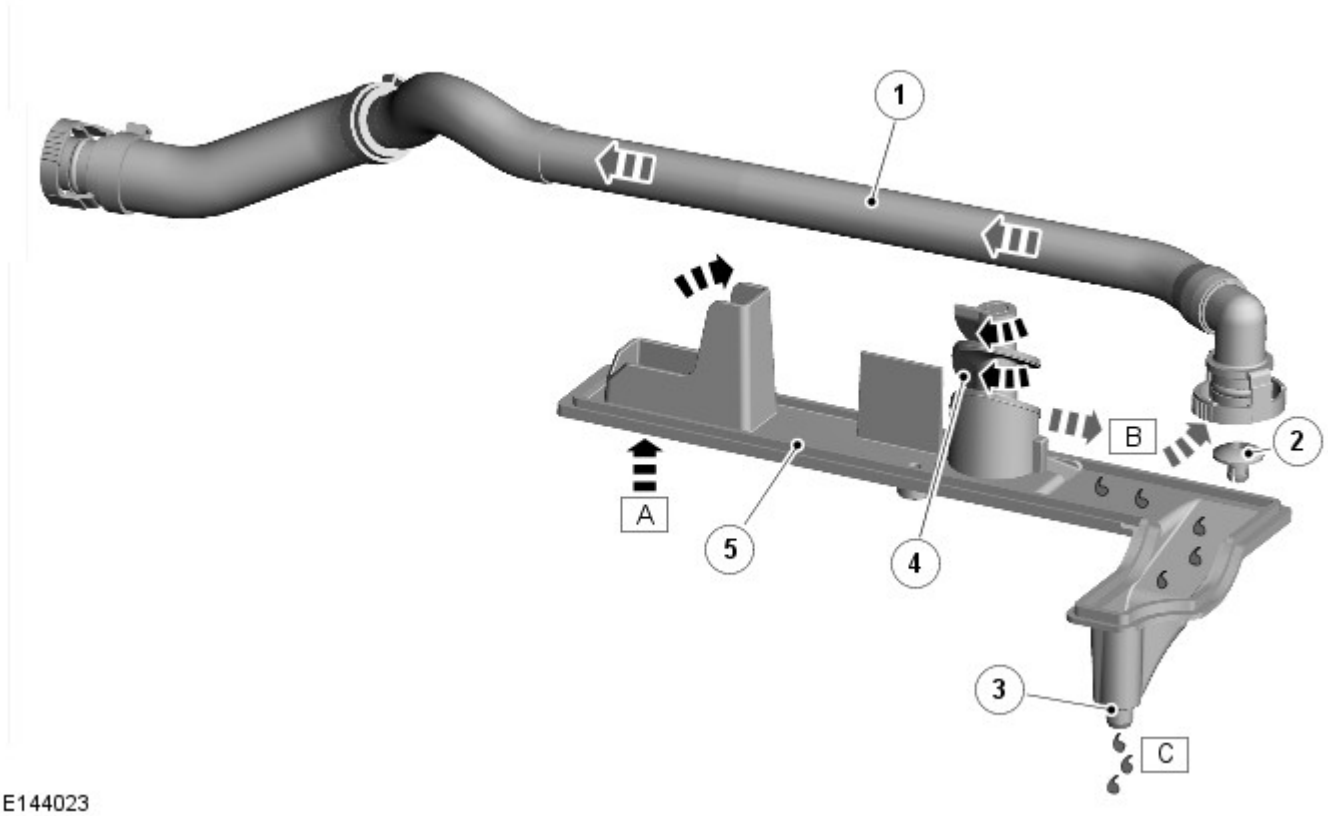
E144022

Item	Part Number	Description
A	-	Gas/Oil vapor
B	-	Gas vapor
C	-	Oil
1	-	Positive Crankcase Ventilation (PCV) valve
2	-	Oil separator
3	-	Flexible hose
4	-	Baffle plate
5	-	Oil drain

The part load breather consists of an oil separator, a PCV valve and a flexible hose. The oil separator and the PCV valve are installed in the top of the right camshaft cover. The flexible hose connects the right camshaft cover to the inlet of the supercharger.

The oil separator is installed in a channel in the top of the camshaft cover. A baffle plate, which incorporates a gas inlet and an oil drain, is installed over the channel. The PCV valve is installed on the outside of the camshaft cover and connected to the gas outlet from the channel to the flexible hose. The PCV valve regulates the crankcase pressure and crank case flow to optimize engine performance.

Full Load Breather



E144023

Item	Part Number	Description
A	-	Gas/Oil vapor
B	-	Gas vapor
C	-	Oil
1	-	Flexible hose
2	-	Two-way valve
3	-	Oil drain
4	-	Oil separator
5	-	Baffle plate

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 left camshaft cover. The flexible hose connects the left camshaft cover to the left air duct of the intake air distribution and filtering system.

The oil separator is installed in a channel in the top of the camshaft 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 regulates fresh air flow and improves idle stability.

Published: 05-Nov-2012

Engine Emission Control - V6 S/C 3.0L 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 in the workshop manual.
REFER to: Engine Emission Control (303-08B Engine Emission Control - V6 S/C 3.0L Petrol, Description and Operation) / Engine Emission Control (303-08C, Description and Operation) / Engine Emission Control (303-08C, 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
• Breather hoses • Positive crankcase ventilation valve(s) • Fuel level • Fuel contamination/grade/quality • Throttle body	• Fuse(s) • Loose or corroded electrical connectors • Engine Control Module (ECM)

3. If an obvious cause for an observed or reported condition is found, correct the cause (if possible) before proceeding to the symptom chart.
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 • Fuel system • Evaporative emissions purge valve	For battery information, CKP sensor tests, fuel system and purge valve tests, refer to relevant workshop manual section. Refer to the guided diagnostic routine on the approved diagnostic system.
Engine stalls soon after start	• Breather system disconnected/restricted • Engine Control Module (ECM) relay • MAF sensor • Ignition system • Air filter restricted • Air leakage • Fuel lines	Check the engine breather hoses, PCV. Check the Engine Control Module (ECM) relay operation. For MAF sensor, ignition system tests, air intake information and fuel line information, refer to relevant workshop manual section.
Poor throttle response	• ECT sensor • MAF sensor • Transmission malfunction • Traction control event • Air leakage • Breather system disconnected/restricted	For ECT, MAF sensor tests, intake system checks and transmission information, refer to relevant workshop manual section. Check the breather system hoses, PCV.

DTC Index

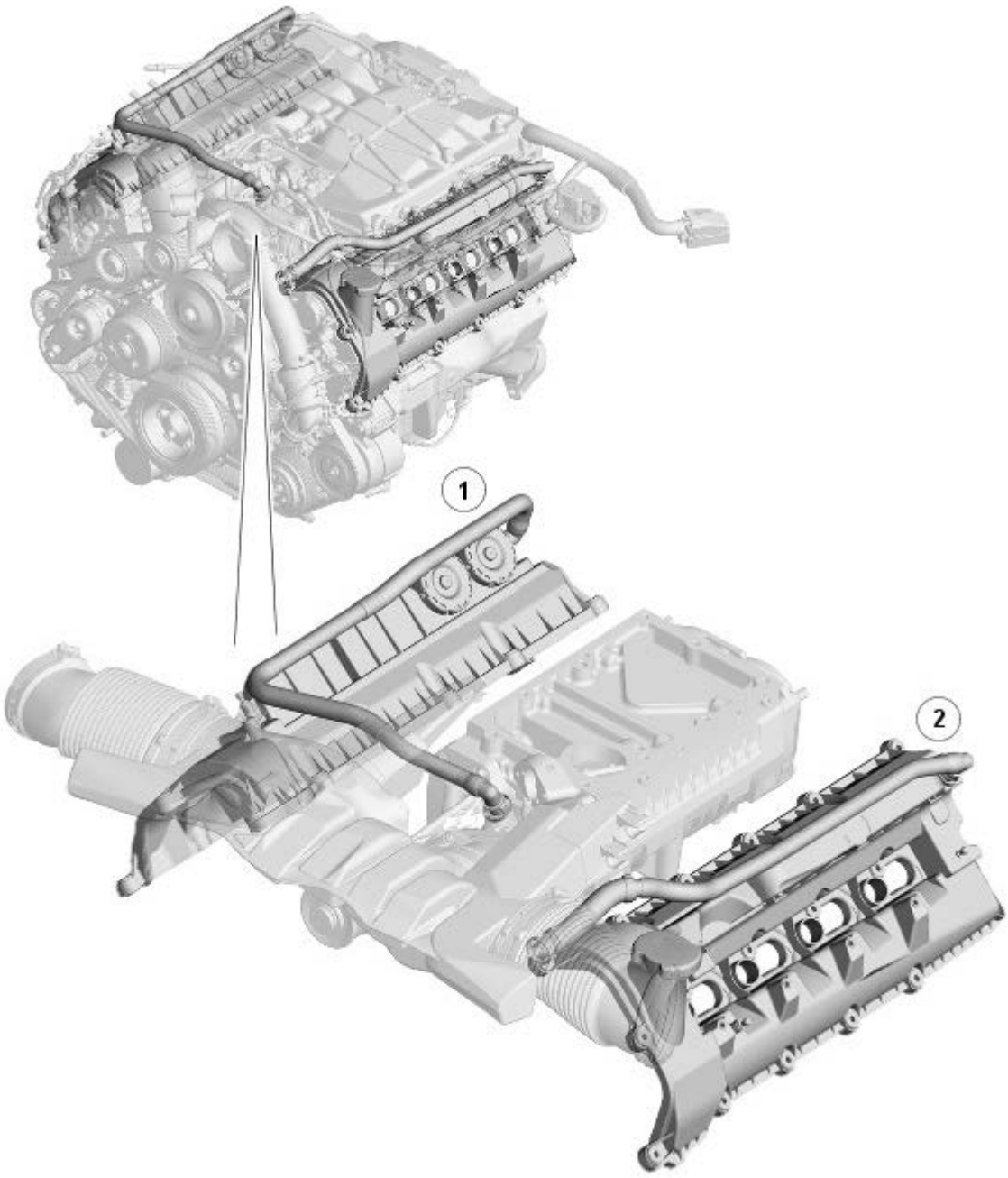
For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.
REFER to: Diagnostic Trouble Code (DTC) Index - V6 S/C 3.0L Petrol , DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation).

Published: 02-May-2013

Engine Emission Control - V8 S/C 5.0L Petrol - Engine Emission Control

Description and Operation

COMPONENT LOCATION



E146645

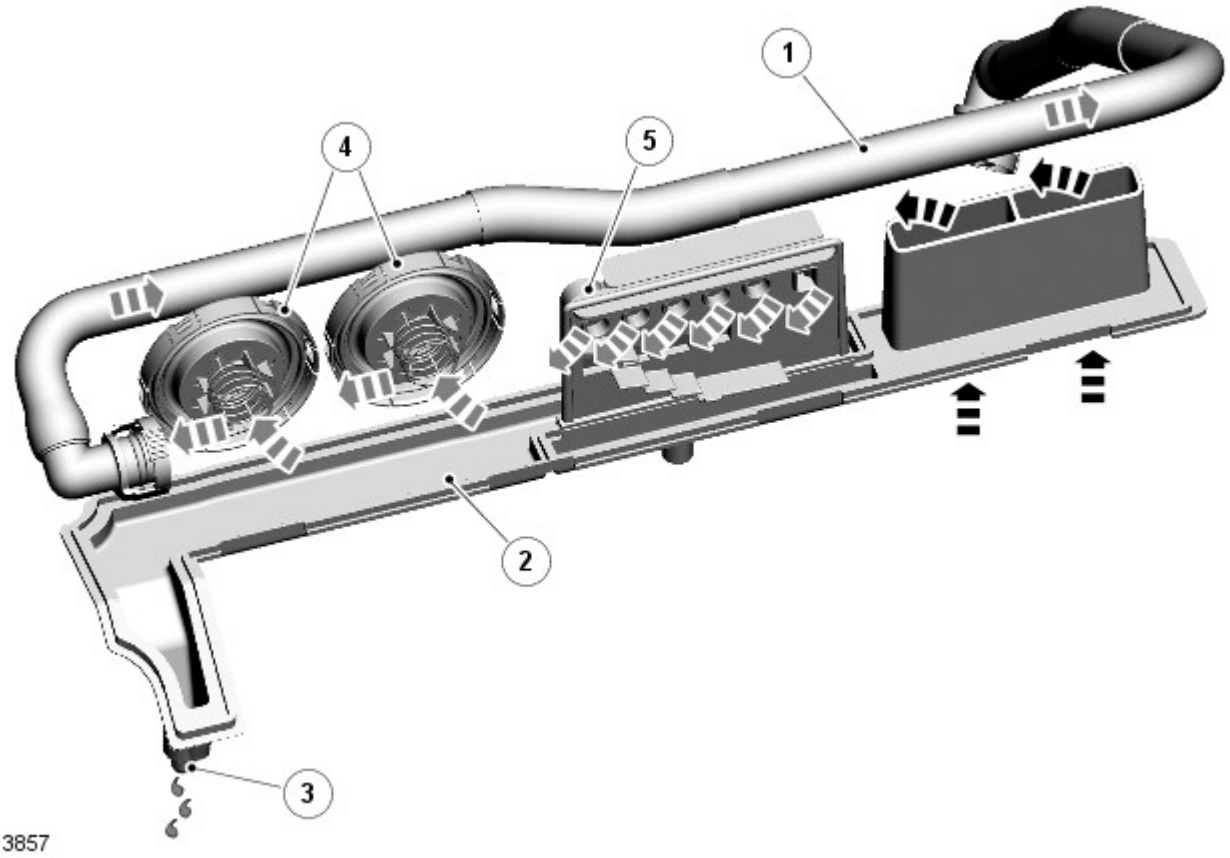
Item	Part Number	Description
1	-	Part load breather
2	-	Full load breather

OVERVIEW

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 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 camshaft covers reduces the load on the joint seals in those areas.

DESCRIPTION

Part Load Breather

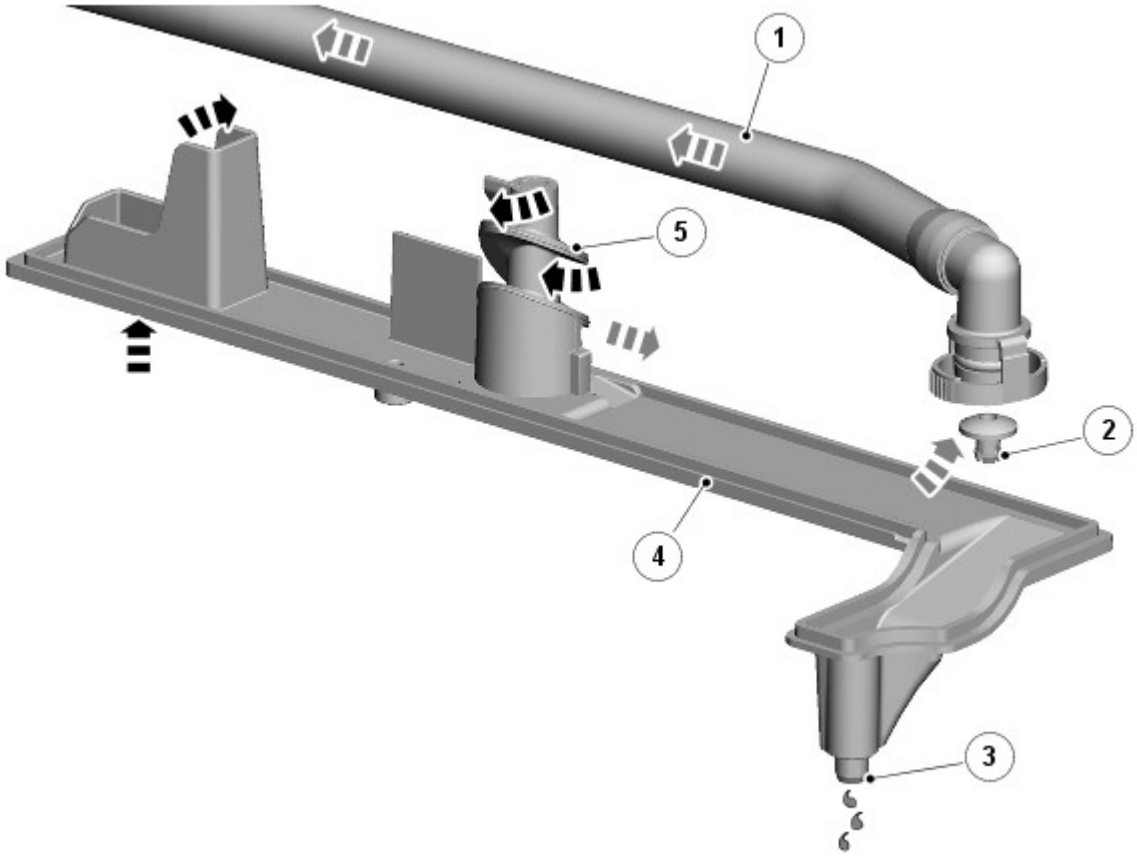


Item	Part Number	Description
1	-	Flexible hose
2	-	Baffle plate
3	-	Oil drain
4	-	Positive crankcase ventilation valves
5	-	Oil separator

The part load breather consists of an oil separator, two Positive Crankcase Ventilation valves and a flexible hose. The oil separator and the Positive Crankcase Ventilation valves are installed in the top of the right camshaft cover. The flexible hose connects the right camshaft cover to the intake of the supercharger.

The oil separator is installed in a channel in the top of the camshaft cover. A baffle plate, which incorporates a gas intake and an oil drain, is installed over the channel. The two Positive Crankcase Ventilation valves are integrated into the camshaft cover and connected in parallel in the gas outlet from the channel to the flexible hose. The Positive Crankcase Ventilation valves regulate the crankcase pressure.

Full Load Breather



E113867

Item	Part Number	Description
1	-	Flexible hose
2	-	Check valve
3	-	Oil drain
4	-	Baffle plate
5	-	Oil separator

The full load breather consists of an oil separator, a check valve and a flexible hose. The oil separator and the check valve are installed in the top of the left camshaft cover. The flexible hose connects the left camshaft cover to the clean air duct of the intake air distribution and filtering system.

The oil separator is installed in a channel in the top of the camshaft cover. A baffle plate, which incorporates a gas intake and an oil drain, is installed over the channel. The check valve is installed in the gas outlet from the channel. The two-way valve regulates fresh air flow and improves idle stability.

Published: 27-Feb-2013

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 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 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 breather hoses • Oil separator	• Fuse(s) • Wiring harness • Loose or corroded electrical connector(s) • Intake manifold tuning (IMT) 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
Engine stops/stalls	• Breather system disconnected/restricted/blocked	Check the engine breather system. Check the oil separator. Check for DTCs indicating a throttle or sensor fault. Rectify as necessary.
Excessive fuel consumption	• Breather system restricted/blocked	
Excessive black smoke		
Excessive emissions		
Excessive blow-by	• Breather system restricted/blocked	Check the engine breather hoses. Check the oil separator. Rectify as necessary.
Engine oil leaks	• Breather system restricted/blocked	Check the engine breather hoses. Check the oil separator. Rectify as necessary.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - V8 S/C 5.0L Petrol, DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation).

Published: 28-Oct-2013

Engine Emission Control - TDV8 4.4L Diesel -

Torque Specifications

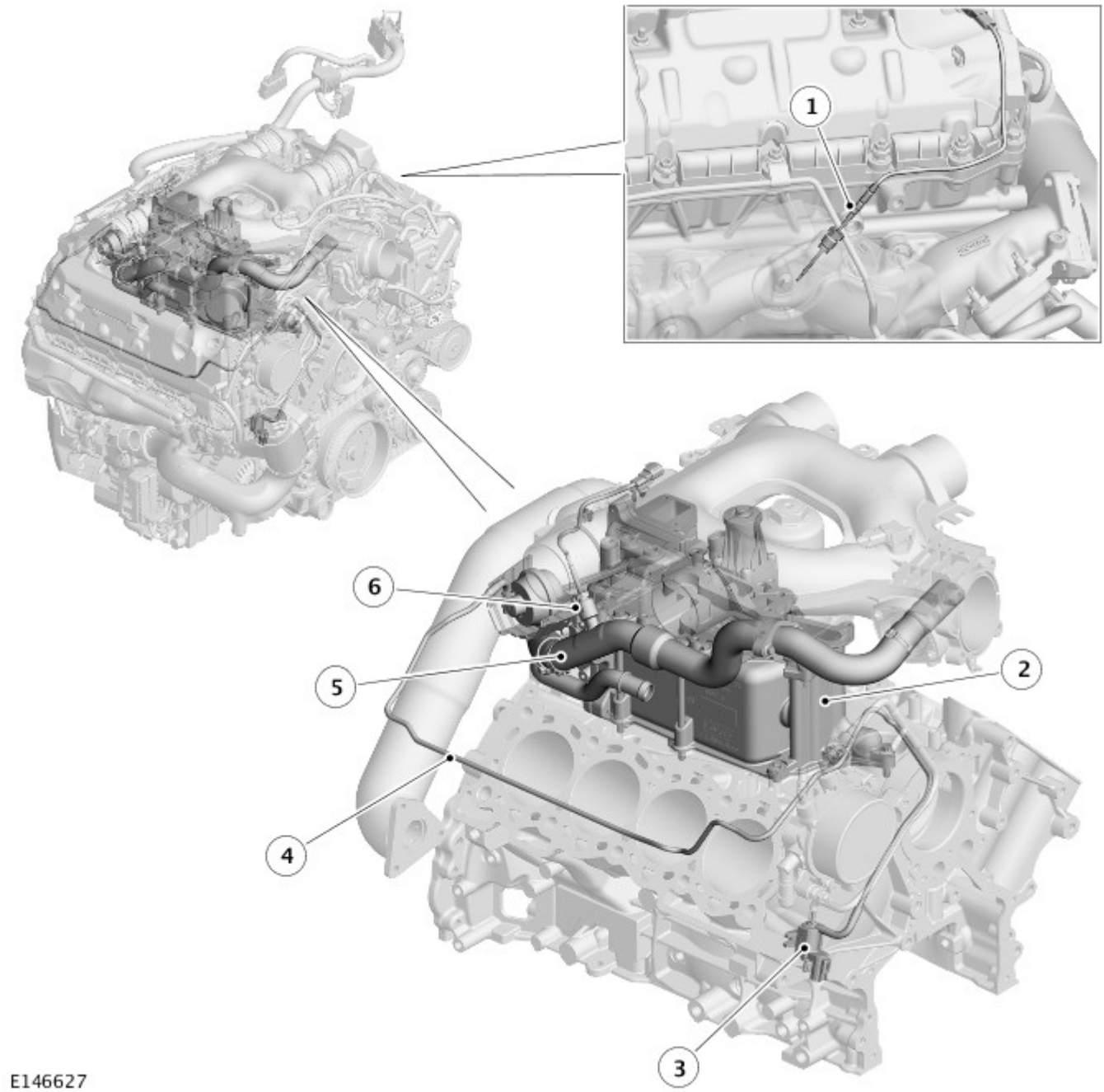
Item	Nm	lb-ft	lb-in
Exhaust gas recirculation (EGR) Assembly to cylinder block bolts	23	17	204
EGR valve inlet tube bolts	10	7	89
EGR valve inlet tube bracket bolt	10	7	89
EGR valve outlet tube bolts	10	7	89
EGR valve to cooler housing bolts	12	9	106
Crankcase vent tube bolts	10	7	89
Crankcase vent separator to EGR assembly bolts	5	-	45

Published: 02-Dec-2013

Engine Emission Control - TDV8 4.4L Diesel - Engine Emission Control

Description and Operation

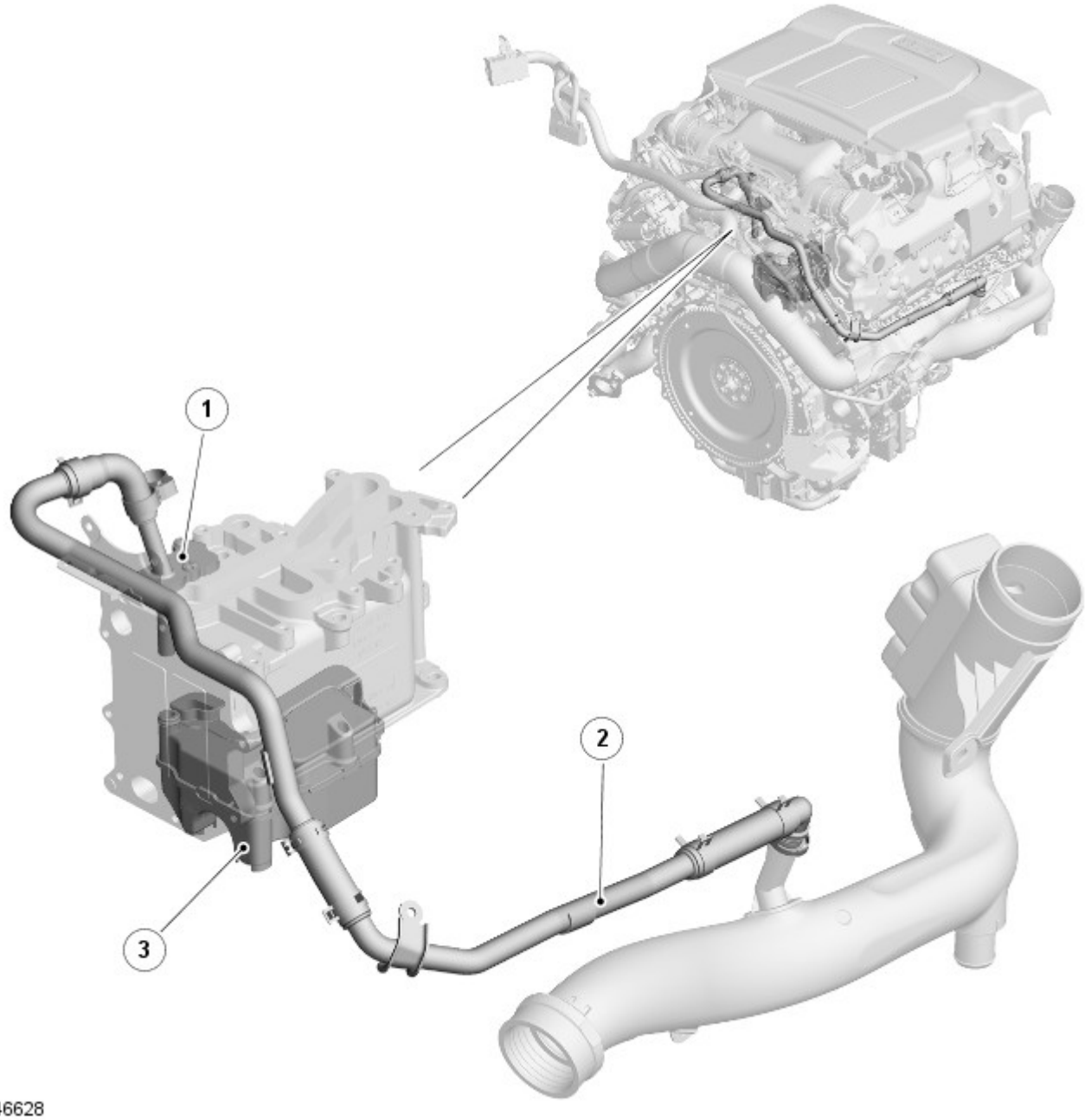
COMPONENT LOCATION - EXHAUST GAS RECIRCULATION



E146627

Item	Part Number	Description
1	-	EGR cooler and valve housing
2	-	EGR bypass valve solenoid
3	-	Vacuum tube
4	-	EGR outlet tube
5	-	EGR outlet temperature sensor

COMPONENT LOCATION - CRANKCASE VENTILATION



E146628

Item	Part Number	Description
1	-	Oil baffle and ventilation cap
2	-	Crankcase ventilation hose and tube assembly
3	-	Oil separator

OVERVIEW

Exhaust Gas Recirculation System

The EGR (Exhaust Gas Recirculation) system is used to control the amount of exhaust gas being recirculated 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 recirculated via the clean air induction system.

DESCRIPTION

Exhaust Gas Recirculation System

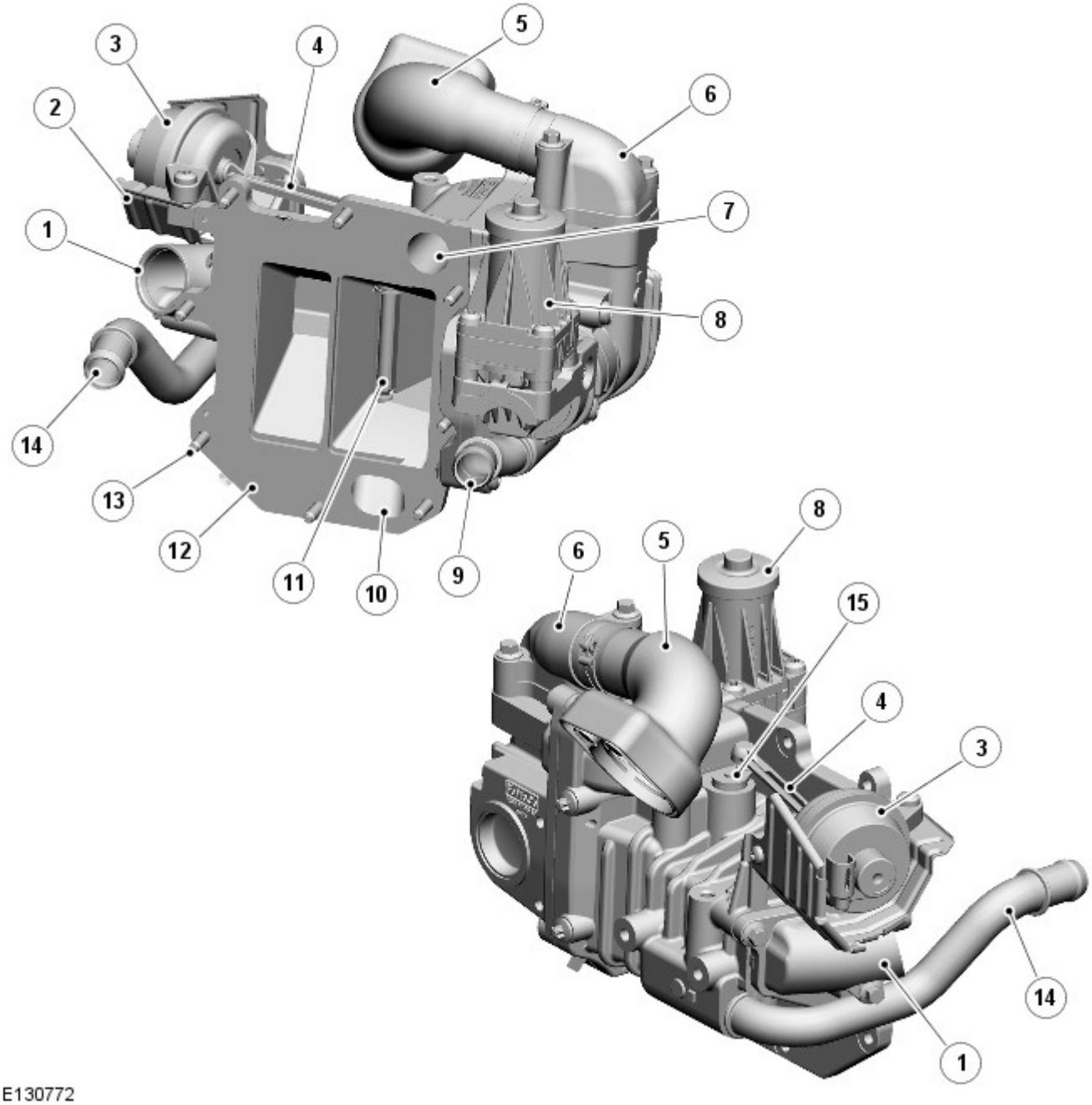
The EGR system comprises an EGR cooler and valve housing assembly, which is attached to the cylinder block between the two cylinder banks. The EGR cooler and valve housing assembly incorporates an EGR valve and motor, an EGR cooler, and a cooler bypass valve and actuator.

The EGR valve housing is connected to the vehicle cooling system, via hoses. The EGR intake pipe is connected to the

exhaust manifold crossover pipe at the rear of the engine. The exhaust gas passes through the cooler and is expelled through EGR outlet pipe into the intake manifold.

The EGR valve motor is a DC (Direct Current) stepper motor with integral position sensor, which is controlled by the ECM (Engine Control Module). The ECM uses the EGR valve motor to control the amount of exhaust gas being recirculated in order to reduce exhaust emissions and combustion noise. The EGR is enabled when the engine is at normal operating temperature and can operate at engine idle or under all part load operating conditions, in both the transient and steady states. EGR only operates in mono turbocharger mode and is shut-off before bi-turbocharger mode is initiated.

EXHAUST GAS RECIRCULATION VALVE HOUSING



E130772

Item	Part Number	Description
1	-	EGR outlet pipe connection
2	-	Heat shield
3	-	EGR vacuum actuator
4	-	Actuator rod
5	-	EGR intake pipe
6	-	EGR valve housing
7	-	Coolant gallery
8	-	EGR valve motor
9	-	EGR cooler engine coolant outlet
10	-	Coolant gallery
11	-	Bypass valve

12	-	Gasket
13	-	Attachment screws (8 off)
14	-	EGR engine coolant intake
15	-	Bypass valve actuator arm

The EGR valve housing is attached to the EGR cooler end tank housing. The valve housing is sealed to the end tank housing with a gasket and secured with eight screws.

The EGR valve motor is secured to the valve body with four thorx screws and a gasket. The valve motor has an electrical connector which connects into the engine wiring harness.

The EGR vacuum actuator is attached to the valve housing with two thorx screws. A heat shield is positioned under the actuator to protect it from heat emitted from the EGR outlet pipe. The actuator is connected to the emissions vacuum system and is operated by a vacuum produced by the vacuum pump and controlled by an ECM controlled EGR bypass valve solenoid.

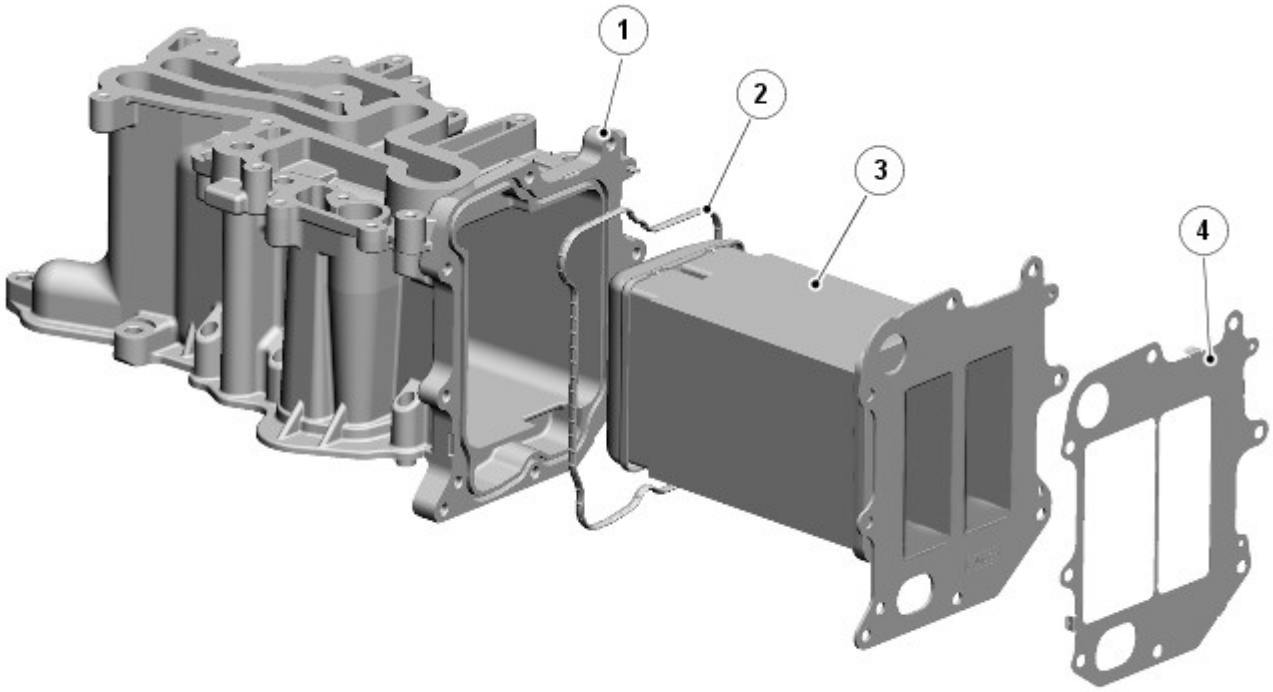
The EGR vacuum actuator is connected to the bypass valve in the valve housing by an actuator rod and arm. Linear movement of the vacuum actuator is passed through the rod to the arm, which converts the movement into rotary movement of the bypass valve. The bypass valve is either open or closed, so all exhaust gasses are either cooled by being directed through the cooler or bypass the cooler and pass directly into the EGR outlet pipe.

The EGR intake pipe is connected to the valve housing with two bolts and sealed with a gasket. The pipe between the valve housing and the crossover pipe connections is fitted with an insulating sock to reduce heat emissions from the pipe. The intake pipe is attached to the crossover pipe between the two exhaust manifolds and is secured with a clamp.

Exhaust gasses exit the valve housing via an EGR outlet pipe which connects into the intake manifold.

Two pipes allow for the connection of hoses from the engine cooling system. The two pipes allow for the engine coolant to flow into the valve housing, around the EGR cooler and out through the valve housing and back into the engine cooling system.

EXHAUST GAS RECIRCULATION COOLER



E130773

Item	Part Number	Description
1	-	End tank housing
2	-	Seal
3	-	End tank cooler
4	-	Gasket

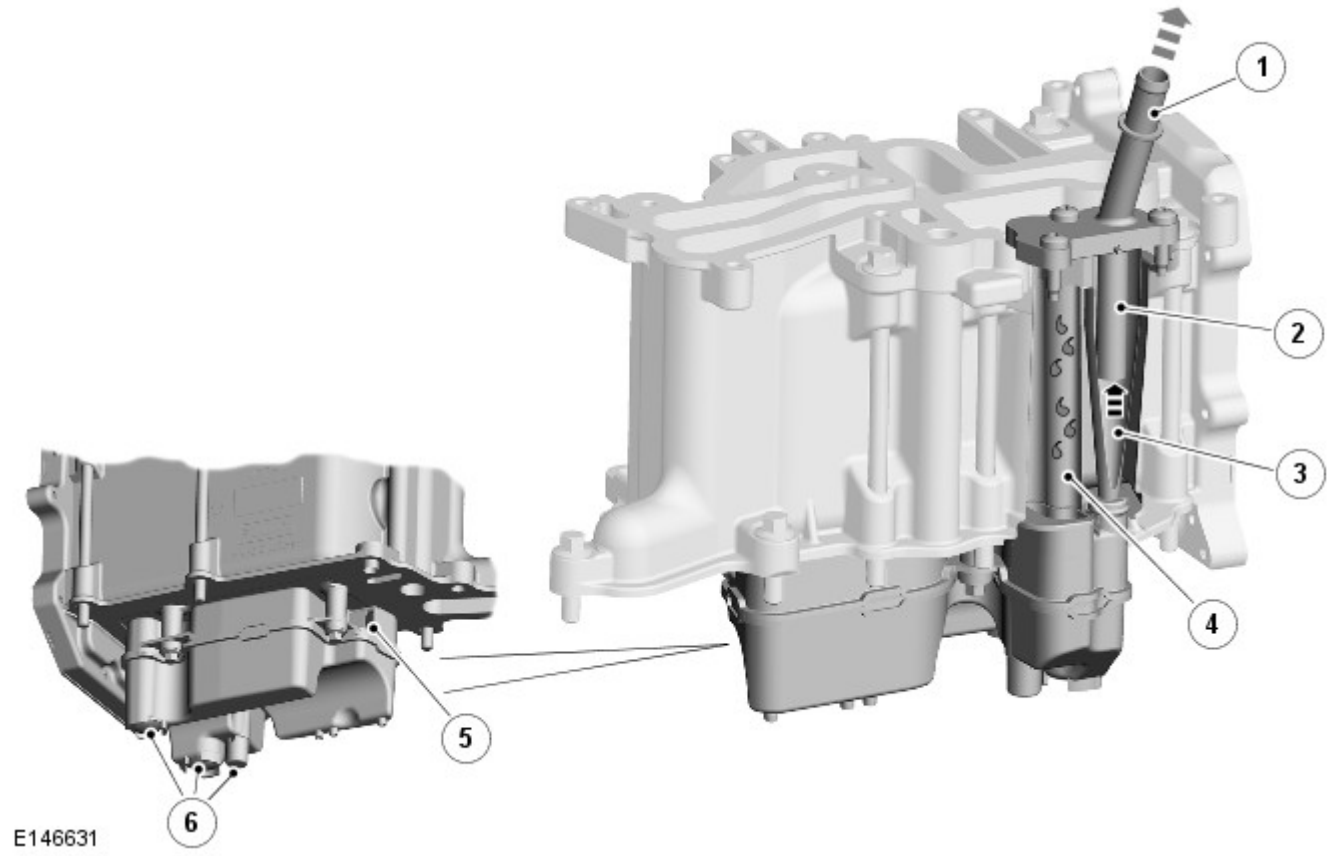
The EGR cooler assembly is located on the top of the engine and secured to the crankcase with nine bolts. A gasket between the end tank housing and the crankcase prevents oil leakage. Three threaded bosses on the base of the end tank housing provide for the attachment of the crankcase ventilation oil separator. The hole which passes through the end tank housing allows for the crankcase ventilation tube location and connection with the oil separator. The top face of the end tank housing provides the location for the engine oil filter and cooler assembly.

The end tank housing has eight threaded holes which allow for the attachment of the EGR valve housing. A gasket in the end tank housing seals the joint between the housing and the end tank cooler. A gasket seals the joint between the end

tank cooler and the valve housing.

Two holes in the end tank cooler allow engine coolant from the thermostat housing to pass from the valve housing, circulate around the void between the end tank housing and the end tank cooler, then return to the valve housing before being passed back to the thermostat housing.

Crankcase Ventilation



Item	Part Number	Description
1	-	Ventilation cap
2	-	Oil baffle
3	-	Gas outlet channel
4	-	Oil drain channel
5	-	Gas intake
6	-	Oil drain valves

The crankcase ventilation system comprises an oil separator and a ventilation tube and hose assembly.

The oil separator is attached to the base of the EGR cooler, between the two banks of the cylinder block. An opening in the side of the oil separator provides an intake for gasses from the crankcase. Drain valves in the base of the oil separator provide outlets for the oil. Two spigots on top of the oil separator locate in a gas outlet channel and an oil drain channel in the base of the EGR cooler. The other end of the channels are fitted with an oil baffle and ventilation cap. The ventilation tube and hose assembly is connected between the ventilation cap and the intake duct of the primary turbocharger.

OPERATION

Exhaust Gas Recirculation System

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 NOx (oxides of nitrogen), a noxious class of pollutants associated with acid rain. This is a particular problem for diesel engines at low to medium loads. 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.

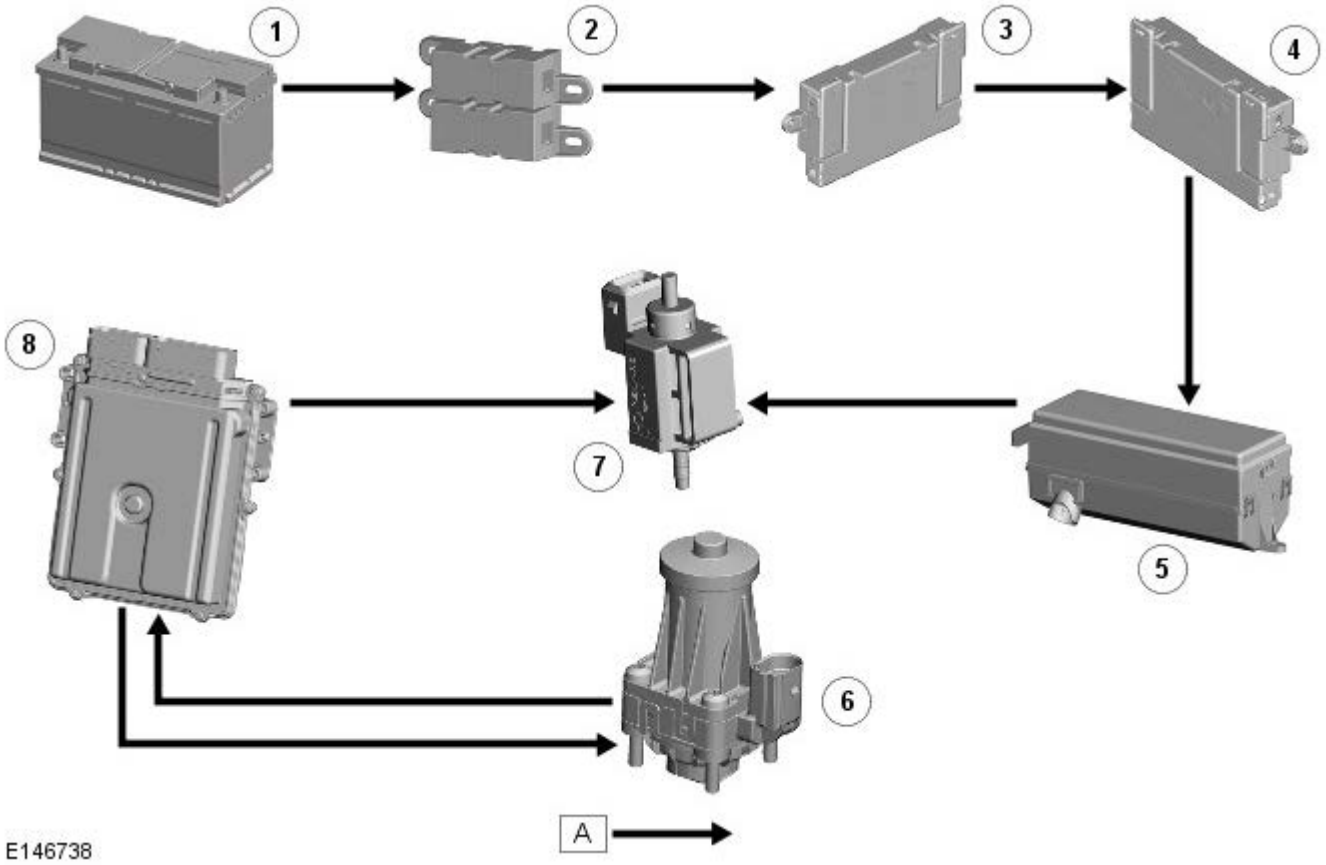
At low engine speeds and loads, over 50 percent of the cylinder charge can be made up of recycled exhaust gas. This is routed from the exhaust manifolds through the EGR coolers before being supplied to the electric throttle. The volume of exhaust gas added to the intake charge is regulated by the EGR valves, actuated according to precise engine speed and load maps by the ECM.

Crankcase Ventilation

Clean air being drawn into the primary turbocharger when the engine is running creates a vacuum in the ventilation tube and hose assembly. This vacuum in turn creates a vacuum in the oil separator and draws gasses from the crankcase into

the separator. The gasses pass through the oil separator, where oil particles separate from the gasses. The gasses are then drawn through the gas outlet channel in the EGR cooler, where the oil baffle removes any remaining oil particles, which drain back into the oil separator. The gasses then pass through the ventilation tube and hose assembly to the clean air duct, and are mixed with the clean air being drawn into the turbocharger. The oil drains out of the oil separator through the drain valves, and down through the cylinder block into the oil pan.

Control Diagram



A = Hardwired.

Item	Part Number	Description
1	-	Battery
2	-	Battery Junction Box 2 (BJB2)
3	-	Battery Junction Box (BJB)
4	-	Auxiliary Junction Box (AJB)
5	-	Engine Junction Box (EJB)
6	-	EGR bypass valve solenoid
7	-	EGR valve motor
8	-	Engine Control Module (ECM)

Published: 11-May-2011

Engine Emission Control - TDV8 4.4L Diesel - Engine Emission Control

Diagnosis and Testing

Principles of Operation

For a detailed description of the engine emission 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.

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
• Engine breather hoses • Oil separator • Exhaust gas recirculation (EGR) pipes (check for cracks) • EGR valve(s) • EGR cooler(s)	• Fuse(s) • Wiring harness • Loose or corroded electrical connector(s) • Intake manifold tuning (IMT) valve • 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	• EGR valve(s) stuck open	Check the EGR valve and circuits. Refer to the electrical guides. Check the mechanical condition of the EGR valves. Rectify as necessary.
Engine stops/stalls	• EGR valve(s) stuck open • Breather system disconnected/restricted/blocked	Check the EGR valve and circuits. Refer to the electrical guides. Check the mechanical condition of the EGR valves. Check the engine breather system. Check the oil separator. REFER to: Crankcase Vent Oil Separator (303-08D Engine Emission Control - TDV8 4.4L Diesel, Removal and Installation). Check for DTCs indicating an EGR valve, throttle or sensor fault. Rectify as necessary.
Excessive fuel consumption Excessive black smoke Excessive emissions	• EGR valve(s) stuck open • EGR not operating • Breather system restricted/blocked	
Excessive blow-by	• Breather system restricted/blocked	Check the engine breather hoses. Check the oil separator. REFER to: Crankcase Vent Oil Separator (303-08D Engine Emission Control - TDV8 4.4L Diesel, Removal and Installation). Rectify as necessary.
Engine oil leaks	• Breather system restricted/blocked	Check the engine breather hoses. Check the oil separator. REFER to: Crankcase Vent Oil Separator (303-08D Engine Emission Control - TDV8 4.4L Diesel, Removal and Installation). Rectify as necessary.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - TDV8 4.4L Diesel, DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation).

Published: 24-Oct-2013

Engine Emission Control - TDV8 4.4L Diesel - Crankcase Vent Oil Separator

Removal and Installation

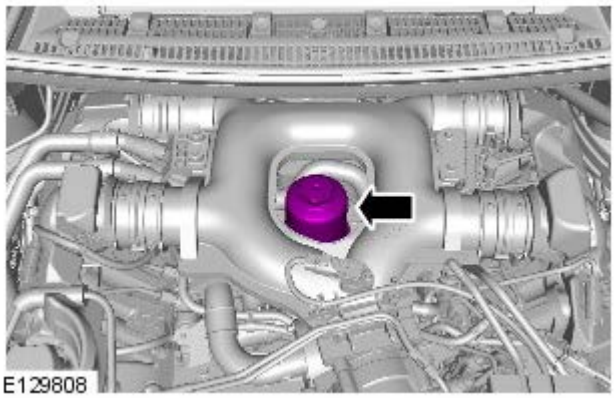
Removal

NOTES:

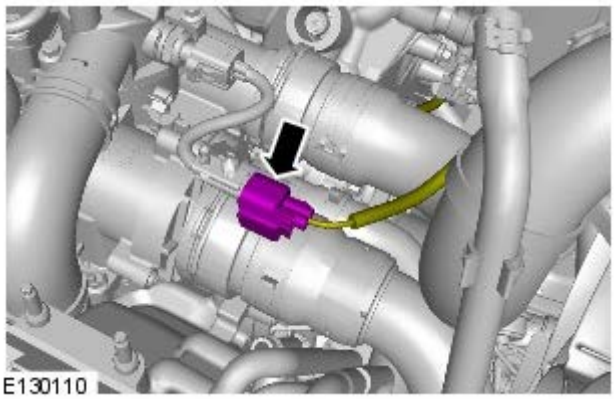
Some variation in the illustrations may occur, but the essential information is always correct.

Engine shown removed for clarity.

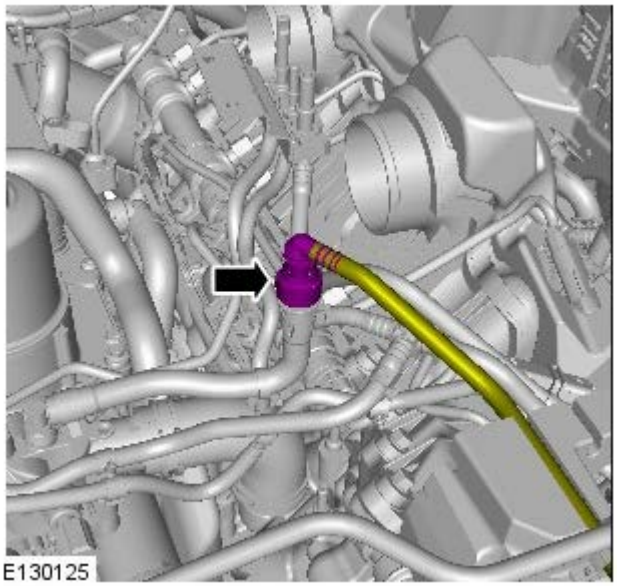
1. Refer to: Fuel Rail RH (303-04E Fuel Charging and Controls - TDV8 4.4L Diesel, Removal and Installation).


E129808

2.
   - Loosen the oil filter cover 3 turns and allow the engine oil to drain.


E130110

3.

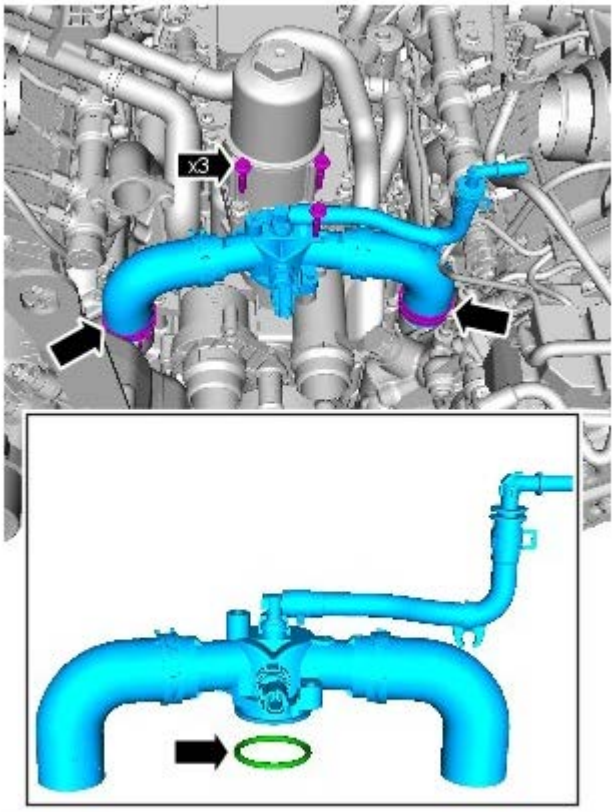

E130125

4. CAUTIONS:

   Be prepared to collect escaping coolant.

   Make sure that all openings are sealed. Use new blanking caps.

5. CAUTIONS:

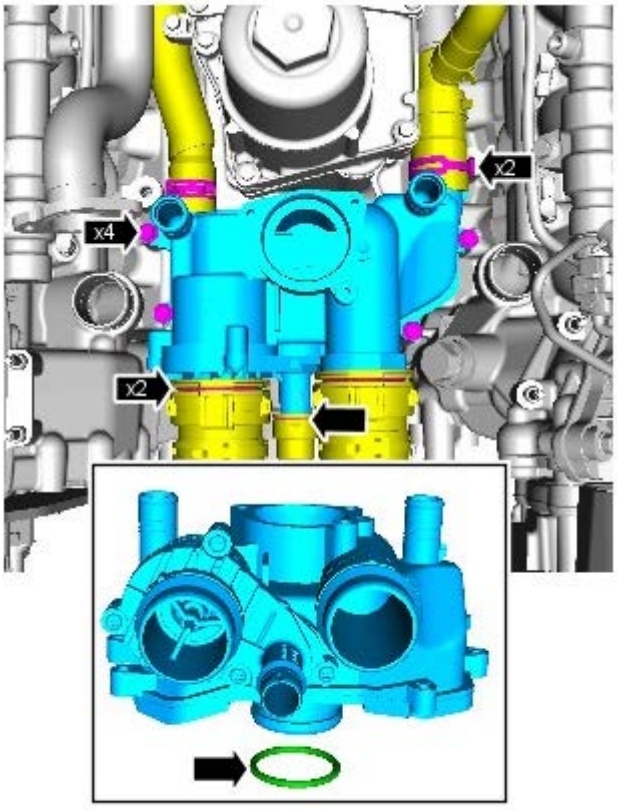


E145026

Be prepared to collect escaping coolant.

Make sure that all openings are sealed. Use new blanking caps.

NOTE: Remove and discard the O-ring seal.



E145027

6. CAUTIONS:

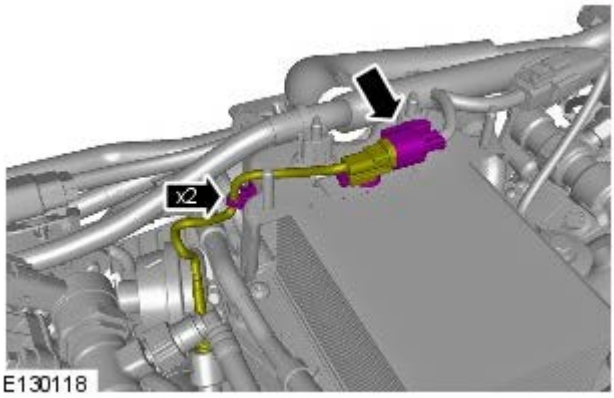
Clamp the hoses to minimize coolant loss.

Be prepared to collect escaping coolant.

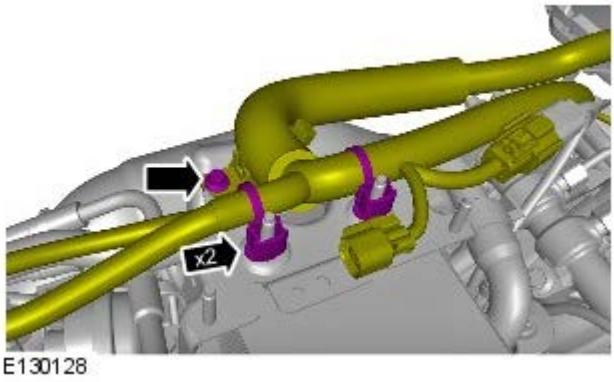
Make sure that all openings are sealed. Use new blanking caps.

NOTE: Remove and discard the O-ring seal.

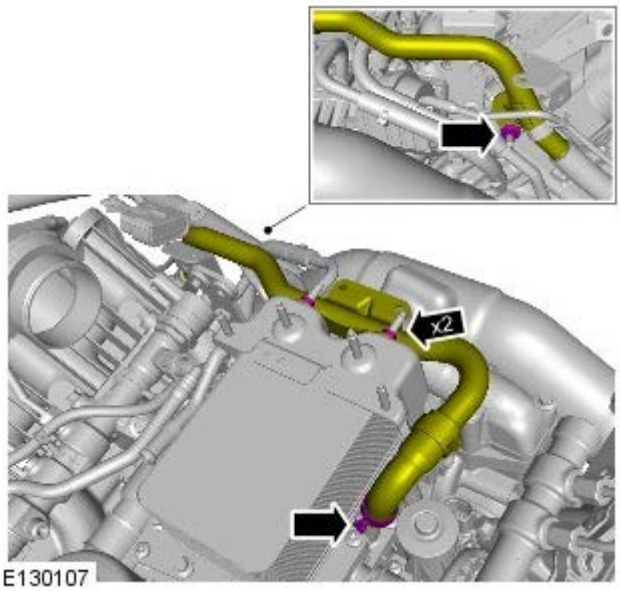
7.



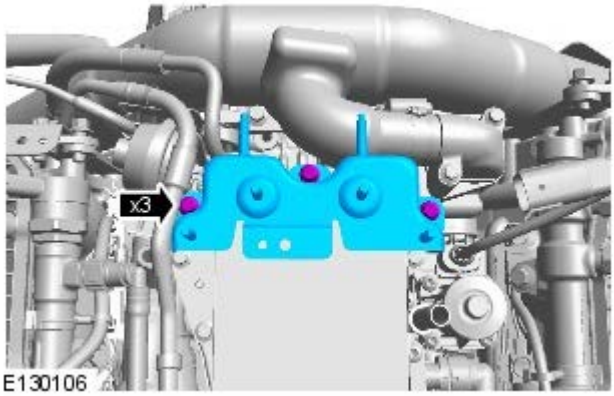
8.



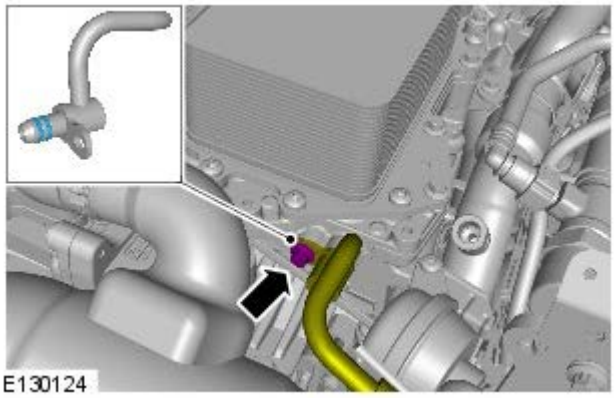
9. CAUTION: Make sure that all openings are sealed. Use new blanking caps.



10.



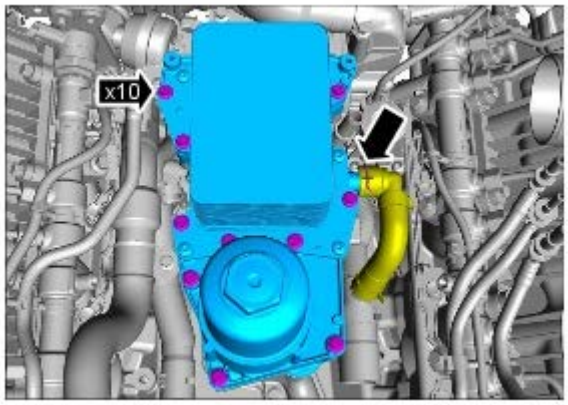
11. CAUTIONS:



Be prepared to collect escaping oil.

Make sure that all openings are sealed. Use new blanking caps.

Inspect the O-rings, replace if damaged.

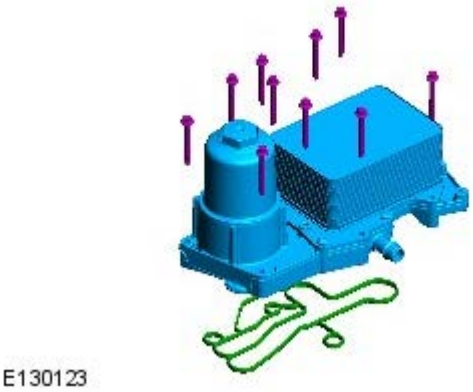


12. CAUTIONS:

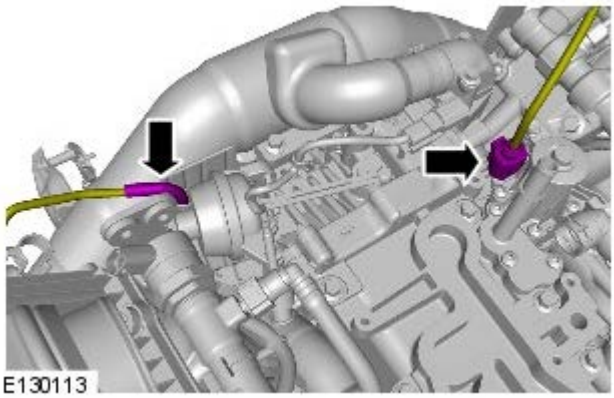
Be prepared to collect escaping oil.

Be prepared to collect escaping coolant.

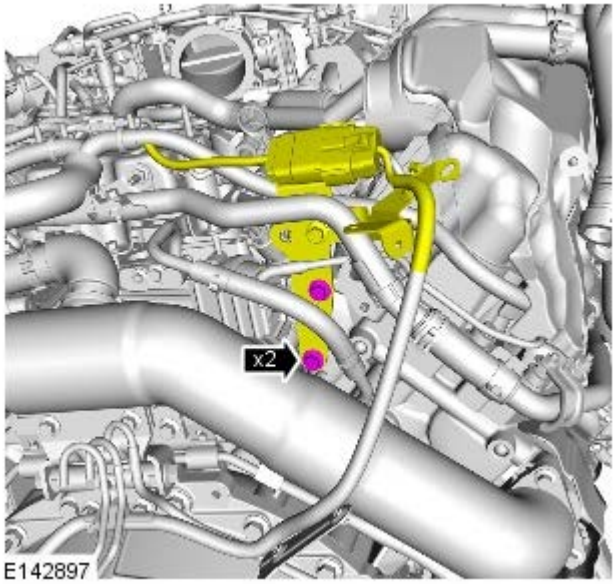
NOTE: Remove and discard the gasket.



13.



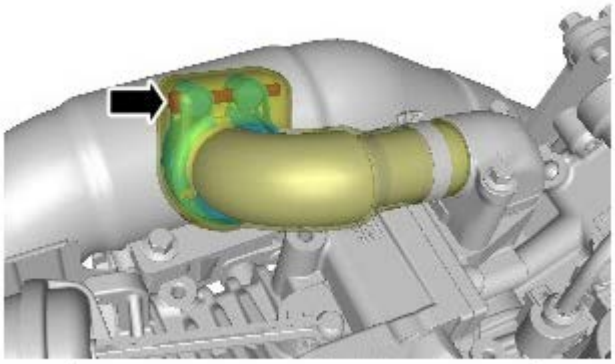
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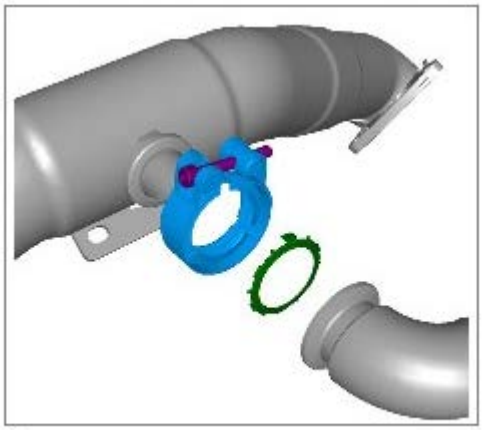


E142897

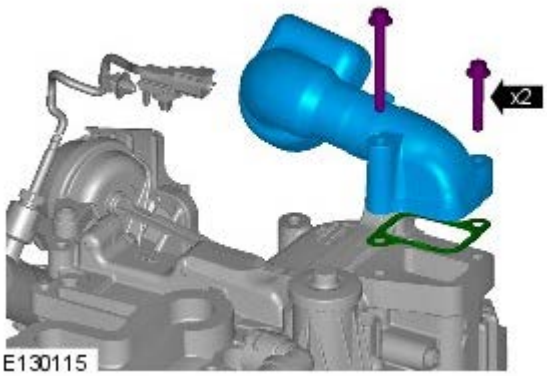
15. CAUTION: Make sure that all openings are sealed. Use new blanking caps.

NOTE: Remove and discard the gasket.



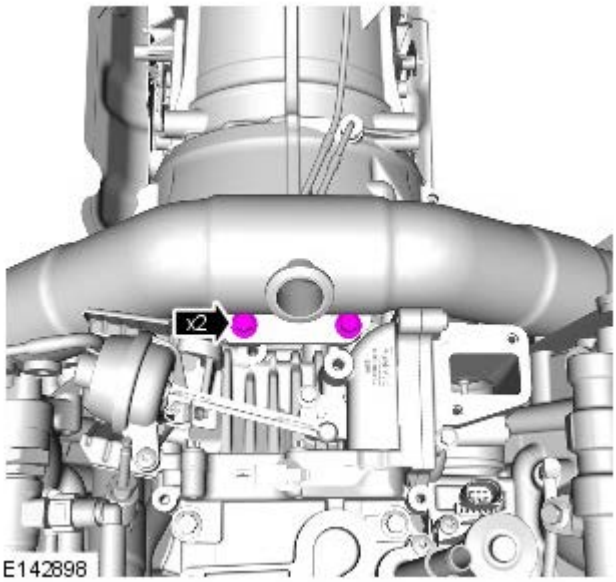

E130116

16. NOTE: Remove and discard the gasket.

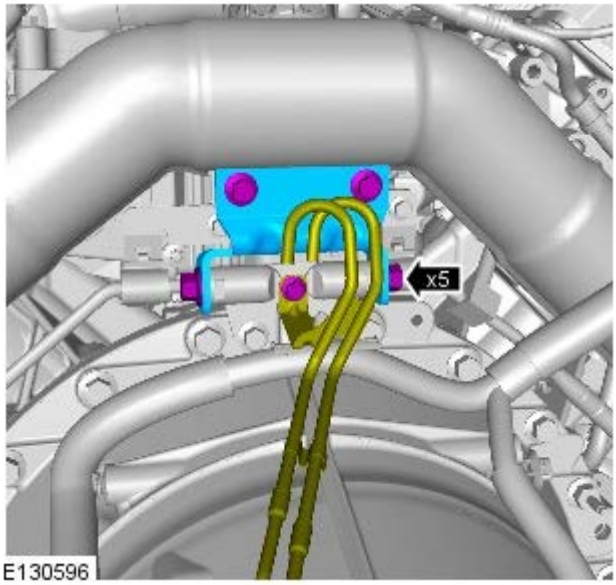


E130115

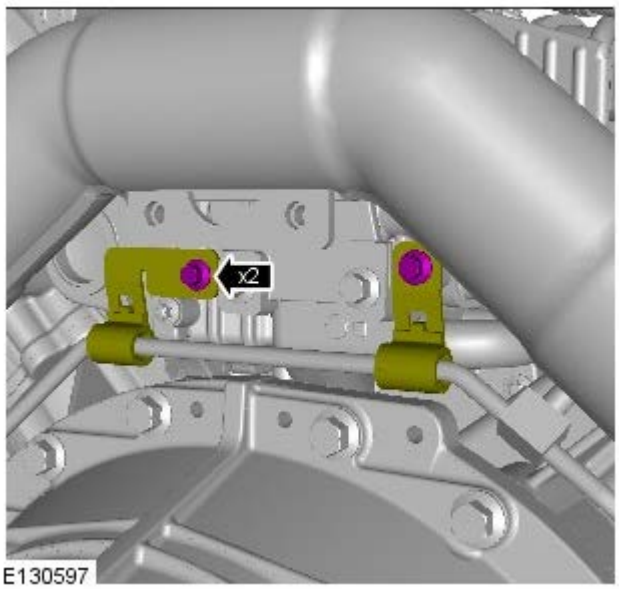
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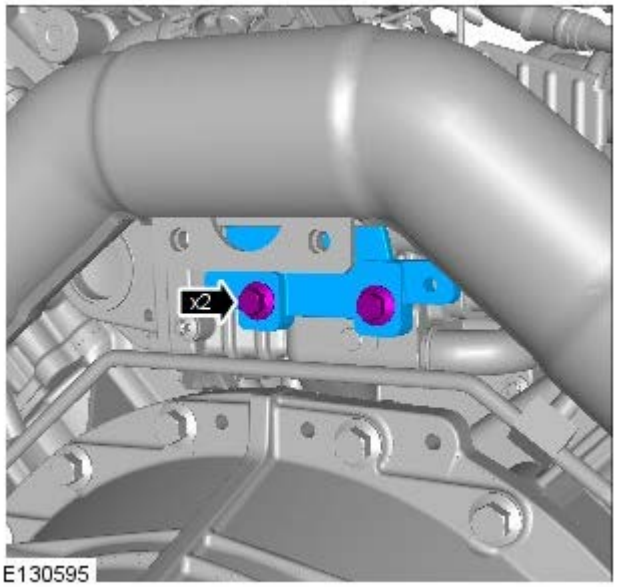
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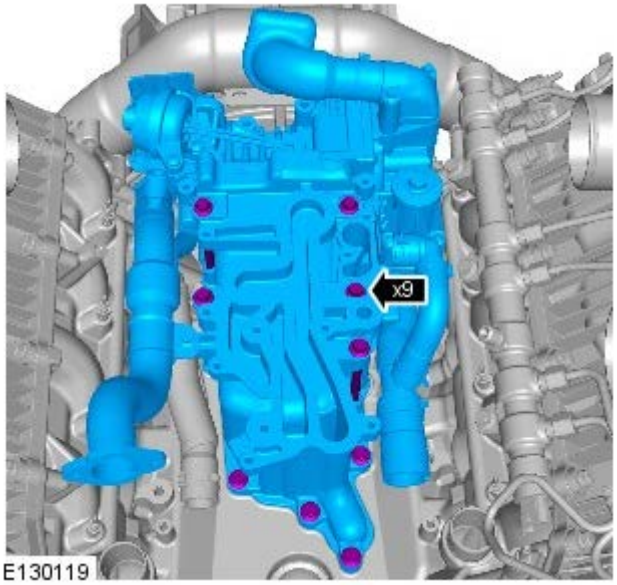


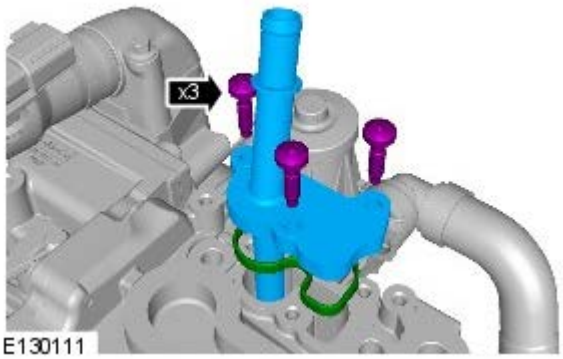
19.



20.







21. CAUTIONS:

Be prepared to collect escaping oil.

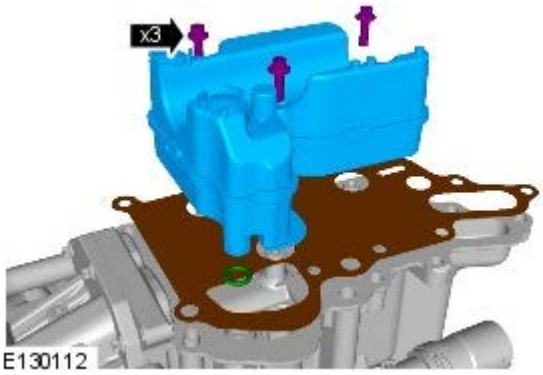
Be prepared to collect escaping coolant.

22. CAUTION: Inspect the seal, replace if damaged.

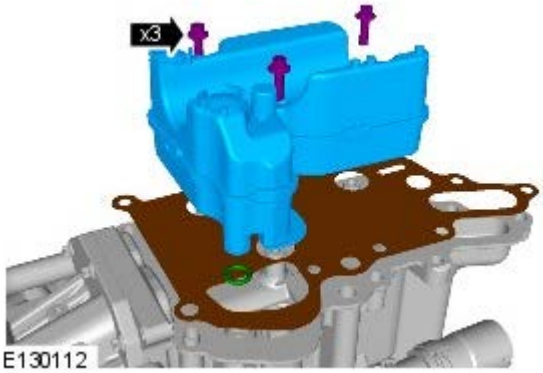
Do not disassemble further if removed for access only

23. CAUTION: Inspect the seal, replace if damaged

NOTE: Remove and discard the gasket.



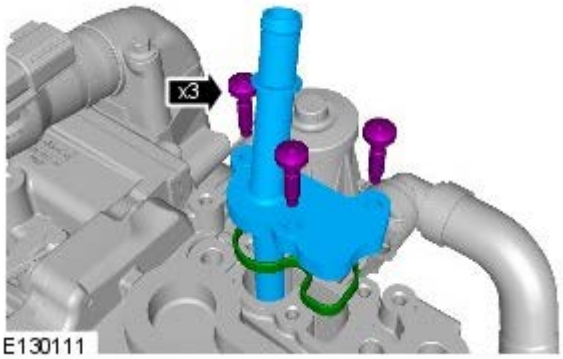
Installation



1. CAUTION: Make sure that the mating faces are clean and free of corrosion and foreign material.

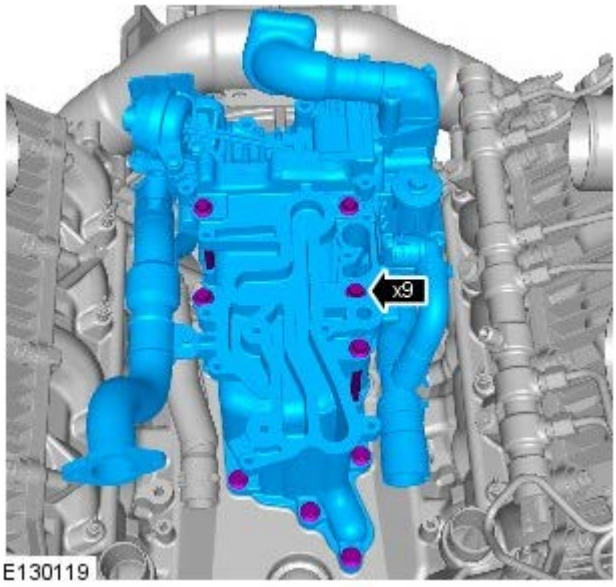
   NOTE: Install a new gasket.

   Torque: 5 Nm



2. CAUTION: Make sure that the mating faces are clean and free of corrosion and foreign material.

   Torque: 10 Nm



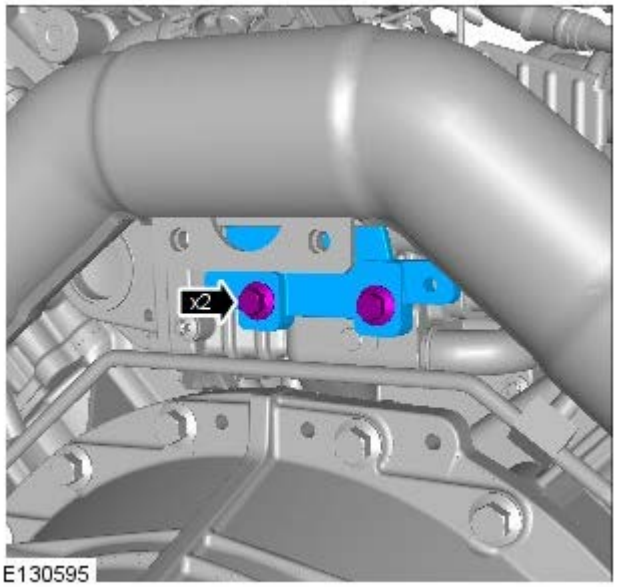
3. CAUTIONS:

   Make sure that the mating faces are clean and free of corrosion and foreign material.

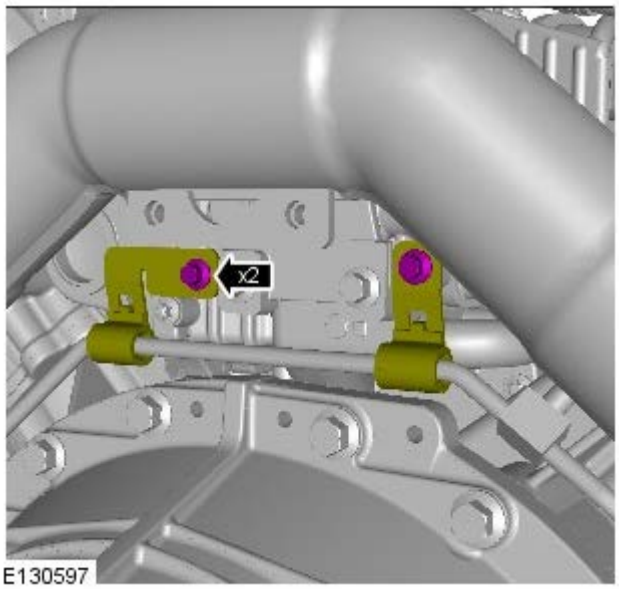
   Install all the bolts finger tight before final tightening.

   Torque: 23 Nm

4. *Torque:* 23 Nm

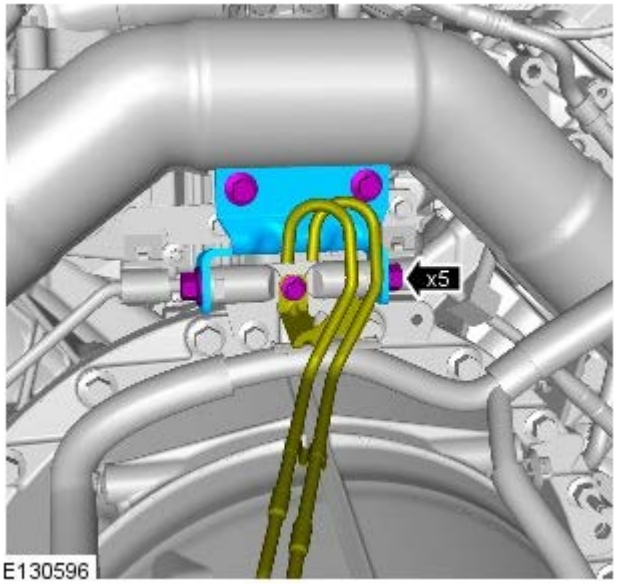


5. *Torque:* 10 Nm

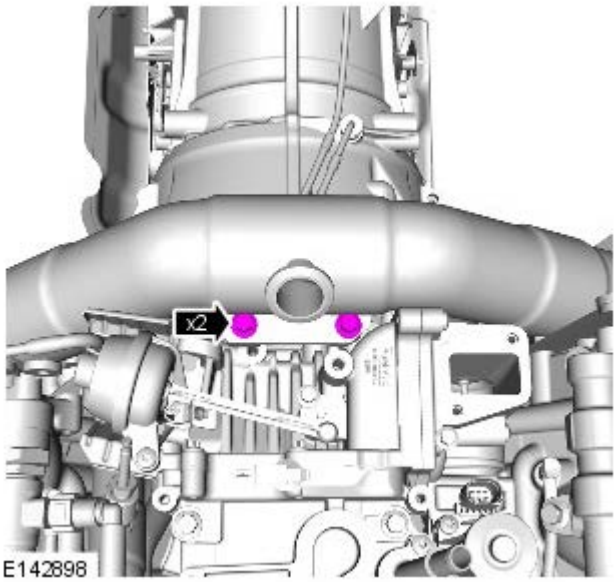


6. CAUTION: Install all the bolts finger tight before final tightening.

Torque:
M8 23 Nm
M6 10 Nm

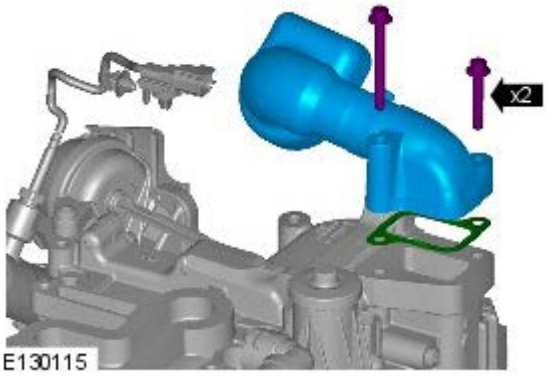


7. *Torque:* 23 Nm



8. NOTE: Install a new gasket.

   Torque: 10 Nm

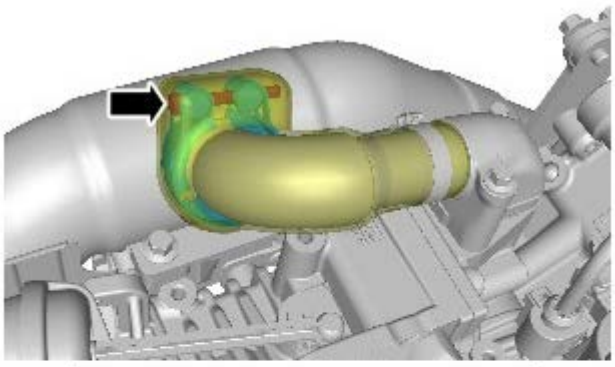


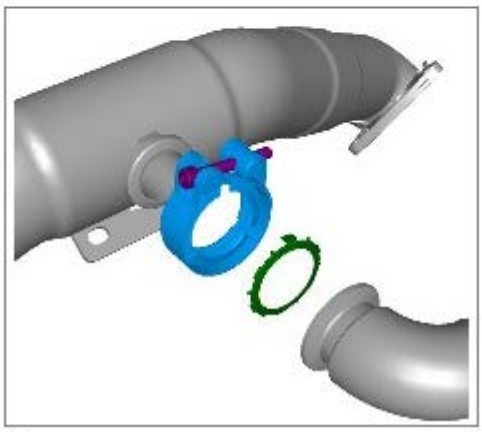
9. NOTES:

   Remove and discard the blanking caps.

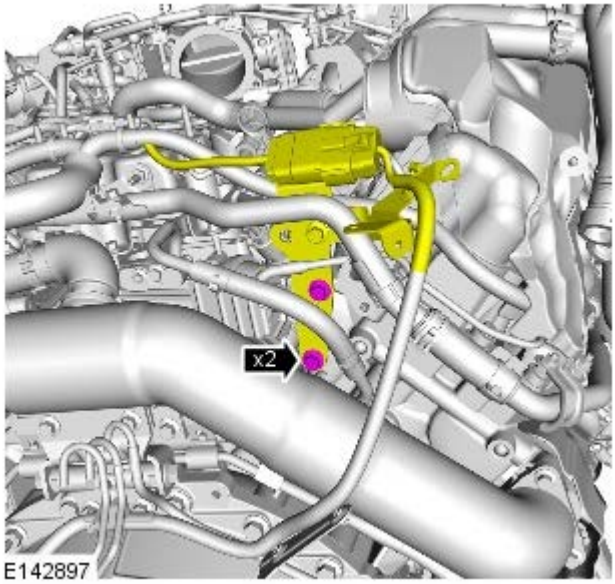
   Install a new gasket.

   Torque: 7 Nm

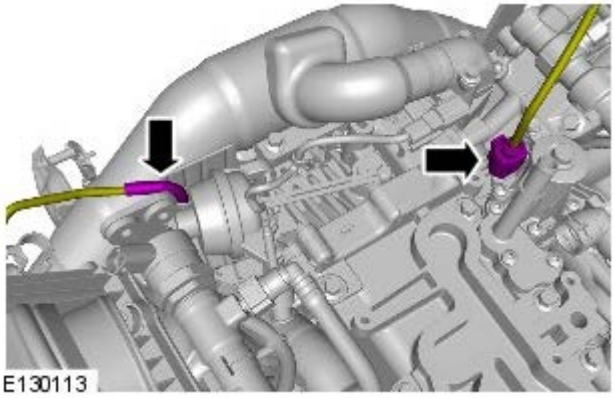


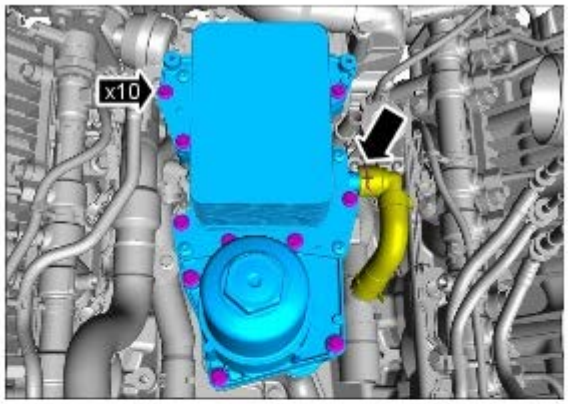


10. *Torque:* 25 Nm



11.





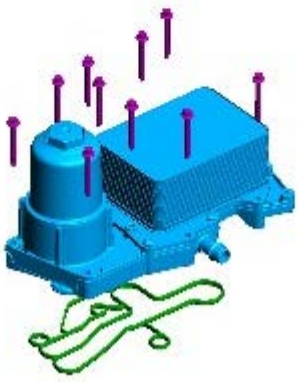
12. CAUTIONS:

Make sure that the surface is clean and free of foreign material.

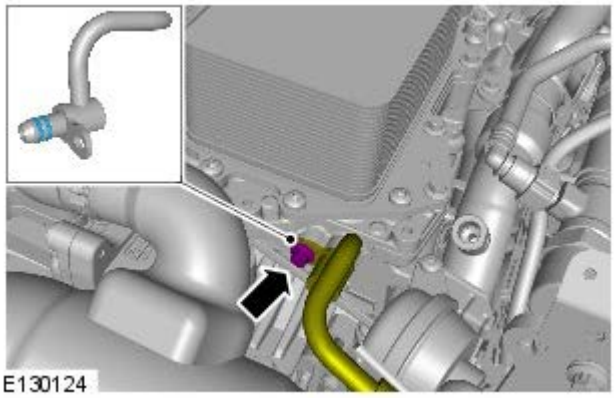
Install all the bolts finger tight before final tightening.

NOTE: Install a new gasket.

Torque: 13 Nm

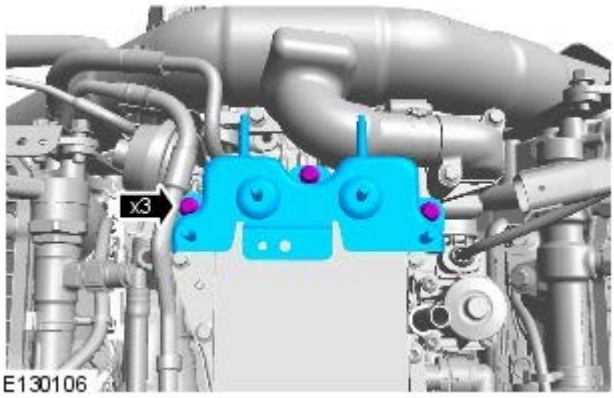


13. CAUTION: Make sure that the mating faces are clean and free of corrosion and foreign material.



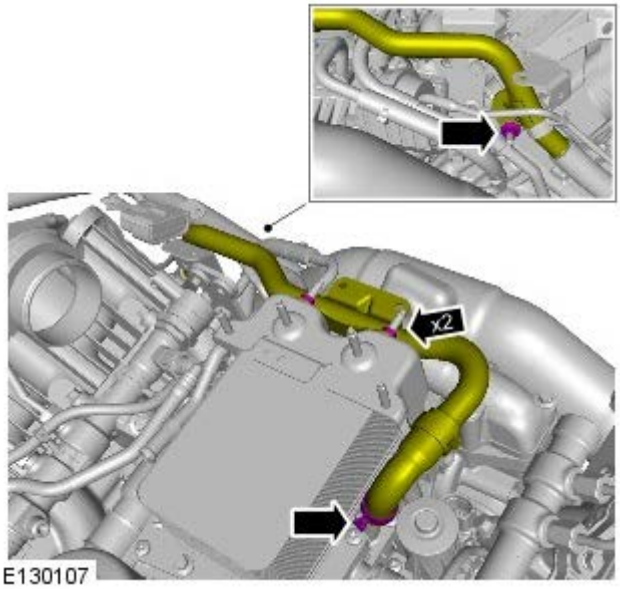
NOTE: Remove and discard the blanking caps.

Torque: 10 Nm



14. CAUTION: Install all the bolts finger tight before final tightening.

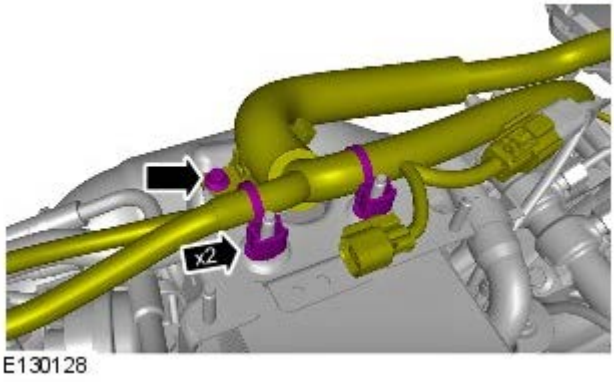
Torque: 10 Nm



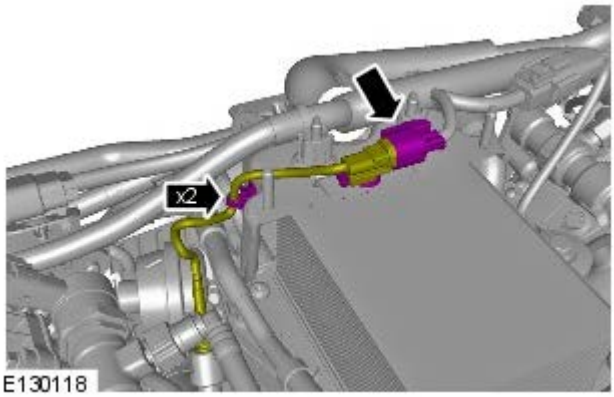
15. NOTE: Remove and discard the blanking caps.

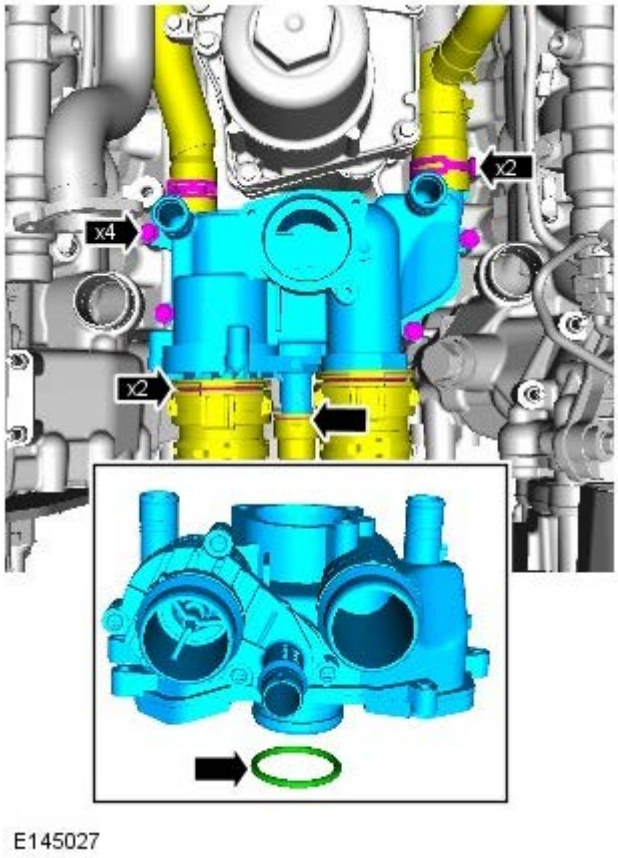
Torque: 10 Nm

16. *Torque:* 10 Nm



17.





18. CAUTION: Install all the bolts finger tight before final tightening.

NOTES:

Remove and discard the blanking caps.

Install a new O-ring seal.

Torque: 10 Nm

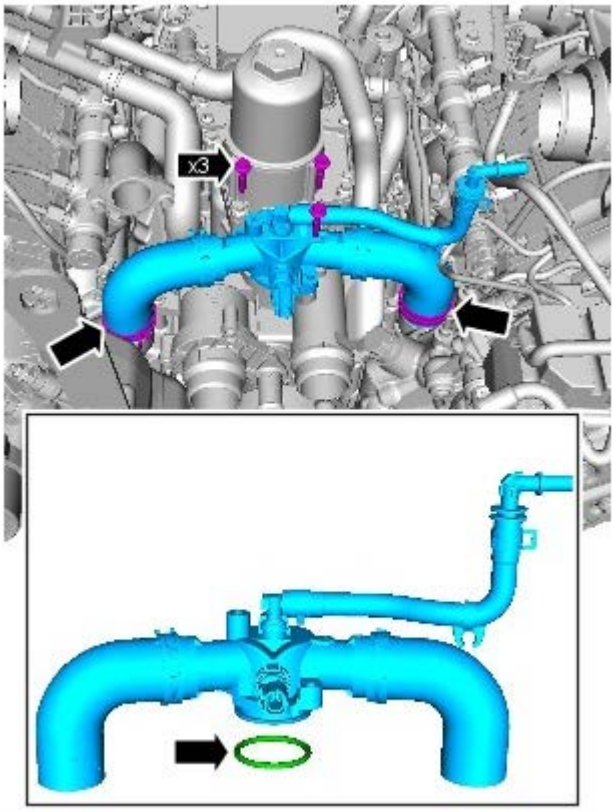
19. CAUTION: Install all the bolts finger tight before final tightening.

NOTES:

Remove and discard the blanking caps.

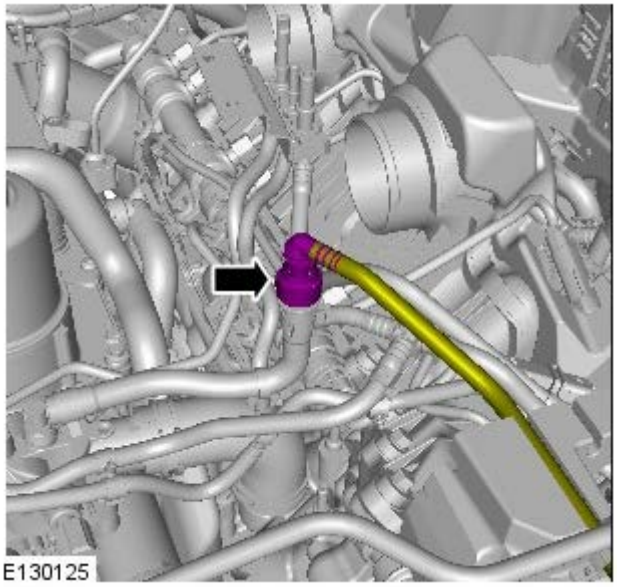
Install a new O-ring seal.

Torque: 10 Nm



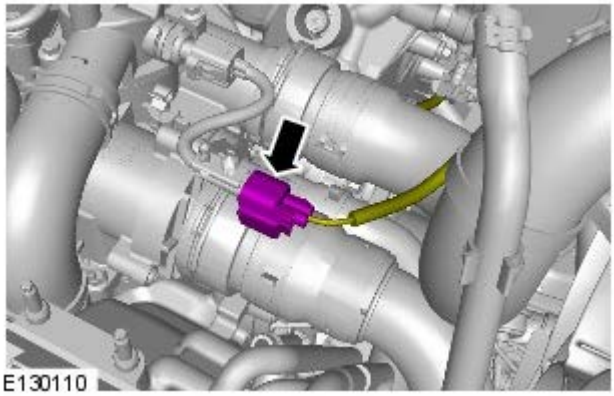
E145026

20. NOTE: Remove and discard the blanking caps.



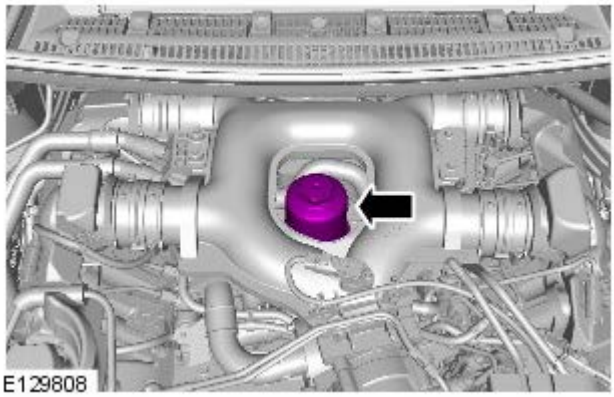
E130125

21.



E130110

22. CAUTION: Tighten the component finger tight first.



Torque: 35 Nm

23. Refer to: Fuel Rail RH (303-04E Fuel Charging and Controls - TDV8 4.4L Diesel, Removal and Installation).

24. Check and top-up the engine oil.

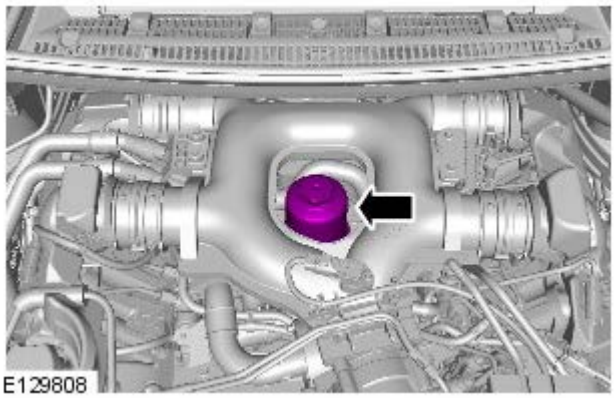
Published: 24-Oct-2013

Engine Emission Control - TDV8 4.4L Diesel - Exhaust Gas Recirculation (EGR) Cooler

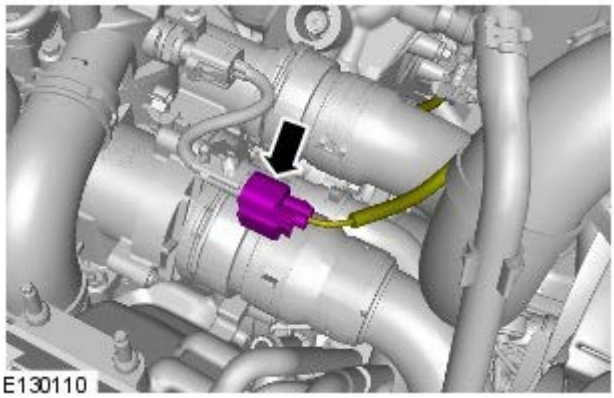
Removal and Installation

Removal

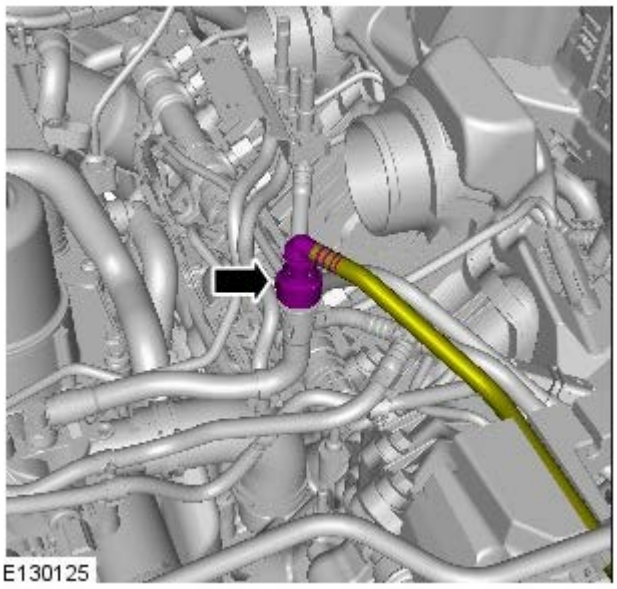
1. Refer to: Fuel Rail RH (303-04E Fuel Charging and Controls - TDV8 4.4L Diesel, Removal and Installation).


E129808

2.
   - Loosen the oil filter cover 3 turns and allow the engine oil to drain.


E130110

3.


E130125

4. CAUTIONS:

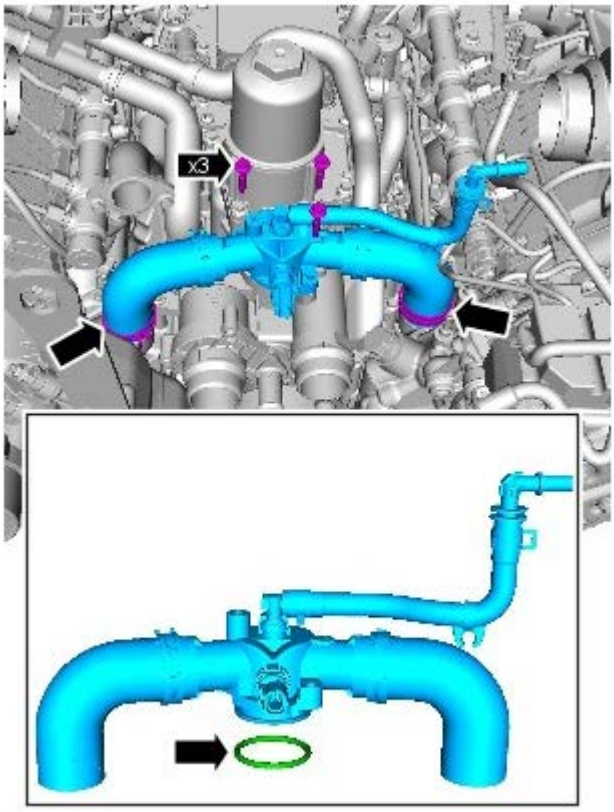
   Be prepared to collect escaping coolant.

   Make sure that all openings are sealed. Use new blanking caps.

5. CAUTIONS:

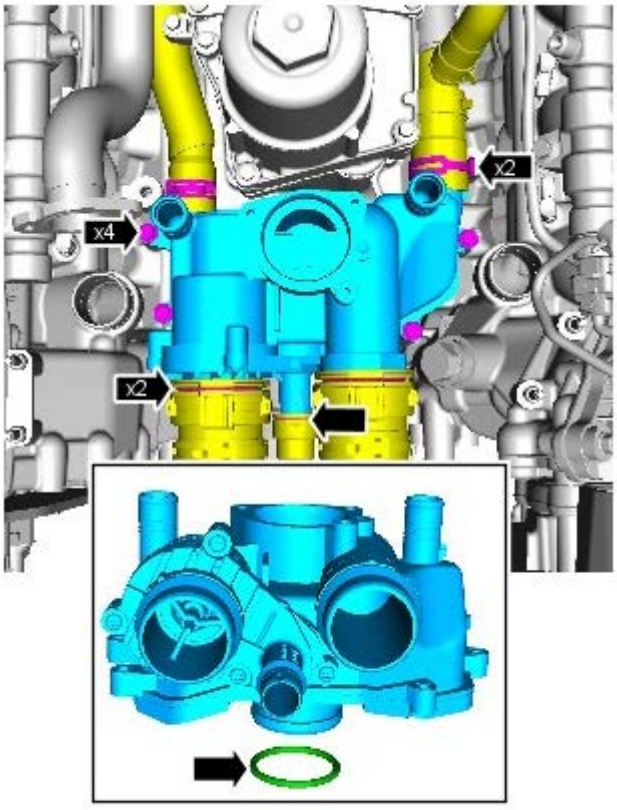
   Be prepared to collect escaping coolant.

   Make sure that all openings are sealed. Use new blanking caps.



E145026

NOTE: Remove and discard the O-ring seal.



E145027

6. CAUTIONS:

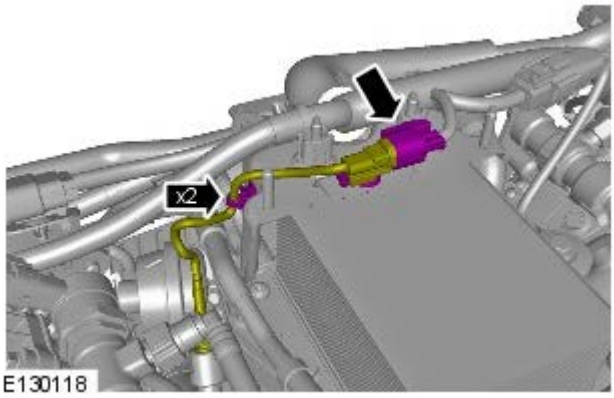
Clamp the hoses to minimize coolant loss.

Be prepared to collect escaping coolant.

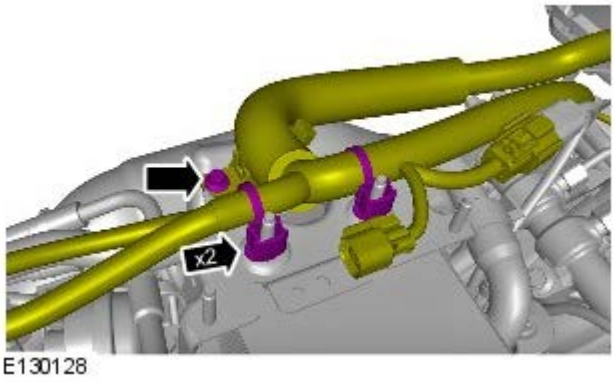
Make sure that all openings are sealed. Use new blanking caps.

NOTE: Remove and discard the O-ring seal.

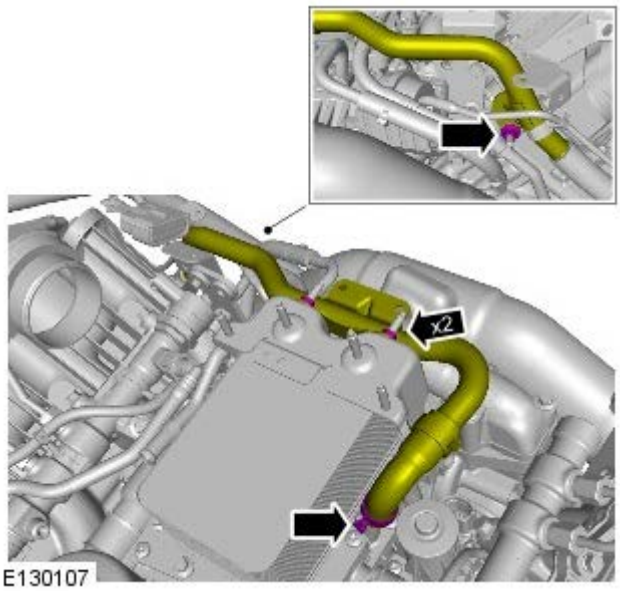
7.



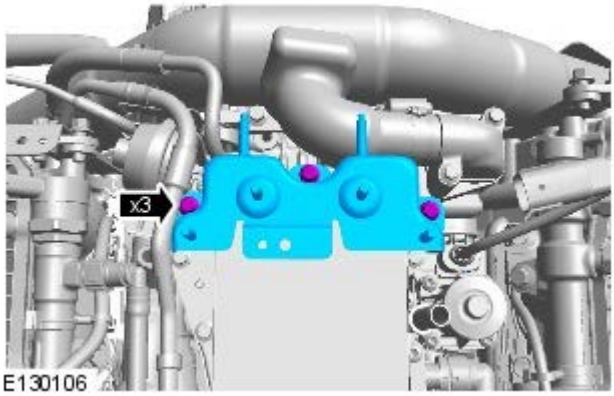
8.



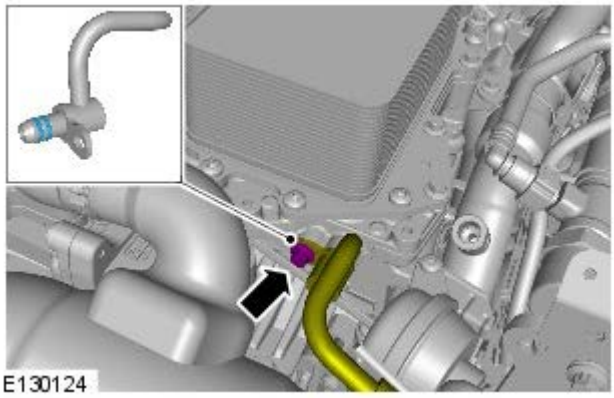
9. CAUTION: Make sure that all openings are sealed. Use new blanking caps.



10.



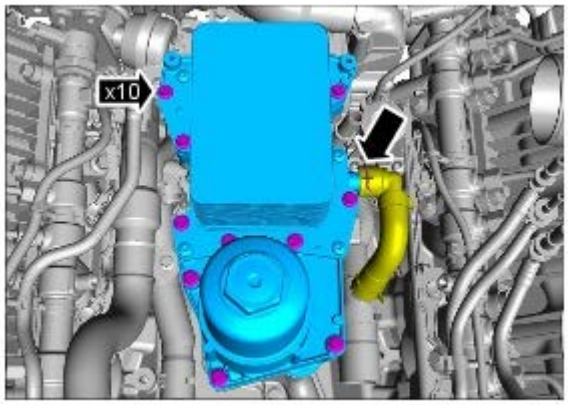
11. CAUTIONS:



Be prepared to collect escaping oil.

Make sure that all openings are sealed. Use new blanking caps.

Inspect the O-rings, replace if damaged.

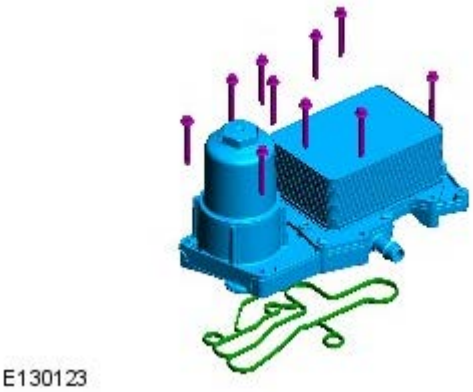


12. CAUTIONS:

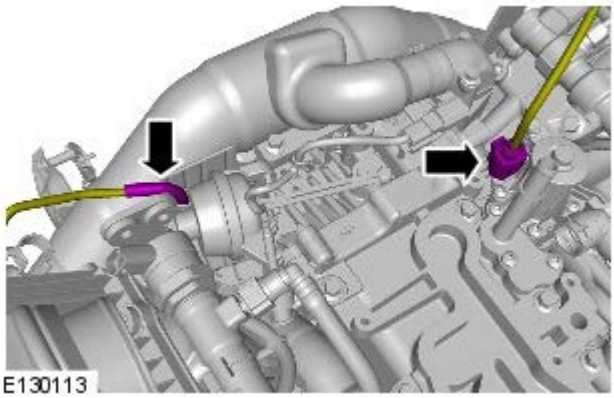
Be prepared to collect escaping oil.

Be prepared to collect escaping coolant.

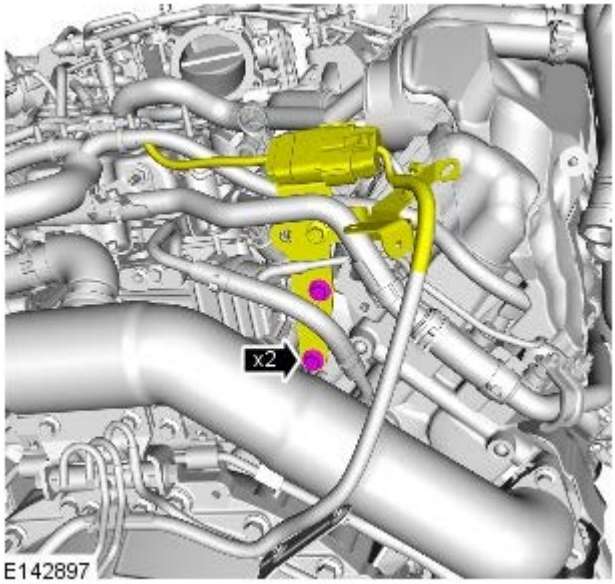
NOTE: Remove and discard the gasket.



13.



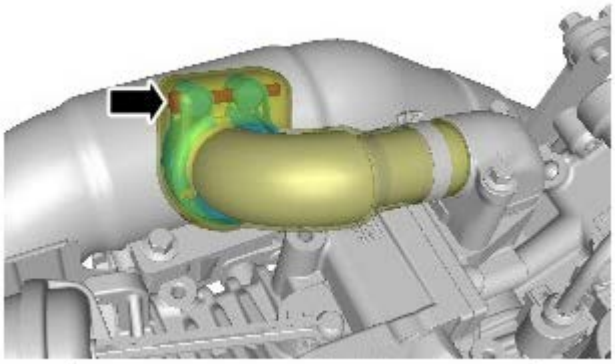
14.

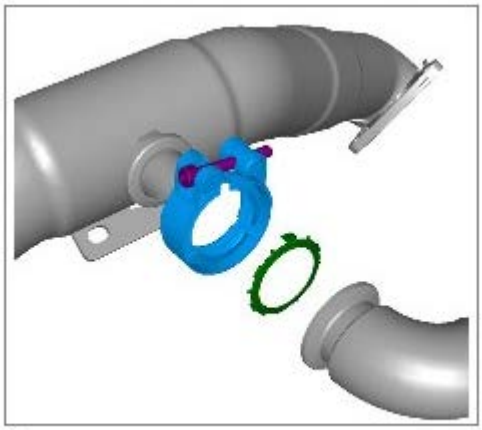


E142897

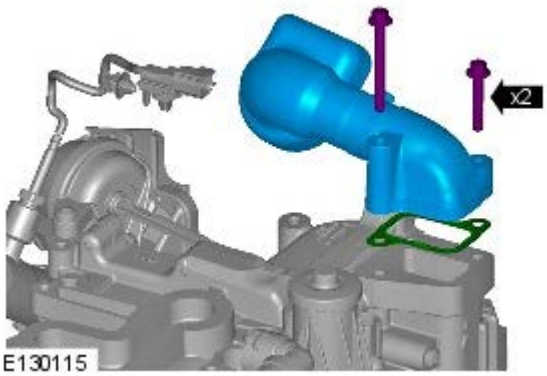
15. CAUTION: Make sure that all openings are sealed. Use new blanking caps.

NOTE: Remove and discard the gasket.



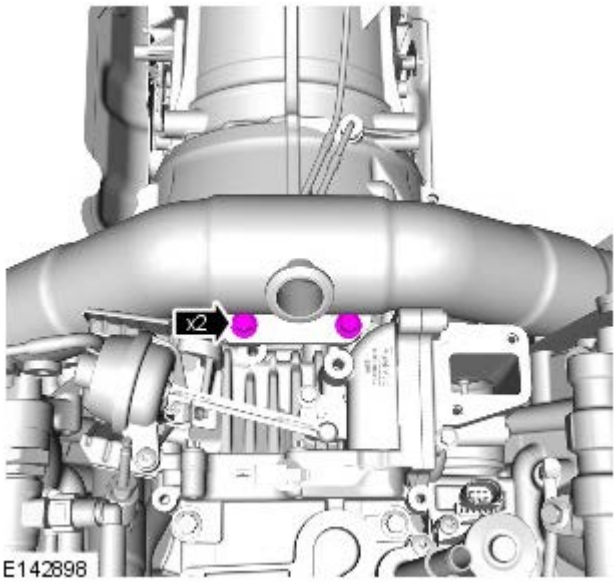

E130116

16. NOTE: Remove and discard the gasket.

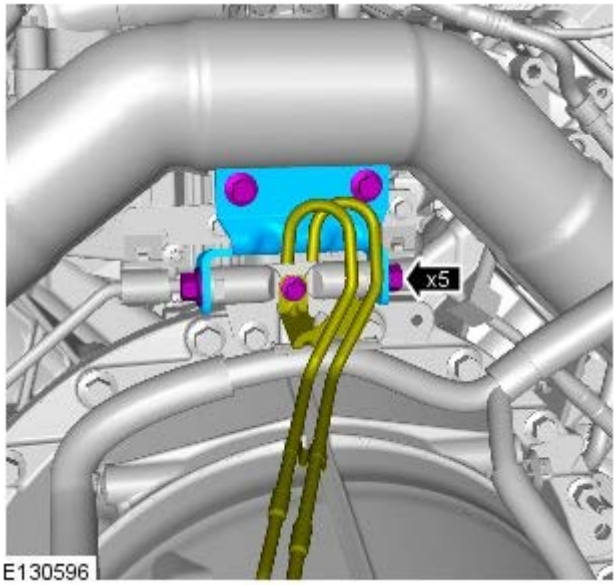


E130115

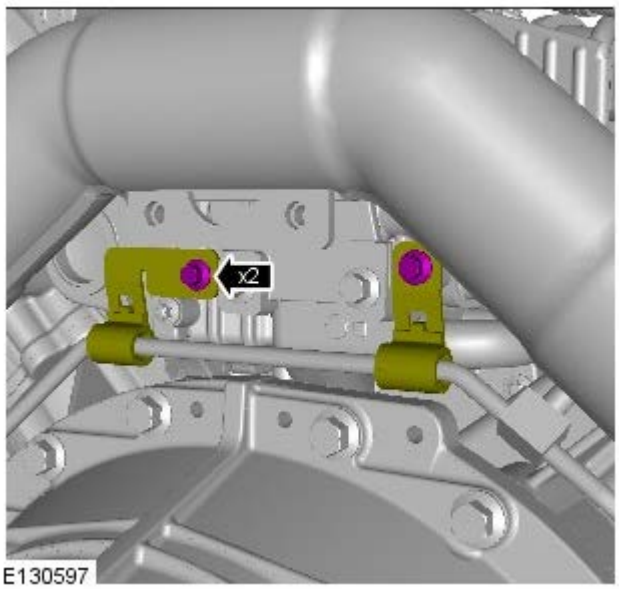
17.



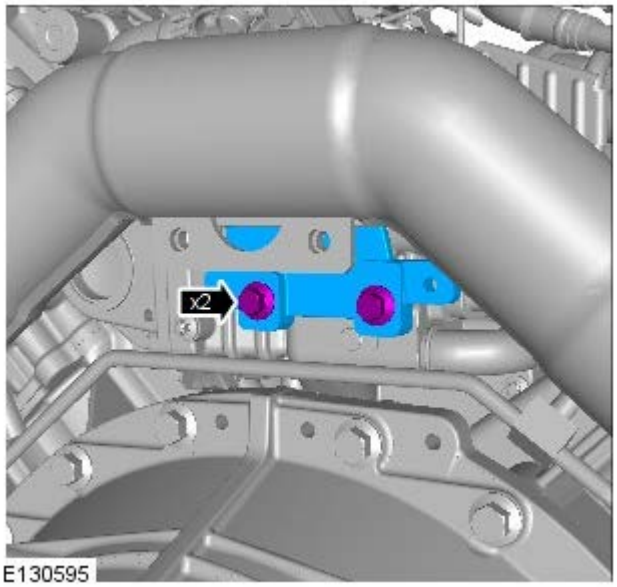
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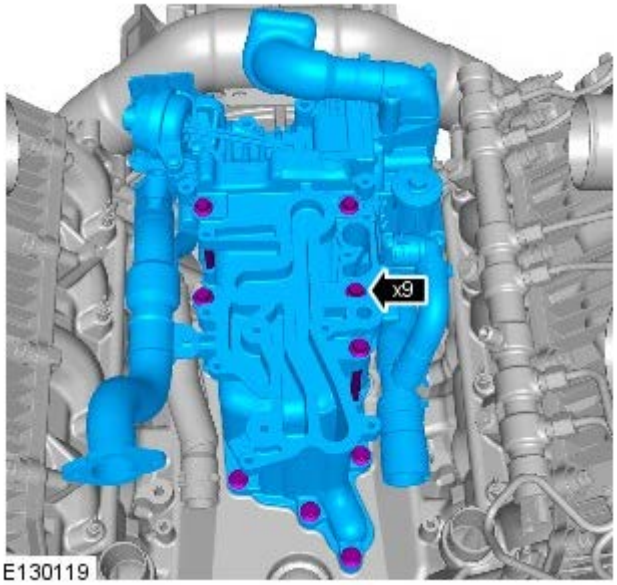
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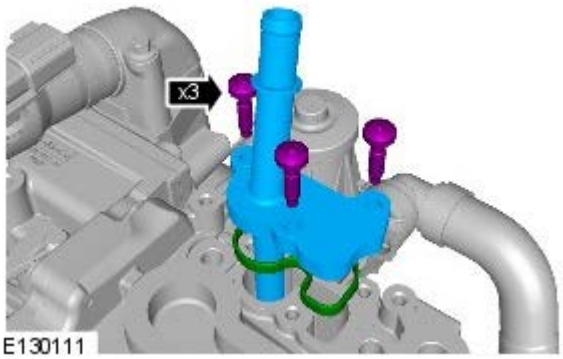
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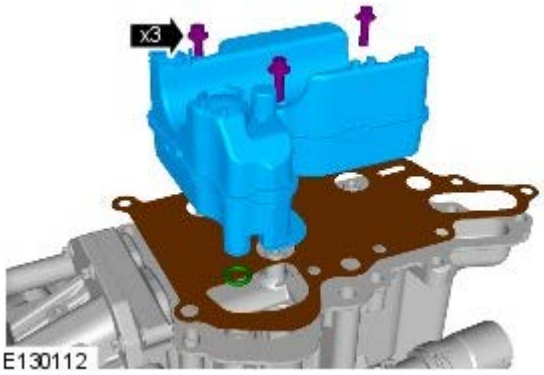
21.



22. Do not disassemble further if removed for access only

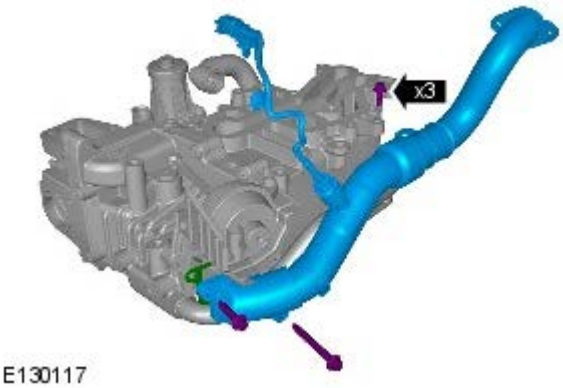


23.



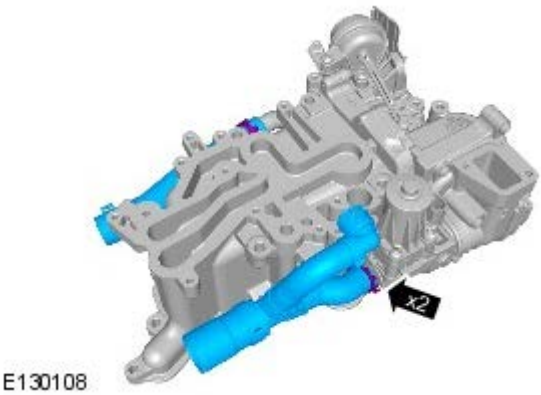
E130112

24.



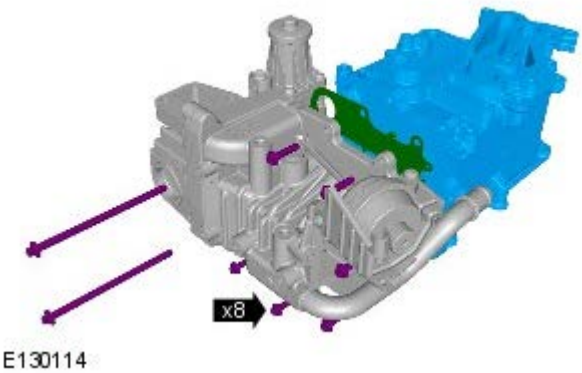
E130117

25.



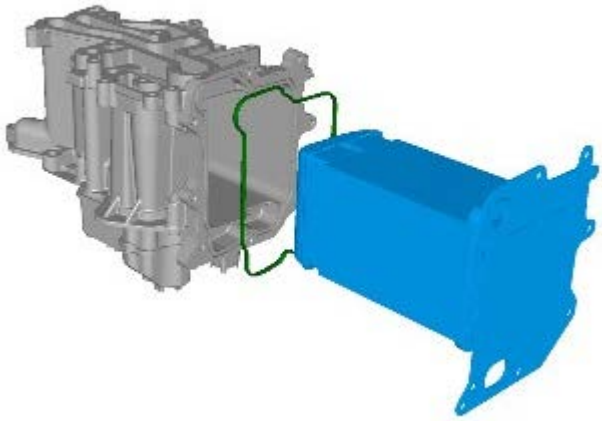
E130108

26.



E130114

27.



E130665

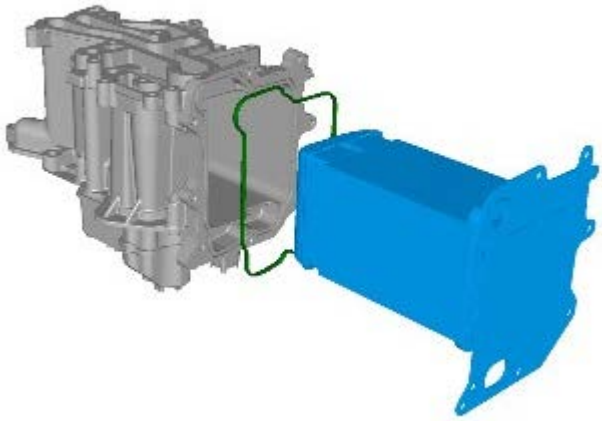
Installation



E130666

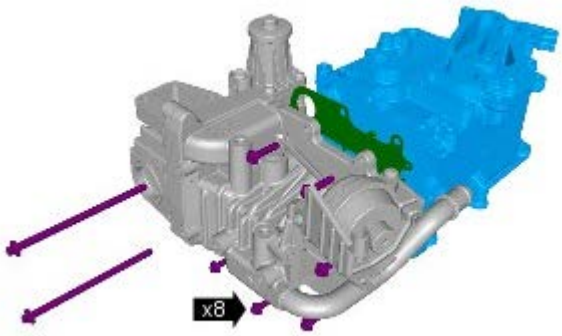
1. CAUTION: Make sure the rubber mounts are installed correctly.

2.



E130665

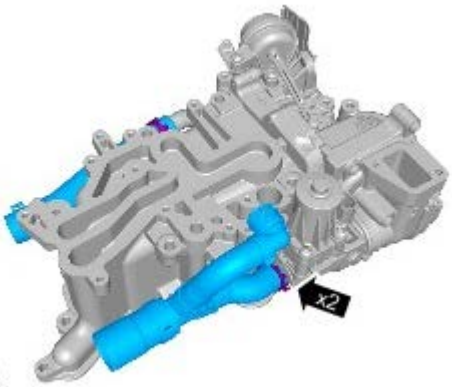
3. CAUTION: Install all the bolts finger tight before final tightening.



E130114

Torque: 12 Nm

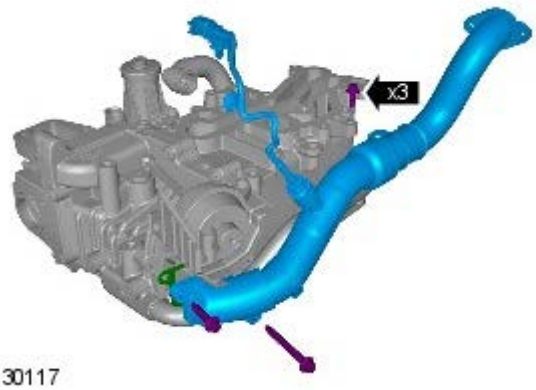
4.



E130108

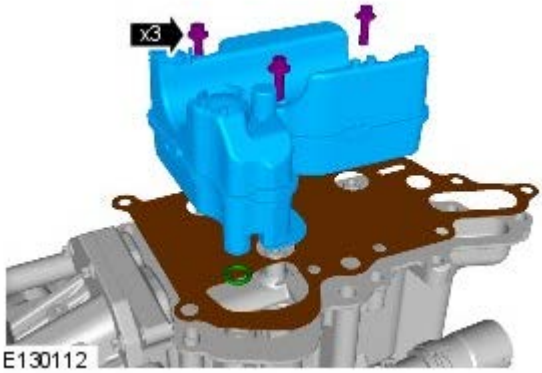
5. CAUTION: Install all the bolts finger tight before final tightening.

Torque: 10 Nm



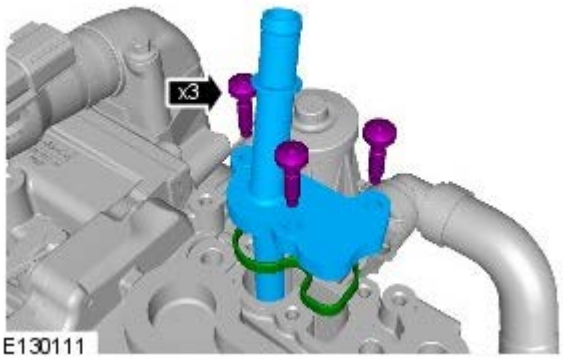
E130117

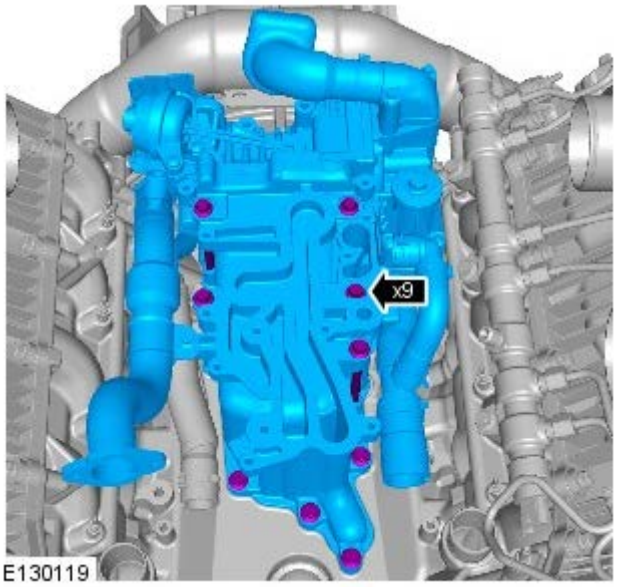
6. *Torque:* 5 Nm



E130112

7. *Torque:* 10 Nm





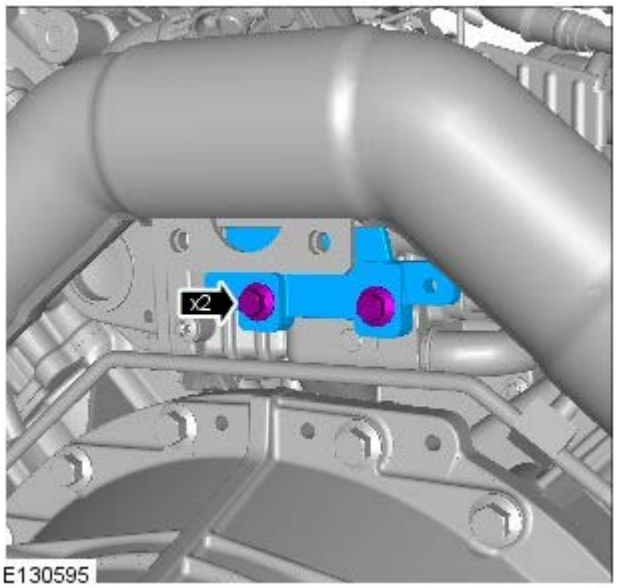
8. CAUTIONS:

   Make sure that the mating faces are clean and free of corrosion and foreign material.

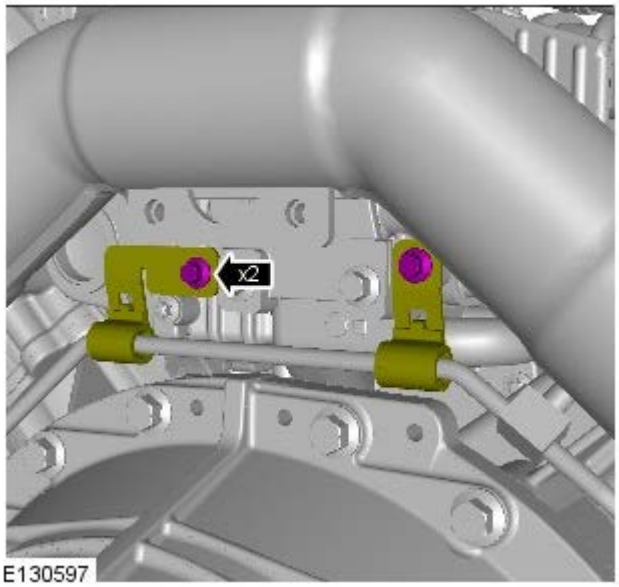
   Install all the bolts finger tight before final tightening.

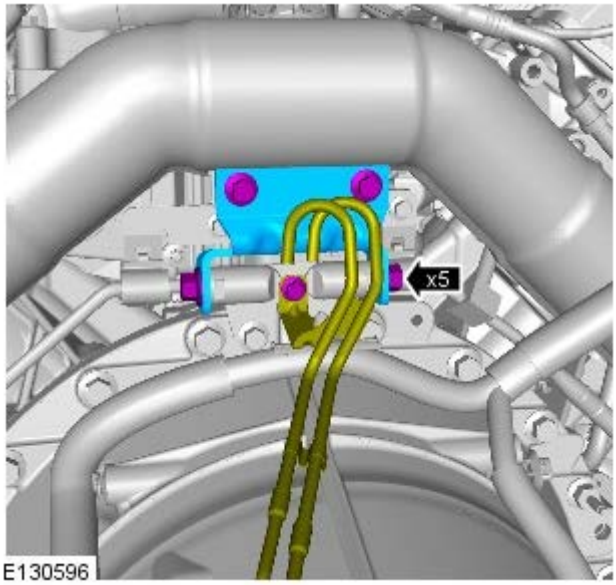
   Torque: 23 Nm

9. *Torque:* 23 Nm



10. *Torque:* 10 Nm

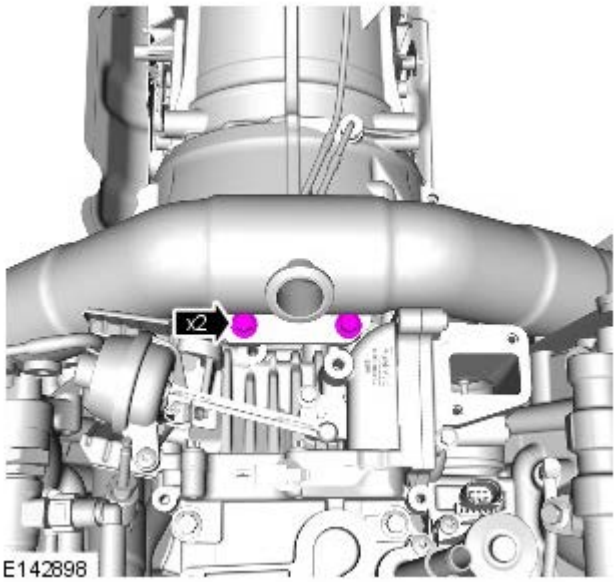




11. CAUTION: Install all the bolts finger tight before final tightening.

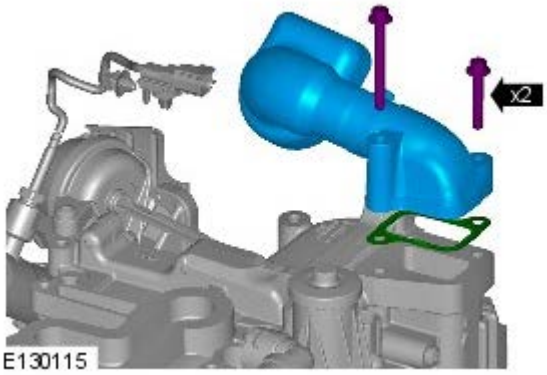
    Torque:
    M8 23 Nm
    M6 10 Nm

12. *Torque:* 23 Nm



13. NOTE: Install a new gasket.

    Torque: 10 Nm



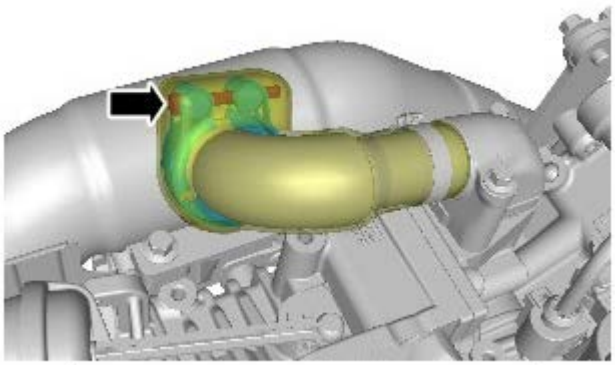
E130115

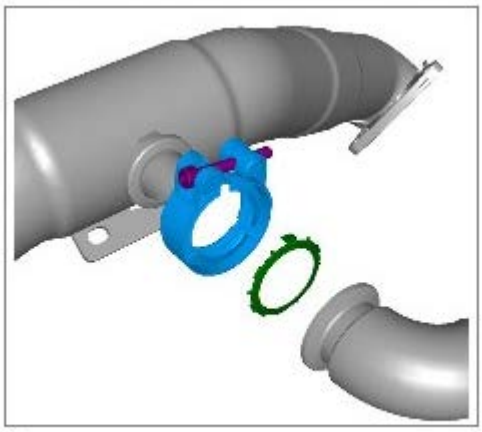
14. NOTES:

Remove and discard the blanking caps.

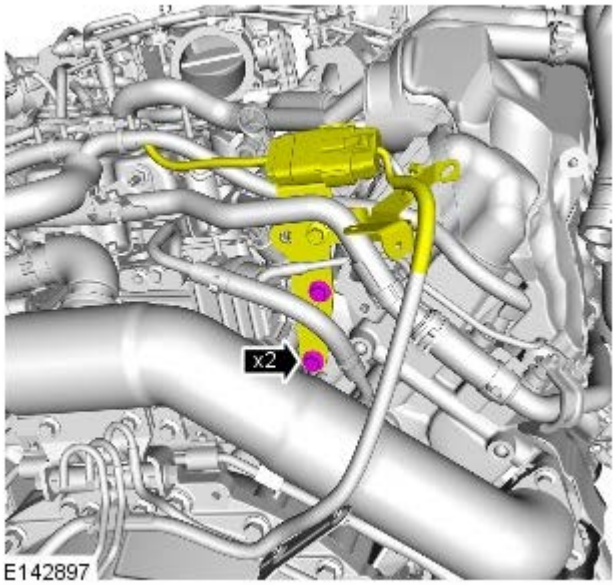
Install a new gasket.

Torque: 7 Nm



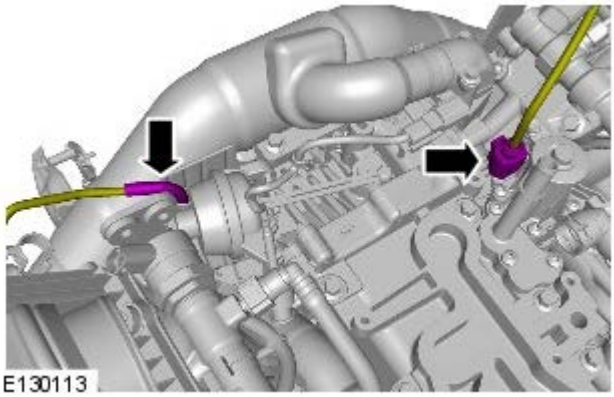

E130116

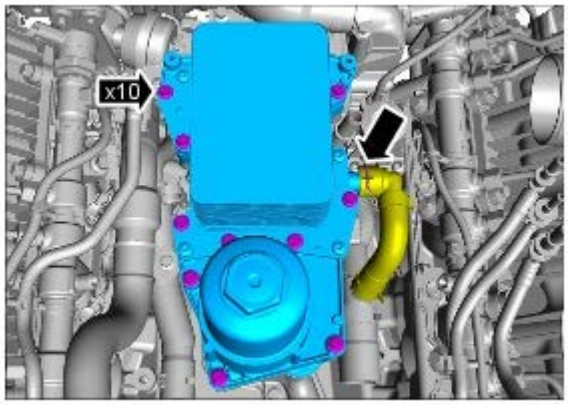
15. *Torque:* 25 Nm



E142897

16.


E130113



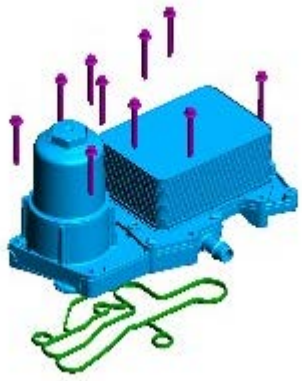
17. CAUTIONS:

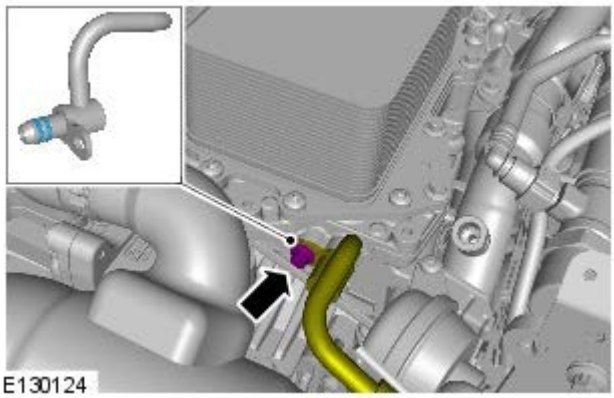
    Make sure that the surface is clean and free of foreign material.

    Install all the bolts finger tight before final tightening.

    NOTE: Install a new gasket.

    Torque: 13 Nm


E130123


E130124

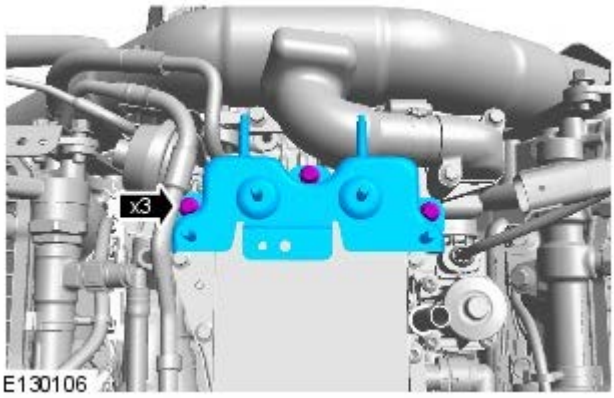
18. CAUTION: Make sure that the mating faces are clean and free of corrosion and foreign material.

    NOTE: Remove and discard the blanking caps.

    Torque: 10 Nm

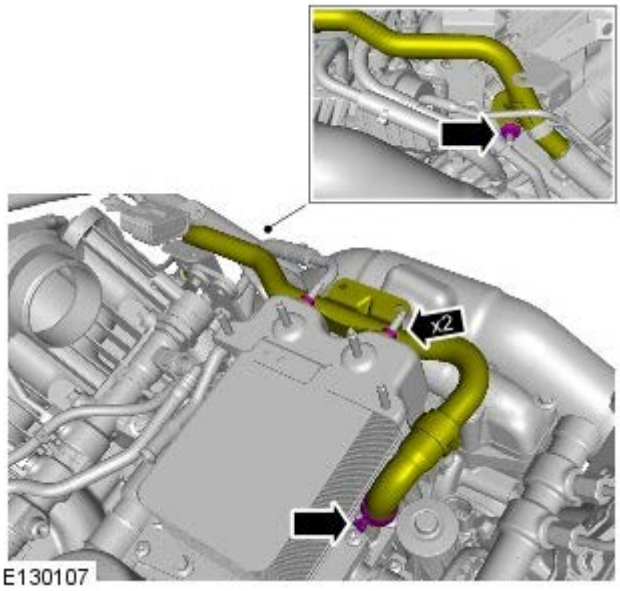
19. CAUTION: Install all the bolts finger tight before final tightening.

    Torque: 10 Nm

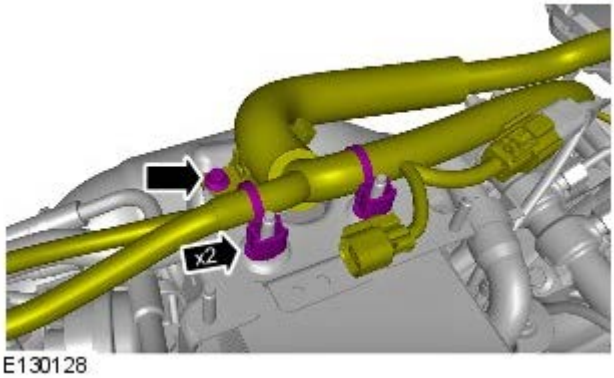


20. NOTE: Remove and discard the blanking caps.

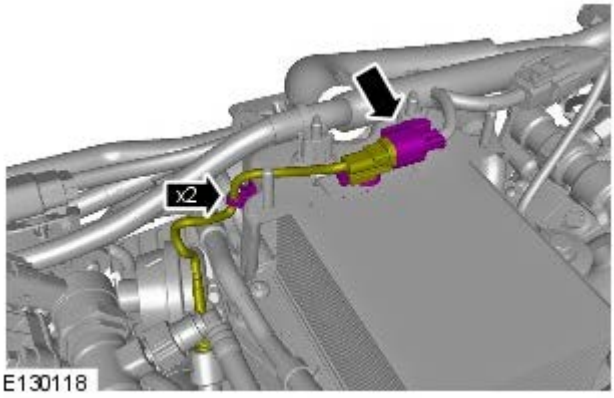
Torque: 10 Nm



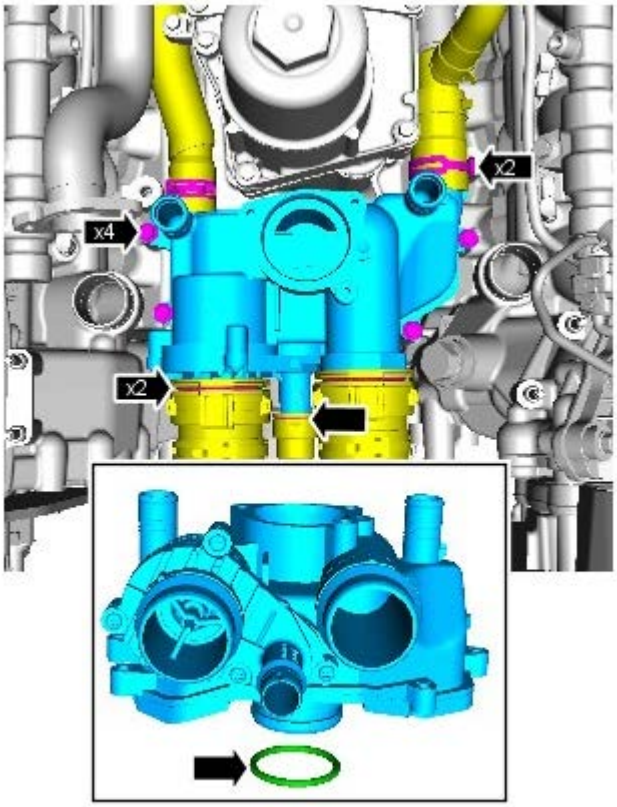
21. *Torque:* 10 Nm



22.



23. CAUTION: Install all the bolts finger tight before final tightening.



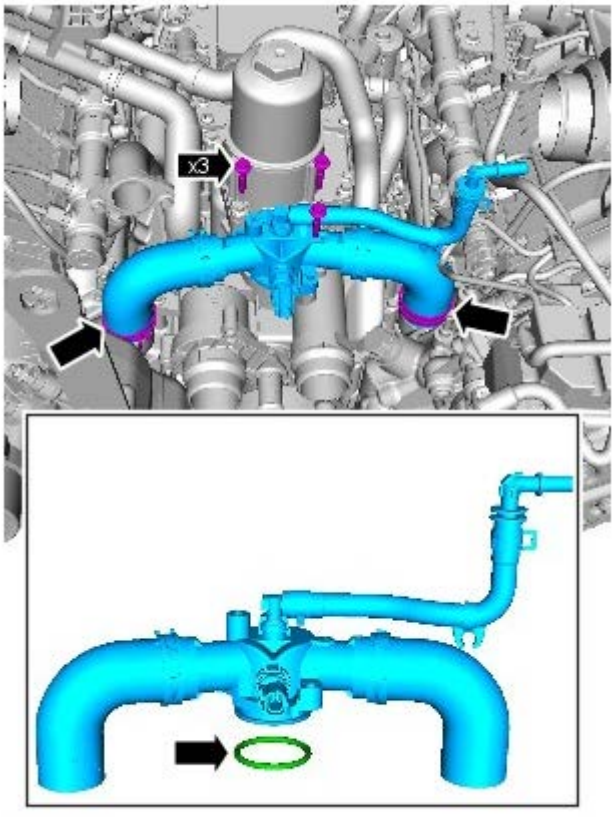
E145027

NOTES:

Remove and discard the blanking caps.

Install a new O-ring seal.

Torque: 10 Nm



E145026

24. CAUTION: Install all the bolts finger tight before final tightening.

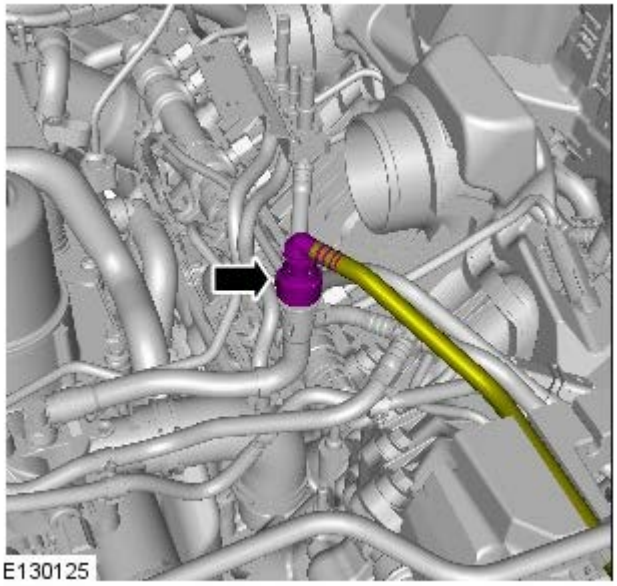
NOTES:

Remove and discard the blanking caps.

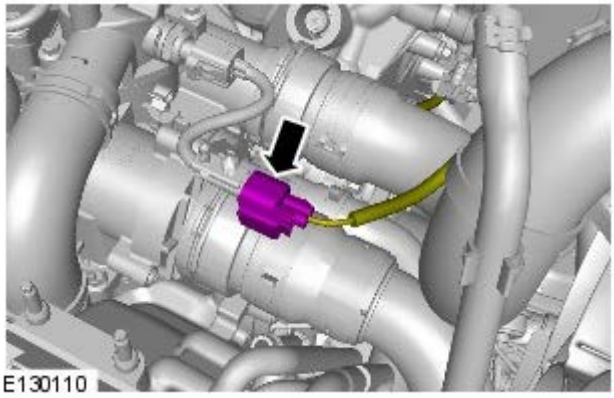
Install a new O-ring seal.

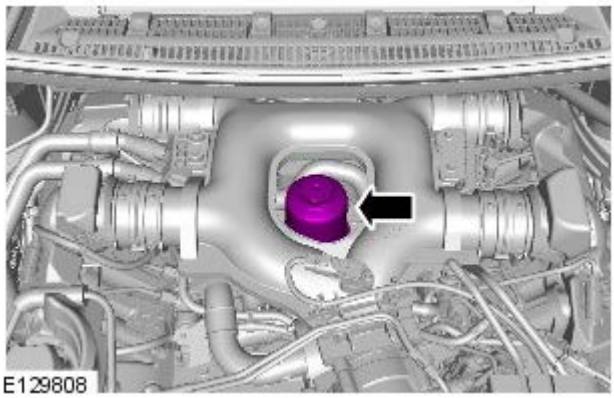
Torque: 10 Nm

25. NOTE: Remove and discard the blanking caps.



26.





27. CAUTION: Tighten the component finger tight first.

Torque: 35 Nm

28. Refer to: Fuel Rail RH (303-04E Fuel Charging and Controls - TDV8 4.4L Diesel, Removal and Installation).

29. Check and top-up the engine oil.

Published: 24-Oct-2013

Engine Emission Control - TDV8 4.4L Diesel - Exhaust Gas Recirculation (EGR) Valve

Removal and Installation

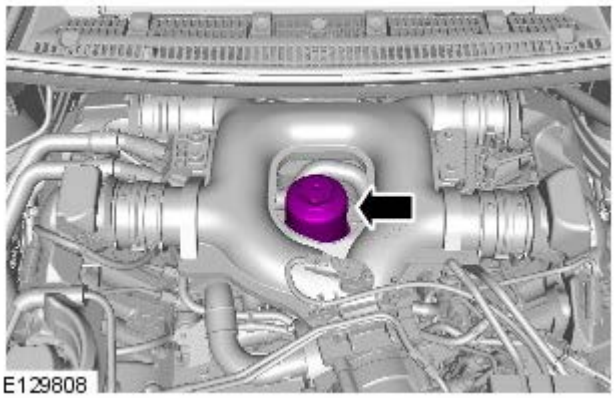
Removal

NOTES:

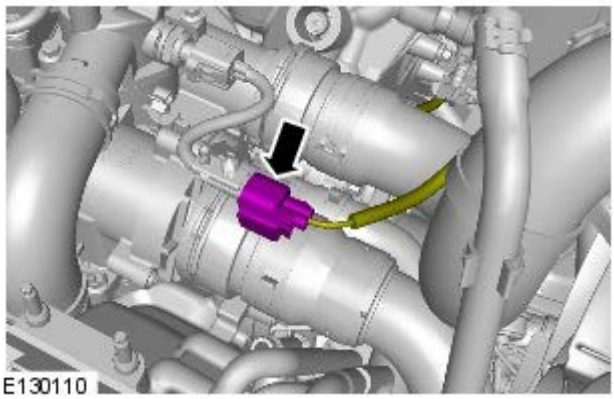
Some variation in the illustrations may occur, but the essential information is always correct.

Engine shown removed for clarity.

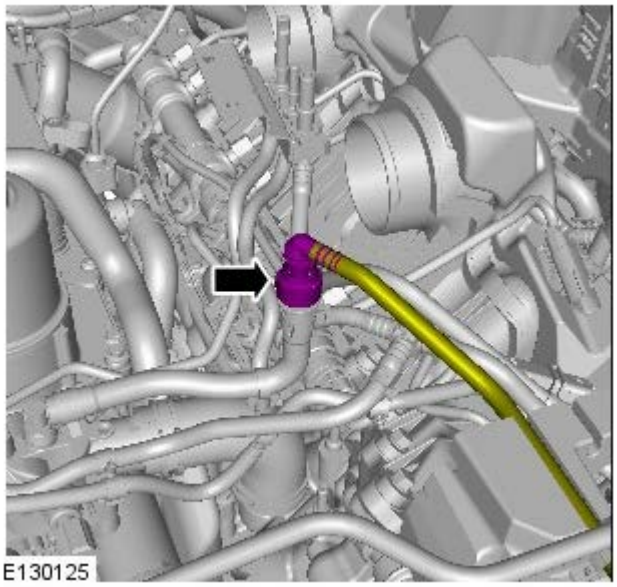
1. Refer to: Fuel Rail RH (303-04E Fuel Charging and Controls - TDV8 4.4L Diesel, Removal and Installation).


E129808

2.
   - Loosen the oil filter cover 3 turns and allow the engine oil to drain.


E130110

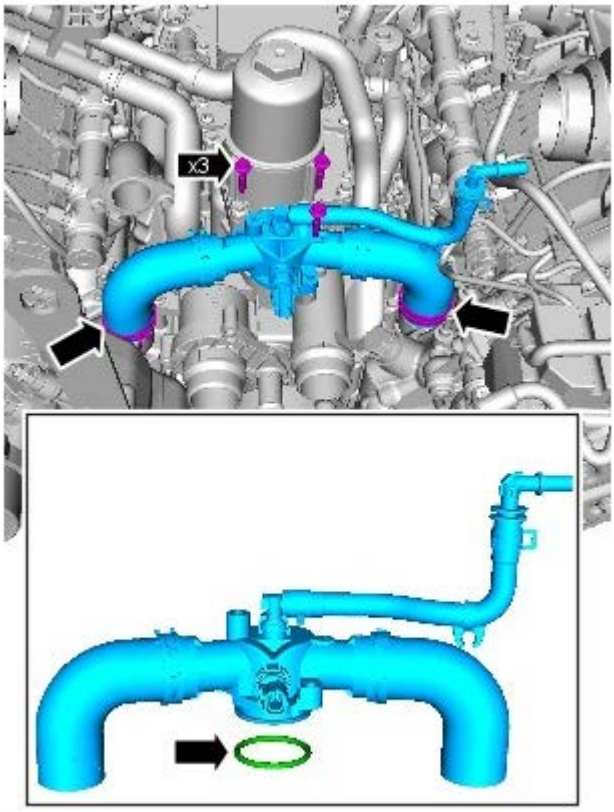
3.


E130125

4. CAUTIONS:

   Be prepared to collect escaping coolant.

   Make sure that all openings are sealed. Use new blanking caps.



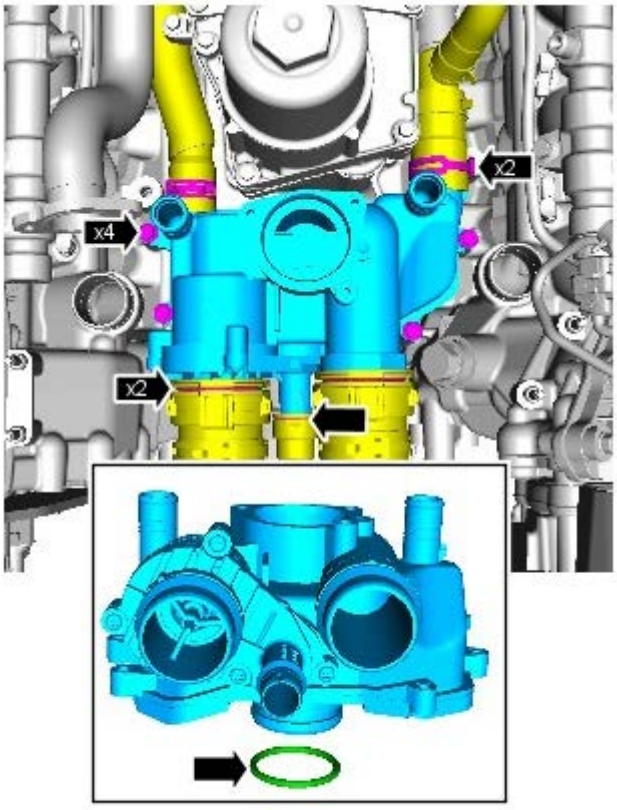
E145026

5. CAUTIONS:

Be prepared to collect escaping coolant.

Make sure that all openings are sealed. Use new blanking caps.

NOTE: Remove and discard the O-ring seal.



E145027

6. CAUTIONS:

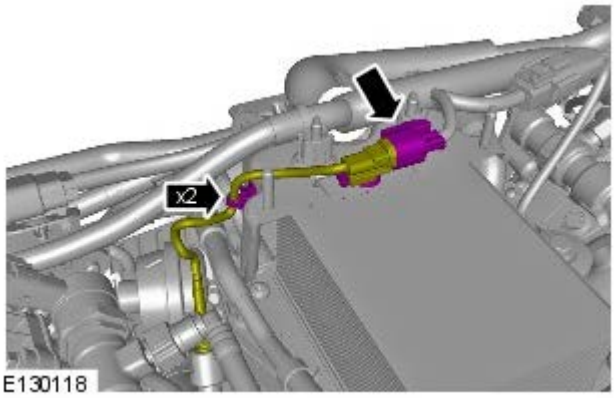
Clamp the hoses to minimize coolant loss.

Be prepared to collect escaping coolant.

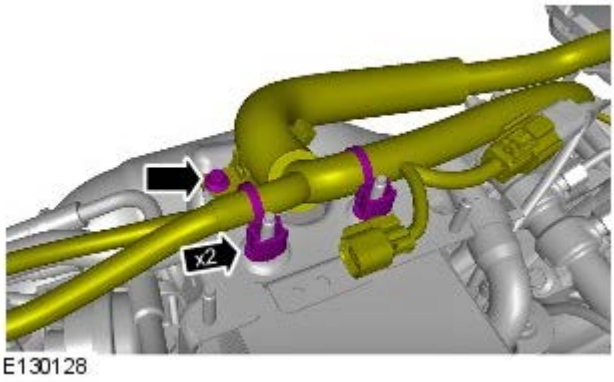
Make sure that all openings are sealed. Use new blanking caps.

NOTE: Remove and discard the O-ring seal.

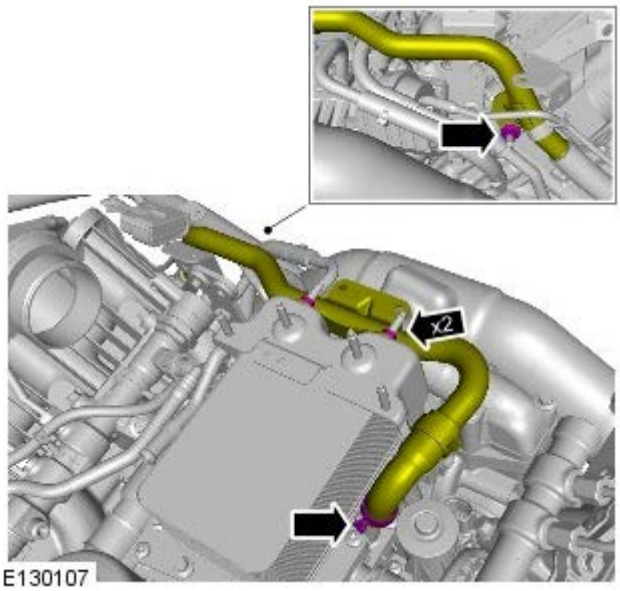
7.



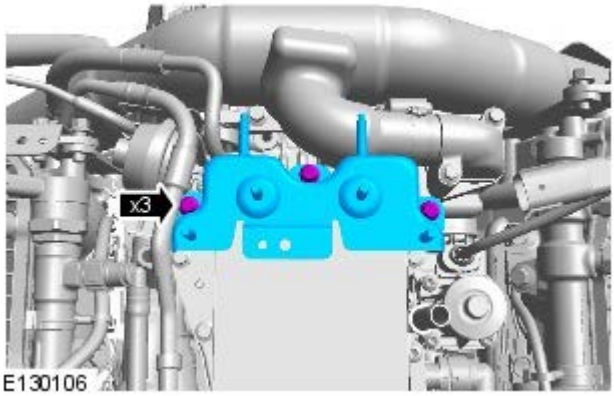
8.



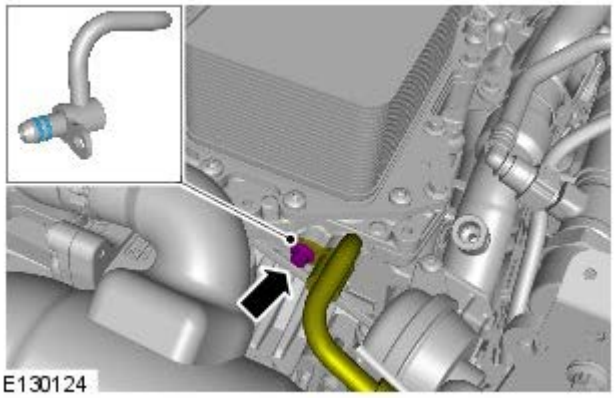
9. CAUTION: Make sure that all openings are sealed. Use new blanking caps.



10.



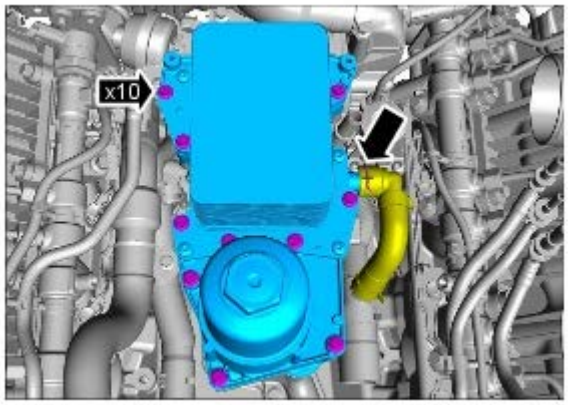
11. CAUTIONS:



Be prepared to collect escaping oil.

Make sure that all openings are sealed. Use new blanking caps.

Inspect the O-rings, replace if damaged.

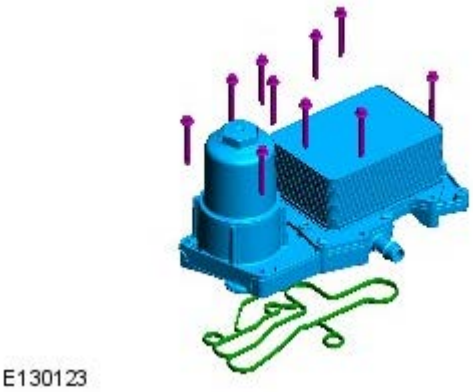


12. CAUTIONS:

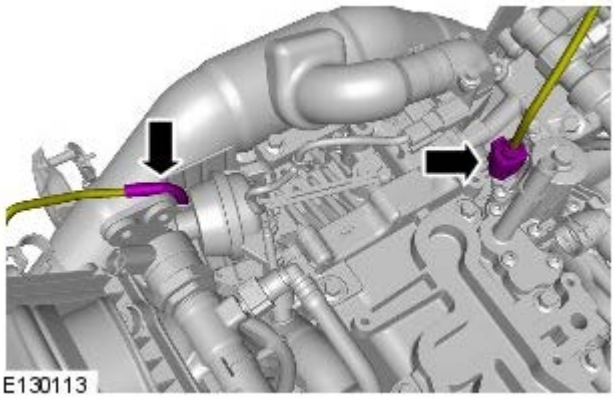
Be prepared to collect escaping oil.

Be prepared to collect escaping coolant.

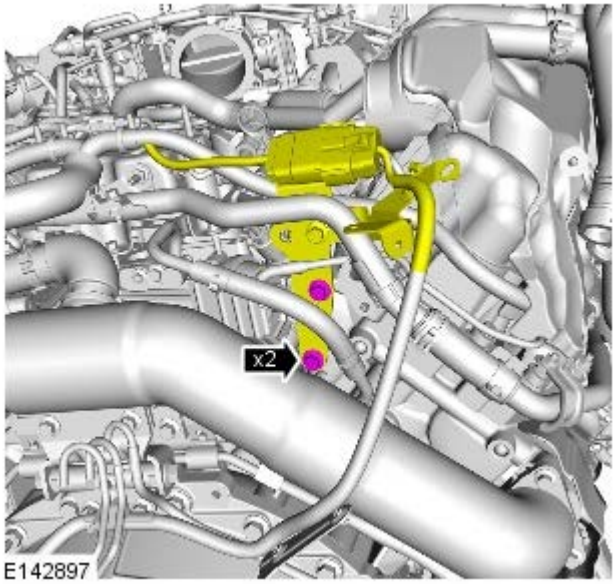
NOTE: Remove and discard the gasket.



13.



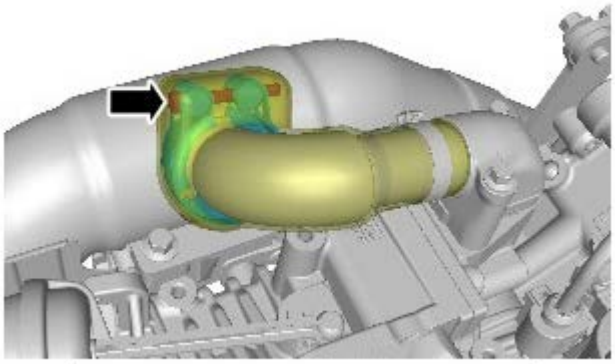
14.

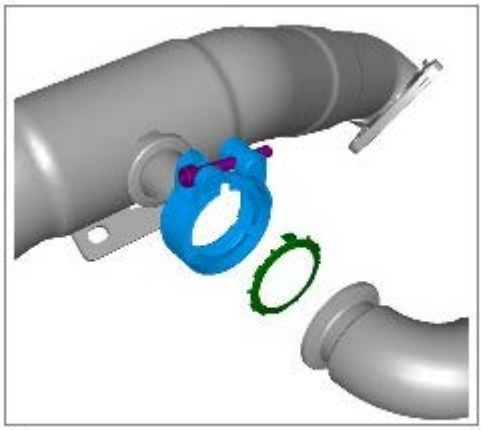


E142897

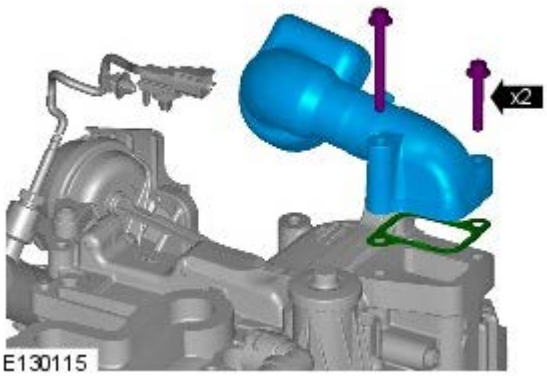
15. CAUTION: Make sure that all openings are sealed. Use new blanking caps.

NOTE: Remove and discard the gasket.



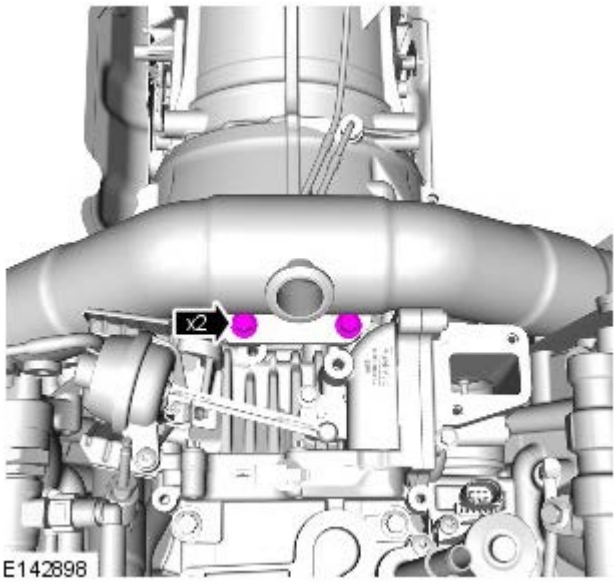

E130116

16. NOTE: Remove and discard the gasket.

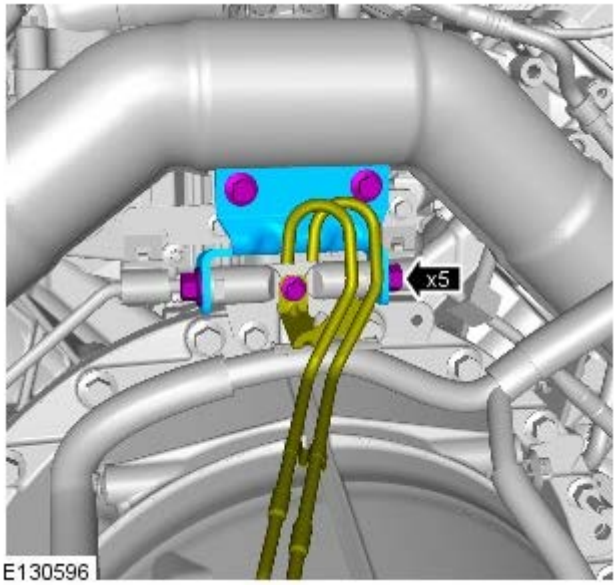


E130115

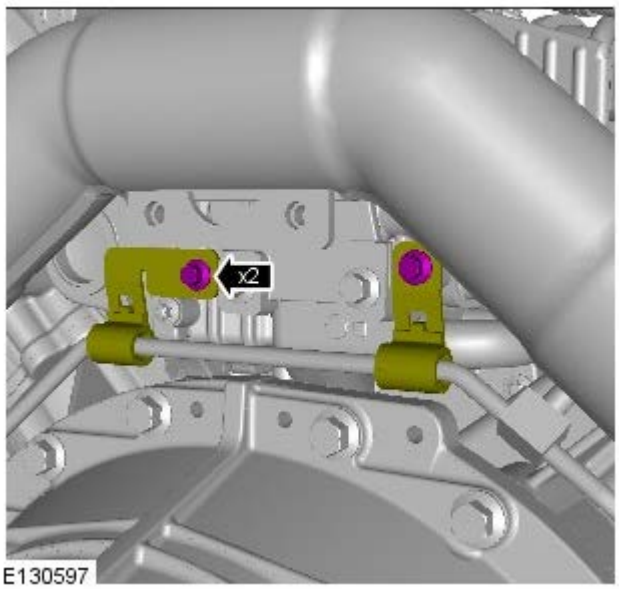
17.



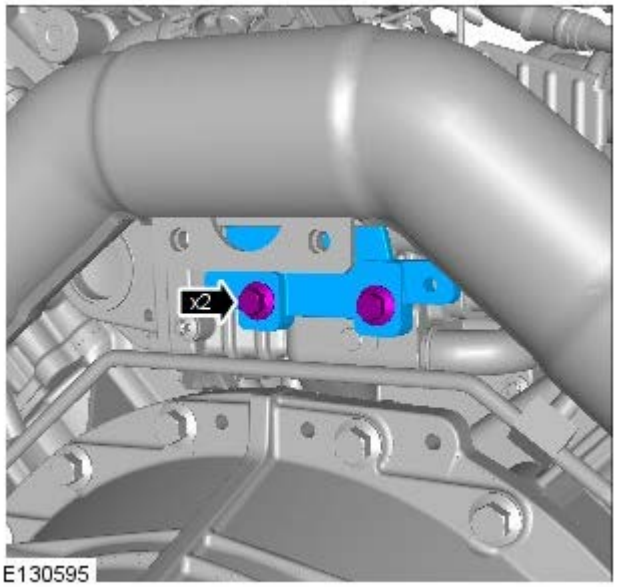
18.

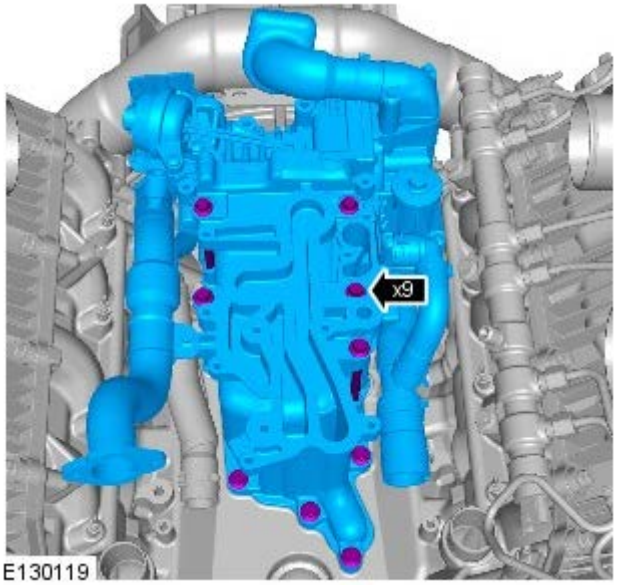


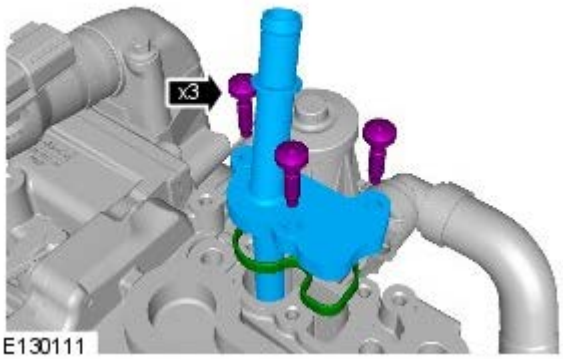
19.



20.







21. CAUTIONS:

⚠ Be prepared to collect escaping oil.

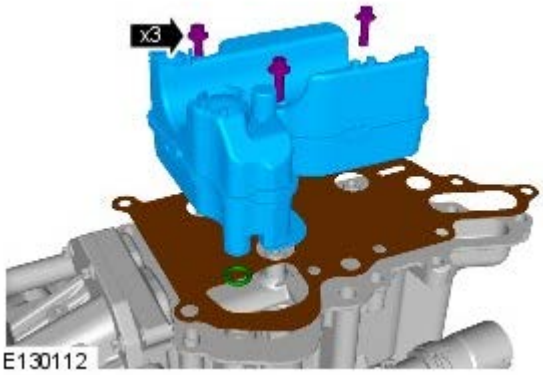
⚠ Be prepared to collect escaping coolant.

22. ⚠ CAUTION: Inspect the seal, replace if damaged

Do not disassemble further if removed for access only

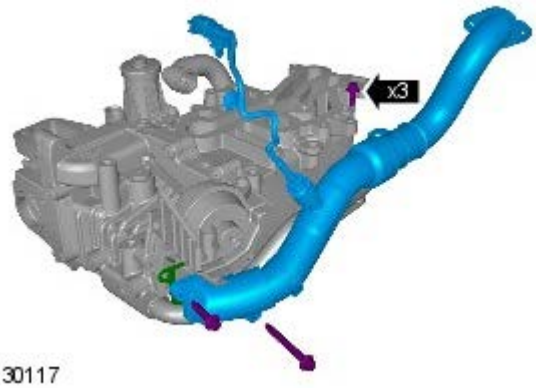
23. ⚠ CAUTION: Inspect the seal, replace if damaged

△ NOTE: Remove and discard the gasket.



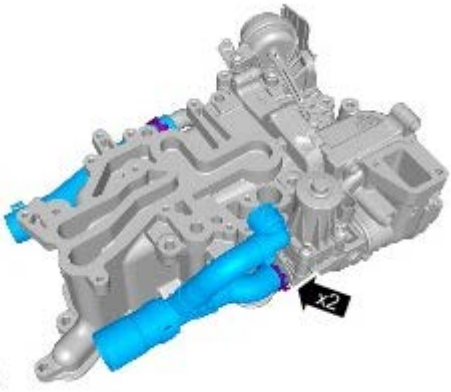
E130112

24. NOTE: Remove and discard the gasket.



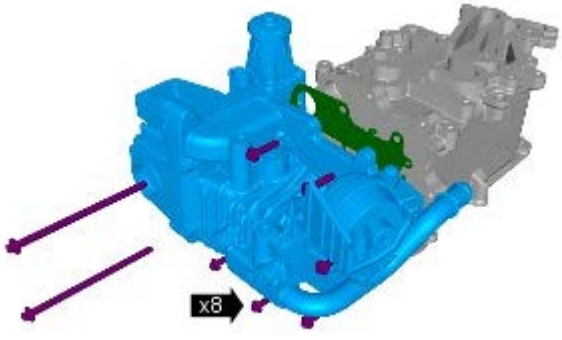
E130117

25.



E130108

26. NOTE: Remove and discard the gasket.



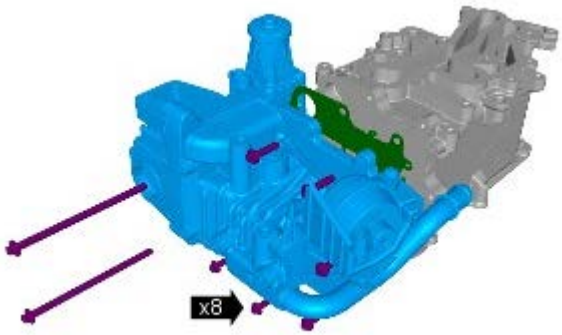
E130120

Installation

1. CAUTION: Install all the bolts finger tight before final tightening.

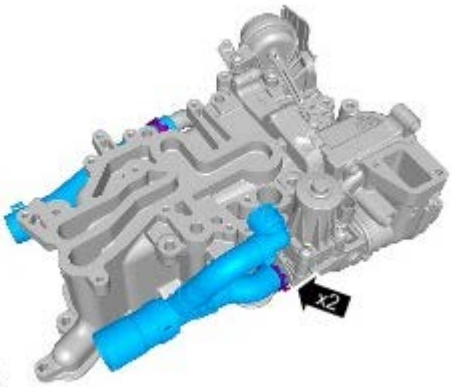
   NOTE: Install a new gasket.

   Torque: 12 Nm

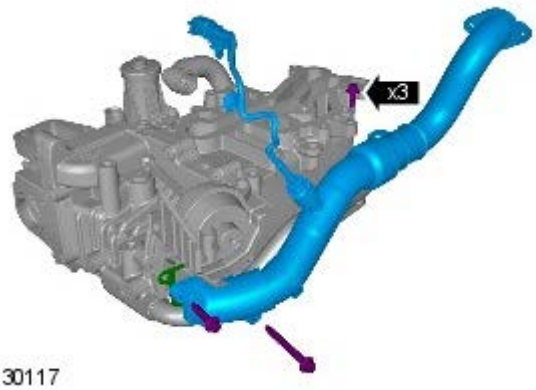


E130120

2.



E130108

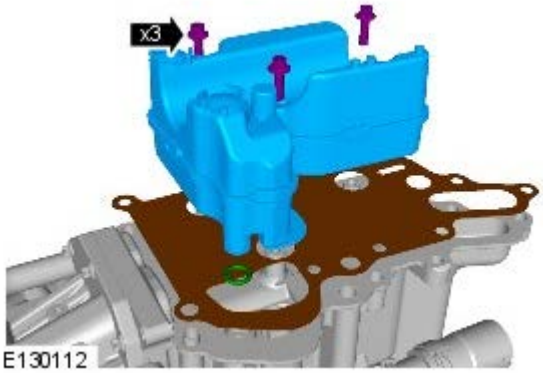


E130117

3. CAUTION: Install all the bolts finger tight before final tightening.

NOTE: Install a new gasket.

Torque: 10 Nm



E130112

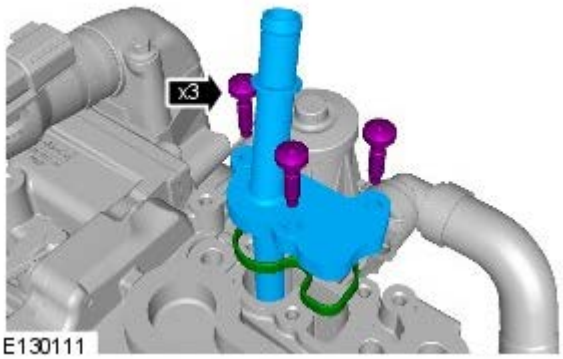
4. CAUTION: Make sure that the mating faces are clean and free of corrosion and foreign material.

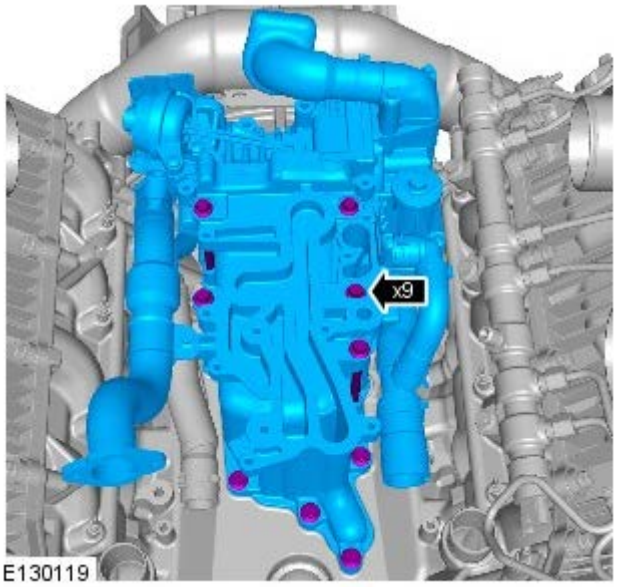
NOTE: Install a new gasket.

Torque: 5 Nm

5. CAUTION: Make sure that the mating faces are clean and free of corrosion and foreign material.

Torque: 10 Nm





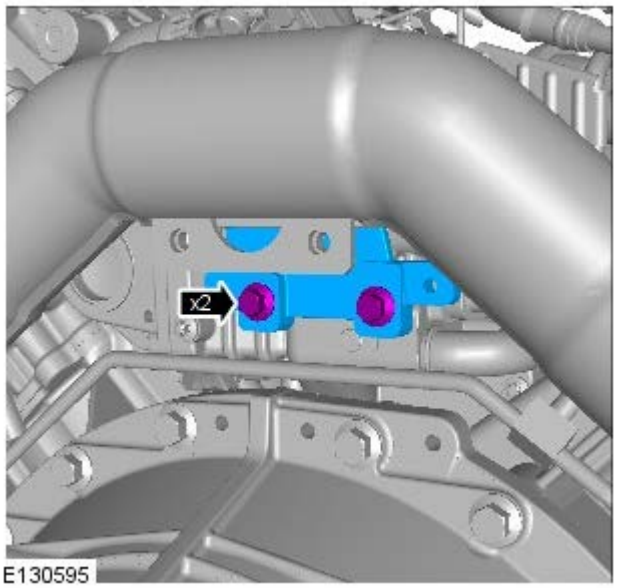
6. CAUTIONS:

   Make sure that the mating faces are clean and free of corrosion and foreign material.

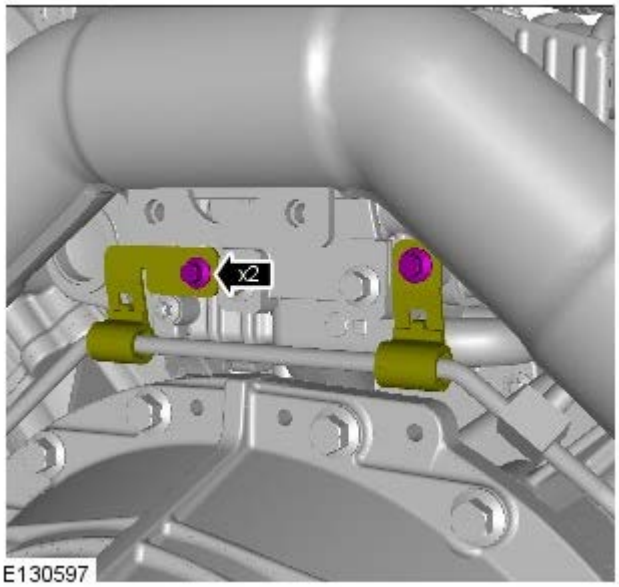
   Install all the bolts finger tight before final tightening.

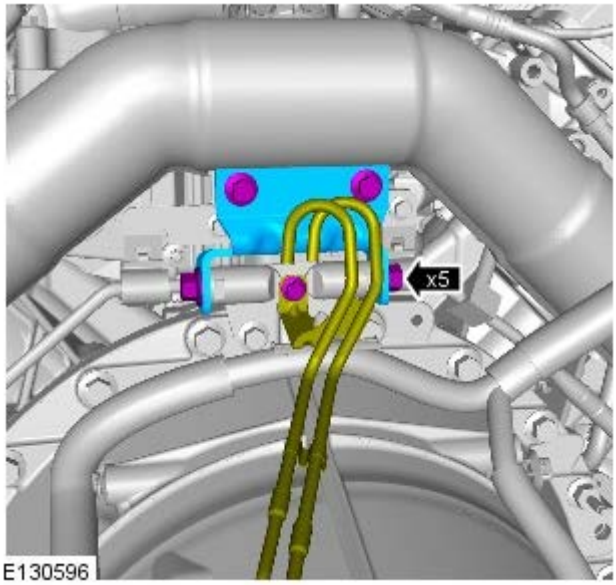
   Torque: 23 Nm

7. *Torque:* 23 Nm



8. *Torque:* 10 Nm

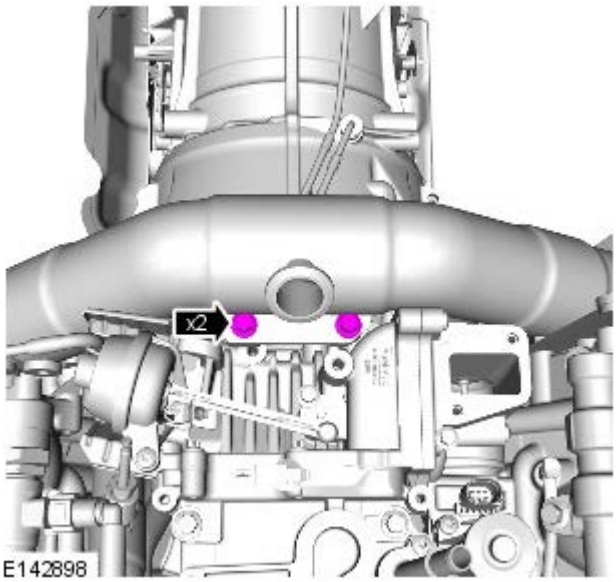




9. CAUTION: Install all the bolts finger tight before final tightening.

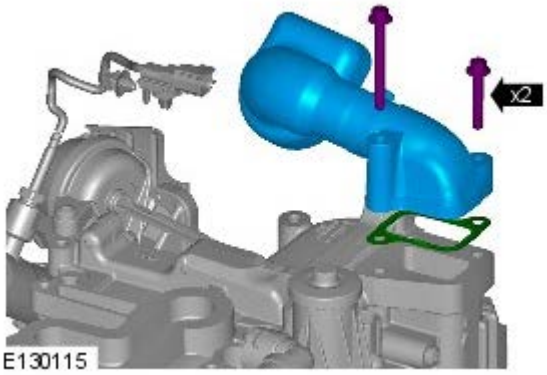
   Torque:
   M8 23 Nm
   M6 10 Nm

10. *Torque:* 23 Nm



11. NOTE: Install a new gasket.

    Torque: 10 Nm



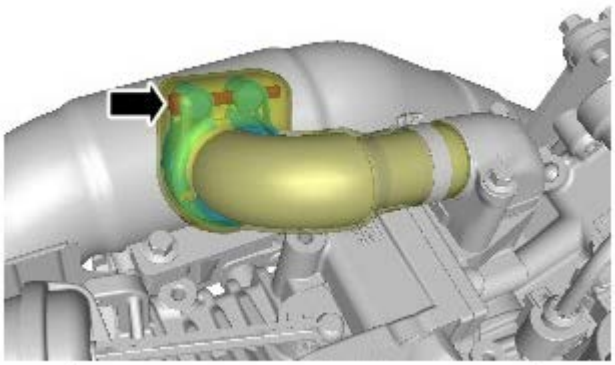
E130115

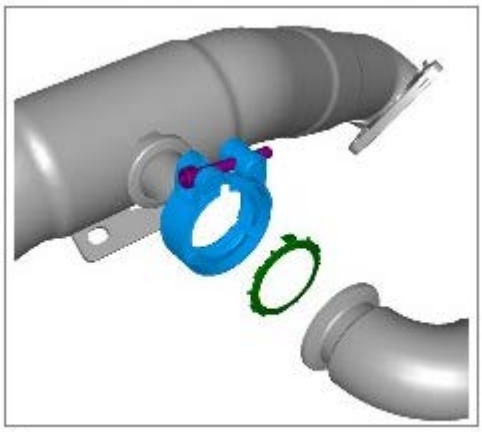
12. NOTES:

Remove and discard the blanking caps.

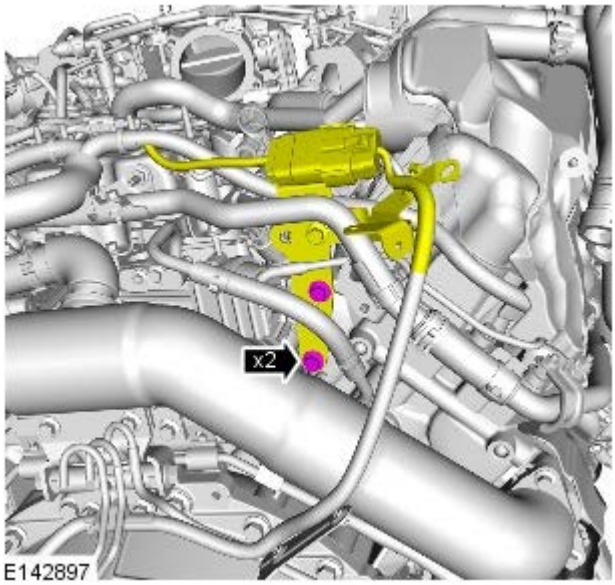
Install a new gasket.

Torque: 7 Nm



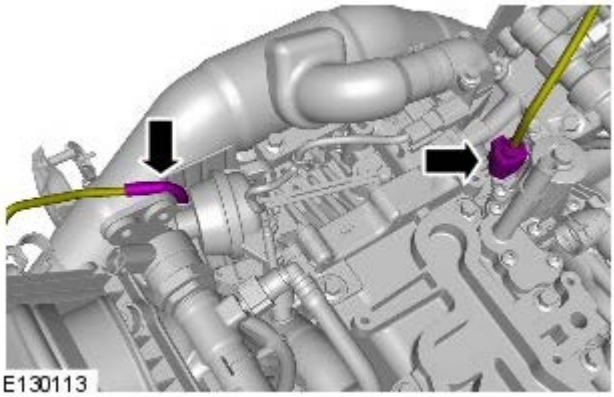

E130116

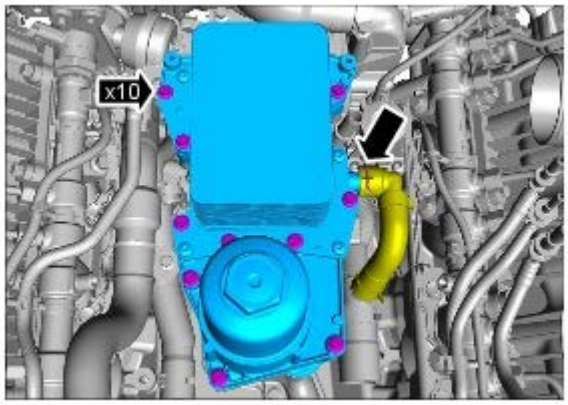
13. *Torque:* 25 Nm



E142897

14.





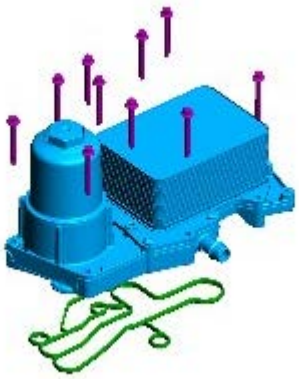
15. CAUTIONS:

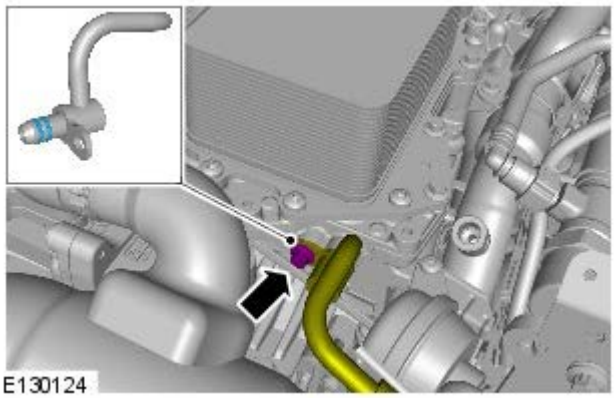
⚠ Make sure that the surface is clean and free of foreign material.

⚠ Install all the bolts finger tight before final tightening.

NOTE: Install a new gasket.

Torque: 13 Nm





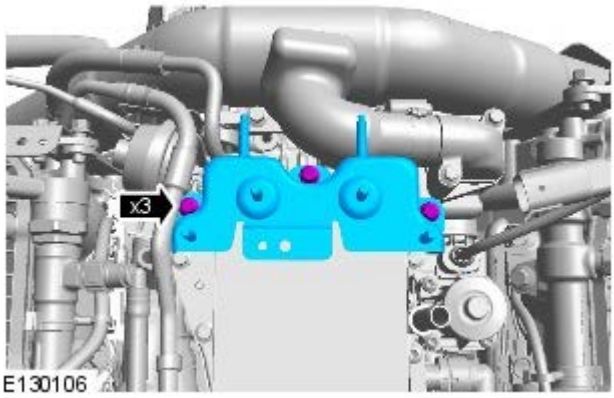
16. ⚠ CAUTION: Make sure that the mating faces are clean and free of corrosion and foreign material.

NOTE: Remove and discard the blanking caps.

Torque: 10 Nm

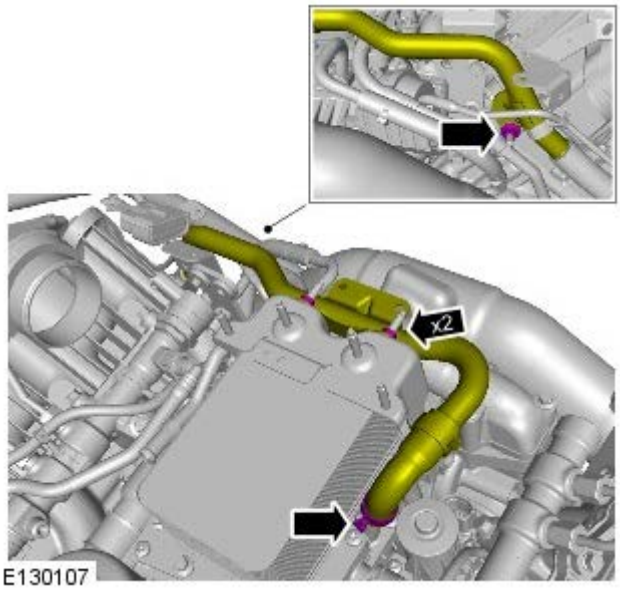
17. ⚠ CAUTION: Install all the bolts finger tight before final tightening.

Torque: 10 Nm

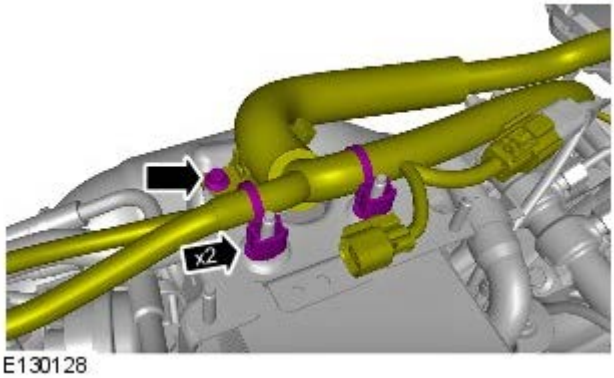


18. NOTE: Remove and discard the blanking caps.

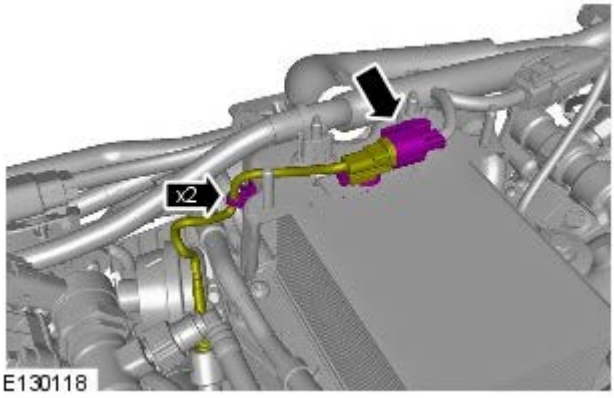
Torque: 10 Nm



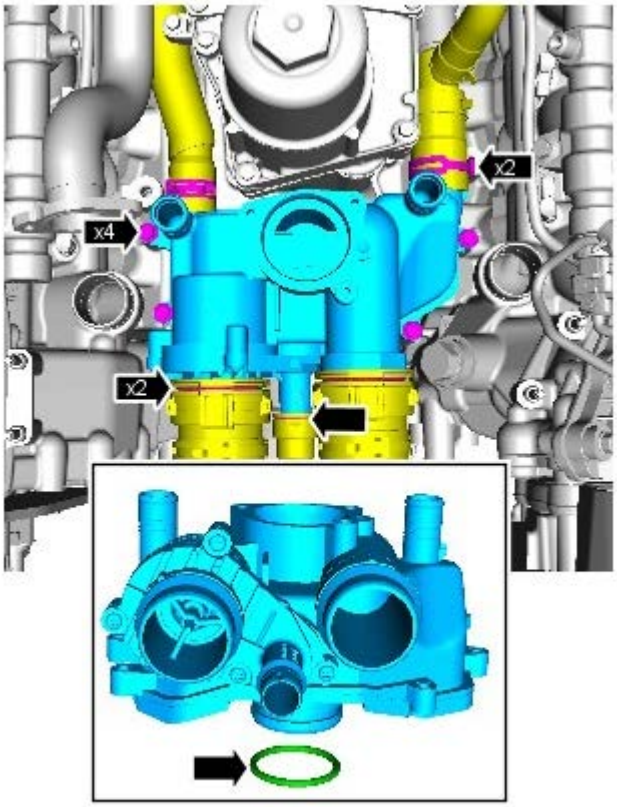
19. *Torque:* 10 Nm



20.



21. CAUTION: Install all the bolts finger tight before final tightening.



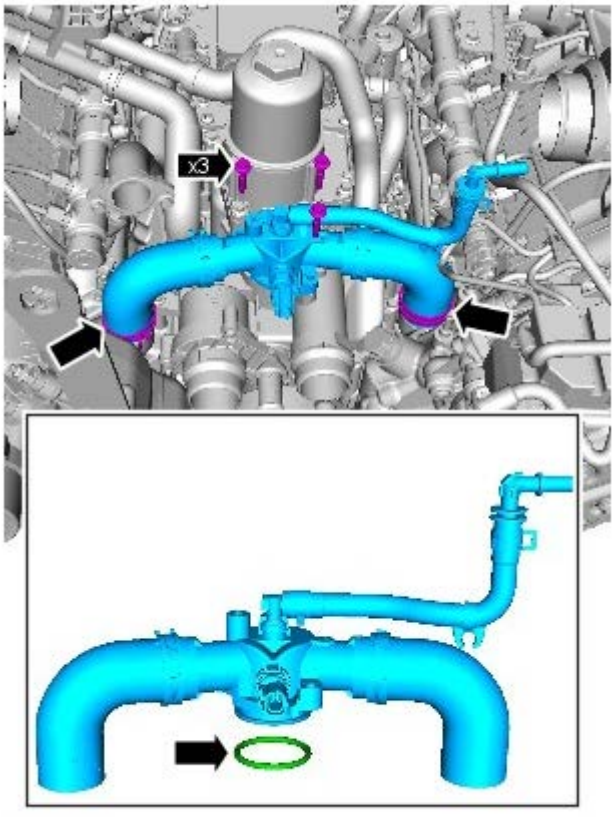
E145027

NOTES:

Remove and discard the blanking caps.

Install a new O-ring seal.

Torque: 10 Nm



E145026

22. CAUTION: Install all the bolts finger tight before final tightening.

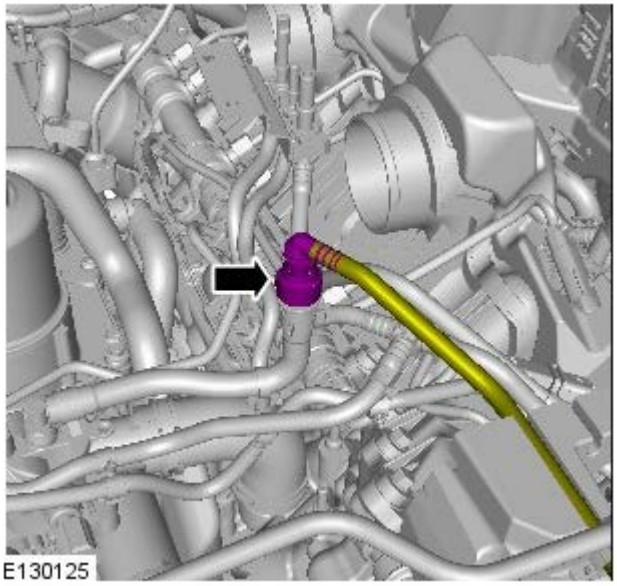
NOTES:

Remove and discard the blanking caps.

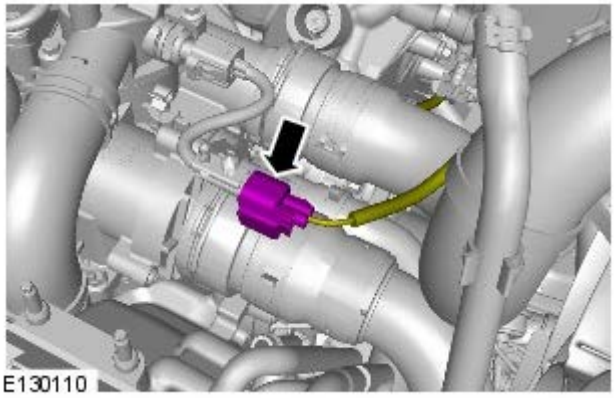
Install a new O-ring seal.

Torque: 10 Nm

23. NOTE: Remove and discard the blanking caps.

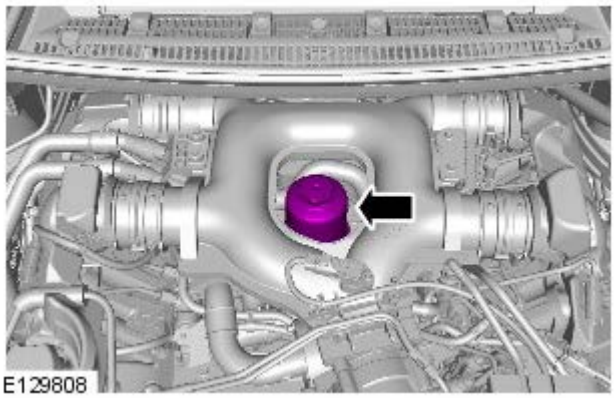


24.



25. CAUTION: Tighten the component finger tight first.

Torque: 35 Nm



26. Refer to: Fuel Rail RH (303-04E Fuel Charging and Controls - TDV8 4.4L Diesel, Removal and Installation).

27. Check and top-up the engine oil.

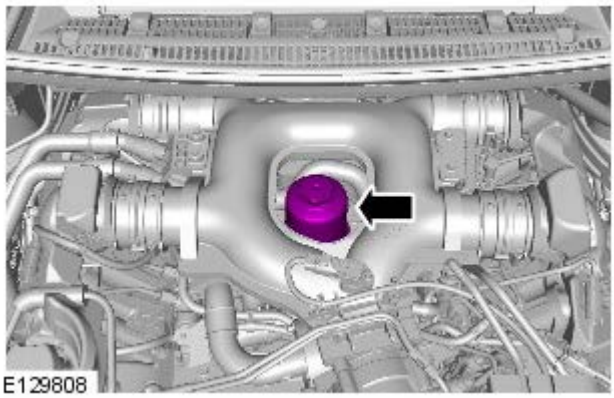
Published: 24-Oct-2013

Engine Emission Control - TDV8 4.4L Diesel - Exhaust Gas Recirculation (EGR) Valve Outlet Tube

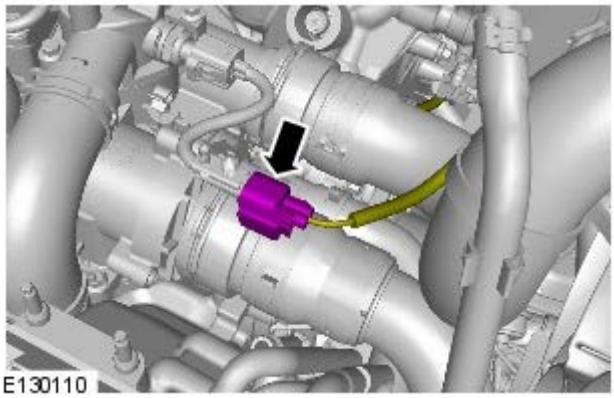
Removal and Installation

Removal

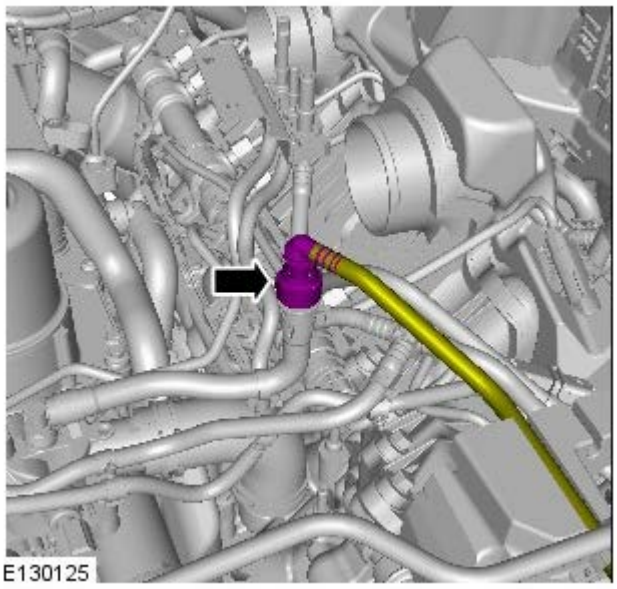
1. Refer to: Fuel Rail RH (303-04E Fuel Charging and Controls - TDV8 4.4L Diesel, Removal and Installation).


E129808

2.
   - Loosen the oil filter cover 3 turns and allow the engine oil to drain.


E130110

3.


E130125

4. CAUTIONS:

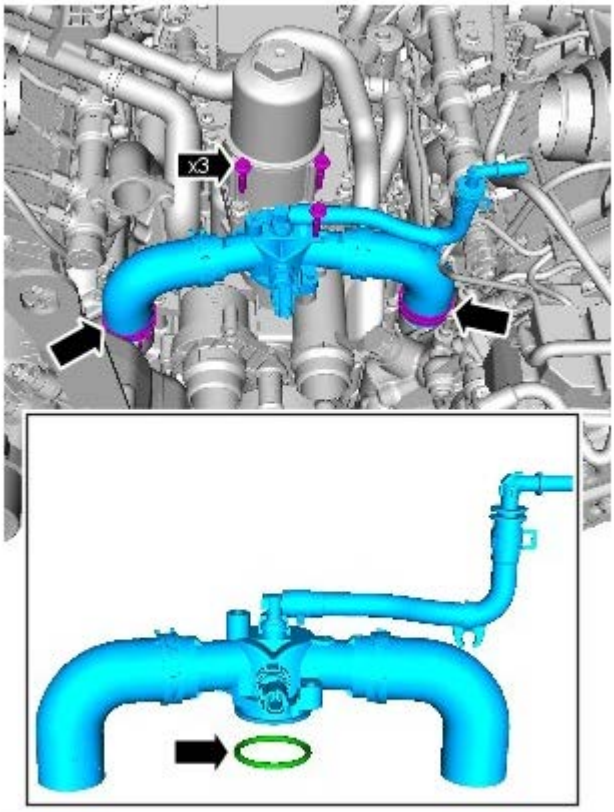
   Be prepared to collect escaping coolant.

   Make sure that all openings are sealed. Use new blanking caps.

5. CAUTIONS:

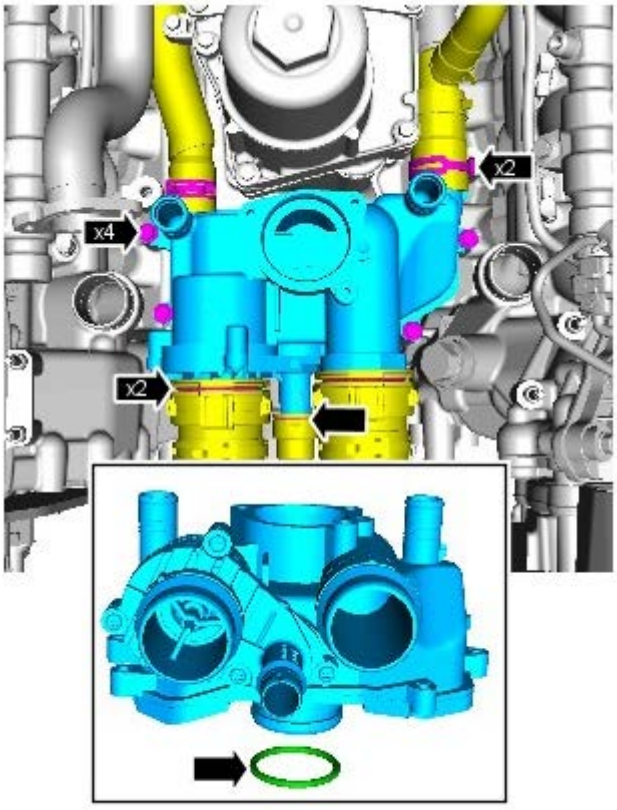
   Be prepared to collect escaping coolant.

   Make sure that all openings are sealed. Use new blanking caps.



E145026

NOTE: Remove and discard the O-ring seal.



E145027

6. CAUTIONS:

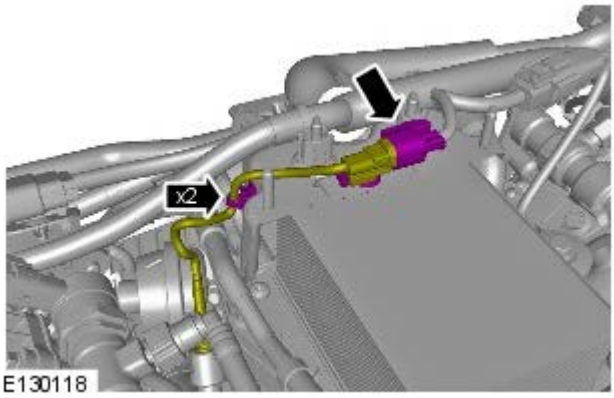
Clamp the hoses to minimize coolant loss.

Be prepared to collect escaping coolant.

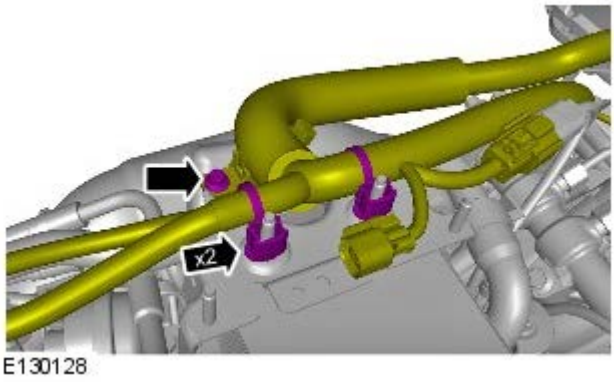
Make sure that all openings are sealed. Use new blanking caps.

NOTE: Remove and discard the O-ring seal.

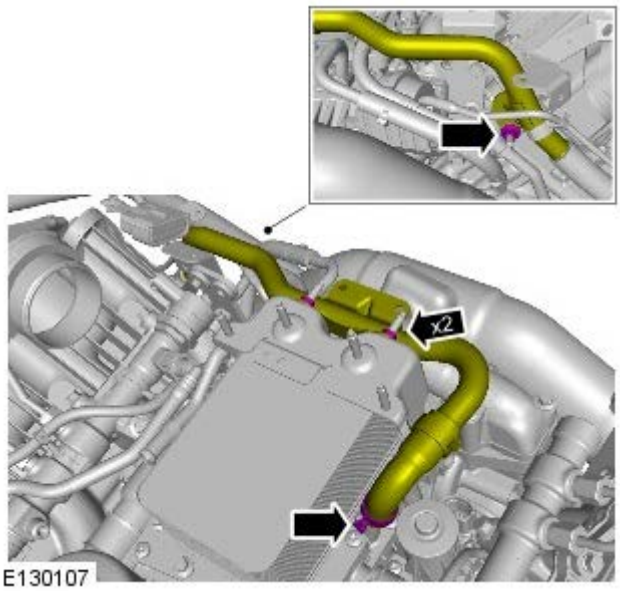
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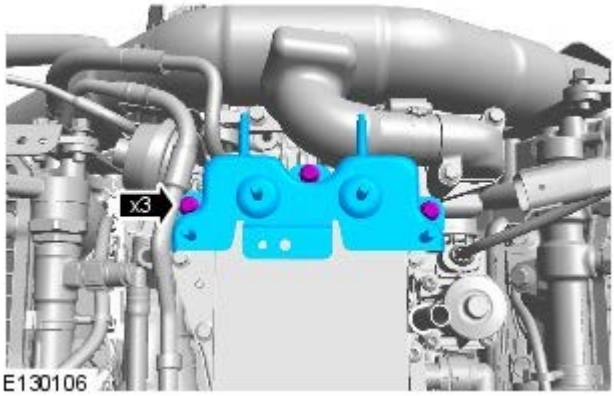
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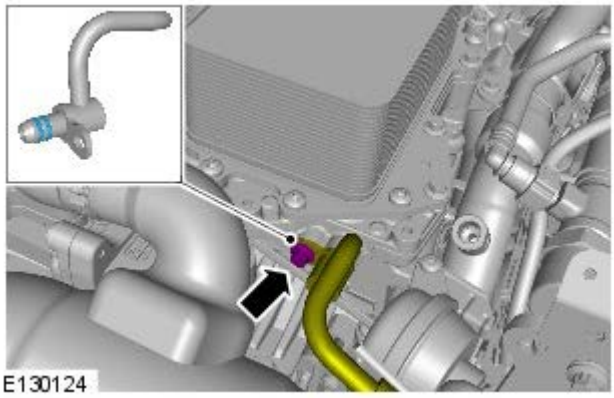
9. CAUTION: Make sure that all openings are sealed. Use new blanking caps.



10.



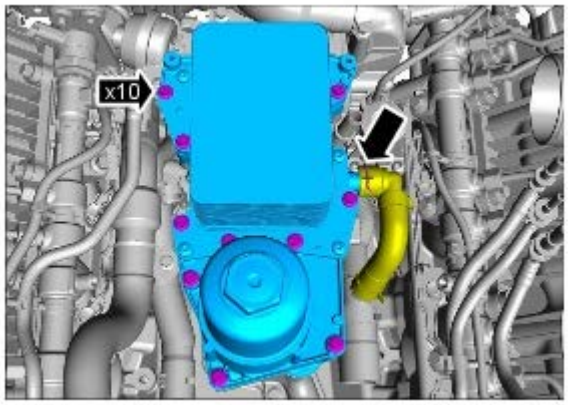
11. CAUTIONS:



Be prepared to collect escaping oil.

Make sure that all openings are sealed. Use new blanking caps.

Inspect the O-rings, replace if damaged.

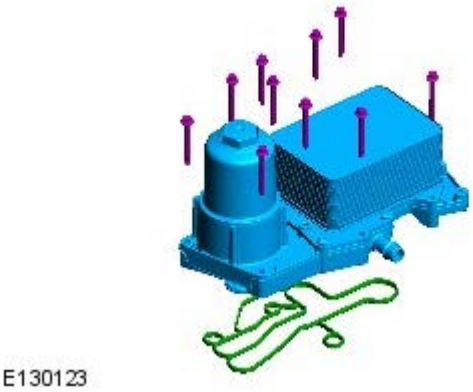


12. CAUTIONS:

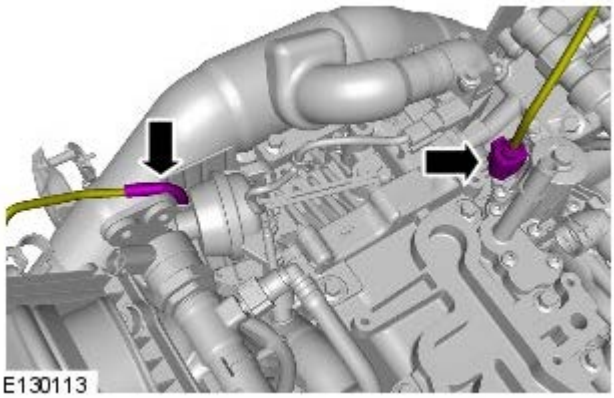
Be prepared to collect escaping oil.

Be prepared to collect escaping coolant.

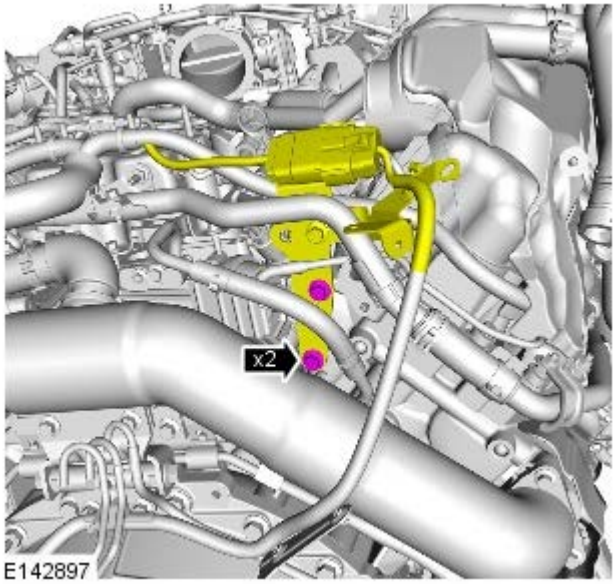
NOTE: Remove and discard the gasket.



13.



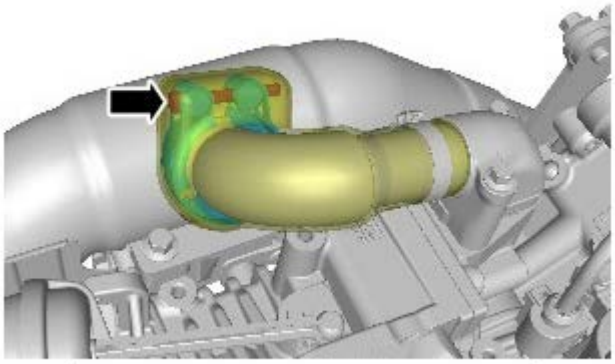
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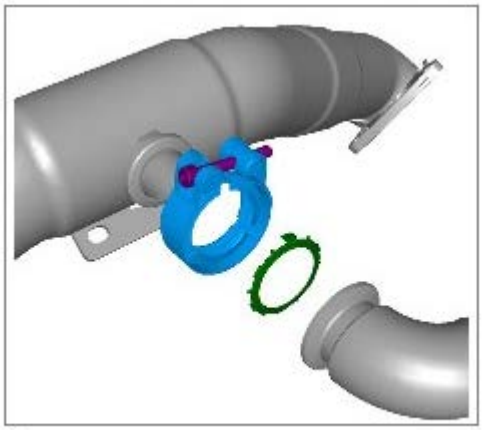


E142897

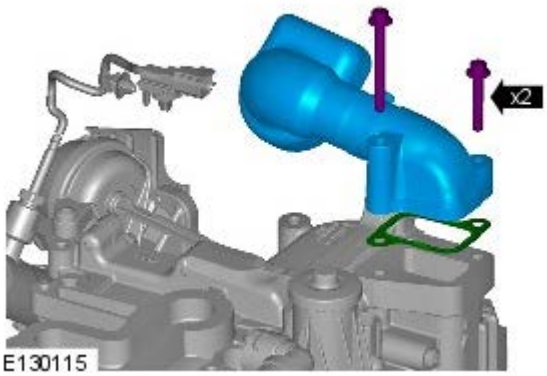
15. CAUTION: Make sure that all openings are sealed. Use new blanking caps.

NOTE: Remove and discard the gasket.



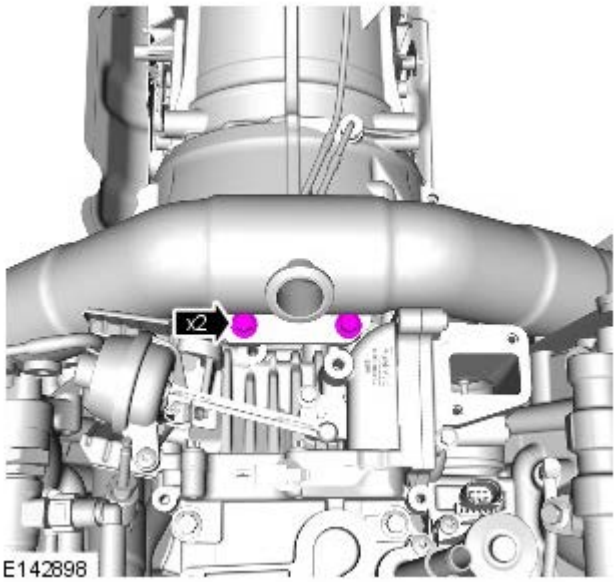

E130116

16. NOTE: Remove and discard the gasket.

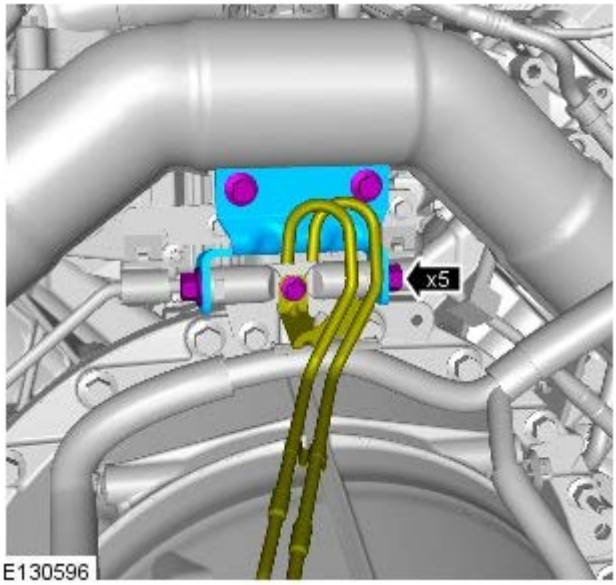


E130115

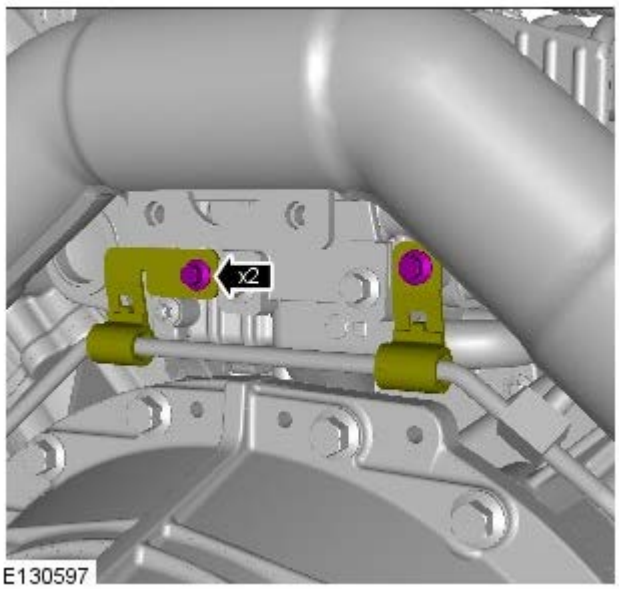
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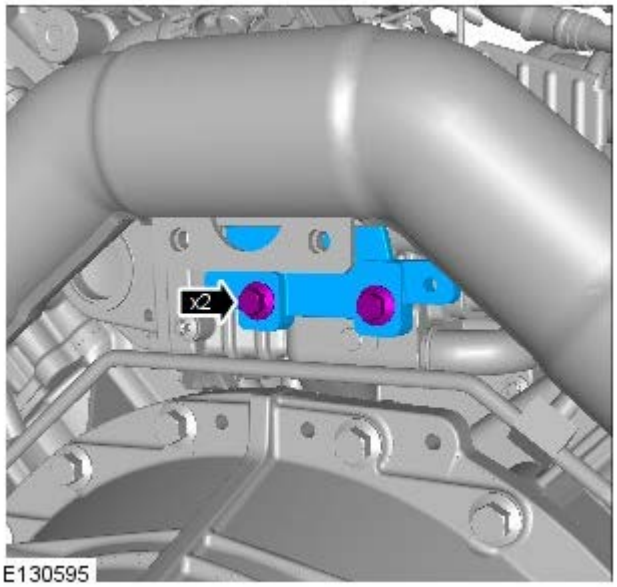
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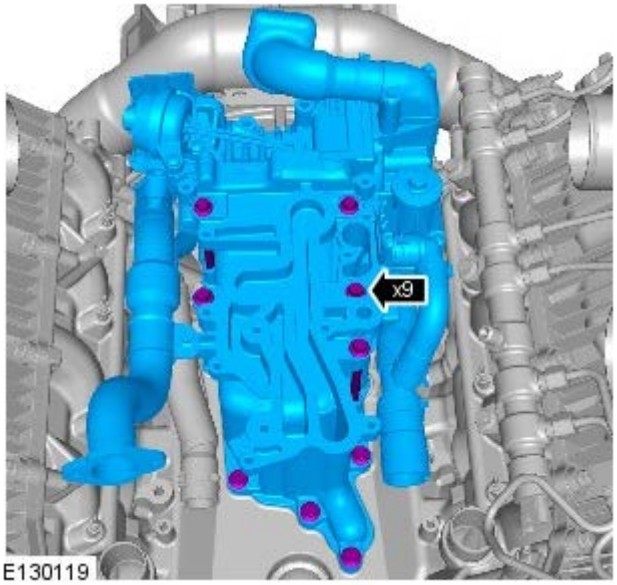
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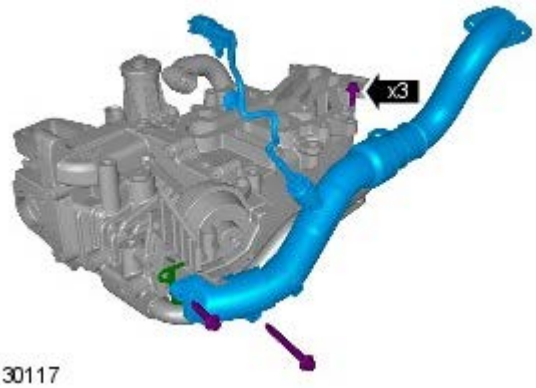
20.



E130595



E130119



E130117

21. CAUTIONS:

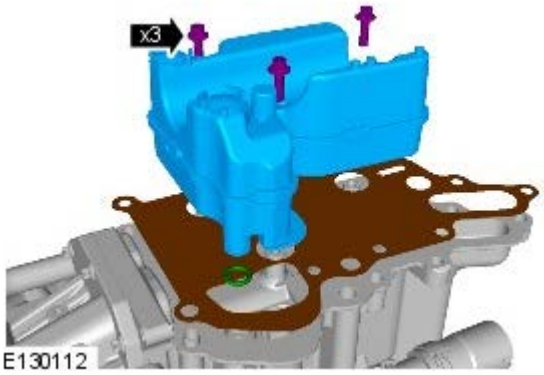
Be prepared to collect escaping oil.

Be prepared to collect escaping coolant.

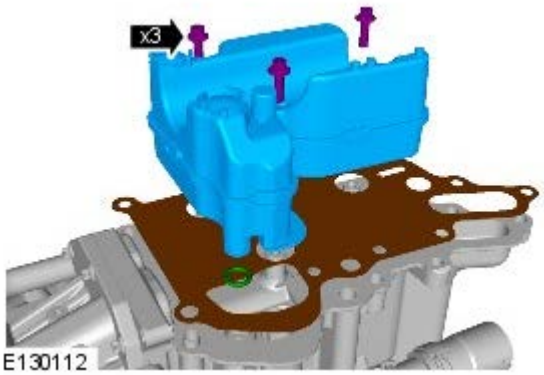
22. NOTE: Remove and discard the gasket.

23. CAUTION: Inspect the seal, replace if damaged.

NOTE: Remove and discard the gasket.



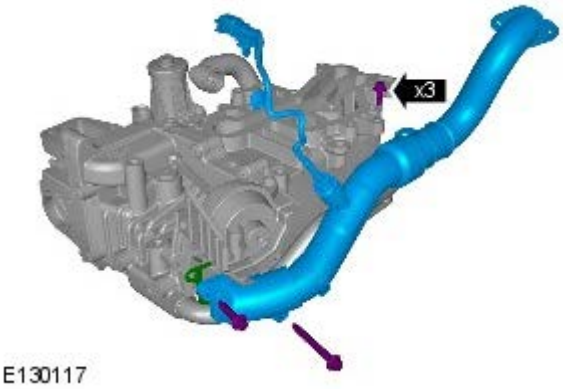
Installation



1. CAUTION: Make sure that the mating surfaces are clean and free of corrosion and foreign material.

   NOTE: Install a new gasket.

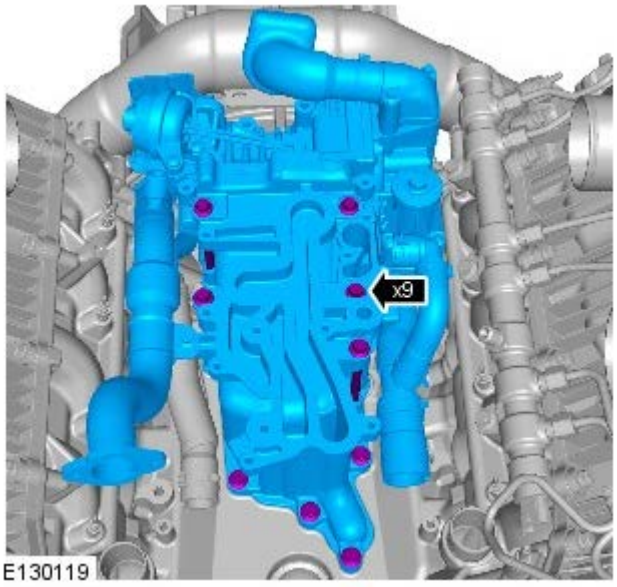
   Torque: 5 Nm



2. CAUTION: Install all the bolts finger tight before final tightening.

   NOTE: Install a new gasket.

   Torque: 10 Nm



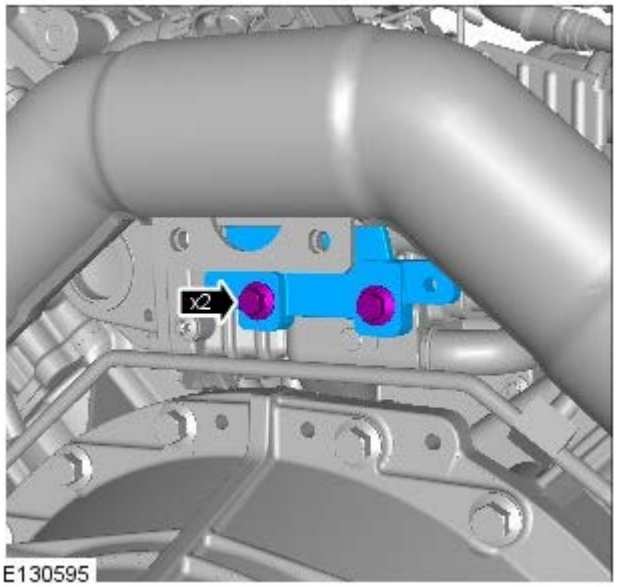
3. CAUTIONS:

   Make sure that the mating faces are clean and free of corrosion and foreign material.

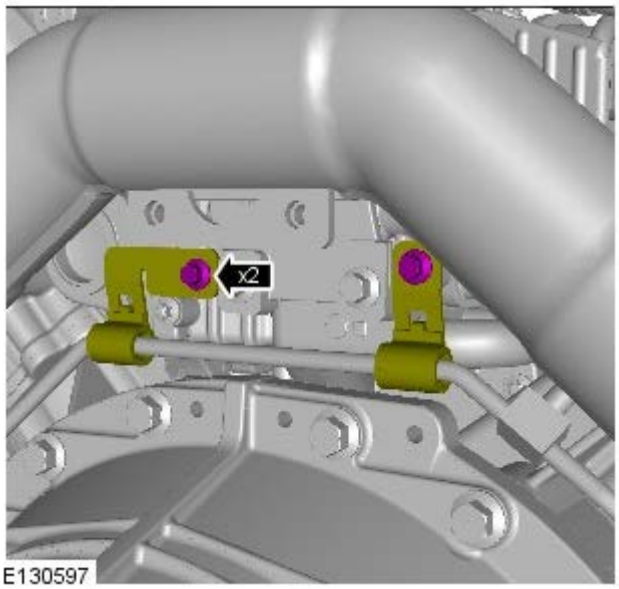
   Install all the bolts finger tight before final tightening.

   Torque: 23 Nm

4. *Torque:* 23 Nm

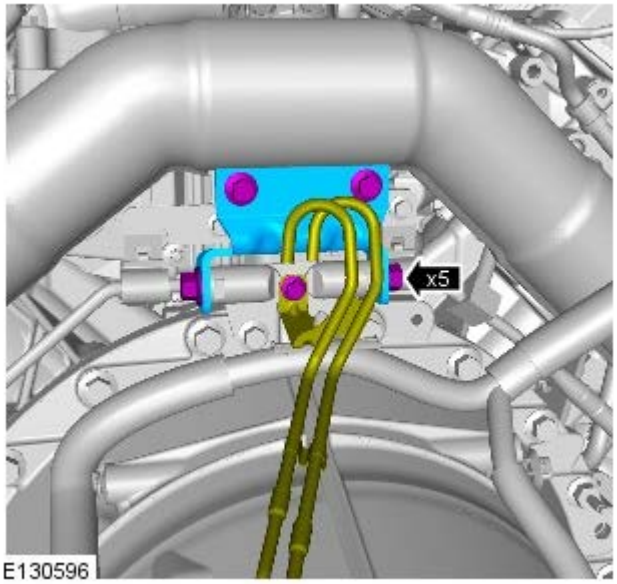


5. *Torque:* 10 Nm

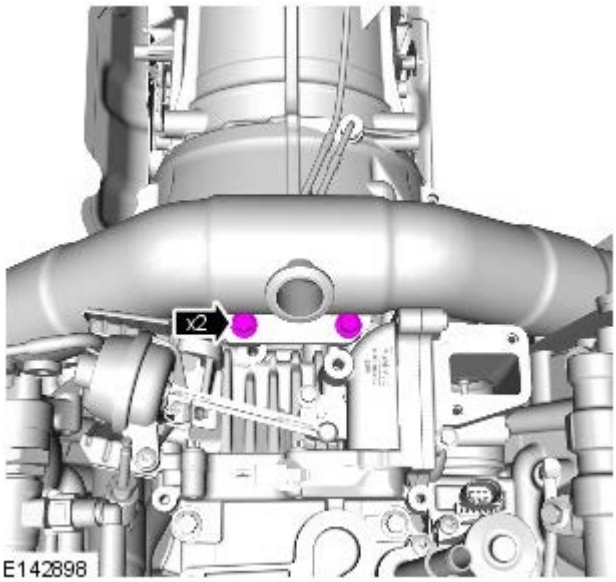


6. CAUTION: Install all the bolts finger tight before final tightening.

Torque:
M8 23 Nm
M6 10 Nm

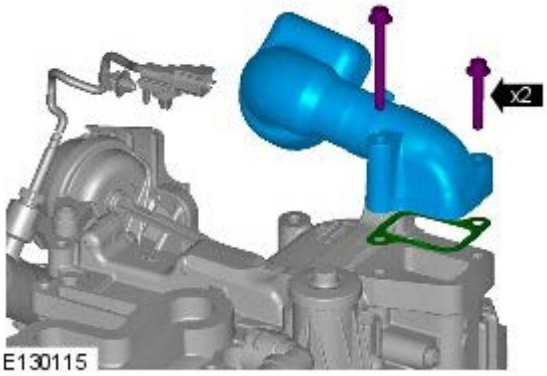


7. *Torque:* 23 Nm



8. NOTE: Install a new gasket.

   Torque: 10 Nm

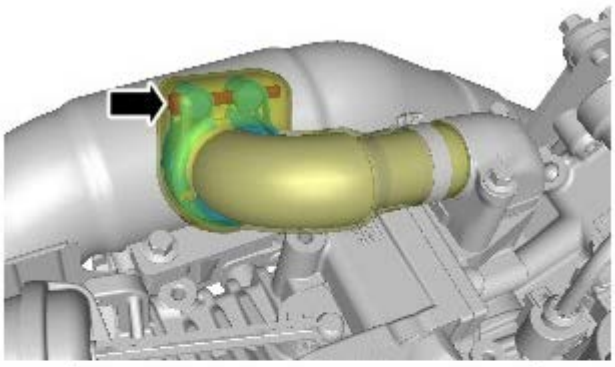


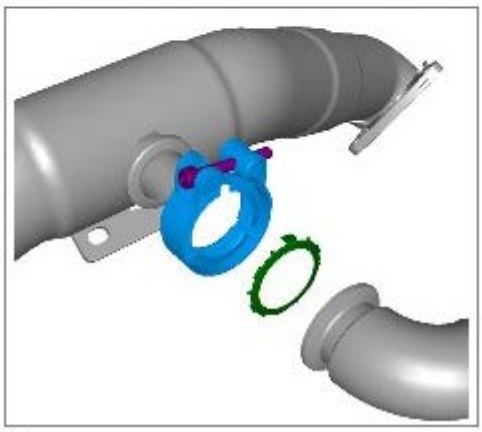
9. NOTES:

   Remove and discard the blanking caps.

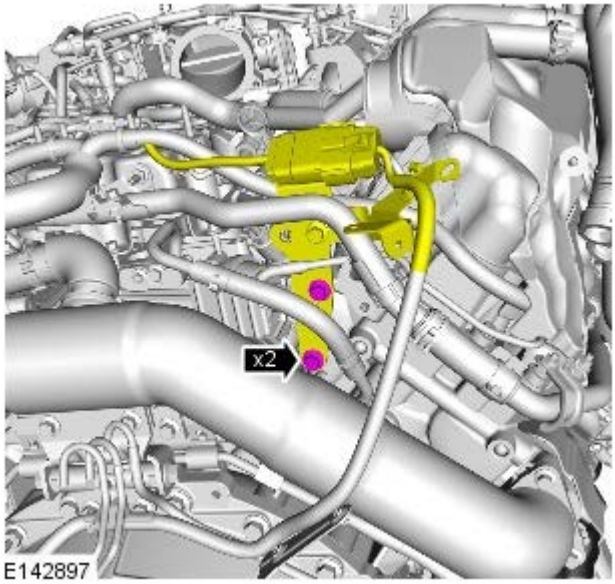
   Install a new gasket.

   Torque: 7 Nm

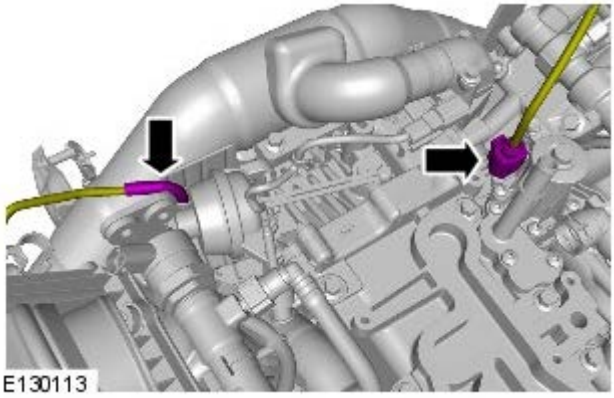


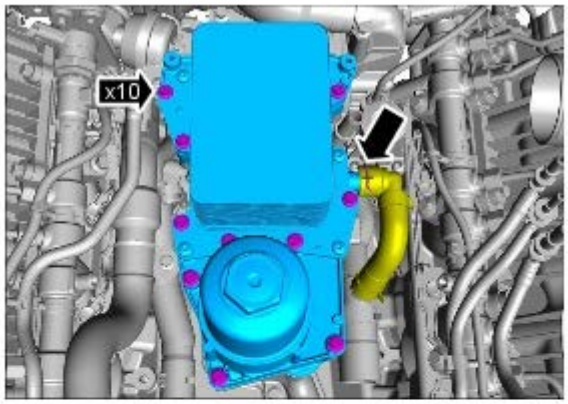


10. *Torque:* 25 Nm



11.





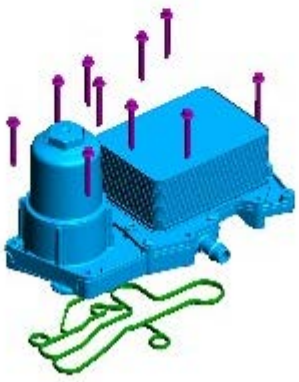
12. CAUTIONS:

Make sure that the surface is clean and free of foreign material.

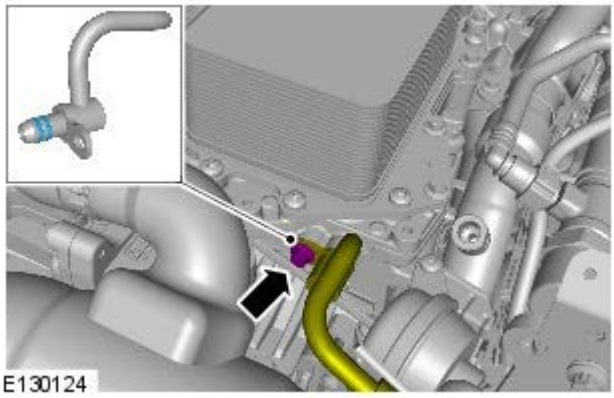
Install all the bolts finger tight before final tightening.

NOTE: Install a new gasket.

Torque: 13 Nm

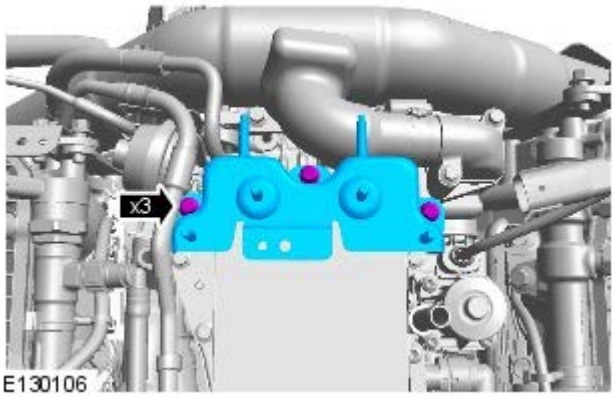


13. CAUTION: Make sure that the mating faces are clean and free of corrosion and foreign material.



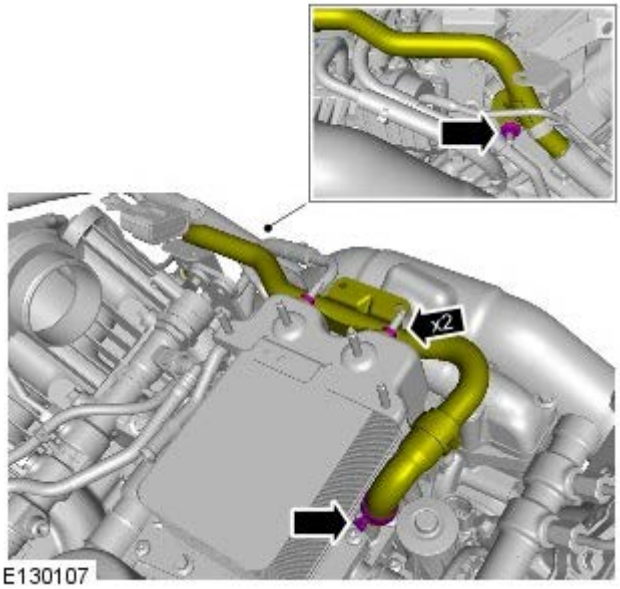
NOTE: Remove and discard the blanking caps.

Torque: 10 Nm



14. CAUTION: Install all the bolts finger tight before final tightening.

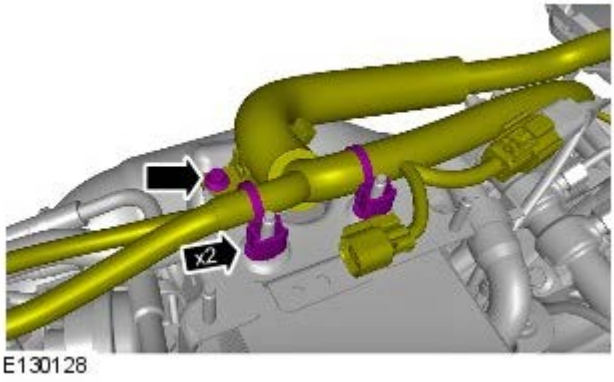
Torque: 10 Nm



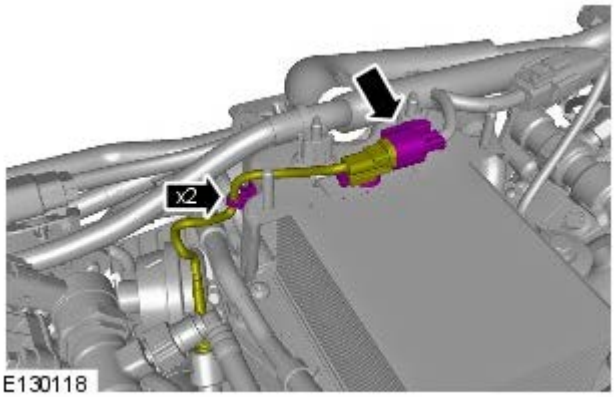
15. NOTE: Remove and discard the blanking caps.

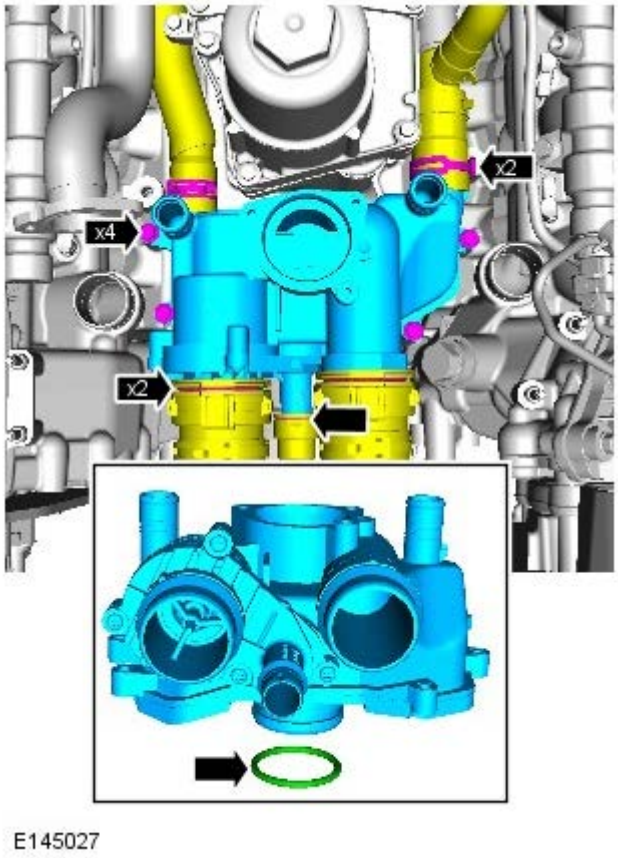
Torque: 10 Nm

16. *Torque:* 10 Nm



17.





18. CAUTION: Install all the bolts finger tight before final tightening.

NOTES:

Remove and discard the blanking caps.

Install a new O-ring seal.

Torque: 10 Nm

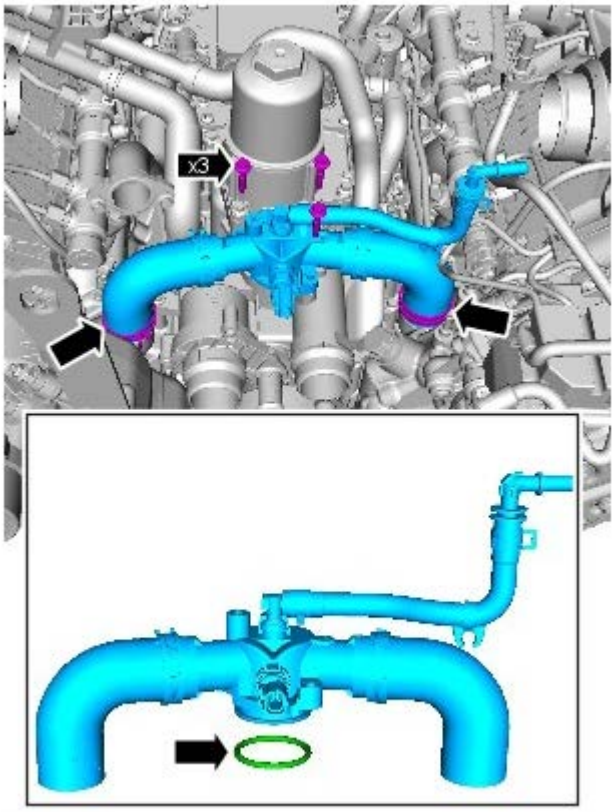
19. CAUTION: Install all the bolts finger tight before final tightening.

NOTES:

Remove and discard the blanking caps.

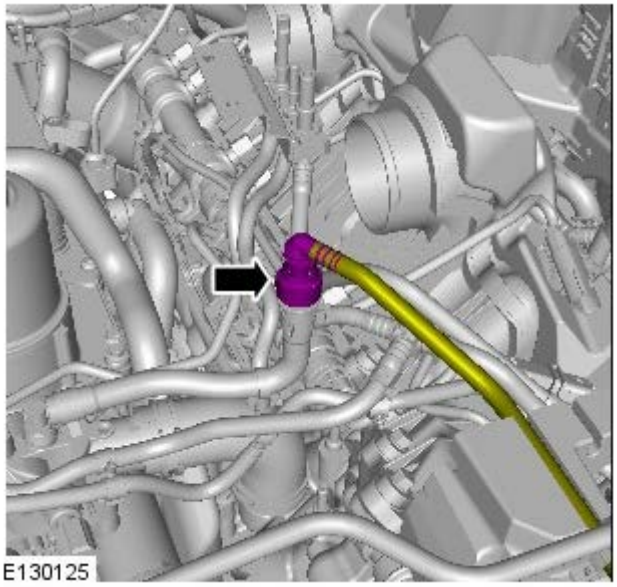
Install a new O-ring seal.

Torque: 10 Nm



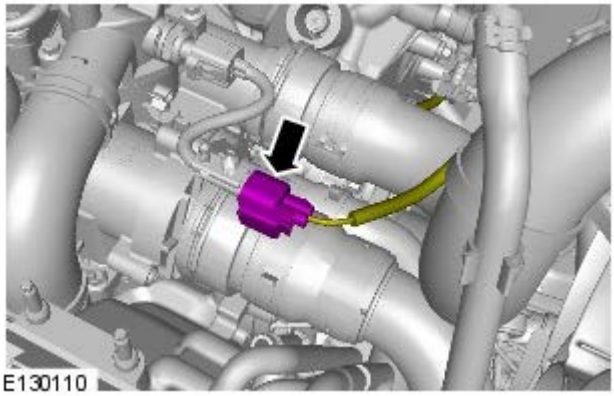
E145026

20. NOTE: Remove and discard the blanking caps.



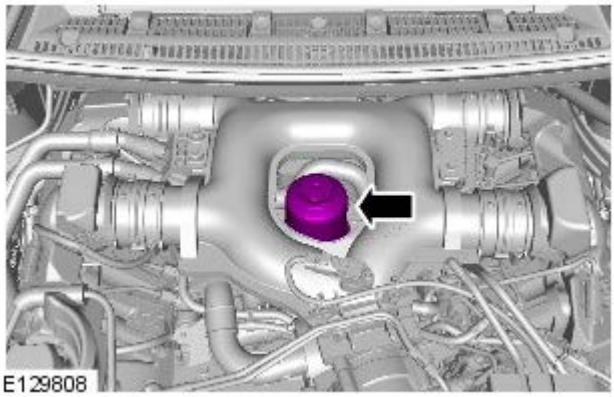
E130125

21.



E130110

22. CAUTION: Tighten the component finger tight first.



Torque: 35 Nm

23. Refer to: Fuel Rail RH (303-04E Fuel Charging and Controls - TDV8 4.4L Diesel, Removal and Installation).

24. Check and top-up the engine oil.

Published: 27-Jun-2013

Intake Air Distribution and Filtering - TDV6 3.0L Diesel -

Torque Specification

Description	Nm	lb-ft	lb-in
Air cleaner outlet pipe clip	3.5	-	31
*Charge air cooler torx bolt	9	7	-
Charge air cooler M6	5	4	-
Charge air cooler nut	9	7	-
Charge air cooler inlet pipe clip	5	-	44
Charge air cooler outlet pipe clip	5	-	44

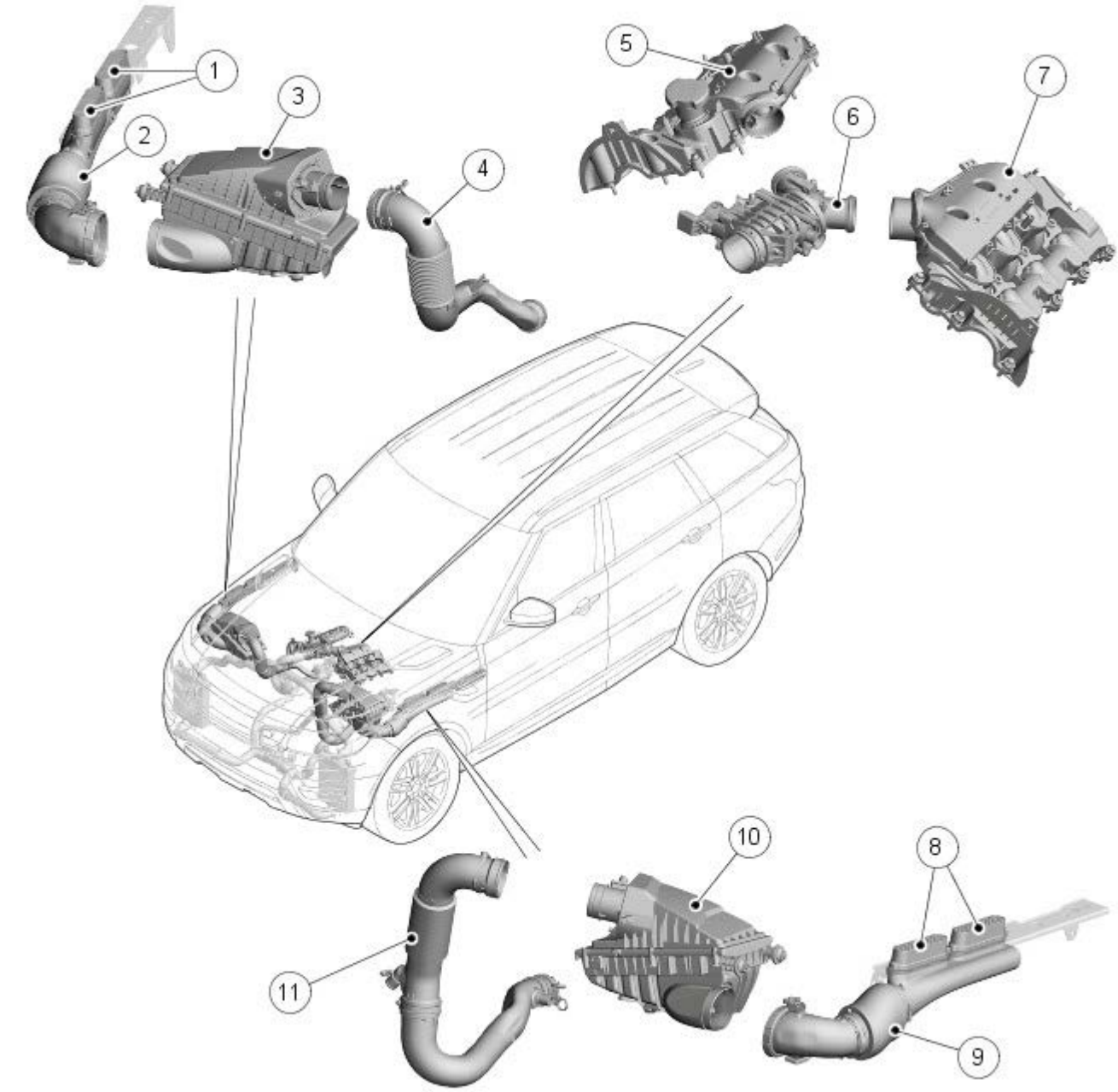
* A new nut must be installed.

Published: 22-May-2013

Intake Air Distribution and Filtering - TDV6 3.0L Diesel - Intake Air Distribution and Filtering

Description and Operation

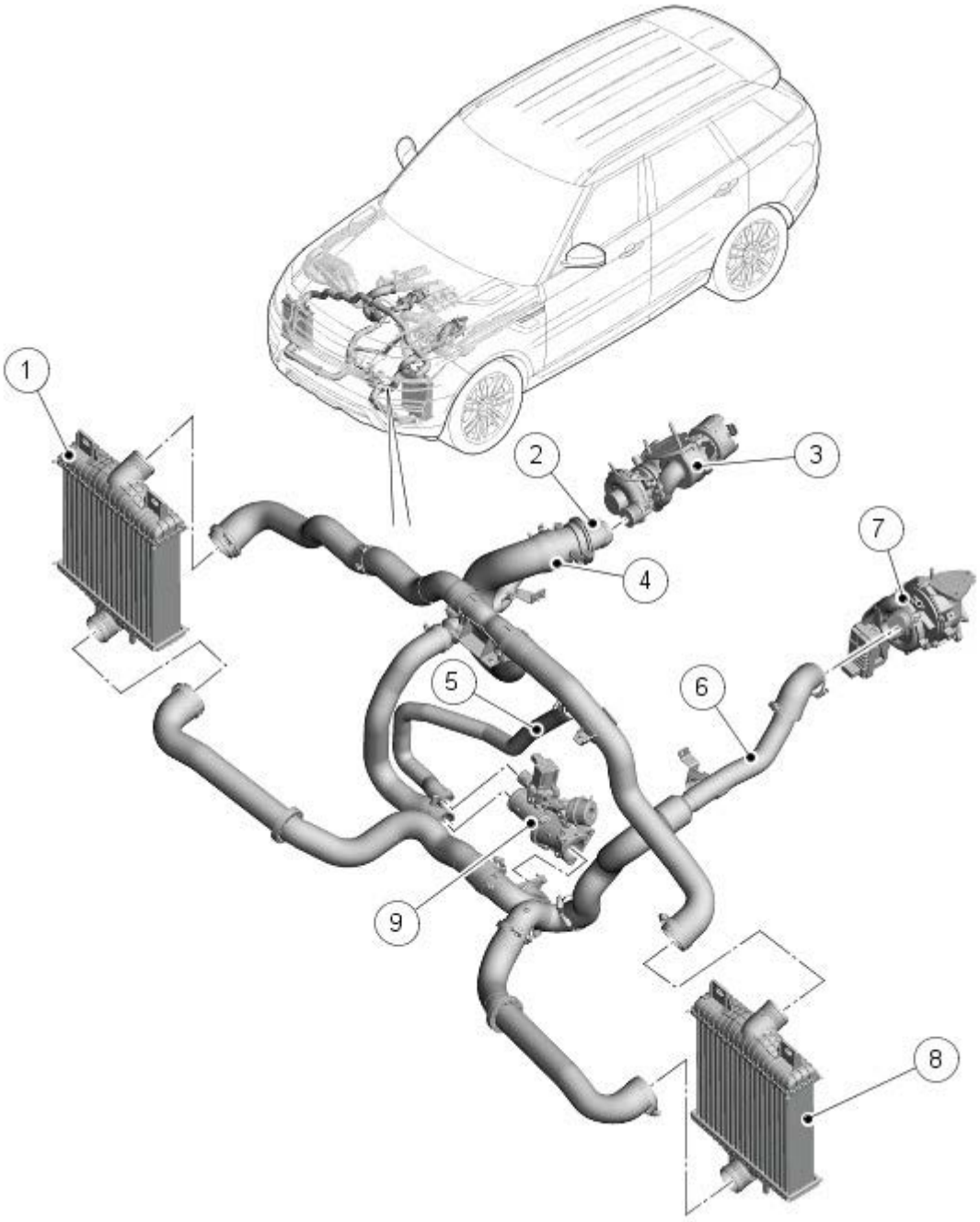
COMPONENT LOCATION - SHEET 1 OF 2



E153450

Item	Part Number	Description
1	-	Right intake grilles
2	-	Right dirty air duct
3	-	Right air cleaner
4	-	Right clean air ducts
5	-	Right intake manifold (integral with camshaft cover)
6	-	Electric throttle
7	-	Left intake manifold (integral with camshaft cover)
8	-	Left intake grilles
9	-	Left dirty air duct
10	-	Left air cleaner
11	-	Left clean air ducts

COMPONENT LOCATION - SHEET 2 OF 2



E153451

Item	Part Number	Description
1	-	Right charge air cooler
2	-	Charge air ducts – secondary turbocharger to charge air intake valve
3	-	Secondary turbocharger
4	-	Charge air ducts – charge air coolers to electric throttle
5	-	Charge air duct – charge air intake valve to left clean air duct
6	-	Charge air ducts – primary turbocharger and charge air intake valve to charge air coolers
7	-	Primary turbocharger
8	-	Left charge air cooler
9	-	Charge air intake valve

OVERVIEW

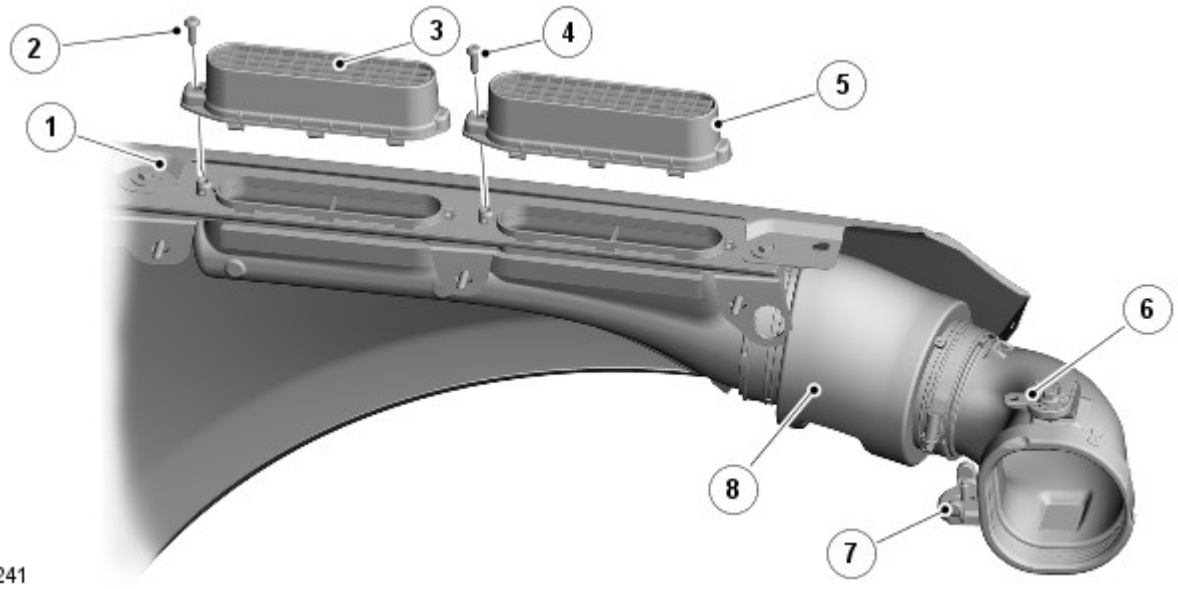
The intake air distribution and filtering system cleans, compresses and cools the intake air. The system comprises:

- Two dirty air ducts.
- Two air cleaners.
- Two clean air ducts.
- Two turbochargers.
- Charge air ducts.
- A charge air intake valve.
- Two charge air coolers.
- An electric throttle.
- Two intake manifolds.

Air flows through the dirty air ducts, air cleaners and clean air ducts to the compressor intakes of the turbochargers. The turbochargers compress the air, which is then transferred through the charge air ducts to the charge air intake valve, charge air coolers, electric throttle and the intake manifolds.

DESCRIPTION

Dirty Air Ducts



E144241

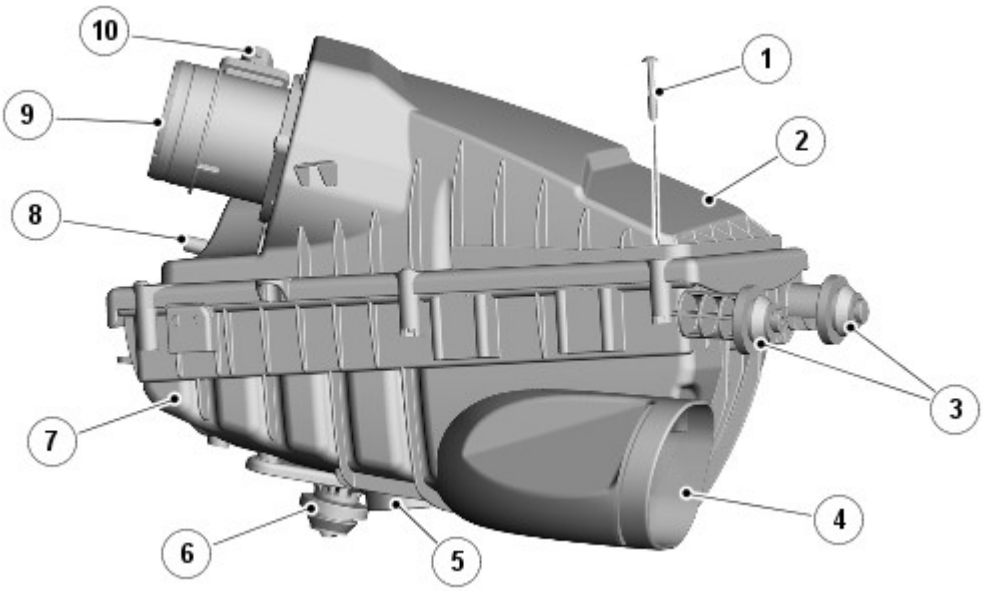
Item	Part Number	Description
1	-	Front fender support
2	-	Screw
3	-	Intake grille
4	-	Screw
5	-	Intake grille
6	-	Front upper bracket
7	-	Front lower bracket
8	-	Non-porous sleeve

The dirty air ducts are installed in the front fenders to transfer ambient air from under the edges of the hood to the air cleaners.

Each dirty air duct locates in the intake of the related air cleaner and is attached to the front inner fender with two brackets. The intake of each dirty air duct is attached to two intake grilles on top of the front fender support. When the hood is closed, the intake grilles locate in guides attached to the hood inner panel.

A porous section, covered by a non-porous sleeve to prevent moisture ingress, is incorporated into each dirty air duct to reduce induction noise.

Air Cleaners



E144242

Item	Part Number	Description
1	-	Screw (6 off)
2	-	Lid
3	-	Isolators
4	-	Air intake
5	-	Drain valve
6	-	Isolator
7	-	Base
8	-	Engine vacuum system connection (left air cleaner only)
9	-	Air outlet
10	-	Mass Air Flow (MAF) sensor (left air cleaner) or Mass Air Flow and Temperature (MAFT) sensor (right air cleaner)

An air cleaner is located in each front corner of the engine compartment. Three spigots fitted with isolator bushes locate each air cleaner in holes in the related front inner fender and front suspension housing.

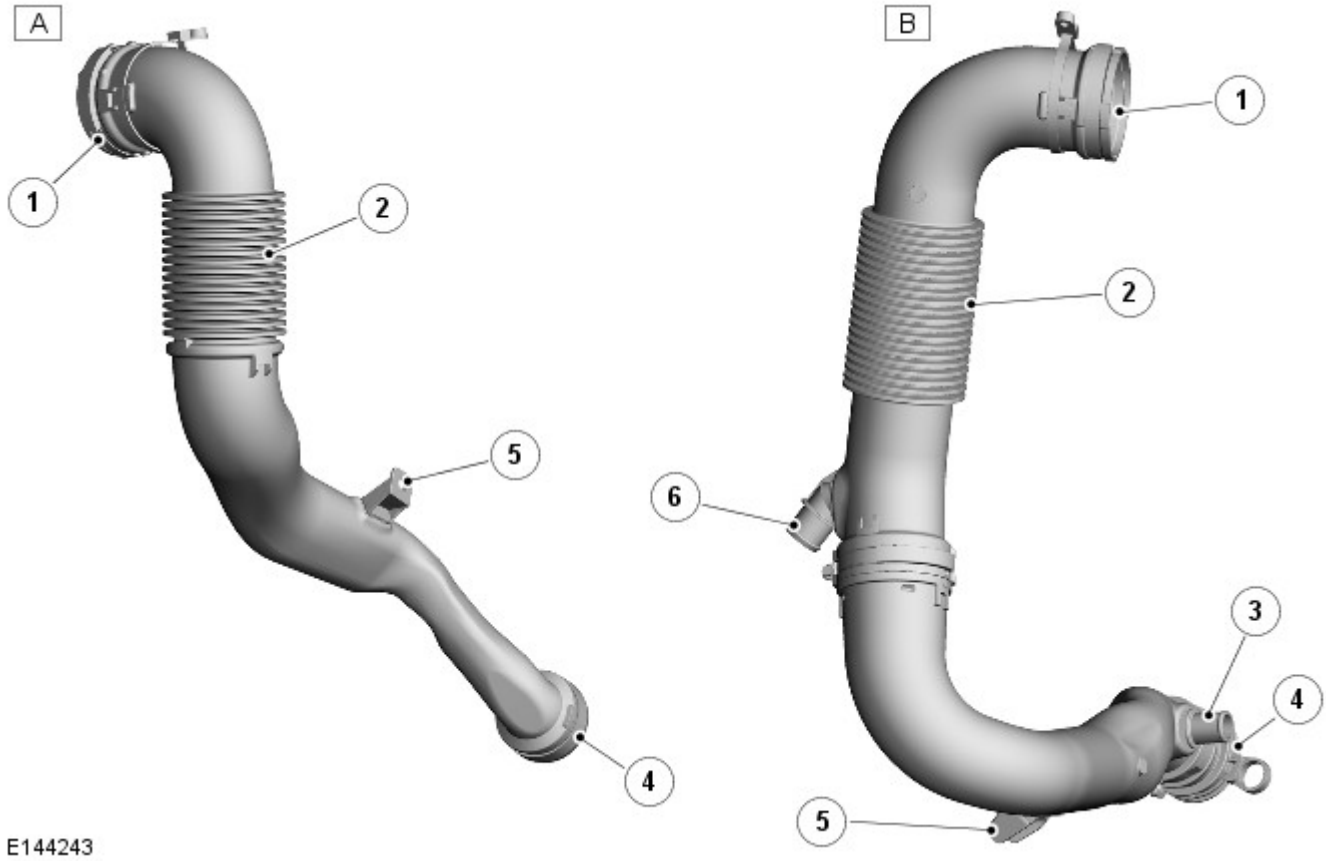
Each air cleaner consists of a filter element installed in a base and enclosed with a lid secured by six screws. The filter element is a pleated, paper type with an integral seal. Air intake and outlet connections are incorporated into the base and lid respectively. The bottom of the base incorporates a drain valve to prevent the accumulation of water in the air cleaner.

The lid of the left air cleaner incorporates a connection for the engine vacuum system. For additional information, refer to:

Turbocharger (303-04B Fuel Charging and Controls - Turbocharger - SDV6 3.0L Diesel - Hybrid Electric Vehicle/TDV6 3.0L Diesel, Description and Operation),
Engine Emission Control (303-08A Engine Emission Control - TDV6 3.0L Diesel, Description and Operation).

The air outlet connection of each air cleaner incorporates either a MAF (Mass Air Flow) sensor (left air cleaner) or a MAFT (Mass Air Flow and Temperature) sensor (right air cleaner). The sensors are connected to the ECM (Engine Control Module).
For additional information, refer to: Electronic Engine Controls (303-14A Electronic Engine Controls - TDV6 3.0L Diesel, Description and Operation).

Clean Air Ducts



A = Right clean air duct; B = Left clean air duct

Item	Part Number	Description
1	-	Air intake
2	-	Convolute
3	-	Crankcase ventilation hose connection
4	-	Air outlet

5	-	Bracket
6	-	Charge air bypass hose connection

The clean air ducts transfer air from the air cleaner outlets to the compressor intakes on the turbochargers. Each clean air duct incorporates a convolute section to accommodate relative movement between the engine mounted turbochargers and the body mounted air cleaners. The left clean air duct also incorporates connections for:

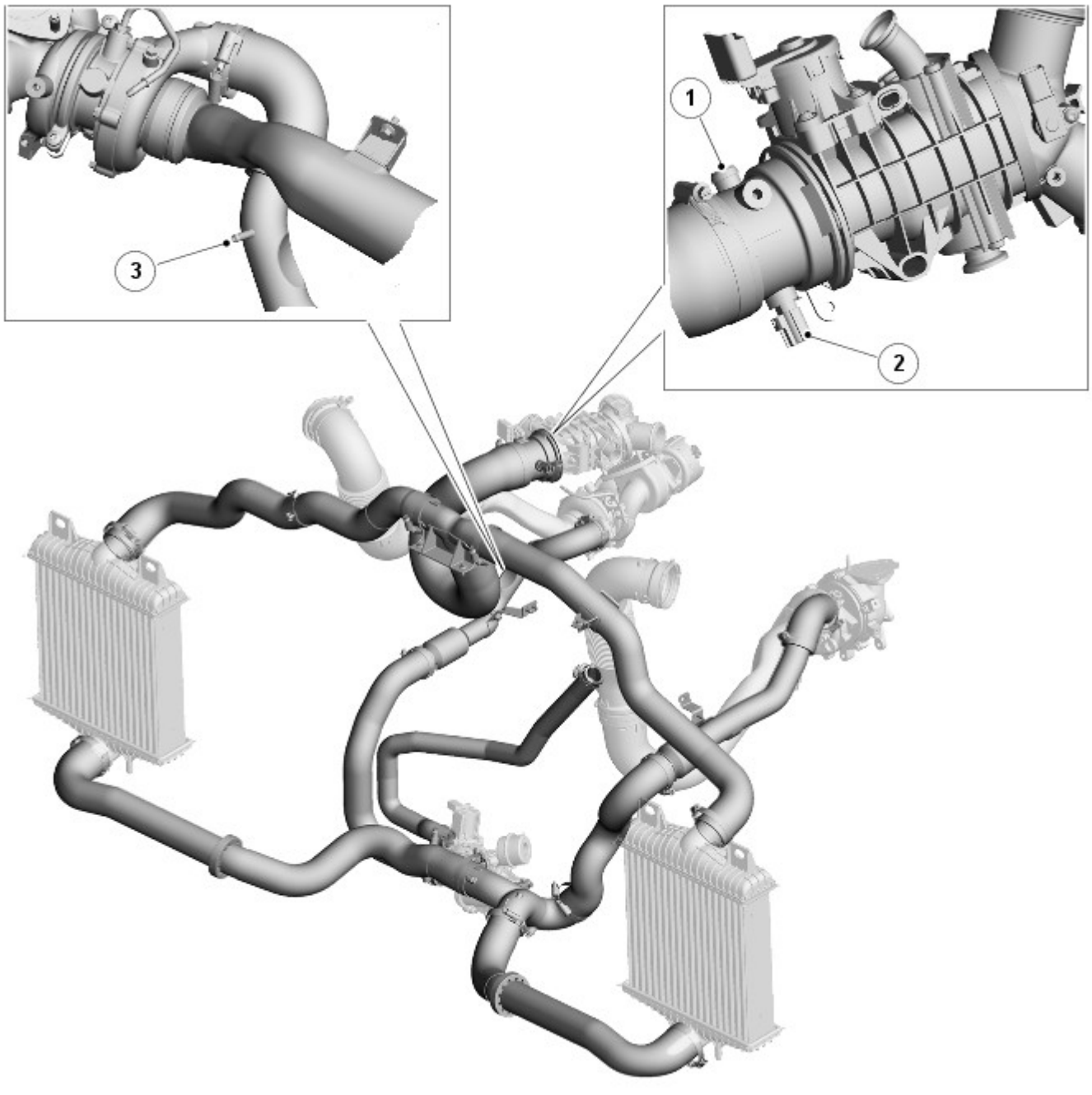
- The bypass hose from the charge air intake valve.
  For additional information, refer to: Turbocharger (303-04B Fuel Charging and Controls - Turbocharger - SDV6 3.0L Diesel - Hybrid Electric Vehicle/TDV6 3.0L Diesel, Description and Operation).
- The crankcase ventilation hose from the oil separator.
  For additional information, refer to: Engine Emission Control (303-08A Engine Emission Control - TDV6 3.0L Diesel, Description and Operation).

Brackets on the clean air ducts attach the ducts to the A/C compressor (left air duct) and the generator mounting bracket (right clean air duct).

Turbochargers

The turbochargers are attached to the exhaust manifolds. A VGT (variable geometry turbine) turbocharger, designated as the primary turbocharger, is located on the left side of the engine. A fixed vane turbocharger, designated as the secondary turbocharger, is installed on the right side of the engine.
For additional information, refer to: Turbocharger (303-04B Fuel Charging and Controls - Turbocharger - SDV6 3.0L Diesel - Hybrid Electric Vehicle/TDV6 3.0L Diesel, Description and Operation).

Charge Air Ducts



E144244

Item	Part Number	Description

1	-	Secondary turbocharger air tube connection
2	-	Charge air temperature sensor
3	-	Secondary turbocharger charge air pressure connection

The charge air ducts interconnect the turbocharger compressor outlets, charge air intake valve, charge air coolers and electric throttle.

The charge air duct connection with the electric throttle incorporates connections for:

- An air tube connected to the secondary turbocharger.
  For additional information, refer to: Turbocharger (303-04B Fuel Charging and Controls - Turbocharger - SDV6 3.0L Diesel - Hybrid Electric Vehicle/TDV6 3.0L Diesel, Description and Operation).
- A charge air temperature sensor connected to the ECM.
  For additional information, refer to: Electronic Engine Controls (303-14A Electronic Engine Controls - TDV6 3.0L Diesel, Description and Operation).

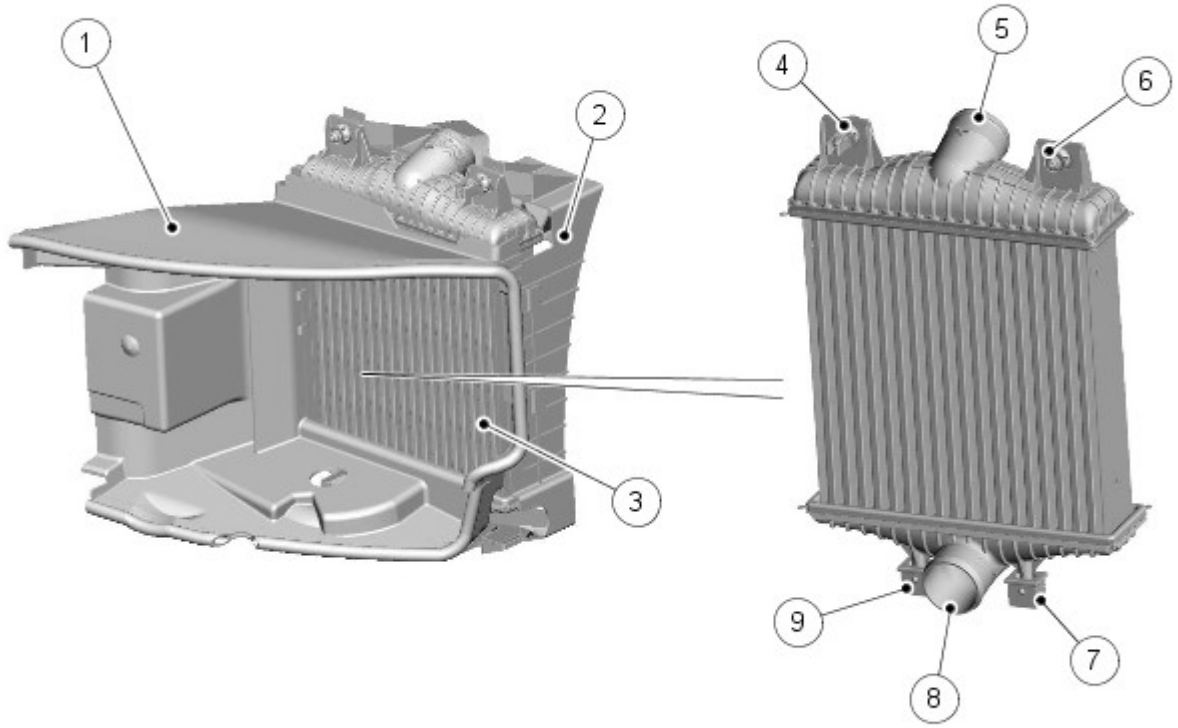
The charge air duct connected to the outlet of the secondary turbocharger incorporates a connection for the charge air pressure sensor.
For additional information, refer to: Electronic Engine Controls (303-14A Electronic Engine Controls - TDV6 3.0L Diesel, Description and Operation).

Charge Air Intake Valve

The charge air intake valve is attached to a bracket on the front subframe and the cooling pack protector.

The charge air intake valve is used by the ECM to change turbocharger operation between mono and bi-turbo modes. The valve controls the flow of air from the compressor of the secondary turbocharger to the clean air duct of the primary turbocharger and to the charge air coolers.
For additional information, refer to: Turbocharger (303-04B Fuel Charging and Controls - Turbocharger - SDV6 3.0L Diesel - Hybrid Electric Vehicle/TDV6 3.0L Diesel, Description and Operation).

Charge Air Coolers



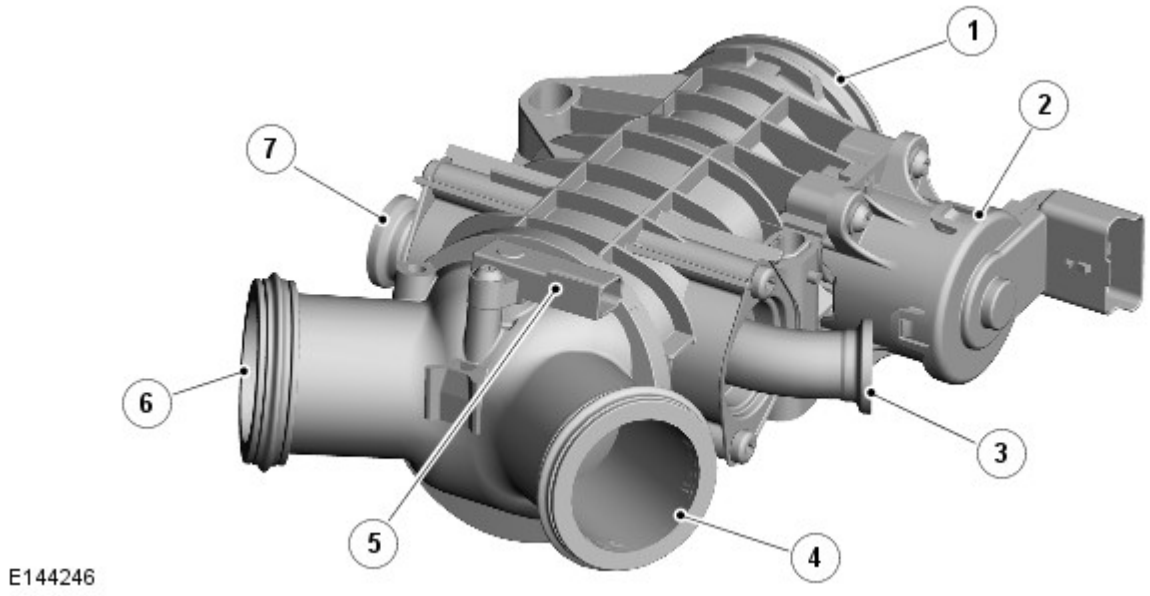
E153452

Item	Part Number	Description
1	-	Front air duct
2	-	Rear air duct
3	-	Charge air cooler
4	-	Isolator bush
5	-	Air intake
6	-	Isolator bush
7	-	Isolator
8	-	Air outlet
9	-	Isolator

The charge air coolers are air to air heat exchangers that reduce the intake air temperature.

A charge air cooler is installed each side of the cooling pack, behind the outer air intakes in the front bumper. The charge air coolers are installed in air ducts attached to the front bumper armature and the front end carrier. The lower end tank of each charge air cooler is located in the air ducts by two spigots fitted with isolator bushes. The upper end tank of each charge air cooler is attached to the front end carrier and the air ducts with two isolator bushes, nuts and bolts.

Electric Throttle



Item	Part Number	Description
1	-	Air intake
2	-	Electric motor
3	-	Right Exhaust Gas Recirculation (EGR) pipe connection
4	-	Right intake manifold connection
5	-	Manifold Absolute Pressure (MAP) sensor
6	-	Left intake manifold sensor
7	-	Left EGR pipe connection

The electric throttle regulates the air flow from the charge air coolers to the intake manifolds.

The electric throttle is installed at the front of the engine, between the cylinder heads. Two outlets on the electric throttle locate in the two intake manifolds. A stud bolt attaches the electric throttle to the right cylinder head.

The throttle plate is operated by a DC (Direct Current) electric motor attached to the throttle body. The motor is controlled by the ECM and is constantly adjusted the throttle according to the EGR valve opening, and in response to driver inputs with the throttle pedal, to control the amount of air allowed into the intake manifolds.
For additional information, refer to: Electronic Engine Controls (303-14A Electronic Engine Controls - TDV6 3.0L Diesel, Description and Operation).

Pipe connections on both sides of the throttle body allow for the attachment of the outlet pipes from the EGR (Exhaust Gas Recirculation) valves. The pipe attachments in the throttle body are specifically designed to mix the recirculated exhaust gas with the intake air and provide an even distribution to each side of the engine.

A MAP sensor is located in the top of the throttle body where the air flow splits for the two intake manifolds.
For additional information, refer to: Electronic Engine Controls (303-14A Electronic Engine Controls - TDV6 3.0L Diesel, Description and Operation).

Intake Manifolds

The intake manifolds are an integral part of the camshaft covers. Each intake manifold is connected to the electric throttle by a push fit, sealed connection.
For additional information, refer to: Engine (303-01A Engine - TDV6 3.0L Diesel, Description and Operation).

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:

Intake Air Distribution and Filtering (303-12A Intake Air Distribution and Filtering - TDV6 3.0L Diesel, Description and Operation),
Intake Air Distribution and Filtering (303-12 Intake Air Distribution and Filtering - TDV6 3.0L Diesel, Description and Operation),
Intake Air Distribution and Filtering (303-12 Intake Air Distribution and Filtering - 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
• 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: 31-Jul-2012

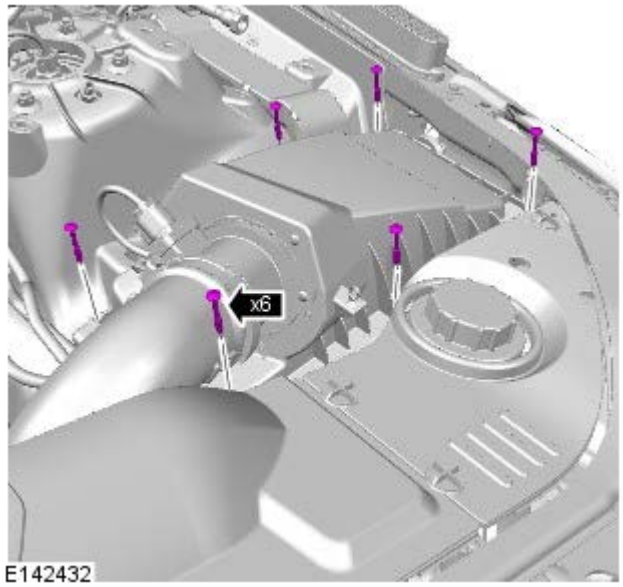
Intake Air Distribution and Filtering - TDV6 3.0L Diesel - Air Cleaner Element

Removal and Installation

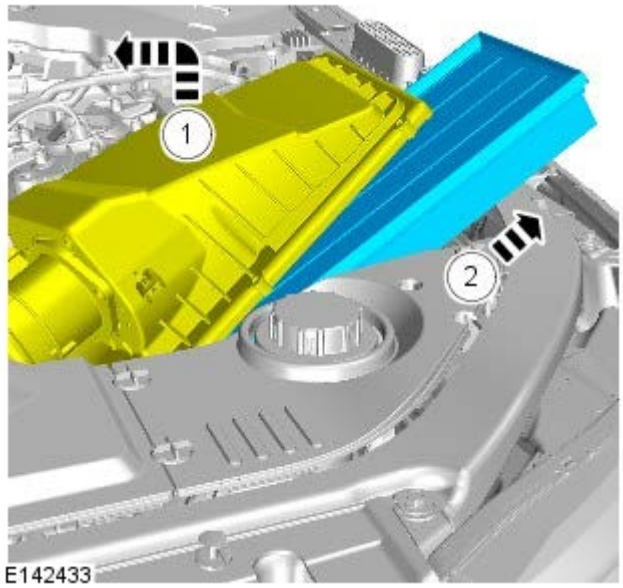
Removal

NOTE: Removal steps in this procedure may contain installation details.

1.



2.



Installation

1. To install, reverse the removal procedure.

Published: 15-May-2013

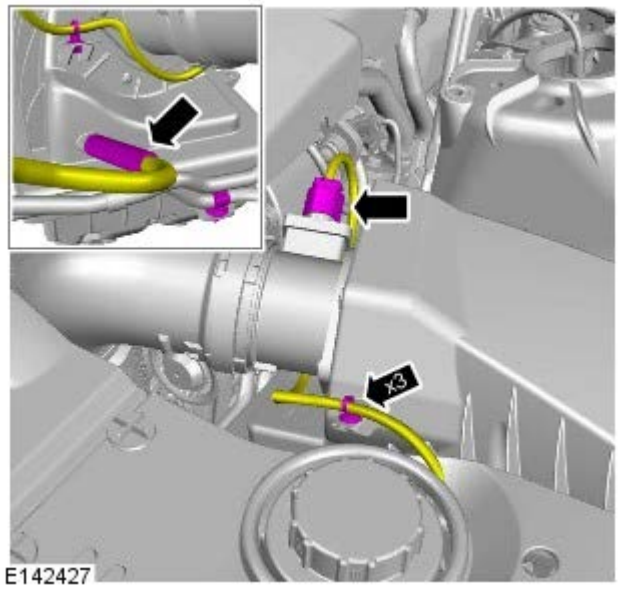
Intake Air Distribution and Filtering - TDV6 3.0L Diesel - Air Cleaner LH

Removal and Installation

Removal

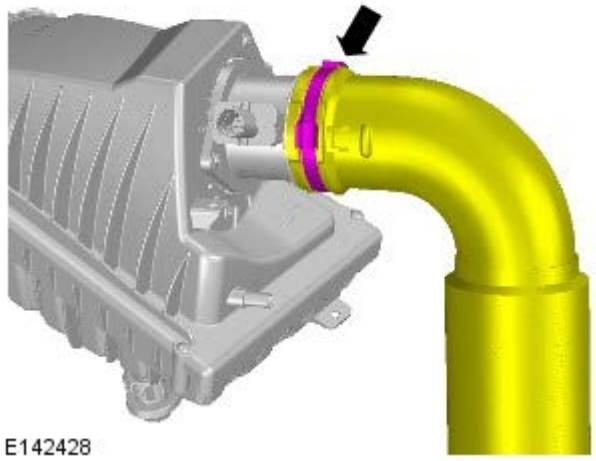
NOTE: Removal steps in this procedure may contain installation details.

1.

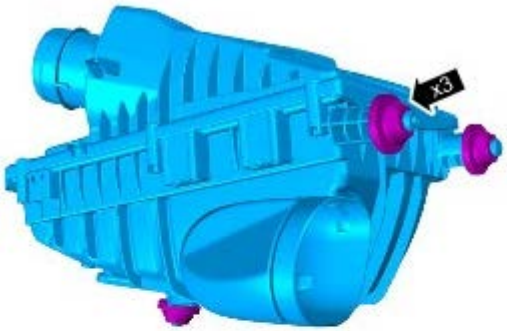


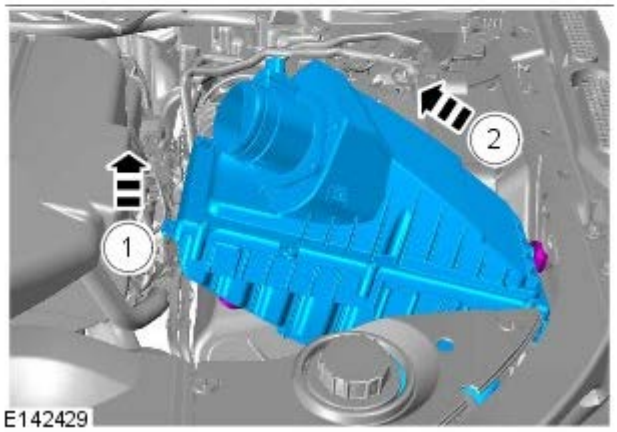
2. NOTE: Make sure the retaining clip is correctly installed and tightened..

   Torque: 3 Nm

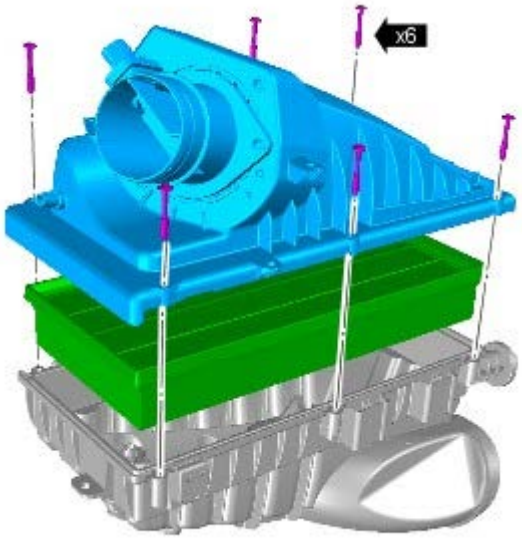


3.





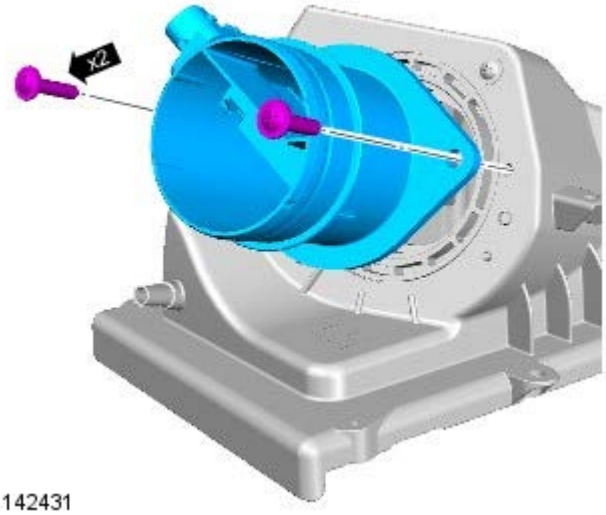
E142429



E142430

4. NOTE: Do not disassemble further if the component is removed for access only.

5. NOTE: Remove and discard the O-ring seals.



E142431

Installation

1. To install, reverse the removal procedure.

Published: 15-May-2013

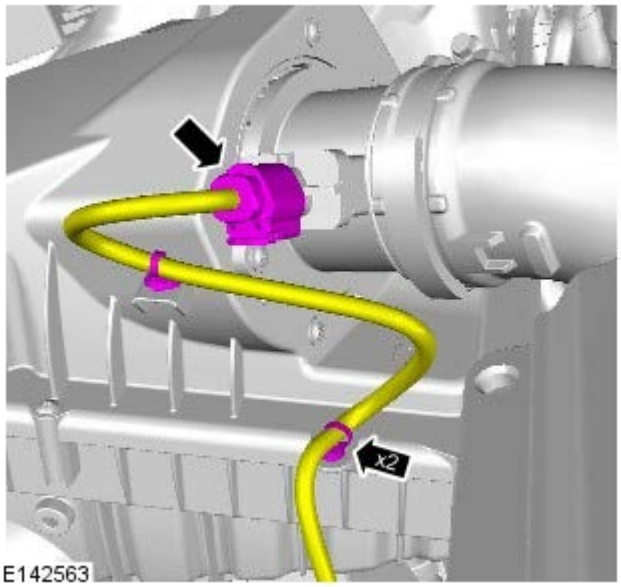
Intake Air Distribution and Filtering - TDV6 3.0L Diesel - Air Cleaner RH

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1.

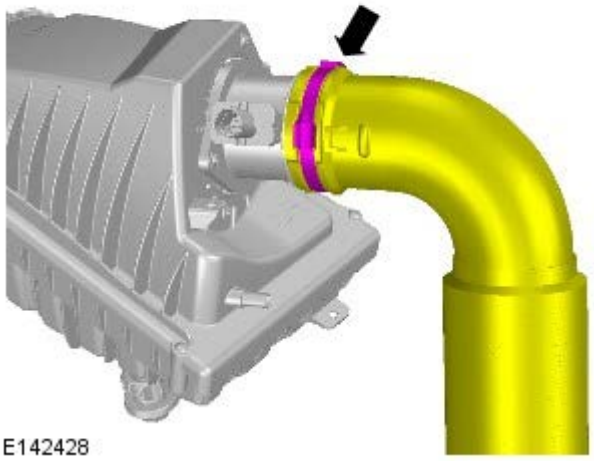


2. NOTES:

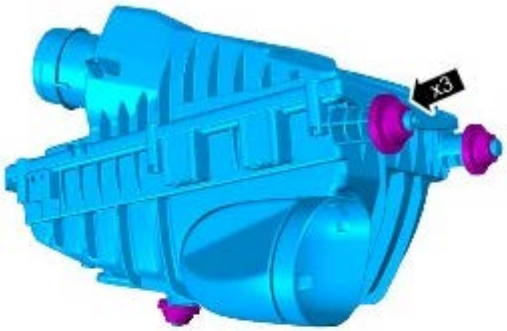
   Make sure the retaining clip is correctly installed and tightened..

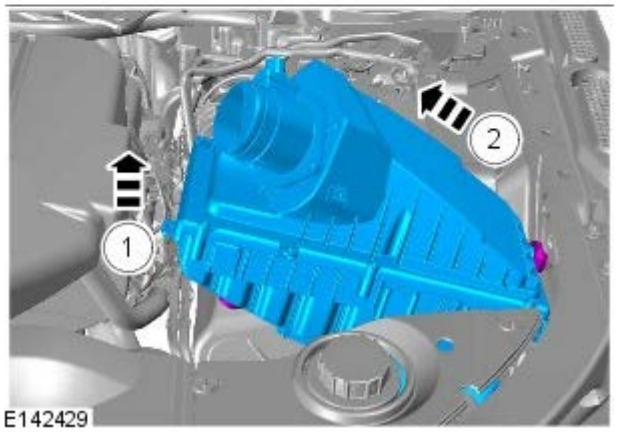
   Left-hand shown, right-hand similar.

   Torque: 3 Nm

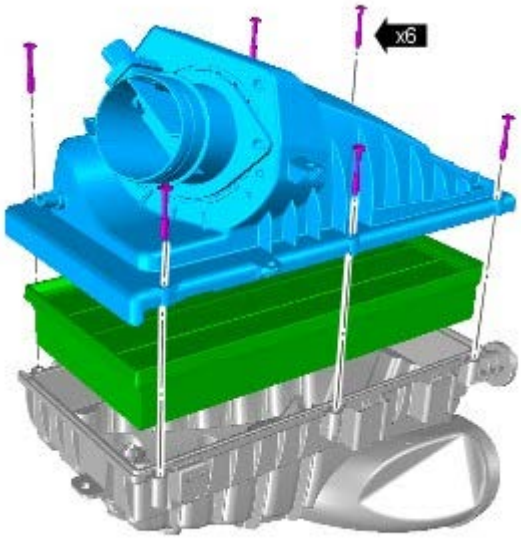


3. NOTE: Left-hand shown, right-hand similar.





E142429



E142430

4. NOTES:

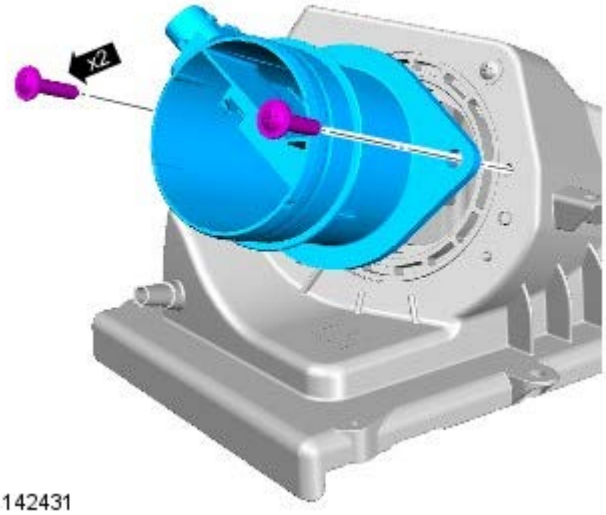
Left-hand shown, right-hand similar.

Do not disassemble further if the component is removed for access only.

5. NOTES:

Remove and discard the O-ring seals.

Left-hand shown, right-hand similar.



E142431

Installation

1. To install, reverse the removal procedure.

Published: 04-Apr-2013

Intake Air Distribution and Filtering - V6 S/C 3.0L Petrol -

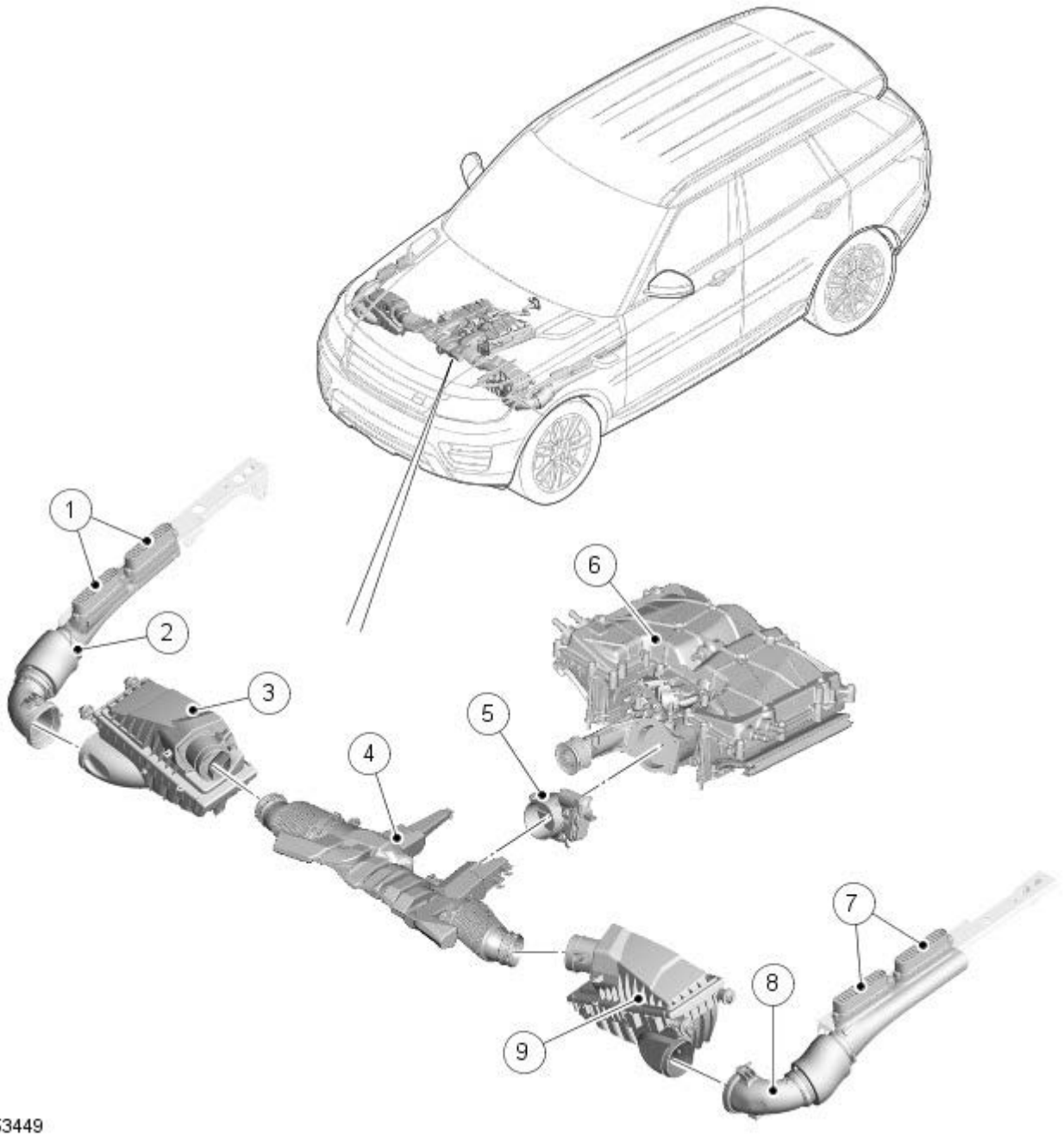
Description	Nm	lb-ft	lb-in
Air cleaner retaining bolts	8	6	71
Air cleaner outlet pipe T-connector retaining bolt	10	7	88
Air cleaner outlet pipe clips	3.5	2.5	31
Charge air cooler top assembly retaining bolts	25	18	221
Charge air cooler lower assembly retaining bolts	25	18	221
Supercharger assembly to cylinder head retaining bolts	25	18	221
Throttle body retaining studs	10	7	88
Manifold absolute pressure and temperature (MAPT) sensor	5	3.7	44
Coolant outlet pipe	11	8	97

Published: 02-May-2013

Intake Air Distribution and Filtering - V6 S/C 3.0L Petrol - Intake Air Distribution and Filtering

Description and Operation

COMPONENT LOCATION



E153449

Item	Part Number	Description
1	-	Right intake grilles
2	-	Right dirty air duct
3	-	Right air cleaner
4	-	Clean air ducts
5	-	Electric throttle
6	-	Supercharger and intake manifolds
7	-	Left intake grilles
8	-	Left dirty air duct
9	-	Left air cleaner

OVERVIEW

The intake air distribution and filtering system comprises:

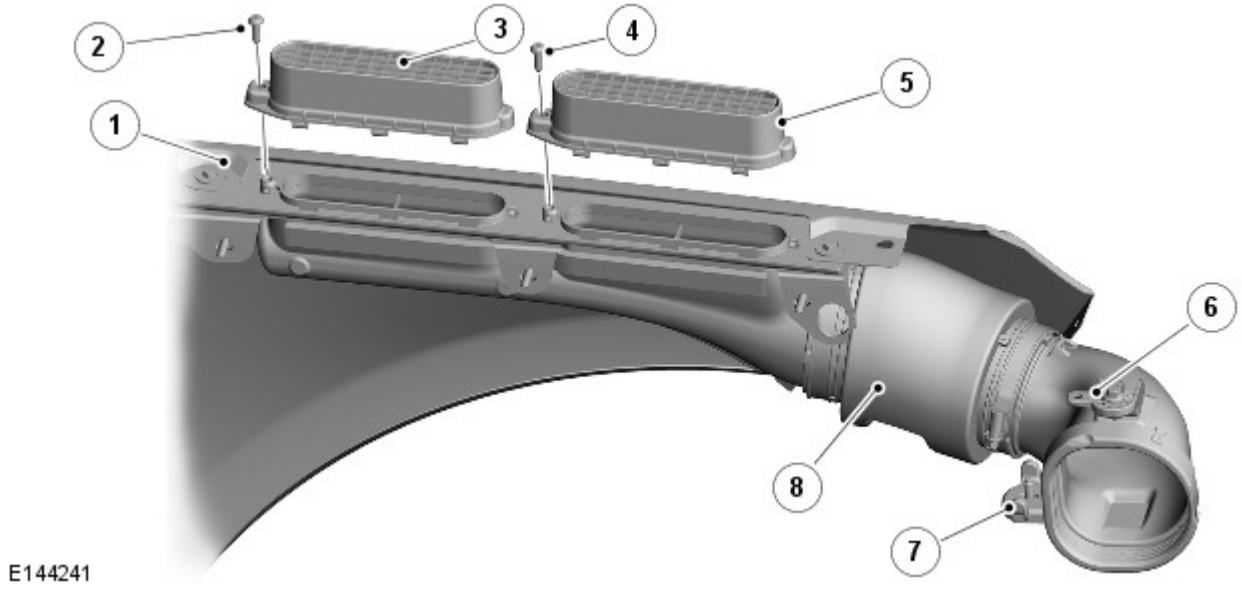
- Two dirty air ducts

Two air cleaners
- Clean air ducts
- An electric throttle
- Supercharger and intake manifolds

Air flows through the dirty air ducts, air cleaners, clean air ducts and electric throttle to the supercharger. The supercharger compresses the air, which is then directed through charge air coolers in the intake manifolds and into the cylinders.

DESCRIPTION

Dirty Air Ducts



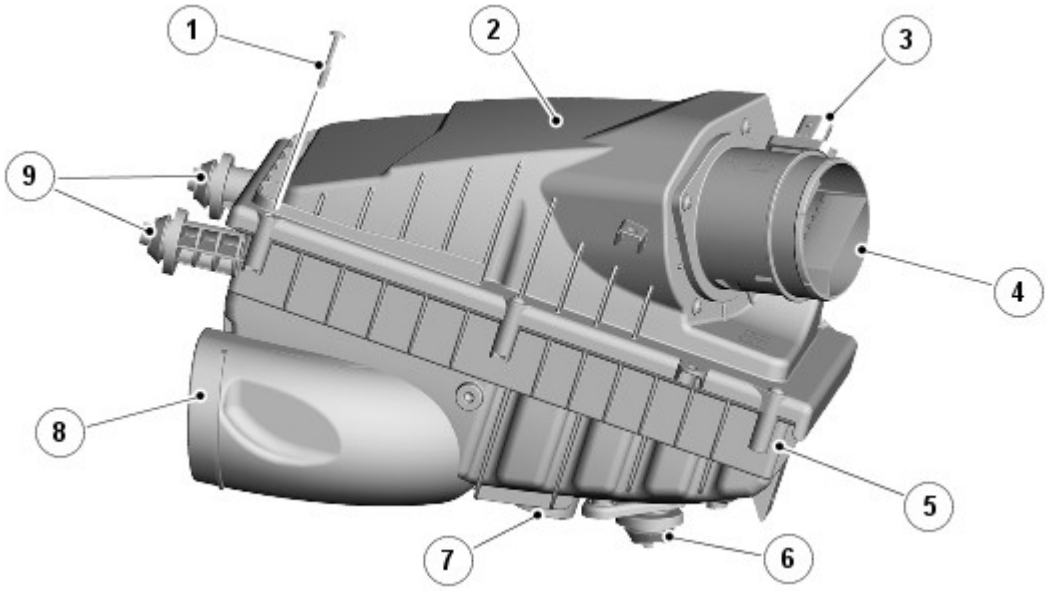
Item	Part Number	Description
1	-	Front fender support
2	-	Screw
3	-	Intake grille
4	-	Screw
5	-	Intake grille
6	-	Front upper bracket
7	-	Front lower bracket
8	-	Non-porous sleeve

The dirty air ducts are installed in the front fenders to transfer ambient air from under the edges of the hood to the air cleaners.

Each dirty air duct locates in the intake of the related air cleaner and is attached to the front inner fender with two brackets. The intake of each dirty air duct is attached to two intake grilles on top of the front fender support. When the hood is closed, the intake grilles locate in guides attached to the hood inner panel.

A porous section, covered by a non-porous sleeve to prevent moisture ingress, is incorporated into each dirty air duct to reduce induction noise.

Air Cleaners



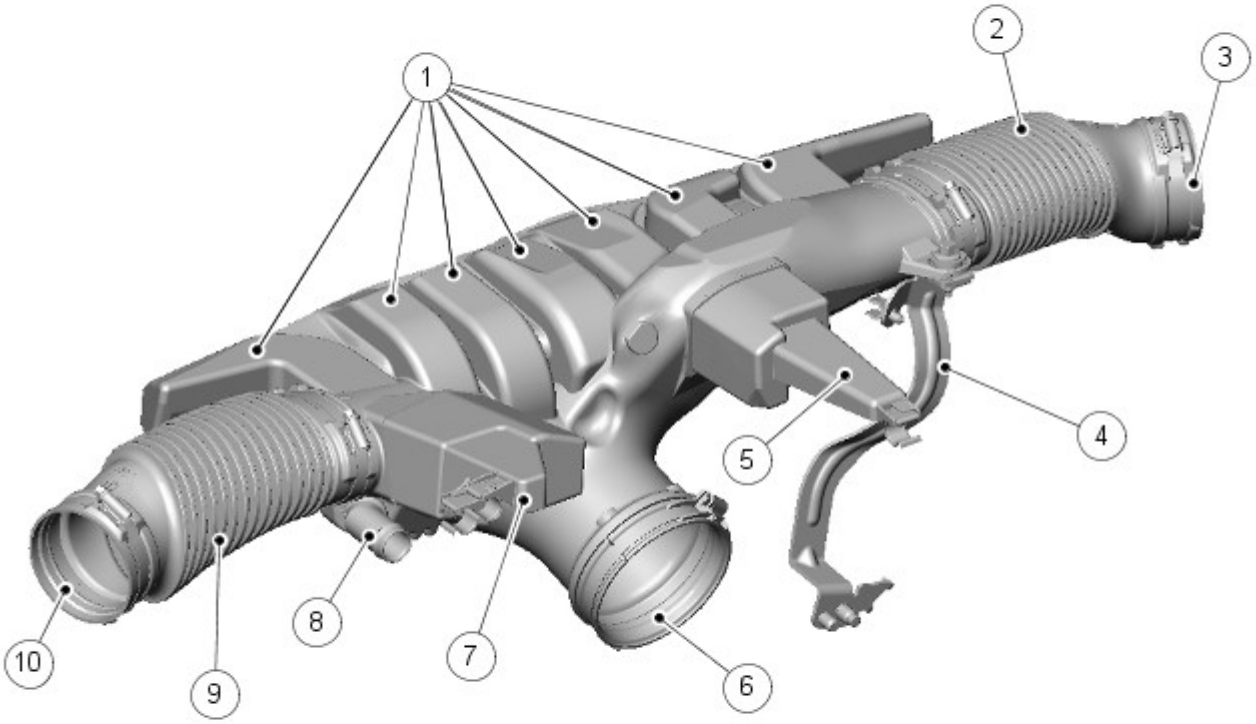
Item	Part Number	Description
1	-	Screw (6 off)
2	-	Lid
3	-	Mass Air Flow and Temperature (MAFT) sensor
4	-	Air outlet
5	-	Base
6	-	Isolator
7	-	Drain valve
8	-	Air intake
9	-	Isolators

An air cleaner is located in each front corner of the engine compartment. Three spigots fitted with isolator bushes locate each air cleaner in holes in the related front inner fender and front suspension housing.

Each air cleaner consists of a filter element installed in a base and enclosed with a lid secured by six screws. The filter element is a pleated, paper type with an integral seal. Air intake and outlet connections are incorporated into the base and lid respectively. The bottom of the base incorporates a drain valve to prevent the accumulation of water in the air cleaner.

The air outlet connection of each air cleaner incorporates a MAFT (Mass Air Flow and Temperature) sensor. The sensors are connected to the ECM (Engine Control Module).
For additional information, refer to: Electronic Engine Controls (303-14B Electronic Engine Controls - V6 S/C 3.0L Petrol, Description and Operation).

Clean Air Ducts



E153550

Item	Part Number	Description
1	-	Resonators
2	-	Right convolute
3	-	Right air intake
4	-	Support bracket
5	-	Resonator
6	-	Air outlet
7	-	Resonator
8	-	Full load breather connector stub
9	-	Left convolute
10	-	Left air intake

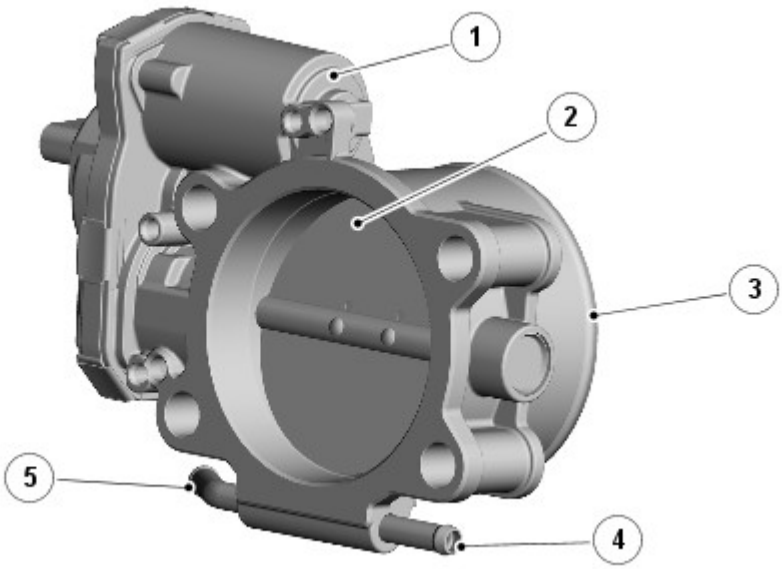
The clean air ducts transfers air from the air cleaner outlets to the electric throttle. Two convolute sections in the clean air ducts accommodate the relative movement between the engine mounted electric throttle and the body mounted air cleaners.

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 right cylinder head.

Electric Throttle



E144601

Item	Part Number	Description
1	-	Electric motor
2	-	Air intake
3	-	Air outlet
4	-	Coolant feed connection
5	-	Coolant return connection

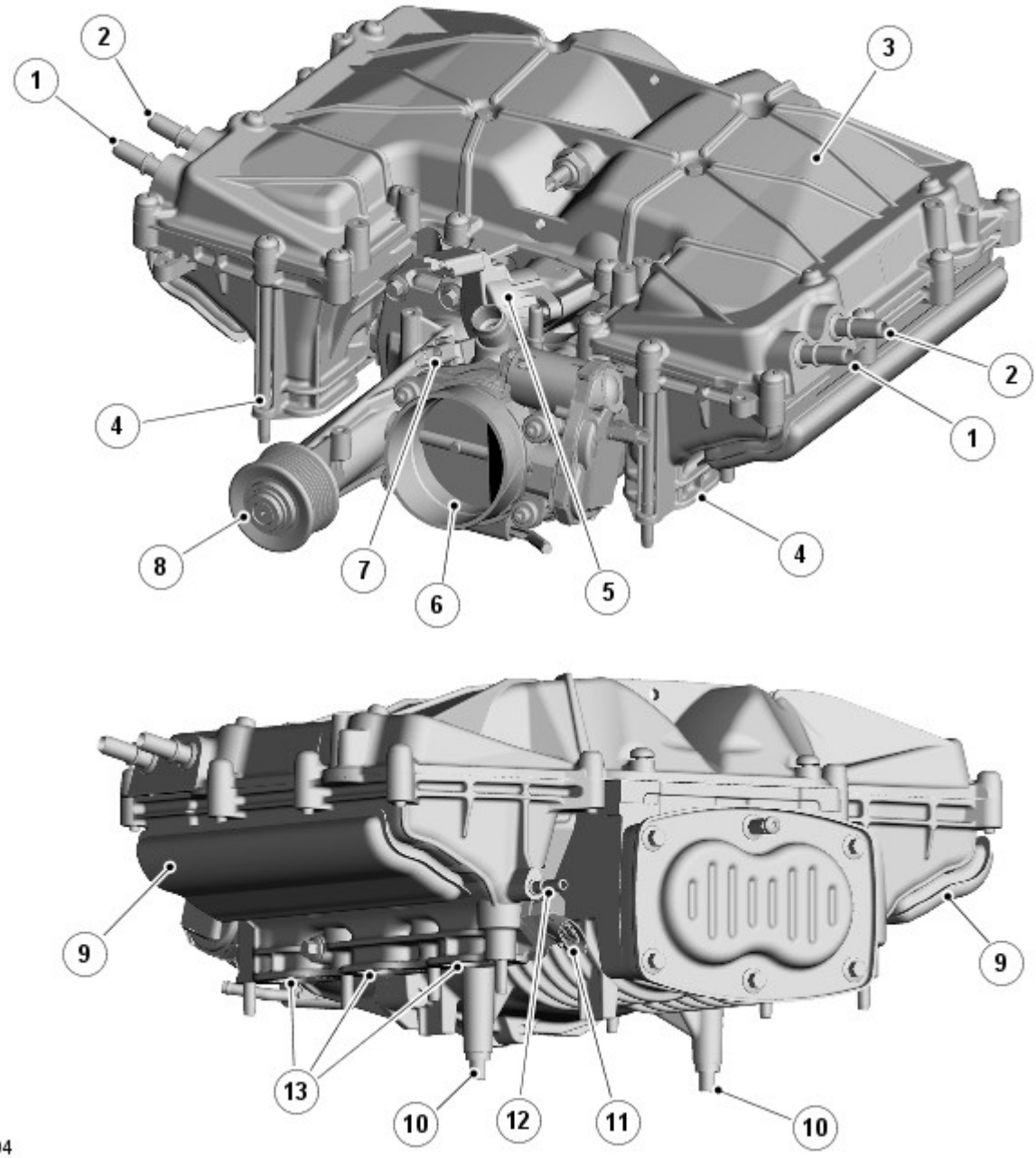
The electric throttle regulates the air flow into the supercharger.

The electric throttle is installed at the front of the engine, between the cylinder heads. Four bolts attach the electric throttle to the supercharger.

The throttle plate is operated by a DC (Direct Current) electric motor attached to the throttle body. The motor is controlled by the ECM and is constantly adjusted in response to driver inputs with the throttle pedal to precisely control the amount of air allowed into the intake manifold.
For additional information, refer to: Electronic Engine Controls (303-14B Electronic Engine Controls - V6 S/C 3.0L Petrol, Description and Operation).

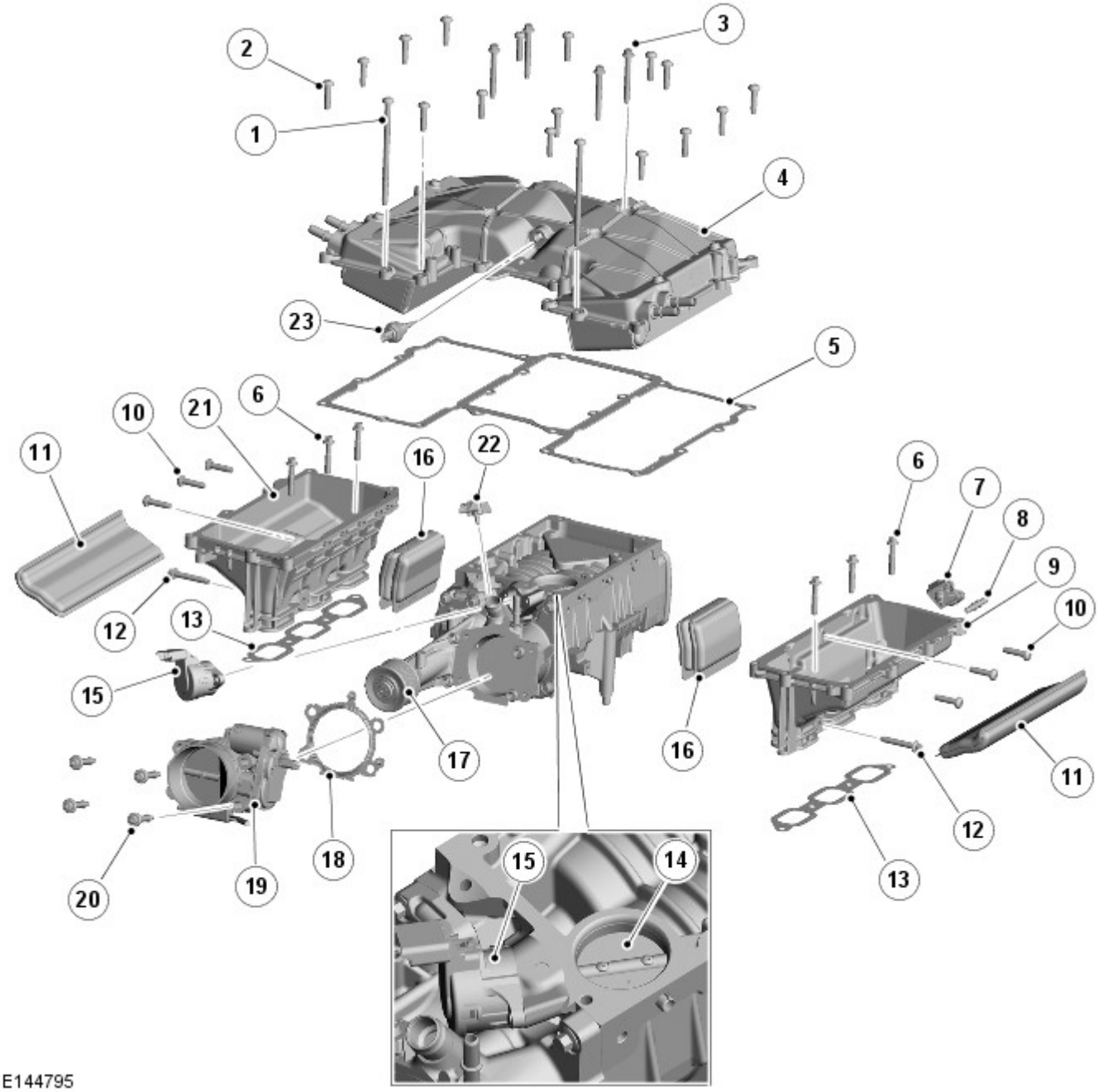
To prevent icing, coolant is circulated across the throttle body through coolant feed and return connections.

Supercharger and Intake Manifolds - Assembled



Item	Part Number	Description
1	-	Coolant outlet connections
2	-	Coolant inlet connections
3	-	Charge air cooler tank top
4	-	Intake manifolds
5	-	Bypass valve actuator
6	-	Inlet port
7	-	Manifold Absolute Pressure (MAP) sensor
8	-	Pulley
9	-	Noise, Vibration and Harshness (NVH) pads
10	-	Dowel
11	-	Manifold Absolute Pressure and Temperature (MAPT) sensor
12	-	Vacuum connector stub
13	-	Outlet ports

Supercharger and Intake Manifolds - Exploded



Item	Part Number	Description
1	-	Screw M8 x 35 mm (15 off)
2	-	Screw M8 x 150 mm (2 off)
3	-	Screw M8 x 65 mm (4 off)
4	-	Charge air cooler tank top
5	-	Gasket
6	-	Screw M8 x 45 mm (6 off)
7	-	Charge air cooler tank with Manifold Absolute Pressure and Temperature (MAPT) sensor
8	-	Vacuum outlet hose connector
9	-	Left intake manifold
10	-	Screw M8 x 35 mm (6 off)
11	-	Gasket
12	-	Screw M8 x 50 mm
13	-	Noise, Vibration and Harshness (NVH) pad (2 off)
14	-	Bypass valve
15	-	Bypass valve actuator
16	-	NVH pad rear (2 off)
17	-	Supercharger pulley
18	-	Gasket
19	-	Electric throttle
20	-	Screw and bush (4 off)

21	-	Right intake manifold
22	-	Manifold Absolute Pressure (MAP) sensor
23	-	Charge air temperature sensor

The 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 supercharger to the cylinder intake ports.

The intake manifolds are attached to their related cylinder heads and the sides of the supercharger. Two dowels locate the supercharger in position on the cylinder block. A charge air cooler tank top is installed on top of the supercharger and intake manifolds to form the air duct from the supercharger outlet to the intake manifolds. A charge air cooler is installed in each intake manifold.

A NVH (Noise, Vibration and Harshness) pad is attached to the side of each intake manifold. The rear of the right intake manifold incorporates a connection port for the symposer intake pipe. The rear of the left intake manifold incorporates:

- A connector stub for the brake vacuum system.
- A MAPT (Manifold Absolute Pressure and Temperature) sensor.

The supercharger is a Roots blower with high angle helix rotors driven at 2.5 times engine speed by the secondary belt of the accessory drive.

The two rotors of the supercharger 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. A pulley transfers power from the accessory drive to the shaft of one of the rotors.

A DC electric actuator on the front cover is attached to a bypass valve in the housing. The bypass valve allows air to bypass the rotors, to control the outlet pressure of the supercharger. Operation of the actuator is controlled by a PWM (Pulse Width Modulation) signal from the ECM. A Hall effect position sensor in the actuator returns a 0.5 to 4.5 V signal to the ECM. This allows the ECM to identify the position of the bypass valve for closed-loop control.

The front cover also incorporates:

- The supercharger air intake 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.

OPERATION

At closed or partially open throttle positions, the bypass valve is fully open, allowing intake air to bypass the supercharger. This results in little or no pressure increase across the supercharger. Progressive opening of the throttle reduces the depression downstream of the electric throttle. This is sensed by the ECM from the MAP sensor input. The ECM then signals the bypass valve actuator to progressively close the bypass valve. As the bypass valve closes there is a corresponding increase in the outlet pressure from the supercharger, which increases engine power output.

Published: 05-Nov-2012

Intake Air Distribution and Filtering - V6 S/C 3.0L 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 in the workshop manual.
REFER to: Intake Air Distribution and Filtering (303-12B Intake Air Distribution and Filtering - V6 S/C 3.0L Petrol, Description and Operation) /
Intake Air Distribution and Filtering (303-12C, Description and Operation) /
Intake Air Distribution and Filtering (303-12C, 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 cleaner element (contaminated/blocked) • Restricted air intake • Supercharger • Supercharger (cooling fan) 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 cleaner element	Clear the restriction. Replace the air cleaner element as necessary. Refer to the relevant workshop manual section.
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. Refer to the relevant workshop manual section.
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. Refer to the relevant workshop manual section.
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. Refer to the relevant workshop manual section.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - V6 S/C 3.0L Petrol , DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation).

Published: 24-Jul-2012

Intake Air Distribution and Filtering - V6 S/C 3.0L Petrol - Air Cleaner Element

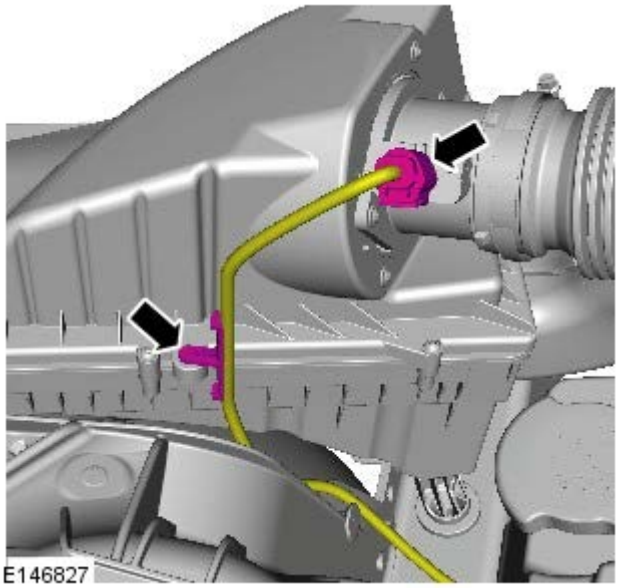
Removal and Installation

Removal

NOTES:

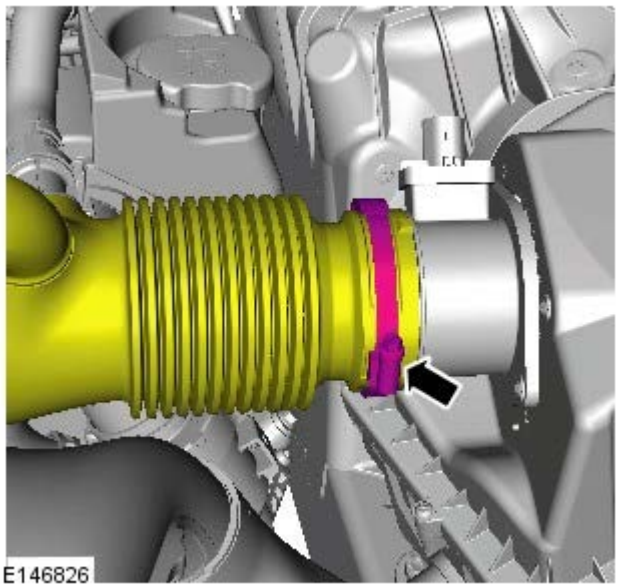
Removal steps in this procedure may contain installation details.

Some variation in the illustrations may occur, but the essential information is always correct.



1. NOTE: Left-hand shown, right-hand similar.

2.



3. NOTES:

   Left-hand shown, right-hand similar.

   Air cleaner shown removed for clarity.



E146829



E125233

4. NOTES:

   Left-hand shown, right-hand similar.

   Air cleaner shown removed for clarity.

5. Repeat the above procedure on the opposite side.

Installation

1. To install, reverse the removal procedure.

Published: 24-Jul-2012

Intake Air Distribution and Filtering - V6 S/C 3.0L Petrol - Air Cleaner LH

Removal and Installation

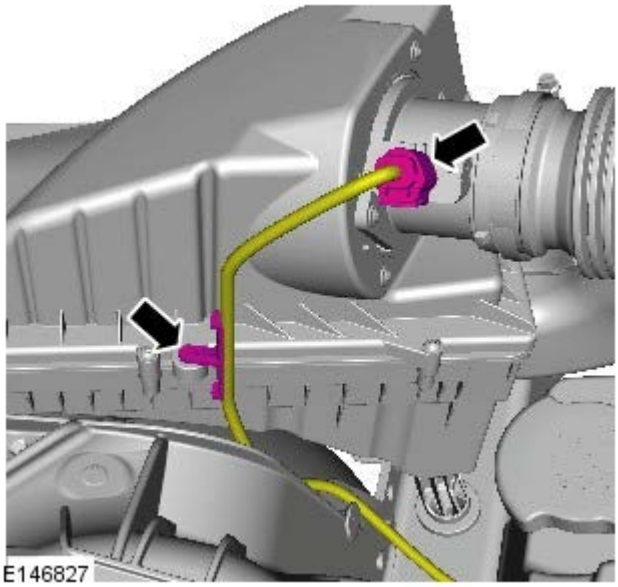
Removal

NOTES:

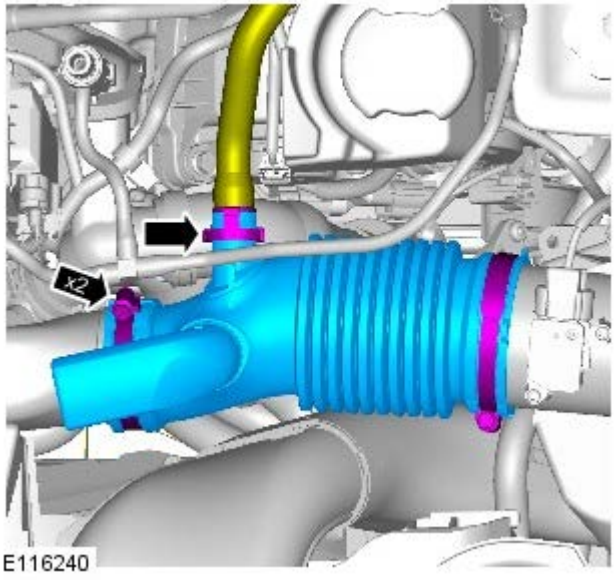
Removal steps in this procedure may contain installation details.

Some variation in the illustrations may occur, but the essential information is always correct.

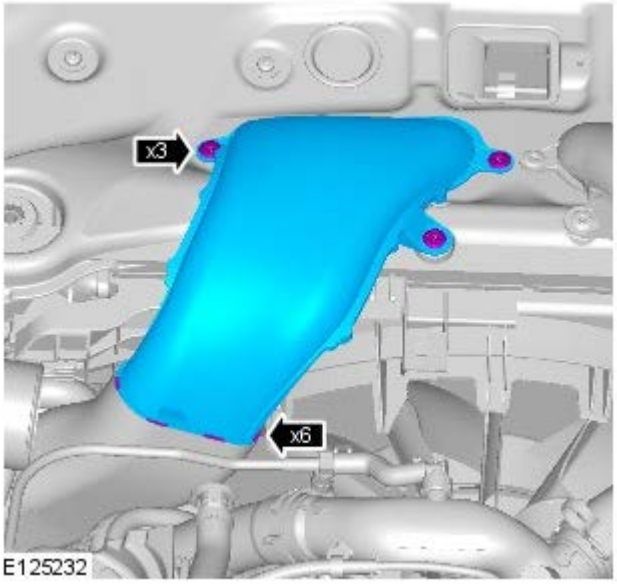
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2.

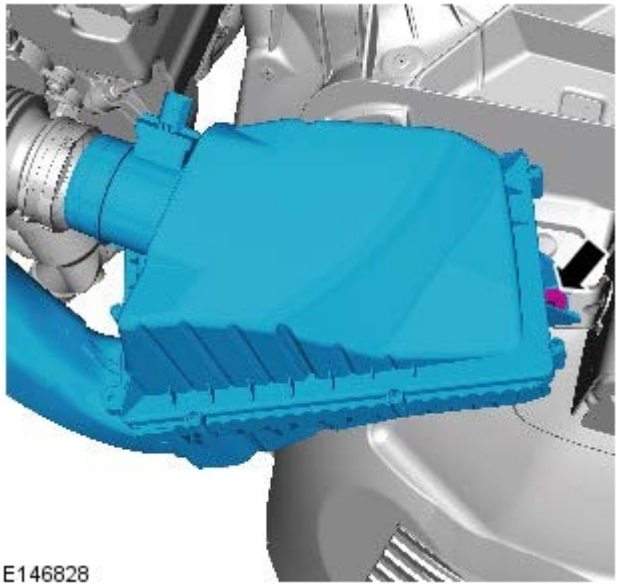


3.



E125232

4. *Torque:* 8 Nm


E146828

5. NOTE: Do not disassemble further if the component is removed for access only.



E146829

6.



E125233

7.



E125230

Installation

1. To install, reverse the removal procedure.

Published: 24-Jul-2012

Intake Air Distribution and Filtering - V6 S/C 3.0L Petrol - Air Cleaner RH

Removal and Installation

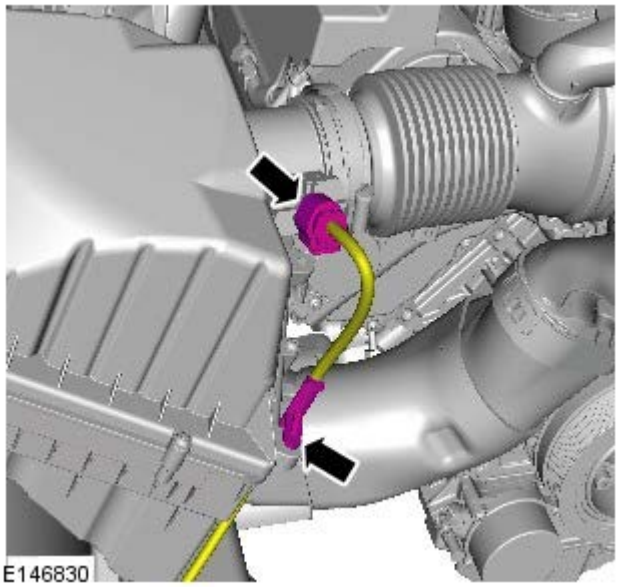
Removal

NOTES:

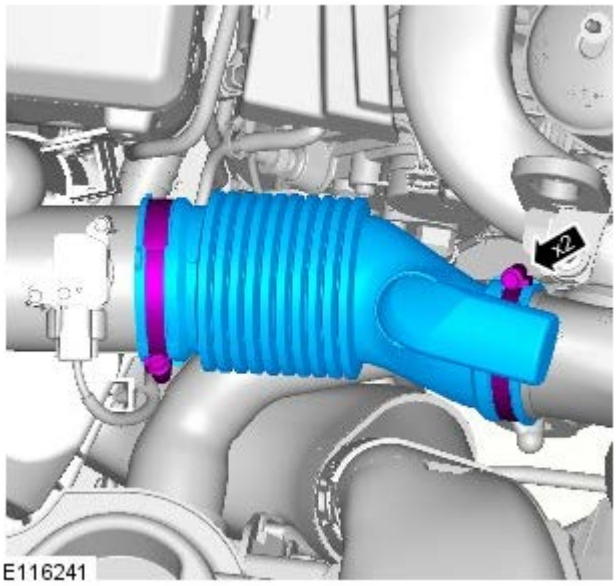
Removal steps in this procedure may contain installation details.

Some variation in the illustrations may occur, but the essential information is always correct.

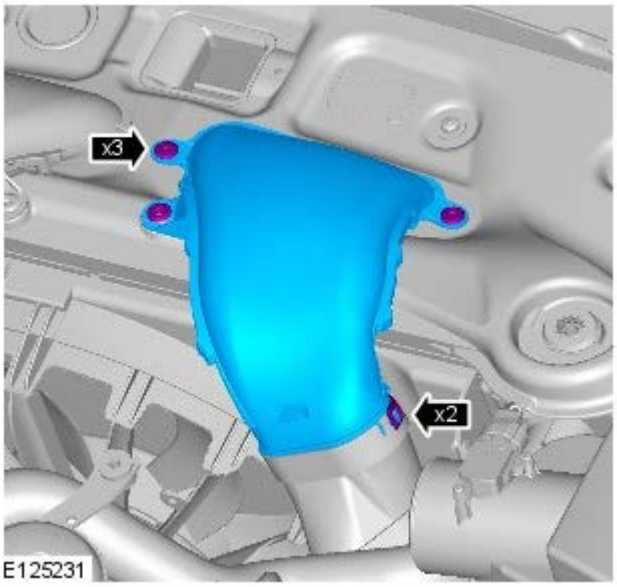
1.



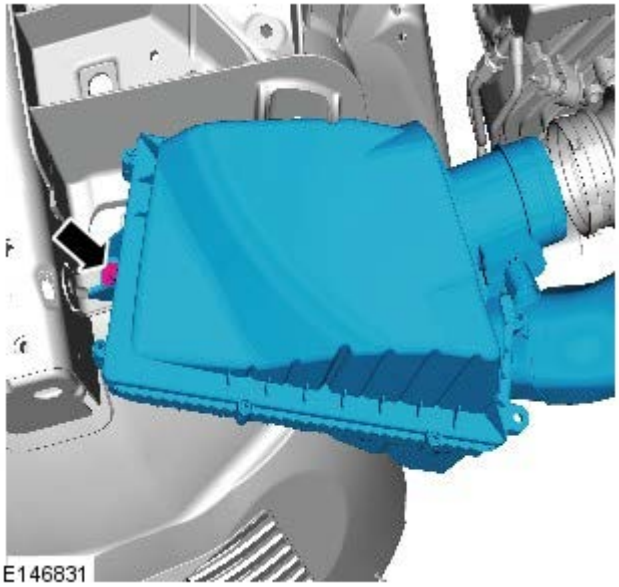
2.



3.



4. *Torque:* 8 Nm



5. NOTES:

   Do not disassemble further if the component is removed for access only.

   Left-hand shown, right-hand similar.



E146829

6. NOTE: Left-hand shown, right-hand similar.



E125233

7. NOTE: Left-hand shown, right-hand similar.



E125230

Installation

1. To install, reverse the removal procedure.

Published: 24-Jul-2012

Intake Air Distribution and Filtering - V6 S/C 3.0L Petrol - Air Cleaner Outlet Pipe LH

Removal and Installation

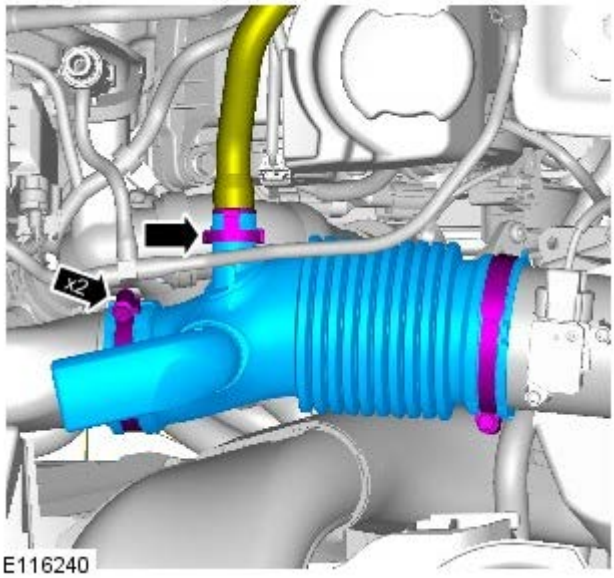
Removal

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.



Installation

1. To install, reverse the removal procedure.

Published: 24-Jul-2012

Intake Air Distribution and Filtering - V6 S/C 3.0L Petrol - Air Cleaner Outlet Pipe RH

Removal and Installation

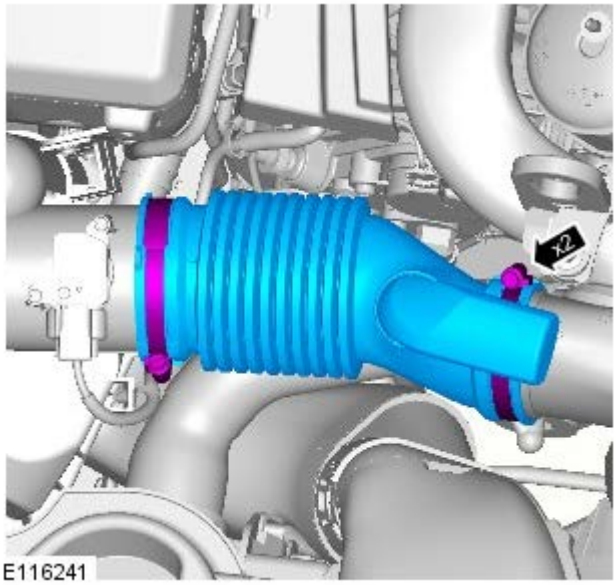
Removal

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.



Installation

1. To install, reverse the removal procedure.

Published: 24-Jul-2012

Intake Air Distribution and Filtering - V6 S/C 3.0L Petrol - Air Cleaner Outlet Pipe T-Connector

Removal and Installation

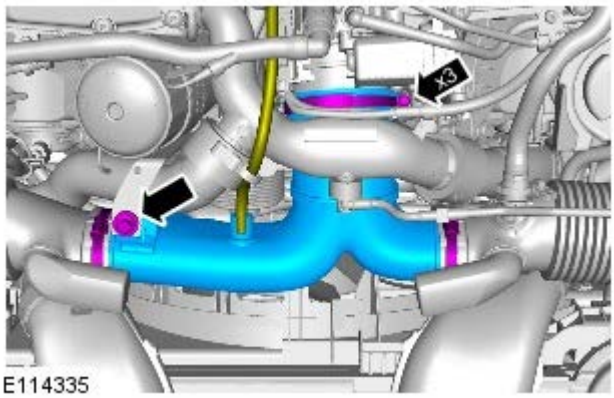
Removal

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 - V6 S/C 3.0L Petrol (501-05, Removal and Installation).



2. *Torque:* 10 Nm

Installation

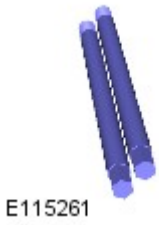
1. To install, reverse the removal procedure.

Published: 02-May-2013

Intake Air Distribution and Filtering - V6 S/C 3.0L Petrol - Charge Air Cooler

Removal and Installation

Special Tool(s)

 E115261	303-1444-01 Exhaust Manifold Installation Guide Pins - Threaded

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 Battery and Charging System - General Information, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

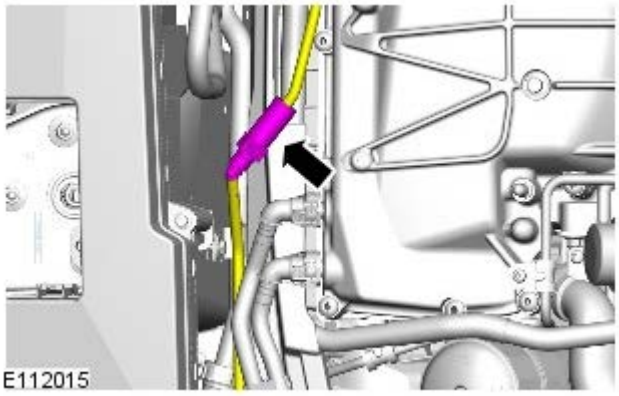
3. Refer to: Cooling System Partial Draining, Filling and Bleeding (303-03B Engine Cooling - V6 S/C 3.0L Petrol, General Procedures).

4. Refer to: Secondary Bulkhead Center Panel - V6 S/C 3.0L Petrol (501-02 Front End Body Panels, Removal and Installation).

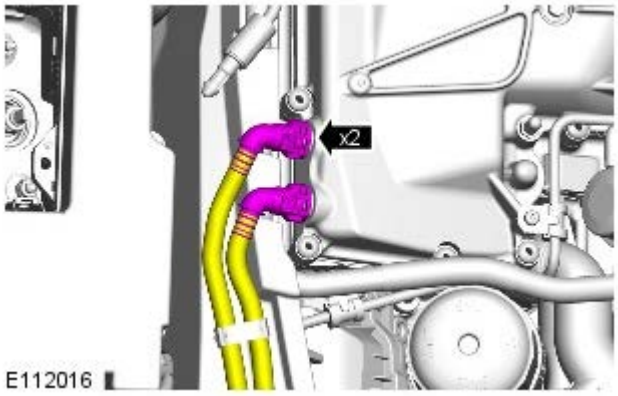
5. Refer to: Fuel Injection Component Cleaning Using Pressure Cleaner (303-04C Fuel Charging and Controls - V6 S/C 3.0L Petrol, General Procedures).

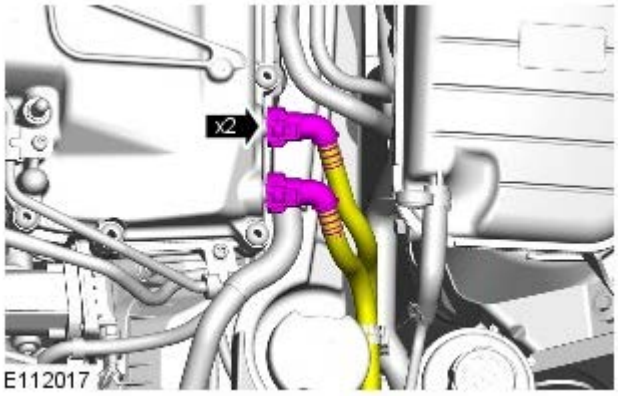
6. Refer to: Fuel System Pressure Release - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (310-00 Fuel System - General Information, General Procedures).

7.

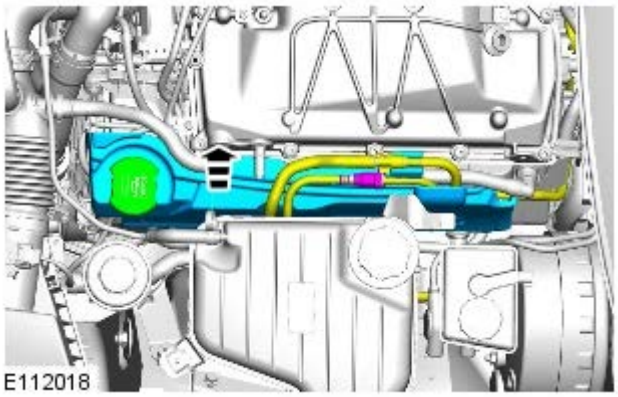


8. CAUTION: Be prepared to collect escaping coolant.

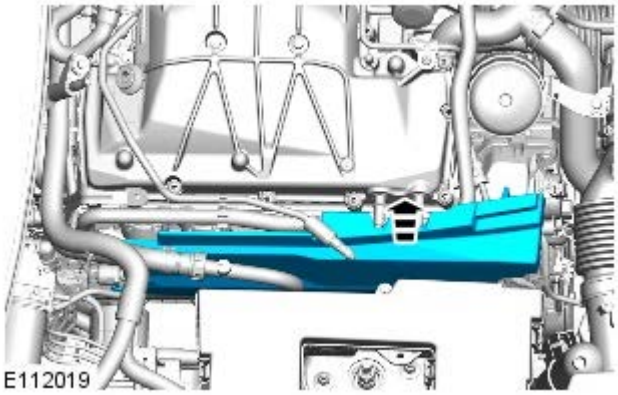




9. CAUTION: Be prepared to collect escaping coolant.

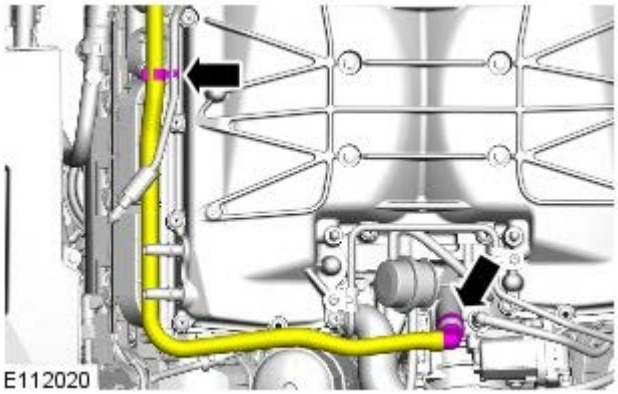


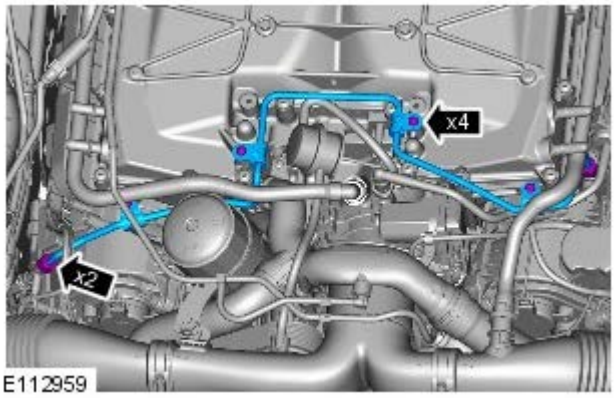
10. CAUTION: Be prepared to collect escaping fluids.



11.

12.





13. 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.

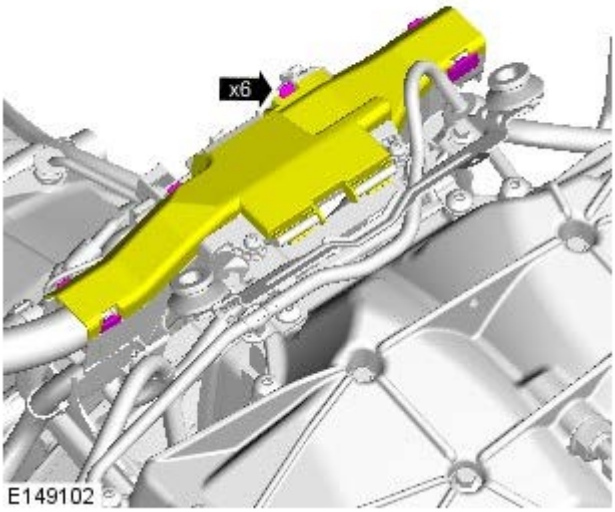
    CAUTIONS:

    Make sure that the fuel line union does not rotate.

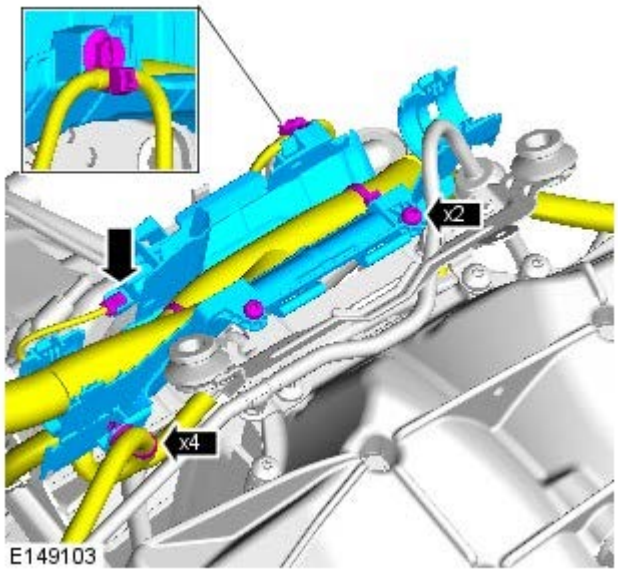
    Be prepared to collect escaping fluids.

    Make sure that all openings are sealed. Use new blanking caps.

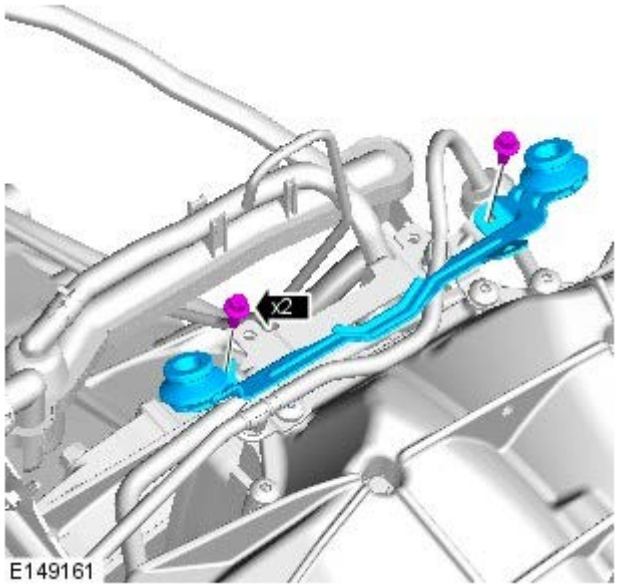
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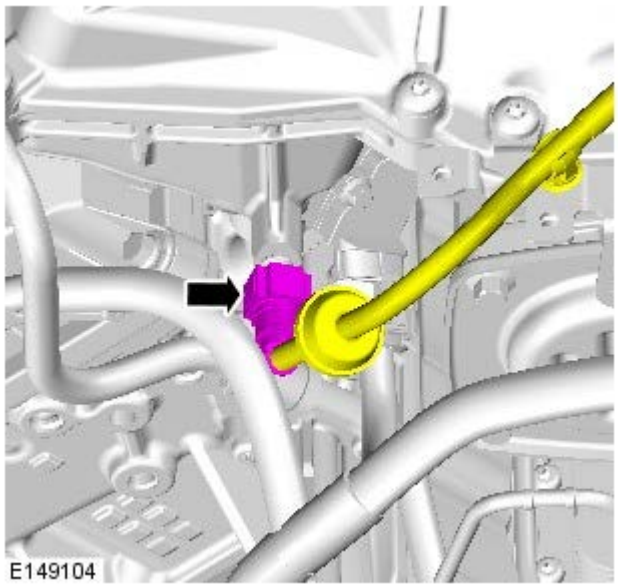
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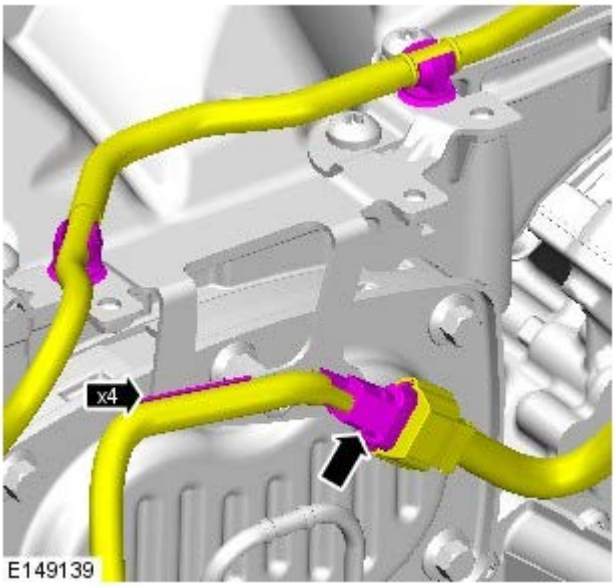
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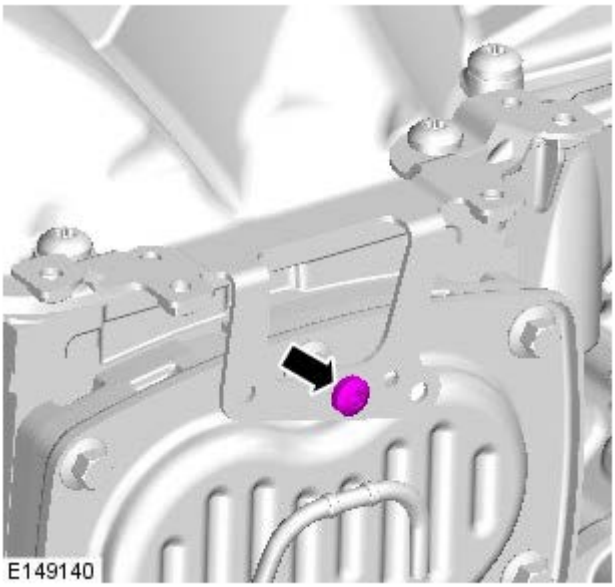
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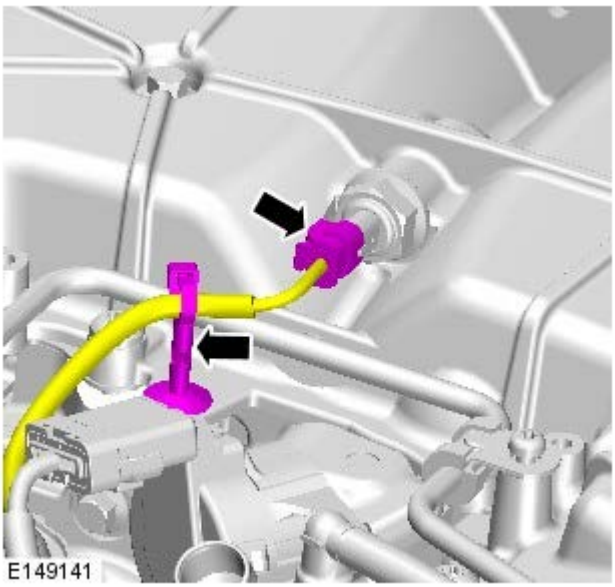
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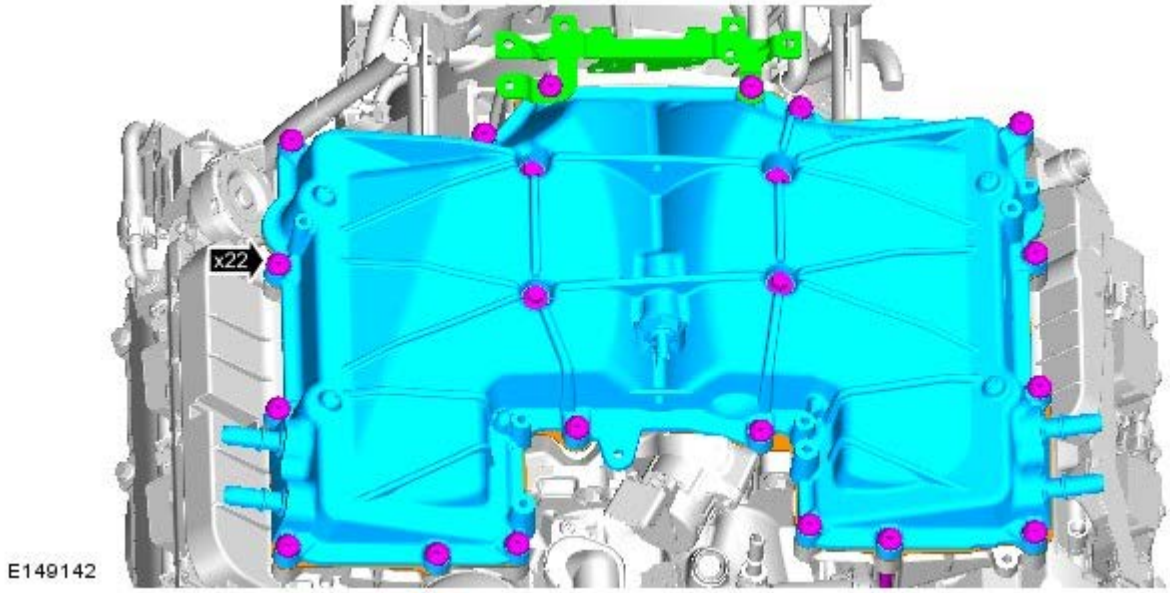
19.

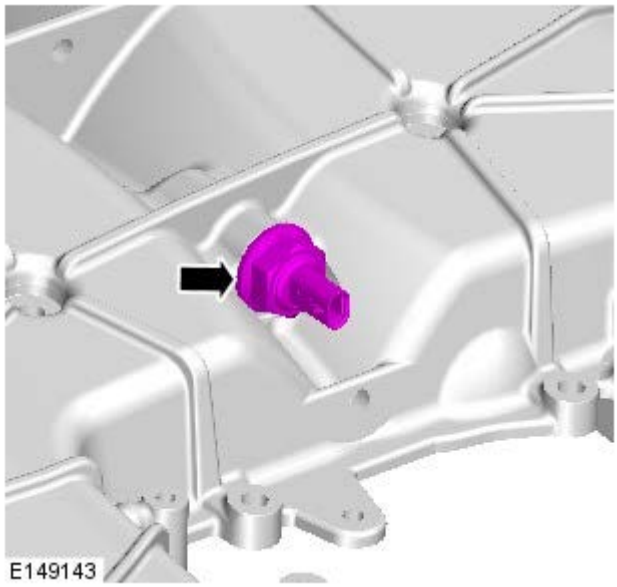


20.



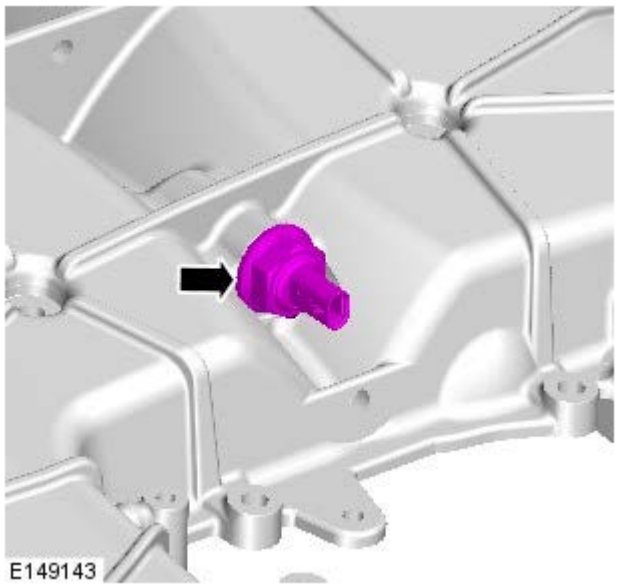
21. NOTE: The gasket is to be reused unless damaged.





22. NOTE: Do not disassemble further if the component is removed for access only.

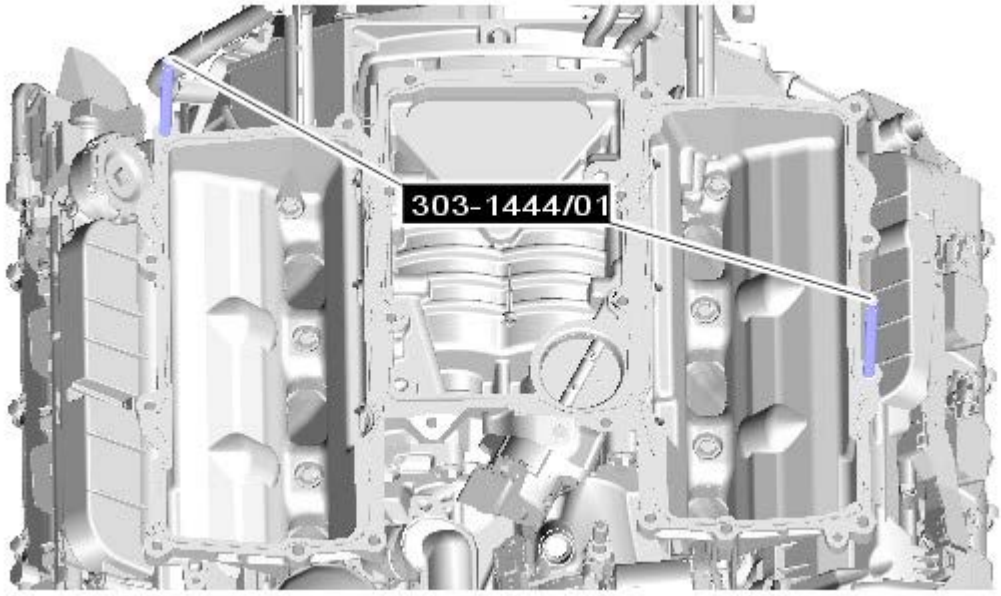
Installation



1. NOTE: This step is only required if a new component is installed.

   Torque: 24 Nm

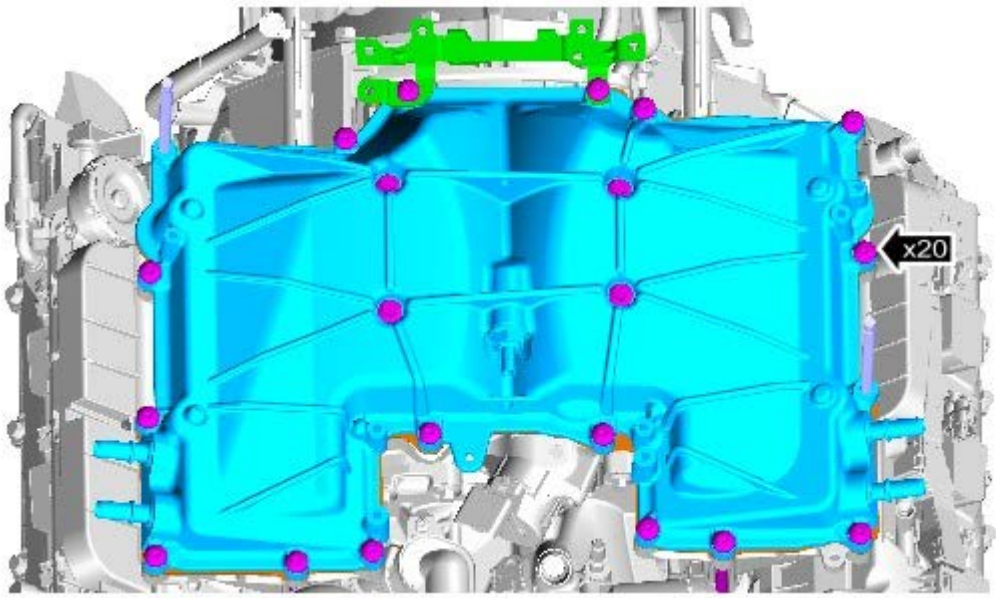
2. *Special Tool(s):* 303-1444-01



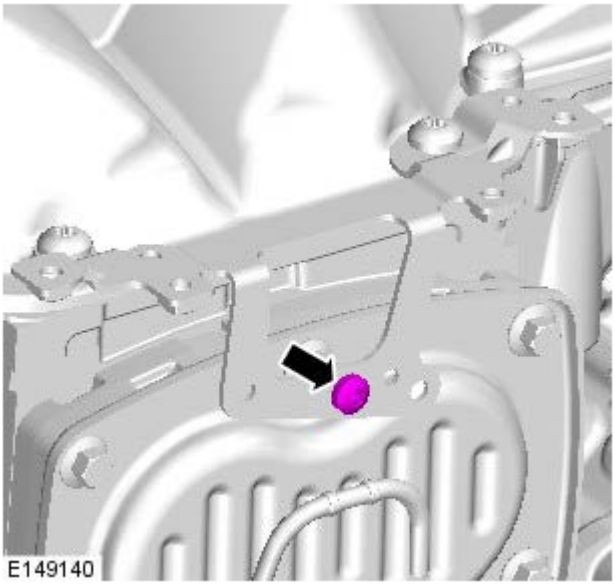
E149144

3. CAUTION: Only tighten the bolt finger-tight at this stage.

NOTE: The gasket is to be reused unless damaged.

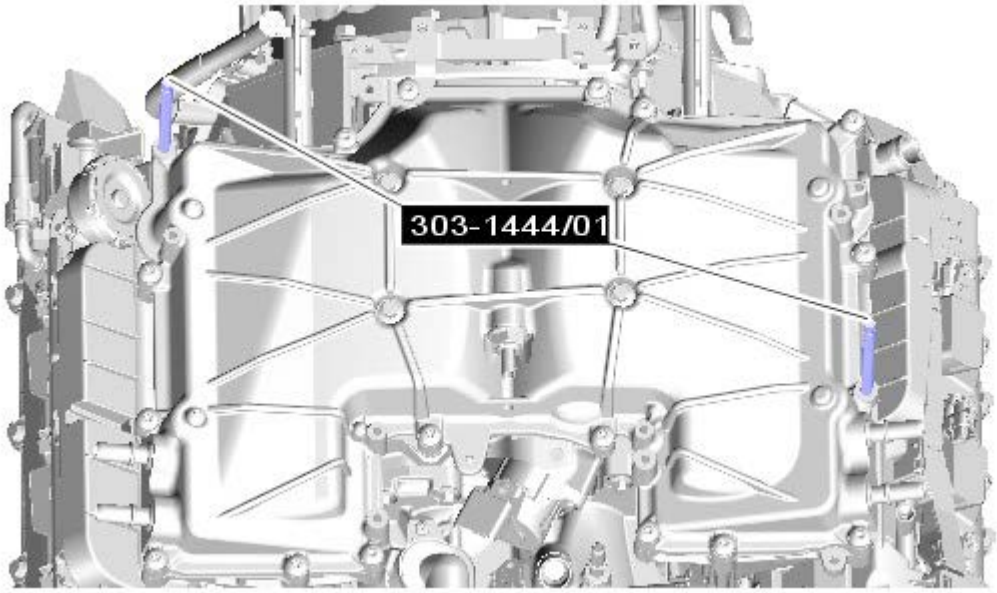


E149145


E149140

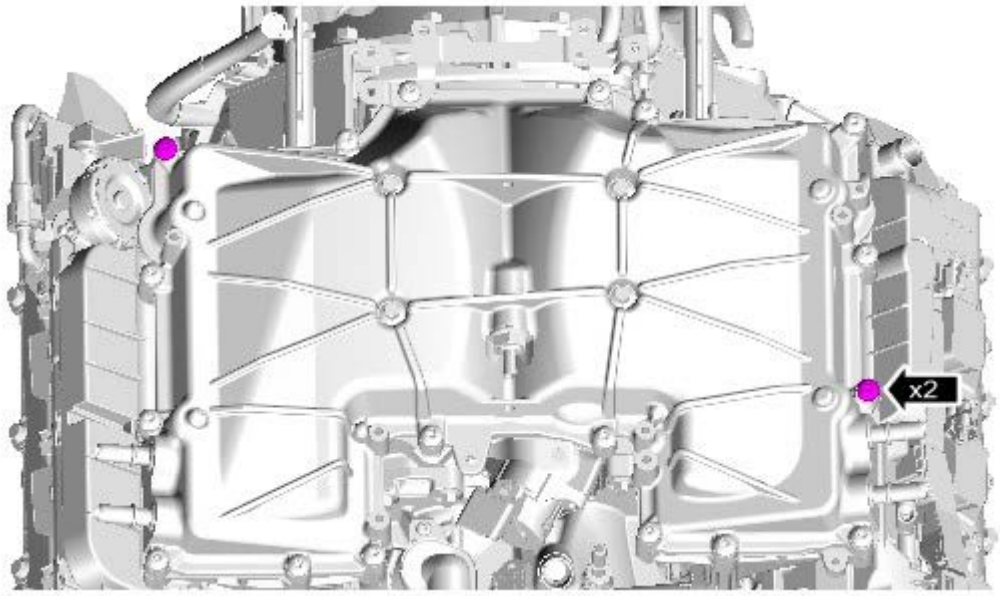
4. CAUTION: Only tighten the bolt finger-tight at this stage.

5. *Special Tool(s):* 303-1444-01



E149146

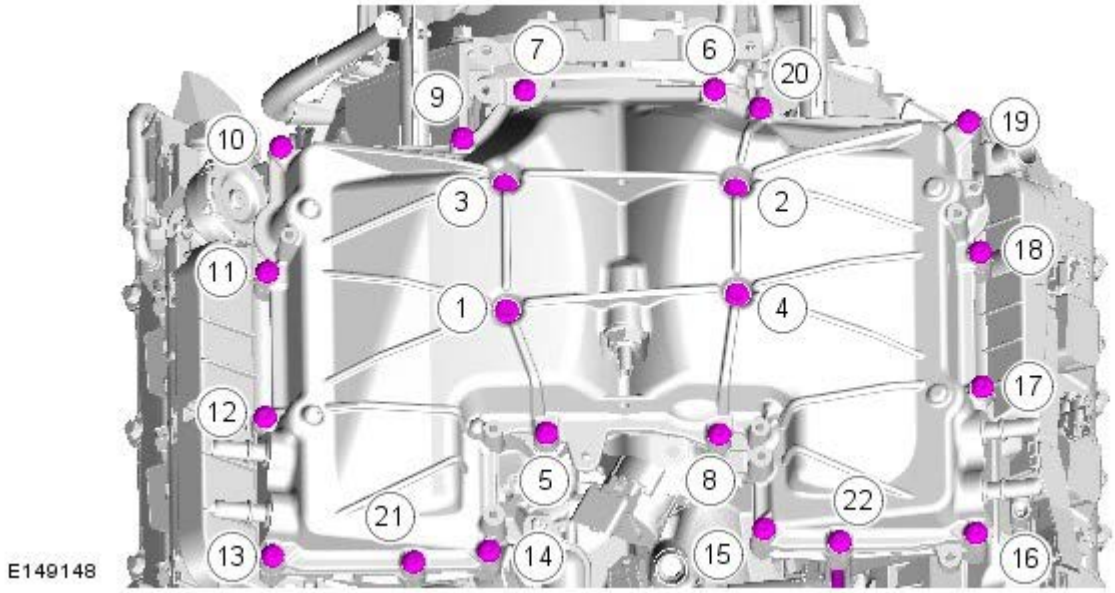
6. CAUTION: Only tighten the bolts finger tight at this stage.



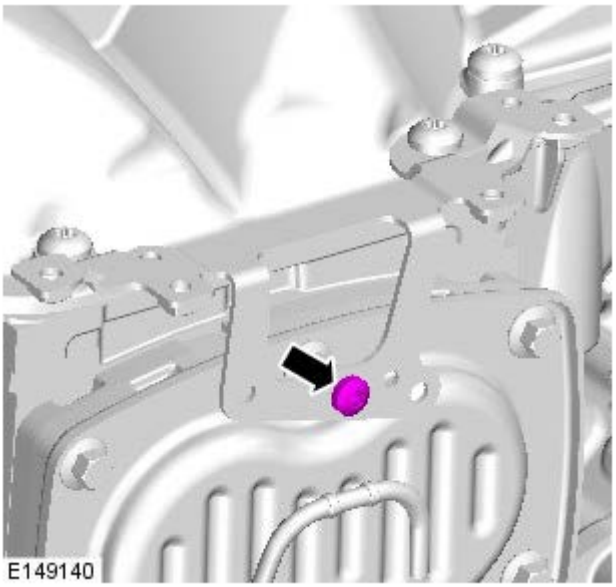
E149147

7. CAUTION: Tighten the bolts in the sequence shown.

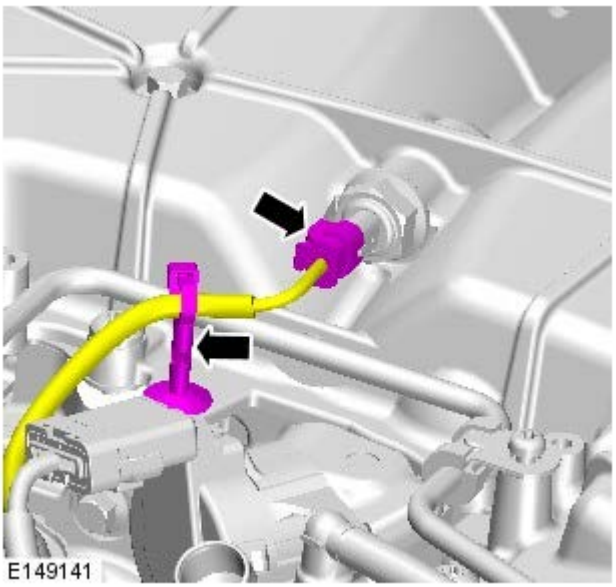
Torque: 25 Nm



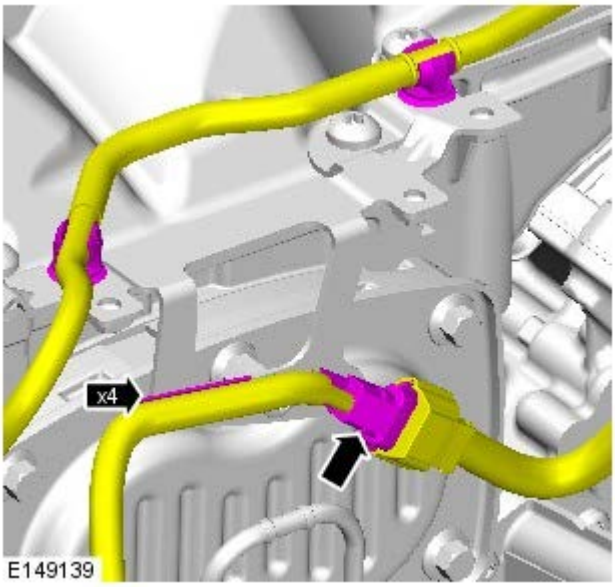
8. *Torque:* 12 Nm



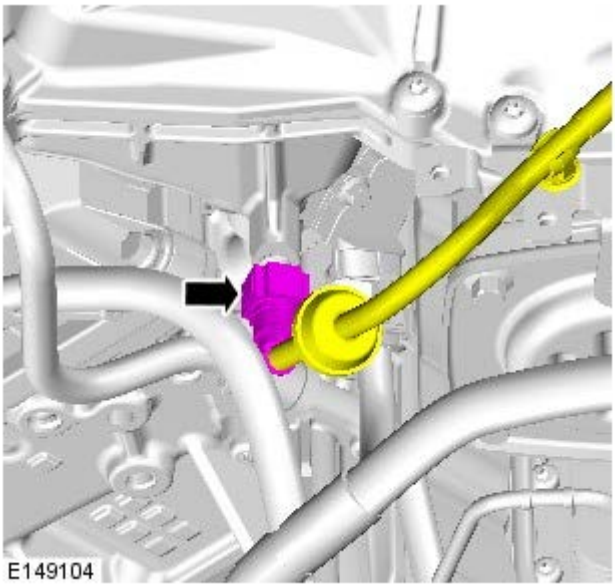
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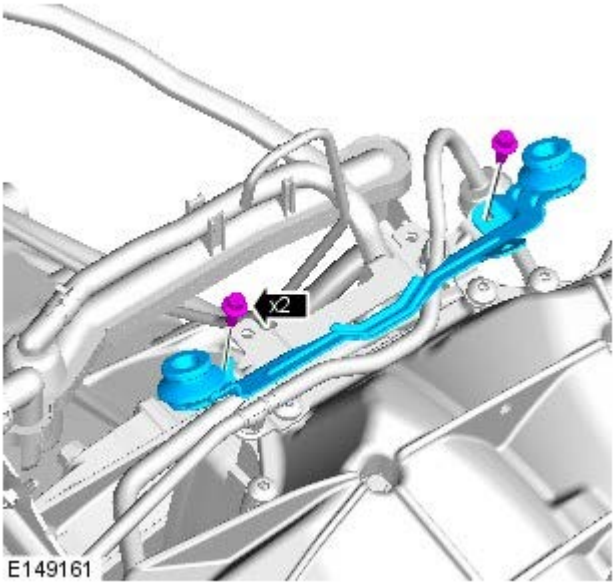
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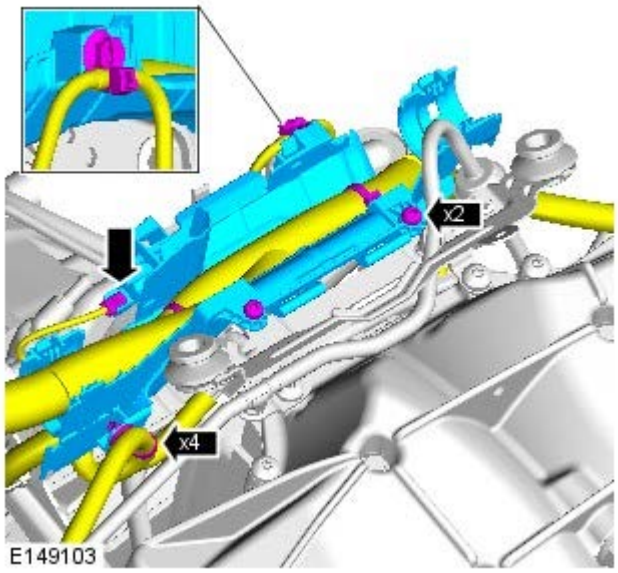
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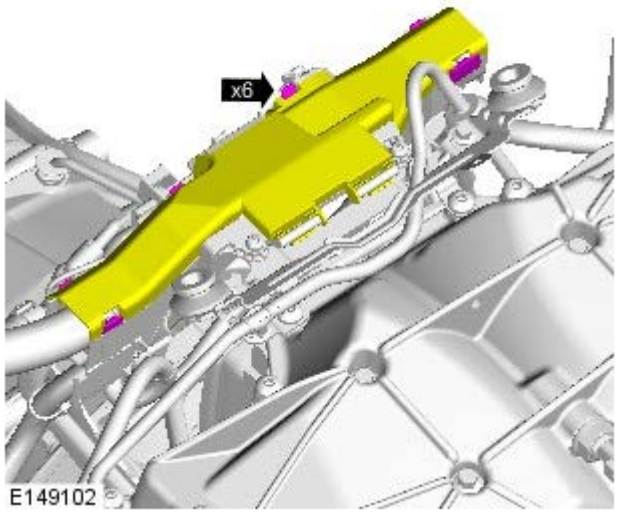
12. *Torque:* 10 Nm

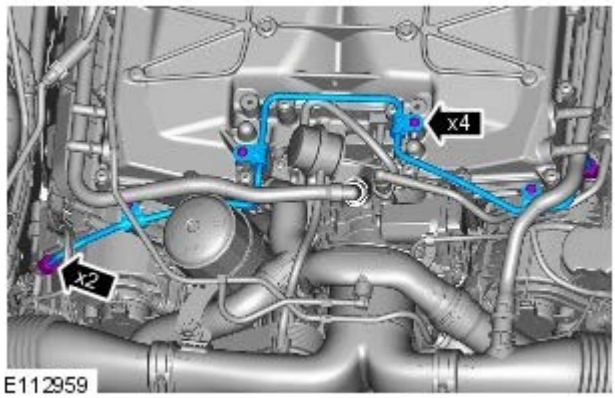


13. *Torque:* 10 Nm



14.





15. 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.

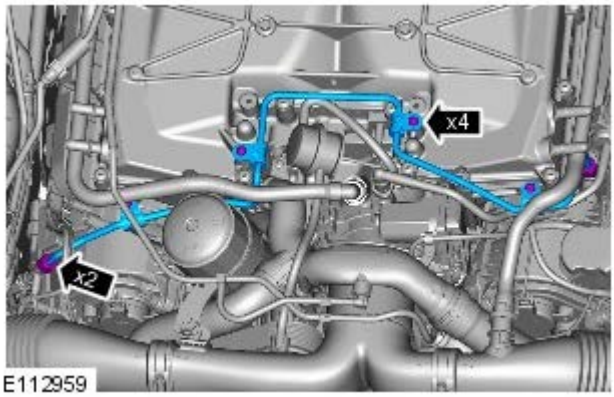
NOTES:

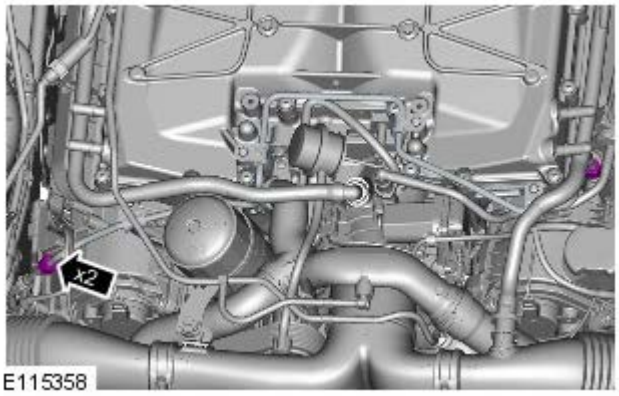
Do not tighten at this stage.

Remove and discard the blanking caps.

16. 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.

Torque:
Union 21 Nm
M6 12 Nm





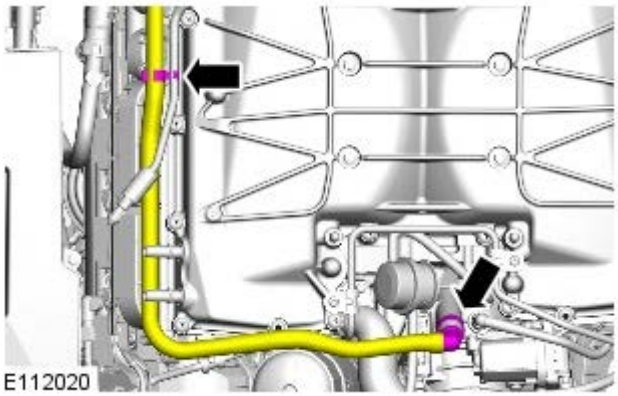
17. WARNINGS:

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.

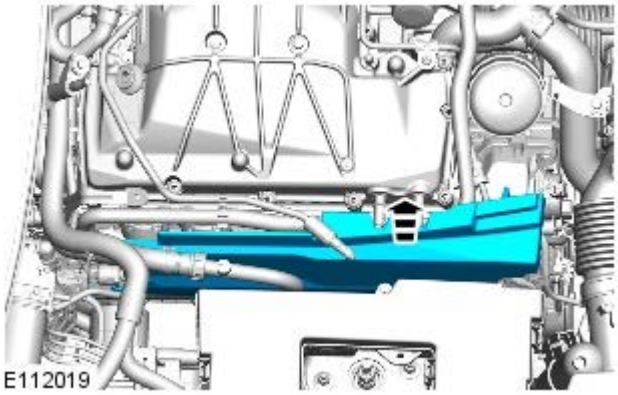
After carrying out repairs, the fuel system must be checked visually for leaks. Failure to follow these instructions may result in personal injury.

Torque: 21 Nm

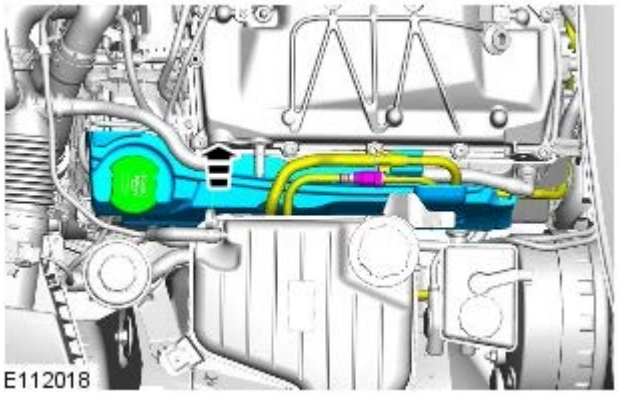
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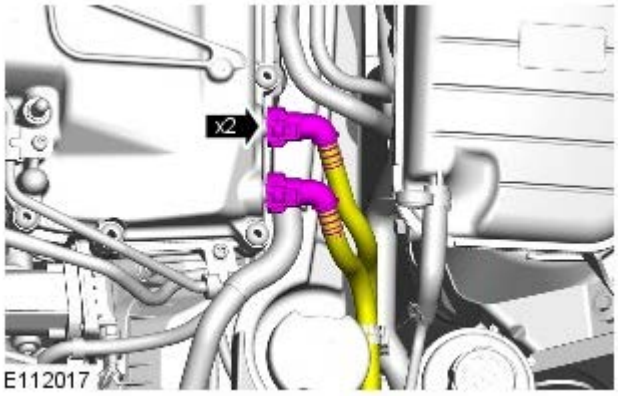
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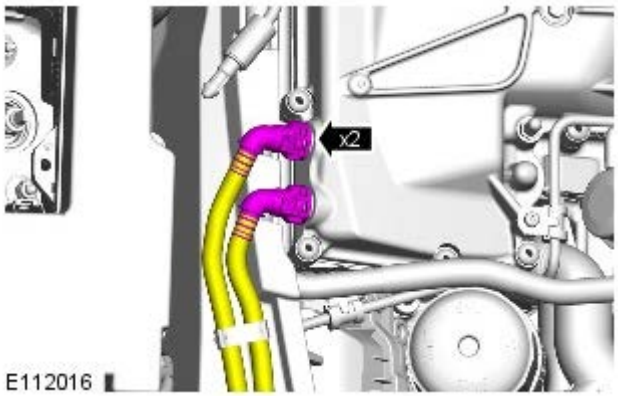
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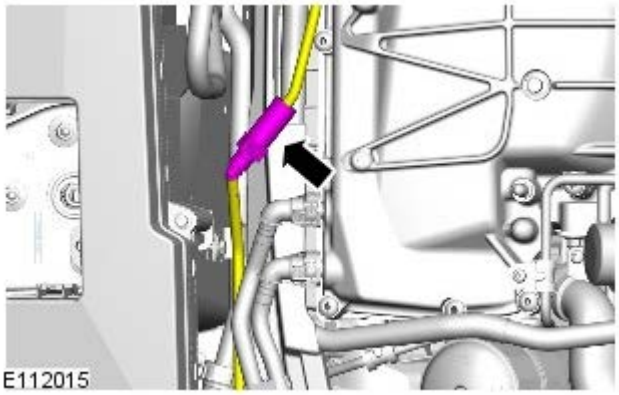
21.



22.



23.



24. Refer to: Cooling System Partial Draining, Filling and Bleeding (303-03B Engine Cooling - V6 S/C 3.0L Petrol, General Procedures).

25. Refer to: Secondary Bulkhead Center Panel - V6 S/C 3.0L Petrol (501-02 Front End Body Panels, Removal and Installation).

26. Connect the battery ground cable.

    Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 02-May-2013

Intake Air Distribution and Filtering - V6 S/C 3.0L 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

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: 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.

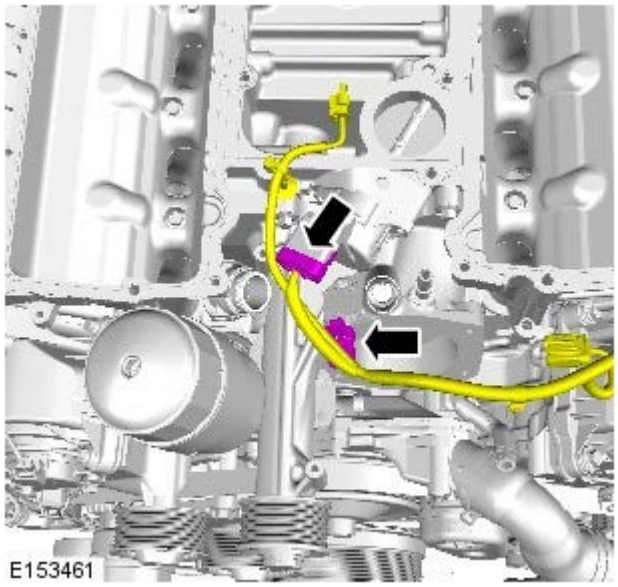
3. Refer to: Charge Air Cooler (303-12B Intake Air Distribution and Filtering - V6 S/C 3.0L Petrol, Removal and Installation).

4. Refer to: Throttle Body (303-04C Fuel Charging and Controls - V6 S/C 3.0L Petrol, Removal and Installation).

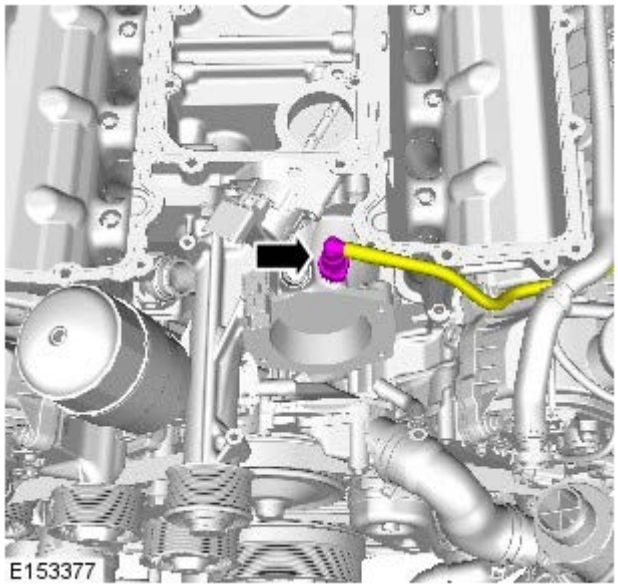
5. Refer to: Supercharger Belt (303-05B Accessory Drive - V6 S/C 3.0L Petrol, Removal and Installation).

6. Refer to: Manifold Absolute Pressure (MAP) Sensor (303-14B Electronic Engine Controls - V6 S/C 3.0L Petrol, Removal and Installation).

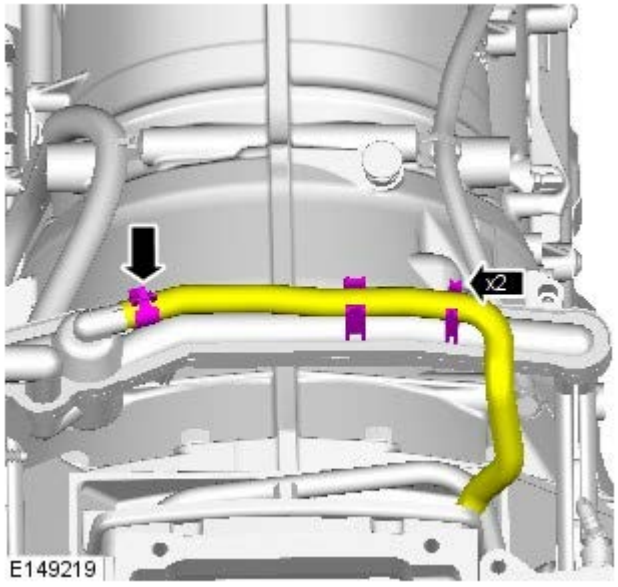
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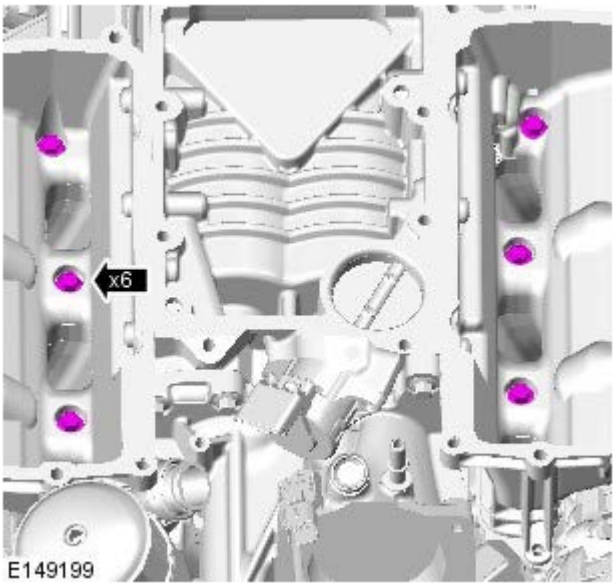
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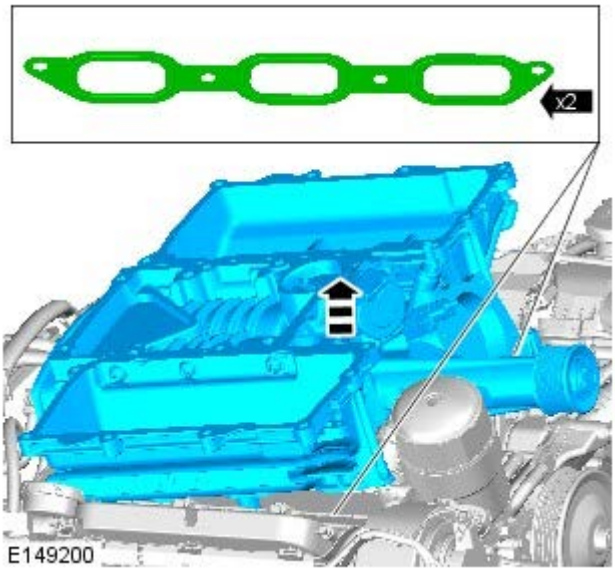
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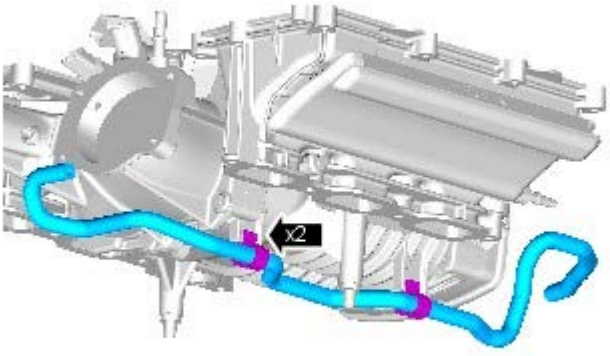
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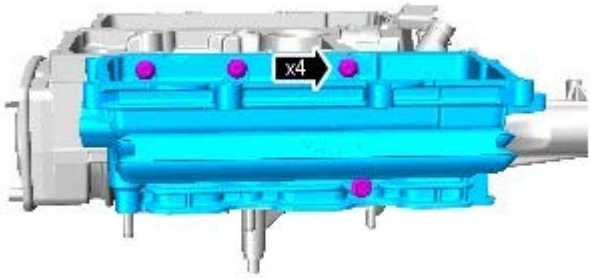
11. NOTE: Remove and discard the gasket.



12. NOTE: Do not disassemble further if the component is removed for access only.

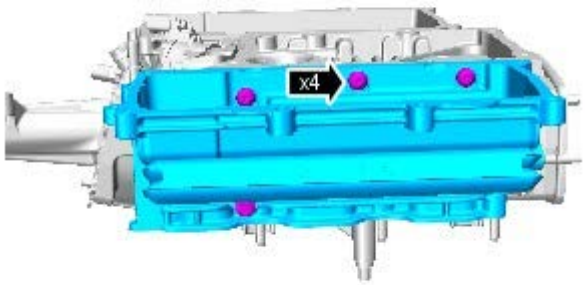


13.



E153535

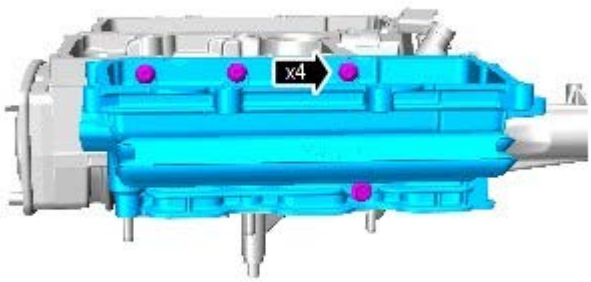
14.



E153534

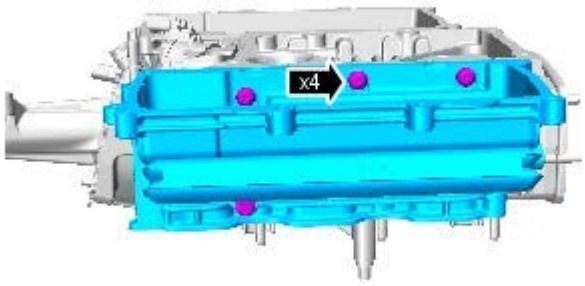
Installation

1. *Torque:* 25 Nm



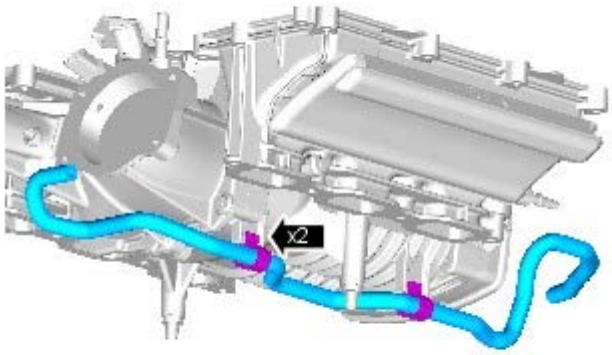
E153535

2. *Torque:* 25 Nm

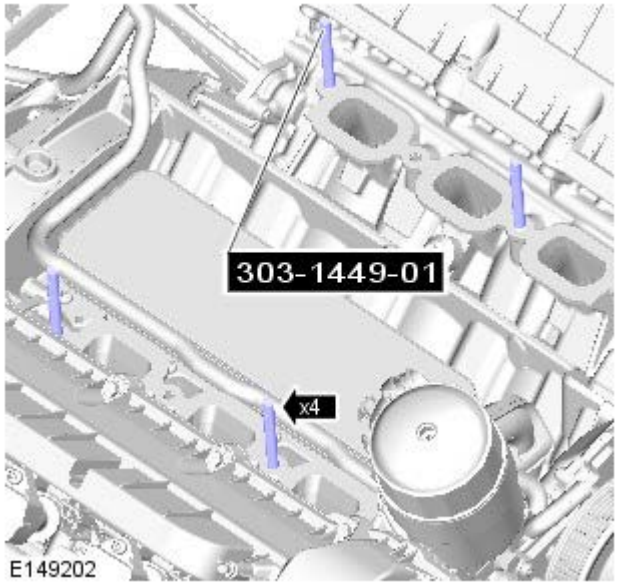


E153534

3.



E149201



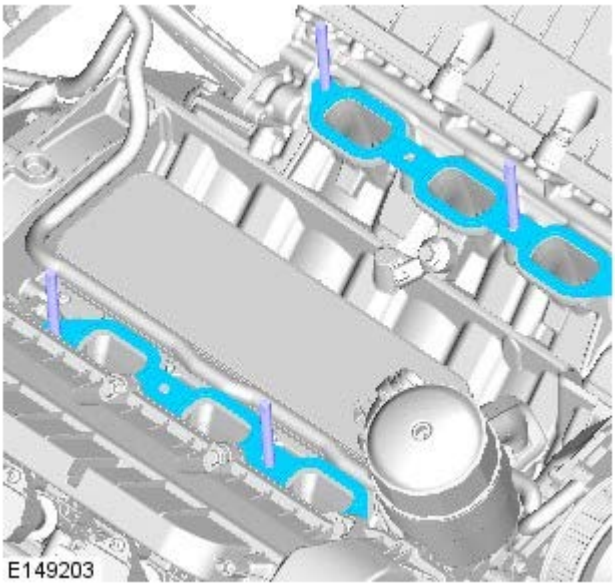
E149202

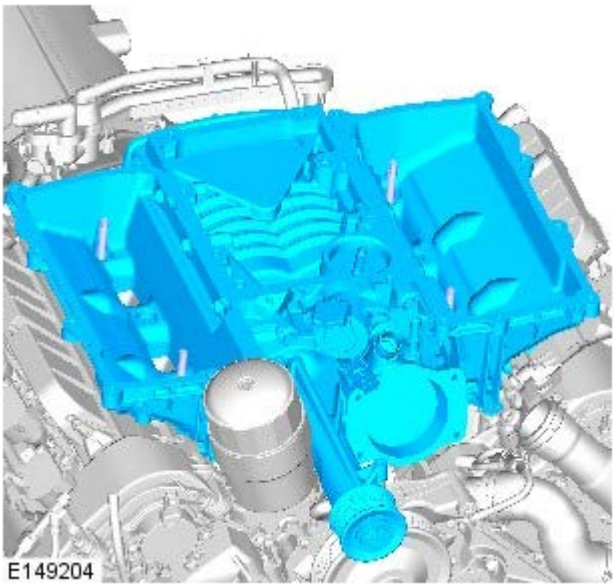
4. CAUTION: If a new cylinder head has been installed then the special tool 303-1449-02 without the thread must be used to install the supercharger.

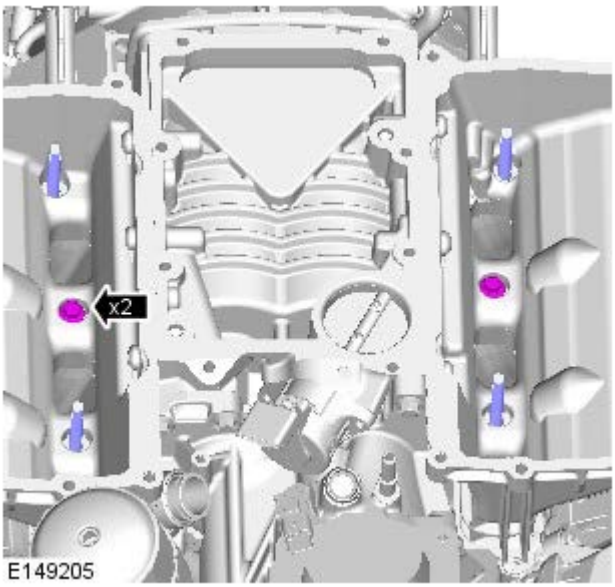
- *Special Tool(s):* 303-1449-01
- *Special Tool(s):* 303-1449-02

5. CAUTION: Make sure that the mating faces are clean and free of foreign material.

NOTE: Install new gaskets.







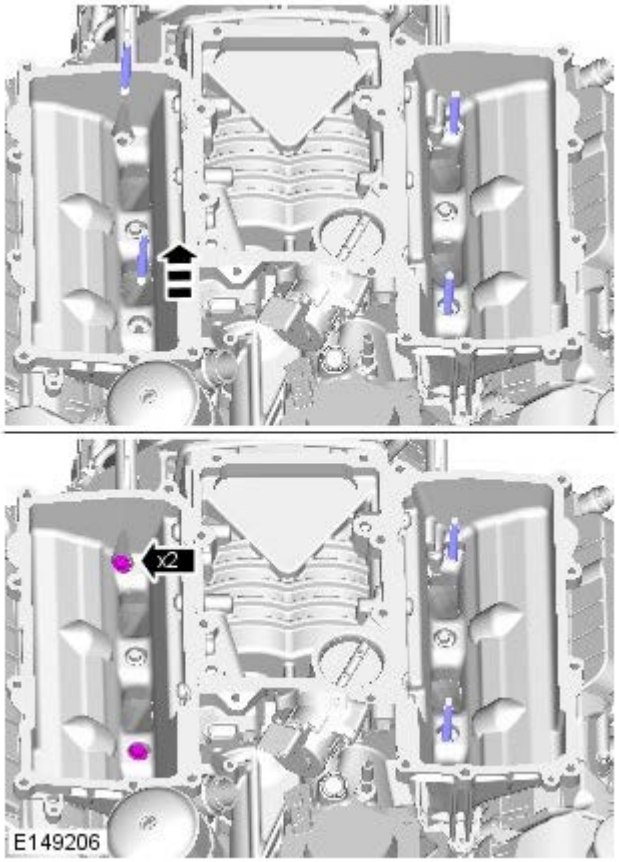
6. CAUTIONS:

   Make sure that the mating faces are clean and free of foreign material.

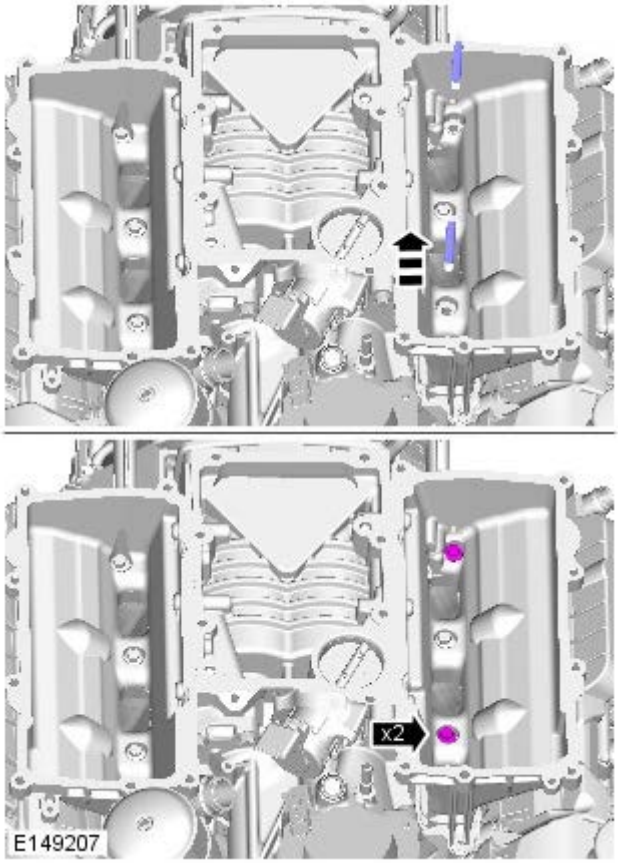
   Take extra care not to damage the component.

7. *Torque:* 25 Nm

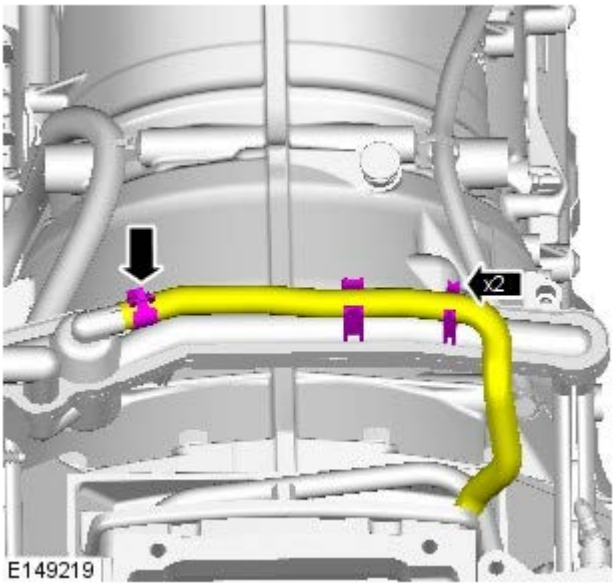
8. *Torque:* 25 Nm



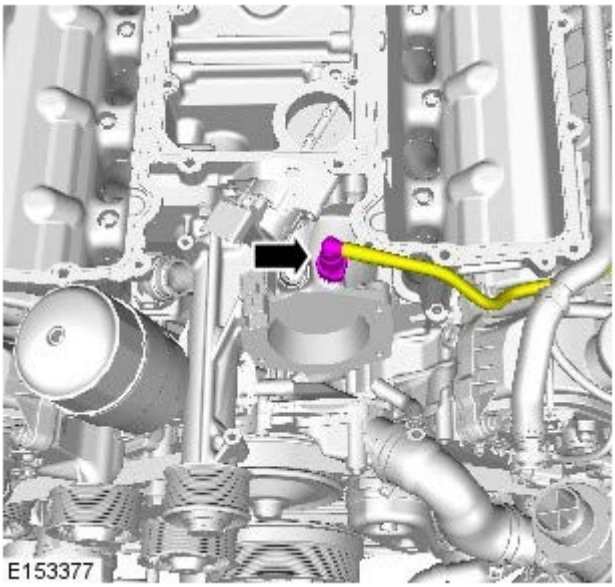
9. *Torque:* 25 Nm



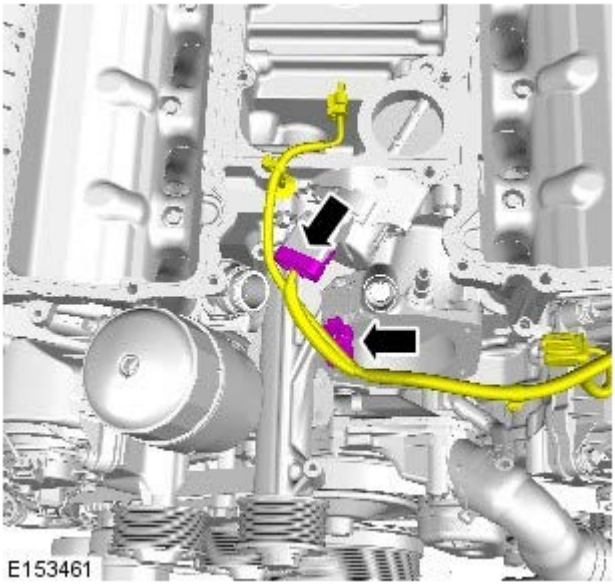
10.



11.



12.



13. Refer to: Manifold Absolute Pressure (MAP) Sensor (303-14B Electronic Engine Controls - V6 S/C 3.0L Petrol, Removal and Installation).

14. Refer to: Supercharger Belt (303-05B Accessory Drive - V6 S/C 3.0L Petrol, Removal and Installation).

15. Refer to: Throttle Body (303-04C Fuel Charging and Controls - V6 S/C 3.0L Petrol, Removal and Installation).

16. Refer to: Charge Air Cooler (303-12B Intake Air Distribution and Filtering - V6 S/C 3.0L Petrol, Removal and Installation).

17. Connect the battery ground cable.

    Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 18-Nov-2013

Intake Air Distribution and Filtering - V6 S/C 3.0L Petrol - Supercharger Spring Isolator

Removal and Installation

Removal

CAUTION: Make sure that all open ports are covered to prevent any foreign material ingress.

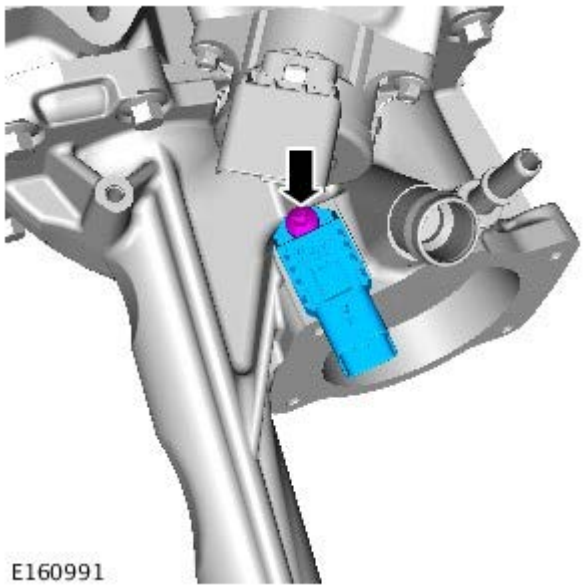
NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. WARNING: Make sure to support the vehicle with axle stands.

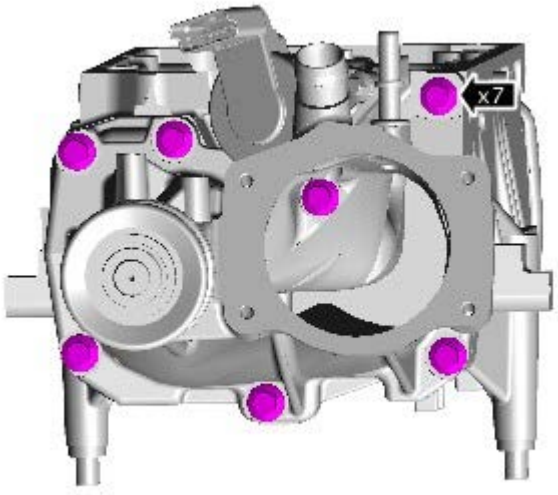
   Raise and support the vehicle.

2. Refer to: Supercharger (303-12B Intake Air Distribution and Filtering - V6 S/C 3.0L Petrol, Removal and Installation).

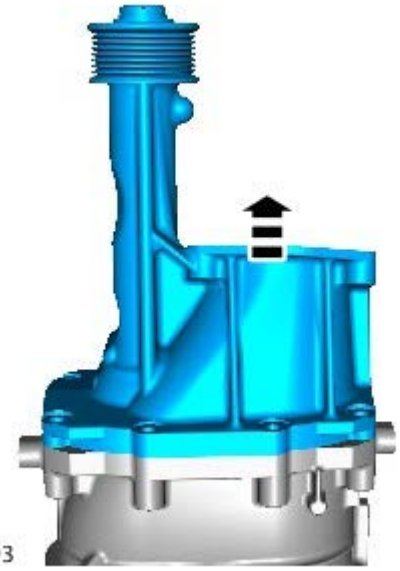
3.



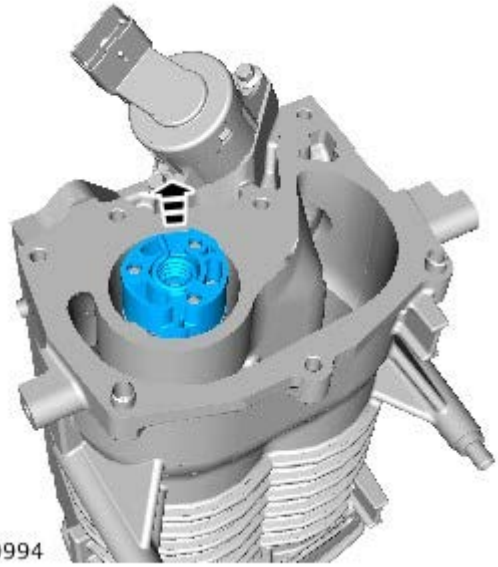
4.



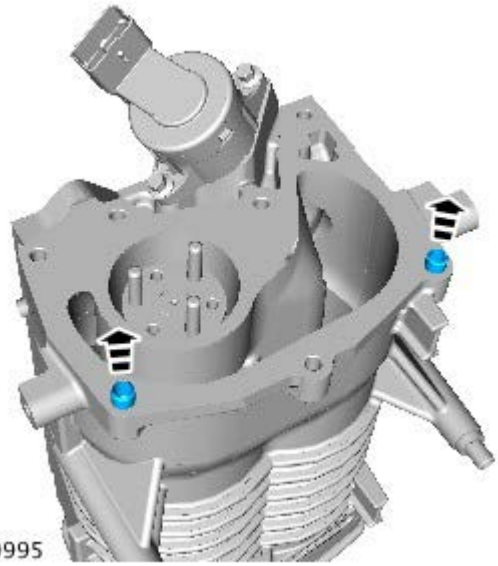
5.


E160993

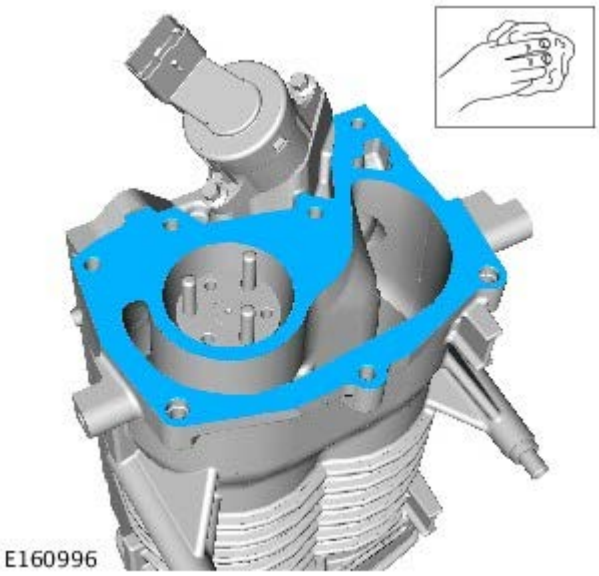
6. CAUTION: Make sure that all open ports are covered to prevent any foreign material ingress.


E160994

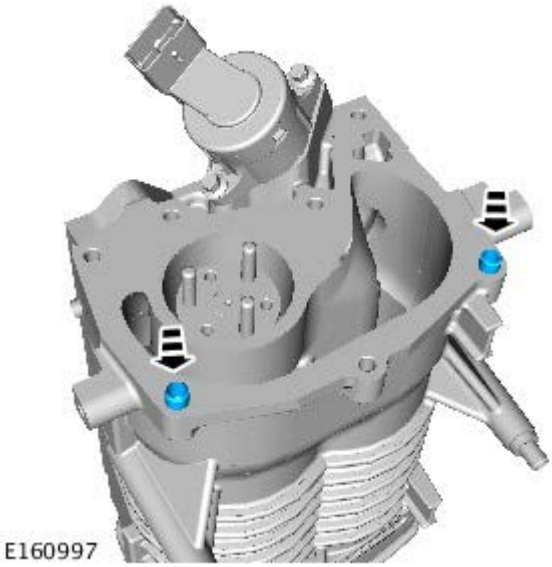
7.


E160995

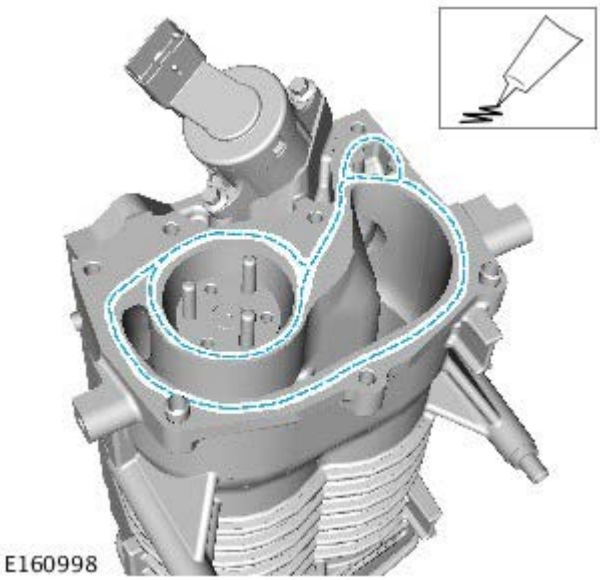
8. CAUTION: Make sure that all open ports are covered to prevent any foreign material ingress.



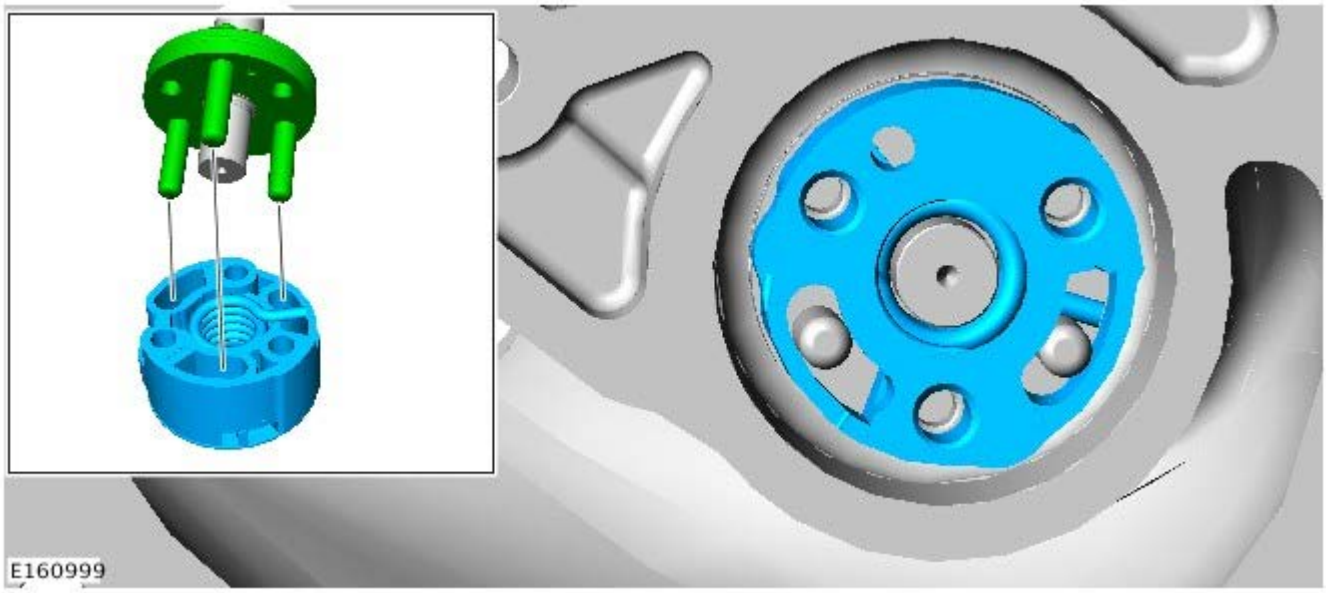
Installation



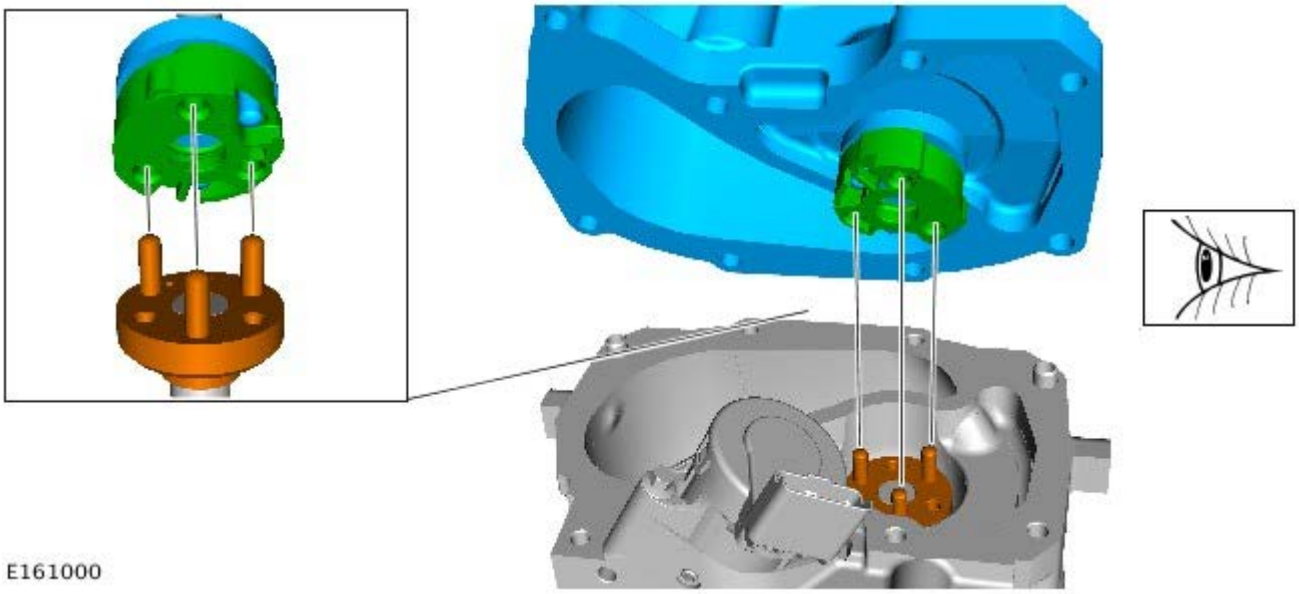
1. CAUTION: Make sure that all open ports are covered to prevent any foreign material ingress.



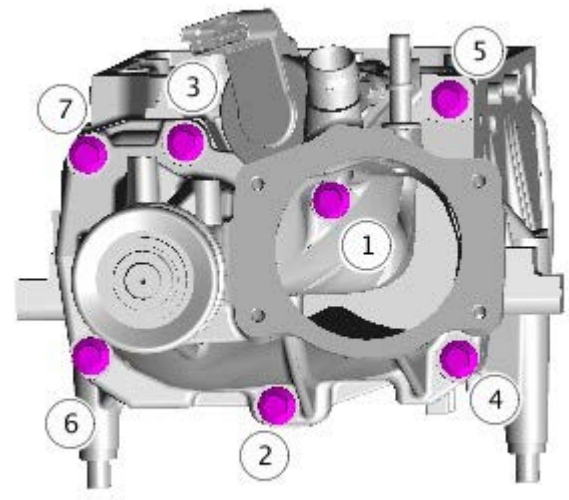
2. CAUTION: Apply a continuous bead of gasket sealant as shown on the illustration. The application of the sealant must be 1mm diameter. Install the component immediately after applying the sealant without smearing the sealant.



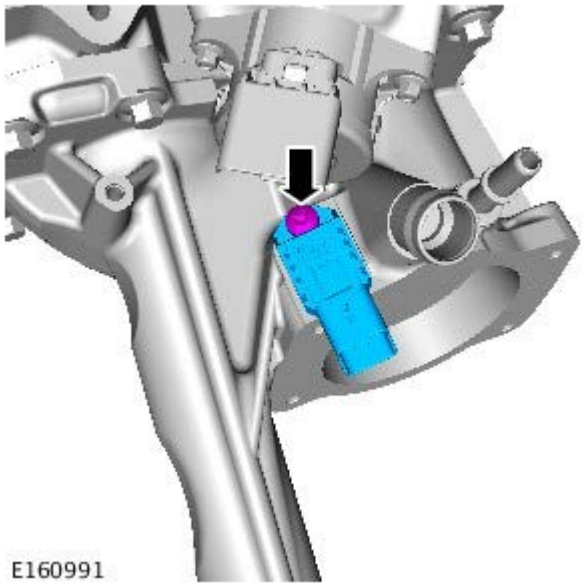
4.



5. *Torque:* 27 Nm



6. *Torque:* 5 Nm

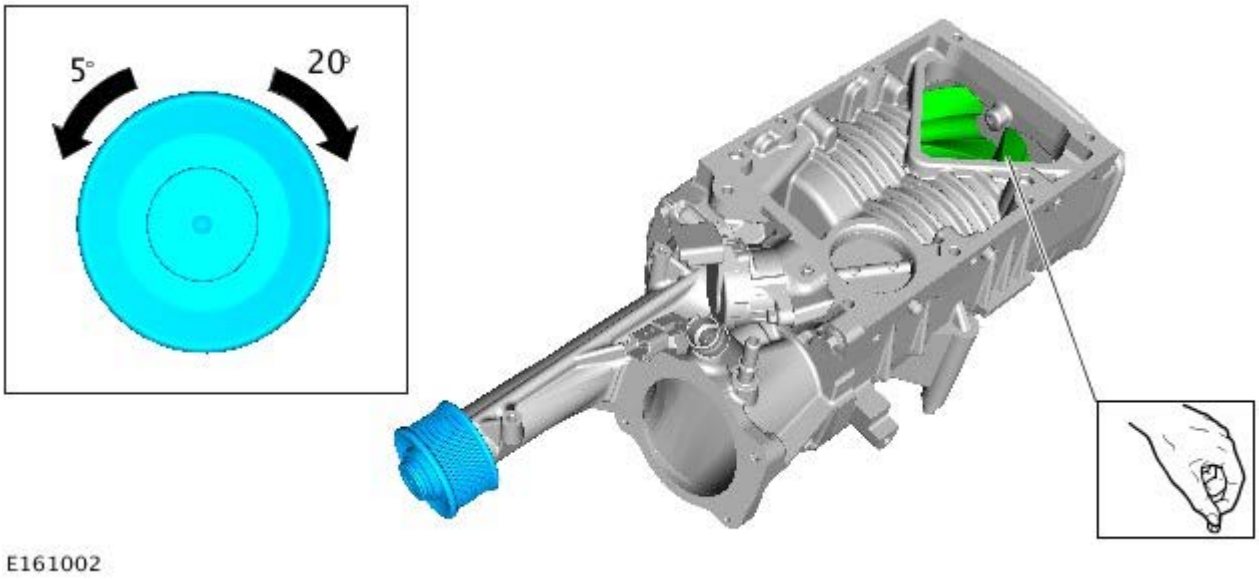


7. CAUTIONS:

   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



8. Refer to: Supercharger (303-12B Intake Air Distribution and Filtering - V6 S/C 3.0L Petrol, Removal and Installation).

Published: 12-Sep-2012

Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol -

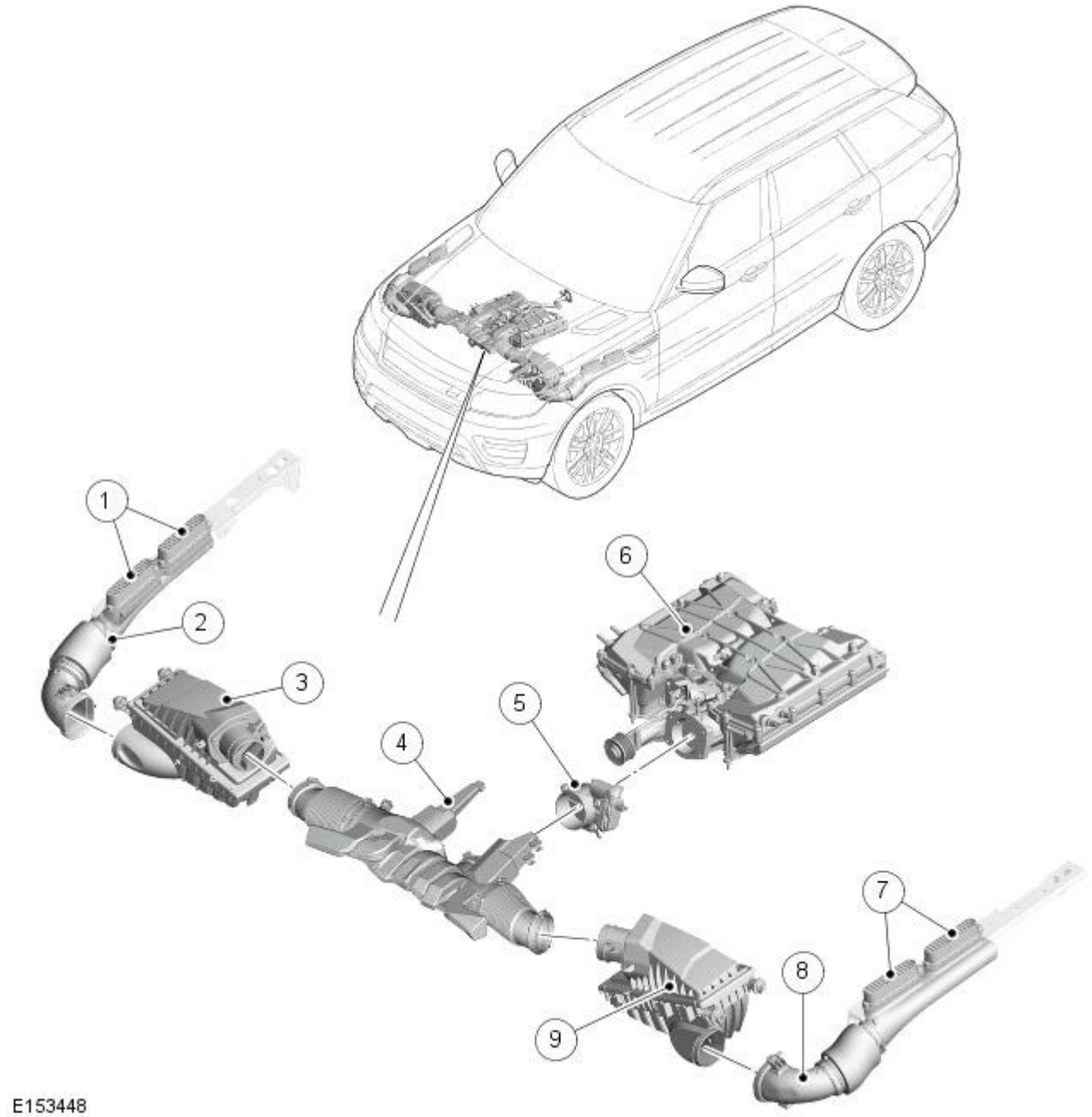
Description	Nm	lb-ft	lb-in
Air Cleaner Outlet Pipe T-Connector bolt	10	7	-
Air Cleaner Outlet Pipe T-Connector clip	3.5	-	31
Air Cleaner Outlet clips	3.5	-	31
Supercharger retaining bolts	25	18	-
Charge air cooler lower assembly retaining bolts	25	18	-
Throttle body retaining studs	10	7	-
Charge air cooler top assembly retaining bolts	25	18	-
Manifold absolute pressure and temperature (MAPT) sensor	5	-	44
Coolant outlet pipe	11	8	-

Published: 02-May-2013

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	-	Right intake grilles
2	-	Right dirty air duct
3	-	Right air cleaner
4	-	Clean air ducts
5	-	Electric throttle
6	-	Supercharger and intake manifolds
7	-	Left intake grilles
8	-	Left dirty air duct
9	-	Left air cleaner

OVERVIEW

The intake air distribution and filtering system comprises:

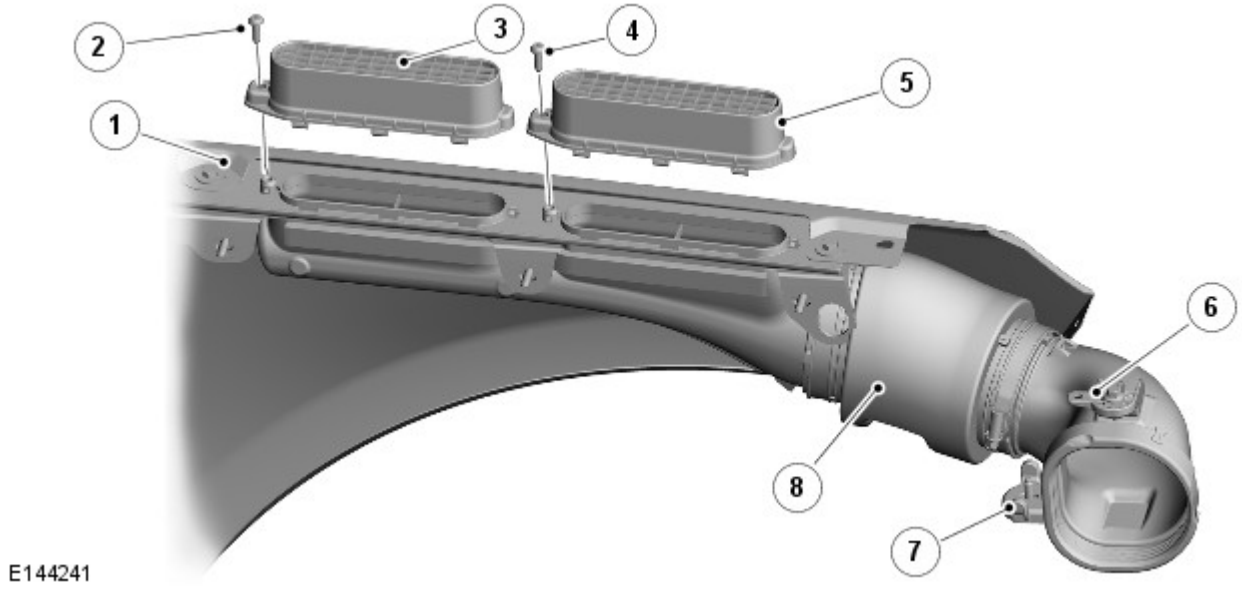
- Two dirty air ducts.

Two air cleaners.
- Clean air ducts.
- An electric throttle.
- A Supercharger and intake manifolds.

Air flows through the dirty air ducts, air cleaners, clean air ducts and electric throttle to the supercharger. The supercharger compresses the air, which is then directed through charge air coolers in the intake manifolds and into the cylinders.

DESCRIPTION

Dirty Air Ducts



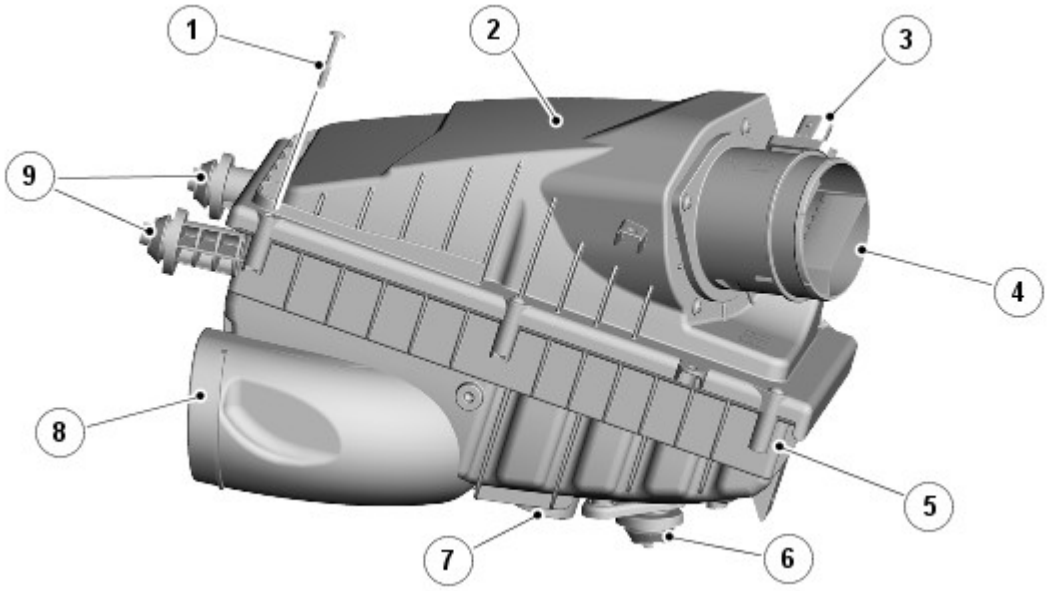
Item	Part Number	Description
1	-	Front fender support
2	-	Screw
3	-	Intake grille
4	-	Screw
5	-	Intake grille
6	-	Front upper bracket
7	-	Front lower bracket
8	-	Non-porous sleeve

The dirty air ducts are installed in the front fenders to transfer ambient air from under the edges of the hood to the air cleaners.

Each dirty air duct locates in the intake of the related air cleaner and is attached to the front inner fender with two brackets. The intake of each dirty air duct is attached to two intake grilles on top of the front fender support. When the hood is closed, the intake grilles locate in guides attached to the hood inner panel.

A porous section, covered by a non-porous sleeve to prevent moisture ingress, is incorporated into each dirty air duct to reduce induction noise.

Air Cleaners



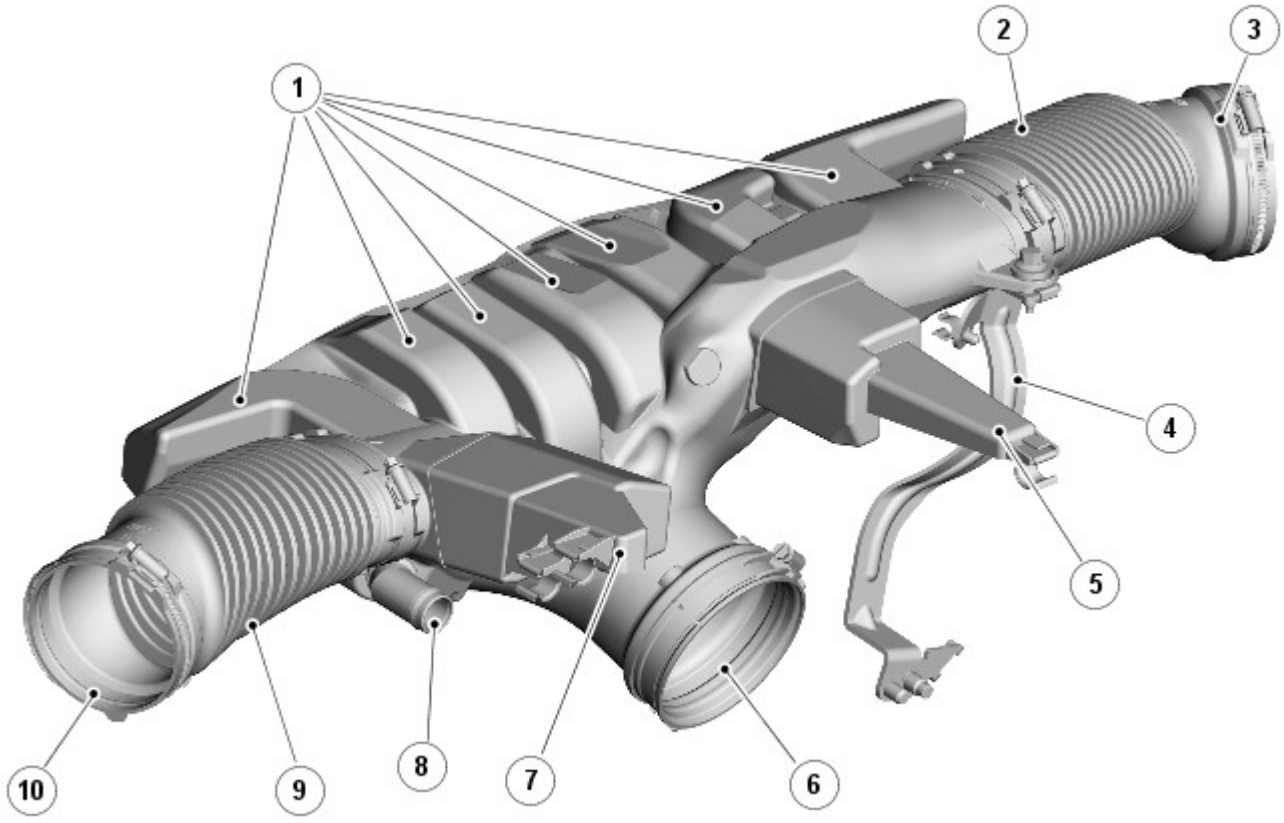
Item	Part Number	Description
1	-	Screw (6 off)
2	-	Lid
3	-	Mass Air Flow and Temperature (MAFT) sensor
4	-	Air outlet
5	-	Base
6	-	Isolator
7	-	Drain valve
8	-	Air intake
9	-	Isolators

An air cleaner is located in each front corner of the engine compartment. Three spigots fitted with isolator bushes locate each air cleaner in holes in the related front inner fender and front suspension housing.

Each air cleaner consists of a filter element installed in a base and enclosed with a lid secured by six screws. The filter element is a pleated, paper type with an integral seal. Air intake and outlet connections are incorporated into the base and lid respectively. The bottom of the base incorporates a drain valve to prevent the accumulation of water in the air cleaner.

The air outlet connection of each air cleaner incorporates a MAFT (Mass Air Flow and Temperature) sensor. The sensors are connected to the ECM (Engine Control Module).
For additional information, refer to: Electronic Engine Controls (303-14C Electronic Engine Controls - V8 S/C 5.0L Petrol, Description and Operation).

Clean Air Ducts



E144753

Item	Part Number	Description
1	-	Resonators
2	-	Right convolute
3	-	Right air intake
4	-	Support bracket
5	-	Resonator
6	-	Air outlet
7	-	Resonator
8	-	Full load breather connector stub
9	-	Left convolute
10	-	Left air intake

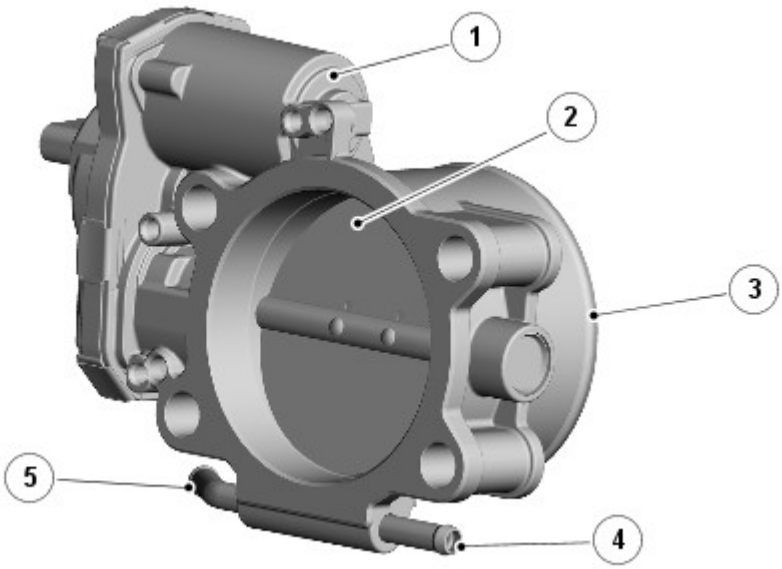
The clean air ducts transfers air from the air cleaner outlets to the electric throttle. Two convolute sections in the clean air ducts accommodate the relative movement between the engine mounted electric throttle and the body mounted air cleaners.

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 right cylinder head.

Electric Throttle



E144601

Item	Part Number	Description
1	-	Electric motor
3	-	Air intake
3	-	Air outlet
4	-	Coolant feed connection
5	-	Coolant return connection

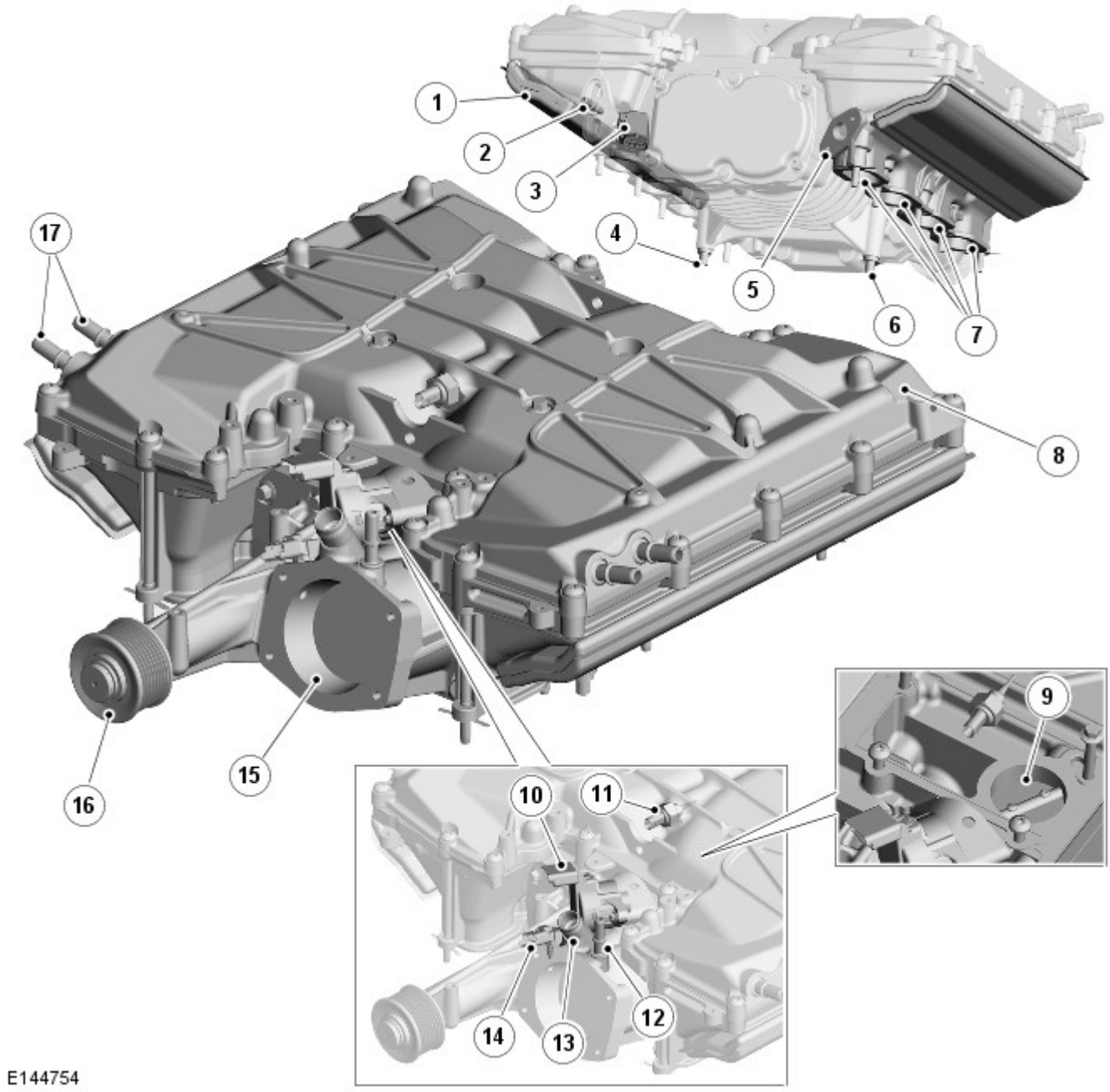
The electric throttle regulates the air flow into the supercharger.

The electric throttle is installed at the front of the engine, between the cylinder heads. Four bolts attach the electric throttle to the supercharger.

The throttle plate is operated by a DC (Direct Current) electric motor attached to the throttle body. The motor is controlled by the ECM and is constantly adjusted in response to driver inputs with the throttle pedal to precisely control the amount of air allowed into the intake manifold.
For additional information, refer to: Electronic Engine Controls (303-14C Electronic Engine Controls - V8 S/C 5.0L Petrol, Description and Operation).

To prevent icing, coolant is circulated across the throttle body through coolant feed and return connections.

Supercharger and Intake Manifolds



Item	Part Number	Description
1	-	Noise Vibration and Harshness (NVH) pad
2	-	Vacuum connector stub
3	-	Manifold Absolute Pressure and Temperature (MAPT) sensor
4	-	Dowel
5	-	Symposer intake pipe connection
6	-	Dowel
7	-	Intake manifold outlet ports
8	-	Charge air cooler tank top
9	-	Bypass valve
10	-	Bypass valve actuator
11	-	Supercharger outlet temperature sensor
12	-	Evaporative emissions connector stub
13	-	Part load breather connector stub
14	-	Manifold Absolute Pressure (MAP) sensor
15	-	Supercharger intake port
16	-	Pulley
17	-	Coolant intake and outlet connections for charge air cooler

The 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 supercharger to the cylinder intake ports.

The intake manifolds are attached to their related cylinder heads and the sides of the supercharger. Two dowels locate

the supercharger in position on the cylinder block. A charge air cooler tank top is installed on top of the supercharger and intake manifolds to form the air duct from the supercharger outlet to the intake manifolds. A charge air cooler is installed in each intake manifold.

A NVH (Noise, Vibration and Harshness) pad is attached to the side of each intake manifold. The rear of the right intake manifold incorporates a connection port for the symposer intake pipe. The rear of the left intake manifold incorporates:

- A connector stub for the brake vacuum system.
- A MAPT (Manifold Absolute Pressure and Temperature) sensor.

The supercharger is a Roots blower with high angle helix rotors driven at 2.1 times engine speed by the secondary belt of the accessory drive.

The two rotors of the supercharger 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. A pulley transfers power from the accessory drive to the shaft of one of the rotors.

A DC electric actuator on the front cover is attached to a bypass valve in the housing. The bypass valve allows air to bypass the rotors, to control the outlet pressure of the supercharger. Operation of the actuator is controlled by a PWM (Pulse Width Modulation) signal from the ECM. A Hall effect position sensor in the actuator returns a 0.5 to 4.5 V signal to the ECM. This allows the ECM to identify the position of the bypass valve for closed-loop control.

The front cover also incorporates:

- The supercharger air intake 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.

OPERATION

Supercharger

At closed or partially open throttle positions, the bypass valve is fully open, allowing intake air to bypass the supercharger. This results in little or no pressure increase across the supercharger. Progressive opening of the throttle reduces the depression downstream of the electric throttle. This is sensed by the ECM from the MAP sensor input. The ECM then signals the bypass valve actuator to progressively close the bypass valve. As the bypass valve closes there is a corresponding increase in the outlet pressure from the supercharger, which increases engine power output.

Published: 27-Feb-2013

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 in 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.

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 cleaner element condition and installation • Restricted air intake • Vacuum hoses condition and installation • Pipework to/from supercharger: condition and installation • Supercharger: condition and installation • Charge air coolers	• Fuse(s) • Wiring harness(es) • Loose or corroded electrical connector(s) • Mass air flow (MAF) sensors • Manifold absolute pressure and temperature (MAPT) sensor • Intake air temperature (IAT) sensor - The IAT sensor is built into the right-hand MAF 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
Vehicle does not start/hard starting	• Restricted/blocked air intake • Restricted/blocked air cleaner element	Check the intake air system for blockages or restriction. Rectify as necessary.
Poor performance	• Intake air system fault • Supercharger fault • Low fuel pressure • Restricted exhaust system	Check the intake air system for blockages or restriction. Rectify as necessary. Check for DTCs indicating a supercharger or fuel pressure fault. Rectify as necessary. Check the exhaust system for evidence of damage or restriction. Rectify as necessary.
Excessive intake noise	• Intake air leak after the supercharger • Intake pipe disconnected/damaged after the air cleaner • Air cleaner assembly incorrectly assembled/damaged	Check the intake air system for loose or disconnected hoses or ducts. Check the hoses and ducts for damage, splits, etc. Rectify as necessary.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - V8 S/C 5.0L Petrol, DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation).

Published: 15-May-2013

Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol - Air Cleaner Element

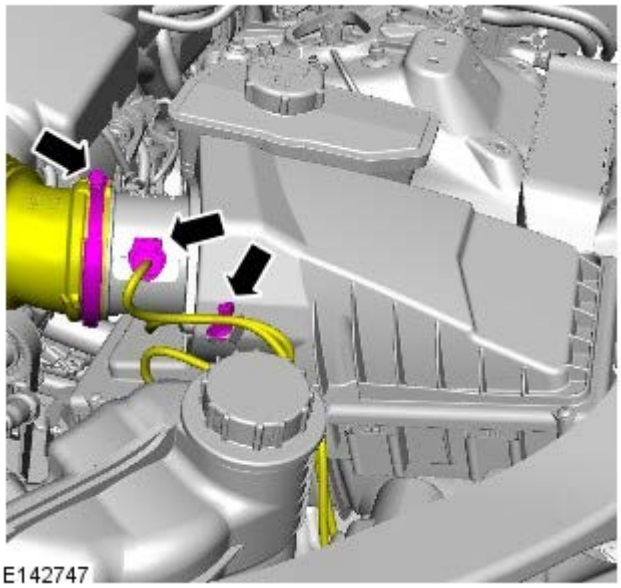
Removal and Installation

Removal

NOTES:

Removal steps in this procedure may contain installation details.

Air cleaner elements must be renewed in pairs.



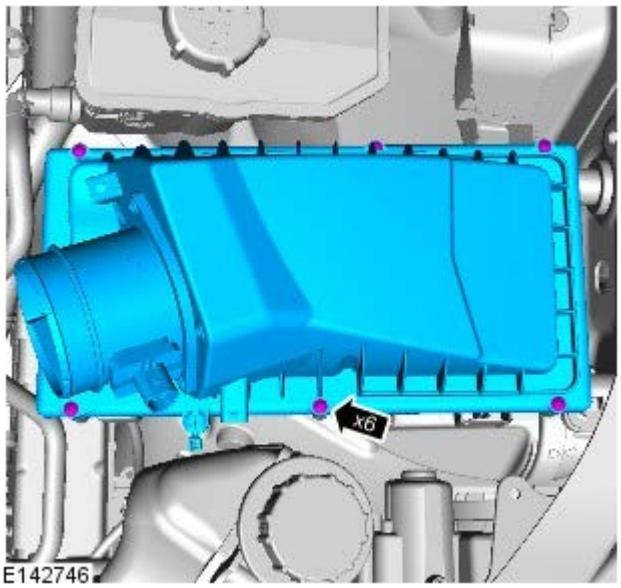
1. NOTES:

   Left-hand shown, right-hand similar.

   Make sure the retaining clip is correctly installed and tightened.

   Some variation in the illustrations may occur, but the essential information is always correct.

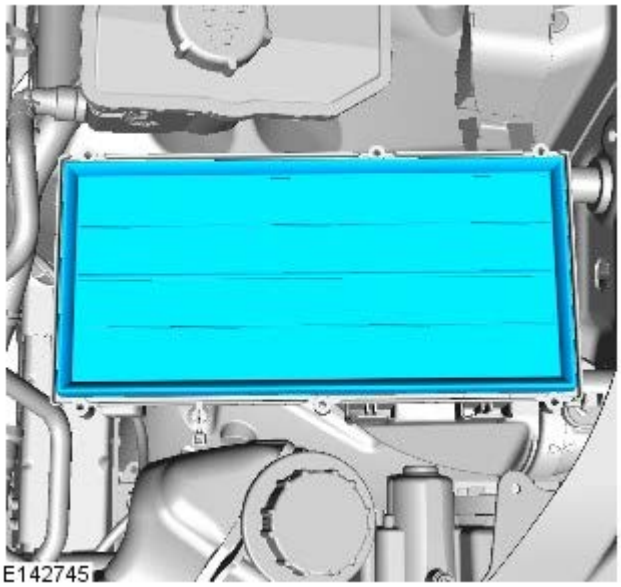
   Torque: 3.5 Nm



2. NOTE: Left-hand shown, right-hand similar.

3. NOTE: Right-hand shown, left-hand similar.

   - Repeat the above procedure for the other side.



Installation

1. To install reverse the removal procedure.

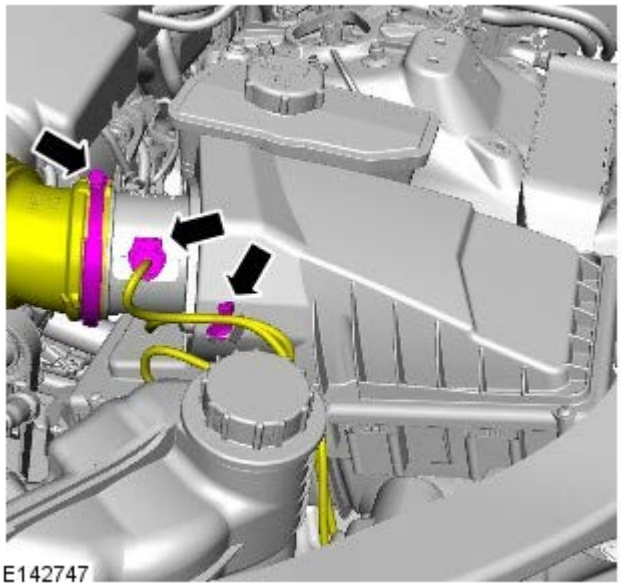
Published: 06-Aug-2012

Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol - Air Cleaner LH

Removal and Installation

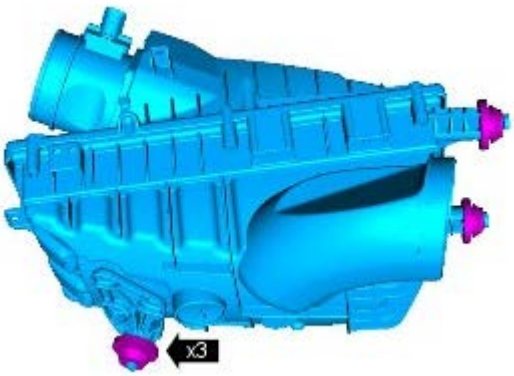
Removal

NOTE: Removal steps in this procedure may contain installation details.

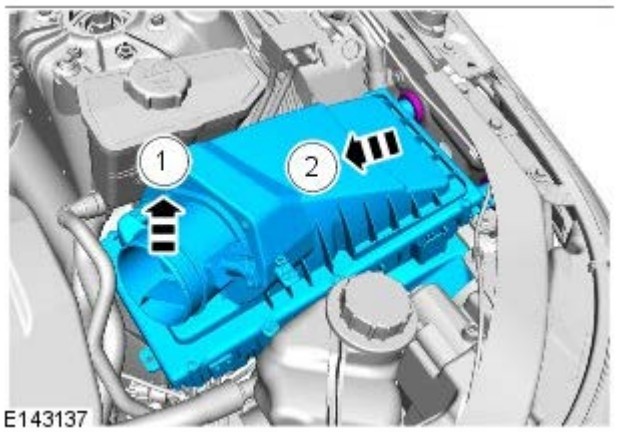


1. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

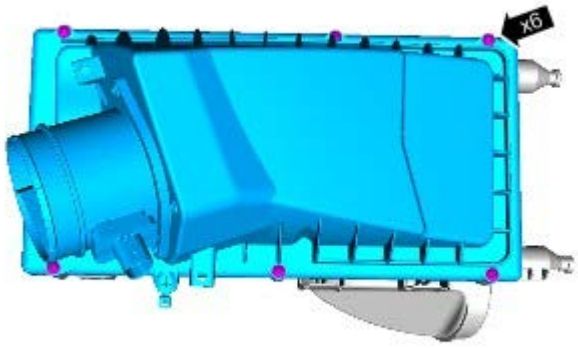
   Torque: 3.5 Nm



2. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

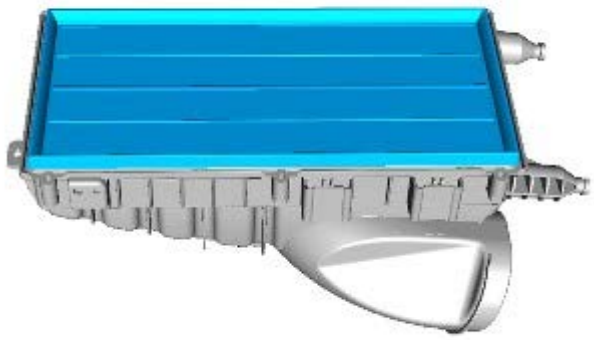


3. NOTE: Do not disassemble further if the component is removed for access only.



E143138

4.



E143136

Installation

1. To install reverse the removal procedure.

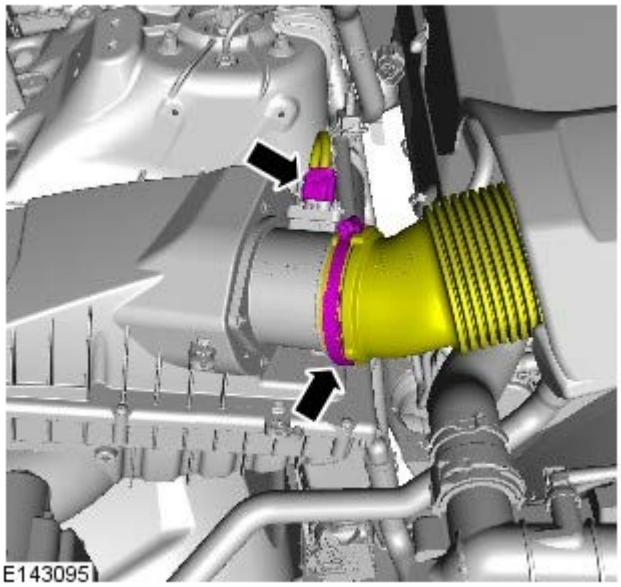
Published: 03-Aug-2012

Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol - Air Cleaner RH

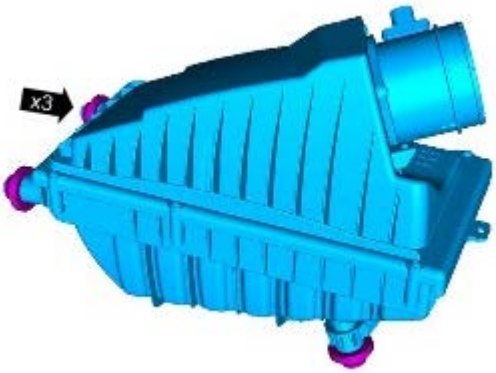
Removal and Installation

Removal

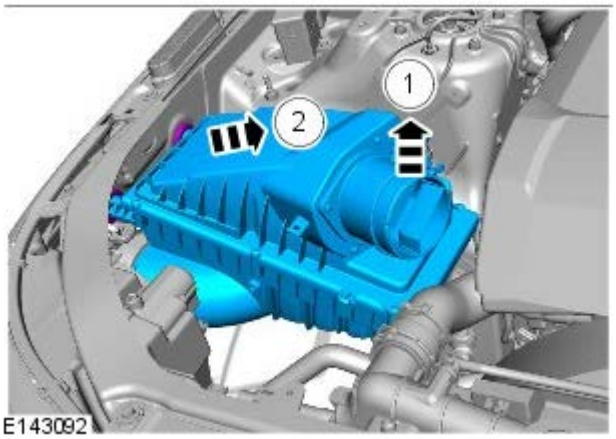
NOTE: Removal steps in this procedure may contain installation details.



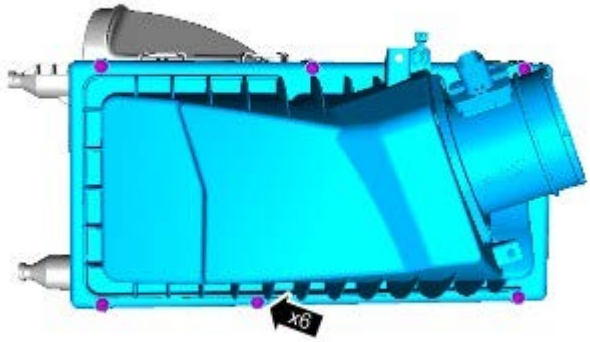
1. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.



2. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.



3. NOTE: Do not disassemble further if the component is removed for access only.



E143093

4.



E143094

Installation

1. To install reverse the removal procedure.

Published: 06-Aug-2012

Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol - Air Cleaner Outlet Pipe LH

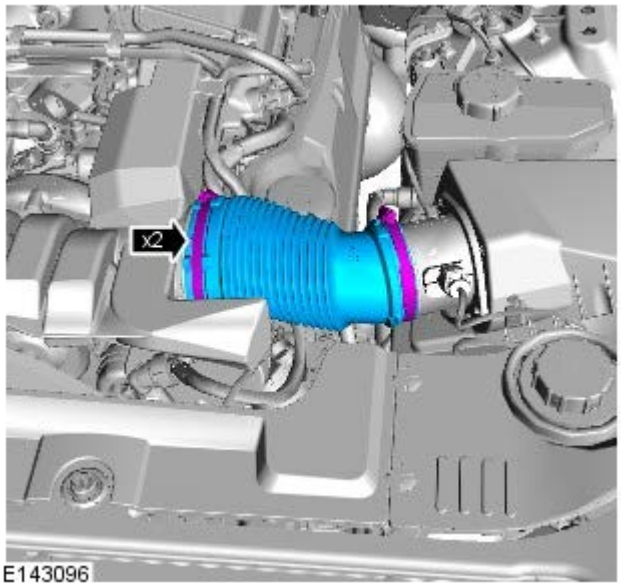
Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Engine Cover - V8 5.0L Petrol/V8 S/C 5.0L Petrol (501-05, Removal and Installation).

2. *Torque:* 3.5 Nm



Installation

1. To install reverse the removal procedure.

Published: 02-Aug-2012

Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol - Air Cleaner Outlet Pipe RH

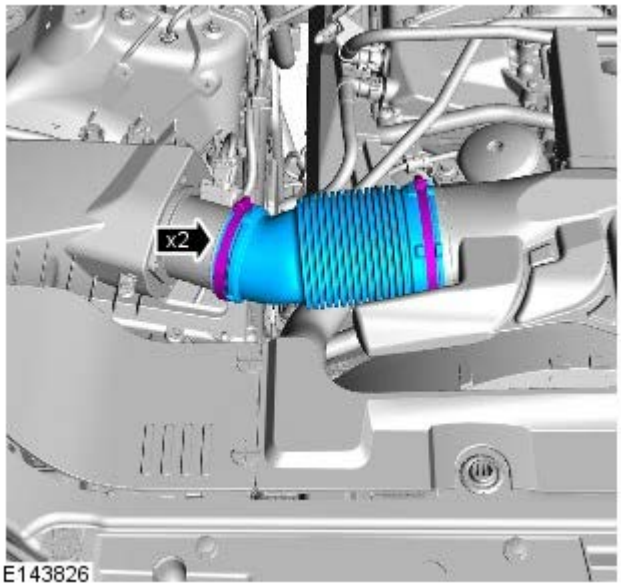
Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Engine Cover - V8 5.0L Petrol/V8 S/C 5.0L Petrol (501-05, Removal and Installation).

2. *Torque:* 3.5 Nm



Installation

1. To install reverse the removal procedure.

Published: 06-Aug-2012

Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol - Air Cleaner Outlet Pipe T-Connector

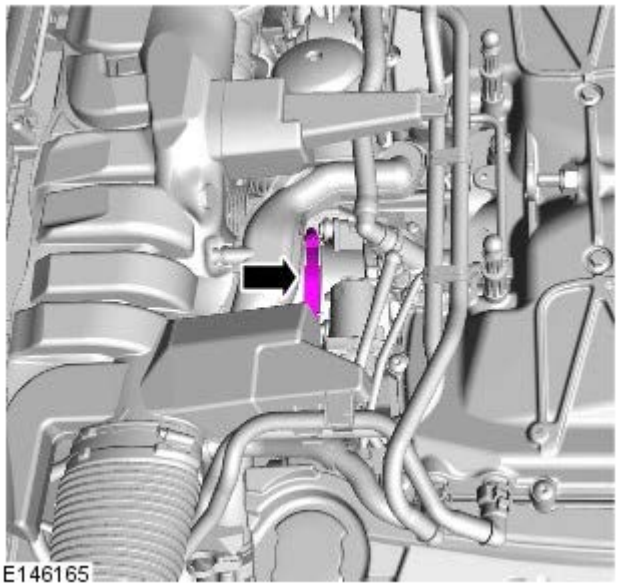
Removal and Installation

Removal

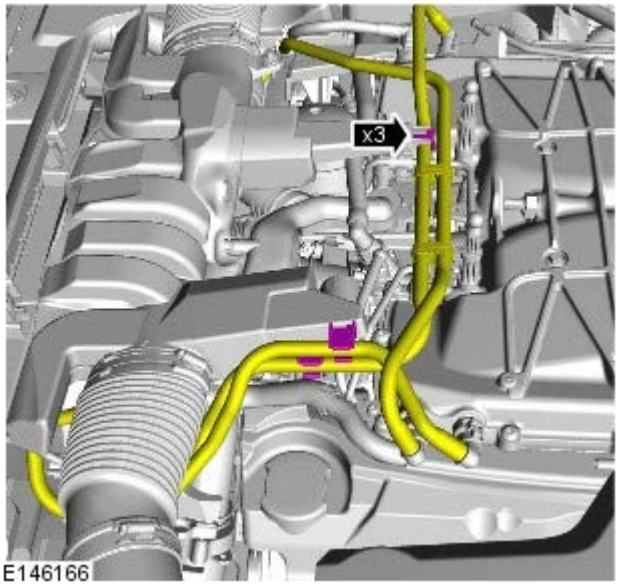
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Engine Cover - V8 5.0L Petrol/V8 S/C 5.0L Petrol (501-05, Removal and Installation).

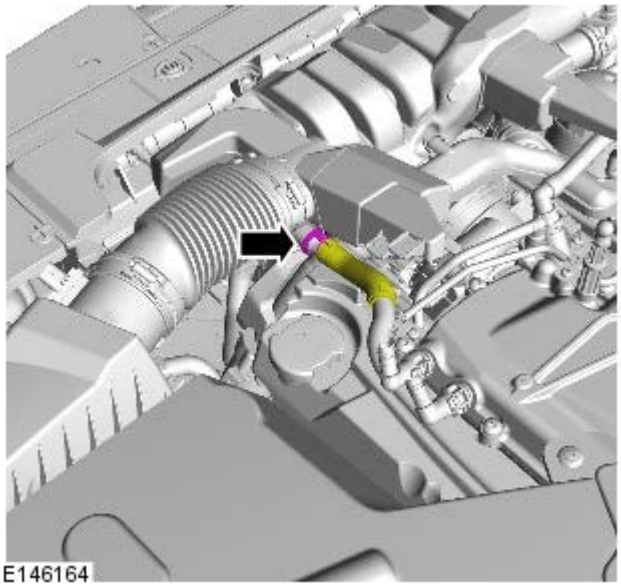
2. *Torque:* 3.5 Nm



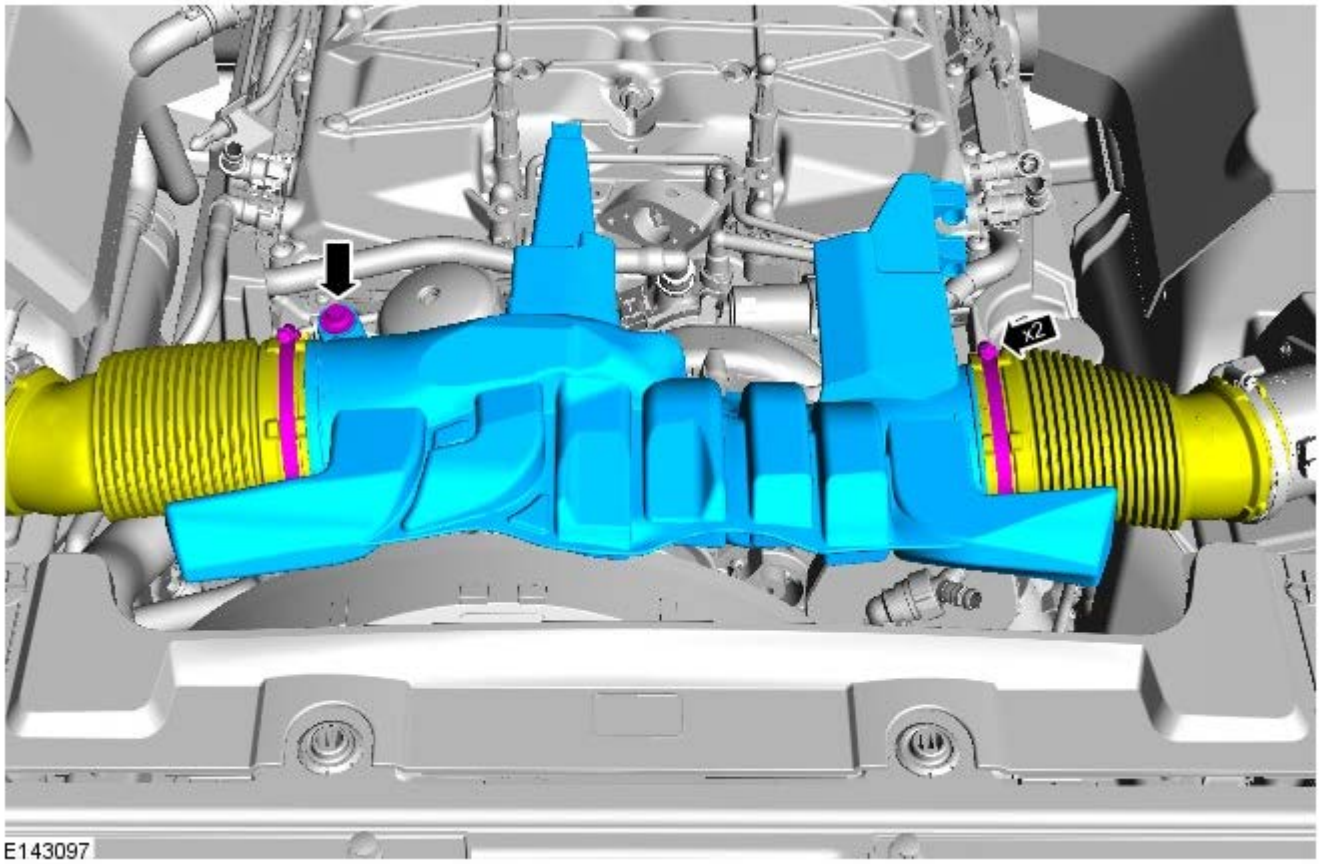
3.



4.



5. *Torque:*
   M6 10 Nm
   Clamp 3.5 Nm



Installation

1. To install, reverse the removal procedure.

Published: 07-Aug-2012

Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol - Charge Air Cooler

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.

After carrying out repairs, the fuel system must be checked visually for leaks. Failure to follow these instructions may result in personal injury.

CAUTION: Make sure that all openings are sealed. Use new blanking caps.

NOTES:

Some variation in the illustrations may occur, but the essential information is always correct.

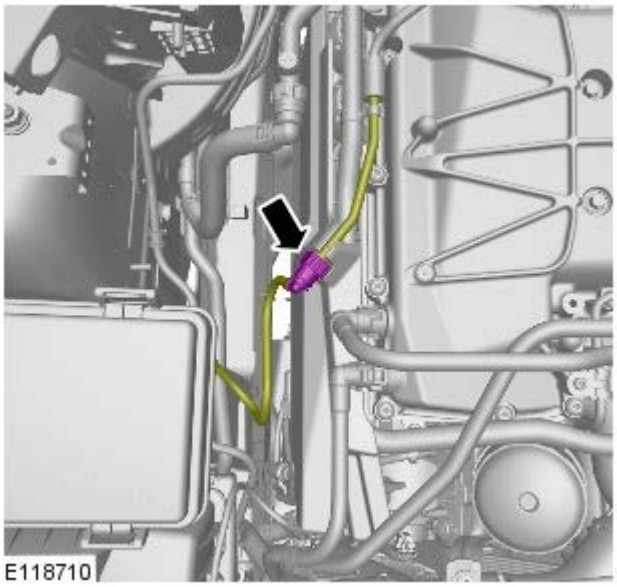
Removal steps in this procedure may contain installation details.

1. Refer to: Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions (100-00 General Information, Description and Operation).
2. Refer to: Fuel System Pressure Release - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (310-00 Fuel System - General Information, General Procedures).
3. Disconnect the battery ground cable.

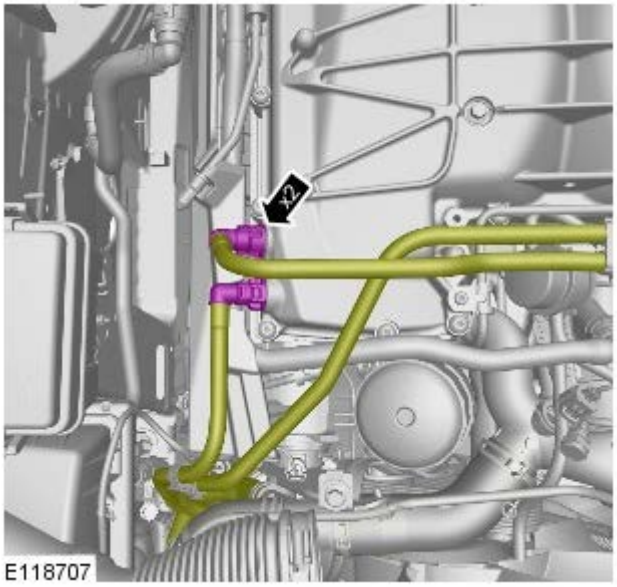
   Refer to: Specifications (414-00, Specifications).
4. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.
5. Refer to: Fuel Injection Component Cleaning (303-04C Fuel Charging and Controls - V6 S/C 3.0L Petrol, General Procedures).
6. Refer to: Cooling System Partial Draining, Filling and Bleeding - V8 S/C 5.0L Petrol (303-03C, General Procedures).
7. Refer to: Cowl Panel Grille (501-02 Front End Body Panels, Removal and Installation).

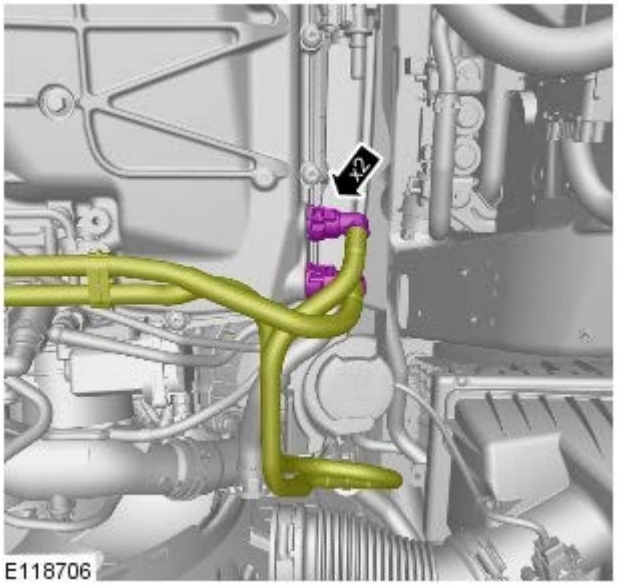
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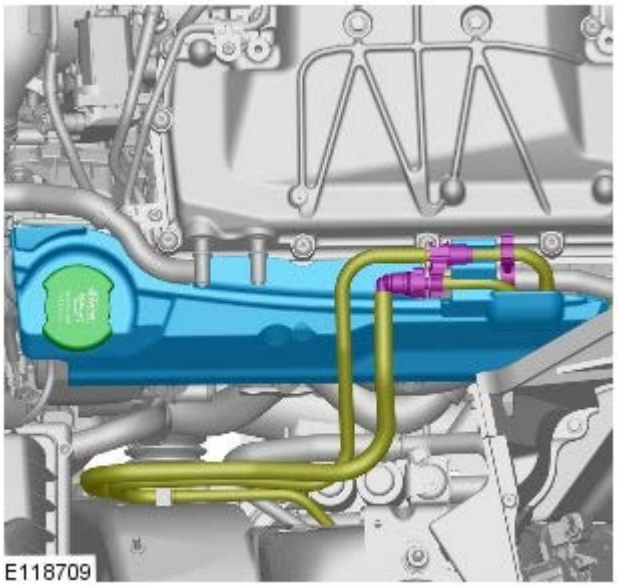
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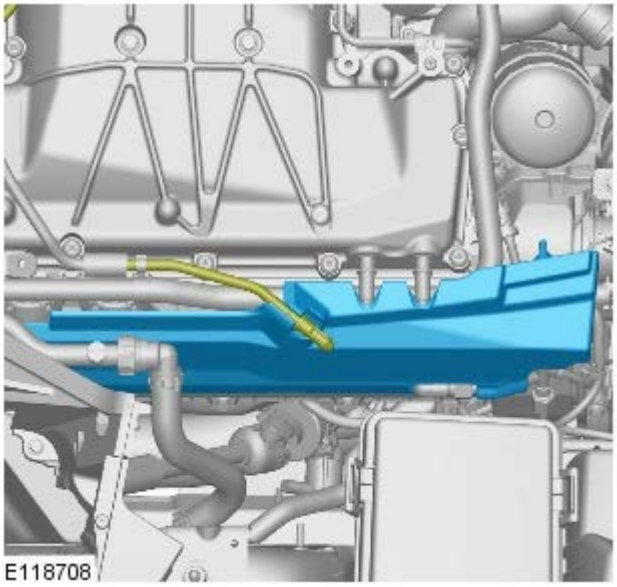
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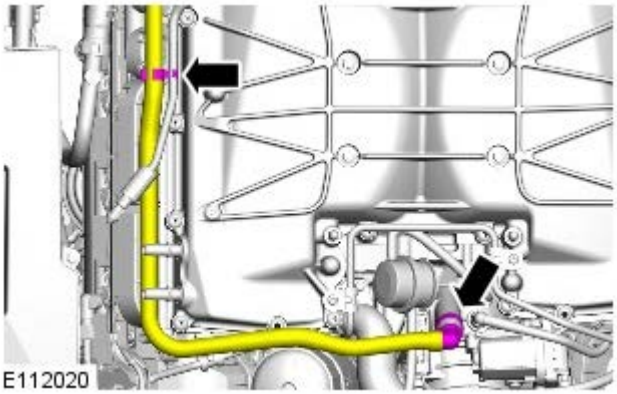
11. CAUTION: Be prepared to collect escaping fluids.



12.



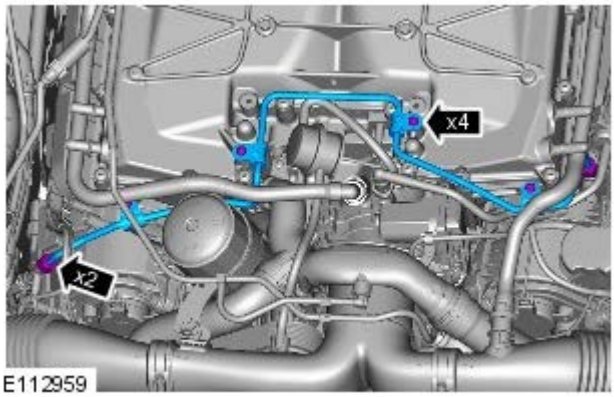
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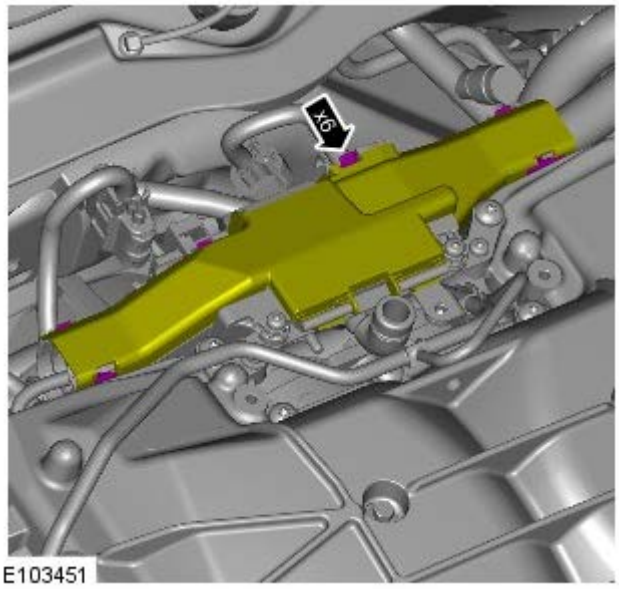
14. CAUTIONS:

Make sure that the fuel line union does not rotate.

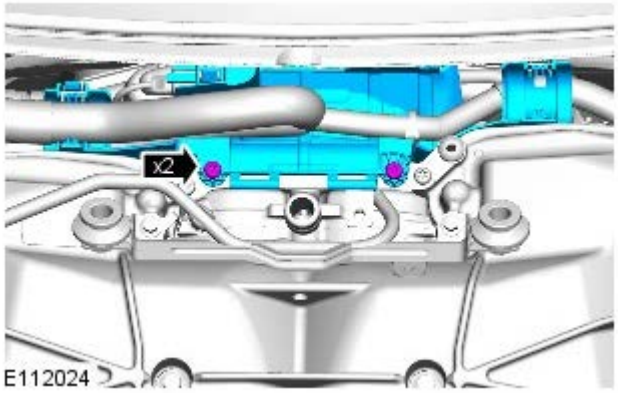
Be prepared to collect escaping fluids.



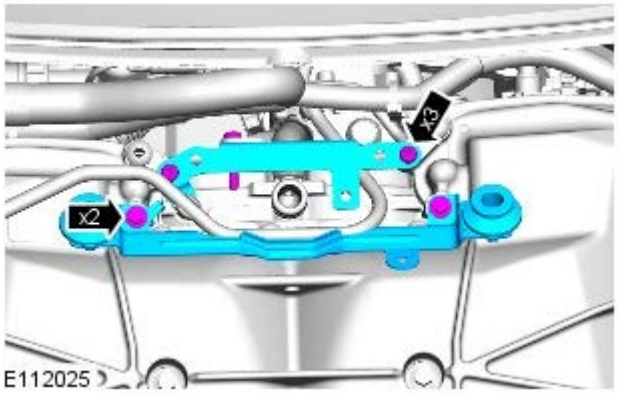
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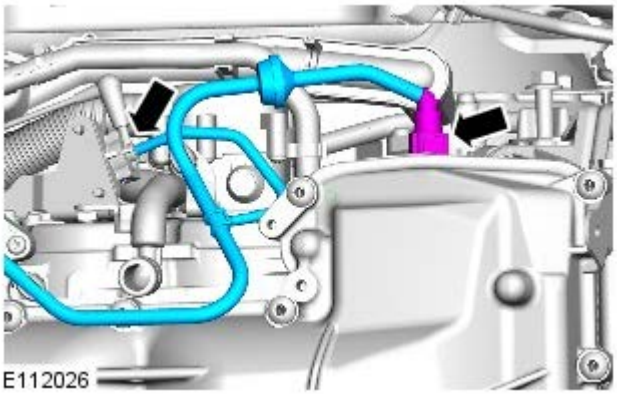
16. *Torque:* 10 Nm



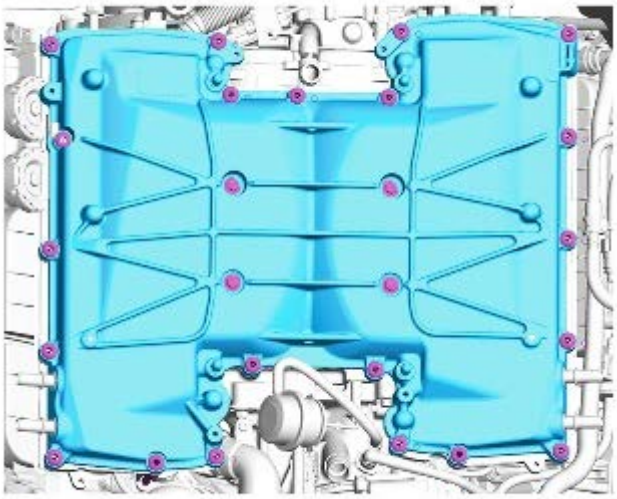
17. *Torque:* 10 Nm



18.



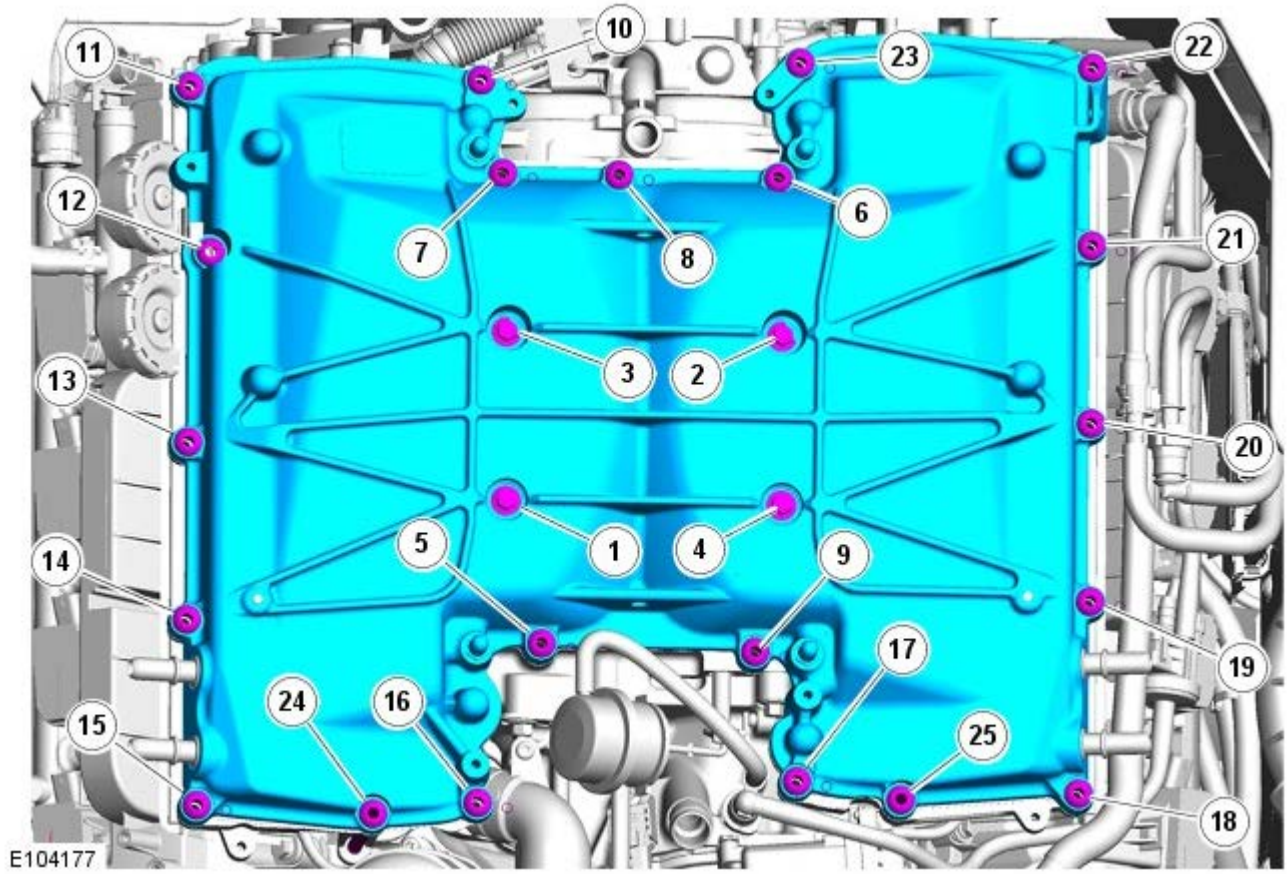
19. NOTE: Remove and discard the gasket.

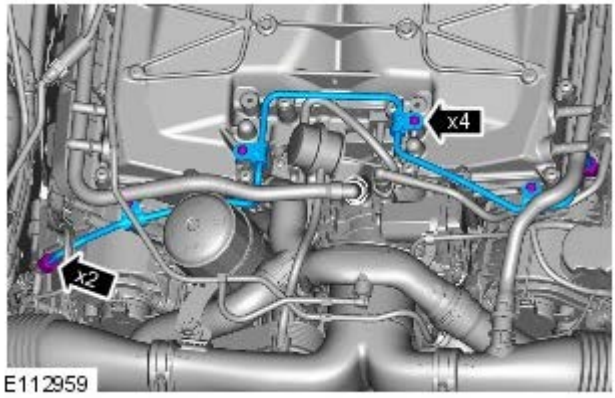


Installation

1. NOTE: Install a new gasket.
   - Install and finger tighten bolts in sequence illustrated.
   - Tighten the bolts in the indicated sequence.

   Torque: 25 Nm



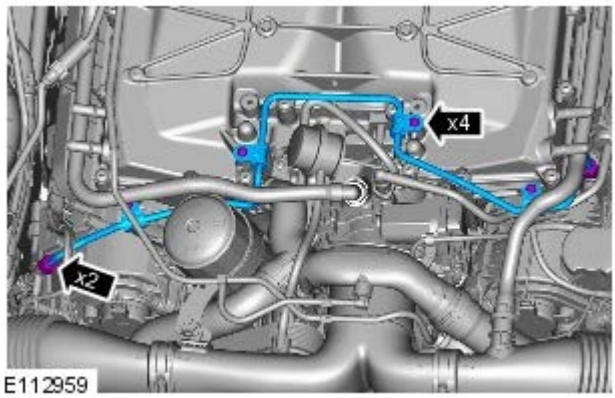


2. CAUTION: Lubricate only the union threads with clean engine oil.

   NOTES:

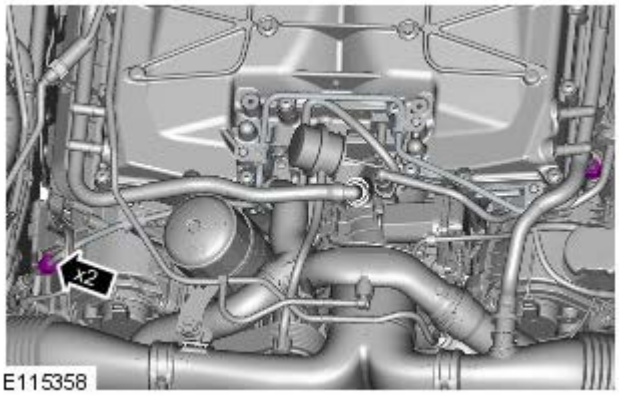
   Do not tighten at this stage.

   Remove and discard the blanking caps.



3. *Torque:*
   Union 20 Nm
   M6 12 Nm

4. *Torque:* 21 Nm



5. To install, reverse the removal procedure.

Published: 12-Sep-2012

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

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.

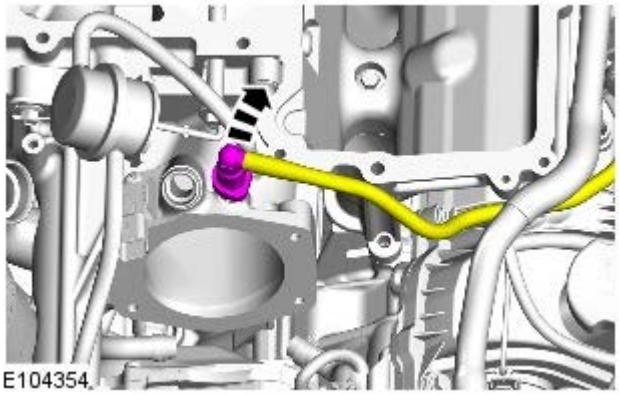
3. Refer to: Charge Air Cooler (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).

4. Refer to: Throttle Body (303-04, Removal and Installation).

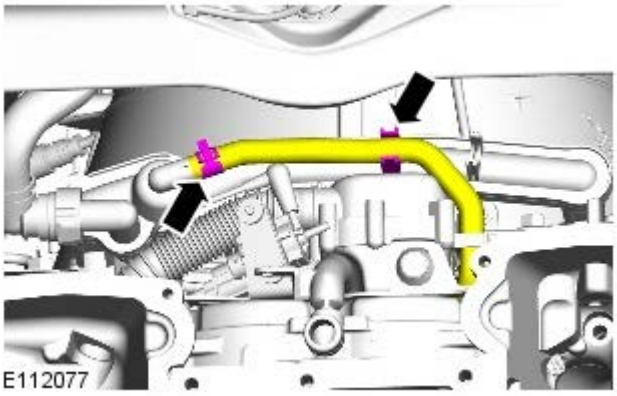
5. Refer to: Supercharger Belt (303-05C Accessory Drive - V8 S/C 5.0L Petrol, Removal and Installation).

6. Refer to: Manifold Absolute Pressure (MAP) Sensor (303-14C Electronic Engine Controls - V8 S/C 5.0L Petrol, Removal and Installation).

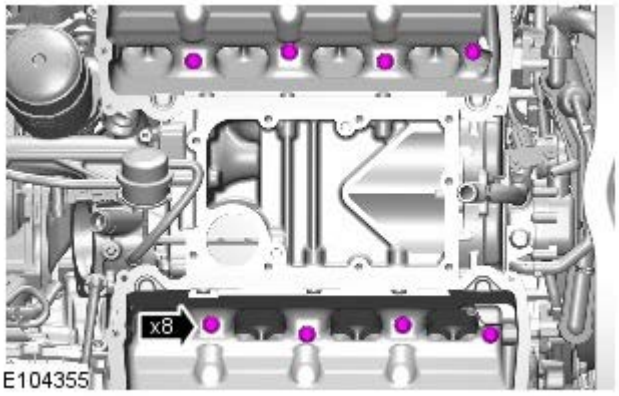
7.


E104354

8.

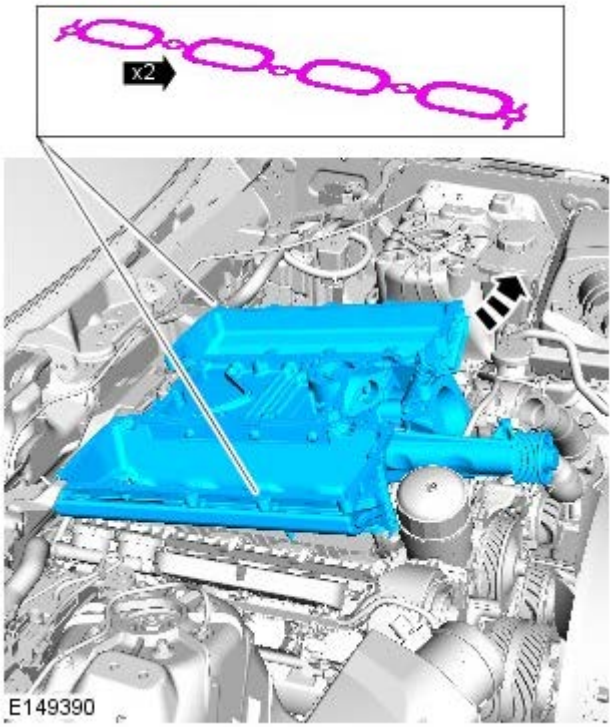


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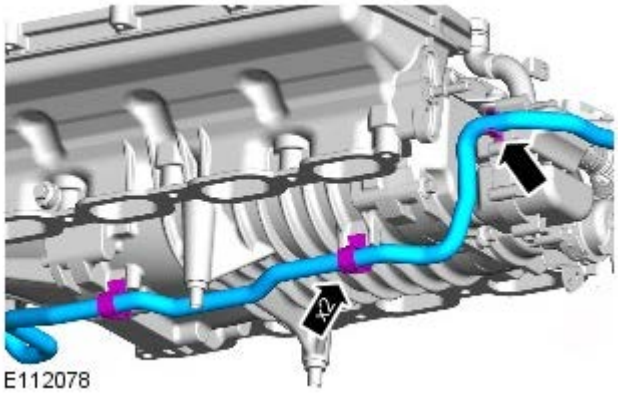


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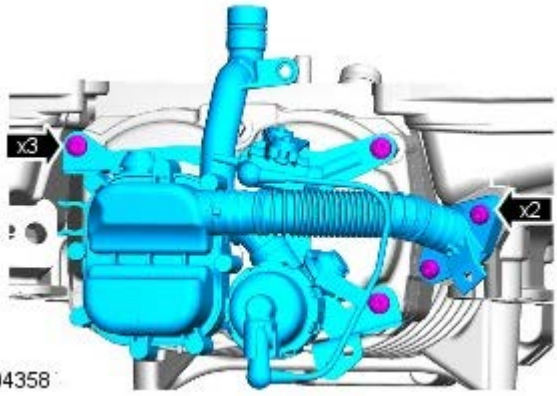
- Discard the gaskets.



11. NOTE: Do not disassemble further if the component is removed for access only.

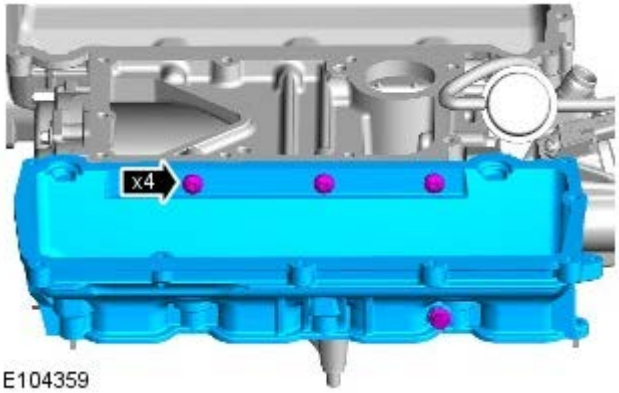

E112078

12.



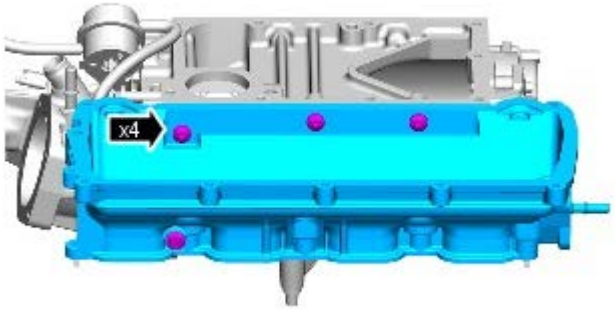
E104358

13.



E104359

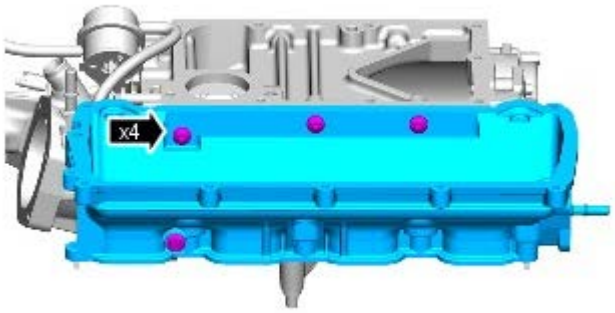
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E104360

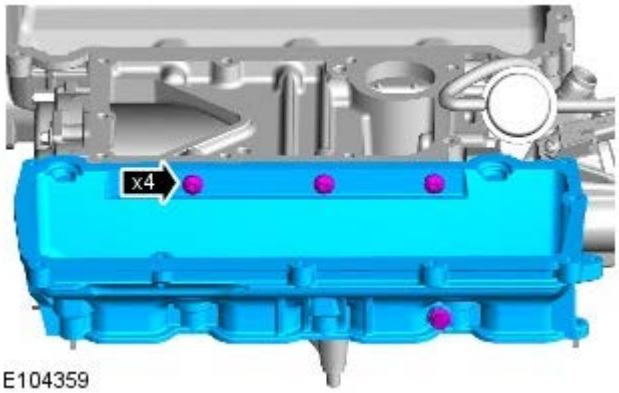
Installation

1. *Torque:* 25 Nm



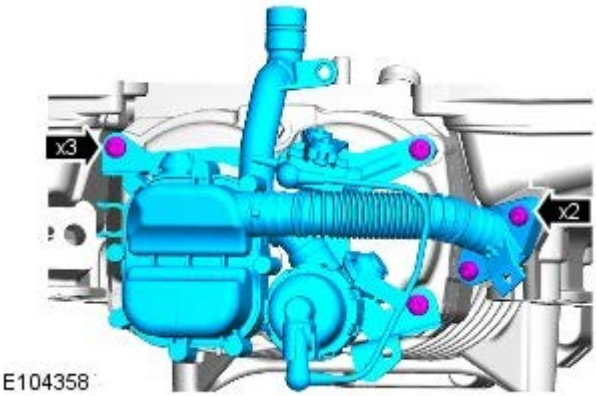
E104360

2. *Torque:* 25 Nm



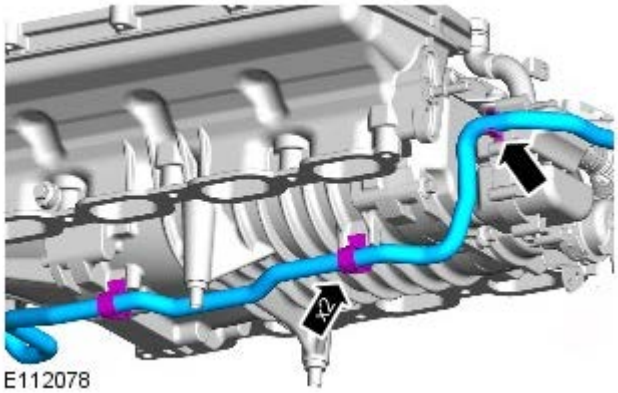
E104359

3. *Torque:* 10 Nm



E104358

4.

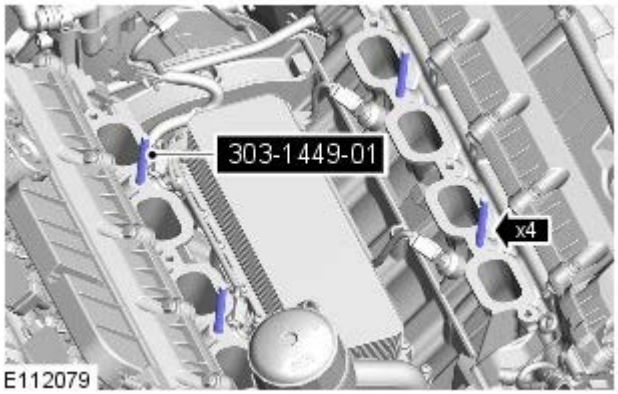


E112078

5. CAUTIONS:

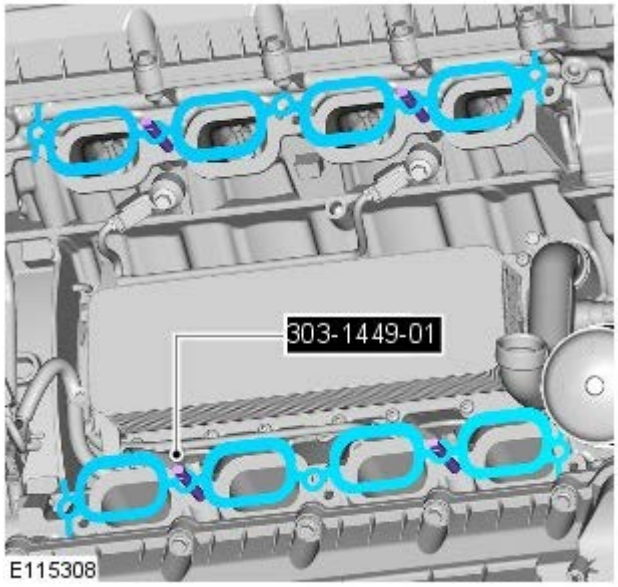
If a new cylinder head has been installed then the special tool 303-1449-02 without the thread must be used to install the supercharger.

If a new cylinder head has been installed, then new taptite bolts must be used to install the supercharger.

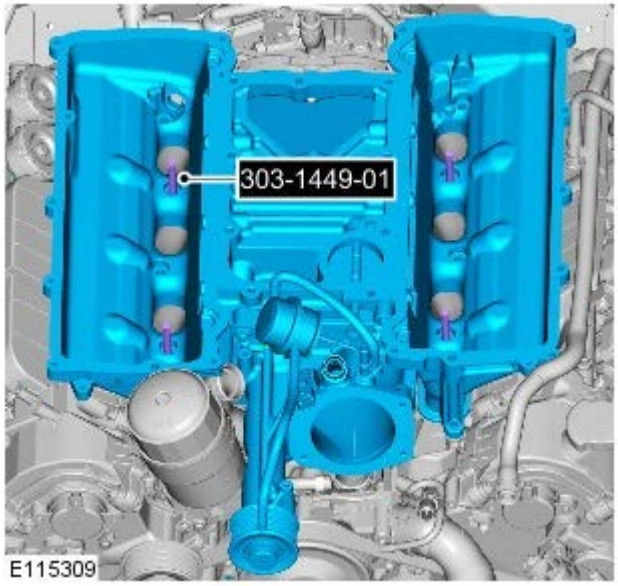


NOTE: New taptite bolts when used cut their own threads on the first application.

- *Special Tool(s):* 303-1449-01
- *Special Tool(s):* 303-1449-02



6. CAUTION: Make sure that the mating faces are clean and free of foreign material.
   - Install new gaskets.

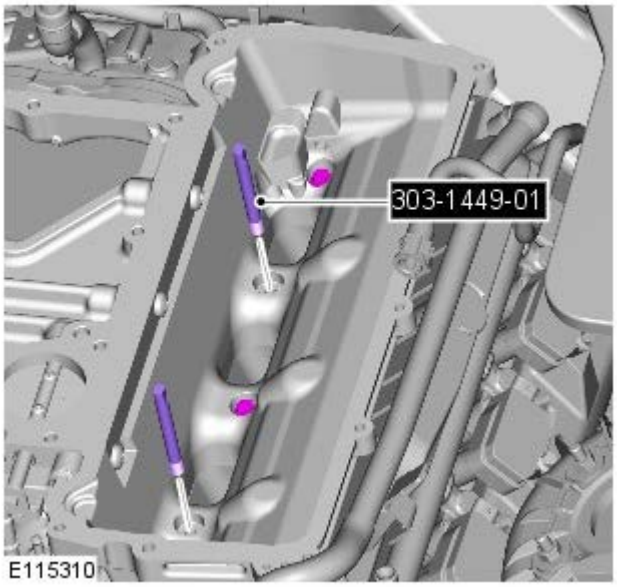


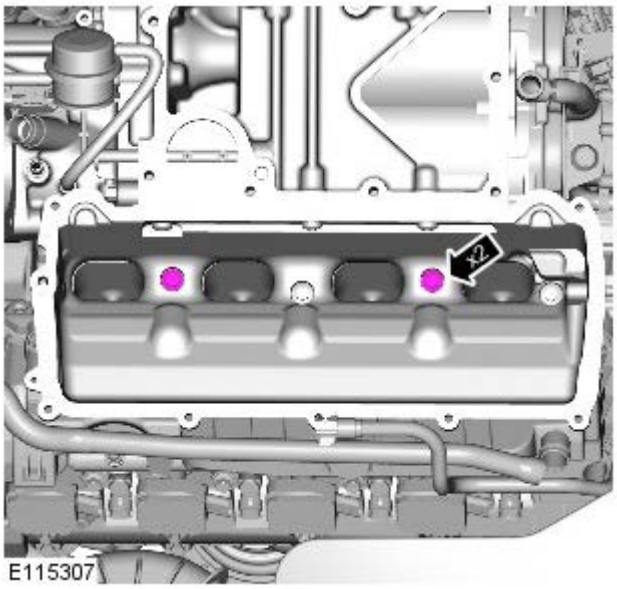
7. CAUTION: Make sure that the mating faces are clean and free of foreign material.

8. 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

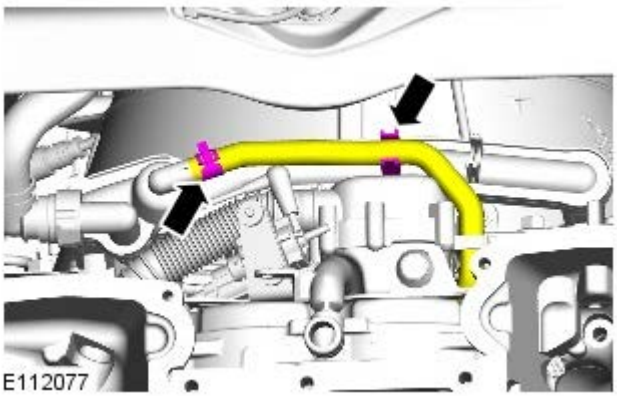




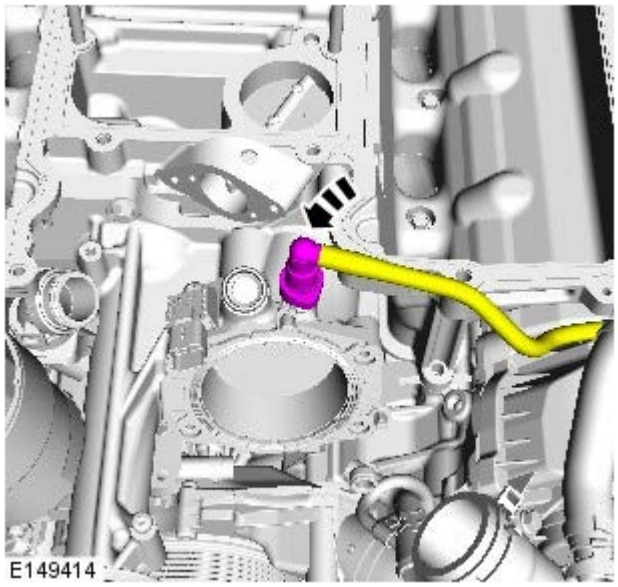
9. NOTE: Left-hand shown, right-hand similar.

   Torque: 25 Nm

10.



11.



12. Refer to: Manifold Absolute Pressure (MAP) Sensor (303-14C Electronic Engine Controls - V8 S/C 5.0L Petrol, Removal and Installation).

13. Refer to: Supercharger Belt (303-05C Accessory Drive - V8 S/C 5.0L Petrol, Removal and Installation).

14. Refer to: Throttle Body (303-04, Removal and Installation).

15. Refer to: Charge Air Cooler (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).

16. Connect the battery ground cable.

    Refer to: Specifications (414-00, Specifications).

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.

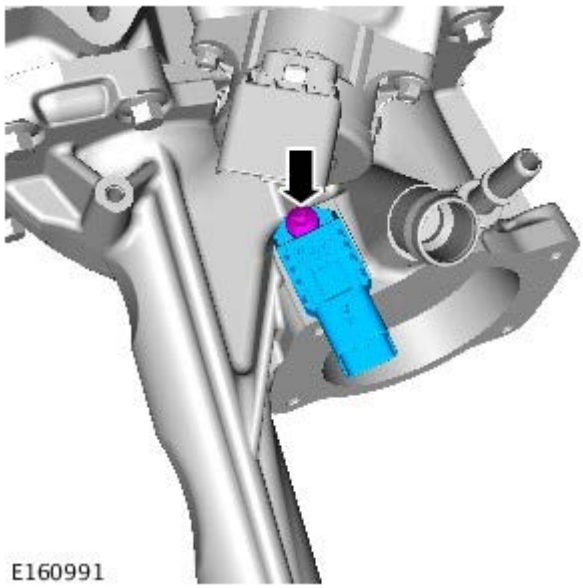
NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. WARNING: Make sure to support the vehicle with axle stands.

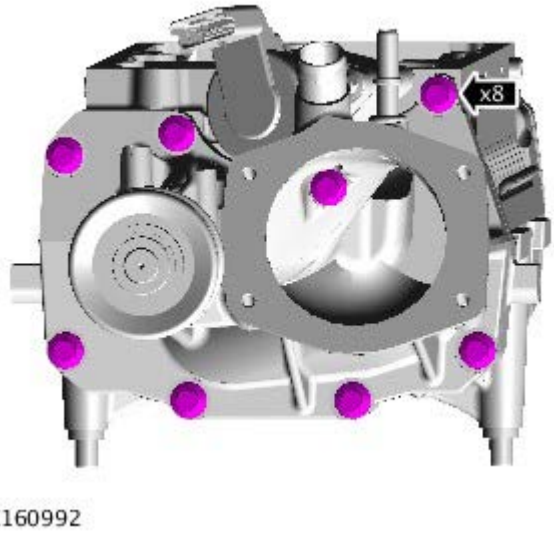
   Raise and support the vehicle.

2. Refer to: Supercharger (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).

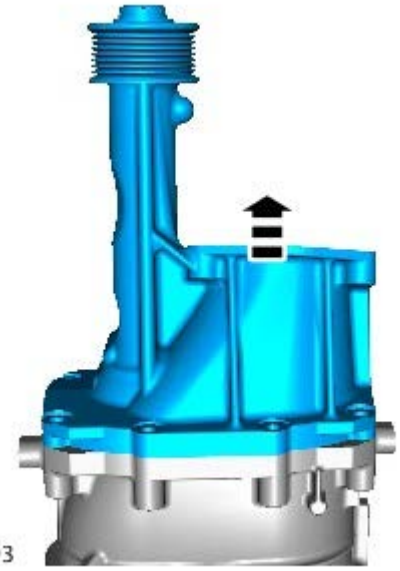
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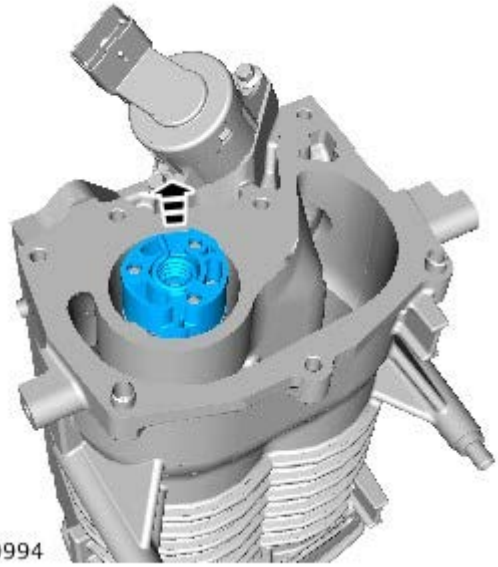
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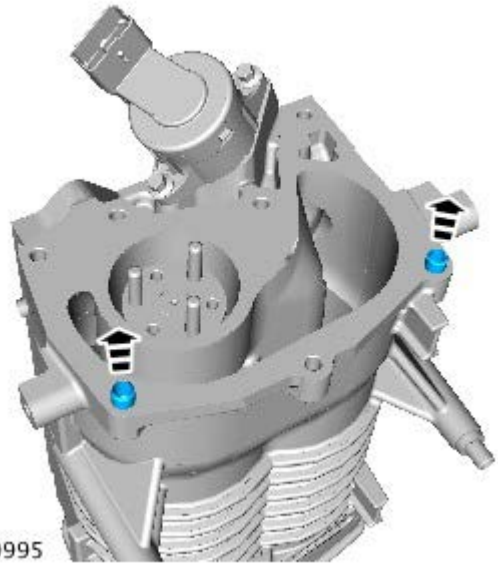
5.


E160993

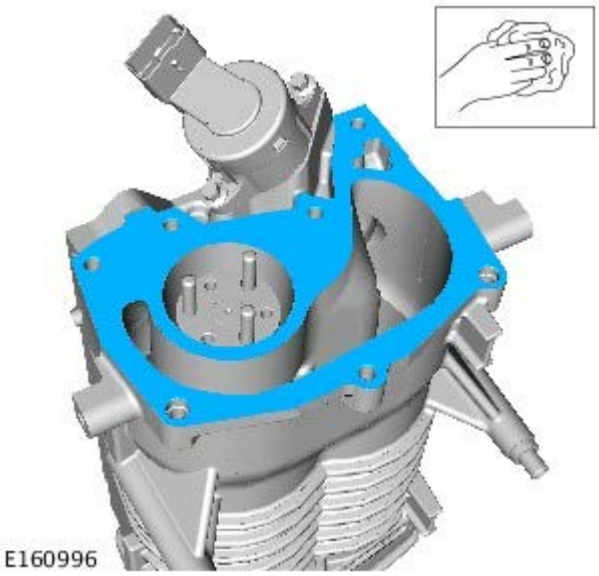
6. CAUTION: Make sure that all open ports are covered to prevent any foreign material ingress.


E160994

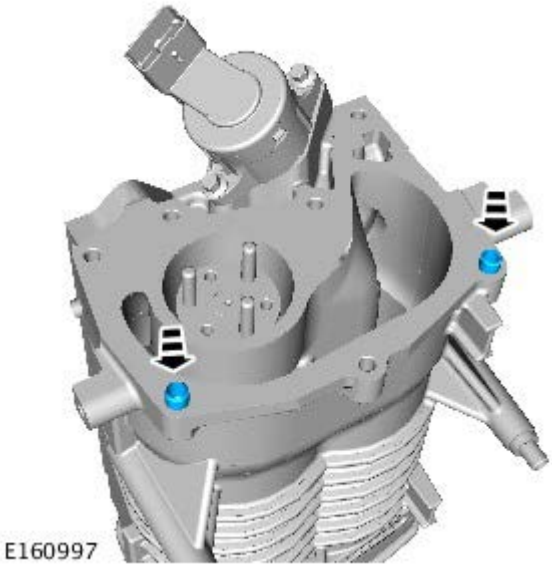
7.


E160995

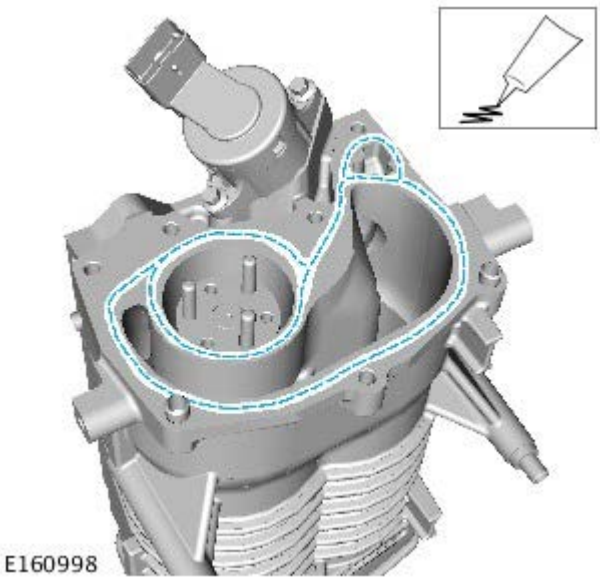
8. CAUTION: Make sure that all open ports are covered to prevent any foreign material ingress.



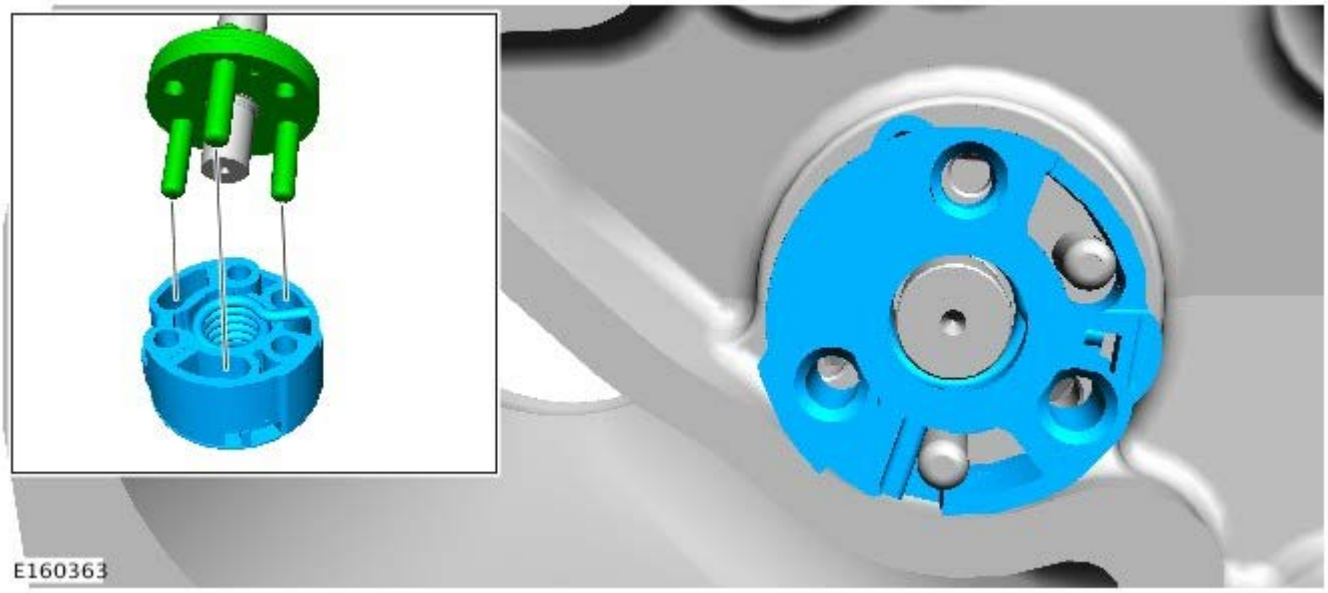
Installation



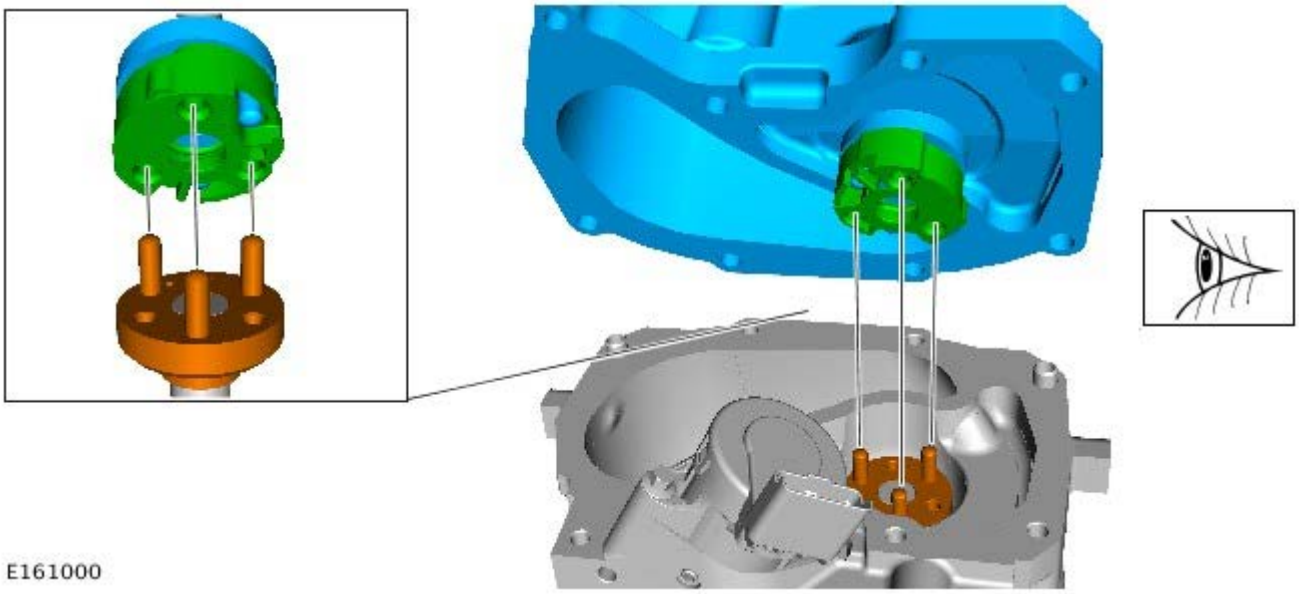
1. CAUTION: Make sure that all open ports are covered to prevent any foreign material ingress.



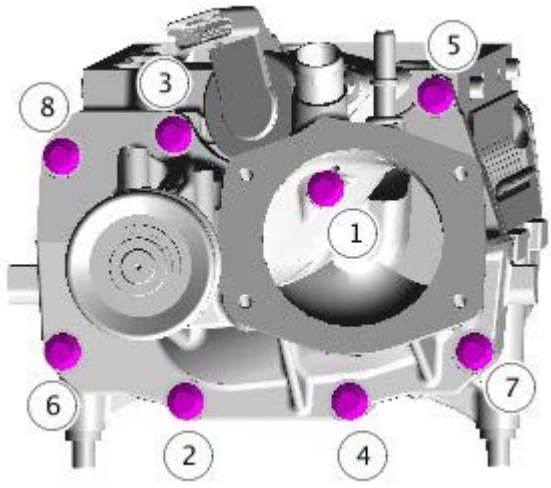
2. CAUTION: Apply a continuous bead of gasket sealant as shown on the illustration. The application of the sealant must be 1mm diameter. Install the component immediately after applying the sealant without smearing the sealant.



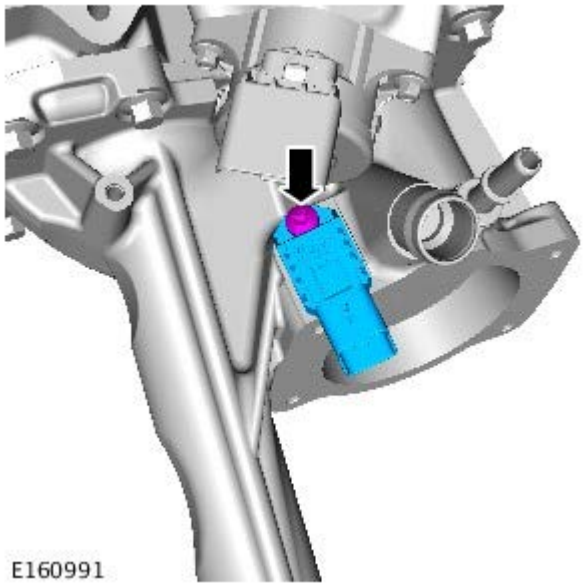
4.



5. *Torque:* 27 Nm



6. *Torque:* 5 Nm

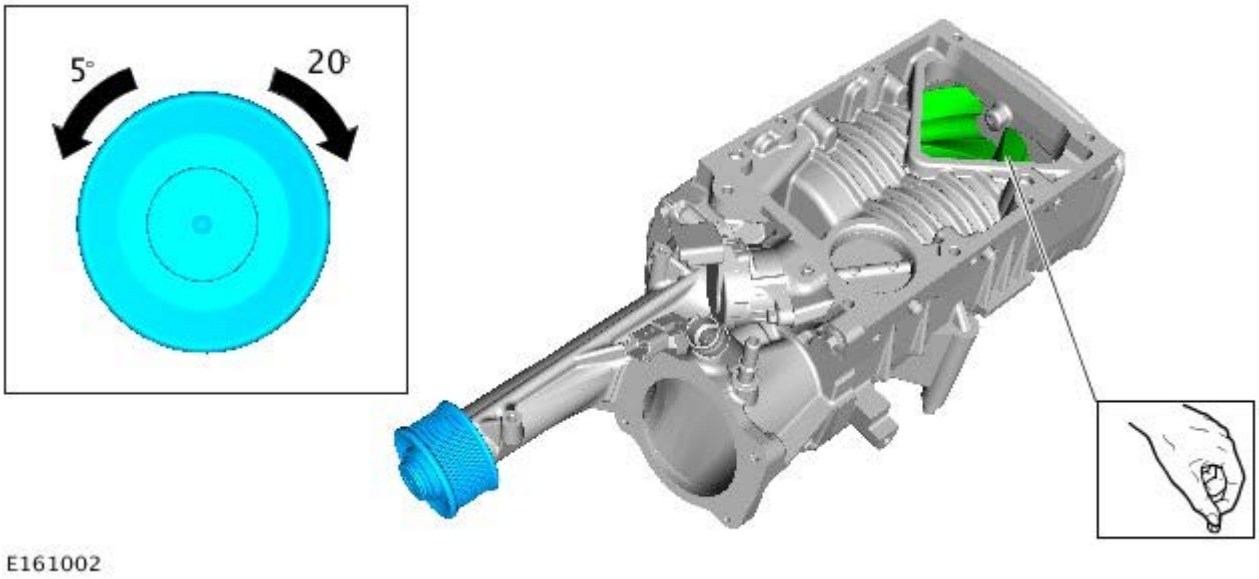


7. CAUTIONS:

   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



8. Refer to: Supercharger (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).

Published: 27-Jun-2013

Intake Air Distribution and Filtering - TDV8 4.4L Diesel -

Torque Specifications

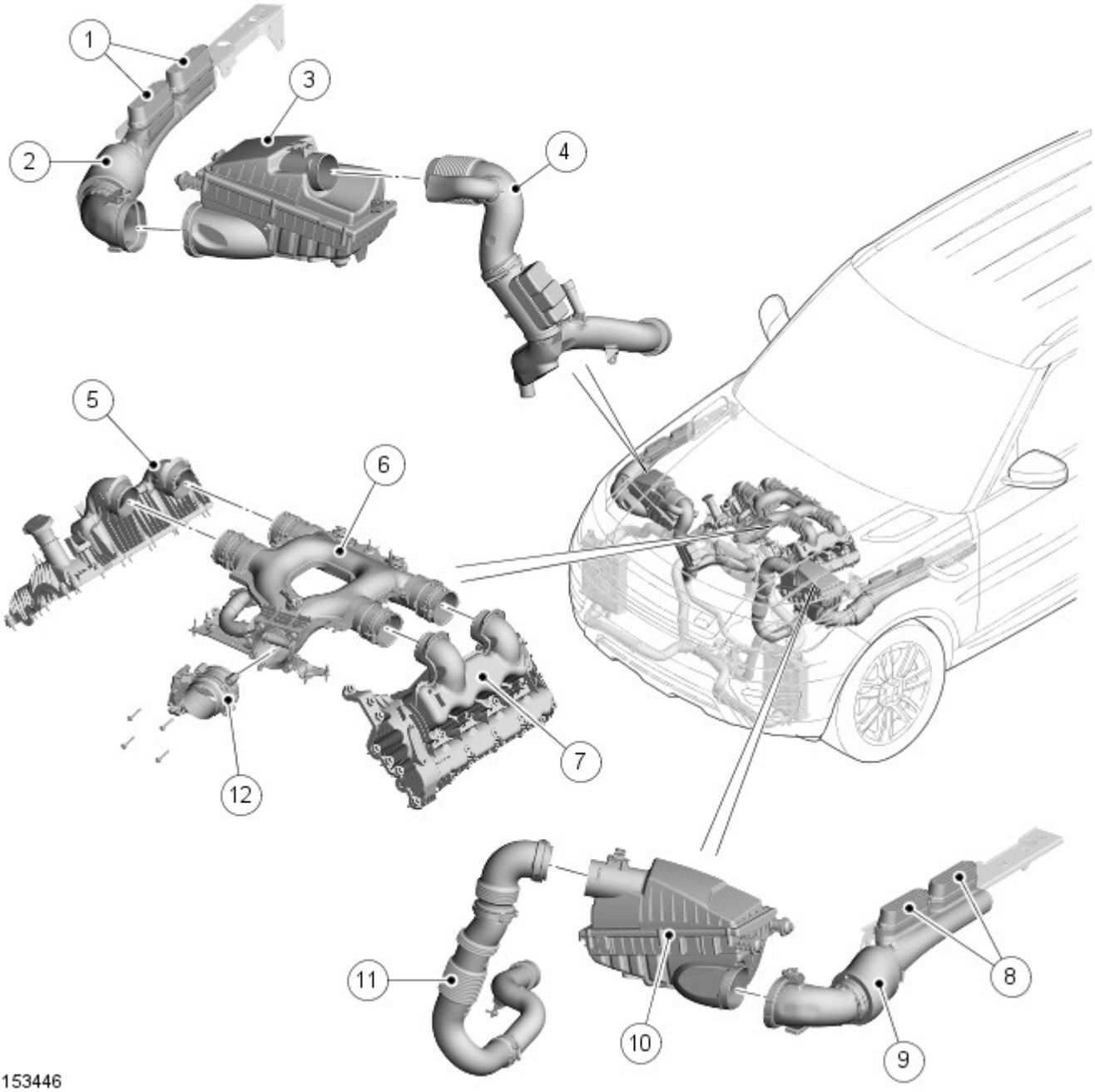
Item	Nm	lb-ft	lb-in
Air cleaner outlet pipe clamp(s)	3.5	-	31
Air cleaner element cover retaining screws	1.6	-	14
Charge air cooler inlet pipe clip	5	-	44
Charge air cooler outlet pipe clip	5	-	44

Published: 02-Dec-2013

Intake Air Distribution and Filtering - TDV8 4.4L Diesel - Intake Air Distribution and Filtering

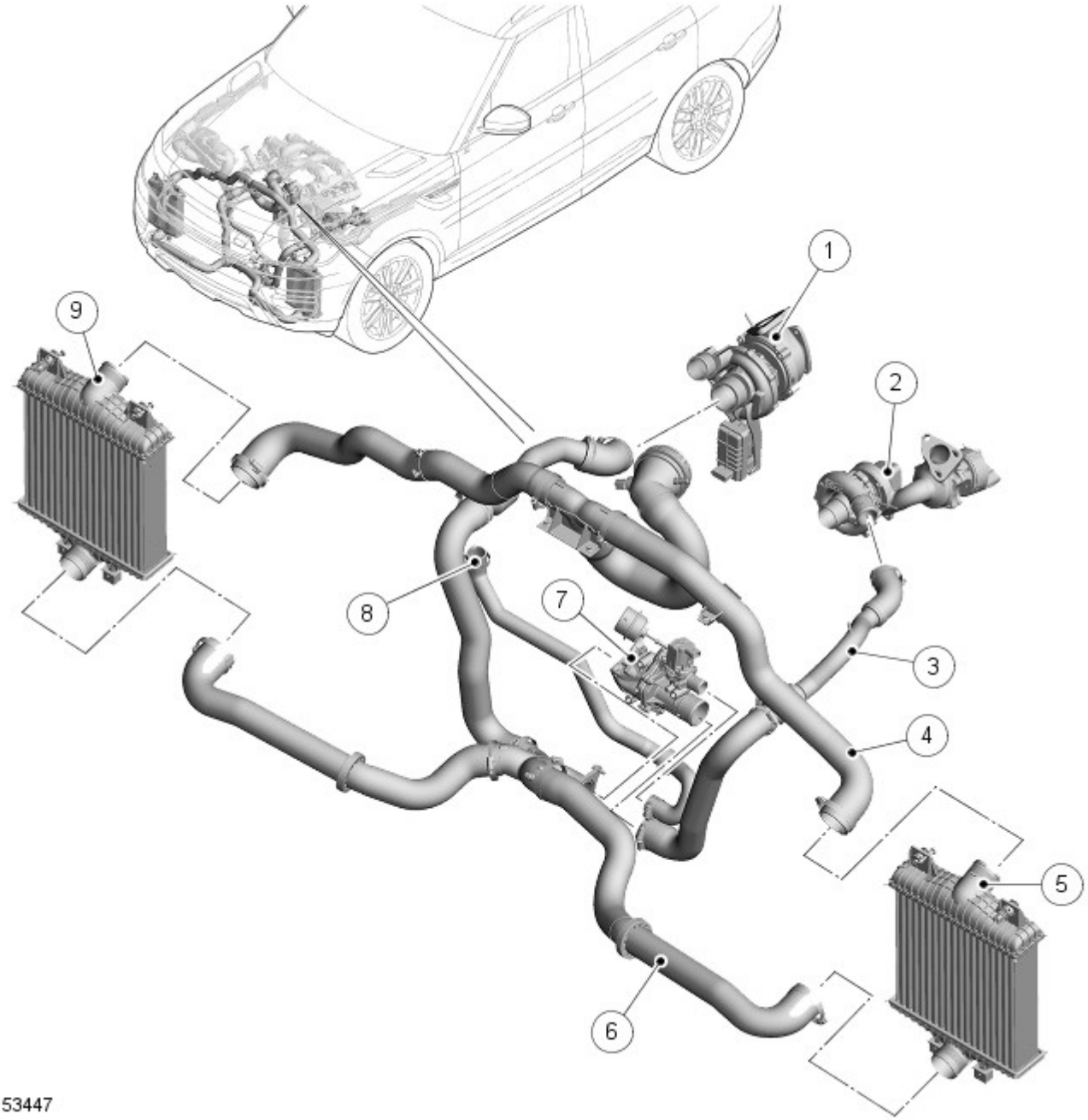
Description and Operation

COMPONENT LOCATION - SHEET 1 OF 2



Item	Part Number	Description
1	-	Right intake grilles
2	-	Right dirty air duct
3	-	Right air cleaner
4	-	Right clean air duct
5	-	Right intake manifold (integral with camshaft cover)
6	-	Charge air manifold
7	-	Left intake manifold (integral with camshaft cover)
8	-	Left intake grilles
9	-	Left dirty air duct
10	-	Left air cleaner
11	-	Left clean air duct
12	-	Electric throttle

COMPONENT LOCATION - SHEET 2 OF 2



E153447

Item	Part Number	Description
1	-	Primary turbocharger
2	-	Secondary turbocharger
3	-	Charge air ducts – secondary turbocharger to charge air intake valve
4	-	Charge air ducts – charge air coolers to electric throttle
5	-	Left charge air cooler
6	-	Charge air ducts – primary turbocharger and turbocharger intake valve to charge air coolers
7	-	Charge air intake valve
8	-	Charge air duct – charge air intake valve to left clean air duct
9	-	Right charge air cooler

OVERVIEW

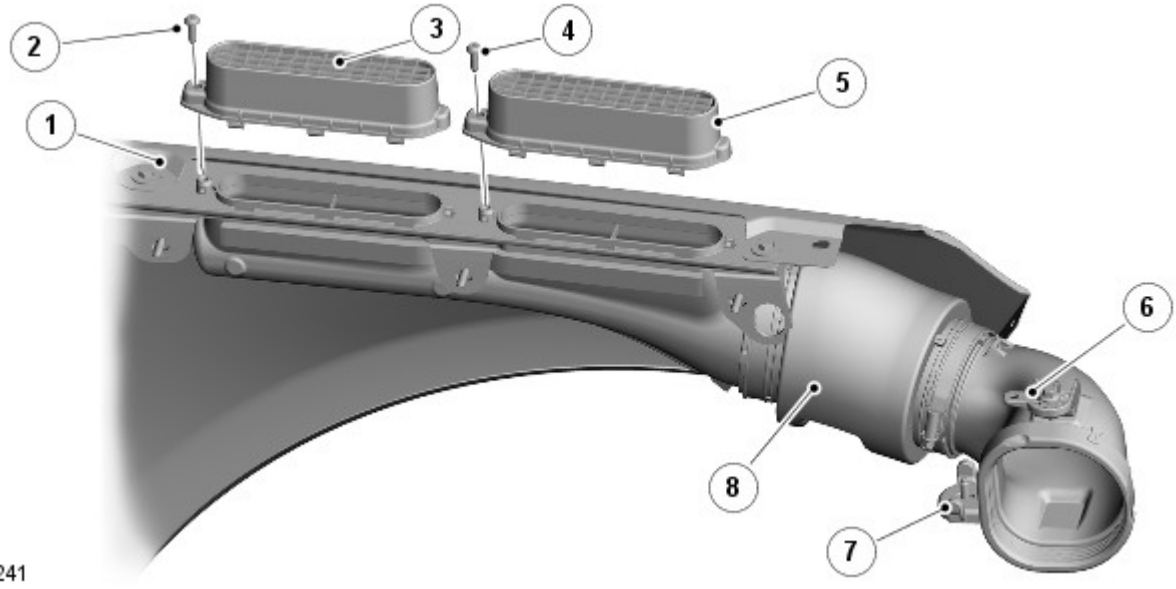
The intake air distribution and filtering system cleans, compresses and cools the intake air. The system comprises:

- Two dirty air ducts.
- Two air cleaners.
- Two clean air ducts.
- Two turbochargers.
- Charge air ducts.
- A turbocharger intake valve.
- Two charge air coolers.
- An electric throttle.
- A charge air manifold.
- Two intake manifolds.

Air flows through the dirty air ducts, air cleaners and clean air ducts to the compressor intakes of the turbochargers. The turbochargers compress the air, which is then transferred through the charge air ducts to the turbocharger intake valve, charge air coolers, electric throttle and intake manifolds.

DESCRIPTION

Dirty Air Ducts



E144241

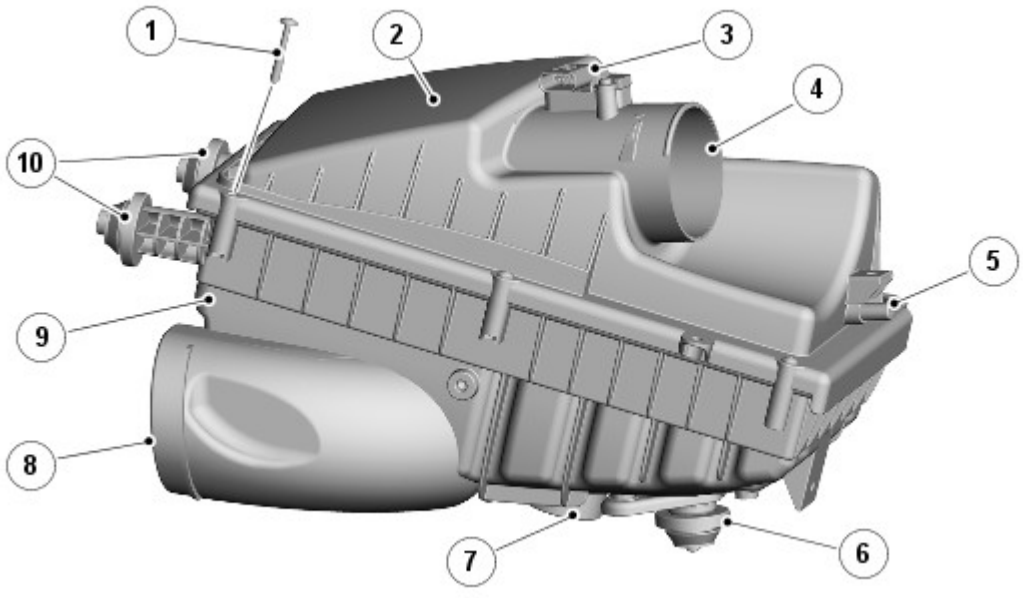
Item	Part Number	Description
1	-	Front fender support
2	-	Screw
3	-	Intake grille
4	-	Screw
5	-	Intake grille
6	-	Front upper bracket
7	-	Front lower bracket
8	-	Non-porous sleeve

The dirty air ducts are installed in the front fenders to transfer ambient air from under the edges of the hood to the air cleaners.

Each dirty air duct locates in the intake of the related air cleaner and is attached to the front inner fender with two brackets. The intake of each dirty air duct is attached to two intake grilles on top of the front fender support. When the hood is closed, the intake grilles locate in guides attached to the hood inner panel.

A porous section, covered by a non-porous sleeve to prevent moisture ingress, is incorporated into each dirty air duct to reduce induction noise.

Air Cleaners



E144571

Item	Part Number	Description
1	-	Screw (6 off)
2	-	Lid
3	-	Mass Air Flow (MAF) sensor (left air cleaner) or Mass Air Flow and Temperature (MAFT) sensor (right air cleaner)
4	-	Air outlet
5	-	Vacuum system connection (right air cleaner only)
6	-	Isolator
7	-	Drain valve
8	-	Air intake
9	-	Base
10	-	Isolators

An air cleaner is located in each front corner of the engine compartment. Three spigots fitted with isolator bushes locate each air cleaner in holes in the related front inner fender and front suspension housing.

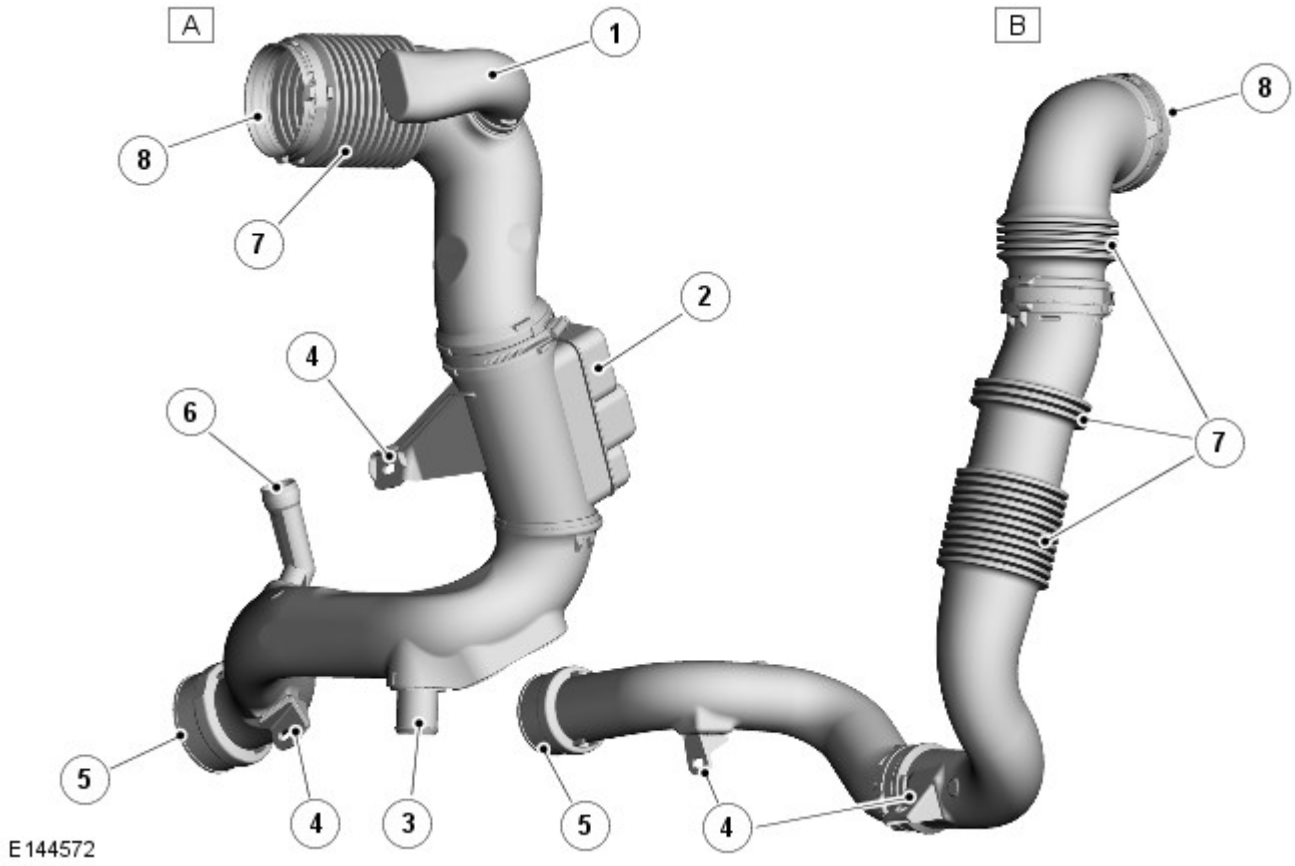
Each air cleaner consists of a filter element installed in a base and enclosed with a lid secured by six screws. The filter element is a pleated, paper type with an integral seal. Air intake and outlet connections are incorporated into the base and lid respectively. The bottom of the base incorporates a drain valve to prevent the accumulation of water in the air cleaner.

The lid of the right air cleaner incorporates a connection for the engine vacuum system. For additional information, refer to:

> Turbocharger (303-04F Fuel Charging and Controls - Turbocharger - TDV8 4.4L Diesel, Description and Operation), Engine Emission Control (303-08D Engine Emission Control - TDV8 4.4L Diesel, Description and Operation).

The lid of each air cleaner incorporates either a MAF (Mass Air Flow) sensor (left air cleaner) or a MAFT (Mass Air Flow and Temperature) sensor (right air cleaner). The sensors are connected to theECM (Engine Control Module).
For additional information, refer to: Electronic Engine Controls (303-14D Electronic Engine Controls - TDV8 4.4L Diesel, Description and Operation).

Clean Air Ducts



A = Right clean air ducts; B = Left clean air ducts

Item	Part Number	Description
1	-	Resonator
2	-	Resonator
3	-	Charge air recirculation connection
4	-	Bracket
5	-	Air outlet
6	-	Crankcase ventilation hose connection

7	-	Convolute
8	-	Air intake

The clean air ducts transfer air from the air cleaner outlets to the compressor intakes on the turbochargers. The clean air ducts incorporate convolute sections to accommodate relative movement between the engine mounted turbochargers and the body mounted air cleaners. The right clean air duct incorporates two resonators to reduce induction noise. The right clean air duct also incorporates connections for:

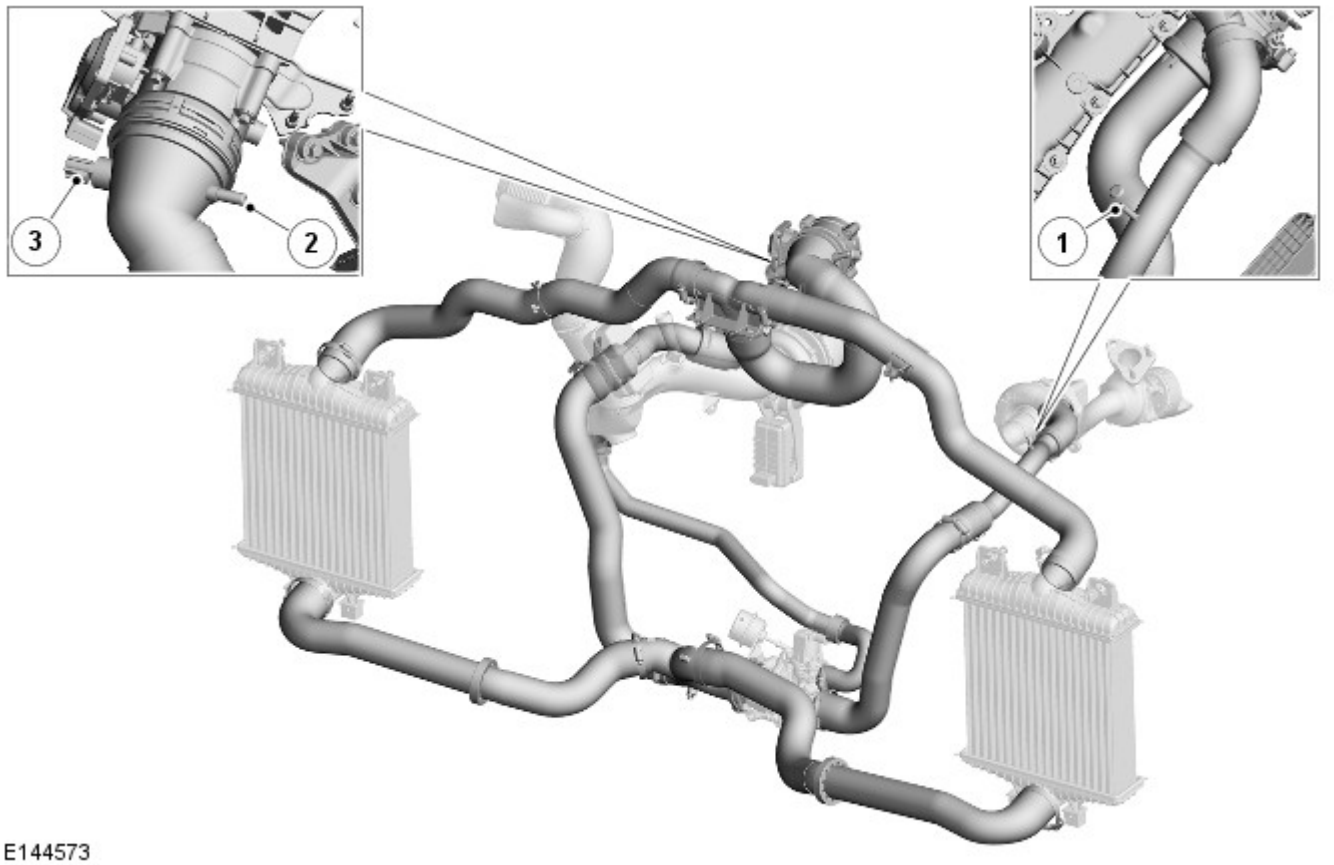
- The bypass hose from the turbocharger intake valve.
  For additional information, refer to: Turbocharger (303-04F Fuel Charging and Controls - Turbocharger - TDV8 4.4L Diesel, Description and Operation).
- The crankcase ventilation hose from the oil separator.
  For additional information, refer to: Engine Emission Control (303-08D Engine Emission Control - TDV8 4.4L Diesel, Description and Operation).

A bracket on each clean air duct is attached to the related engine mounting bracket. The left air cleaner duct also has a bracket that attaches it to a mounting bracket on the A/C (Air/Conditioning) compressor. The right clean air duct also has a bracket that attaches it to the front of the right cylinder head.

Turbochargers

The turbochargers are attached to the exhaust manifolds. A VGT (variable geometry turbine) turbocharger, designated as the primary turbocharger, is located on the right side of the engine. A fixed vane turbocharger, designated as the secondary turbocharger, is installed on the left side of the engine.
For additional information, refer to: Turbocharger (303-04F Fuel Charging and Controls - Turbocharger - TDV8 4.4L Diesel, Description and Operation).

Charge Air Ducts



E144573

Item	Part Number	Description
1	-	Charge air pressure sensor connection
2	-	Secondary turbocharger air pipe connection
3	-	Charge air temperature sensor

The charge air ducts interconnect the turbocharger compressor outlets, turbocharger intake valve, charge air coolers and electric throttle.

The charge air duct connection with the electric throttle incorporates connections for:

- An air tube connected to the secondary turbocharger.
  For additional information, refer to: Turbocharger (303-04F Fuel Charging and Controls - Turbocharger - TDV8 4.4L Diesel, Description and Operation).
- A charge air temperature sensor connected to the ECM (Engine Control Module).
  For additional information, refer to: Electronic Engine Controls (303-14D Electronic Engine Controls - TDV8 4.4L Diesel, Description and Operation).

The charge air duct connected to the outlet of the secondary turbocharger incorporates a connection for the charge air

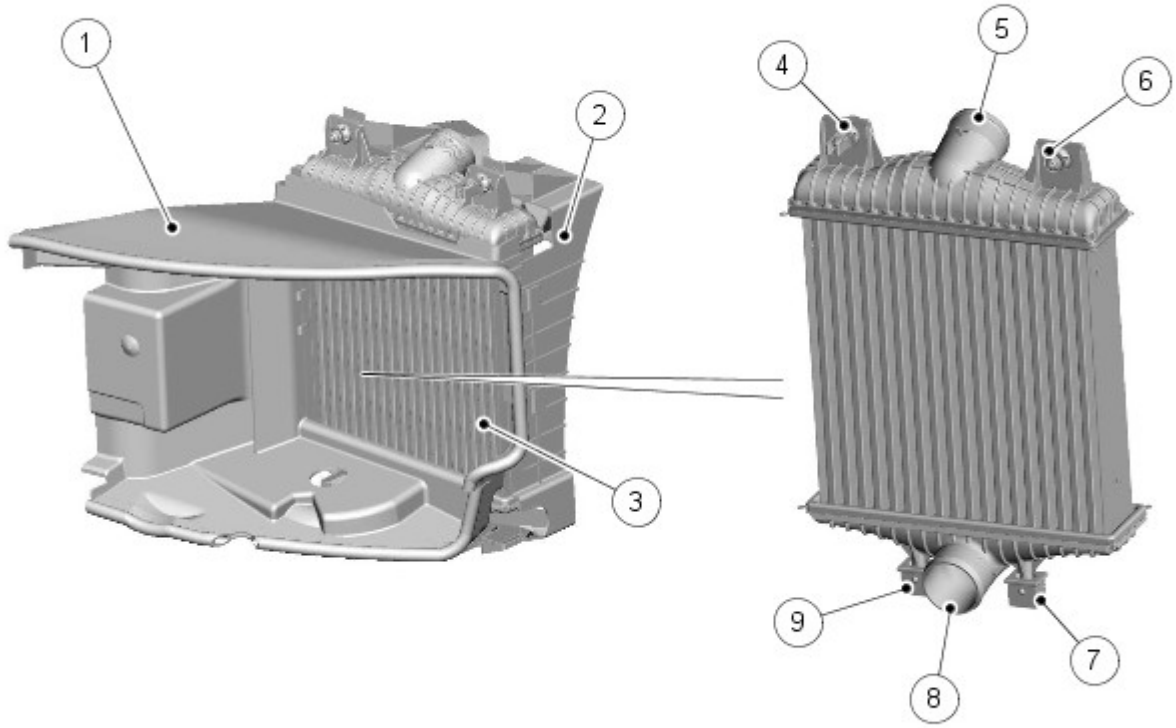
pressure sensor.
For additional information, refer to: Electronic Engine Controls (303-14D Electronic Engine Controls - TDV8 4.4L Diesel, Description and Operation).

Turbocharger Intake Valve

The turbocharger intake valve is attached to a bracket on the front subframe and the cooling pack protector.

The charge air intake valve is used by the ECM to change turbocharger operation between mono and bi-turbo modes. The valve controls the flow of air from the compressor of the secondary turbocharger to the clean air duct of the primary turbocharger and to the charge air coolers.
For additional information, refer to: Turbocharger (303-04F Fuel Charging and Controls - Turbocharger - TDV8 4.4L Diesel, Description and Operation).

Charge Air Coolers



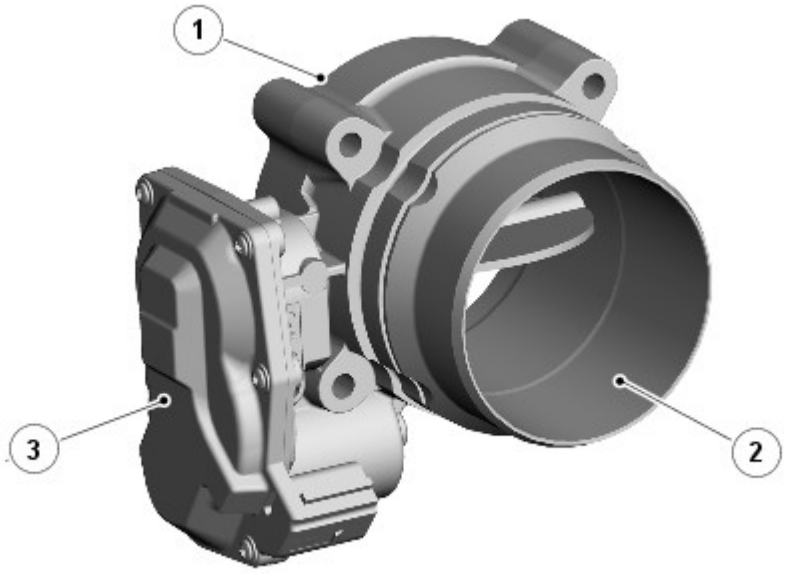
E153452

Item	Part Number	Description
1	-	Front air duct
2	-	Rear air duct
3	-	Charge air cooler
4	-	Isolator bush
5	-	Air intake
6	-	Isolator bush
7	-	Isolator
8	-	Air outlet
9	-	Isolator

The charge air coolers are air to air heat exchangers that reduce the intake air temperature.

A charge air cooler is installed each side of the cooling pack, behind the outer air intakes in the front bumper. The charge air coolers are installed in air ducts attached to the front bumper armature and the front end carrier. The lower end tank of each charge air cooler is located in the air ducts by two spigots fitted with isolator bushes. The upper end tank of each charge air cooler is attached to the front end carrier and the air ducts with two isolator bushes, nuts and bolts.

Electric Throttle



E144574

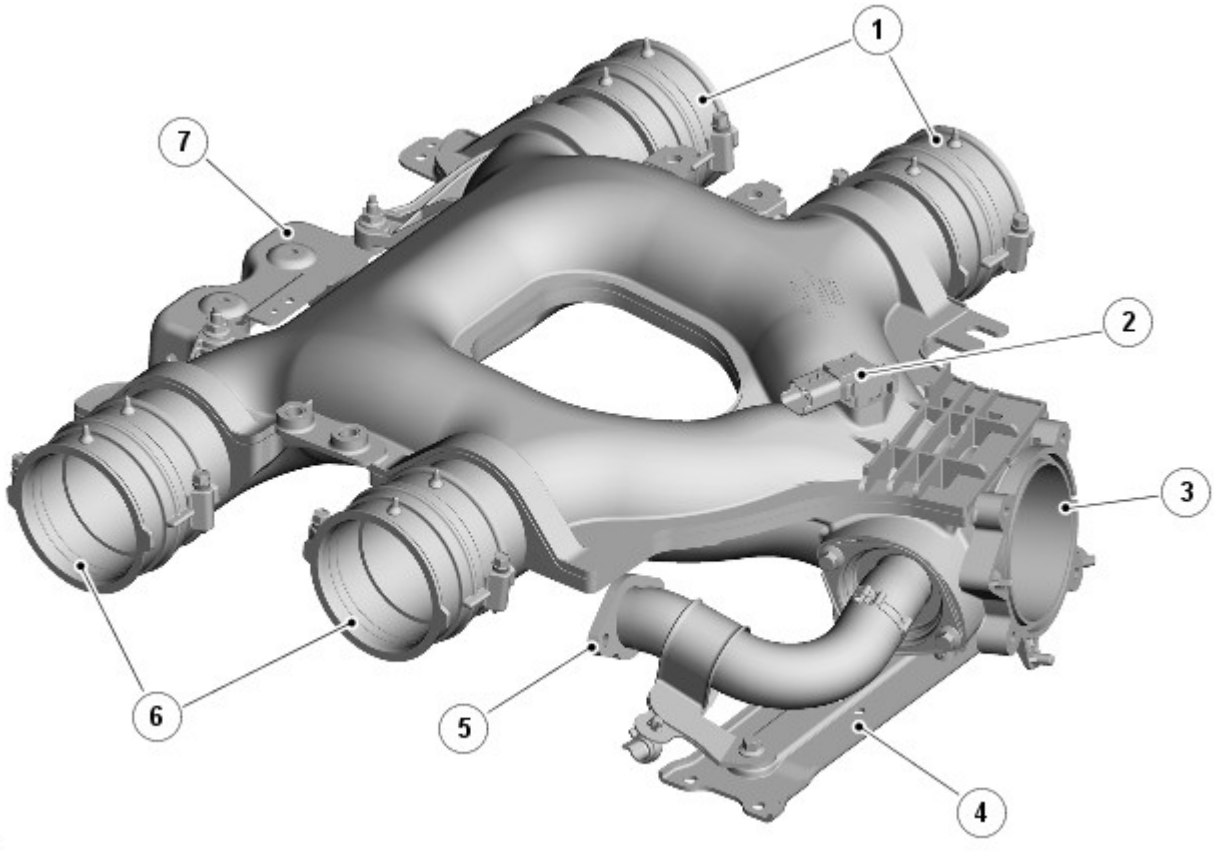
Item	Part Number	Description
1	-	Air outlet
2	-	Air intake
3	-	Electric motor

The electric throttle regulates the air flow from the charge air coolers into the charge air manifold.

The electric throttle is installed at the front of the engine, between the cylinder heads. Four bolts and a gasket are used to attach the electric throttle to the charge air manifold.

The throttle plate is operated by a DC (Direct Current) electric motor attached to the throttle body. The motor is controlled by the ECM and is constantly adjusted the throttle according to the EGR (Exhaust Gas Recirculation) valve opening, and in response to driver inputs with the throttle pedal, to control the amount of air allowed into the intake manifolds.
For additional information, refer to: Electronic Engine Controls (303-14D Electronic Engine Controls - TDV8 4.4L Diesel, Description and Operation).

Charge Air Manifold



E144575

Item	Part Number	Description
1	-	Left intake manifold connections

2	-	Manifold Absolute Pressure (MAP) sensor
3	-	Air intake
4	-	Front support bracket
5	-	Exhaust Gas Recirculation (EGR) pipe
6	-	Right intake manifold connections
7	-	Rear support bracket

The charge air manifold distributes the air from the electric throttle to the two intake manifolds. The manifold is installed between the cylinder banks on two support brackets. The front support bracket is attached to the two cylinder heads. The rear support bracket is attached to the oil cooler and filter assembly.

A pipe connection on the right side of the charge air manifold allows for the attachment of the outlet pipe from the EGR valve. The pipe attachment in the manifold is specifically designed to mix the recirculated exhaust gas with the intake air and provide an even distribution to each side of the engine.

A MAP sensor is located in the top of the charge air manifold where the air flow splits for the two intake manifolds.
For additional information, refer to: Electronic Engine Controls (303-14D Electronic Engine Controls - TDV8 4.4L Diesel, Description and Operation).

Intake Manifolds

The intake manifolds are an integral part of the camshaft covers. Each intake manifold has two hose connections with the charge air manifold.
For additional information, refer to: Engine (303-01D Engine - TDV8 4.4L Diesel, Description and Operation).

Published: 11-May-2011

Intake Air Distribution and Filtering - TDV8 4.4L 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 in 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.

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 cleaner element condition and installation • Restricted air intake • Vacuum hoses condition and installation • Pipework to/from turbochargers: condition and installation • Turbochargers: condition and installation • Charge air coolers	• Fuse(s) • Wiring harness(es) • Loose or corroded electrical connector(s) • Mass air flow (MAF) sensors • Manifold absolute pressure/temperature (MAPT) sensors • Intake air temperature (IAT) sensor - The IAT sensor is built into the right-hand MAF 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
Vehicle does not start/hard starting	• Restricted/Blocked air intake • Restricted/Blocked air cleaner element	Check the intake air system for blockages or restriction. Rectify as necessary.
Poor performance	• Intake air system fault • Turbocharger fault(s) • Exhaust gas recirculation (EGR) valve(s) fault • Low fuel pressure • Restricted exhaust system	Check the intake air system for blockages or restriction. Rectify as necessary. Check for DTCs indicating a turbocharger, EGR valve or fuel pressure fault. Rectify as necessary. Check the exhaust system for evidence of damage or restriction. Rectify as necessary.
Excessive intake noise	• Intake air leak after the turbocharger • Intake pipe disconnected/damaged after the air cleaner • Air cleaner assembly incorrectly assembled/damaged	Check the intake air system for loose or disconnected hoses or ducts. Check the hoses and ducts for damage, splits, etc. Rectify as necessary.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - TDV8 4.4L Diesel, DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation).

Published: 22-Oct-2013

Intake Air Distribution and Filtering - TDV8 4.4L Diesel - Air Cleaner Element

Removal and Installation

Removal

NOTES:

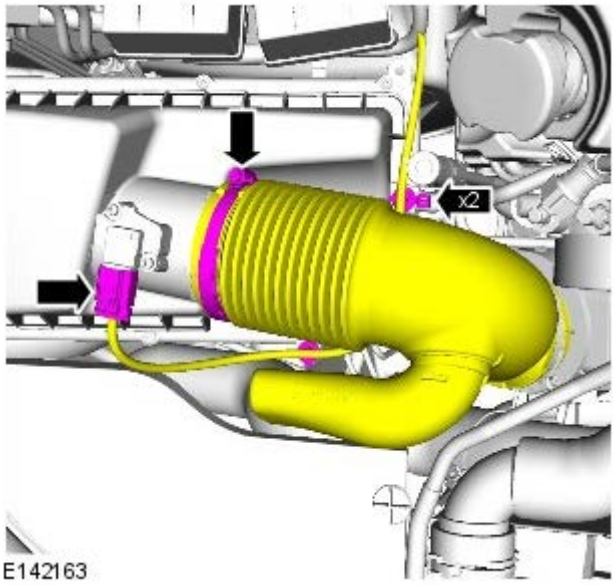
Air cleaner elements must be renewed in pairs.

Removal steps in this procedure may contain installation details.

Some variation in the illustrations may occur, but the essential information is always correct.

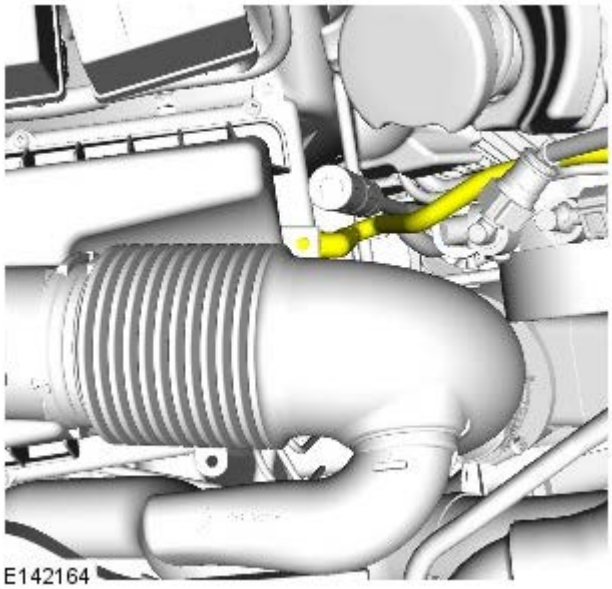
RH illustration shown, LH is similar.

1. Refer to: Engine Cover - 4.4L V8 - TdV8 (501-05 Interior Trim and Ornamentation, Removal and Installation).



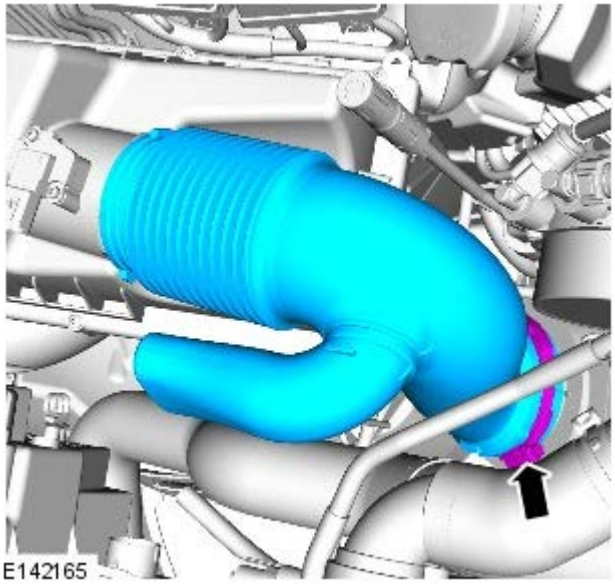
2. CAUTION: Make sure that the retaining clip is correctly installed and tightened.

   Torque: 3.5 Nm



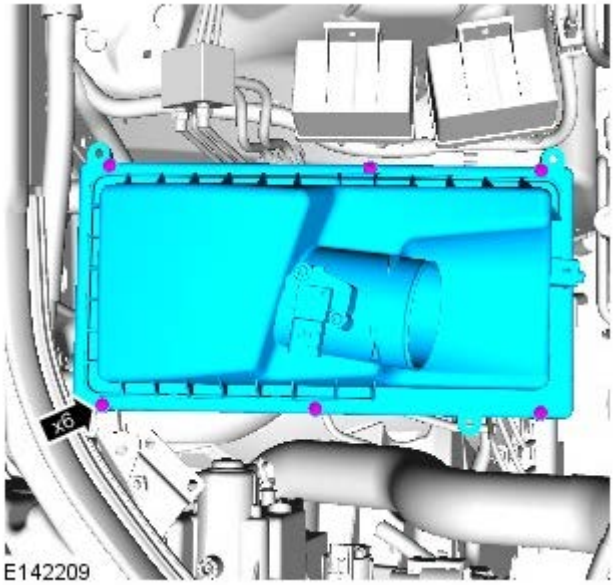
3. NOTE: RH side only.

4. CAUTION: Make sure that the retaining clip is correctly installed and tightened.

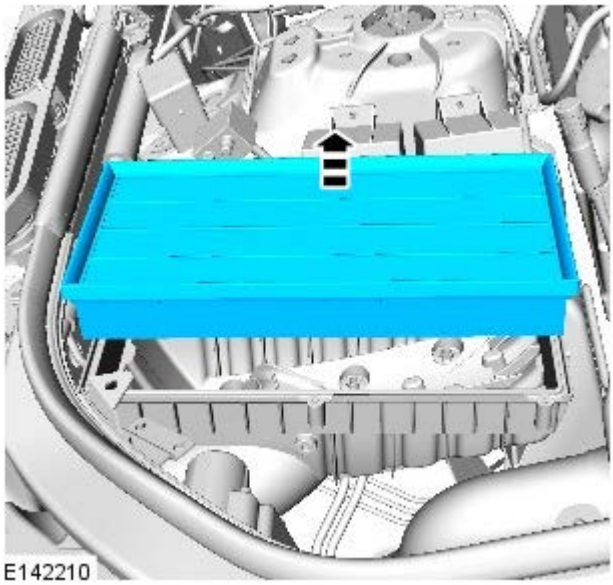


Torque: 3.5 Nm

5. *Torque:* 1.6 Nm



6.



7. Repeat the above procedure for the other side.

Installation

1. To install, reverse the removal procedure.

Published: 22-Oct-2013

Intake Air Distribution and Filtering - TDV8 4.4L Diesel - Air Cleaner LH

Removal and Installation

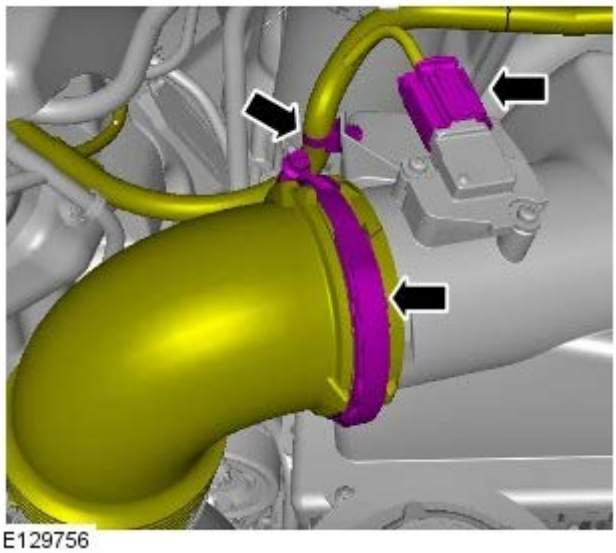
Removal

NOTES:

Removal steps in this procedure may contain installation details.

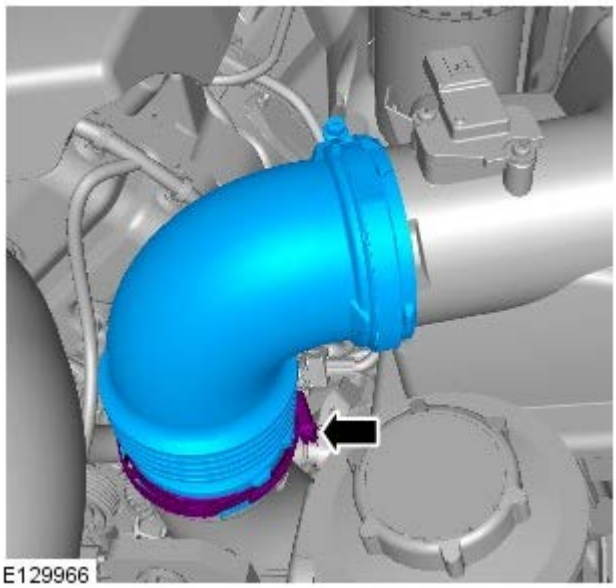
Some variation in the illustrations may occur, but the essential information is always correct.

1. Refer to: Engine Cover - 4.4L V8 - TdV8 (501-05 Interior Trim and Ornamentation, Removal and Installation).


E129756

2. CAUTION: Make sure that the retaining clip is correctly installed and tightened.

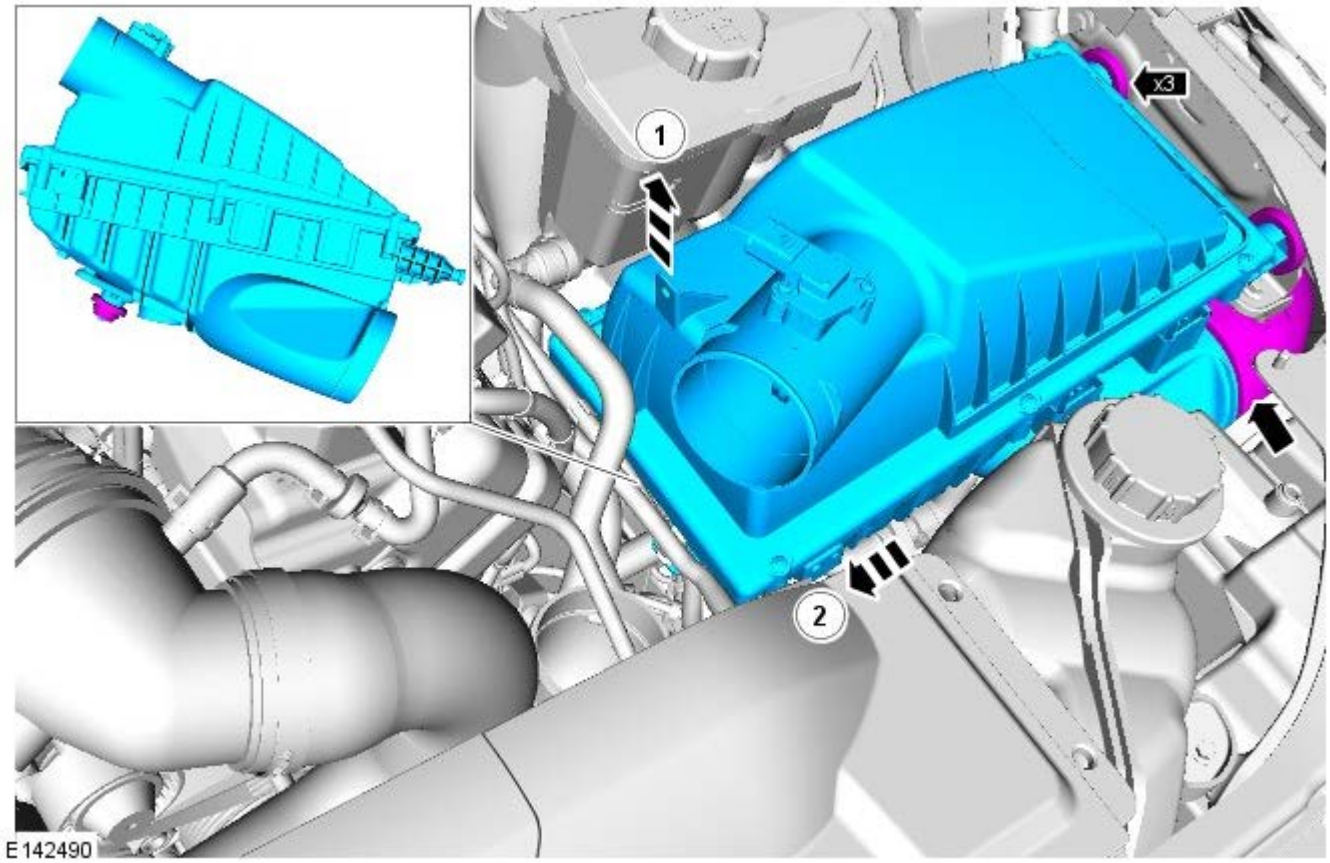
   Torque: 3.5 Nm


E129966

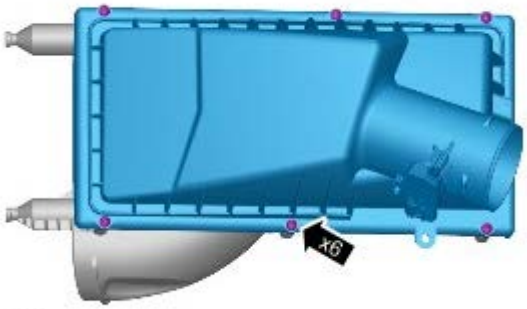
3. CAUTION: Make sure that the retaining clip is correctly installed and tightened.

   Torque: 3.5 Nm

4.



E142490



E118991

5. NOTES:

Do not disassemble further if the component is removed for access only.

RH illustration shown, LH is similar.

Torque: 1.6 Nm

6.


E142491

Installation

1. To install, reverse the removal procedure.

Published: 22-Oct-2013

Intake Air Distribution and Filtering - TDV8 4.4L Diesel - Air Cleaner Outlet Pipe LH

Removal and Installation

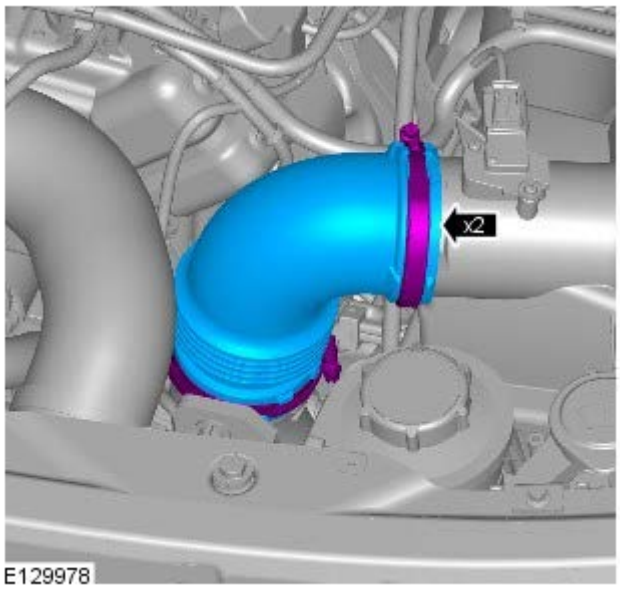
Removal

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 - 4.4L V8 - TdV8 (501-05 Interior Trim and Ornamentation, Removal and Installation).



2. CAUTION: Make sure that the retaining clips are correctly installed and tightened.

   Torque: 3.5 Nm

Installation

1. To install, reverse the removal procedure.

Published: 22-Oct-2013

Intake Air Distribution and Filtering - TDV8 4.4L Diesel - Air Cleaner Outlet Pipe RH

Removal and Installation

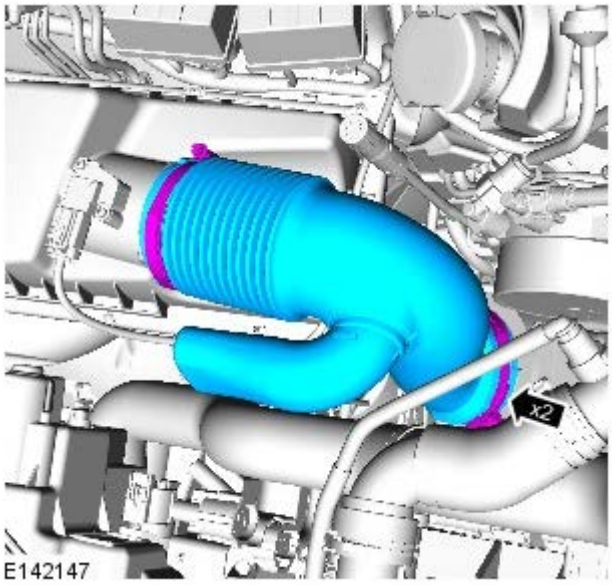
Removal

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. Refer to: Engine Cover - 4.4L V8 - TdV8 (501-05 Interior Trim and Ornamentation, Removal and Installation).



2. CAUTION: Make sure that the retaining clips are correctly installed and tightened.

   Torque: 3.5 Nm

Installation

1. To install, reverse the removal procedure.

Published: 22-Oct-2013

Intake Air Distribution and Filtering - TDV8 4.4L Diesel - Air Cleaner RH

Removal and Installation

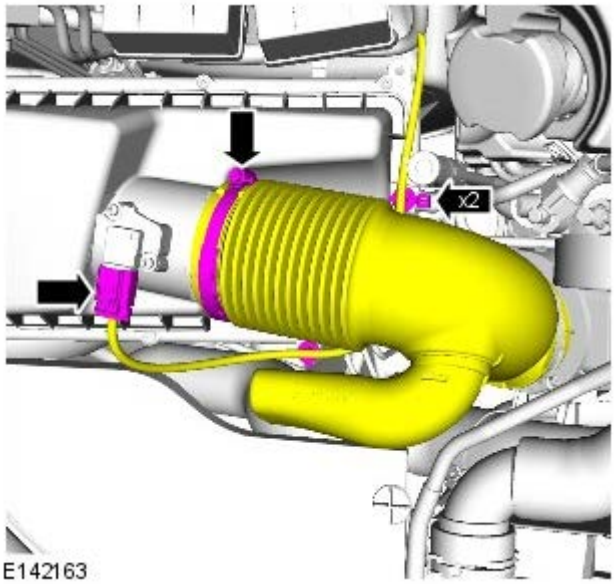
Removal

NOTES:

Removal steps in this procedure may contain installation details.

Some variation in the illustrations may occur, but the essential information is always correct.

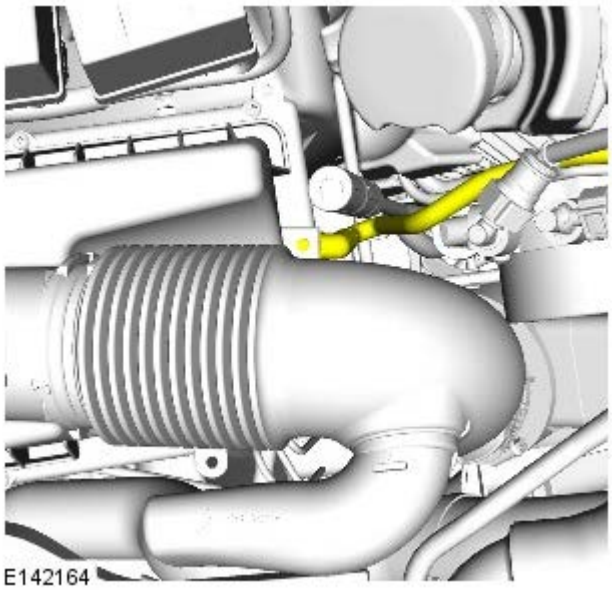
1. Refer to: Engine Cover - 4.4L V8 - TdV8 (501-05 Interior Trim and Ornamentation, Removal and Installation).



2. CAUTION: Make sure that the retaining clip is correctly installed and tightened.

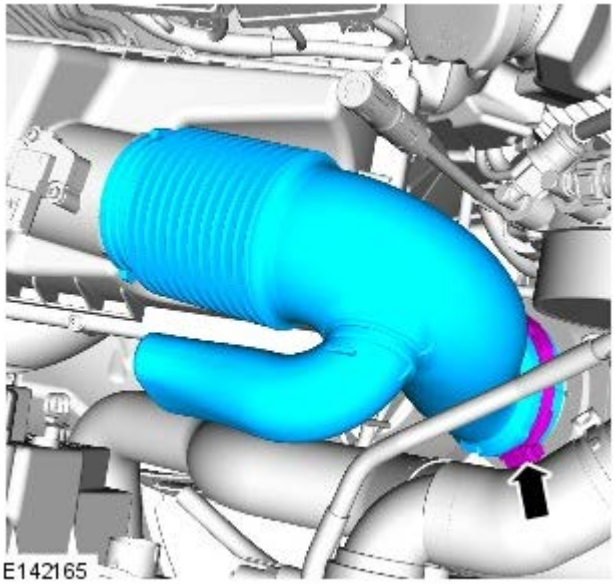
   Torque: 3.5 Nm

3.

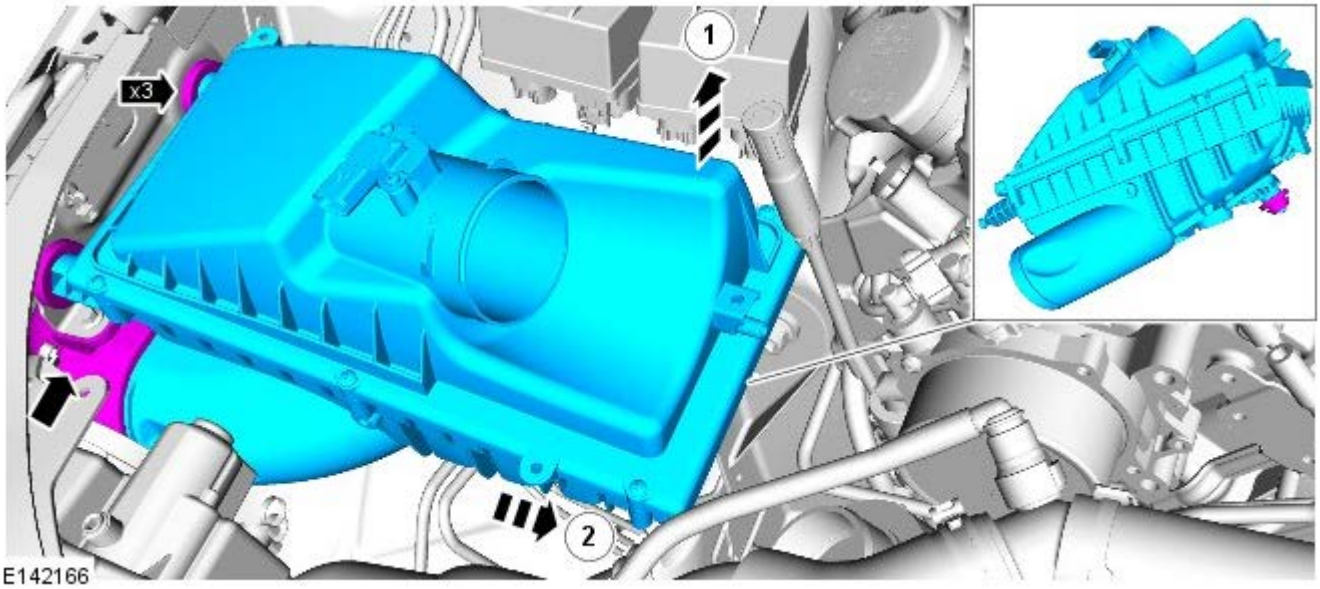


4. CAUTION: Make sure that the retaining clip is correctly installed and tightened.

   Torque: 3.5 Nm

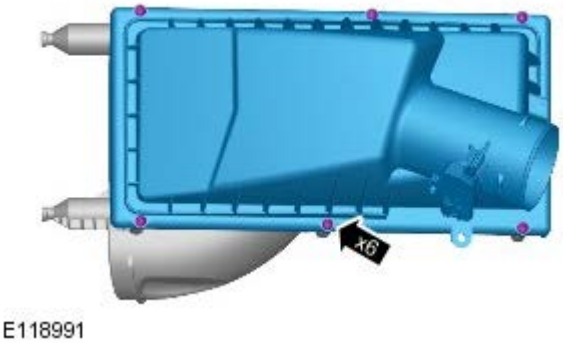


5.

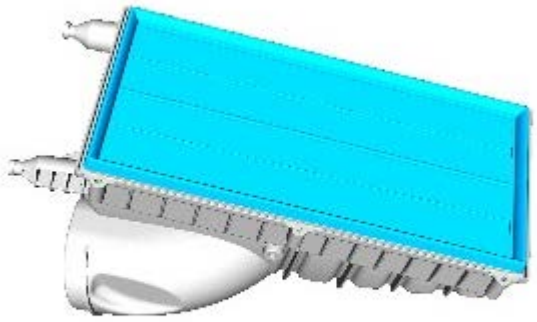


6. NOTE: Do not disassemble further if the component is removed for access only.

Torque: 1.6 Nm



7.



E142489

Installation

1. To install, reverse the removal procedure.

Published: 29-Oct-2013

Intake Air Distribution and Filtering - TDV8 4.4L Diesel - Charge Air Cooler

Removal and Installation

Removal

CAUTION: LH illustration shown, RH is similar.

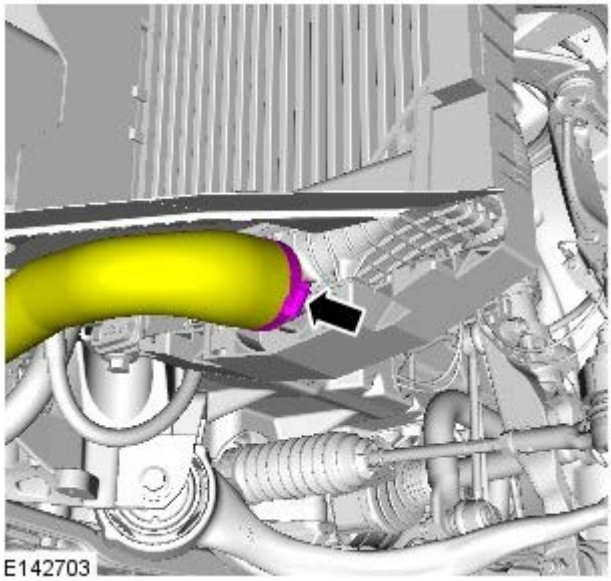
NOTES:

Some variation in the illustrations may occur, but the essential information is always correct.

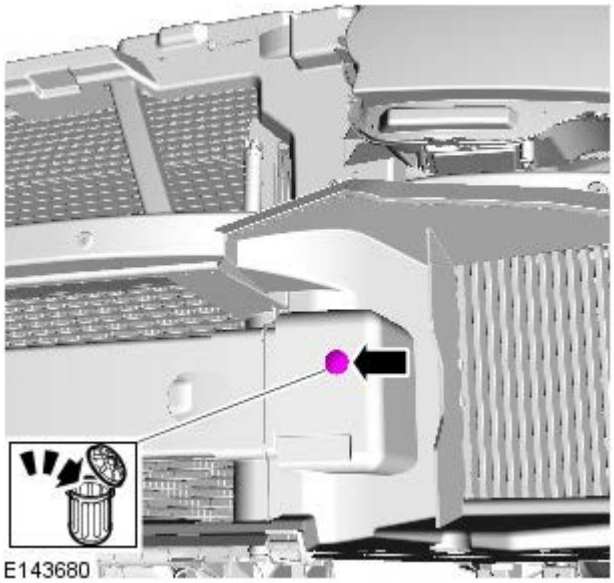
Removal steps in this procedure may contain installation details.

1. Refer to: Front Bumper Cover (501-19 Bumpers, Removal and Installation).

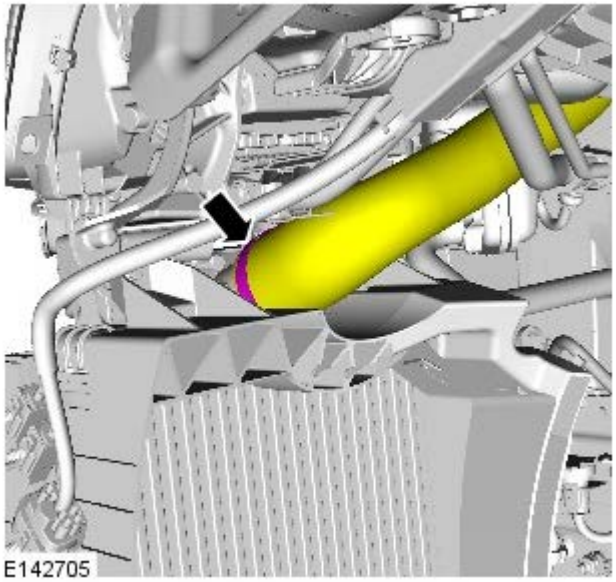
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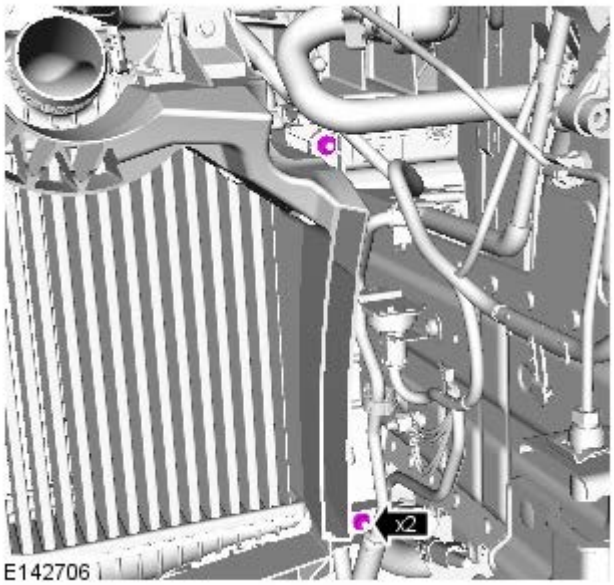
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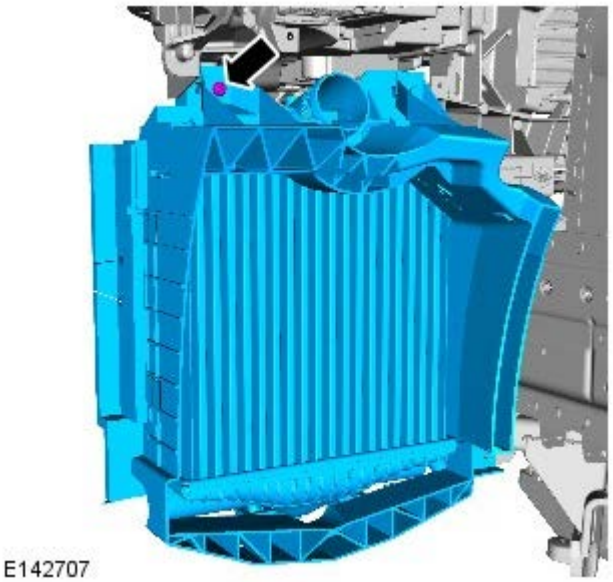
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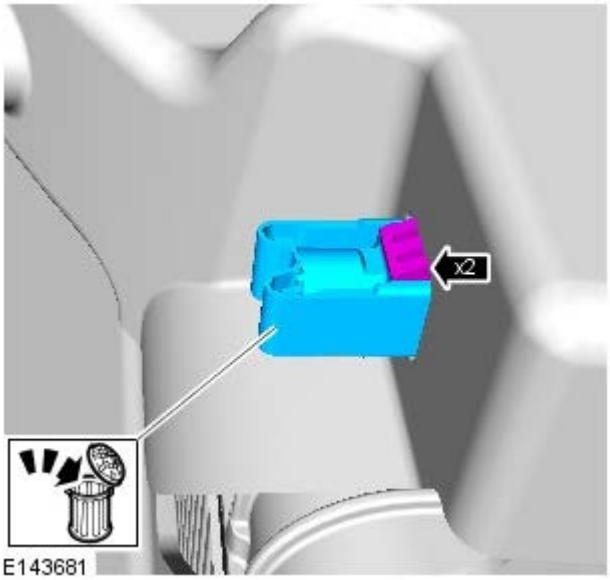
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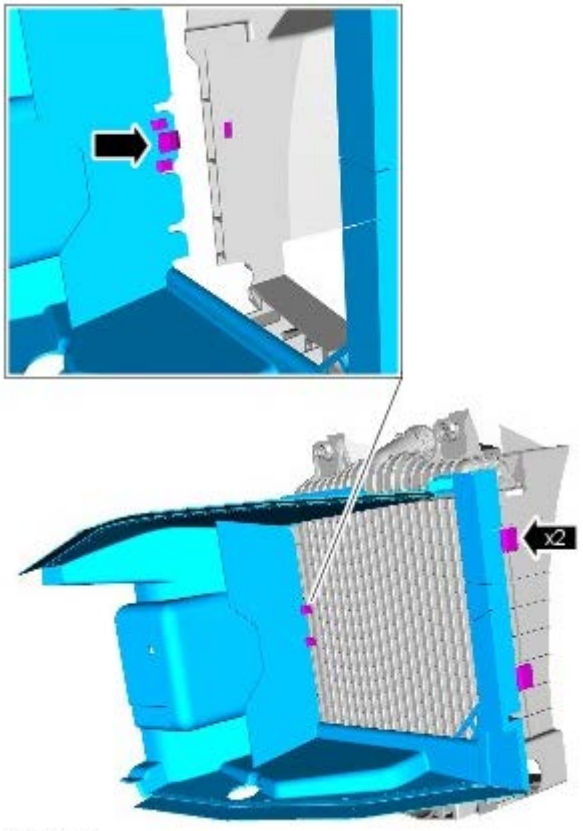
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7.



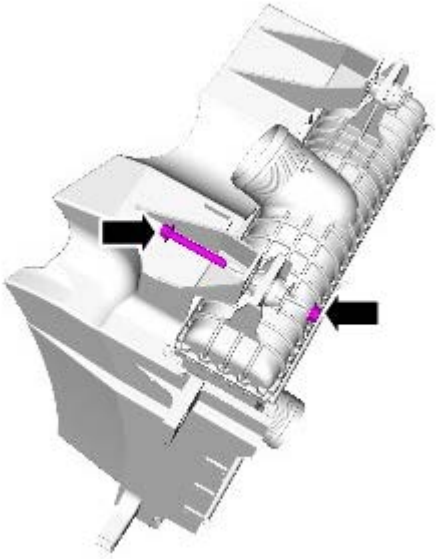
E143681



E142708

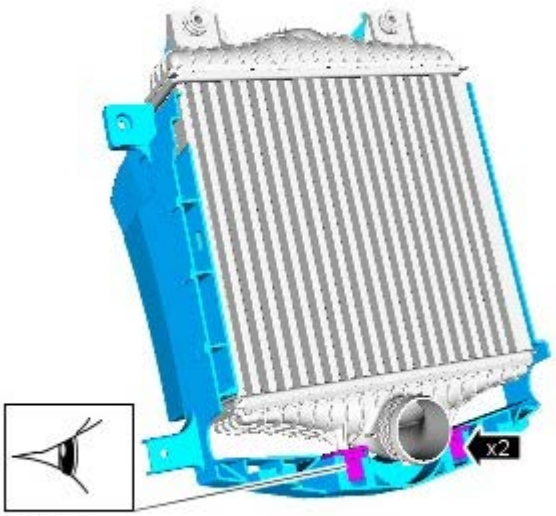
8. NOTE: Do not disassemble further if the component is removed for access only.

9.



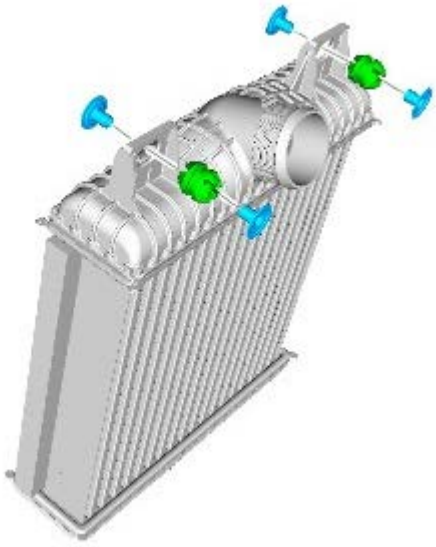
E142709

10. Inspect the components and renew if damaged or worn.



E143683

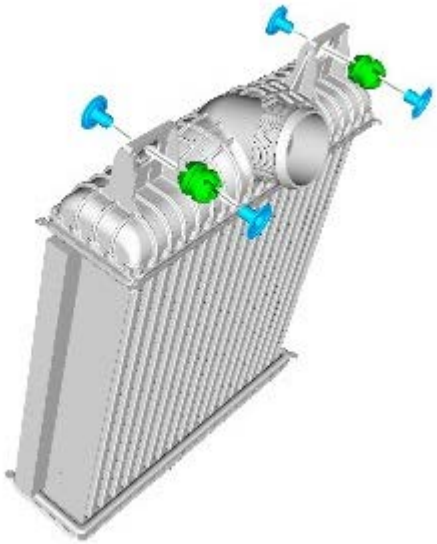
11.



E142711

Installation

1.



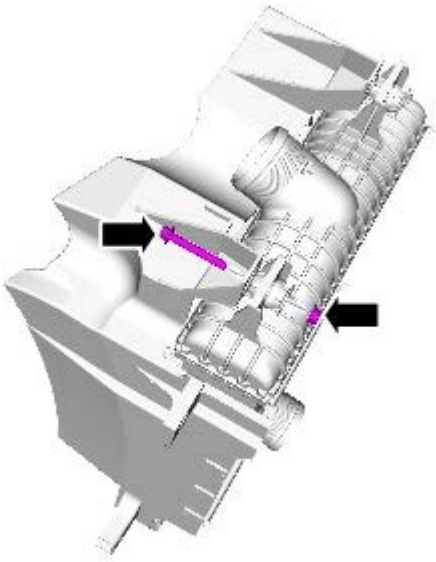
E142711

2.



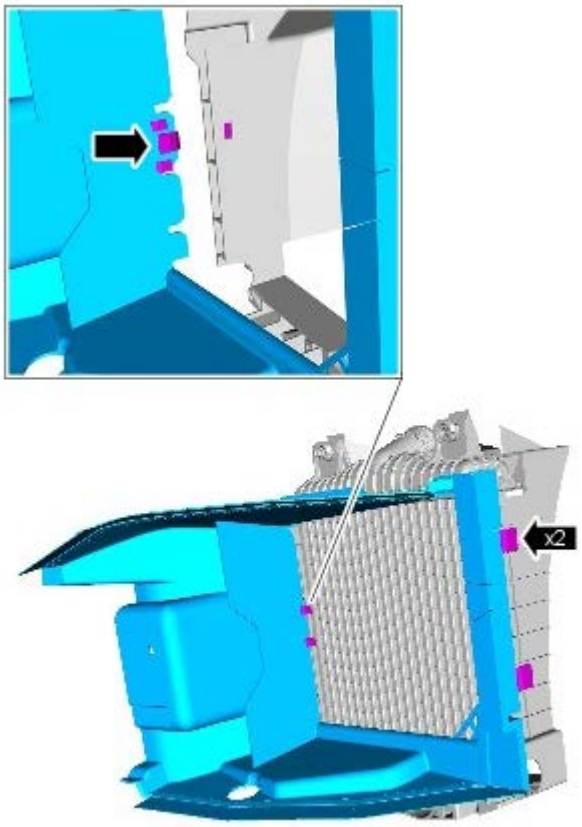
E142710

3. *Torque:* 9 Nm

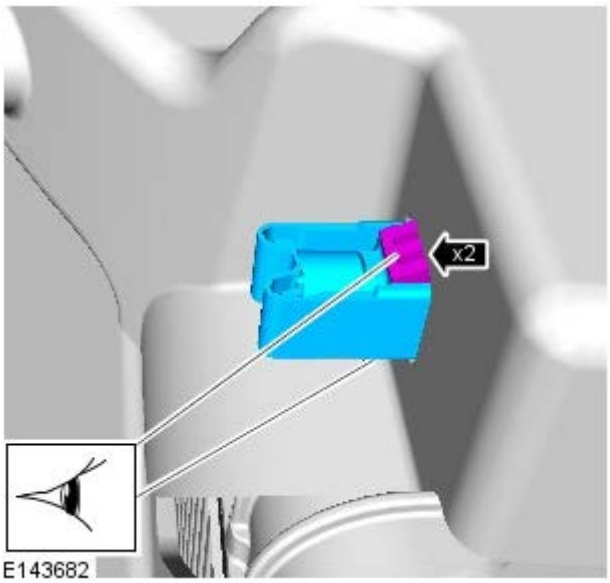


E142709

4.



E142708



E143682

5. NOTES:

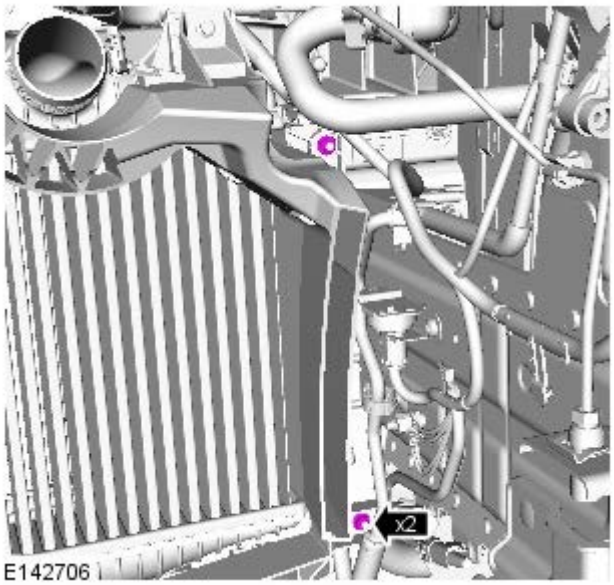
   Make sure that the locking tangs are installed correctly.

   Make sure that new components are installed.

6. *Torque:* 5 Nm


E142707

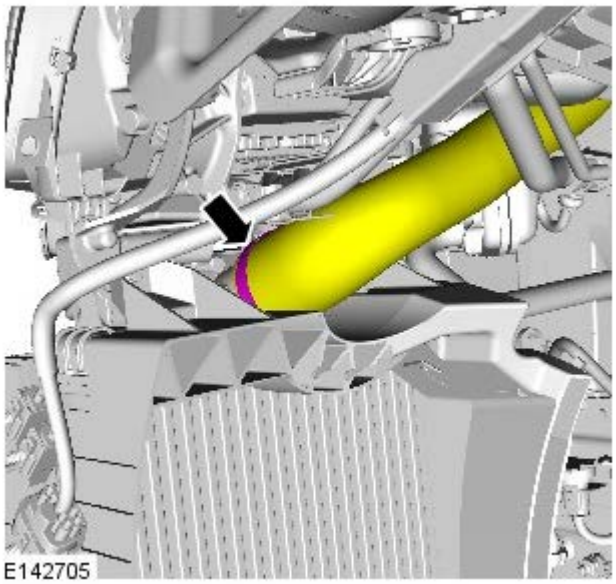
7. *Torque:* 9 Nm



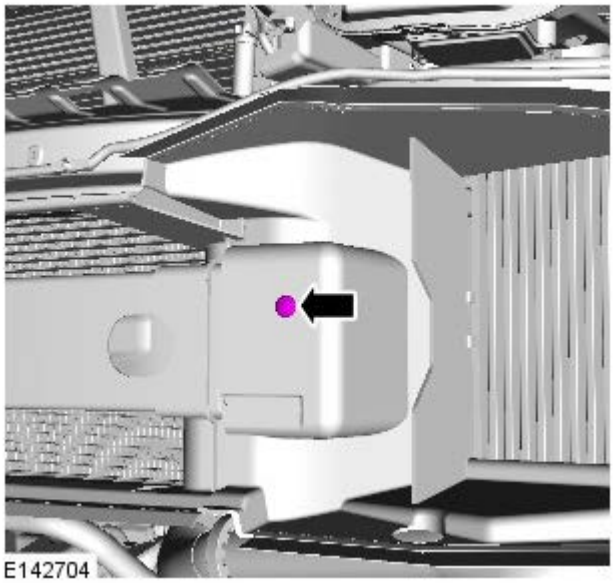
E142706

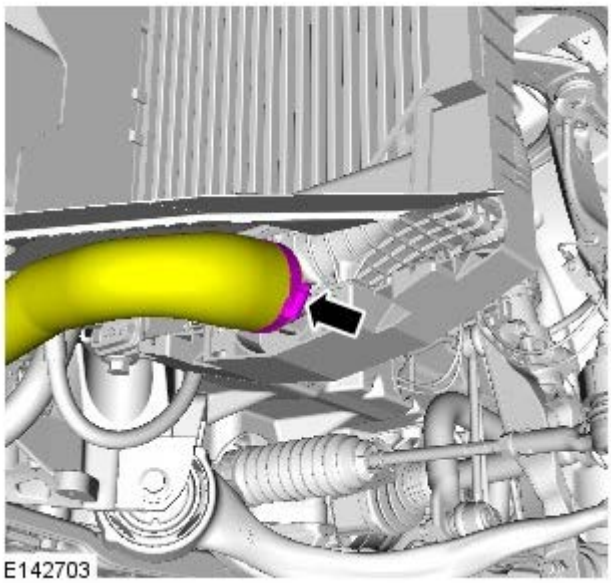
8. NOTE: Make sure the retaining clip is correctly installed and tightened.

   Torque: 3.5 Nm


E142705

9. NOTE: Make sure that new components are installed.


E142704


E142703

10. NOTE: Make sure the retaining clip is correctly installed and tightened.

    Torque: 5 Nm

11. Refer to: Front Bumper Cover (501-19 Bumpers, Removal and Installation).

Published: 31-Aug-2012

Evaporative Emissions - V6 S/C 3.0L Petrol -

Torque Specifications

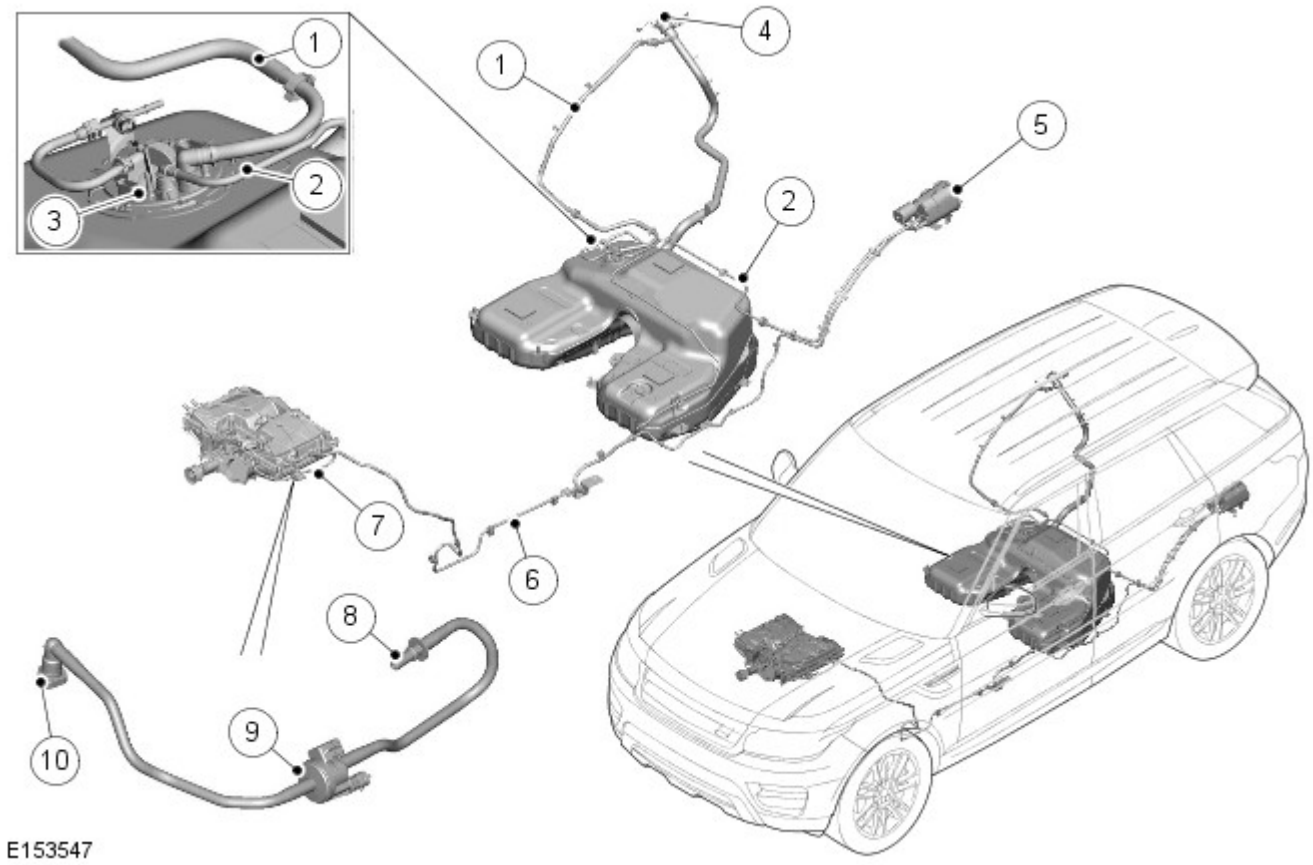
Description	Nm	lb-ft	lb-in
Evaporative emission canister retaining nut	9	-	80

Published: 29-Jan-2014

Evaporative Emissions - V6 S/C 3.0L Petrol - Evaporative Emissions

Description and Operation

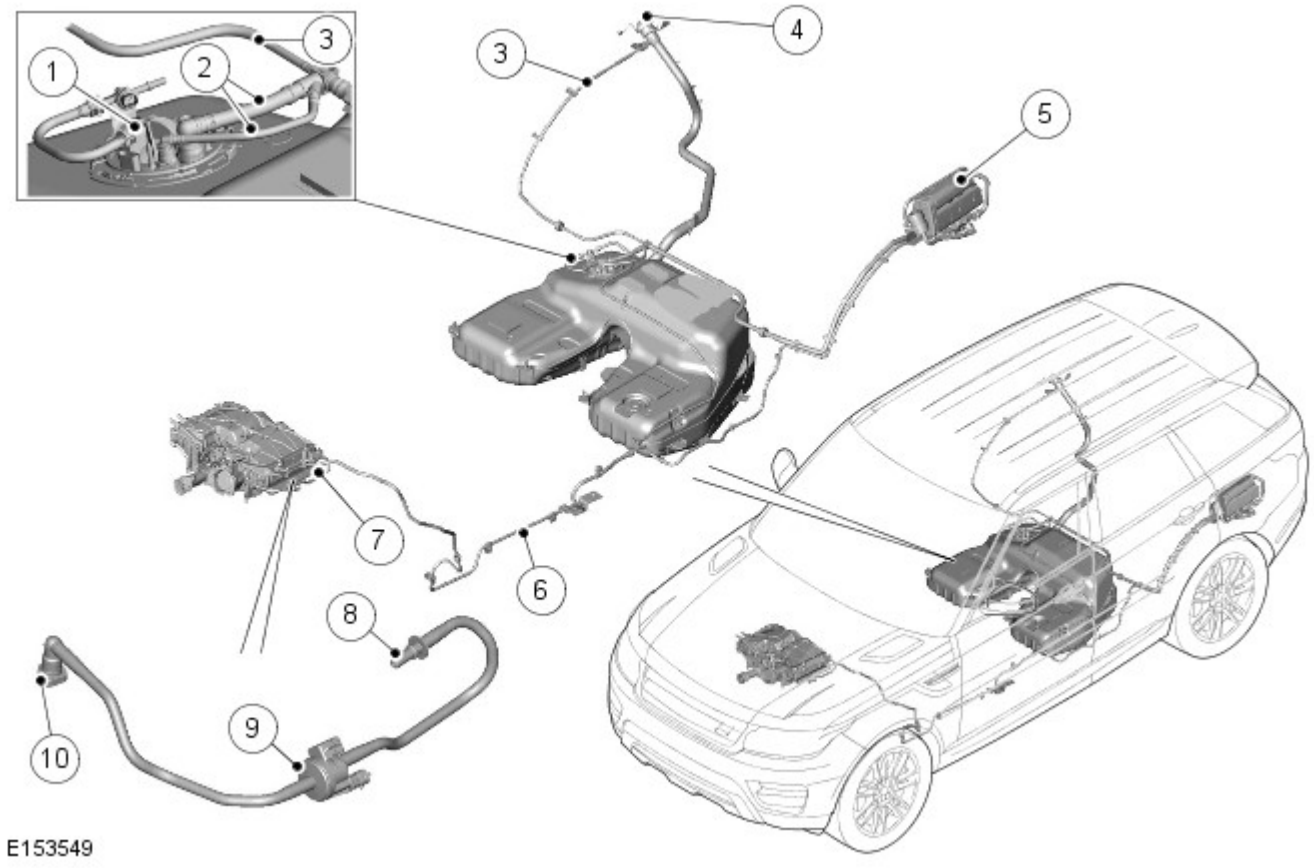
COMPONENT LOCATION



E153547

Item	Part Number	Description
1	-	Refueling breather from tank stub to upper filler pipe connection
2	-	Vent pipe from tank flange to evaporative emissions canister
3	-	Fuel pump module
4	-	Fuel filler pipe/cap
5	-	Evaporative emissions canister
6	-	Purge line - evaporative emissions canister to purge valve
7	-	Purge valve with pipes
8	-	Connection from the evaporative emission canister
9	-	Purge valve
10	-	Connection to the supercharger inlet

COMPONENT LOCATION - NAS



Item	Part Number	Description
1	-	Fuel pump module
2	-	Refueling breather from tank stub to on-board refueling vapor recovery and evaporative emissions canister
3	-	Communication tube - tank to filler pipe
4	-	Fuel filler pipe/cap
5	-	Evaporative emissions canister and DMTL pump
6	-	Purge line - evaporative emissions canister to purge valve
7	-	Purge valve with pipes
8	-	Connection from the evaporative emission canister
9	-	Purge valve
10	-	Connection to the supercharger inlet

OVERVIEW

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 an evaporative emissions canister, purge valve and interconnecting vent pipes and hoses. The vent pipes are connected to the system components using quick release connectors.

On NAS market vehicles, the system is checked for leak tightness by a DMTL (Diagnostic Module Tank Leakage) pump (part of the evaporative emissions canister), which pressurizes the system and checks for leakage.

Fuel vapor is generated by the fuel in the tank and the amount of vapor produced increases as the fuel heats up. Fuel vapor can flow freely to the evaporative emissions canister via the tank venting system. The venting system consists of a combined vent and rollover valve installed in the fuel tank. On all vehicles except NAS, the refueling breather pipes connect from the tank breather stub to the top of the fuel filler pipe, and the fuel tank vent system to the evaporative emissions canister. On NAS vehicles, the fuel tank vent system connects into a refueling breather pipe that connects to the evaporative emissions canister. NAS vehicles also have a communication line that connects the upper part of the filler pipe to the tank vent system.

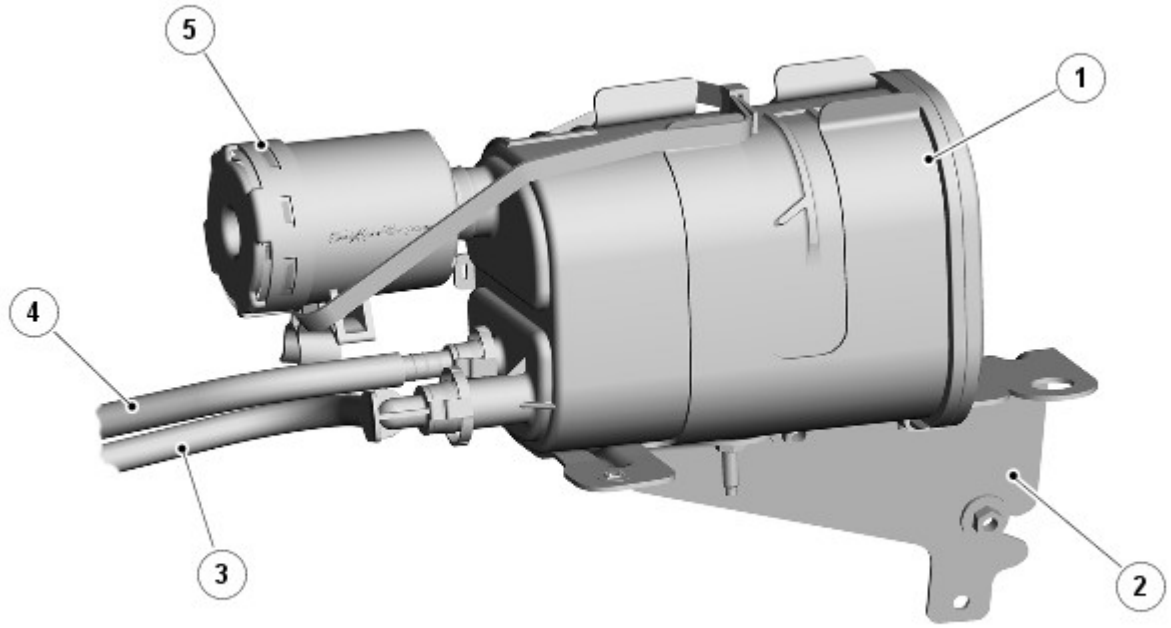
The vapor from the fuel tank passes into the evaporative emission canister where it is absorbed and stored by the charcoal. Because there is a limit to the amount of vapor the canister can contain, the fuel vapor is purged from the canister when the engine is running and burned in the engine during the combustion cycle.

On NAS vehicles the vapor generated in the fuel tank during refueling flows without restriction to the evaporative emission canister. On all vehicles except NAS, the vapor is restricted in its path to the evaporative emission canister but can flow freely during the fuel filling operation to atmosphere, via the filler opening.

DESCRIPTION

Evaporative Emissions Canister

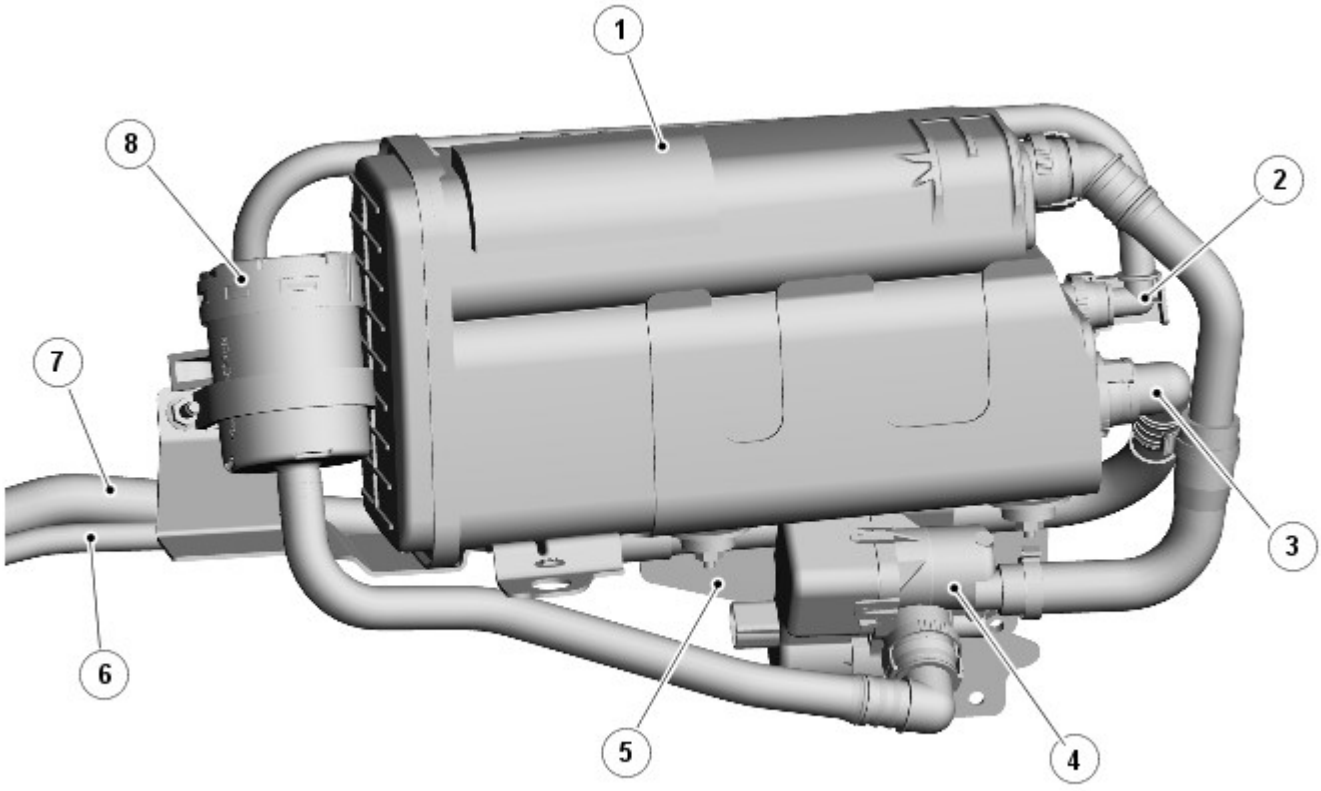
All Except NAS



E146742

Item	Part Number	Description
1	-	Evaporative emissions canister
2	-	Mounting bracket
3	-	Pipe to purge valve
4	-	Pipe from fuel tank vent system
5	-	Air filter

NAS Only



E146743

Item	Part Number	Description
1	-	Evaporative emissions canister
2	-	Connector - pipe to purge valve
3	-	Connector - pipe from fuel tank refueling breather and vent system
4	-	Diagnostic Module Tank Leakage (DMTL) pump
5	-	Mounting bracket
6	-	Pipe to purge valve
7	-	Pipe from fuel tank refueling breather and vent system
8	-	Air filter

The evaporative emission canister is located in the left rear wheel arch, on a bracket attached to the wheel housing inner panel. The canister has three ports which allow for the attachment of an air intake filter, the pipe to the purge valve and the pipe from the tank vent. On NAS vehicles the DMTL pump is installed between the filter and the canister. The canister contains a bed of activated charcoal or carbon, which is capable of absorbing large quantities of fuel vapor.

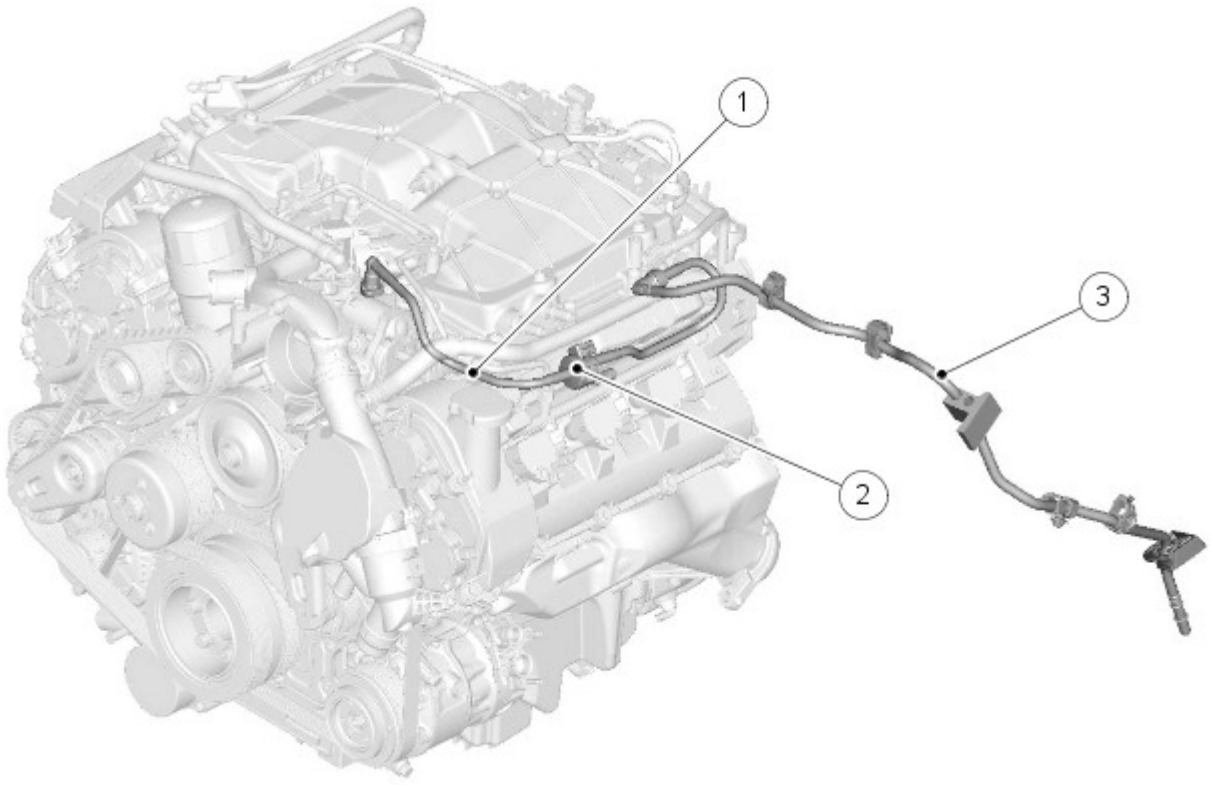
Diagnostic Module Tank Leakage - NAS Only

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.

The DMTL pump incorporates an electric air pump, a PTC (Positive Temperature Coefficient) heating element, a normally open changeover valve and a reference orifice. The DMTL pump is only operated when the ignition is switched off and is controlled by the ECM (Engine Control Module). The ECM also monitors operation of the air pump and the changeover valve for faults.

A connection with the ECM relay in the EJB (Engine Junction Box) supplies battery power to the DMTL pump. The ECM applies separate ground connections to operate the heater element, the air pump and the changeover valve individually, as required.

Purge Valve and Pipes



E153548

Item	Part Number	Description
1	-	Pipe to engine
2	-	Purge valve
3	-	Pipe from evaporative emissions canister

The purge valve is installed on a bracket attached to the left camshaft cover. The pipe to the engine from the purge valve is connected to the supercharger front cover, with a quick release connecter. The pipe to the evaporative emission canister from the purge valve is installed between the left camshaft cover and ignition coil cover, then goes down the rear of the left front suspension housing and along the underside of the vehicle and into the left rear wheel arch.

The purge valve is a solenoid operated valve, which is closed when de-energized. The valve is controlled by the ECM and is operated when engine operating conditions are suitable for purging of the evaporative emission 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 11% and 99% duty or mark space ratio (% open time).

Atmospheric pressure is higher than the pressure at the inlet of the intake supercharger under all throttle settings and engine running conditions. It is this pressure differential that causes air to flow through the EVAP system to the engine.

OPERATION

Purge Valve

The ECM waits until the engine is running above 40 °C (104 °F) coolant temperature, with closed loop fuel operational, before the purging process is activated. Under these conditions the engine should be running smoothly with no warm up enrichment. The purge valve duty (and flow) is initially ramped slowly because the vapor concentration is unknown and a sudden increase in purge could cause the engine to stall or loss of 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 air fuel ratio. 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 air fuel ratio control is maintained.

Diagnostic Module Tank Leakage - NAS Only

To check the fuel tank and the EVAP system for leaks, the ECM operates the DMTL air 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 changeover 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.

Providing there are no leaks, the air pump will begin to pressurize the EVAP system and the load and current draw of the air pump motor increases. By monitoring the rate and level of the current increase, the ECM can determine if there is a leak in the EVAP system.

During normal vehicle operation, 15 seconds after the engine has started, the ECM energizes the heating element in the pump to prevent condensation formation and possible incorrect readings. The heater remains energized until either the engine and ignition are off (if no DMTL test is running) or until after the DMTL test is completed.

Leaks are classified as:

- Minor - equivalent to a hole diameter of 0.5 to 1.0 mm (0.02 to 0.04 in)
- Major - equivalent to hole diameter of 1.0 mm (0.04 in) or greater.

The ECM performs a check for major leaks each time the ignition is switched off, providing the following conditions are met:

- The vehicle speed is zero
- The engine speed is zero
- The pressure altitude (70 kPa (10.15 lbf/in^2) derived from engine load calculations) is below 3047 m (10000 feet)
- The ambient temperature is between 0 and 40 °C (32 and 104 °F)
- The evaporative emission canister vapor concentration factor is less than 3 (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 battery voltage is between 11 and 16 volts
- The last engine running time was more than 10 minutes (to ensure any moisture within the DMTL pump has been removed)
- During the last engine start the difference between engine coolant temperature and ambient air temperature was less than 7 °C (13 °F)
- No errors are detected with the EVAP system 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.

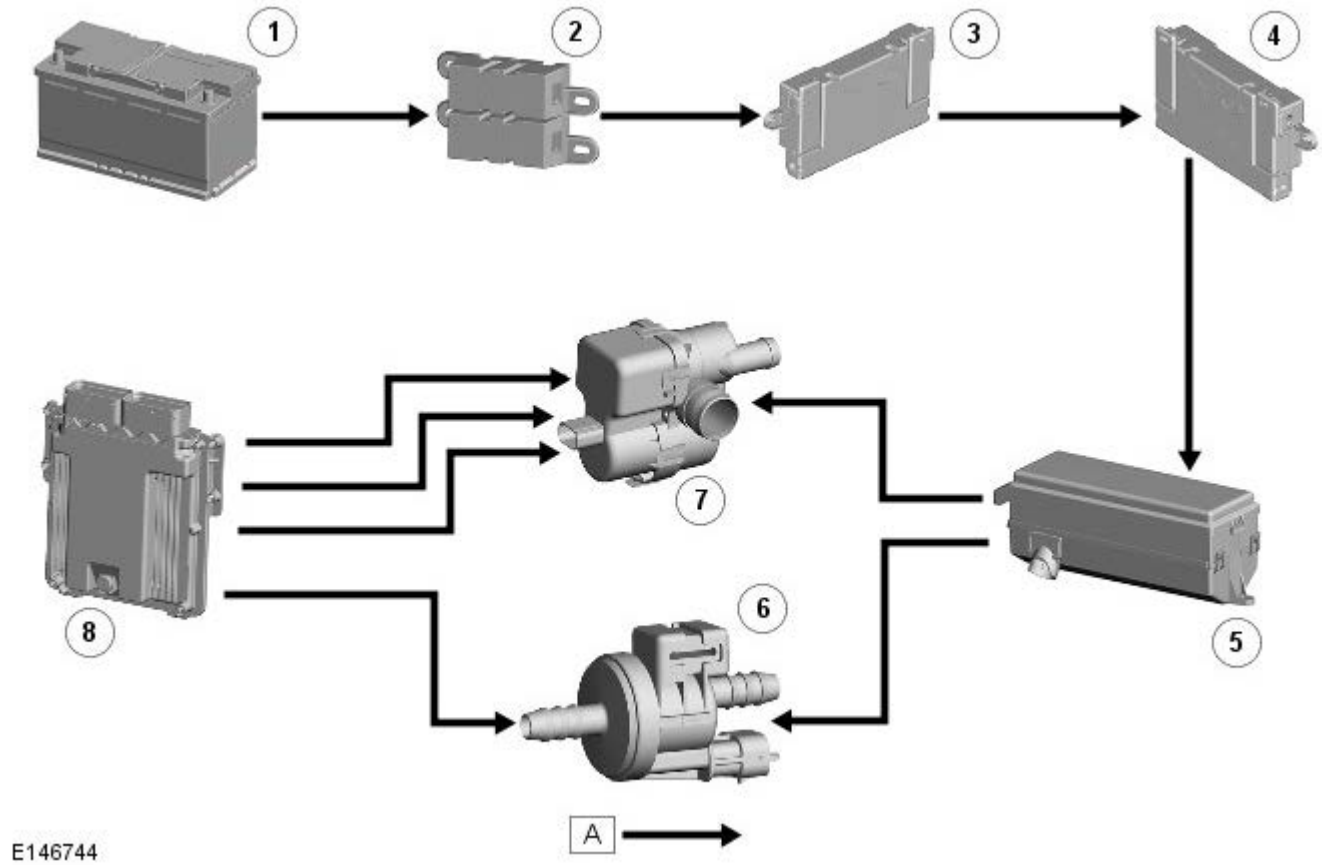
When the leak check is complete, the ECM stops the DMTL pump and opens (de-energizes) the changeover valve.

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 IC (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.

Control Diagram



A = Hardwired.

Item	Part Number	Description
1	-	Battery
2	-	Battery Junction Box 2 (BJB 2)
3	-	Battery Junction Box (BJB)
4	-	Auxiliary Junction Box (AJB)
5	-	Engine Junction Box (EJB)
6	-	Purge valve
7	-	DMTL pump (NAS only)
8	-	Engine Control Module (ECM)

Published: 11-Jul-2012

Evaporative Emissions - V6 S/C 3.0L 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 (303-13A Evaporative Emissions - V6 S/C 3.0L 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

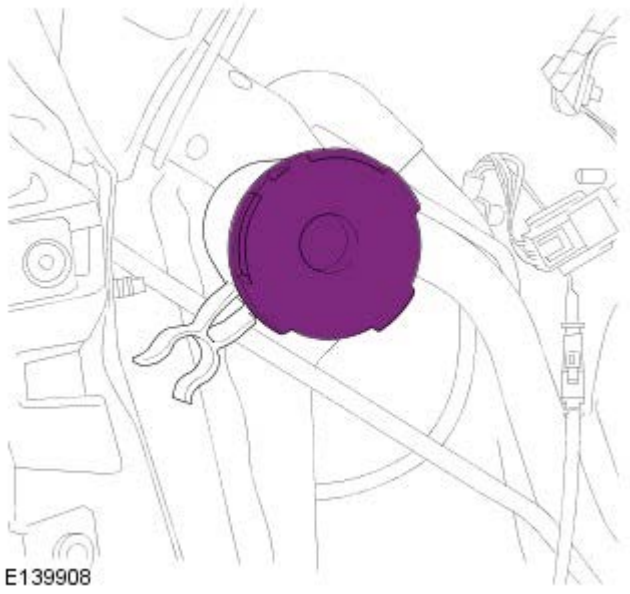
The list below provides some suggested actions to help trace the root cause of the fault

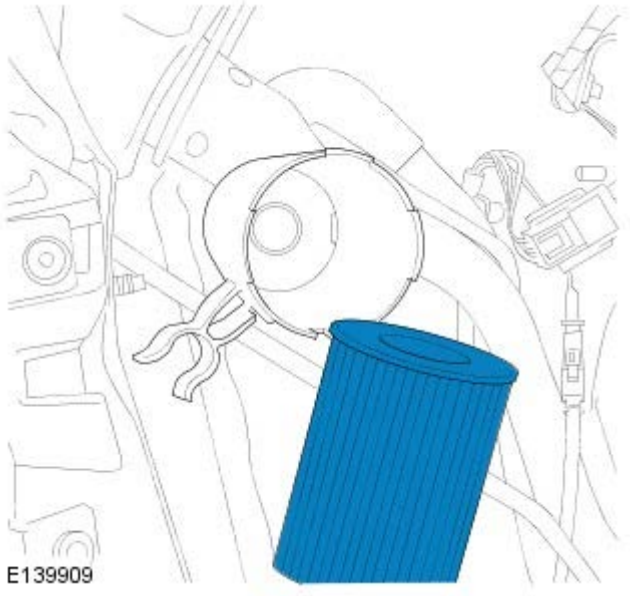
Each action should be followed up with a **Fuel Leak Check** forced test (and ranking value check) in order to determine if any improvement has been made

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-00	DMTL heater 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

P240C-00	DMTL heater electrical high	• 1. Check wiring • 2. Replace DMTL module

Pre and 10MY Denso/Bosch PCM Systems

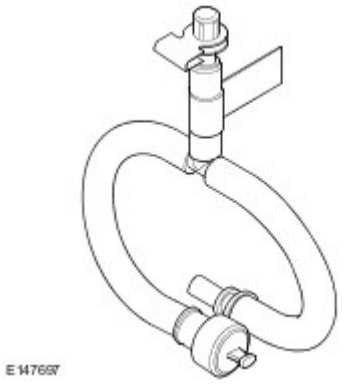




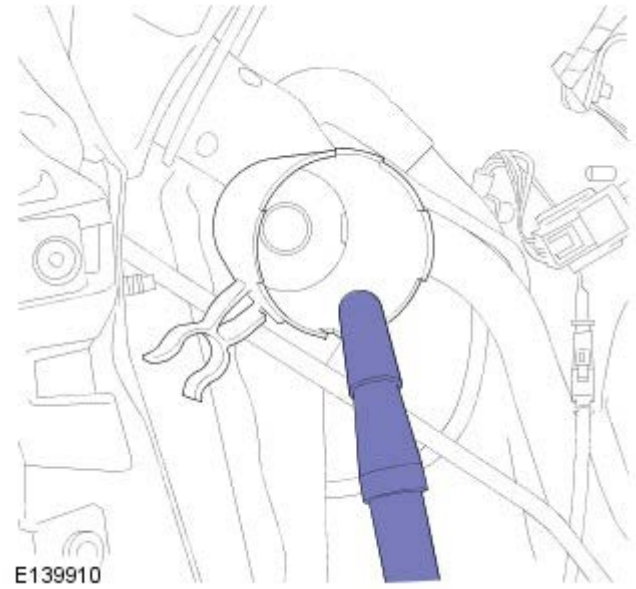
CAUTION: The Maximum pressure of the EVAP system is 0.07 bar **do not exceed**

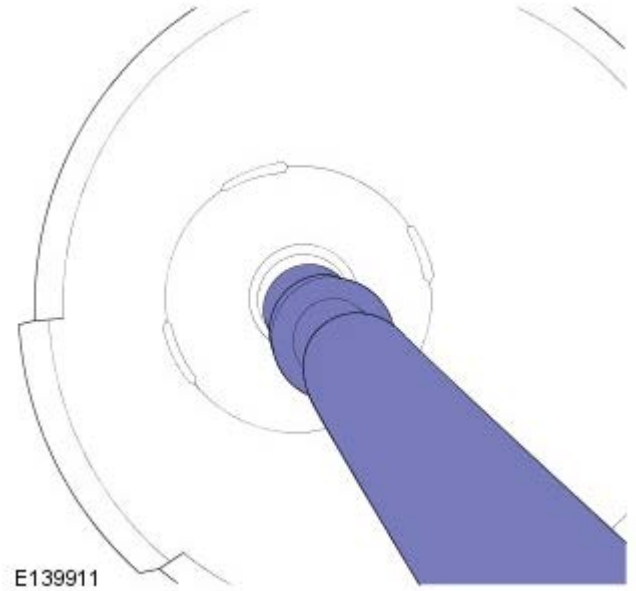
NOTE: Apart from the purge valve connection, it is recommended to smoke test the EVAP system without disturbing any joints associated with the system, this will determine the leak more accurately and quickly

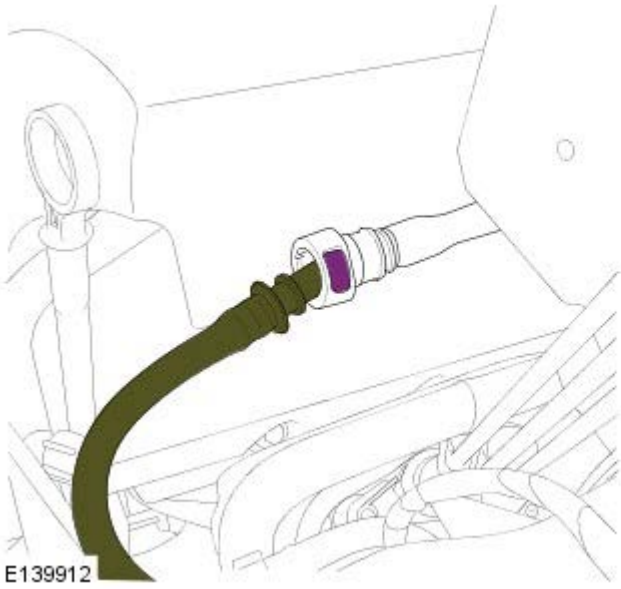
- 1. Remove rear wheel arch liner to access fuel filler neck
- 2. On the fuel filler neck the DMTL filter will be visible as shown in picture. Unclip filter housing from fuel filler neck to gain better access to DMTL filter
- 3. Remove carefully the top of filter to expose filter and remove
- 4. Attach rubber adapter to tip of smoke machine nozzle to ensure tight seal to filter housing. Disconnect the purge pipe from purge valve; this will be an escape point for the smoke to exit
- 5. Allow tester to complete self-test and green READY light to turn ON 2. For best Tester performance; completely unwind Tester's supply hose
- 6. Press **Smoke** on control panel to fill EVAP system with smoke vapour. The control panel **Smoke** light will light indicating smoke production. The smoke setting is on a 15 minute timer. Pressing the **Smoke** button again turns Tester off. It is normal for the flow meter ball, while in the smoke mode, not to be as steady as when it is in the **Test** mode. Note: The pressure gauge is active only after smoke cycle is complete
- 7. Continue introducing smoke into the EVAP System until the flow meter's ball stops descending and this assures the system test pressure is met and smoke will appear from the purge pipe, then close off purge pipe with special tool (Test Adapter Hose/EVAP Port 310-142)



NOTE: Special tool (Test Adapter Hose/EVAP Port 310-142)



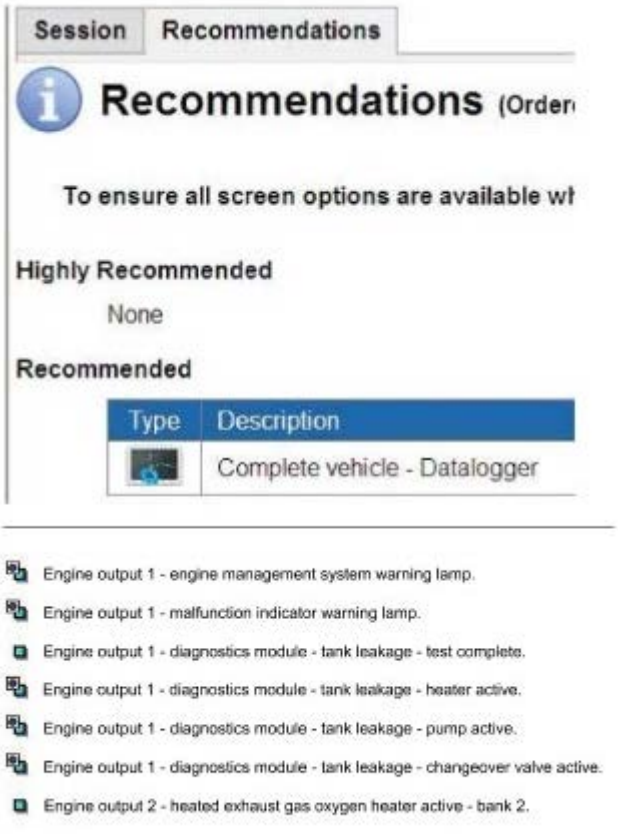




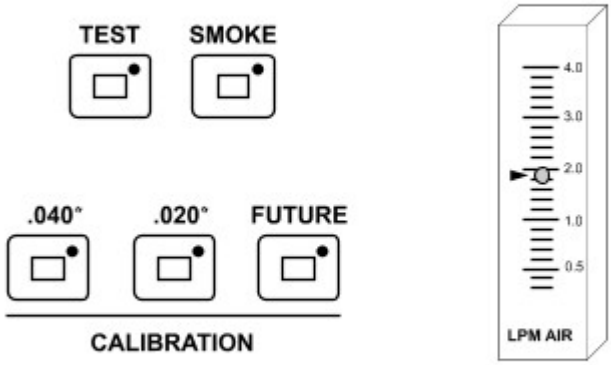
CAUTION: On some vehicles, the DMTL filter can not be removed, in these instances fill the system through the purge valve and smoke will appear from the filter

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

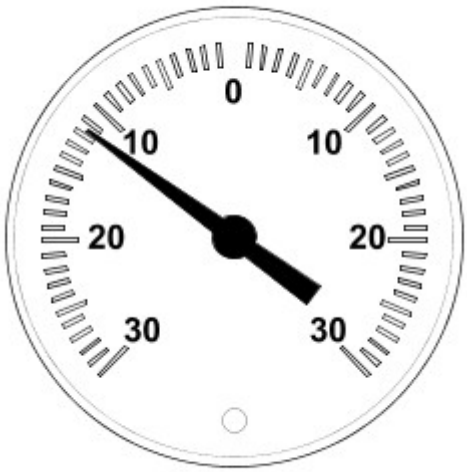
In addition to quantifying the leak with the Phase-One flow test, the Tester allows you the flexibility of testing the vehicle's EVAP system by using either **Pressure Decay** or **Vacuum Decay** methods. Below are instructions for performing both decay tests

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: 31-Aug-2012

Evaporative Emissions - V6 S/C 3.0L Petrol - Evaporative Emission Canister Purge Valve

Removal and Installation

Removal

CAUTION: Make sure that all openings are sealed. Use new blanking caps.

NOTE: Removal steps in this procedure may contain installation details.

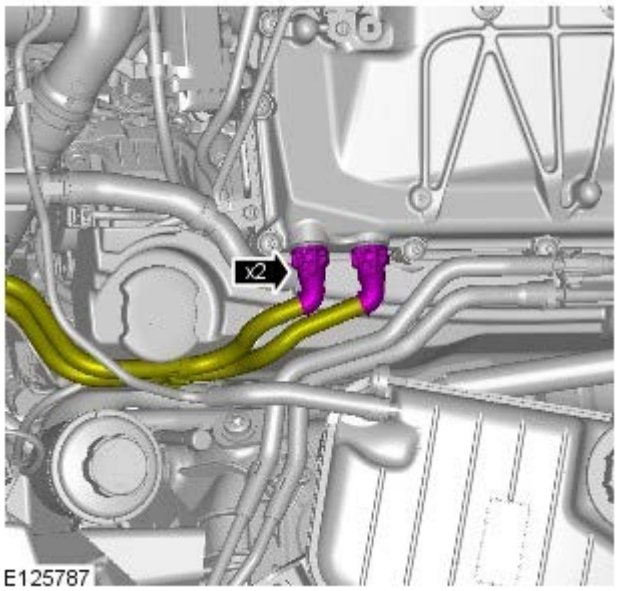
1. Disconnect the battery earth lead.

   Refer to: Battery Disconnect and Connect (414-01, General Procedures).

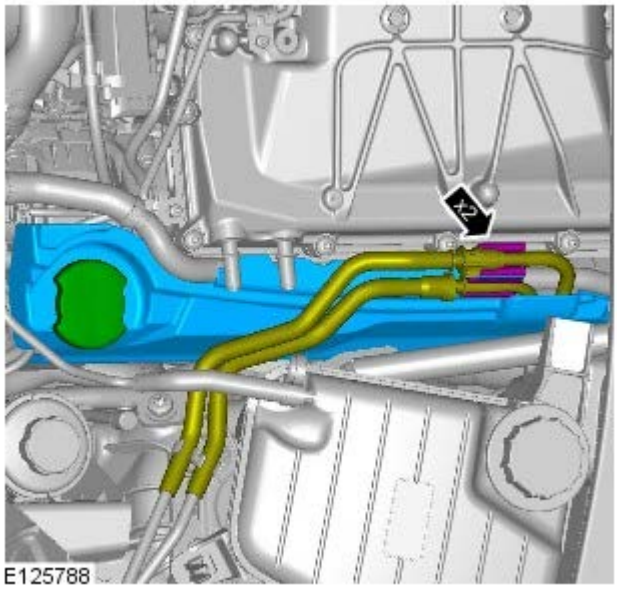
2. Refer to: Engine Cover - V6 S/C 3.0L Petrol (501-05, Removal and Installation).

3. Refer to: Cooling System Partial Draining, Filling and Bleeding (303-03, General Procedures).

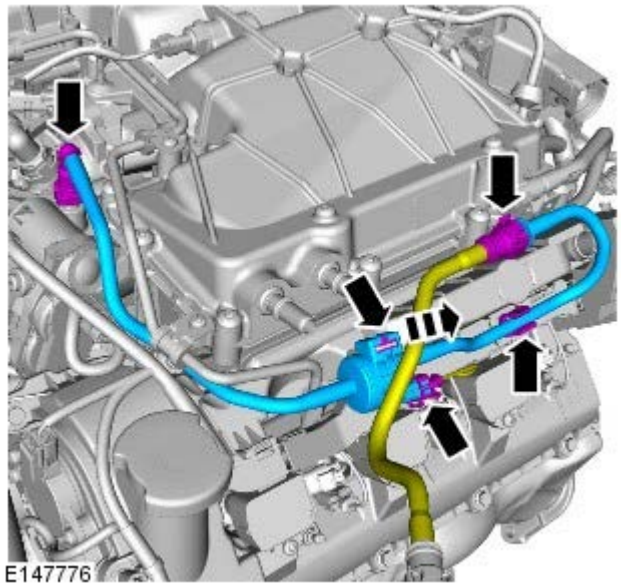
4.



5.



6.



Installation

1. To install reverse the removal procedure.

Published: 31-Jul-2012

Evaporative Emissions - V6 S/C 3.0L Petrol - Evaporative Emission Canister

Removal and Installation

Removal

CAUTION: Make sure that all openings are sealed. Use new blanking caps.

NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

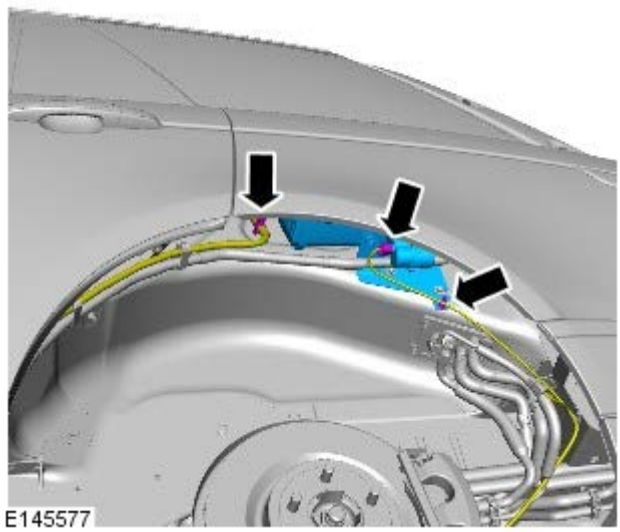
2. Refer to: Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions (100-00 General Information, Description and Operation).

3. WARNING: Make sure to support the vehicle with axle stands.

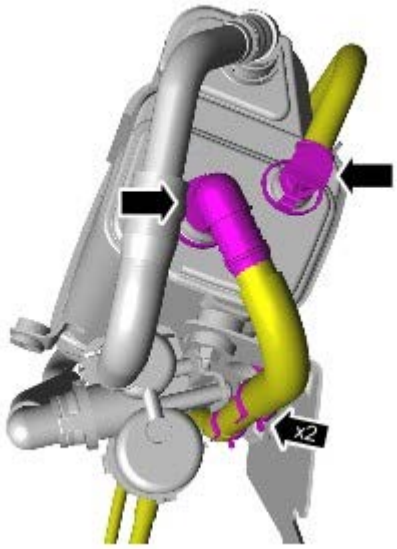
   Raise and support the vehicle.

4. Refer to: Rear Fender Splash Shield (501-08, Removal and Installation).

5.

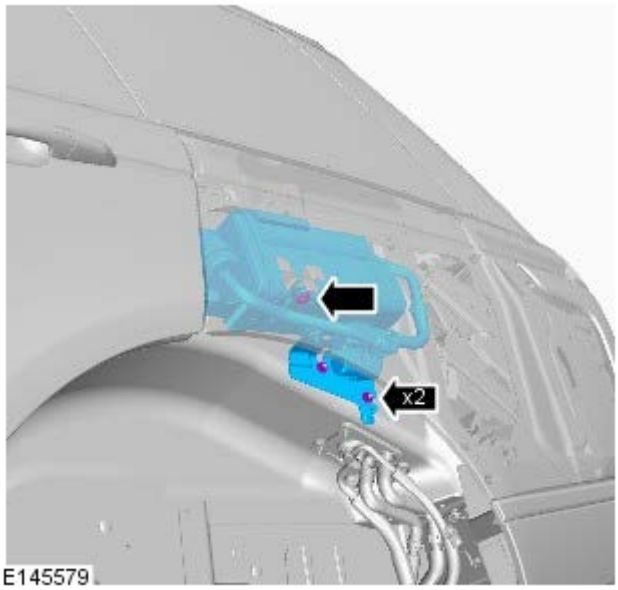


6.



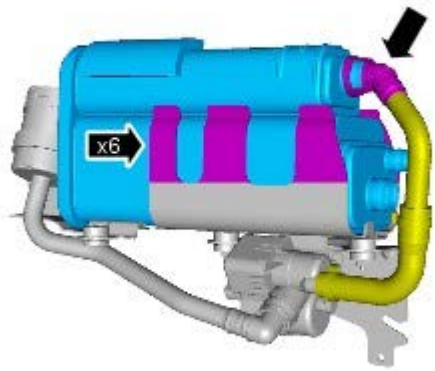
E145578

7. *Torque:* 9 Nm



E145579

8.



E145580

Installation

1. To install, reverse the removal procedure.

Published: 11-Sep-2012

Evaporative Emissions - V8 S/C 5.0L Petrol -

Torque Specifications

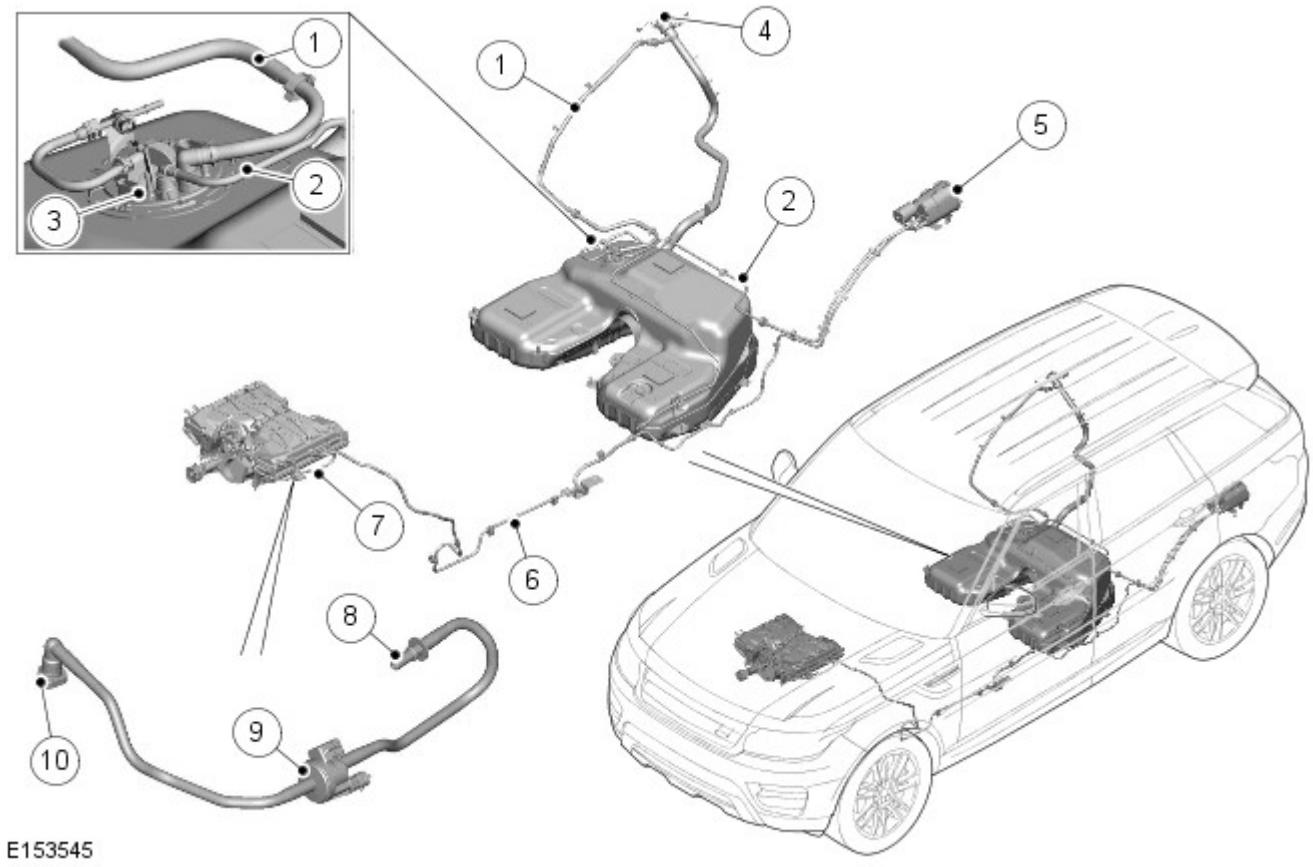
Description	Nm	lb-ft	lb-in
Evaporative emission canister retaining bolts	9	6	-

Published: 14-May-2013

Evaporative Emissions - V8 S/C 5.0L Petrol - Evaporative Emissions

Description and Operation

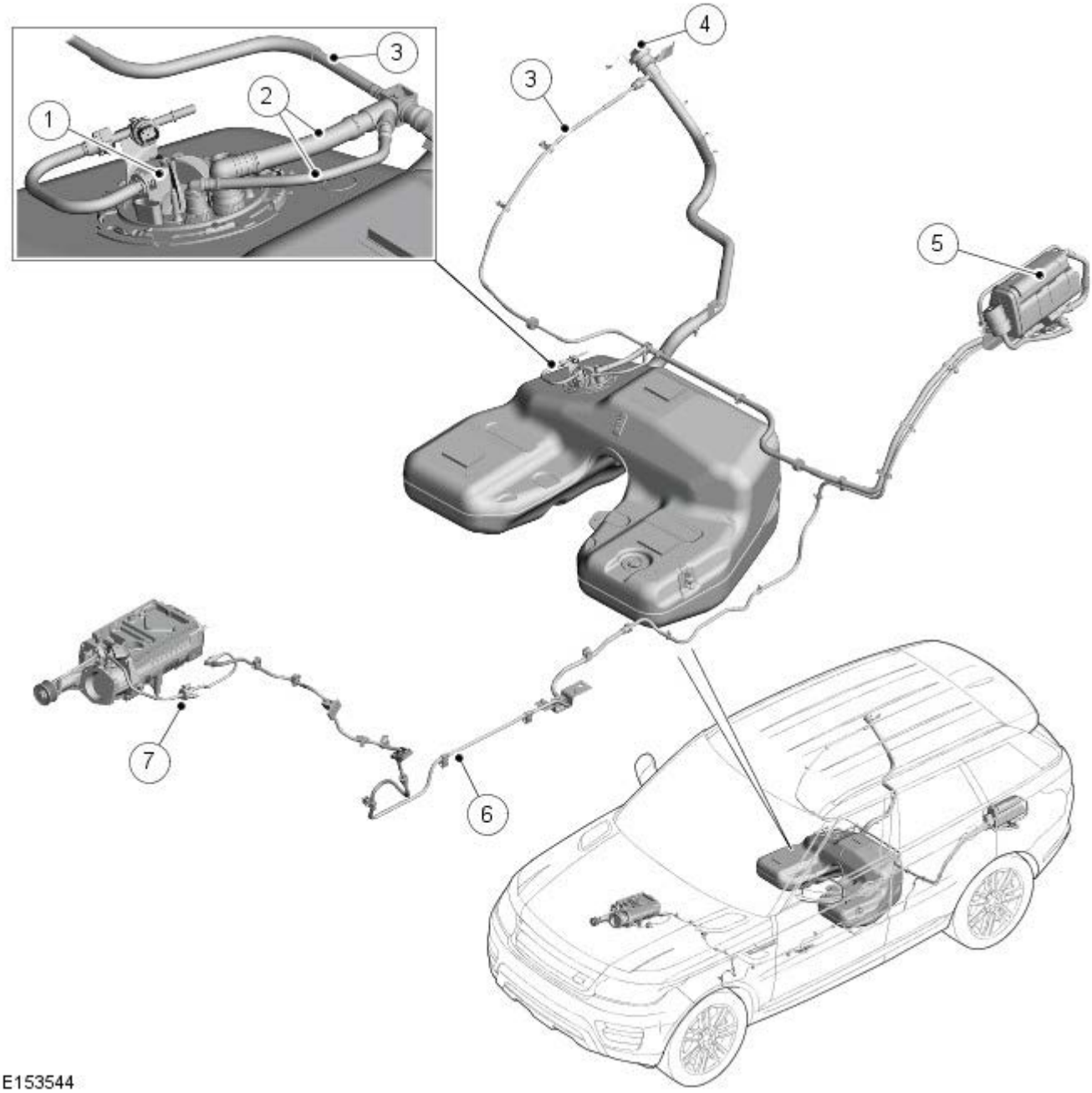
COMPONENT LOCATION - ALL EXCEPT NAS



E153545

Item	Part Number	Description
1	-	Refueling breather from tank stub to upper filler pipe connection
2	-	Vent pipe from tank flange to evaporative emissions canister
3	-	Fuel pump module
4	-	Fuel filler pipe/cap
5	-	Evaporative emissions canister
6	-	Purge line - evaporative emissions canister to purge valve
7	-	Purge valve with pipes
8	-	Connection from the evaporative emission canister
9	-	Purge valve
10	-	Connection to the supercharger inlet

COMPONENT LOCATION - NAS



E153544

Item	Part Number	Description
1	-	Fuel pump module
2	-	Refueling breather from tank stub to on-board refueling vapor recovery and evaporative emissions canister
3	-	Communication tube - tank to filler pipe
4	-	Fuel filler pipe/cap
5	-	Evaporative emissions canister and DMTL pump
6	-	Purge line - evaporative emissions canister to purge valve
7	-	Purge valve with pipes

OVERVIEW

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 an evaporative emissions canister, purge valve and interconnecting vent pipes and hoses. The vent pipes are connected to the system components using quick release connectors.

On NAS market vehicles, the system is checked for leak tightness by a DMTL (Diagnostic Module Tank Leakage) pump (part of the evaporative emissions canister), which pressurizes the system and checks for leakage.

Fuel vapor is generated by the fuel in the tank and the amount of vapor produced increases as the fuel heats up. Fuel vapor can flow freely to the evaporative emissions canister via the tank venting system. The venting system consists of a combined vent and rollover valve installed in the fuel tank. On all vehicles except NAS, the refueling breather pipes connect from the tank breather stub to the top of the fuel filler pipe, and the fuel tank vent system to the evaporative emissions canister. On NAS vehicles, the fuel tank vent system connects into a refueling breather pipe that connects to the evaporative emissions canister. NAS vehicles also have a communication line that connects the upper part of the

filler pipe to the tank vent system.

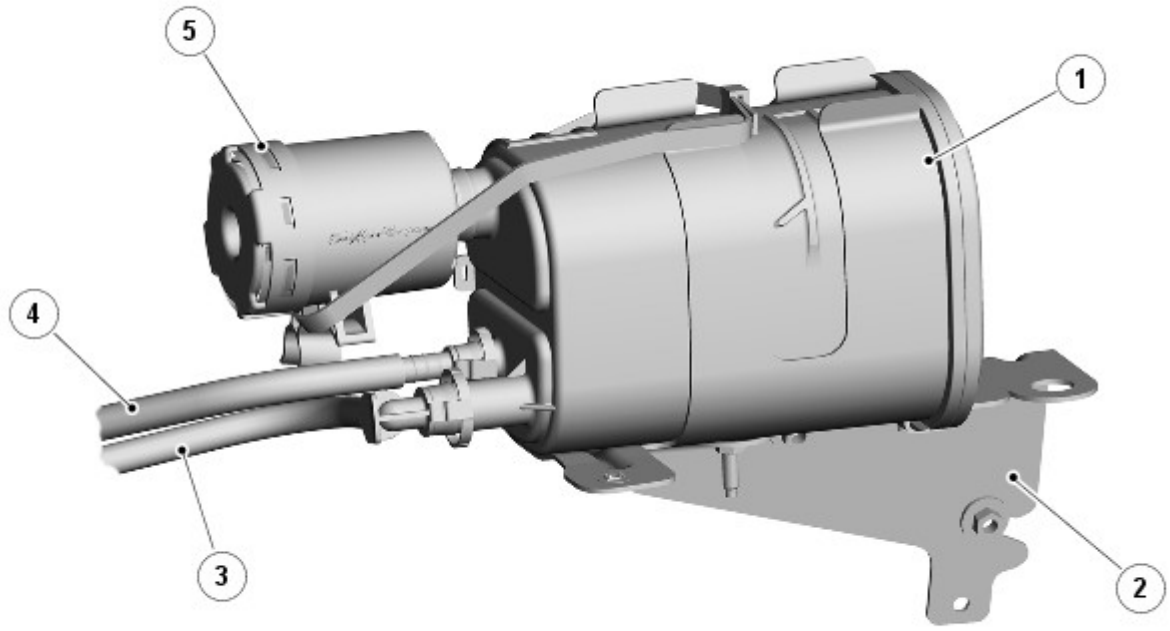
The vapor from the fuel tank passes into the evaporative emission canister where it is absorbed and stored by the charcoal. Because there is a limit to the amount of vapor the canister can contain, the fuel vapor is purged from the canister when the engine is running and burned in the engine during the combustion cycle.

On NAS vehicles the vapor generated in the fuel tank during refueling flows without restriction to the evaporative emission canister. On all vehicles except NAS, the vapor is restricted in its path to the evaporative emission canister but can flow freely during the fuel filling operation to atmosphere, via the filler opening.

DESCRIPTION

Evaporative Emissions Canister

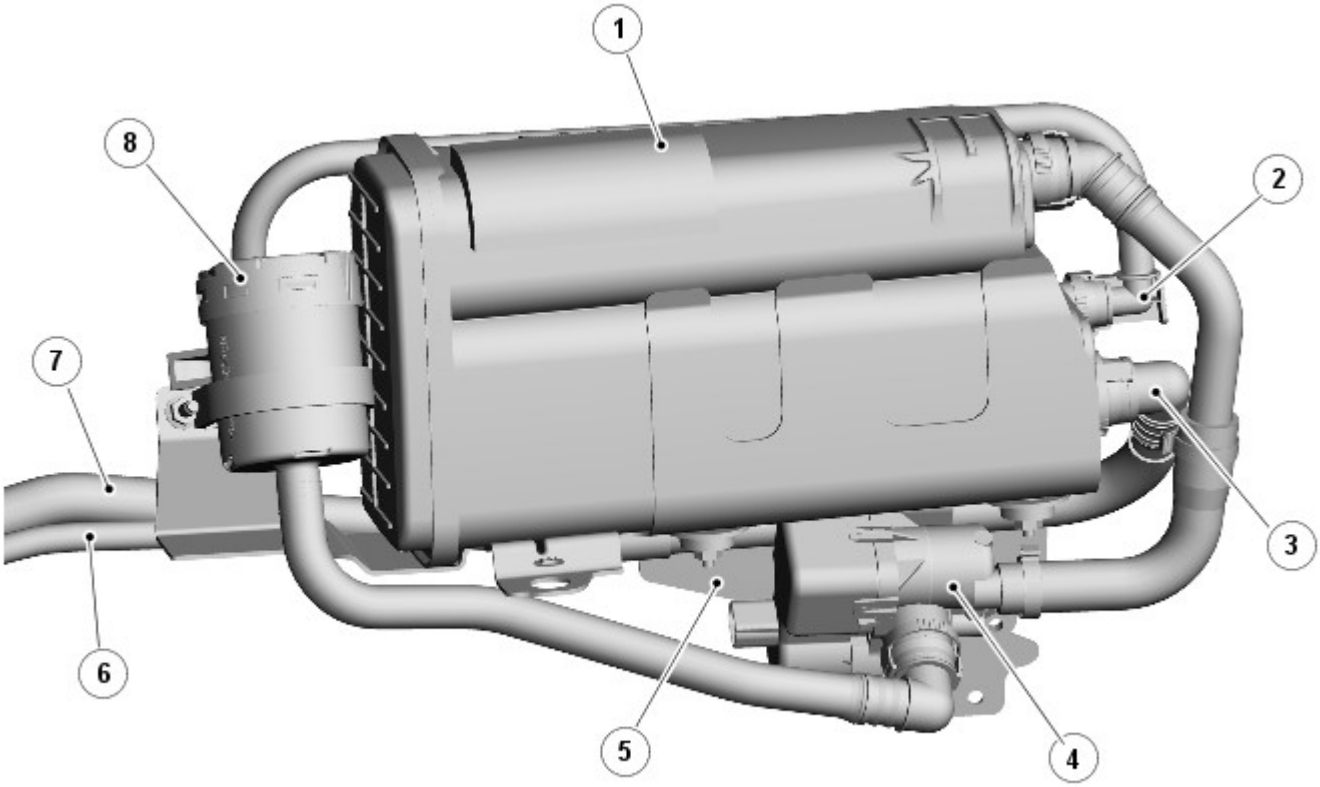
All Except NAS



E146742

Item	Part Number	Description
1	-	Evaporative emissions canister
2	-	Mounting bracket
3	-	Pipe to purge valve
4	-	Pipe from fuel tank vent system
5	-	Air filter

NAS Only



E146743

Item	Part Number	Description
1	-	Evaporative emissions canister
2	-	Connector - pipe to purge valve
3	-	Connector - pipe from fuel tank refueling breather and vent system
4	-	Diagnostic Module Tank Leakage (DMTL) pump
5	-	Mounting bracket
6	-	Pipe to purge valve
7	-	Pipe from fuel tank refueling breather and vent system
8	-	Air filter

The evaporative emission canister is located in the left rear wheel arch, on a bracket attached to the wheel housing inner panel. The canister has three ports which allow for the attachment of an air intake filter, the pipe to the purge valve and the pipe from the tank vent. On NAS vehicles the DMTL pump is installed between the filter and the canister. The canister contains a bed of activated charcoal or carbon, which is capable of absorbing large quantities of fuel vapor.

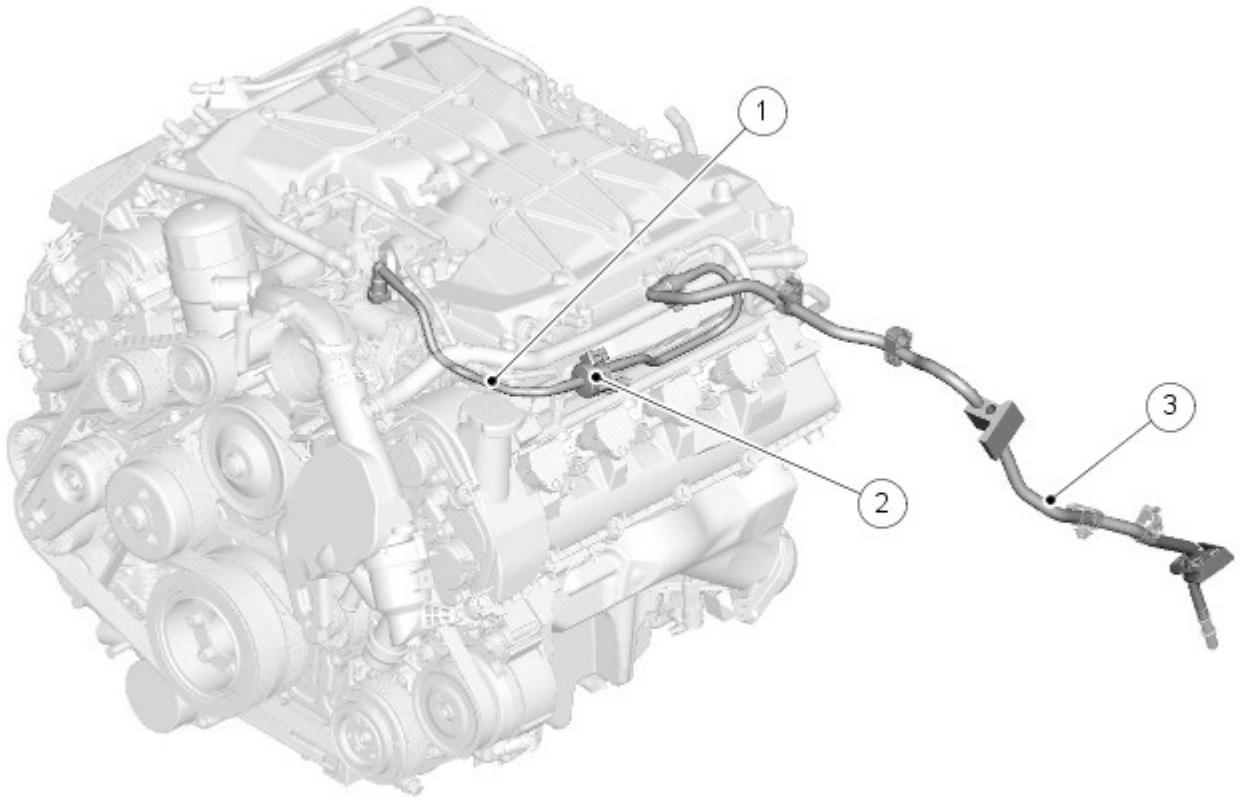
Diagnostic Module Tank Leakage - NAS Only

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.

The DMTL pump incorporates an electric air pump, a PTC (Positive Temperature Coefficient) heating element, a normally open changeover valve and a reference orifice. The DMTL pump is only operated when the ignition is switched off and is controlled by the ECM (Engine Control Module). The ECM also monitors operation of the air pump and the changeover valve for faults.

A connection with the ECM relay in the EJB (Engine Junction Box) supplies battery power to the DMTL pump. The ECM applies separate ground connections to operate the heater element, the air pump and the changeover valve individually, as required.

Purge Valve and Pipes



E153546

Item	Part Number	Description
1	-	Pipe to engine
2	-	Purge valve
3	-	Pipe from evaporative emissions canister

The purge valve is installed on a bracket attached to the left camshaft cover. The pipe to the engine from the purge valve is connected to the supercharger front cover, with a quick release connecter. The pipe to the evaporative emission canister from the purge valve is installed between the left camshaft cover and ignition coil cover, then goes down the rear of the left front suspension housing and along the underside of the vehicle and into the left rear wheel arch.

The purge valve is a solenoid operated valve, which is closed when de-energized. The valve is controlled by the ECM and is operated when engine operating conditions are suitable for purging of the evaporative emission 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 11% and 99% duty or mark space ratio (% open time).

Atmospheric pressure is higher than the pressure at the inlet of the intake supercharger under all throttle settings and engine running conditions. It is this pressure differential that causes air to flow through the EVAP system to the engine.

OPERATION

Purge Valve

The ECM waits until the engine is running above 40 °C (104 °F) coolant temperature, with closed loop fuel operational, before the purging process is activated. Under these conditions the engine should be running smoothly with no warm up enrichment. The purge valve duty (and flow) is initially ramped slowly because the vapor concentration is unknown and a sudden increase in purge could cause the engine to stall or loss of 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 air fuel ratio. 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 air fuel ratio control is maintained.

Diagnostic Module Tank Leakage - NAS Only

To check the fuel tank and the EVAP system for leaks, the ECM operates the DMTL air 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 changeover 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.

Providing there are no leaks, the air pump will begin to pressurize the EVAP system and the load and current draw of the air pump motor increases. By monitoring the rate and level of the current increase, the ECM can determine if there is a leak in the EVAP system.

During normal vehicle operation, 15 seconds after the engine has started, the ECM energizes the heating element in the pump to prevent condensation formation and possible incorrect readings. The heater remains energized until either the

engine and ignition are off (if no DMTL test is running) or until after the DMTL test is completed.

Leaks are classified as:

- Minor - equivalent to a hole diameter of 0.5 to 1.0 mm (0.02 to 0.04 in)
- Major - equivalent to hole diameter of 1.0 mm (0.04 in) or greater.

The ECM performs a check for major leaks each time the ignition is switched off, providing the following conditions are met:

- The vehicle speed is zero
- The engine speed is zero
- The pressure altitude (70 kPa (10.15 lbf/in^2) derived from engine load calculations) is below 3047 m (10000 feet)
- The ambient temperature is between 0 and 40 °C (32 and 104 °F)
- The evaporative emission canister vapor concentration factor is less than 3 (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 battery voltage is between 11 and 16 volts
- The last engine running time was more than 10 minutes (to ensure any moisture within the DMTL pump has been removed)
- During the last engine start the difference between engine coolant temperature and ambient air temperature was less than 7 °C (13 °F)
- No errors are detected with the EVAP system 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.

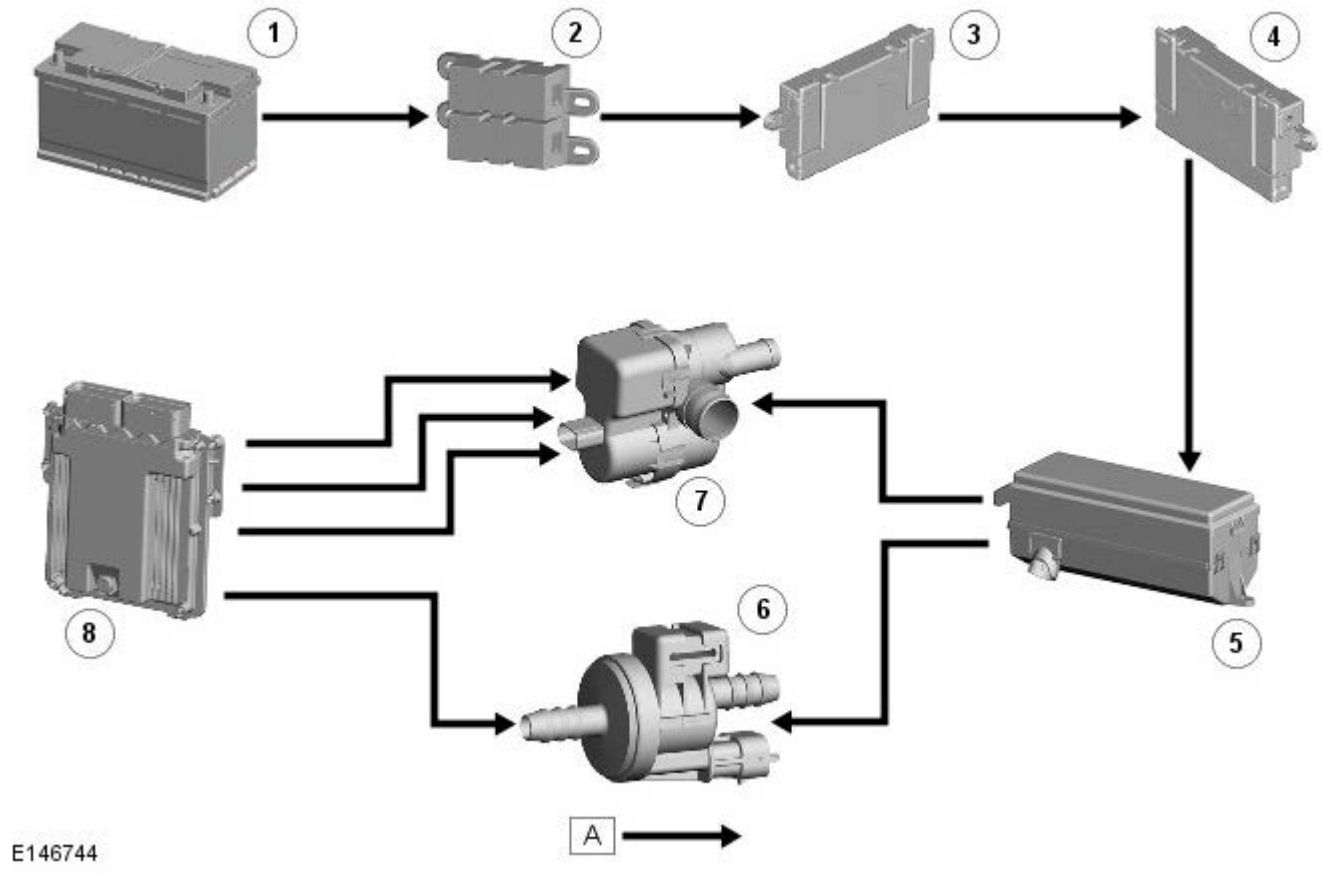
When the leak check is complete, the ECM stops the DMTL pump and opens (de-energizes) the changeover valve.

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 IC (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.

Control Diagram



A = Hardwired.

Item	Part Number	Description

1	-	Battery
2	-	Battery Junction Box 2 (BJB 2)
3	-	Battery Junction Box (BJB)
4	-	Auxiliary Junction Box (AJB)
5	-	Engine Junction Box (EJB)
6	-	Purge valve
7	-	DMTL pump (NAS only)
8	-	Engine Control Module (ECM)

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Evaporative Emissions - 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 (303-13A Evaporative Emissions - V6 S/C 3.0L 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

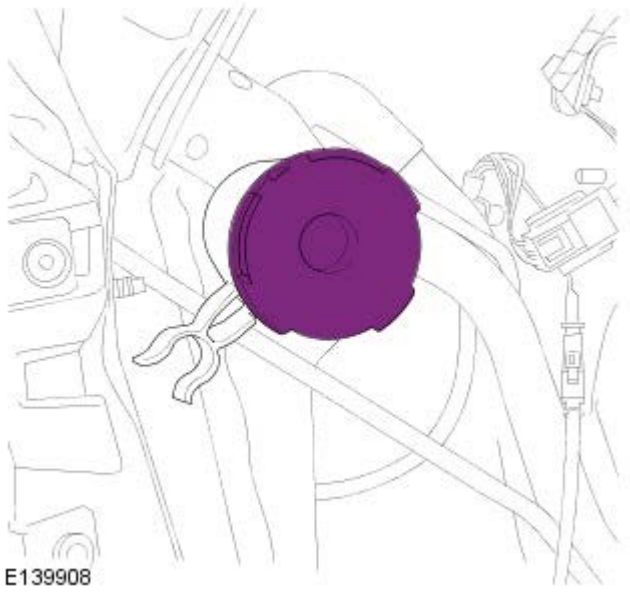
The list below provides some suggested actions to help trace the root cause of the fault

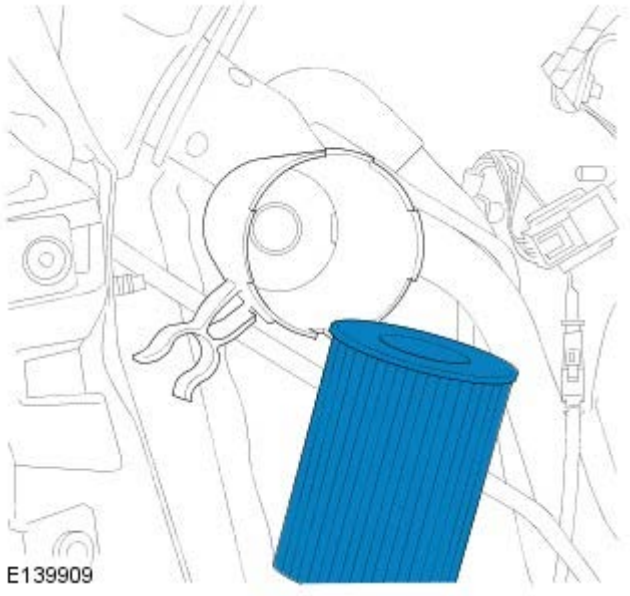
Each action should be followed up with a **Fuel Leak Check** forced test (and ranking value check) in order to determine if any improvement has been made

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-00	DMTL heater 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

P240C-00	DMTL heater electrical high	• 1. Check wiring • 2. Replace DMTL module

Pre and 10MY Denso/Bosch PCM Systems

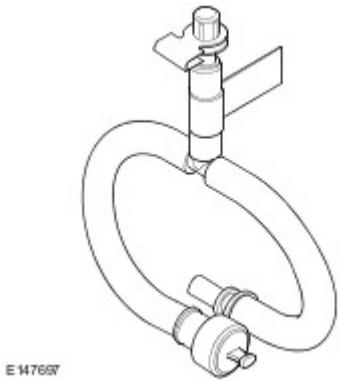




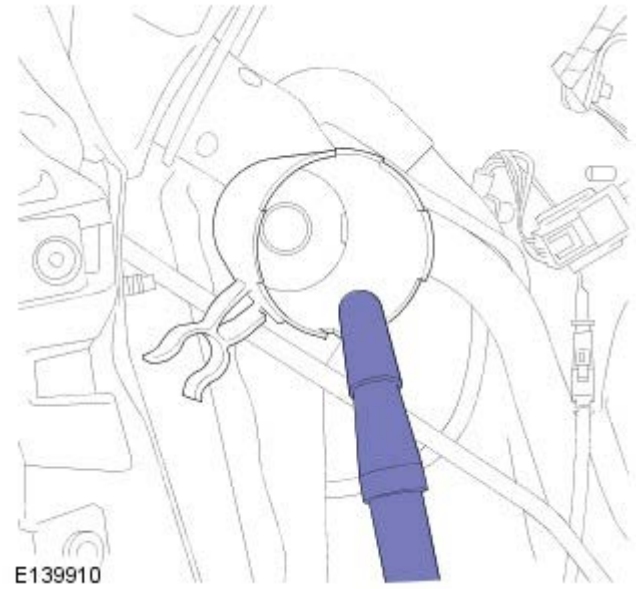
CAUTION: The Maximum pressure of the EVAP system is 0.07 bar **do not exceed**

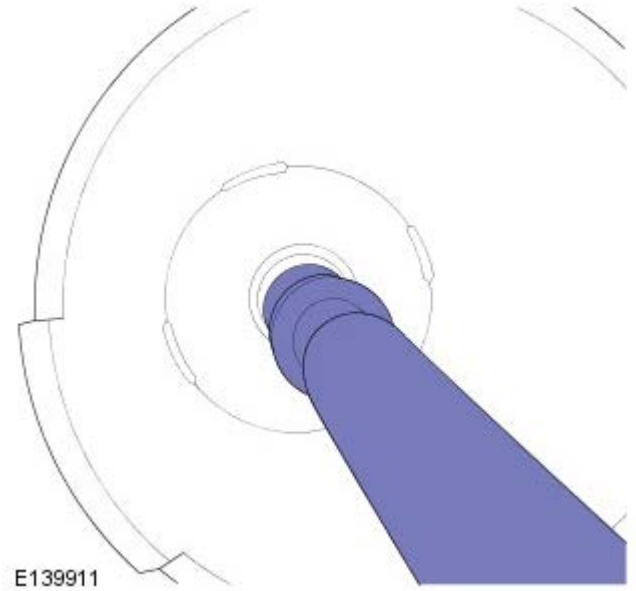
NOTE: Apart from the purge valve connection, it is recommended to smoke test the EVAP system without disturbing any joints associated with the system, this will determine the leak more accurately and quickly

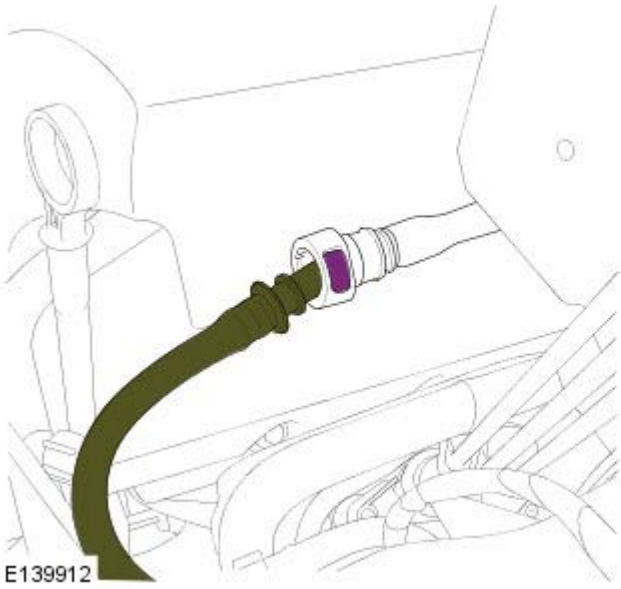
- 1. Remove rear wheel arch liner to access fuel filler neck
- 2. On the fuel filler neck the DMTL filter will be visible as shown in picture. Unclip filter housing from fuel filler neck to gain better access to DMTL filter
- 3. Remove carefully the top of filter to expose filter and remove
- 4. Attach rubber adapter to tip of smoke machine nozzle to ensure tight seal to filter housing. Disconnect the purge pipe from purge valve; this will be an escape point for the smoke to exit
- 5. Allow tester to complete self-test and green READY light to turn ON 2. For best Tester performance; completely unwind Tester's supply hose
- 6. Press **Smoke** on control panel to fill EVAP system with smoke vapour. The control panel **Smoke** light will light indicating smoke production. The smoke setting is on a 15 minute timer. Pressing the **Smoke** button again turns Tester off. It is normal for the flow meter ball, while in the smoke mode, not to be as steady as when it is in the **Test** mode. Note: The pressure gauge is active only after smoke cycle is complete
- 7. Continue introducing smoke into the EVAP System until the flow meter's ball stops descending and this assures the system test pressure is met and smoke will appear from the purge pipe, then close off purge pipe with special tool (Test Adapter Hose/EVAP Port 310-142)



NOTE: Special tool (Test Adapter Hose/EVAP Port 310-142)



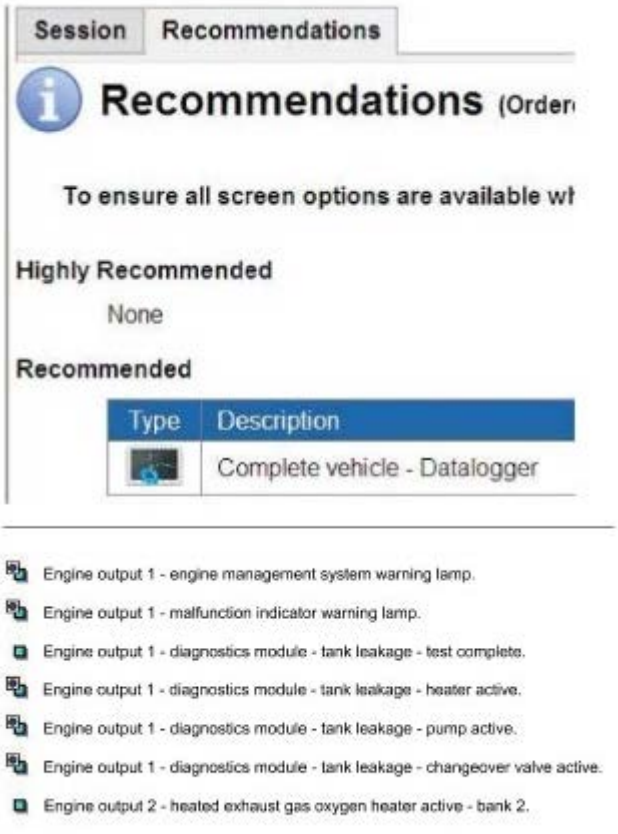




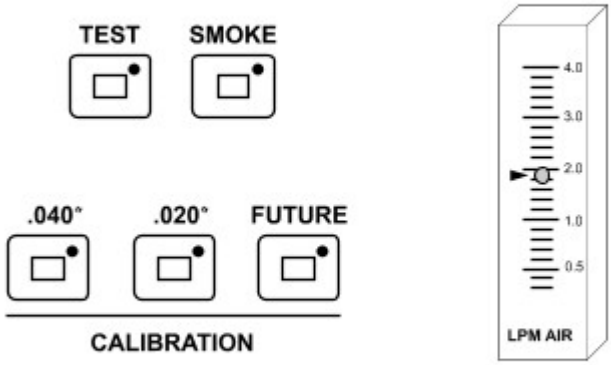
CAUTION: On some vehicles, the DMTL filter can not be removed, in these instances fill the system through the purge valve and smoke will appear from the filter

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

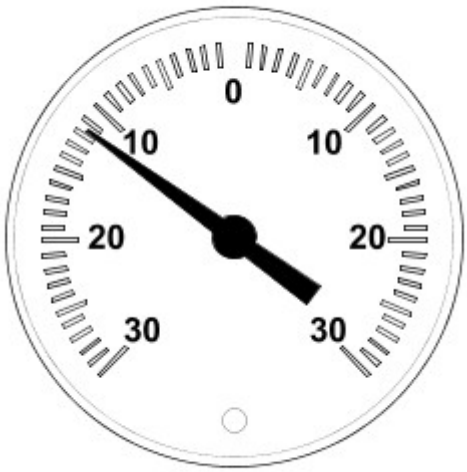
In addition to quantifying the leak with the Phase-One flow test, the Tester allows you the flexibility of testing the vehicle's EVAP system by using either **Pressure Decay** or **Vacuum Decay** methods. Below are instructions for performing both decay tests

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: 31-Jul-2012

Evaporative Emissions - V8 S/C 5.0L Petrol - Evaporative Emission Canister

Removal and Installation

Removal

CAUTION: Make sure that all openings are sealed. Use new blanking caps.

NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

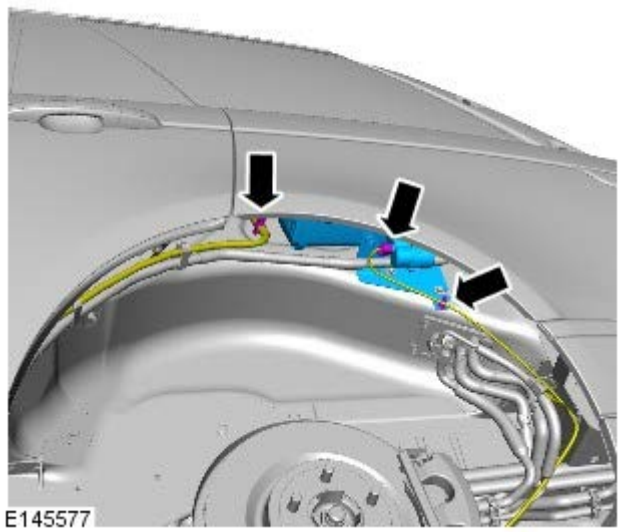
2. Refer to: Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions (100-00 General Information, Description and Operation).

3. WARNING: Make sure to support the vehicle with axle stands.

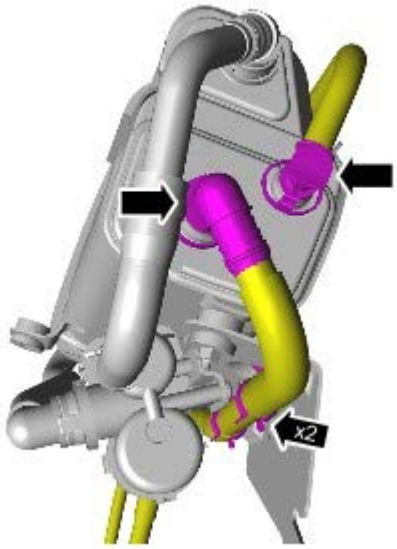
   Raise and support the vehicle.

4. Refer to: Rear Fender Splash Shield (501-08, Removal and Installation).

5.

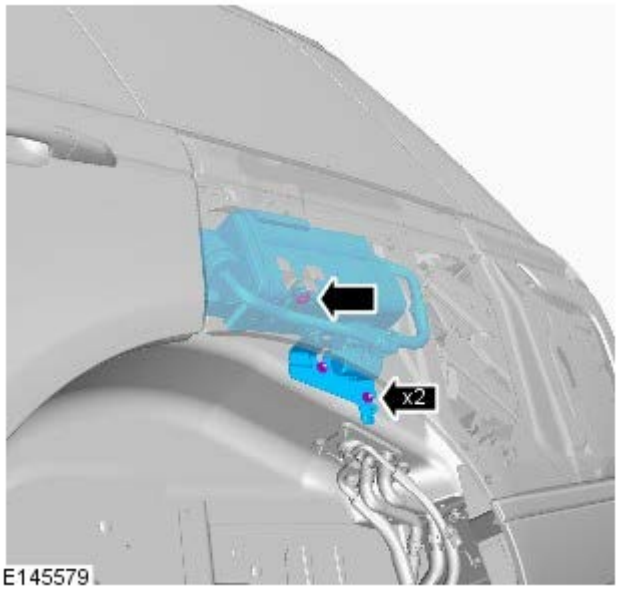


6.



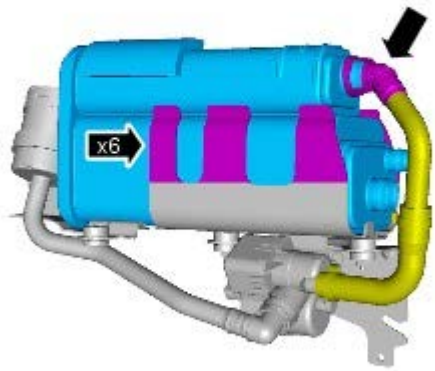
E145578

7. *Torque:* 9 Nm



E145579

8.



E145580

Installation

1. To install, reverse the removal procedure.

Published: 26-Sep-2012

Evaporative Emissions - V8 S/C 5.0L Petrol - Evaporative Emission Canister Purge Valve V8 S/C 5.0L Petrol

Removal and Installation

Removal

CAUTION: Make sure that all openings are sealed. Use new blanking caps.

NOTES:

Removal steps in this procedure may contain installation details.

Some illustrations may show the engine removed for clarity.

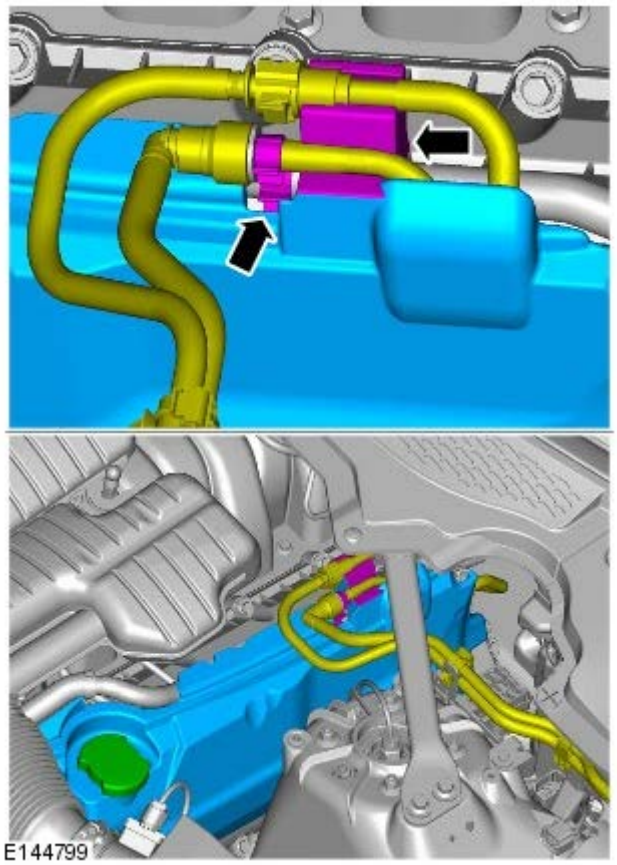
Some variation in the illustrations may occur, but the essential information is always correct.

1. Remove the battery ground cable.

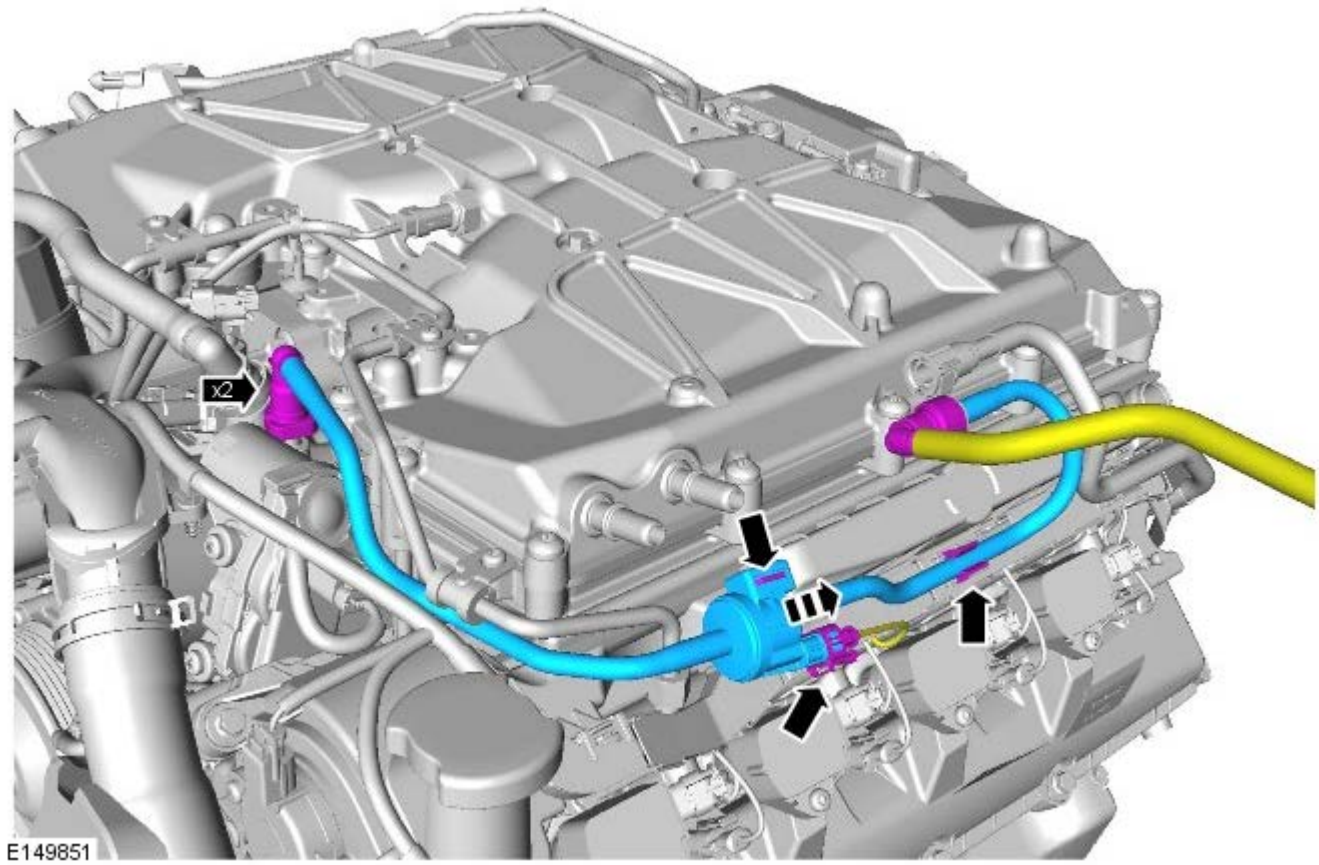
   Refer to: Specifications (414-00, Specifications).

2. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).

3.



4.



Installation

1. To install reverse the removal procedure.

Published: 13-Sep-2012

Electronic Engine Controls - TDV6 3.0L Diesel -

Torque Specification

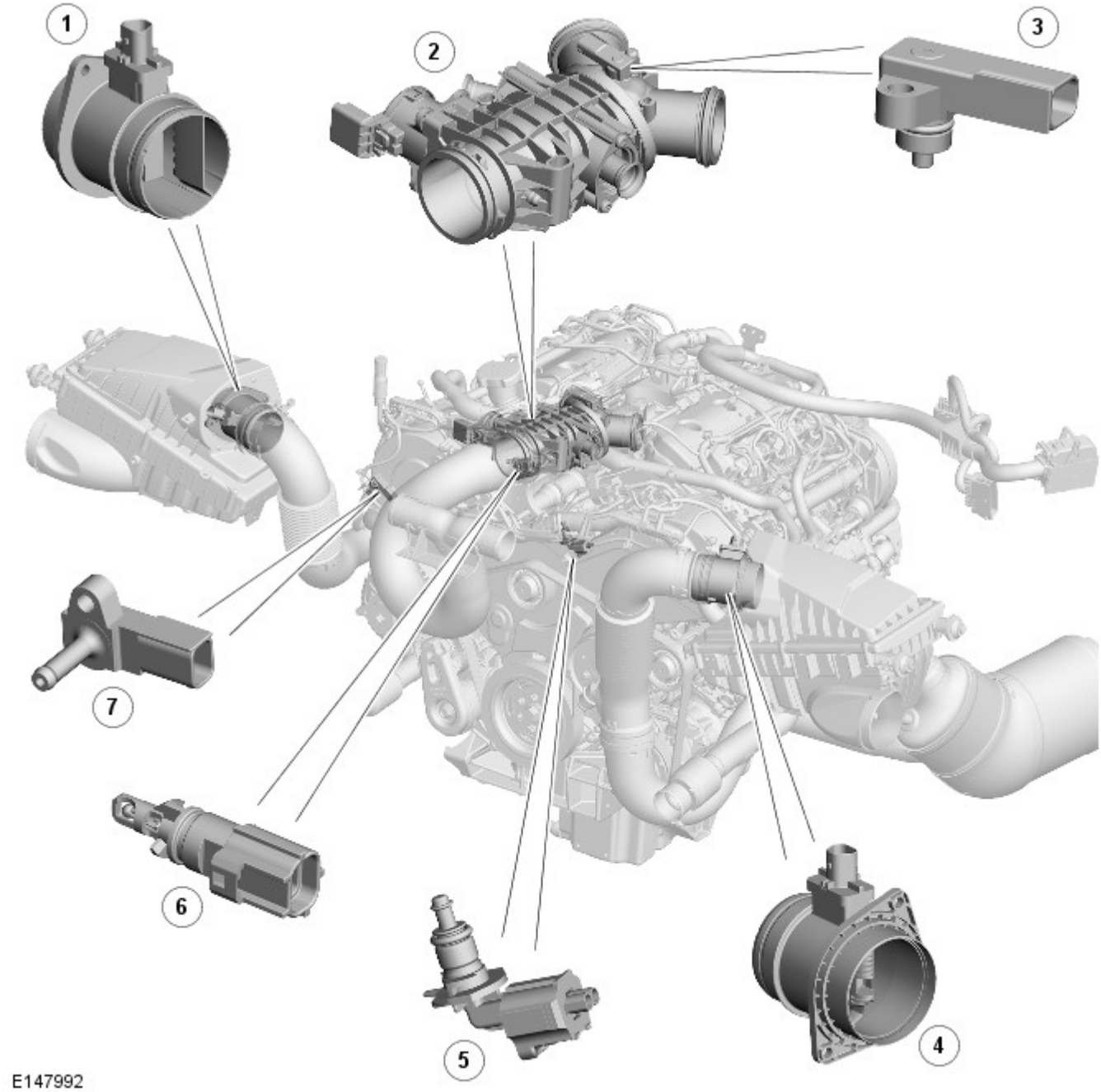
Description	Nm	lb-ft	lb-in
Camshaft position (CMP) sensor retaining bolt	10	7	-
Crankshaft position (CKP) sensor retaining bolt	5	-	44
Engine control module (ECM) retaining nuts	7	-	62
Engine oil pressure (EOP) sensor	14	11	-
Engine oil level sensor retaining bolts	12	9	-
Mass air flow (MAF) sensor	2	-	18
Manifold absolute pressure (MAP) sensor	3	-	27
Exhaust gas temperature sensor RH	35	26	-
Catalytic converter pre temperature sensor	35	26	-
Catalytic converter post temperature sensor	35	26	-
Diesel particulate filter (DPF) post exhaust gas temperature sensor	35	26	-
Heated oxygen sensor (HO2S)	48	35	-

Published: 14-May-2013

Electronic Engine Controls - TDV6 3.0L Diesel - Electronic Engine Controls

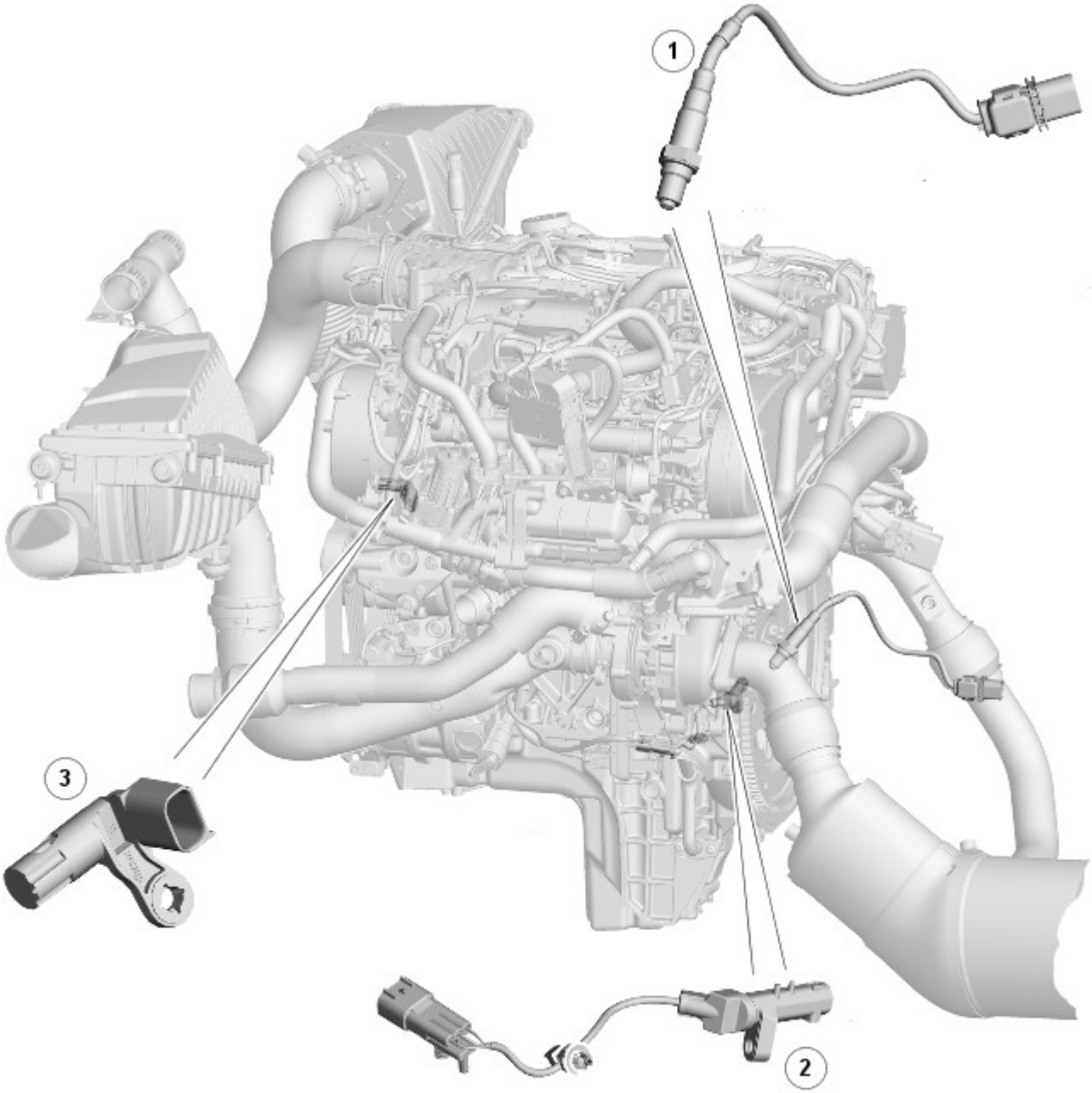
Description and Operation

COMPONENT LOCATION - SHEET 1 OF 3



Item	Part Number	Description
1	-	Mass Air Flow and Temperature (MAFT) sensor
2	-	Electric throttle
3	-	Manifold Absolute Pressure (MAP) sensor
4	-	Mass Air Flow (MAF) sensor
5	-	Engine Coolant Temperature (ECT) sensor
6	-	Charge air temperature sensor
7	-	Charge air pressure sensor

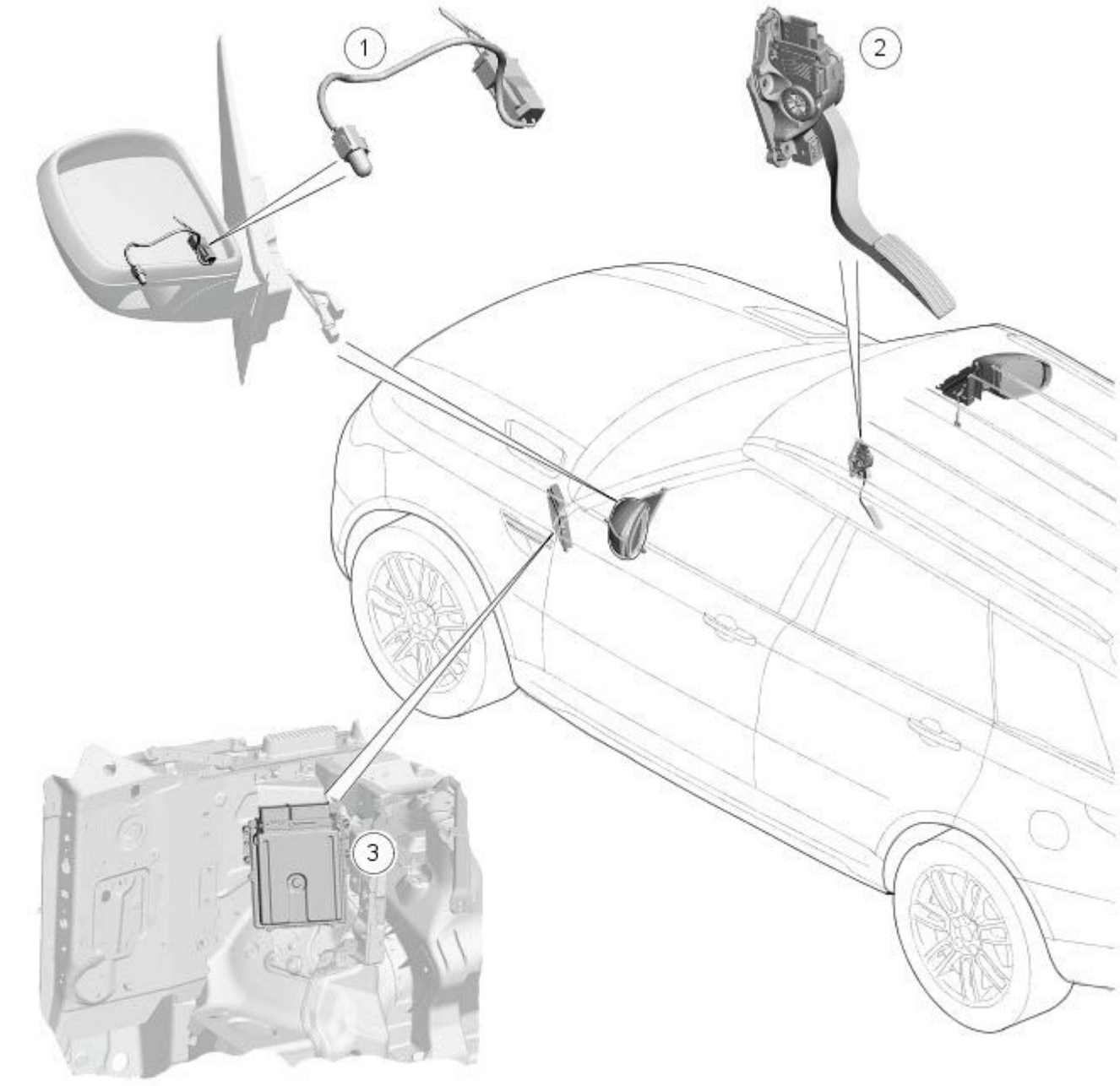
COMPONENT LOCATION - SHEET 2 OF 3



E147993

Item	Part Number	Description
1	-	Heated Oxygen Sensor (HO2S)
2	-	Crankshaft Position (CKP) sensor
3	-	Camshaft Position (CMP) sensor

COMPONENT LOCATION - SHEET 3 OF 3



E153662

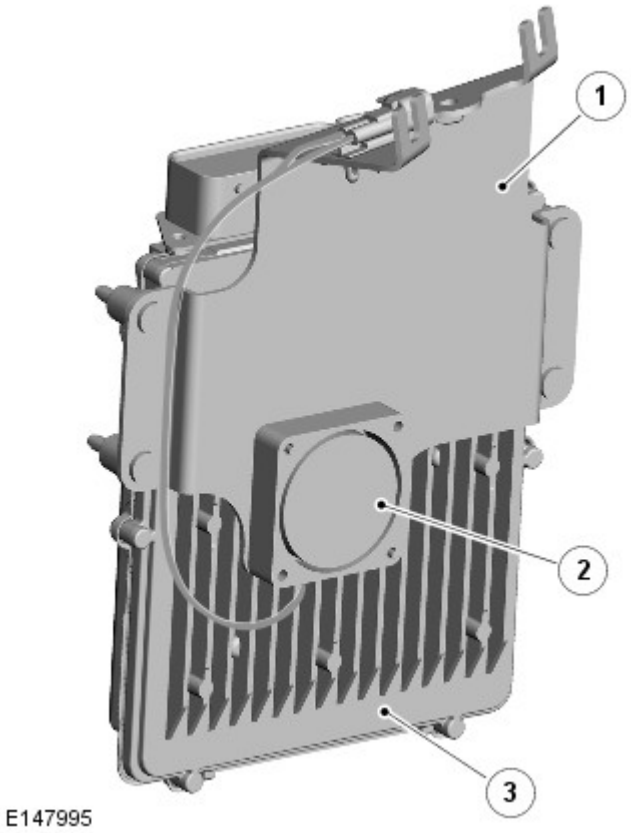
Item	Part Number	Description
1	-	Ambient Air Temperature (AAT) sensor
2	-	Accelerator Pedal Position (APP) sensor
3	-	Engine Control Module (ECM)

OVERVIEW

The TDV6 3.0L diesel engine has an ECM (Engine Control Module) controlled engine management system. The ECM uses multiple sensor inputs and precision control of actuators to achieve optimum performance during all driving conditions.

DESCRIPTION

Engine Control Module



E147995

Item	Part Number	Description
1	-	Upper bracket
2	-	Cooling fan
3	-	ECM

The ECM is installed in the rear left corner of the engine compartment, behind the secondary bulkhead panel. The ECM is attached to brackets on the wheel housing and the fender outer support panel.

In some markets, an electric cooling fan is attached to the upper bracket to prevent the ECM from overheating. The ECM controls the operation of the cooling fan using an internal temperature sensor. 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 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. 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 driveability, 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 (Controller Area Network) Powertrain bus to enable precise engine control under all vehicle operating conditions.

The ECM receives and processes information from the following input sources:

- CKP (Crankshaft Position) sensor.
- CMP (Camshaft Position) sensor.
- MAF (Mass Air Flow) sensor.
- MAFT (Mass Air Flow and Temperature) sensor.
- MAP (Manifold Absolute Pressure) sensor.

- Electric Throttle.
- ECT (Engine Coolant Temperature) sensor.
- APP (Accelerator Pedal Position) sensor.
- Charge air temperature sensor.
- Charge air pressure sensor.
- AAT (Ambient Air Temperature) sensor.
- HO2S (Heated Oxygen) sensor.
- The following brake system components:
  - ABS (Anti-lock brake system control module).
  - Brake pedal switch.
  - For additional information, refer to: Braking Control System (206-11 Brake Controls, Diagnosis and Testing).
  - Brake vacuum sensor (stop/start system vehicles only).
    For additional information, refer to: Brake Booster (206-07 Power Brake Actuation, Description and Operation).
- Oil level and temperature sensor.
  For additional information, refer to: Engine (303-01A Engine - TDV6 3.0L Diesel, Description and Operation).
- The following fuel system components:
  For additional information, refer to: Fuel Charging and Controls (303-04A Fuel Charging and Controls - TDV6 3.0L Diesel, Description and Operation).
  - FRP (Fuel Rail Pressure) sensor.
  - Fuel temperature sensor.
  - For additional information, refer to: Fuel Charging and Controls (303-04A Fuel Charging and Controls - TDV6 3.0L Diesel, Description and Operation).
- The following turbocharger system components:
  - VGT vane position sensor.
  - Turbine intake valve position sensor.
  - Turbine temperature sensor.
  - For additional information, refer to: Turbocharger (303-04B Fuel Charging and Controls - Turbocharger - SDV6 3.0L Diesel - Hybrid Electric Vehicle/TDV6 3.0L Diesel, Description and Operation).
- EGR (Exhaust Gas Recirculation) valve position sensors.
  For additional information, refer to: Engine Emission Control (303-08A Engine Emission Control - TDV6 3.0L Diesel, Description and Operation).
- Active grille air shutter actuator (where fitted).
  For additional information, refer to: Engine Cooling (303-03A Engine Cooling - TDV6 3.0L Diesel, Description and Operation).
- TCS (Transmission Control Switch).
  For additional information, refer to: External Controls (307-05A Automatic Transmission/Transaxle External Controls - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, Description and Operation).
- Terrain Response® switchpack.
  For additional information, refer to: Ride and Handling Optimization (204-06 Ride and Handling Optimization, Description and Operation).
- The following catalytic converter and DPF (Diesel Particulate Filter) system components (where fitted).
  - Turbine outlet temperature sensor.
  - Pre and post catalytic converter exhaust gas temperature sensors.
  - DPF outlet temperature sensor.
  - DPF differential pressure sensor.
  - For additional information, refer to: Exhaust System (309-00A Exhaust System - TDV6 3.0L Diesel, Description and Operation).
- Water in fuel sensor.
  For additional information, refer to: Fuel Tank and Lines (310-01A Fuel Tank and Lines - TDV6 3.0L Diesel, Description and Operation).
- ATCM (Automatic Temperature Contro Modulel).
  For additional information, refer to: Control Components (412-01A Climate Control, Description and Operation).
- RCM (Restraints Control Module).
  For additional information, refer to: Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) (501-20B Supplemental Restraint System, Description and Operation).

The ECM outputs controlling signals to the following sensors and actuators:

- Electric throttle motor.
- ECM cooling fan (where fitted).
- ABS control module.
  For additional information, refer to: Braking Control System (206-11 Brake Controls, Description and Operation).
- Active engine mount solenoid.
  For additional information, refer to: Engine (303-01A Engine - TDV6 3.0L Diesel, Description and Operation).
- The following cooling system components:
  - Engine cooling fans.
  - Active grille air shutter actuator (where fitted).
  - For additional information, refer to: Engine Cooling (303-03A Engine Cooling - TDV6 3.0L Diesel, Description and Operation).
- The following fuel system actuators:
  For additional information, refer to: Fuel Charging and Controls (303-04A Fuel Charging and Controls - TDV6 3.0L Diesel, Description and Operation).
  - Fuel injectors.
  - Fuel pressure control valve.
  - Fuel metering valve.
- The following turbocharger system components:
  - Charge air recirculation solenoid.
  - Charge air solenoid.
  - Turbine intake shut-off valve solenoid.

  - Variable geometry turbine vane actuator.
  - For additional information, refer to: Turbocharger (303-04B Fuel Charging and Controls - Turbocharger - SDV6 3.0L Diesel - Hybrid Electric Vehicle/TDV6 3.0L Diesel, Description and Operation).
- Starter motor.
  For additional information, refer to: Starting System (303-06A Starting System - TDV6 3.0L Diesel, Description and Operation).
- Glow plug control module.
  For additional information, refer to: Glow Plug System (303-07C Glow Plug System - TDV6 3.0L Diesel, Description and Operation).
- The following EGR system components:
  - EGR cooler bypass valve solenoid.
  - EGR valve motors.
  - For additional information, refer to: Engine Emission Control (303-08A Engine Emission Control - TDV6 3.0L Diesel, Description and Operation).
- TCM (Transmission Control Module).
  For additional information, refer to: Transmission Description (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, Description and Operation).
- ATCM (Automatic Temperature Control Module).
- IC (Instrument Cluster).
  For additional information, refer to: Instrument Cluster (413-01 Instrument Cluster, Description and Operation).

Crankshaft Position Sensor



The CKP sensor is located on the left side of the crankshaft rear oil seal. The sensor lead passes through a cover in the side of the cylinder block. The sensor tip is aligned with a reluctor ring on the rear flange of the crankshaft. 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 reluctor ring.

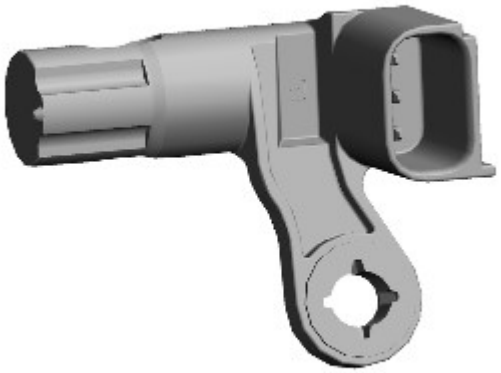
The reluctor ring has a 60 minus 2 pole pattern. The missing poles provide a reference point for the angular position of the crankshaft. When the space with the two missing poles passes the sensor tip, a gap in the signal is produced which the ECM uses to determine the crankshaft position.

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 Powertrain bus for use by other systems.

The CKP sensor receives a 5V supply from the ECM. Two further connections to the ECM provide ground and signal output.

Camshaft Position Sensor



E138807

The CMP sensor is located on the front face of the left cylinder head. The sensor tip protrudes through an aperture in the front face of the cylinder head to pick up on a reluctor ring behind the camshaft pulley.

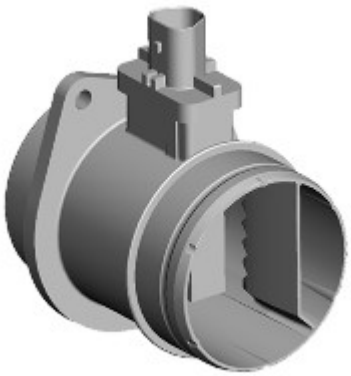
The CMP sensor is a Hall effect sensor which is used by the ECM at engine start-up to synchronize the ECM with the CKP sensor signal. The ECM does this by using the CMP sensor signal to identify the stroke of the piston in No. 1 cylinder to ensure the correct injector timing. Once the ECM has established 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 charge air pressure control. Once the engine is switched off, the engine will crank but will not restart while the fault is present.

Mass Air Flow / Mass Air Flow and Temperature Sensor



E147996

Identical MAFT sensors are attached to the air cleaner outlets, but only the MAFT sensor attached to the right air cleaner provides both mass air flow and temperature signals for the ECM. The engine harness connection with MAF sensor of the left air cleaner is wired so that only the mass air flow signal is connected to the ECM.

The MAF and MAFT sensors work on the hot film principle. The output of sensors 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 signals are also used as a feedback for the EGR system.

The temperature sensor in the right MAFT sensor is a NTC (Negative Temperature Coefficient) thermistor in a voltage divider circuit. Using the voltage output from the temperature sensor, the ECM can correct the fueling map for intake air temperature.

The MAFT sensors receive a 12V supply from the ECM relay in the EJB and a ground connection via the ECM. Separate connections to the ECM are provided for the two mass air flow signals and the temperature signal.

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 charge air pressure, ambient air pressure and ambient air

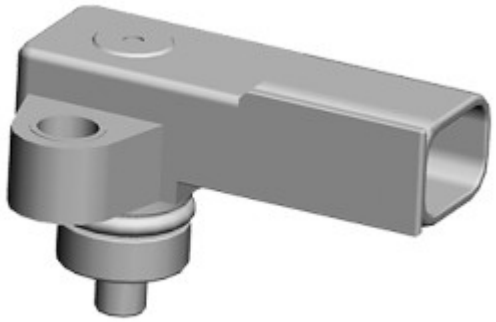
temperature.

If one of the mass air flow sensors fails the ECM implements the default strategy based on engine speed. In the event of a mass air flow sensor signal failure, the following symptoms may be observed:

- EGR system off.
- Delayed engine response.
- Reduced engine performance.

If the temperature sensor fails the ECM uses a default intake air temperature of 40°Celsius (104°F). In the event of a temperature sensor failure, under fueling, resulting in reduced engine performance, may be observed.

Manifold Absolute Pressure Sensor



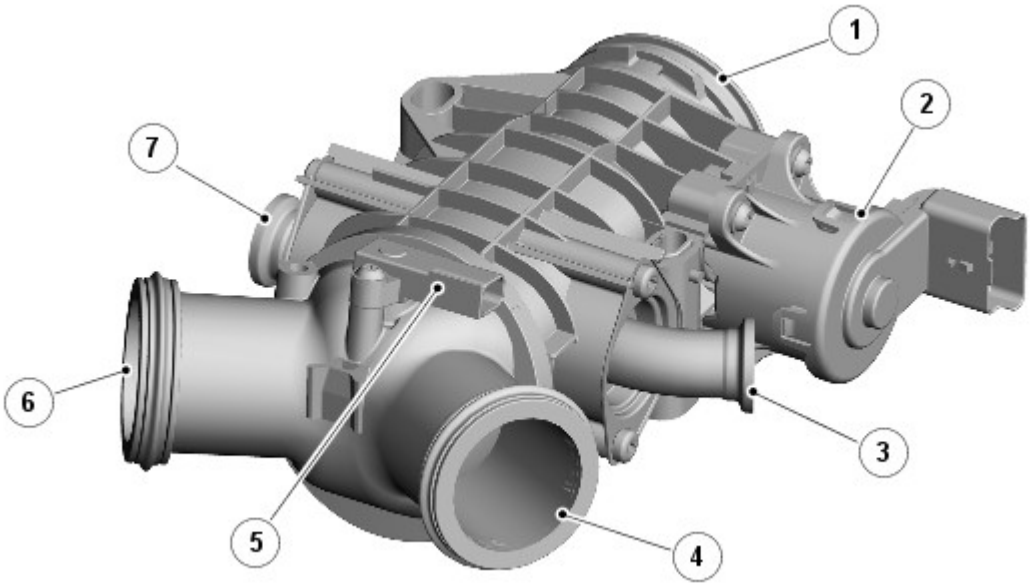
E123688

The MAP sensor is installed in the outlet of the electric throttle, to measure the pressure of the air entering the intake manifolds. 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 signal is used in conjunction with the mass air flow sensor signals 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 and MAFT sensor signals as a substitute.

Electric Throttle



E144246

Item	Part Number	Description
1	-	Air intake
2	-	Electric motor
3	-	Right EGR (Exhaust Gas Recirculation) pipe connection
4	-	Right intake manifold connection
5	-	Manifold Absolute Pressure (MAP) sensor
6	-	Left intake manifold connection
7	-	Left EGR pipe connection

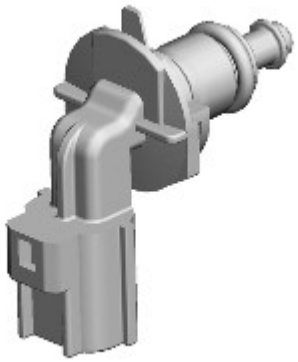
The electric throttle is installed at the front of the engine, between the cylinder heads. The throttle plate is operated by a DC (Dirrect Current) electric motor attached to the throttle body. The motor is controlled by the ECM, which operates the motor in response to driver inputs from the APP (Acceleration Pedal Position) sensor and other engine related sensors to

provide the correct air flow to the intake manifolds.

The ECM has five connections with the electric throttle motor:

- A ground and two 12V feeds to operate the motor in each direction to open or close the throttle plate.
- A 5V reference connection and a signal connection with the TPS (Throttle Position) sensor in the motor, for closed loop control.

Engine Coolant Temperature Sensor



E108397

The ECT sensor is located in the EGR cooler intake hose, at the front of the engine. 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 IC (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 Comfort, or high speed CAN Powertrain bus by the IC for use by other systems.

The ECT sensor circuit consists of an internal voltage divider circuit which incorporates an NTC thermistor. The ECM compares the signal voltage to stored values and adjusts fuel delivery to ensure optimum driveability at all times.

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°C (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.

Accelerator Pedal Position Sensor

NOTE: LHD pedal shown.



E141165

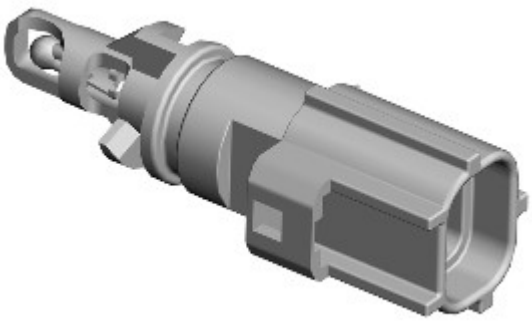
The APP sensor allows the ECM to determine the driver requests for vehicle speed, acceleration and deceleration. The ECM uses this information to determine the torque demand from the engine via injection control.

The APP sensor consists of a twin track rotary potentiometer integrated into the mounting bracket of the accelerator pedal. 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 rev/min to allow the vehicle to move. Torque application and reduction of engine speed back to normal idle speed can be subsequently controlled via brake pedal switch operation.

The ECM constantly checks the range and plausibility of the two signals and stores a fault code if it detects a fault.

Charge Air Temperature Sensor



E148012

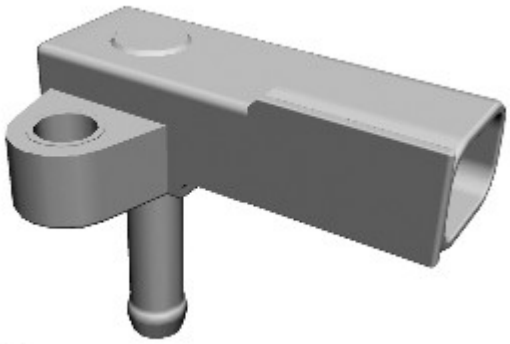
The charge air temperature sensor is located in the charge air duct connection with the electric throttle. The sensor is used to measure the intake air temperature from the turbochargers in order to calculate the required amount of fueling.

The charge air temperature sensor incorporates a NTC thermistor in a voltage divider circuit. The sensor receives a 3.3V reference voltage from the ECM. Using the voltage output from the charge air temperature sensor, the ECM can correct the fueling map for charge air temperature.

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 in black smoke emitting from the exhaust.
- Idle speed control inoperative.

Charge Air Pressure Sensor



E131040

The charge air pressure sensor is located on a bracket attached to the right side of the primary drive cover. The sensor is connected via a hose to the charge air outlet pipe from the fixed vane turbocharger compressor.

The charge air pressure sensor provides a voltage signal to the ECM relative to the output charge air pressure from the fixed vane turbocharger. The 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 charge air pressure sensor uses a diaphragm transducer to measure pressure. The ECM uses the sensor signal for the following functions:

- Maintain manifold charge air pressure.
- Reduce exhaust smoke emissions when driving at high altitude.
- Control of the EGR system.
- To help smooth the transition between mono turbocharger and bi-turbocharger operation.
- To aid the air path diagnostics.

Ambient Air Temperature Sensor



E116093

The AAT 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 Powertrain bus for use by other control modules.

The AAT sensor is installed in the left exterior mirror, with the bulb of the sensor positioned over a hole in the bottom of the mirror casing.

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 sensor. If the AAT sensor and the temperature input of the MAFT sensor are both faulty, the ECM adopts a default ambient temperature of 20 °C (68 °F).

Heated Oxygen Sensor



The HO2S is a wide band type oxygen sensor that allows the ECM to provide closed loop control of the air fuel mixture. The sensor is installed in the left downpipe of the exhaust system, immediately after the connection with the VGT (variable geometry turbine) turbocharger outlet.

Power for the heater element of the HO2S is provided by a battery voltage supply from the ECM relay in the EJB. The circuit through the heater element is completed by a connection with the ECM. The ECM regulates the current flow through the heater element to control the heating of the sensor. The heater element is operated immediately after each engine start and during low load conditions when the temperature of the exhaust gases is insufficient to maintain the required sensor temperature.

The HO2S has four further connections with the ECM, two for the Nernst (oxygen measuring) cell and two for the pump cell. The ECM adjusts the current of the pump cell circuit as necessary to maintain a constant signal from the oxygen measuring cell. The ECM then relates the current of the pump cell circuit to the lambda ratio of the exhaust gases.

If the HO2S fails the ECM defaults to open loop fueling and the emissions content of the exhaust gases increases. With a failed HO2S, the engine will suffer from unstable operation and reduced performance.

Exhaust gas temperature sensors



E153664

Four temperature sensors are used in the DPF system in the following location:

- Pre-DPF Temperature Sensor
- Pre-Catalyst Temperature Sensor (adjacent to the HO2S)
- Post-Catalyst Temperature Sensor
- Post-DPF Temperature Sensor

The pre-sensors measure the temperature of exhaust gas exiting the turbocharger and before it passes through the catalyst converter and DPF, provides the information needed to calculate the DPF temperature. The post-catalyst and post-DPF temperature sensors provide the ECM with temperature signal, which is used as feedback for the ECM, from the actual exhaust gas temperature after the catalyst converter, and DPF. The information is used, in conjunction with other data, to estimate the amount of accumulated particulates and to control the DPF temperature.
For additional information, refer to: Diesel Particulate Filter (309-00A Exhaust System - TDV6 3.0L Diesel, Description and Operation) /
Diesel Particulate Filter (309-00A Exhaust System - TDV6 3.0L Diesel, Description and Operation).

OPERATION

The TDV6 3.0L diesel engine management system is controlled by the ECM and is able to monitor, adapt and precisely control the fuel injection and electric throttle. The ECM uses multiple sensor inputs and precision control of actuators to achieve optimum performance during all driving conditions.

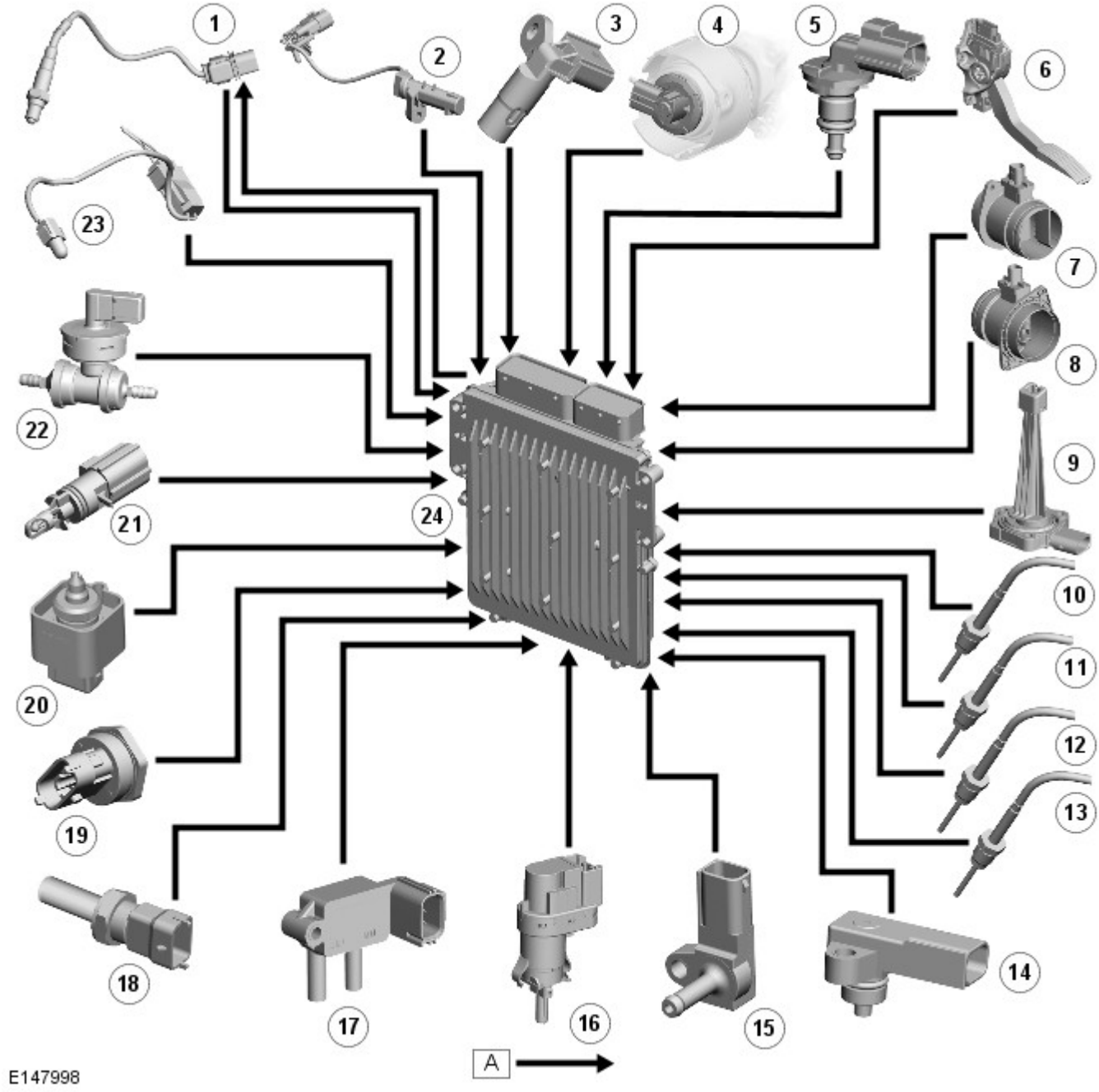
The ECM controls fuel delivery to all six cylinders via a common rail injection system. The common rail system uses a fuel rail to accumulate highly pressurized fuel and feed the six, electronically controlled injectors. The fuel rail is located in close proximity to the injectors, which assists in maintaining 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 the 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.

Control Diagram - Sheet 1 of 2

NOTE: A = Hardwired.



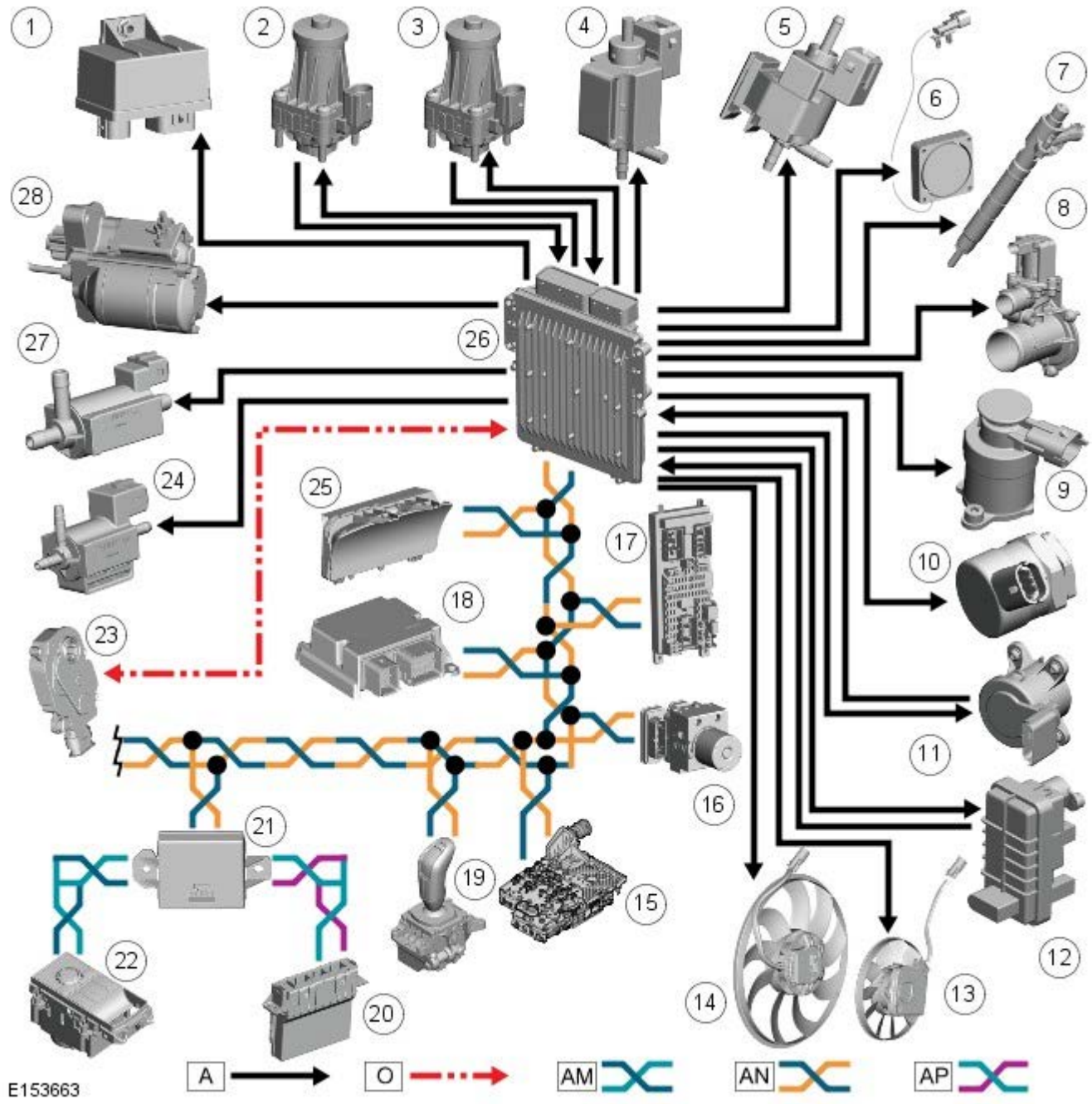
A = Hardwired.

Item	Part Number	Description
1	-	Heated Oxygen (HO2S) sensor
2	-	Crankshaft Position (CKP) sensor
3	-	Camshaft Position (CMP) sensor
4	-	Turbine intake valve position sensor
5	-	Engine Coolant Temperature (ECT) sensor
6	-	Accelerator Pedal Position (APP) sensor
7	-	Mass Air Flow and Temperature (MAFT) sensor
8	-	Mass Air Flow (MAF) sensor
9	-	Oil level and temperature sensor
10	-	Pre catalyst converter exhaust gas temperature sensor (where fitted)
11	-	Post catalyst converter exhaust gas temperature sensor (where fitted)
12	-	Pre DPF exhaust gas temperature sensor (where fitted)
13	-	Post DPF exhaust gas temperature sensor (where fitted)

14	-	Manifold Absolute Pressure (MAP) sensor
15	-	Charge air pressure sensor
16	-	Brake pedal switch
17	-	Differential pressure sensor
18	-	Fuel temperature sensor
19	-	Fuel Rail Pressure (FRP) sensor
20	-	Water in fuel sensor
21	-	Charge air temperature sensor
22	-	Brake vacuum sensor
23	-	Ambient Air Temperature (AAT) sensor
24	-	Engine Control Module (ECM)

Control Diagram - Sheet 2 of 2

NOTE: A = Hardwired, O = LIN (Local Interconnect Network) bus, AM = High speed CAN (Controller Area Network) Chassis bus, AN = High speed CAN Powertrain bus, AP = Medium speed CAN Comfort bus.



Item	Part Number	Description
1	-	Glow plug control module
2	-	Left Exhaust Gas Recirculation (EGR) valve
3	-	Right EGR valve
4	-	EGR cooler bypass valve solenoid
5	-	Engine mount solenoid

6	-	Engine control module cooling fan (where fitted)
7	-	Fuel injector (6 off)
8	-	Charge air recirculation solenoid
9	-	Fuel metering valve
10	-	Fuel pressure control valve
11	-	Electric throttle motor
12	-	Variable geometry turbine vane actuator
13	-	Engine cooling fan 2 (where fitted)
14	-	Engine cooling fan 1
15	-	Transmission Control Module (TCM)
16	-	Anti-lock Brake System (ABS) control module
17	-	Central Junction Box (CJB)
18	-	Restraints Control Module (RCM)
19	-	Transmission Control Switch (TCS)
20	-	Automatic Temperature Control Module (ATCM)
21	-	Gateway Module (GWM)
22	-	Terrain Response® switchpack
23	-	Active grille air shutter actuator (where fitted)
24	-	Turbine intake shut-off valve solenoid
25	-	Instrument Cluster (IC)
26	-	Engine Control Module (ECM)
27	-	Charge air solenoid
28	-	Starter motor

Published: 31-Jul-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: Electronic Engine Controls (303-14A Electronic Engine Controls - TDV6 3.0L Diesel, Description and Operation).

Inspection and Verification

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

Place the vehicle in a well ventilated, quarantined, area and arrange "No Smoking/Fuel Fumes" signs about the vehicle

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 carry out any repairs to the fuel injection system with the engine running. The fuel pressure within the system can be as high as 2000 bar. 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 vapours are always present and may ignite. Failure to follow these instructions 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 medical attention

Wash hands thoroughly after handling fuel, 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 fit blanking plugs to any open orifices or lines

Always carry out the cleaning process before carrying out any repairs to the fuel injection system components. Failure to follow these instructions may result in foreign matter ingress to the fuel injection system

Do not disconnect an injector wiring connector when the engine is running. The fuel injectors are operated by piezo elements controlled by an electrical signal, they can latch open if disconnected when the engine is running. Failure to observe this caution may result in severe engine damage

The low pressure fuel system bleeding procedure must be carried out before this procedure is carried out, or the engine is attempted to be started, following removal or replacement of any low pressure fuel system component. Failure to follow this instruction may result in damage to the fuel injection pump

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

NOTES:

 Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests

 If the module or a component is suspect and the vehicle remains under the Manufacturers warranty, refer to the Warranty Policy and Procedure manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component

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 • Air ingress into fuel system • Fuel filter • Front end accessory drive belt • Air filter and induction hoses • Boost air circuit and intercooler • Exhaust system including oxidation catalyst and particulate filter • Primary turbocharger vane control linkage	• Battery charge and condition • Fuses • Wiring harness • Electrical connector(s) • Sensor(s) • Actuator(s) • Engine control module • Transmission 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.

Symptom Chart

Symptom	Possible Causes	Action
Engine does not crank	• Battery discharged/charging fault • Starting system fault/power distribution fault • Security system/immobilizer engaged • Engine control module relay • Transmission control switch • Pedal switch fault • Engine seized/hydraulically locked	Refer to the owner literature and ensure that the correct start up procedure is being adhered to. Refer to the battery care manual, ensure the vehicle battery is in fully charged and serviceable condition. Check battery cables are correctly connected. Check high current power distribution fusible links are in serviceable condition. Check for DTCs and refer to the relevant DTC index. Check that the security system/immobilizer is disarmed. Check transmission control switch and pedal switches to ensure starter operation is not being inhibited. Check the engine is not seized or hydraulically locked
Engine cranks, but does not start	• The common 5 volt sensor power to both crankshaft position sensor and camshaft position sensor is missing • Battery discharged, starter circuit or motor fault • Low/contaminated fuel • Air leakage • Fuel system low pressure circuit fault • Fuel pump module fault • Blocked fuel filter • Fuel volume control valve blocked/contaminated • Fuel pressure control valve blocked/contaminated • Fuel injection pump failure	Check the 5 volt sensor power is present at both crankshaft position sensor and camshaft position sensor. Refer to the battery care manual and the workshop manual, check that the battery is fully charged and serviceable. Check that the cranking speed is within specification. Investigate and repair start and charge faults as required. Check that the fuel level is sufficient and that the fuel is not contaminated. Check the fuel pump module operation, check the fuel system low pressure circuit for leaks/damage/air ingress. Check the fuel filter for water, blockage. Check the fuel volume control valve and fuel pressure control valve. Check the fuel injection high pressure pump. Check the integrity of the air intake system and boost air circuit for correct installation. Check the crankshaft position sensor and circuits. In cold conditions with no indications of combustion when cranking, check the glow plug circuits. Refer to the new module/component installation note at the top of the document if an engine control module is suspect

	• Crankshaft position sensor • Engine control module fault	
Engine stops, will crank, but will not start, no DTCs logged in the engine control module	• The common 5 volt sensor power to both crankshaft position sensor and camshaft position sensor is missing	Check the 5 volt sensor power is present at both crankshaft position sensor and camshaft position sensor
Difficult to start	• Glow plug system fault (cold engine start) • Low/contaminated fuel • Air leakage • Fuel pump module fault • Fuel system low-pressure circuit delivery fault • Blocked fuel filter • Fuel volume control valve blocked/contaminated • Fuel pressure control valve blocked/contaminated • Exhaust gas recirculation valve(s) fault	If the fault is related to cold starts only, check the glow plugs and associated circuits first. Check the fuel level/possibility of contamination. Check the integrity of the air intake system and for correct installation. Check the fuel pump module operation, check the fuel system low pressure circuit for leaks/damage. Check the fuel filter, fuel volume control valve and fuel pressure control valve. Check the exhaust gas recirculation system valves/actuators
Rough idle	• Intake air system fault • Glow plug system fault (cold engine start) • Low/contaminated fuel • Air ingress into fuel system low pressure circuit • Fuel system low-pressure circuit delivery fault • Blocked fuel filter • Fuel volume control valve blocked/contaminated • Fuel pressure control valve blocked/contaminated • Exhaust gas recirculation valve(s) fault • Exhaust gas recirculation electric throttle valve fault	Check the intake air system for leaks. If the rough idle is from cold, and improves as the engine warms up, check the glow plug system is operating correctly on all cylinders. Check the fuel level/condition. Check the fuel system low pressure circuit for leaks/damage. Check the fuel filter, Fuel volume control valve and fuel pressure control valve. Check the integrity of the air intake system and for correct installation. Check the exhaust gas recirculation system valves/actuators
Lack of power when accelerating	• Low fuel level (simulated misfire mode) • Fuel level sender fault • Blocked fuel filter • Low fuel pressure • Blocked air filter • Air intake system fault • Boost air circuit leak or blockage • Restricted exhaust system • Diesel particulate filter	Check the fuel system for level/contamination/drain water from filter. Validate fuel level sender reading against actual tank contents. Check fuel filter for blockage. Check the fuel pressure. Check the integrity of the air intake system and for correct installation. Check for a blocked diesel particulate filter or catalytic converter, Check the exhaust gas recirculation system. Check the turbochargers for operation including all valves/actuators used to control mono-turbo and bi-turbo mode transitions

	blocked/restricted • Exhaust gas recirculation valve(s) fault • Exhaust gas recirculation electric throttle valve fault • Primary fixed geometry turbocharger fault • Secondary variable geometry turbocharger fault • Turbine shut off valve fault • Compressor recirculation valve fault • Compressor shut off valve fault	
Engine stops/stalls	• Fuel level low (in run dry mode) • Fuel level sender fault • Contaminated fuel • Air ingress into fuel system • Fuel system low pressure circuit fault • Fuel volume control valve blocked/contaminated • Fuel pressure control valve blocked/contaminated • High pressure fuel leak • Exhaust gas recirculation valve(s) fault • Exhaust gas recirculation electric throttle valve fault	Check the fuel level/condition/drain water from filter. Validate fuel level sender reading against actual tank contents. Check the fuel system low pressure circuit for leaks/damage. Check for fuel system leaks, fuel volume control valve and fuel pressure control Valve. Check the exhaust gas recirculation system
Engine judders	• Low fuel level (in torque derate mode) • Fuel level sender fault • Contaminated fuel • Fuel filter blocked • Air ingress into fuel system • Fuel system low pressure circuit fault • Fuel volume control valve blocked/contaminated • Fuel pressure control valve blocked/contaminated • High pressure fuel leak • Fuel injection pump fault • Injector fault	Check the fuel level/condition/drain water from filter and check for blockage. Validate fuel level sender reading against actual tank contents. Check the fuel system low pressure circuit for leaks/damage. Check for fuel system leaks, fuel volume control valve and fuel pressure control valve. Check the fuel injection high pressure pump. Check fuel injector(s)
Excessive fuel consumption	• Tire pressures are incorrect • Vehicle brakes are binding/not releasing • Fuel system leak • Fuel system low pressure circuit fault • Fuel volume control valve blocked/contaminated • Fuel pressure control valve blocked/contaminated	Check and adjust tire pressures. Check brakes are releasing correctly and do not cause excessive drag. Check the fuel system for obvious leaks/damage. Check the fuel volume control valve and fuel pressure control valve. Check for injector DTCs. Check for restricted induction system and air filter. Check the exhaust gas recirculation system including electric throttle plate. Check boost air circuit and intercooler for ineffective cooling or partial blockage. Check for restricted exhaust flow including catalytic converter and diesel particulate filter

	Fuel temperature sensor leak • High pressure fuel leak • Injector(s) failure • Exhaust gas recirculation valve(s) fault • Exhaust gas recirculation electric throttle valve 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-Dec-2013

Electronic Engine Controls - TDV6 3.0L Diesel - Brake Pedal Position (BPP) Switch Adjustment

General Procedures

Check

1. Remove the brake pedal rubber.



2. NOTE: Make sure that the dial test indicator (DTI) gauge is in line with the brake pedal movement.

   Position the DTI gauge on a suitable mounting block, as illustrated.

3. With the aid of another technician, gently press the brake pedal until the stop lamps illuminate.

4. NOTE: The specification is that the stop lamps should illuminate at between 5.5mm and 8.5mm brake pedal travel.

   Note the measurement of the brake pedal travel from rest position until the stop lamps illuminated.

Adjust

NOTE: The Brake Pedal Position Switch is self adjusting when removed and installed.

1. Remove and install Brake Pedal Position Switch.
   For additional information, refer to: Stoplamp Switch (417-01 Exterior Lighting, Removal and Installation).

2. Check the adjustment of the stop lamp switch by following the **Check** procedure in this procedure and carry out the **Adjust** procedure if required.

Published: 31-Jul-2012

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.

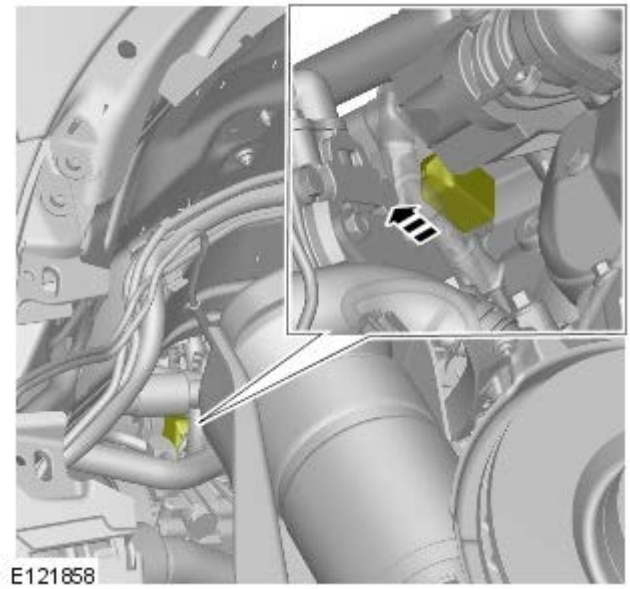
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

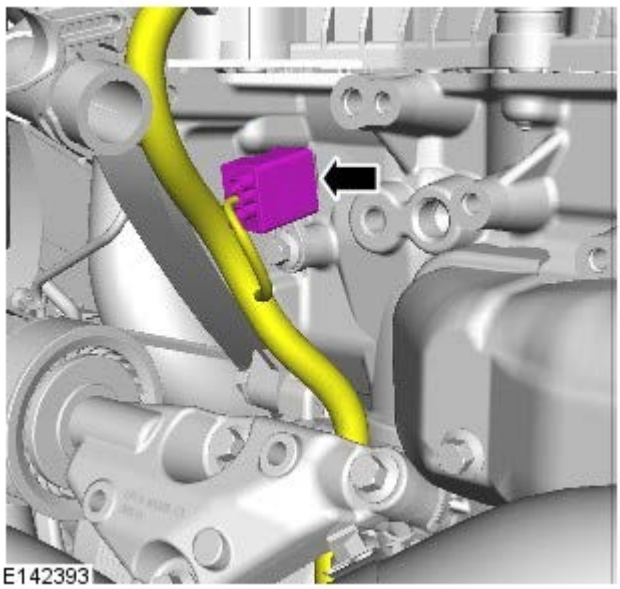
2. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05, Removal and Installation).

3. Refer to: Exhaust Gas Recirculation (EGR) Valve LH (303-08A Engine Emission Control - TDV6 3.0L Diesel, Removal and Installation).

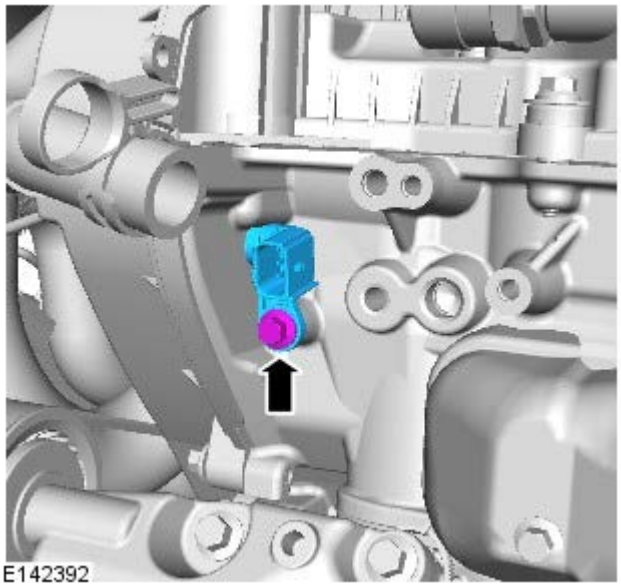
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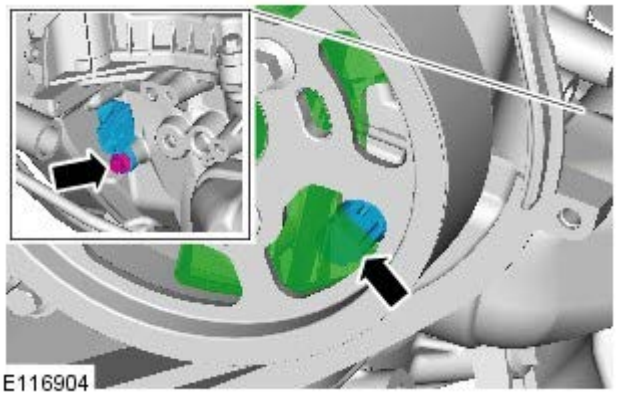
5.



6. *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: 13-Sep-2012

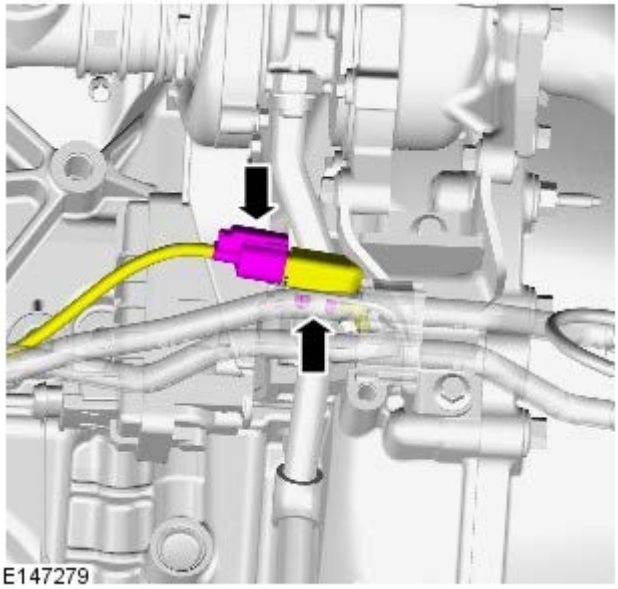
Electronic Engine Controls - TDV6 3.0L Diesel - Crankshaft Position (CKP) Sensor

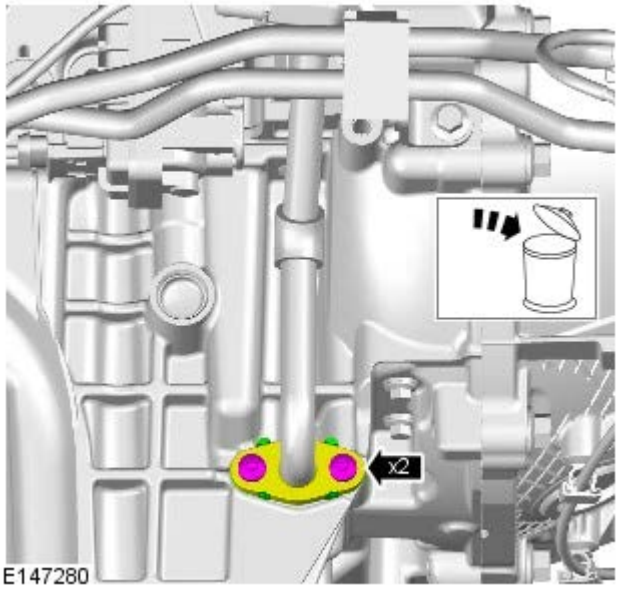
Removal and Installation

Removal

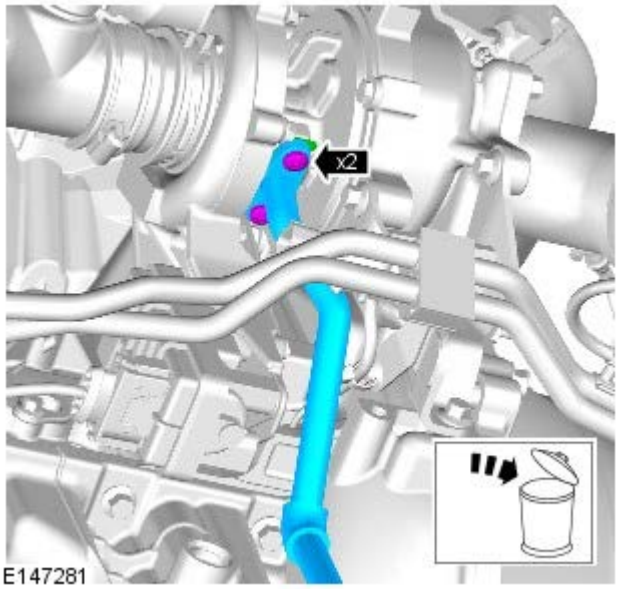
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Fender Splash Shield (501-02 Front End Body Panels, Removal and Installation).
2. Refer to: Engine Oil Draining and Filling (303-01A Engine - TDV6 3.0L Diesel, General Procedures).
3.

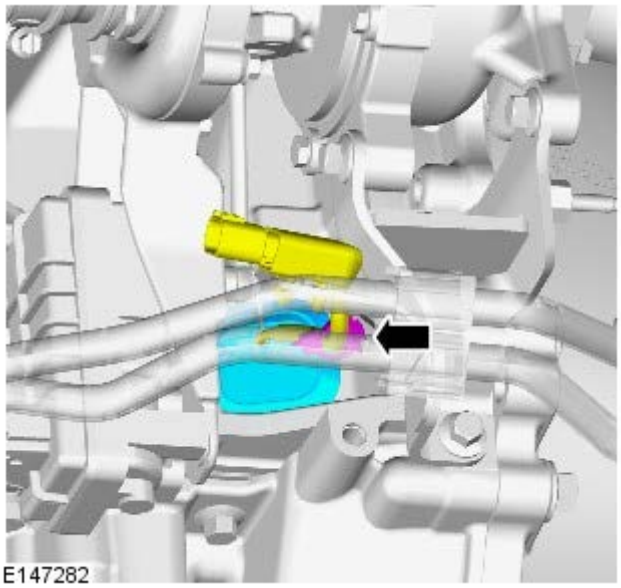


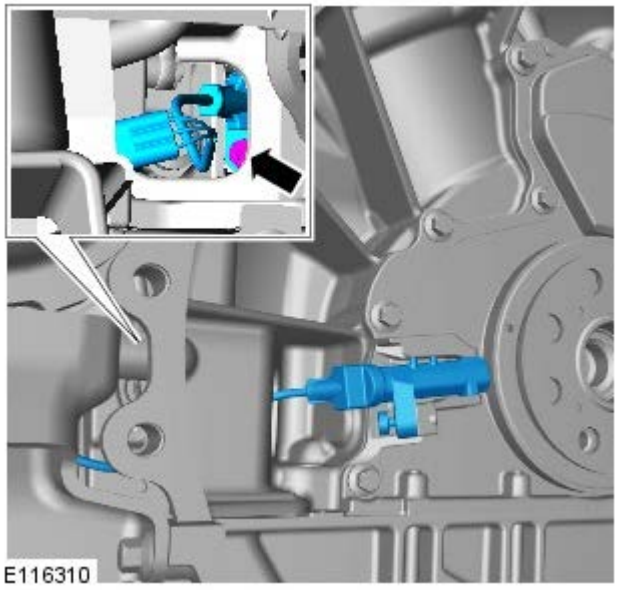


4. NOTE: Remove and discard the gasket.
   - *Torque:* 10 Nm
5.
   - *Torque:* 10 Nm



6.





7. 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.

NOTES:

Engine shown removed for clarity.

The CKP sensor retaining bolt should not be removed from the CKP sensor.

- *Torque:* 5 Nm

Installation

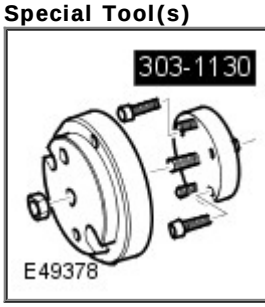
1. To install, reverse the removal procedure.

Published: 31-Aug-2012

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

NOTE: Removal steps in this procedure may contain installation details.

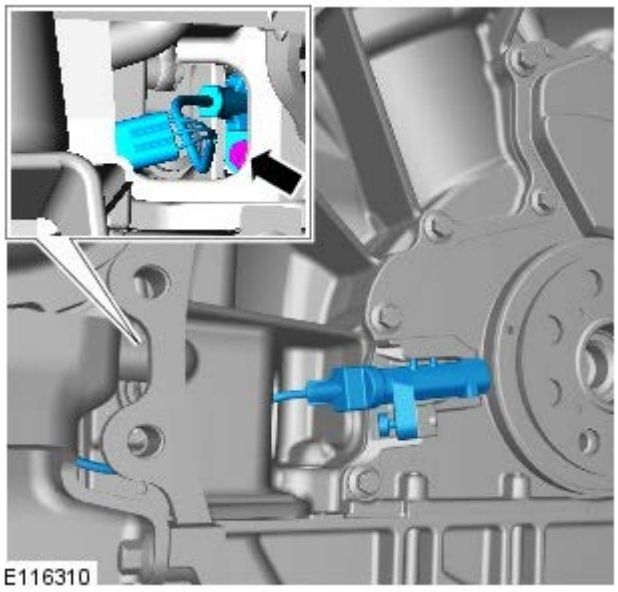
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

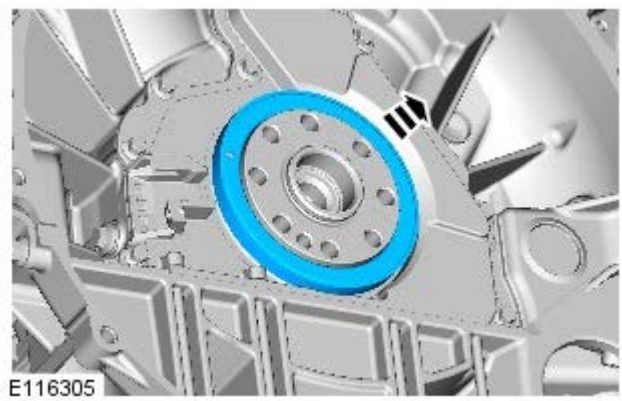
3. Refer to: Flexplate (303-01A Engine - TDV6 3.0L Diesel, Removal and Installation).



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.

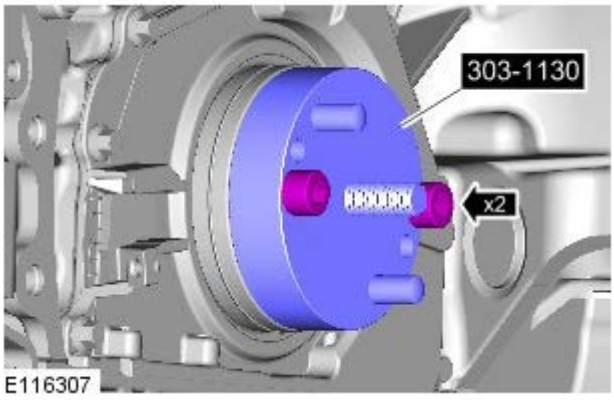


Installation



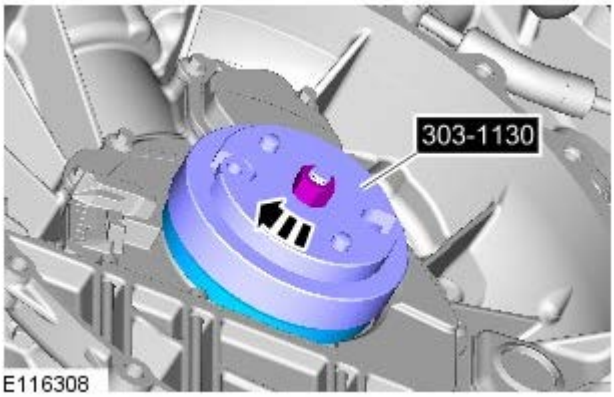
E116306

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



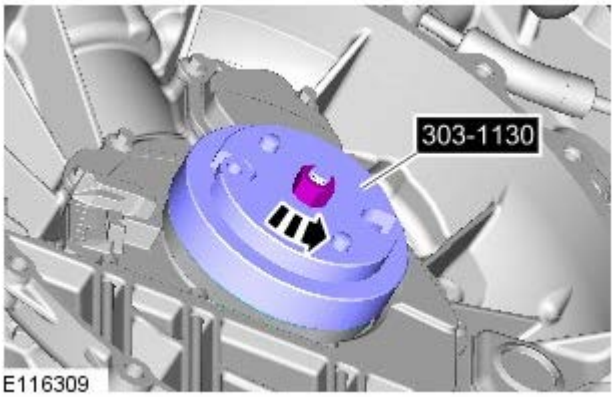
E116307

2. Install the special tool.



E116308

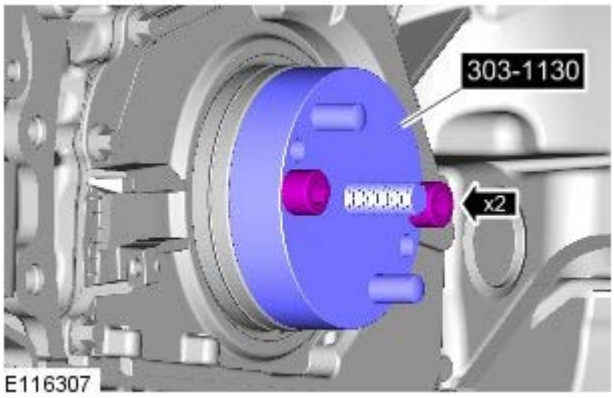
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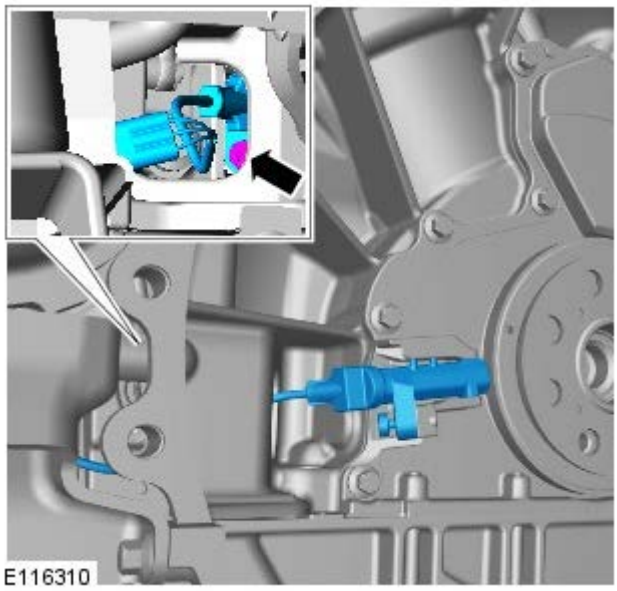
E116309

4.

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 Engine - TDV6 3.0L Diesel, Removal and Installation).

8. Connect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

Published: 08-Aug-2012

Electronic Engine Controls - TDV6 3.0L Diesel - Diesel Particulate Filter (DPF) Differential Pressure Sensor

Removal and Installation

Removal

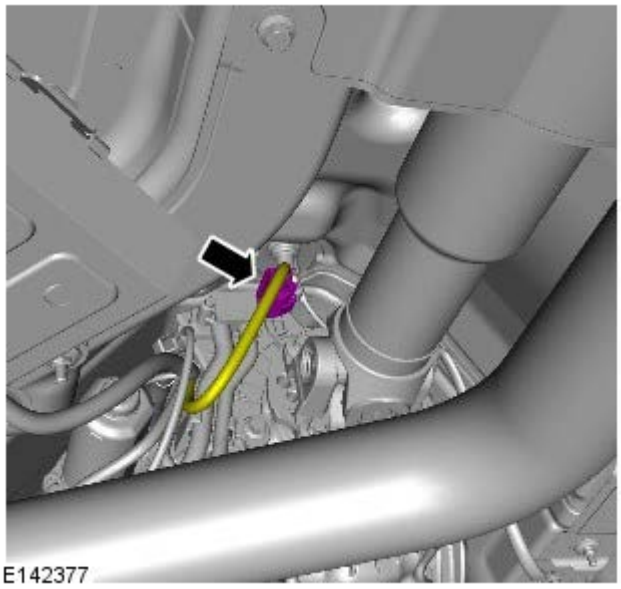
WARNING: Observe due care when working near a hot exhaust system.

NOTE: Removal steps in this procedure may contain installation details.

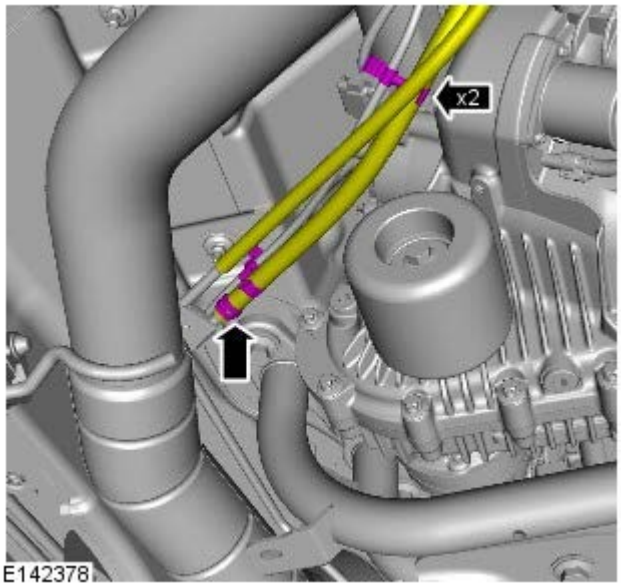
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

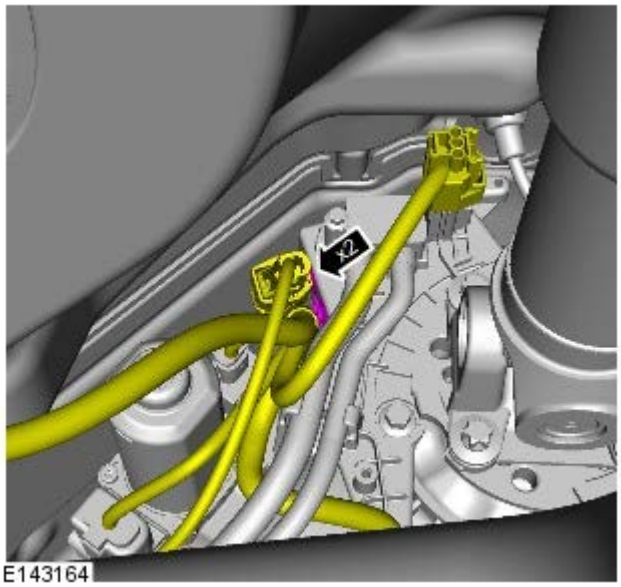
2.



3.

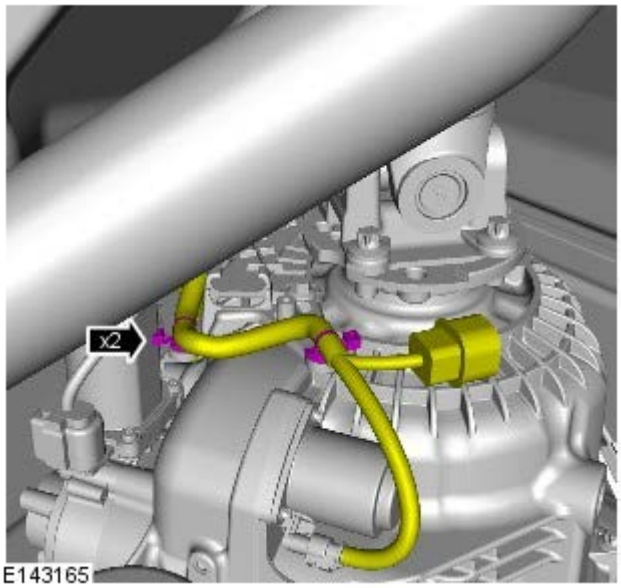


4.



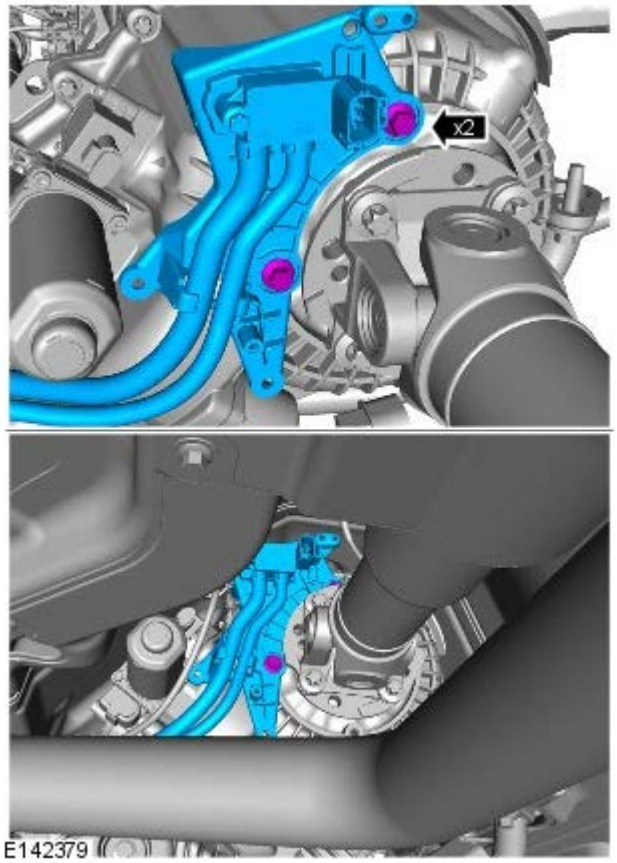
E143164

5.



E143165

6. *Torque:* 20 Nm



Installation

1. To install, reverse the removal procedure.
2. If a new unit is installed, configure using the approved diagnostic tool.

Published: 31-Jul-2012

Electronic Engine Controls - TDV6 3.0L Diesel - Engine Coolant Temperature (ECT) Sensor

Removal and Installation

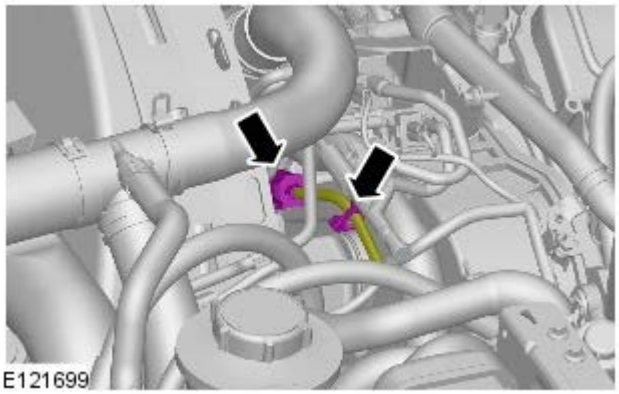
Removal

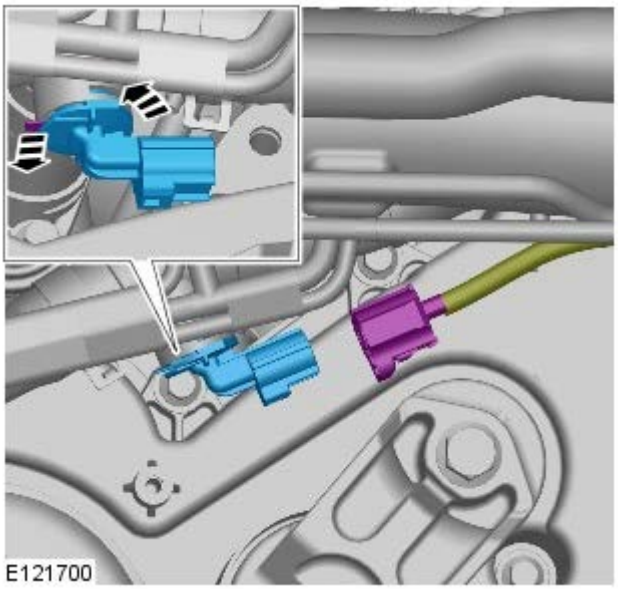
CAUTION: Make sure that all openings are sealed. Use new blanking caps.

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Engine Cover - TDV6 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. Check and top up coolant level.

Published: 31-Jul-2012

Electronic Engine Controls - TDV6 3.0L Diesel - Engine Control Module (ECM)

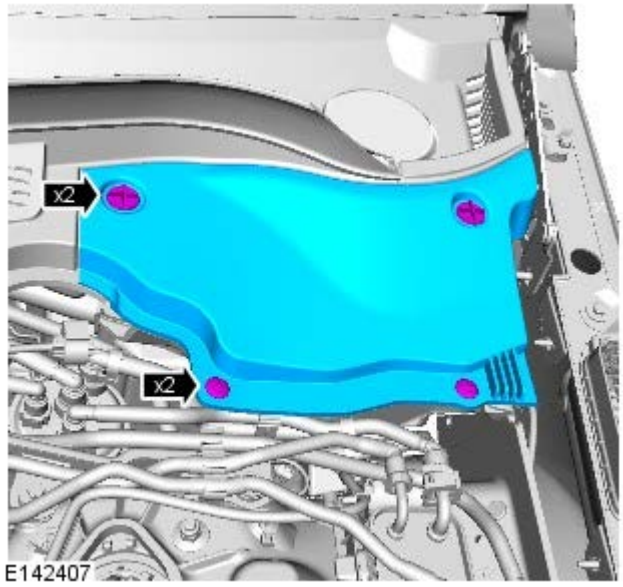
Removal and Installation

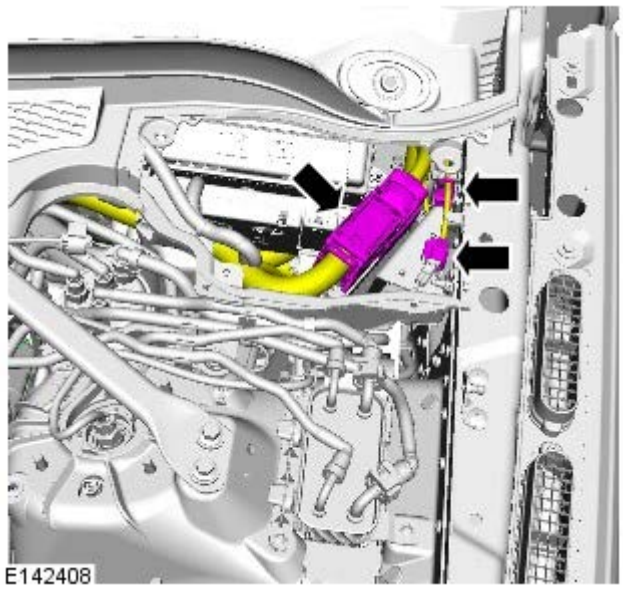
Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Specifications (414-00, Specifications).

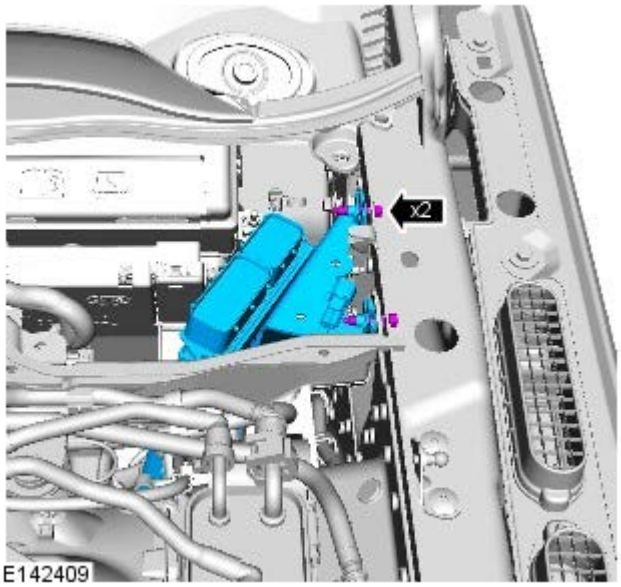
2.



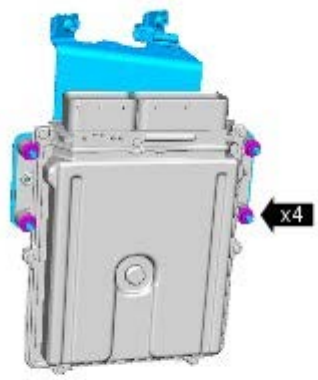


3. CAUTION: Before the disconnection or removal of any components, make sure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

4.



5.
- *Torque:* 7 Nm



E142410

Installation

1. To install, reverse the removal procedure.
2. If a new unit is installed, configure using the approved diagnostic tool.

Published: 06-Aug-2012

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.

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

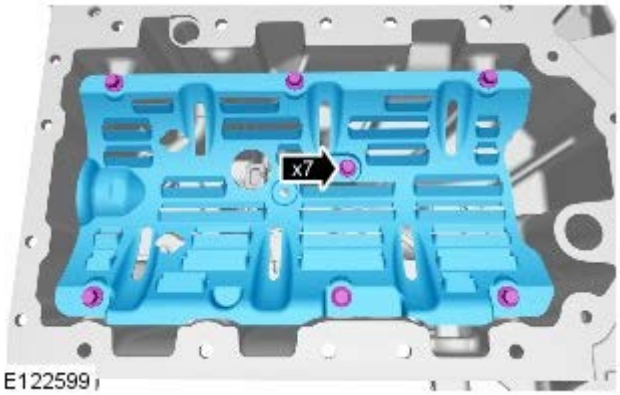
2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

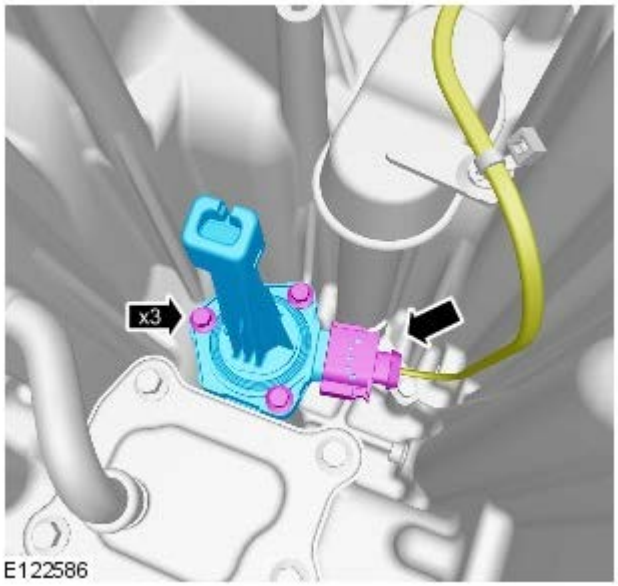
3. Remove the oil pan.

   Refer to: Oil Pan (303-01A, Removal and Installation).

4. *Torque:* 12 Nm



5. *Torque:* 12 Nm



Installation

1. To install, reverse the removal procedure.

Published: 31-Jul-2012

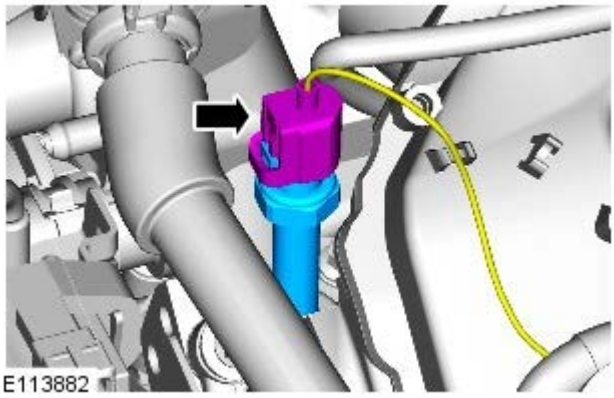
Electronic Engine Controls - TDV6 3.0L Diesel - Engine Oil Pressure (EOP) Sensor

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05, Removal and Installation).



2. NOTE: Make sure that all the component mating are clean
   - *Torque:* 14 Nm

Installation

1. To install, reverse the removal procedure.

Published: 31-Jul-2012

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.

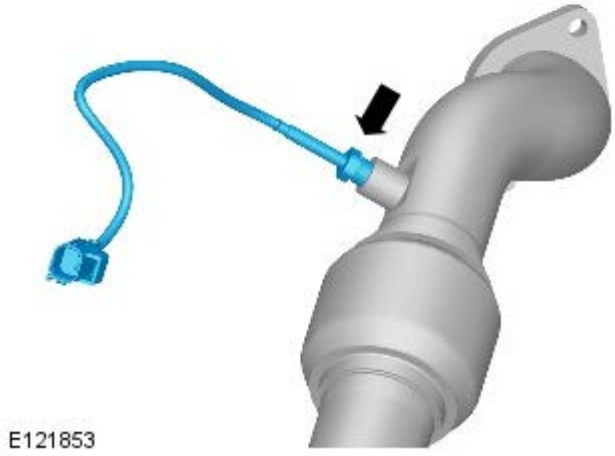
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Refer to: Exhaust System (309-00A, 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.

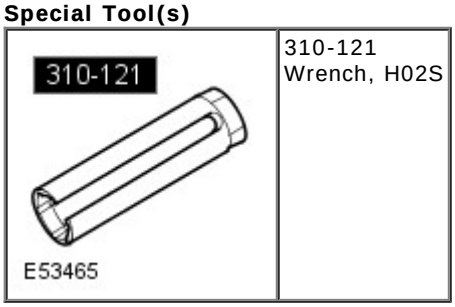
   To install, reverse the removal procedure.

Published: 04-Aug-2012

Electronic Engine Controls - TDV6 3.0L Diesel - Heated Oxygen Sensor (HO2S)

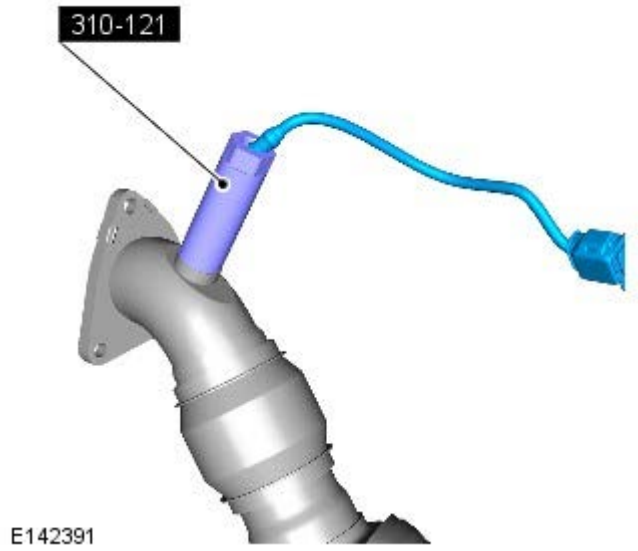
Removal and Installation

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: Catalytic Converter (309-00A Exhaust System - TDV6 3.0L Diesel, Removal and Installation).

3. 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. If a new unit is installed, configure using the approved diagnostic tool.

Published: 31-Jul-2012

Electronic Engine Controls - TDV6 3.0L Diesel - Intake Air Temperature (IAT) Sensor

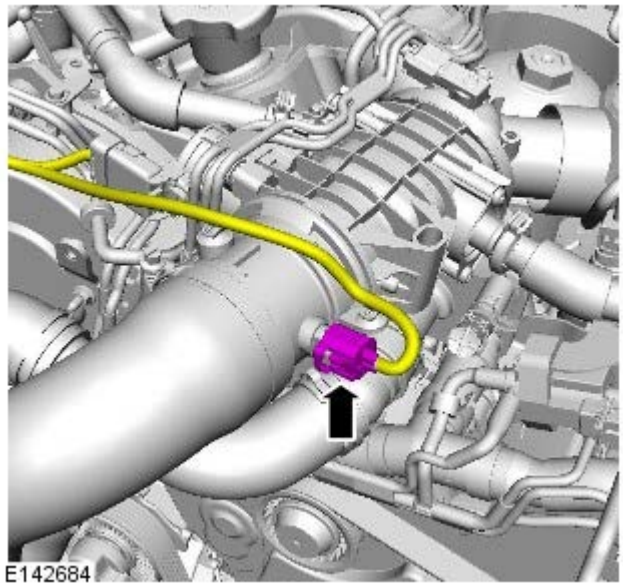
Removal and Installation

Removal

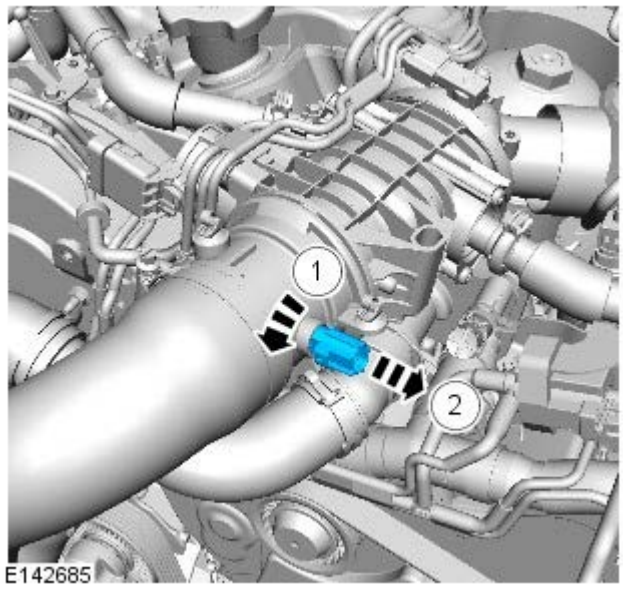
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05, Removal and Installation).

2.



3.



Installation

1. To install, reverse the removal procedure.

Published: 31-Jul-2012

Electronic Engine Controls - TDV6 3.0L Diesel - Manifold Absolute Pressure (MAP) Sensor

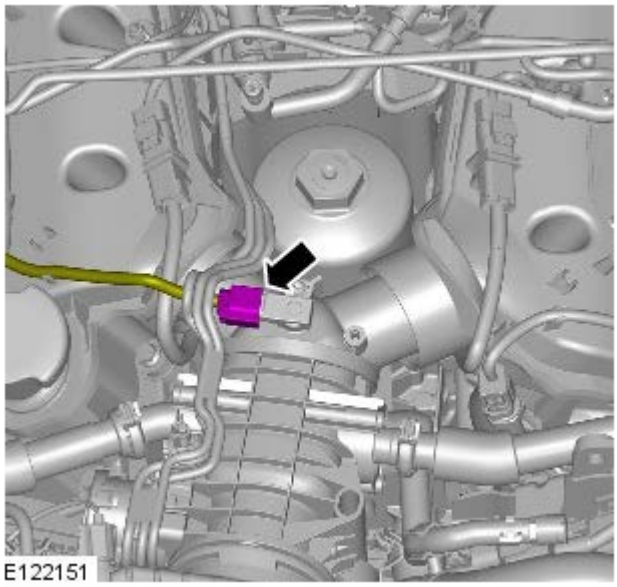
Removal and Installation

Removal

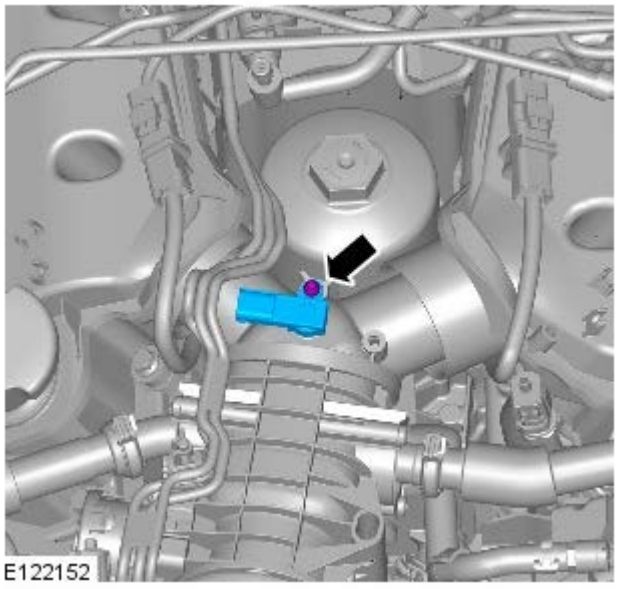
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05, Removal and Installation).

2.



3. *Torque:* 3 Nm



Installation

1. To install, reverse the removal procedure.

Published: 06-Aug-2012

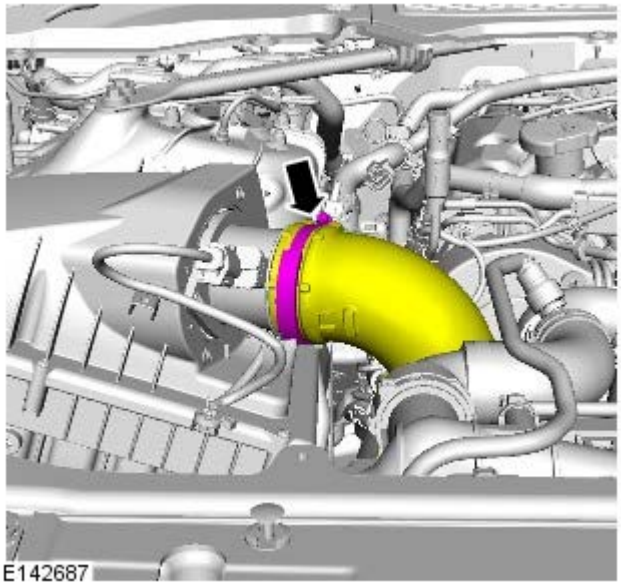
Electronic Engine Controls - TDV6 3.0L Diesel - Mass Air Flow (MAF) Sensor

Removal and Installation

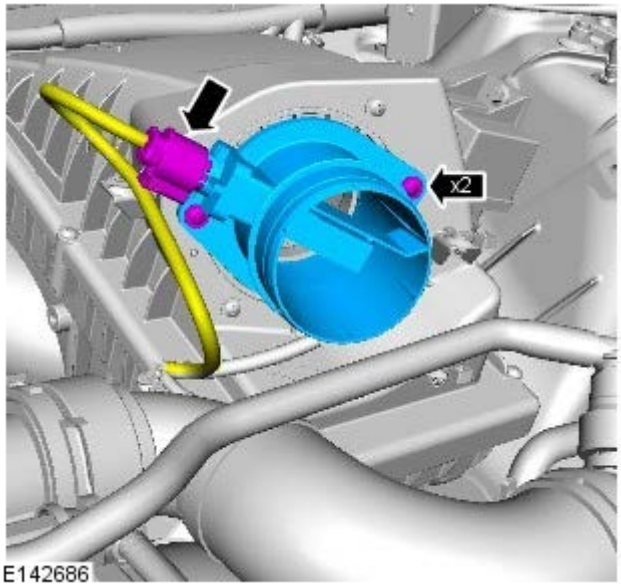
Removal

NOTE: Removal steps in this procedure may contain installation details.

1.



2. *Torque:* 2 Nm



Installation

1. To install, reverse the removal procedure.

Published: 06-Aug-2012

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. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

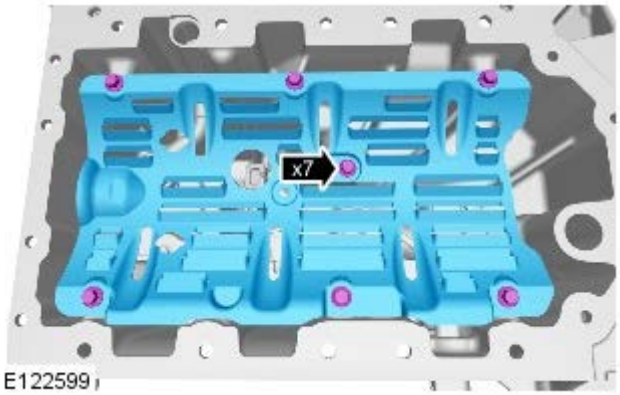
2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

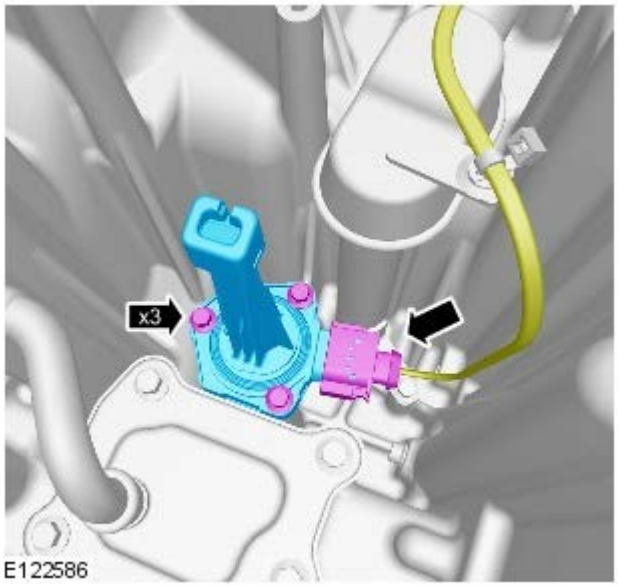
3. Remove the oil pan.

   Refer to: Oil Pan (303-01A, Removal and Installation).

4. *Torque:* 12 Nm



5. *Torque:* 12 Nm



Installation

1. To install, reverse the removal procedure.

Published: 02-May-2013

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.

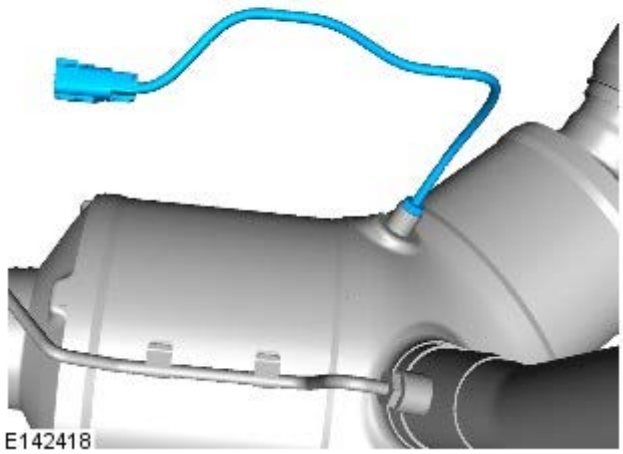
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Refer to: Exhaust System - Vehicles With: Diesel Particulate Filter (DPF) (309-00A Exhaust System - TDV6 3.0L Diesel, 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: 08-Aug-2012

Electronic Engine Controls - TDV6 3.0L Diesel - Post DPF Exhaust Gas Temperature Sensor

Removal and Installation

Removal

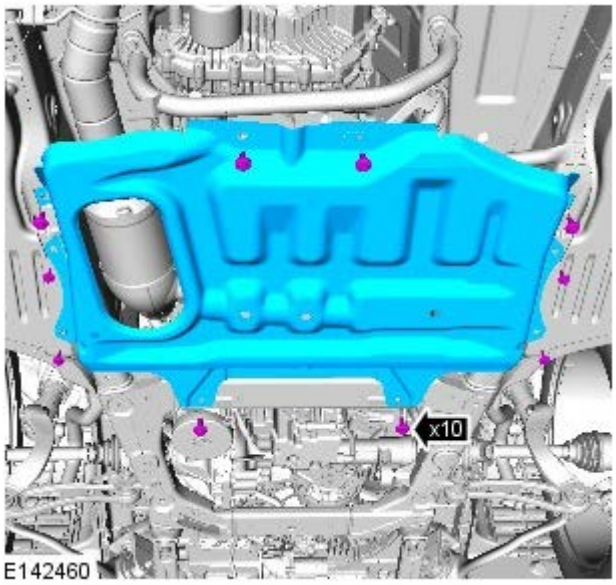
WARNING: Observe due care when working near a hot exhaust system.

NOTE: Removal steps in this procedure may contain installation details.

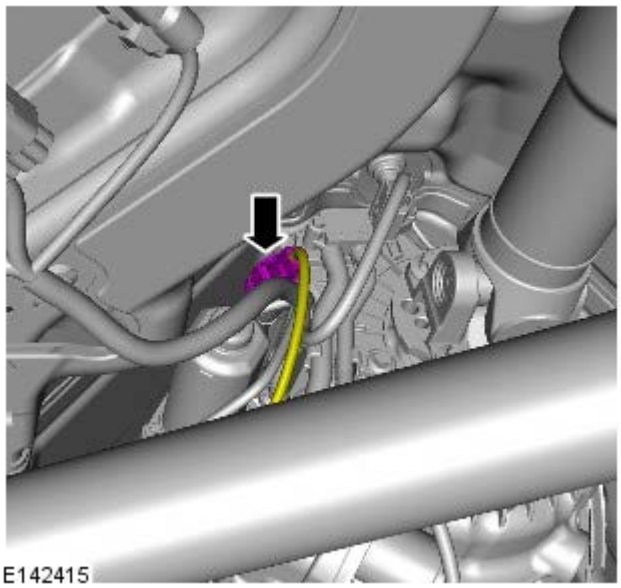
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

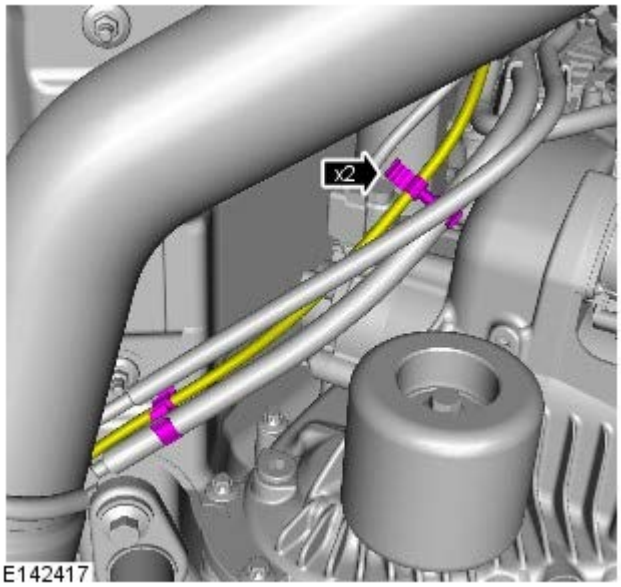
2. *Torque:*
   M10 60 Nm
   M6 10 Nm

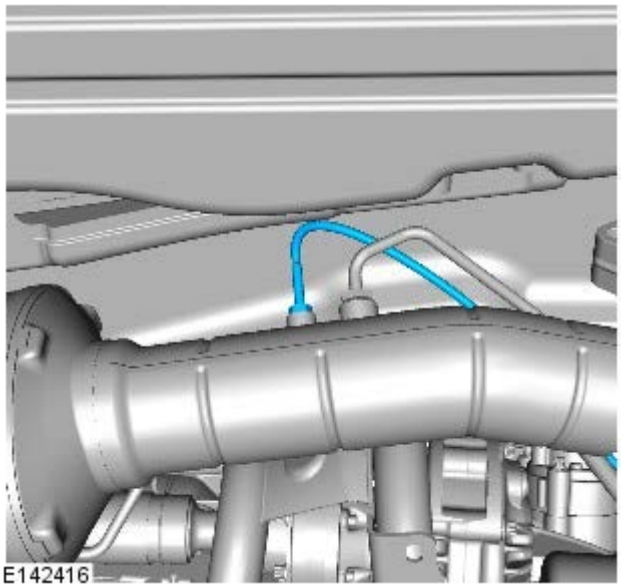


3.



4.





5. 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: 02-May-2013

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 - Vehicles With: Diesel Particulate Filter (DPF) (309-00A Exhaust System - TDV6 3.0L Diesel, 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: 22-Oct-2012

Electronic Engine Controls - V6 S/C 3.0L Petrol -

Torque Specifications

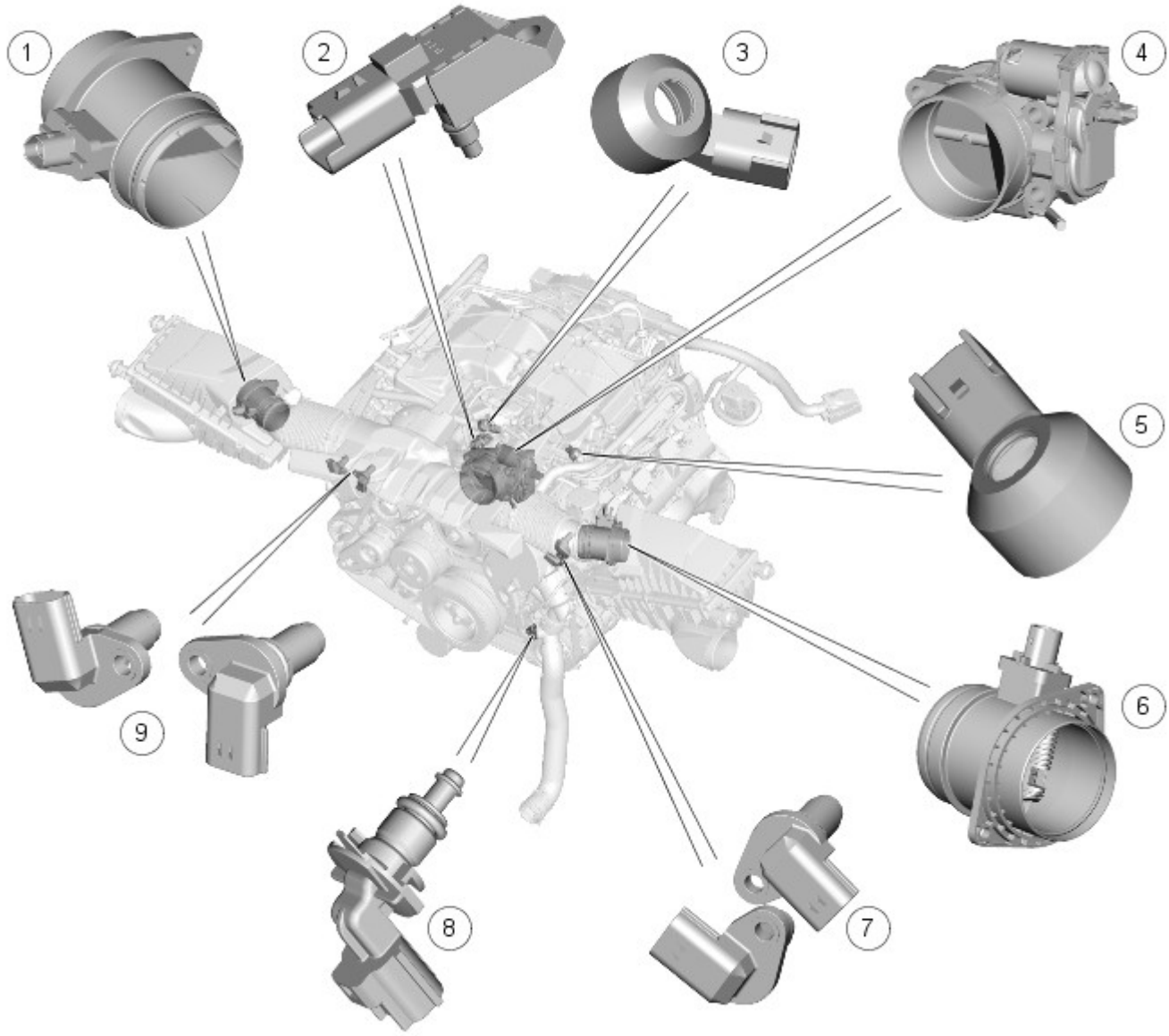
Description	Nm	lb-ft	lb-in
Camshaft position (CMP) sensor(s) retaining bolt	10	7	-
Crankshaft position (CKP) sensor retaining bolt	10	7	-
Heated oxygen sensor(s) (HO2S)	48	35	-
Catalyst monitor sensor(s)	48	35	-
Knock sensor(s) (KS) retaining bolt	20	15	-
Fuel rail pressure (FRP) sensor	32	24	-
Manifold absolute pressure and temperature (MAPT) sensor	5	-	44
Mass air flow (MAF) sensor	1.6	-	14
Engine oil level sensor retaining bolts	12	9	-
Variable valve timing (VVT) oil control solenoid(s) retaining bolt	10	7	-
Engine control module (ECM) retaining bolt	7	-	62
Engine control module (ECM) retaining nut	7	-	62
ECM retaining bracket bolt	7	-	62

Published: 27-May-2013

Electronic Engine Controls - V6 S/C 3.0L Petrol - Electronic Engine Controls

Description and Operation

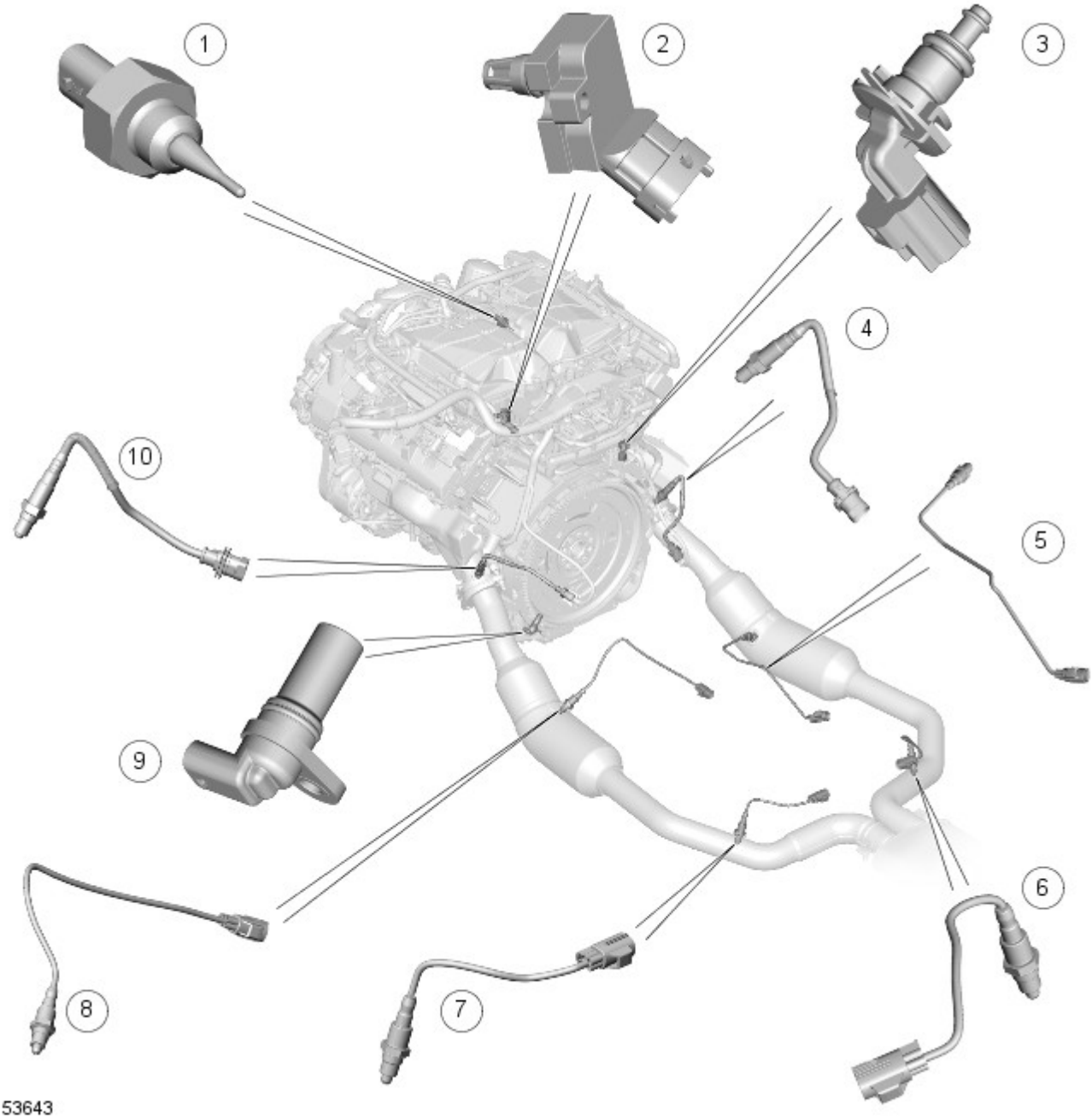
COMPONENT LOCATION - SHEET 1 OF 3



E153642

Item	Part Number	Description
1	-	Right Mass Air Flow and Temperature (MAFT) sensor
2	-	Manifold Absolute Pressure (MAP) sensor
3	-	Knock sensor (Bank 1)
4	-	Electric throttle
5	-	Knock sensor (Bank 2)
6	-	Left Mass Air Flow and Temperature (MAFT) sensor
7	-	Camshaft Position (CMP) sensors (2 off)
8	-	Engine Coolant Temperature (ECT 2) sensor 2
9	-	Camshaft Position (CMP) sensors (2 off)

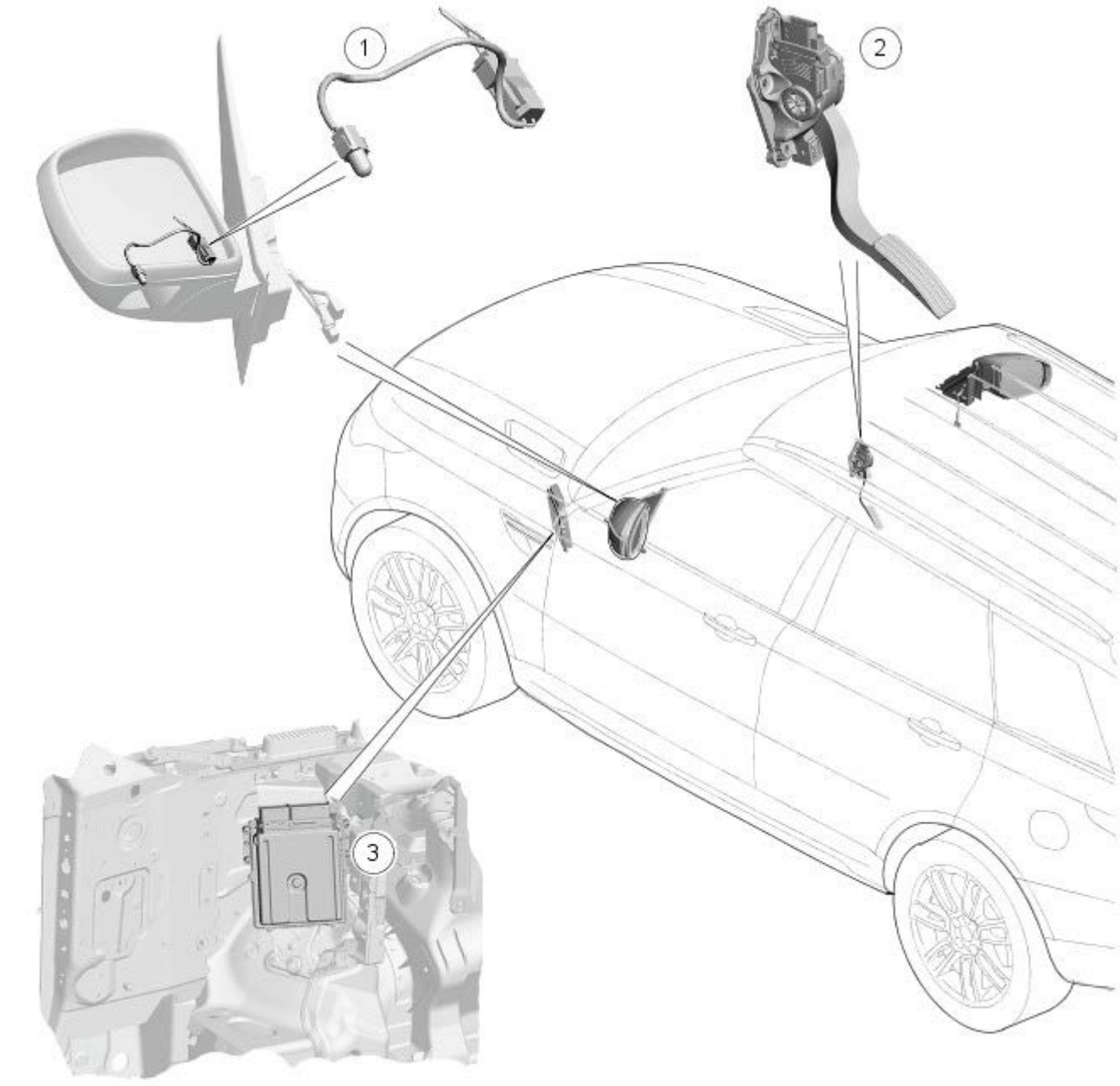
COMPONENT LOCATION - SHEET 2 OF 3



E153643

Item	Part Number	Description
1	-	Charge air temperature sensor
2	-	Manifold Absolute Pressure and Temperature (MAPT) sensor
3	-	Engine Coolant Temperature (ECT 1) sensor 1
4	-	Right pre catalyst Heated Oxygen (HO2S) sensor
5	-	Right mid catalyst Heated Oxygen (HO2S) sensor
6	-	Right post catalyst Heated Oxygen (HO2S) sensor
7	-	Left post catalyst Heated Oxygen (HO2S) sensor
8	-	Left mid catalyst Heated Oxygen (HO2S) sensor
9	-	Crankshaft Position (CKP) sensor
10	-	Left pre catalyst Heated Oxygen (HO2S) sensor

COMPONENT LOCATION - SHEET 3 OF 3



E153662

Item	Part Number	Description
1	-	Ambient Air Temperature (AAT) sensor
2	-	Accelerator Pedal Position (APP) sensor
3	-	Engine Control Module (ECM)

OVERVIEW

The electronic engine control system operates the engine to generate the output demanded by the accelerator pedal and loads imposed by other systems. The electronic engine control 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 electronic engine control 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.

DESCRIPTION

Engine Control Module



E148512

The ECM is installed in the rear left corner of the engine compartment, behind the secondary bulkhead panel. The ECM is attached to brackets on the wheel housing and the fender outer support panel.

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 (2 off).
- MAP (Manifold Absolute Pressure) sensor.
- MAFT (Mass Air Flow and Temperature) sensors (2 off).
- MAPT (Manifold Absolute Pressure and Temperature) sensor.
- Charge air temperature sensor.
- TPS (Throttle Position) sensor.
- Heated Oxygen (HO2S) sensors (6 off).
- APP (Accelerator Pedal Position) sensor.
- AAT (Ambient Air Temperature) sensor.
- Supercharger bypass valve actuator.
  For additional information, refer to: Intake Air Distribution and Filtering (303-12B Intake Air Distribution and Filtering - V6 S/C 3.0L Petrol, Description and Operation).
- FRPT (Fuel Rail Pressure and Temperature) sensor.
  For additional information, refer to: Fuel Charging and Controls (303-04C Fuel Charging and Controls - V6 S/C 3.0L Petrol, Description and Operation).
- Engine cooling fans.
  For additional information, refer to: Engine Cooling (303-03B Engine Cooling - V6 S/C 3.0L Petrol, Description and Operation).
- Brake pedal switch.
  For additional information, refer to: Braking Control System (206-11 Brake Controls, Description and Operation).
- Oil level and temperature sensor.
  For additional information, refer to: Engine (303-01B Engine - V6 S/C 3.0L Petrol, Description and Operation).
- Flex fuel sensor (where fitted).
  For additional information, refer to: Fuel Tank and Lines (310-01B Fuel Tank and Lines - V6 S/C 3.0L Petrol, Description and Operation).
- Fuel LP (low pressure) sensor.
  For additional information, refer to: Fuel Tank and Lines (310-01B Fuel Tank and Lines - V6 S/C 3.0L Petrol, Description and Operation).
- FPDM (Fuel Pump Driver Module.
  For additional information, refer to: Fuel Tank and Lines (310-01B Fuel Tank and Lines - V6 S/C 3.0L Petrol, Description and Operation).
- TCS (Transmission Control Switch).
  For additional information, refer to: External Controls (307-05A Automatic Transmission/Transaxle External Controls - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, Description and Operation).
- RCM (Restrains Control Module).
  For additional information, refer to: Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) (501-20B Supplemental Restraint System, Description and Operation).

The ECM provides outputs to the following:

- Electric throttle.
- ECM relay.
- Fuel injectors (6 off).
  For additional information, refer to: Fuel Charging and Controls (303-04C Fuel Charging and Controls - V6 S/C 3.0L Petrol, Description and Operation).
- Ignition coils (6 off).
  For additional information, refer to: Engine Ignition (303-07A Engine Ignition - V6 S/C 3.0L Petrol, Description and Operation).
- VCT (Variable Camshaft Timing) solenoids (4 off).
  For additional information, refer to: Engine (303-01B Engine - V6 S/C 3.0L Petrol, Description and Operation).
- Evaporative emissions purge valve.
  For additional information, refer to: Evaporative Emissions (303-13A Evaporative Emissions - V6 S/C 3.0L Petrol,

Description and Operation).
- Engine starter relay.
  For additional information, refer to: Starting System (303-06B Starting System - V6 S/C 3.0L Petrol, Description and Operation).
- Engine cooling fans.
  For additional information, refer to: Engine Cooling (303-03B Engine Cooling - V6 S/C 3.0L Petrol, Description and Operation).
- Supercharger bypass valve actuator.
  For additional information, refer to: Intake Air Distribution and Filtering (303-12B Intake Air Distribution and Filtering - V6 S/C 3.0L Petrol, Description and Operation).
- Charge air coolant pump relay.
  For additional information, refer to: Supercharger Cooling (303-03D Supercharger Cooling - V6 S/C 3.0L Petrol, Description and Operation).
- HP fuel pumps.
  For additional information, refer to: Fuel Charging and Controls (303-04C Fuel Charging and Controls - V6 S/C 3.0L Petrol, Description and Operation).
- FPDM (Fuel Pump Driver Module).
  For additional information, refer to: Fuel Tank and Lines (310-01B Fuel Tank and Lines - V6 S/C 3.0L Petrol, Description and Operation).
- DMTL (diagnostic module tank leakage) pump (where fitted).
  For additional information, refer to: Evaporative Emissions (303-13A Evaporative Emissions - V6 S/C 3.0L Petrol, Description and Operation).

Crankshaft Position Sensor



E148504

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 oil pan, 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.

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.

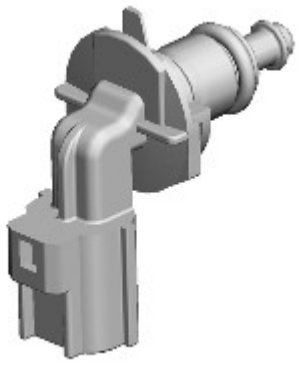
Each CMP sensor is secured with a single screw and sealed with an O-ring. On each CMP sensor, a three pin electrical connector provides the interface with the engine harness.

The head of each CMP sensor faces a reluctor ring attached to the front of the related VCT actuator.

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 Bank1 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.

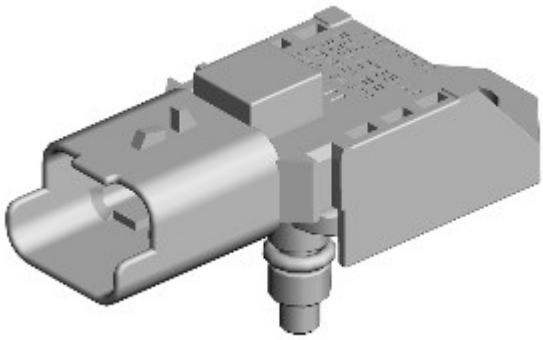
Two knock sensors are installed on the inboard side of each cylinder head, one the midway of Bank 1, and one mid-way of Bank 2 cylinders. Each knock sensor is secured with a single screw. On each knock sensor, a two pin electrical connector provides the interface with the engine harness.

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



E148520

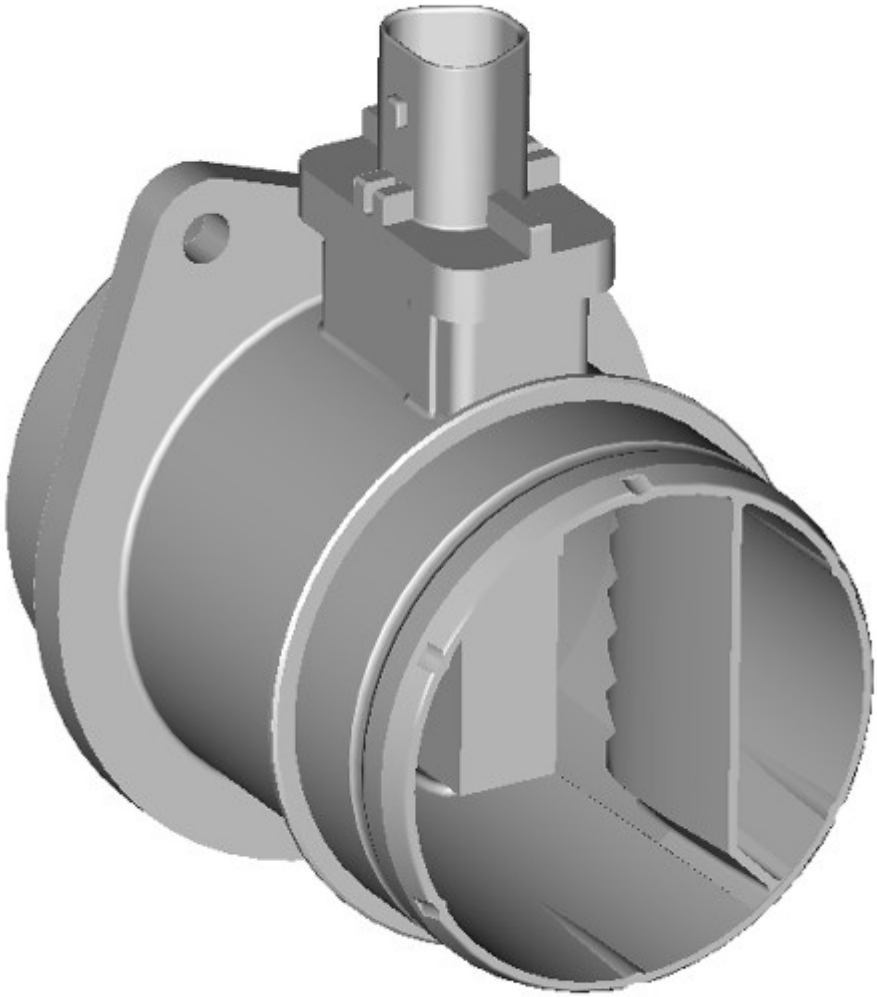
The MAP sensor allows the ECM to calculate the load on the engine, which is used in the calculation of fuel injection time.

The MAP sensor is installed in the air inlet of the 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



E153646

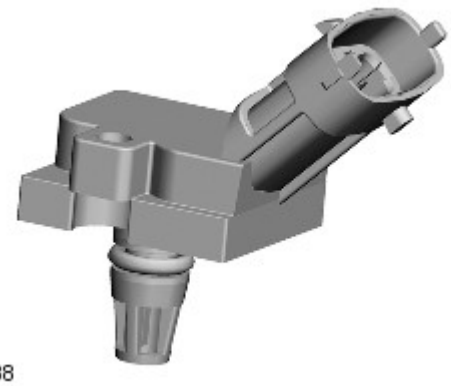
The MAFT sensors allow the ECM to measure the mass flow and the temperature of the air flow into the engine. The mass air flow is measured with a hot film element in the sensor. The temperature of the air flow is measured with a NTC thermistor in the sensor. The mass air flow is used to determine the fuel quantity to be injected in order to maintain the stoichiometric air:fuel mixture required for correct operation of the engine and the catalytic converters.

Identical MAFT sensors are attached to each of the air cleaner outlets. 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 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

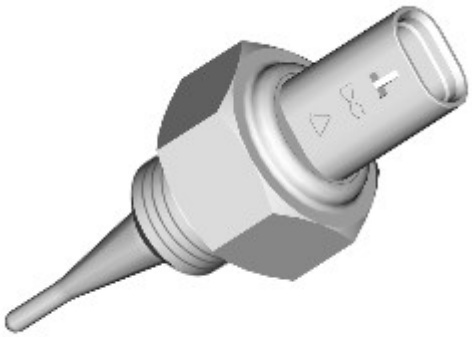


E116088

The MAPT sensor allows the ECM to calculate the charge air 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 rear of the LH intake manifold. 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.

Charge Air Temperature Sensor



E149162

The charge air temperature sensor is installed in the supercharger intercooler top cover. A two pin electrical connector provides the interface between the sensor and the engine harness. The sensor contains an NTC thermistor with supply and return connections to the ECM.

The ECM supplies the charge air temperature sensor with a 5 V reference voltage and translates the return voltage into a temperature. The ECM uses the input:

- To monitor operation of the charge air coolant pump
- For air mass calculations used in control of the supercharger bypass valve, as part of the charge air strategy that co-ordinates operation of the electric throttle and the bypass valve, and predicts the air mass delivered to the cylinders.

NOTE: The charge air temperature sensor is introduced together with the electric actuator for the SC (supercharger) bypass valve (in place of the vacuum actuator), which enables more accurate control of the bypass air flow.

If the charge air temperature sensor fails, the ECM substitutes the input with a modeled temperature. Failure of the sensor is unlikely to be noticeable to the driver.

Throttle Position Sensors

The TPS sensors allow the ECM to determine the position and angular rate of change of the throttle blade.

There are two TPS sensors located in the electric throttle. See below for details of the electric throttle.

If a TPS 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 TPS sensor, the engine will suffer from poor running and throttle response.

Heated Oxygen Sensors



E148505

A pre catalyst HO2S is installed in the outlet of each exhaust manifold, which enables independent closed loop control of the air:fuel mixture for each cylinder bank.

NOTE: A mid catalyst and a post catalyst HO2S (heated oxygen sensor) is installed in each branch of the exhaust system. Together with the pre catalyst sensors, these are used by the ECM (engine control module) to monitor the performance of the catalytic converters.

The heater elements of the pre catalyst HO2S 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 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 pre catalyst sensors.

The pre catalyst HO2S sensor produces a constant voltage, with a variable current that is proportional to the lambda ratio. The ECM monitors the pre catalyst HO2S by checking the signal against maximum and minimum threshold, for open and short circuit conditions. If a HO2S fails:

- The ECM defaults to open loop fueling for the related cylinder bank
- The CO (carbon monoxide) and emissions content of the exhaust gases increases
- The exhaust smells of rotten eggs (hydrogen sulphide).

With a failed pre catalyst HO2S the engine will suffer from unstable operation and reduced performance.

Accelerator Pedal Position Sensor



E141165

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 control module) and the TCM (Transmission Control Module), to determine the setting of the electric throttle.

The APP sensor is integrated into the accelerator pedal, which is attached to 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



E116093

The AAT 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) Powertrain bus for use by other control modules.

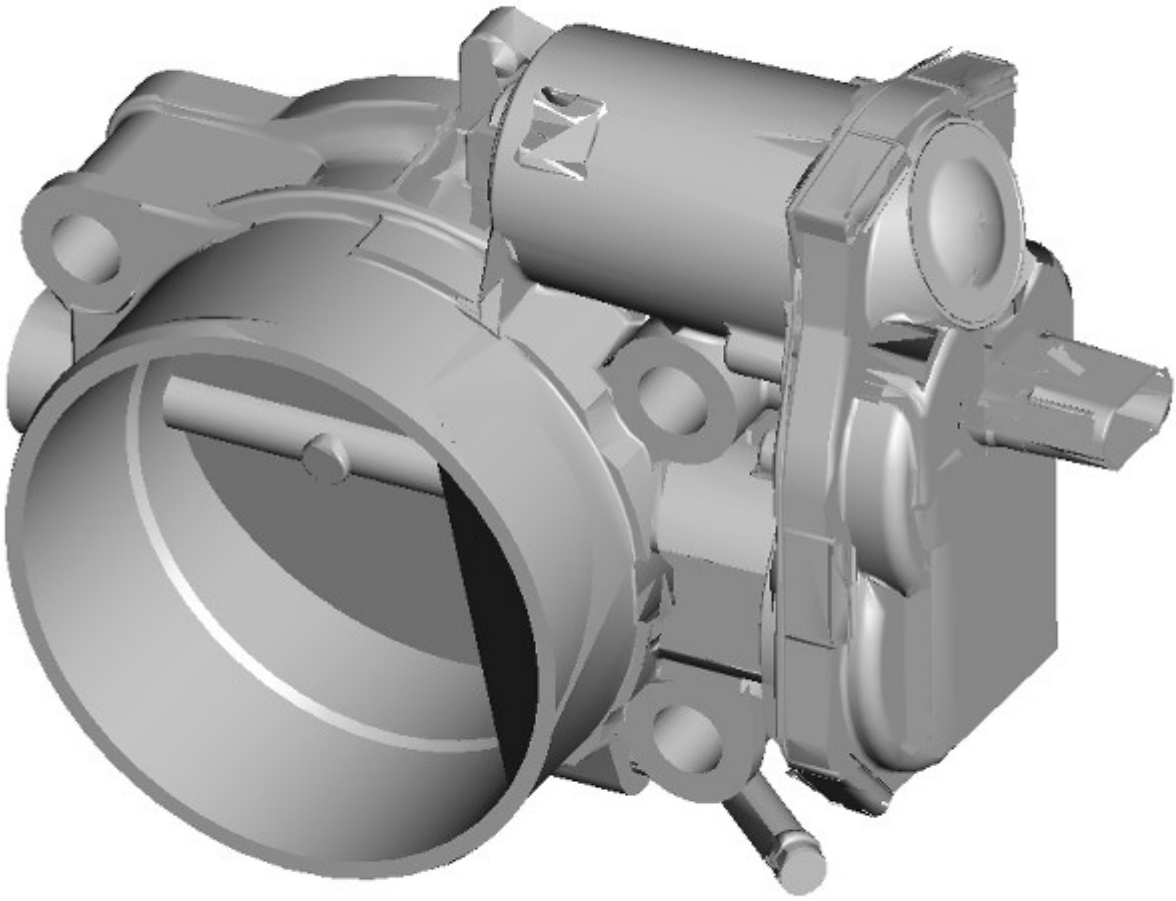
The AAT sensor is installed in the left exterior mirror, with the bulb of the sensor positioned over a hole in the bottom of the mirror casing.

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).

Electric throttle



E153645

The ECM uses the electric throttle to regulate engine torque.

The electric throttle is installed between the clean air duct and the supercharger.
For additional information, refer to: Intake Air Distribution and Filtering (303-12B Intake Air Distribution and Filtering - V6 S/C 3.0L Petrol, 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 map to determine the required position of the throttle plate. The ECM and electric throttle are also required to:

- Monitor requests for cruise control operation
- Automatically operate the electric 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.

OPERATION

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 (Engine Junction Box).

When the ignition is turned on, battery voltage is applied to the ignition sense input from the CJB (Central Junction Box). 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)
- Up to 5 minutes when cooling fans are required.

On completion of the power down routines the ECM de-energizes the ECM relay.

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 HO2S sensors
- The MAFT sensors
- The CKP sensor
- Electric 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

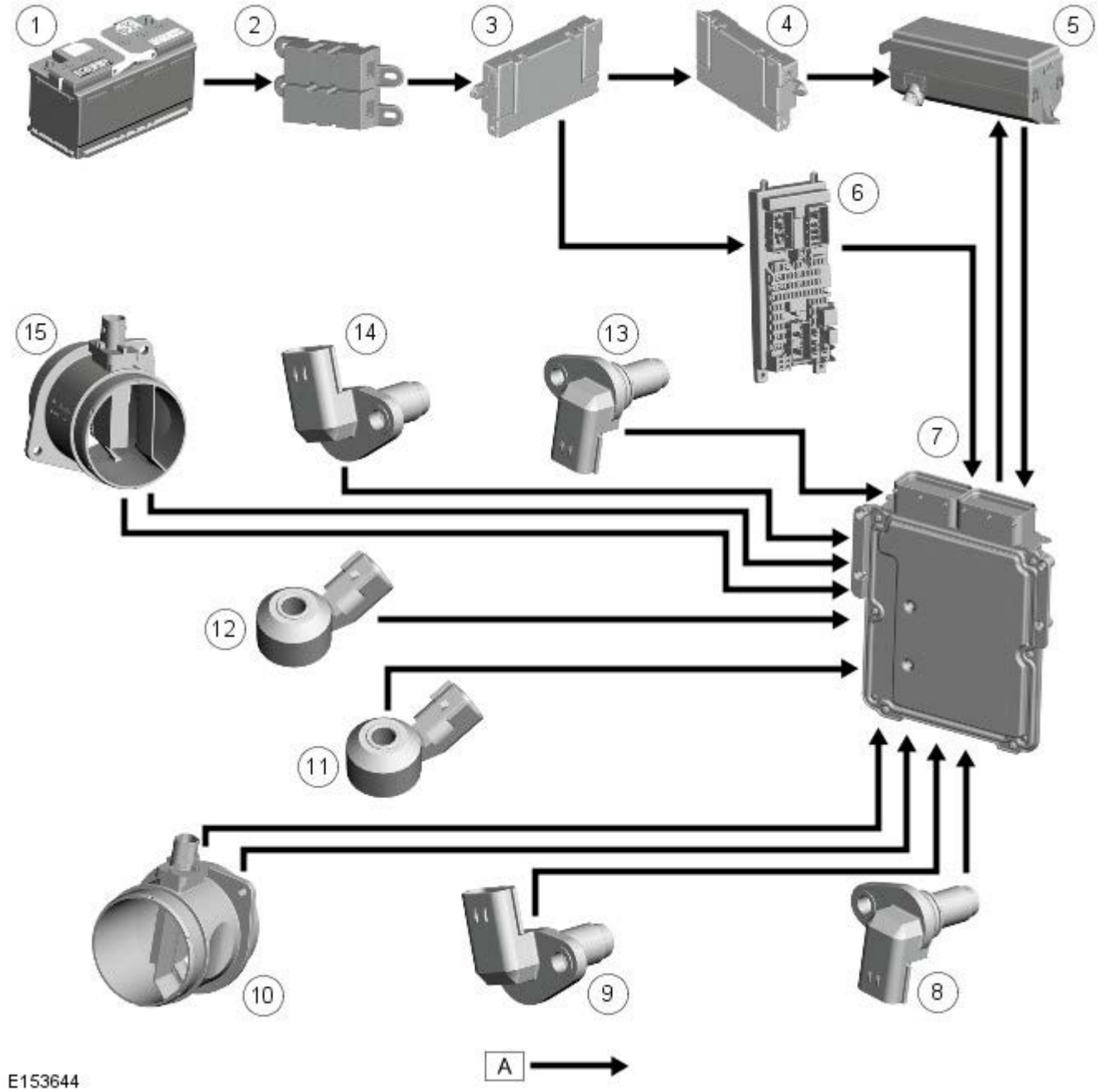
Legislation requires that the ECM must be able to detect the presence of an engine misfire. It must be able to detect misfires at two separate levels. The first level is an amount of misfire that could lead to the legislated emissions limit being exceeded by a given amount. The second level is a misfire 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. The ECM 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 judgment to an individual cylinder, which can be viewed on Land Rover approved diagnostic equipment.

Control Diagram - Sheet 1 of 2

 NOTE: A = Hardwired.

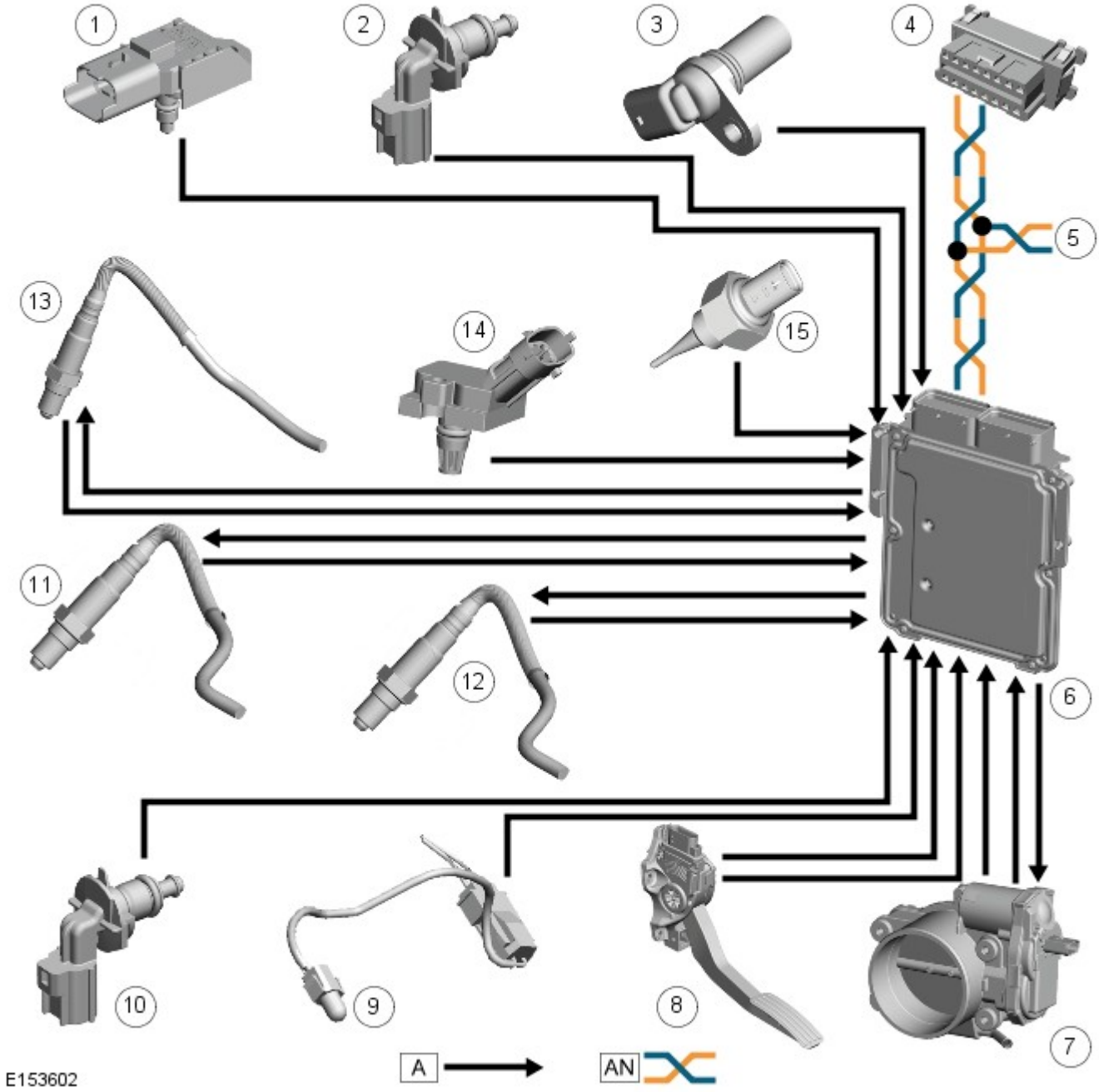


E153644

Item	Part Number	Description
1	-	Battery
2	-	Battery Junction Box 2 (BJB2)
3	-	Battery Junction Box (BJB)
4	-	Auxiliary Junction Box (AJB)
5	-	Engine Junction Box (EJB)
6	-	Central Junction Box (CJB)
7	-	Engine Control Module (ECM)
8	-	Left intake Camshaft Position (CMP) sensor
9	-	Left exhaust Camshaft Position (CMP) sensor
10	-	Left Mass Air Flow and Temperature (MAFT) sensor
11	-	Left knock sensor
12	-	Right knock sensor
13	-	Right intake Camshaft Position (CMP) sensor
14	-	Right exhaust Camshaft Position (CMP) sensor
15	-	Right Mass Air Flow and Temperature (MAFT) sensor

Control Diagram - Sheet 2 of 2

NOTE: A = Hardwired, AN = High speed CAN (Controller Area Network) Powertrain bus.



Item	Part Number	Description
1	-	Manifold Absolute Pressure (MAP) sensor
2	-	Engine Coolant Temperature sensor (ECT 2)
3	-	Crankshaft Position (CKP) sensor
4	-	Diagnostic connector
5	-	High speed CAN connection to other system control modules
6	-	Engine Control Module (ECM)
7	-	Electric throttle
8	-	Accelerator Pedal Position (APP) sensor
9	-	Ambient Air Temperature (AAT) sensor
10	-	Engine Coolant Temperature sensor (ECT 1)
11	-	Right and left mid catalyst heated oxygen sensor (2 off)
12	-	Right and left post catalyst heated oxygen sensor (2 off)
13	-	Right and left pre catalyst heated oxygen sensor (2 off)
14	-	Manifold Absolute Pressure and Temperature (MAPT) sensor
15	-	Charge air temperature sensor

Published: 06-Mar-2013

Electronic Engine Controls - V6 S/C 3.0L Petrol - Electronic Engine Controls

Diagnosis and Testing

Principle of Operation

For a detailed description of electronic engine controls, refer to the relevant description and operation section of the workshop manual. REFER to:

Electronic Engine Controls (303-14B Electronic Engine Controls - V6 S/C 3.0L Petrol, Description and Operation),
Electronic Engine Controls (303-14D, Description and Operation),
Electronic Engine Controls (303-14D, 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 and condition • Cooling system coolant level • Fuel level/fuel leaks • Fuel contamination/grade/quality • Throttle body • Accessory drive belt • Sensor installation/condition • Cooling fan • Air cleaner condition	• Fuses • Wiring harness • Electrical connector(s) • 5 volt sensor supply • Sensor(s) • Engine control module • Transmission 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

Symptom Chart

Symptom	Possible Cause	Action
Engine non-start		
Engine does not crank	• Security system / immobilizer engaged • Engine in shut-down mode • Engine control module relay • Battery • Starting system • Engine seized	• Check that the security system is disarmed • Read DTCs and refer to DTC index in section 100-00 for engine control module relay diagnostics • Ensure the battery is in fully charged and serviceable condition • For starting system tests refer to the relevant section of the workshop manual • For engine system tests refer to the relevant section of the workshop manual
Engine cranks, but does not fire	• Engine breather system disconnected/restricted • Ignition system • Fuel system • Electronic engine controls	• Ensure the engine breather system is free from restriction and is correctly installed • For ignition system tests refer to the relevant section of the workshop manual • For fuel system tests refer to the relevant section of the workshop manual • Read DTCs and refer to DTC index in section 100-00 for electronic engine control diagnostics
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	• For purge valve tests refer to the relevant section of the workshop manual • For fuel system tests refer to the relevant section of the workshop manual • For ignition system tests refer to the relevant section of the workshop manual

	cracks/damage • Ignition coil failure(s)	
Difficult to start		
Difficult cold start	• Check engine coolant level/anti-freeze content • Battery • Electronic engine controls • Fuel pump • Evaporative emissions purge valve	• Check the engine coolant level and condition. Refer to the relevant sections of the workshop manual • Ensure the battery is in a fully charged and serviceable condition. Refer to the battery care manual and the relevant sections of the workshop manual. • Read DTCs and refer to DTC index in section 100-00 for electronic engine control diagnostics • For fuel system tests refer to the relevant section of the workshop manual • Refer to the relevant section of the workshop manual and check the purge valve and associated hoses and connections
Difficult hot start	• Injector leak • Electronic engine controls • Evaporative emissions purge valve • Fuel pump • Ignition system	• Refer to the relevant section of the workshop manual, carry out injector leak tests, install new injectors as necessary • Read DTCs and refer to DTC index in section 100-00 for electronic engine control diagnostics • Refer to the relevant section of the workshop manual and check the purge valve and associated hoses and connections • For fuel system tests refer to the relevant section of the workshop manual • For ignition system tests refer to the relevant section of the workshop manual
Difficult to start after hot soak (vehicle standing, engine off, after engine has reached operating temperature)	• Injector leak • Electronic engine controls • Evaporative emissions purge valve • Fuel pump • Ignition system	• Refer to the relevant section of the workshop manual, carry out injector leak tests, install new injectors as necessary • Read DTCs and refer to DTC index in section 100-00 for electronic engine control diagnostics • Refer to the relevant section of the workshop manual and check the purge valve and associated hoses and connections • For fuel system tests refer to the relevant section of the workshop manual • For ignition system tests refer to the relevant section of the workshop manual
Engine cranks too fast/slow	• Compressions high/low • Battery • Starting system	• Refer to the relevant section of the workshop manual, carry out compression tests • Ensure the battery is in a fully charged and serviceable condition. Refer to the battery care manual and the relevant sections of the workshop manual • For starting system tests refer to the relevant section of the workshop manual
Engine stalls		
Engine stalls soon after start	• Breather system disconnected/restricted • Engine control module relay • Electronic engine controls • Ignition system • Air intake system restricted • Air leakage • Fuel lines	• Ensure the engine breather system is free from restriction and is correctly installed • Read DTCs and refer to DTC index in section 100-00 for engine control module relay diagnostics • Read DTCs and refer to DTC index in section 100-00 for electronic engine control diagnostics • For ignition system tests refer to the relevant section of the workshop manual • Check for blockage in air cleaner element and air intake system • Check for leakage in air intake system • For fuel system tests refer to the relevant section of the workshop manual
Engine stalls on overrun	• Engine control module relay • Throttle position sensors	• Read DTCs and refer to DTC index in section 100-00 for engine control module relay and throttle position sensor diagnostics

Engine stalls at steady speed	Engine control module relay • Crankshaft position sensor • Throttle position sensors	Read DTCs and refer to DTC index in section 100-00 for engine control module relay, crankshaft position sensor and throttle position sensor diagnostics
Engine stalls with speed control enabled	• Engine control module relay	• Read DTCs and refer to DTC index in section 100-00 for engine control module relay diagnostics
Engine stalls when manoeuvring	• Engine control module relay • Throttle position sensors • Additional engine loads (power assisted steering, air conditioning, etc) • Transmission malfunction • CAN malfunction	• Read DTCs and refer to DTC index in section 100-00 for engine control module relay and throttle position sensor diagnostics • Check for excessive loads being placed on the engine from power assisted steering, air conditioning systems etc • Refer to the workshop manual or transmission troubleshooting guide for transmission system tests • Refer to the relevant section of the workshop manual and the electrical wiring diagrams to perform CAN network tests
Poor driveability		
Engine hesitates/poor acceleration	• Fuel pressure, fuel pump, fuel lines • Injector leak • Air leakage • Electronic engine controls • Ignition system • Transmission malfunction • Throttle motor • Restricted pedal travel (carpet, etc)	• For fuel system tests refer to the relevant section of the workshop manual • Carry out fuel injector leak tests, install new injectors as necessary • Check for leakage from air intake system • Read DTCs and refer to DTC index in section 100-00 for electronic engine control diagnostics • For ignition system tests refer to the relevant section of the workshop manual • Refer to the workshop manual or transmission troubleshooting guide for transmission system tests • Ensure accelerator pedal is free from restriction
Engine backfires	• Fuel pump, fuel lines • Air leakage • Electronic engine controls • Ignition system • Sticking variable camshaft timing hub	• For fuel system tests refer to the relevant section of the workshop manual • Check for leakage from air intake system • Read DTCs and refer to DTC index in section 100-00 for electronic engine control diagnostics • For ignition system tests refer to the relevant section of the workshop manual • Read DTCs and refer to DTC index in section 100-00 for variable camshaft timing system diagnostics
Engine surges	• Fuel pump, fuel lines • Electronic engine controls • Ignition system	• For fuel system tests refer to the relevant section of the workshop manual • Read DTCs and refer to DTC index in section 100-00 for electronic engine control diagnostics • For ignition system tests refer to the relevant section of the workshop manual
Engine detonates/knocks	• Electronic engine controls • Fuel pump, fuel lines, fuel quality • Air leakage • Sticking variable camshaft timing hub	• Read DTCs and refer to DTC index in section 100-00 for electronic engine control diagnostics • For fuel system tests refer to the relevant section of the workshop manual • Check for leakage from air intake system • Read DTCs and refer to DTC index in section 100-00 for variable camshaft timing system diagnostics
No throttle response	• Electronic engine controls • Throttle motor	• Read DTCs and refer to DTC index in section 100-00 for electronic engine control and throttle system diagnostics
Speed control inhibited or disabled	• Default mode enabled • Speed control, brake switch • Electronic engine controls • CAN fault	• Check message center for default message, read DTCs and refer to DTC index • Refer to the relevant section of the workshop manual for speed control, and brake switch tests • Read DTCs and refer to DTC index in section

		100-00 for electronic engine control diagnostics • Refer to the relevant section of the workshop manual and the electrical wiring diagrams to perform CAN network tests
Poor throttle response	• Breather system disconnected/restricted • Electronic engine controls • Transmission malfunction • Traction control event • Air leakage	• Ensure engine breather system is free from restriction and is correctly installed • Read DTCs and refer to DTC index in section 100-00 for electronic engine control diagnostics • Refer to the workshop manual or transmission troubleshooting guide for transmission system tests • Check for leakage in air intake system
Engine defaults, warning light and messages. Refer to the owner handbook	• Electronic engine controls	• Read DTCs and refer to DTC index in section 100-00 for electronic engine control diagnostics

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 - V6 S/C 3.0L Petrol , DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation).

Published: 11-Dec-2013

Electronic Engine Controls - V6 S/C 3.0L Petrol - Brake Pedal Position (BPP) Switch Adjustment

General Procedures

Check

1. Remove the brake pedal rubber.



2. NOTE: Make sure that the dial test indicator (DTI) gauge is in line with the brake pedal movement.

   Position the DTI gauge on a suitable mounting block, as illustrated.

3. With the aid of another technician, gently press the brake pedal until the stop lamps illuminate.

4. NOTE: The specification is that the stop lamps should illuminate at between 5.5mm and 8.5mm brake pedal travel.

   Note the measurement of the brake pedal travel from rest position until the stop lamps illuminated.

Adjust

NOTE: The Brake Pedal Position Switch is self adjusting when removed and installed.

1. Remove and install Brake Pedal Position Switch.
   For additional information, refer to: Stoplamp Switch (417-01 Exterior Lighting, Removal and Installation).

2. Check the adjustment of the stop lamp switch by following the **Check** procedure in this procedure and carry out the **Adjust** procedure if required.

Published: 02-May-2013

Electronic Engine Controls - V6 S/C 3.0L Petrol - Camshaft Position (CMP) Sensor LH

Removal and Installation

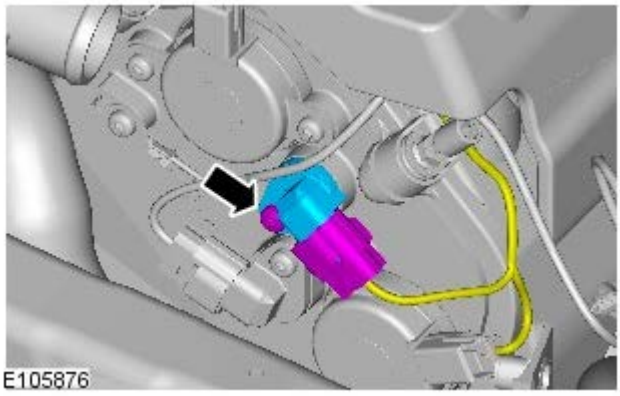
Removal

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. Refer to: Thermostat Housing (303-03, Removal and Installation).



3. 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.

Published: 02-May-2013

Electronic Engine Controls - V6 S/C 3.0L Petrol - Camshaft Position (CMP) Sensor RH

Removal and Installation

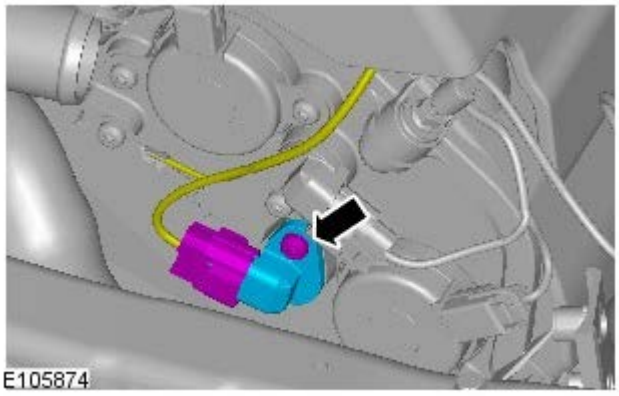
Removal

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: Thermostat Housing (303-03, Removal and Installation).



3. 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 - V6 S/C 3.0L Petrol - Crankshaft Position (CKP) Sensor

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

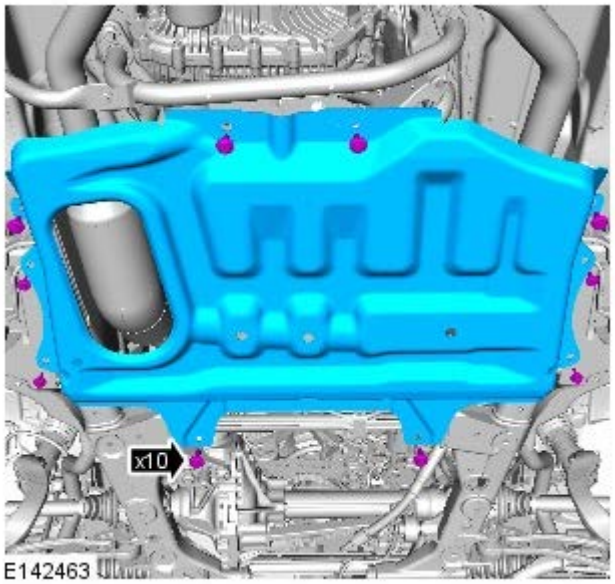
1. Disconnect the battery ground cable.

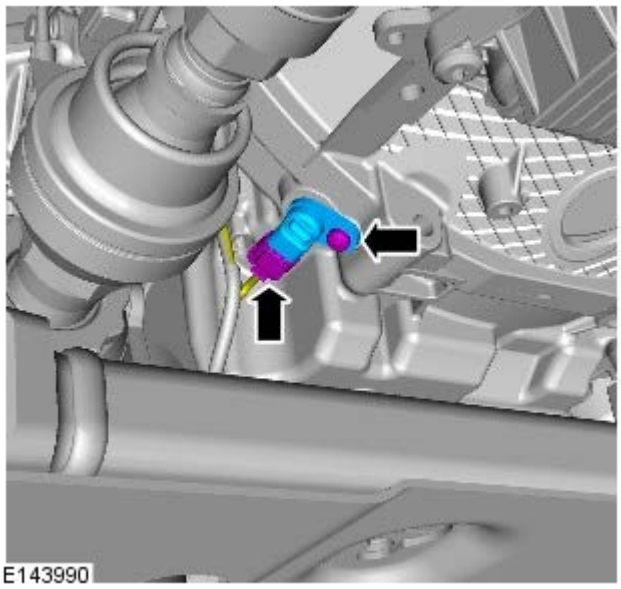
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. *Torque:*
   M10 60 Nm
   M6 10 Nm





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: 02-May-2013

Electronic Engine Controls - V6 S/C 3.0L Petrol - Engine Coolant Temperature (ECT) Sensor

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

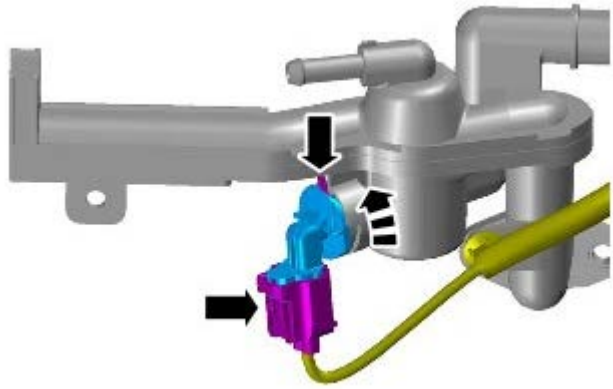
1. WARNING: Make sure to support the vehicle with axle stands.

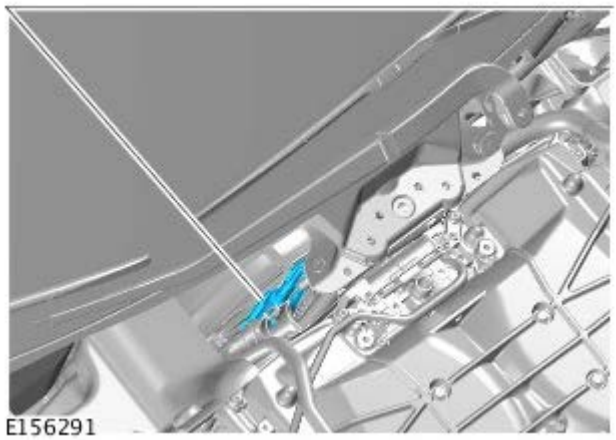
   Raise and support the vehicle.

2. Refer to: Secondary Bulkhead Center Panel - V6 S/C 3.0L Petrol (501-02 Front End Body Panels, Removal and Installation).

3. Refer to: Cooling System Partial Draining, Filling and Bleeding (303-03B Engine Cooling - V6 S/C 3.0L Petrol, General Procedures).

4.





Installation

1. To install, reverse the removal procedure.

Published: 02-May-2013

Electronic Engine Controls - V6 S/C 3.0L Petrol - Engine Oil Level Sensor

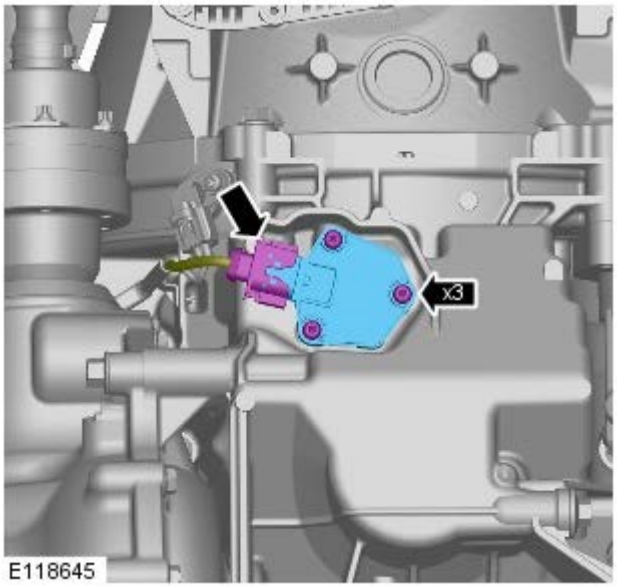
Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).
2. Refer to: Engine Oil Vacuum Draining and Filling (303-01B Engine - V6 S/C 3.0L Petrol, General Procedures).
3. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.



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: 12 Nm

Installation

1. NOTE: Install a new O-ring seal.

   To install, reverse the removal procedure.

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Electronic Engine Controls - V6 S/C 3.0L Petrol - Fuel Rail Pressure (FRP) Sensor

Removal and Installation

Removal

CAUTIONS:

Make sure that all openings are sealed. Use new blanking caps.

Make sure that the tools and equipment are clean, free of foreign material and lubricant.

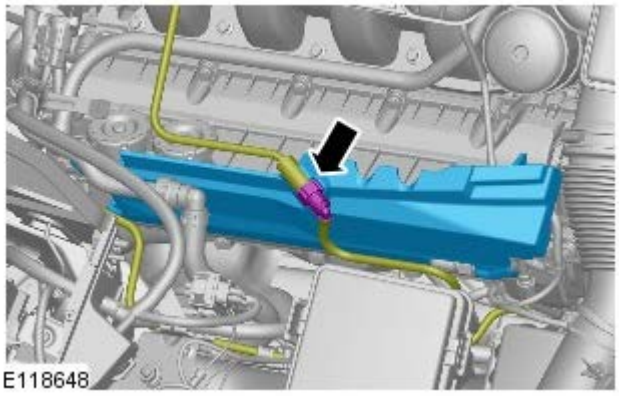
NOTES:

Removal steps in this procedure may contain installation details.

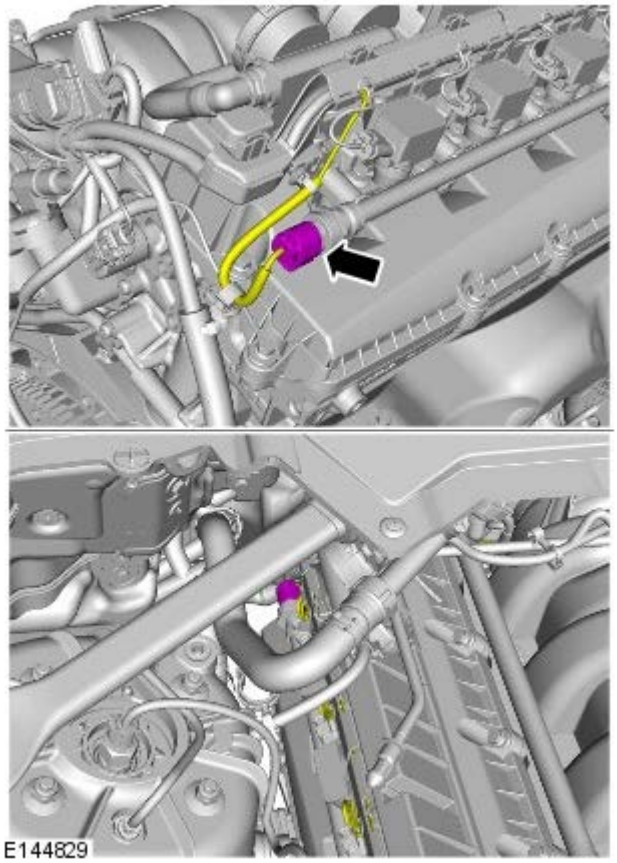
Some variation in the illustrations may occur, but the essential information is always correct.

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 - V6 S/C 3.0L 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 - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (501-05 Interior Trim and Ornamentation, Removal and Installation).
5. Refer to: Cowl Panel Grille (501-02 Front End Body Panels, Removal and Installation).
6. Refer to: Fuel Injection Component Cleaning (303-04C Fuel Charging and Controls - V6 S/C 3.0L Petrol, General Procedures).
7.



8.

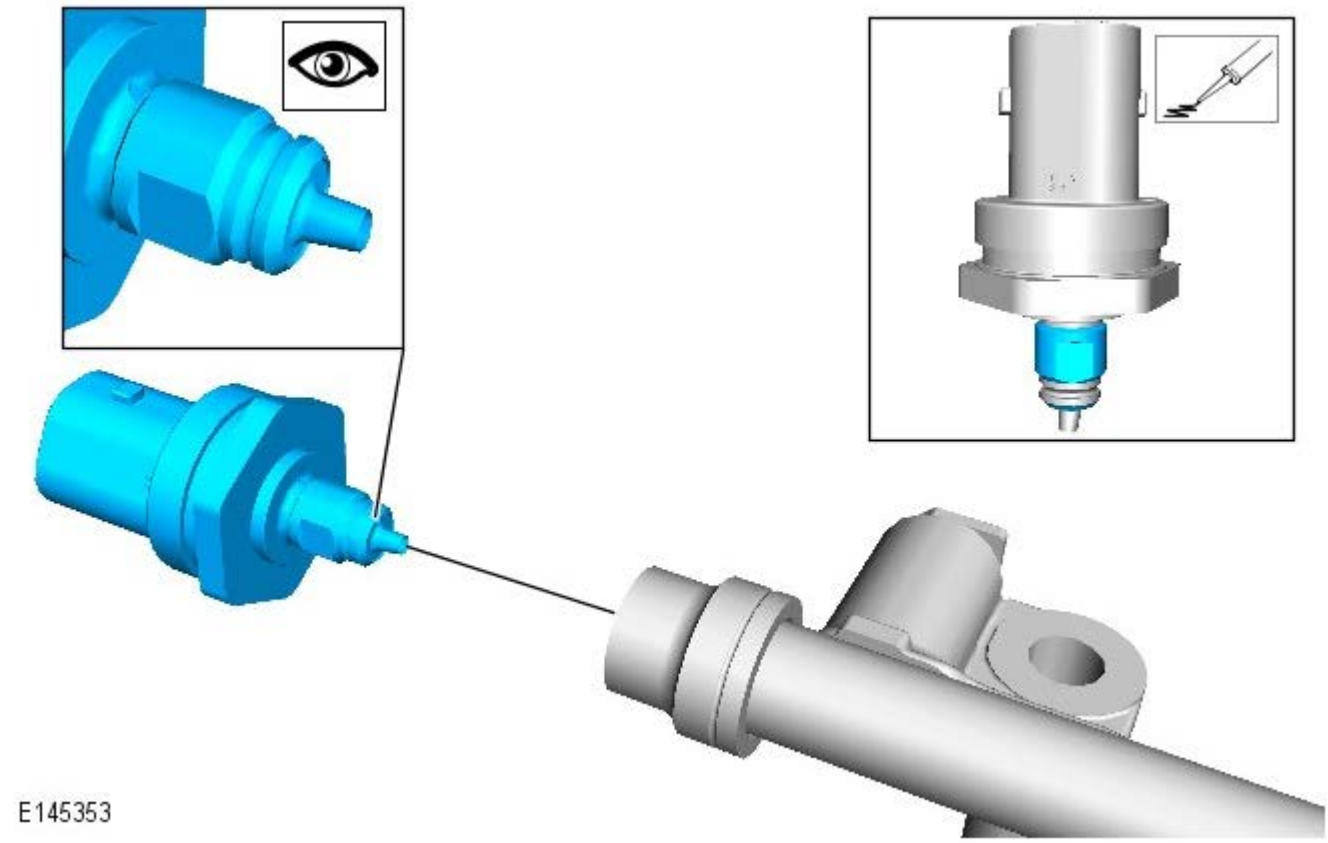


9. CAUTION: Be prepared to collect escaping fluids.

   NOTE: During lubrication, keep the component vertically as shown.

   Lubricate with Molykote W15 as shown.

   Torque: 38 Nm



Installation

1. To install, reverse the removal procedure.

Published: 02-May-2013

Electronic Engine Controls - V6 S/C 3.0L Petrol - Knock Sensor (KS) LH

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

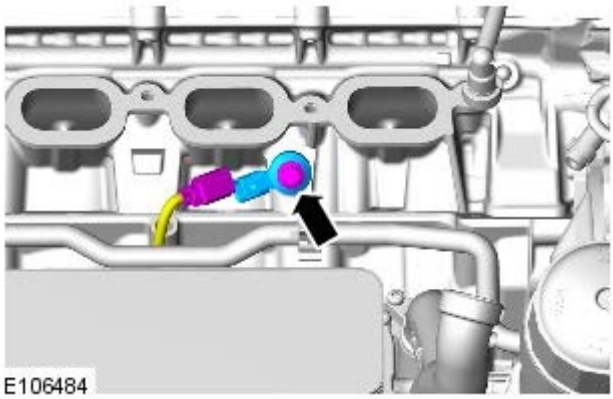
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 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: Supercharger (303-12, Removal and Installation).



4. NOTE: Note the orientation of the component prior to removal.

   Torque: 20 Nm

Installation

1. NOTE: Make sure that the component is installed to the noted removal position.

   To install, reverse the removal procedure.

Published: 02-May-2013

Electronic Engine Controls - V6 S/C 3.0L Petrol - Knock Sensor (KS) RH

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

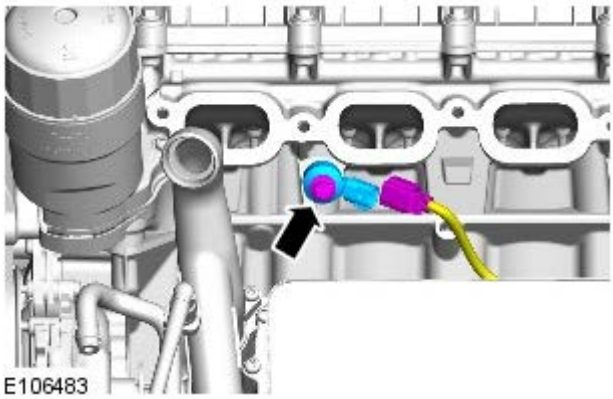
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 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: Supercharger (303-12, Removal and Installation).



4. NOTE: Note the orientation of the component prior to removal.

   Torque: 20 Nm

Installation

1. NOTE: Make sure that the component is installed to the noted removal position.

   To install, reverse the removal procedure.

Published: 02-May-2013

Electronic Engine Controls - V6 S/C 3.0L Petrol - Manifold Absolute Pressure (MAP) Sensor

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

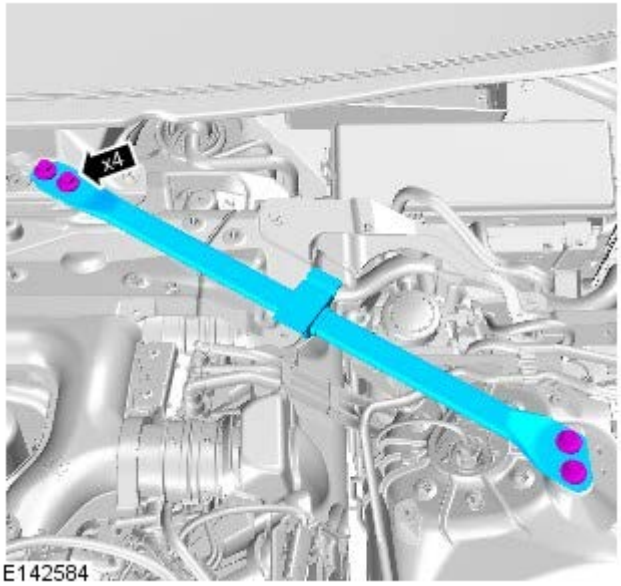
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

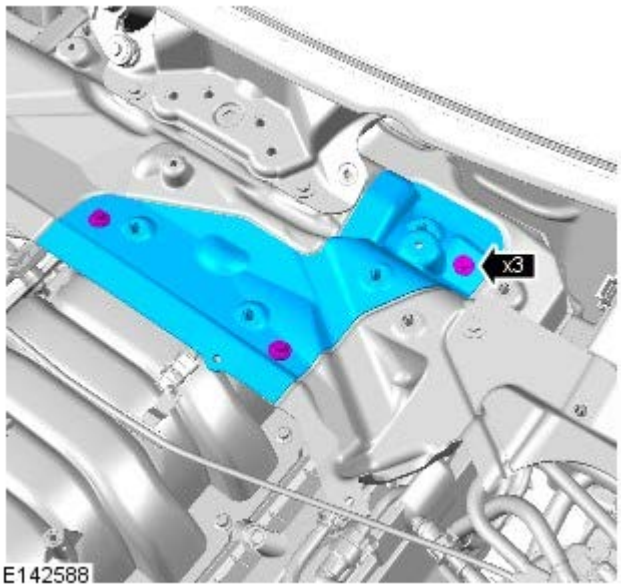
2. Refer to: Engine Cover - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (501-05 Interior Trim and Ornamentation, Removal and Installation).

3. Refer to: Cowl Panel Grille (501-02 Front End Body Panels, Removal and Installation).

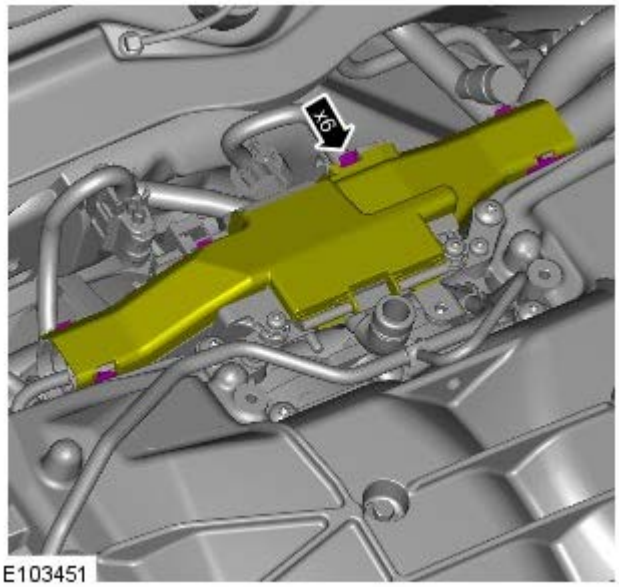
4. *Torque:* 55 Nm



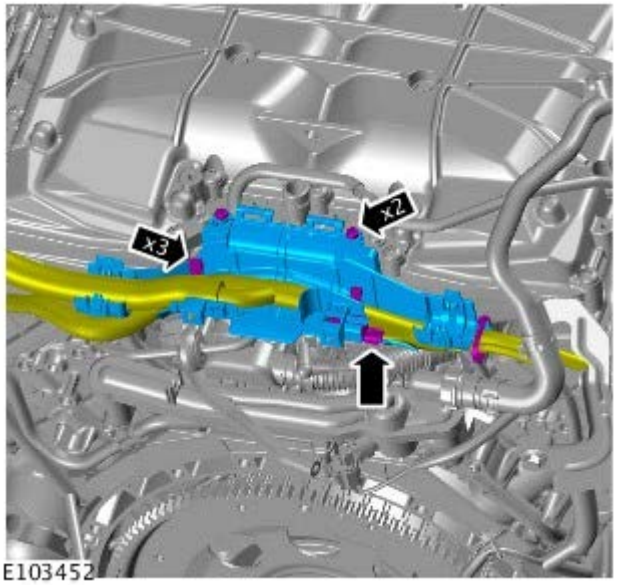
5. *Torque:* 6 Nm



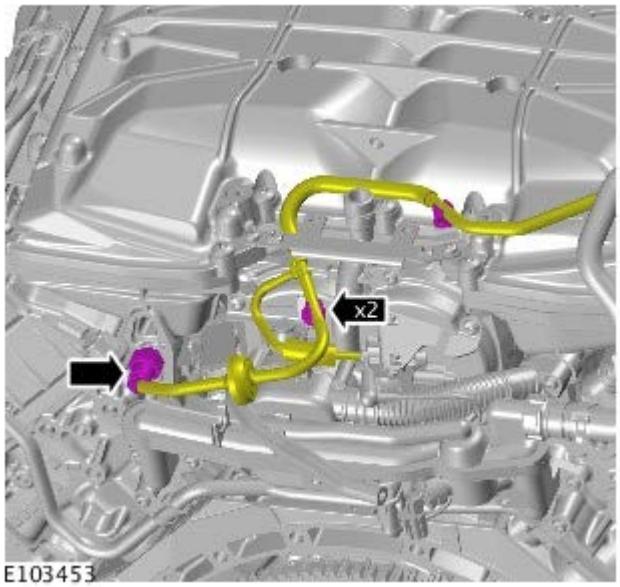
6. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.



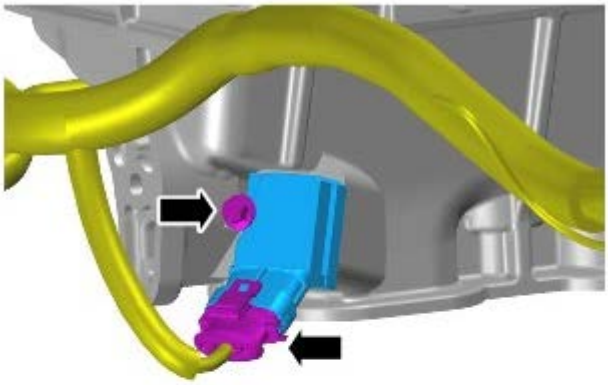
7. *Torque:* 10 Nm

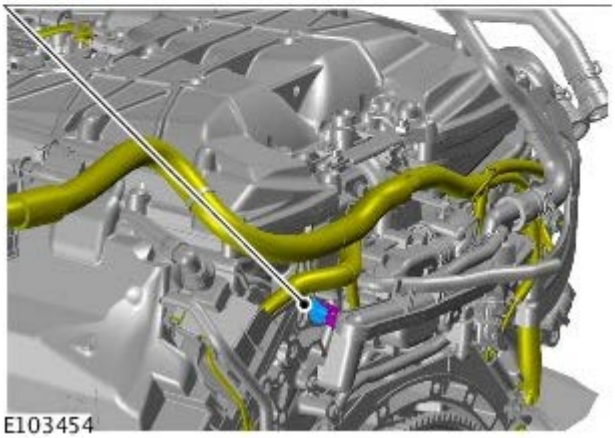


8.



9. *Torque:* 5 Nm





Installation

1. To install, reverse the removal procedure.

Published: 02-May-2013

Electronic Engine Controls - V6 S/C 3.0L Petrol - Variable Valve Timing (VVT) Oil Control Solenoid LH

Removal and Installation

Removal

NOTES:

Removal steps in this procedure may contain installation details.

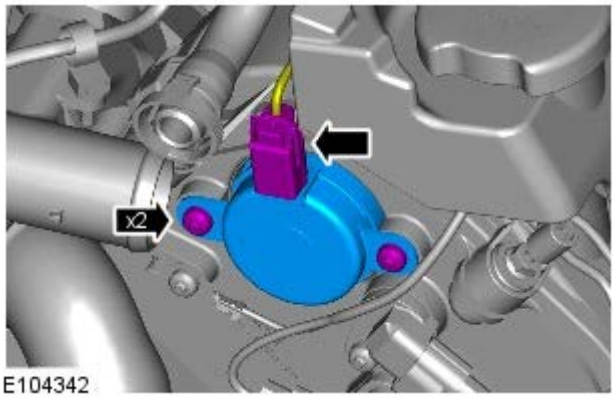
Some variation in the illustrations may occur, but the essential information is always correct.

1. WARNING: Make sure to support the vehicle with axle stands.

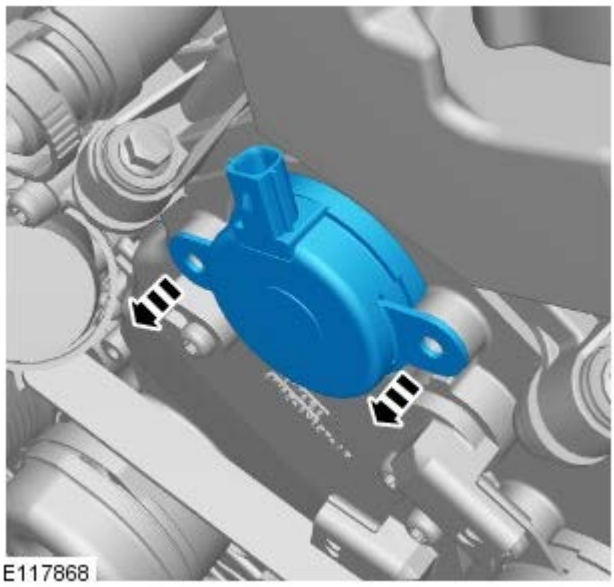
   Raise and support the vehicle.

2. Refer to: Thermostat Housing (303-03B Engine Cooling - V6 S/C 3.0L Petrol, Removal and Installation).

3. *Torque:* 10 Nm



4. CAUTION: Evenly and progressively, remove the VVT units from each side.



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: 02-May-2013

Electronic Engine Controls - V6 S/C 3.0L Petrol - Variable Valve Timing (VVT) Oil Control Solenoid RH

Removal and Installation

Removal

NOTES:

Removal steps in this procedure may contain installation details.

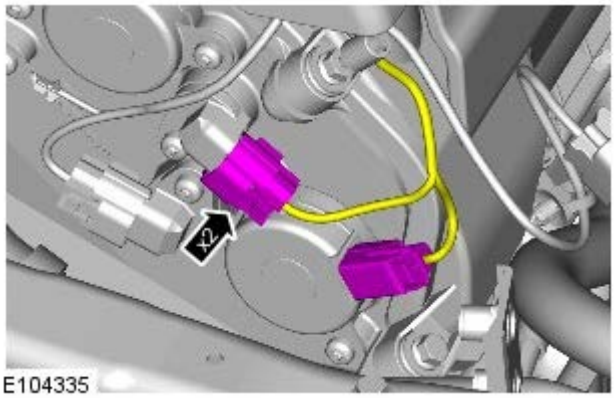
Some variation in the illustrations may occur, but the essential information is always correct.

1. WARNING: Make sure to support the vehicle with axle stands.

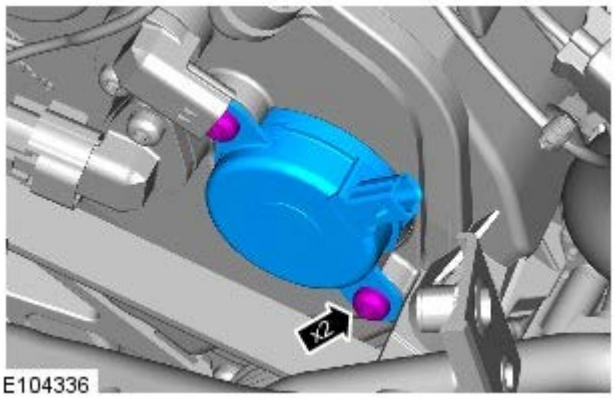
   Raise and support the vehicle.

2. Refer to: Thermostat Housing (303-03B Engine Cooling - V6 S/C 3.0L Petrol, Removal and Installation).

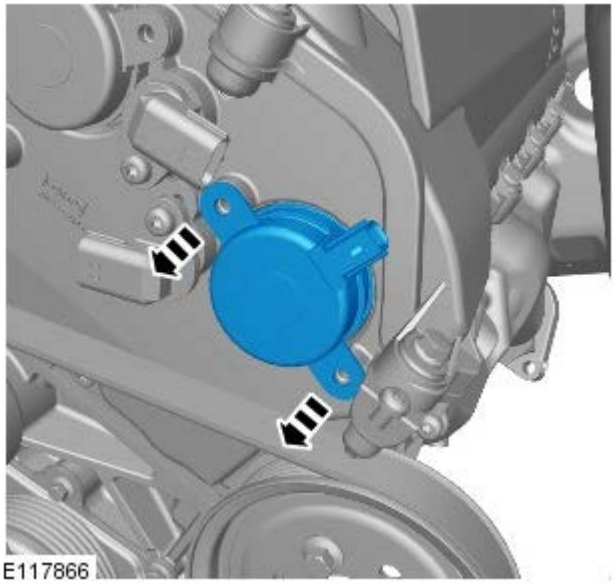
3.



4. *Torque:* 10 Nm



5. CAUTION: Evenly and progressively, remove the VVT units from each side.



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: 02-May-2013

Electronic Engine Controls - V6 S/C 3.0L Petrol - Left Mid catalyst Heated Oxygen Sensor (HO2S)

Removal and Installation

Removal

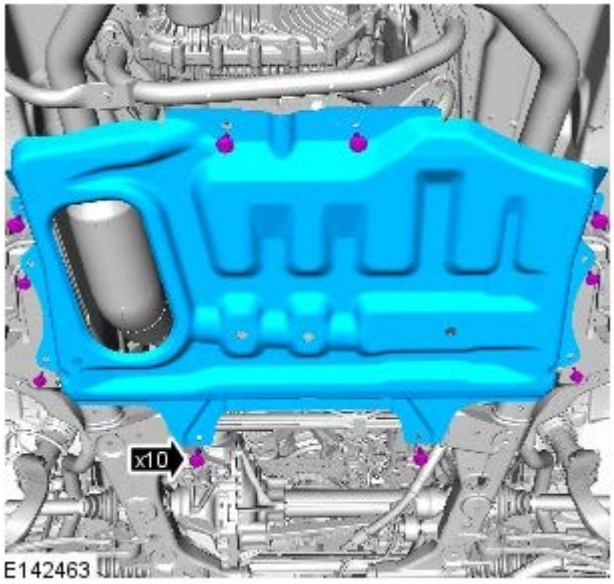
WARNING: Observe due care when working near a hot exhaust system.

NOTE: Removal steps in this procedure may contain installation details.

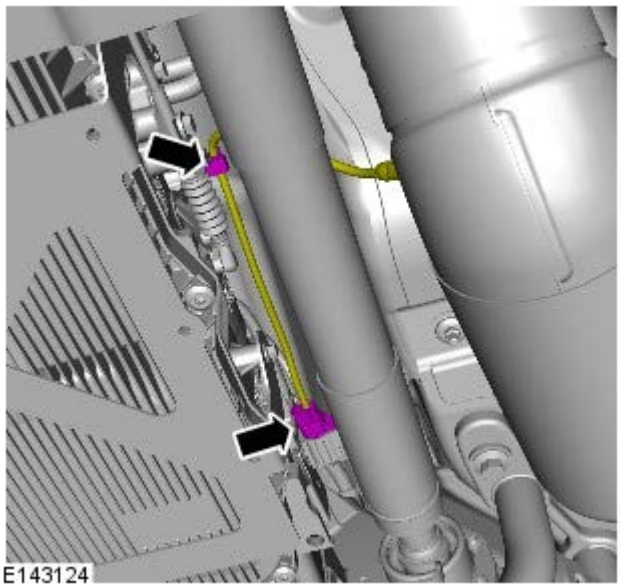
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. *Torque:*
   M10 60 Nm
   M6 10 Nm

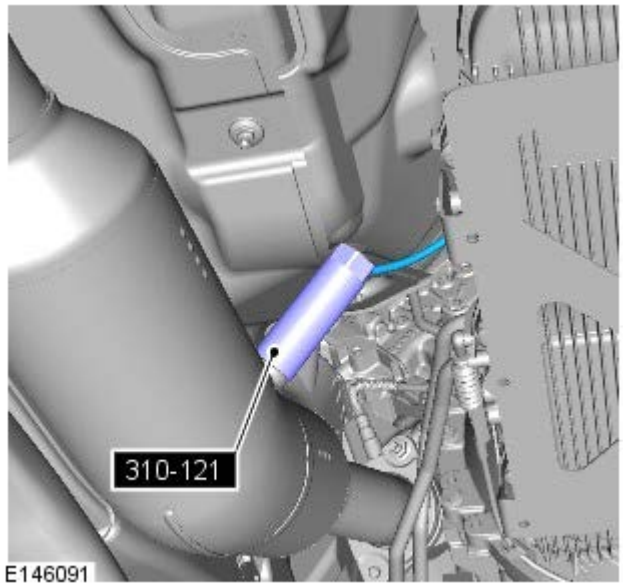


3.



4. 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: 02-May-2013

Electronic Engine Controls - V6 S/C 3.0L Petrol - Right Mid catalyst Heated Oxygen Sensor (HO2S)

Removal and Installation

Removal

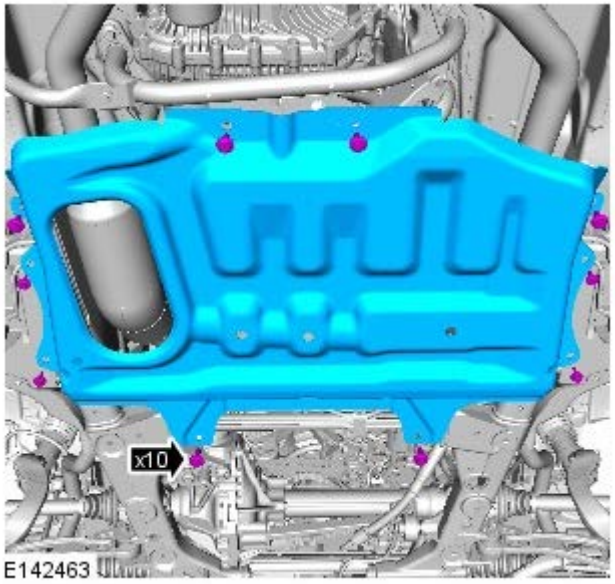
WARNING: Observe due care when working near a hot exhaust system.

NOTE: Removal steps in this procedure may contain installation details.

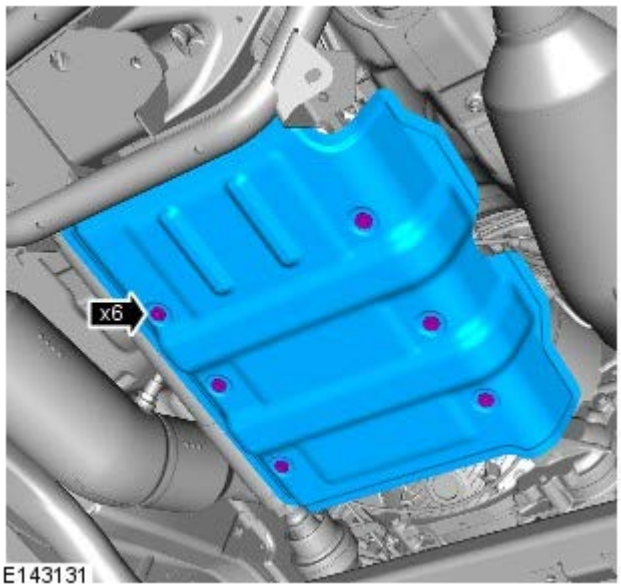
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

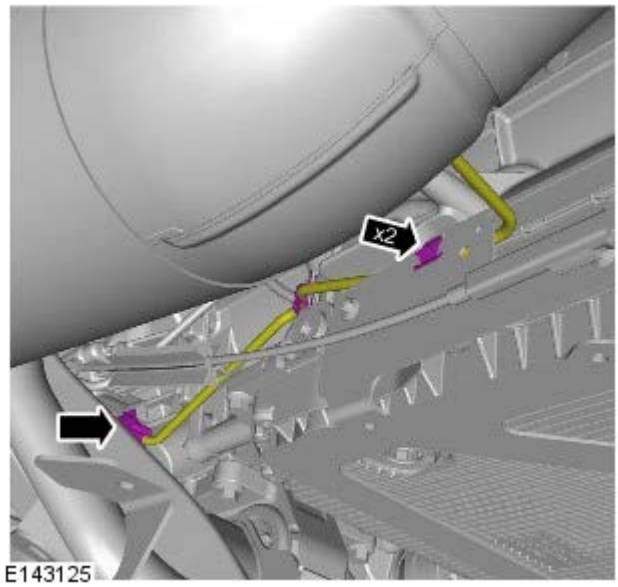
2. *Torque:*
   M10 60 Nm
   M6 10 Nm

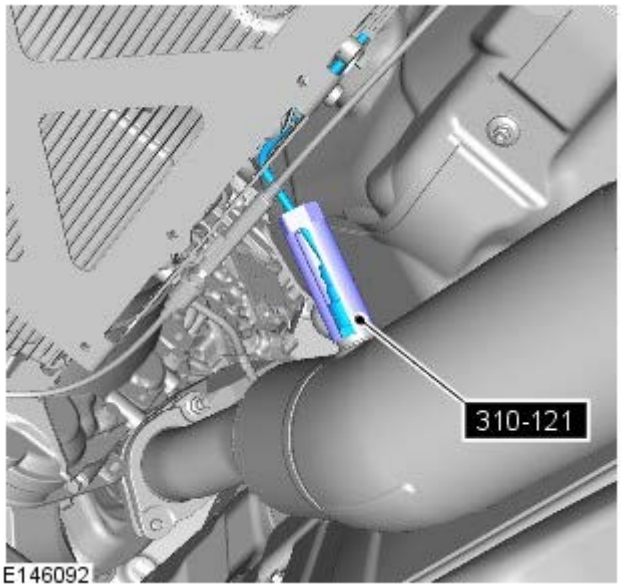


3. *Torque:* 10 Nm



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: 02-May-2013

Electronic Engine Controls - V6 S/C 3.0L Petrol - Pre catalyst Heated Oxygen Sensor (HO2S)

Removal and Installation

Special Tool(s)

	310-121 Wrench, H02S

Removal

WARNING: Observe due care when working near a hot exhaust system.

NOTES:

Removal steps in this procedure may contain installation details.

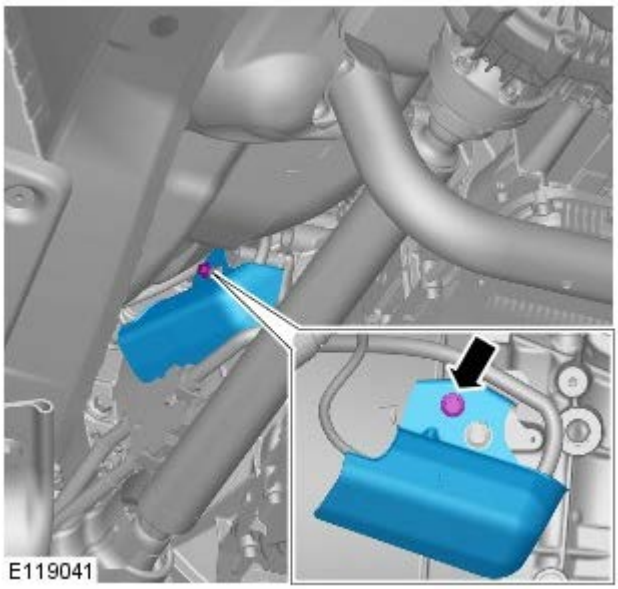
LH illustration shown, RH is similar.

1. WARNING: Make sure to support the vehicle with axle stands.

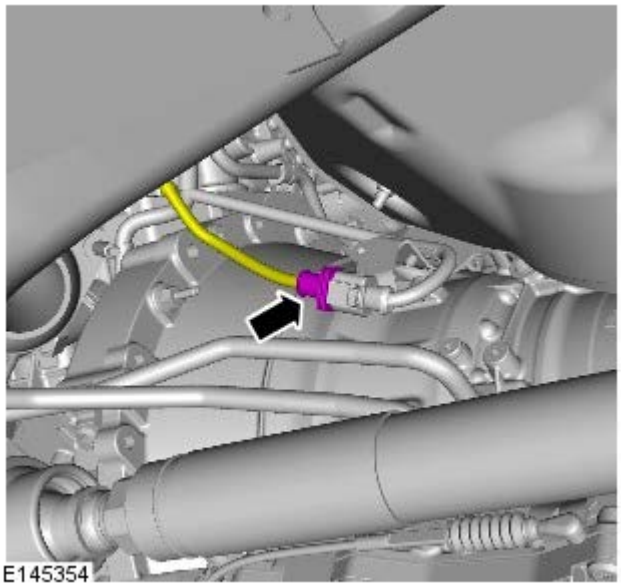
   Raise and support the vehicle.

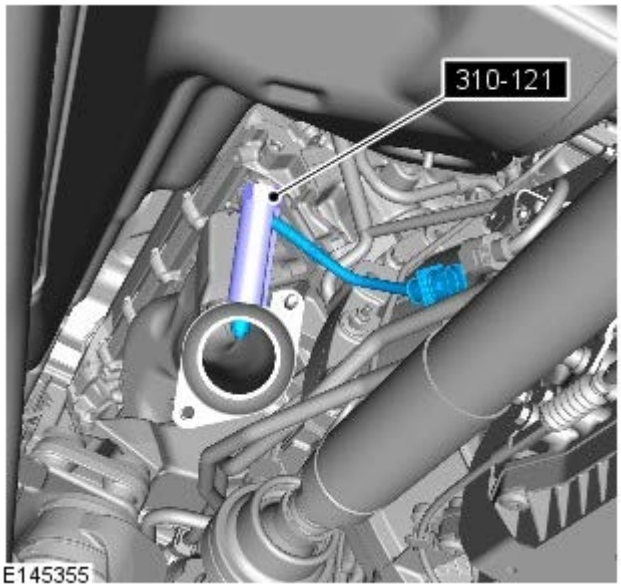
2. Refer to: Exhaust System (309-00B Exhaust System - V6 S/C 3.0L Petrol, Removal and Installation).

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.

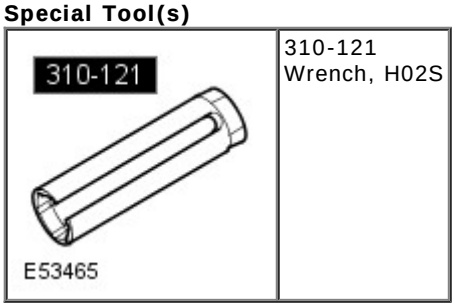
   To install, reverse the removal procedure.

Published: 02-May-2013

Electronic Engine Controls - V6 S/C 3.0L Petrol - Post catalyst Heated Oxygen Sensor (HO2S)

Removal and Installation

Special Tool(s)

	310-121 Wrench, H02S

Removal

WARNING: Observe due care when working near a hot exhaust system.

NOTES:

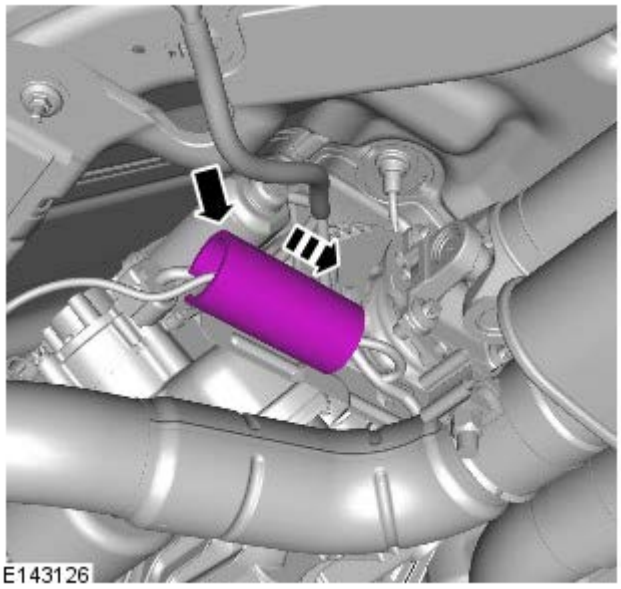
Removal steps in this procedure may contain installation details.

LH illustration shown, RH is similar.

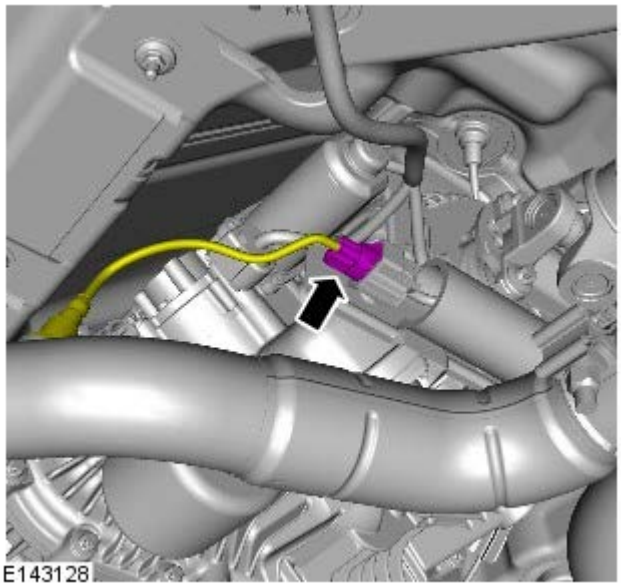
1. WARNING: Make sure to support the vehicle with axle stands.

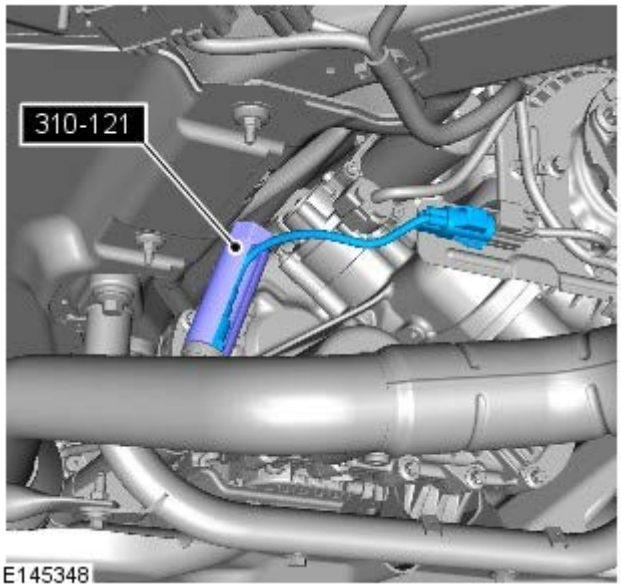
   Raise and support the vehicle.

2.



3.





4. 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: 06-Aug-2012

Electronic Engine Controls - V6 S/C 3.0L Petrol - Mass Air Flow (MAF) Sensor

Removal and Installation

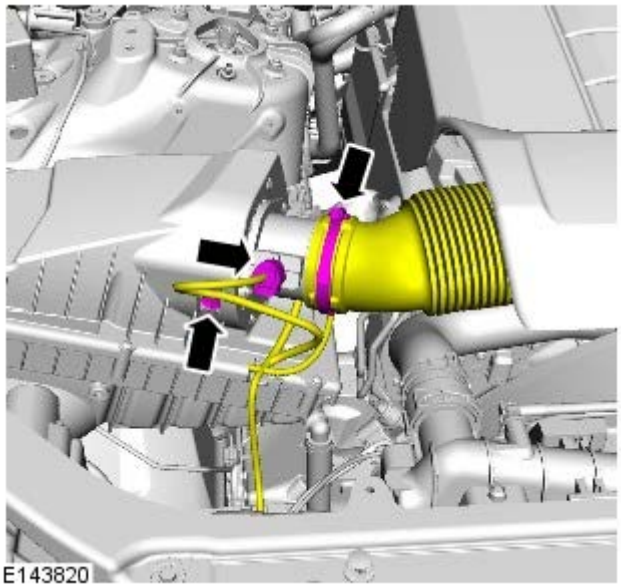
Removal

NOTES:

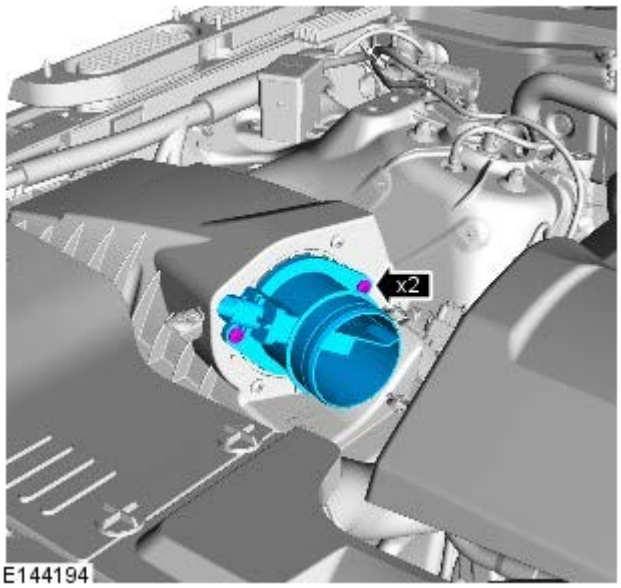
Removal steps in this procedure may contain installation details.

Right-hand shown, left-hand similar.

1. *Torque:* 3.5 Nm



2. *Torque:* 1.6 Nm



Installation

1. To install, reverse the removal procedure.

Published: 07-Sep-2012

Electronic Engine Controls - V6 S/C 3.0L Petrol - Engine Control Module (ECM)

Removal and Installation

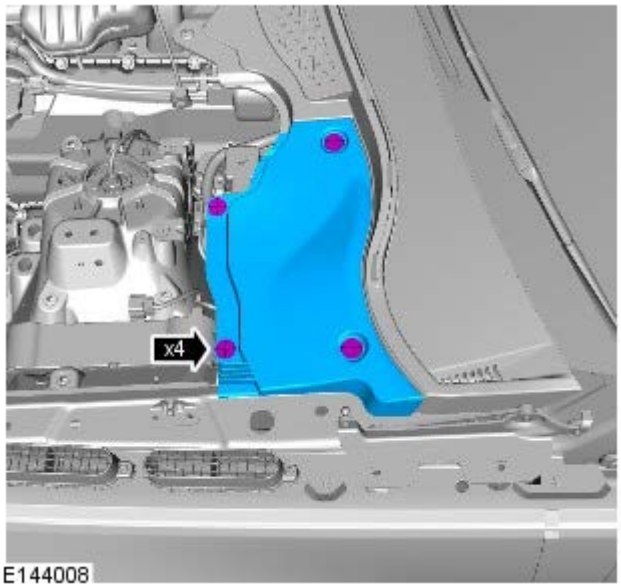
Removal

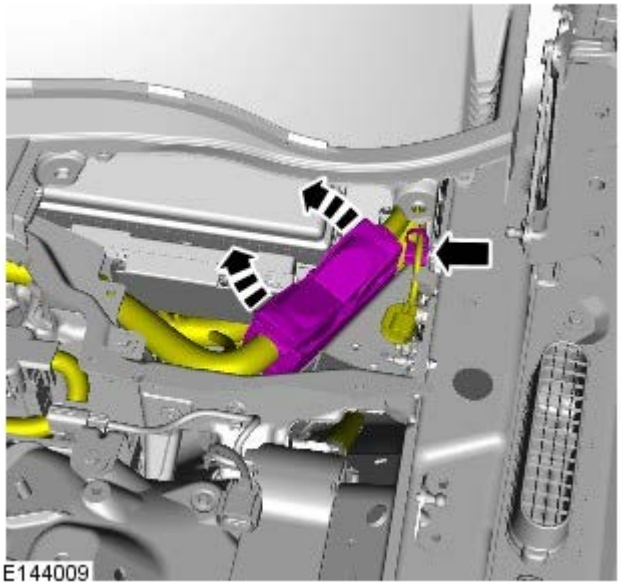
NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

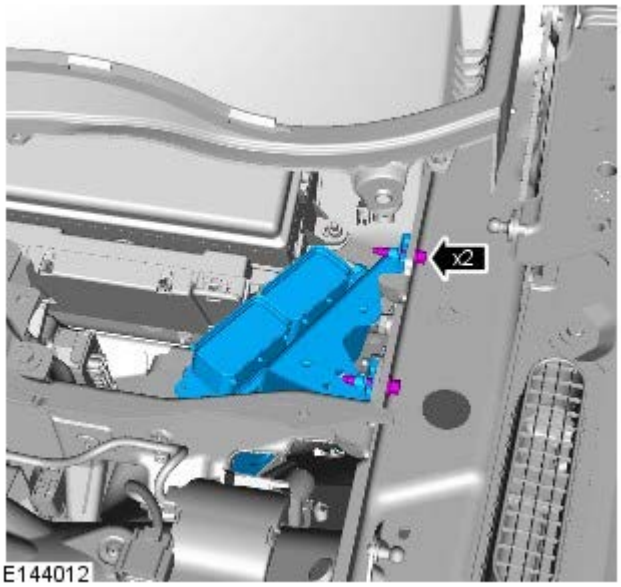
2.





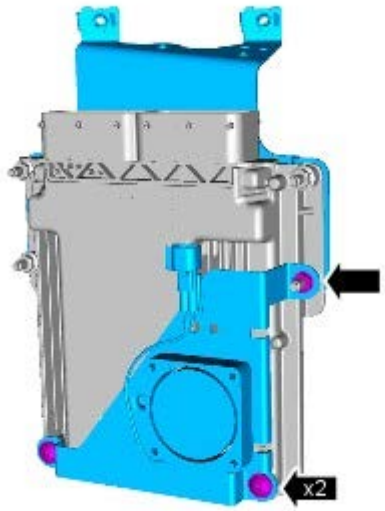
3. CAUTION: Before the disconnection or removal of any components, make sure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

4. *Torque:* 9 Nm



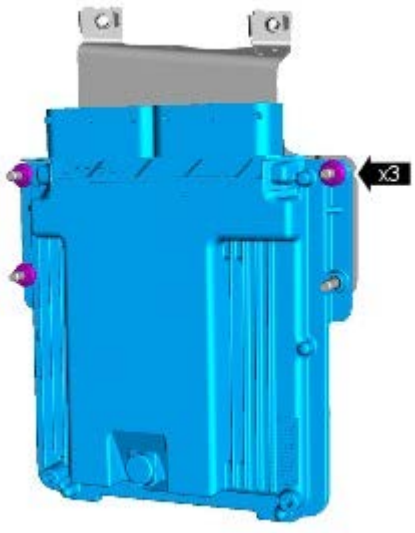
E144012

5. *Torque:* 9 Nm



E144010

6. *Torque:* 9 Nm



E144011

Installation

1. To install, reverse the removal procedure.
2. If a new unit is installed, configure using the approved diagnostic tool.

Published: 11-Sep-2012

Electronic Engine Controls - V8 S/C 5.0L Petrol -

Torque Specifications

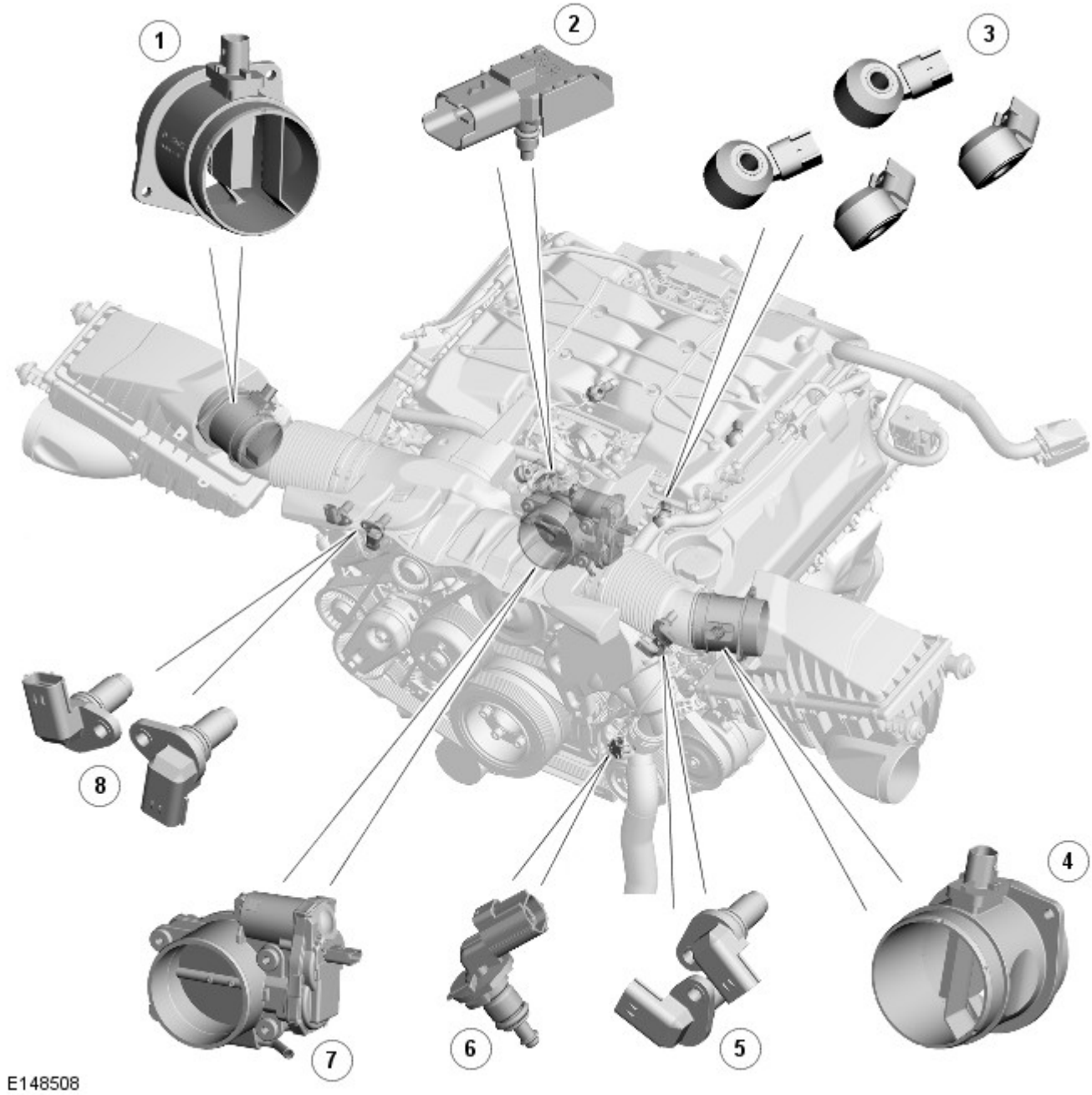
Description	Nm	lb-ft	lb-in
Camshaft position (CMP) sensor(s) retaining bolt	10	7	-
Crankshaft position (CKP) sensor retaining bolt	10	7	-
Heated oxygen sensor(s) (HO2S)	48	35	-
Knock sensor(s) (KS) retaining bolt	20	15	-
Fuel rail pressure (FRP) sensor	33	24	-
Fuel rail pressure and temperature sensor (FRPT) sensor	38	28	-
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	-
Mass air flow (MAF) sensor screw	1.6	-	14.1
Engine control module (ECM) bracket to body retaining bolt	9	-	80
ECM to bracket retaining nut	9	-	80
Transmission undershield M10 bolt	60	44	-
Transmission undershield M6 bolt	10	7	-

Published: 27-May-2013

Electronic Engine Controls - V8 S/C 5.0L Petrol - Electronic Engine Controls

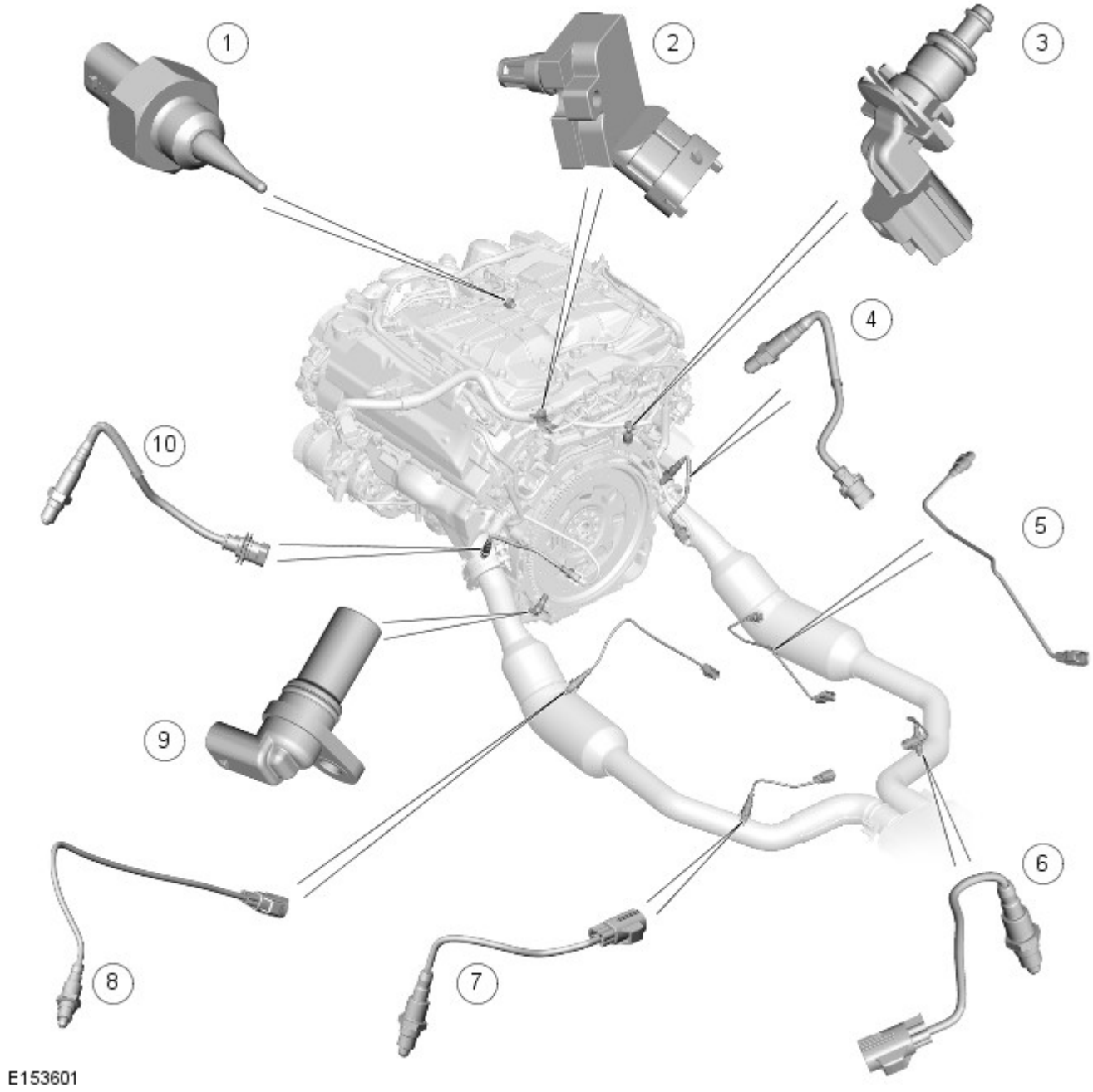
Description and Operation

COMPONENT LOCATION - SHEET 1 OF 3



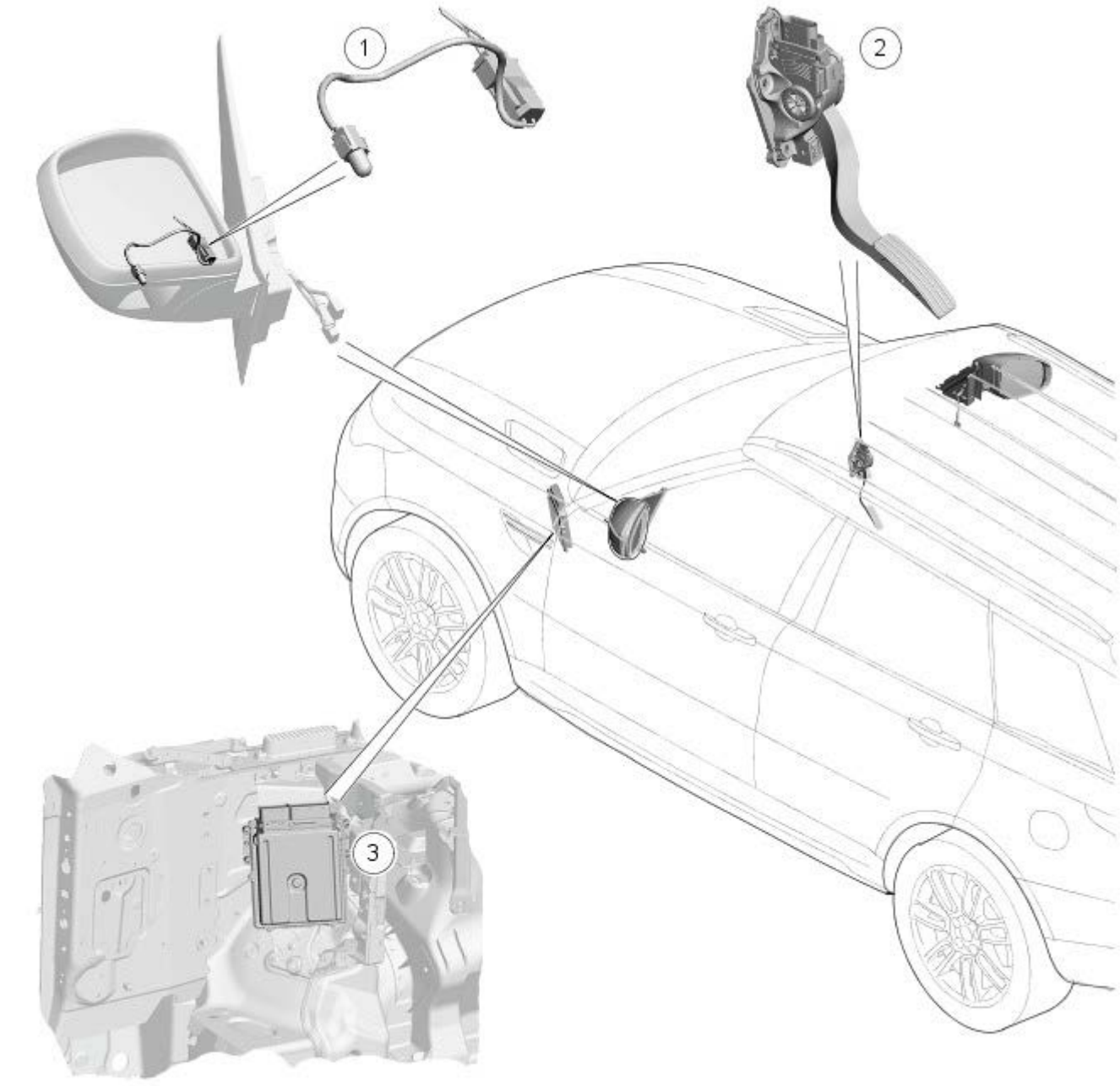
Item	Part Number	Description
1	-	Right Mass Air Flow and Temperature (MAFT) sensor
2	-	Manifold Absolute Pressure (MAP) sensor
3	-	Knock sensors (4 off)
4	-	Left Mass Air Flow and Temperature (MAFT) sensor
5	-	Camshaft Position (CMP) sensors (2 off)
6	-	Engine Coolant Temperature (ECT 2) sensor 2
7	-	Electric throttle
8	-	Camshaft Position (CMP) sensors (2 off)

COMPONENT LOCATION - SHEET 2 OF 3



Item	Part Number	Description
1	-	Charge air temperature sensor
2	-	Manifold Absolute Pressure and Temperature (MAPT) sensor
3	-	Engine Coolant Temperature (ECT 1) sensor 1
4	-	Right pre catalyst Heated Oxygen (HO2S) sensor
5	-	Right mid catalyst Heated Oxygen (HO2S) sensor
6	-	Right post catalyst Heated Oxygen (HO2S) sensor
7	-	Left post catalyst Heated Oxygen (HO2S) sensor
8	-	Left mid catalyst Heated Oxygen (HO2S) sensor
9	-	Crankshaft Position (CKP) sensor
10	-	Left pre catalyst Heated Oxygen (HO2S) sensor

COMPONENT LOCATION - SHEET 3 OF 3



E153662

Item	Part Number	Description
1	-	Ambient Air Temperature (AAT) sensor
2	-	Accelerator Pedal Position (APP) sensor
3	-	Engine Control Module (ECM)

OVERVIEW

The electronic engine control system operates the engine to generate the output demanded by the accelerator pedal and loads imposed by other systems. The electronic engine control 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 electronic engine control 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.

DESCRIPTION

Engine Control Module



E148512

The ECM is installed in the rear left corner of the engine compartment, behind the secondary bulkhead panel. The ECM is attached to brackets on the wheel housing and the fender outer support panel.

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.
- Charge air temperature sensor.
- TPS (Throttle Position) sensor.
- Heated Oxygen (HO2S) sensors (6 off).
- APP (Accelerator Pedal Position) sensor.
- AAT (Ambient Air Temperature) sensor.
- Supercharger bypass valve actuator.
  For additional information, refer to: Intake Air Distribution and Filtering (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Description and Operation).
- FRPT (Fuel Rail Pressure and Temperature) sensor.
  For additional information, refer to: Fuel Charging and Controls (303-04D Fuel Charging and Controls - V8 S/C 5.0L Petrol, Description and Operation).
- Engine cooling fans.
  For additional information, refer to: Engine Cooling (303-03C Engine Cooling - V8 S/C 5.0L Petrol, Description and Operation).
- Brake pedal switch.
  For additional information, refer to: Braking Control System (206-11 Brake Controls, Description and Operation).
- Oil level and temperature sensor.
  For additional information, refer to: Engine (303-01C Engine - V8 S/C 5.0L Petrol, Description and Operation).
- Flex fuel sensor (where fitted).
  For additional information, refer to: Fuel Tank and Lines (310-01C Fuel Tank and Lines - V8 S/C 5.0L Petrol, Description and Operation).
- Fuel LP (low pressure) sensor.
  For additional information, refer to: Fuel Tank and Lines (310-01C Fuel Tank and Lines - V8 S/C 5.0L Petrol, Description and Operation).
- FPDM (Fuel Pump Driver Module.
  For additional information, refer to: Fuel Tank and Lines (310-01C Fuel Tank and Lines - V8 S/C 5.0L Petrol, Description and Operation).
- TCS (Transmission Control Switch).
  For additional information, refer to: External Controls (307-05A Automatic Transmission/Transaxle External Controls - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, Description and Operation).
- RCM (Restrains Control Module).
  For additional information, refer to: Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) (501-20B Supplemental Restraint System, Description and Operation).

The ECM provides outputs to the following:

- Electric throttle.
- ECM relay.
- Fuel injectors (8 off).
  For additional information, refer to: Fuel Charging and Controls (303-04D Fuel Charging and Controls - V8 S/C 5.0L Petrol, Description and Operation).
- Ignition coils (8 off).
  For additional information, refer to: Engine Ignition (303-07B Engine Ignition - V8 S/C 5.0L Petrol, Description and Operation).
- VCT (Variable Camshaft Timing) solenoids (4 off).
  For additional information, refer to: Engine (303-01C Engine - V8 S/C 5.0L Petrol, Description and Operation).
- Evaporative emissions purge valve.
  For additional information, refer to: Evaporative Emissions (303-13B Evaporative Emissions - V8 S/C 5.0L Petrol,

Description and Operation).
- Engine starter relay.
  For additional information, refer to: Starting System (303-06C Starting System - V8 S/C 5.0L Petrol, Description and Operation).
- Engine cooling fans.
  For additional information, refer to: Engine Cooling (303-03C Engine Cooling - V8 S/C 5.0L Petrol, Description and Operation).
- Supercharger bypass valve actuator.
  For additional information, refer to: Intake Air Distribution and Filtering (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Description and Operation).
- Charge air coolant pump relay.
  For additional information, refer to: Supercharger Cooling (303-03E Supercharger Cooling - V8 S/C 5.0L Petrol, Description and Operation).
- HP fuel pumps.
  For additional information, refer to: Fuel Charging and Controls (303-04D Fuel Charging and Controls - V8 S/C 5.0L Petrol, Description and Operation).
- FPDM (Fuel Pump Driver Module.
  For additional information, refer to: Fuel Tank and Lines (310-01C Fuel Tank and Lines - V8 S/C 5.0L Petrol, Description and Operation).
- DMTL (diagnostic module tank leakage) pump (where fitted).
  For additional information, refer to: Evaporative Emissions (303-13B Evaporative Emissions - V8 S/C 5.0L Petrol, Description and Operation).

Crankshaft Position Sensor



E148504

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 oil pan, 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.

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.

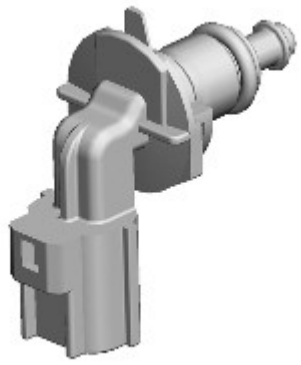
Each CMP sensor is secured with a single screw and sealed with an O-ring. On each CMP sensor, a three pin electrical connector provides the interface with the engine harness.

The head of each CMP sensor faces a reluctor ring attached to the front of the related VCT actuator.

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 Bank1 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.

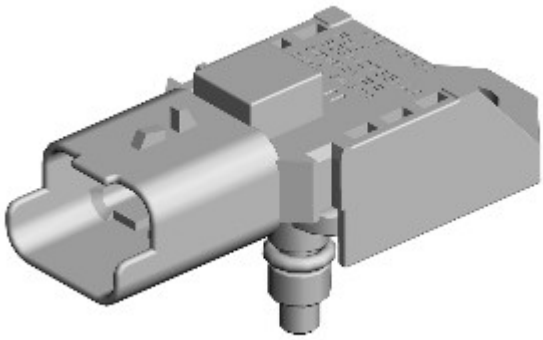
Two knock sensors are installed on the inboard side of each cylinder head, one mid-way between the front two cylinders, and one mid-way between the rear two cylinders. Each knock sensor is secured with a single screw. On each knock sensor, a two pin electrical connector provides the interface with the 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



E148520

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 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



E148513

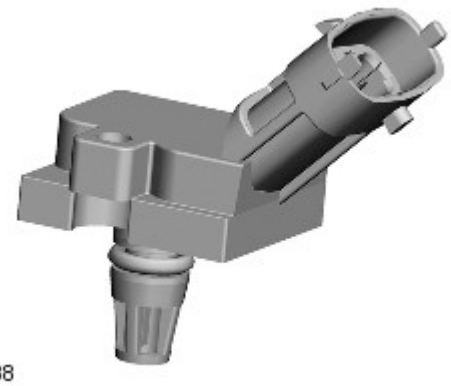
The MAFT sensors allow the ECM to measure the mass flow and the temperature of the air flow into the engine. The mass air flow is measured with a hot film element in the sensor. The temperature of the air flow is measured with a NTC thermistor in the sensor. The mass air flow is used to determine the fuel quantity to be injected in order to maintain the stoichiometric air:fuel mixture required for correct operation of the engine and the catalytic converters.

Identical MAFT sensors are attached to each of the air cleaner outlets. 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 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

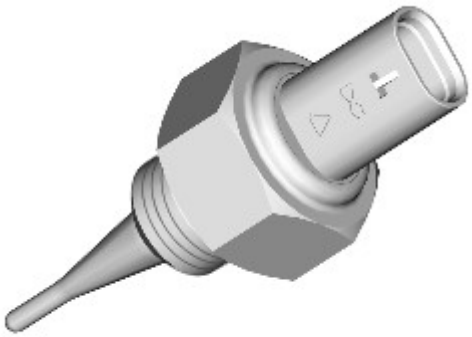


E116088

The MAPT sensor allows the ECM to calculate the charge air 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 rear of the LH intake manifold. 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.

Charge Air Temperature Sensor



E149162

The charge air temperature sensor is installed in the supercharger intercooler top cover. A two pin electrical connector provides the interface between the sensor and the engine harness. The sensor contains an NTC thermistor with supply and return connections to the ECM.

The ECM supplies the charge air temperature sensor with a 5 V reference voltage and translates the return voltage into a temperature. The ECM uses the input:

- To monitor operation of the charge air coolant pump
- For air mass calculations used in control of the supercharger bypass valve, as part of the charge air strategy that co-ordinates operation of the electric throttle and the bypass valve, and predicts the air mass delivered to the cylinders.

NOTE: The charge air temperature sensor is introduced together with the electric actuator for the SC (supercharger) bypass valve (in place of the vacuum actuator), which enables more accurate control of the bypass air flow.

If the charge air temperature sensor fails, the ECM substitutes the input with a modeled temperature. Failure of the sensor is unlikely to be noticeable to the driver.

Throttle Position Sensors

The TPS sensors allow the ECM to determine the position and angular rate of change of the throttle blade.

There are two TPS sensors located in the electric throttle. See below for details of the electric throttle.

If a TPS 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 TPS sensor, the engine will suffer from poor running and throttle response.

Heated Oxygen Sensors



E148505

A pre catalyst HO2S is installed in the outlet of each exhaust manifold, which enables independent closed loop control of the air:fuel mixture for each cylinder bank.

NOTE: A mid catalyst and a post catalyst HO2S (heated oxygen sensor) is installed in each branch of the exhaust system. Together with the pre catalyst sensors, these are used by the ECM (engine control module) to monitor the performance of the catalytic converters.

The heater elements of the pre catalyst HO2S 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 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 pre catalyst sensors.

The pre catalyst HO2S sensor produces a constant voltage, with a variable current that is proportional to the lambda ratio. The ECM monitors the pre catalyst HO2S by checking the signal against maximum and minimum threshold, for open and short circuit conditions. If a HO2S fails:

- The ECM defaults to open loop fueling for the related cylinder bank
- The CO (carbon monoxide) and emissions content of the exhaust gases increases
- The exhaust smells of rotten eggs (hydrogen sulphide).

With a failed pre catalyst HO2S the engine will suffer from unstable operation and reduced performance.

Accelerator Pedal Position Sensor



E141165

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 control module) and the TCM (Transmission Control Module), to determine the setting of the electric throttle.

The APP sensor is integrated into the accelerator pedal, which is attached to 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



E116093

The AAT 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) Powertrain bus for use by other control modules.

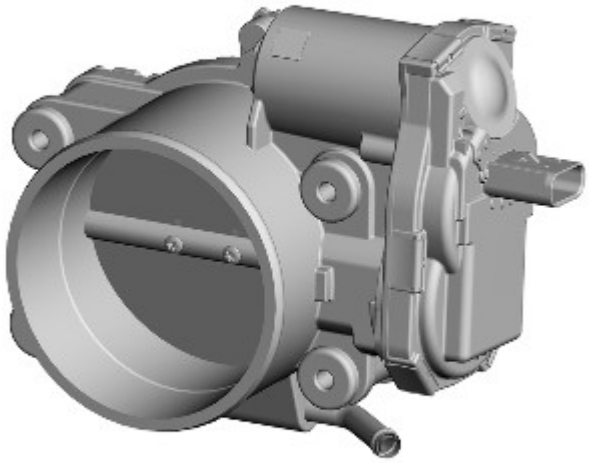
The AAT sensor is installed in the left exterior mirror, with the bulb of the sensor positioned over a hole in the bottom of the mirror casing.

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).

Electric Throttle



E148517

The ECM uses the electric throttle to regulate engine torque.

The electric throttle is installed between the clean air duct and the supercharger.
For additional information, refer to: Intake Air Distribution and Filtering (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, 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 map to determine the required position of the throttle plate. The ECM and electric throttle are also required to:

- Monitor requests for cruise control operation
- Automatically operate the electric 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.

OPERATION

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 (Engine Junction Box).

When the ignition is turned on, battery voltage is applied to the ignition sense input from the CJB (Central Junction Box). 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)
- Up to 5 minutes when cooling fans are required.

On completion of the power down routines the ECM de-energizes the ECM relay.

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 HO2S sensors
- The MAFT sensors
- The CKP sensor
- Electric 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.

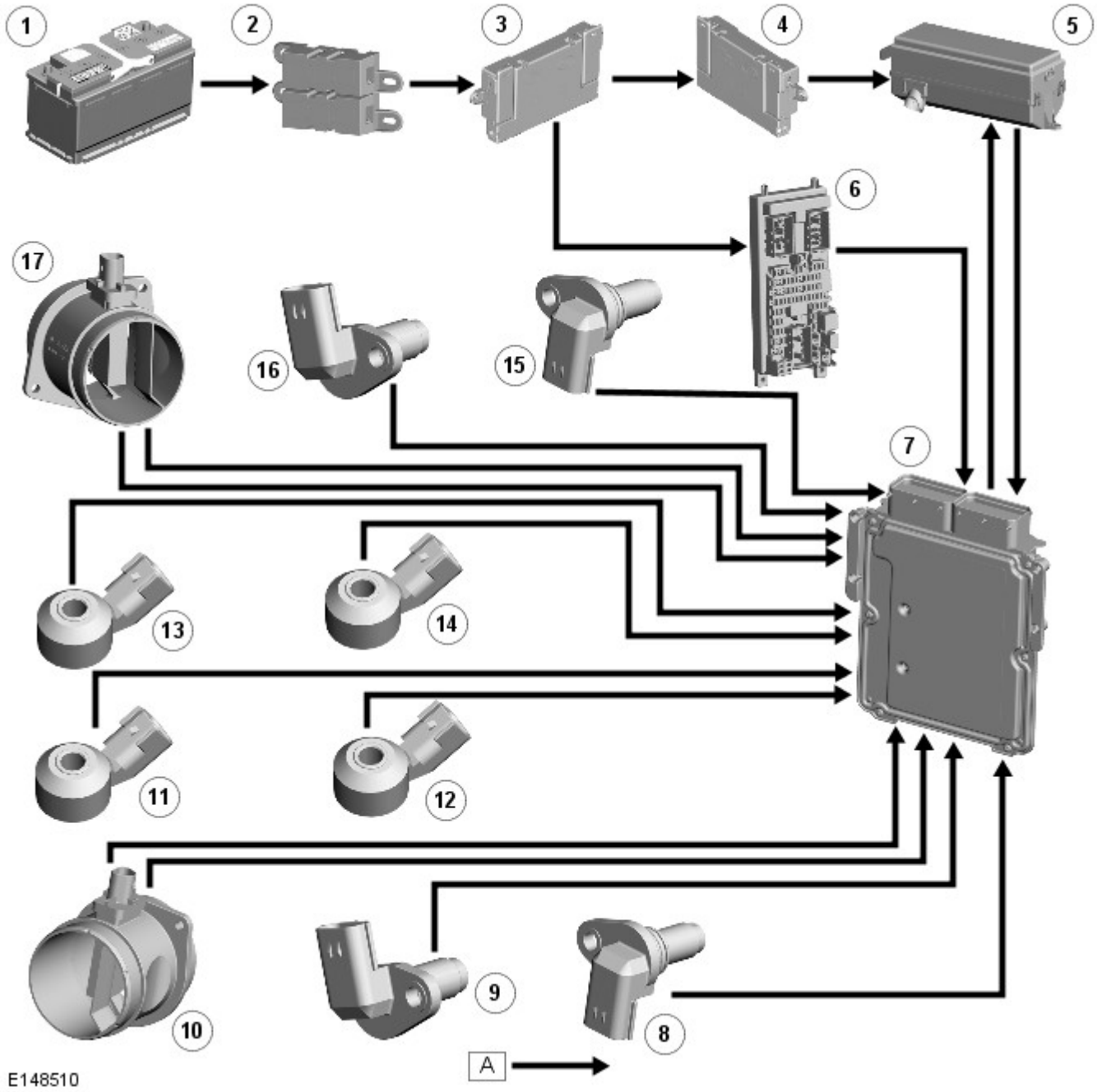
The ECM monitors the number of misfire occurrences within two engine revolution ranges. If the ECM determines a misfire failure within either of these two ranges, over two consecutive journeys, it will record a fault code and details of the engine speed, engine load and engine coolant temperature. In 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. The ECM 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 judgment 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.

Control Diagram - Sheet 1 of 2

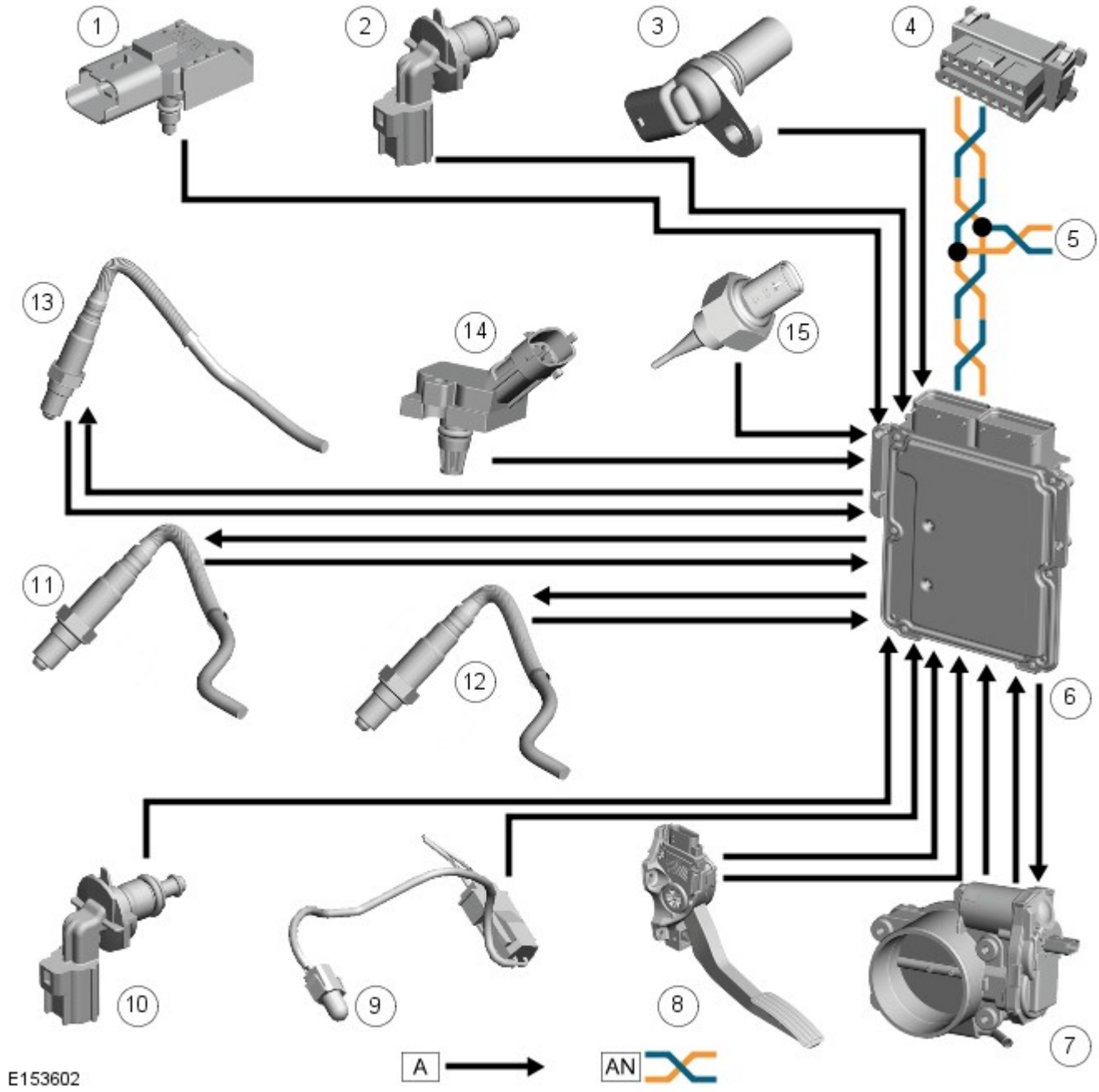


A = Hardwired.

Item	Part Number	Description
1	-	Battery
2	-	Battery Junction Box 2 (BJB2)
3	-	Battery Junction Box (BJB)
4	-	Auxiliary Junction Box (AJB)
5	-	Engine Junction Box (EJB)
6	-	Central Junction Box (CJB)
7	-	Engine Control Module (ECM)
8	-	Left intake Camshaft Position (CMP) sensor
9	-	Left exhaust Camshaft Position (CMP) sensor
10	-	Left Mass Air Flow and Temperature (MAFT) sensor
11	-	Left front knock sensor
12	-	Left rear knock sensor
13	-	Right rear knock sensor
14	-	Right front knock sensor
15	-	Right intake Camshaft Position (CMP) sensor
16	-	Right exhaust Camshaft Position (CMP) sensor
17	-	Right Mass Air Flow and Temperature (MAFT) sensor

Control Diagram - Sheet 2 of 2

NOTE: A = Hardwired, AN = High speed CAN (Controller Area Network) Powertrain bus.



Item	Part Number	Description
1	-	Manifold Absolute Pressure (MAP) sensor
2	-	Engine Coolant Temperature sensor (ECT 2)
3	-	Crankshaft Position (CKP) sensor
4	-	Diagnostic connector
5	-	High speed CAN connection to other system control modules
6	-	Engine Control Module (ECM)
7	-	Electric throttle
8	-	Accelerator Pedal Position (APP) sensor
9	-	Ambient Air Temperature (AAT) sensor
10	-	Engine Coolant Temperature sensor (ECT 1)
11	-	Right and left mid catalyst heated oxygen sensor (2 off)
12	-	Right and left post catalyst heated oxygen sensor (2 off)
13	-	Right and left pre catalyst heated oxygen sensor (2 off)
14	-	Manifold Absolute Pressure and Temperature (MAPT) sensor
15	-	Charge air temperature sensor

Published: 12-Feb-2013

Electronic Engine Controls - V8 S/C 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 (303-14C Electronic Engine 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
• Engine oil level • Cooling system coolant level • Fuel level • Fuel contamination/grade/quality • Fuel leaks • Front end accessory drive belt • Air filter and induction hoses • Exhaust system • Charge air intake system • Supercharger	• Fuses • Wiring harness • Electrical connector(s) • 5 volt sensor supply • Sensor(s) • Engine control module • Transmission 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.

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. Check for ignition system, fuel system and electronic engine control DTCs and refer to the relevant DTC Index
Engine cranks and fires, but will not start	• 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 • Exhaust gas recirculation valve stuck open • Fuel pump • Purge valve	• Check the engine coolant level and condition. Ensure the battery is in a fully charged and serviceable condition. Check for electronic engine controls, engine emissions, fuel system and evaporative emissions system related DTCs and refer to the relevant DTC Index
Difficult hot start	• Injector leak	• Check for injector leak, install new injector as required.

	• Electronic engine control • Purge valve • Fuel pump • Ignition system • Exhaust gas recirculation valve stuck open	Check for electronic engine controls, evaporative emissions, fuel system, ignition system and engine emission system related DTCs and refer to the relevant DTC Index
Difficult to start after hot soak (vehicle standing, engine off, after engine has reached operating temperature)	• Injector leak • Electronic engine control • Purge valve • Fuel pump • Ignition system • Exhaust gas recirculation valve stuck open	• Check for injector leak, install new injector as required. Check for electronic engine controls, evaporative emissions, fuel system, ignition system and engine emission system related DTCs and refer to the relevant DTC Index
Engine stalls soon after start	• Breather system disconnected/restricted • Engine control module relay • Electronic engine control • Ignition system • Air intake system restricted • Air leakage • Fuel lines	• Ensure the engine breather system is free from restriction and is correctly installed. Check for electronic engine control, ignition system and fuel system related DTCs and refer to the relevant DTC Index. Check for blockage in air filter element and air intake system. Check for air leakage in air intake system
Engine hesitates/poor acceleration	• Fuel pressure, fuel pump, fuel lines • Injector leak • Boost air leakage • Supercharger failure • Electronic engine control • Throttle motor • Restricted accelerator pedal travel (carpet, etc) • Ignition system • Exhaust gas recirculation 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. Check for correct supercharger operation. Ensure accelerator pedal is free from restriction. Check for electronic engine controls, ignition, engine emission system and transmission related DTCs and refer to the relevant DTC Index
Engine backfires	• Fuel pump/lines • Air leakage • Electronic engine controls • Ignition system • Sticking variable camshaft timing hub	• Check for fuel system failures. Check for air leakage in intake air system. Check for electronic engine controls, ignition system and variable camshaft timing system 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. Check for electronic engine controls, throttle system and ignition system related DTCs and refer to the relevant DTC Index
Engine detonates/knocks	• Fuel pump/lines • Air leakage • Electronic engine controls • Sticking variable camshaft timing hub	• Check for fuel system failures. Check for air leakage in intake air system. Check for electronic engine controls and variable camshaft timing system related DTCs and refer to the relevant DTC Index
No throttle response	• Electronic engine controls • Throttle motor	• Check for electronic engine controls and throttle system related DTCs and refer to the relevant DTC Index
Poor throttle response	• Breather system disconnected/restricted • Electronic engine control • Transmission malfunction • Traction control event	• Ensure the engine breather system is free from restriction and is correctly installed. Check for electronic engine controls, transmission and traction control related DTCs and refer to the related DTC Index. Check for air leakage in intake air system

	• Boost air leakage	

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 S/C 5.0L Petrol, DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation).

Published: 11-Dec-2013

Electronic Engine Controls - V8 S/C 5.0L Petrol - Brake Pedal Position (BPP) Switch Adjustment

General Procedures

Check

1. Remove the brake pedal rubber.



2. NOTE: Make sure that the dial test indicator (DTI) gauge is in line with the brake pedal movement.

   Position the DTI gauge on a suitable mounting block, as illustrated.

3. With the aid of another technician, gently press the brake pedal until the stop lamps illuminate.

4. NOTE: The specification is that the stop lamps should illuminate at between 5.5mm and 8.5mm brake pedal travel.

   Note the measurement of the brake pedal travel from rest position until the stop lamps illuminated.

Adjust

NOTE: The Brake Pedal Position Switch is self adjusting when removed and installed.

1. Remove and install Brake Pedal Position Switch.
   For additional information, refer to: Stoplamp Switch (417-01 Exterior Lighting, Removal and Installation).

2. Check the adjustment of the stop lamp switch by following the **Check** procedure in this procedure and carry out the **Adjust** procedure if required.

Published: 31-Jul-2012

Electronic Engine Controls - V8 S/C 5.0L Petrol - Camshaft Position (CMP) Sensor LH

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

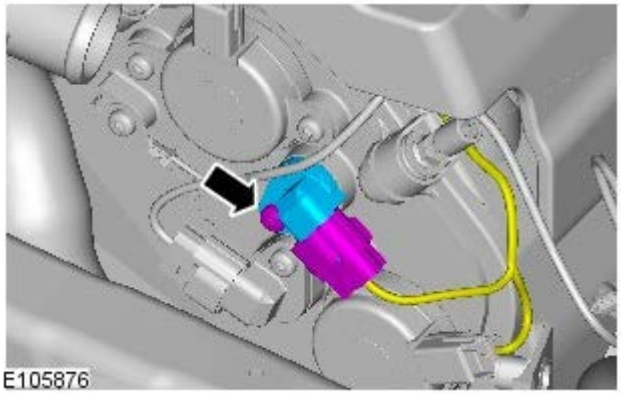
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 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: Thermostat Housing (303-03C Engine Cooling - V8 S/C 5.0L Petrol, 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.

Published: 11-Sep-2012

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.

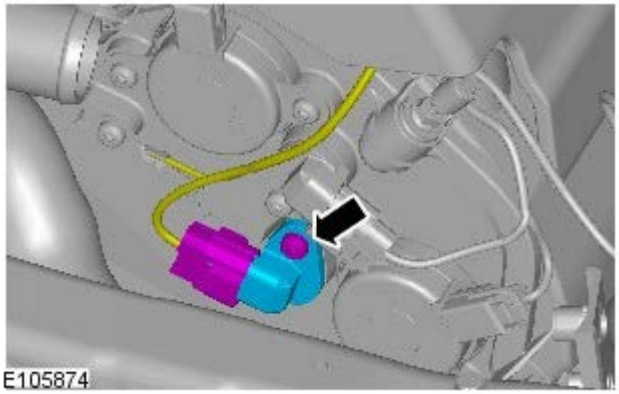
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 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: Thermostat Housing (303-03C Engine Cooling - V8 S/C 5.0L Petrol, 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.

Published: 31-Jul-2012

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.

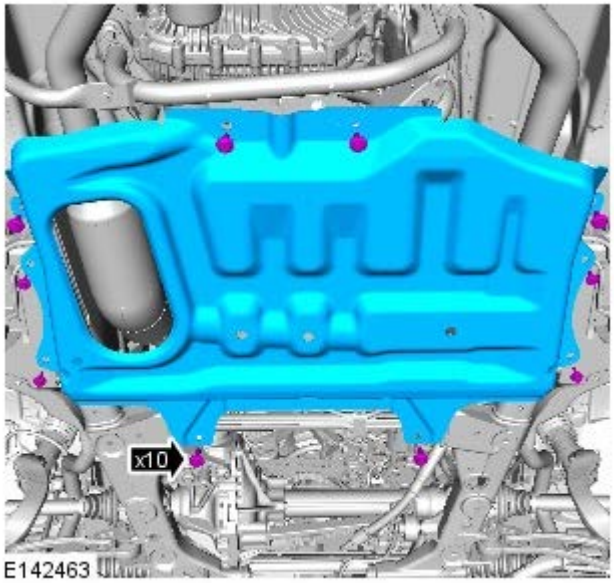
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

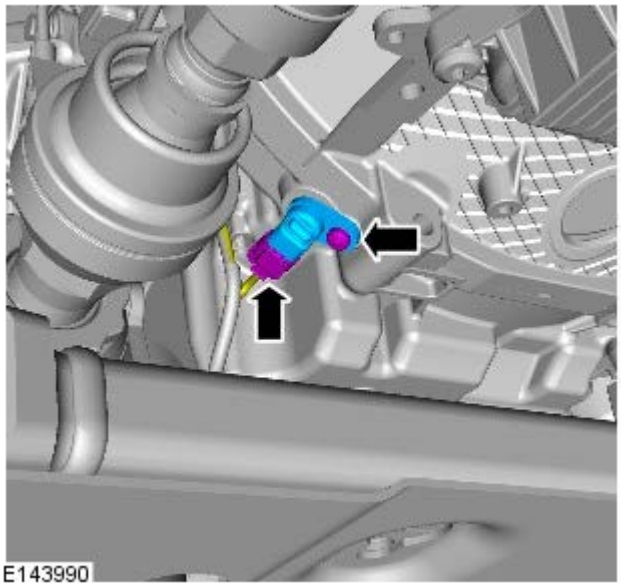
   Raise and support the vehicle.

3. *Torque:*
   M10 60 Nm
   M6 10 Nm



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: 07-Sep-2012

Electronic Engine Controls - V8 S/C 5.0L Petrol - Engine Control Module (ECM)

Removal and Installation

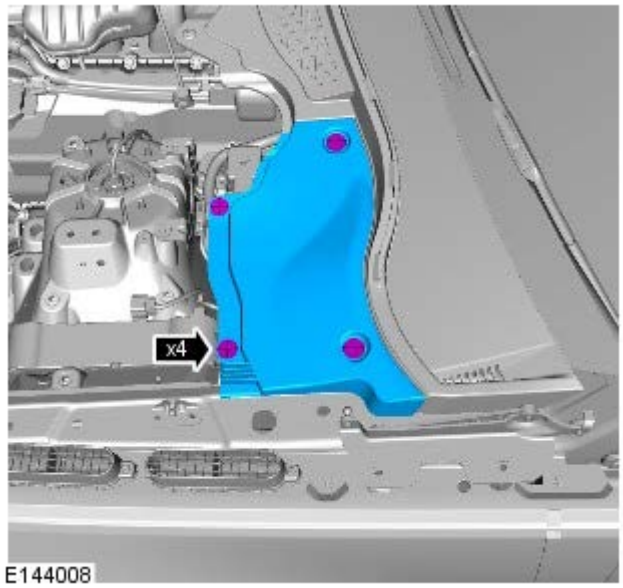
Removal

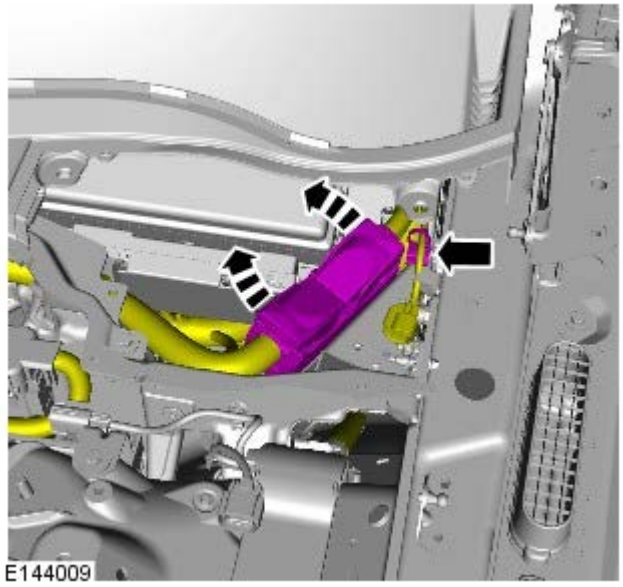
NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

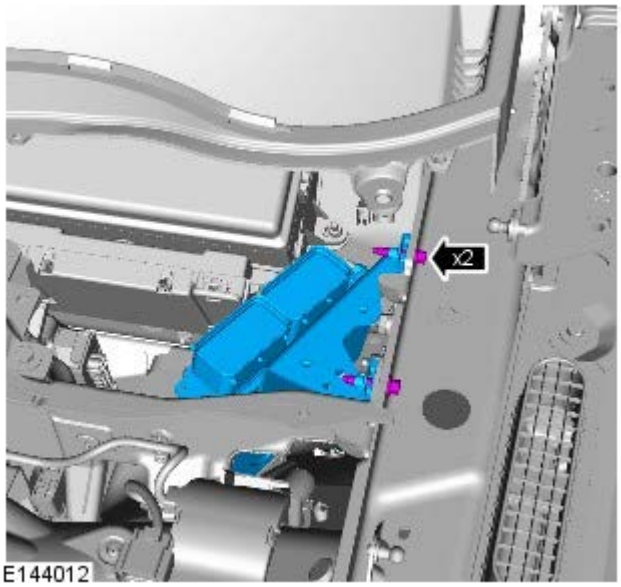
2.





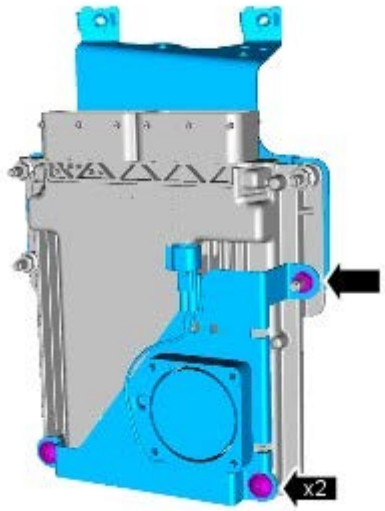
3. CAUTION: Before the disconnection or removal of any components, make sure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

4. *Torque:* 9 Nm



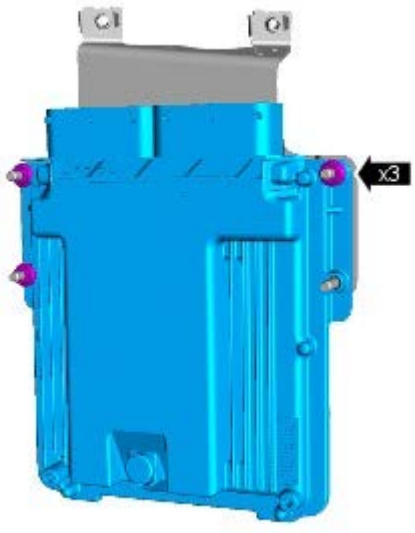
E144012

5. *Torque:* 9 Nm



E144010

6. *Torque:* 9 Nm



E144011

Installation

1. To install, reverse the removal procedure.
2. If a new unit is installed, configure using the approved diagnostic tool.

Published: 24-Apr-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.

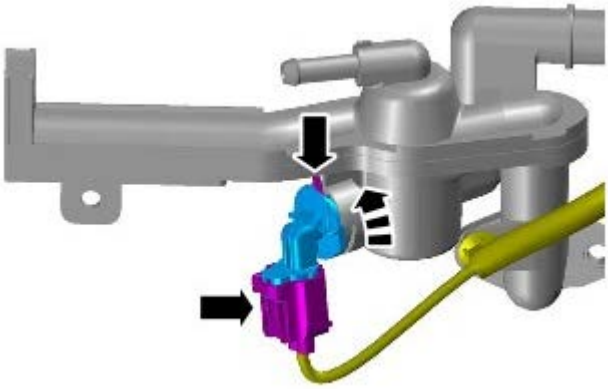
1. WARNING: Make sure to support the vehicle with axle stands.

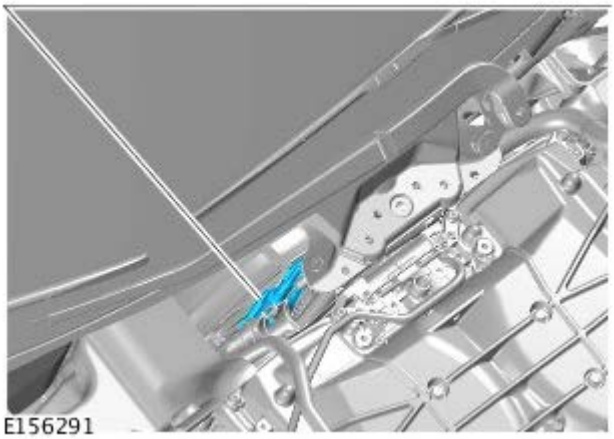
   Raise and support the vehicle.

2. Refer to: Secondary Bulkhead Center Panel - V8 S/C 5.0L Petrol (501-02, Removal and Installation).

3. Refer to: Cooling System Partial Draining, Filling and Bleeding - V8 S/C 5.0L Petrol (303-03C Engine Cooling - V8 S/C 5.0L Petrol, General Procedures).

4.





Installation

1. To install, reverse the removal procedure.

Published: 24-Aug-2012

Electronic Engine Controls - V8 S/C 5.0L Petrol - Engine Oil Level Sensor

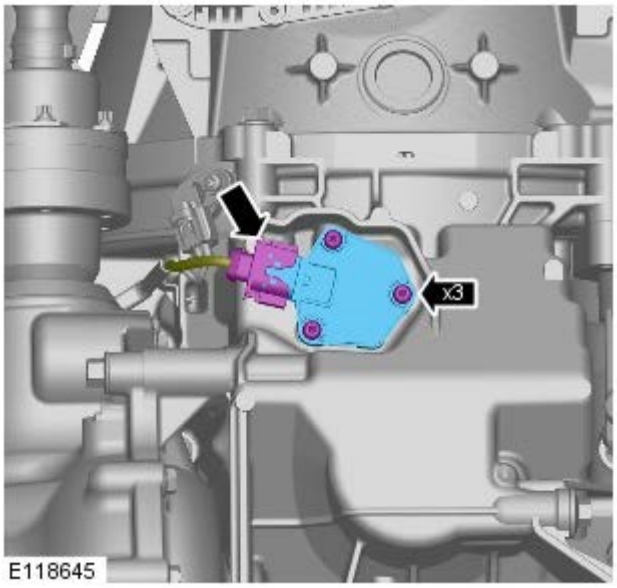
Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Engine Undershield (501-02, Removal and Installation).
2. Refer to: Engine Oil Draining and Filling (303-01C Engine - V8 S/C 5.0L Petrol, General Procedures).
3. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.



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: Install a new O-ring seal.

   Torque: 12 Nm

Installation

1. To install, reverse the removal procedure.

Published: 31-Jul-2012

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.

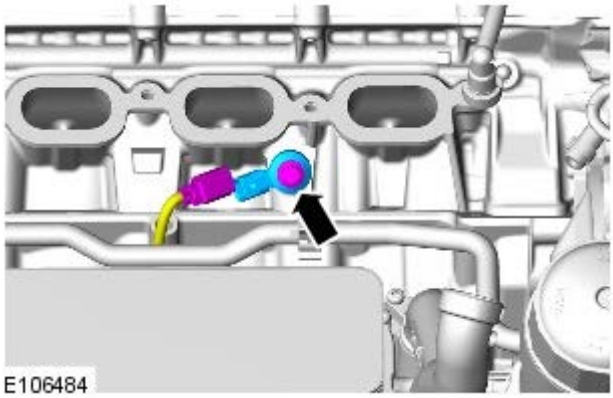
1. Disconnect the battery ground cable.

   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: Supercharger (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).



4. CAUTION: Note the fitted position of the component prior to removal.

   NOTE: Make sure that the component is installed to the noted removal position.

   Torque: 20 Nm

Installation

1. To install, reverse the removal procedure.

Published: 31-Jul-2012

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.

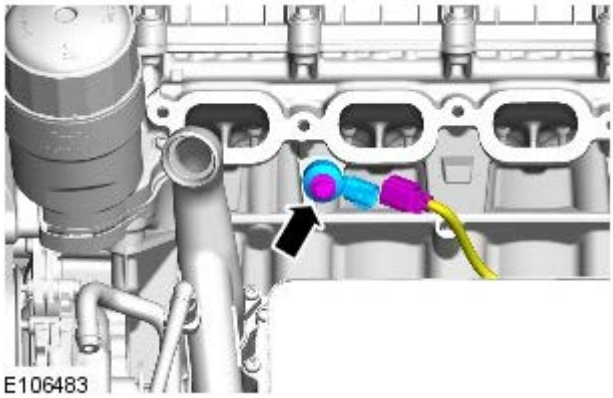
1. Disconnect the battery ground cable.

   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: Supercharger (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).



4. CAUTION: Note the fitted position of the component prior to removal.

   NOTE: Make sure that the component is installed to the noted removal position.

   Torque: 20 Nm

Installation

1. To install, reverse the removal procedure.

Published: 16-Nov-2012

Electronic Engine Controls - V8 S/C 5.0L Petrol - Fuel Rail Pressure (FRP) Sensor

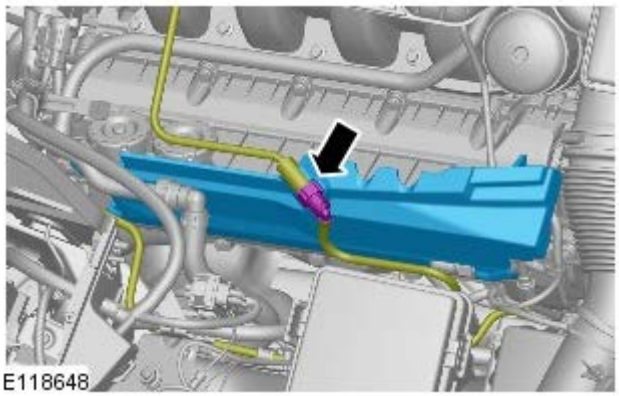
Removal and Installation

Removal

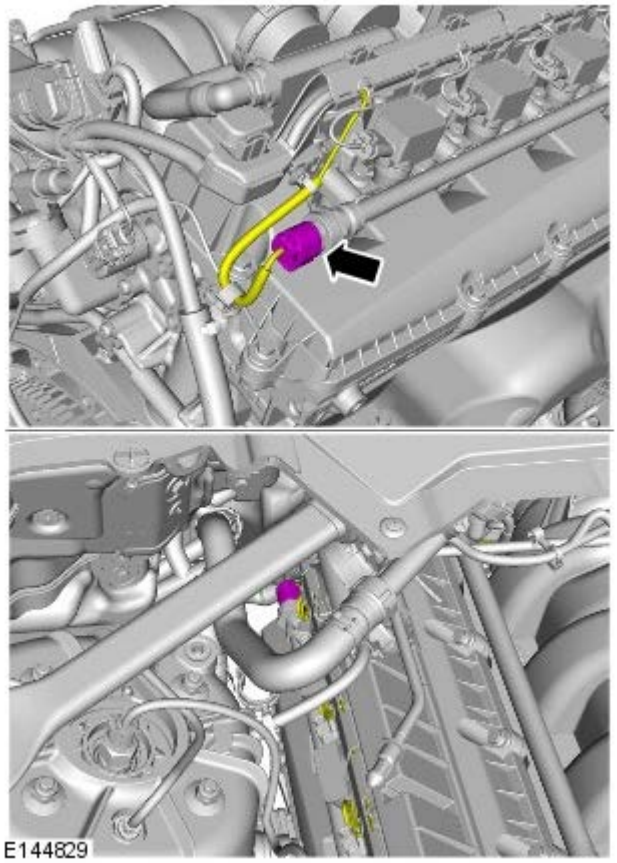
CAUTION: Make sure that all openings are sealed. Use new blanking caps.

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 - V8 5.0L Petrol/V8 S/C 5.0L Petrol (310-00, General Procedures).
3. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).
4. Refer to: Engine Cover - V8 5.0L Petrol/V8 S/C 5.0L Petrol (501-05, Removal and Installation).
5. Refer to: Cowl Panel Grille (501-02, Removal and Installation).
6. Refer to: Fuel Injection Component Cleaning (303-04, General Procedures).
7. 

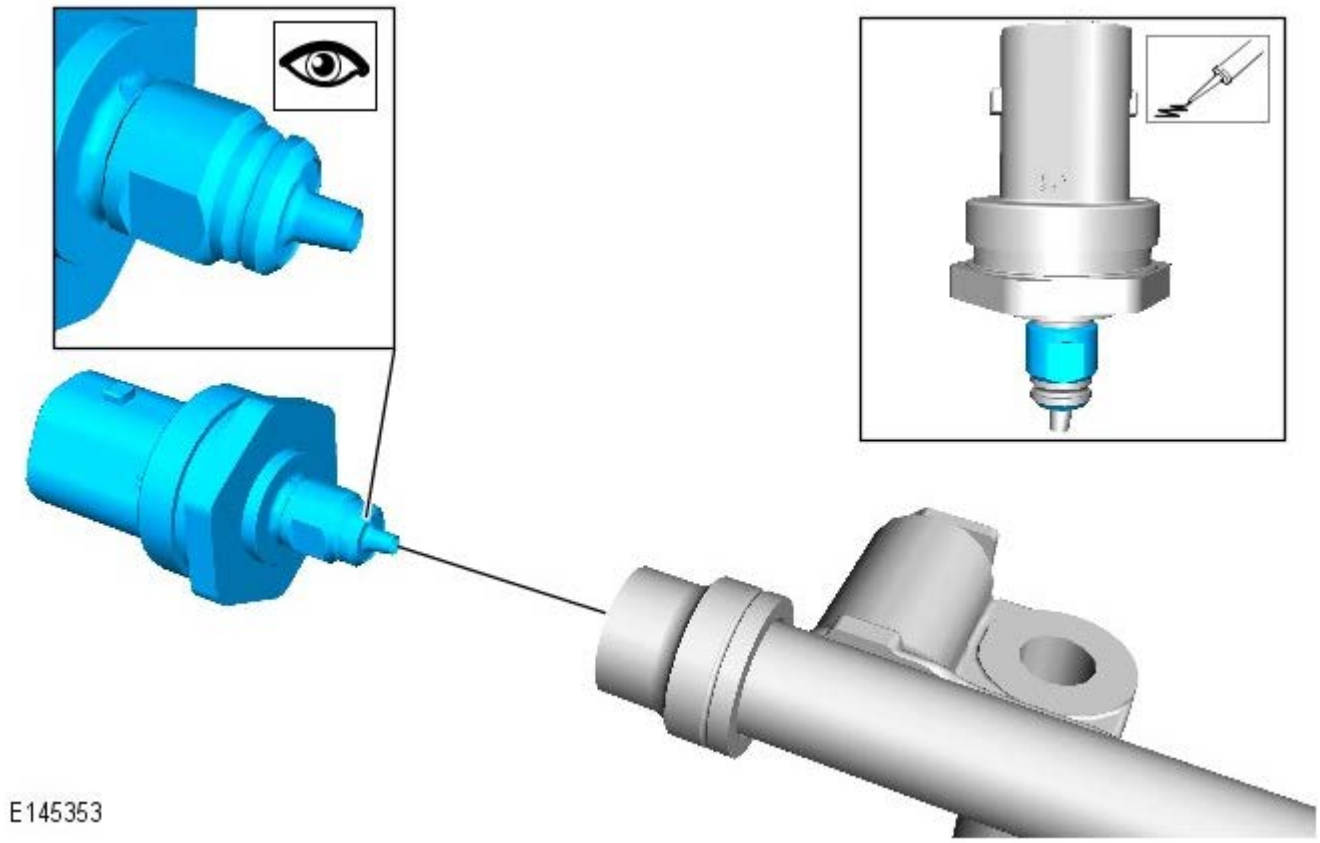
8.



9. NOTE: During lubrication, keep the component vertically as shown.

   Lubricate with Molykote W15 as shown.

   Torque: 38 Nm



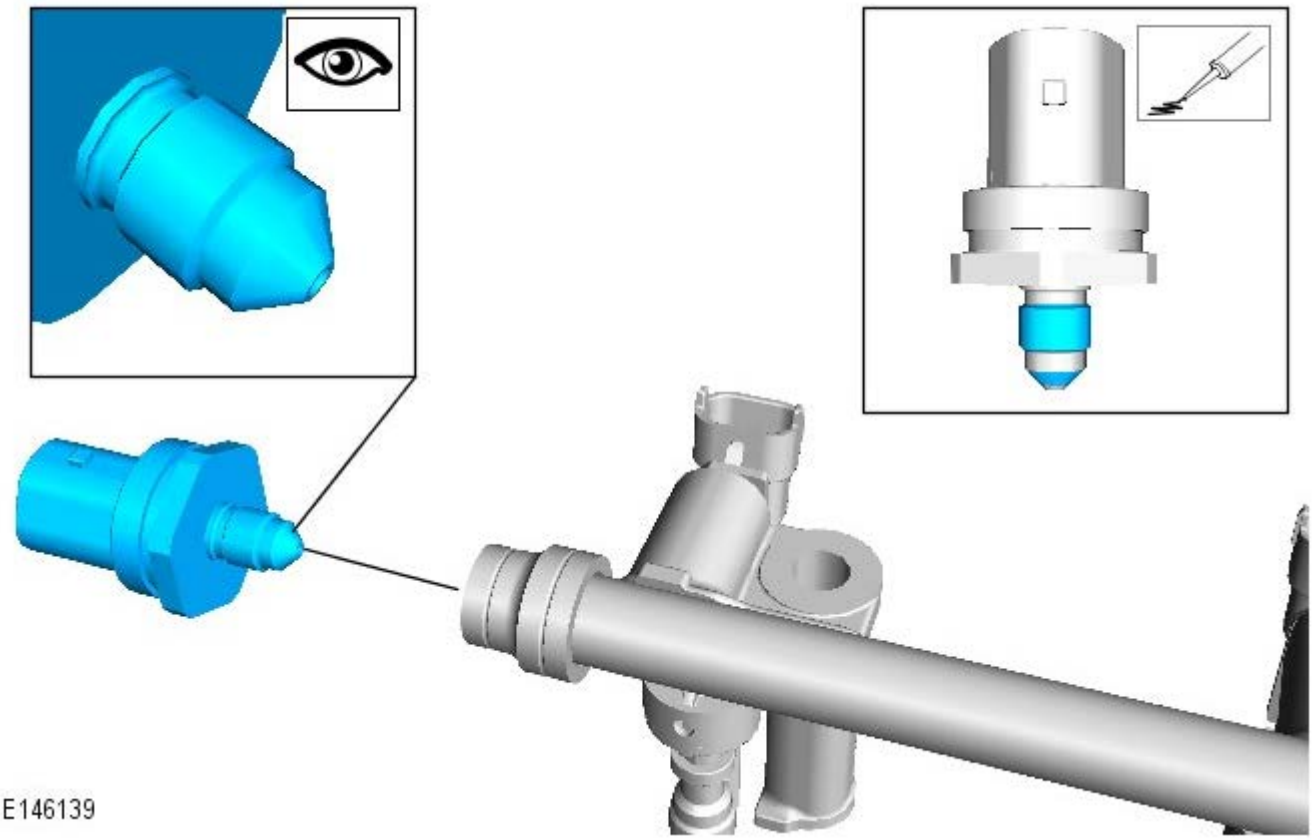
10. NOTES:

If equipped.

During lubrication, keep the component vertically as shown.

Lubricate with Shell Ondina 933 as shown.

Torque: 33 Nm



Installation

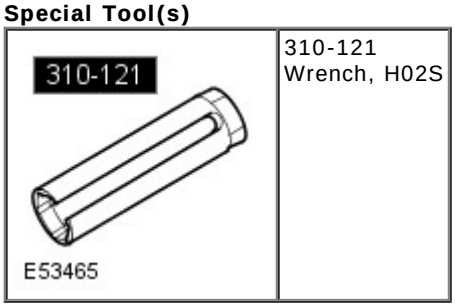
1. To install, reverse the removal procedure.

Published: 04-Dec-2012

Electronic Engine Controls - V8 S/C 5.0L Petrol - Left Mid catalyst Heated Oxygen Sensor (HO2S)

Removal and Installation

Special Tool(s)

	310-121 Wrench, H02S

Removal

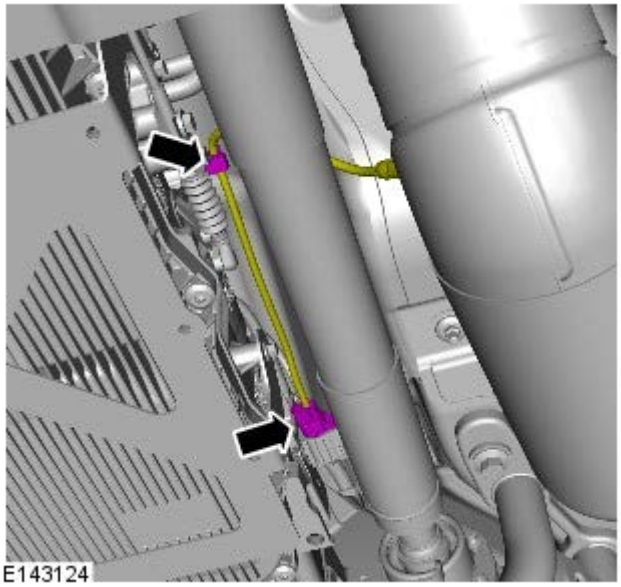
WARNING: Observe due care when working near a hot exhaust system.

NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

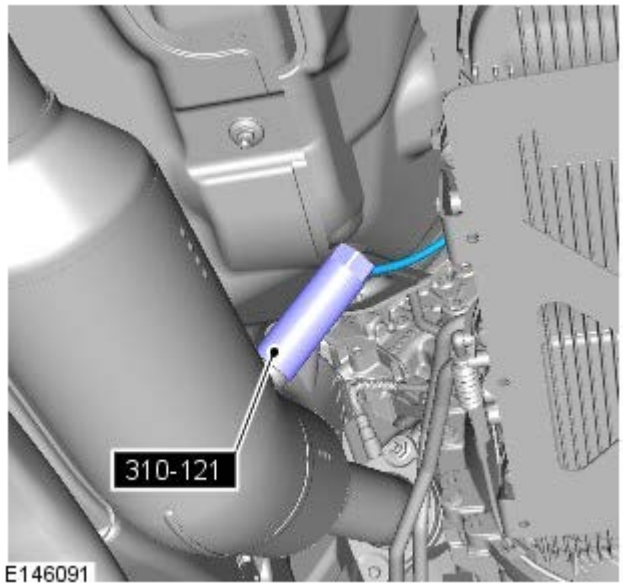
   Raise and support the vehicle.

2.



3. CAUTION: 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: 09-Apr-2013

Electronic Engine Controls - V8 S/C 5.0L Petrol - Manifold Absolute Pressure (MAP) Sensor

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.

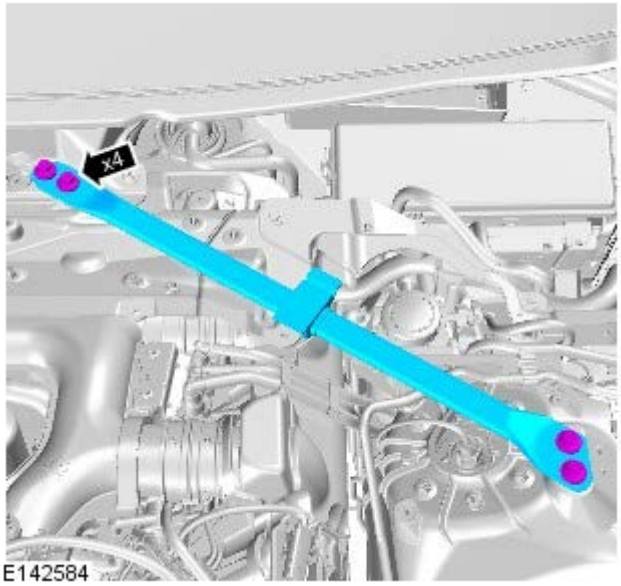
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

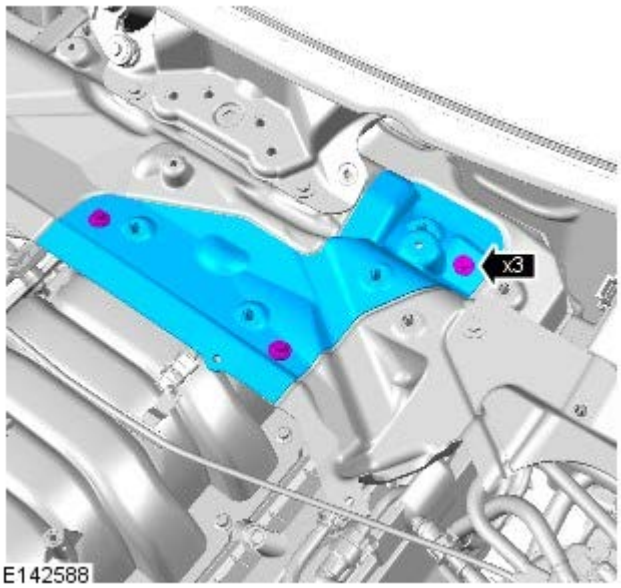
2. Refer to: Engine Cover - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (501-05 Interior Trim and Ornamentation, Removal and Installation).

3. Refer to: Cowl Panel Grille (501-02 Front End Body Panels, Removal and Installation).

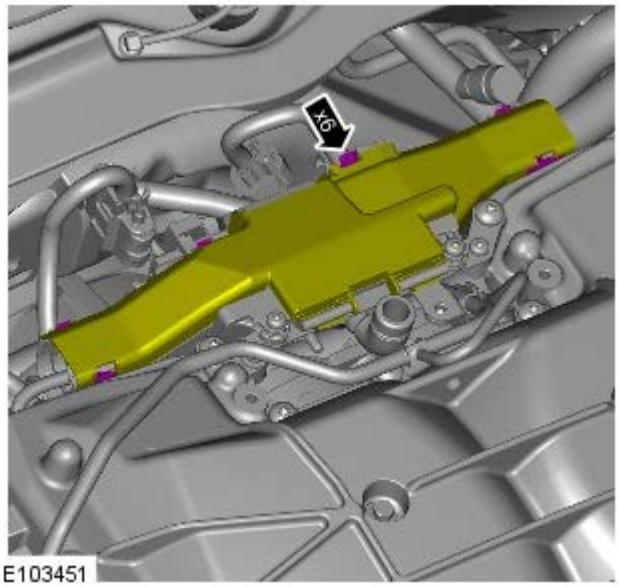
4. *Torque:* 55 Nm



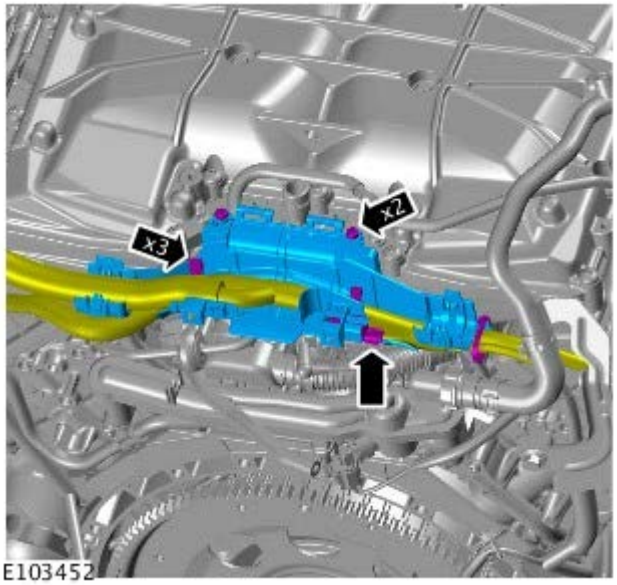
5. *Torque:* 6 Nm



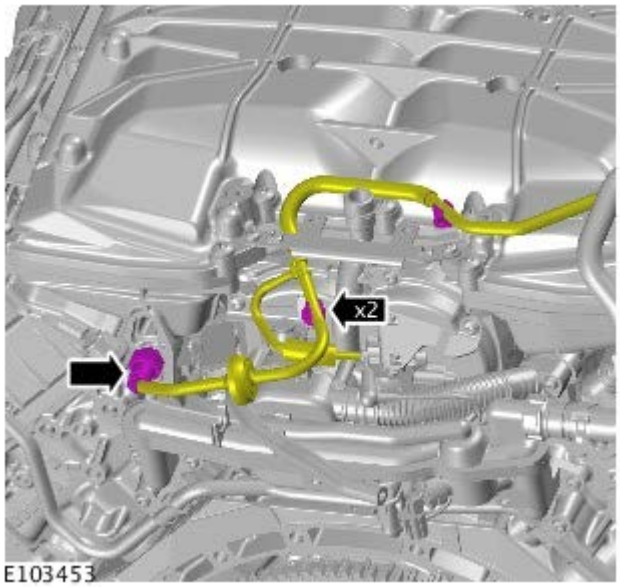
6.



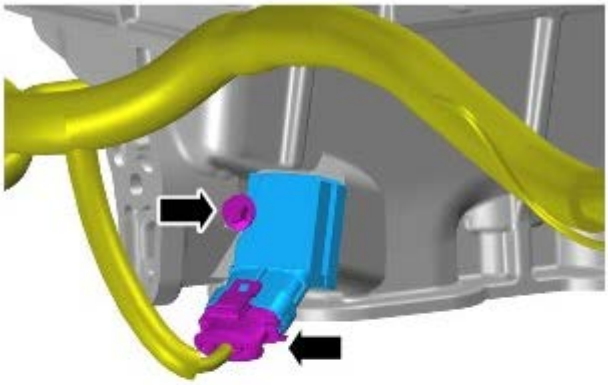
7. *Torque:* 10 Nm

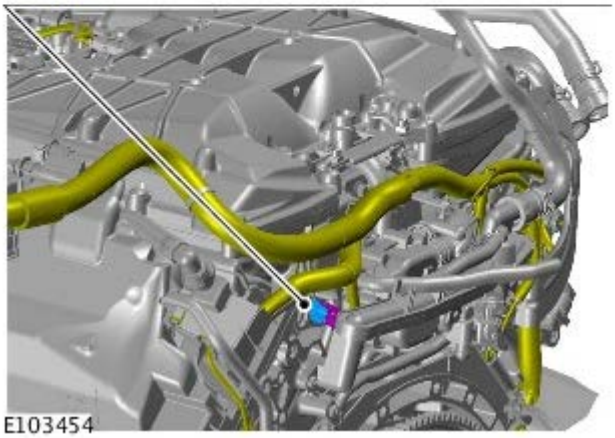


8.



9. *Torque:* 5 Nm





Installation

1. To install, reverse the removal procedure.

Published: 06-Aug-2012

Electronic Engine Controls - V8 S/C 5.0L Petrol - Mass Air Flow (MAF) Sensor

Removal and Installation

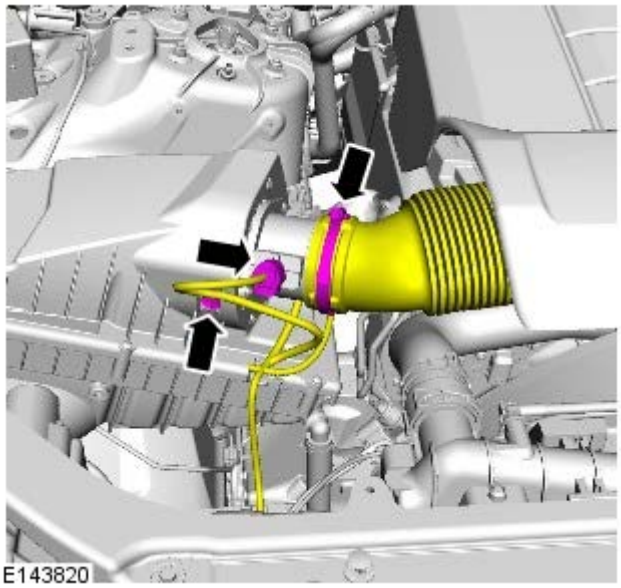
Removal

NOTES:

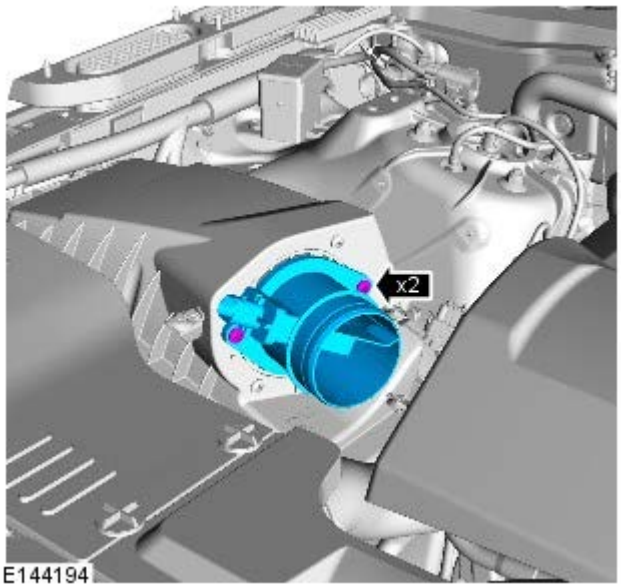
Removal steps in this procedure may contain installation details.

Right-hand shown, left-hand similar.

1. *Torque:* 3.5 Nm



2. *Torque:* 1.6 Nm



Installation

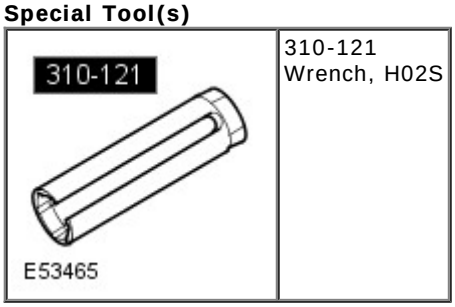
1. To install, reverse the removal procedure.

Published: 10-Sep-2012

Electronic Engine Controls - V8 S/C 5.0L Petrol - Post catalyst Heated Oxygen Sensor (HO2S)

Removal and Installation

Special Tool(s)

	310-121 Wrench, H02S

Removal

WARNING: Observe due care when working near a hot exhaust system.

NOTES:

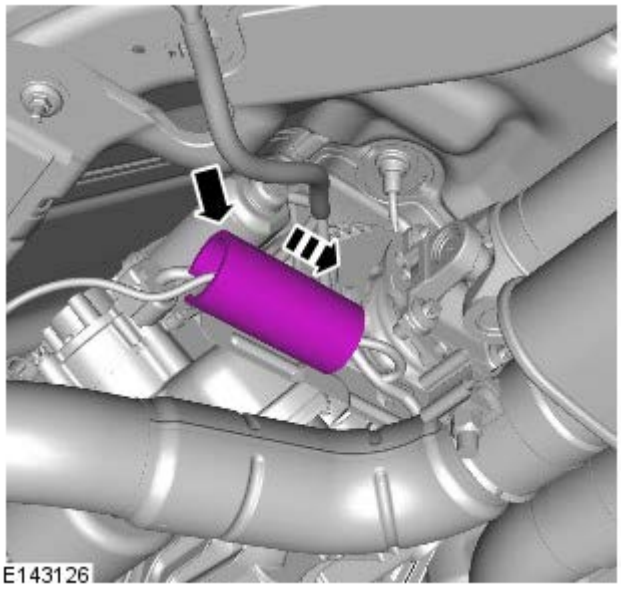
Removal steps in this procedure may contain installation details.

LH illustration shown, RH is similar.

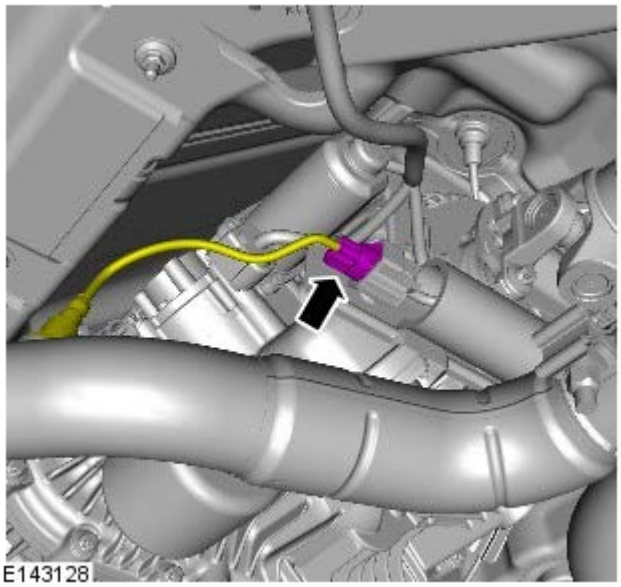
1. WARNING: Make sure to support the vehicle with axle stands.

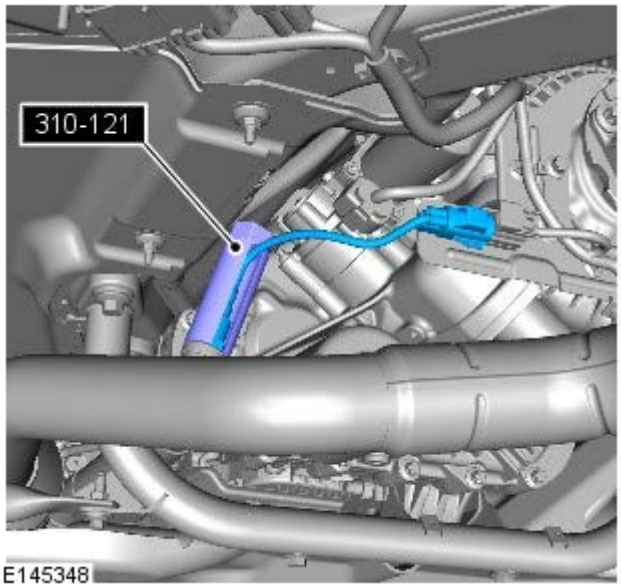
   Raise and support the vehicle.

2.



3.





4. 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.

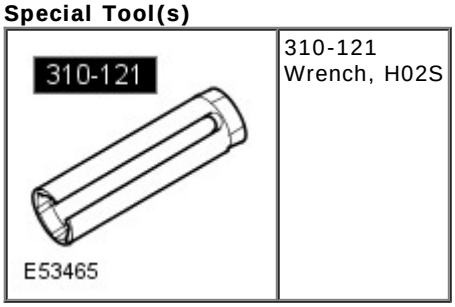
2. If a new unit is installed, configure using the approved diagnostic tool.

Published: 10-Sep-2012

Electronic Engine Controls - V8 S/C 5.0L Petrol - Pre catalyst Heated Oxygen Sensor (HO2S)

Removal and Installation

Special Tool(s)

	310-121 Wrench, H02S

Removal

WARNING: Observe due care when working near a hot exhaust system.

NOTES:

Removal steps in this procedure may contain installation details.

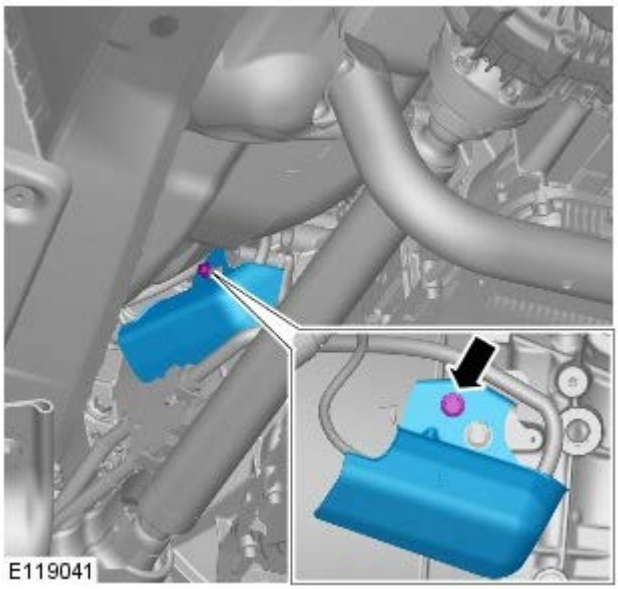
LH illustration shown, RH is similar.

1. WARNING: Make sure to support the vehicle with axle stands.

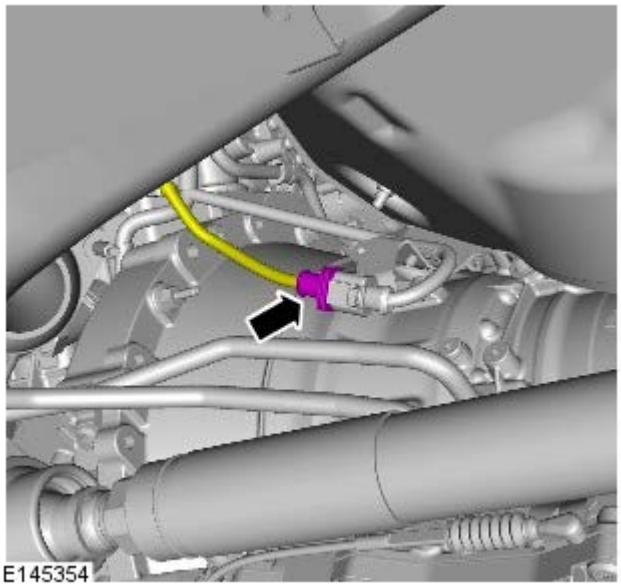
   Raise and support the vehicle.

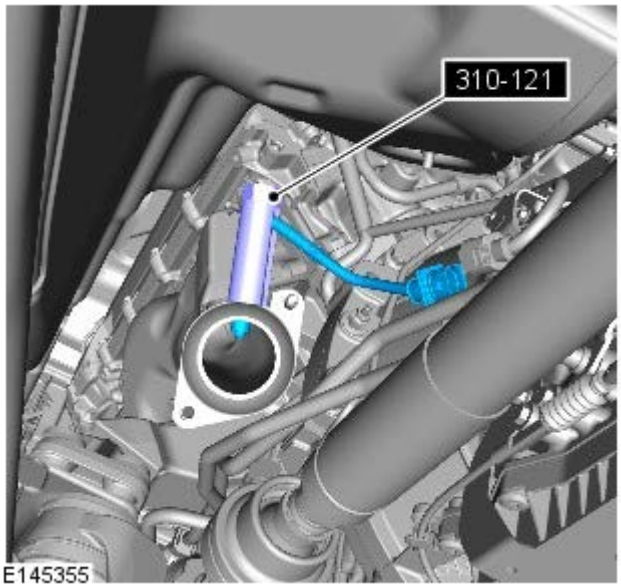
2. Refer to: Exhaust System (309-00C Exhaust System - V8 S/C 5.0L Petrol, Removal and Installation).

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. If a new unit is installed, configure using the approved diagnostic tool.

Published: 31-Jul-2012

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.

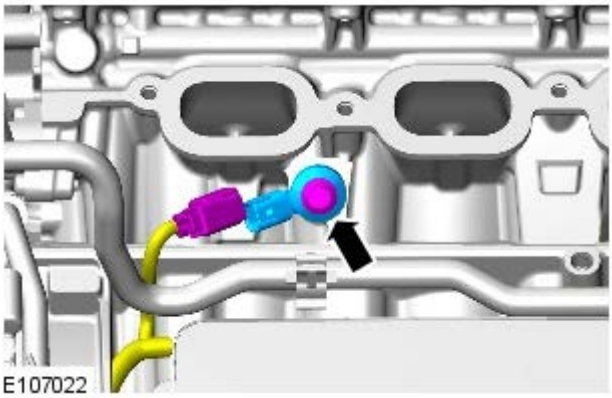
1. Disconnect the battery ground cable.

   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: Supercharger (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).



4. CAUTION: Note the fitted position of the component prior to removal.

   NOTE: Make sure that the component is installed to the noted removal position.

   Torque: 20 Nm

Installation

1. To install, reverse the removal procedure.

Published: 31-Jul-2012

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.

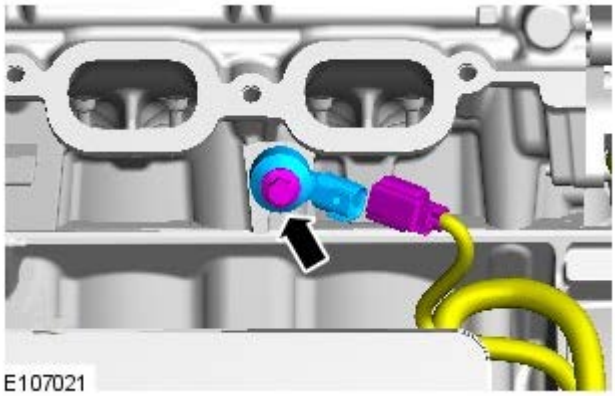
1. Disconnect the battery ground cable.

   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: Supercharger (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).



4. CAUTION: Note the fitted position of the component prior to removal.

   NOTE: Make sure that the component is installed to the noted removal position.

   Torque: 20 Nm

Installation

1. To install, reverse the removal procedure.

Published: 24-Aug-2012

Electronic Engine Controls - V8 S/C 5.0L Petrol - Right Mid catalyst Heated Oxygen Sensor (HO2S)

Removal and Installation

Special Tool(s)

	310-121 Wrench, H02S

Removal

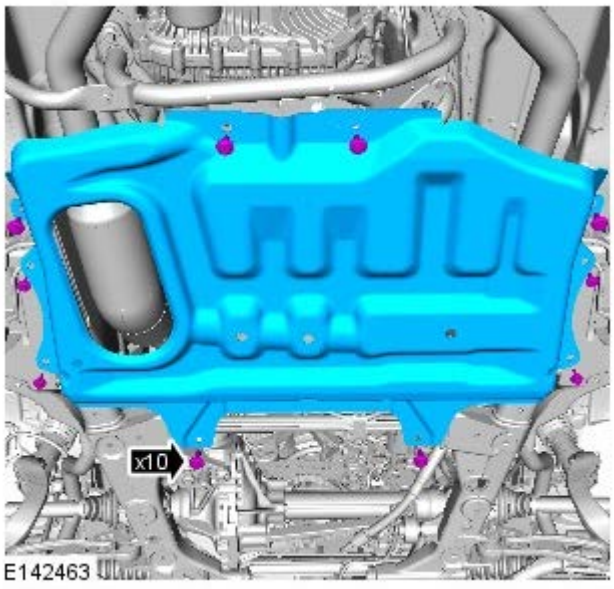
WARNING: Observe due care when working near a hot exhaust system.

NOTE: Removal steps in this procedure may contain installation details.

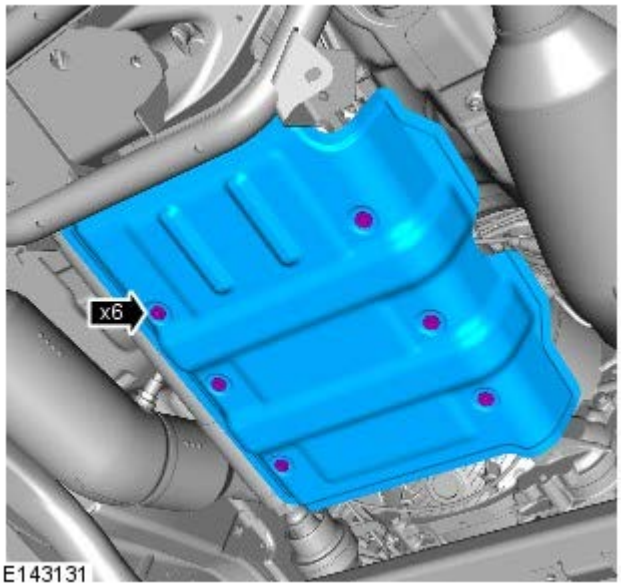
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

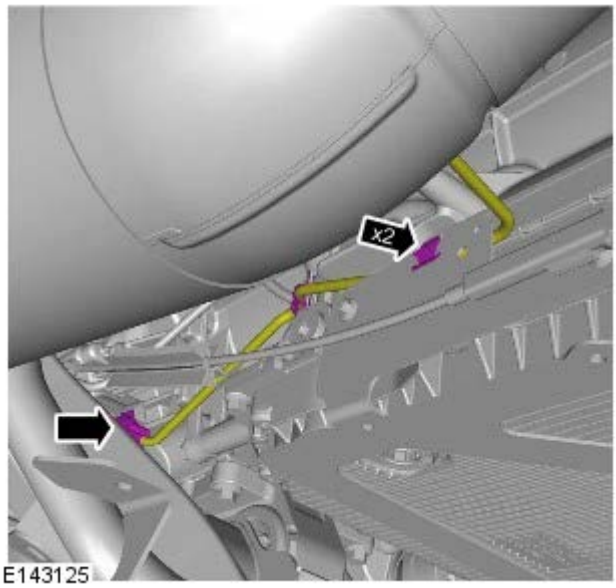
2. *Torque:*
   M10 60 Nm
   M6 10 Nm

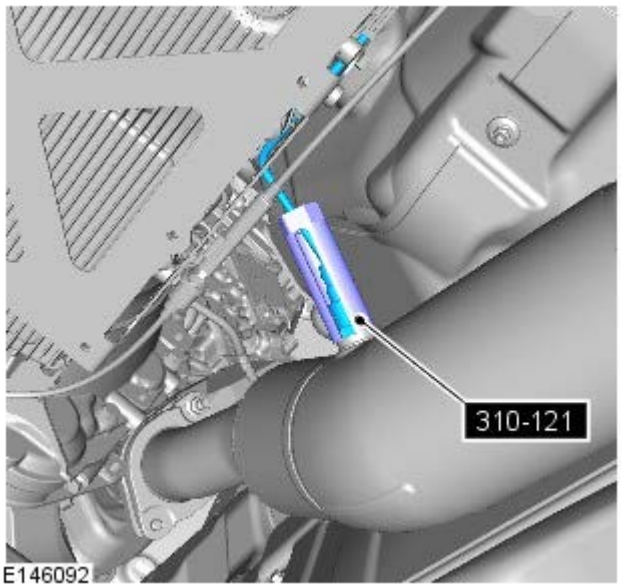


3. *Torque:* 10 Nm



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: 31-Jul-2012

Electronic Engine Controls - V8 S/C 5.0L Petrol - Variable Valve Timing (VVT) Oil Control Solenoid LH

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.

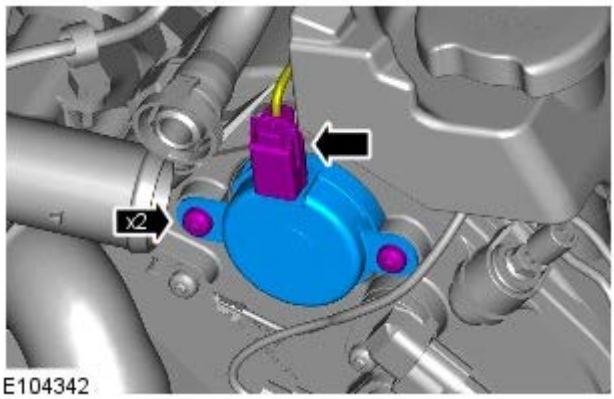
   Refer to: Specifications (414-00, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

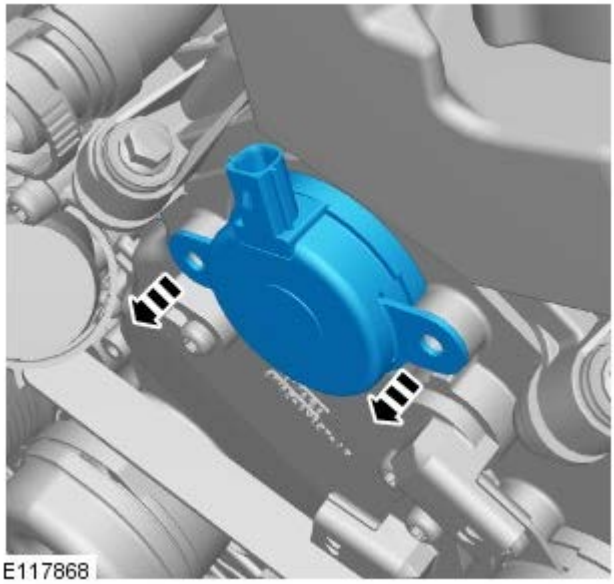
   Raise and support the vehicle.

3. Refer to: Thermostat Housing (303-03C Engine Cooling - V8 S/C 5.0L Petrol, Removal and Installation).

4. *Torque:* 10 Nm



5. CAUTION: Evenly and progressively, remove the VVT units from each side.



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: 31-Jul-2012

Electronic Engine Controls - V8 S/C 5.0L Petrol - Variable Valve Timing (VVT) Oil Control Solenoid 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.

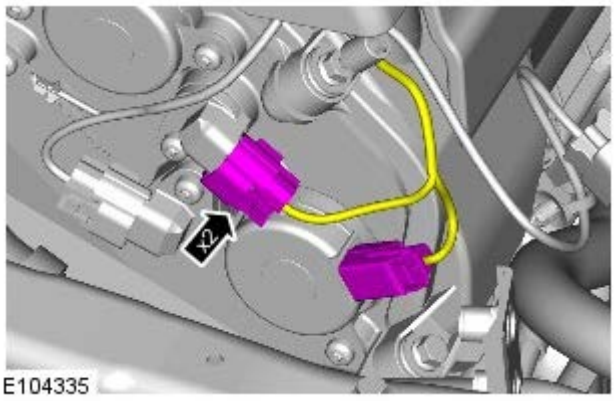
   Refer to: Specifications (414-00, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

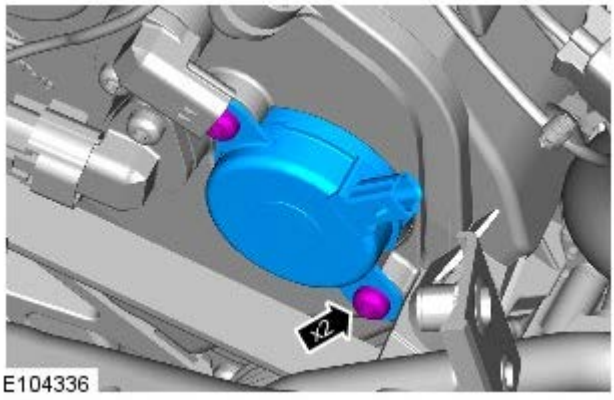
3. Refer to: Thermostat Housing (303-03C Engine Cooling - V8 S/C 5.0L Petrol, Removal and Installation).

4.



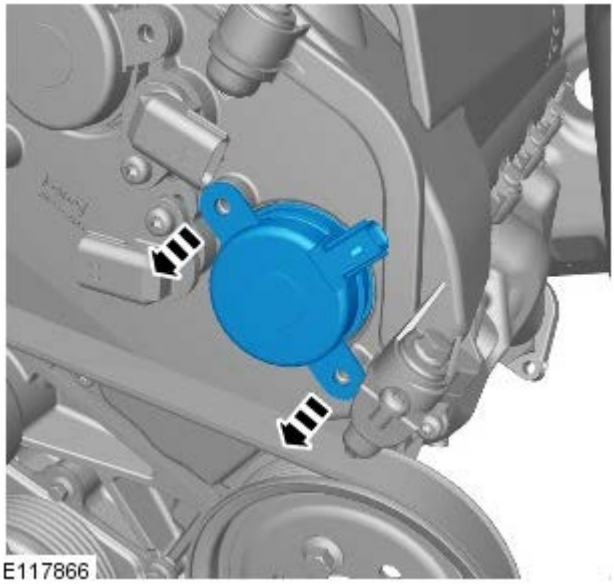
E104335

5. *Torque:* 10 Nm



E104336

6. CAUTION: Evenly and progressively, remove the VVT units from each side.



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: 31-Jul-2012

Electronic Engine Controls - TDV8 4.4L Diesel -

Torque Specifications

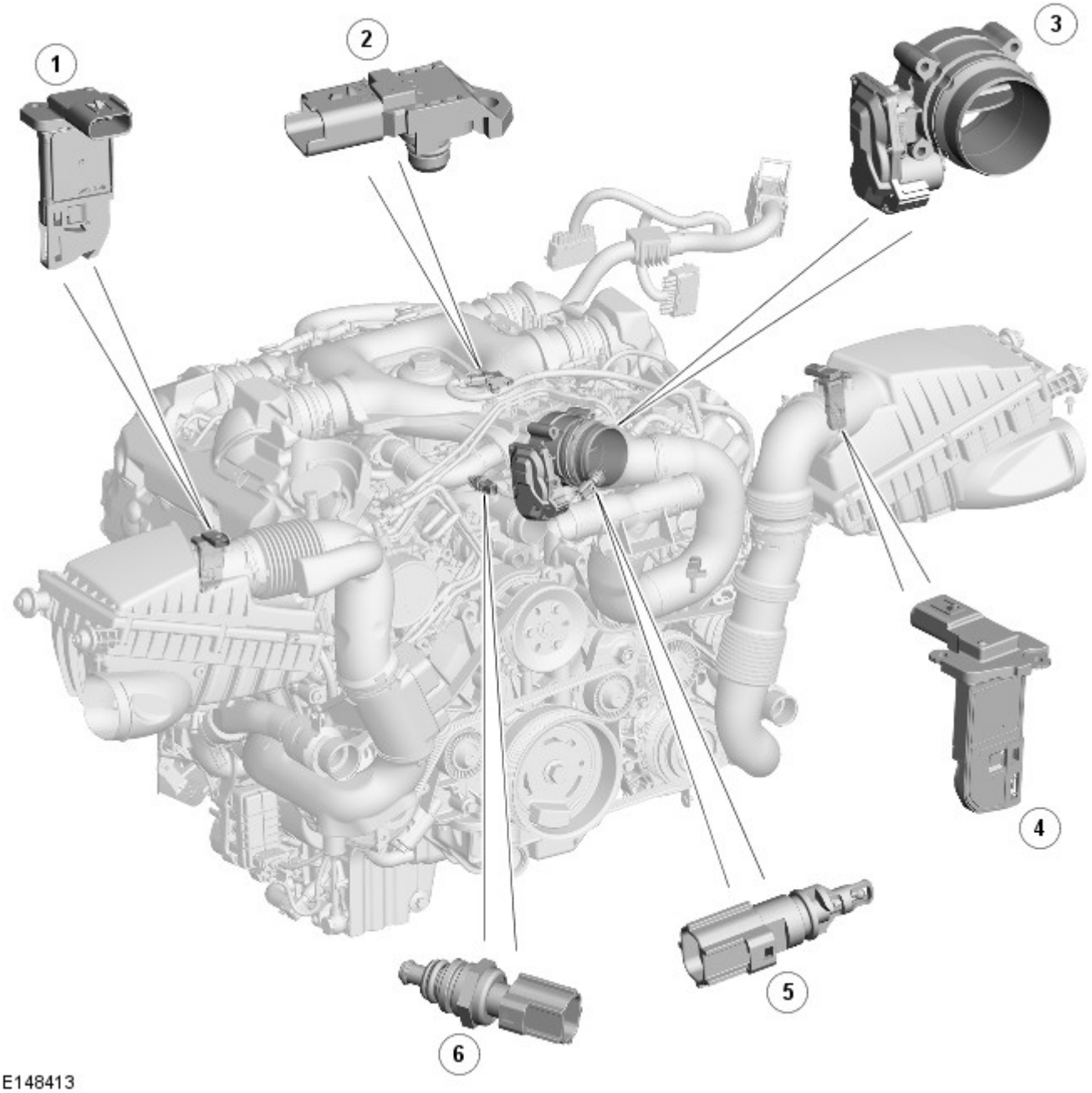
Item	Nm	lb-ft	lb-in
Camshaft position (CMP) sensor bolt	10	7	-
Crankshaft position (CKP) sensor bolt	5	-	44
Engine control module (ECM) support bracket to body nut	9	-	80
ECM to cooling fan bracket bolts	9	-	80
Engine oil pressure (EOP) sensor	14	10	-
Automatic transmission splash shield bolts	10	7	-
Pre catalytic temperature sensor wiring connector heat shield to transmission bolts	10	7	-
Pre catalytic temperature sensor	35	26	-
Post catalytic temperature sensor	35	26	-
Post diesel particulate filter (DPF) exhaust gas temperature sensor	35	26	-
Exhaust gas temperature sensor LH	35	26	-
RH turbocharger heat shield bolts	10	7	-
RH turbocharger support bracket bolts	23	17	-

Published: 02-Dec-2013

Electronic Engine Controls - TDV8 4.4L Diesel - Electronic Engine Controls

Description and Operation

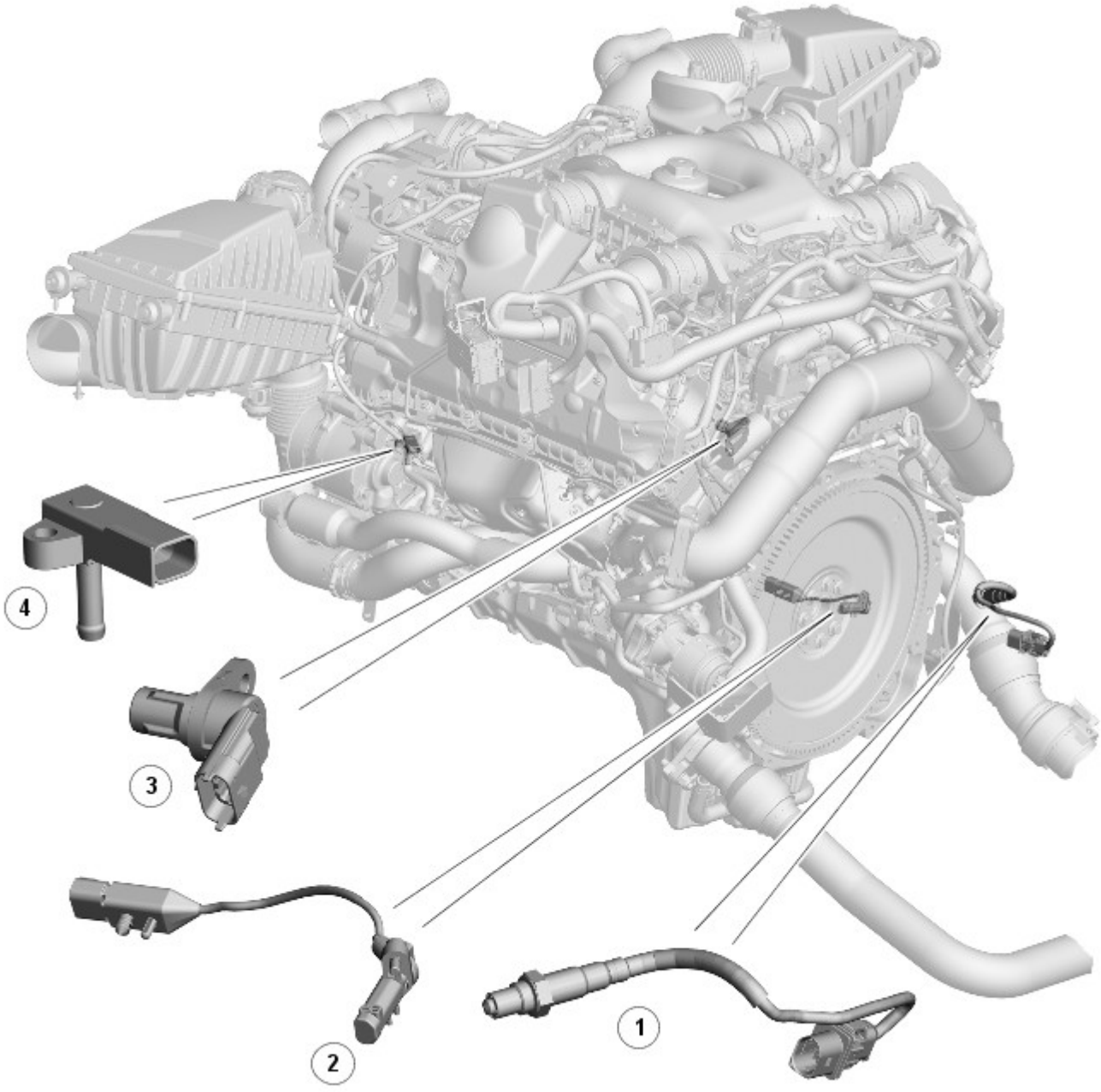
COMPONENT LOCATION - SHEET 1 OF 3



E148413

Item	Part Number	Description
1	-	Mass Air Flow and Temperature (MAFT) sensor
2	-	Manifold Absolute Pressure (MAP) sensor
3	-	Electric throttle
4	-	Mass Air Flow (MAF) sensor
5	-	Secondary turbocharger outlet pressure sensor
6	-	Engine Coolant Temperature (ECT) sensor

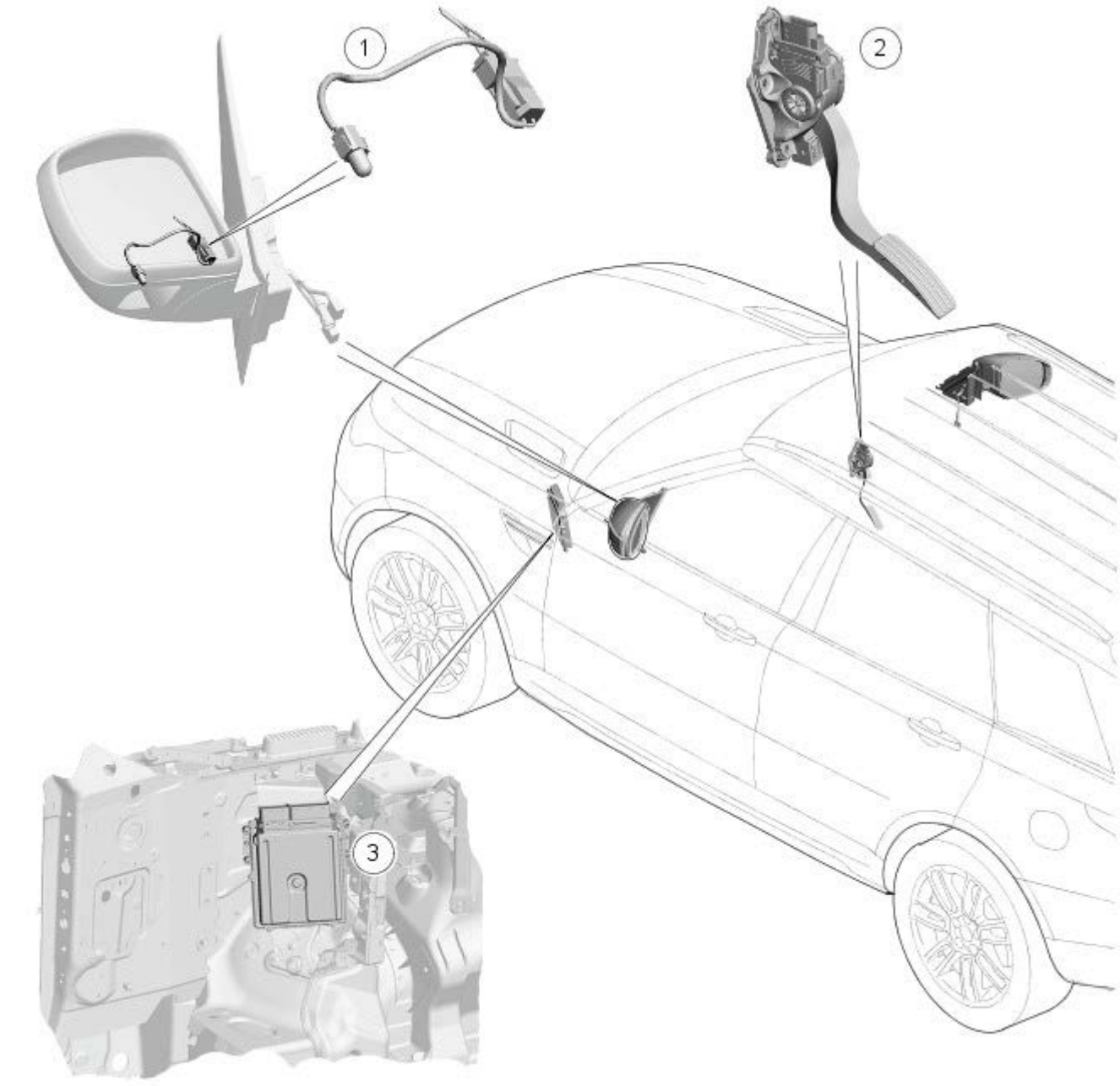
COMPONENT LOCATION - SHEET 2 OF 3



E148414

Item	Part Number	Description
1	-	Heated Oxygen Sensor (HO2S)
2	-	Crankshaft Position (CKP) sensor
3	-	Camshaft Position (CMP) sensor
4	-	Charge air pressure sensor

COMPONENT LOCATION - SHEET 3 OF 3



E153662

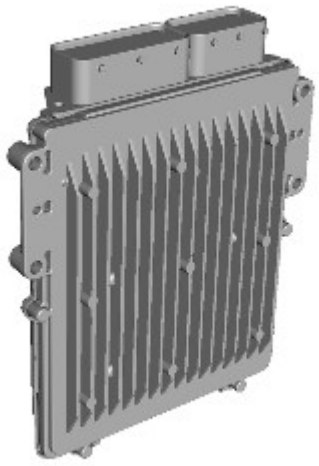
Item	Part Number	Description
1	-	Ambient Air Temperature (AAT) sensor
2	-	Accelerator Pedal Position (APP) sensor
3	-	Engine Control Module (ECM)

OVERVIEW

The TDV8 4.4L diesel engine has an engine management system controlled by an ECM (Engine Control Module) 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.

DESCRIPTION

Engine Control Module



E154689

The ECM is installed in the rear left corner of the engine compartment, behind the secondary bulkhead panel. The ECM is attached to brackets on the wheel housing and the fender outer support panel.

The ECM is 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. 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 the 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 driveability, 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 (Controller Area Network) Powertrain bus to enable precise engine control under all vehicle operating conditions.

The ECM receives and processes information from the following input sources:

- CKP (Crankshaft Position) sensor.
- CMP (Camshaft Position) sensor.
- MAF (Mass Air Flow) sensor.
- MAFT (Mass Air Flow and Temperature) sensor.
- MAP (Manifold Absolute Pressure) sensor.
- TPS (Throttle Position) sensor.
- ECT (Engine Coolant Temperature) sensor.
- APP (Accelerator Pedal Position) sensor.
- Charge air temperature sensor.
- Charge air pressure sensor.
- AAT (Ambient Air Temperature) sensor.
- HO2S (Heated Oxygen) sensor.
- The following brake system components:
  - ABS (Anti-lock brake system control module).
  - Brake pedal switch.
  - For additional information, refer to: Braking Control System (206-11 Brake Controls, Description and Operation).
- Oil level and temperature sensor.
  For additional information, refer to: Engine (303-01D Engine - TDV8 4.4L Diesel, Description and Operation).
- The following fuel system components:
  - FRP (Fuel Rail Pressure) sensor.
  - Fuel temperature sensor.
  - For additional information, refer to: Fuel Charging and Controls (303-04E Fuel Charging and Controls - TDV8 4.4L Diesel, Description and Operation).
- The following turbocharger system components:
  - VGT vane position sensor.

    - Turbine intake valve position sensor.
    - Turbine temperature sensor.
    - For additional information, refer to: Turbocharger (303-04F Fuel Charging and Controls - Turbocharger - TDV8 4.4L Diesel, Description and Operation).
- EGR (Exhaust Gas Recirculation) valve position sensors.
  For additional information, refer to: Engine Emission Control (303-08D Engine Emission Control - TDV8 4.4L Diesel, Description and Operation).
- TCS (Transmission Control Switch).
- Terrain Response® switchpack.
  For additional information, refer to: Ride and Handling Optimization (204-06 Ride and Handling Optimization, Description and Operation).
- The following catalytic converter and DPF (Diesel Particulate Filter) system components (where fitted).
    - Turbine outlet temperature sensor.
    - Pre and post catalytic converter exhaust gas temperature sensors.
    - DPF outlet temperature sensor.
    - DPF differential pressure sensor.
    - For additional information, refer to: Exhaust System (309-00D Exhaust System - TDV8 4.4L Diesel, Description and Operation).
- Water in fuel sensor.
  For additional information, refer to: Fuel Tank and Lines (310-01D Fuel Tank and Lines - TDV8 4.4L Diesel, Description and Operation).
- ATCM (Automatic Temperature Control Module).
  For additional information, refer to: Control Components (412-01A Climate Control, Description and Operation).
- RCM (Restraint Control Module).
  For additional information, refer to: Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) (501-20B Supplemental Restraint System, Description and Operation).

The ECM outputs controlling signals to the following sensors and actuators:

- Electric throttle actuator.
- ABS control module.
  For additional information, refer to: Braking Control System (206-11 Brake Controls, Description and Operation).
- Active engine mount solenoid.
  For additional information, refer to: Engine (303-01D Engine - TDV8 4.4L Diesel, Description and Operation).
- The engine cooling fans.
  For additional information, refer to: Engine Cooling (303-03F Engine Cooling - TDV8 4.4L Diesel, Description and Operation).
- The following fuel system components:
    - Fuel injectors.
    - Fuel pressure control valve.
    - Fuel metering valve.
    - For additional information, refer to: Fuel Charging and Controls (303-04E Fuel Charging and Controls - TDV8 4.4L Diesel, Description and Operation).
- The following turbocharger system components:
    - Charge air recirculation solenoid.
    - Charge air solenoid.
    - Turbine intake shut-off valve solenoid.
    - Variable geometry turbine vane actuator.
    - For additional information, refer to: Turbocharger (303-04F Fuel Charging and Controls - Turbocharger - TDV8 4.4L Diesel, Description and Operation).
- Starter motor.
  For additional information, refer to: Starting System (303-06D Starting System - TDV8 4.4L Diesel, Description and Operation).
- Glow plug control module.
  For additional information, refer to: Glow Plug System (303-07D Glow Plug System - TDV8 4.4L Diesel, Description and Operation).
- The following EGR (exhaust gas recirculation) system components:
    - EGR cooler bypass valve solenoid.
    - EGR valve motors.
    - For additional information, refer to: Engine Emission Control (303-08D Engine Emission Control - TDV8 4.4L Diesel, Description and Operation).
- TCM (Transmission Control Module).
  For additional information, refer to: Transmission Description (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, Description and Operation).
- ATCM module.
- IC (Instrument Cluster).
  For additional information, refer to: Instrument Cluster (413-01 Instrument Cluster, Description and Operation).

Crankshaft Position Sensor



E130964

The CKP sensor is located on the right side of the crankshaft rear oil seal. The sensor lead passes through a cover in the side of the cylinder block. The sensor tip is aligned with a reluctor ring on the rear flange of the crankshaft. The sensor produces a square wave signal, the frequency of which is proportional to engine speed.

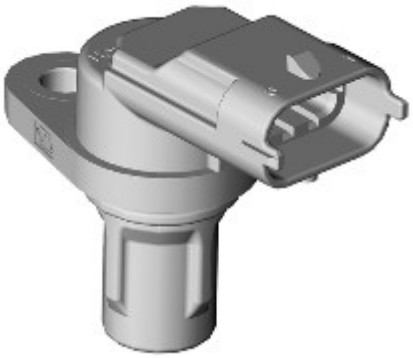
The CKP is a Hall effect sensor. The sensor measures the magnetic field variation induced by the reluctor ring.

The reluctor ring has a 60 minus 2 pole pattern. The missing poles provide a reference point for the angular position of the crankshaft. When the space with the two missing poles passes the sensor tip, a gap in the signal is produced which the ECM uses to determine the crankshaft position.

The ECM uses the signal from the CKP sensor for the following functions:

- Synchronization.
- Determine fuel injection timing.
- Enable the fuel pump relay circuit (after the priming period).
- Produce an engine speed signal which is broadcast on the high speed CAN Powertrain bus for use by other systems.

Camshaft Position Sensor



E130963

The CMP sensor is located on the rear face of the left cylinder head. The sensor tip protrudes through the face to pick up on the reluctor ring behind the camshaft pulley.

The CMP sensor is a Hall effect sensor which is 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 the stroke of the piston in No. 1 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; camshaft signal frequency too high or total failure of the camshaft signal. 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 charge air pressure control. Once the engine is switched off, the engine will crank but will not restart while the fault is present.

Mass Air Flow / Mass Air Flow and Temperature Sensor



E130965

Identical mass air flow and temperature sensors are installed in the air cleaner outlets, but only the MAFT (Mass Air Flow and Temperature) sensor in the right air cleaner provides both mass air flow and temperature signals for the ECM. The engine harness connection with MAF (Mass Air Flow) sensor attached of the left air cleaner is wired so that only the mass air flow signal is connected to the ECM.

The MAF and MAFT sensors work on the hot film principle. Both 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 signals are also used as a feedback for the EGR (Exhaust Gas Recirculation) system.

The temperature sensor in the right MAFT sensor is a NTC (Negative Temperature Coefficient) thermistor in a voltage divider circuit. Using the voltage output from the temperature sensor, the ECM can correct the fueling map for intake air temperature.

The MAF and MAFT sensors receive a 12V supply from the ECM relay in the EJB and a ground connection via the ECM. Separate connections to the ECM are provided for the two mass air flow signals and the temperature signal.

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 charge air pressure, ambient air pressure and ambient air temperature.

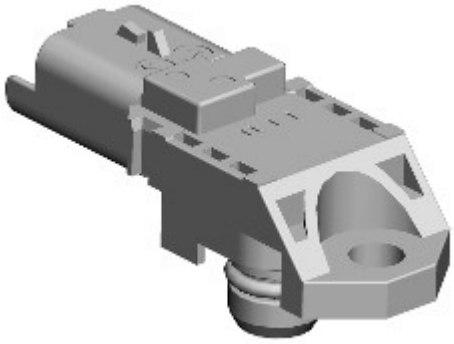
If one of the mass air flow sensors fails the ECM implements the default strategy based on engine speed. In the event of a mass air flow sensor signal failure, the following symptoms may be observed:

- Difficult starting.
- Engine stalls after starting.
- Delayed engine response.
- Emission control inoperative.
- Idle speed control inoperative.
- Reduced engine performance.

If the temperature sensor fails the ECM uses a default intake air temperature of -5°Celsius (23°F). In the event of a temperature sensor failure, any of the following symptoms may be observed:

- Over fueling, resulting in black smoke from the exhaust.
- Idle speed control inoperative.

Manifold Absolute Pressure (MAP) Sensor



E131041

The MAP (Manifold Absolte Pressure) sensor is installed in the charge air manifold, to measure the pressure of the air entering the intake manifolds. The sensor is a semi-conductor type sensor which responds to pressure acting on a membrane within the sensor, altering the output voltage.

The MAP sensor has a 3 pin connector which is connected to the ECM and provides a 5V reference voltage from the ECM, a signal input to the ECM and a ground connection.

The ECM uses the MAP sensor signal for the following functions:

- Maintain manifold charge air pressure.
- Reduce exhaust smoke emissions when driving at high altitude.
- Control of the EGR system.

If the MAP sensor fails, the ECM uses a default pressure of 1013 mbar (14 lbf/in²). In the event of a MAP sensor failure, the following symptoms may be observed:

- Altitude compensation inoperative (black smoke emitted from the exhaust).
- Active boost control inoperative.

Electric Throttle



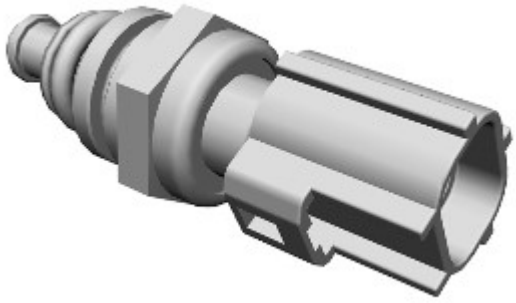
E130974

The electric throttle is installed at the front of the engine, between the cylinder heads. The throttle plate is operated by a DC (Direct Current) electric motor attached to the throttle body. The motor is controlled by the ECM, which operates the motor in response to driver inputs from the APP (Accelerator Pedal Position) sensor and other engine related sensors to provide the correct air flow to the intake manifolds.

The ECM has 5 connections with the electric throttle motor:

- A ground and two 12V feeds to operate the motor in each direction to open or close the throttle plate.
- A 5V reference connection and a signal connection with the TPS (Throttle Position) sensor in the motor, for closed loop control.

Engine Coolant Temperature Sensor



E130966

The ECT (Engine Coolant Temperature) sensor is located in the thermostat housing. 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 IC (Instrument Cluster) uses the temperature information for generation of engine temperature messages. The engine coolant temperature signal is also transmitted on the high speed CAN Powertrain, or medium speed CAN Comfort 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. The ECM compares the signal voltage to stored values and adjusts fuel delivery to ensure optimum driveability at all times.

The input to the sensor is a 5V 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°C (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.

Accelerator Pedal Position Sensor

NOTE: LHD pedal shown.



E141165

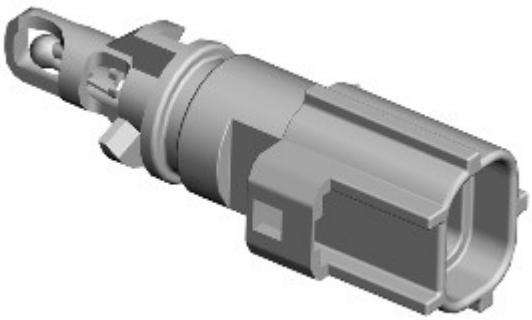
The APP sensor allows the ECM to determine the driver requests for vehicle speed, acceleration and deceleration. The ECM uses this information to determine the torque demand from the engine via injection control.

The APP sensor consists of a twin track rotary potentiometer integrated into the mounting bracket of the accelerator pedal. 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 rev/min to allow the vehicle to move. Torque application and reduction of engine speed back to normal idle speed can be subsequently controlled via brake pedal switch operation.

The ECM constantly checks the range and plausibility of the two signals and stores a fault code if it detects a fault.

Charge Air Temperature Sensor



E148012

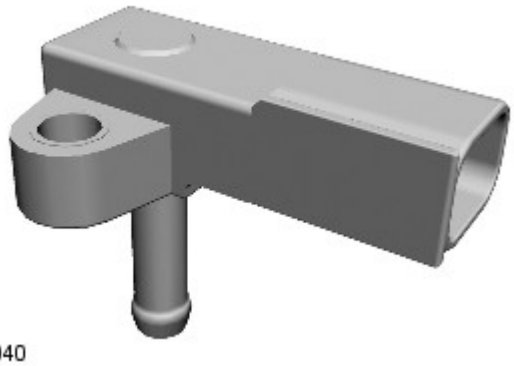
The charge air temperature sensor is located in the charge air duct connection with the electric throttle. The sensor is used to measure the intake air temperature from the turbochargers in order to calculate the required amount of fueling.

The charge air temperature sensor incorporates a NTC thermistor in a voltage divider circuit. The sensor receives a 3.3V reference voltage from the ECM. Using the voltage output from the charge air temperature sensor, the ECM can correct the fueling map for charge air temperature.

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 in black smoke emitting from the exhaust.
- Idle speed control inoperative.

Charge Air Pressure Sensor



E131040

The charge air pressure sensor is attached to the rear suspension bracket of the dynamic response hydraulic pump. The sensor is connected via a hose to the charge air outlet pipe from the fixed vane turbocharger compressor.

The charge air pressure sensor provides a voltage signal to the ECM relative to the output charge air pressure from the fixed vane turbocharger. The 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 charge air pressure sensor uses a diaphragm transducer to measure pressure. The ECM uses the sensor signal for the following functions:

- Maintain manifold charge air pressure.
- Reduce exhaust smoke emissions when driving at high altitude.
- Control of the EGR system.
- To help smooth the transition between mono turbocharger and bi-turbocharger operation.
- To aid the air path diagnostics.

Ambient Air Temperature Sensor



E116093

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 Powertrain bus for use by other control modules.

The AAT sensor is installed in the left exterior mirror, with the bulb of the sensor positioned over a hole in the bottom of the mirror casing.

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 sensor. If the AAT sensor and the temperature input of the MAFT sensor are both faulty, the ECM adopts a default ambient temperature of 20 °C (68 °F).

Heated Oxygen Sensor



The HO2S is a wide band type oxygen sensor that allows the ECM to provide closed loop control of the air:fuel mixture. The sensor is installed in the right downpipe of the exhaust system, immediately after the connection with the VGT (variable geometry turbine) turbocharger outlet.

Power for the heater element of the HO2S is provided by a battery voltage supply from the ECM relay in the EJB. The circuit through the heater element is completed by a connection with the ECM. The ECM regulates the current flow through the heater element to control the heating of the sensor. The heater element is operated immediately after each engine start and during low load conditions when the temperature of the exhaust gases is insufficient to maintain the required sensor temperature.

The HO2S has four further connections with the ECM, two for the Nernst (oxygen measuring) cell and two for the pump cell. The ECM adjusts the current of the pump cell circuit as necessary to maintain a constant signal from the oxygen measuring cell. The ECM then relates the current of the pump cell circuit to the lambda value of the exhaust gases.

If a HO2S fails the ECM defaults to open loop fueling and the emissions content of the exhaust gases increases. With a failed HO2S, the engine will suffer from unstable operation and reduced performance.

Exhaust gas temperature sensors



E153664

Four temperature sensors are used in the DPF system in the following location:

- Pre-DPF Temperature Sensor
- Pre-Catalyst Temperature Sensor (adjacent to the HO2S)
- Post secondary turbocharger exhaust gas temperature sensor
- Post-DPF Temperature Sensor

The pre-sensors measure the temperature of exhaust gas exiting the turbocharger and before it passes through the catalyst converter and DPF, provides the information needed to calculate the DPF temperature. The post-catalyst and post-DPF temperature sensors provide the ECM with temperature signal, which is used as feedback for the ECM, from the actual exhaust gas temperature after the catalyst converter, and DPF. The information is used, in conjunction with other data, to estimate the amount of accumulated particulates and to control the DPF temperature.
For additional information, refer to: Diesel Particulate Filter (309-00D Exhaust System - TDV8 4.4L Diesel, Description and Operation) /
Diesel Particulate Filter (309-00D Exhaust System - TDV8 4.4L Diesel, Description and Operation).

OPERATION

The TDV8 4.4L diesel engine management system is controlled by the ECM and is able to monitor, adapt and precisely control the fuel injection and electric throttle. The ECM uses multiple sensor inputs and precision control of actuators to achieve optimum performance during all driving conditions.

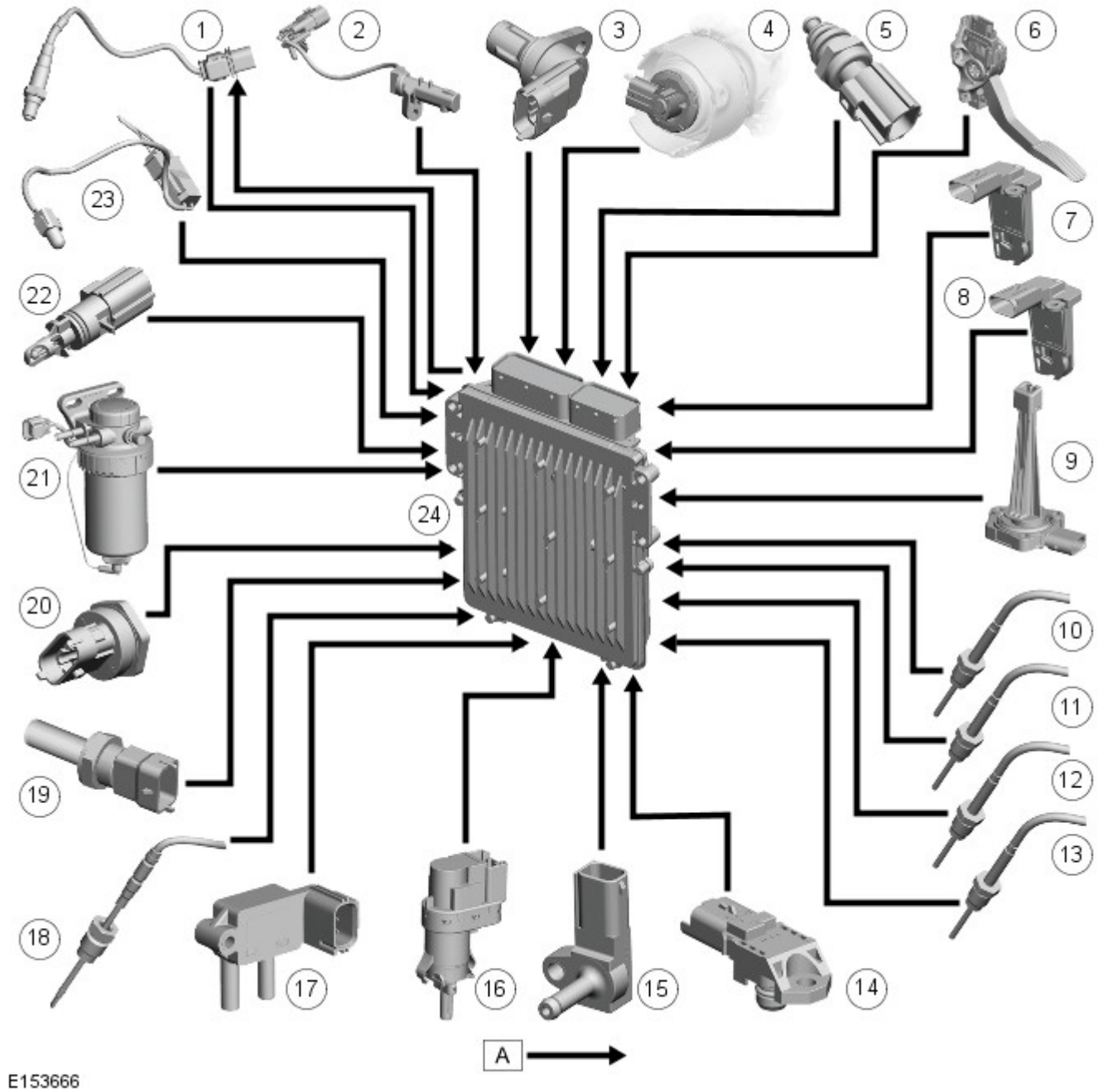
The ECM controls fuel delivery to all eight cylinders via a common rail injection system. The common rail system uses a fuel rail to accumulate highly pressurized fuel and feed the eight, electronically controlled injectors. The fuel rail is located in close proximity to the injectors, which assists 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 the 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.

Control Diagram - Sheet 1 of 2

NOTE: A = Hardwired.



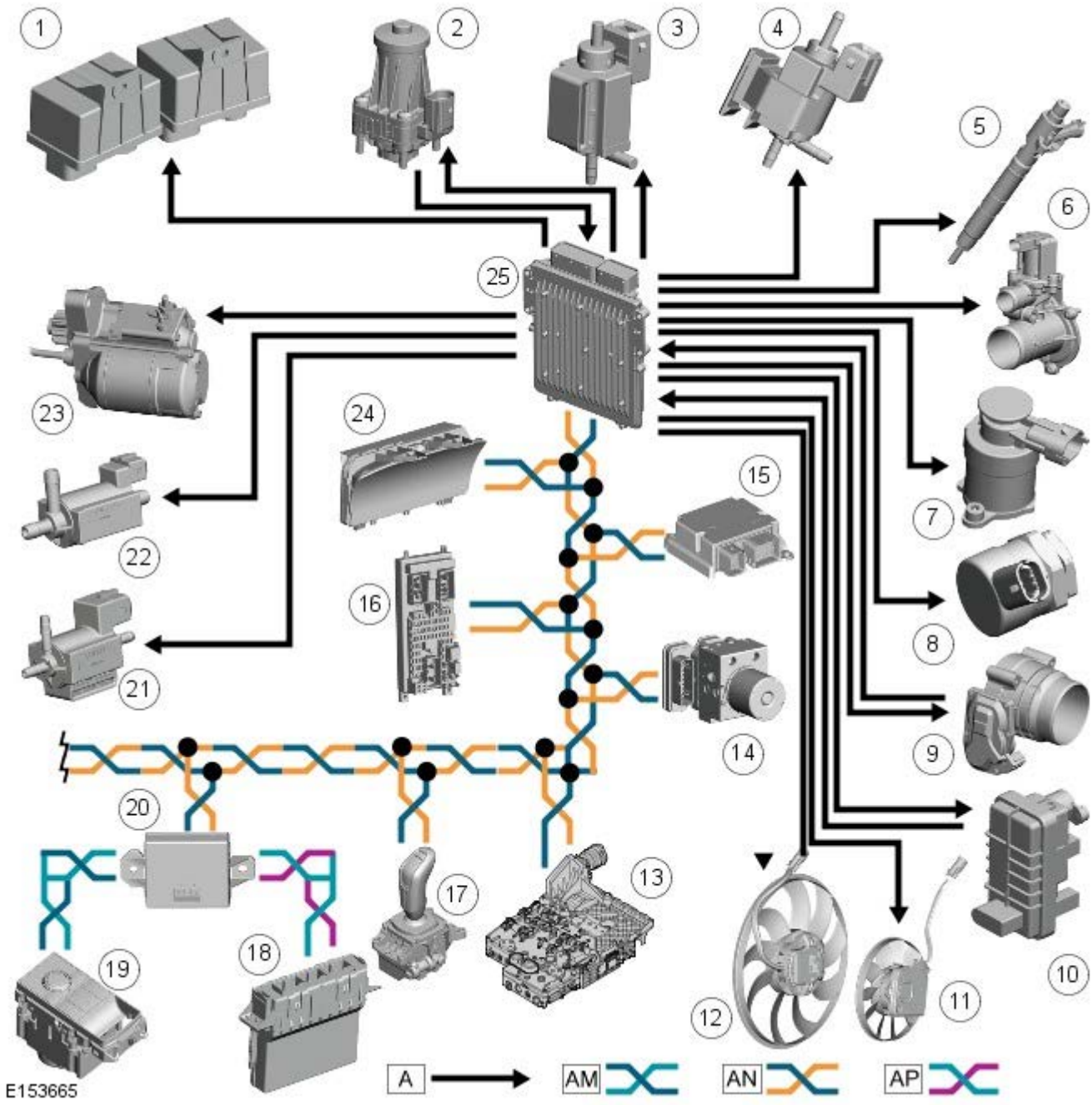
E153666

Item	Part Number	Description
1	-	Heated Oxygen Sensor (HO2S)
2	-	Crankshaft Position (CKP) sensor
3	-	Camshaft Position (CMP) sensor
4	-	Turbine intake valve position sensor
5	-	Engine Coolant Temperature (ECT) sensor
6	-	Accelerator Pedal Position (APP) sensor
7	-	Mass Air Flow and Temperature (MAFT) sensor
8	-	Mass Air Flow (MAF) sensor
9	-	Oil level and temperature sensor
10	-	Pre catalyst converter exhaust gas temperature sensor (where fitted)
11	-	Post secondary turbocharger exhaust gas temperature sensor (where fitted)
12	-	Pre DPF exhaust gas temperature sensor (where fitted)
13	-	Post DPF exhaust gas temperature sensor (where fitted)
14	-	Manifold Absolute Pressure (MAP) sensor

15	-	Charge air pressure sensor
16	-	Brake pedal switch
17	-	Differential pressure sensor
18	-	Exhaust Gas Recirculation (EGR) cooler inlet temperature sensor
19	-	Fuel temperature sensor
20	-	Fuel Rail Pressure (FRP) sensor
21	-	Water in fuel sensor
22	-	Charge air temperature sensor
23	-	Ambient Air Temperature (AAT) sensor
24	-	Engine Control Module (ECM)

Control Diagram - Sheet 2 of 2

NOTE: A = Hardwired, AM = High speed CAN (Controller Area Network) Chassis bus, AN = High speed CAN Powertrain bus, AP = Medium speed CAN Comfort bus.



Item	Part Number	Description
1	-	Glow plug control modules
2	-	Exhaust Gas Recirculation (EGR) valve
3	-	EGR cooler bypass valve solenoid
4	-	Engine mount solenoid
5	-	Fuel injector (8 off)
6	-	Charge air recirculation solenoid

7	-	Fuel metering valve
8	-	Fuel pressure control valve
9	-	Electric throttle motor
10	-	Variable geometry turbine vane actuator
11	-	Engine cooling fan 2
12	-	Engine cooling fan 1
13	-	Transmission Control Module (TCM)
14	-	Anti-lock brake system control module (ABS)
15	-	Restraints Control Module (RCM)
16	-	Central Junction Box (CJB)
17	-	Transmission Control Switch (TCS)
18	-	Automatic Temperature Control Module (ATCM)
19	-	Terrain Response® switchpack
20	-	Gateway Module (GWM)
21	-	Turbine intake shut-off valve solenoid
22	-	Charge air solenoid
23	-	Starter motor
24	-	Instrument Cluster (IC)
25	-	Engine Control module (ECM)

Published: 11-Dec-2013

Electronic Engine Controls - TDV8 4.4L Diesel - Brake Pedal Position (BPP) Switch Adjustment

General Procedures

Check

1. Remove the brake pedal rubber.



2. NOTE: Make sure that the dial test indicator (DTI) gauge is in line with the brake pedal movement.

   Position the DTI gauge on a suitable mounting block, as illustrated.

3. With the aid of another technician, gently press the brake pedal until the stop lamps illuminate.

4. NOTE: The specification is that the stop lamps should illuminate at between 5.5mm and 8.5mm brake pedal travel.

   Note the measurement of the brake pedal travel from rest position until the stop lamps illuminated.

Adjust

NOTE: The Brake Pedal Position Switch is self adjusting when removed and installed.

1. Remove and install Brake Pedal Position Switch.
   For additional information, refer to: Stoplamp Switch (417-01 Exterior Lighting, Removal and Installation).

2. Check the adjustment of the stop lamp switch by following the **Check** procedure in this procedure and carry out the **Adjust** procedure if required.

Published: 24-Oct-2013

Electronic Engine Controls - TDV8 4.4L Diesel - Camshaft Position (CMP) Sensor

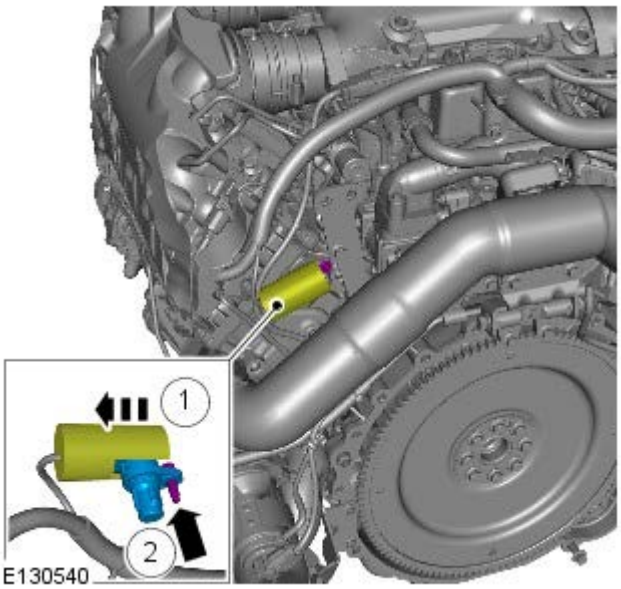
Removal and Installation

Removal

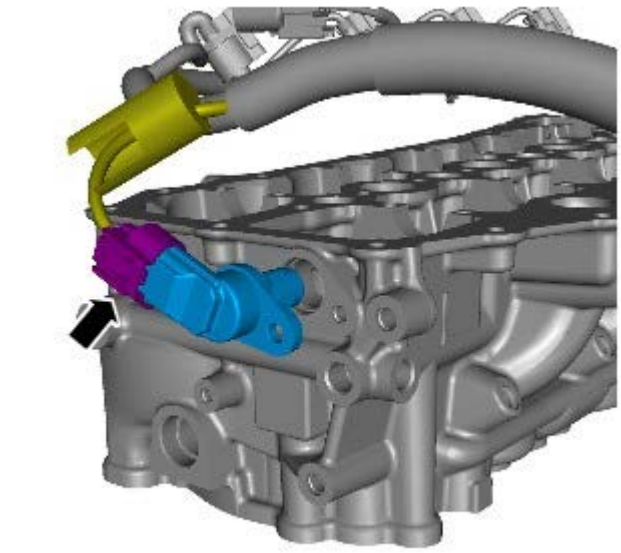
CAUTION: Make sure that all openings are sealed. Use new blanking caps.

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Engine Cover - 4.4L V8 - TdV8 (501-05 Interior Trim and Ornamentation, Removal and Installation).
2. Refer to: Secondary Bulkhead Center Panel - TDV8 4.4L Diesel (501-02, Removal and Installation).
3. *Torque:* 10 Nm



4. CAUTION: Be prepared to collect escaping oil.



Installation

1. CAUTION: Make sure the protection shield is correctly aligned onto the camshaft position sensor.

   To install, reverse the removal procedure.

Published: 31-Aug-2012

Electronic Engine Controls - TDV8 4.4L Diesel - Crankshaft Position (CKP) Sensor

Removal and Installation

Removal

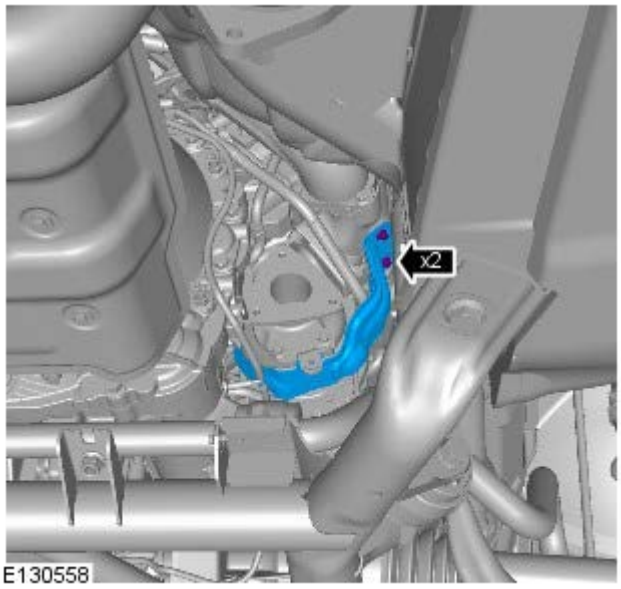
NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

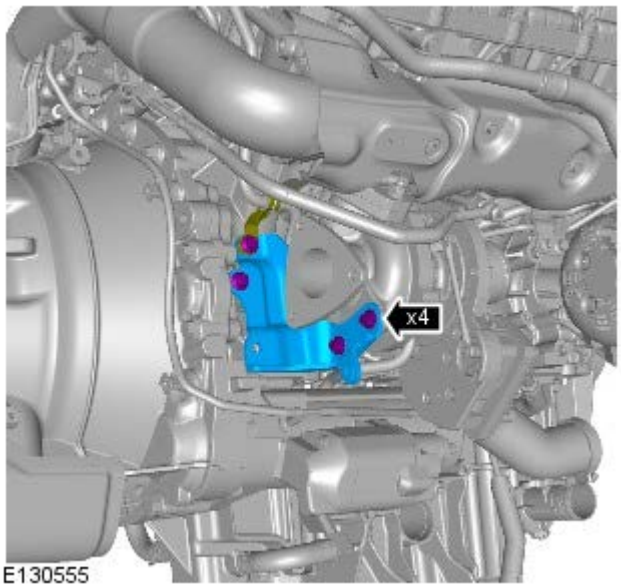
   Raise and support the vehicle.

2. Refer to: Starter Motor (303-06, Removal and Installation).

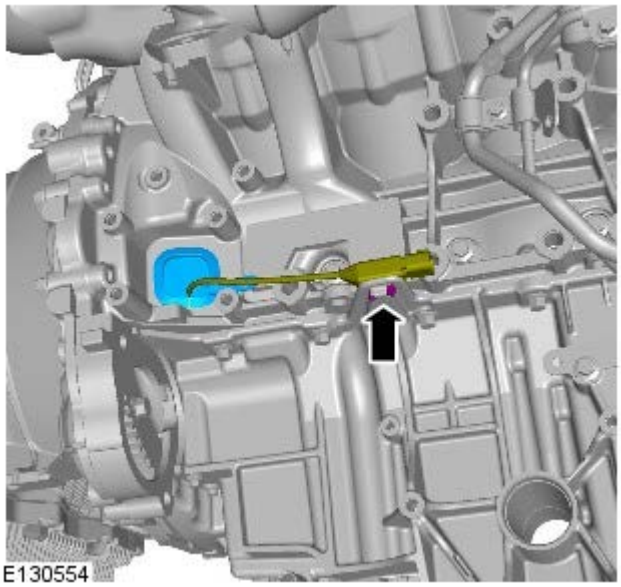
3. *Torque:* 10 Nm

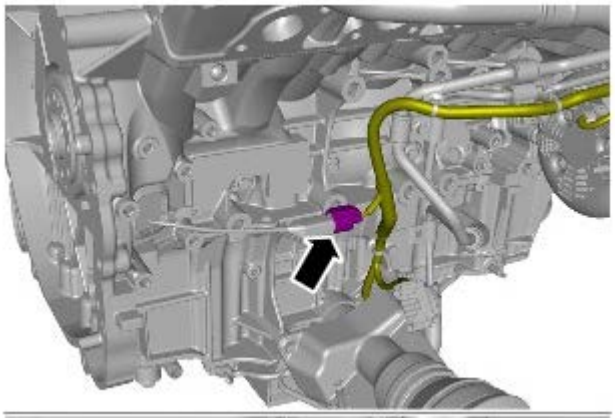


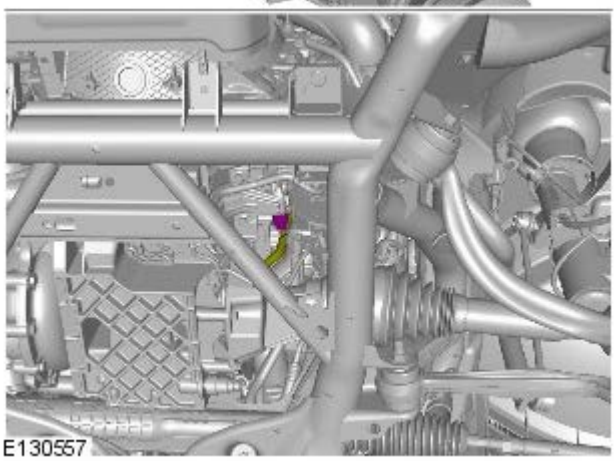
4. *Torque:* 23 Nm



5.


E130554

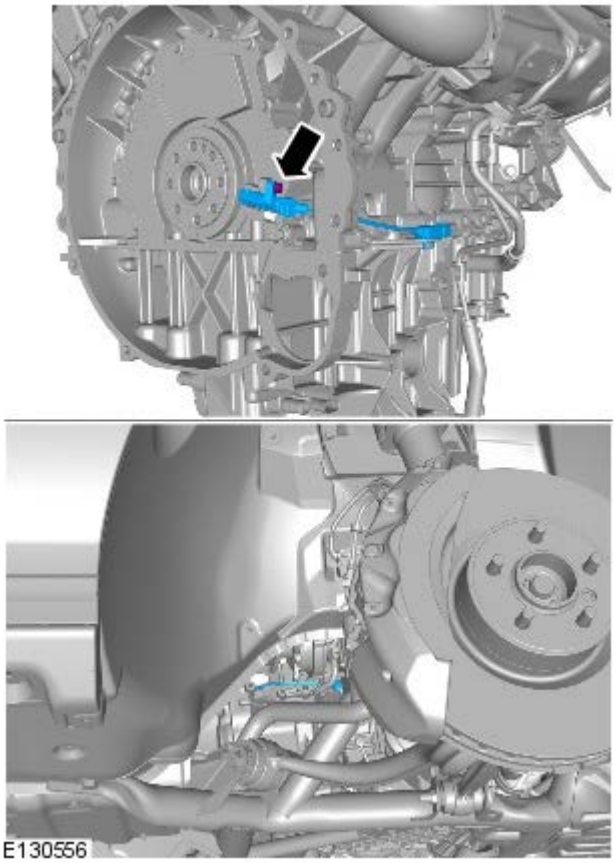



E130557

6. 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.

7. NOTE: The CKP sensor retaining bolt should not be removed from the CKP sensor.

   Torque: 5 Nm



Installation

1. CAUTIONS:

   Install the CKP sensor correctly into the housing. Failure to follow this instruction may result in damage to the CKP sensor.

   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.

Published: 31-Aug-2012

Electronic Engine Controls - TDV8 4.4L Diesel - Crankshaft Position (CKP) Sensor Ring

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.

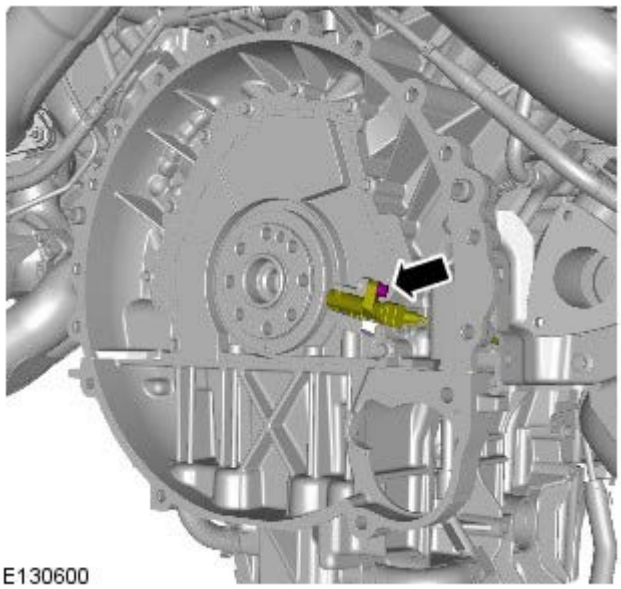
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

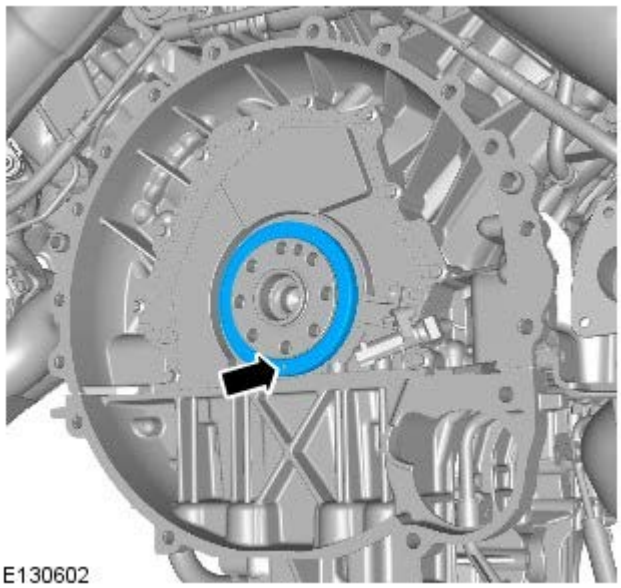
   Raise and support the vehicle.

3. Refer to: Flexplate (303-01, Removal and Installation).


E130600

4. NOTE: The CKP sensor bolt should not be removed from the CKP sensor.

   Torque: 5 Nm


E130602

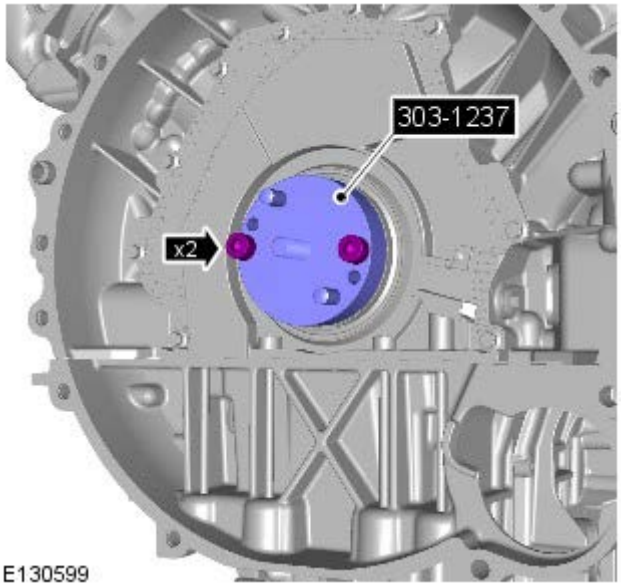
5. NOTE: Note the position of the crankshaft position (CKP) sensor pulse wheel during removal. It must be returned to its original position during installation.

Installation



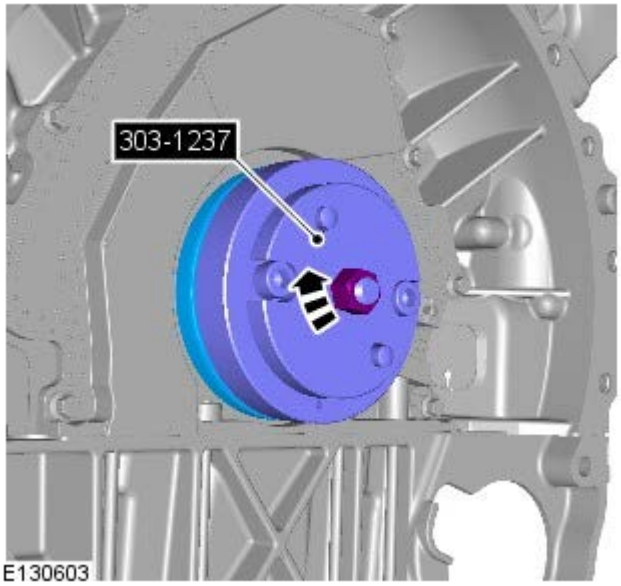
E130601

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.



E130599

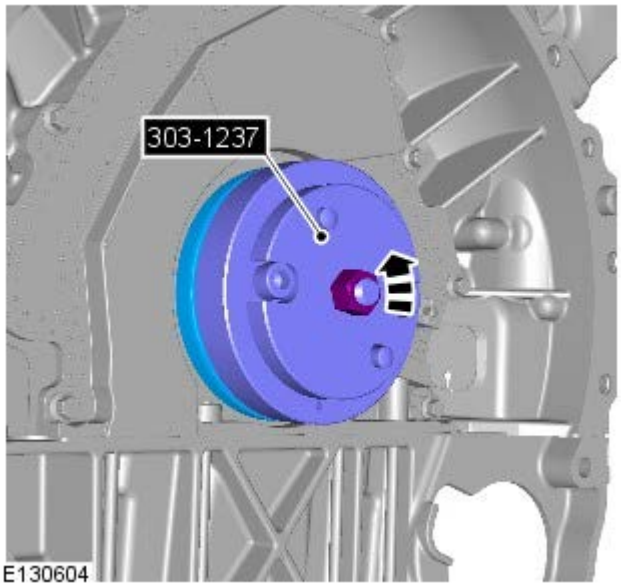
2. Install the special tool.



E130603

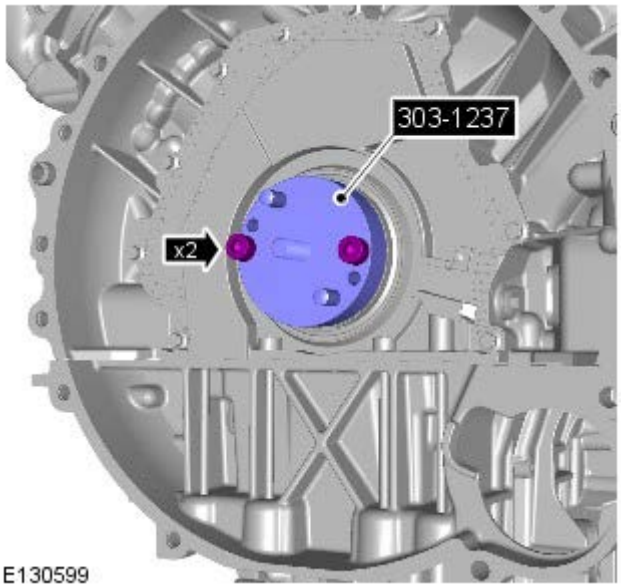
3.

4.

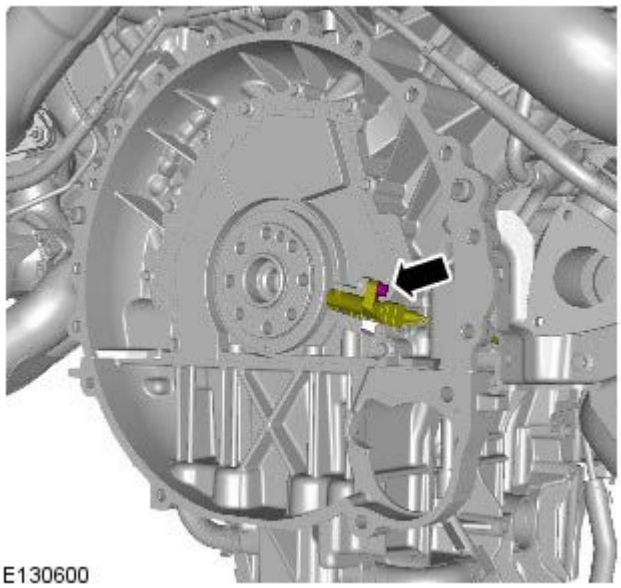


E130604

5. Remove the special tool.



E130599


E130600

6. CAUTION: Install the CKP sensor correctly into the housing. Failure to follow this instruction may result in damage to the CKP sensor.

   Torque: 5 Nm

7. To install, reverse the removal procedure.

Published: 08-Aug-2012

Electronic Engine Controls - TDV8 4.4L Diesel - Diesel Particulate Filter (DPF) Differential Pressure Sensor

Removal and Installation

Removal

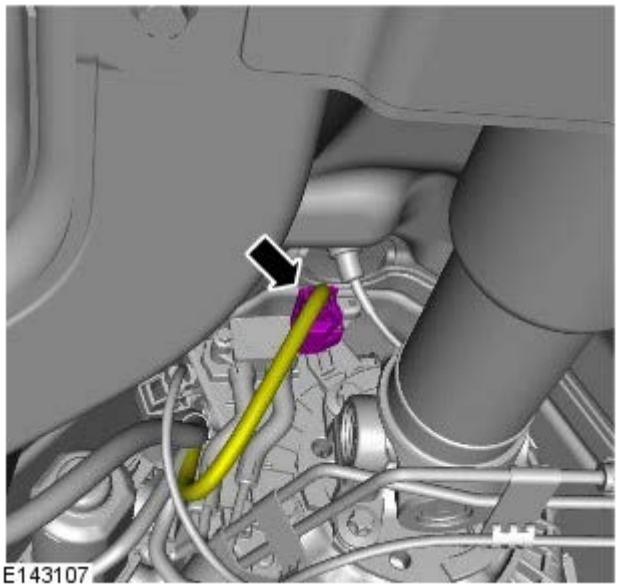
WARNING: Observe due care when working near a hot exhaust system.

NOTE: Removal steps in this procedure may contain installation details.

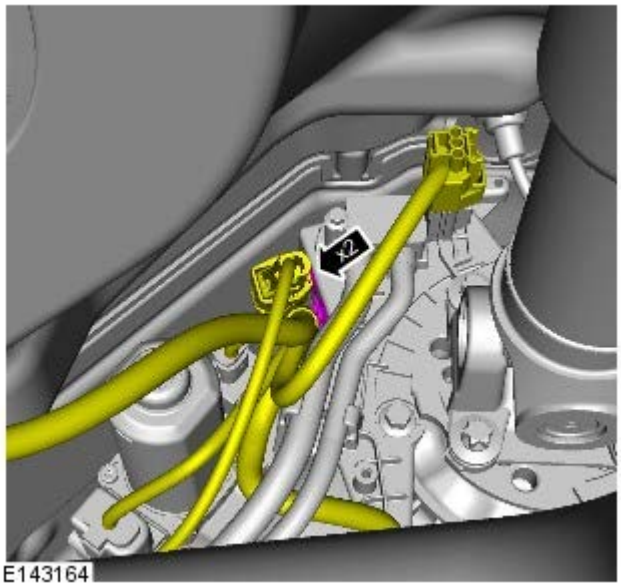
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

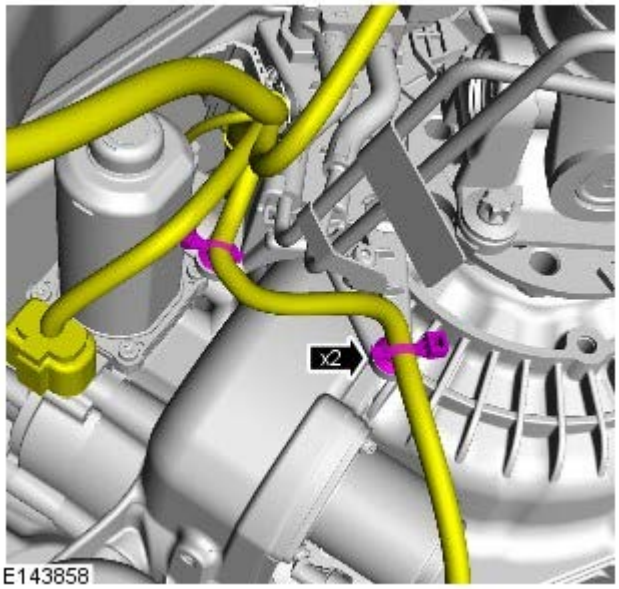
2.



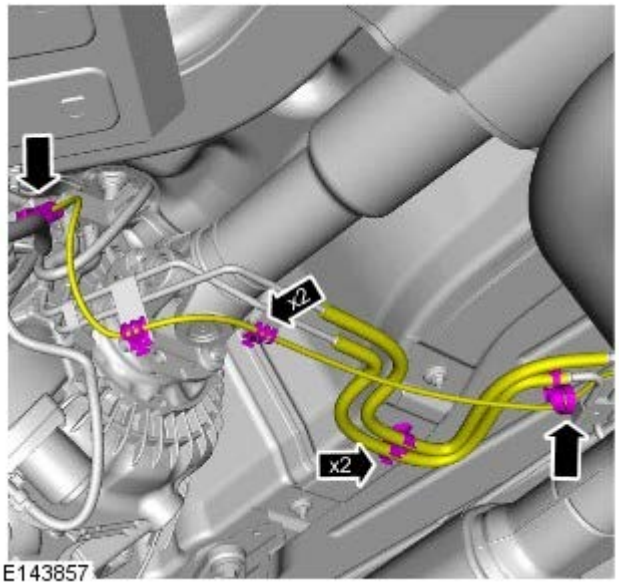
3.



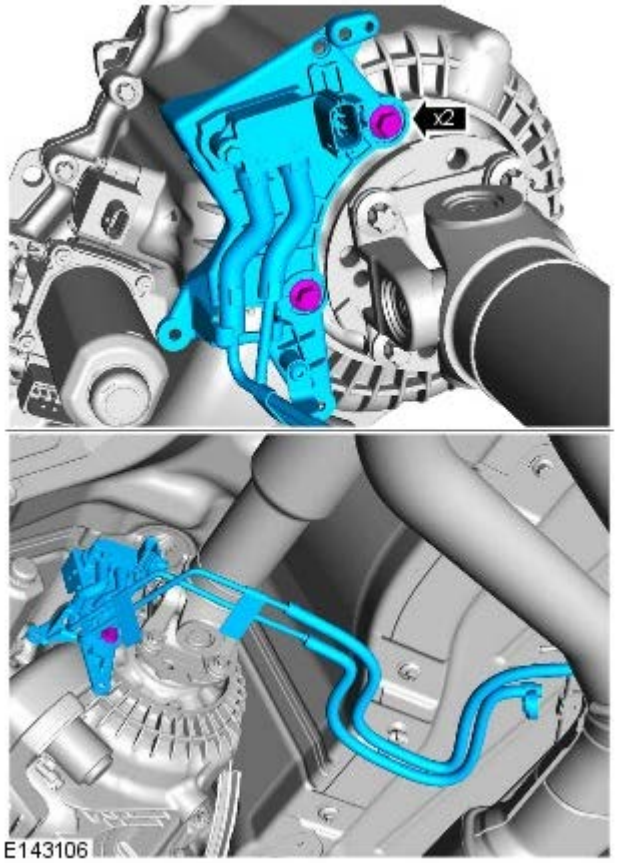
4.



5.



6. *Torque:* 20 Nm



Installation

1. To install, reverse the removal procedure.
2. If a new unit is installed, configure using the approved diagnostic tool.

Published: 24-Aug-2012

Electronic Engine Controls - TDV8 4.4L Diesel - Engine Control Module (ECM)

Removal and Installation

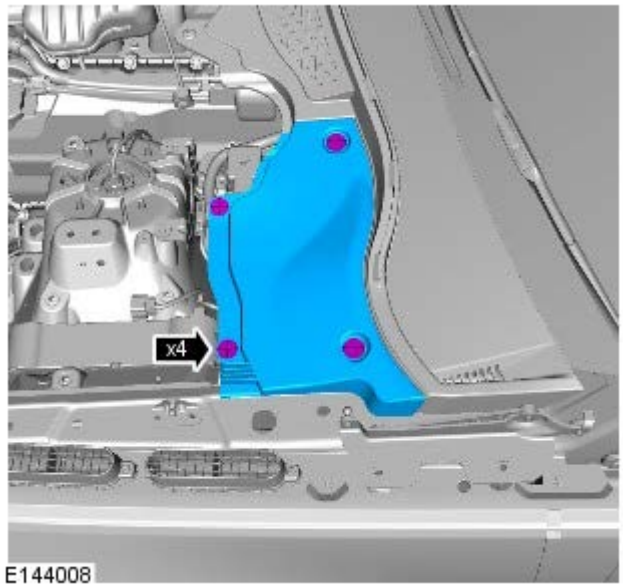
Removal

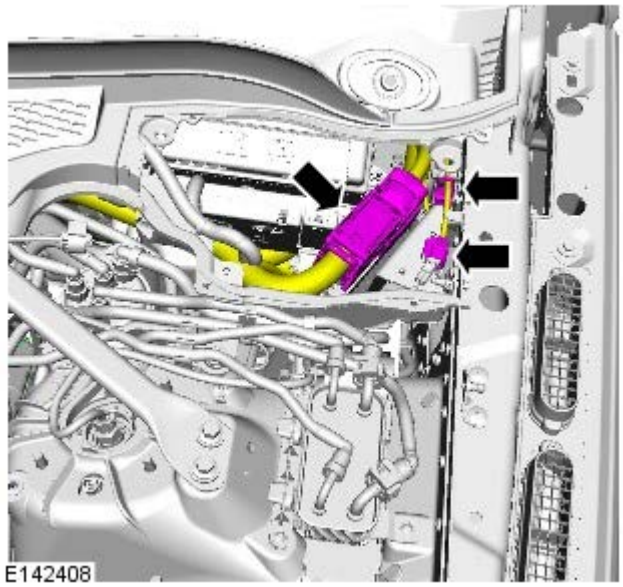
NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

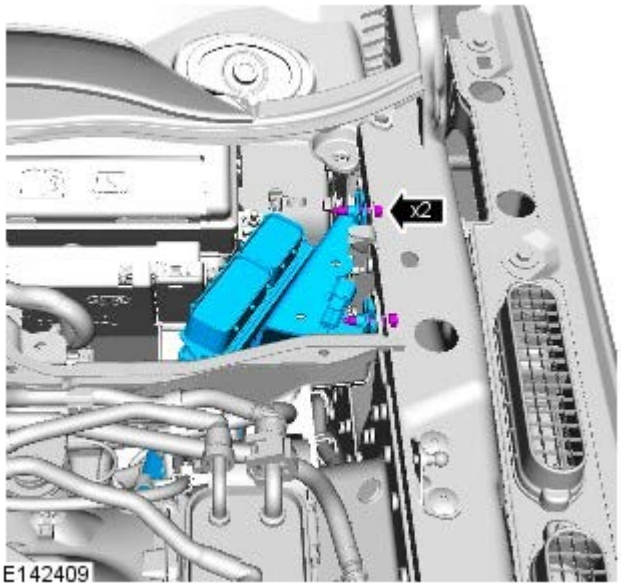
2.



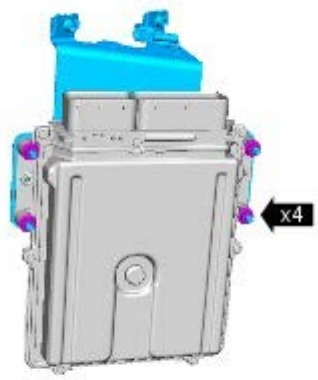


3. CAUTION: Before the disconnection or removal of any components, make sure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

4. *Torque:* 9 Nm



5. *Torque:* 9 Nm



Installation

1. To install, reverse the removal procedure.
2. If a new unit is installed, configure using the approved diagnostic tool.

Published: 31-Aug-2012

Electronic Engine Controls - TDV8 4.4L Diesel - Engine Coolant Temperature (ECT) 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 Battery and Charging System - General Information, Specifications).

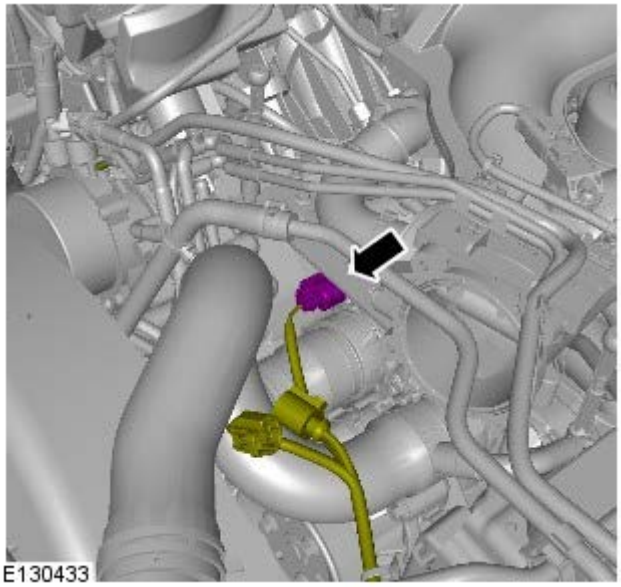
2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

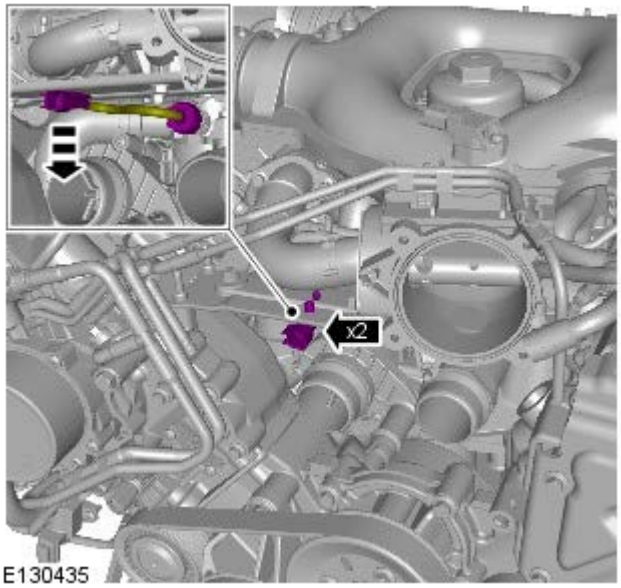
3. Refer to: Throttle Body (303-04, Removal and Installation).

4. Refer to: Cooling System Partial Draining, Filling and Bleeding (303-03, General Procedures).

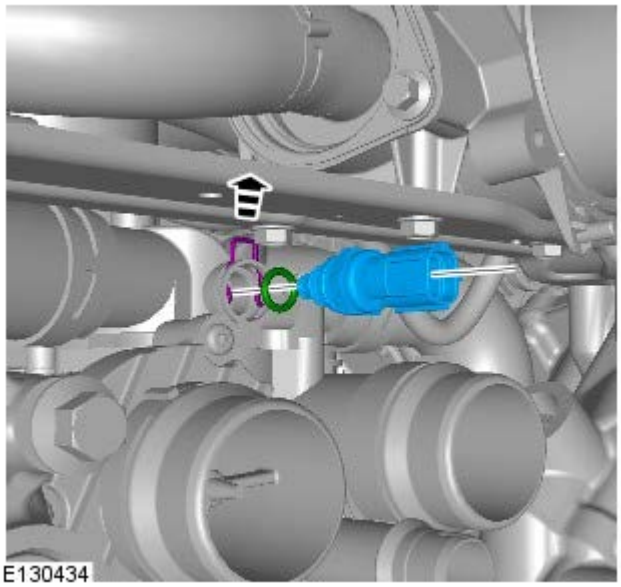
5.



6.



7. CAUTION: Be prepared to collect escaping fluids.



Installation

1. To install, reverse the removal procedure.

Published: 16-Aug-2012

Electronic Engine Controls - TDV8 4.4L Diesel - Exhaust Gas Temperature Sensor LH

Removal and Installation

Removal

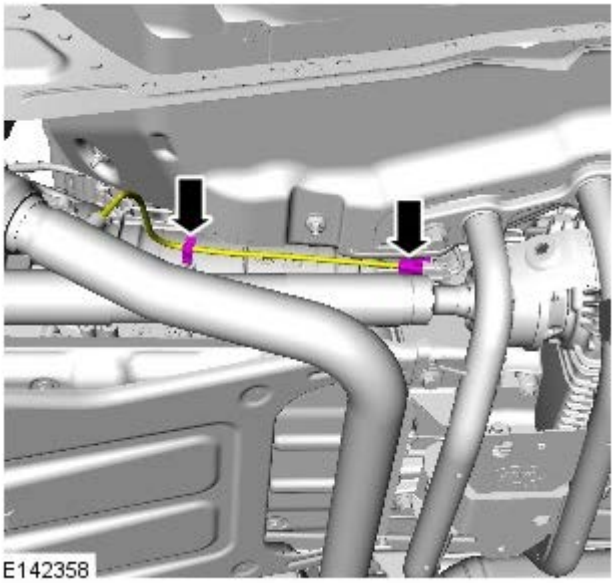
WARNING: Observe due care when working near a hot exhaust system.

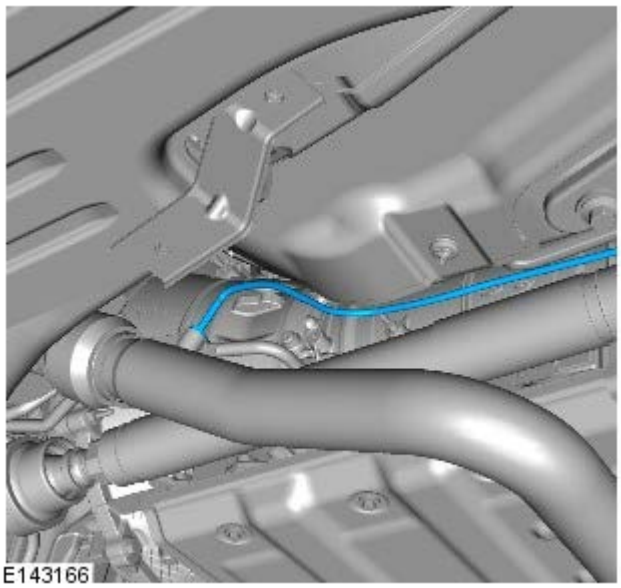
NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2.





3. CAUTION: 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: 24-Aug-2012

Electronic Engine Controls - TDV8 4.4L Diesel - Exhaust Manifold Temperature Sensor

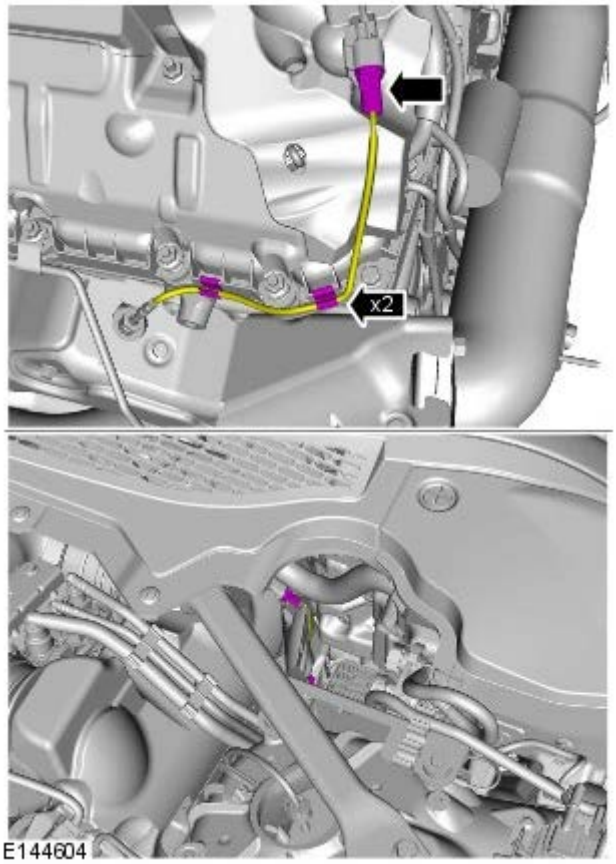
Removal and Installation

Special Tool(s)

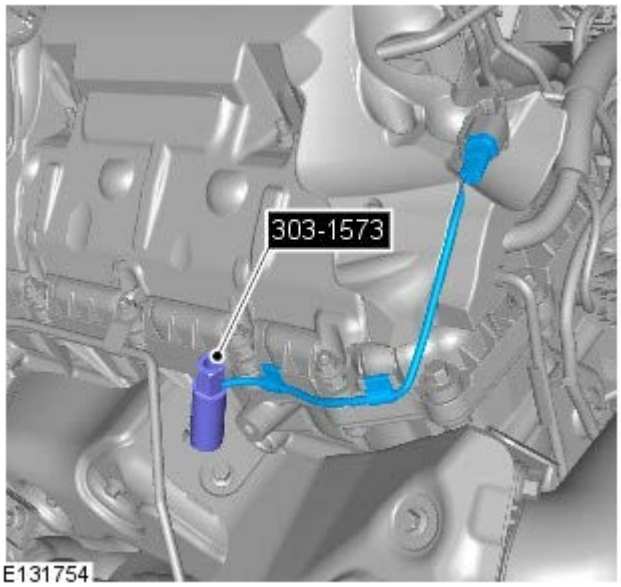
 E131753	JLR-303-1573 Remover, Exhaust Manifold Temperature Sensor

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Engine Cover - 4.4L V8 - TdV8 (501-05 Interior Trim and Ornamentation, Removal and Installation).
2. Refer to: Fuel Filter Element (310-01, Removal and Installation).
3. 

E144604
4. CAUTION: Make sure that all openings are sealed. Use new blanking caps.
   - *Special Tool(s):* JLR-303-1573
     Torque: 32 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: 04-Aug-2012

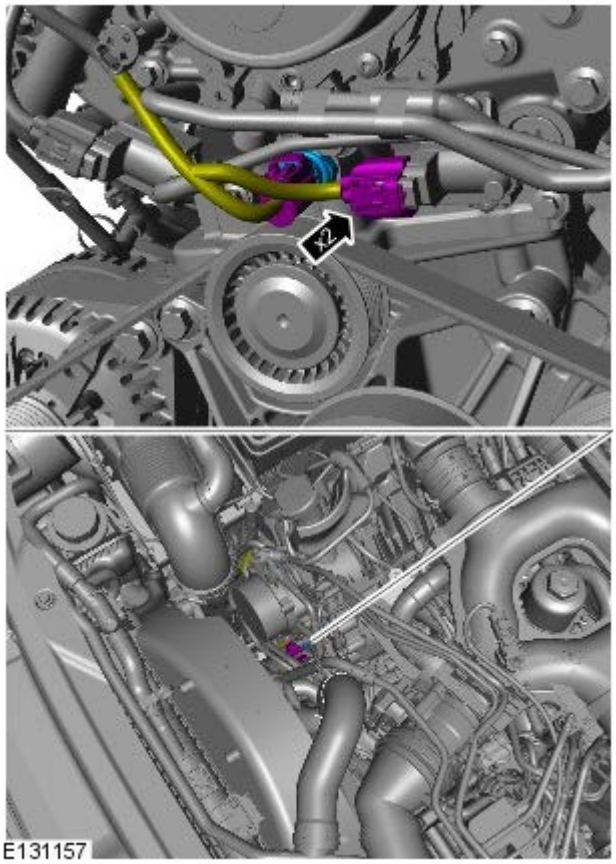
Electronic Engine Controls - TDV8 4.4L Diesel - Engine Oil Pressure (EOP) Sensor

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Engine Cover - 4.4L V8 - TdV8 (501-05, Removal and Installation).



2. CAUTIONS:

   Make sure that all openings are sealed. Use new blanking caps.

   Be prepared to collect escaping oil.

   NOTE: Note the position of the wiring harness.

   Torque: 14 Nm

Installation

1. CAUTION: Make sure the wiring harness is installed to its original position.

   To install, reverse the removal procedure.

Published: 24-Jul-2013

Electronic Engine Controls - TDV8 4.4L Diesel - Fuel Rail Pressure (FRP) Sensor

Removal and Installation

Removal

CAUTION: The use of an electronic torque and angle gauge is recommended during the high pressure fuel pipe tightening procedure.

NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

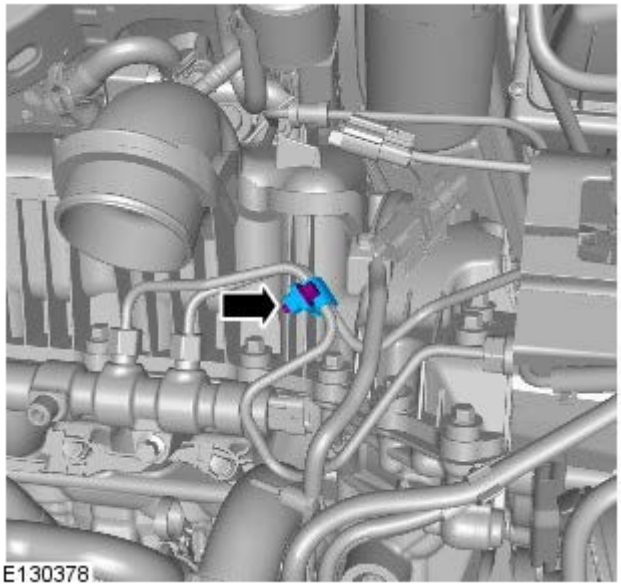
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

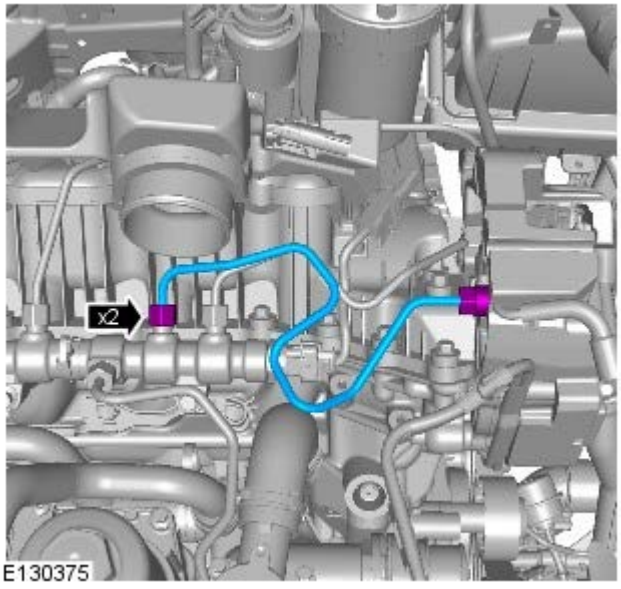
2. Refer to: Diesel Fuel System Health and Safety Precautions (100-00 General Information, Description and Operation).

3. Refer to: Fuel Injection Component Cleaning (303-04A Fuel Charging and Controls - TDV6 3.0L Diesel, General Procedures).

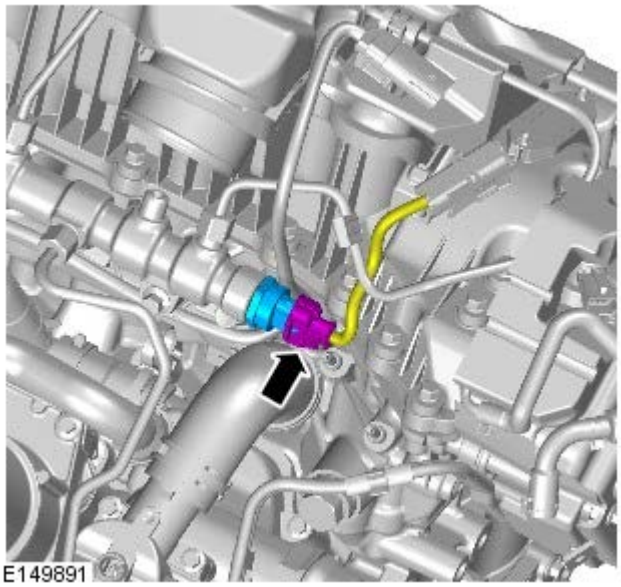
4. Refer to: Intake Manifold Plenum Chamber (303-01D Engine - TDV8 4.4L Diesel, Removal and Installation).

5.





6. CAUTION: Discard the fuel pipes.



7. 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.

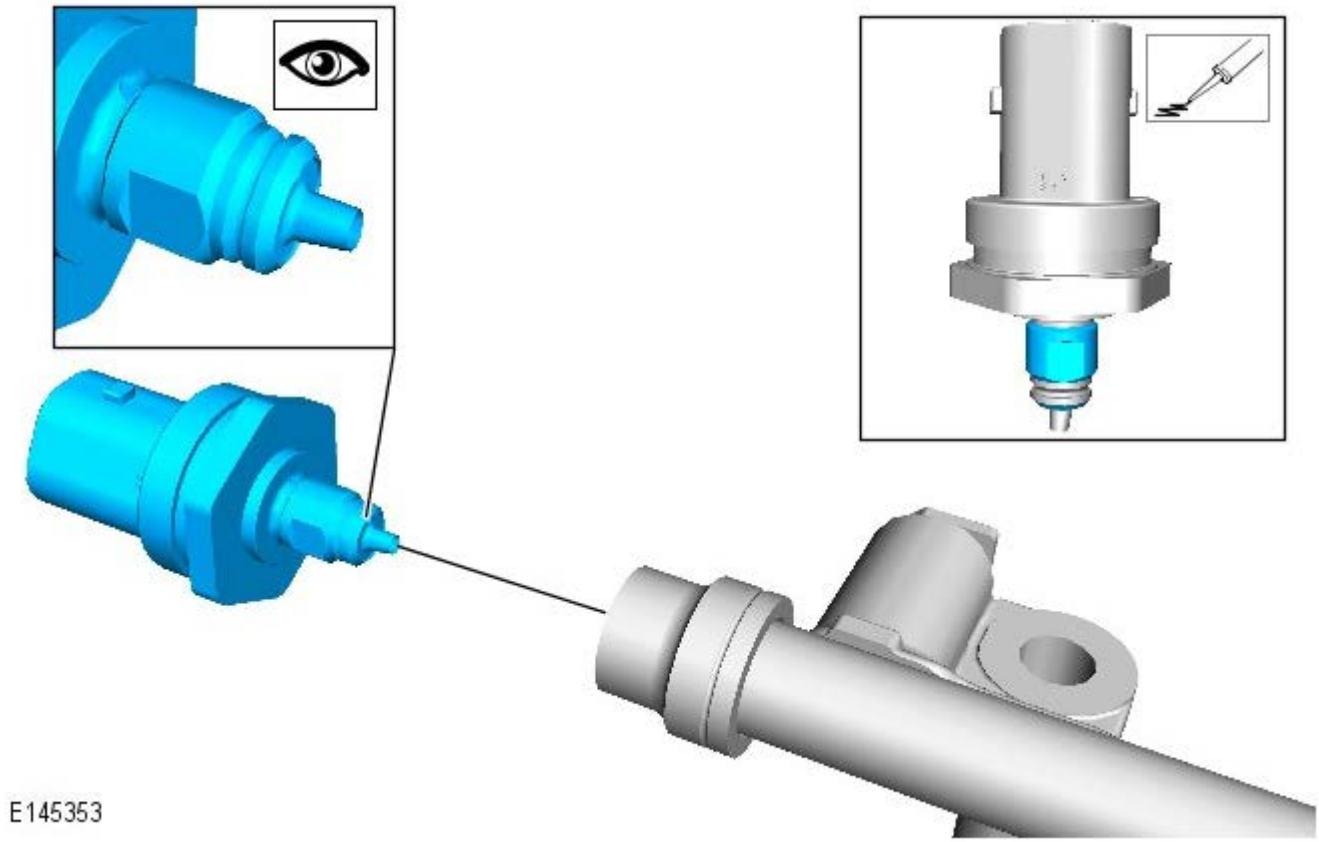
Installation

1. NOTES:

   During lubrication, keep the component vertically as shown.

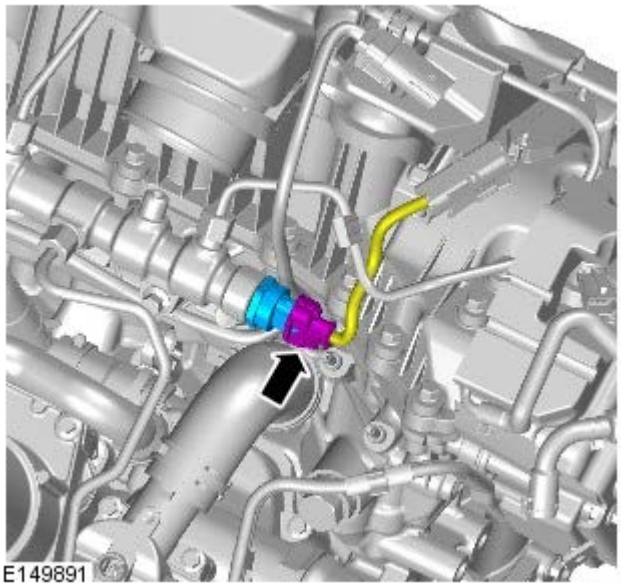
   Install the component finger tight at this stage.

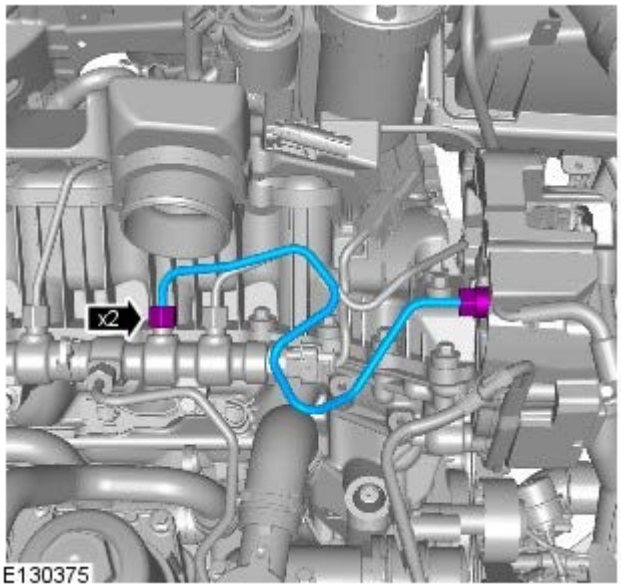
   Lubricate with Ft1v27 as shown.

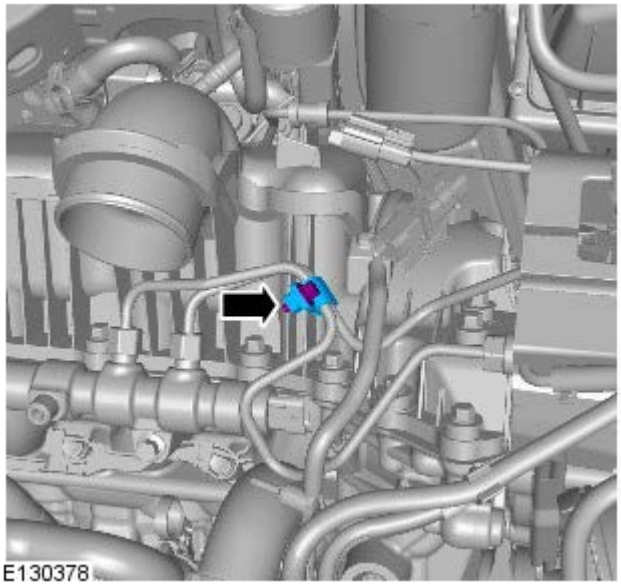


2. CAUTION: Make sure that the wiring harness is not twisted or damaged on installation. Failure to follow this instruction may result in damage to the vehicle.

   Torque: 70 Nm







3. CAUTIONS:

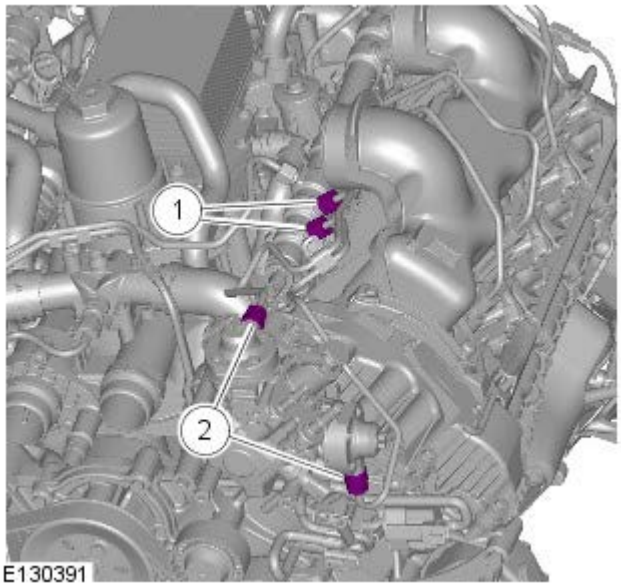
   Install new fuel pipes.

   Only tighten the unions finger-tight at this stage.

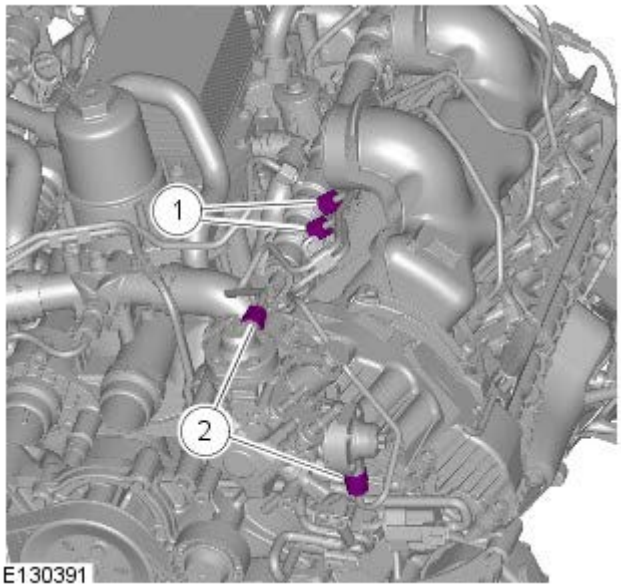
4. CAUTION: Only tighten the bolt finger-tight at this stage.

5. Tighten all.

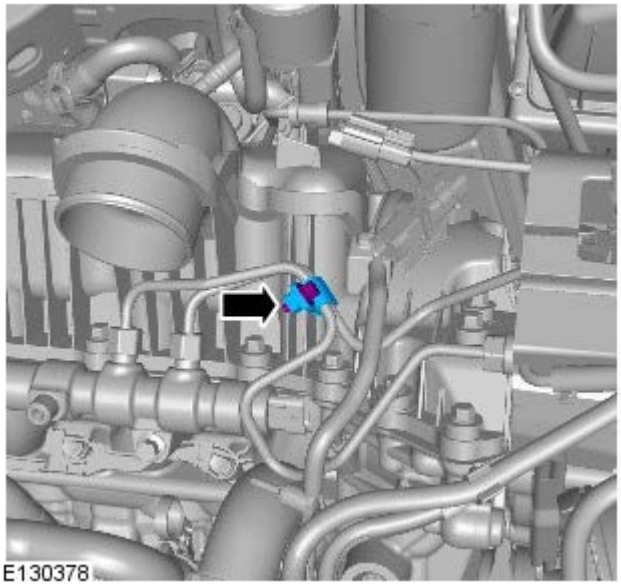
   Torque: 10 Nm



6. *Torque:*
   1 73°
   2 80°



7. *Torque:* 10 Nm



8. Refer to: Intake Manifold Plenum Chamber (303-01D Engine - TDV8 4.4L Diesel, Removal and Installation).

9. Refer to: High-Pressure Fuel System Bleeding (310-00 Fuel System - General Information, General Procedures).

10. Connect the battery ground cable.

Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 31-Jul-2012

Electronic Engine Controls - TDV8 4.4L Diesel - Heated Oxygen Sensor (HO2S)

Removal and Installation

Special Tool(s)

	310-121 Wrench, H02S

Removal

WARNING: Observe due care when working near a hot exhaust system.

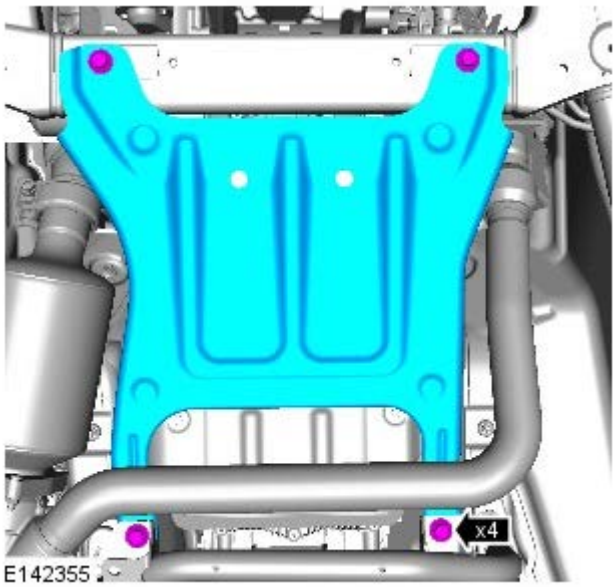
NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

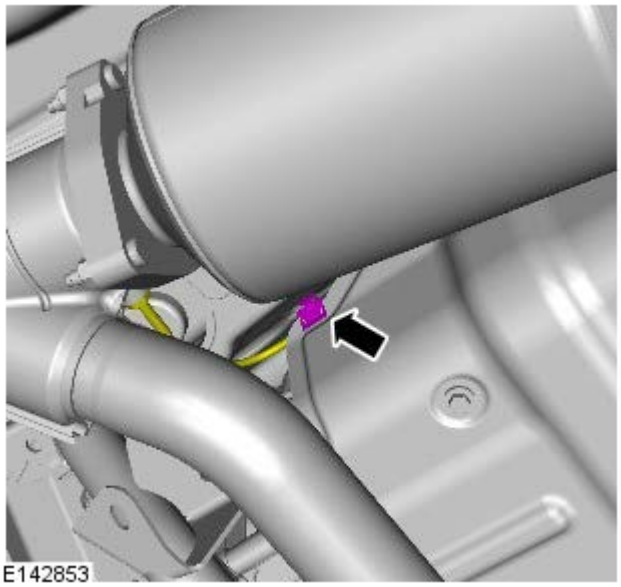
   Raise and support the vehicle.

2. Refer to: Catalytic Converter (309-00, Removal and Installation).

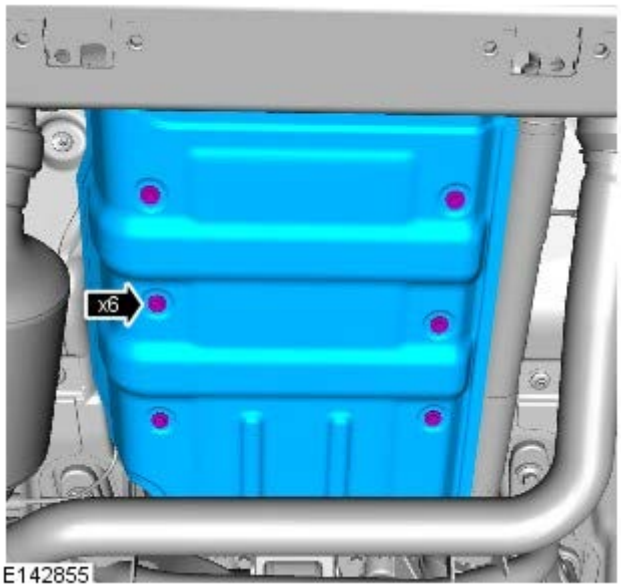
3. *Torque:* 60 Nm



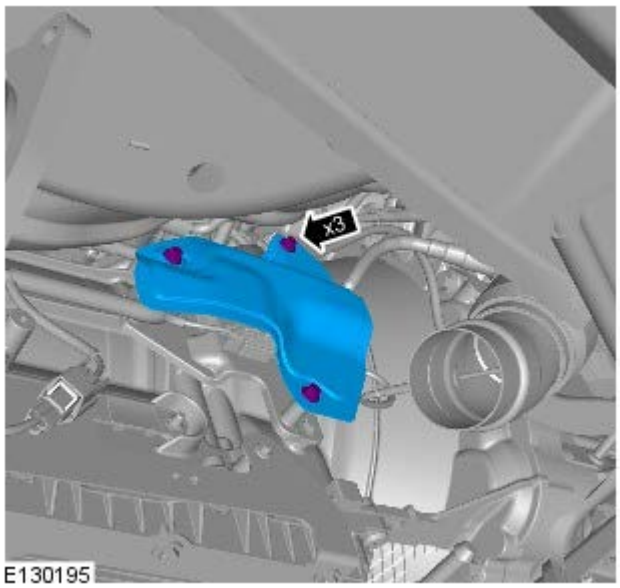
4.



5. *Torque:* 10 Nm

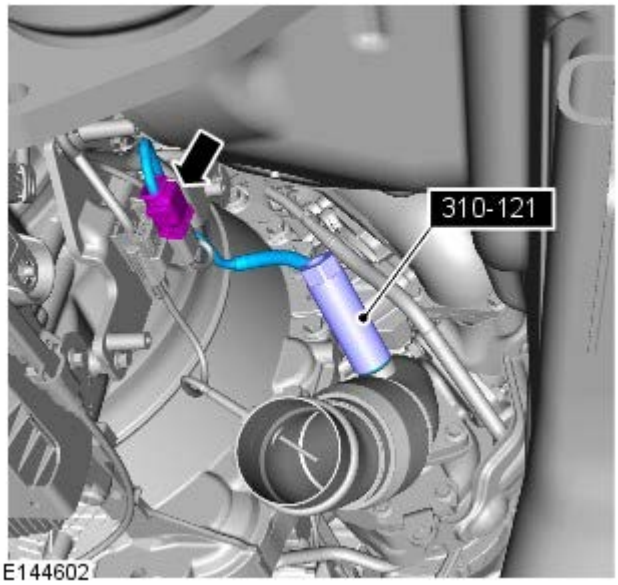


6. *Torque:* 10 Nm



7. CAUTION: Make sure that the mating faces are clean and free of foreign material.

   Special Tool(s): 310-121
   Torque: 48 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: 31-Jul-2012

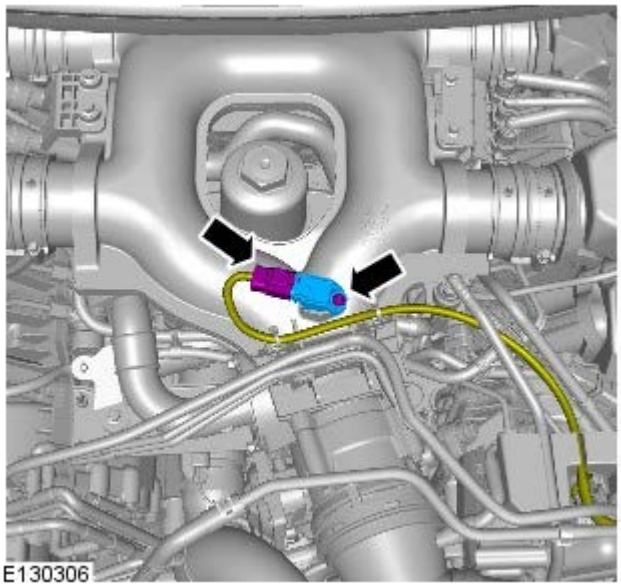
Electronic Engine Controls - TDV8 4.4L Diesel - Manifold Absolute Pressure and Temperature (MAPT) Sensor

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Engine Cover - 4.4L V8 - TdV8 (501-05, Removal and Installation).



2. *Torque:* 3 Nm

Installation

1. To install, reverse the removal procedure.
2. Using the approved diagnostic equipment, clear the powertrain control module (PCM) adaptions.

Published: 06-Aug-2012

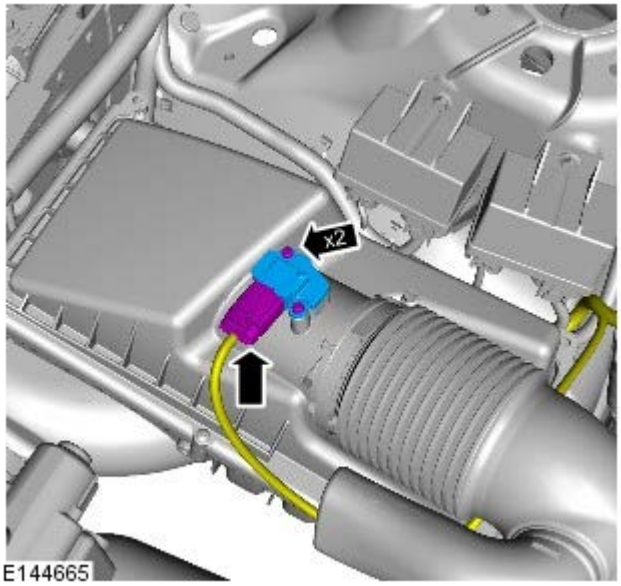
Electronic Engine Controls - TDV8 4.4L Diesel - Mass Air Flow (MAF) Sensor

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. *Torque:* 1.6 Nm



Installation

1. To install, reverse the removal procedure.

Published: 31-Jul-2012

Electronic Engine Controls - TDV8 4.4L Diesel - Pre Catalytic Converter Temperature Sensor

Removal and Installation

Removal

WARNING: Observe due care when working near a hot exhaust system.

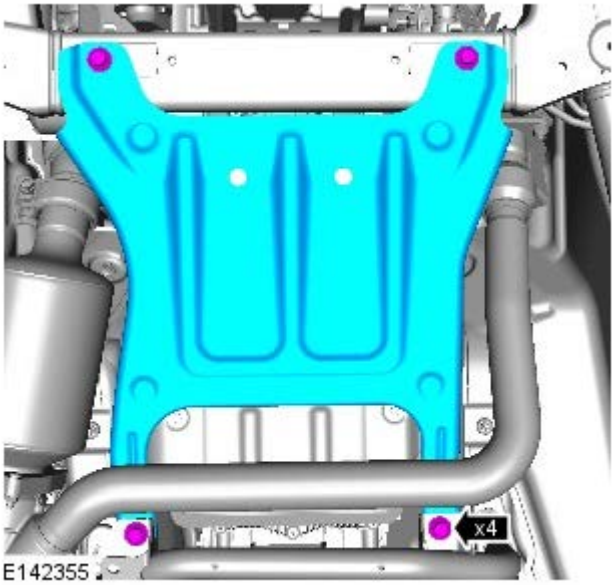
NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

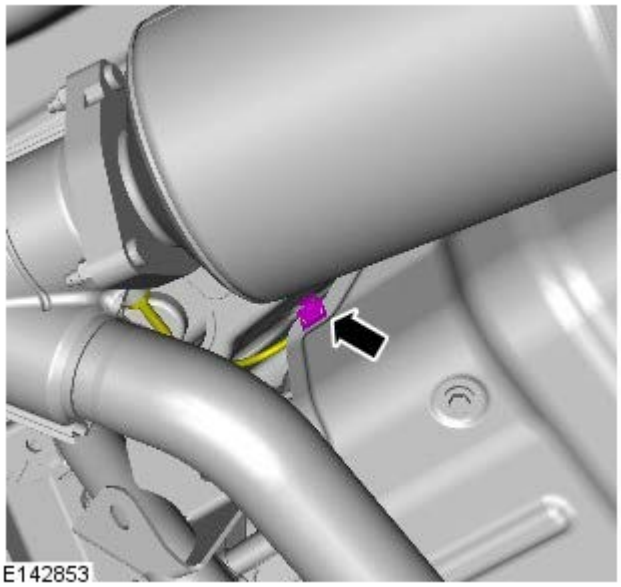
   Raise and support the vehicle.

2. Refer to: Catalytic Converter (309-00, Removal and Installation).

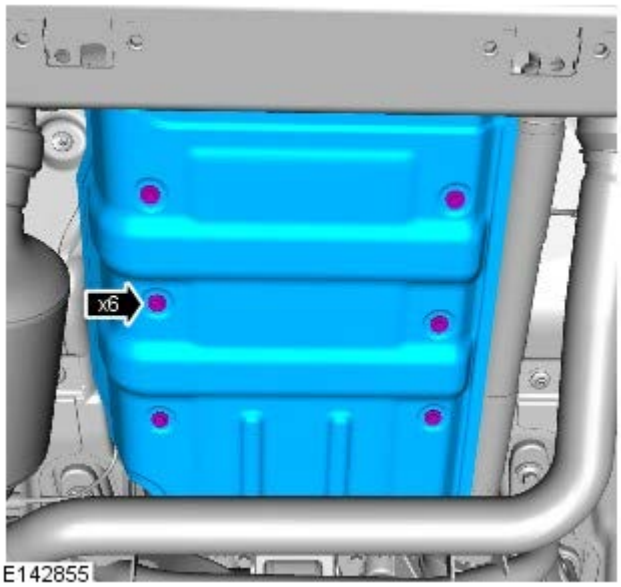
3. *Torque:* 60 Nm



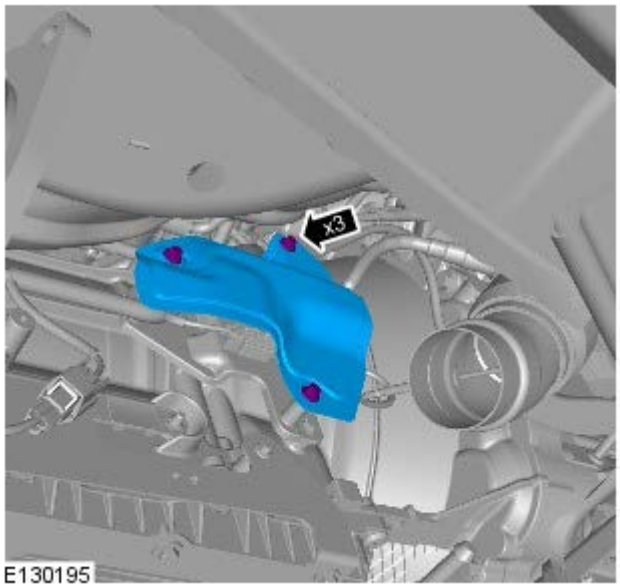
4.

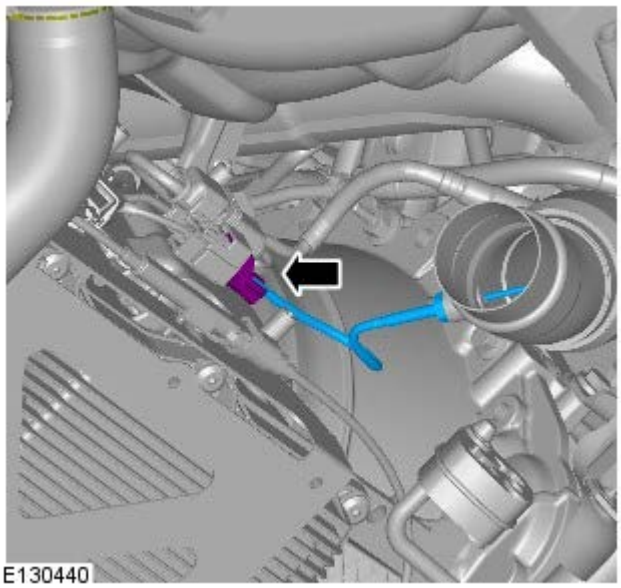


5. *Torque:* 10 Nm



6. *Torque:* 10 Nm





7. 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: 31-Jul-2012

Electronic Engine Controls - TDV8 4.4L Diesel - Post Catalytic Converter Temperature Sensor

Removal and Installation

Removal

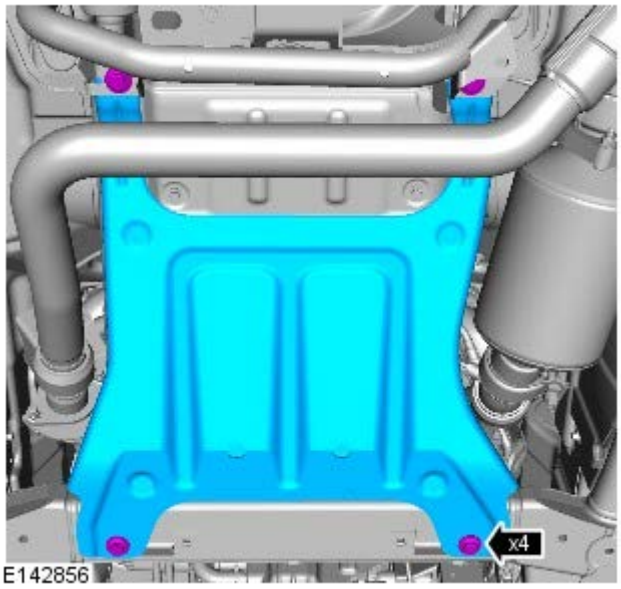
WARNING: Observe due care when working near a hot exhaust system.

NOTE: Removal steps in this procedure may contain installation details.

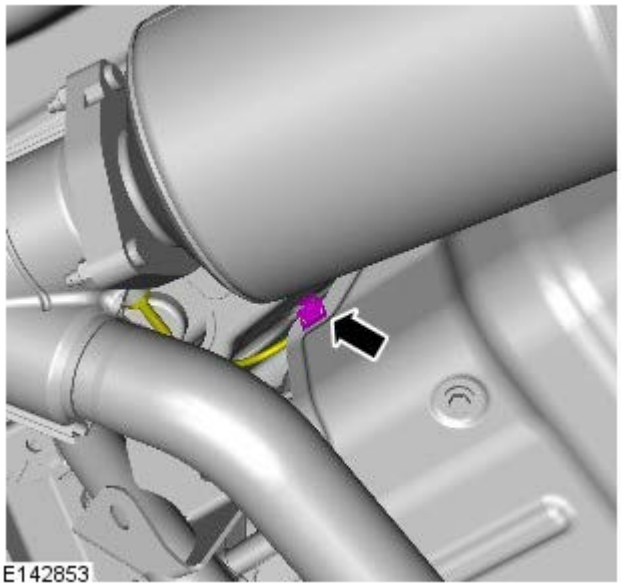
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

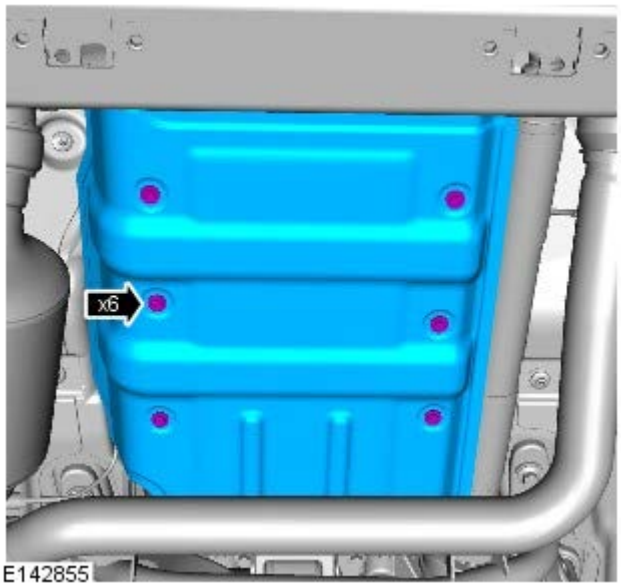
2. *Torque:* 60 Nm

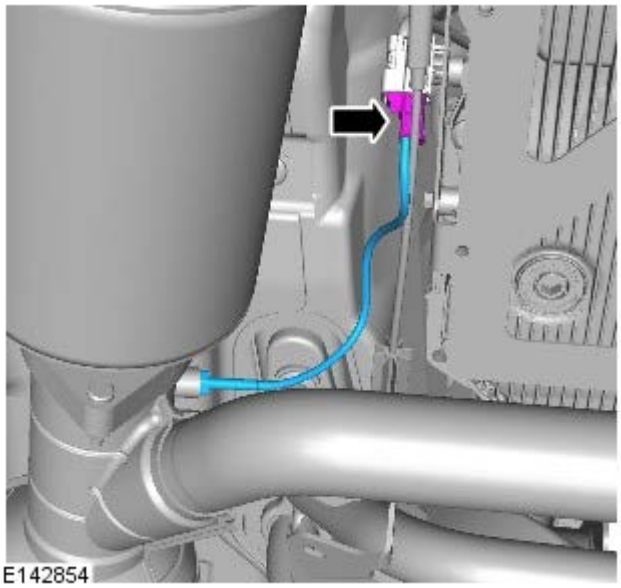


3.



4. *Torque:* 10 Nm





5. 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: 31-Jul-2012

Electronic Engine Controls - TDV8 4.4L Diesel - Post DPF Exhaust Gas Temperature Sensor

Removal and Installation

Removal

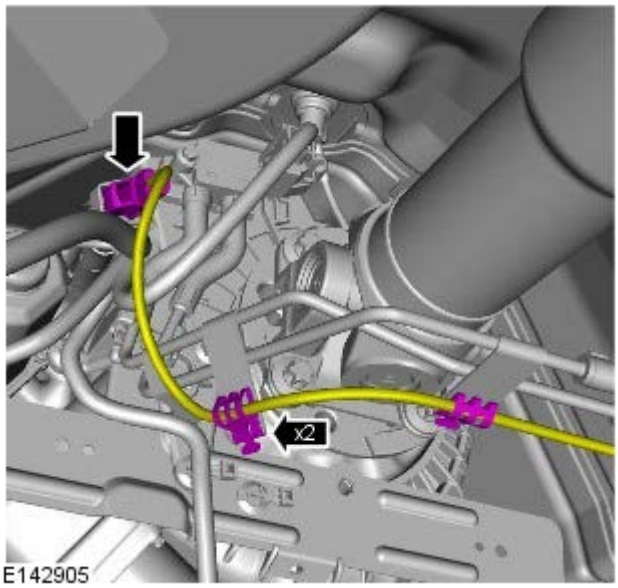
WARNING: Observe due care when working near a hot exhaust system.

NOTE: Removal steps in this procedure may contain installation details.

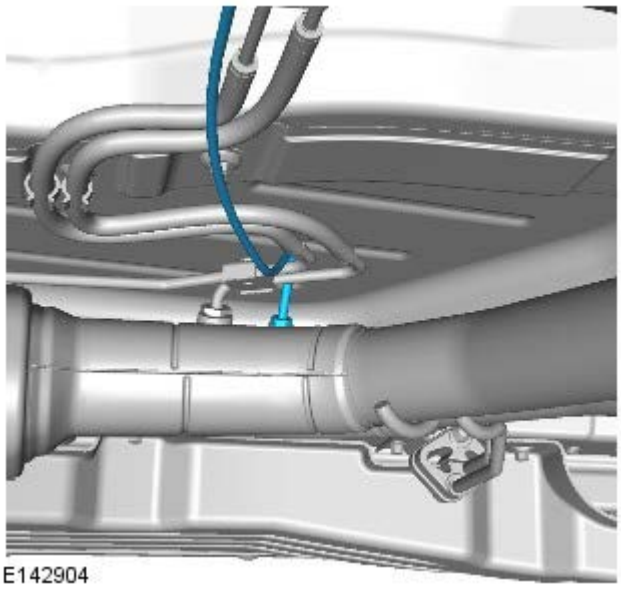
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2.



E142905


E142904

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: 13-Sep-2012

Electronic Engine Controls - SDV6 3.0L Diesel - Hybrid Electric Vehicle -

Torque Specification

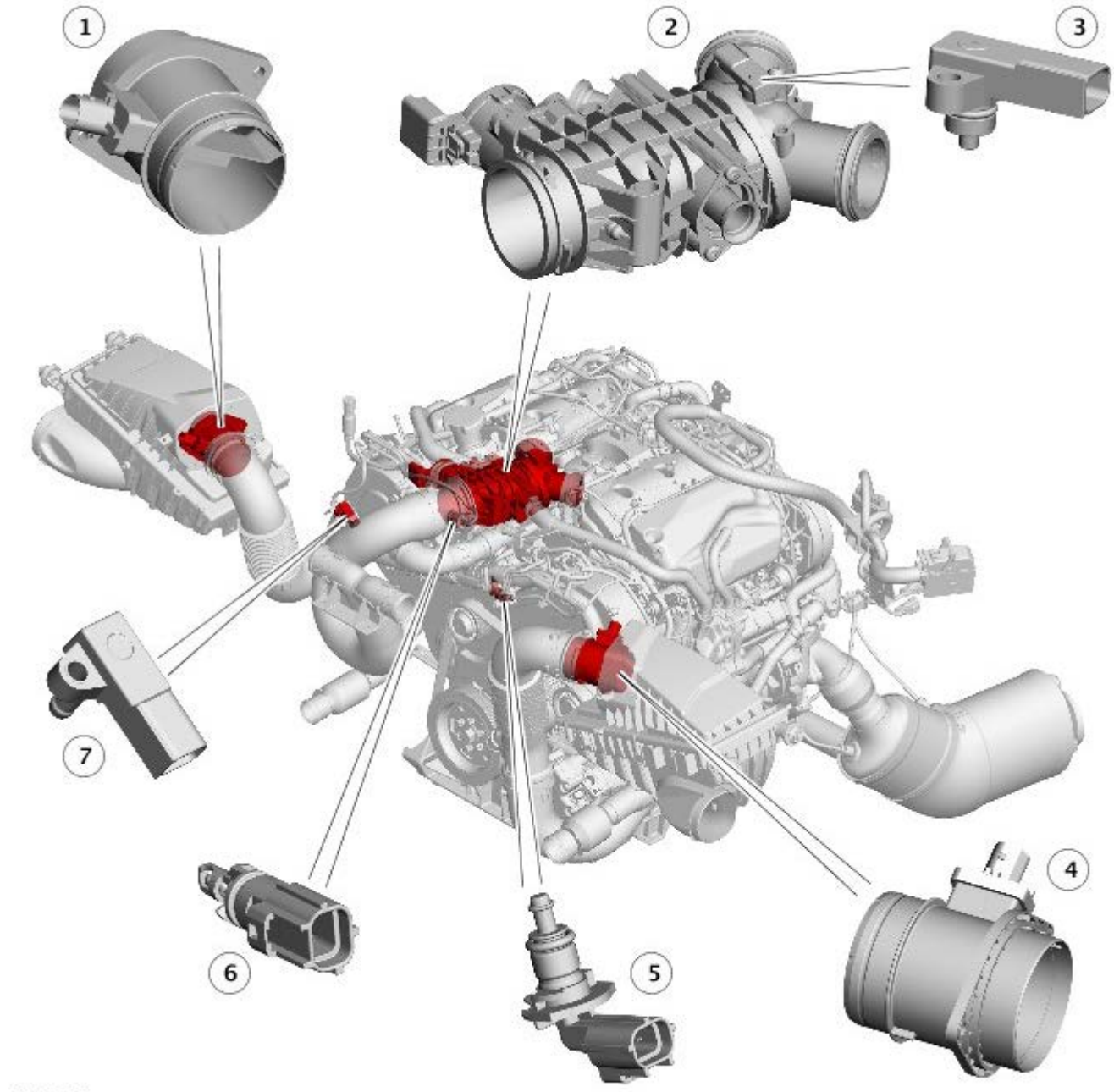
Description	Nm	lb-ft	lb-in
Camshaft position (CMP) sensor retaining bolt	10	7	-
Crankshaft position (CKP) sensor retaining bolt	5	-	44
Engine control module (ECM) retaining nuts	7	-	62
Engine oil pressure (EOP) sensor	14	11	-
Engine oil level sensor retaining bolts	12	9	-
Mass air flow (MAF) sensor	2	-	18
Manifold absolute pressure (MAP) sensor	3	-	27
Exhaust gas temperature sensor RH	35	26	-
Catalytic converter pre temperature sensor	35	26	-
Catalytic converter post temperature sensor	35	26	-
Diesel particulate filter (DPF) post exhaust gas temperature sensor	35	26	-
Heated oxygen sensor (HO2S)	48	35	-

Published: 06-Sep-2013

Electronic Engine Controls - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Electronic Engine Controls

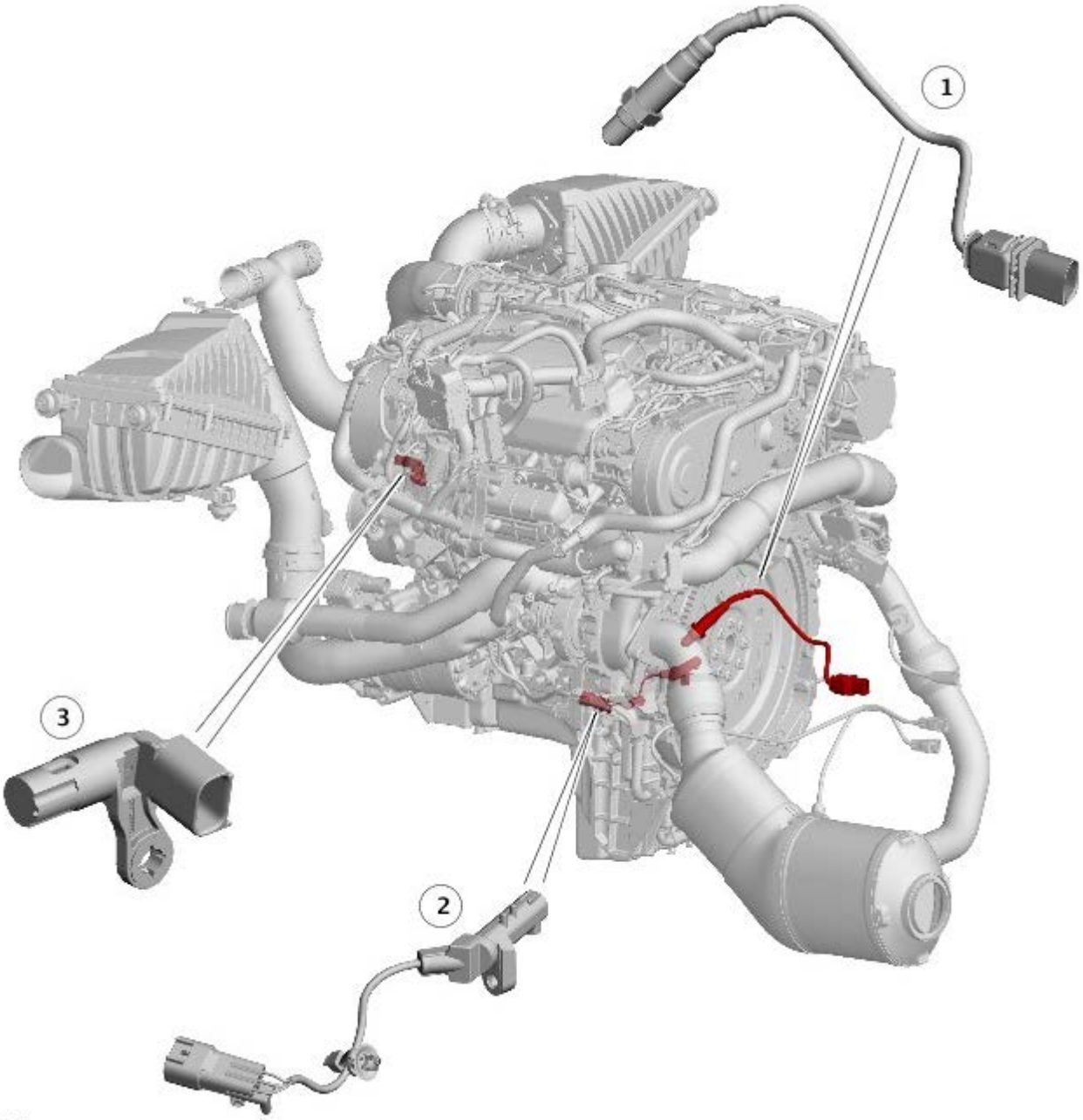
Description and Operation

COMPONENT LOCATION - SHEET 1 OF 3



Item	Part Number	Description
1	-	Mass air flow and temperature sensor
2	-	Electric throttle
3	-	Manifold absolute pressure sensor
4	-	Mass air flow sensor
5	-	Engine coolant temperature sensor
6	-	Charge air temperature sensor
7	-	Charge air pressure sensor

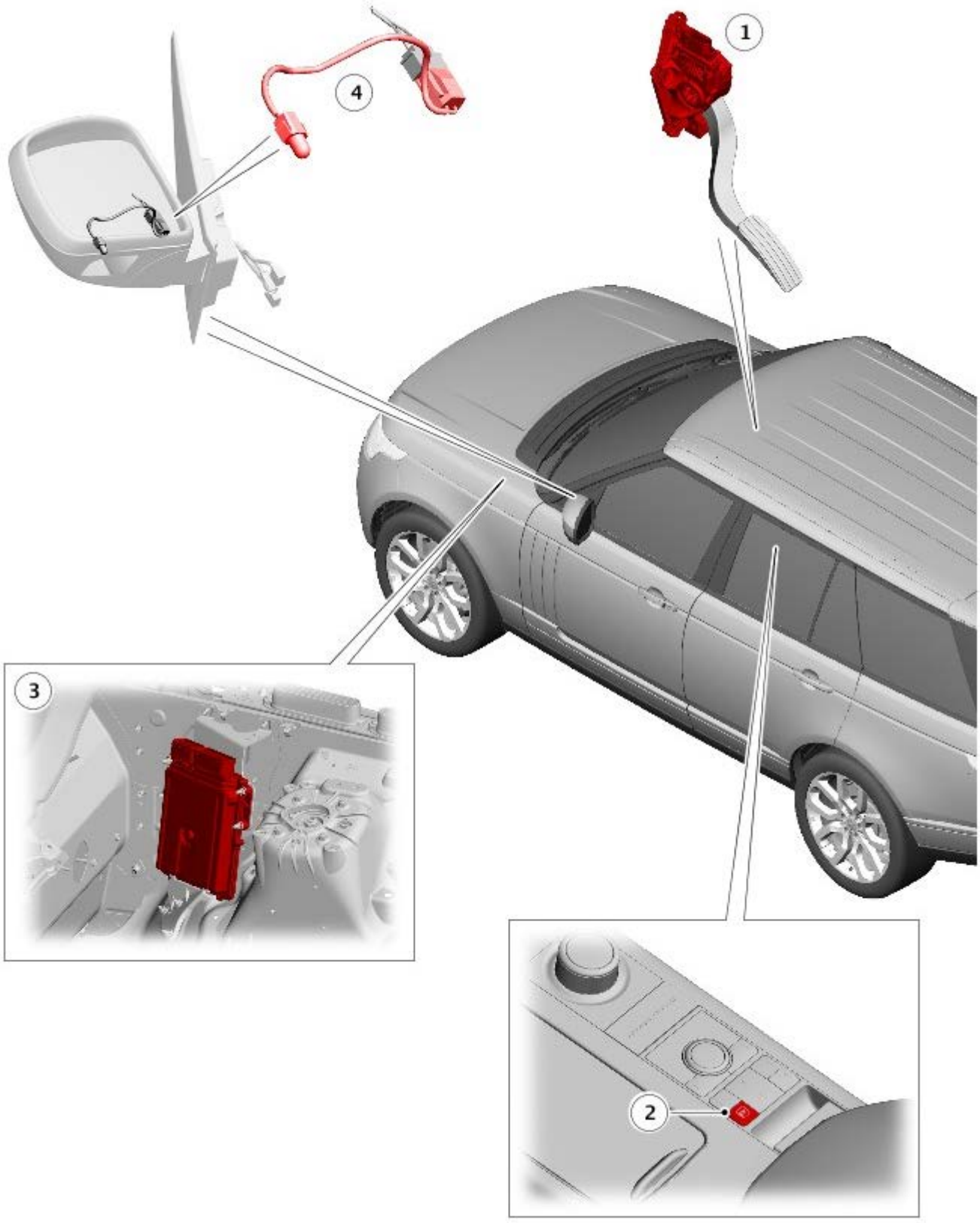
COMPONENT LOCATION - SHEET 2 OF 3



E159163

Item	Part Number	Description
1	-	Heated oxygen sensor
2	-	Crankshaft position sensor
3	-	Camshaft position sensor

COMPONENT LOCATION - SHEET 3 OF 3



E158932

Item	Part Number	Description
1	-	Accelerator pedal position sensor
2	-	Electric vehicle mode switch
3	-	Engine control module
4	-	Ambient air temperature sensor

OVERVIEW

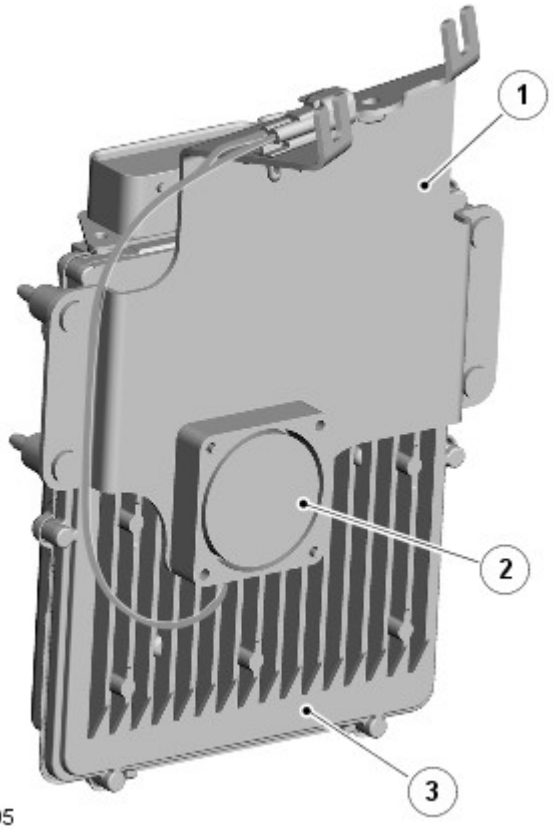
The TDV6 3.0L diesel engine has an ECM (engine control module) controlled engine management system. The ECM uses multiple sensor inputs and precision control of actuators to achieve optimum performance during all driving conditions.

The ECM operates the engine in conjunction with the motor generator to provide the vehicle with a parallel hybrid drive. An EV (electric vehicle) mode switch in the floor console allows the driver to select a mode of operation where the ECM

uses the motor generator as much as possible.

DESCRIPTION

Engine Control Module



E147995

Item	Part Number	Description
1	-	Upper bracket
2	-	Cooling fan
3	-	Engine control module

The ECM is installed in the rear left corner of the engine compartment, behind the secondary bulkhead panel. The ECM is attached to brackets on the wheel housing and the fender outer support panel.

In some markets, an electric cooling fan is attached to the upper bracket to prevent the ECM from overheating. The ECM controls the operation of the cooling fan using an internal temperature sensor. 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 is 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. 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 driveability, 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 (controller area network) HEV (hybrid electric vehicle) systems and the high speed CAN powertrain systems to enable precise control of the engine and motor generator under all vehicle operating conditions.

The software in the ECM incorporates a VSC (vehicle supervisory controller) to manage the following hybrid functions:

- Power up/down of the HEV battery and the EPIC (electric power inverter converter).
- HEV battery state of charge management.
- Calculation of the total power demand for the engine and the motor generator.
- Calculation of the optimum torque distribution between the engine and the motor generator.
- Calculation of the HEV driving mode.
- Management of the HEV driving mode transitions.
- Control of the motor generator dual mass flywheel and clutch assembly, in conjunction with the TCM (transmission control module), to ensure smooth torque transitions.
- Energy management control of the electric A/C (air conditioning) compressor.
- Management of any HEV system faults.

The ECM receives and processes information from the following input sources:

- CKP (crankshaft position) sensor.
- CMP (camshaft position) sensor.
- MAF (mass air flow) sensor.
- MAFT (mass air flow and temperature) sensor.
- MAP (manifold absolute pressure) sensor.
- TP (throttle position) sensor.
- ECT (engine coolant temperature) sensor.
- APP (accelerator pedal position) sensor.
- Charge air temperature sensor.
- Charge air pressure sensor.
- Ambient air temperature sensor.
- HO2S (heated oxygen sensor).
- The following brake system components:
  - ABS (anti-lock brake system) control module.
    For additional information, refer to: Braking Control System - TDV6 3.0L Diesel - Hybrid Electric Vehicle (206-11 Brake Controls, Description and Operation).
  - Brake pedal switch.
    For additional information, refer to: Braking Control System - TDV6 3.0L Diesel - Hybrid Electric Vehicle (206-11 Brake Controls, Description and Operation).
  - Brake vacuum sensor.
    For additional information, refer to: Brake Booster - TDV6 3.0L Diesel - Hybrid Electric Vehicle (206-07 Power Brake Actuation, Description and Operation).
- Oil level and temperature sensor.
  For additional information, refer to: Engine (303-01E Engine - SDV6 3.0L Diesel - Hybrid Electric Vehicle, Description and Operation).
- The following fuel system components:
  - FRP (fuel rail pressure) sensor.
  - Fuel temperature sensor.
  - For additional information, refer to: Fuel Charging and Controls (303-04 Fuel Charging and Controls - TDV6 3.0L Diesel, Description and Operation).
- The following turbocharger system components:
  - VGT vane position sensor.
  - Turbine intake valve position sensor.
  - Turbine temperature sensor.
  - For additional information, refer to: Turbocharger (303-04 Fuel Charging and Controls - Turbocharger - TDV6 3.0L Diesel, Description and Operation).
- EGR (exhaust gas recirculation) valve position sensors.
  For additional information, refer to: Engine Emission Control (303-08 Engine Emission Control - TDV6 3.0L Diesel, Description and Operation).
- Active grille air shutter motor.
  For additional information, refer to: Engine Cooling (303-03G Engine Cooling - SDV6 3.0L Diesel - Hybrid Electric Vehicle, Description and Operation).
- TCS (transmission control switch).
  For additional information, refer to: External Controls (307-05 Automatic Transmission/Transaxle External Controls - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, Description and Operation).
- Terrain Response® switchpack.
  For additional information, refer to: Ride and Handling Optimization (204-06 Ride and Handling Optimization, Description and Operation).
- The following catalytic converter and DPF (diesel particulate filter) system components (where fitted).
  - Pre and post catalyst exhaust gas temperature sensors (where fitted).
  - Pre and post DPF exhaust gas temperature sensors (where fitted).
  - DPF differential pressure sensor.
  - For additional information, refer to: Diesel Particulate Filter (309-00A Exhaust System - TDV6 3.0L Diesel, Description and Operation).
- Water in fuel sensor.
  For additional information, refer to: Fuel Tank and Lines (310-01E Fuel Tank and Lines - SDV6 3.0L Diesel - Hybrid Electric Vehicle, Description and Operation).
- ATCM (automatic temperature control module).
  For additional information, refer to: Control Components (412-01B Climate Control - SDV6 3.0L Diesel - Hybrid Electric Vehicle, Description and Operation).
- RCM (restraints control module).
  For additional information, refer to: Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) (501-20 Supplemental Restraint System, Description and Operation).
- BECM (battery energy control module) and EPICM (electric power inverter converter module).
  For additional information, refer to: Battery and Cables - TDV6 3.0L Diesel - Hybrid Electric Vehicle (414-01, Description and Operation).

The ECM outputs controlling signals to the following sensors and actuators:

- Electric throttle motor.
- ECM cooling fan (where fitted).
- ABS control module.
  For additional information, refer to: Braking Control System - TDV6 3.0L Diesel - Hybrid Electric Vehicle (206-11 Brake Controls, Description and Operation).
- Active engine mount solenoid.
  For additional information, refer to: Engine (303-01E Engine - SDV6 3.0L Diesel - Hybrid Electric Vehicle, Description and Operation).
- The following cooling system components:
  - Electric cooling fans.
  - Active grille air shutter motor.
  - For additional information, refer to: Engine Cooling (303-03G Engine Cooling - SDV6 3.0L Diesel - Hybrid Electric Vehicle, Description and Operation).
- The following fuel system actuators:
  - Fuel injectors.
  - Fuel pressure control valve.
  - Fuel volume control valve.
  - For additional information, refer to: Fuel Charging and Controls (303-04 Fuel Charging and Controls - TDV6 3.0L Diesel, Description and Operation).
- The following turbocharger system components:
  - Charge air recirculation solenoid.
  - Charge air solenoid.
  - Turbine intake shut-off valve solenoid.
  - Variable geometry turbine vane actuator.
  - For additional information, refer to: Turbocharger (303-04 Fuel Charging and Controls - Turbocharger - TDV6 3.0L Diesel, Description and Operation).
- Starter motor solenoids.
  For additional information, refer to: Starting System (303-06E Starting System - SDV6 3.0L Diesel - Hybrid Electric Vehicle, Description and Operation).
- Glow plug control module.
  For additional information, refer to: Glow Plug System (303-07 Glow Plug System - TDV6 3.0L Diesel, Description and Operation).
- The following EGR system components:
  - EGR cooler bypass valve solenoid.
  - EGR valve motors.
  - For additional information, refer to: Engine Emission Control (303-08 Engine Emission Control - TDV6 3.0L Diesel, Description and Operation).
- TCM.
  For additional information, refer to: Transmission Description (307-01B Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed - Hybrid Electric Vehicle - Automatic Transmission – AWD, Description and Operation).
- ATCM.
  For additional information, refer to: Control Components (412-01B Climate Control - SDV6 3.0L Diesel - Hybrid Electric Vehicle, Description and Operation).
- Instrument cluster.
  For additional information, refer to: Instrument Cluster - TDV6 3.0L Diesel - Hybrid Electric Vehicle (413-01 Instrument Cluster, Description and Operation).
- EPICM.
  For additional information, refer to: Battery and Cables - TDV6 3.0L Diesel - Hybrid Electric Vehicle (414-01, Description and Operation).

Electric Vehicle Mode Switch



E158933

The EV mode switch controls the selection of the EV hybrid driving mode. The switch is a non-latching switch installed in the Terrain Response® switchpack, in the floor console. Pressing and releasing the switch produces a high speed CAN message from the Terrain Response® switchpack to the ECM via the gateway module. With the first press and release of the switch, the ECM adopts the EV driving mode. When the switch is pressed and released again, the ECM returns to the standard hybrid driving mode. When EV mode is selected on, a LED (light emitting diode) in the switch is illuminated.

To guard against incorrect operation or a broken switch, if the switch is pressed for more than 10 seconds no change of state occurs. If the input from the EV mode switch is held high for more than one minute, a DTC (diagnostic trouble code) is stored in the Terrain Response® switchpack.

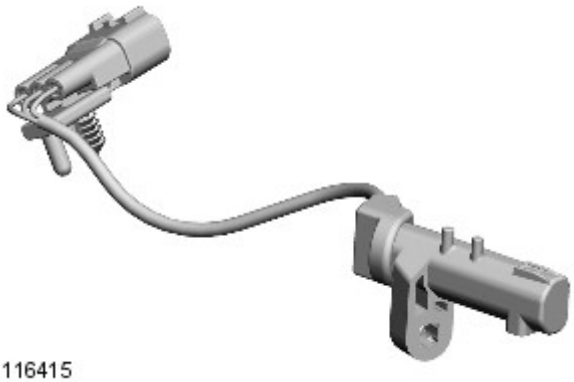
Electric Vehicle Mode Warning Indicator



E159176

An EV mode warning indicator is located in the instrument cluster. The warning indicator is illuminated when the EV mode is selected on. When the motor generator is running without the engine, the warning indicator illuminates green; when the engine is running the warning indicator illuminates gray. Operation of the warning indicator is controlled by a high speed CAN bus message from the ECM.

Crankshaft Position Sensor



E116415

The CKP sensor is located on the left side of the crankshaft rear oil seal. The sensor lead passes through a cover in the side of the cylinder block. The sensor tip is aligned with a reluctor ring on the rear flange of the crankshaft. 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 reluctor ring.

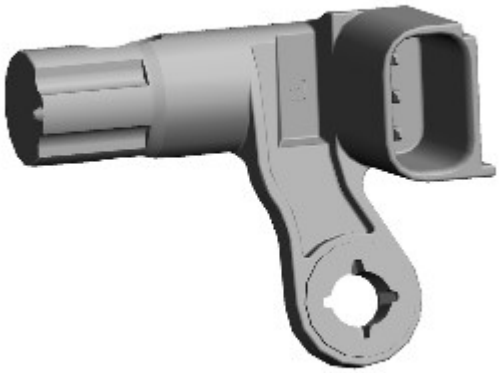
The reluctor ring has a 60 minus 2 pole pattern. The missing poles provide a reference point for the angular position of the crankshaft. When the space with the two missing poles passes the sensor tip, a gap in the signal is produced which the ECM uses to determine the crankshaft position.

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 powertrain systems for use by other systems.

The CKP sensor receives a 5V supply from the ECM. Two further connections to the ECM provide ground and signal output.

Camshaft Position Sensor



E138807

The CMP sensor is located on the front face of the left cylinder head. The sensor tip protrudes through an aperture in the front face of the cylinder head to pick up on a reluctor ring behind the camshaft pulley.

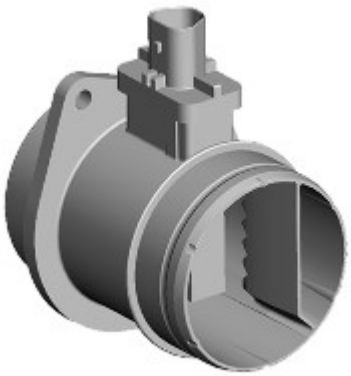
The CMP sensor is a Hall effect sensor which is used by the ECM at engine start-up to synchronize the ECM with the CKP sensor signal. The ECM does this by using the CMP sensor signal to identify the stroke of the piston in No. 1 cylinder to ensure the correct injector timing. Once the ECM has established 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 charge air pressure control. Once the engine is switched off, the engine will crank but will not restart while the fault is present.

Mass Air Flow / Mass Air Flow and Temperature Sensor



E147996

Identical MAFT sensors are attached to the air cleaner outlets, but only the MAFT sensor attached to the right air cleaner provides both MAF and temperature signals for the ECM. The engine harness connection with MAFT sensor of the left air cleaner is wired so that only the MAF signal is connected to the ECM.

The MAF sensors work on the hot film principle. 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 signals are also used as a feedback for the EGR system.

The temperature sensor in the right MAFT sensor is a NTC (negative temperature coefficient) thermistor in a voltage divider circuit. Using the voltage output from the temperature sensor, the ECM can correct the fueling map for intake air temperature.

The MAFT sensors receive a 12V supply from the ECM relay in the EJB and a ground connection via the ECM. Separate connections to the ECM are provided for the two MAF signals and the temperature signal.

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 charge air pressure, ambient air pressure and ambient air

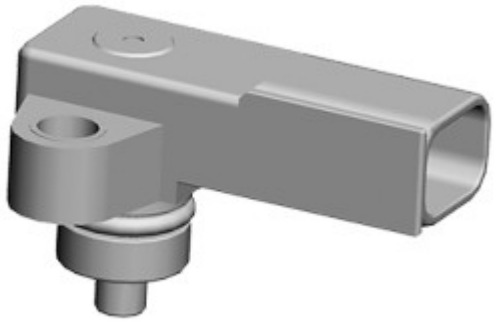
temperature.

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 temperature sensor fails the ECM uses a default intake air temperature of 40°Celsius (104°F). In the event of a temperature sensor failure, under fueling, resulting in reduced engine performance, may be observed.

Manifold Absolute Pressure Sensor



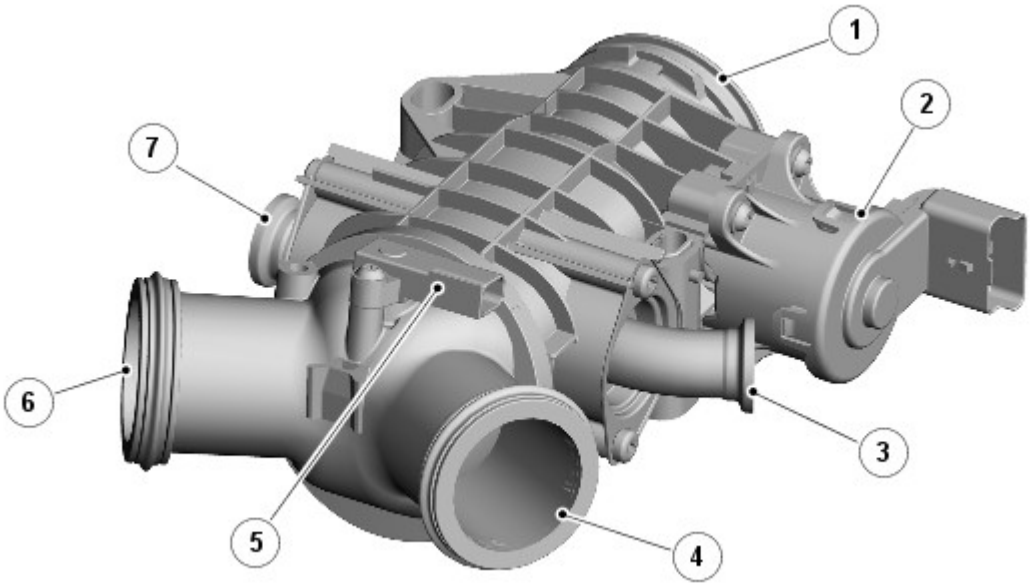
E123688

The MAP sensor is installed in the outlet of the electric throttle, to measure the pressure of the air entering the intake manifolds. 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 signal is used in conjunction with the MAF sensor signals 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 MAFT sensor signals as a substitute.

Electric Throttle



E144246

Item	Part Number	Description
1	-	Air intake
2	-	Electric motor
3	-	Right exhaust gas recirculation pipe connection
4	-	Right intake manifold connection
5	-	Manifold absolute pressure sensor
6	-	Left intake manifold connection
7	-	Left exhaust gas recirculation pipe connection

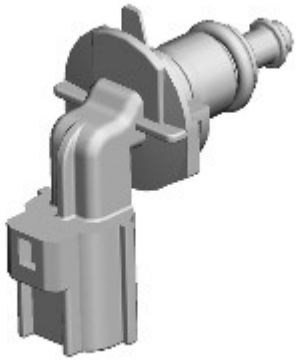
The electric throttle is installed at the front of the engine, between the cylinder heads. The throttle plate is operated by a DC (direct current) electric motor attached to the throttle body. The motor is controlled by the ECM, which operates the motor in response to driver inputs from the APP sensor and other engine related sensors to provide the correct air flow

to the intake manifolds.

The ECM has five connections with the electric throttle motor:

- A ground and two 12V feeds to operate the motor in each direction to open or close the throttle plate.
- A 5V reference connection and a signal connection with the TP sensor in the motor, for closed loop control.

Engine Coolant Temperature Sensor



E108397

The ECT sensor is located in the EGR cooler intake hose, at the front of the engine. 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 comfort and convenience systems 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. The ECM compares the signal voltage to stored values and adjusts fuel delivery to ensure optimum driveability at all times.

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°C (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.

Accelerator Pedal Position Sensor

NOTE: LHD (left-hand drive) pedal shown.



E141165

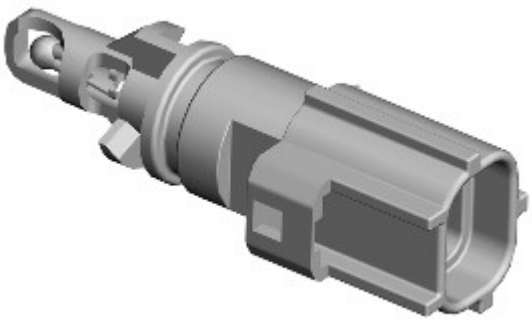
The APP sensor allows the ECM to determine the driver requests for vehicle speed, acceleration and deceleration. The ECM uses this information to determine the torque demand from the engine via injection control.

The APP sensor consists of a twin track rotary potentiometer integrated into the mounting bracket of the accelerator pedal. 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 rev/min to allow the vehicle to move. Torque application and reduction of engine speed back to normal idle speed can be subsequently controlled via brake pedal switch operation.

The ECM constantly checks the range and plausibility of the two signals and stores a fault code if it detects a fault.

Charge Air Temperature Sensor



E148012

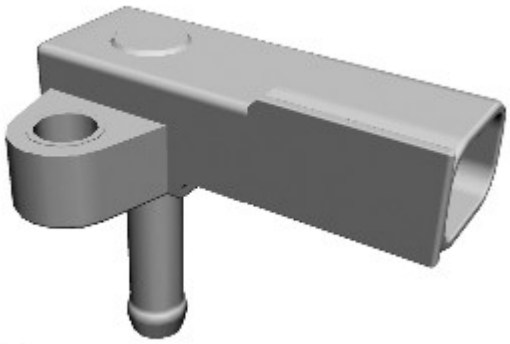
The charge air temperature sensor is located in the charge air duct connection with the electric throttle. The sensor is used to measure the intake air temperature from the turbochargers in order to calculate the required amount of fueling.

The charge air temperature sensor incorporates a NTC thermistor in a voltage divider circuit. The sensor receives a 3.3V reference voltage from the ECM. Using the voltage output from the charge air temperature sensor, the ECM can correct the fueling map for charge air temperature.

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 in black smoke emitting from the exhaust.
- Idle speed control inoperative.

Charge Air Pressure Sensor



E131040

The charge air pressure sensor is located on a bracket attached to the right side of the primary drive cover. The sensor is connected via a hose to the charge air outlet pipe from the fixed vane turbocharger compressor.

The charge air pressure sensor provides a voltage signal to the ECM relative to the output charge air pressure from the fixed vane turbocharger. The 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 charge air pressure sensor uses a diaphragm transducer to measure pressure. The ECM uses the sensor signal for the following functions:

- Maintain manifold charge air pressure.
- Reduce exhaust smoke emissions when driving at high altitude.
- Control of the EGR system.
- To help smooth the transition between mono turbocharger and bi-turbocharger operation.
- To aid the air path diagnostics.

Ambient Air Temperature Sensor



E116093

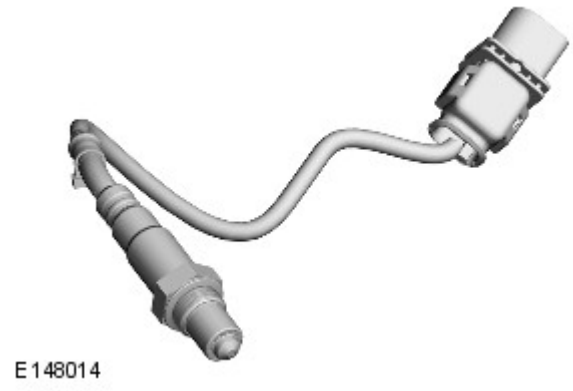
The AAT (ambient air temperature) sensor is a NTC thermistor that allows the ECM to monitor the temperature of the air around the vehicle. The ECM uses the AT input for a number of functions, including engine cooling fan control. The ECM also transmits the ambient temperature on the high speed CAN powertrain systems for use by other control modules.

The AAT sensor is installed in the left exterior mirror, with the bulb of the sensor positioned over a hole in the bottom of the mirror casing.

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 sensor. If the AAT sensor and the temperature input of the MAFT sensor are both faulty, the ECM adopts a default ambient temperature of 20 °C (68 °F).

Heated Oxygen Sensor



The HO2S is a wide band type oxygen sensor that allows the ECM to provide closed loop control of the air:fuel mixture. The sensor is installed in the left downpipe of the exhaust system, immediately after the connection with the VGT (variable geometry turbine) turbocharger outlet.

Power for the heater element of the HO2S is provided by a battery voltage supply from the ECM relay in the EJB. The circuit through the heater element is completed by a connection with the ECM. The ECM regulates the current flow through the heater element to control the heating of the sensor. The heater element is operated immediately after each engine start and during low load conditions when the temperature of the exhaust gases is insufficient to maintain the required sensor temperature.

The HO2S has four further connections with the ECM, two for the Nernst (oxygen measuring) cell and two for the pump cell. The ECM adjusts the current of the pump cell circuit as necessary to maintain a constant signal from the oxygen measuring cell. The ECM then relates the current of the pump cell circuit to the lambda ratio of the exhaust gases.

If the HO2S fails the ECM defaults to open loop fueling and the emissions content of the exhaust gases increases. With a failed HO2S, the engine will suffer from unstable operation and reduced performance.

OPERATION

The TDV6 3.0L diesel engine management system is controlled by the ECM and is able to monitor, adapt and precisely control the fuel injection and electric throttle. 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 constantly monitors the inputs from the APP sensor and the control modules of other systems to determine the overall torque output required from the engine and motor generator. The ECM also monitors the state of charge of the HEV battery. Torque arbitration by the ECM software determines the torque required from each power source to produce the overall torque output. The ECM then operates the fuel injectors and electric throttle to produce the torque required from the engine, and/or transmits the torque required from the motor generator to the EPICM on the high speed CAN HEV systems.

NOTE: If the engine temperature is too high, the HEV battery state of charge gauge is replaced by the ECT gauge.

The ECM automatically stops and starts the engine as required for the different HEV driving modes. Illumination of the warning indicators normally associated with an engine shut down, for example the ignition and low oil pressure warning indicators, is suppressed when the engine stops in HEV operation.

In the following circumstances the ECM always runs the engine and only uses the motor generator for boosting, if required:

- If the transfer case is in low range.
- If a Terrain Response® special program is active.
- If the suspension is selected to off-road height.
- If the HEV battery has a low state of charge.

The ECM adopts different HEV driving modes in order to optimize fuel economy throughout the drive cycle. The driving modes are:

- Hybrid drive.
- Boosting.
- Regenerative braking.
- Coasting.
- EV (electric vehicle).
- EV inhibit/sport.

HYBRID DRIVE MODE

In hybrid drive, while the torque demand from the driver is low, the ECM uses the motor generator to provide the drive into the transmission. When the torque demand exceeds a pre-determined level, the ECM starts the engine and uses it to provide the drive into the transmission instead of the motor generator.

BOOSTING MODE

At high torque demands the ECM supplements the drive from the engine with torque from the motor generator to boost the total torque output.

REGENERATIVE BRAKING MODE

During braking, the ECM signals the EPICM on the high speed CAN HEV systems to operate the motor generator in the generator mode. The road wheels then drive the motor generator, and the braking effect this produces is incorporated into the braking torque applied by the brake system.
For additional information, refer to: Braking Control System - TDV6 3.0L Diesel - Hybrid Electric Vehicle (206-11, Description and Operation).

COASTING MODE

If the throttle pedal is released, but the brake pedal is not applied, the vehicle enters an over-run condition. and the ECM operates the motor generator in generator mode. At higher vehicle speeds, to avoid slowing the vehicle too much, the ECM sets a low generator output. The low generator output is used to charge the 12 volt battery system and provide power for the electric A/C compressor (if required). At lower speeds the ECM sets a higher generator output, which is used to charge the HEV battery.

ELECTRIC VEHICLE MODE

In EV mode the ECM maximizes use of the motor generator to drive the vehicle. For EV mode to activate, the following conditions are required:

- Ignition in power mode 7.
- No HEV system fault logged that requires the engine to keep running.
- Accelerator pedal demand does not exceed the capability of motor generator.
- The HEV battery state of charge is equal to or greater than the calibrated EV entry minimum.
- HEV battery discharge power capability is equal to or greater than the calibrated threshold.
- The ECT is 50°C (122°F) or more.
- The transfer case is not in low range.
- The wade sensing system is inactive.
- The suspension is not in off-road height.
- The transmission does not require the engine to keep running (as it does when changing gear, for example).
- There is no active Terrain Response® special program.

When the EV mode switch is pressed the TRS (Terrain Response® switchpack) transmits the switch selection on the high speed CAN chassis systems to the gateway module. The gateway module transfers the message to the high speed CAN powertrain system. On receipt of the message:

- The instrument cluster illuminates the EV mode warning indicator and the engine start marker.
  For additional information, refer to: Instrument Cluster - TDV6 3.0L Diesel - Hybrid Electric Vehicle (413-01, Description and Operation).
- The TCM adopts a different shift strategy to make best use of the torque available from the motor generator.
  For additional information, refer to: Transmission Description (307-01B Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed - Hybrid Electric Vehicle - Automatic Transmission – AWD, Description and Operation).
- The ECM:
  - Sends a signal to the TRS to illuminate the indicator LED in the EV mode switch.
  - Reduces the value of available HEV battery power transmitted to the ATCM, which reduces the speed of the electric A/C compressor to conserve power.
    For additional information, refer to: Control Components (412-01B Climate Control - SDV6 3.0L Diesel - Hybrid Electric Vehicle, Description and Operation).
  - Stops the engine, if running.

In EV mode, using only torque from the motor generator, the vehicle has a range of approximately 1.6 km (1 mile). If torque demand is kept below the engine start marker, the ECM uses only the motor generator to drive the vehicle until the HEV battery state of charge decreases to a point where it can no longer provide sufficient power. The ECM then starts the engine again to drive the vehicle and signals the EPICM to switch the motor generator to the generator mode and recharge the HEV battery. When the engine starts the EV mode warning indicator and the engine start marker in the instrument cluster change color to gray until the HEV battery state of charge has recovered sufficient to drive the motor generator again.

ELECTRIC VEHICLE INHIBIT/COMMANDSHIFT MODE

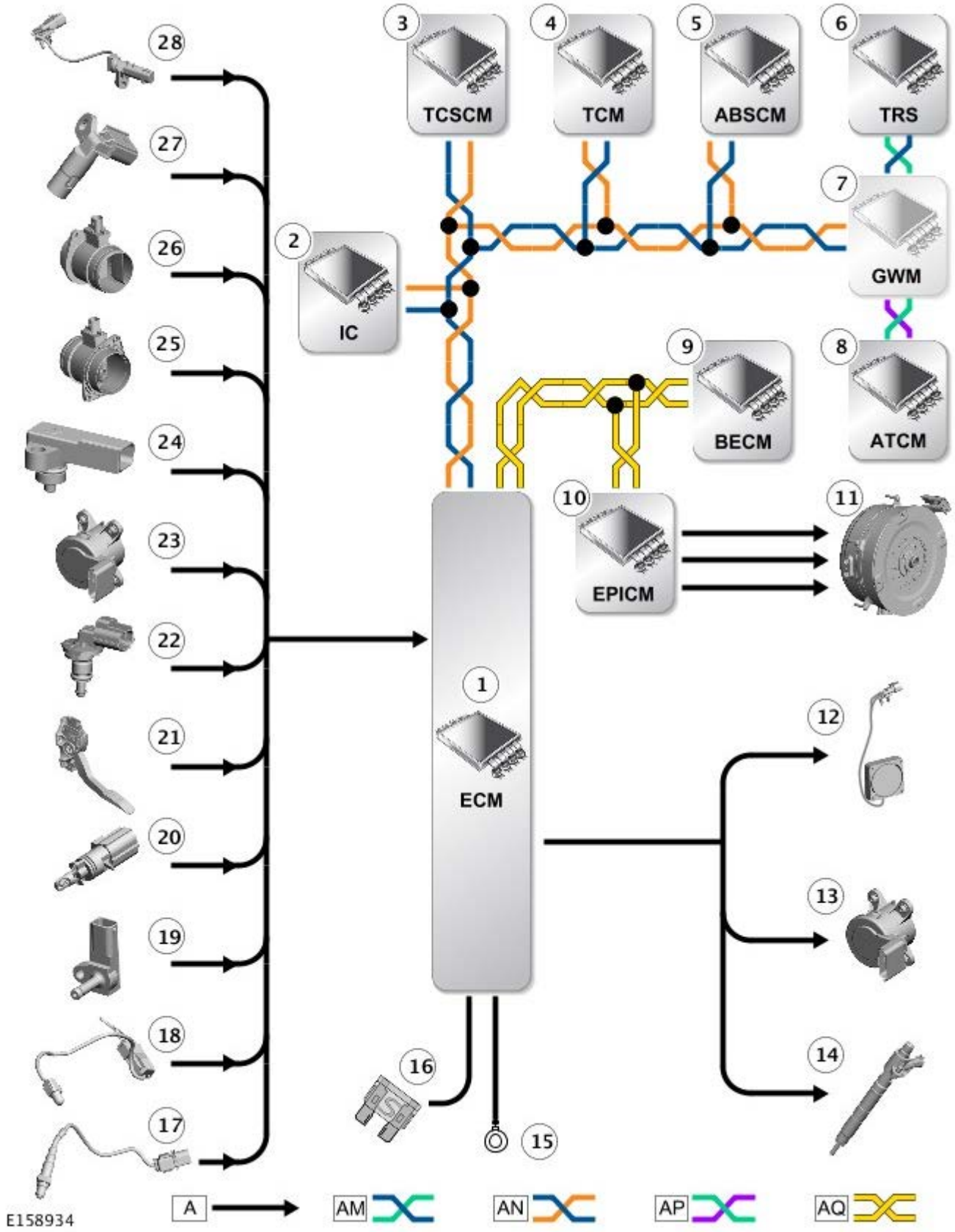
The EV mode is inhibited when the auto stop/start system is selected off or the transmission is in CommandShift mode. The engine runs continuously and the motor generator provides boosting assistance when required for maximum performance. The ECM disables driving with solely electric power when in this mode.

When the transmission is in CommandShift mode the power gauge in the instrument cluster is replaced with a standard tachometer.

Management of HEV System Faults

The ECM is in constant communication with the components of the HEV system. If a fault is reported by any of the components the ECM sends a command to the instrument cluster to display the relevant warning indicator and text message.

Control Diagram



A = Hardwired; AM = High speed CAN chassis systems; AN = High speed CAN powertrain systems; AP = Medium speed CAN comfort and convenience systems; AQ = High speed CAN HEV systems.

Item	Part Number	Description
1	-	Engine control module
2	-	Instrument cluster
3	-	Transmission control switch control module
4	-	Transmission control module
5	-	Anti-lock brake system control module
6	-	Terrain Response® switchpack
7	-	Gateway module
8	-	Automatic temperature control module

9	-	Battery energy control module
10	-	Electric power inverter converter module
11	-	Motor generator
12	-	Engine control module cooling fan (where fitted)
13	-	Electric throttle motor
14	-	Fuel injector (6 off)
15	-	Ground
16	-	Power supply
17	-	Heated oxygen sensor
18	-	Ambient air temperature sensor
19	-	Charge air pressure sensor
20	-	Charge air temperature sensor
21	-	Accelerator pedal position sensor
22	-	Engine coolant temperature sensor
23	-	Electric throttle motor
24	-	Manifold absolute pressure sensor
25	-	Mass air flow sensor
26	-	Mass air flow and temperature sensor
27	-	Camshaft position sensor
28	-	Crankshaft position sensor

Published: 11-Dec-2013

Electronic Engine Controls - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Brake Pedal Position (BPP) Switch Adjustment

General Procedures

Check

1. Remove the brake pedal rubber.



2. NOTE: Make sure that the dial test indicator (DTI) gauge is in line with the brake pedal movement.

   Position the DTI gauge on a suitable mounting block, as illustrated.

3. With the aid of another technician, gently press the brake pedal until the stop lamps illuminate.

4. NOTE: The specification is that the stop lamps should illuminate at between 5.5mm and 8.5mm brake pedal travel.

   Note the measurement of the brake pedal travel from rest position until the stop lamps illuminated.

Adjust

NOTE: The Brake Pedal Position Switch is self adjusting when removed and installed.

1. Remove and install Brake Pedal Position Switch.
   For additional information, refer to: Stoplamp Switch (417-01 Exterior Lighting, Removal and Installation).

2. Check the adjustment of the stop lamp switch by following the **Check** procedure in this procedure and carry out the **Adjust** procedure if required.

Published: 31-Jul-2012

Electronic Engine Controls - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Camshaft Position (CMP) Sensor

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

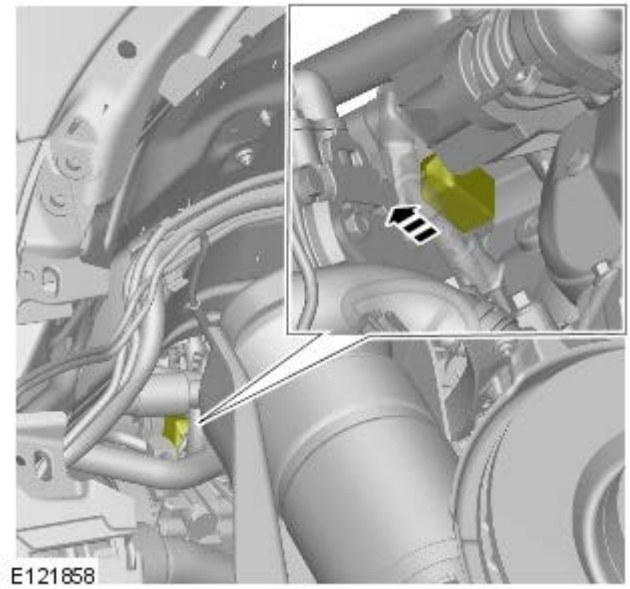
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

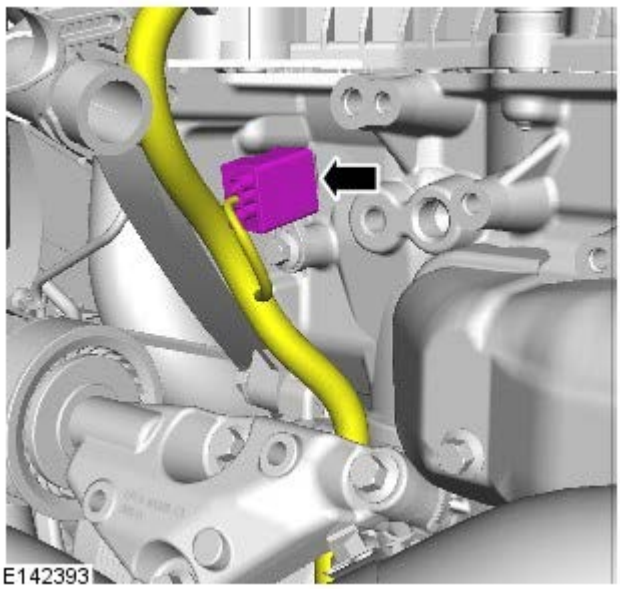
2. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05, Removal and Installation).

3. Refer to: Exhaust Gas Recirculation (EGR) Valve LH (303-08A Engine Emission Control - TDV6 3.0L Diesel, Removal and Installation).

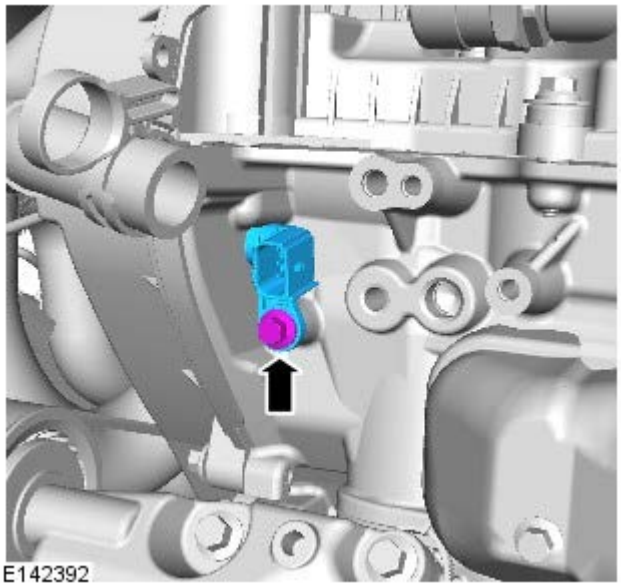
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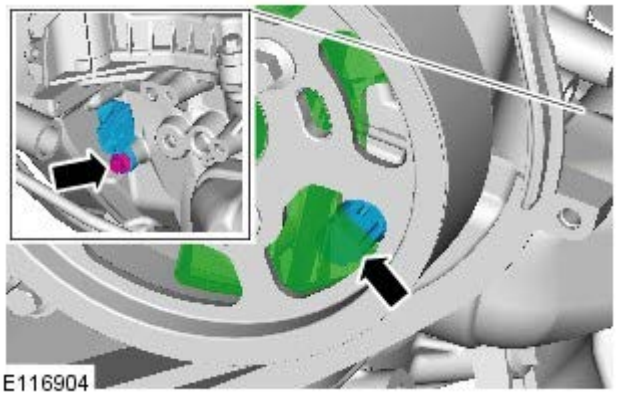
5.



6. *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: 13-Sep-2012

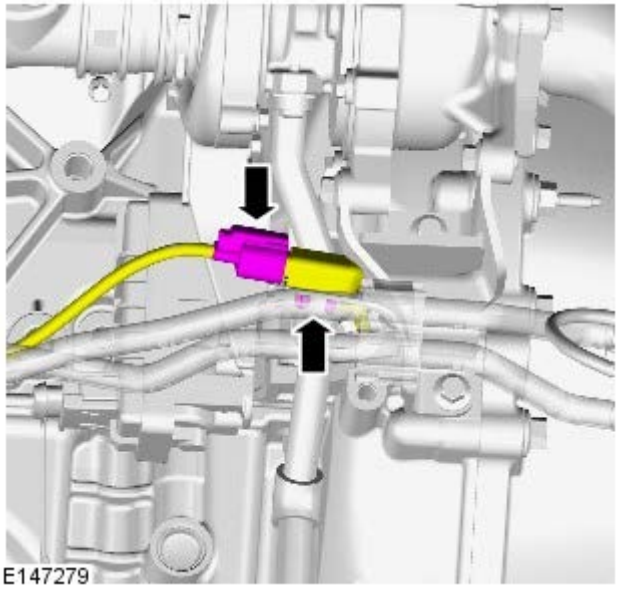
Electronic Engine Controls - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Crankshaft Position (CKP) Sensor

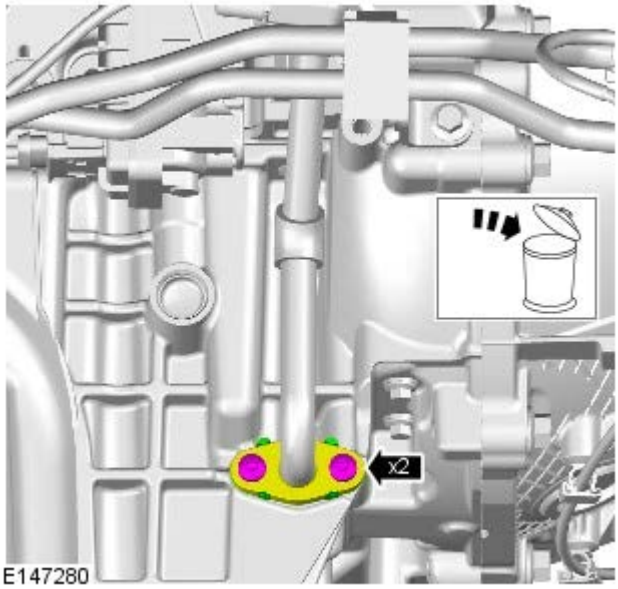
Removal and Installation

Removal

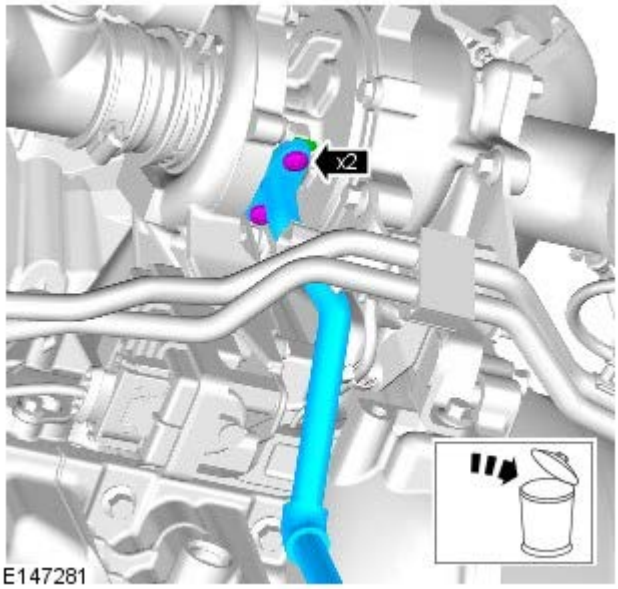
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Fender Splash Shield (501-02 Front End Body Panels, Removal and Installation).
2. Refer to: Engine Oil Draining and Filling (303-01A Engine - TDV6 3.0L Diesel, General Procedures).
3.

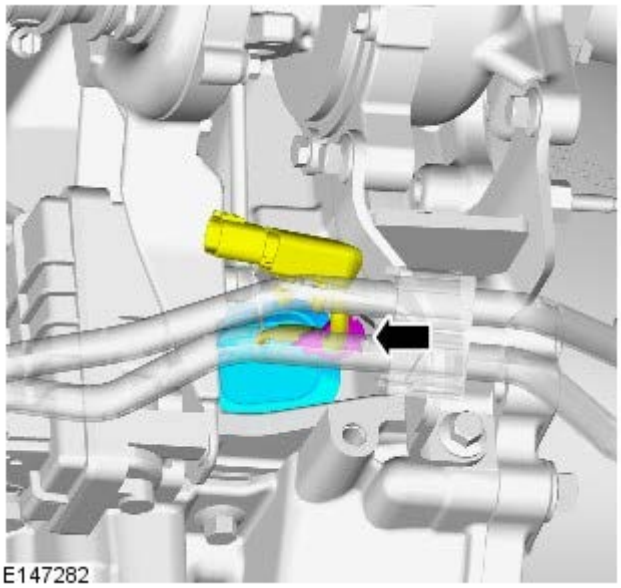


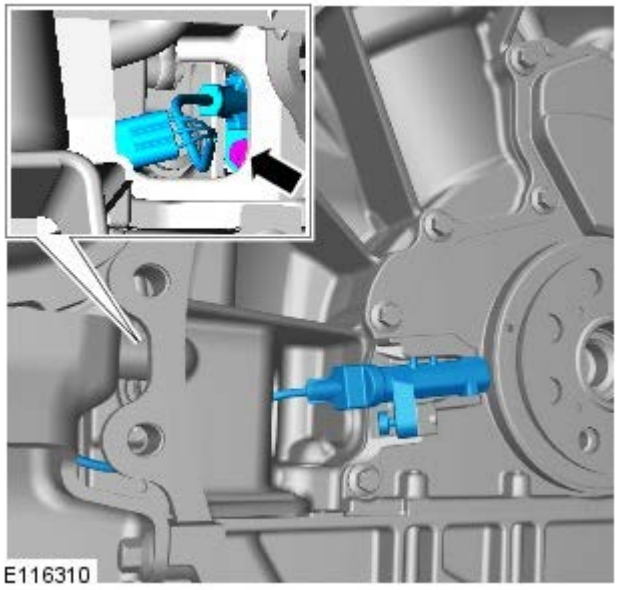


4. NOTE: Remove and discard the gasket.
   - *Torque:* 10 Nm
5.
   - *Torque:* 10 Nm



6.





7. 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.

NOTES:

Engine shown removed for clarity.

The CKP sensor retaining bolt should not be removed from the CKP sensor.

- *Torque:* 5 Nm

Installation

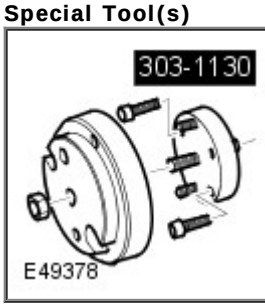
1. To install, reverse the removal procedure.

Published: 06-Sep-2013

Electronic Engine Controls - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Crankshaft Position (CKP) Sensor Ring

Removal and Installation

Special Tool(s)

	303-1130 Installer - Crankshaft Position (CKP) Sensor Ring

Removal

WARNING: This procedure can only be carried out after the vehicle has been decommissioned, by an approved person.

NOTES:

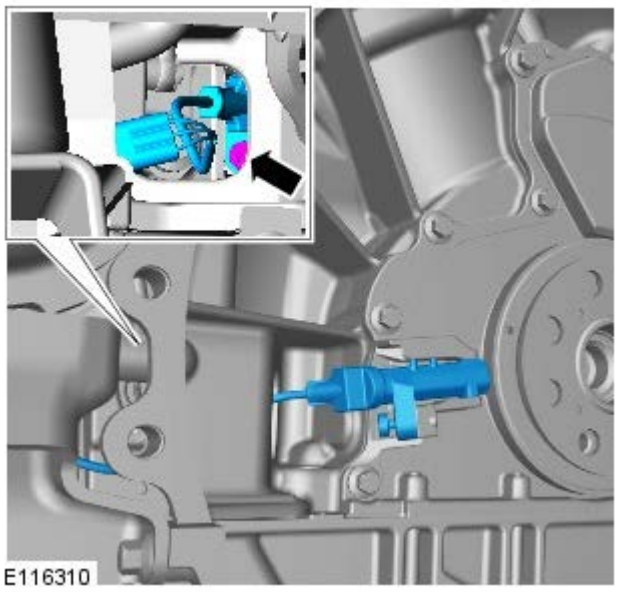
Some variation in the illustrations may occur, but the essential information is always correct.

Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

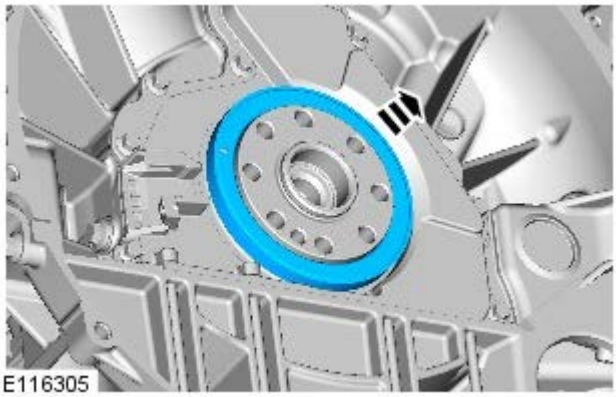
2. Refer to: Flexplate (303-01E Engine - SDV6 3.0L Diesel - Hybrid Electric Vehicle, Removal and Installation).



3. 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.

4.

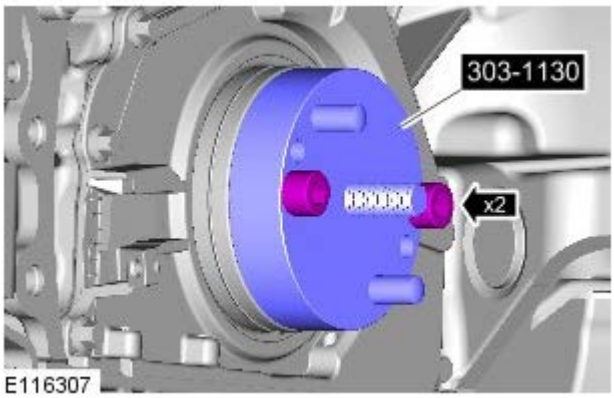


Installation



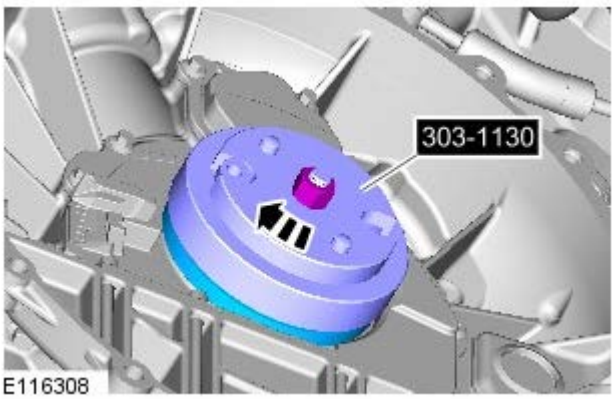
E116306

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



E116307

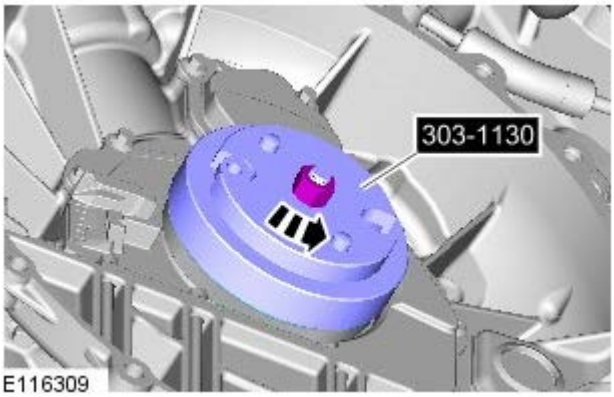
2. Install the special tool.



E116308

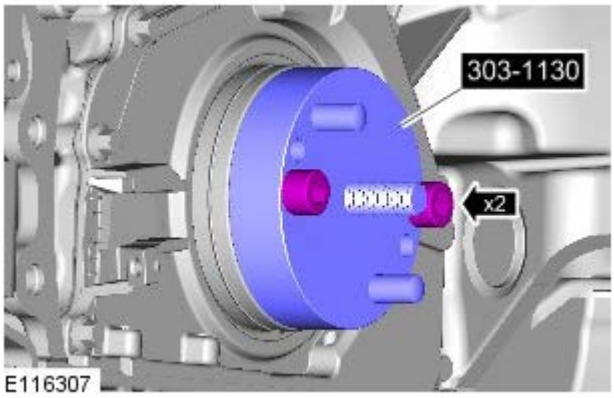
3.

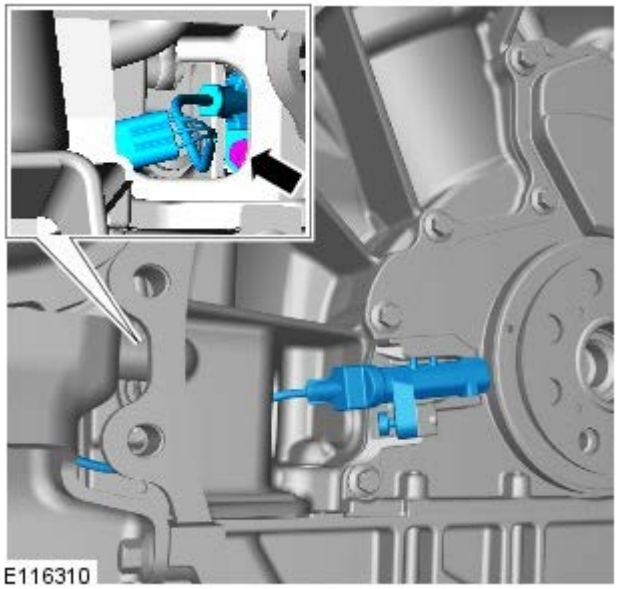
4.



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 (303-01E Engine - SDV6 3.0L Diesel - Hybrid Electric Vehicle, Removal and Installation).

Published: 08-Aug-2012

Electronic Engine Controls - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Diesel Particulate Filter (DPF) Differential Pressure Sensor

Removal and Installation

Removal

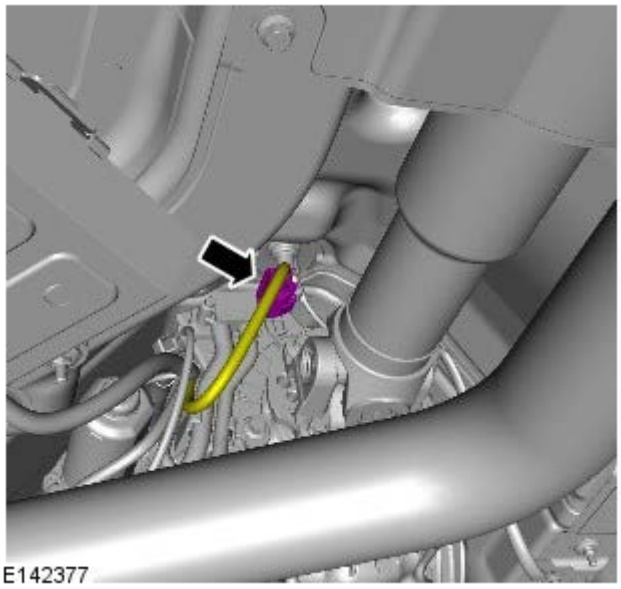
WARNING: Observe due care when working near a hot exhaust system.

NOTE: Removal steps in this procedure may contain installation details.

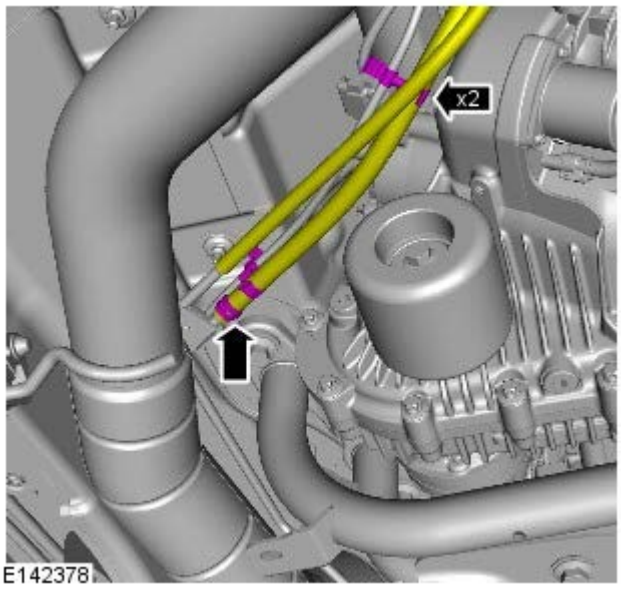
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

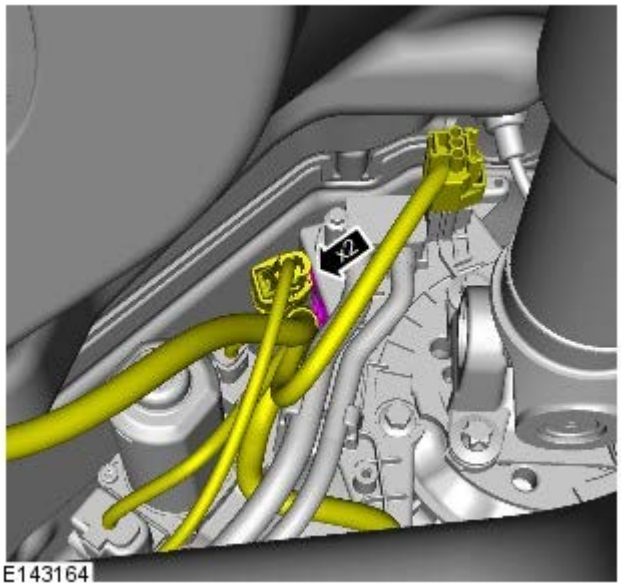
2.



3.

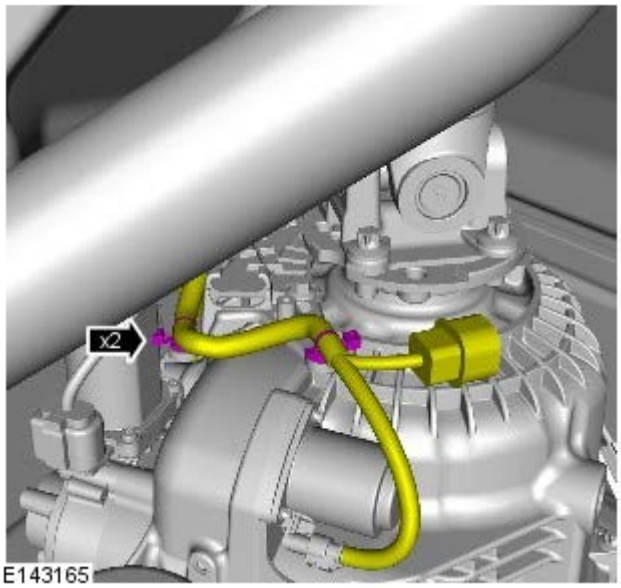


4.



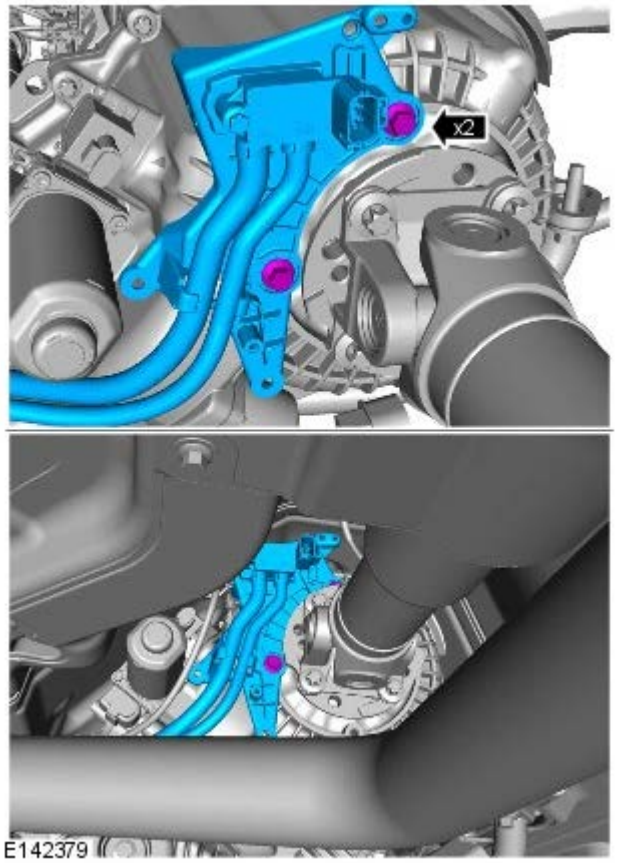
E143164

5.



E143165

6. *Torque:* 20 Nm



Installation

1. To install, reverse the removal procedure.
2. If a new unit is installed, configure using the approved diagnostic tool.

Published: 31-Jul-2012

Electronic Engine Controls - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Engine Coolant Temperature (ECT) Sensor

Removal and Installation

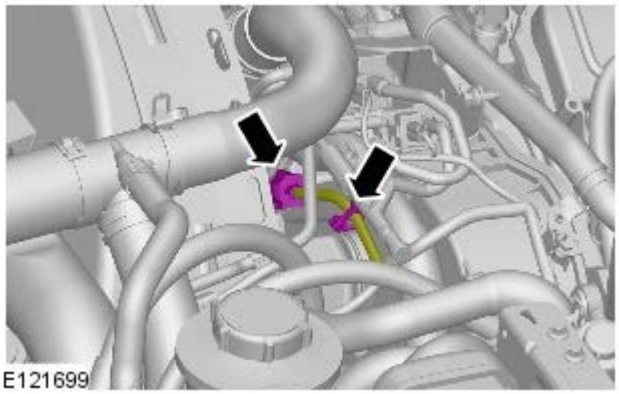
Removal

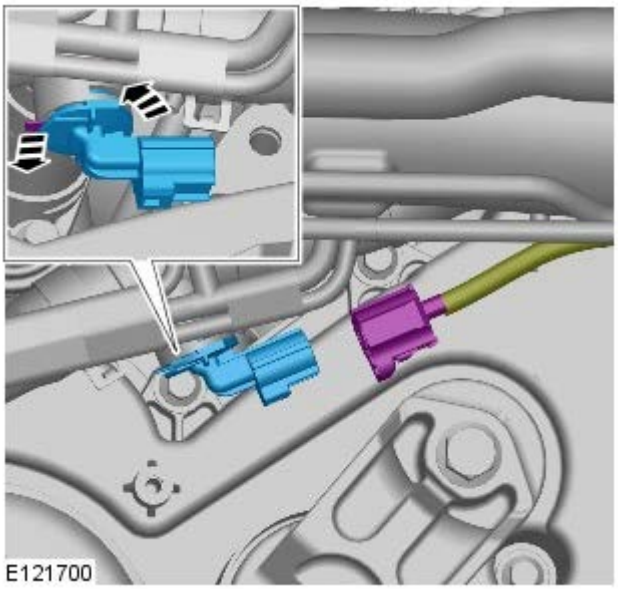
CAUTION: Make sure that all openings are sealed. Use new blanking caps.

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Engine Cover - TDV6 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. Check and top up coolant level.

Published: 31-Jul-2012

Electronic Engine Controls - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Engine Control Module (ECM)

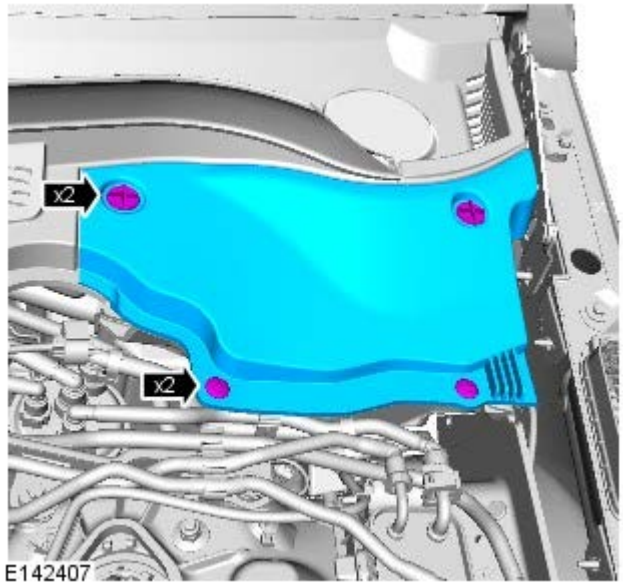
Removal and Installation

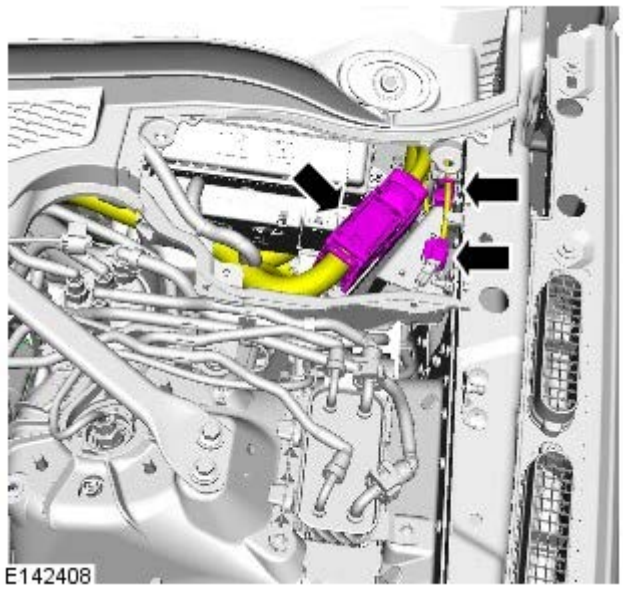
Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Specifications (414-00, Specifications).

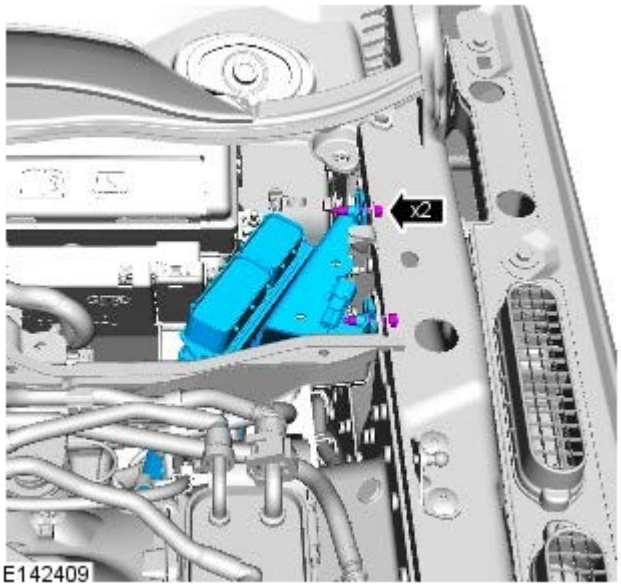
2.



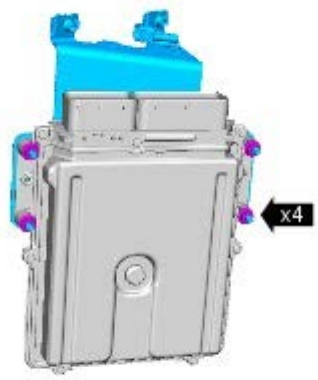


3. CAUTION: Before the disconnection or removal of any components, make sure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

4.



5.
- *Torque:* 7 Nm



E142410

Installation

1. To install, reverse the removal procedure.
2. If a new unit is installed, configure using the approved diagnostic tool.

Published: 06-Aug-2012

Electronic Engine Controls - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Engine Oil Level 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, Specifications).

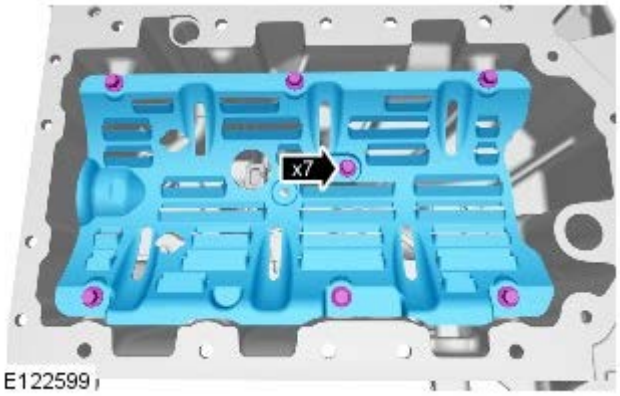
2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

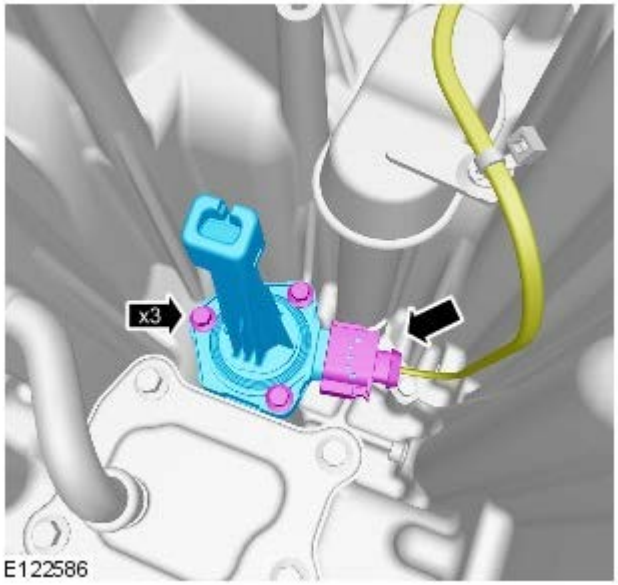
3. Remove the oil pan.

   Refer to: Oil Pan (303-01A, Removal and Installation).

4. *Torque:* 12 Nm



5. *Torque:* 12 Nm



Installation

1. To install, reverse the removal procedure.

Published: 31-Jul-2012

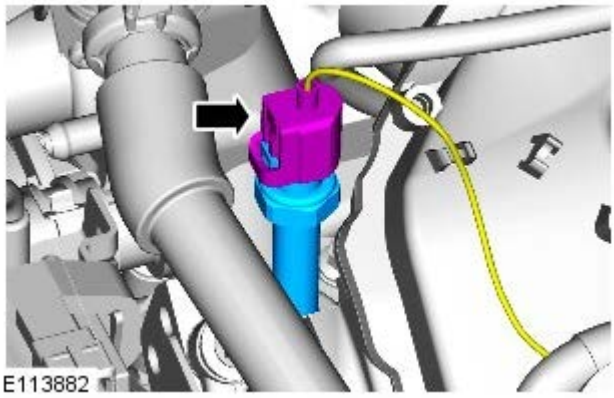
Electronic Engine Controls - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Engine Oil Pressure (EOP) Sensor

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05, Removal and Installation).



2. NOTE: Make sure that all the component mating are clean
   - *Torque:* 14 Nm

Installation

1. To install, reverse the removal procedure.

Published: 31-Jul-2012

Electronic Engine Controls - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Exhaust Gas Temperature Sensor RH

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

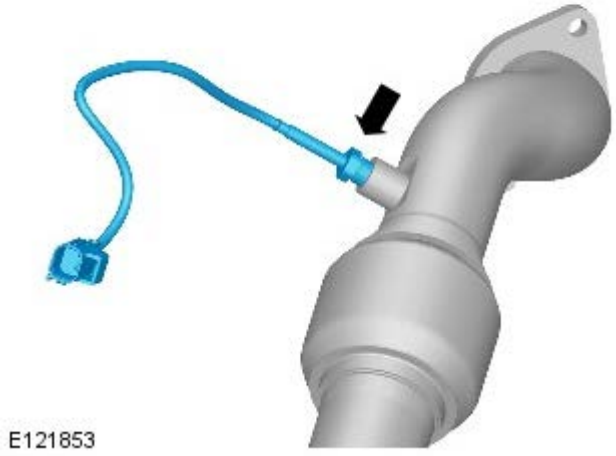
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Refer to: Exhaust System (309-00A, 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.

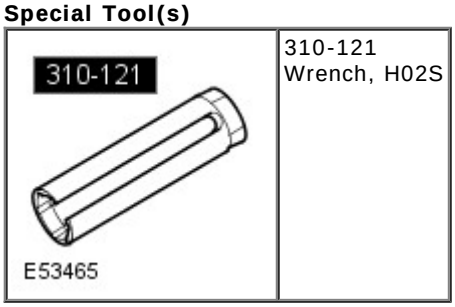
   To install, reverse the removal procedure.

Published: 04-Aug-2012

Electronic Engine Controls - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Heated Oxygen Sensor (HO2S)

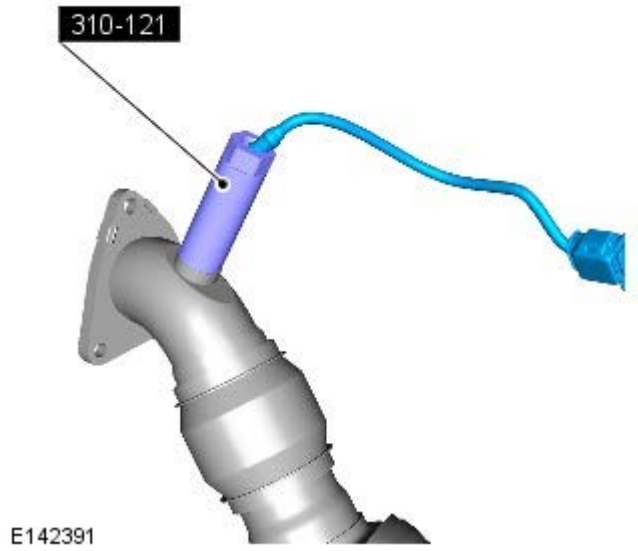
Removal and Installation

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: Catalytic Converter (309-00A Exhaust System - TDV6 3.0L Diesel, Removal and Installation).

3. 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. If a new unit is installed, configure using the approved diagnostic tool.

Published: 31-Jul-2012

Electronic Engine Controls - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Intake Air Temperature (IAT) Sensor

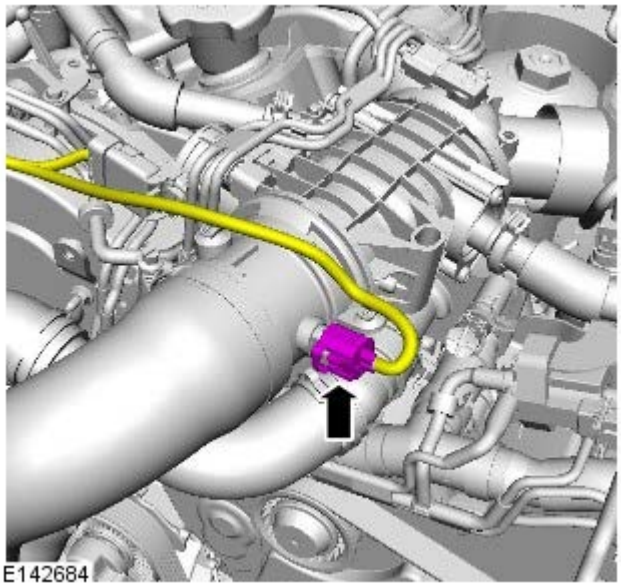
Removal and Installation

Removal

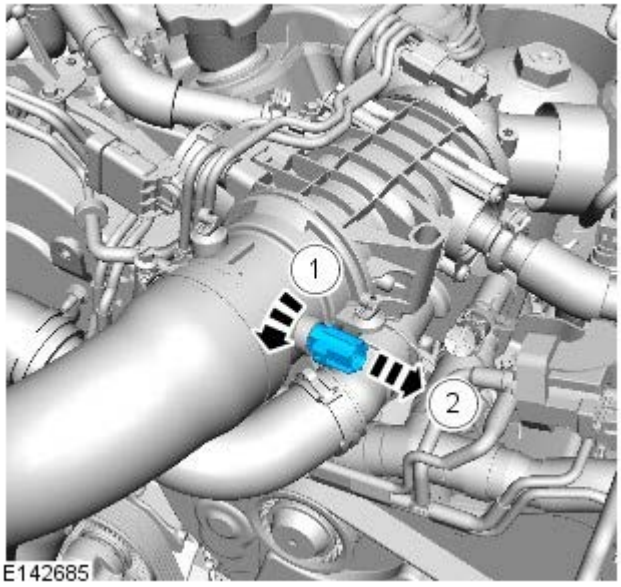
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05, Removal and Installation).

2.



3.



Installation

1. To install, reverse the removal procedure.

Published: 31-Jul-2012

Electronic Engine Controls - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Manifold Absolute Pressure (MAP) Sensor

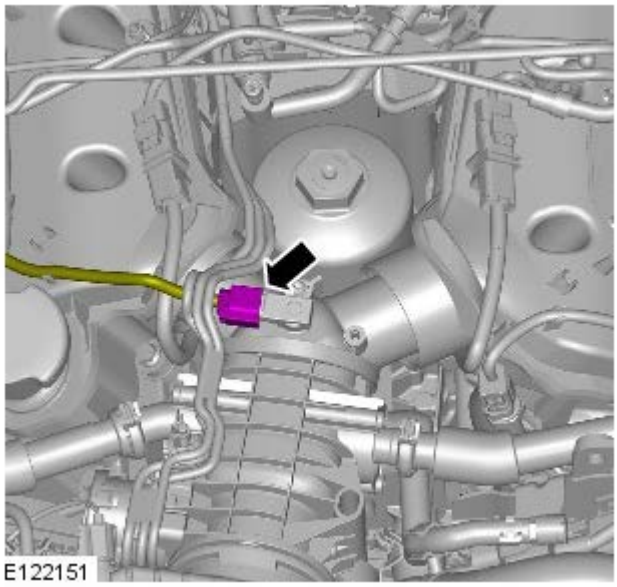
Removal and Installation

Removal

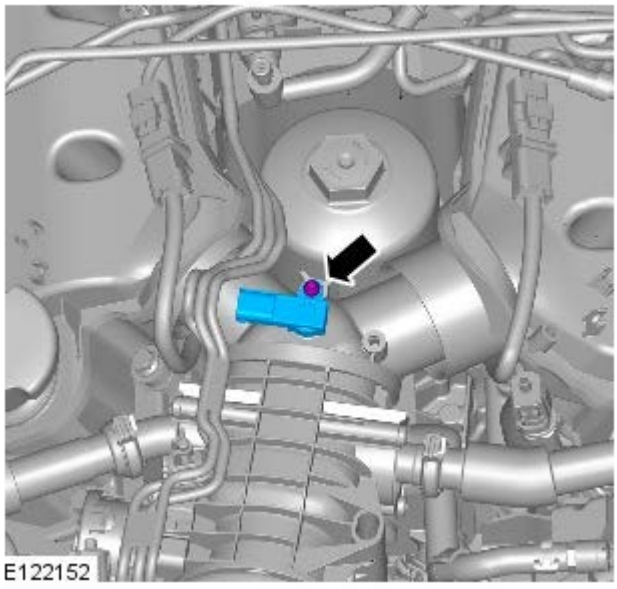
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05, Removal and Installation).

2.



3. *Torque:* 3 Nm



Installation

1. To install, reverse the removal procedure.

Published: 06-Aug-2012

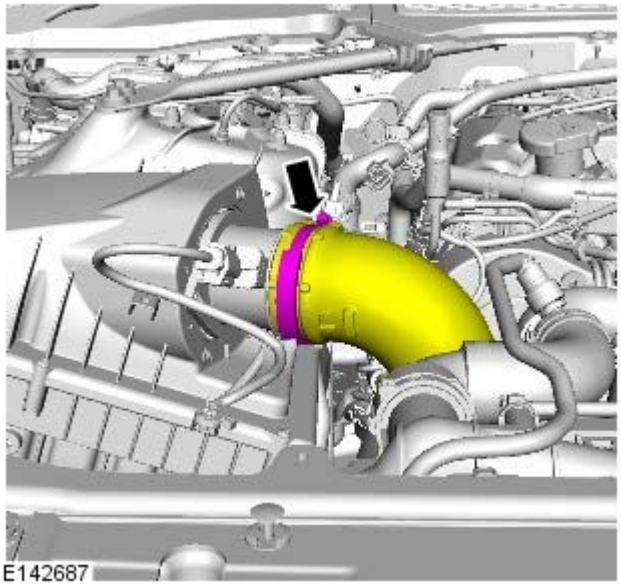
Electronic Engine Controls - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Mass Air Flow (MAF) Sensor

Removal and Installation

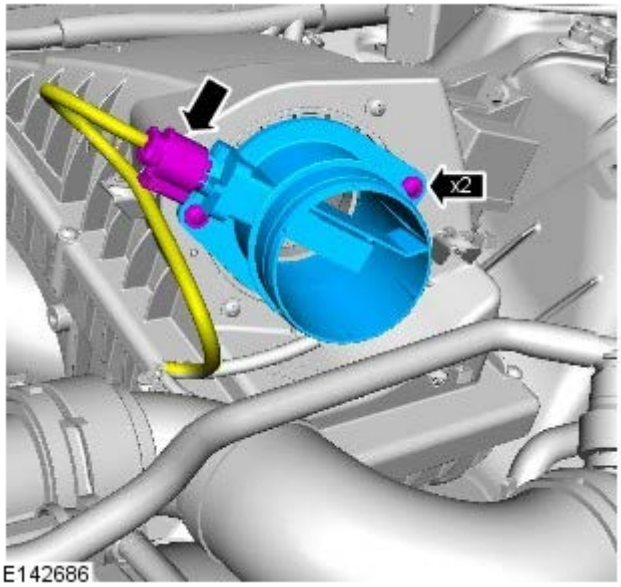
Removal

NOTE: Removal steps in this procedure may contain installation details.

1.



2. *Torque:* 2 Nm



Installation

1. To install, reverse the removal procedure.

Published: 06-Aug-2012

Electronic Engine Controls - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Oil Temperature 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, Specifications).

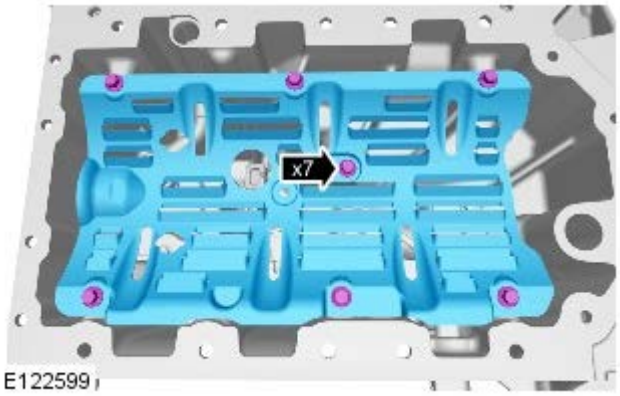
2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

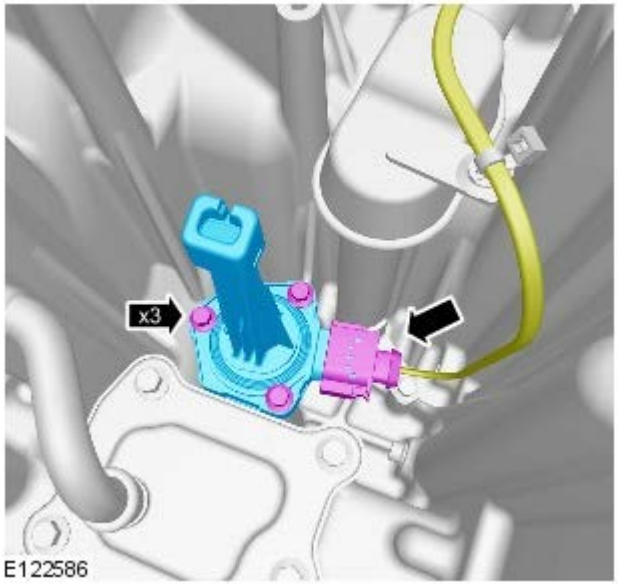
3. Remove the oil pan.

   Refer to: Oil Pan (303-01A, Removal and Installation).

4. *Torque:* 12 Nm



5. *Torque:* 12 Nm



Installation

1. To install, reverse the removal procedure.

Published: 31-Jul-2012

Electronic Engine Controls - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Post Catalytic Converter Temperature Sensor

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

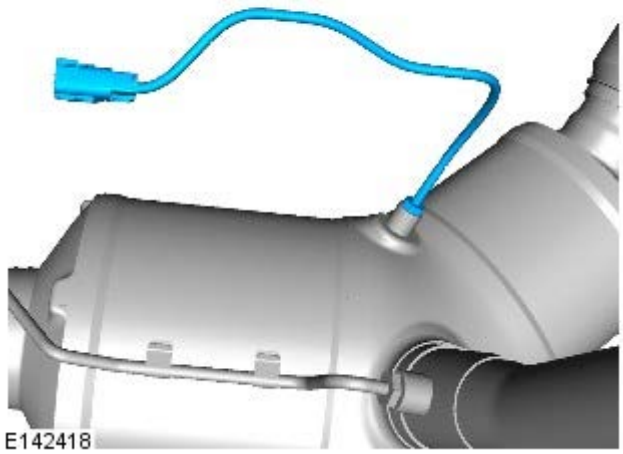
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Refer to: Exhaust System - Vehicles With: Diesel Particulate Filter (DPF) (309-00A Exhaust System - TDV6 3.0L Diesel, 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: 08-Aug-2012

Electronic Engine Controls - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Post DPF Exhaust Gas Temperature Sensor

Removal and Installation

Removal

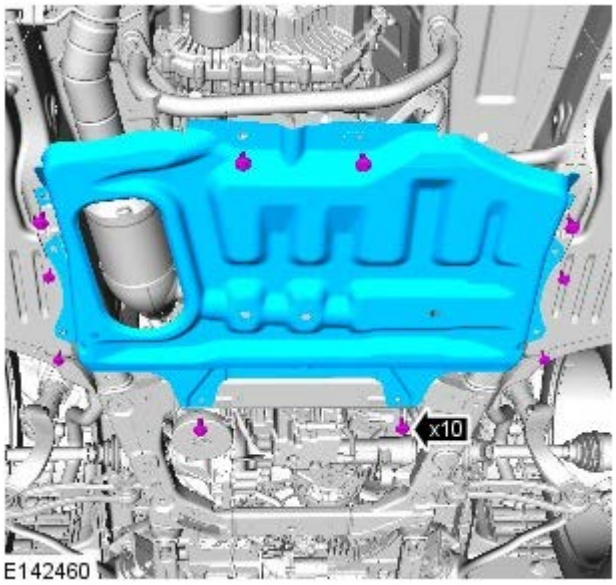
WARNING: Observe due care when working near a hot exhaust system.

NOTE: Removal steps in this procedure may contain installation details.

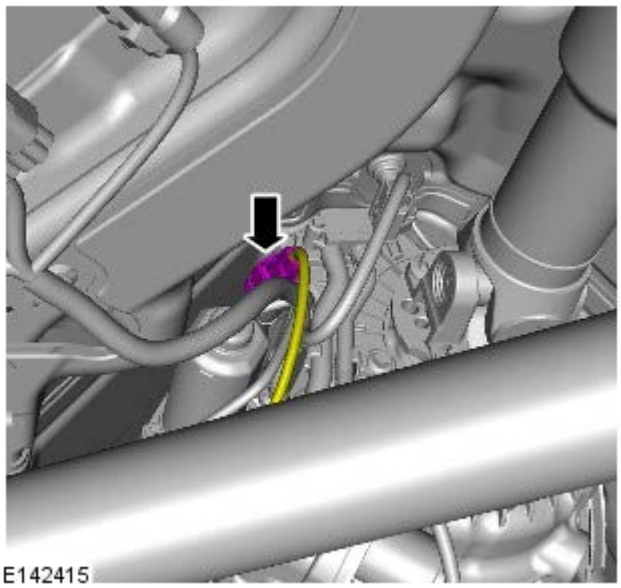
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

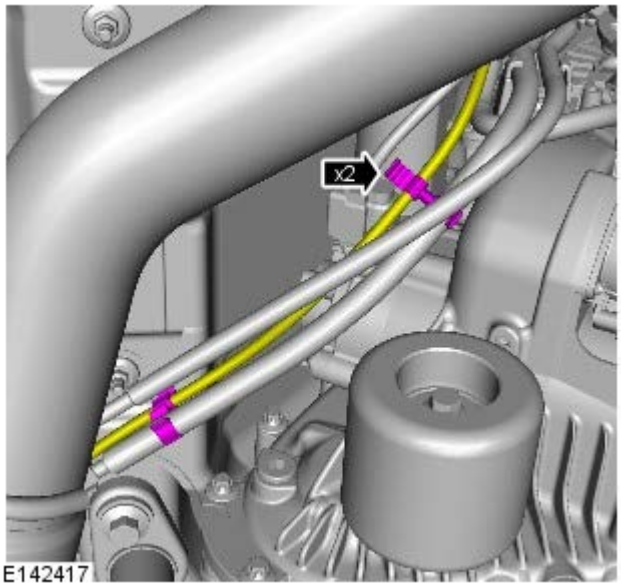
2. *Torque:*
   M10 60 Nm
   M6 10 Nm

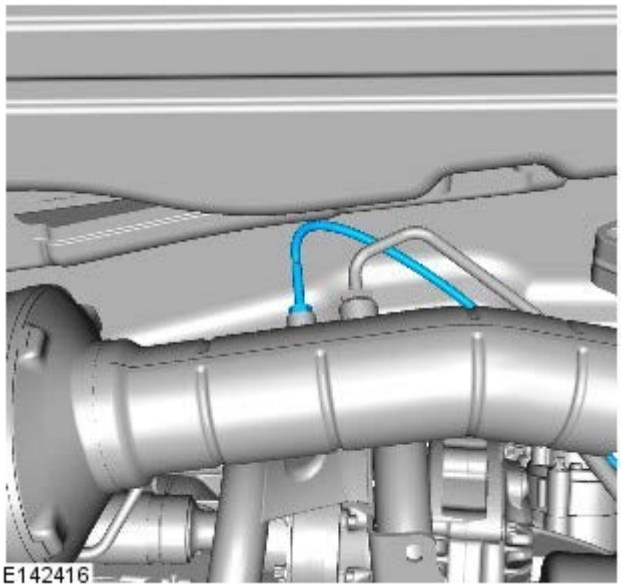


3.



4.





5. 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: 31-Jul-2012

Electronic Engine Controls - SDV6 3.0L Diesel - Hybrid Electric Vehicle - 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 - Vehicles With: Diesel Particulate Filter (DPF) (309-00A Exhaust System - TDV6 3.0L Diesel, 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: 24-Oct-2012

Automatic Transmission / Transaxle - 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.

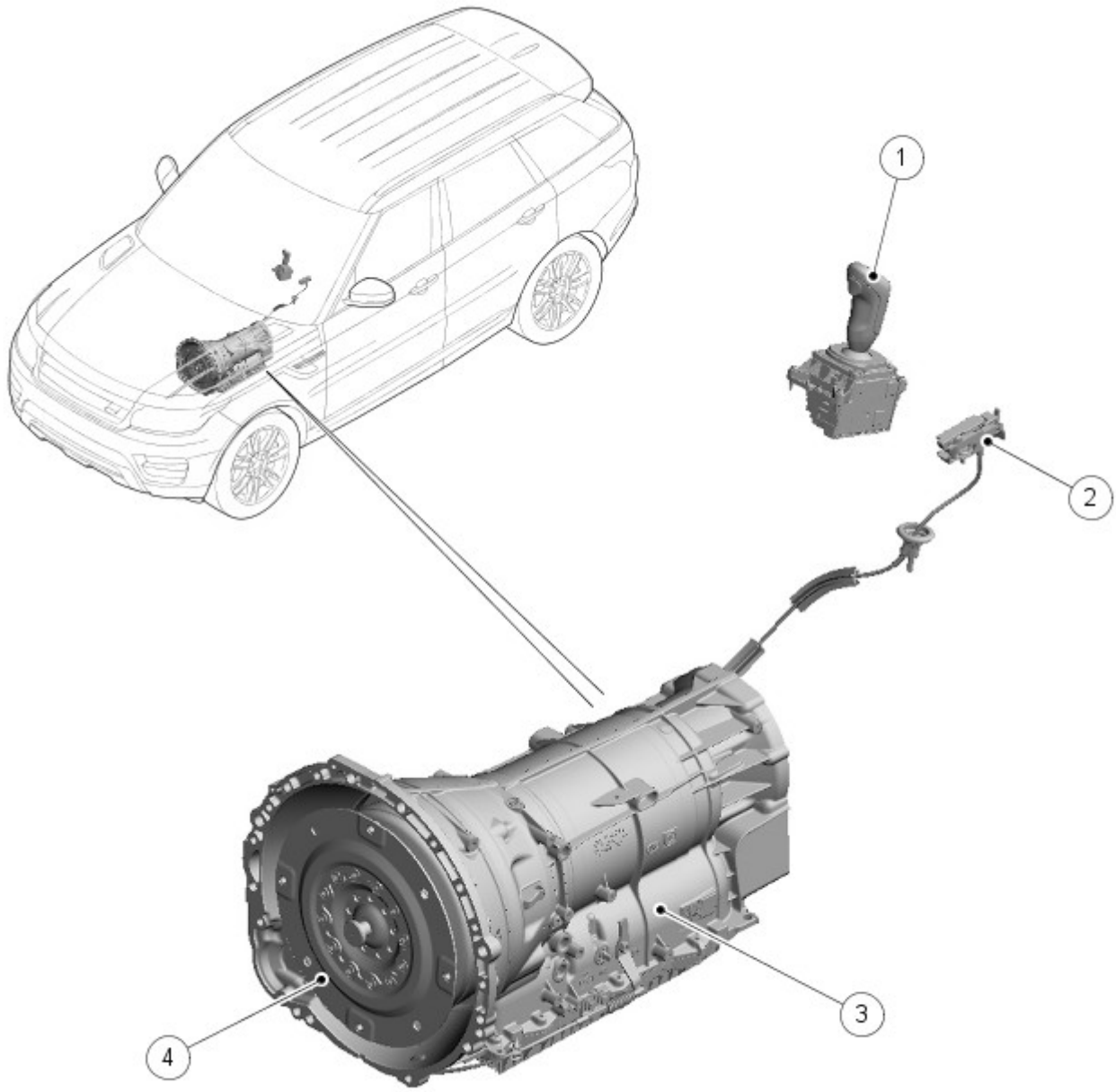
Description	Nm	lb-ft	lb-in
Transmission retaining bolts	40	30	-
Transmission mount retaining bolts	60	44	-
*Transmission fluid fill plug	35	26	-
*Transmission control module (TCM) and main control valve body retaining bolts	8	-	53
Torque converter retaining bolts	63	46	-
Transmission fluid cooler tube retaining bolt	22	16	-
Transmission fluid drain plug	8	-	53
*Transmission fluid pan, gasket and filter retaining bolts	10	7	-

Published: 14-May-2013

Automatic Transmission / Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - Transmission Description

Description and Operation

COMPONENT LOCATION



E152432

Item	Part Number	Description
1	-	Transmission Control Switch (TCS)
2	-	Emergency Park Release (EPR) 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) Powertrain bus for communications
- Default mode if major faults occur
- Diagnostics available from the TCM via the High speed CAN Powertrain 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 TCS (Transmission Control Switch) in the floor console.
For additional information, refer to: External Controls (307-05A Automatic Transmission/Transaxle External Controls - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, 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 TCS 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.

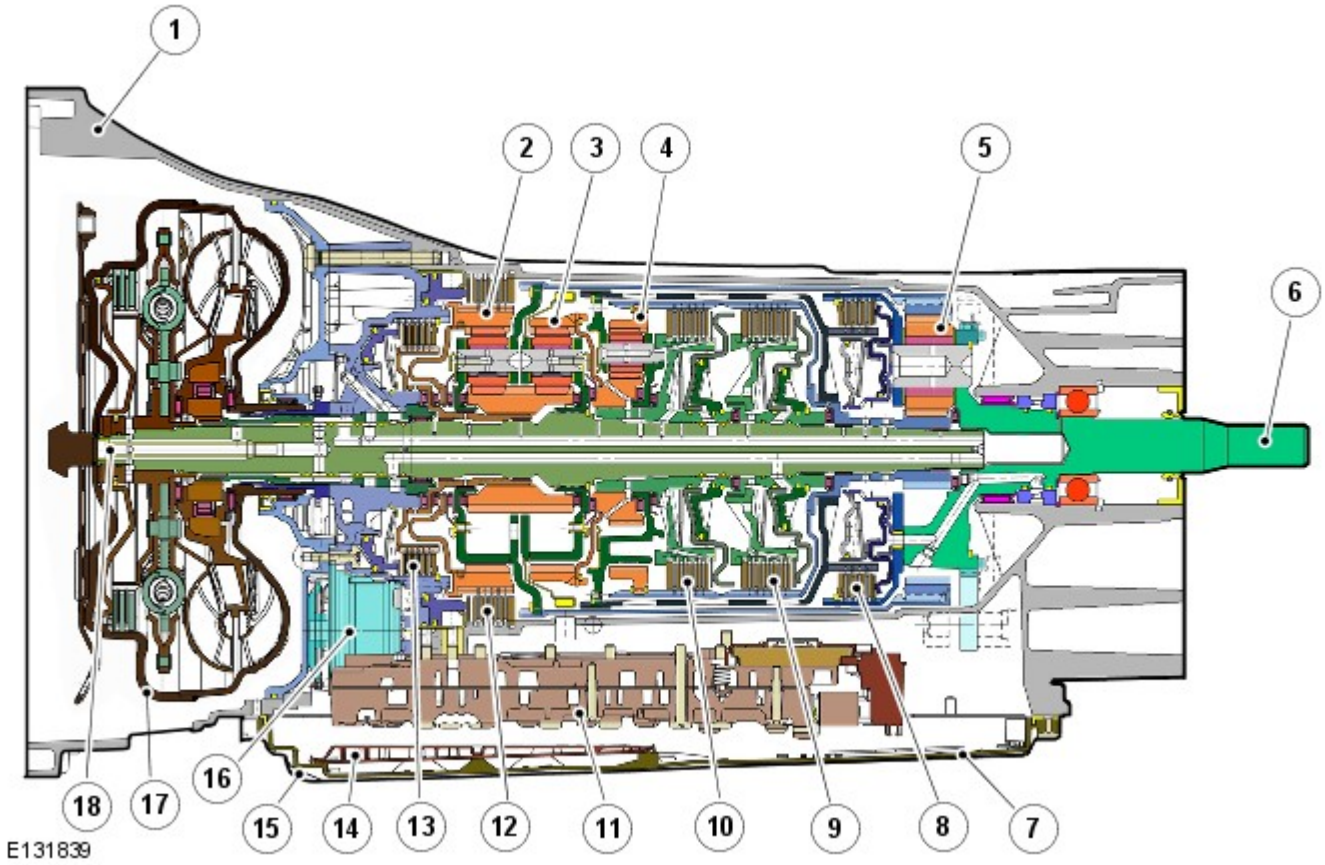
The internal oil pump is driven by a simplex chain and 2 drive gears from the input shaft. The oil pump is a double stroke vane cell pump which delivers 50 cm^2 of transmission fluid per revolution.

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:

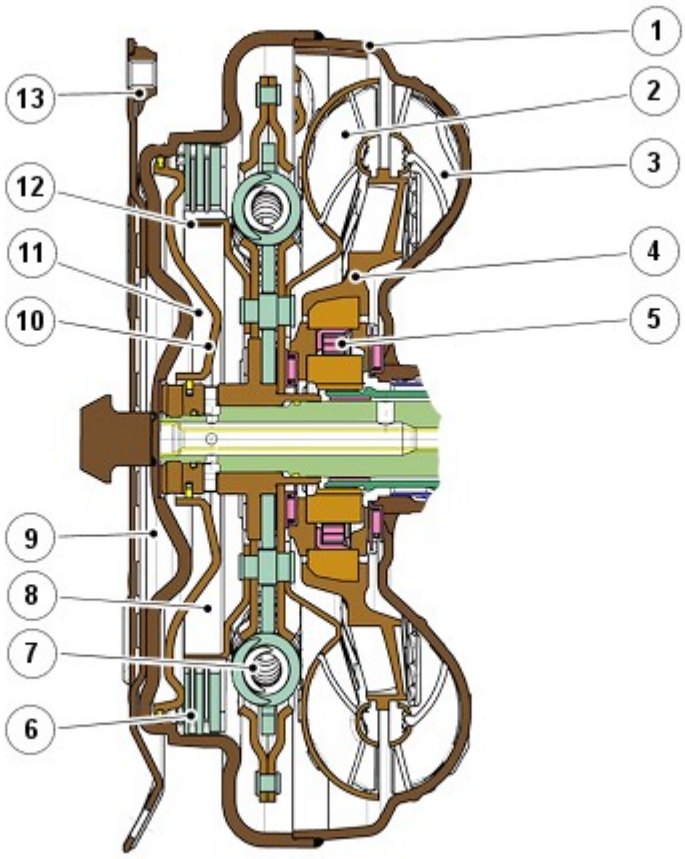
- Input shaft
- Output shaft
- Mechatronic valve block which contains the solenoids, speed sensors and the TCM
- Three rotating multiplate drive clutches
- Two fixed multiplate brake clutches
- Four planetary gear trains.

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.

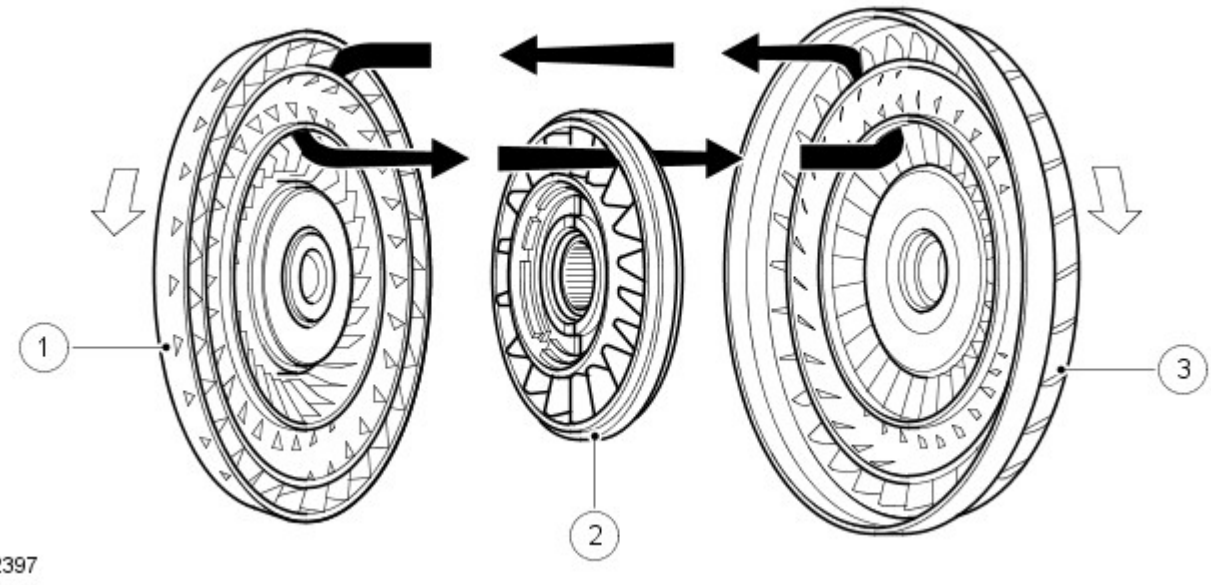
The torque converter comprises an impeller, a stator and a turbine. The torque converter is a sealed unit with all components located between the converter housing cover and the impeller. The two components are welded together to form a sealed, fluid filled housing. With the impeller brazed to the converter 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.

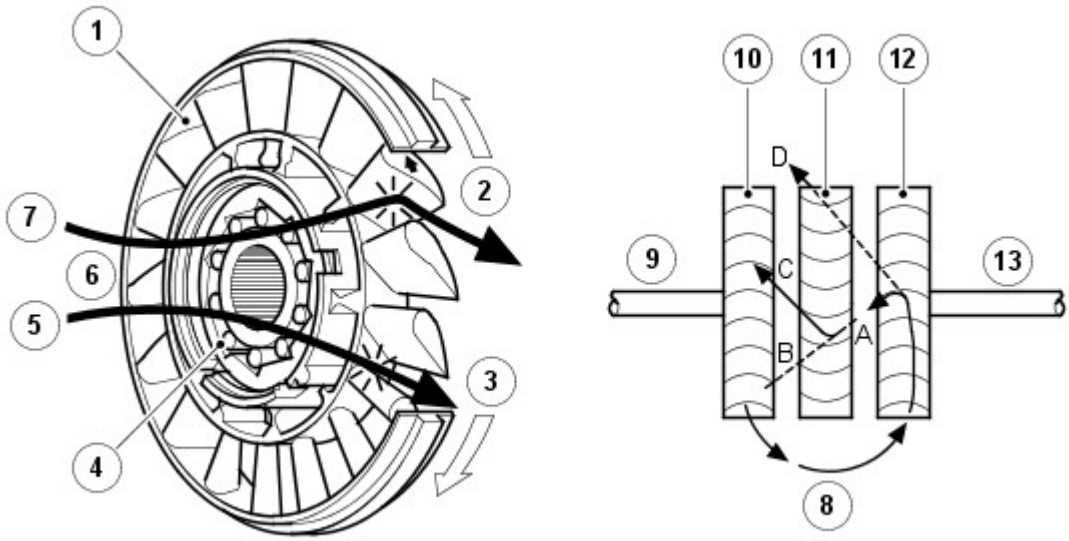
Stator

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



E 42398

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 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 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.

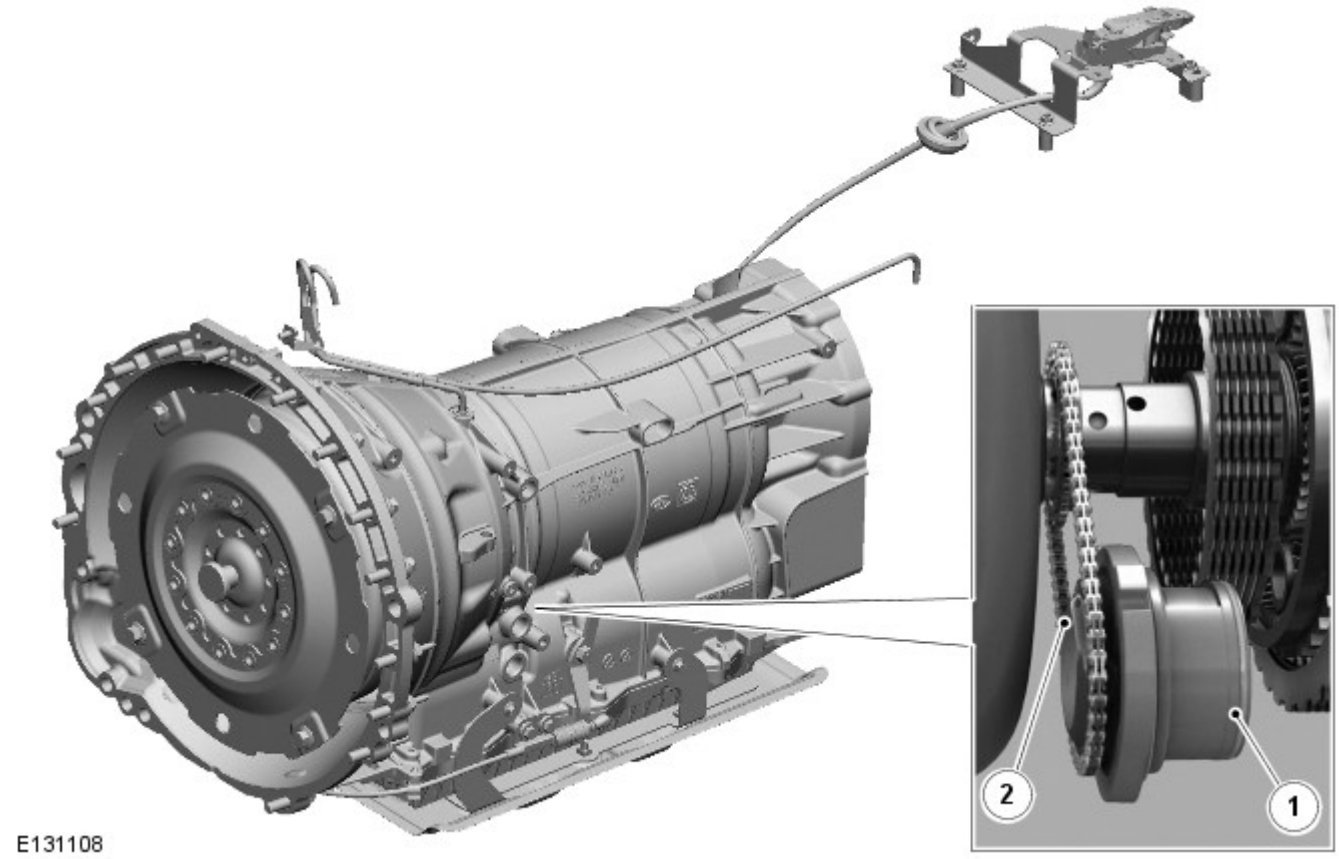
The standstill decoupling feature is new for the 8 speed transmission. When the vehicle comes to a standstill (with the brakes applied), the converter is disconnected from the driveline so that only a slight residual load remains. This further reduces fuel consumption. Decoupling is by actuating clutch 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.

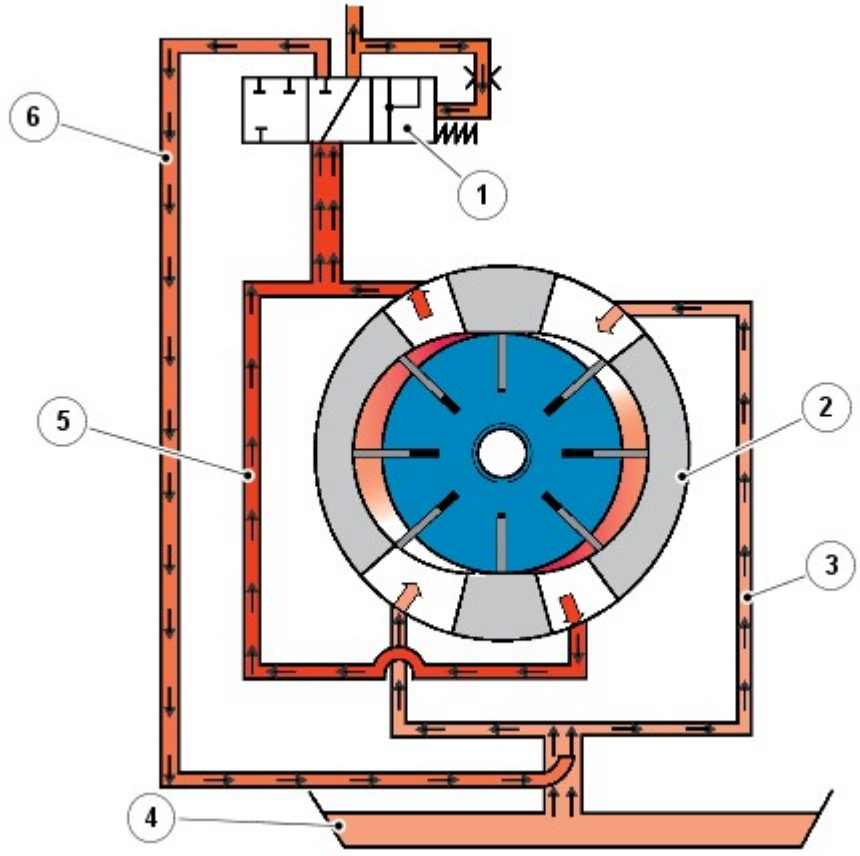
The ZF 8HP70 fluid pump is a double stroke, vane type pump and is located below the transmission input shaft. The pump is driven by a chain drive from a sprocket located on the torque converter. The pump has a delivery rate of 50 cm^3 per revolution. The drive sprocket is driven at engine speed through a splined connection in the torque converter shell.

Double Vane Fluid Pump Location



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.

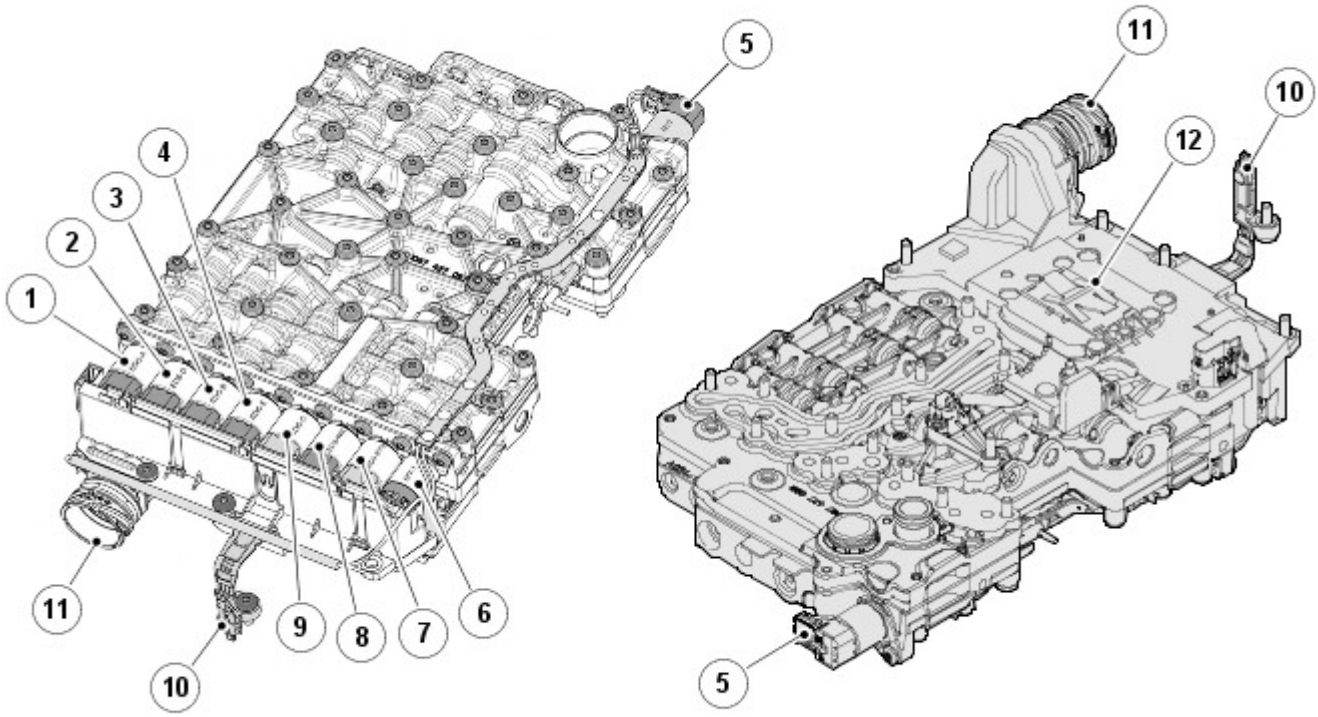
The pressure relief valve controls the pressure and flow of fluid delivered to the transmission valve block, torque converter and other components. Pressure is controlled by a relief valve which limits the maximum system pressure to 32 bar (464 lbf/in²). The pressure control maintains a constant pressure 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 pressurised 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.

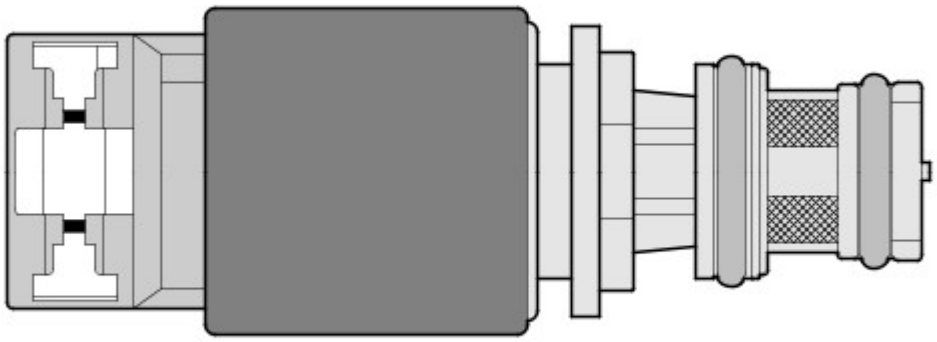
Mechatronic Valve Block



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 output shaft speed sensor
11	-	Electrical connector
12	-	Transmission Control Module (TCM) - hidden

Electronic Pressure Regulator Solenoids (EPRS)



E42713

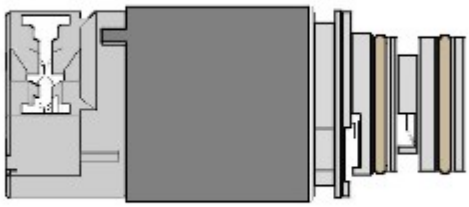
Seven EPRS are located in the valve block. The solenoids are controlled by PWM signals from the TCM. The solenoids convert the electrical signals into hydraulic control pressure proportional to the signal to actuate the spool valves for precise transmission operation.

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)



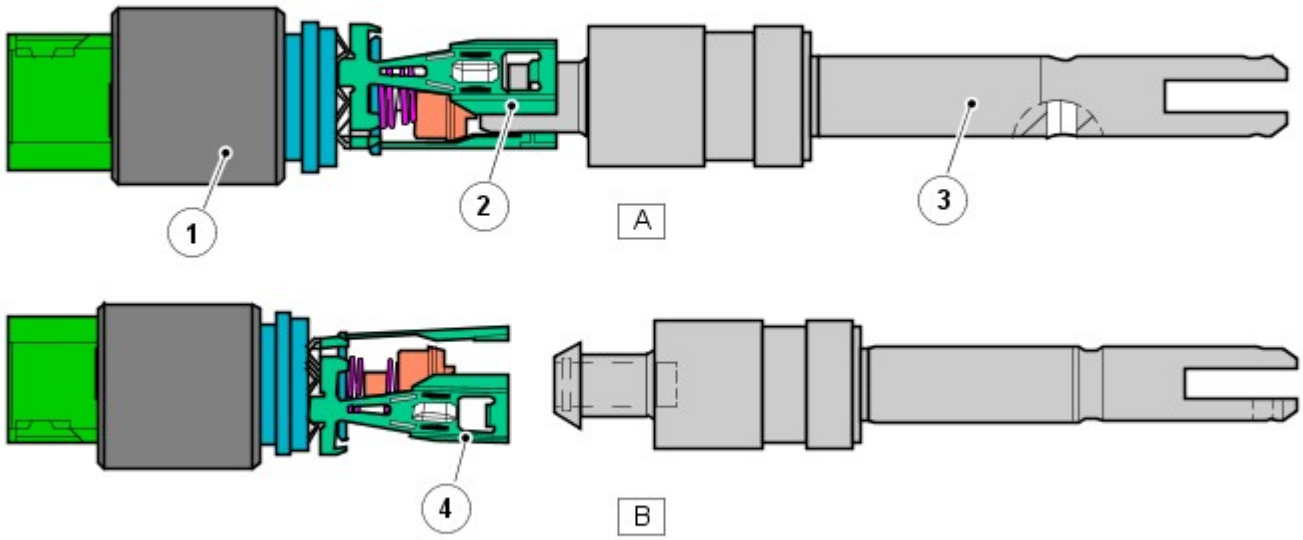
E42714

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 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 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 (deenergized) 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 deenergized. 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 the TCM and compared to engine speed signals received on the high speed CAN Powertrain 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

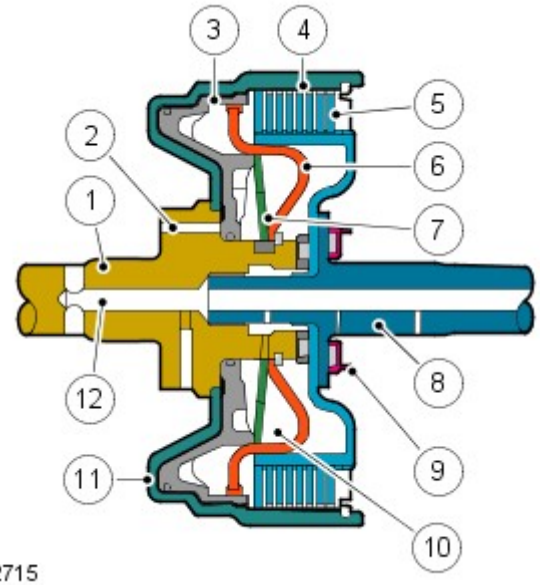
The valve block contains spool valves which control various functions of the transmission. The spool valves are of conventional design and are operated by fluid pressure.

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.



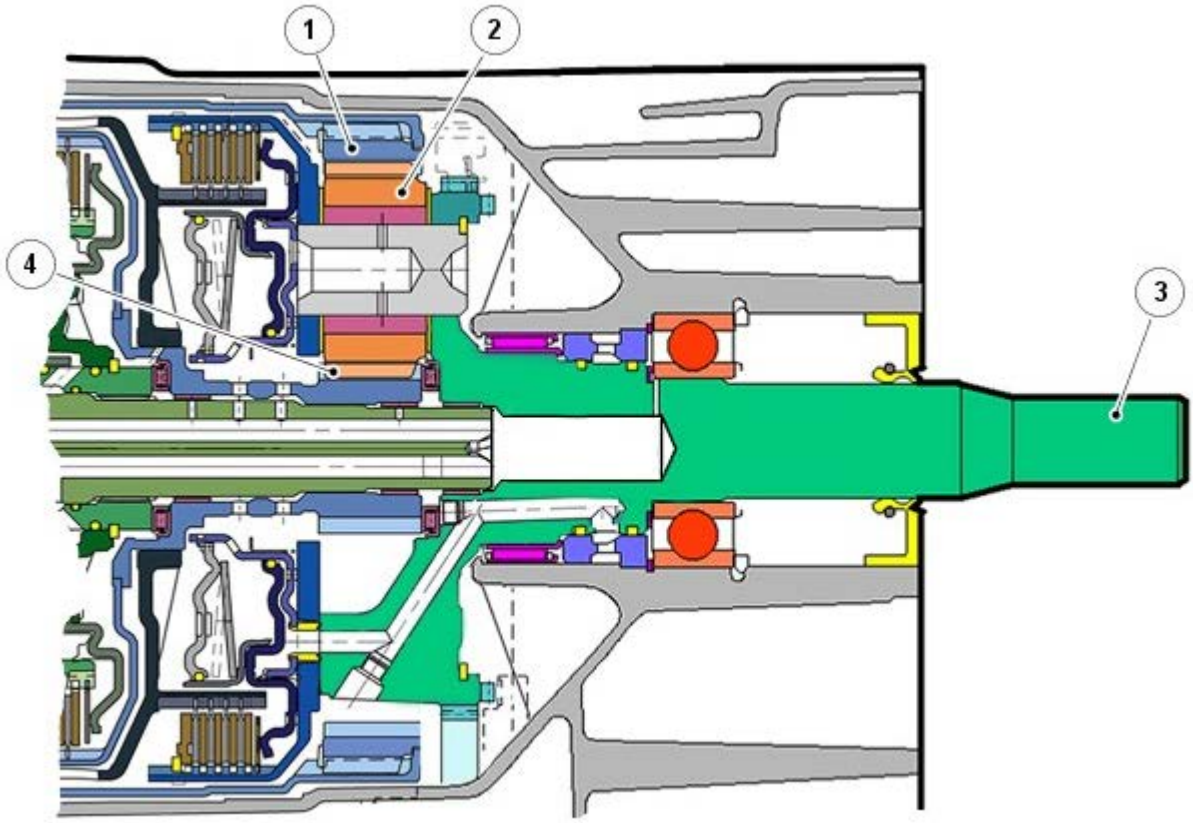
E131255

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

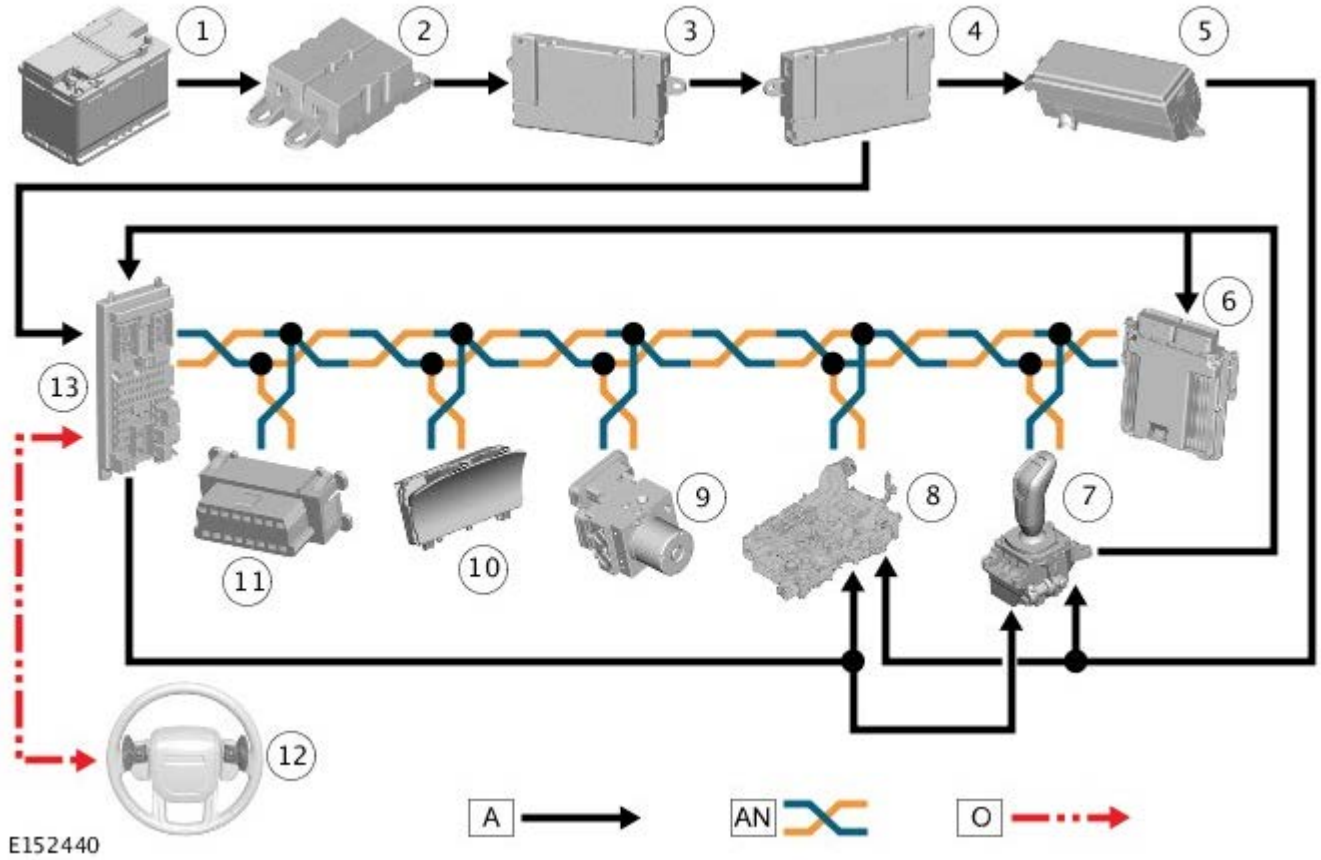
TRANSMISSION CONTROL MODULE

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, AN = High speed CAN (Controller Area Network) Powertrain bus, O = LIN (Local Interconnect Network) bus.



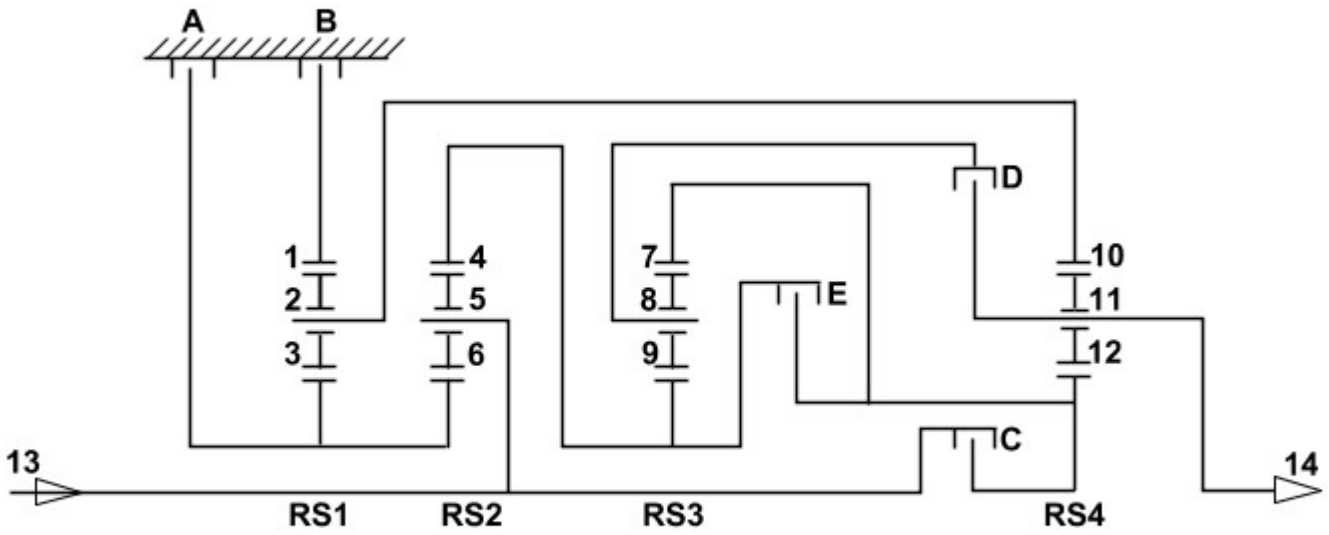
Item	Part Number	Description
1	-	Battery
2	-	Battery Junction Box (BJB2) (250 A megafuse)
3	-	Battery Junction Box (BJB)
4	-	Auxiliary Junction Box (AJB)
5	-	Engine Junction Box (EJB)
6	-	Engine Control Module (ECM)
7	-	Transmission Control Switch (TCS)
8	-	Transmission Control Module (TCM)
9	-	Anti-lock Brake System (ABS) control module
10	-	Instrument Cluster (IC)
11	-	Diagnostic connector
12	-	Steering wheel paddle switches
13	-	Central Junction Box (CJB)

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.



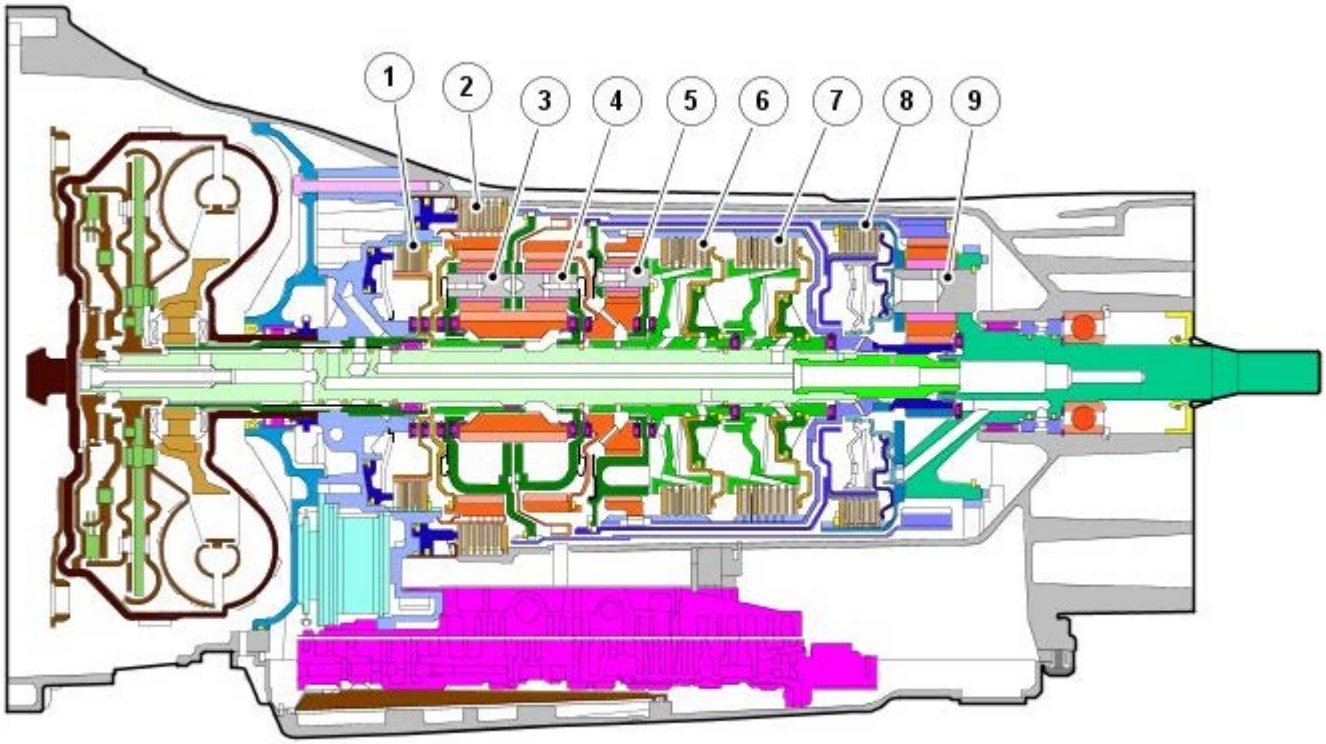
E131258

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

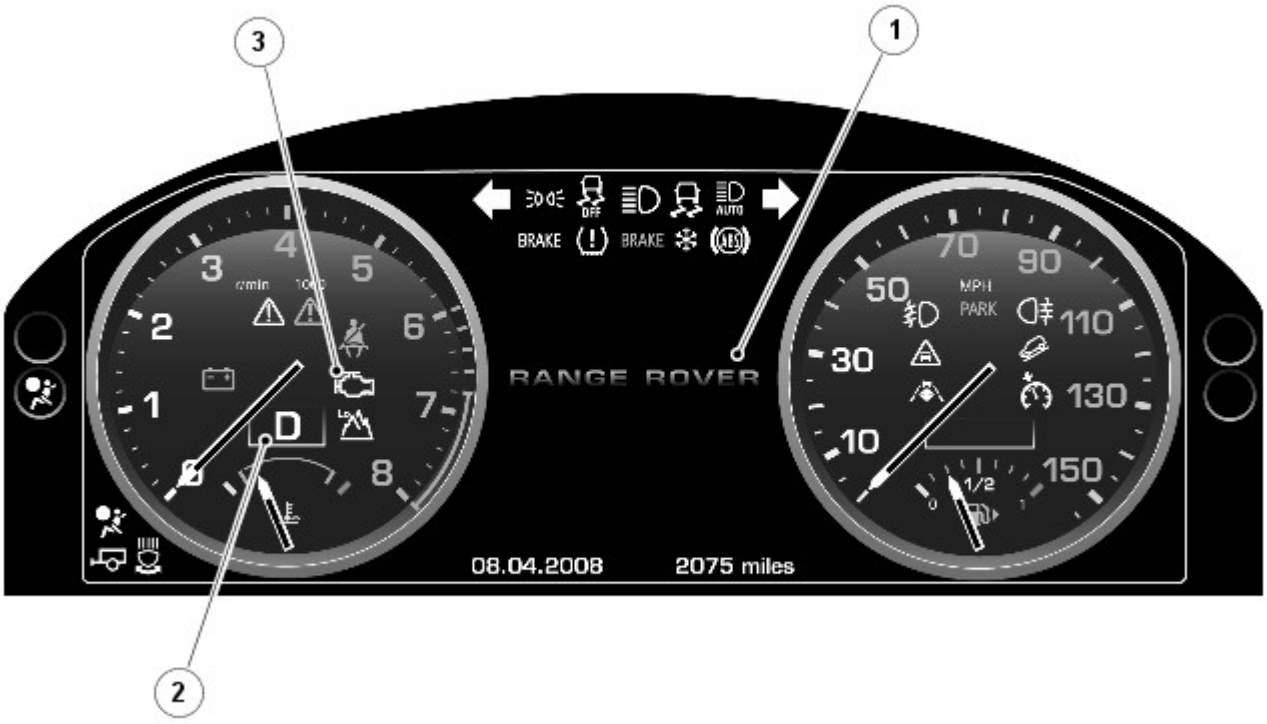


E131259

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



E119473

Item	Part Number	Description
1	-	Message center
2	-	Transmission status display
3	-	Malfunction Indicator Lamp (MIL)

The TFT (Thin Film Transistor) display IC (Instrument Cluster) is connected to the TCM via the high speed CAN Powertrain bus. Transmission status is transmitted by the TCM and displayed to the driver in one of two displays in the IC.
For additional information, refer to: Instrument Cluster (413-01 Instrument Cluster, Description and Operation).

Malfunction Indicator Lamp

The MIL (Malfunction Indicator Lamp) is located in the tachometer of the IC. 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 Powertrain bus. 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 IC. 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 IC. The message center is a 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 Information and Message Center, 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 TCS, 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 Powertrain 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) control module also supply data to the TCM on the high speed CAN Powertrain 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 Powertrain 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 high speed CAN Powertrain bus.

The TCM determines the position of the selector lever using signals from the TCS on the high speed CAN Powertrain bus and LIN (Local Interconnect Network) bus

The TCM transmits the position of the TCS and any manual gear selected on the high speed CAN Powertrain bus. This information is shown in the gear selector display in the IC.

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 IC. The driver needs to select neutral or park and then press the brake pedal to restart the engine.

If the start/stop switch is pressed when driving, the message ENGINE STOP SWITCH 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 switch 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: 11-May-2011

Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - 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 (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, 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

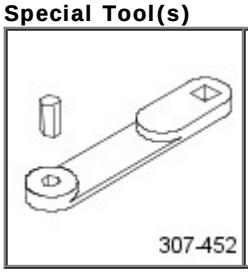
For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - DTC: Transmission Control Module (TCM) (100-00 General Information, Description and Operation).

Published: 16-Oct-2012

Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - Transmission Fluid Level Check V8 5.0L Petrol/V8 S/C 5.0L Petrol

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.

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 2000rpm for a minimum of 30 seconds. Move the TCS to the park and allow the engine to idle between 600rpm and 750rpm.

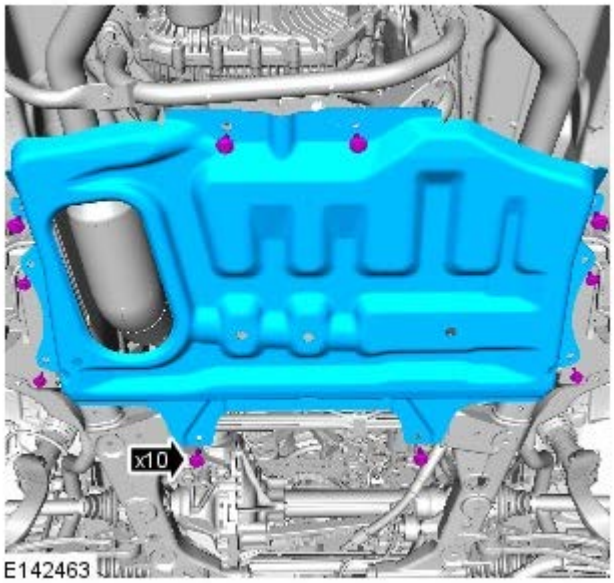
4. CAUTION: Make sure that the transmission fluid temperature is below 30 degrees before starting the fluid level check.

   Connect the diagnostic tool to the vehicle.

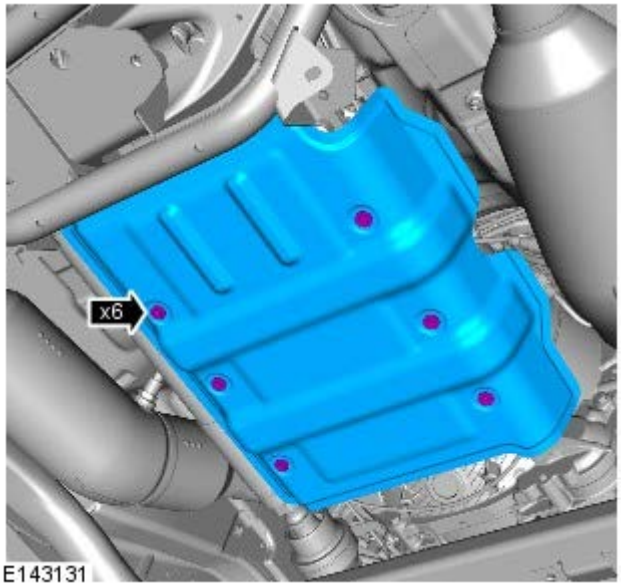
5. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

6.



7.

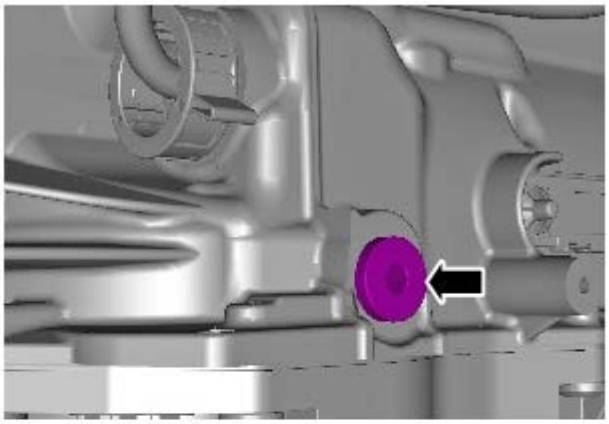


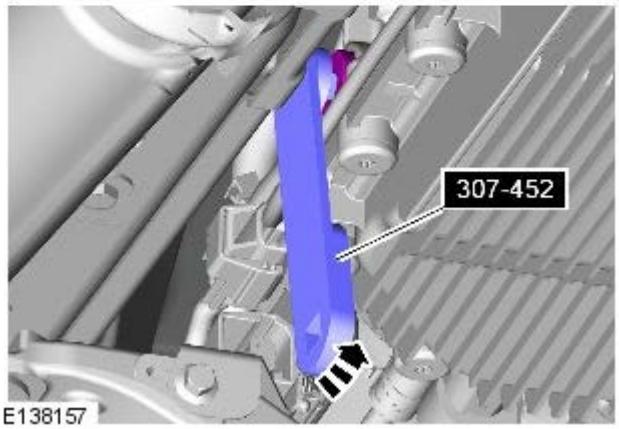
8. Place a suitable container under the transmission fluid fill plug.

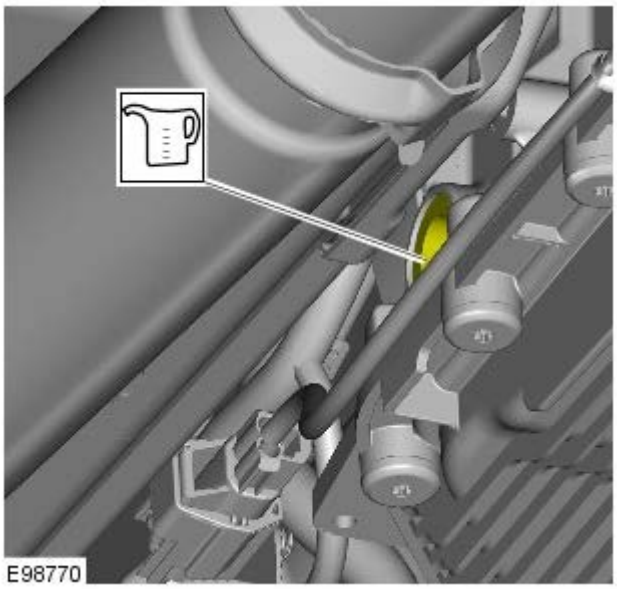
9. CAUTION: The transmission fluid level must only be checked when the temperature of the fluid is between 30 degrees and 50 degrees. The fluid level obtained will be incorrect if the reading is outside this temperature range.

   Clean the area around the transmission fluid level plug.

   Special Tool(s): 307-452

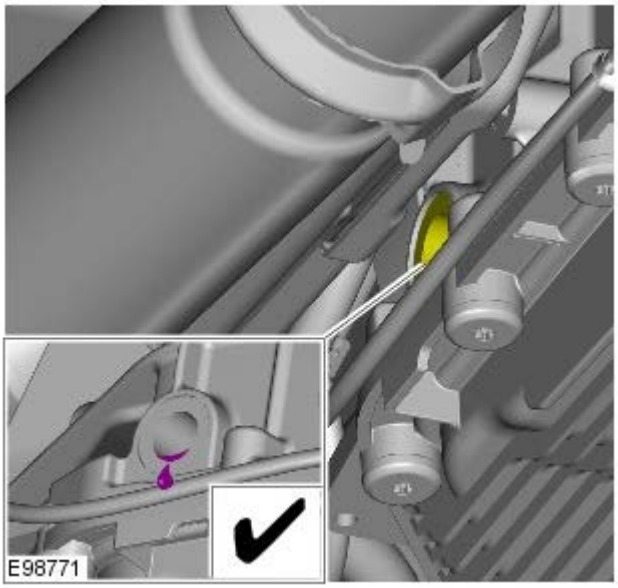




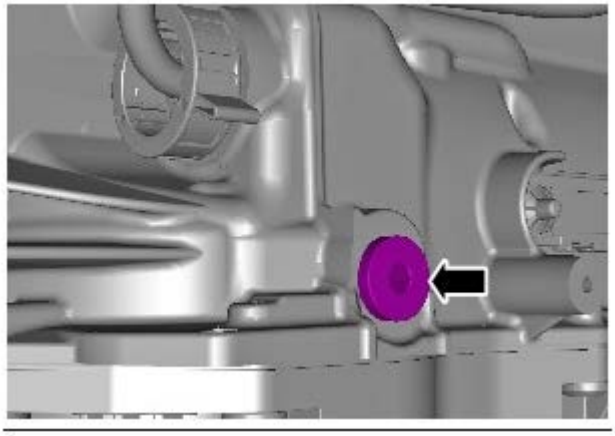


Adjustment

1. NOTE: Use transmission fluid meeting Land Rover specification.
    - Refer to: Specifications (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, Specifications).
    - Start the engine and idle between 600 rpm and 750 rpm.
    - Remove the oil fill plug.
    - 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.
    - Refit the plug.
    - Confirm that the transmission oil temperature is still below 30 deg C. This will ensure that the transmission is overfilled, which is necessary to prevent air suction.
2.
    - All clutches and brakes must be filled, output speed must be 0 rpm, therefore:
    - Apply and hold the footbrake.
    - Engage Pos. R and wait 5 seconds.
    - Engage Pos. D and wait 5 seconds.
    - Tip Up to second gear and wait 5 seconds.
    - Engage Pos. N.
3. To ensure that the torque converter is filled with oil, rev up the engine in Pos. N to 2000 RPM for a minimum of 30 seconds, then engage Pos. P and ensure that the engine is idling between 600 RPM and 750 RPM.
4. NOTE: If the temperature has exceeded 50°C (ideally 40°) before the plug was re-fitted you must start again with the procedure.

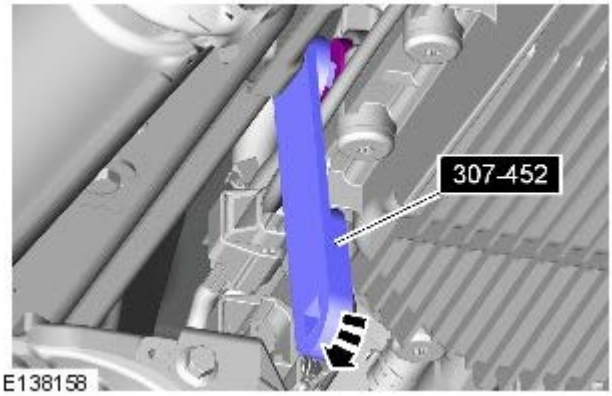


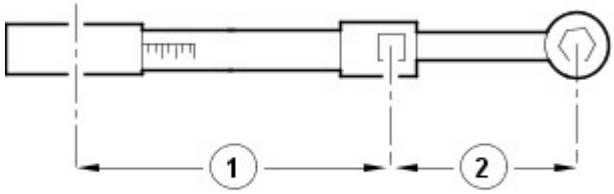
With oil sump temperature between 30°C and 50°C (target 40°C) open lateral filling plug again. If the temperature is still below 40°C, allow oil to drain until 40°C are reached. If the temperature is between 40°C and 50°C, allow oil to drain, until the stream becomes a slow dribbling, then re-fit the plug.



5. NOTE: Install a new fluid level filler plug.

Special Tool(s): 307-452





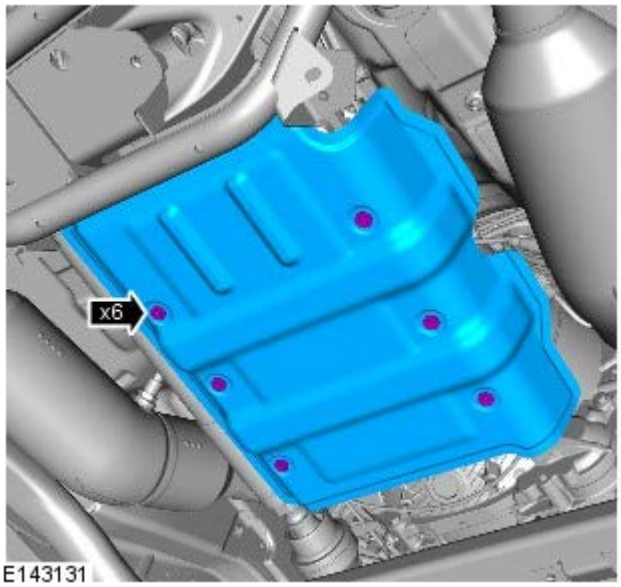
6. CAUTION: Make sure the transmission fluid fill plug is tightened to the correct specification. Failure to follow this instruction may result in damage to the vehicle.

- 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.

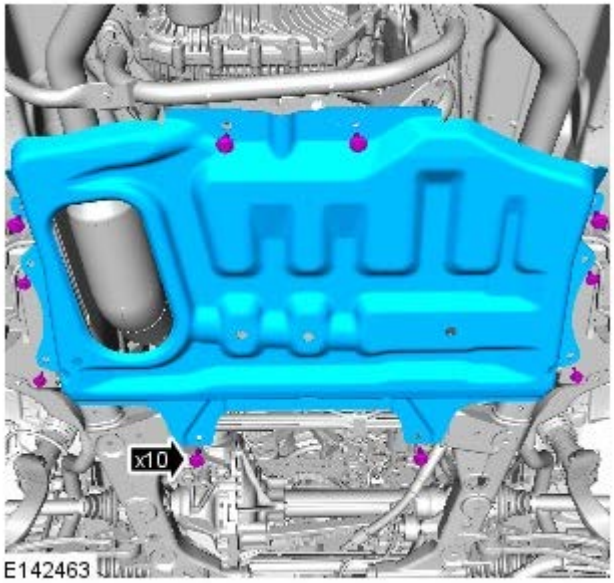
7. Remove the special tool.

8. Remove the container.

9. *Torque:* 10 Nm



10. *Torque:*
M10 60 Nm
M6 10 Nm



11. Lower the vehicle.

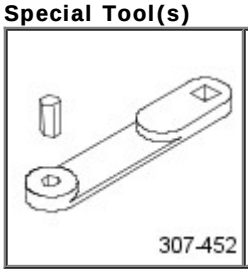
12. Disconnect the diagnostic tool.

Published: 16-Oct-2012

Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - Transmission Fluid Level Check TDV6 3.0L Diesel /TDV8 4.4L Diesel

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.

All vehicles

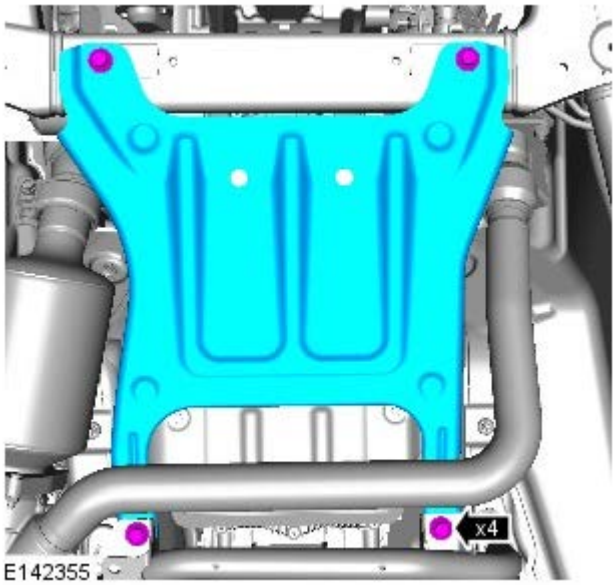
1. NOTE: For vehicles with oil cooler thermostat, ensure that transmission oil temperature, at least once has exceeded the opening temperature of the thermostat, which is 69°C. After that allow the oil temperature to drop below 30°C.
   - The following steps must be observed before starting the transmission 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 2000rpm for a minimum of 30 seconds. Move the TCS to the park and allow the engine to idle between 600rpm and 750rpm.
4. 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.
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.

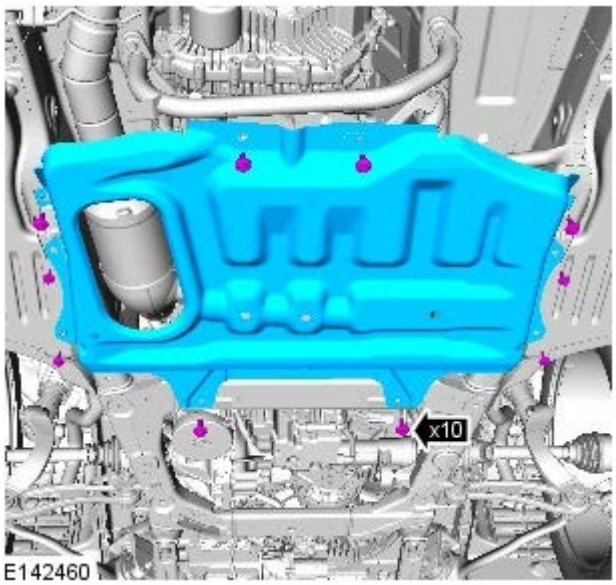
Vehicles with 4.4L diesel engine

7.



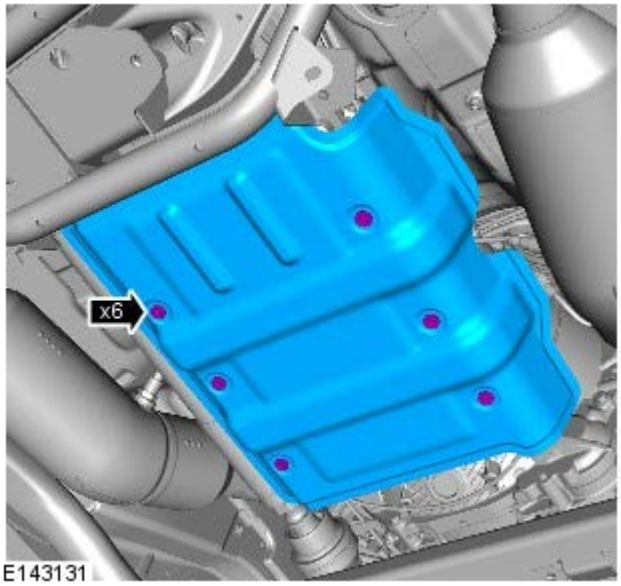
Vehicles with 3.0L diesel engine

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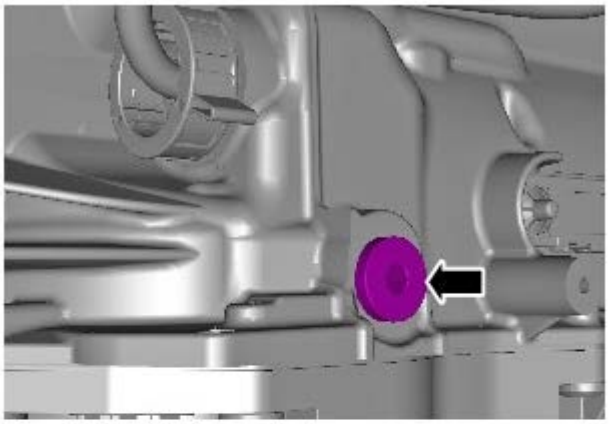


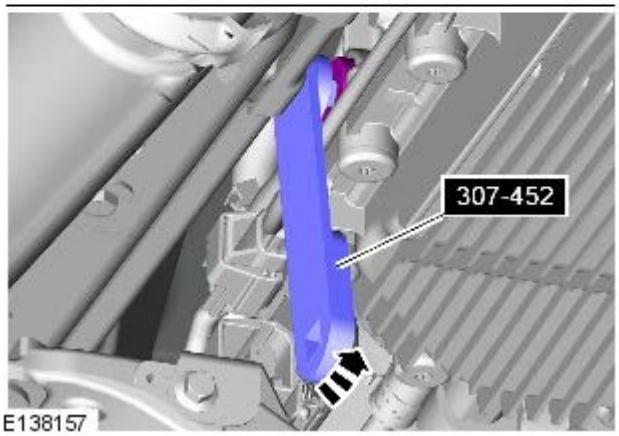
All vehicles

9.



10. Place a suitable container under the transmission fluid fill plug.





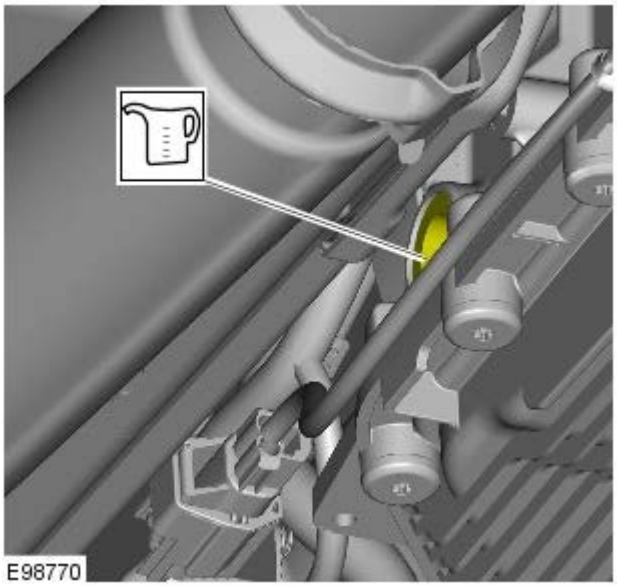
11. CAUTION: The transmission fluid level must only be checked when the temperature of the fluid is between 30 degrees and 50 degrees. The fluid level obtained will be incorrect if the reading is outside this temperature range.

    Clean the area around the transmission fluid level plug.

    Special Tool(s): 307-452

Adjustment

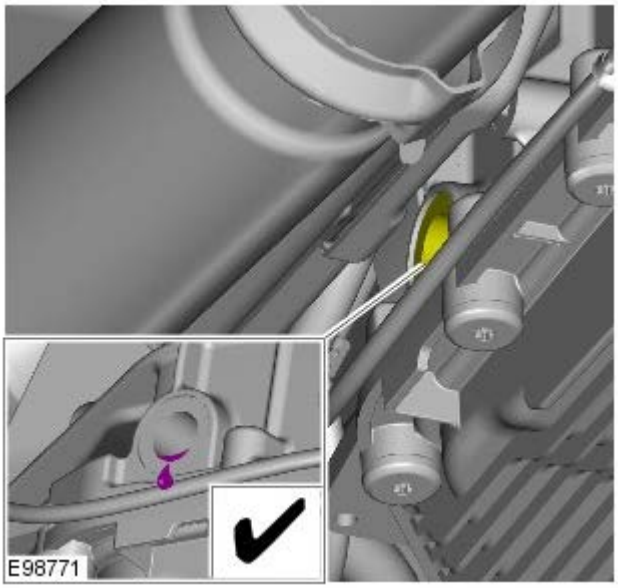
All vehicles



1. NOTE: Use transmission fluid meeting Land Rover specification.
   - Refer to: Specifications (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, Specifications).
   - Start the engine and idle between 600 rpm and 750 rpm.
   - Remove the oil fill plug.
   - 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.
   - Refit the plug.
   - Confirm that the transmission oil temperature is still below 30 deg C. This will ensure that the transmission is overfilled, which is necessary to prevent air suction.

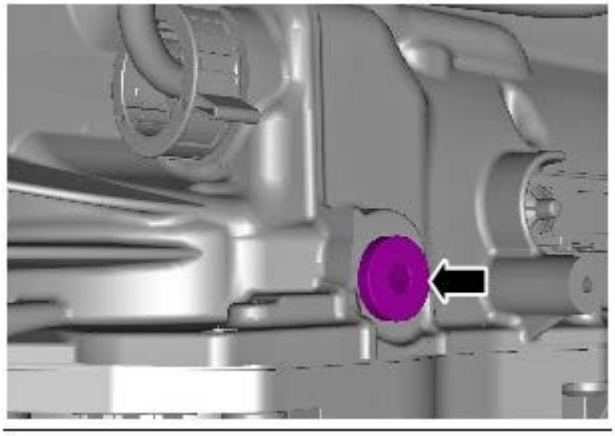
2.
   - All clutches and brakes must be filled, output speed must be 0 rpm, therefore:
   - Apply and hold the footbrake.
   - Engage Pos. R and wait 5 seconds.
   - Engage Pos. D and wait 5 seconds.
   - Tip Up to second gear and wait 5 seconds.
   - Engage Pos. N.

3. To ensure that the torque converter is filled with oil, rev up the engine in Pos. N to 2000 RPM for a minimum of 30 seconds, then engage Pos. P and ensure that the engine is idling between 600 RPM and 750 RPM.



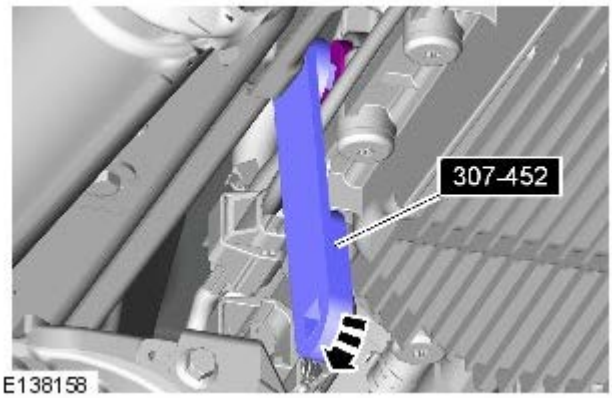
4. NOTE: If the temperature has exceeded 50°C (ideally 40°) before the plug was re-fitted you must start again with the procedure.

   With oil sump temperature between 30°C and 50°C (target 40°C) open lateral filling plug again. If the temperature is still below 40°C, allow oil to drain until 40°C are reached. If the temperature is between 40°C and 50°C, allow oil to drain, until the stream becomes a slow dribbling, then re-fit the plug.

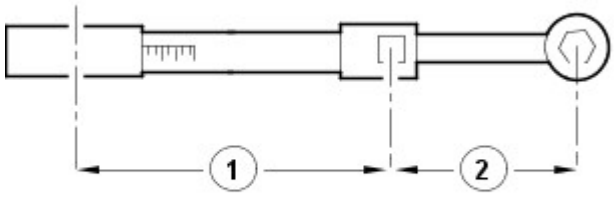


5. NOTE: Install a new fluid level filler plug.

   Special Tool(s): 307-452



6. 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.

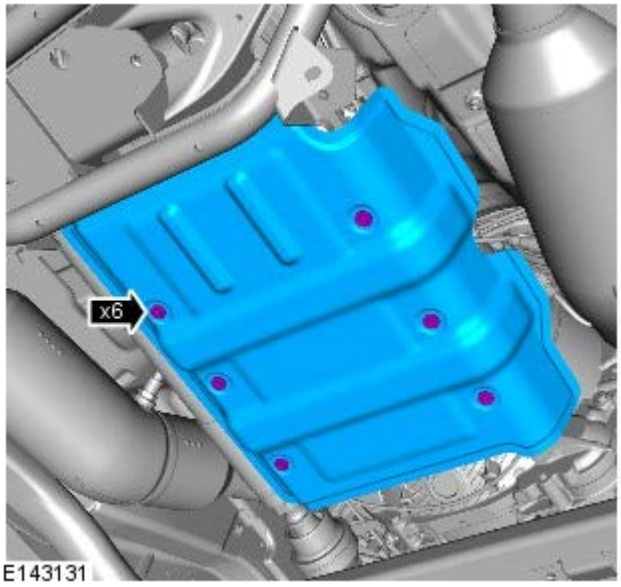


- To make sure the transmission fill plug is torqued to the correct specification. Using the special tool and torque wrench the following calculation steps must be followed.
- Step 1. Multiply 35 Nm by the effective length of the torque wrench (1).
- Step 2. Add the effective length of the special tool (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.

7. Remove the special tool.

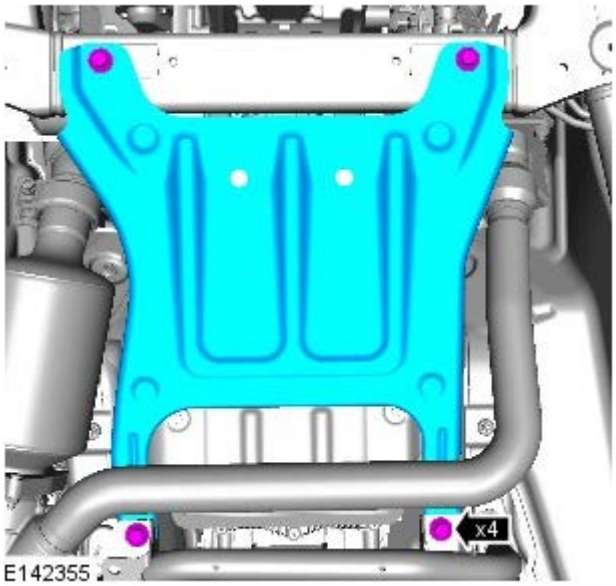
8. Remove the container.

9. *Torque:* 10 Nm



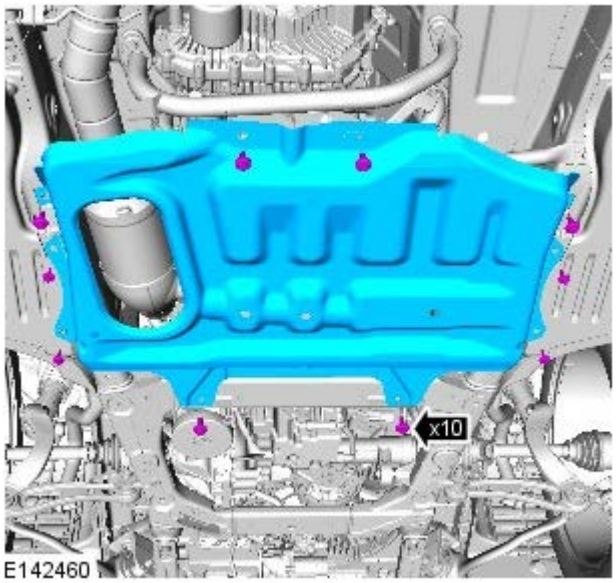
Vehicles with 4.4L diesel engine

10. *Torque:* 60 Nm



Vehicles with 3.0L diesel engine

11. *Torque:*
    M10 60 Nm
    M6 10 Nm



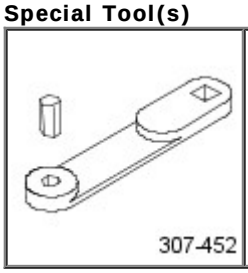
12. Lower the vehicle.
13. Disconnect the diagnostic tool.

Published: 31-Jul-2012

Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - Transmission Fluid Drain and Refill V8 5.0L Petrol/V8 S/C 5.0L Petrol

General Procedures

Special Tool(s)

	307-452 Wrench, Transmission Filler Plug

WARNINGS:

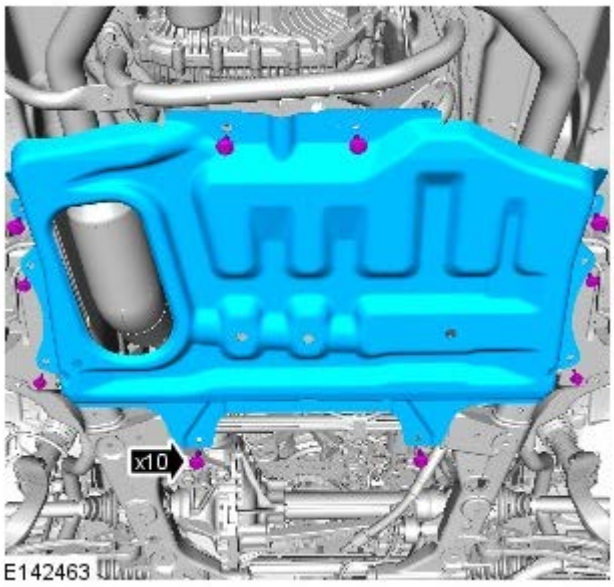
Observe due care when draining, as the fluid can be very hot.

Observe due care when working near a hot exhaust system.

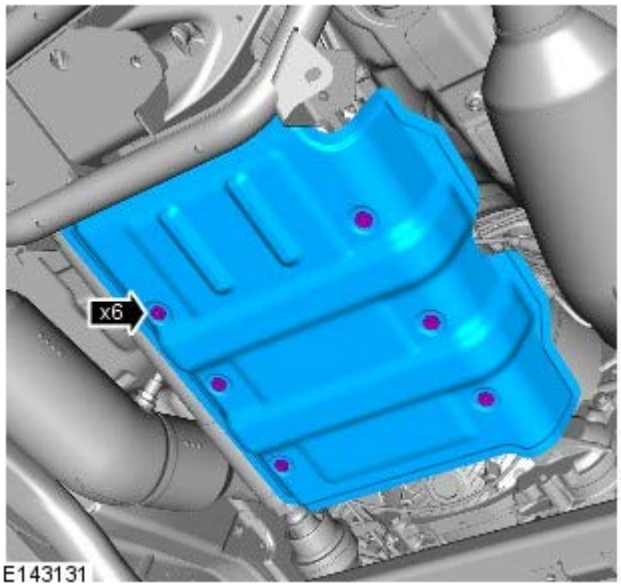
1. WARNING: Make sure to support the vehicle with axle stands.

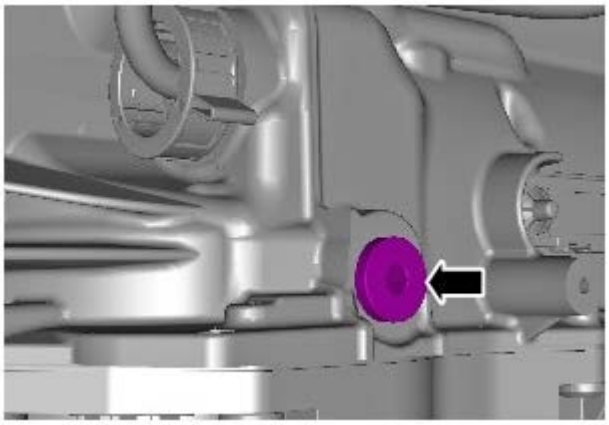
   Raise and support the vehicle.

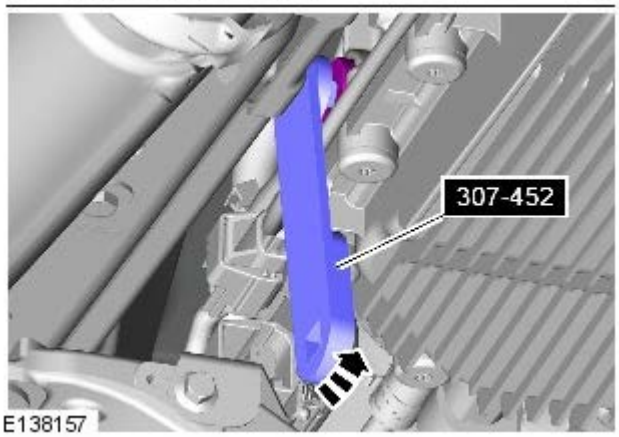
2.



3.





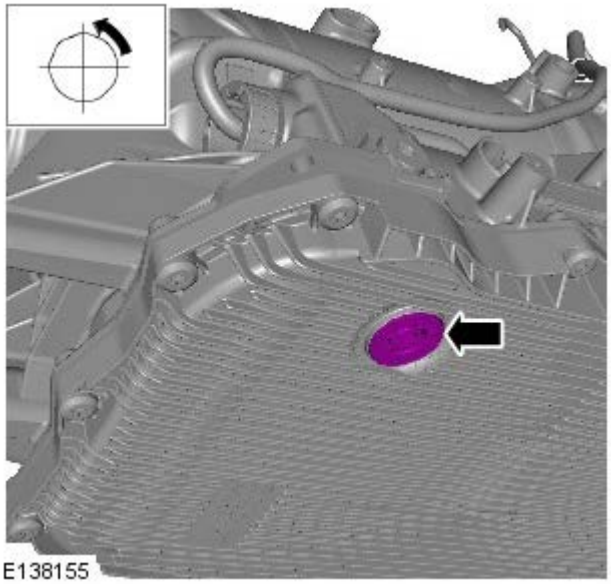


4. NOTE: Drain the fluid into a suitable container.

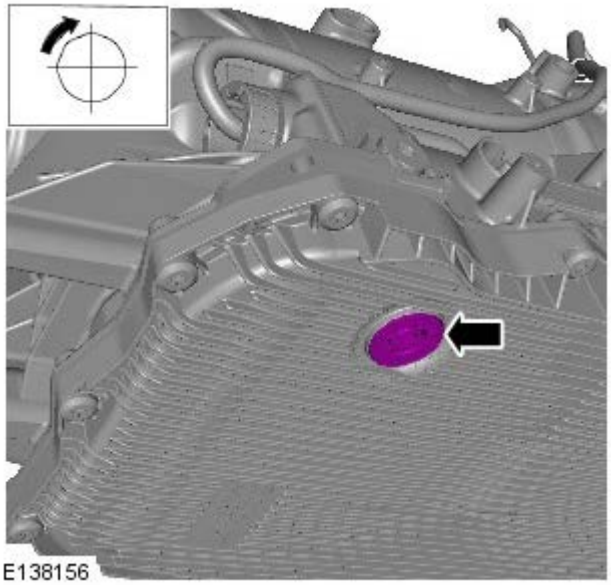
   Clean the area around the transmission fluid level plug.

   Special Tool(s): 307-452

5.
   - Allow the fluid to drain.
   - Discard the component.



6. *Torque:* 8 Nm



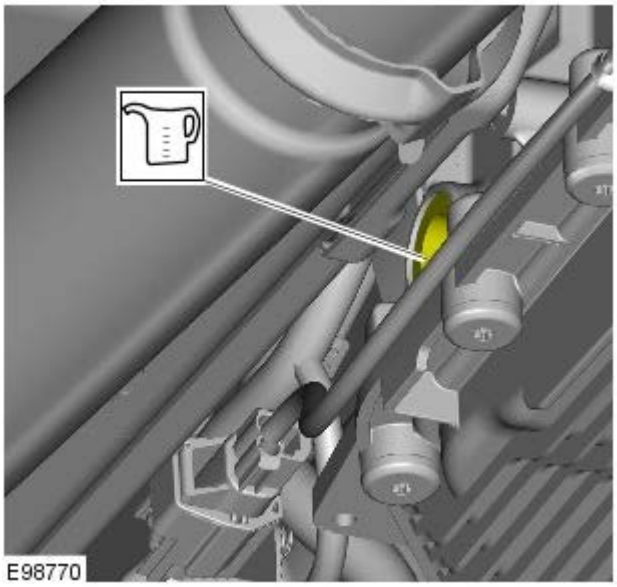
7. Carry out a transmission fluid level check.

   Refer to: Transmission Fluid Level Check - V8 5.0L Petrol/V8 S/C 5.0L Petrol (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, General Procedures).

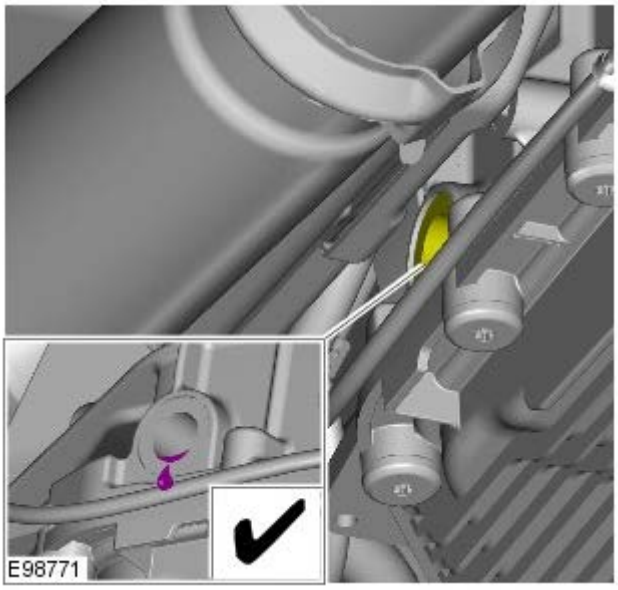
8. CAUTION: Make sure the correct specification and quanity of oil is used.

   NOTE: Use transmission fluid meeting Land Rover specification.

   - Refill the transmission with fluid.

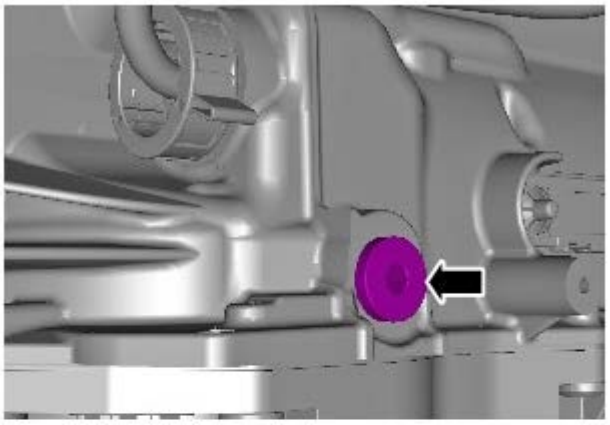


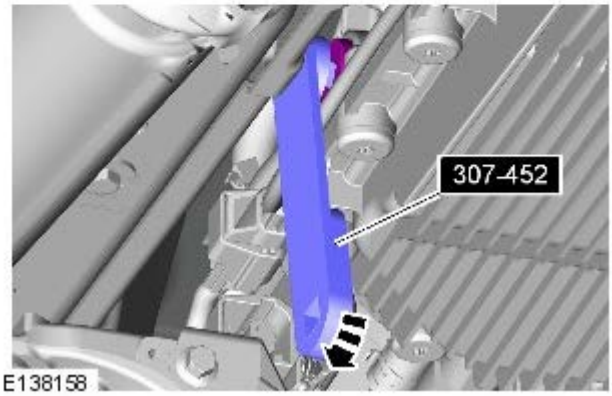
9. Allow the transmission fluid to drain from the transmission fluid filler plug hole until the flow almost stops.



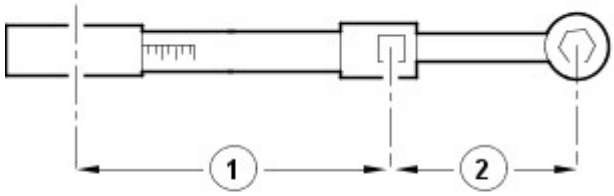
10. NOTE: Install a new fluid level filler plug.

Special Tool(s): 307-452





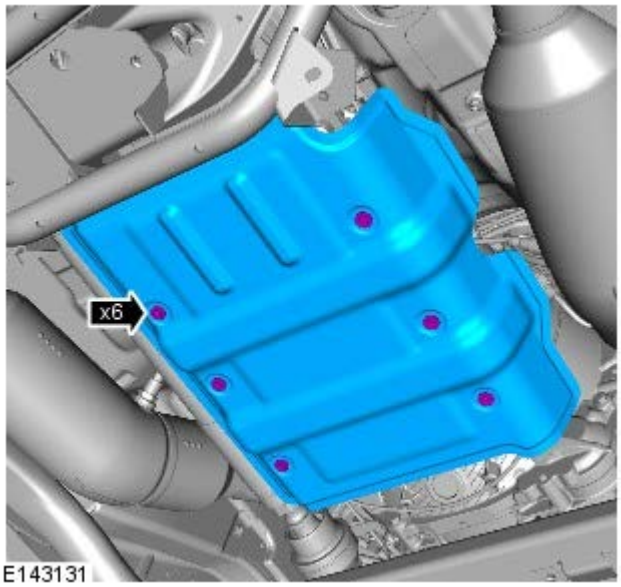
E138158



E37107

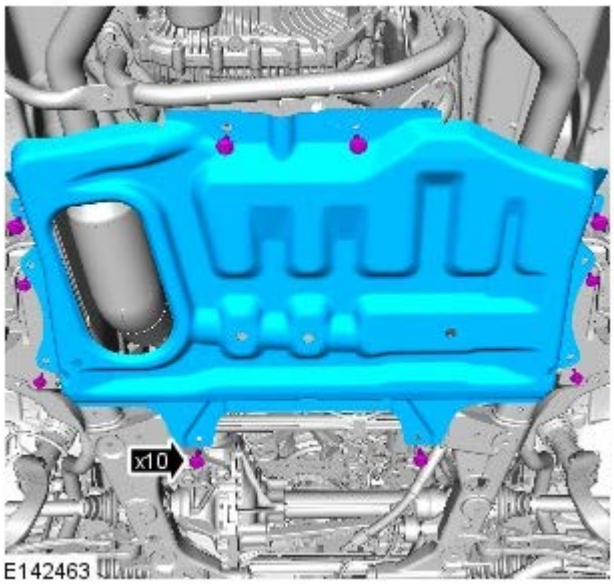
11. CAUTION: Make sure the transmission fluid fill plug is tightened to the correct specification. Failure to follow this instruction may result in damage to the vehicle.
    - Carry out a transmission fluid level check.
    - To make sure the transmission fill plug is torqued to the correct specification. 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.

12. *Torque:* 10 Nm



E143131

13. *Torque:*
    M10 60 Nm
    M6 10 Nm



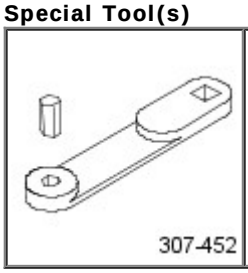
14. Lower the vehicle.

Published: 31-Jul-2012

Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - Transmission Fluid Drain and Refill TDV6 3.0L Diesel /TDV8 4.4L Diesel

General Procedures

Special Tool(s)

	307-452 Wrench, Transmission Filler Plug

Draining

WARNINGS:

Observe due care when draining, as the fluid can be very hot.

Observe due care when working near a hot exhaust system.

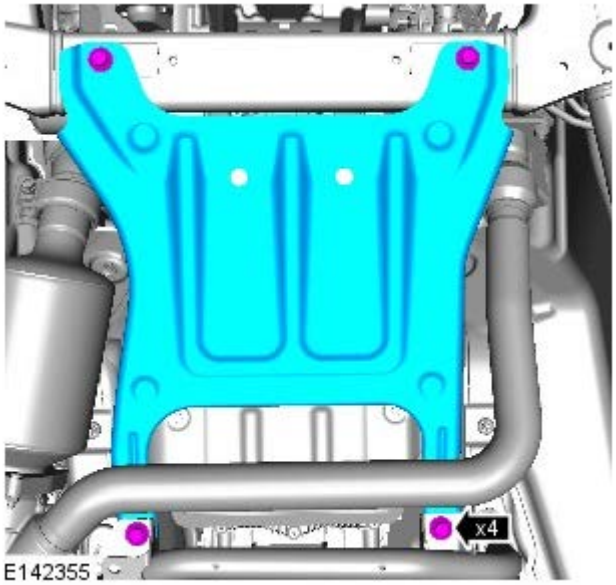
All vehicles

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

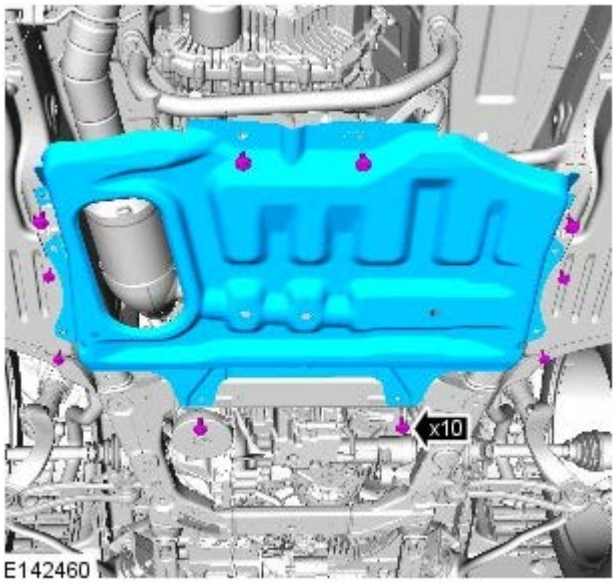
Vehicles with 4.4L diesel engine

2.



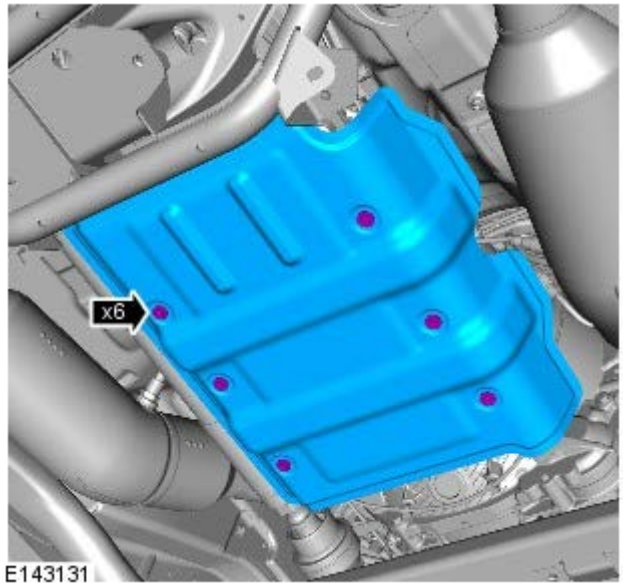
Vehicles with 3.0L diesel engine

3.



All vehicles

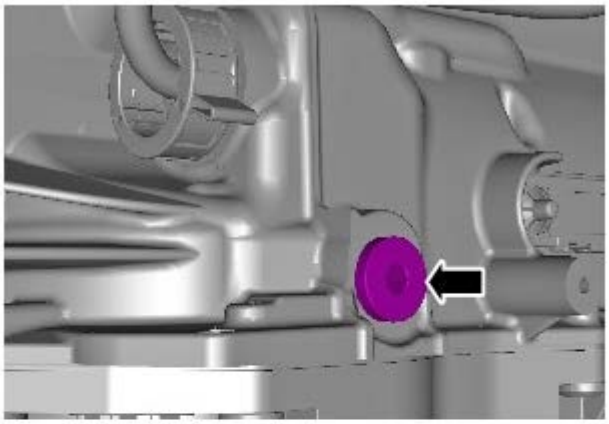
4.

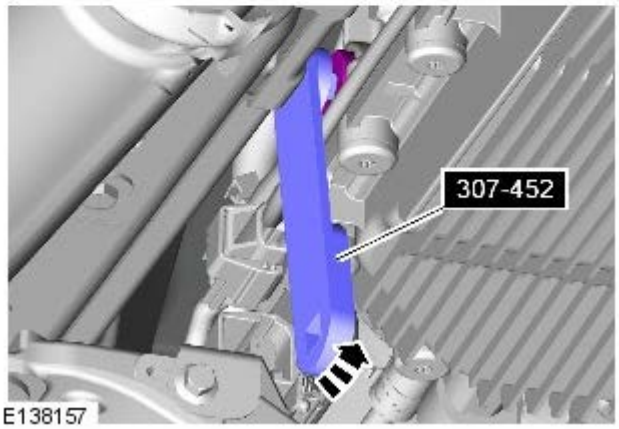


5. NOTE: Drain the fluid into a suitable container.

Clean the area around the transmission fluid level plug.

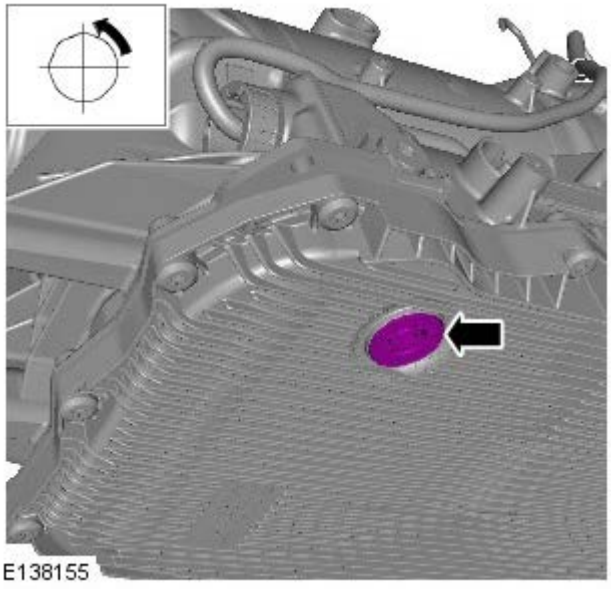
Special Tool(s): 307-452





6.

- Allow the fluid to drain.
- Discard the component.



Filling

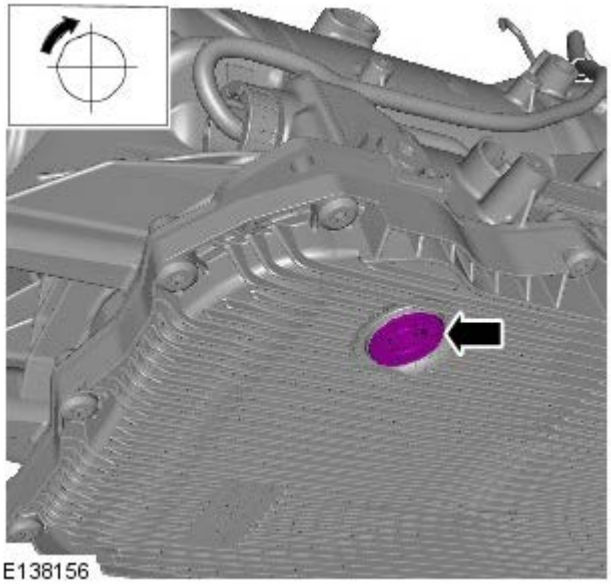
WARNINGS:

Observe due care when draining, as the fluid can be very hot.

Observe due care when working near a hot exhaust system.

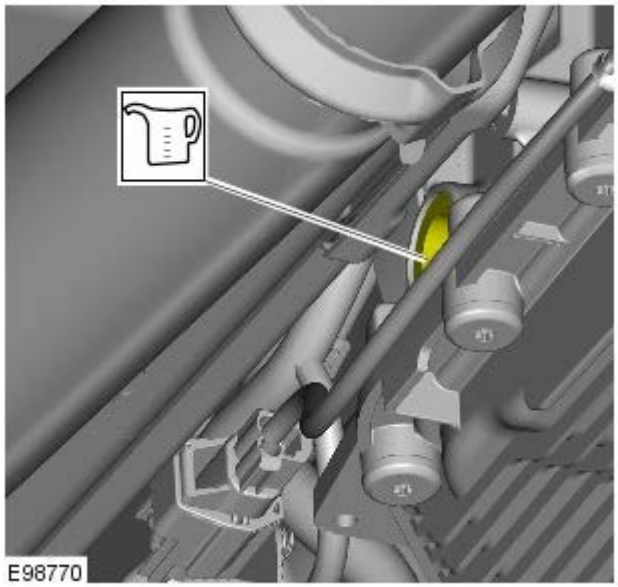
All vehicles

1. *Torque:* 8 Nm



2. Carry out a transmission fluid level check.

   Refer to: Transmission Fluid Level Check - TDV6 3.0L Diesel /TDV8 4.4L Diesel (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, General Procedures).

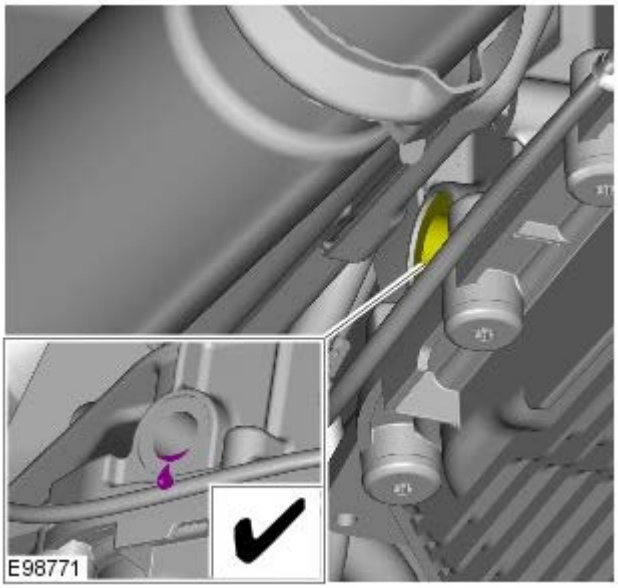


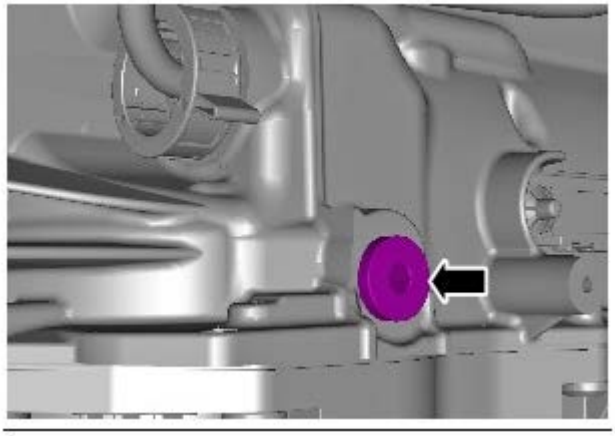
3. CAUTION: Make sure the correct specification and quanity of oil is used.

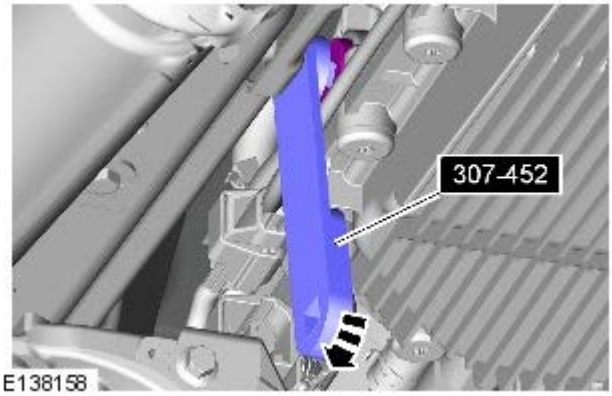
   NOTE: Use transmission fluid meeting Land Rover specification.

   - Refill the transmission with fluid.

4. Allow the transmission fluid to drain from the transmission fluid filler plug hole until the flow almost stops.

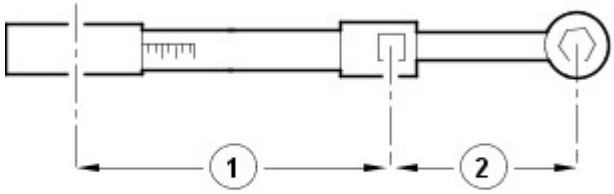






5. NOTE: Install a new fluid level filler plug.

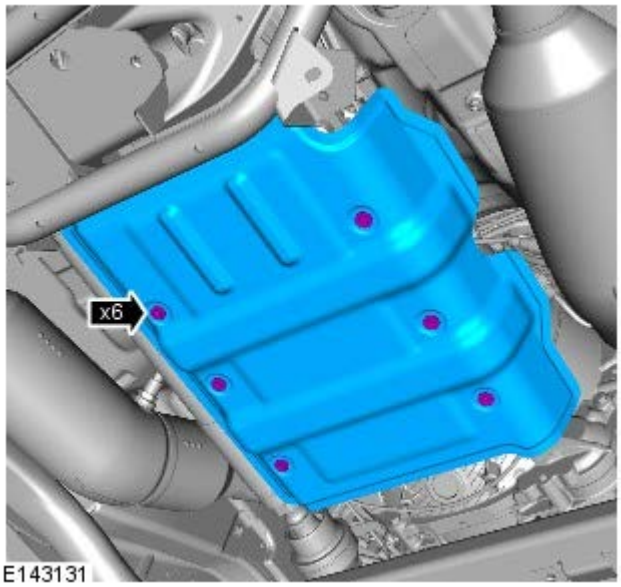
Special Tool(s): 307-452



6. 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.

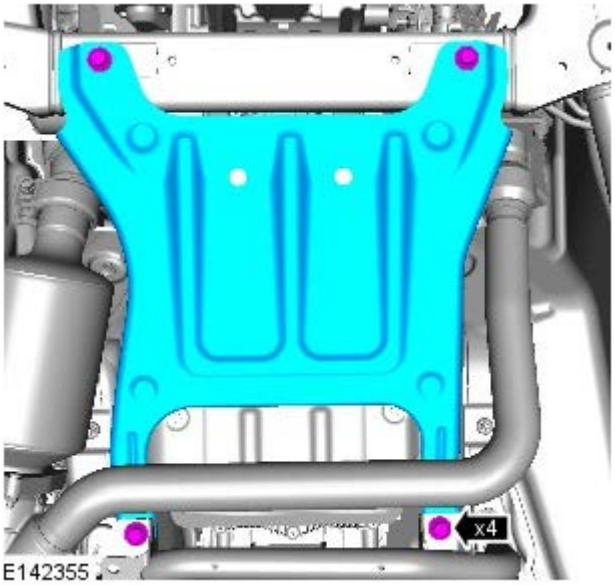
- Carry out a transmission fluid level check.
- To make sure the transmission fill plug is torqued to the correct specification. Using the special tool and torque wrench the following calculation steps must be followed.
- Step 1. Multiply 35 Nm by the effective length of the torque wrench (1).
- Step 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.

7. *Torque:* 10 Nm



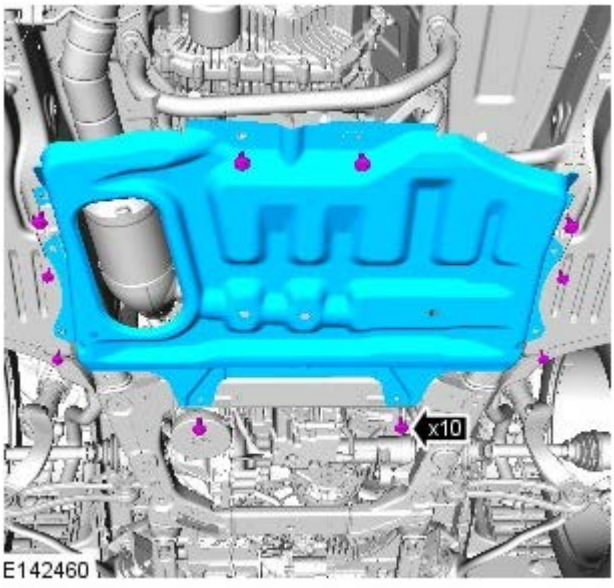
Vehicles with 4.4L diesel engine

8. *Torque:* 60 Nm



Vehicles with 3.0L diesel engine

9. *Torque:*
   M10 60 Nm
   M6 10 Nm



All vehicles

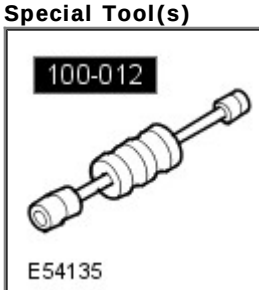
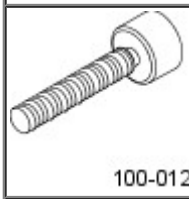
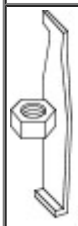
10. Lower the vehicle.

Published: 13-Sep-2012

Automatic Transmission/Transaxle - 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.

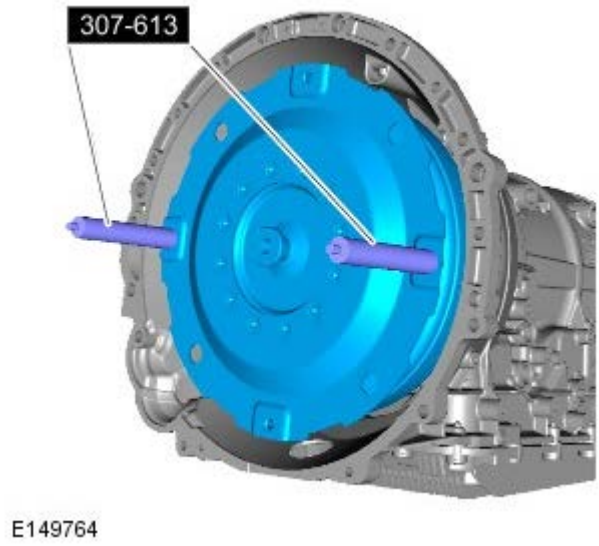
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

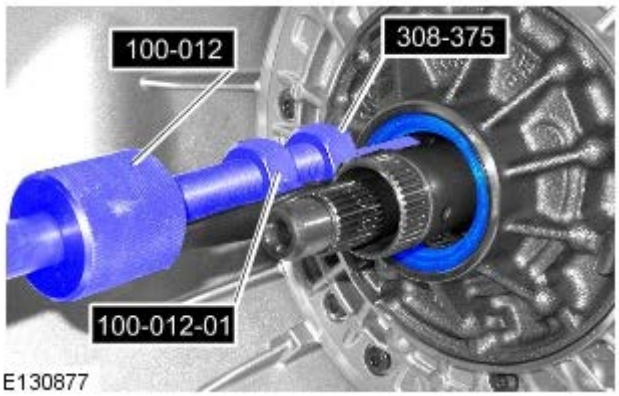
3. Refer to: Transmission - TDV8 4.4L Diesel (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, Removal).



E149764

4. CAUTION: Be prepared to collect escaping fluids.

   Special Tool(s): 307-613



E130877

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

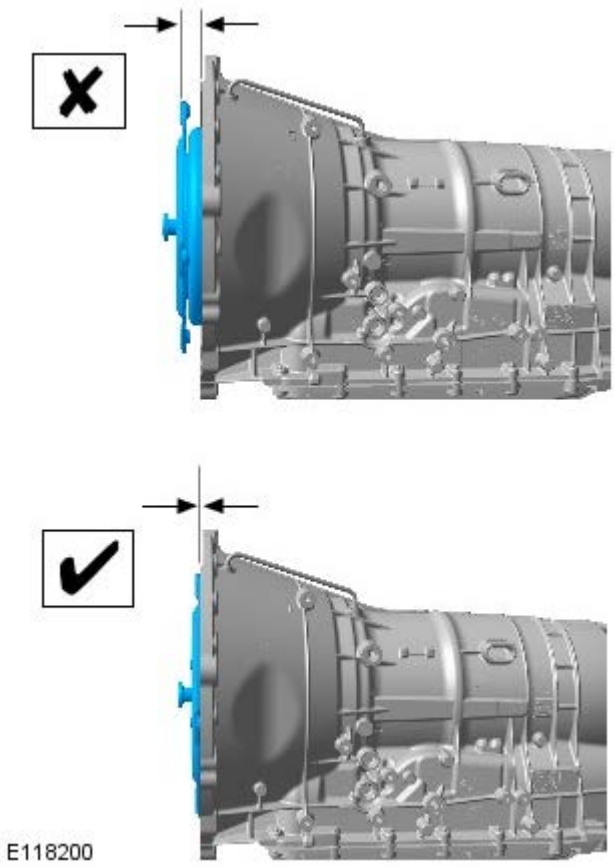


E130980

1. CAUTION: Install a new seal.

   Special Tool(s): JLR-308-845

2. CAUTION: Make sure the torque converter is fully located into the oil pump drive.



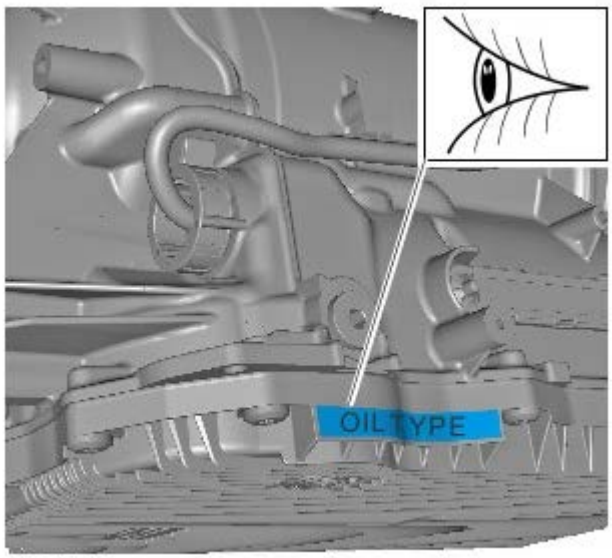
E118200

3. Install the transmission and transfer gearbox.

   Refer to: Transmission - TDV8 4.4L Diesel (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, Removal).

4. Connect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).



E138154

5. CAUTIONS:

   Make sure the correct specification and quanity 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.

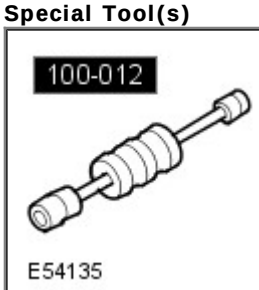
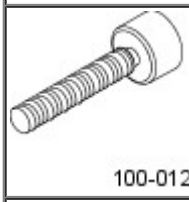
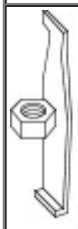
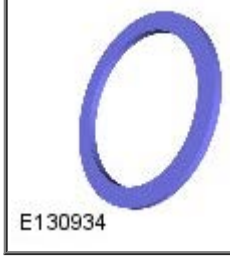
   - Carry out a transmission fluid level check.
   - To make sure the transmission fill plug is torqued to the correct specification. Using the special tool and torque wrench the following calculation steps must be followed.
   - Step 1. Multiply 35 Nm by the effective length of the torque wrench (1).
   - 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.

Published: 04-Oct-2013

Automatic Transmission/Transaxle - 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

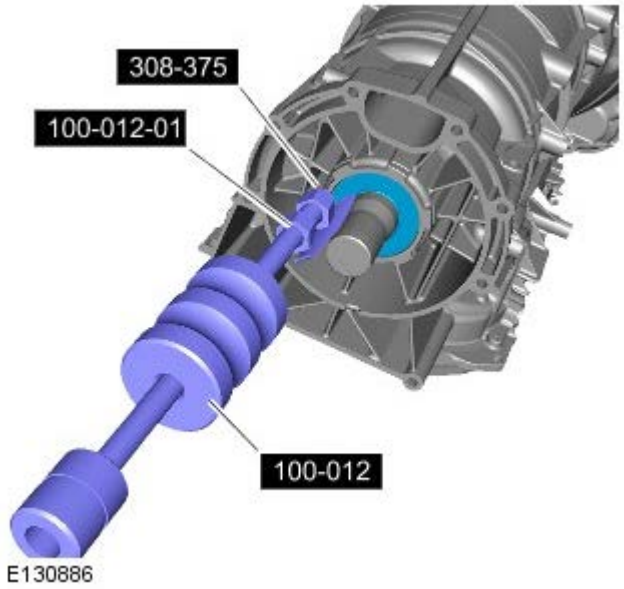
Removal

NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. Refer to: Transfer Case - TDV6 3.0L Diesel (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, Removal).
   Refer to: Transfer Case - TDV8 4.4L Diesel (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, Removal).
   Refer to: Transfer Case - V8 5.0L Petrol/V8 S/C 5.0L Petrol (308-07 Transfer Case, Removal).

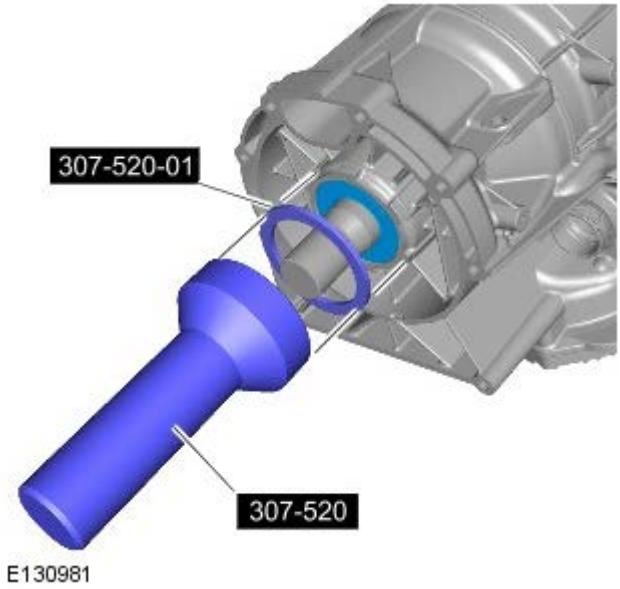
2. CAUTION: Care must be taken to avoid damage to the seal register and running surface.

   Special Tool(s): 100-012, 100-012-01, 308-375



E130886

Installation



E130981

1. CAUTIONS:

   Oil seals must be installed 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 (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, Installation).
   Refer to: Transfer Case - TDV8 4.4L Diesel (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, Installation).
   Refer to: Transfer Case - V8 5.0L Petrol/V8 S/C 5.0L Petrol (308-07 Transfer Case, Installation).

3. Carry out a transmission fluid level check.

   Refer to: Transmission Fluid Level Check - V8 5.0L Petrol/V8 S/C 5.0L Petrol (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, General Procedures).
   Refer to: Transmission Fluid Level Check - TDV6 3.0L Diesel /TDV8 4.4L Diesel (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, General Procedures).

Published: 07-Sep-2012

Automatic Transmission / Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - Selector Shaft Seal

Removal and Installation

Special Tool(s)

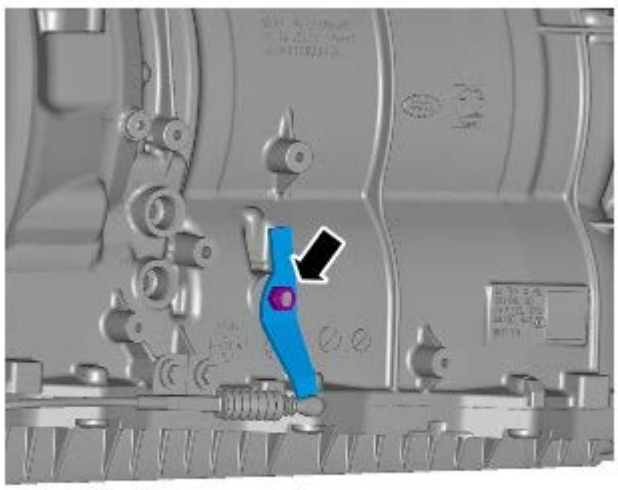
307-509-1  E50766	Seal extractor 307-509-1(LRT-44-033/1)
307-509-2  E50767	Seal extractor 307-509-2(LRT-44-033/2)
307-509-3  E50768	Seal installer 307-509-3(LRT-44-033/3)

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. TORQUE: 12 Nm



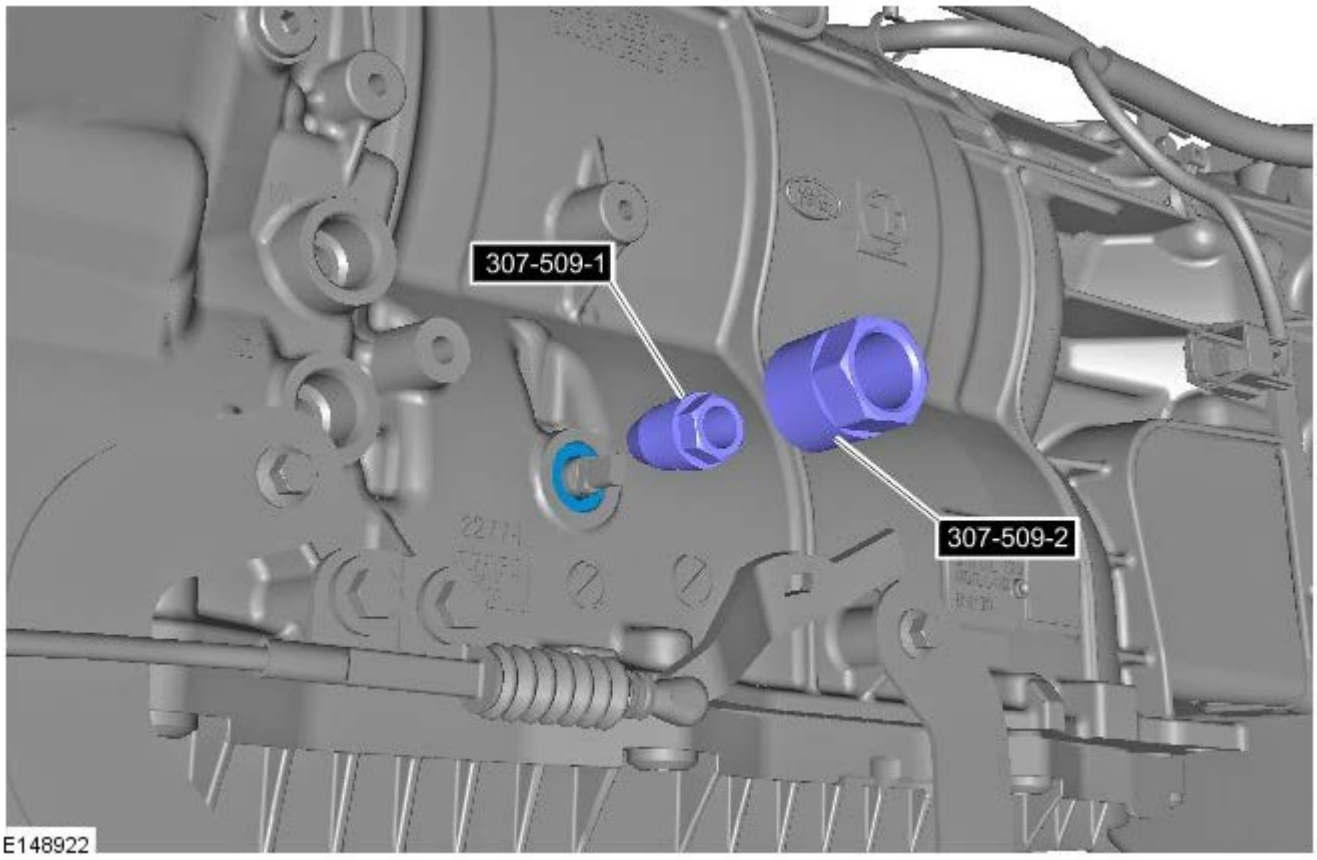
E149590

3. Release the selector cable and lever.
   - Remove the nut.

4. CAUTION: Before the disconnection or removal of any components, make sure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

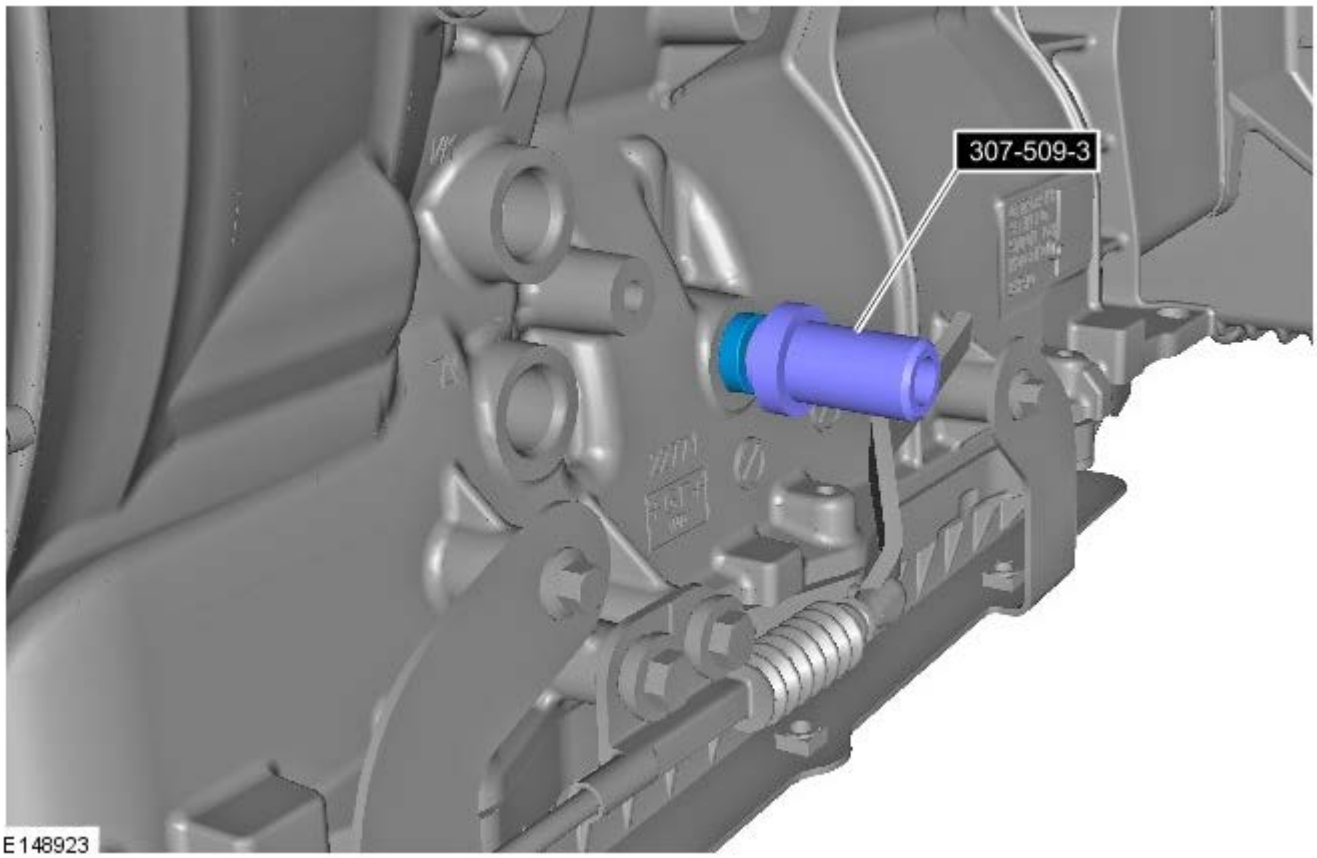
Remove the selector shaft seal.

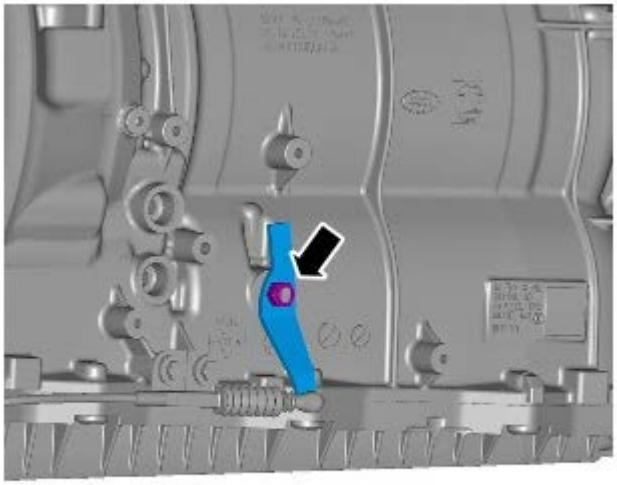
- Install 307-509-1 to the seal.
- Install 307-509-2 to 307-509-1 and extract the seal.



Installation

1. Using 307-509-3, install the selector shaft seal.
   - Clean the components.





E149590

2. Install the selector cable and lever.
    - Secure with the clip.
    - TORQUE: 12 Nm

Published: 11-Mar-2013

Automatic Transmission/Transaxle - 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 fluids.

CAUTION: Make sure all suitable safety precautions are taken to protect the TCM and main control valve body electrical connector pins against electrostatic discharge.

NOTES:

The transmission control module (TCM) is part of the main control valve body and cannot be serviced separately.

Some variation in the illustrations may occur, but the essential information is always correct.

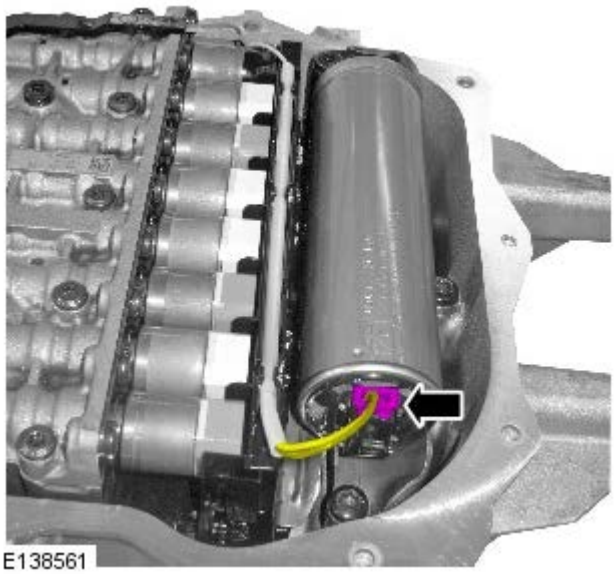
All vehicles

1. Remove the transmission fluid pan.

   Refer to: Transmission Fluid Pan, Gasket and Filter (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, Removal and Installation).

Vehicles with Stop/Start

2. CAUTION: Take precautions to avoid any electrostatic charging, which could damage this component.


E138561

3.



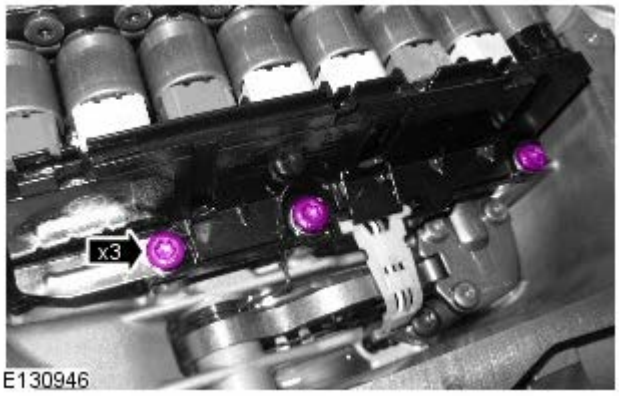
E138562

4. CAUTION: Remove and discard the O-ring seals.



E138563

All vehicles



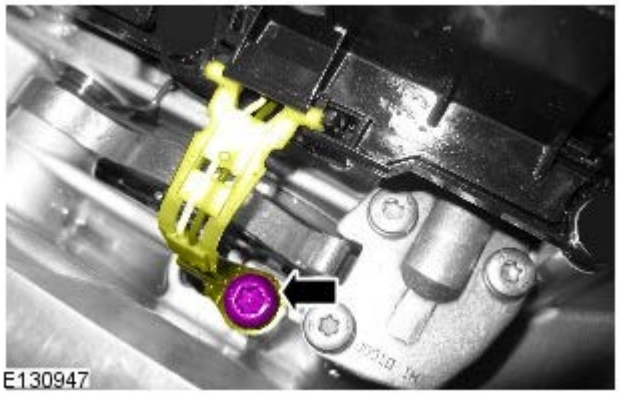
E130946

5. CAUTIONS:

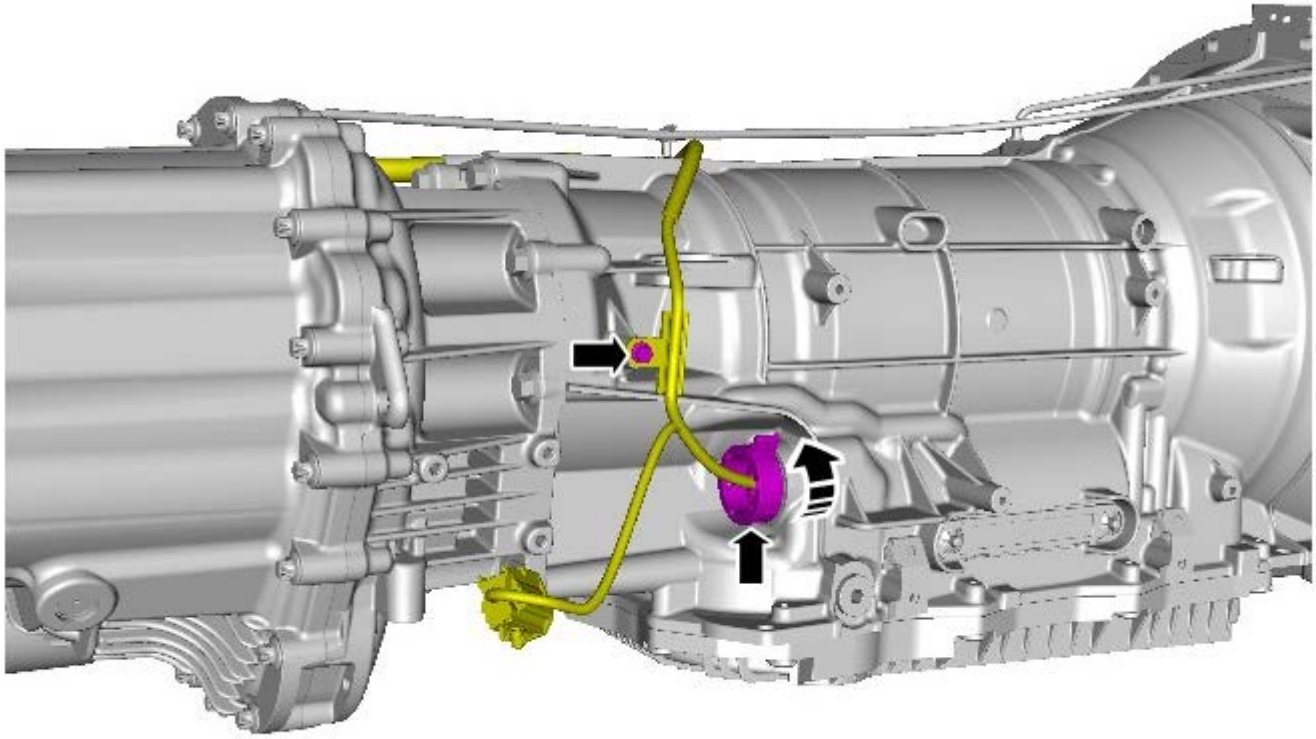
   Discard the bolts.

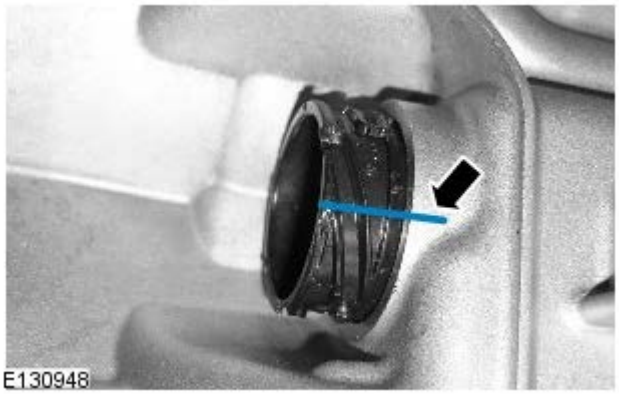
   Take precautions to avoid any electrostatic charging, which could damage this component.

6. CAUTION: Discard the bolt.



7.



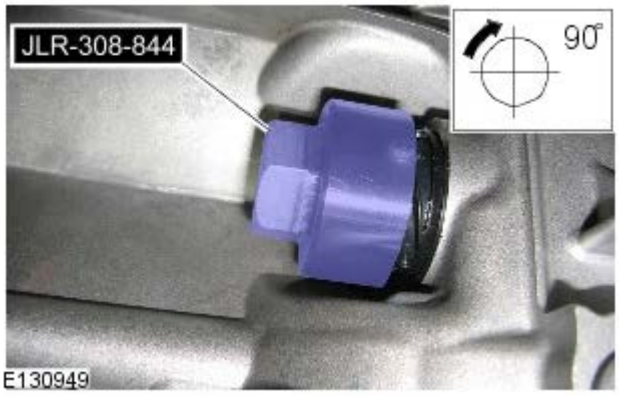


8. NOTE: Note the orientation of the component prior to removal.

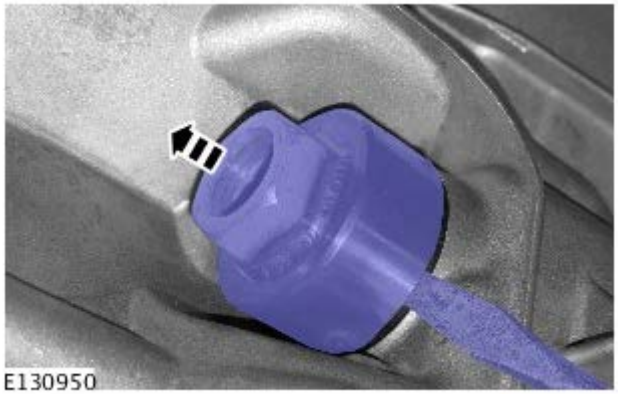
9.

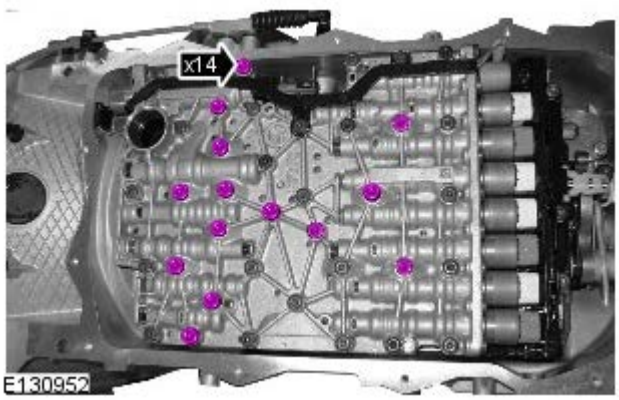


10. *Special Tool(s):* JLR-308-844



11.

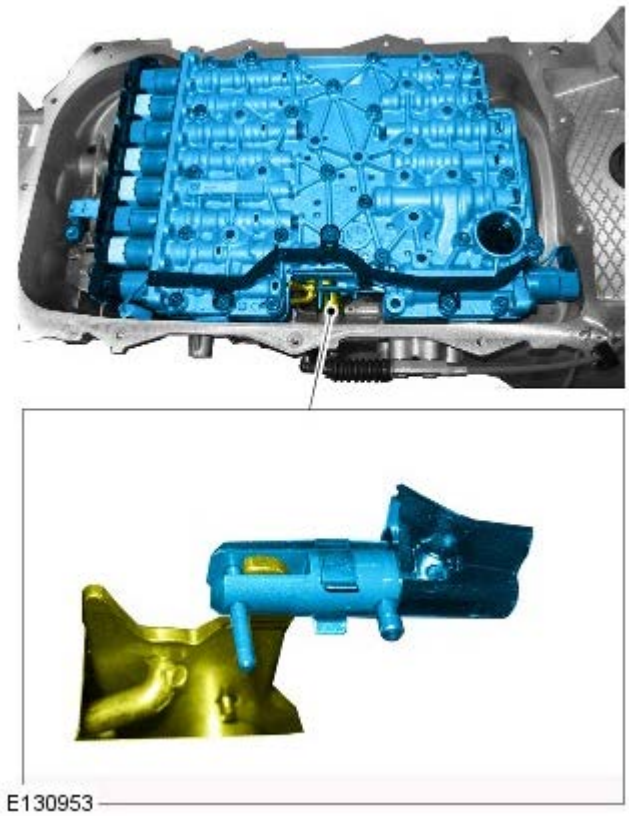




12. CAUTION: Discard the bolts.

Torque: 8 Nm

13. NOTE: Note the position of the manual park brake release.



E130953

Installation

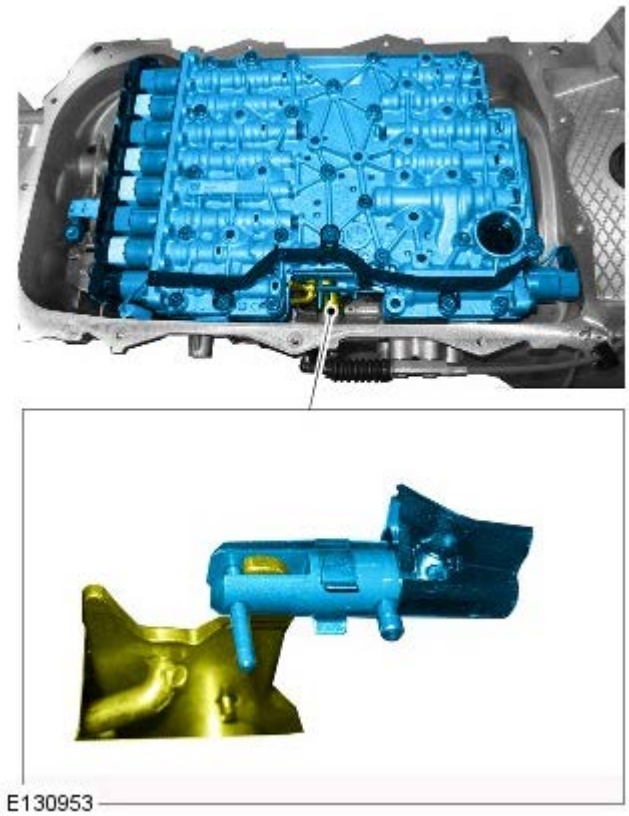
All vehicles

1.



E150701

2. NOTE: Make sure that the component is installed to the noted removal position.



E130953

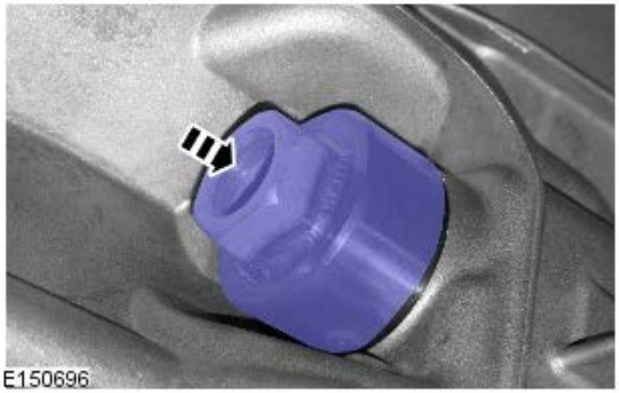
3.

- *Special Tool(s):* JLR-308-844



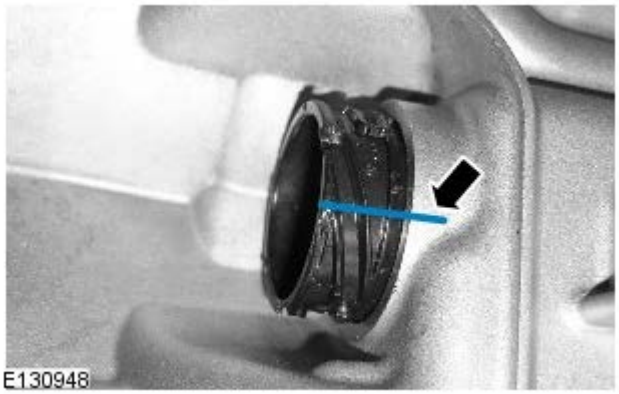
E150812

4.



E150696

5. CAUTION: Make sure that the electrical connector is installed in the correct orientation as noted in the

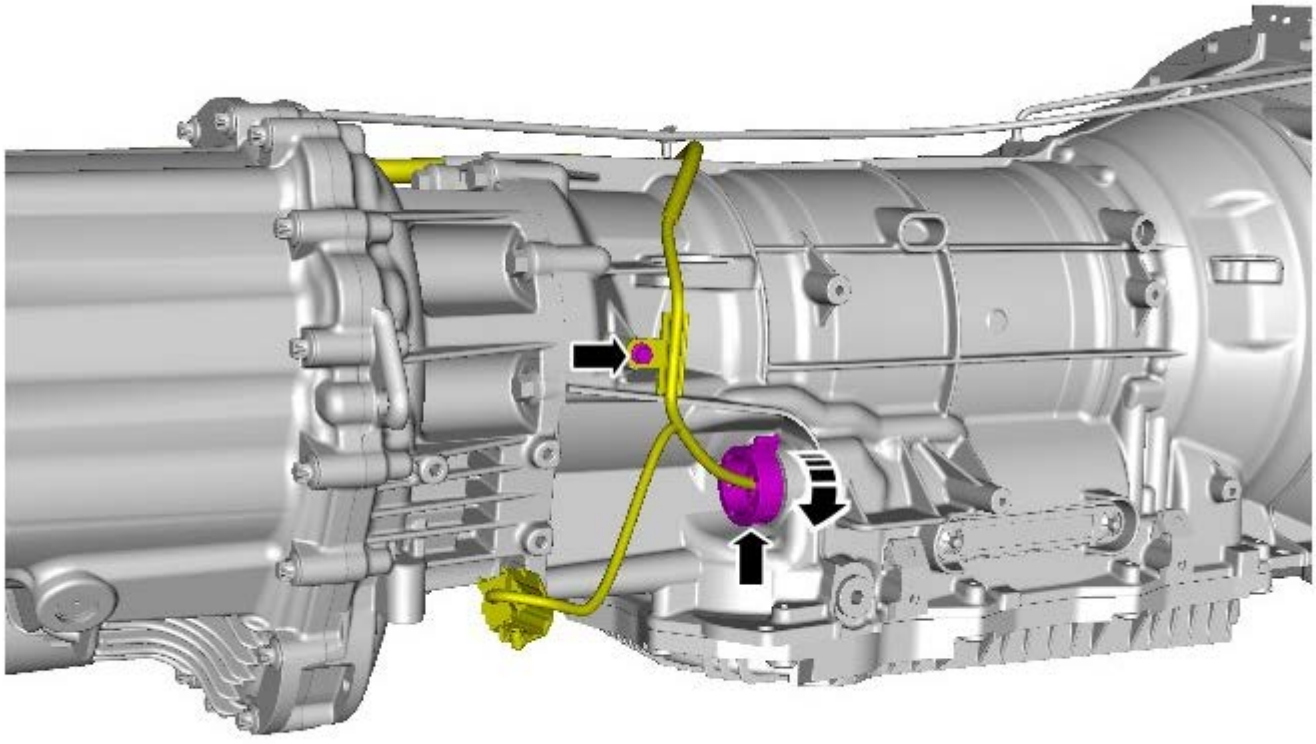

E130948

removal step.

6.


E150697

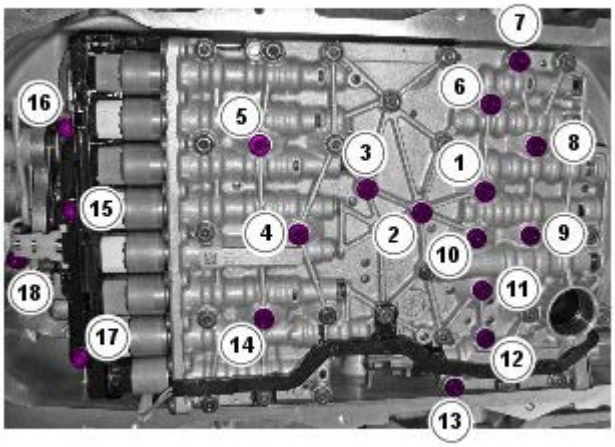
7. *Torque:* 10 Nm


E149992

8. CAUTION: Make sure that new bolts are installed.

NOTE: Tighten the retaining bolts evenly and progressively.

Torque: 8 Nm



E130933

Vehicles with Stop/Start

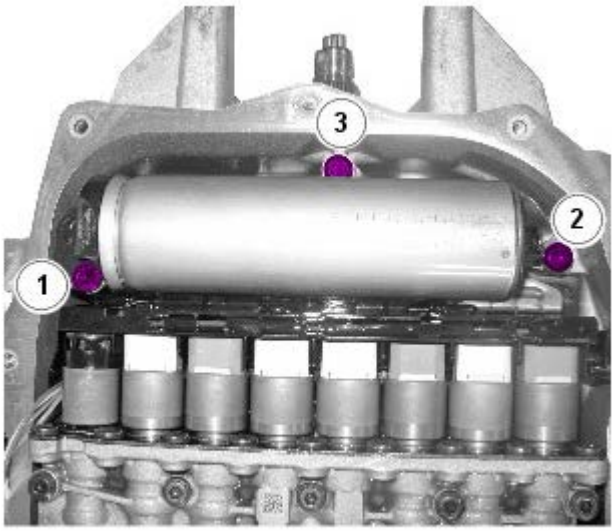
9. CAUTION: A new O-ring seal is to be installed.



E138563

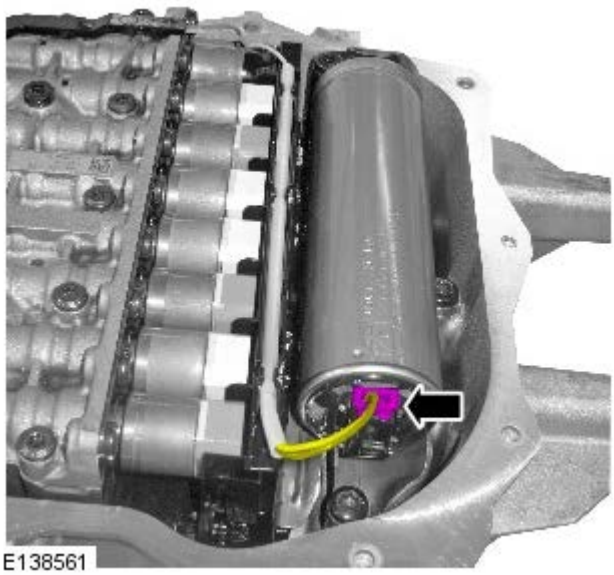
10. CAUTION: Make sure that new bolts are installed.

NOTE: Tighten the retaining bolts evenly and progressively.



E138566

11.


E138561

All vehicles

12. Refer to: Transmission Fluid Pan, Gasket and Filter (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, Removal and Installation).

13. Using the diagnostic tool, calibrate the main control valve body and the transmission control module (TCM).

Published: 10-Sep-2012

Automatic Transmission / Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - Transmission Fluid Pan, Gasket and Filter

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

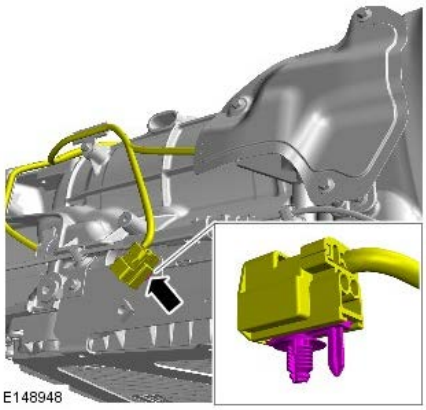
   Refer to: Specifications (414-00, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

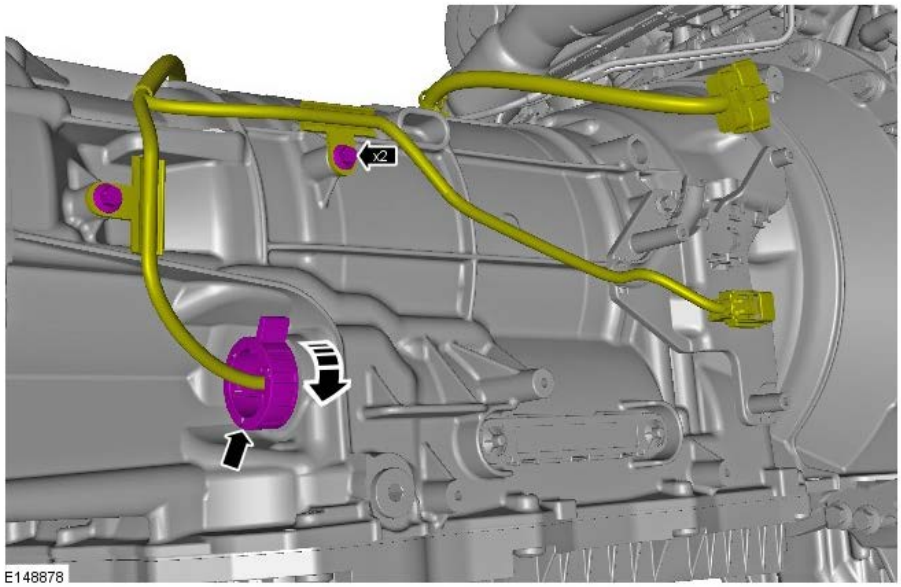
   Raise and support the vehicle.

3. Refer to: Transmission Fluid Drain and Refill - TDV6 3.0L Diesel /TDV8 4.4L Diesel (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, General Procedures).
   Refer to: Transmission Fluid Drain and Refill - V8 5.0L Petrol/V8 S/C 5.0L Petrol (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, General Procedures).

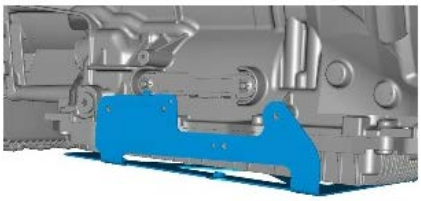
4.

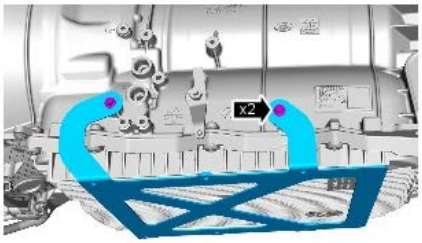


5.



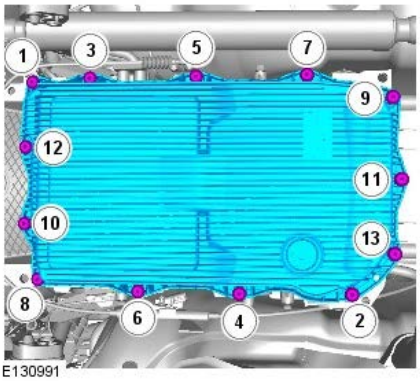
6. *Torque:* 10 Nm





E148881

7. CAUTIONS:



E130991

Take extra care when removing the component, prevent damage to the mating faces.

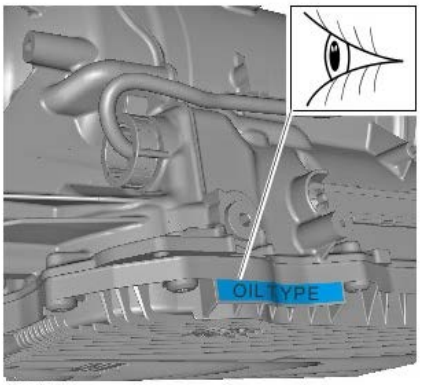
Make sure that the area around the component is clean and free of foreign material.

Be prepared to collect escaping fluids.

Discard the components.

Torque: 10 Nm

Installation



E138154

1. CAUTIONS:

Make sure that new components are installed.

Make sure that the mating faces are clean and free of foreign material.

Make sure the correct specification and quanity of oil is used.

To install, reverse the removal procedure.

Published: 16-Oct-2012

Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - Transmission Support Insulator

Removal and Installation

Removal

NOTES:

Some variation in the illustrations may occur, but the essential information is always correct.

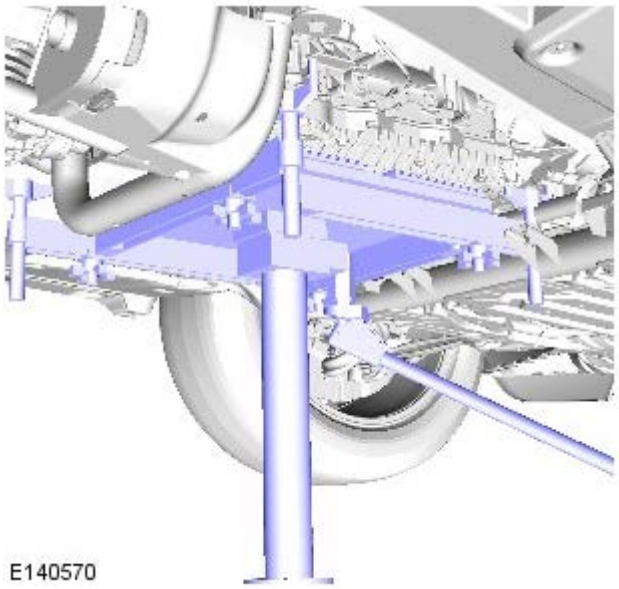
Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.
   For additional information, refer to: Specifications (414-00, Specifications).

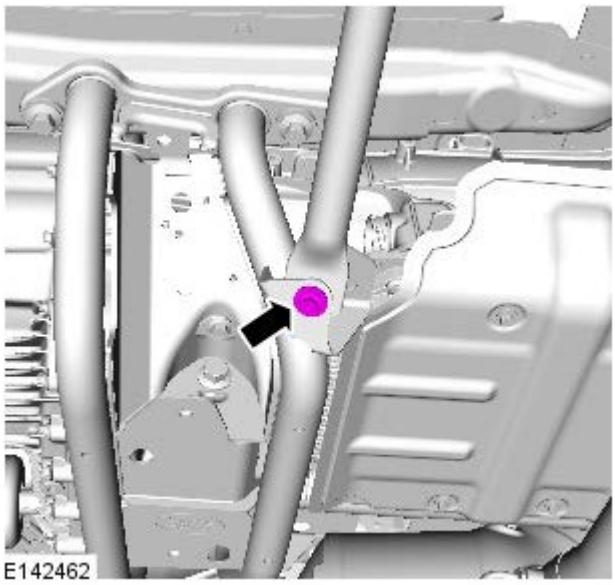
2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

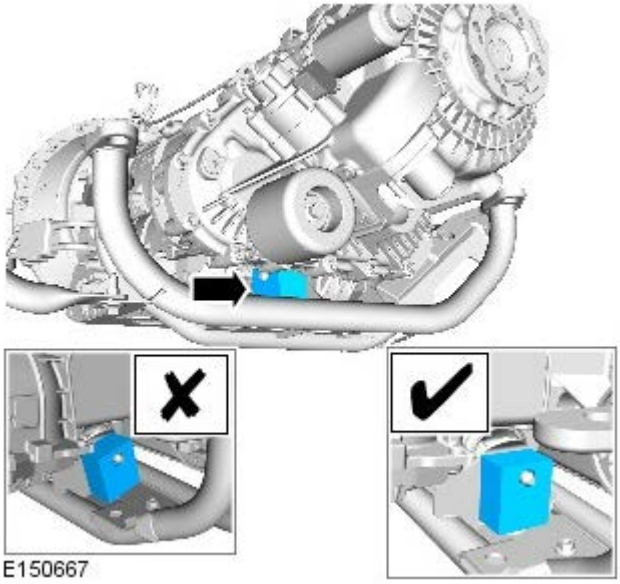
3. Using a suitable hydraulic jack, support the transmission.



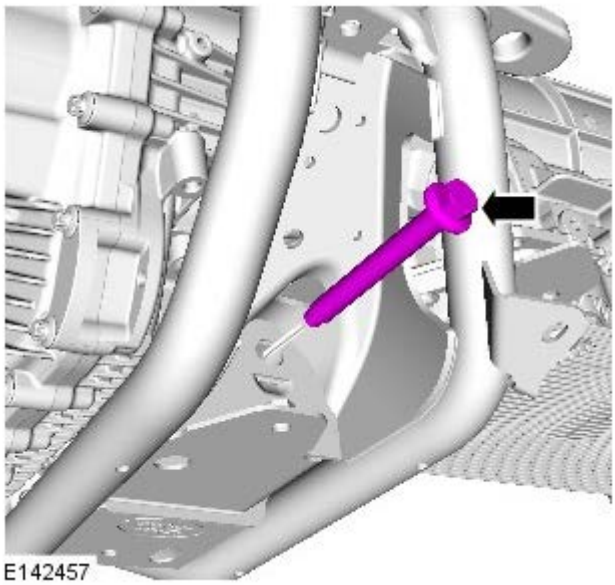
4. TORQUE: 24 Nm



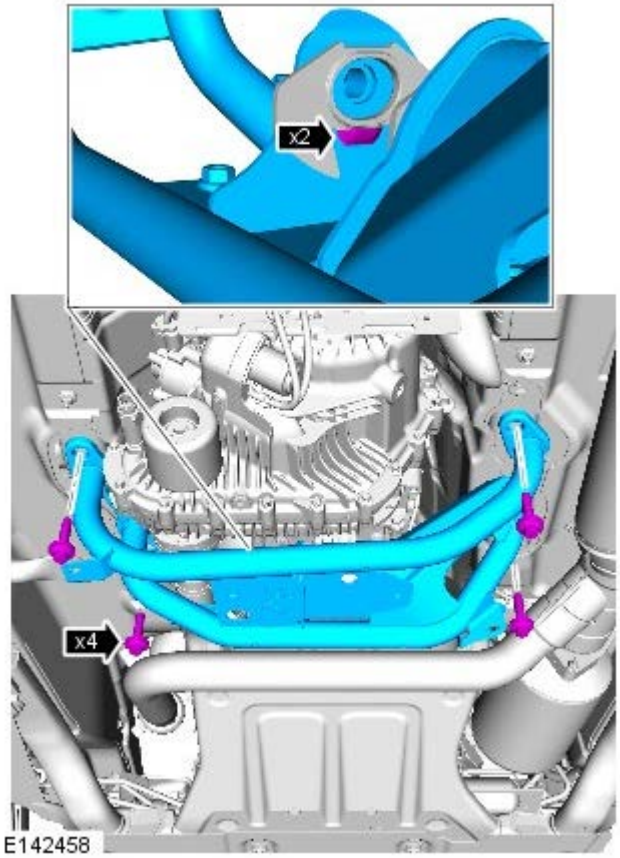
5. CAUTION: Note the fitted position of the component prior to removal.



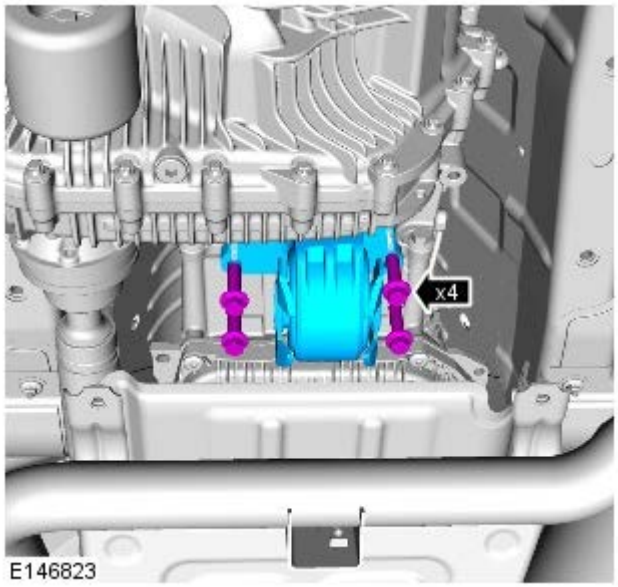
6. TORQUE: 175 Nm



7. TORQUE: 110 Nm



8. TORQUE: 60 Nm



Installation

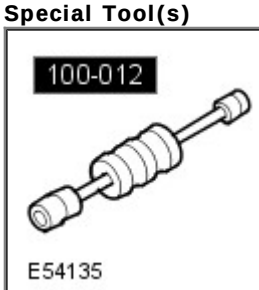
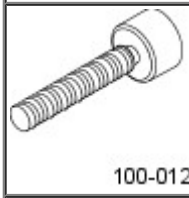
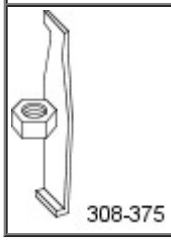
1. To install, reverse the removal procedure.

Published: 04-Jul-2013

Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - Transmission TDV6 3.0L Diesel

Removal

Special Tool(s)

	100-012 Slide Hammer
	100-012-01 Slide Hammer Adapter
	303-1069 Adapter, Wrench
	308-375 Remover, Input and Output Seal

NOTES:

Some variation in the illustrations may occur, but the essential information is always correct.

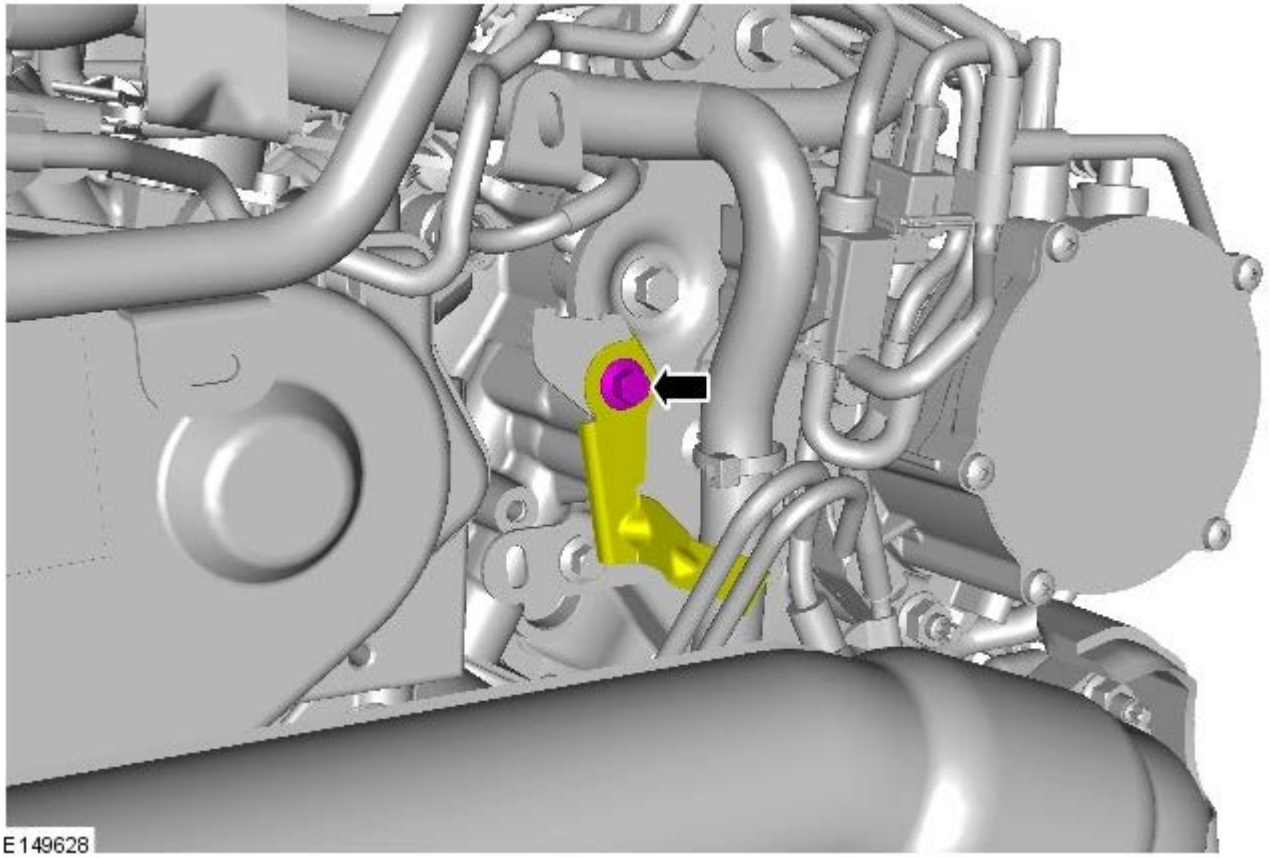
Some illustrations may show the transmission removed for clarity.

1. Disconnect the battery earth lead.

   Refer to: Specifications (414-01, Specifications).

2. Refer to: Secondary Bulkhead Center Panel - TDV6 3.0L Diesel (501-02, Removal and Installation).

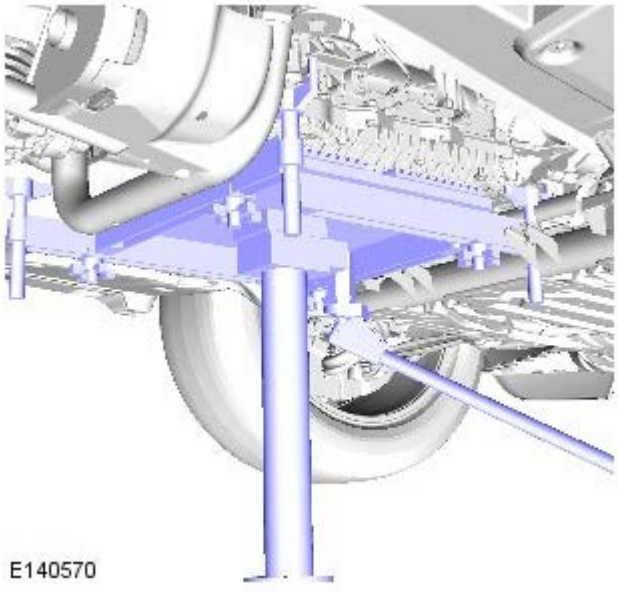
3.


E149628

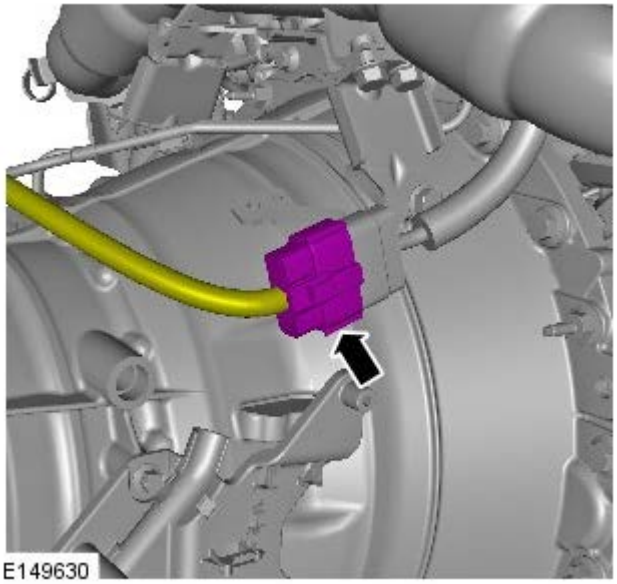
4. Refer to: Front Driveshaft - TDV6 3.0L Diesel (205-01 Driveshaft, Removal and Installation).

5. Refer to: Rear Driveshaft - TDV6 3.0L Diesel (205-01 Driveshaft, Removal and Installation).

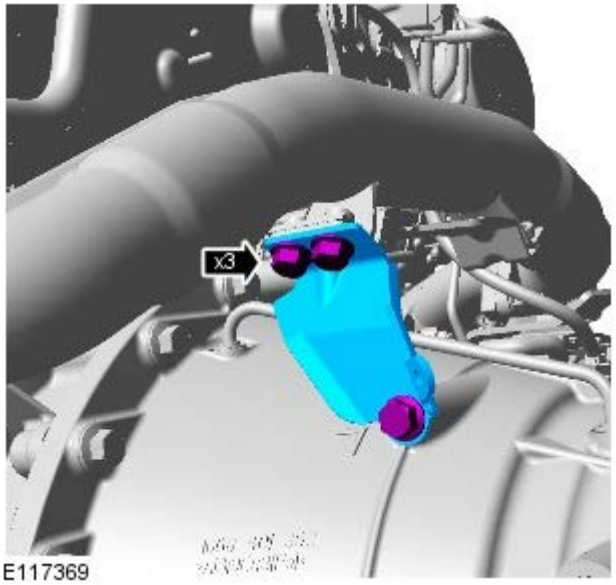
6. Using a transmission jack, support the transmission.


E140570

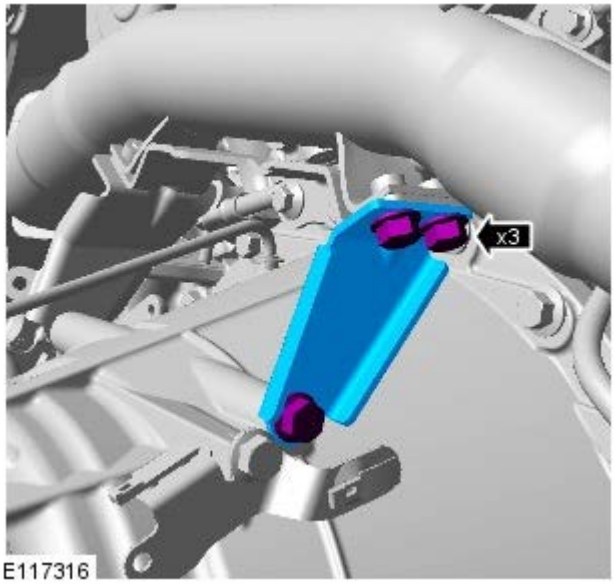
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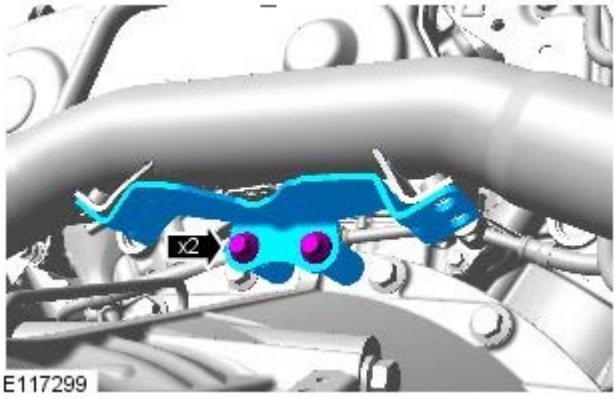
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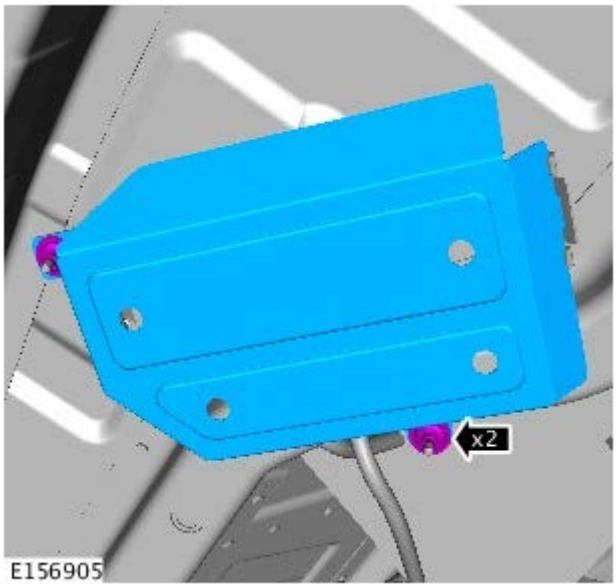
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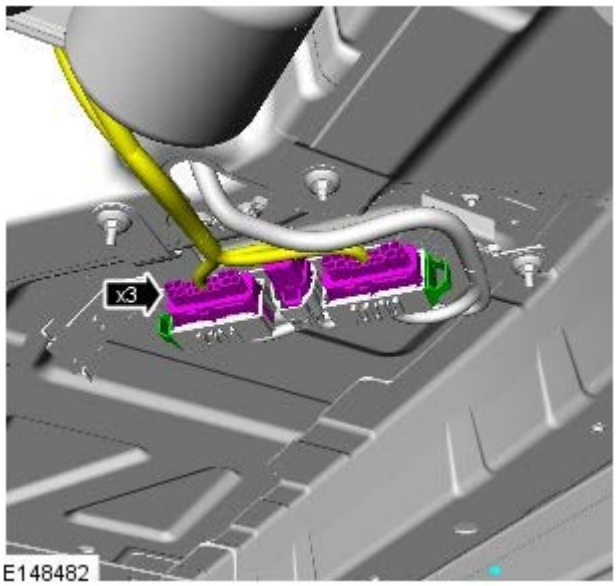
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11.

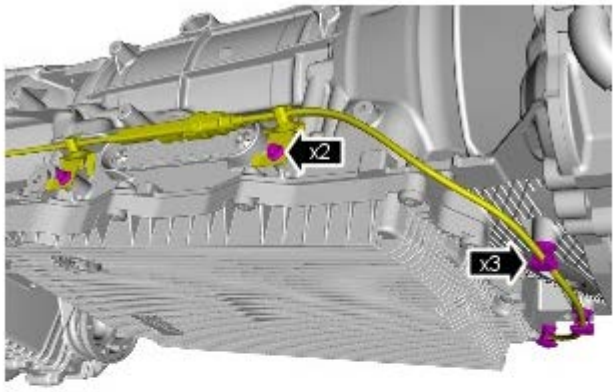


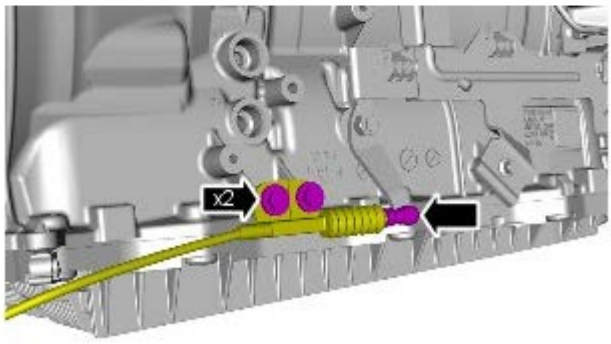
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13.

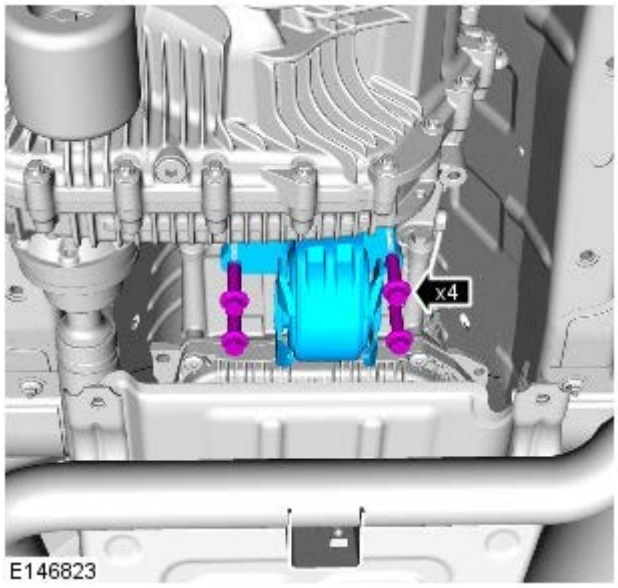
- Secure the cable to the floor.





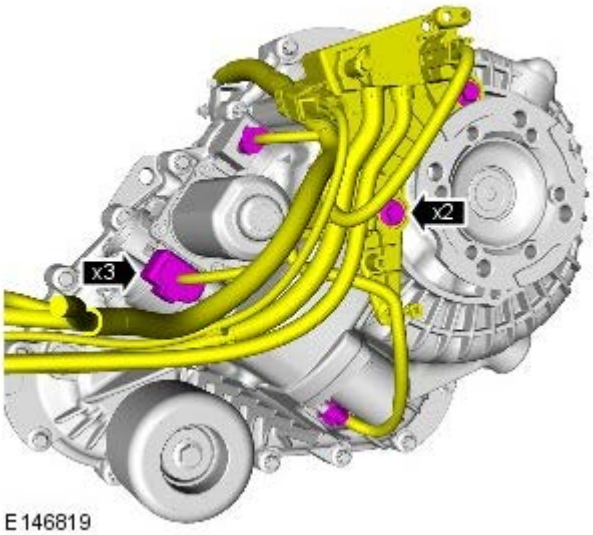
E150353

14.



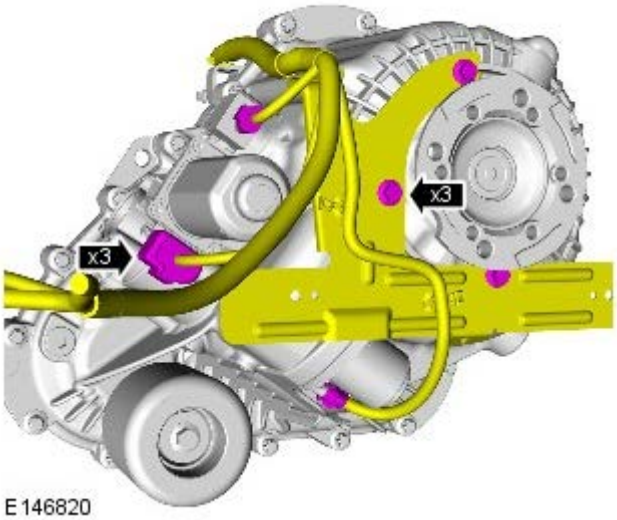
E146823

15. NOTE: Vehicles with DPF (Diesel Particulate Filter) installed only.



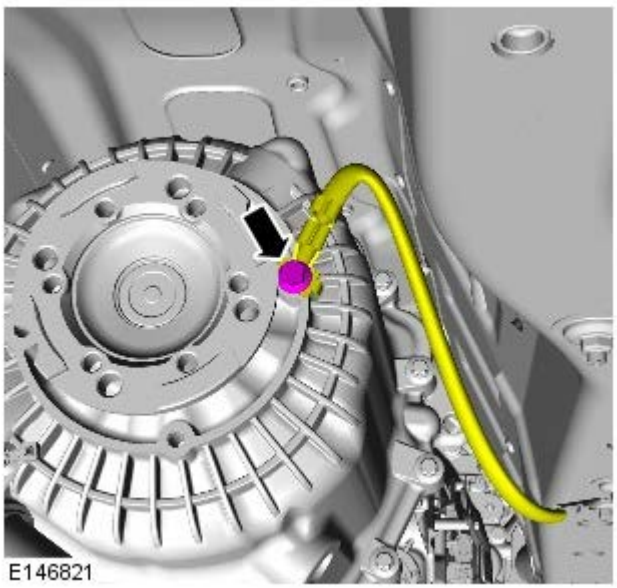
E146819

16. NOTE: Vehicles without diesel particulate filter (DPF).



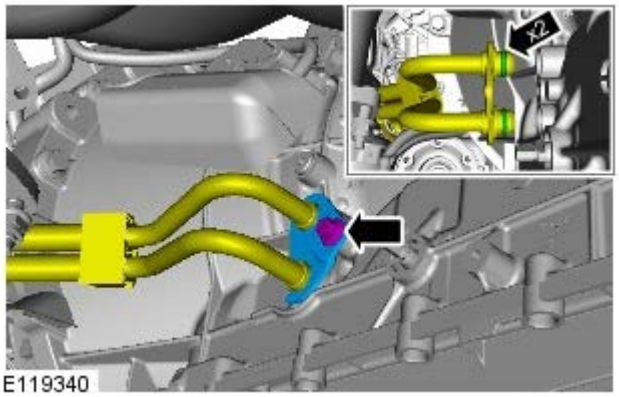
E146820

17.


E146821

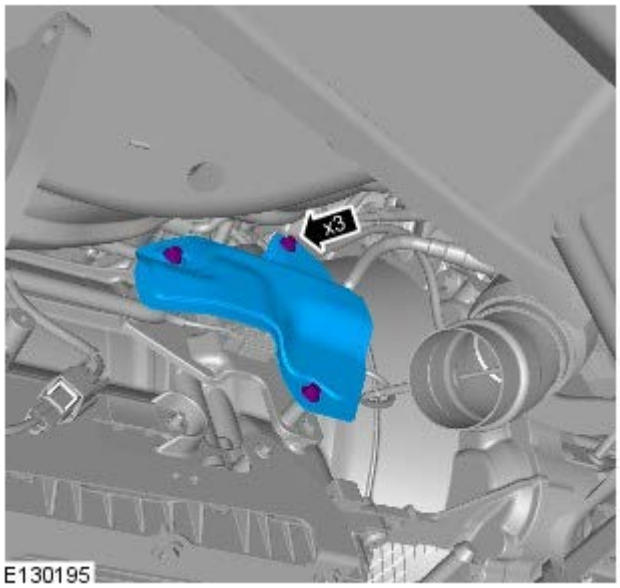
18. WARNING: Be prepared to collect escaping fluids.

CAUTION: Make sure that all openings are sealed. Use new blanking caps.

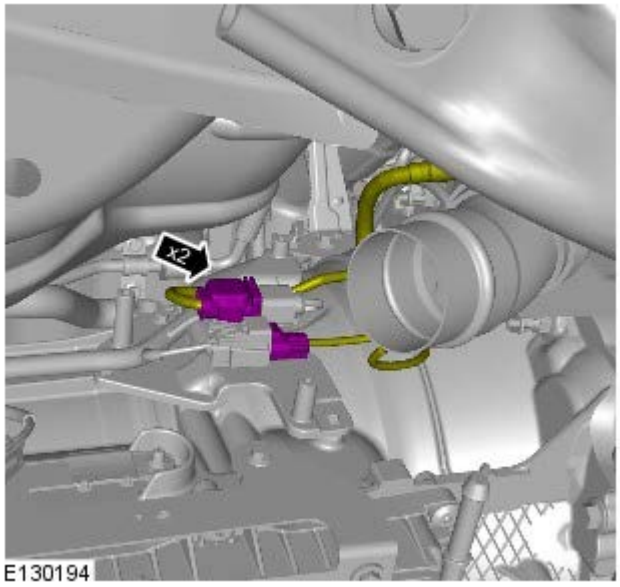


NOTE: Remove and discard the O-ring seals.

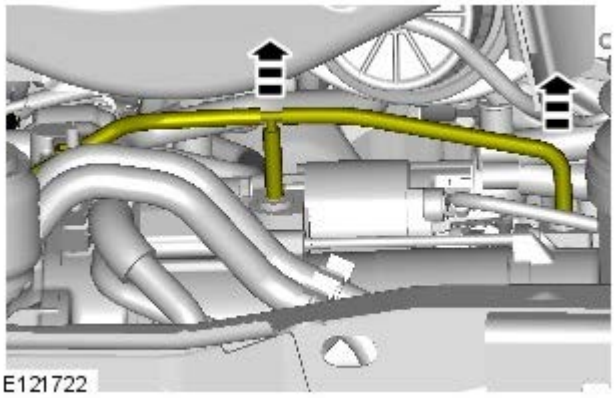
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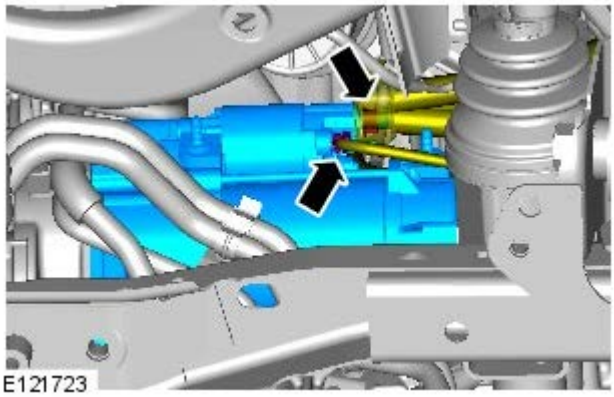
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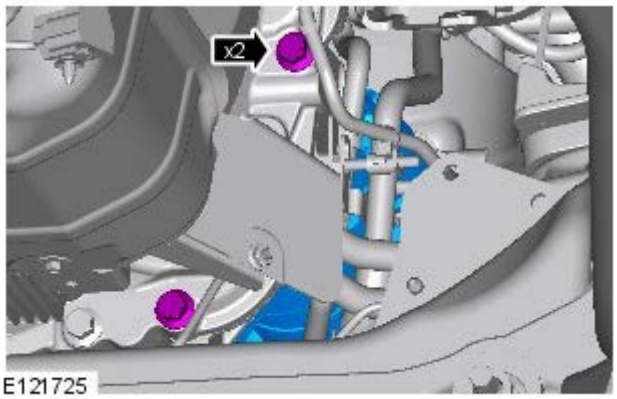
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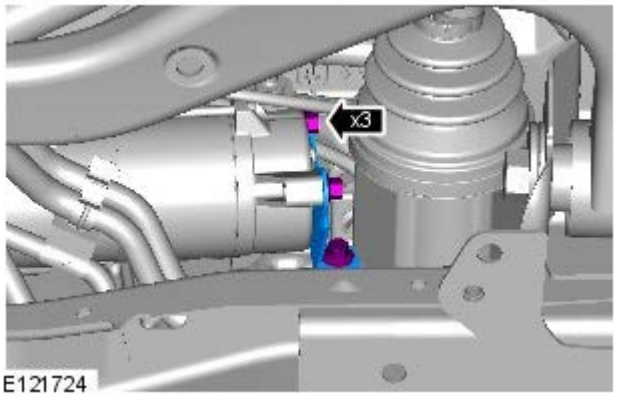
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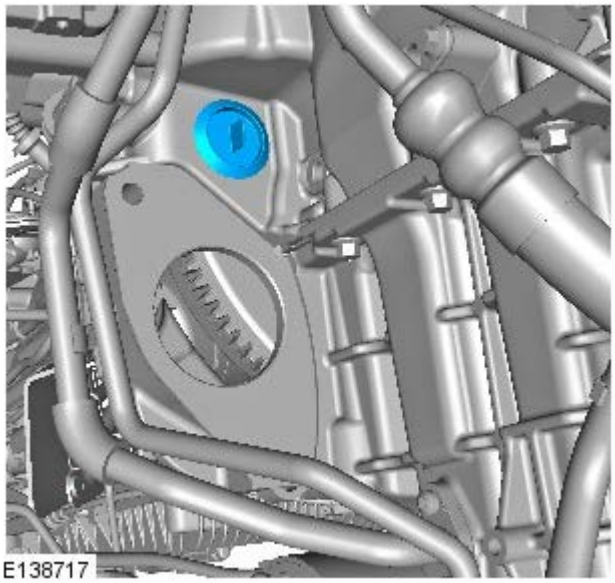
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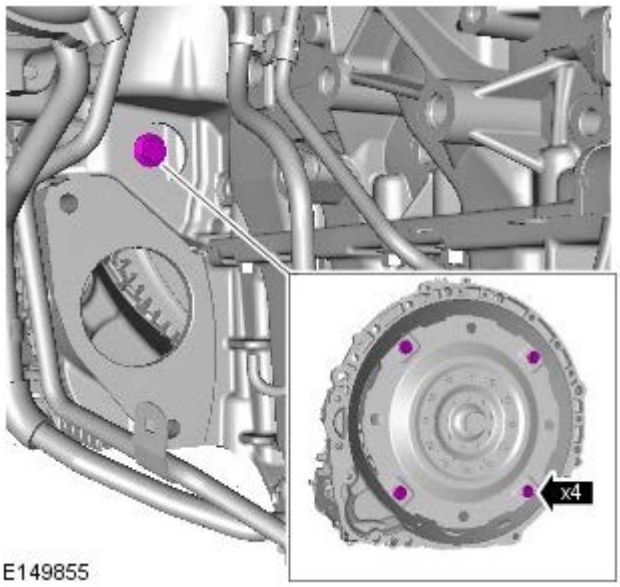
24.



25.


E138717

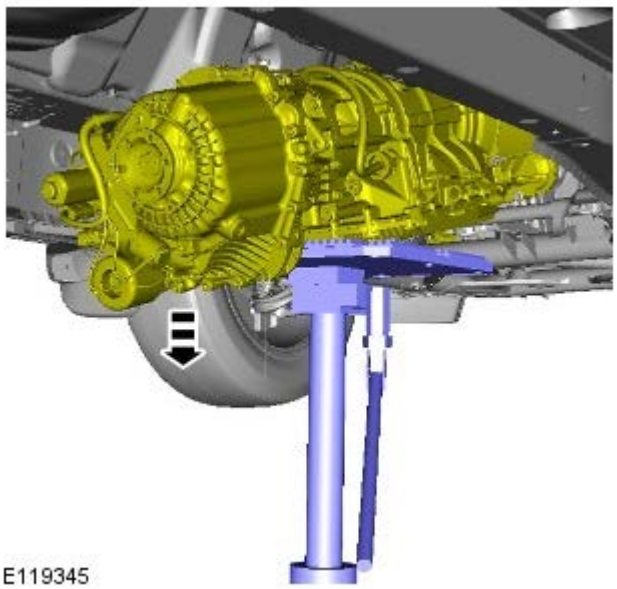
26. CAUTION: Only rotate the crankshaft clockwise.



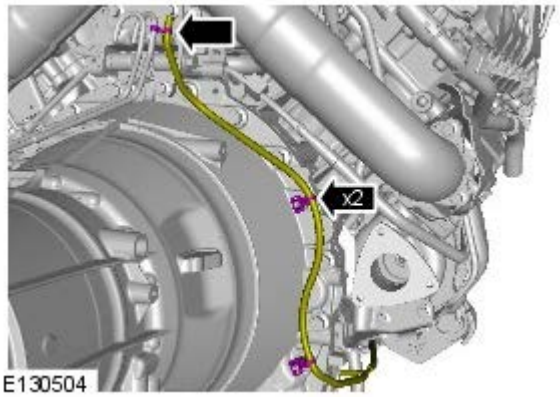
E149855

27. WARNING: Make sure that the transmission is secured with suitable retaining straps.

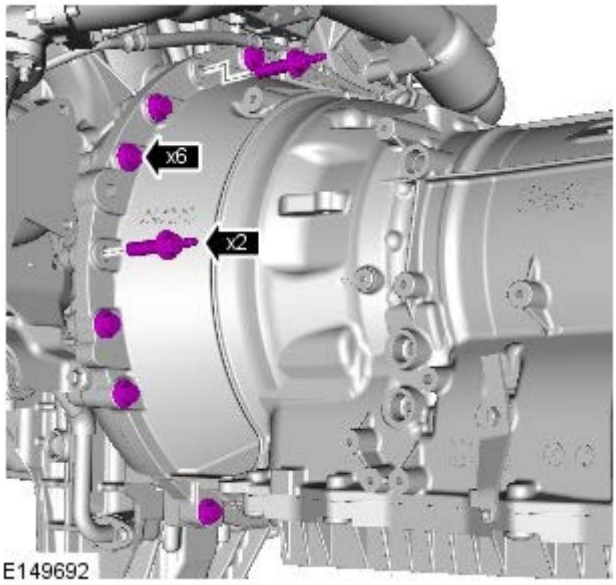
Lower the rear of the transmission for access.


E119345

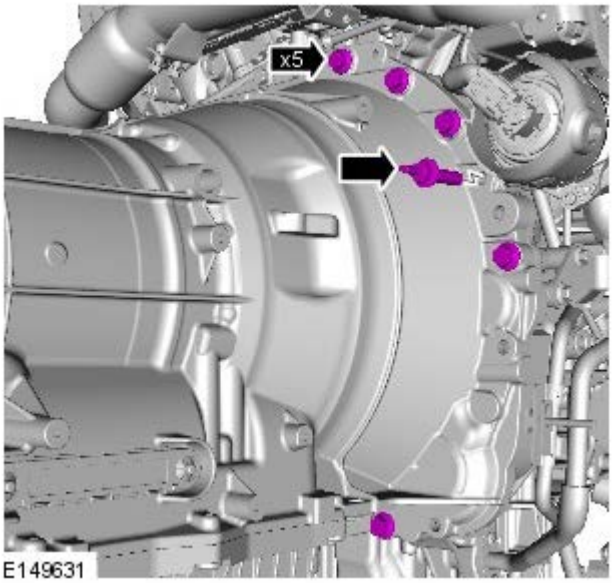
28.



29.



30.

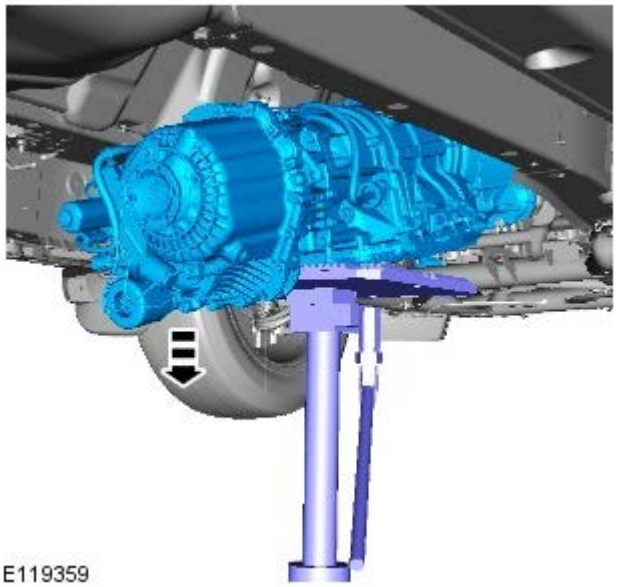


31. WARNINGS:

 This step requires the aid of another technician.

 Make sure that the transmission is secured with suitable retaining straps.

 CAUTION: Make sure that the torque converter remains in the transmission.

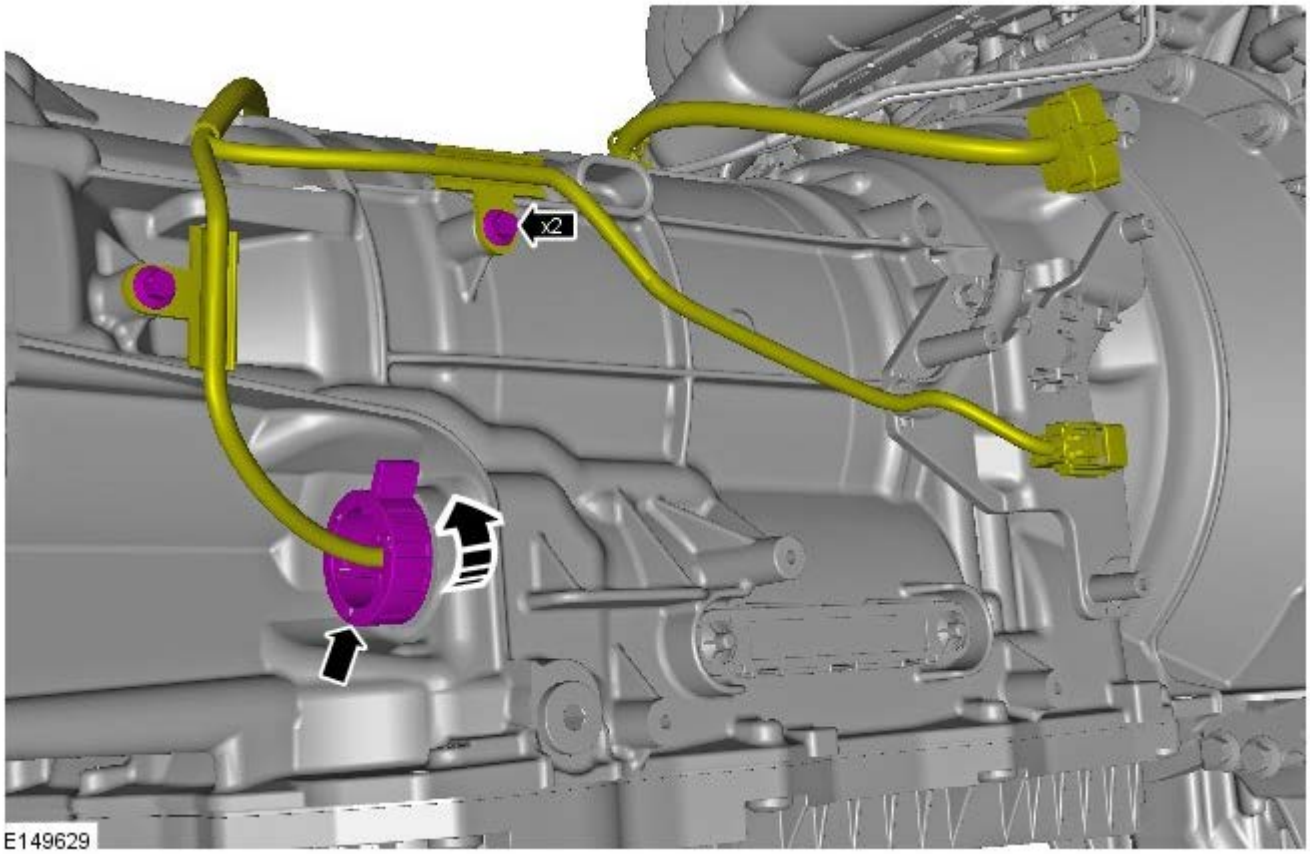


NOTES:

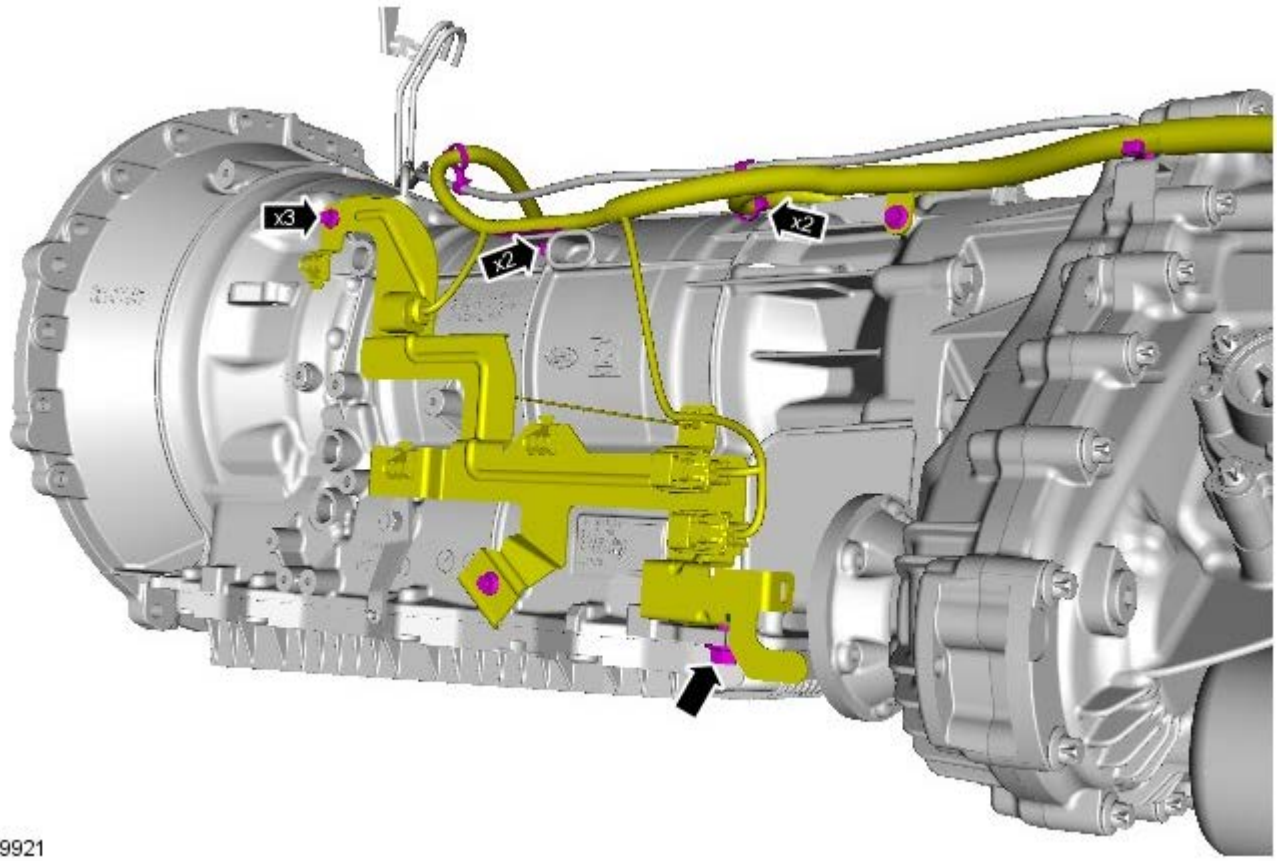
Do not disassemble further if the component is removed for access only.

Secure the torque converter to the transmission using suitable cable ties.

32.

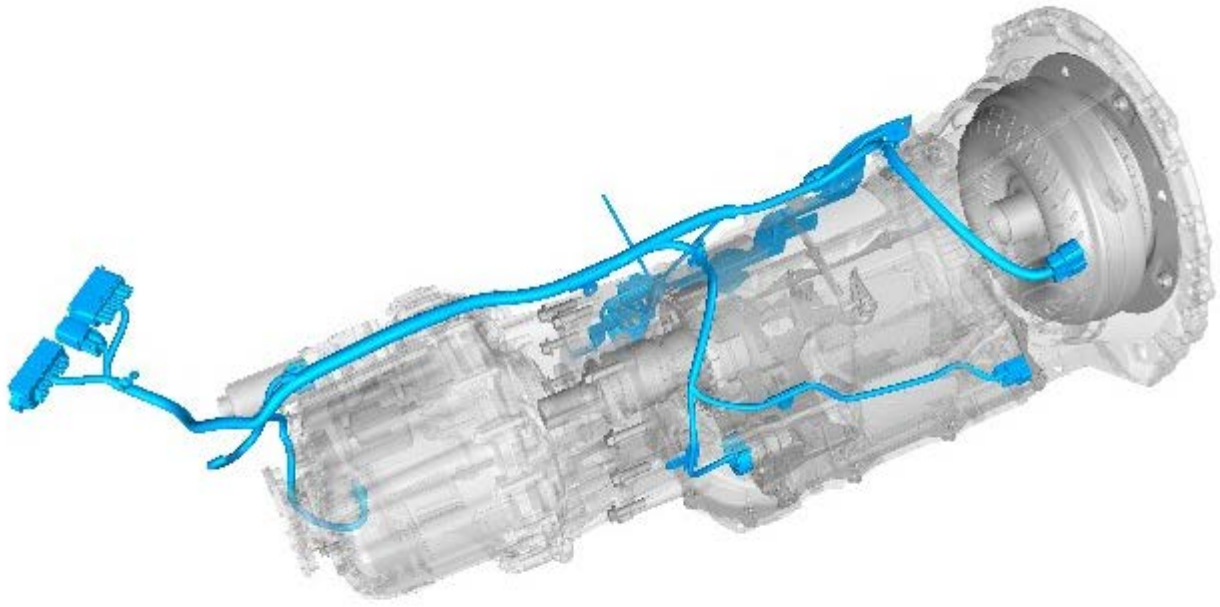


33.



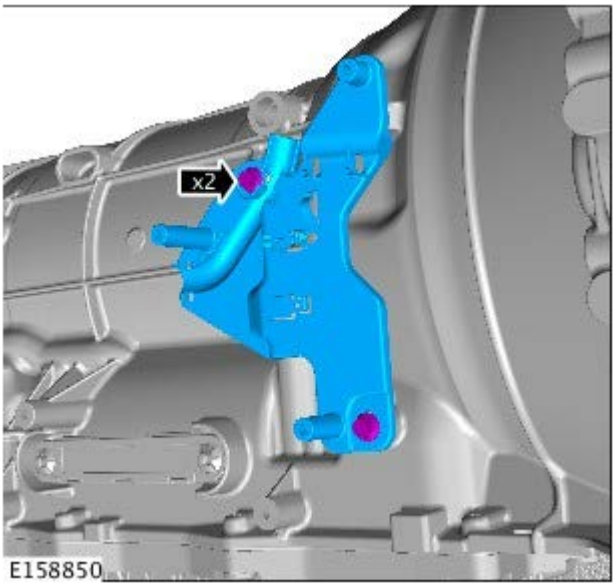
E149921

34.

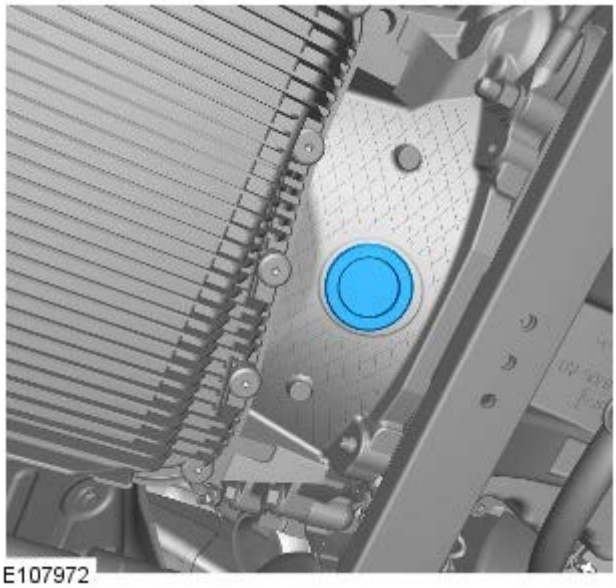


E158851

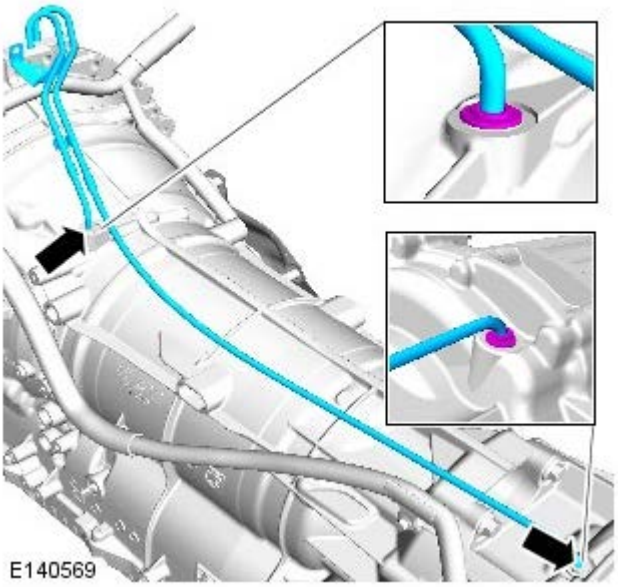
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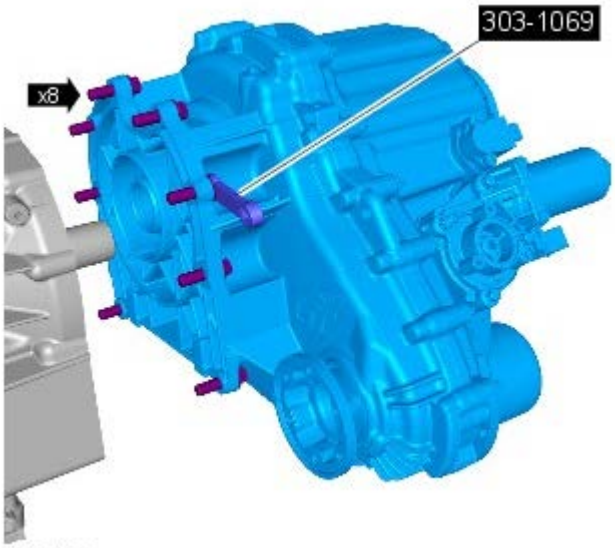
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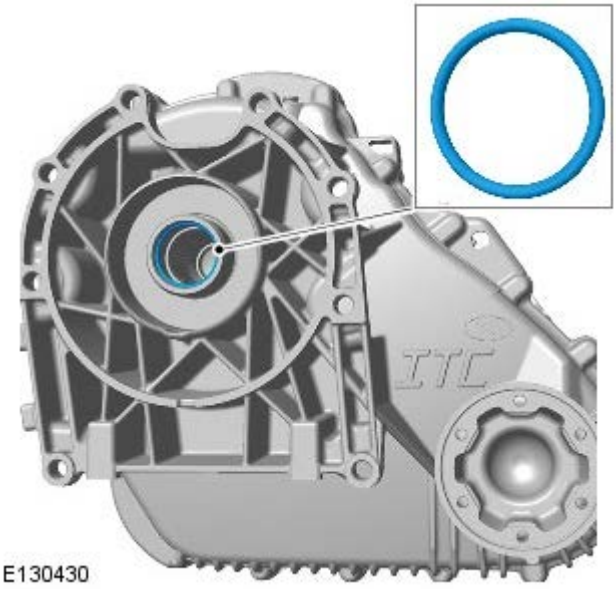
37. CAUTION: Always plug any open connections to prevent contamination.



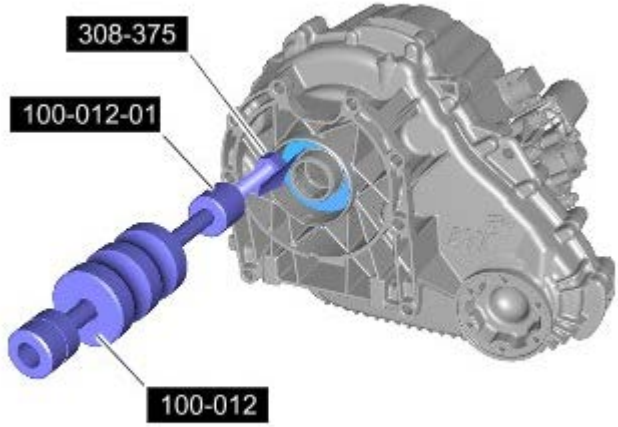
38. *Special Tool(s):* 303-1069



E130188


E130430

39. CAUTION: Do not carry out this step if a new transfer box is to be installed.



E131138

40. CAUTIONS:

Care must be taken to avoid damage to the seal register and running surface.

Do not carry out this step if a new transfer box is to be installed.

Note the fitted position of the component prior to removal.

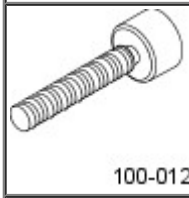
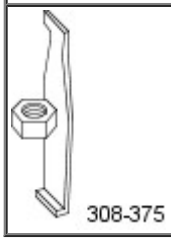
- *Special Tool(s):* 100-012, 100-012-01, 308-375

Published: 13-Feb-2014

Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - Transmission TDV8 4.4L Diesel

Removal

Special Tool(s)

	100-012 Slide Hammer
	100-012-01 Slide Hammer Adapter
	303-1069 Adapter, Wrench
	308-375 Remover, Input and Output Seal

NOTES:

Some variation in the illustrations may occur, but the essential information is always correct.

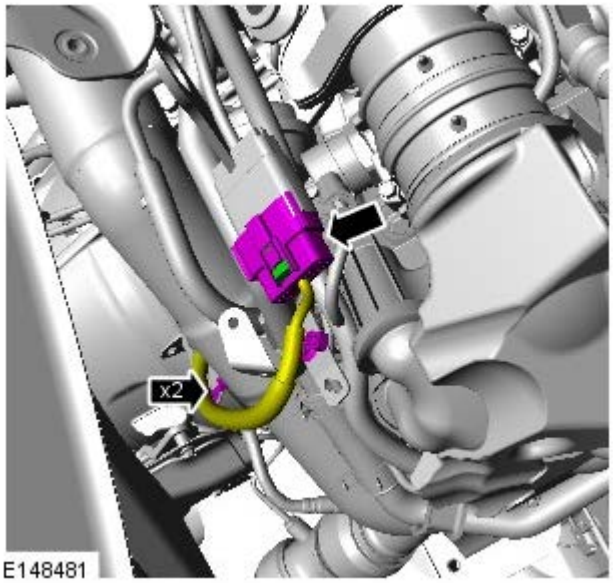
Some illustrations may show the transmission removed for clarity.

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

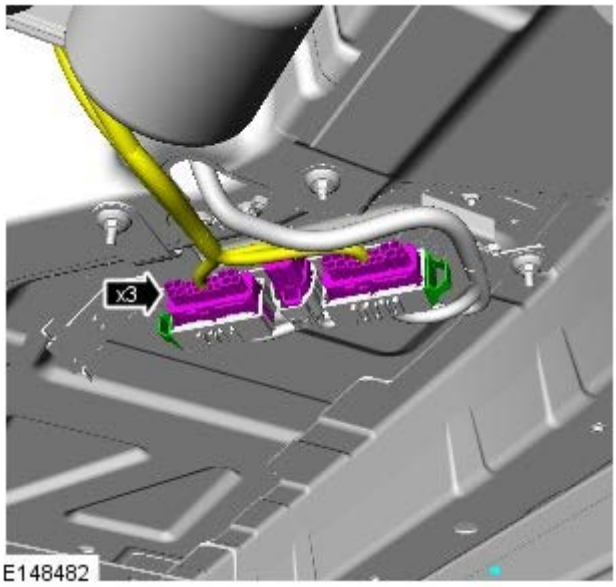
2. Refer to: Secondary Bulkhead Center Panel - TDV8 4.4L Diesel (501-02, Removal and Installation).

3.



4. WARNING: Make sure to support the vehicle with axle stands.
   Raise and support the vehicle.

5.

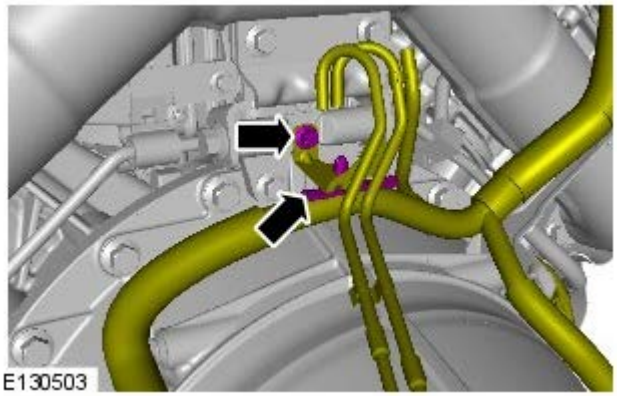


6. Refer to: Front Driveshaft - TDV8 4.4L Diesel (205-01 Driveshaft, Removal and Installation).

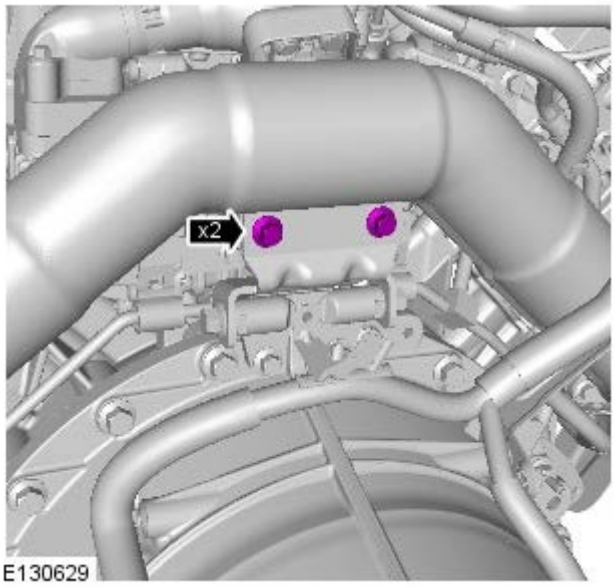
7. Refer to: Exhaust System - Vehicles With: Diesel Particulate Filter (DPF) (309-00D Exhaust System - TDV8 4.4L Diesel, Removal and Installation).
   Refer to: Exhaust System - Vehicles Without: Diesel Particulate Filter (DPF) (309-00D Exhaust System - TDV8 4.4L Diesel, Removal and Installation).

8. Refer to: Rear Driveshaft - TDV8 4.4L Diesel (205-01 Driveshaft, Removal and Installation).

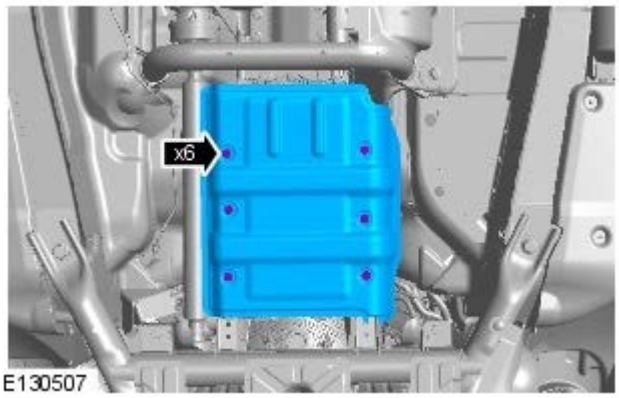
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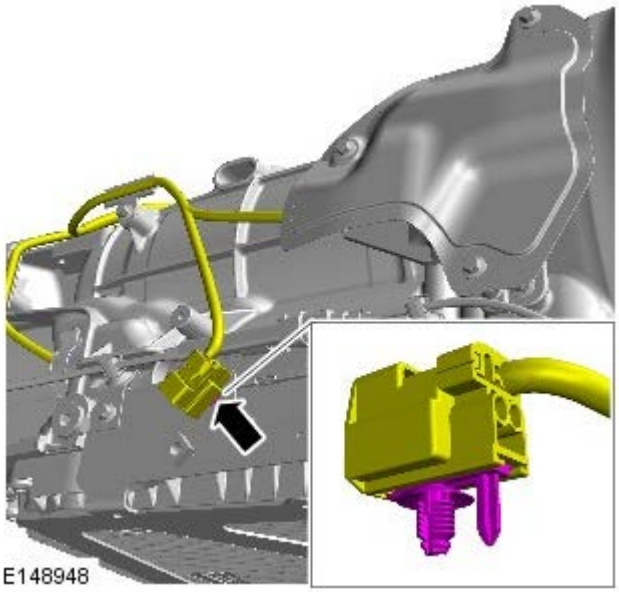
10.



11.

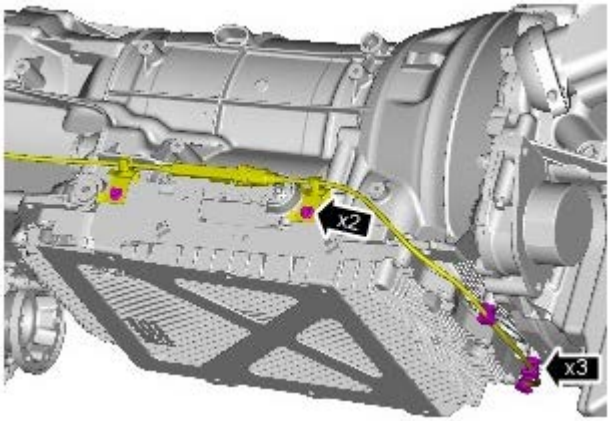


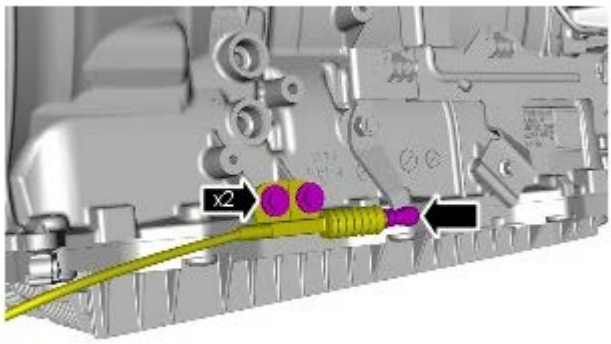
12.


E148948

13.

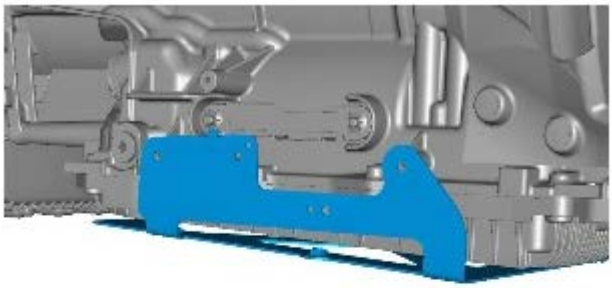
- Secure the cable to the floor using suitable cable ties.

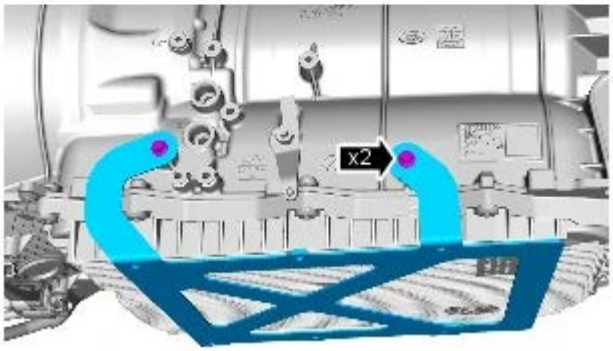




E150358

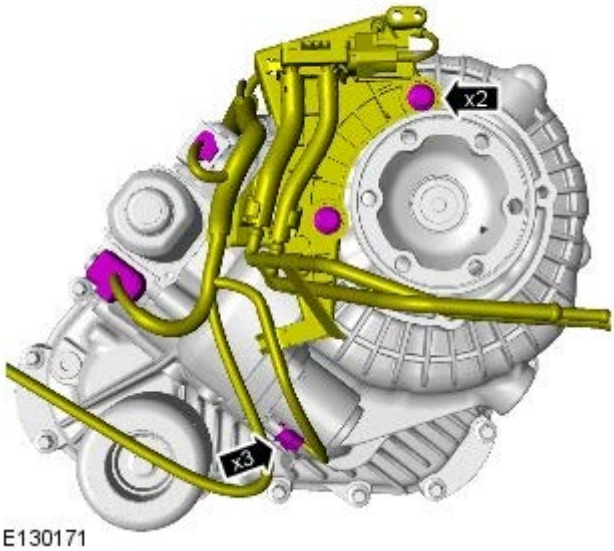
14.





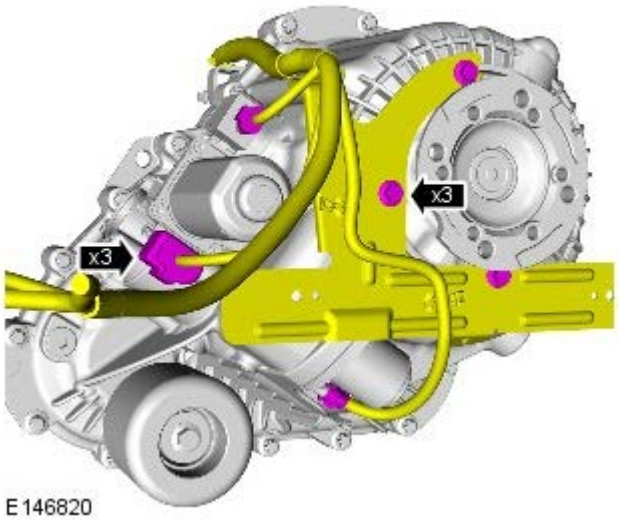
E148881

15. NOTE: Vehicles with diesel particulate filer (DPF).



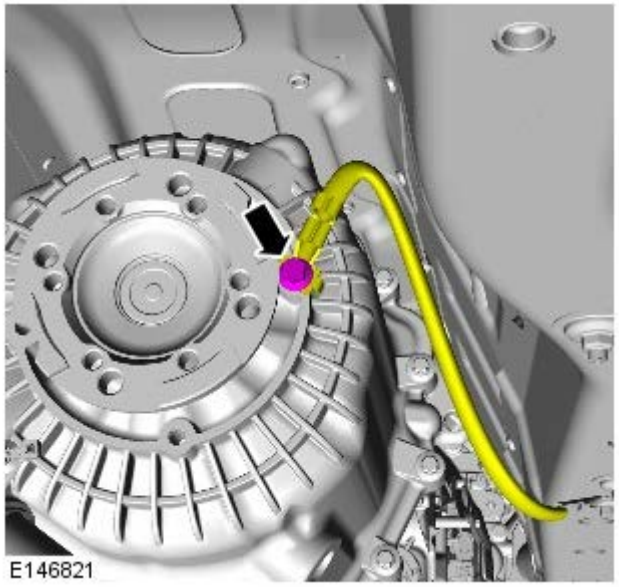
E130171

16. NOTE: Vehicles without diesel particulate filer (DPF).

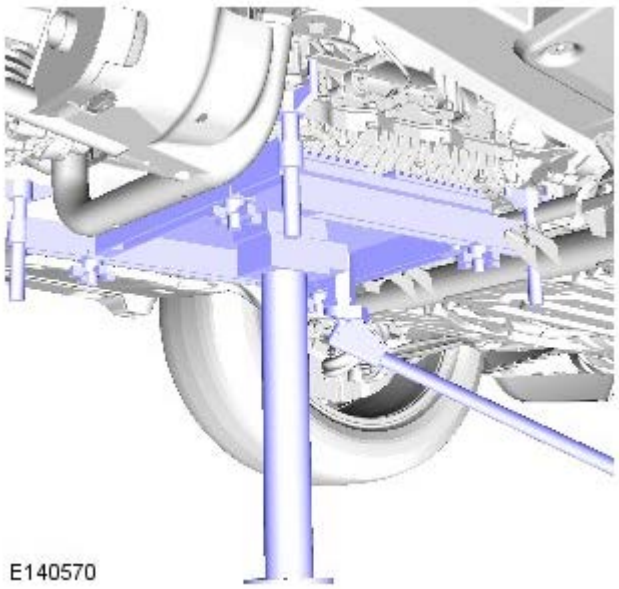


E146820

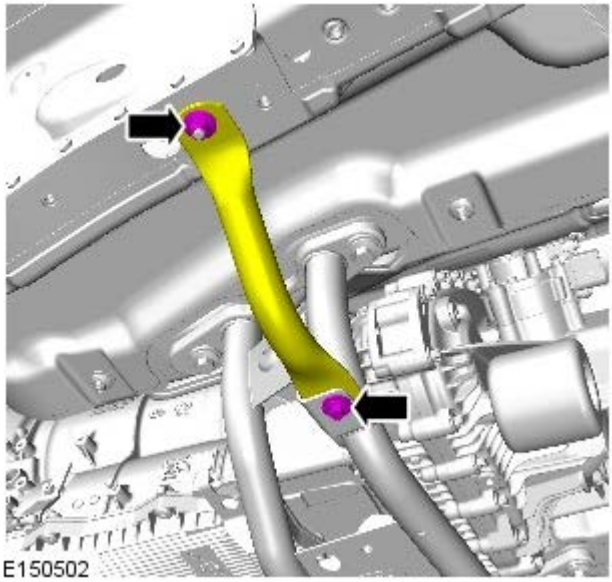
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E146821

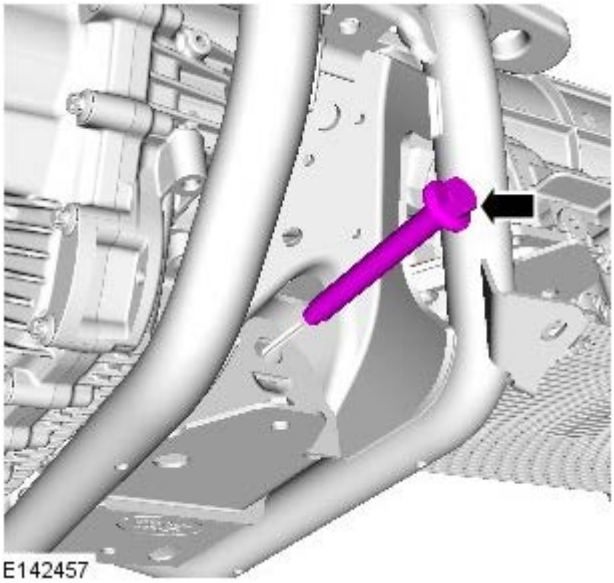
18. Using a transmission jack, support the transmission.


E140570

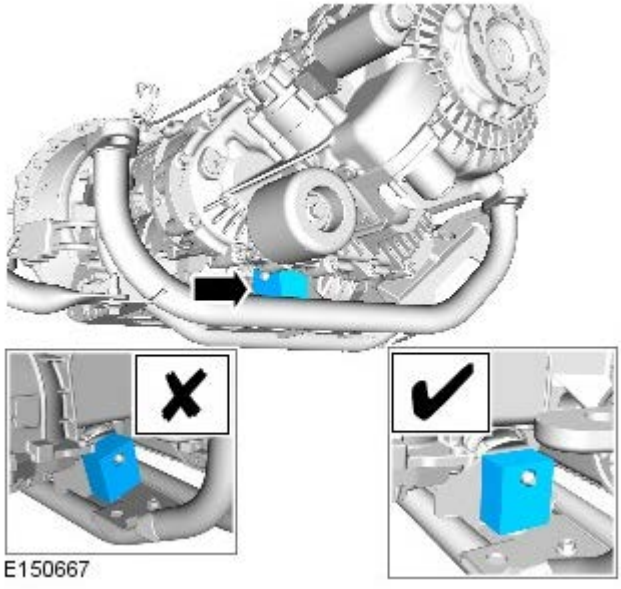
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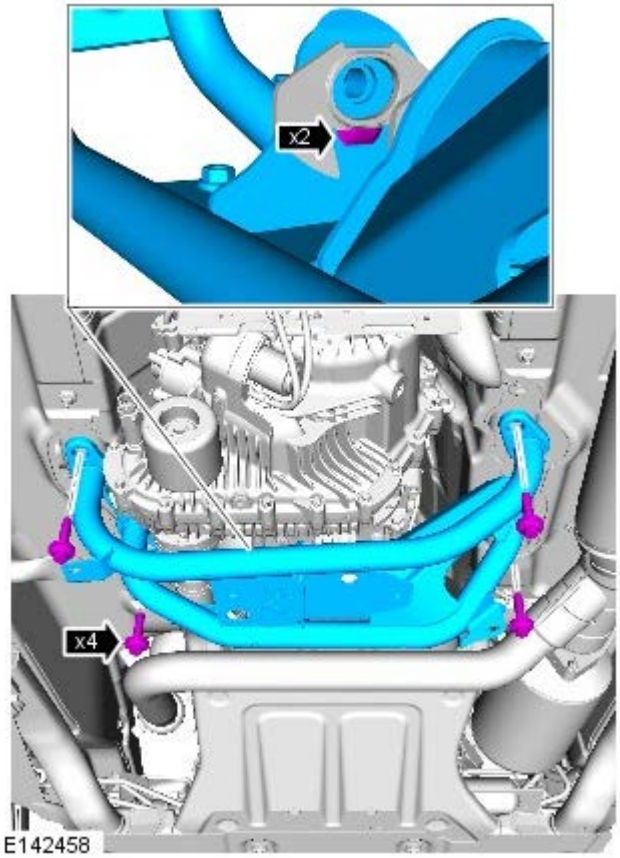
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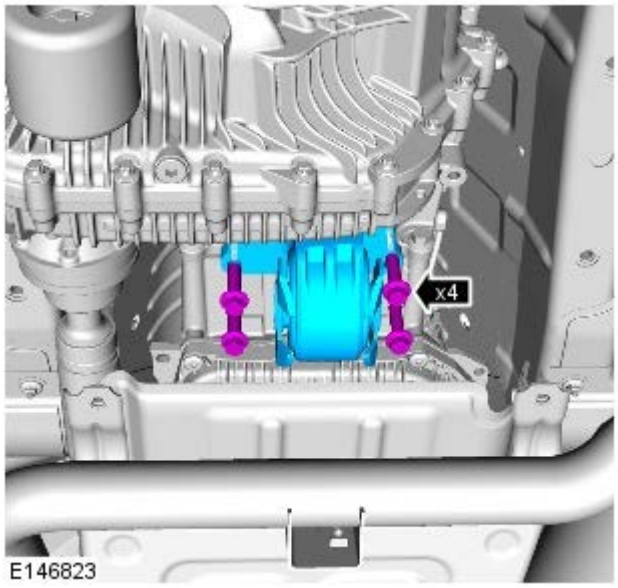
21. NOTE: Note the orientation of the component prior to removal



22.



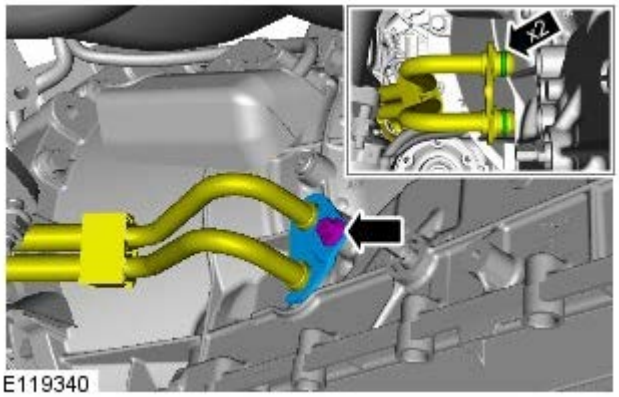
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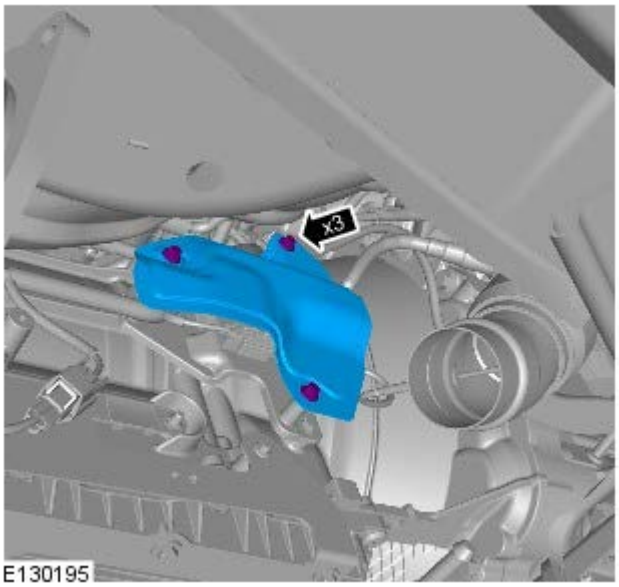
24. WARNING: Be prepared to collect escaping fluids.

CAUTION: Make sure that all openings are sealed. Use new blanking caps.

NOTE: Remove and discard the O-ring seals.

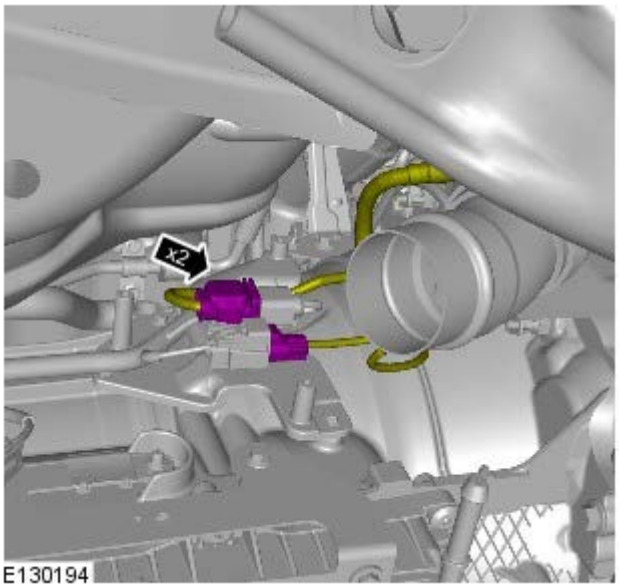


25.



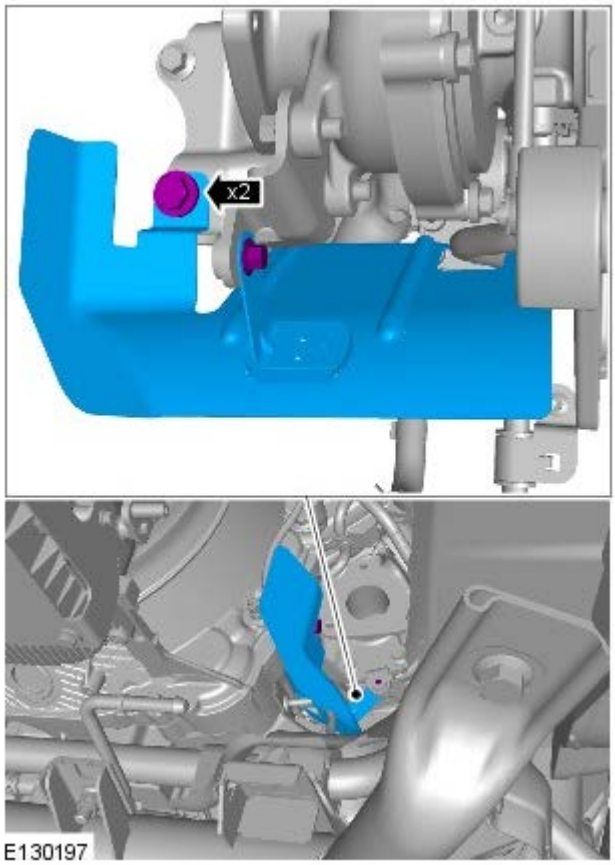
E130195

26.

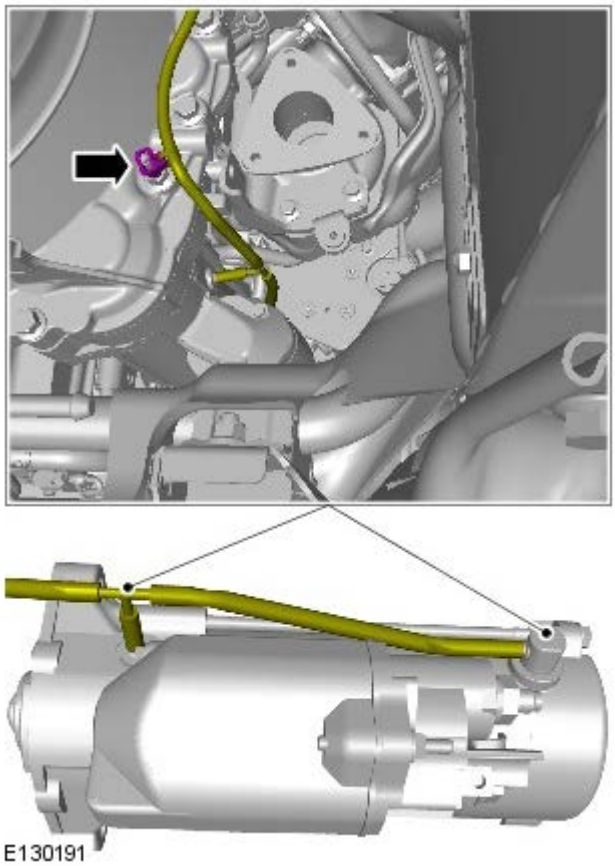


E130194

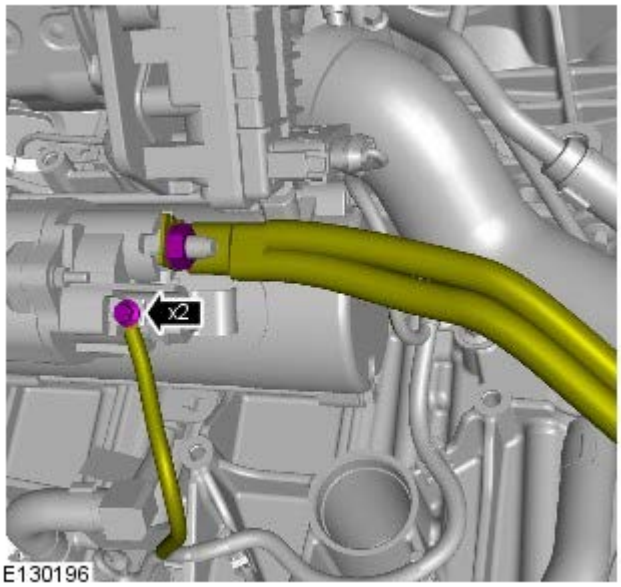
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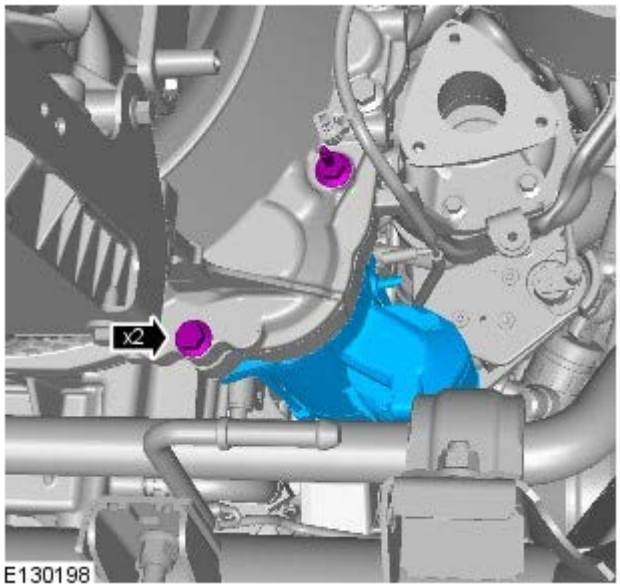
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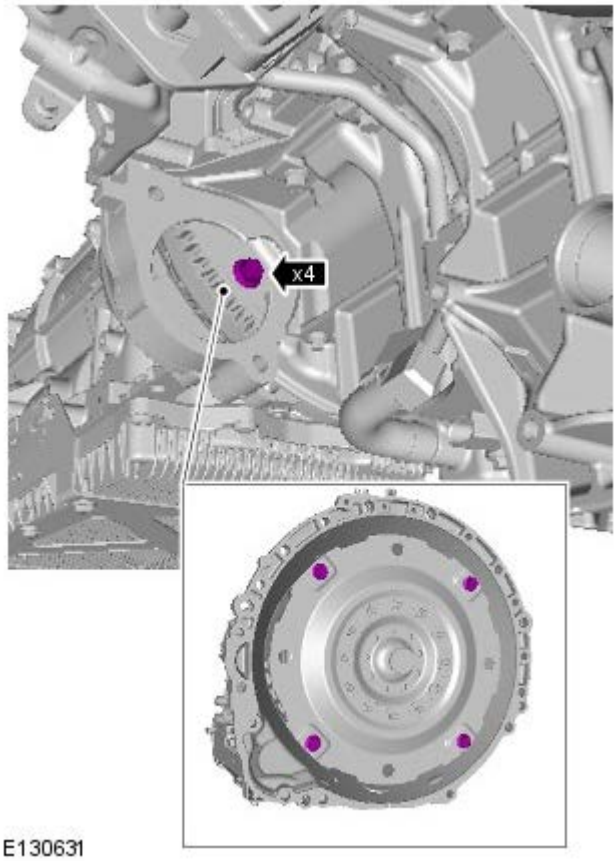
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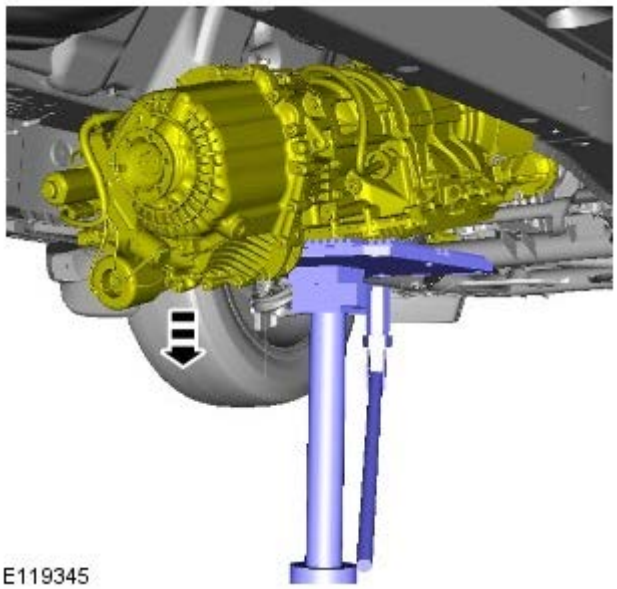
30.



31. CAUTION: Only rotate the crankshaft clockwise.



E130631

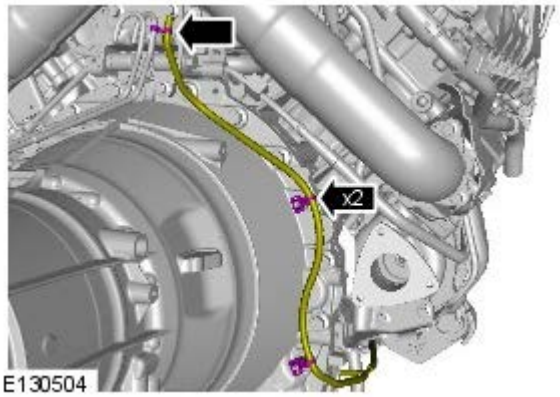


E119345

32. WARNING: Make sure that the transmission is secured with suitable retaining straps.

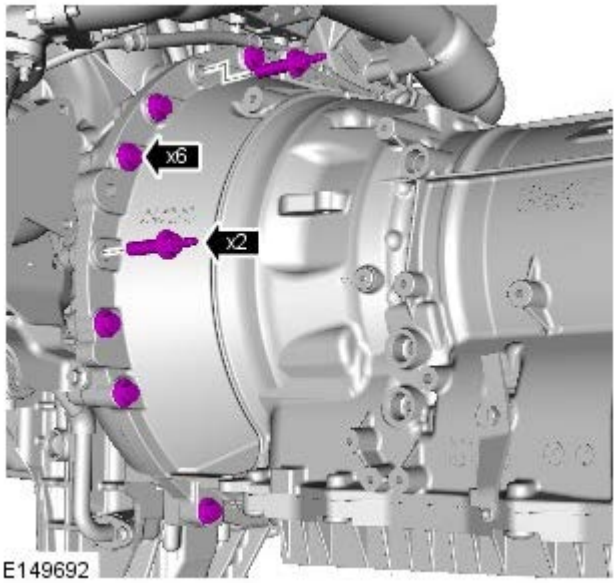
- Using a suitable wooden block, support the engine on the subframe.
- Lower the engine and transmission avoiding any contact with the bulkhead and body panels.

33.

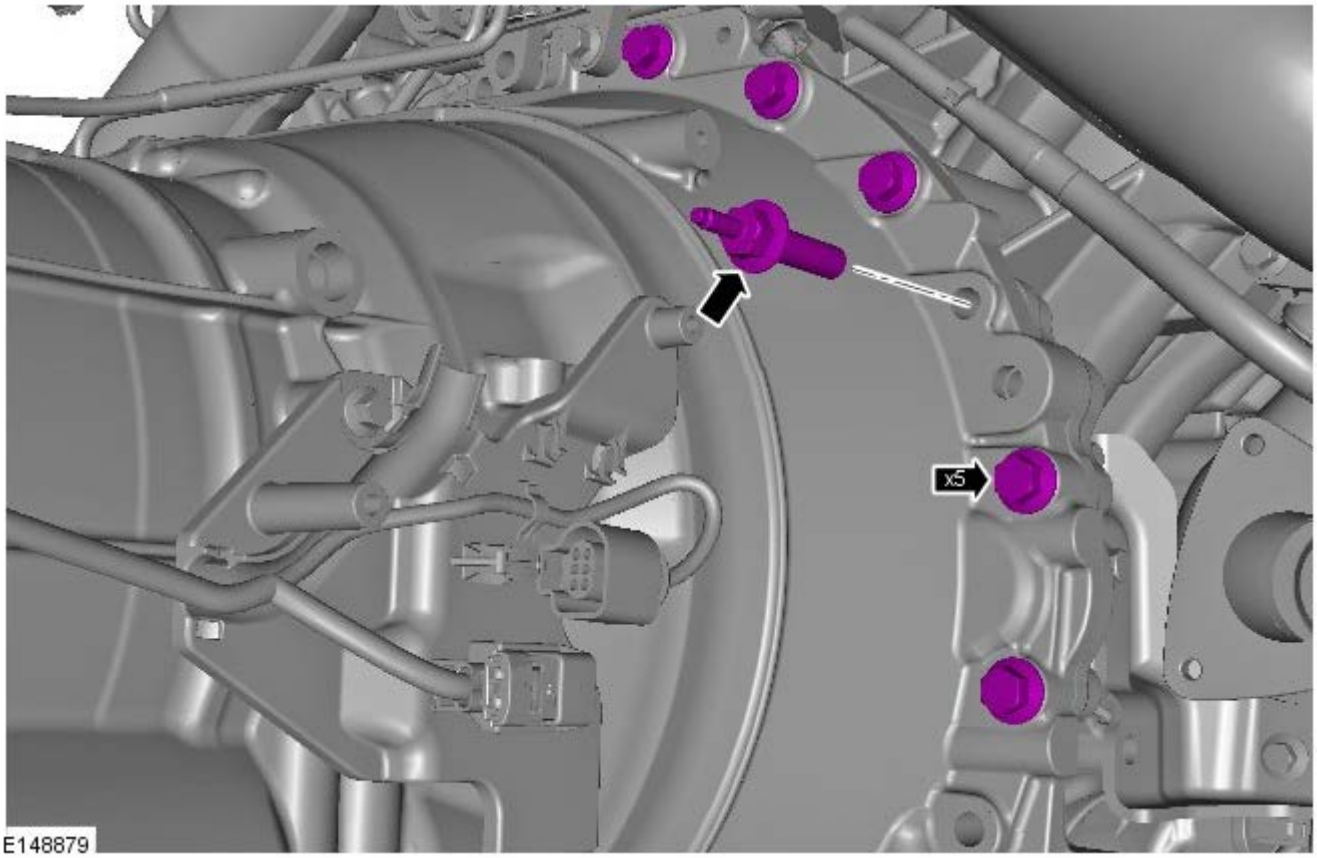


E130504

34.



35.

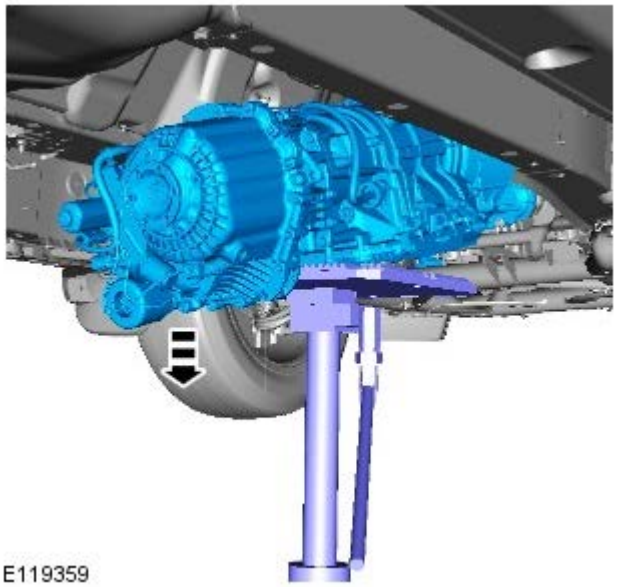


36. WARNING: This step requires the aid of another technician.

CAUTIONS:

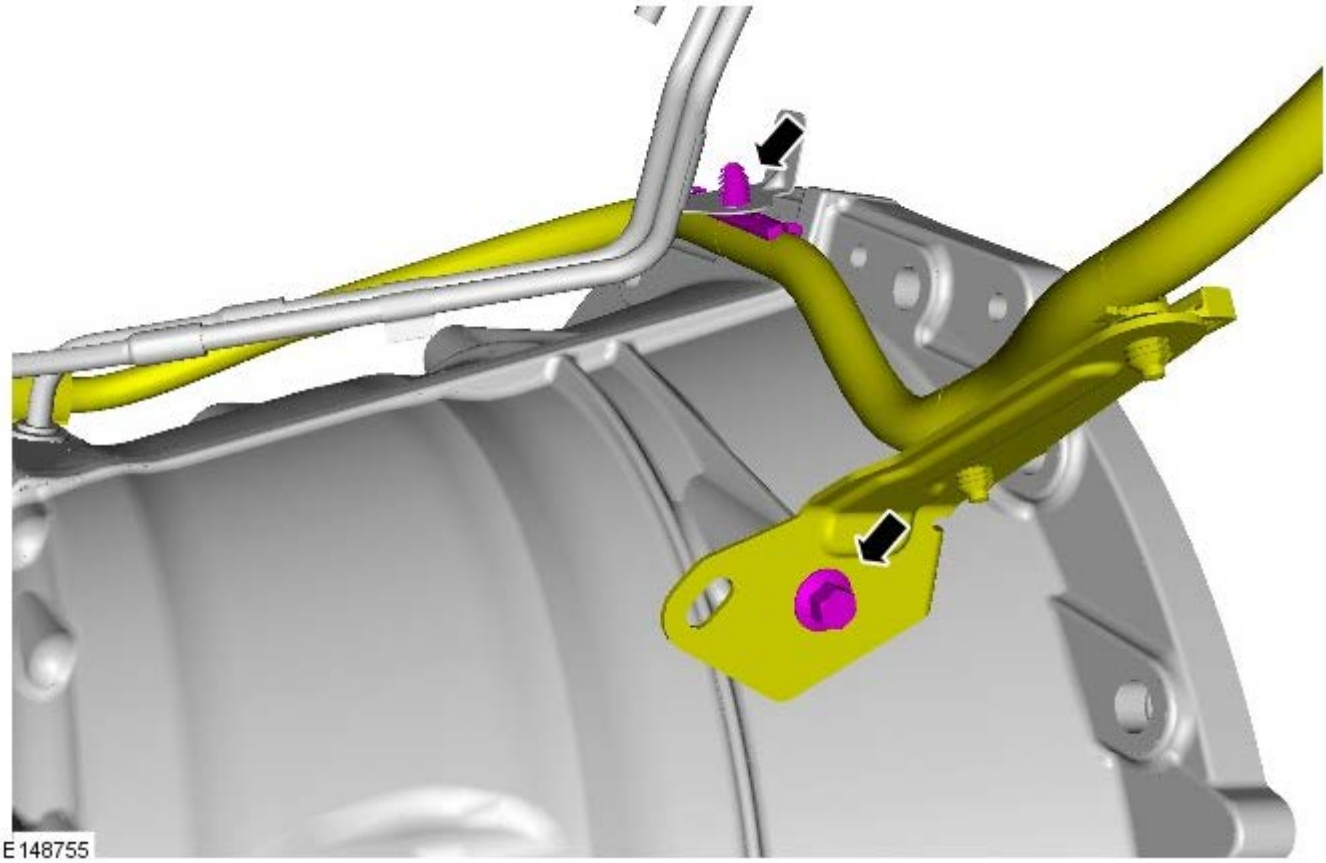
Make sure that the torque converter remains in the transmission.

Secure the torque converter to the transmission using suitable cable ties.



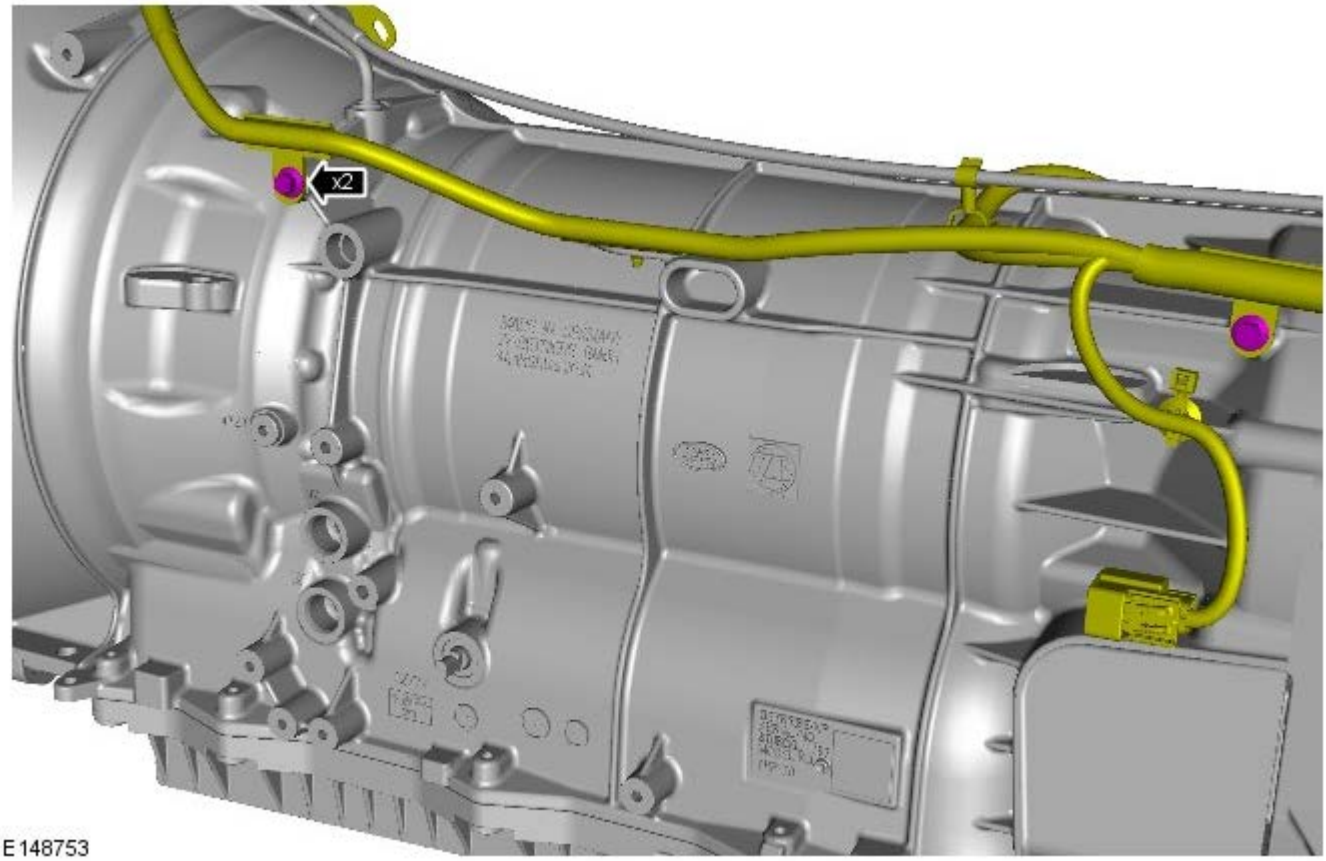
E119359

37. Do not disassemble further if removed for access only.



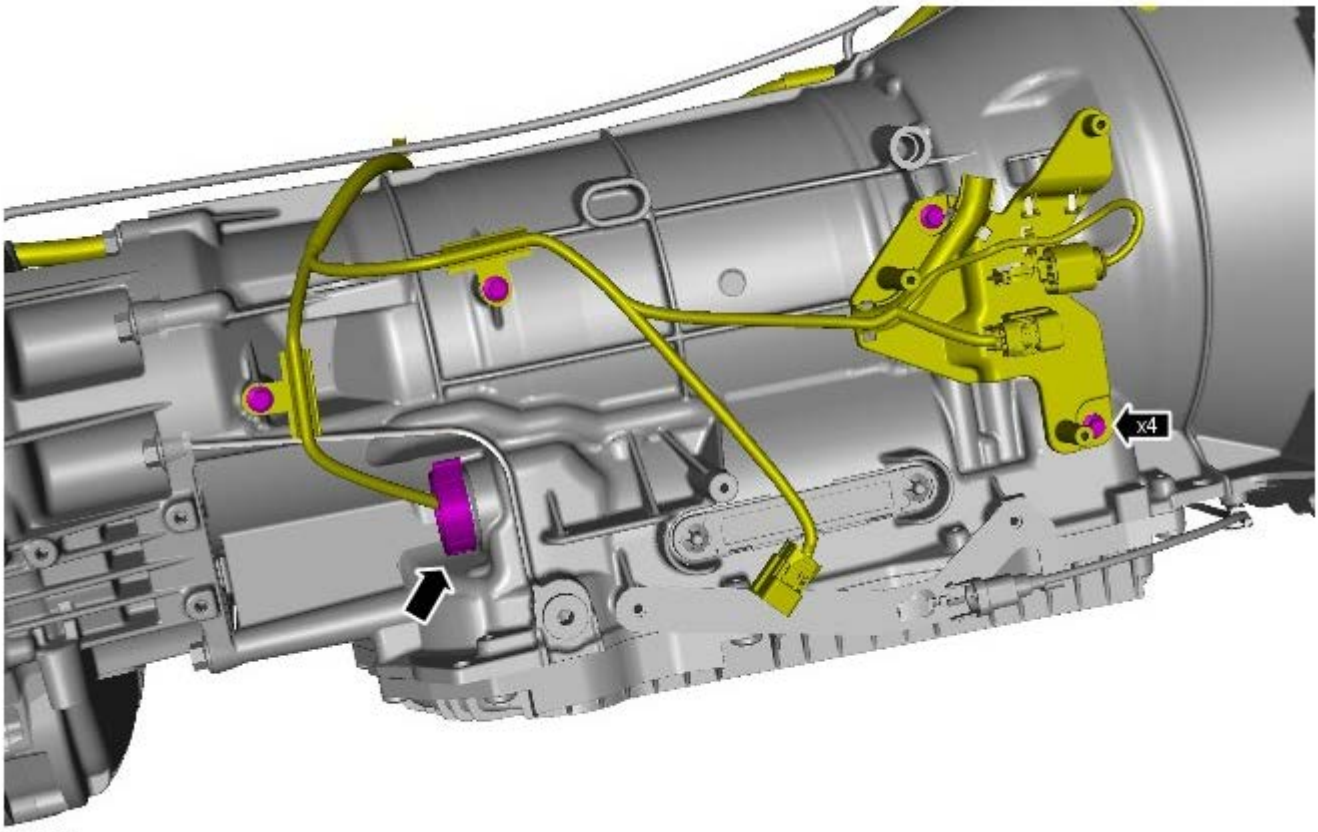
E148755

38.



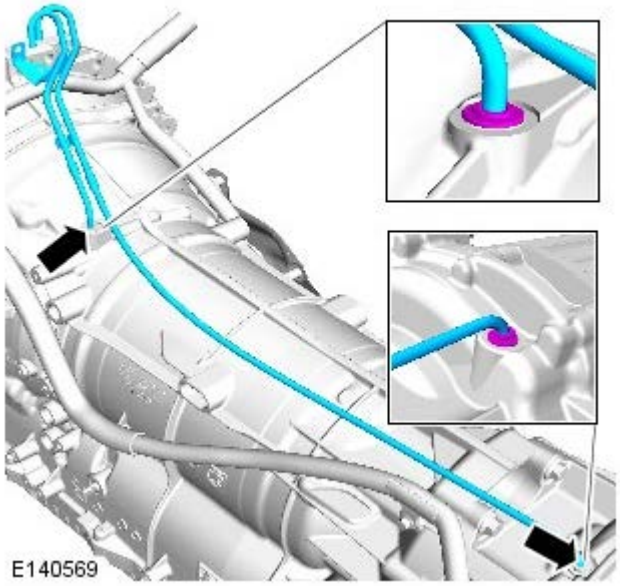
E148753

39.

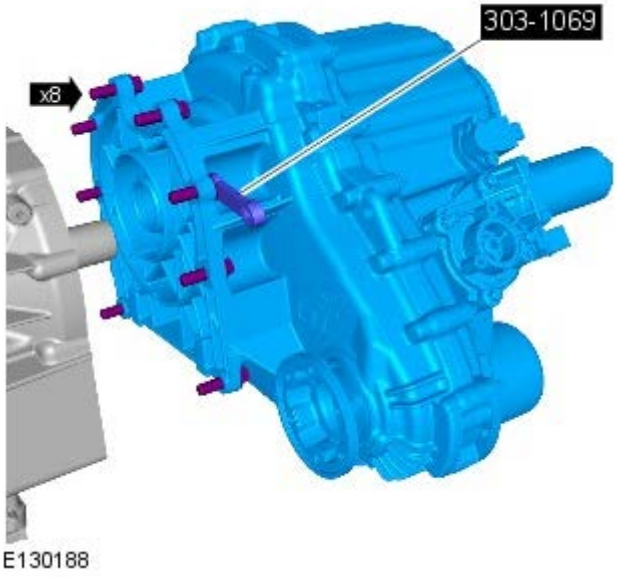


E148754

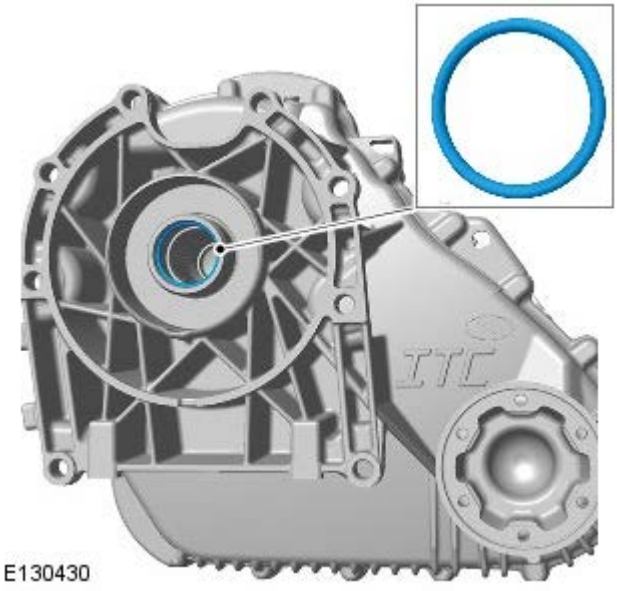
40. CAUTION: Always plug any open connections to prevent contamination.



41. *Special Tool(s):* 303-1069

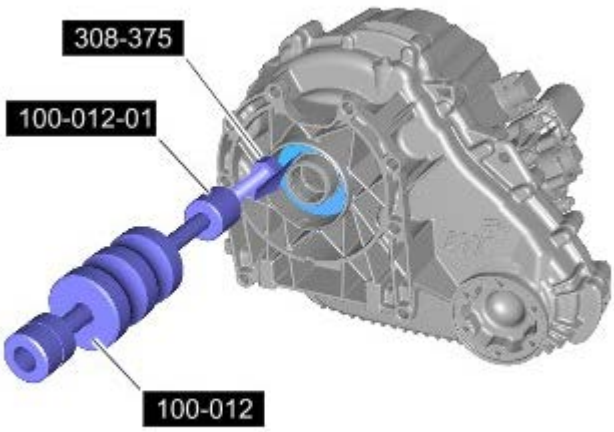


42. CAUTION: Do not carry out this step if a new transfer box is to be installed.



43. CAUTIONS:

Care must be taken to avoid damage to the seal register and running surface.



E131138

Do not carry out this step if a new transfer box is to be installed.

Note the fitted position of the component prior to removal.

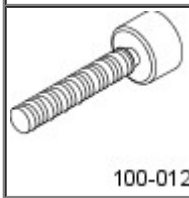
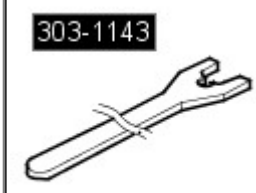
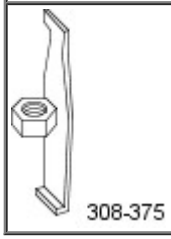
- *Special Tool(s):* 100-012, 100-012-01, 308-375

Published: 04-Jul-2013

Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - Transmission V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol

Removal

Special Tool(s)

	100-012 Slide Hammer
	100-012-01 Slide Hammer Adapter
	303-1069 Adapter, Wrench
	303-1142 Viscous Coupling Wrench
	303-1143 Viscous Coupling Holding Tool
	308-375 Remover, Input and Output Seal

NOTES:

Some variation in the illustrations may occur, but the essential information is always correct.

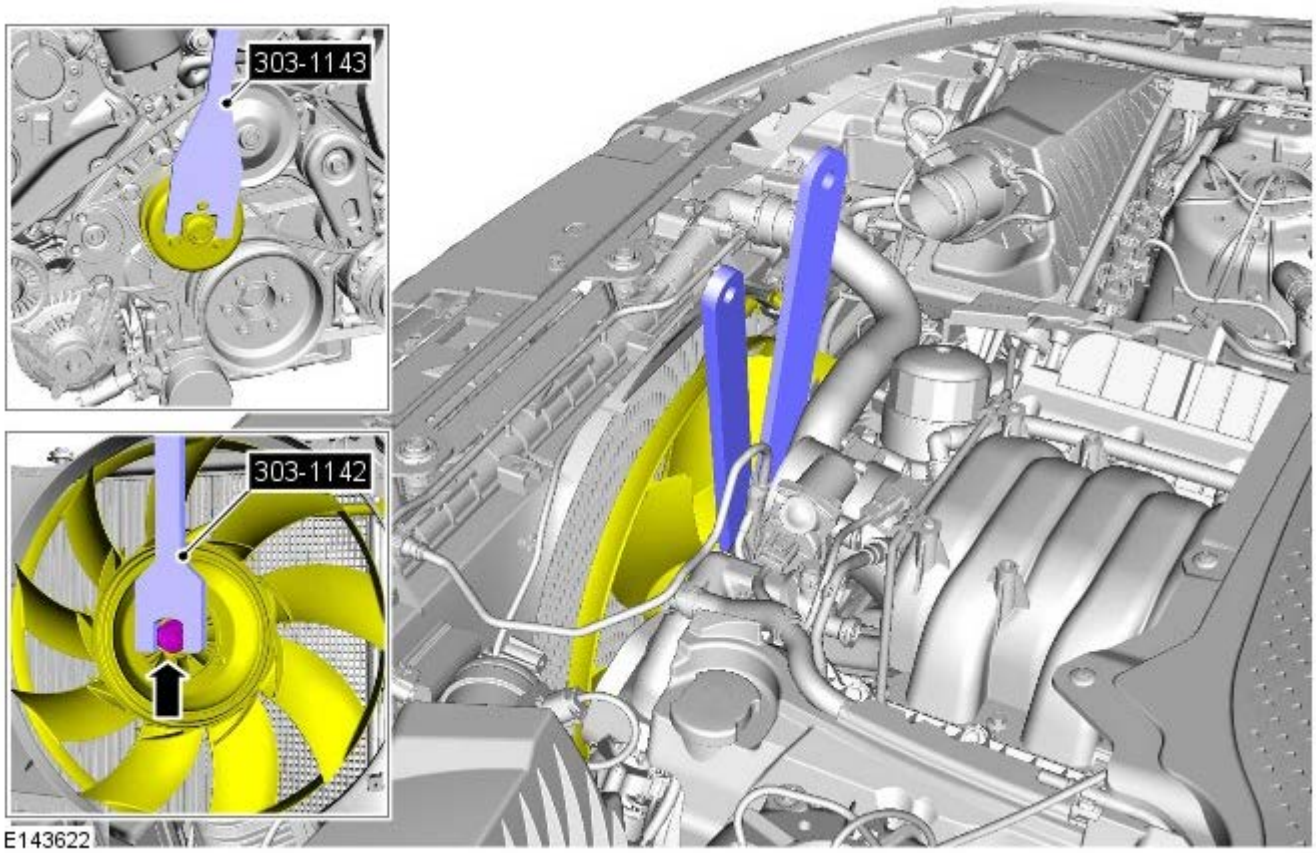
Some illustrations may show the transmission removed for clarity.

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-01, Specifications).

2. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).

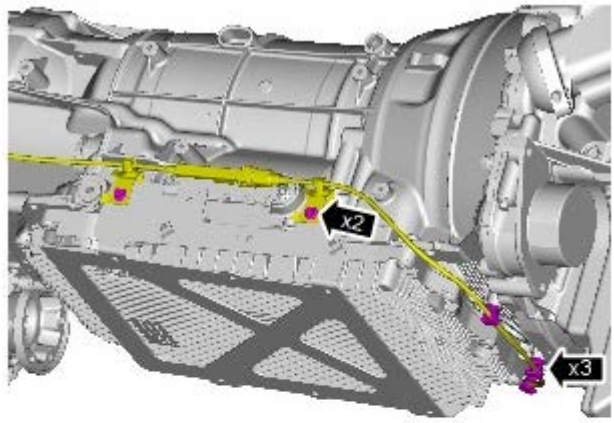
3.
   - *Special Tool(s):* 303-1143
   - *Special Tool(s):* 303-1142
   - *Torque:* 65 Nm

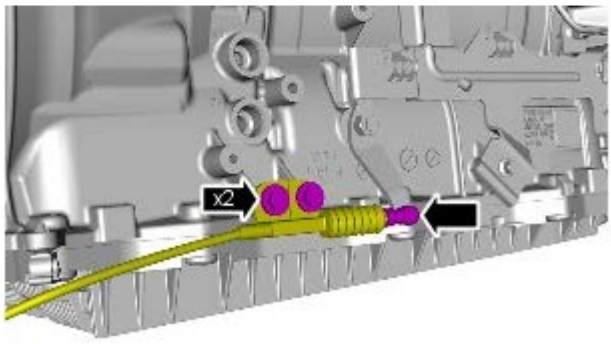


4. Refer to: Front Driveshaft - V8 5.0L Petrol/V8 S/C 5.0L Petrol (205-01, Removal and Installation).

5. Refer to: Rear Driveshaft - V8 5.0L Petrol/V8 S/C 5.0L Petrol (205-01, Removal and Installation).

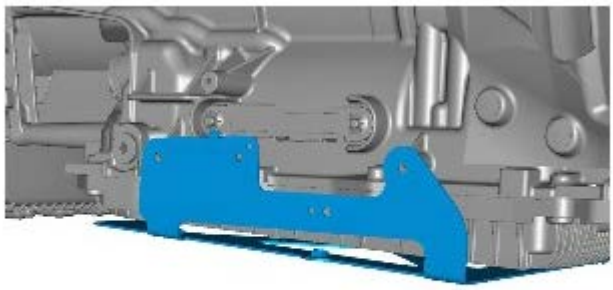
6.
   - Secure with 2 cable ties.

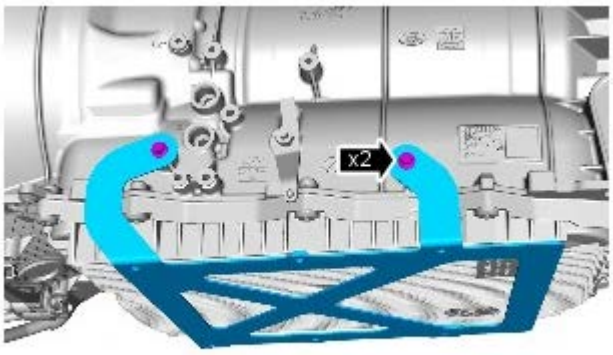




E150358

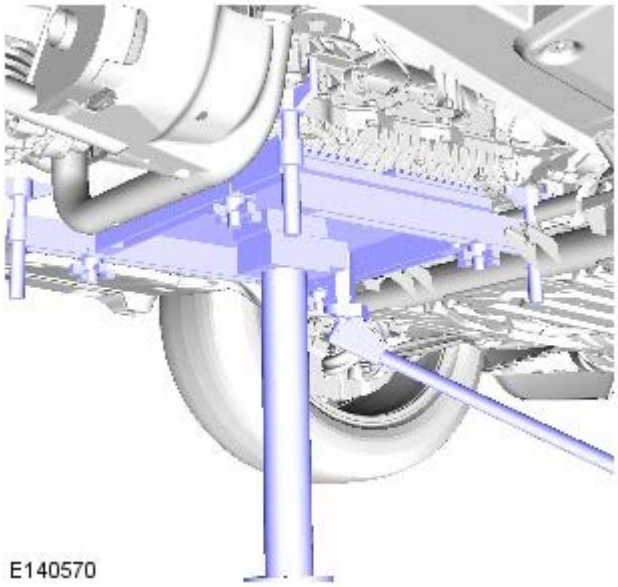
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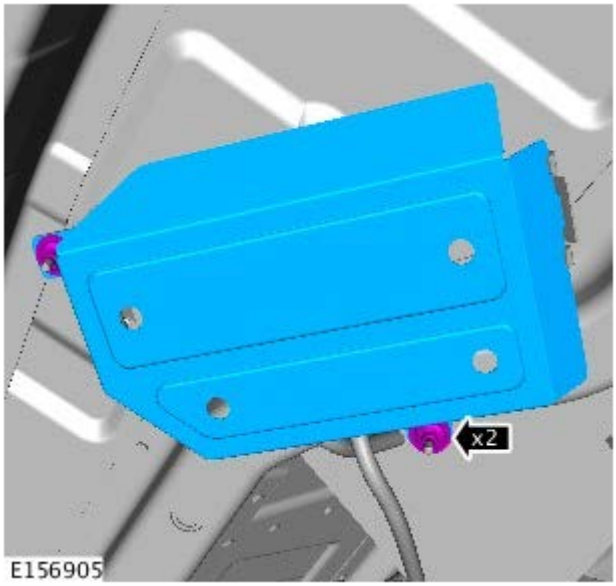


E148881

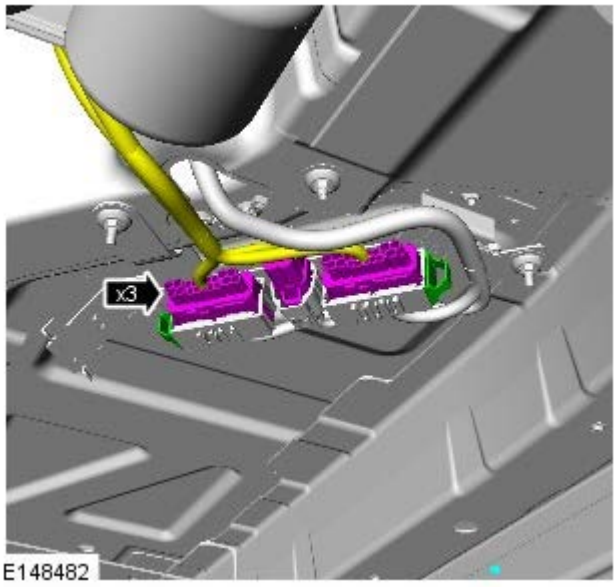
8. NOTE: Using a suitable transmission jack support the differential case.



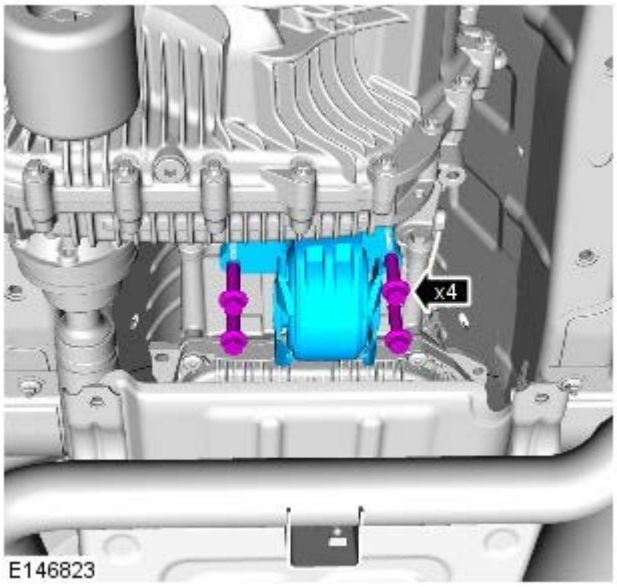
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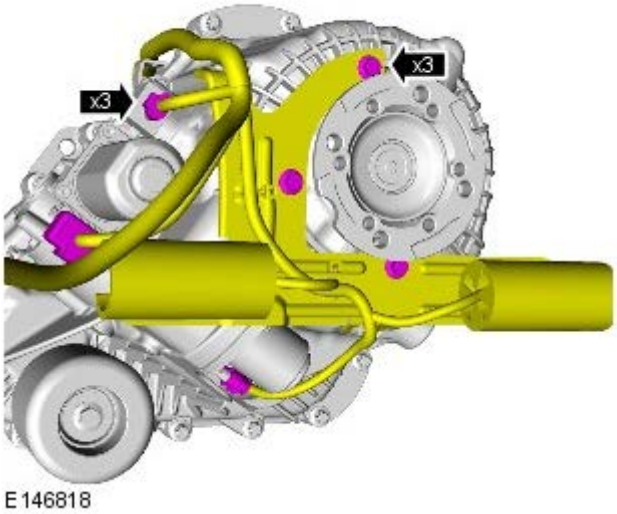
10.



11.



12.

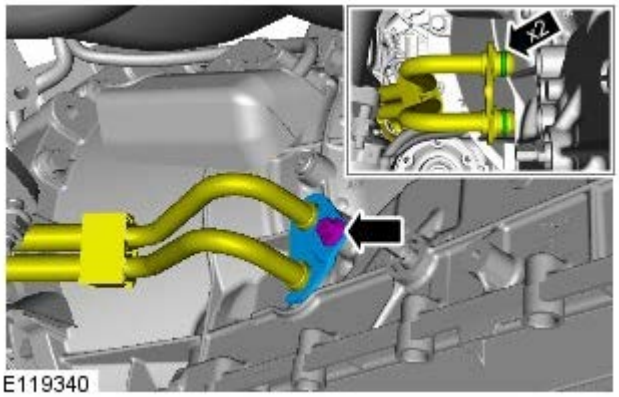


13. CAUTIONS:

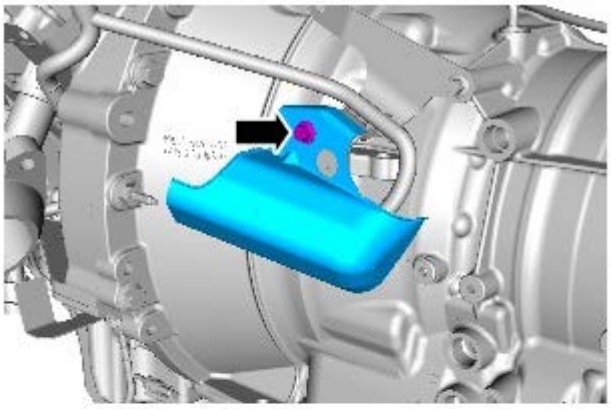
Be prepared to collect escaping fluids.

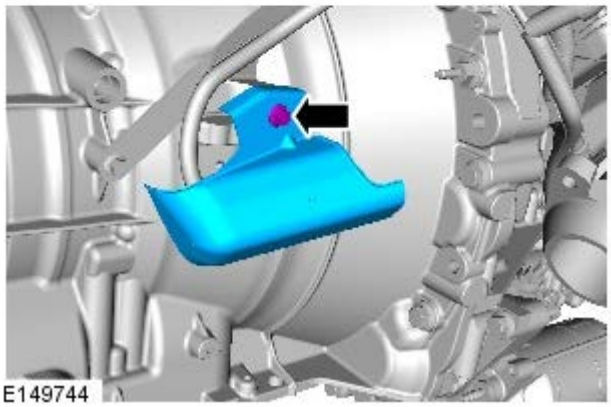
Make sure that all openings are sealed. Use new blanking caps.

- Discard the O-ring seals.

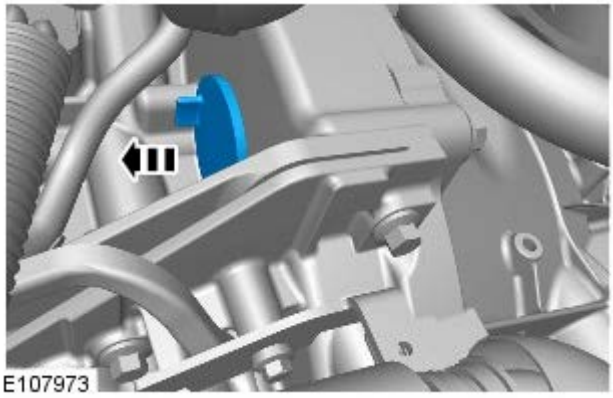


14.

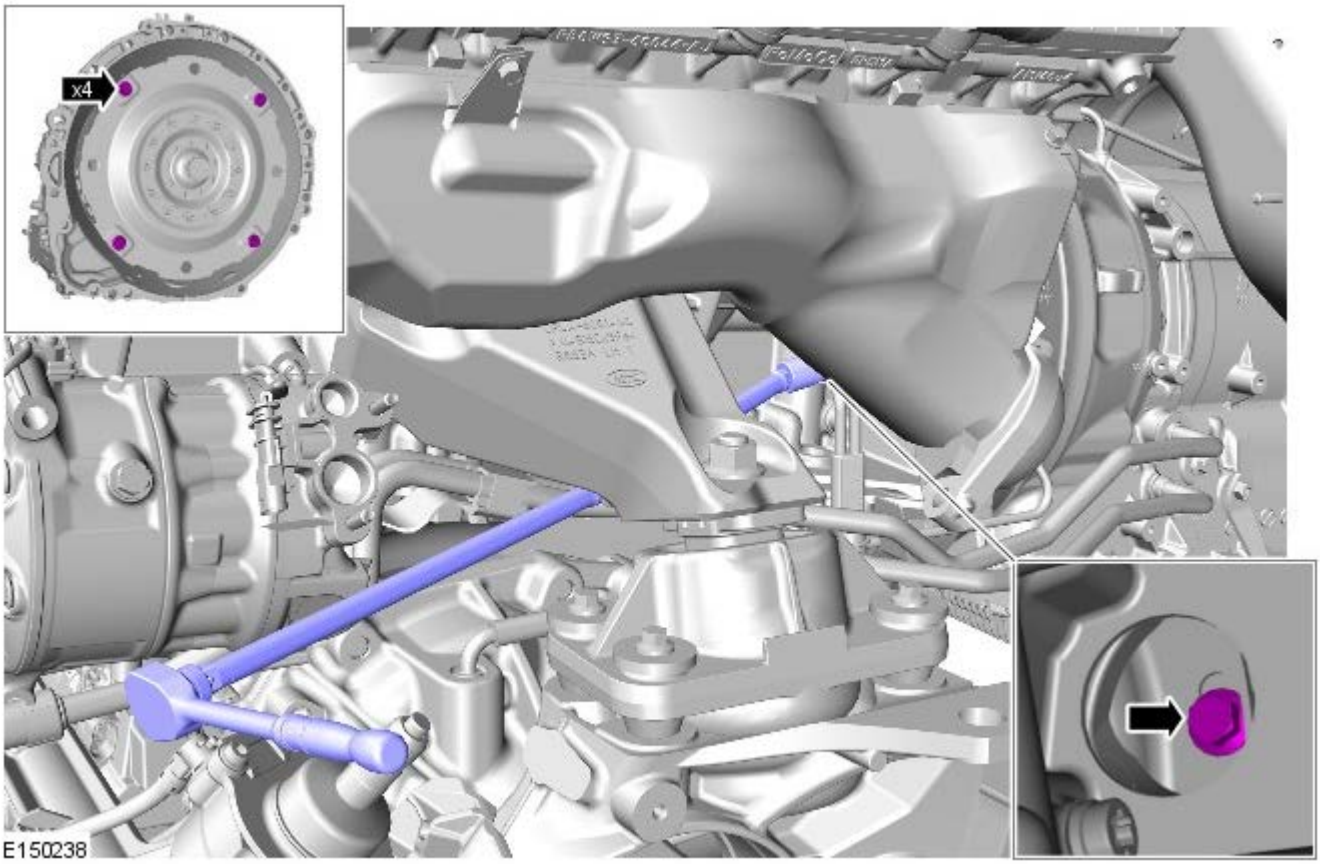


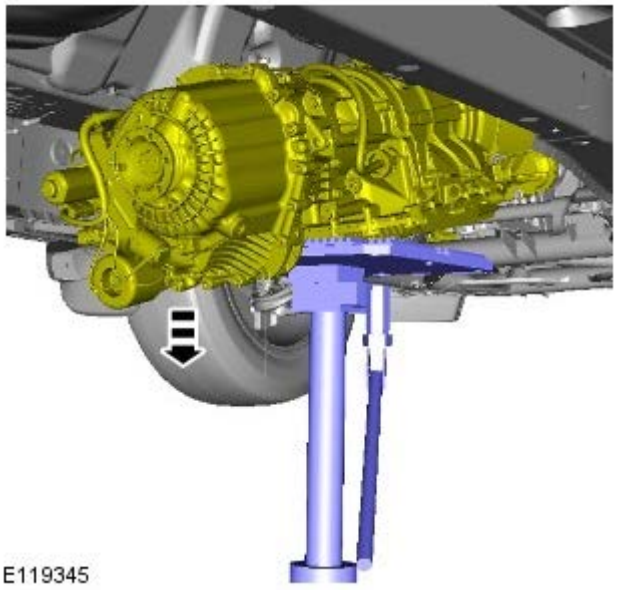


15.



16. CAUTION: Only rotate the crankshaft clockwise.

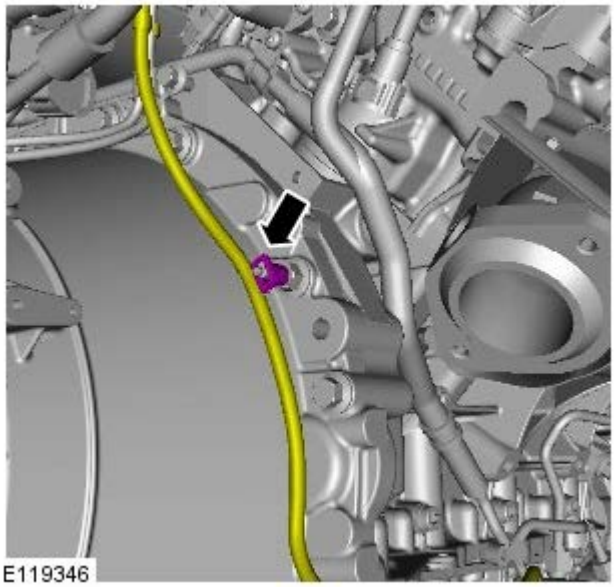




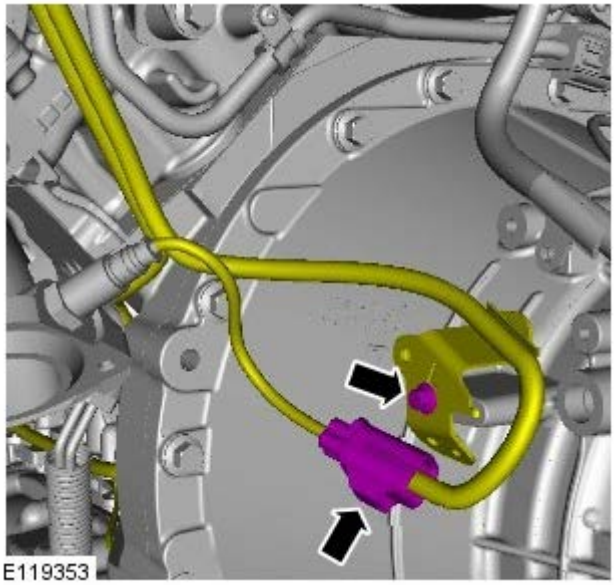
17. WARNING: Make sure that the transmission is secured with suitable retaining straps.

    Lower the rear of the transmission for access.

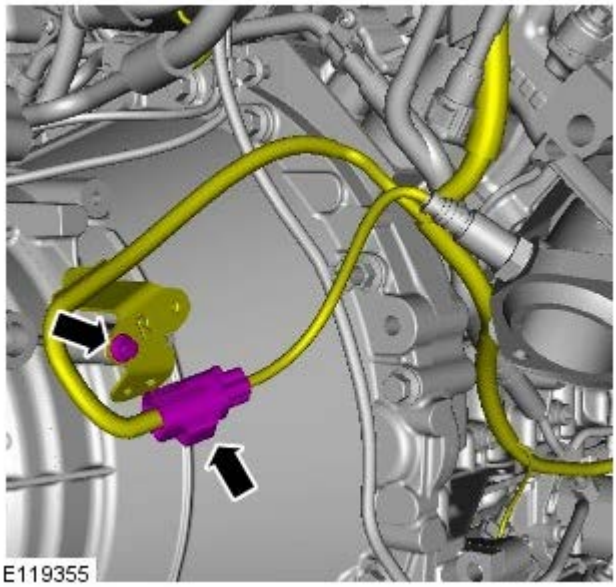
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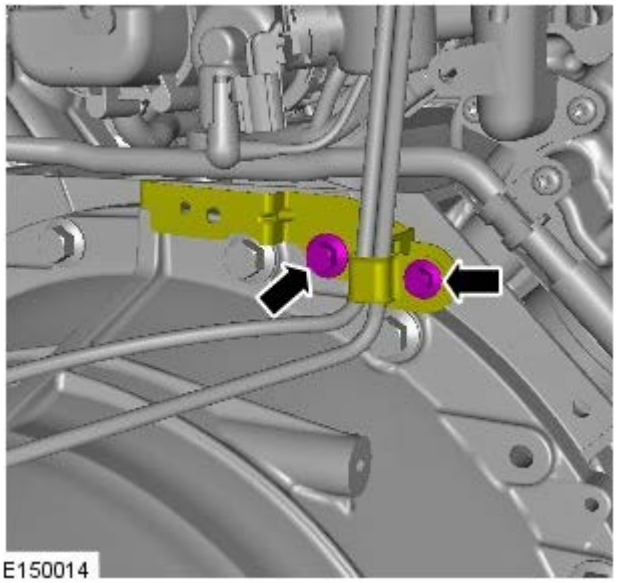
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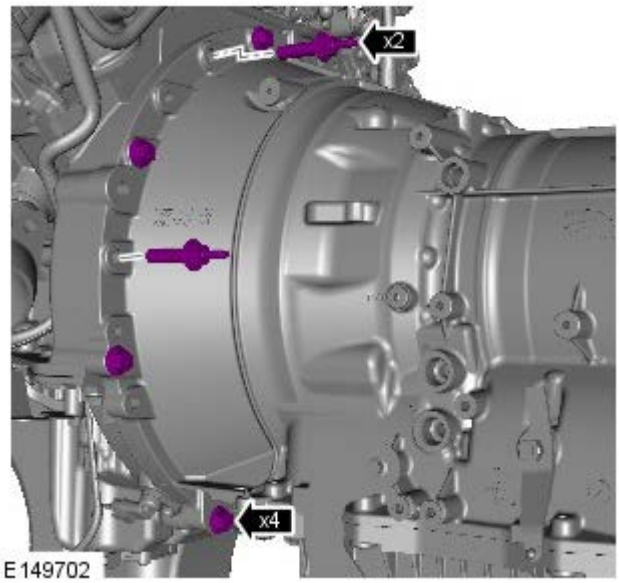
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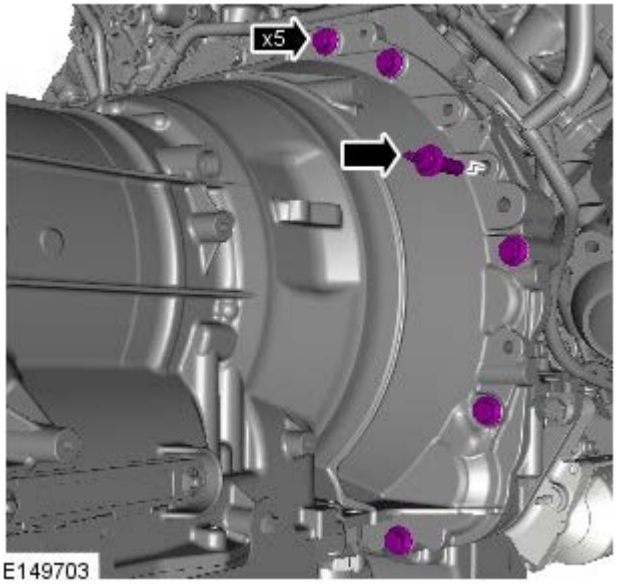
21.



22.

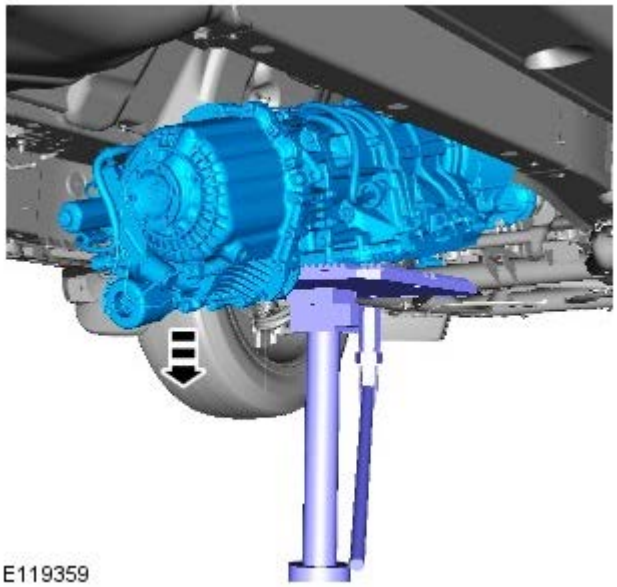


23.



24. WARNING: This step requires the aid of another technician.

CAUTION: Make sure that the torque converter

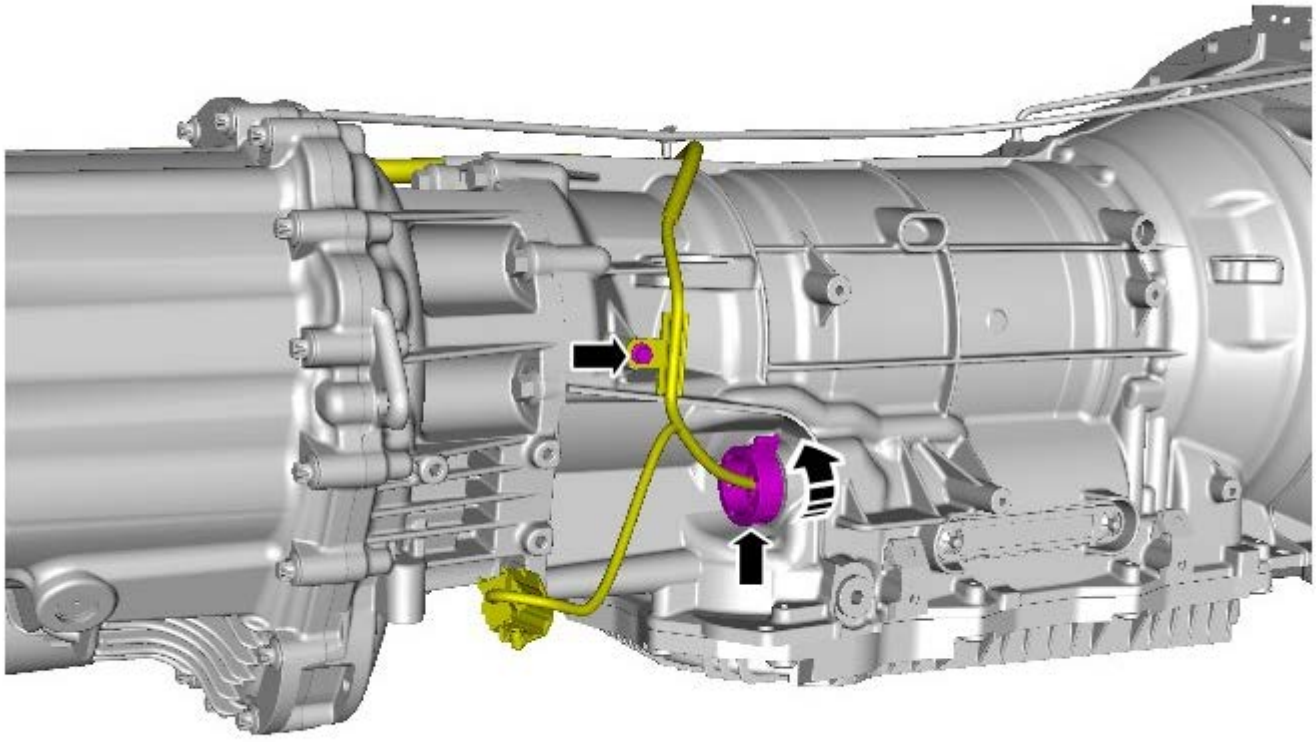


E119359

remains in the transmission.

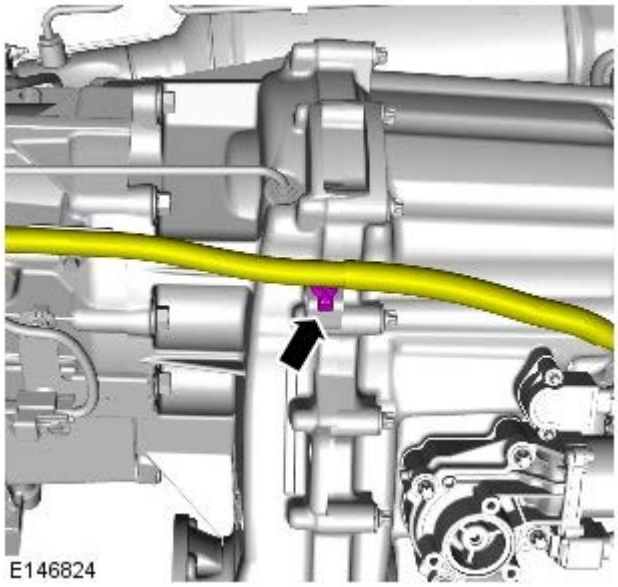
NOTE: Secure the torque converter to the transmission using suitable cable ties.

25. NOTE: Do not disassemble further if the component is removed for access only.

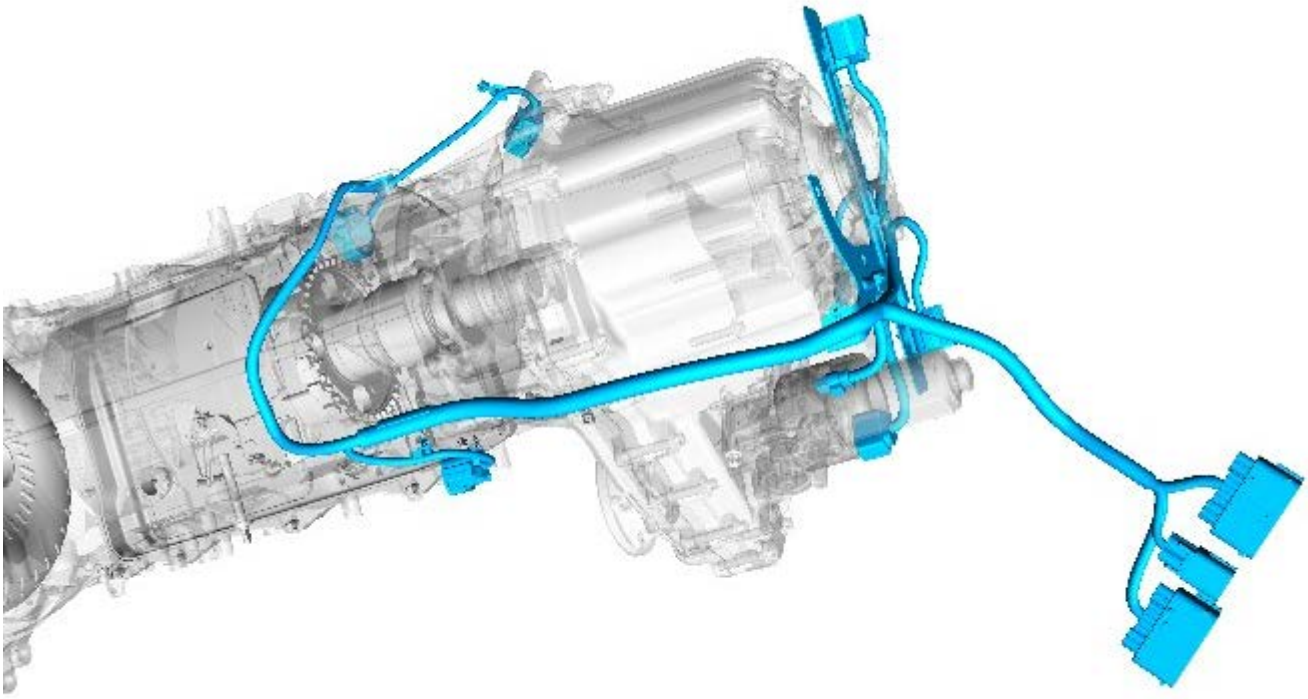


E149706

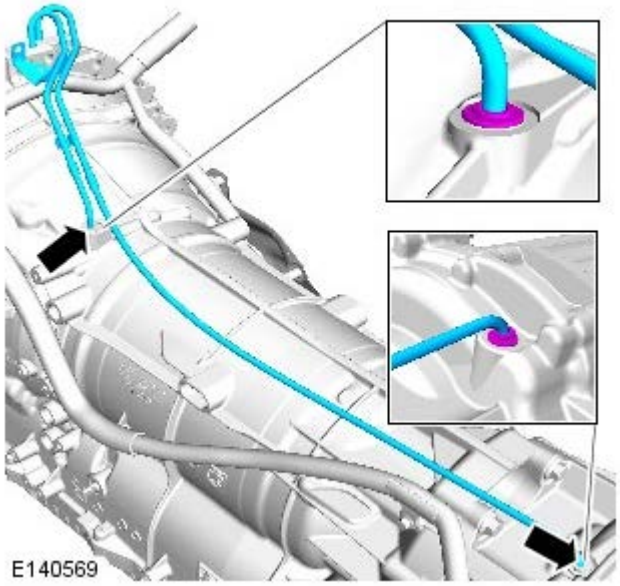
26.



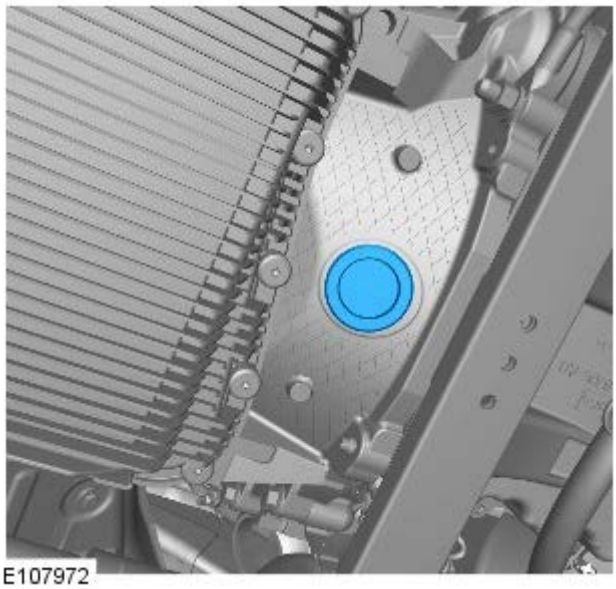
27.



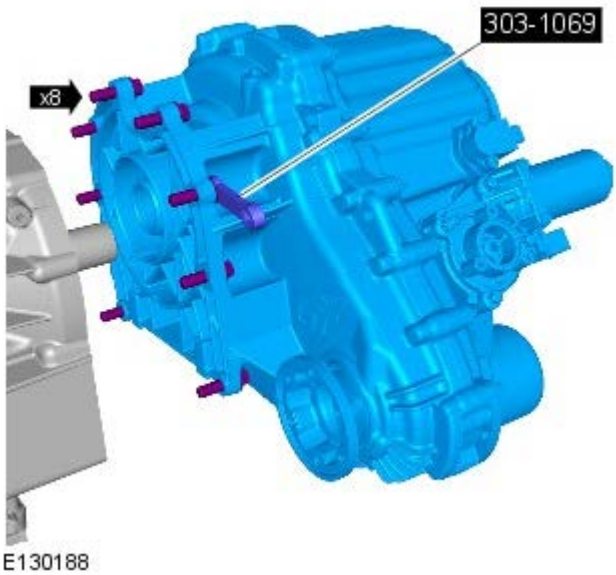
28. CAUTION: Always plug any open connections to prevent contamination.



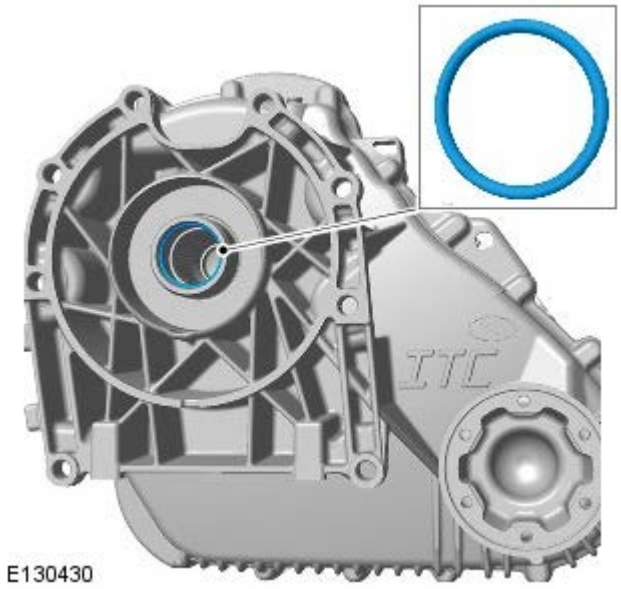
29.



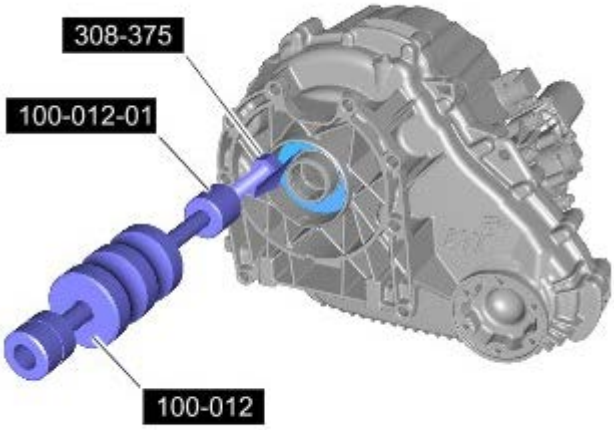
30. *Special Tool(s):* 303-1069



31. CAUTION: Do not carry out this step if a new transfer box is to be installed.



E130430



E131138

32. CAUTIONS:

⚠ Care must be taken to avoid damage to the seal register and running surface.

⚠ Note the fitted position of the component prior to removal.

- *Special Tool(s):* 100-012, 100-012-01, 308-375

Published: 13-Feb-2014

Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - Transmission TDV6 3.0L Diesel

Installation

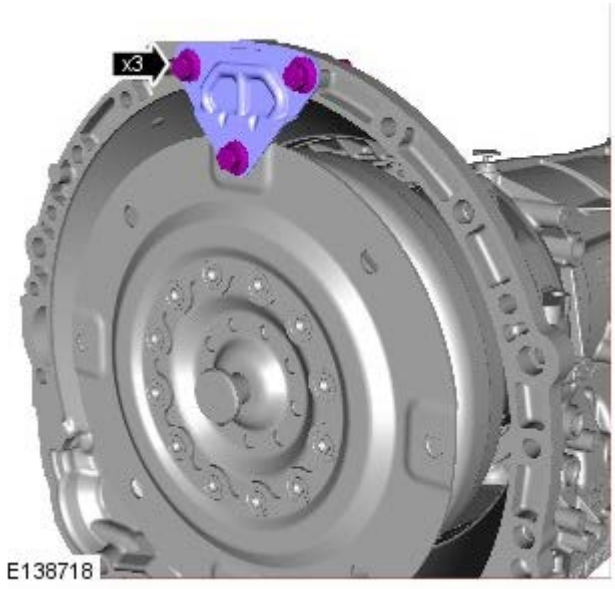
Special Tool(s)

303-1069  E53727	303-1069 Adapter, Wrench
308-598  E50941	308-598 Installer, Oil Seal

NOTES:

Some variation in the illustrations may occur, but the essential information is always correct.

Some illustrations may show the transmission removed for clarity.



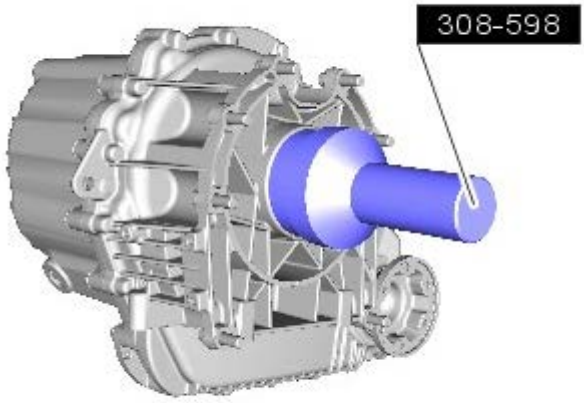
1. NOTE: This step is only required if a new component is installed.

   Remove the torque converter retainer.

2. NOTE: Make sure that the torque converter is fully engaged to the transmission.



E138283



E50943

3. CAUTION: Oil seals must be fitted dry.

   NOTES:

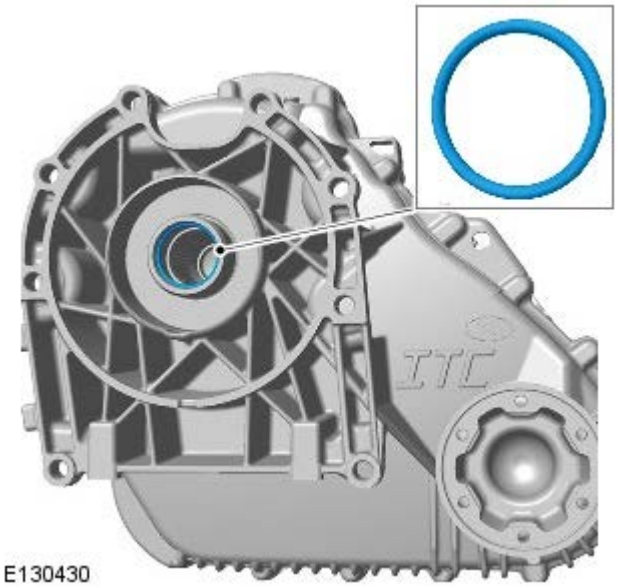
   This step is only required if previously removed.

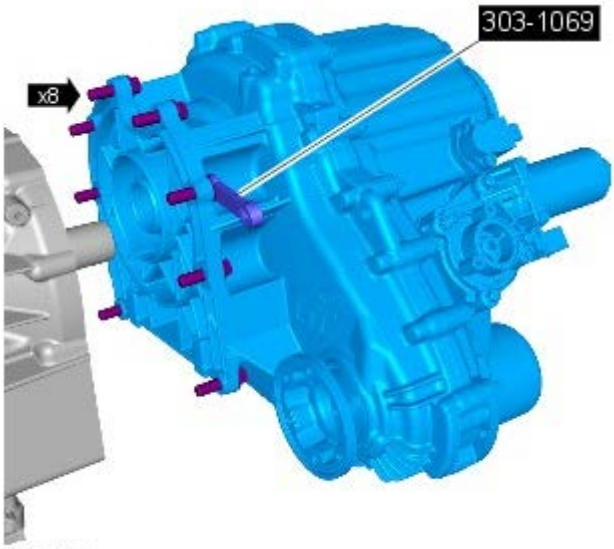
   Make sure that this component is installed to the noted removal position.

   Special Tool(s): 308-598

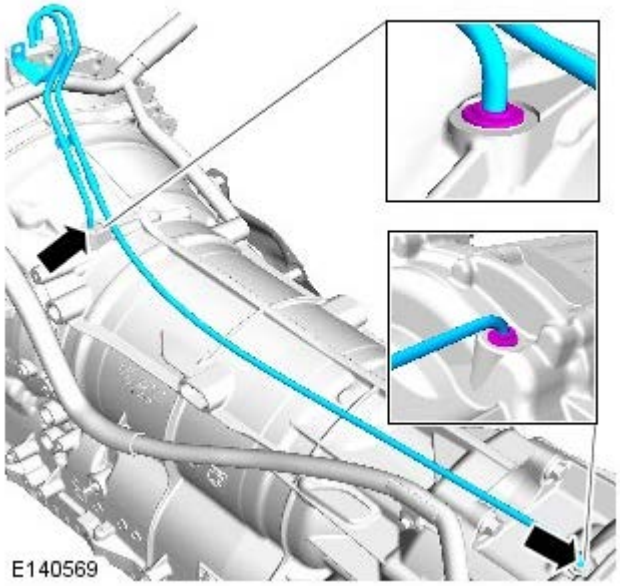
4. NOTE: This step is only required if previously removed.

   Install a new O-ring seal.





5. NOTE: This step is only required if previously removed.
   - *Special Tool(s):* 303-1069
   - Clean the component mating faces.
   - Lubricate input shaft splines with 'Weicon TL7391' grease.
   - *Torque:* 45 Nm



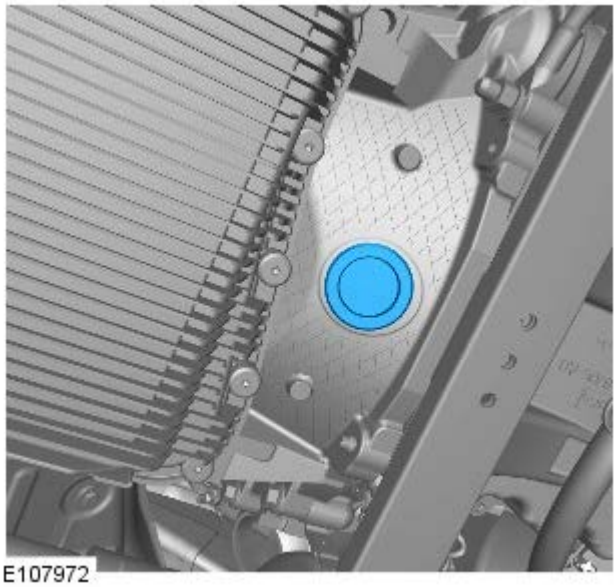
6. CAUTIONS:

   To prevent water ingress and subsequent transmission damage, make sure that the breather is fully pushed home into the transmission casing. The white line around the circumference of the pipe should not be visible when correctly installed.

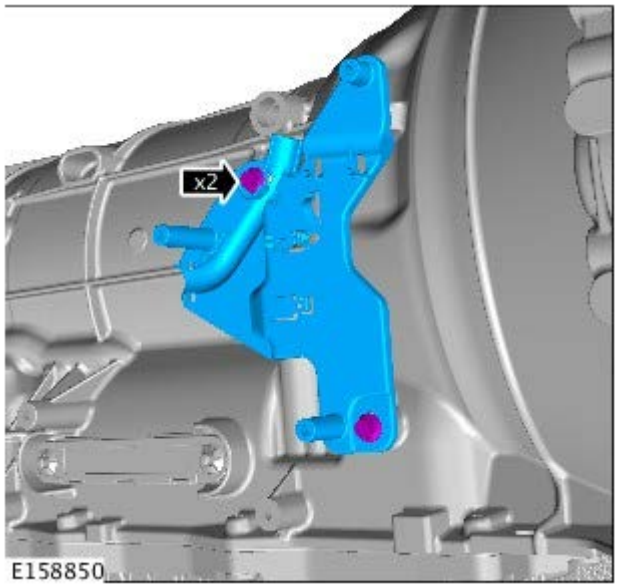
   Remove the blanking plugs.

   NOTE: This step is only required if a new component is installed.

7.

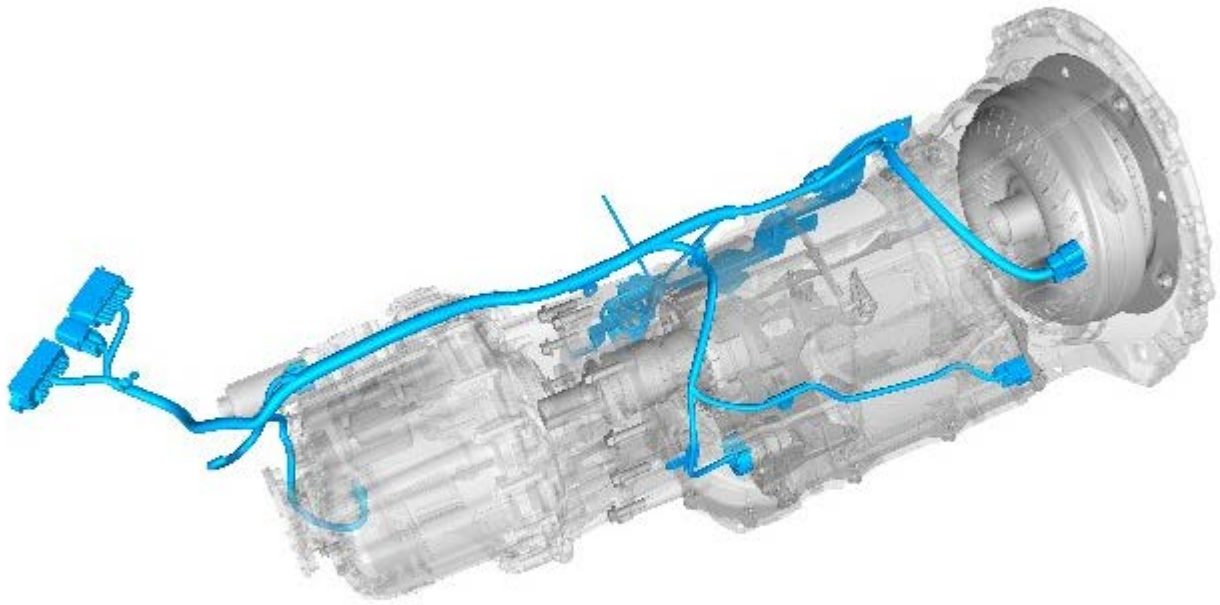

E107972

8. *Torque:* 9 Nm



E158850

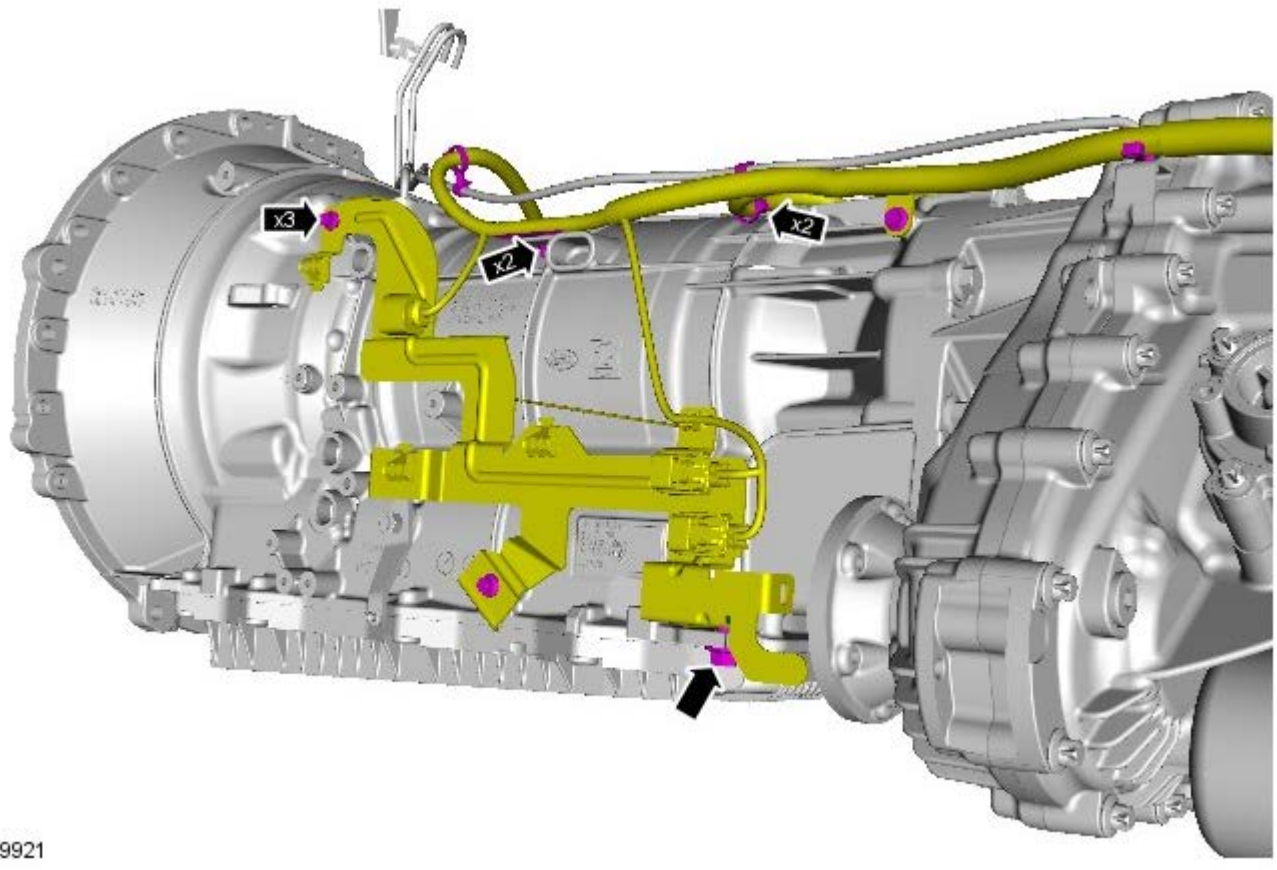
9.



E158851

10. NOTE: This step is only required if previously removed.

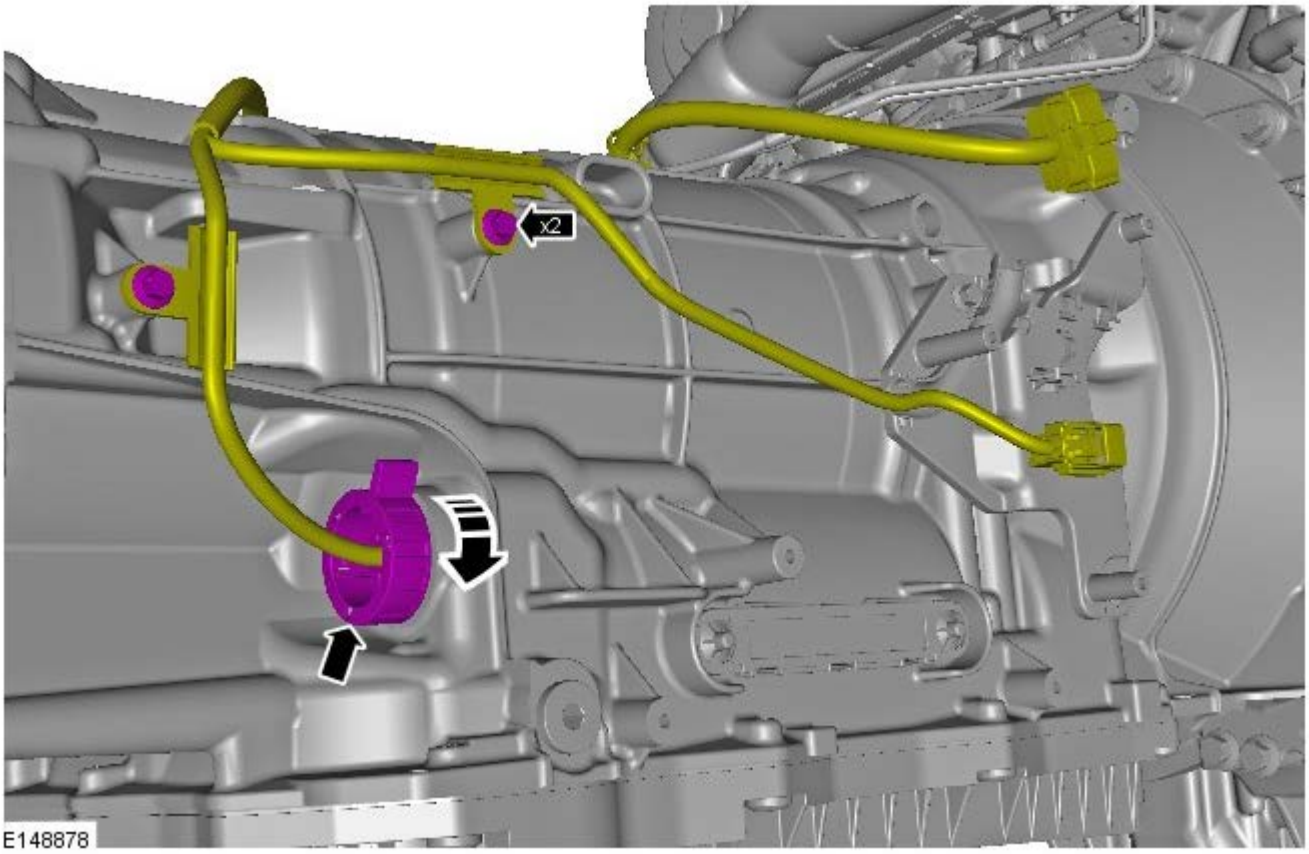
Torque:
M8 25 Nm
M6 10 Nm

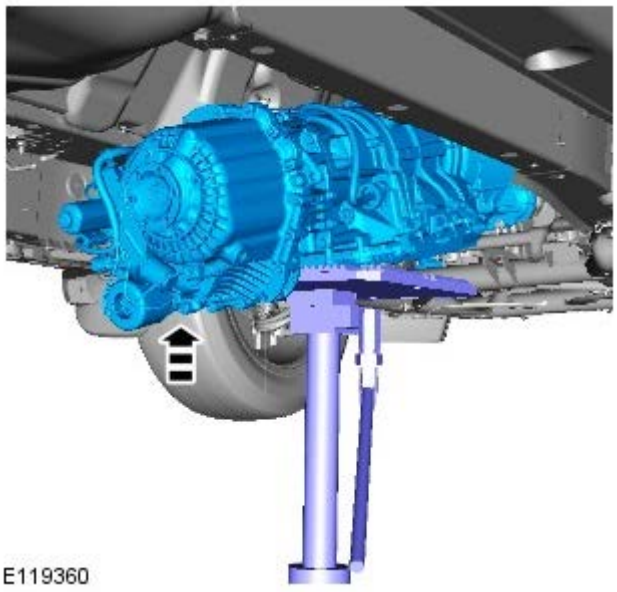


E149921

11. NOTE: This step is only required if previously removed.

Torque: 10 Nm





12. WARNING: Make sure that the transmission is secured with suitable retaining straps.

    CAUTIONS:

    Apply grease of the correct specification to the torque converter spigot.

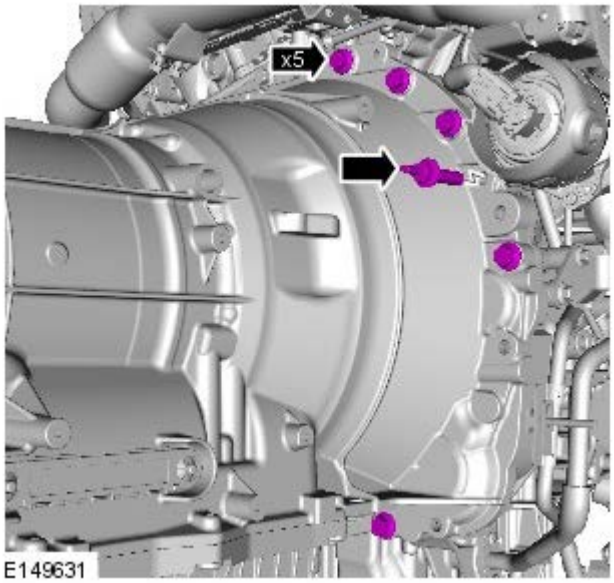
    Make sure that the torque converter remains in the transmission.

    Remove and discard the cable ties securing the torque converter.

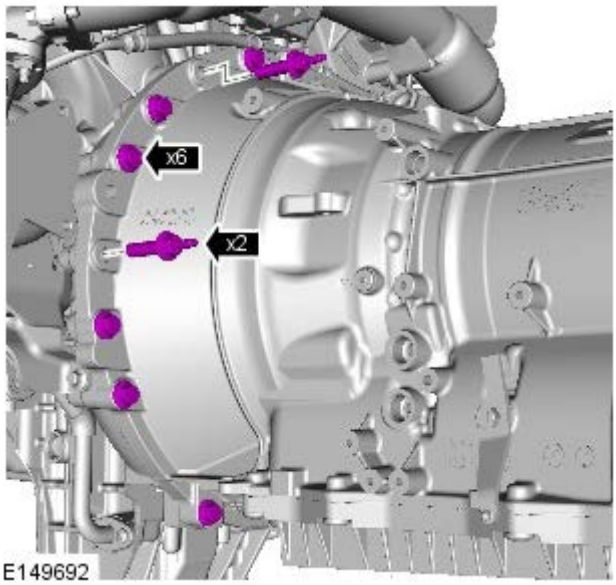
    NOTE: This step requires the aid of other technicians.

    Using a suitable hydraulic jack, support the transmission.

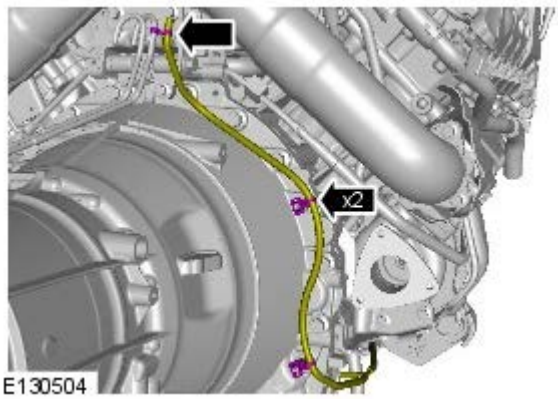
13. *Torque:* 40 Nm



14. *Torque:* 40 Nm

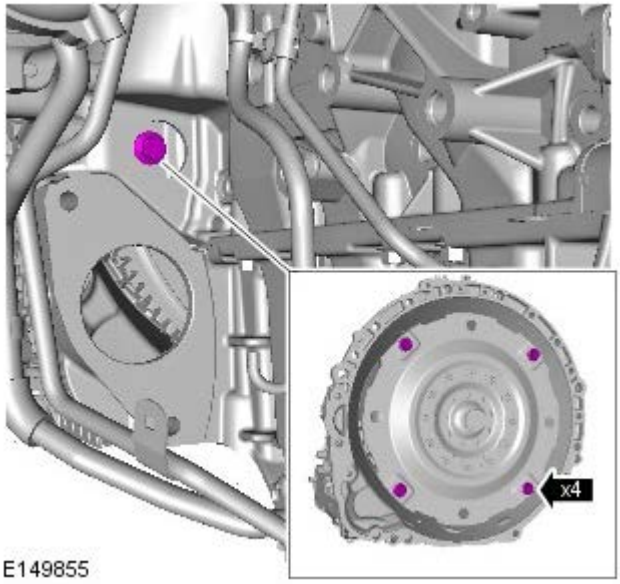


15.

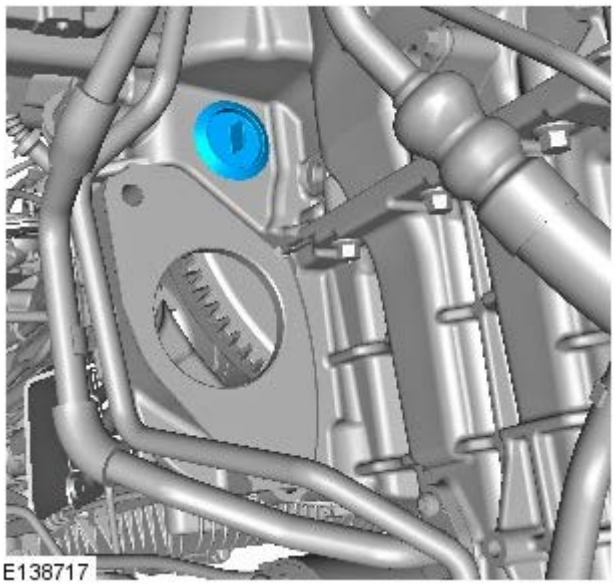


16. CAUTION: Only rotate the crankshaft clockwise.

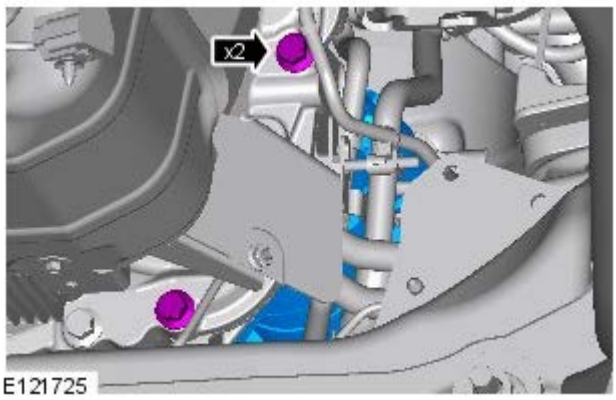
Torque: 63 Nm



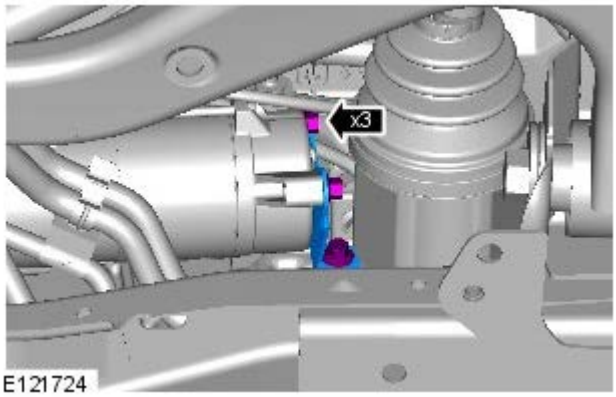
17.



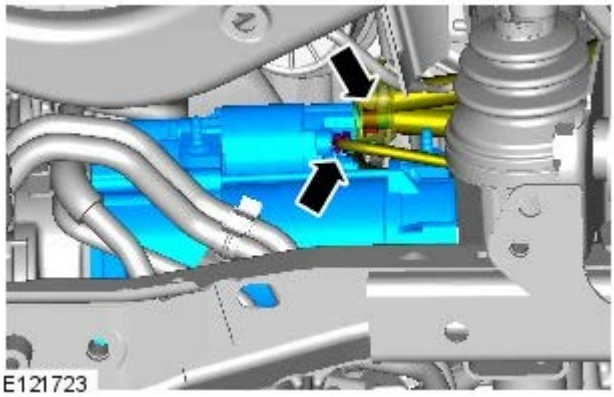
18. *Torque:* 45 Nm



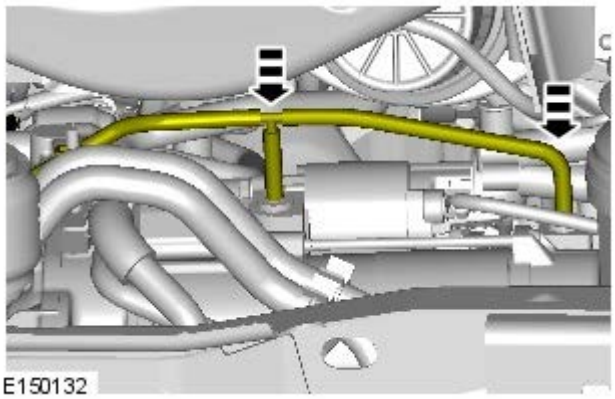
19. *Torque:* 30 Nm



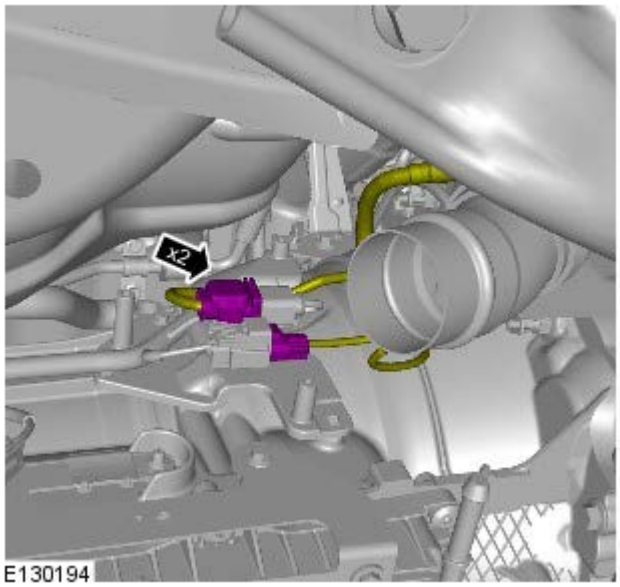
20. *Torque:*
    M8 10 Nm
    M6 7 Nm



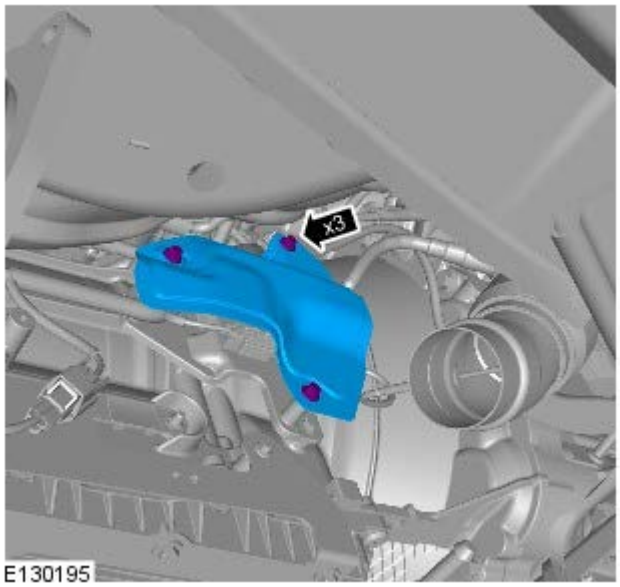
21.

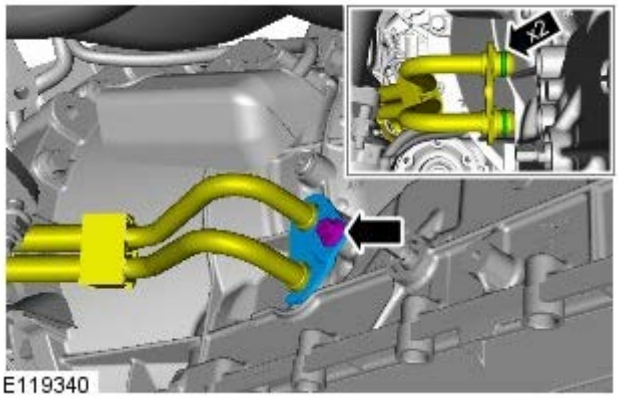


22.



23. *Torque:* 10 Nm



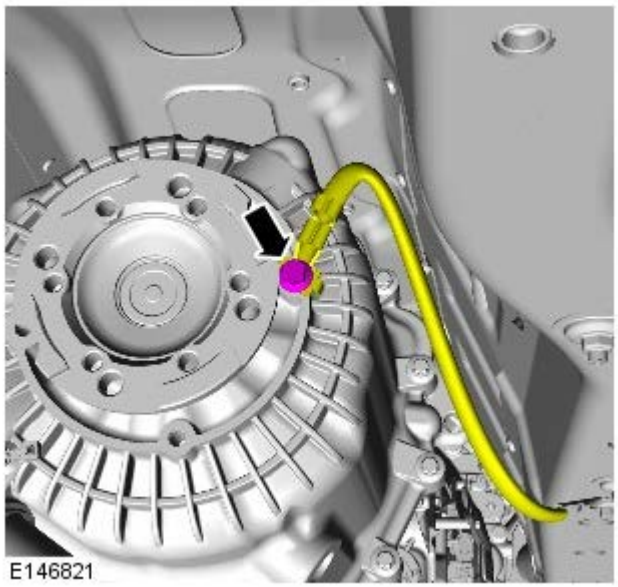


24. CAUTION: Be prepared to collect escaping fluids.

NOTE: Install new O-ring seals.

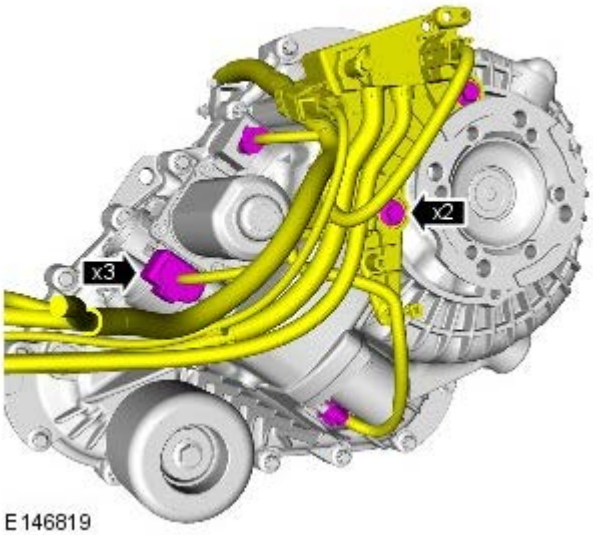
Torque: 22 Nm

25. *Torque:* 25 Nm



26. NOTE: Vehicles with DPF (Diesel Particulate Filter) installed only.

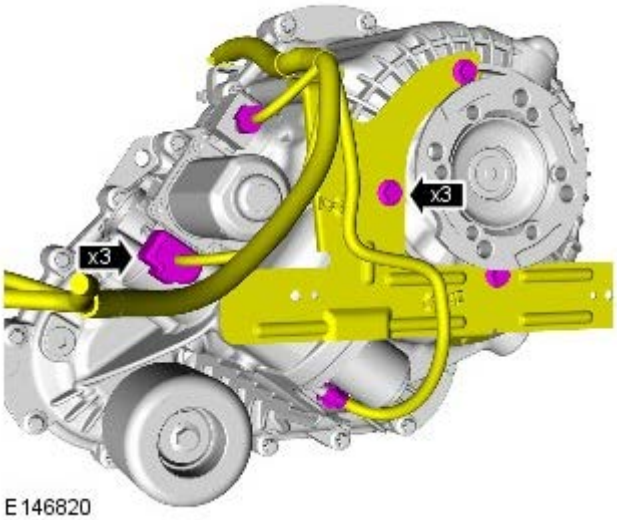
Torque: 25 Nm



E146819

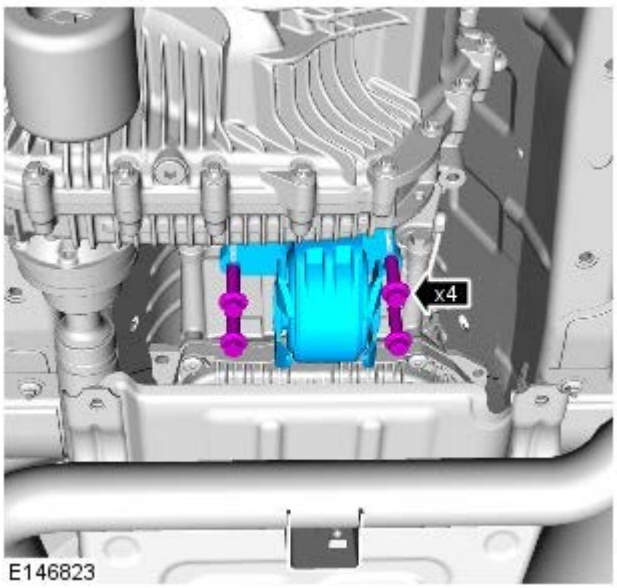
27. NOTE: Vehicles without diesel particulate filer (DPF).

    Torque: 25 Nm



E146820

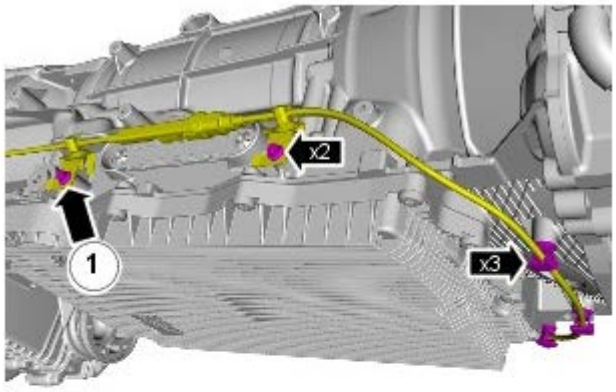
28. *Torque:* 60 Nm

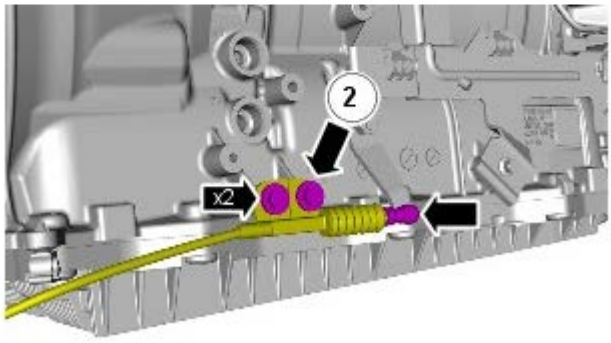


E146823

29.

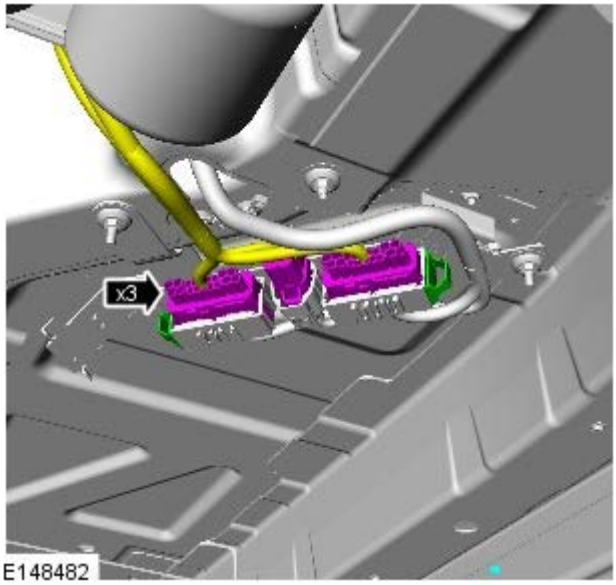
- *Torque:* 10 Nm





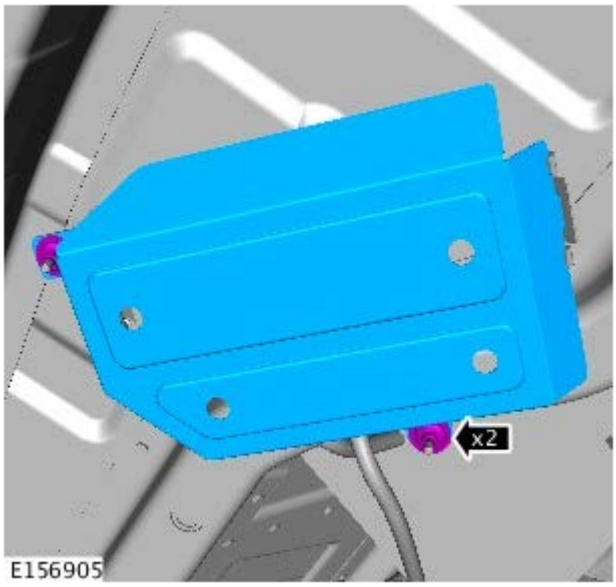
E149962

30.

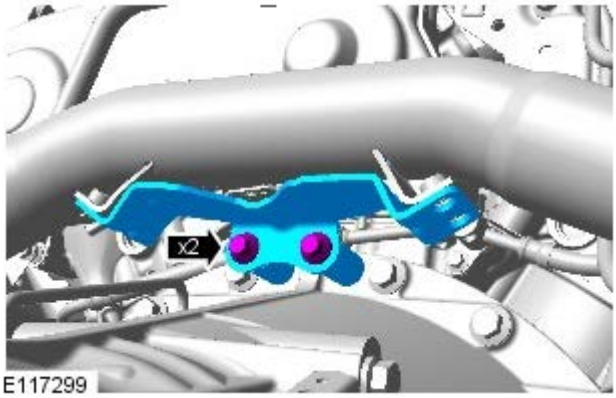


E148482

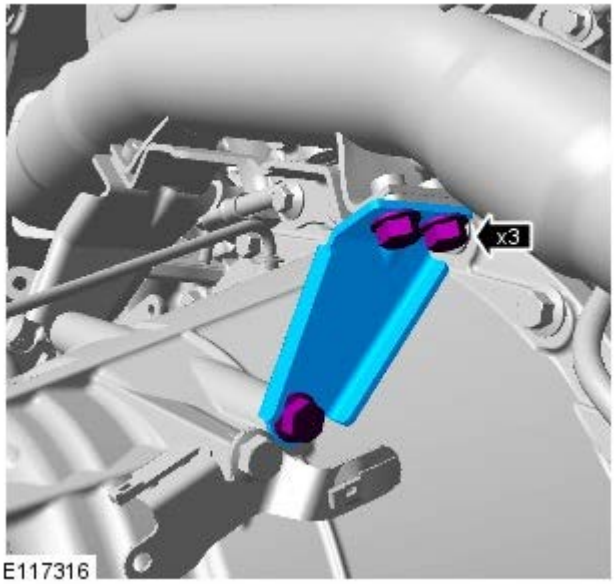
31. *Torque:* 9 Nm



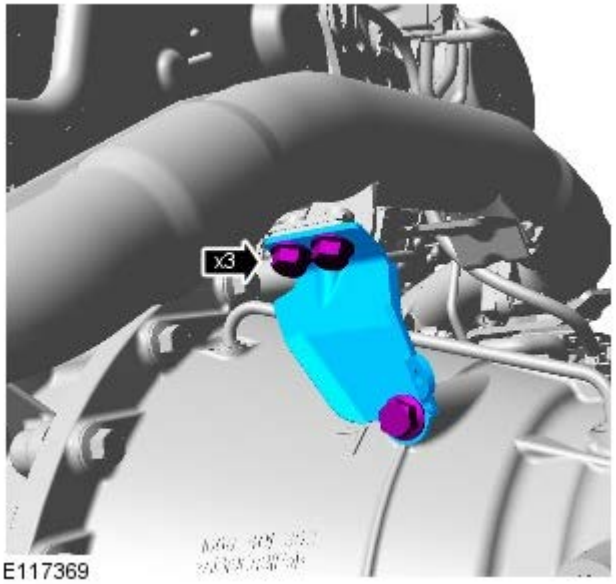
32. *Torque:* 23 Nm



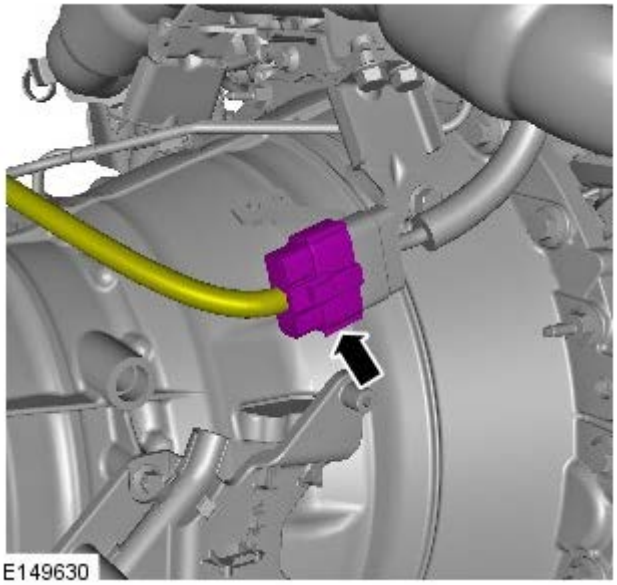
33. *Torque:* 23 Nm



34. *Torque:* 23 Nm



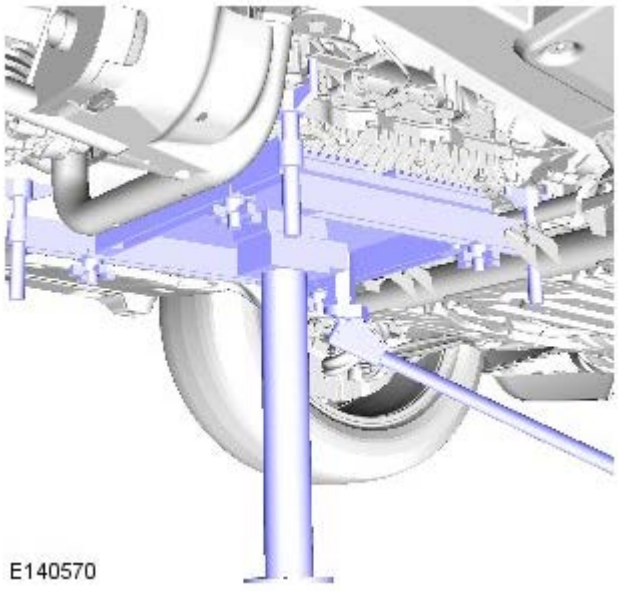
35.



36. Refer to: Rear Driveshaft - TDV6 3.0L Diesel (205-01 Driveshaft, Removal and Installation).

37. Refer to: Front Driveshaft - TDV6 3.0L Diesel (205-01 Driveshaft, Removal and Installation).

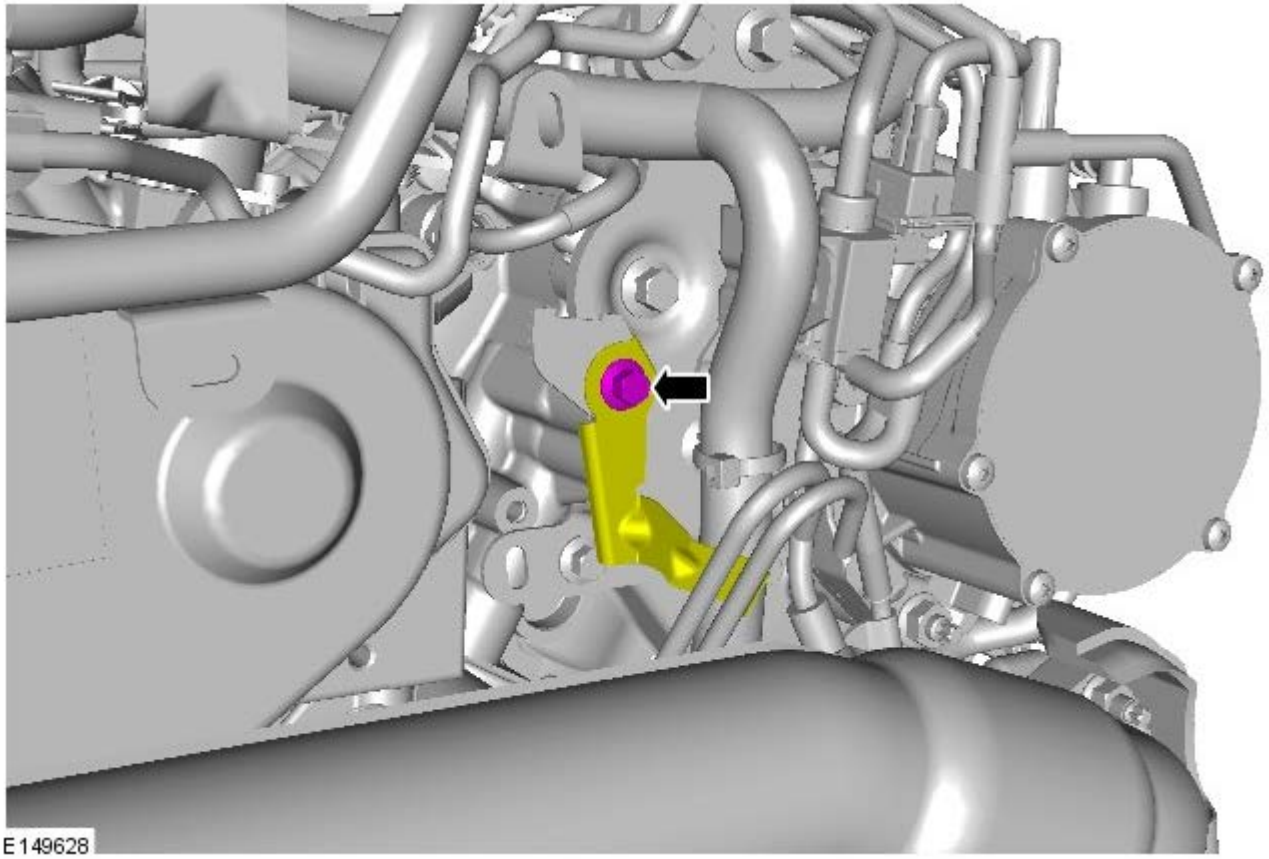
38. Remove the jack supporting the transmission.



39. Lower the vehicle.

40. Refer to: Secondary Bulkhead Center Panel - TDV6 3.0L Diesel (501-02, Removal and Installation).

41. *Torque:* 12 Nm



42. Refer to: Secondary Bulkhead Center Panel - TDV6 3.0L Diesel (501-02, Removal and Installation).

43. Connect the battery ground cable.

    Refer to: Specifications (414-01, Specifications).

44. Carry out a transmission fluid level check.

    Refer to: Transmission Fluid Level Check - TDV6 3.0L Diesel /TDV8 4.4L Diesel (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, General Procedures).

Published: 13-Feb-2014

Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - Transmission TDV8 4.4L Diesel

Installation

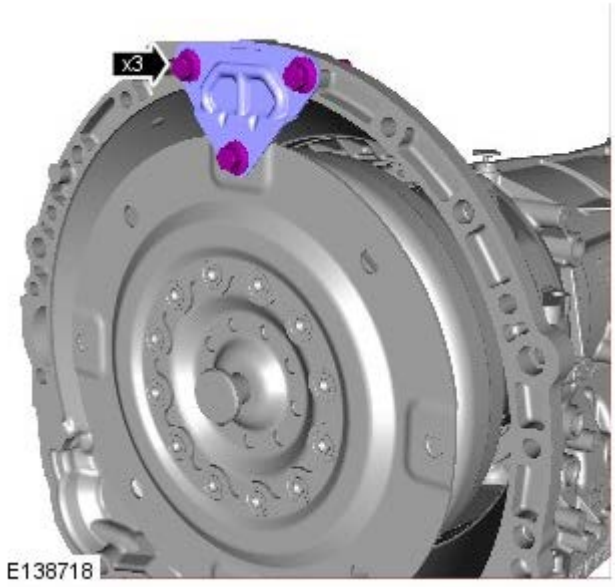
Special Tool(s)

303-1069  E53727	303-1069 Adapter, Wrench
308-598  E50941	308-598 Installer, Oil Seal

NOTES:

Some variation in the illustrations may occur, but the essential information is always correct.

Some illustrations may show the transmission removed for clarty.

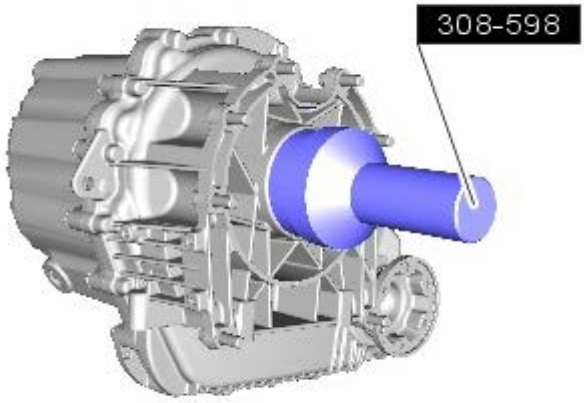


1. NOTE: This step is only required if a new component is installed.

2. NOTE: Make sure that the torque converter is fully engaged to the transmission.



E138283



E50943

3. CAUTION: Oil seals must be fitted dry.

   NOTES:

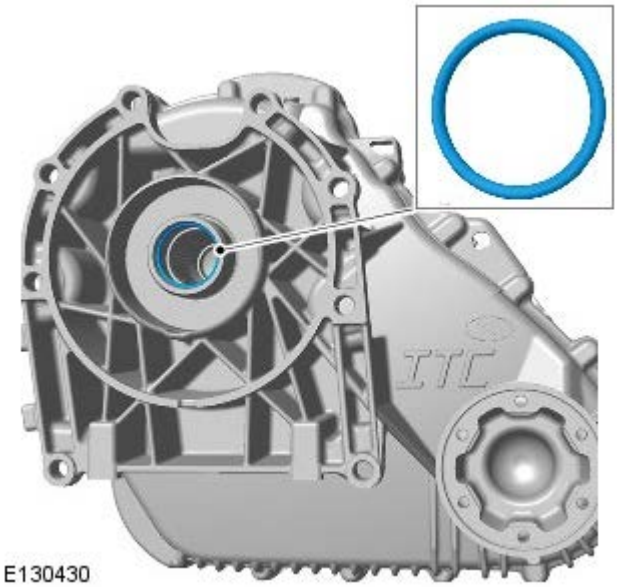
   This step is only required if previously removed.

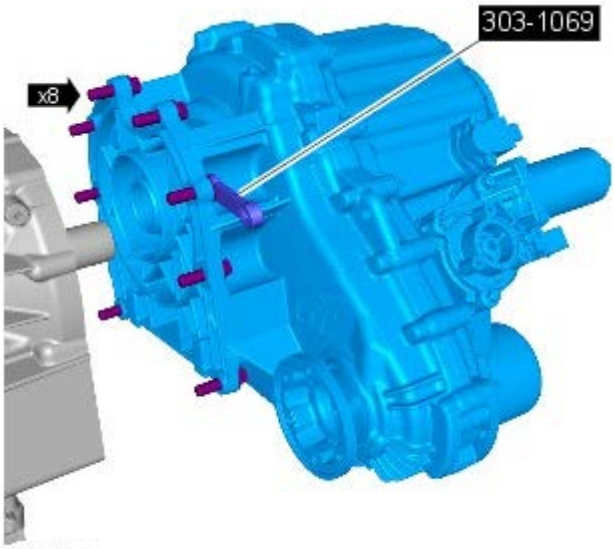
   Make sure that this component is installed to the noted removal position.

   Special Tool(s): 308-598

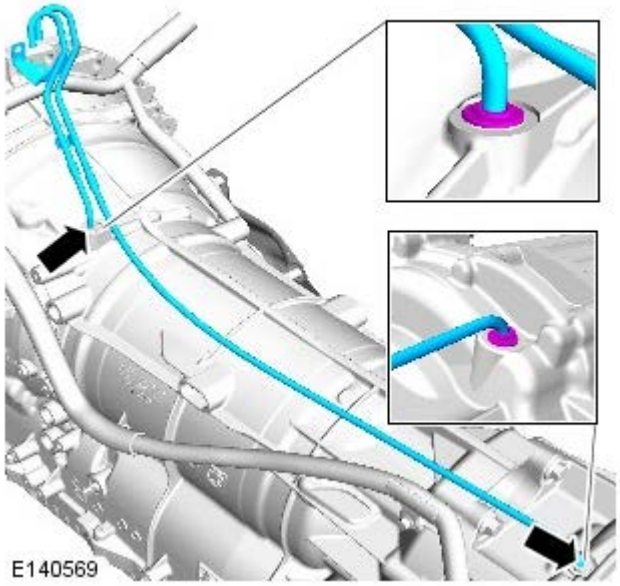
4. NOTE: This step is only required if previously removed.

   Install a new O-ring seal.





5. NOTE: This step is only required if previously removed.
   - *Special Tool(s):* 303-1069
   - Clean the component mating faces.
   - Lubricate input shaft splines with 'Weicon TL7391' grease.
   - *Torque:* 45 Nm



6. CAUTIONS:

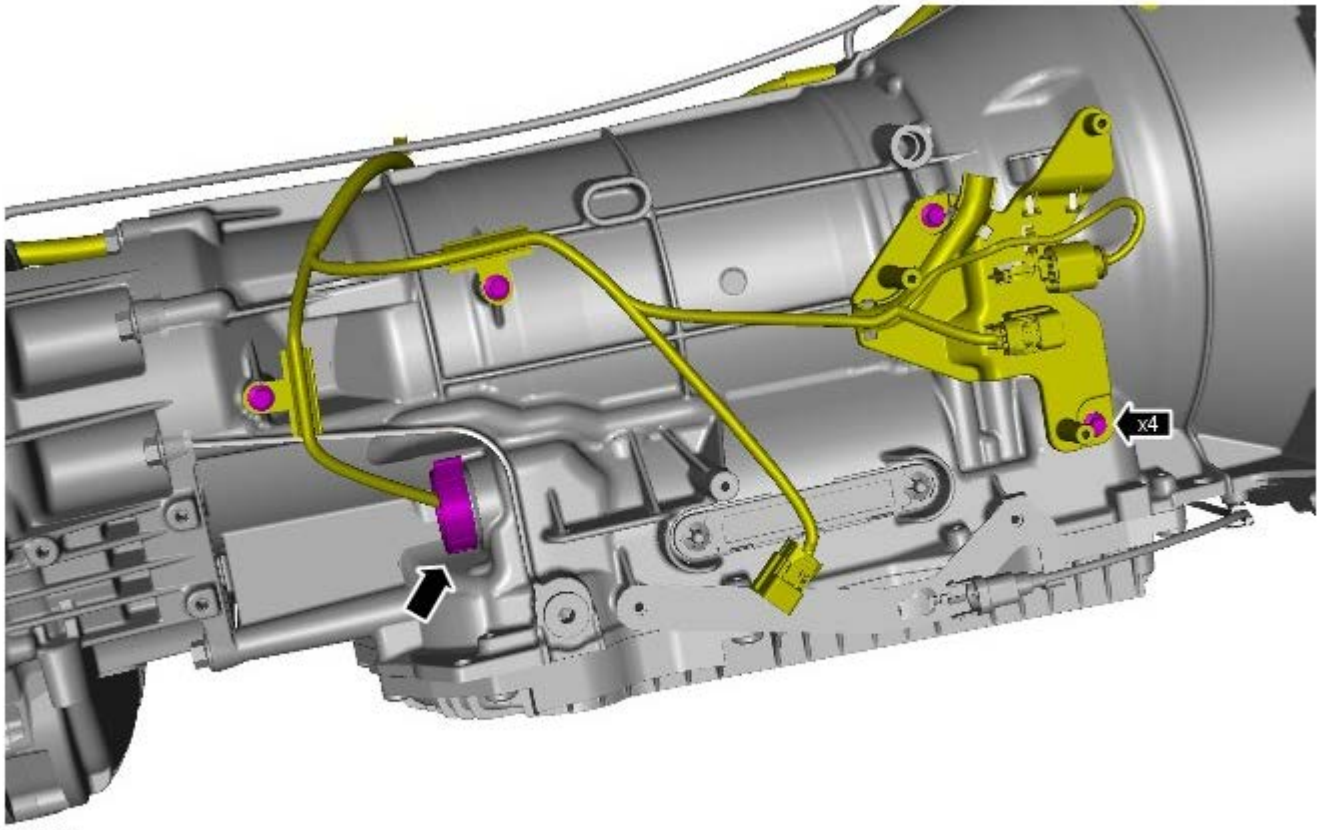
   Remove the blanking plugs.

   To prevent water ingress and subsequent transmission damage, make sure that the breather is fully pushed home into the transmission casing. The white line around the circumference of the pipe should not be visible when correctly installed.

   NOTE: This step is only required if previously removed.

7. NOTE: This step is only required if previously removed.

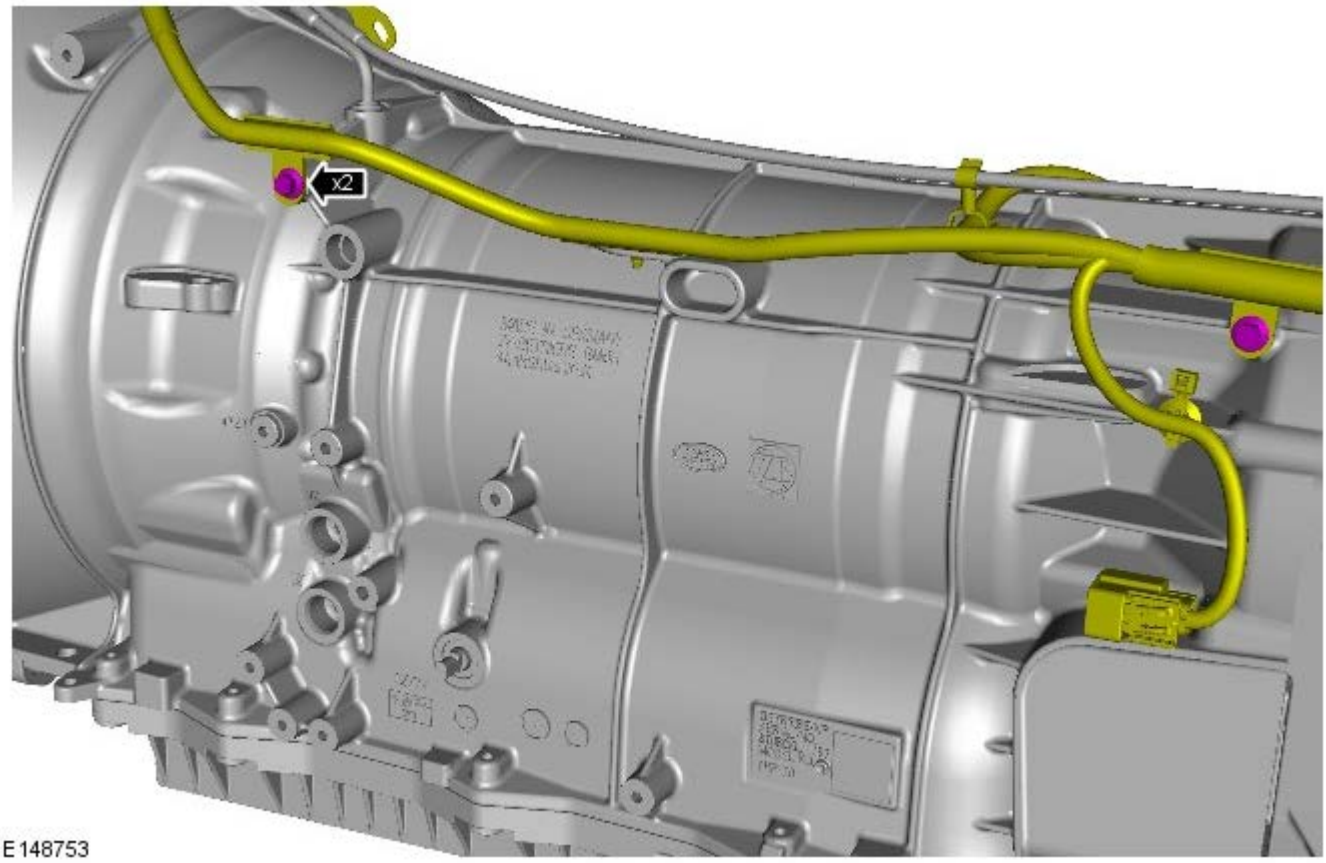
   Torque: 8 Nm



E148754

8. NOTE: This step is only required if previously removed.

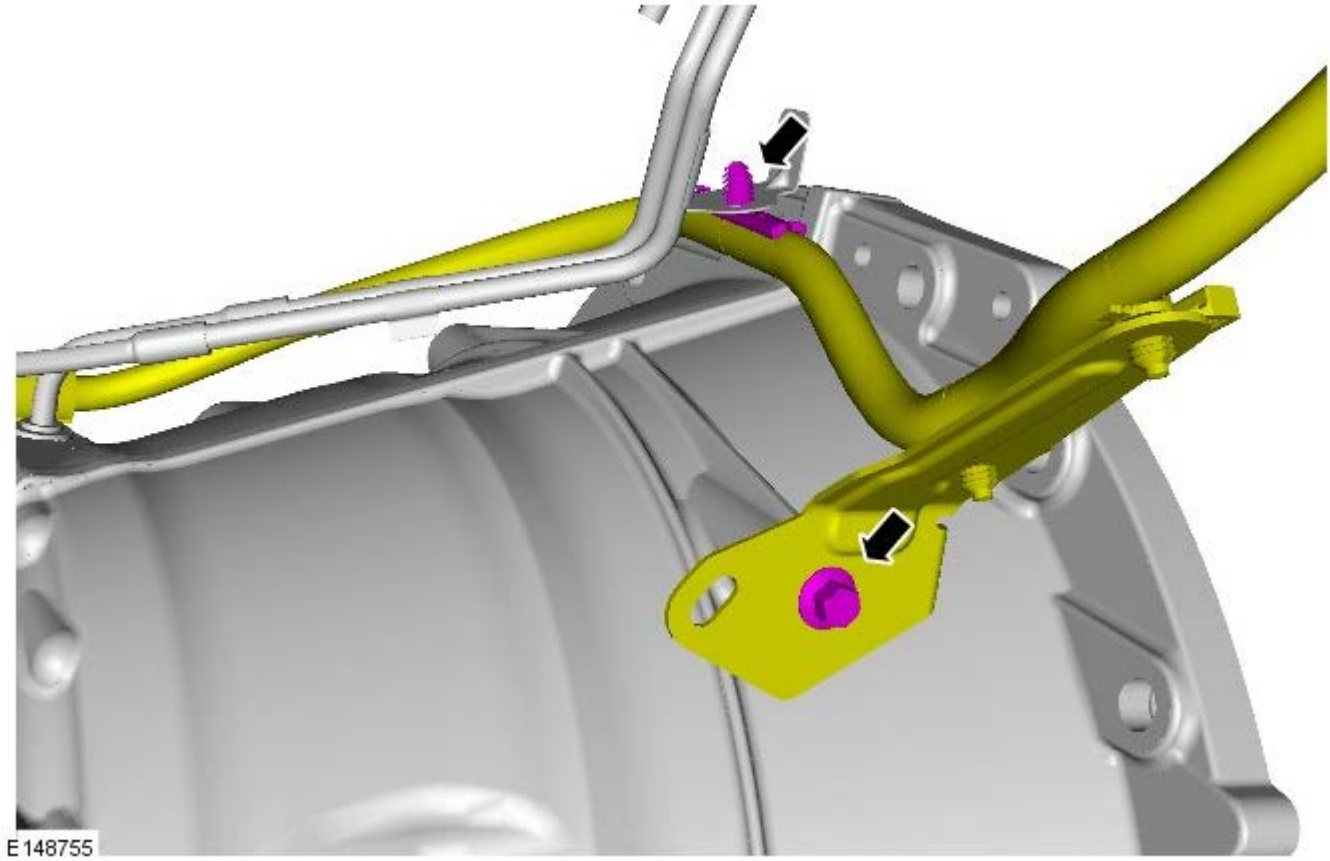
Torque: 10 Nm

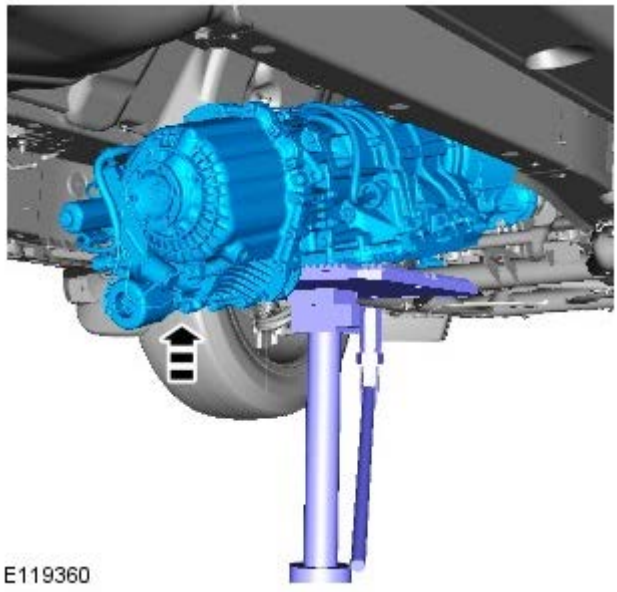


E148753

9. NOTE: This step is only required if previously removed.

Torque: 12 Nm





10. WARNING: Make sure that the transmission is secured with suitable retaining straps.

CAUTIONS:

Apply grease of the correct specification to the torque converter spigot.

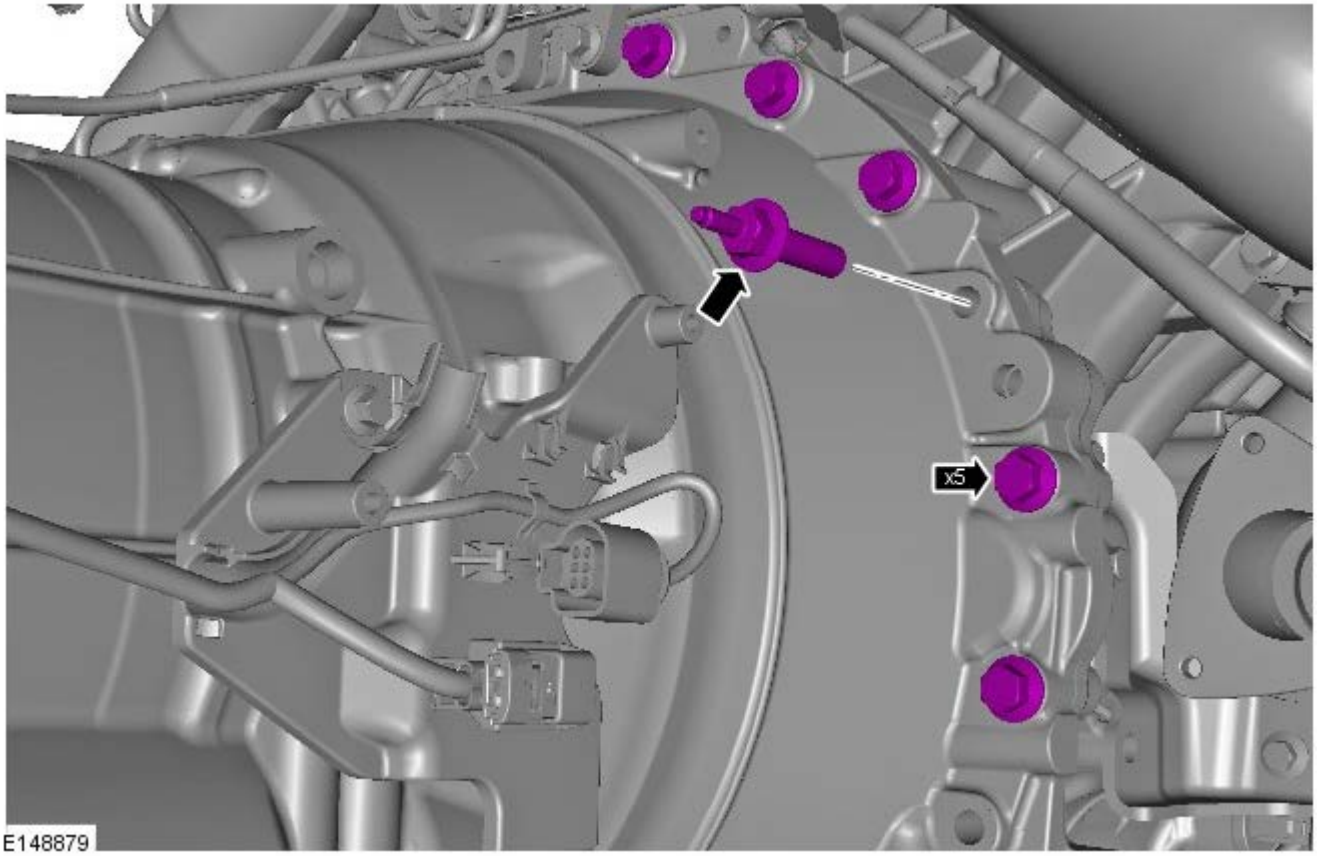
Make sure that the torque converter remains in the transmission.

Remove and discard the cable ties securing the torque converter.

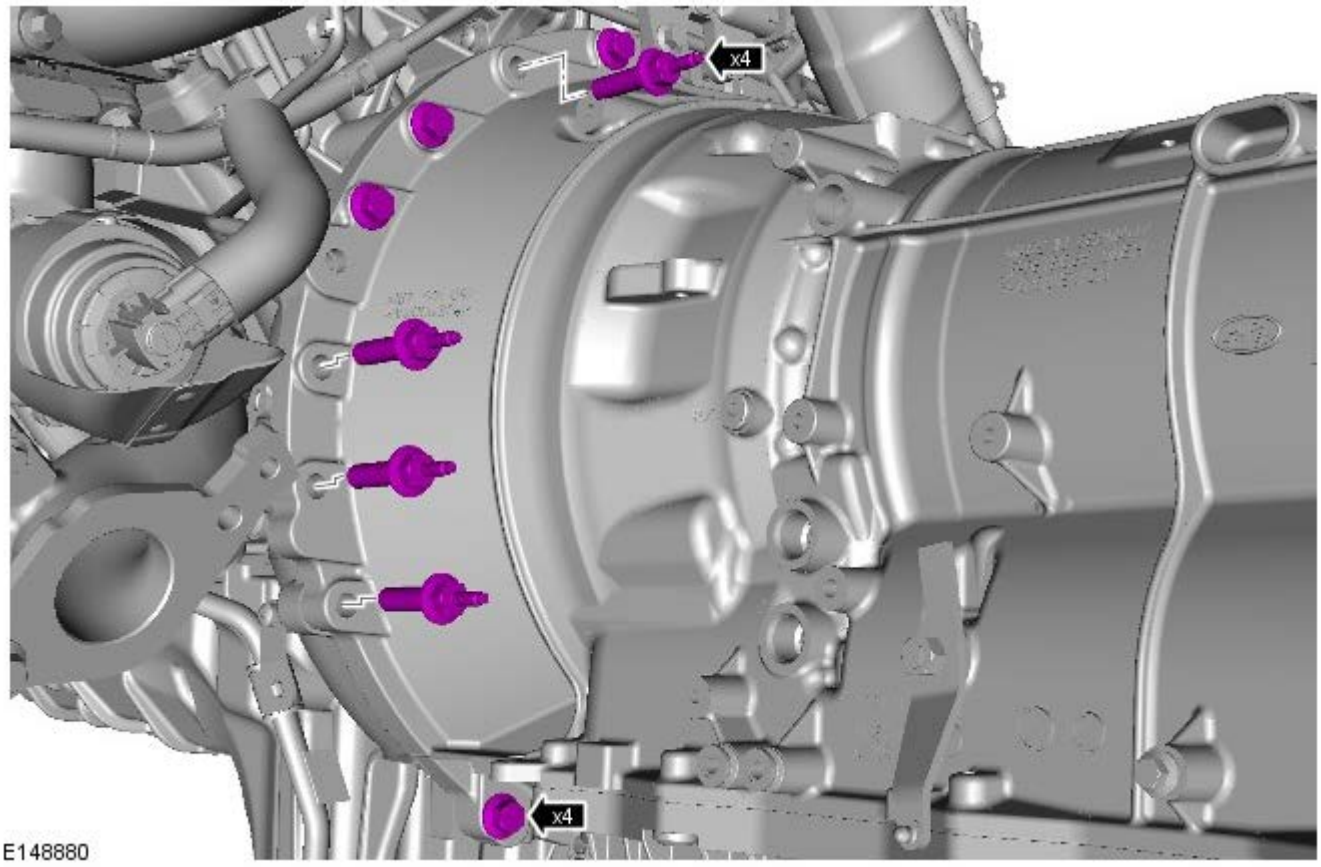
NOTE: This step requires the aid of other technicians.

Using a suitable hydraulic jack, support the transmission.

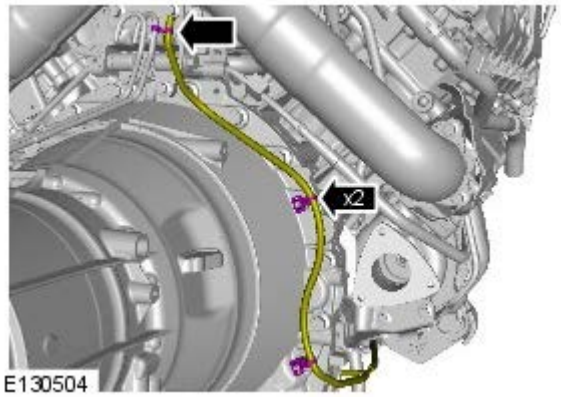
11. *Torque:* 40 Nm



12. *Torque:* 40 Nm

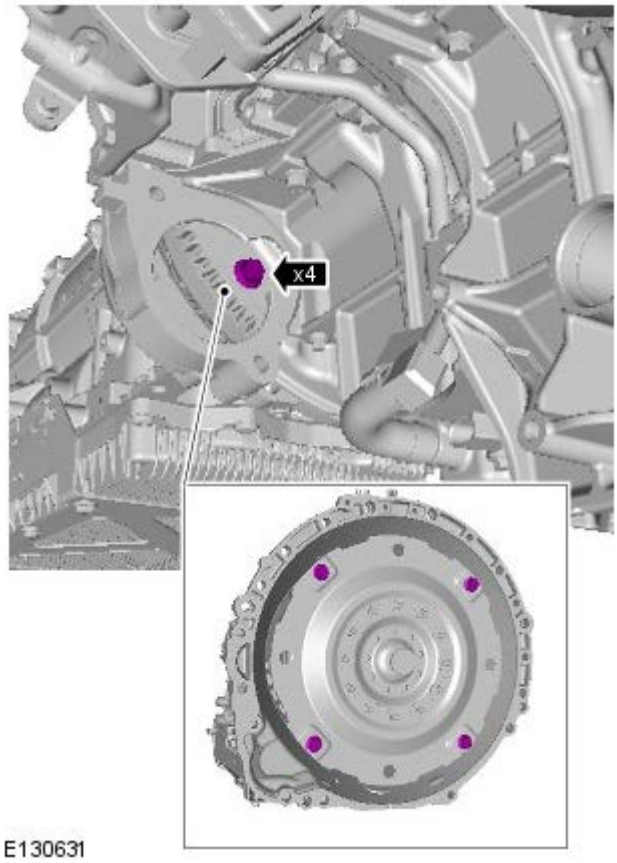


13.

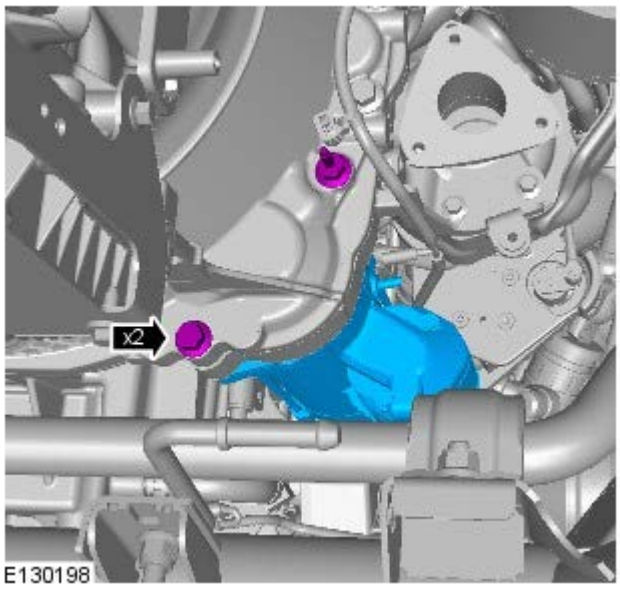


14. CAUTION: Only rotate the crankshaft clockwise.

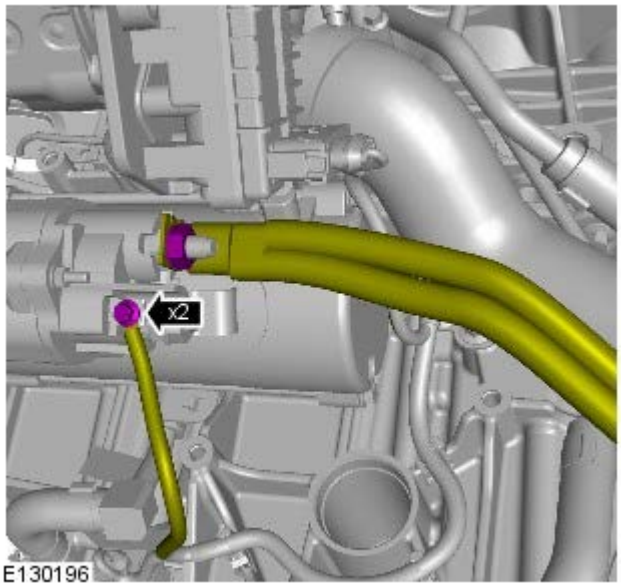
Torque: 63 Nm



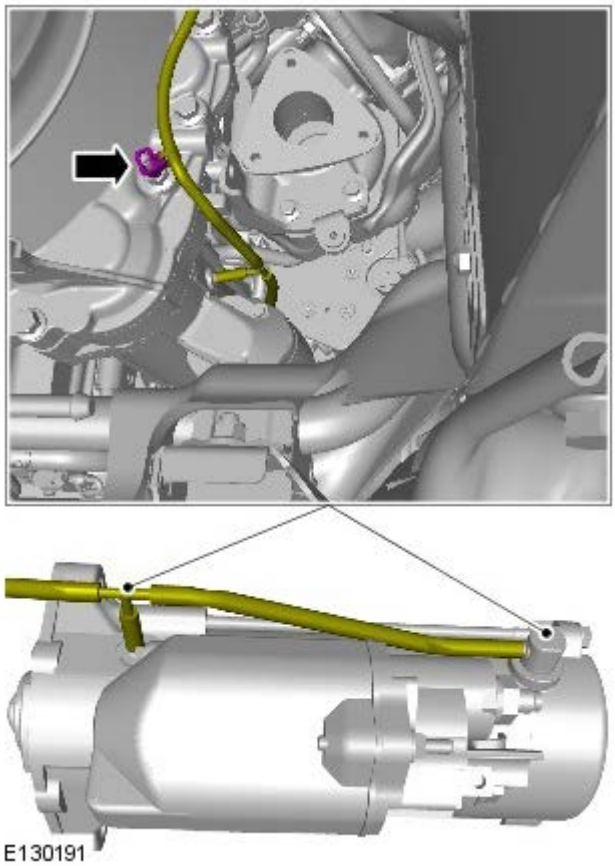
15. *Torque:* 45 Nm



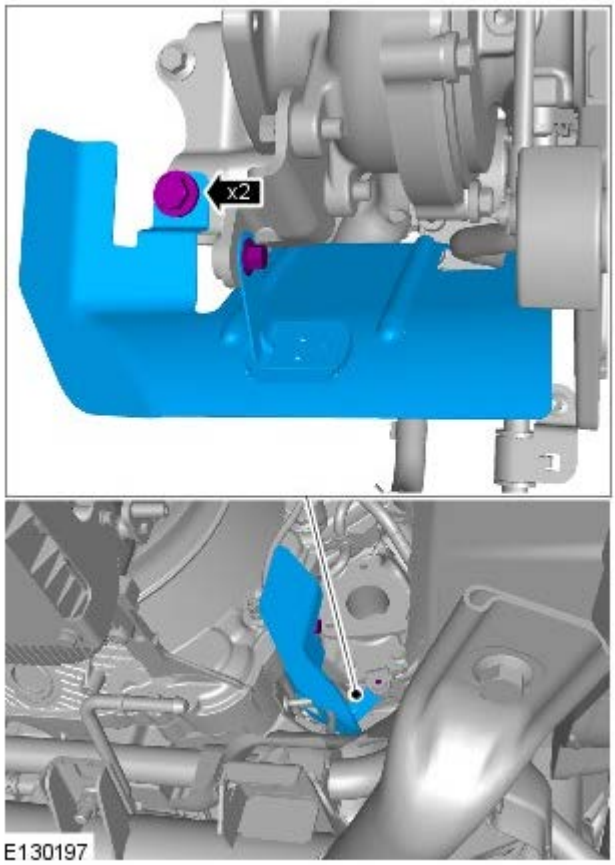
16. *Torque:*
M8 25 Nm
M5 3 Nm



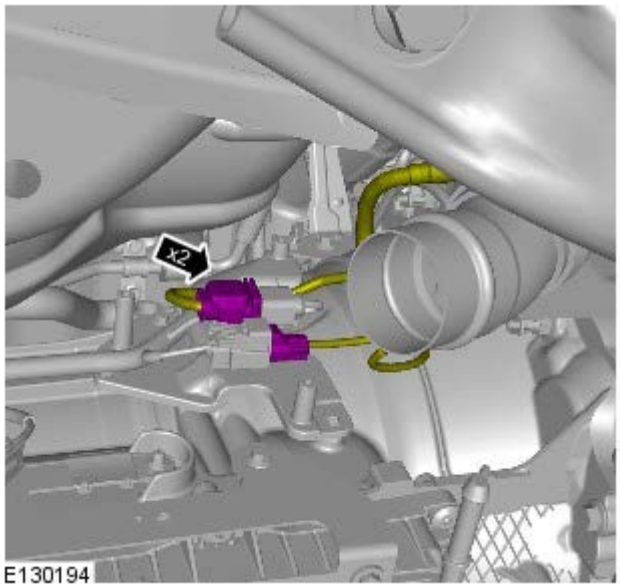
17.



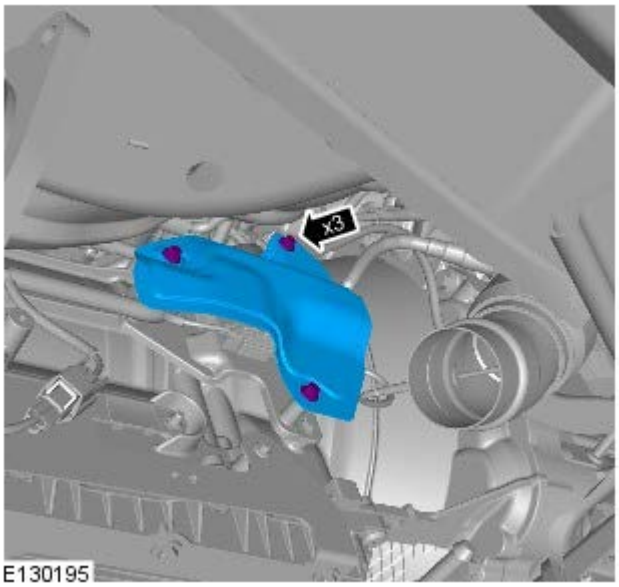
18. *Torque:* 10 Nm

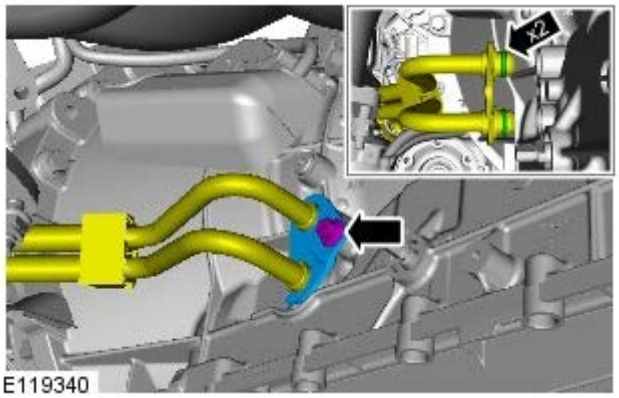


19.



20. *Torque:* 10 Nm



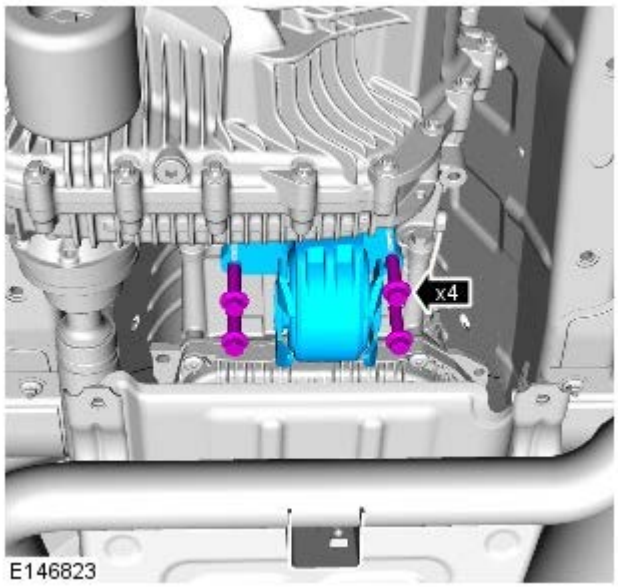


21. WARNING: Be prepared to collect escaping fluids.

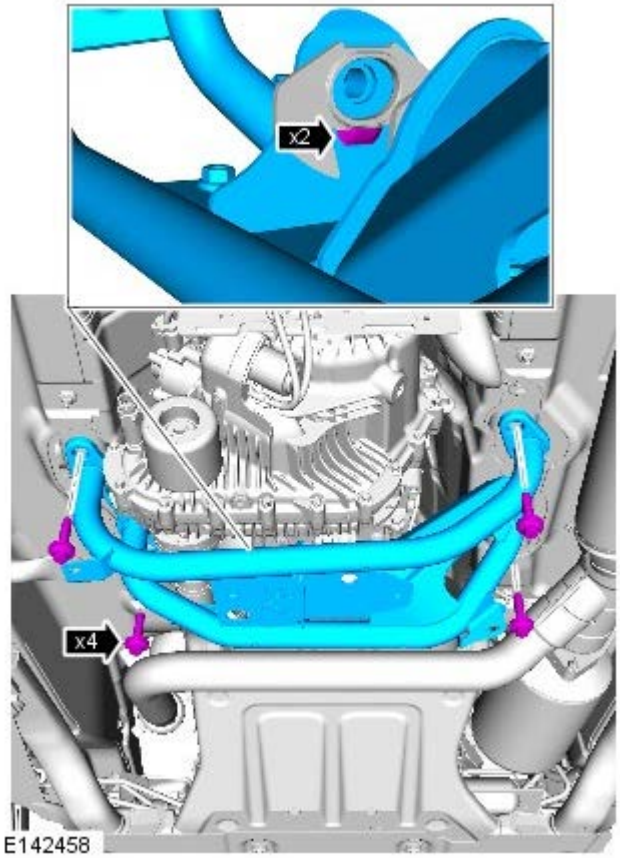
CAUTION: Install new O-ring seals.

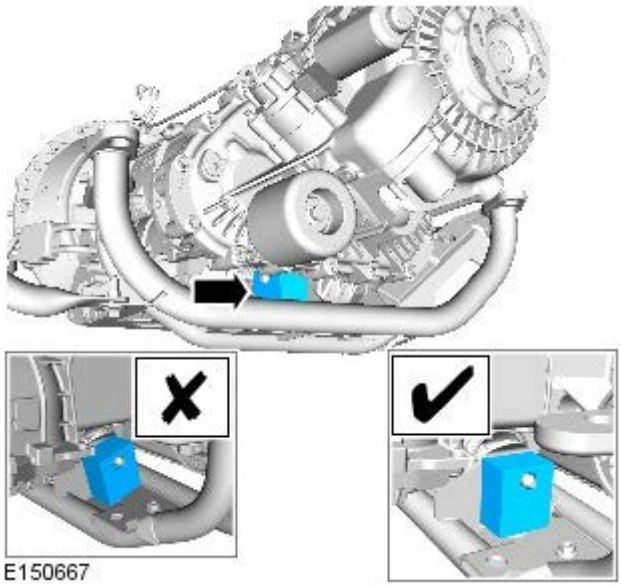
Torque: 22 Nm

22. *Torque:* 60 Nm



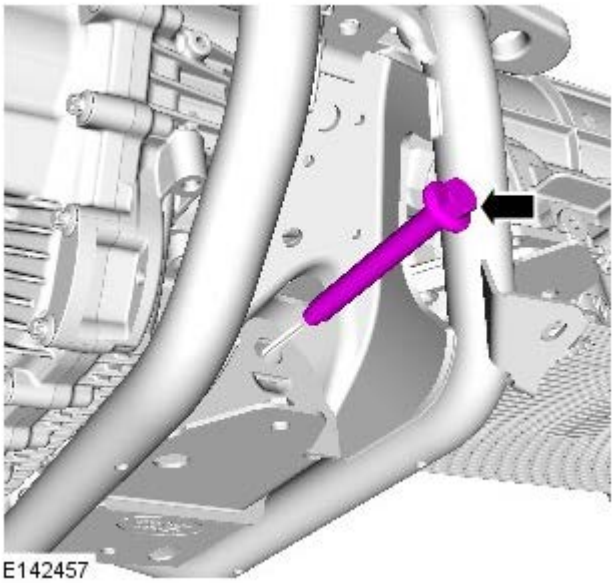
23. *Torque:* 110 Nm



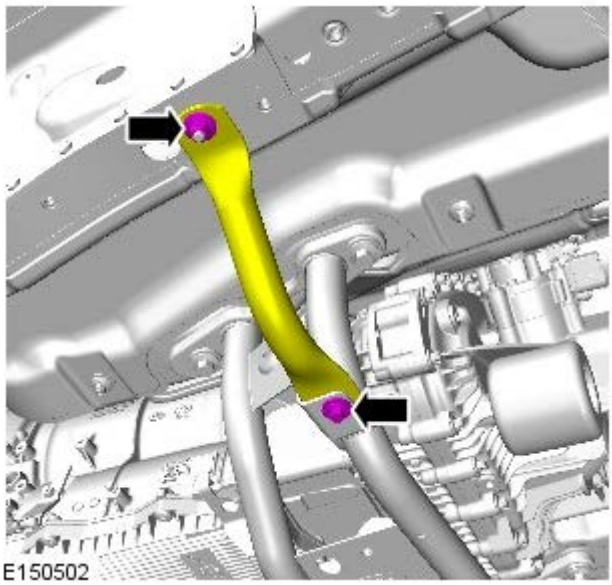


24. CAUTION: Make sure that the components are installed to the noted position in the removal steps.

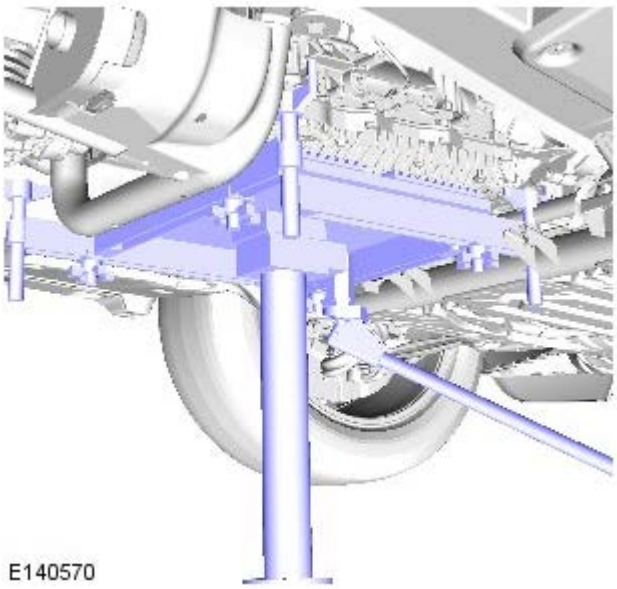
25. *Torque:* 175 Nm


E142457

26. *Torque:*
    M8 nut 20 Nm
    M8 bolt 24 Nm

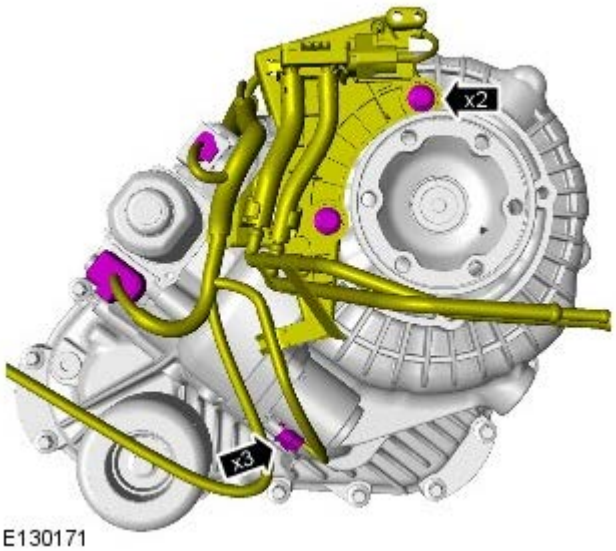

E150502

27. Remove the jack supporting the transmission.


E140570

28. NOTE: Vehicles with diesel particulate filter (DPF).

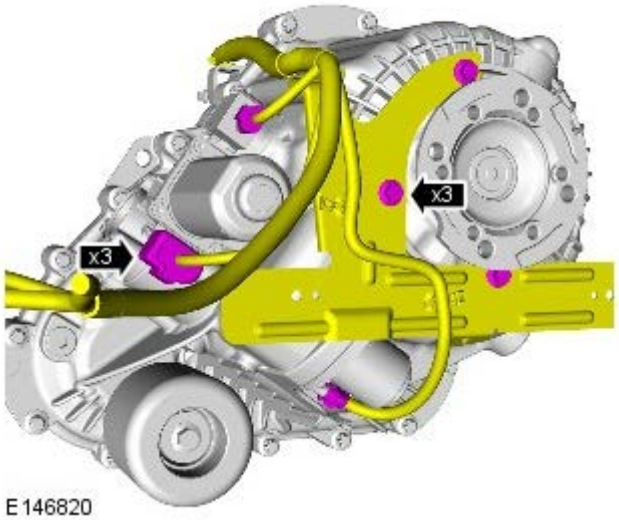
    Torque: 25 Nm



E130171

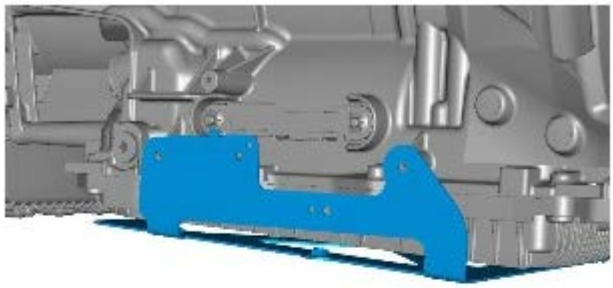
29. NOTE: Vehicles without diesel particulate filter (DPF).

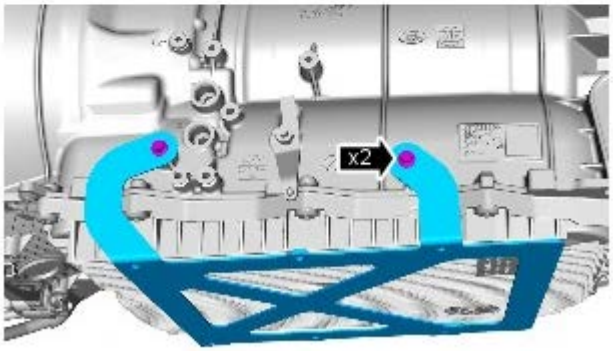
Torque: 25 Nm



E146820

30. *Torque:* 10 Nm

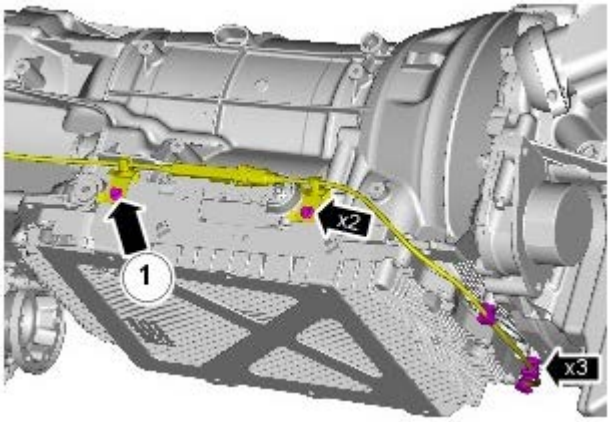


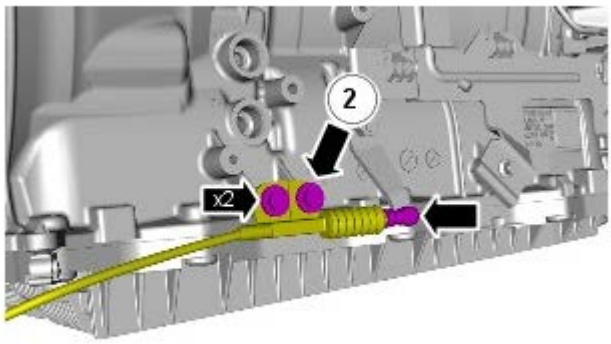


E148881

31.

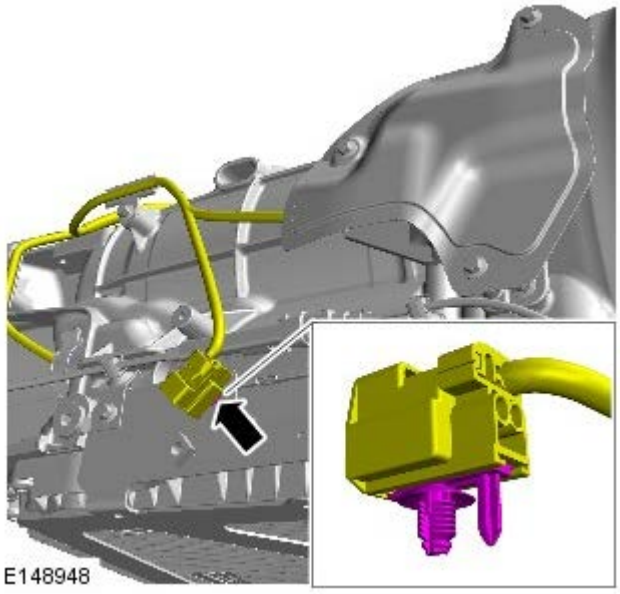
- *Torque:*
  Upper bolts (1) 10 Nm
  Lower bolts (2) 11 Nm



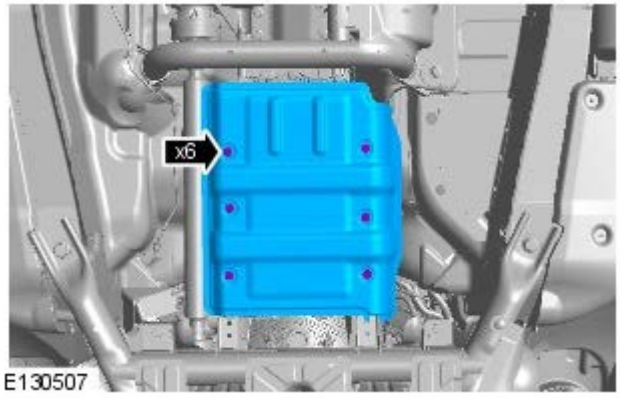


E150013

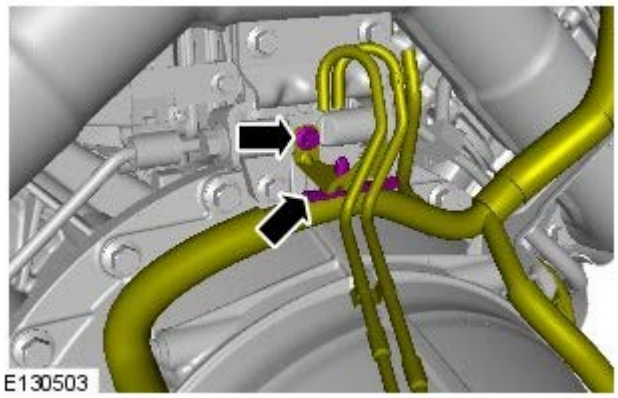
32.



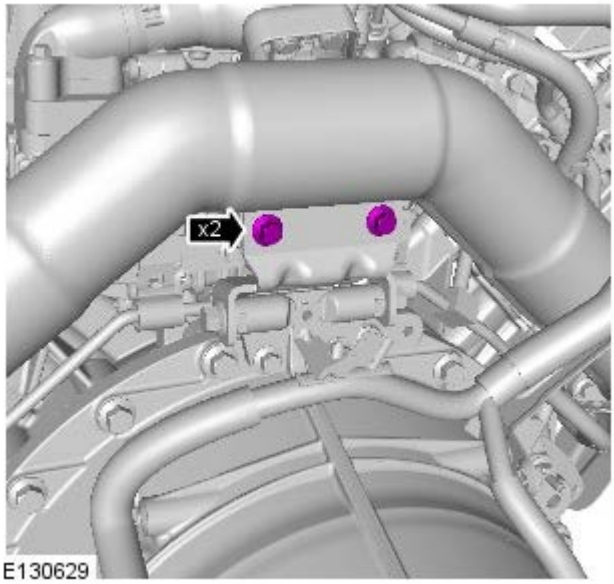
33. *Torque:* 10 Nm



34. *Torque:* 8 Nm



35. *Torque:* 10 Nm

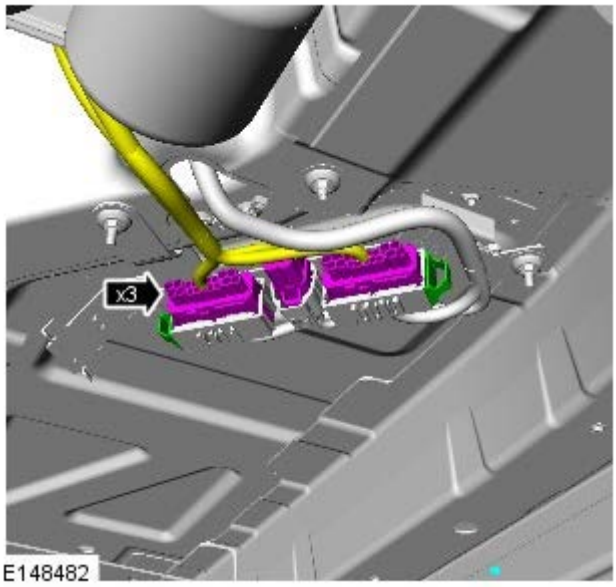


36. Refer to: Rear Driveshaft - TDV8 4.4L Diesel (205-01 Driveshaft, Removal and Installation).

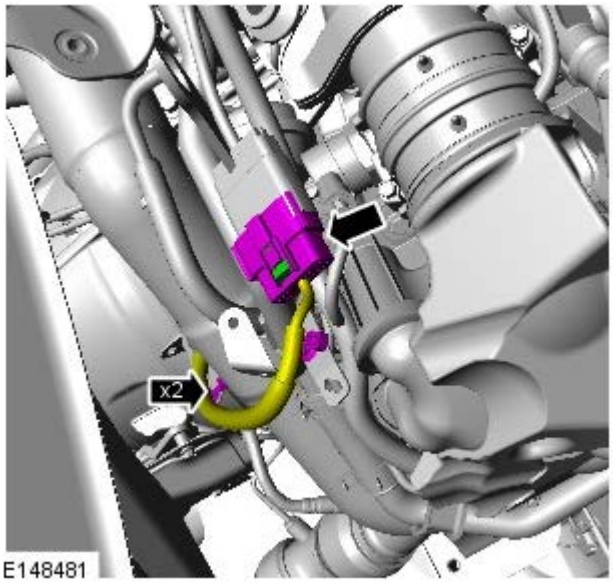
37. Refer to: Exhaust System - Vehicles With: Diesel Particulate Filter (DPF) (309-00D Exhaust System - TDV8 4.4L Diesel, Removal and Installation).
Refer to: Exhaust System - Vehicles Without: Diesel Particulate Filter (DPF) (309-00D Exhaust System - TDV8 4.4L Diesel, Removal and Installation).

38. Refer to: Front Driveshaft - TDV8 4.4L Diesel (205-01 Driveshaft, Removal and Installation).

39.



40.



41. Refer to: Secondary Bulkhead Center Panel - TDV8 4.4L Diesel (501-02, Removal and Installation).

42. Connect the battery ground cable.

    Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

43. Carry out a transmission fluid level check.

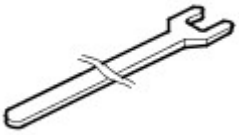
    Refer to: Transmission Fluid Level Check - TDV6 3.0L Diesel /TDV8 4.4L Diesel (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, General Procedures).

Published: 13-Feb-2014

Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - Transmission V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol

Installation

Special Tool(s)

303-1069  E53727	303-1069 Adapter, Wrench
303-1142  E46076	303-1142 Viscous Coupling Wrench
303-1143  E55382	303-1143 Viscous Coupling Holding Tool
308-598  E50941	308-598 Installer, Oil Seal

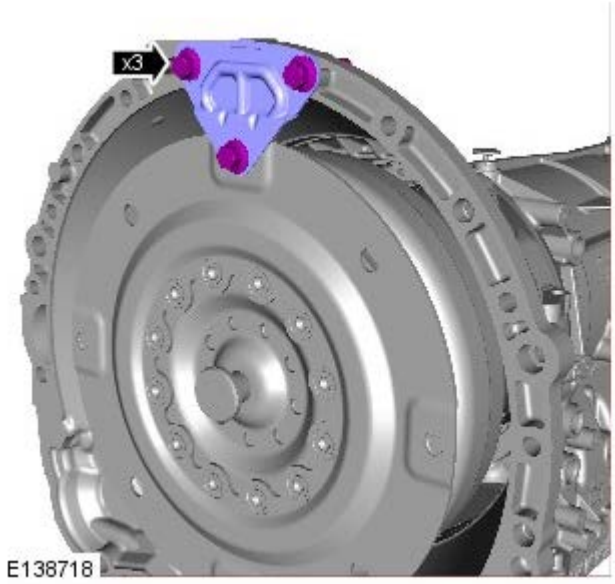
NOTES:

Some variation in the illustrations may occur, but the essential information is always correct.

Some illustrations may show the transmission removed for clarity.

1. NOTE: This step is only required if a new component is installed.

   Remove the torque converter retainer.



2. NOTE: Make sure that the torque converter is fully engaged to the transmission.



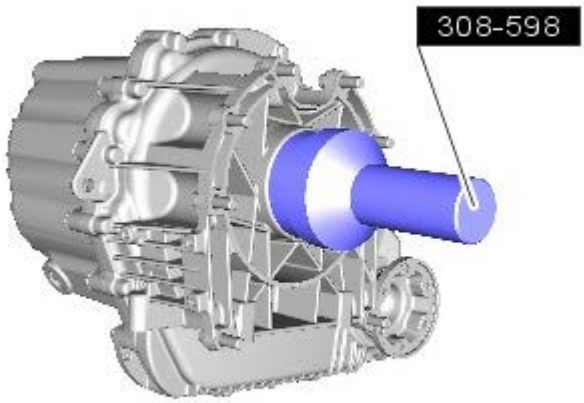
3. CAUTION: Oil seals must be fitted dry.

NOTES:

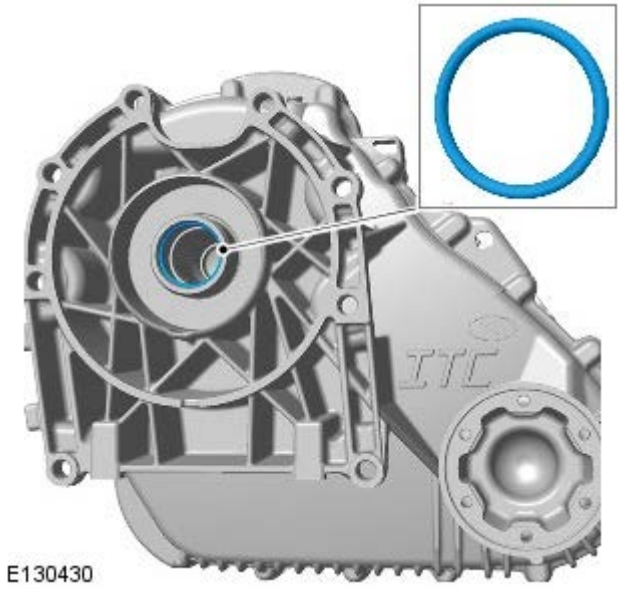
This step is only required if previously removed.

Make sure that this component is installed to the noted removal position.

Special Tool(s): 308-598



E50943

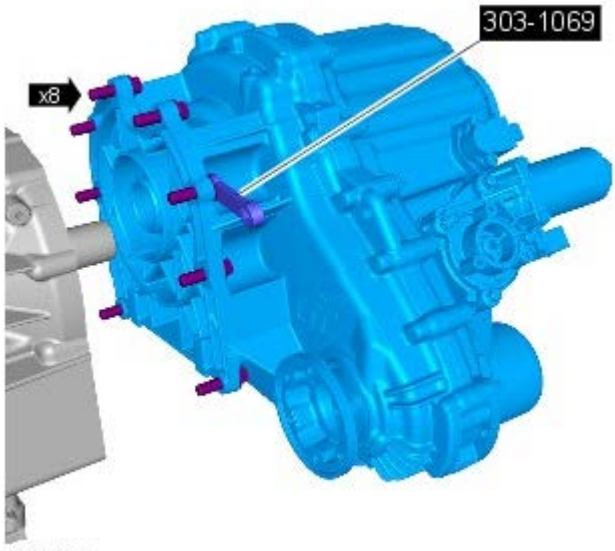


E130430

4. NOTES:

   Install a new O-ring seal.

   This step is only required if a new component is installed.

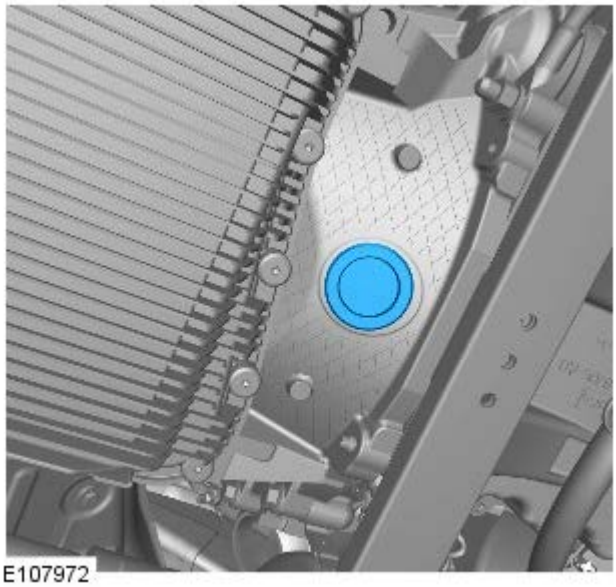


E130188

5. NOTE: This step is only required if a new component is installed.

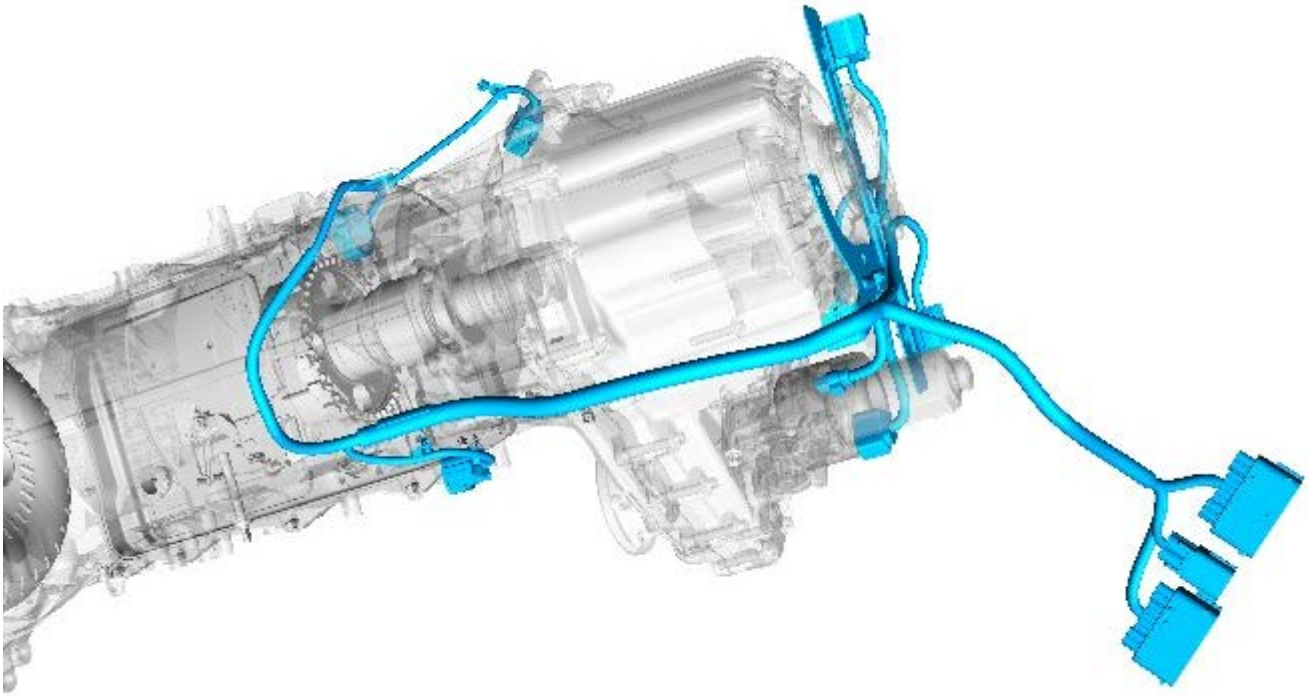
   - *Special Tool(s):* 303-1069
   - Clean the component mating face.
   - Lubricate input shaft splines with 'Weicon TL7391' grease.
   - *Torque:* 45 Nm

6.



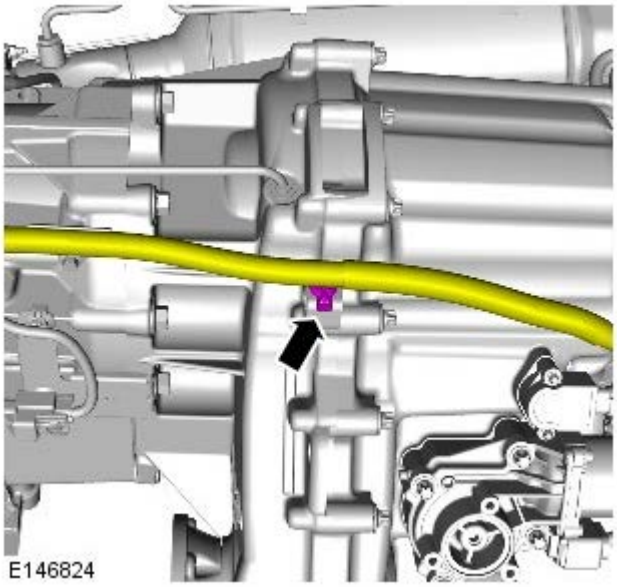
E107972

7. NOTE: This step is only required if a new component is installed.



E158845

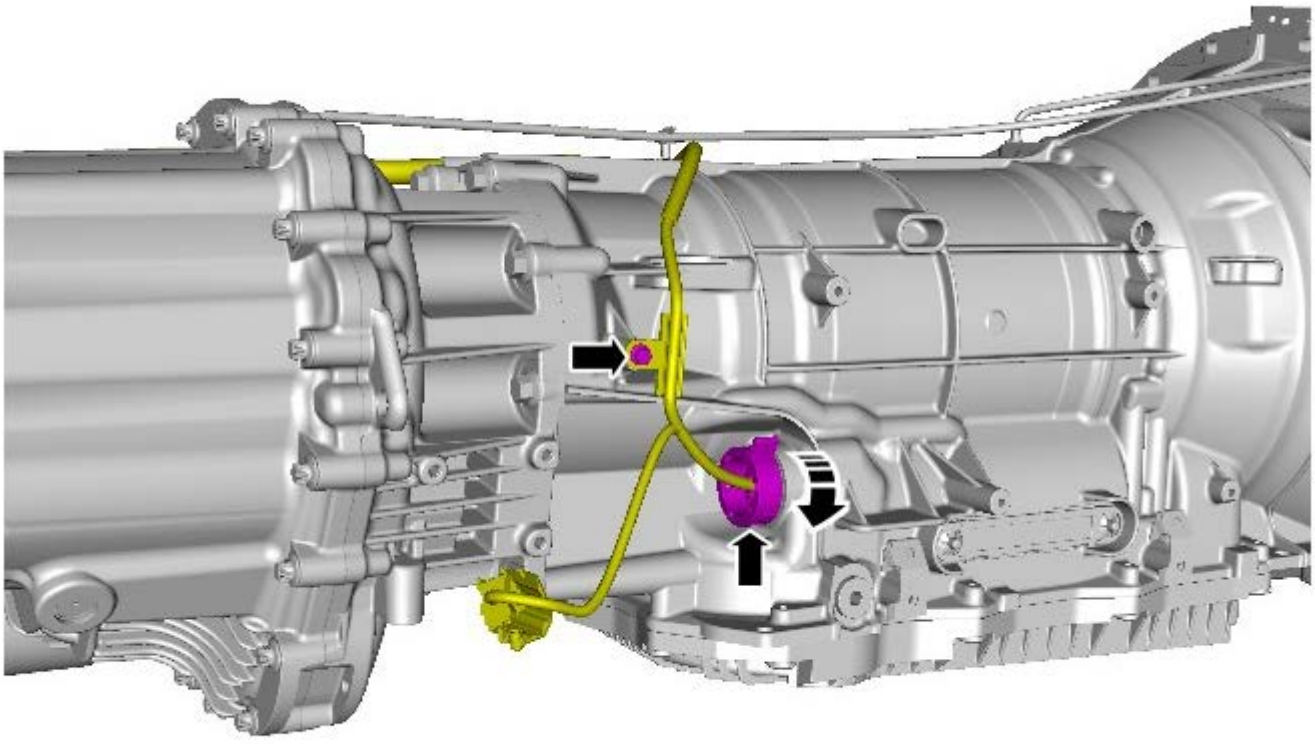
8. NOTE: This step is only required if a new component is installed.



E146824

9. NOTE: This step is only required if a new component is installed.

   Torque: 8 Nm



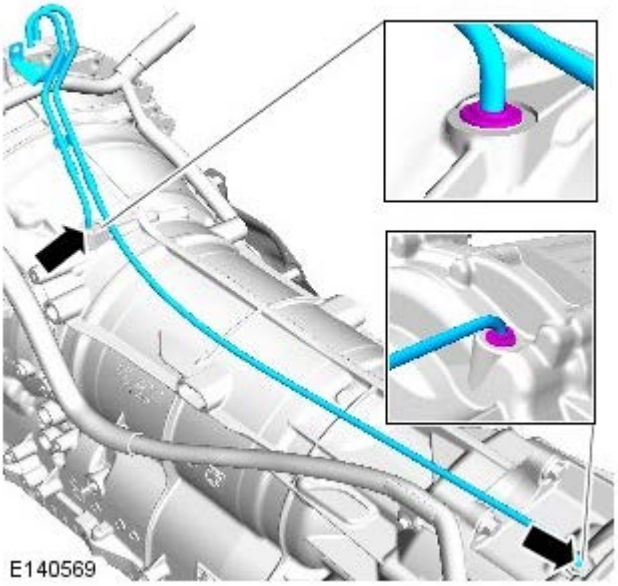
E149992

10. CAUTIONS:

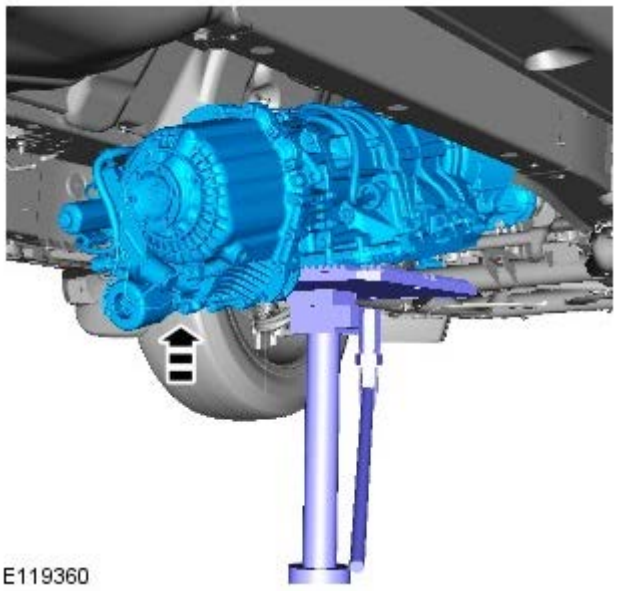
    To prevent water ingress and subsequent transmission damage, make sure that the breather is fully pushed home into the transmission casing. The white line around the circumference of the pipe should not be visible when correctly installed.

    Remove the blanking plugs.

    NOTE: This step is only required if a new



component is installed.



11. WARNING: Make sure that the transmission is secured with suitable retaining straps.

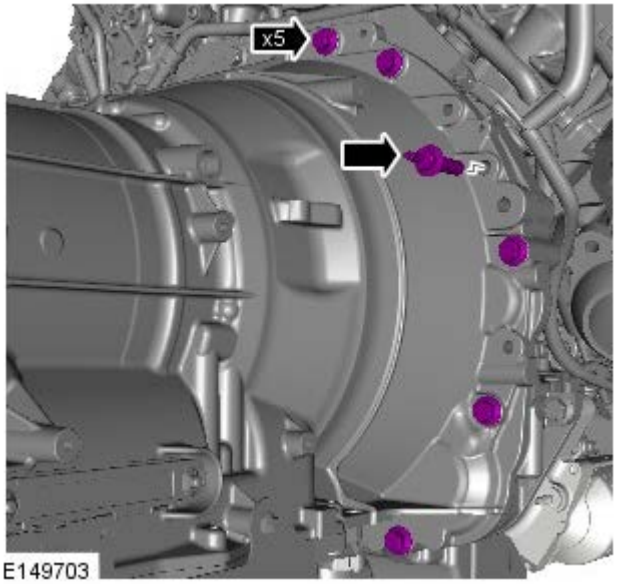
CAUTIONS:

Apply grease of the correct specification to the torque converter spigot.

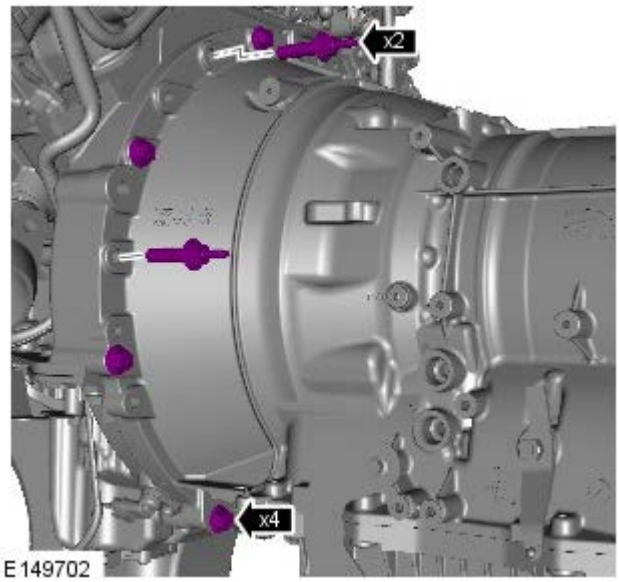
Make sure the torque converter remains connected to the transmission.

Using a suitable hydraulic jack, support the transmission.

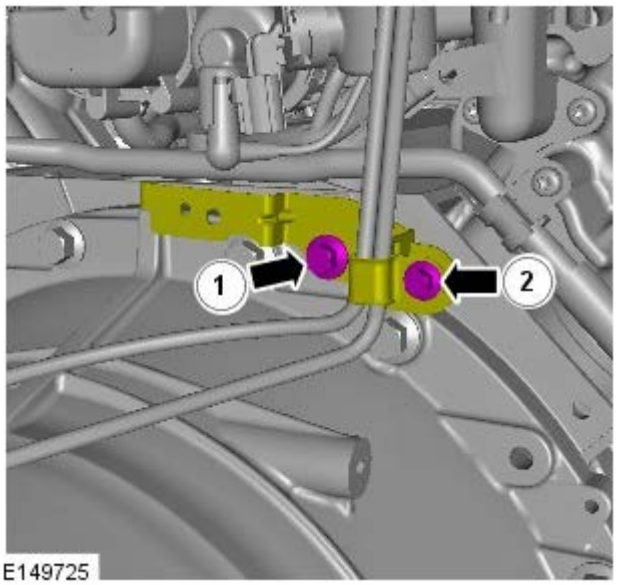
12. *Torque:* 40 Nm



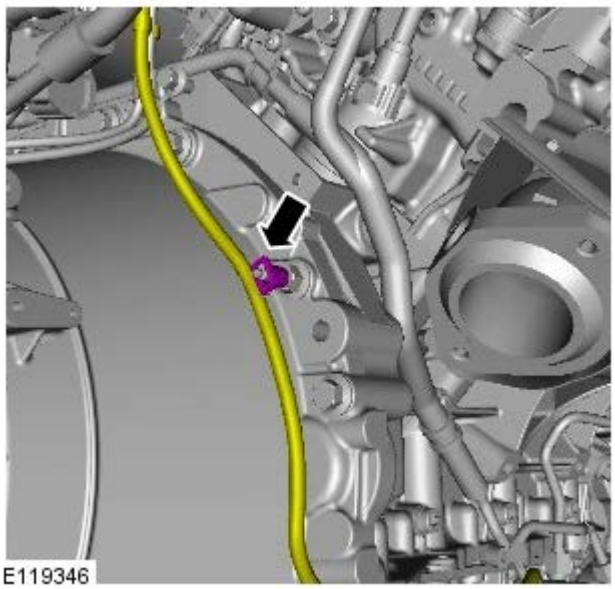
13. *Torque:* 40 Nm



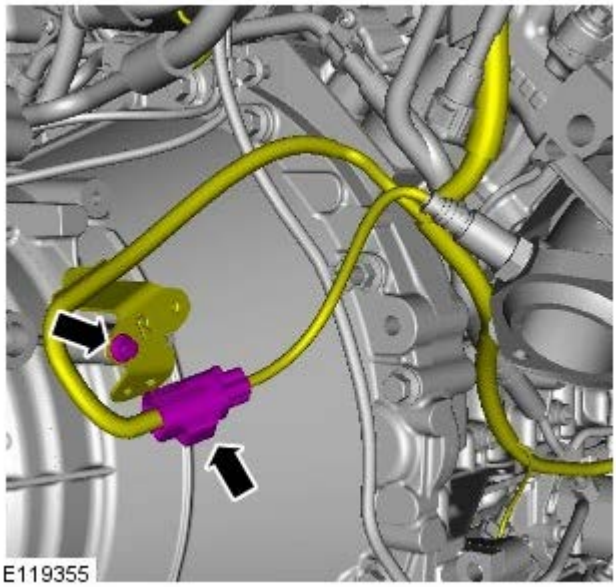
14. *Torque:*
    M8 20 Nm
    M6 10 Nm



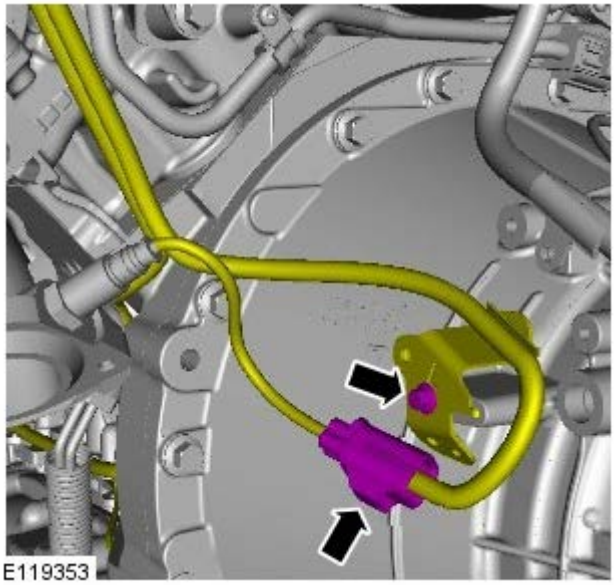
15.



16. *Torque:* 10 Nm

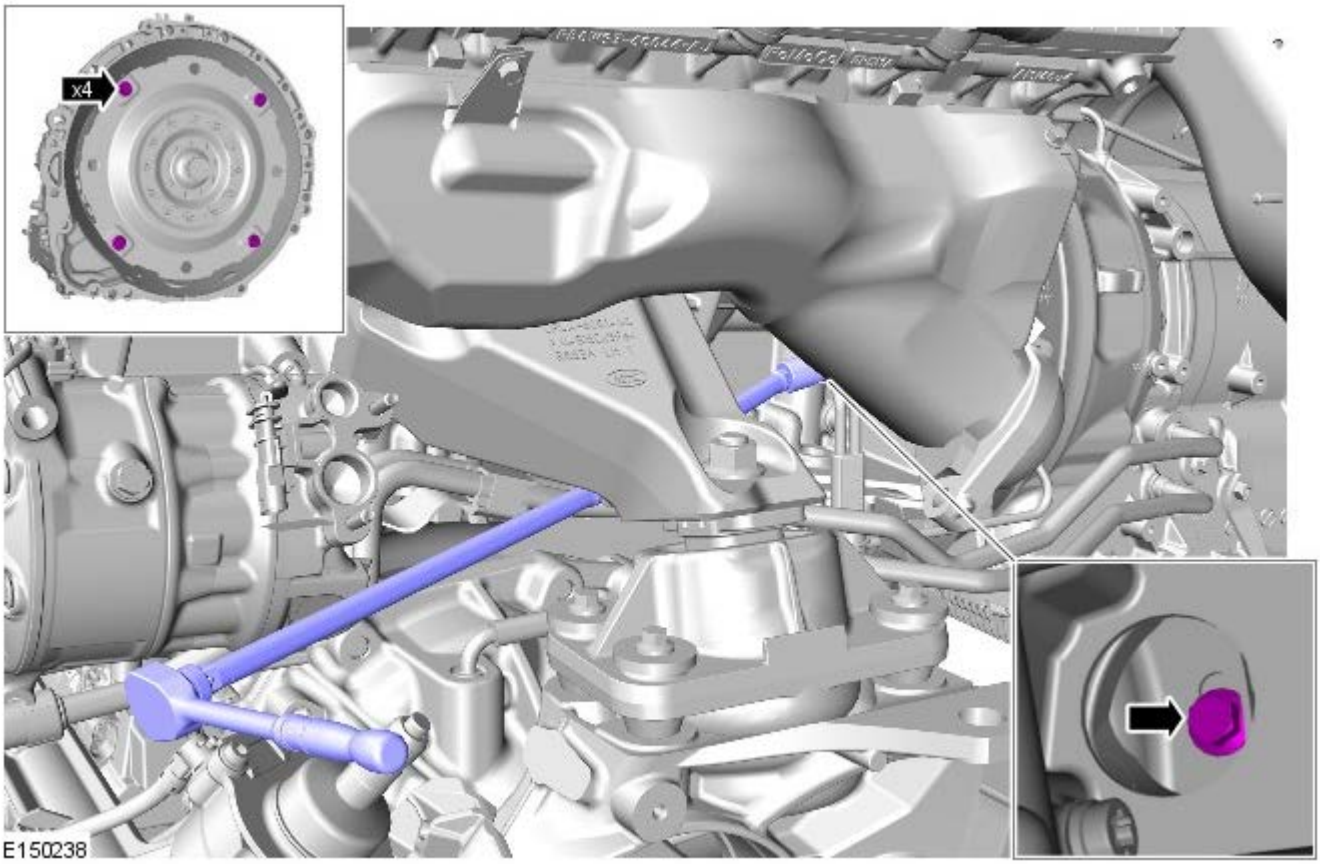


17. *Torque:* 10 Nm

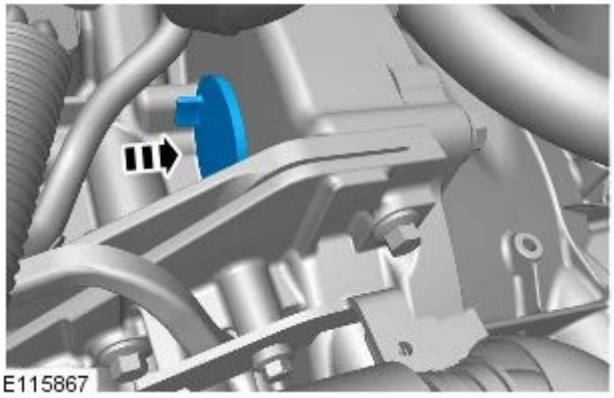


18. CAUTION: Only rotate the crankshaft clockwise.

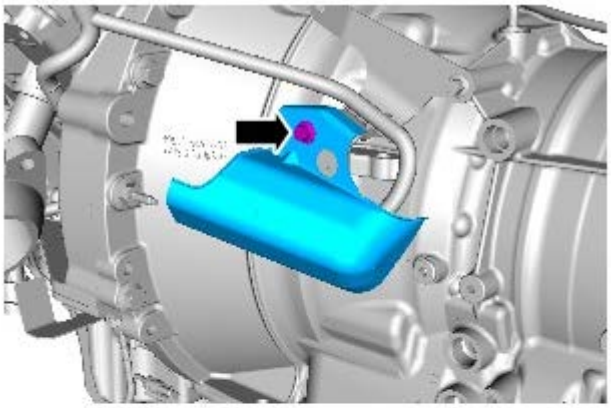
Torque: 63 Nm

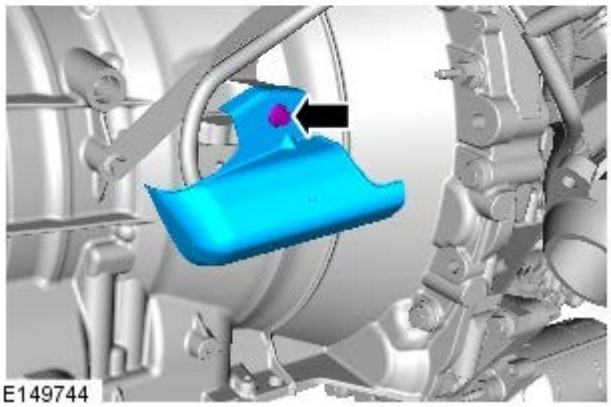


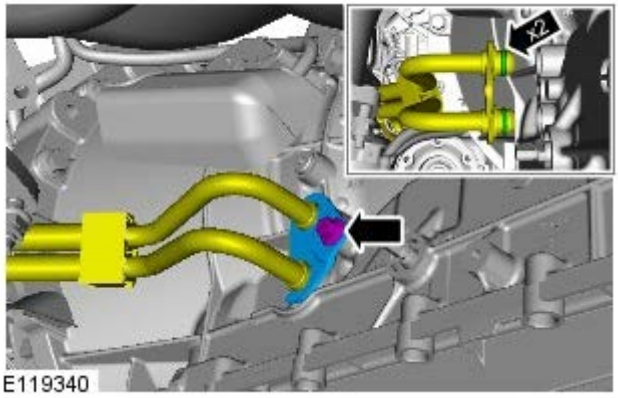
19.



20. *Torque:* 15 Nm







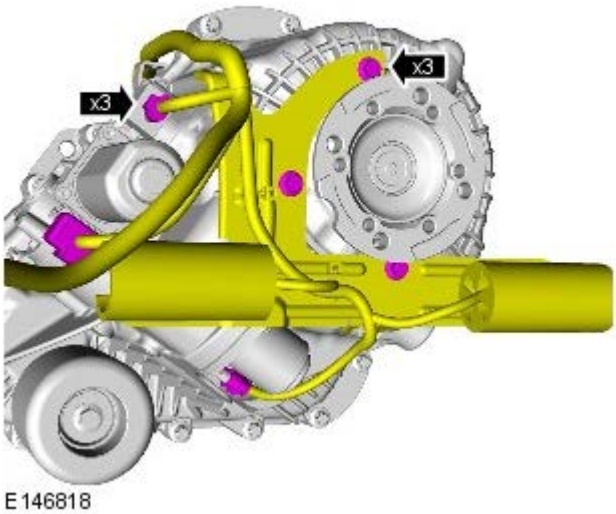
21. CAUTIONS:

    Be prepared to collect escaping fluids.

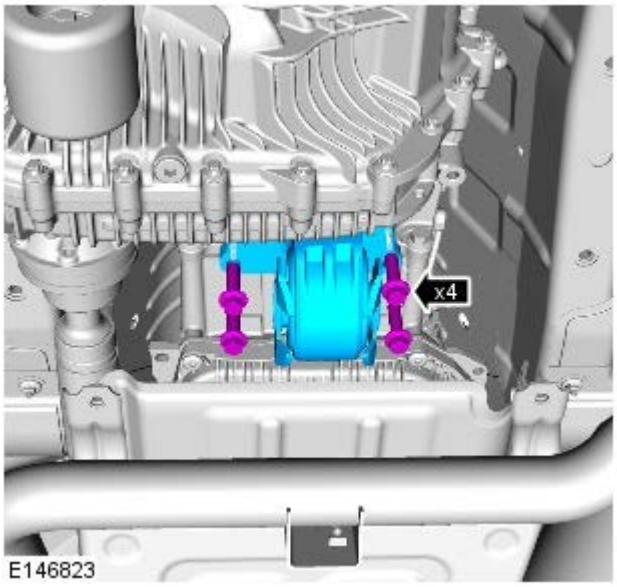
    Install new o-ring seals

    Torque: 22 Nm

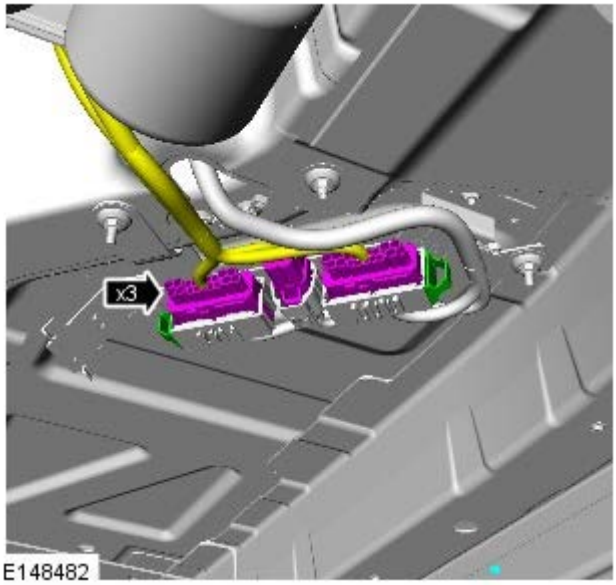
22. *Torque:* 25 Nm



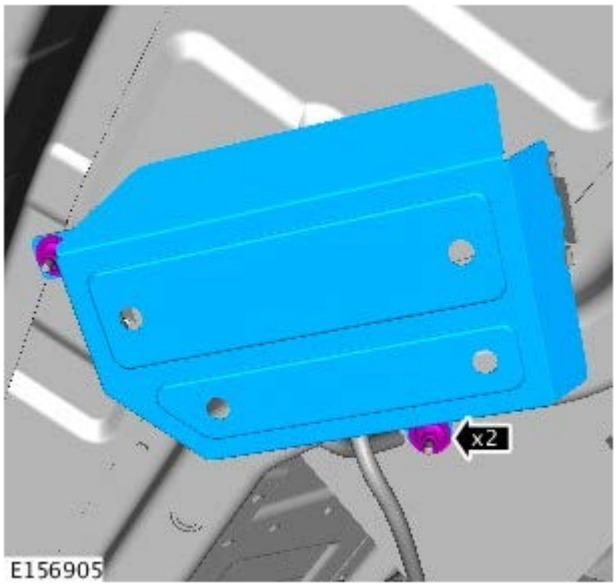
23. *Torque:* 60 Nm



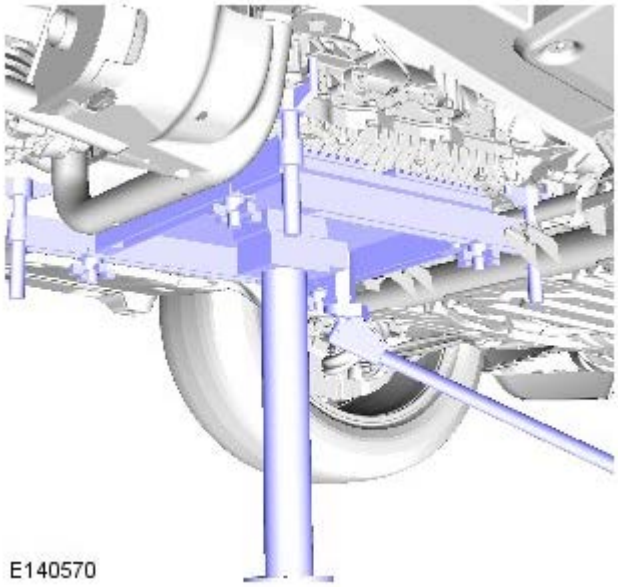
24.



25. *Torque:* 9 Nm

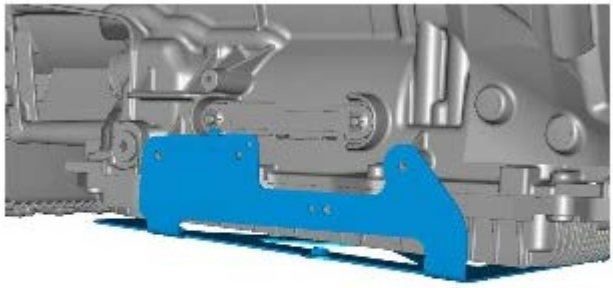


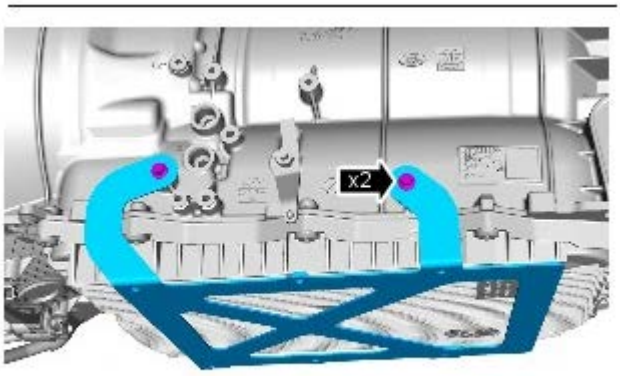
26. Support the transmission.



E140570

27. *Torque:* 9 Nm

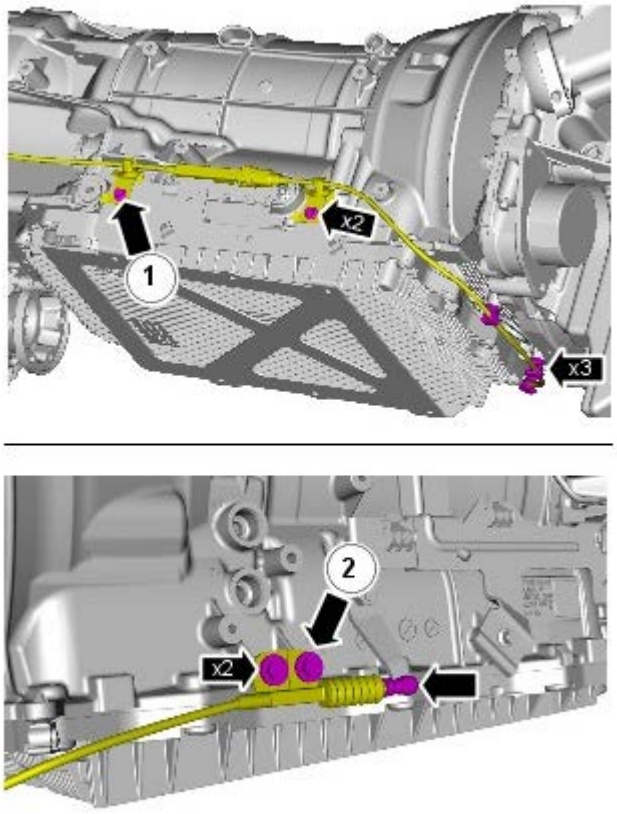




E148881

28. NOTE: Install new retaining clips.

Torque: 9 Nm



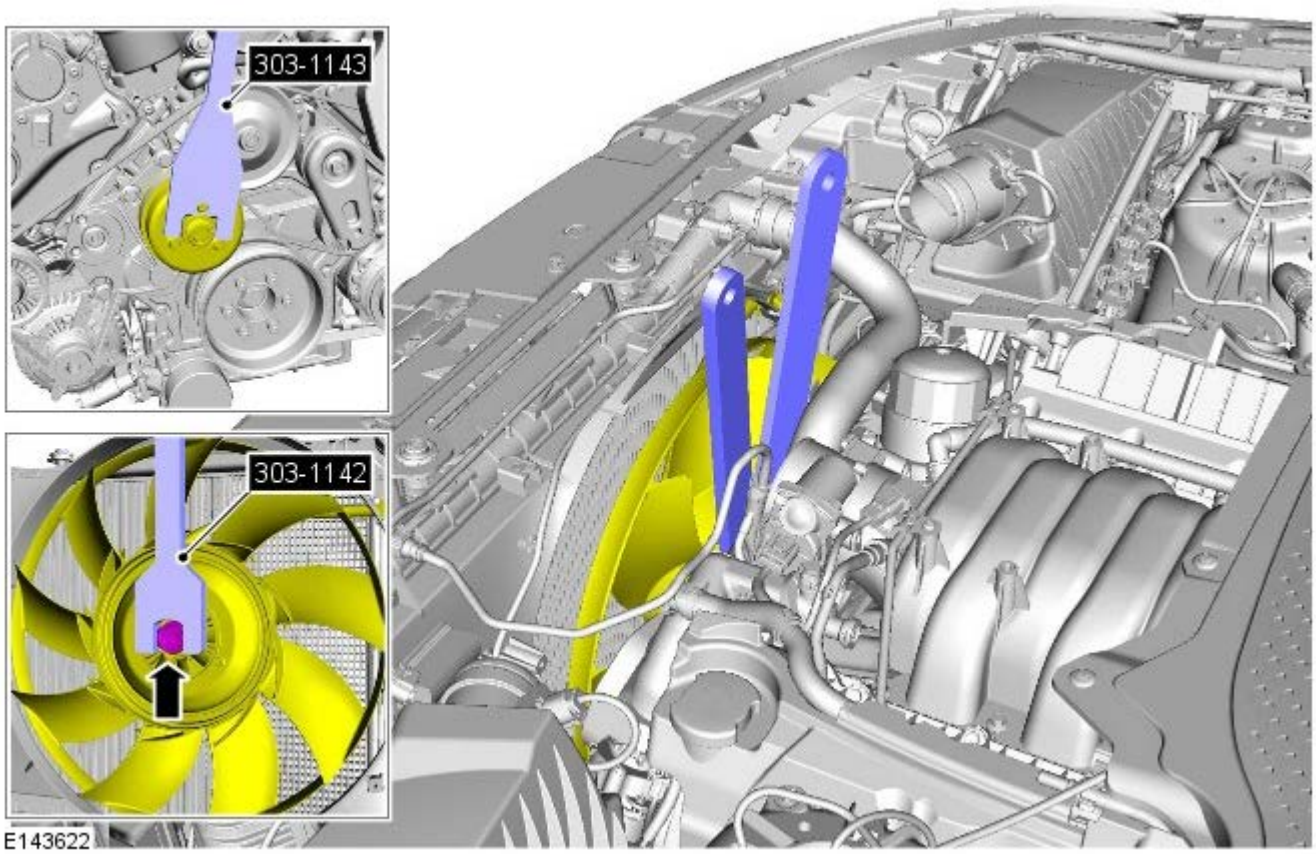
E150013

29. Refer to: Rear Driveshaft - V8 5.0L Petrol/V8 S/C 5.0L Petrol (205-01, Removal and Installation).

30. Refer to: Front Driveshaft - V8 5.0L Petrol/V8 S/C 5.0L Petrol (205-01, Removal and Installation).

31. Lower the vehicle.

32.
    - *Special Tool(s):* 303-1143
    - *Special Tool(s):* 303-1142
    - *Torque:* 65 Nm



33. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).

34. Install the battery ground cable.

    Refer to: Specifications (414-01, Specifications).

35. Carry out a transmission fluid level check.

    Refer to: Transmission Fluid Level Check - V8 5.0L Petrol/V8 S/C 5.0L Petrol (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, General Procedures).

Published: 06-Sep-2013

Automatic Transmission / Transaxle - Vehicles With: 8HP70 8-Speed - Hybrid Electric Vehicle - 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
Maintenance	Change the fluid at 60,000 Km (38,000 miles) intervals.

Capacities

	Liters
Transmission	6.6

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.

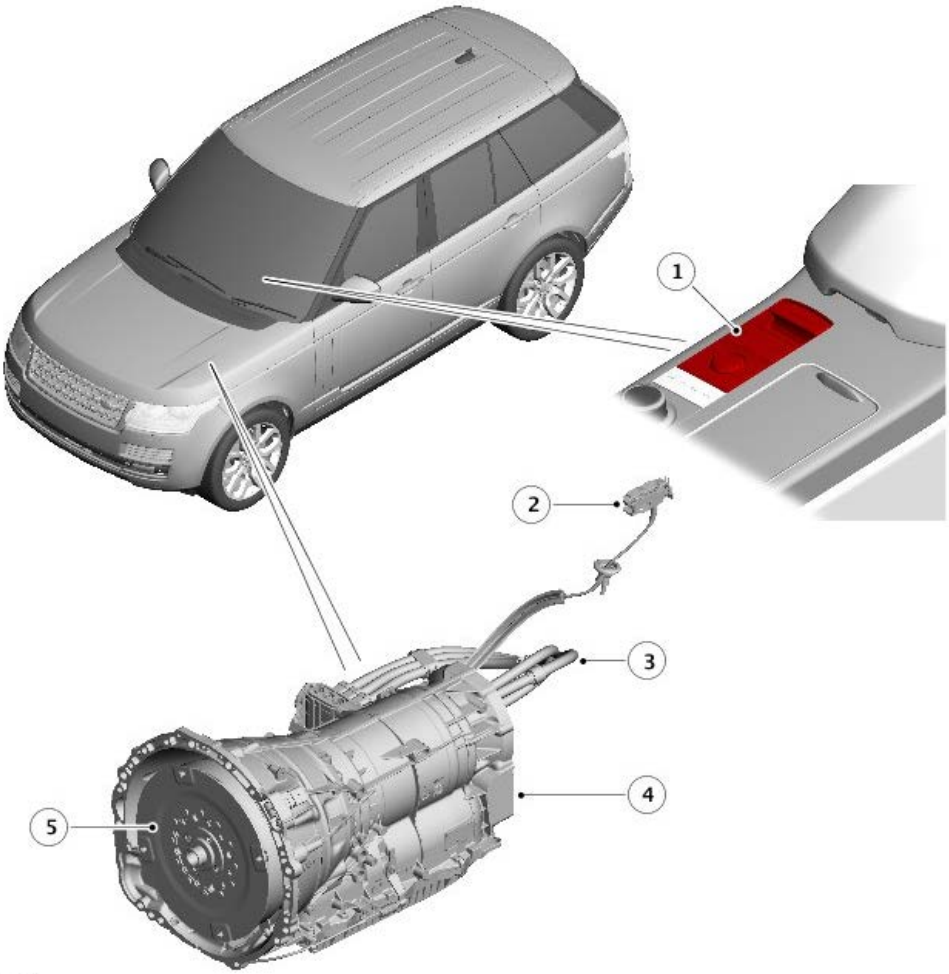
Description	Nm	lb-ft	lb-in
Transmission retaining bolts	40	30	-
Transmission mount retaining bolts	62	45	-
Hybrid module retaining bolts M6	10	7	-
*Hybrid module retaining bolts M8	Stage 1 - 5 Stage 2 - 60 degrees	-	Stage 1 - 44 Stage 2 - 60 degrees
*Dual mass flywheel centre flange bolts	15	11	-
*Dual mass flywheel to hybrid module bolts	15	11	-
Flex plate to Hybrid module bolts	63	46	-
Transmission fluid cooler tube retaining bolt	22	16	-
Hybrid module coolant tube retaining bolts	10	7	-
HEV cables retaining bolts	10	7	-
High voltage connector retaining bolts	10	7	-
High voltage connector splash shield retaining bolts	10	7	-
Emergency park release cable retaining bolts (LH side)	10	7	-
Emergency park release cable retaining bolts (RH side)	9	6	-
Emergency park release lever	12	9	-
Motor Generator speed sensor splash shield retaining bolts	13	9	-
Transmission fluid fill plug	35	26	-
Transmission fluid drain plug	8	-	53
*Transmission fluid pan, gasket and filter retaining bolts	10	7	-
*Transmission control module (TCM) and main control valve body retaining bolts	8	6	-
Electric oil pump	8	6	-

Published: 06-Sep-2013

Automatic Transmission / Transaxle - Vehicles With: 8HP70 8-Speed - Hybrid Electric Vehicle - Automatic Transmission – AWD - Transmission Description

Description and Operation

COMPONENT LOCATION



E159067

Item	Part Number	Description
1	-	Transmission Control Switch (TCS)
2	-	Emergency park release lever and cable
3	-	Hybrid electric Vehicle (HEV) High voltage cables
4	-	ZF 8P70H Automatic transmission
5	-	Hybrid drive assembly (Dual mass flywheel, engine disconnect clutch and Motor Generator (MG))

OVERVIEW

The ZF 8P70H transmission is an electronically controlled, hydraulically operated, 8 speed automatic unit, unique to the Hybrid Electric Vehicle (HEV). 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' valve block.

The ZF 8P70H transmission is similar in design to the conventional ZF 8HP70 transmission but has the following major differences:

- Torque converter is replaced with a hybrid drive assembly which comprises a dual mass flywheel, an engine disconnect clutch and a Motor Generator (MG)
- Shortened output shaft to maintain common transmission length
- Transmission-integrated electric ATF (automatic transmission fluid) pump is added to operate when the vehicle is stationary or at low speeds. A mechanical ATF pump operates when the transmission input shaft is rotating. The electric ATF pump operates at engine speeds of up to 500 Revolutions Per Minute (RPM). Once the engine speed has reached 500 RPM, the electric ATF pump is switched off and the mechanical ATF pump supplies the transmission operating pressure. The electric ATF pump has a separate electrical connector located on the right side of the transmission housing. The electric ATF pump removes the requirement for the Hydraulic Impulse Storage (HIS) accumulator found on the conventional ZF 8 speed transmission
- Brake 'B' is now used as a 'Launch Clutch' to start the vehicle moving from standstill.

The ZF 8P70H transmission has the following features:

- Designed to be maintenance free
- Transmission fluid is replaced at 60,000 km (37,000 miles) intervals
- Engine disconnect clutch to disengage engine from Motor Generator when vehicle is operating in EV mode.
- Shift programs controlled by the TCM and the ECM (engine control module)
- 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 via the high speed CAN (controller area network) powertrain systems bus for communications
- Fail safe mode if major faults occur
- Support diagnostic services available from the TCM via the high speed CAN powertrain system bus.

The transmission selections are made using the rotary TCS (transmission control switch) in the floor console.

The HEV TDV6 3.0L Diesel engine features stop/start technology. The electric ATF pump ensures pressurized ATF is available to the shift elements as quickly as possible when the engine is started.

COMPONENT DESCRIPTION

TRANSMISSION

The transmission comprises the main transmission housing which contains all of the transmission components. The transmission housing also incorporates an integral housing for the hybrid drive assembly (dual mass flywheel, engine disconnect clutch and the MG).

A fluid pan is attached to the lower face of the transmission housing and is secured with bolts. The fluid pan is sealed to the transmission housing with a gasket. Removal of the fluid pan allows access to the Mechatronic valve block and the electric ATF pump. 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 TCS 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 feature of the ZF 8P70H transmission is Transmission Idle Control (TIC), which is the decoupling of the transmission when the vehicle is at a standstill. Normally the transmission remains in gear with the launch clutch slipping and the vehicle is prevented from moving by applying the brake. The TIC system disengages the launch clutch and only a minimum rotating load remains. This has the effect of further reducing fuel consumption.

The ZF 8P70H transmission has two ATF pumps; one is mechanical, the second is electric.

The mechanical ATF pump is driven by a simplex chain and 2 drive gears from the input shaft. The ATF pump is a double stroke vane cell pump which delivers 50 cm^2 of transmission fluid per revolution.

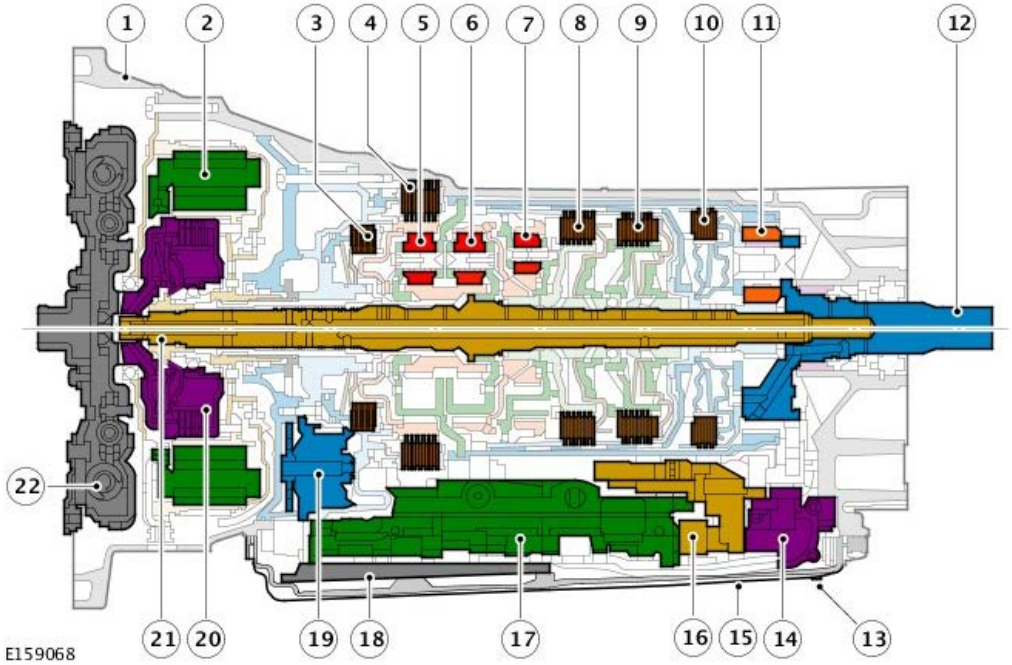
The integrated electric ATF pump ensures pressurized ATF is available to the shift elements as quickly as possible when the engine is started. The electric ATF pump is located at the rear of the transmission and delivers 50 cm^2 of transmission fluid per revolution. The pump provides ATF pressure and flow to the shift elements and the disconnect clutch primarily when the vehicle is stationary or at low speeds. The electric ATF pump is deactivated once the input shaft speed exceeds 500 rpm, when the transmission mechanical ATF pump is capable of delivering the correct pressure and flow of ATF.

The transmission housing provides protection for the hybrid drive assembly and also provides the attachment for the transmission to the engine. The dual mass flywheel and the MG which together comprise the hybrid drive assembly are serviceable as separate assemblies.

The transmission housing 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
- One fixed multiplate brake clutch and a launch clutch
- Four planetary gear trains.

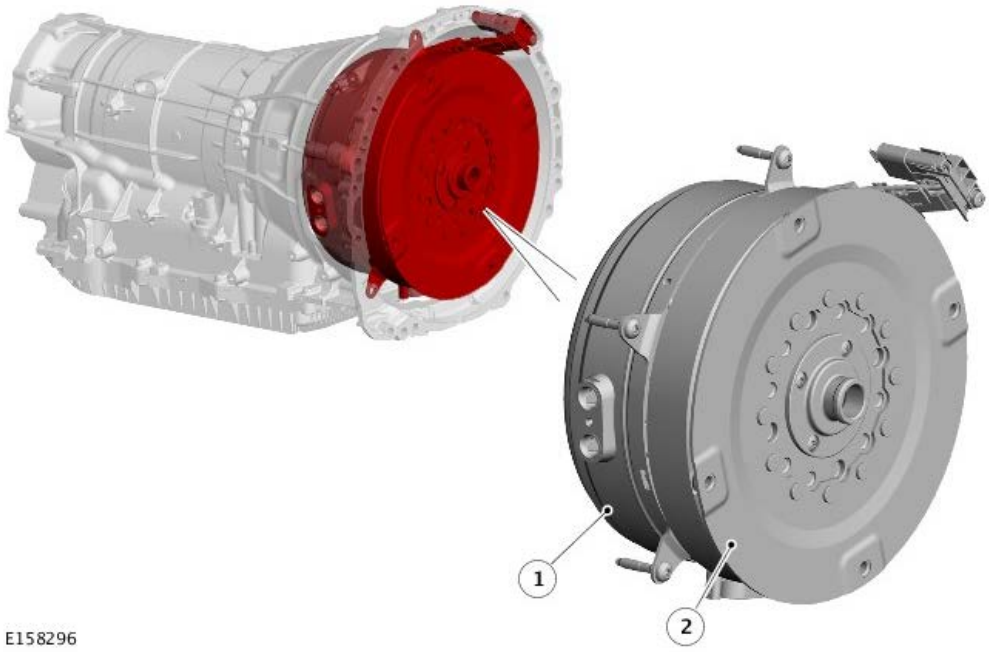
Transmission Sectional View



Item	Part Number	Description
1	-	Transmission casing
2	-	Motor Generator (MG)
3	-	Brake A
4	-	Launch clutch
5	-	Gear set 1
6	-	Gear set 2
7	-	Gear set 3
8	-	Clutch E
9	-	Clutch C
10	-	Clutch D
11	-	Gear set 4
12	-	Output shaft
13	-	Drain plug
14	-	Electric Automatic Transmission Fluid (ATF) pump
15	-	Fluid pan
16	-	Transmission Control Module (TCM)
17	-	Mechatronic valve block
18	-	ATF filter
19	-	Mechanical ATF vane pump

20	-	Engine disconnect clutch
21	-	Input shaft
22	-	Dual mass flywheel

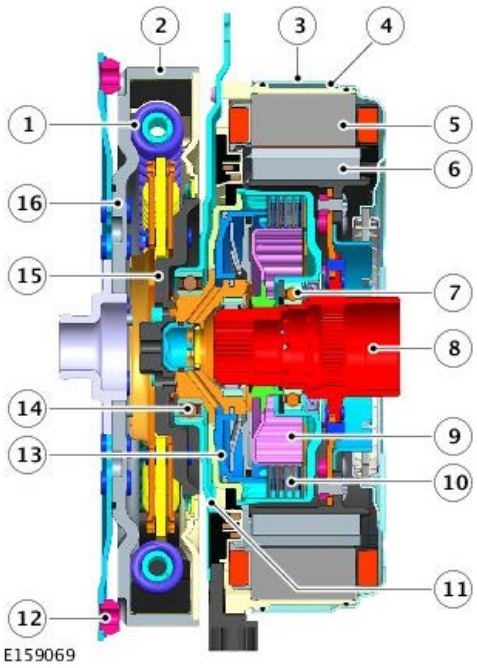
HYBRID DRIVE ASSEMBLY



E158296

Item	Part Number	Description
1	-	Motor Generator (MG)
2	-	Dual mass flywheel

Hybrid Drive Assembly - Sectional View



E159069

Item	Part Number	Description
1	-	Torsion springs
2	-	Dual mass flywheel assembly
3	-	Motor Generator (MG) assembly
4	-	Cooling gallery
5	-	Stator
6	-	Rotor
7	-	Bearing
8	-	Drive flange
9	-	Drive hub
10	-	Engine disconnect clutch
11	-	Bearing plate
12	-	Drive plate attachment holes (4 off)
13	-	Piston
14	-	Bearing
15	-	Secondary mass
16	-	Primary mass

The hybrid drive assembly comprises a dual mass flywheel and a Motor Generator (MG).

The hybrid drive assembly is positively located on the transmission input shaft splines and the assembly is retained in the transmission casing by five flanges on the MG bearing plate which are retained in the transmission casing with screws.

Dual Mass Flywheel

The dual mass flywheel is the coupling element between the engine and the transmission and is located in the front of the transmission casing, on the engine side of the transmission. The driven power from the engine crankshaft is transmitted mechanically through the dual mass flywheel and via the engine disconnect clutch to the transmission. The dual mass flywheel is connected to the engine by a drive plate attached to the rear of the crankshaft.

The dual mass flywheel comprises a primary mass (flywheel) and a secondary mass that transmits drive from the engine to the transmission. The secondary mass is supported on a roller bearing within the primary mass. The primary mass is secured to the drive plate on the crankshaft with 4 bolts. The drive between the primary and secondary masses is transmitted through a torsional spring damper. The dual mass flywheel provides a rotational torque input to the transmission, via the engine disconnect clutch, without transmitting torsional and transient vibrations produced by the engine.

Motor Generator (MG)

For details of the MG and regenerative braking functions refer to Battery, Mounting and Cables and Braking Controls For additional information, refer to:

Battery and Cables - TDV6 3.0L Diesel - Hybrid Electric Vehicle (414-01, Description and Operation),
Braking Control System - TDV6 3.0L Diesel - Hybrid Electric Vehicle (206-11, Description and Operation).

Engine Disconnect Clutch

The engine disconnect clutch is located within the MG and is not a serviceable item. The clutch piston receives pressurized ATF from both the mechanical and electrical ATF pumps via a solenoid operated valve in the Mechatronic valve block.

The engine disconnect clutch is hydraulically controlled by an Electronic Pressure Regulating Solenoid (EPRS) valve, which is controlled by the TCM in response to requests from the ECM. The ECM hosts software to control the Hybrid Electric Vehicle (HEV) systems.
For additional information, refer to: Battery and Cables - TDV6 3.0L Diesel - Hybrid Electric Vehicle (414-01, Description and Operation).

The control of the EPRS allows the engine disconnect clutch to have three states of operation as follows:

- Fully engaged
- Controlled slip variable engagement
- Fully disengaged.

The EPRS valve is operated by PWM (pulse width modulation) signals from the TCM to give full, partial or no lock-up of the engine disconnect clutch.

The engine disconnect clutch is a hydro-mechanical device which controls the source of the torque input into the transmission. The torque input can be from the MG, or the engine, or a combination of both. The engagement and disengagement is controlled by the TCM to provide a smooth transition between Electric Vehicle (EV) mode and parallel mode. The engine disconnect clutch comprises a piston and a set of four clutch friction plates. Hydraulic pressure generated by either the mechanical ATF pump or electric ATF pump is applied to the piston via the EPRS valve.

When the engine disconnect clutch is closed (plates locked together) the MG rotor is coupled to the engine. When the engine disconnect clutch is open (plates unlocked) the engine is separated from the MG rotor. This clutch allows the ECM to regulate how each power source inputs torque into the transmission to provide the vehicle drive.

The command to open or close the engine disconnect clutch is generated by the ECM and passed onto the TCM via the CAN HEV systems bus. The TCM is responsible for modulating the hydraulic pressure to the disconnect clutch, via the EPRS valve, to engage or dis-engage the disconnect clutch.

In the unlocked condition, the hydraulic pressure supplied to the piston chamber is reduced and the piston moves to release the pressure on the clutch friction plates. In this condition the clutch friction plates are released and torque from the engine is not transferred to the transmission.

In the locked condition, the disconnect clutch spool valve is actuated by the EPRS valve. Pressurized hydraulic fluid is directed into the piston chamber. The piston moves with the pressure and pushes the clutch friction plates together. As the pressure increases, the friction between the clutch friction 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.

Before the clutch is locked the engine speed is adjusted so that when the engine disconnect clutch is being locked there is minimal slip and the transition of torque input between the engine and the MG/transmission input shaft is seamless. The ECM, in conjunction with the TCM, calculates the required engine speed to ensure the transition between torque input sources is smooth.

For example:

1. When accelerating slowly from a standstill, the MG will provide the initial torque and the engine disconnect clutch will be open. As the torque required exceeds the MG capability the engine will be started, the ECM sets the engine speed to match the speed of the MG and the speeds are synchronized. As the engine disconnect clutch is closed, the two torque inputs seamlessly blend together.
2. When accelerating fast from a standstill, the loading on the MG is increased. If the engine and MG speeds are synchronized when the engine disconnect clutch is closed, the loading (mechanical drag) will lower the engine speed which would be noticeable to the driver. To compensate for this the ECM takes the loading into consideration when calculating the engine speed. The increased engine speed compensates for the expected loading when the engine disconnect clutch is closed, providing a seamless transition of torque input.

Launch Clutch

The torque applied into the transmission is controlled by the launch clutch. The TCM and the ECM control the operation of the launch clutch. The launch clutch was previously 'Brake B' clutch in the conventional ZF 8HP70 transmission. The launch clutch allows extended periods of clutch slip to regulate variations of torque from the engine or MG. This eliminates vibrations or shudder from the powertrain. The launch clutch provides the controlled clutch slip provided by the torque converter in the conventional transmission.

When the torque input is provided by the MG, the launch clutch enables any load to be gradually introduced onto the MG rotor. Too much load will slow the MG rotor. If the MG rotor speed is too low, the differential in speed between the MG rotor and the rotating magnetic field will cause the rotor to stall.

Transmission Idle Control

The Transmission Idle Control (TIC) feature is a standstill decoupling feature. When the vehicle comes to a standstill in Drive (with the brakes applied and the engine running), the engine torque input is disconnected from the driveline so that only a slight residual load remains. Decoupling is by actuating clutch B in the transmission, and is dependent on load and output speed.

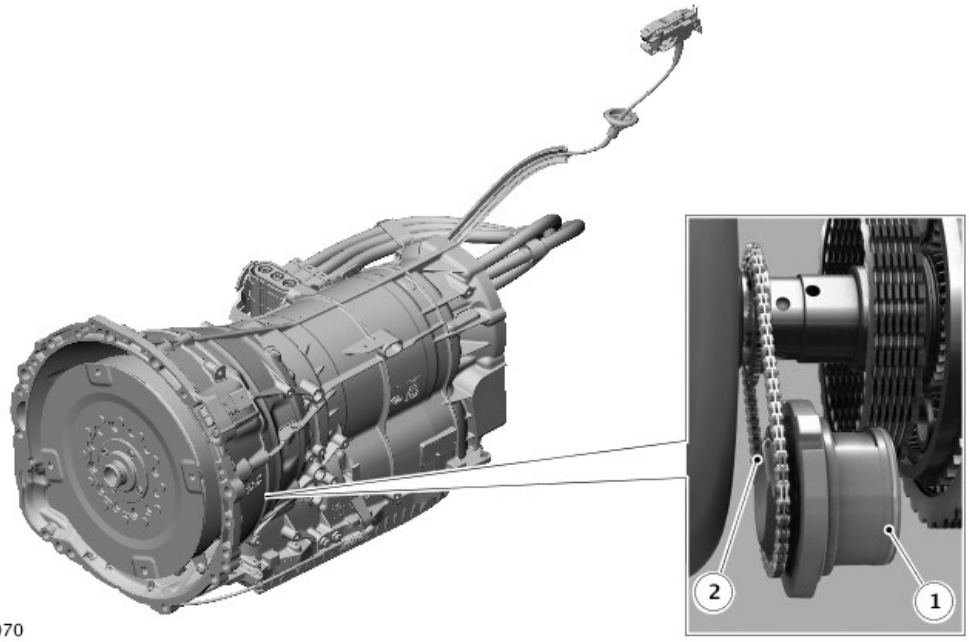
AUTOMATIC TRANSMISSION FLUID (ATF) PUMPS

Mechanical Automatic Transmission Fluid (ATF) Pump

The mechanical ATF pump is an integral part of the transmission. The ATF 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.

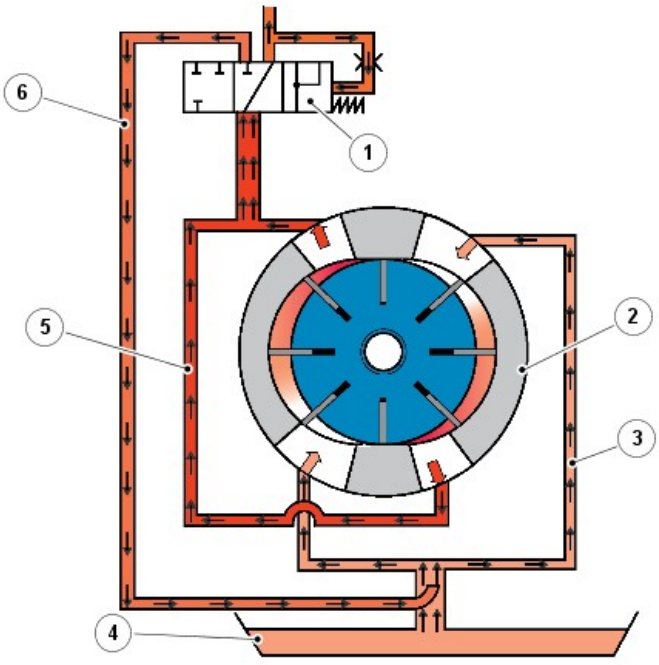
The ZF 8HP70 ATF pump is a double stroke, vane type pump and is located below the transmission input shaft. The pump is driven by a chain drive from a sprocket located on the input shaft. The pump has a delivery rate of 50 cm^3 per revolution. The drive sprocket is driven at engine speed and/or MG speed through a sprocket on the transmission input shaft.

Mechanical ATF Pump Location



Item	Part Number	Description
1	-	ATF pump
2	-	Chain drive from transmission input shaft

Mechanical ATF 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 mechanical ATF 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. A simplex chain transmits the rotation of the transmission input shaft 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 input shaft which is directly connected to the engine crankshaft and the MG.

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 mechanical ATF 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 pressurised fluid is allowed to recirculate through the pump.

Electric Automatic Transmission Fluid (ATF) Pump



E159071

Item	Part Number	Description
1	-	Suction pipe from ATF filter
2	-	Mounting bolt (3 off)
3	-	Electric ATF pump assembly
4	-	Mechatronic valve block
5	-	ATF filter
6	-	ATF outlet from pressure line
7	-	Pump
8	-	Electric motor
9	-	Contact pins for electrical connections
10	-	Pump control hardware
11	-	ATF inlet from suction pipe

A low voltage (12 volt) electric ATF pump is located in the transmission, at the rear of the Mechatronic valve block.

The electric ATF pump receives a 12V power supply from the primary battery, via the Battery Junction Box (BJB2), the BJB, the Auxiliary Junction Box (AJB) and a electric ATF pump relay in the Engine Junction Box (EJB). The electric ATF pump relay is energized by a power supply from the ignition relay in the Central Junction Box (CJB) and is separately fused.

The Electric ATF pump has a PWM connection to the TCM. The PWM connection provides a duty cycle for the pump and also sends a 'pump status' signal back to the TCM.

The electric ATF pump is connected to the transmission hydraulic circuit and is controlled by the TCM. The pump has two electrical connections with the TCM; a PWM connection for electric motor operation and diagnostic feedback and a ground.

The pump provides pressure and flow to the transmission and the engine disconnect clutch when the vehicle is stationary and when driving in EV mode and the MG speed is slow. The pump is deactivated once the transmission input shaft speed exceeds 500 rpm, when the transmission mechanical ATF pump is capable of delivering the correct pressure and flow of ATF. The pump has a delivery rate of 50 cm3 per revolution.

The electric ATF pump can have two failure states; the pump's integral software can report back a permanent failure to the TCM or the TCM can detect the loss of 'pump status' signal. In both cases the TCM will send a request to the ECM on the high speed CAN powertrain systems bus to run the Motor Generator which will rotate the transmission input shaft and operate the mechanical ATF pump.

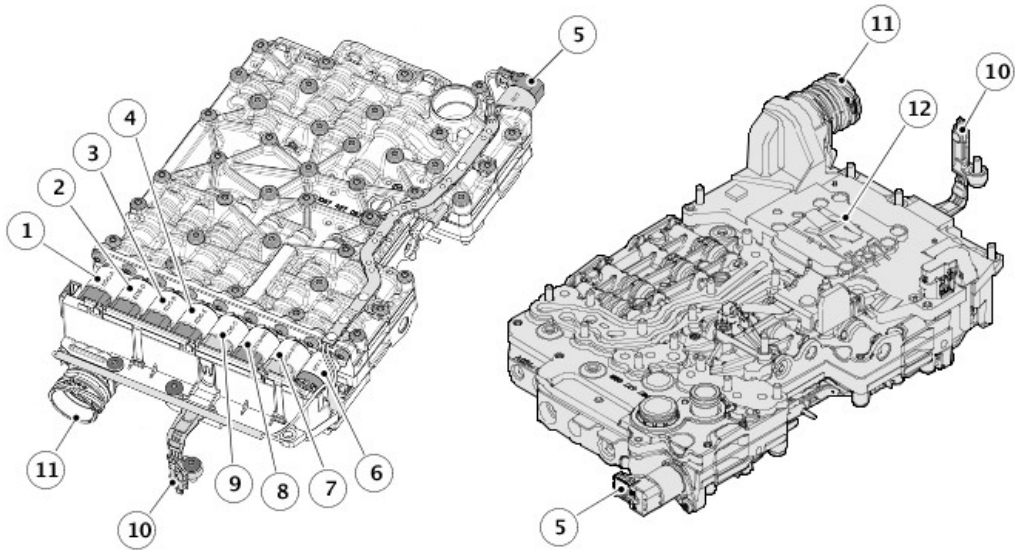
MECHATRONIC VALVE BLOCK

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.

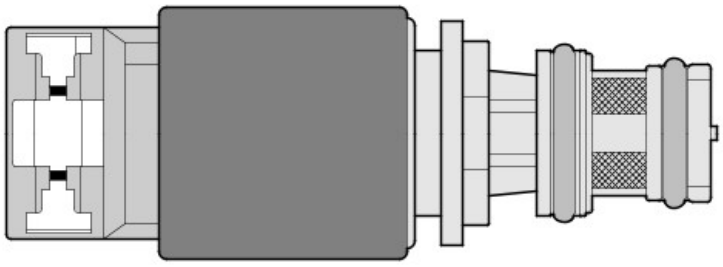
Mechatronic Valve Block



E159496

Item	Part Number	Description
1	-	EPRS A - A brake valve
2	-	EPRS D - D clutch valve
3	-	EPRS B - Launch clutch 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 output shaft speed sensor
11	-	Electrical connector
12	-	Transmission Control Module (TCM) - hidden

Electronic Pressure Regulator Solenoids (EPRS)



E42713

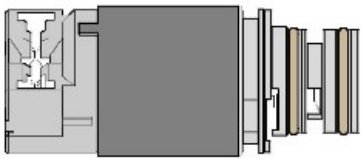
Seven EPRS are located in the valve block. The solenoids are controlled by PWM signals from the TCM. The solenoids convert the electrical signals into hydraulic control pressure proportional to the signal to actuate the spool valves for precise transmission operation.

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)



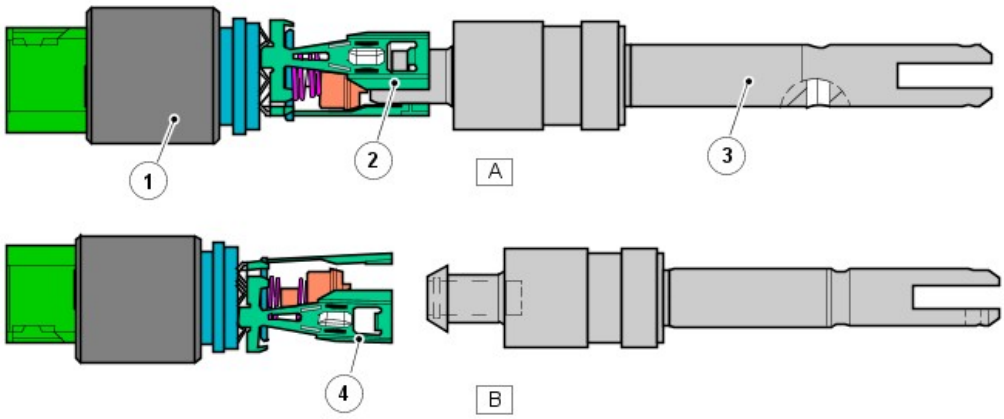
E42714

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 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 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 (deenergized) 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 deenergized. 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

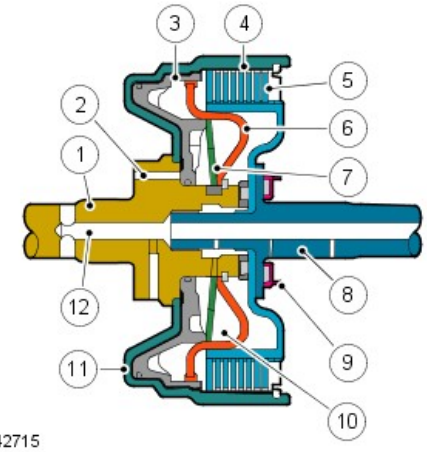
The Mechatronic valve block contains spool valves which control various functions of the transmission. The spool valves are of conventional design and are operated by fluid pressure.

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, one brake and a launch clutch 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 mechanical or the electric ATF 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, 1 brake and a launch clutch. 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, 1 brake and a launch clutch, 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.

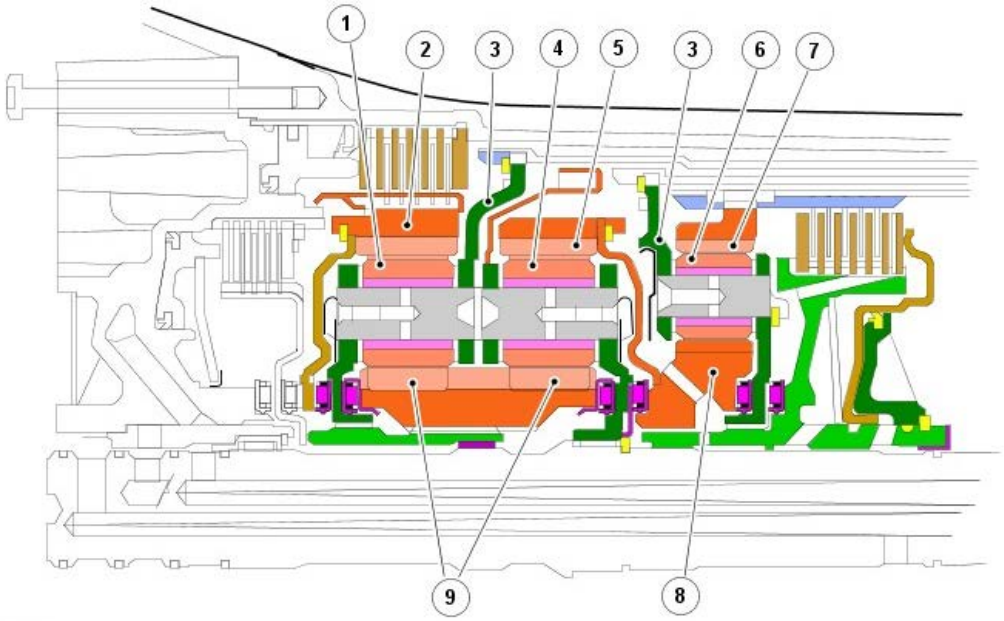
Planetary Gear Sets 1, 2 and 3

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.



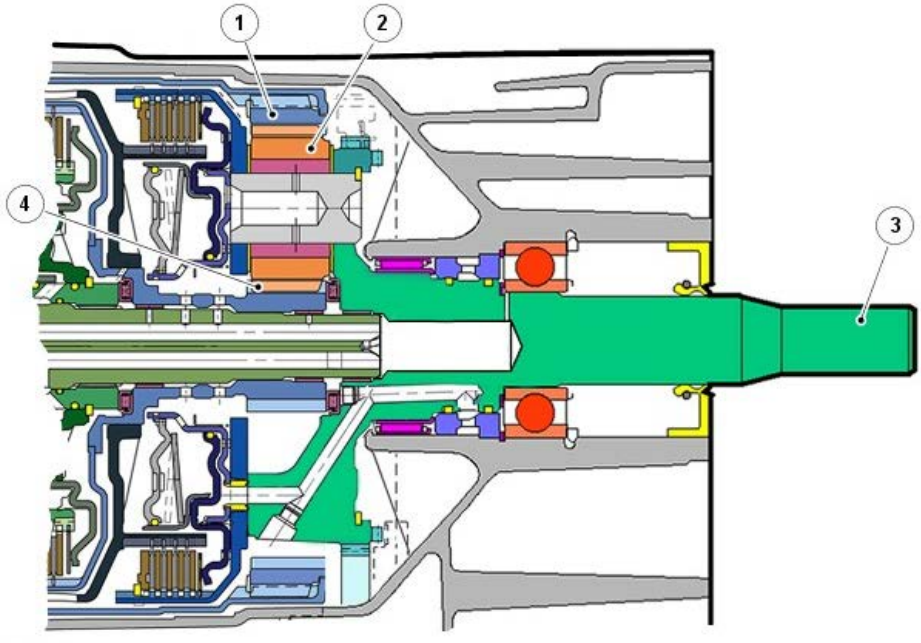
E131255

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 via the high speed CAN powertrain systems

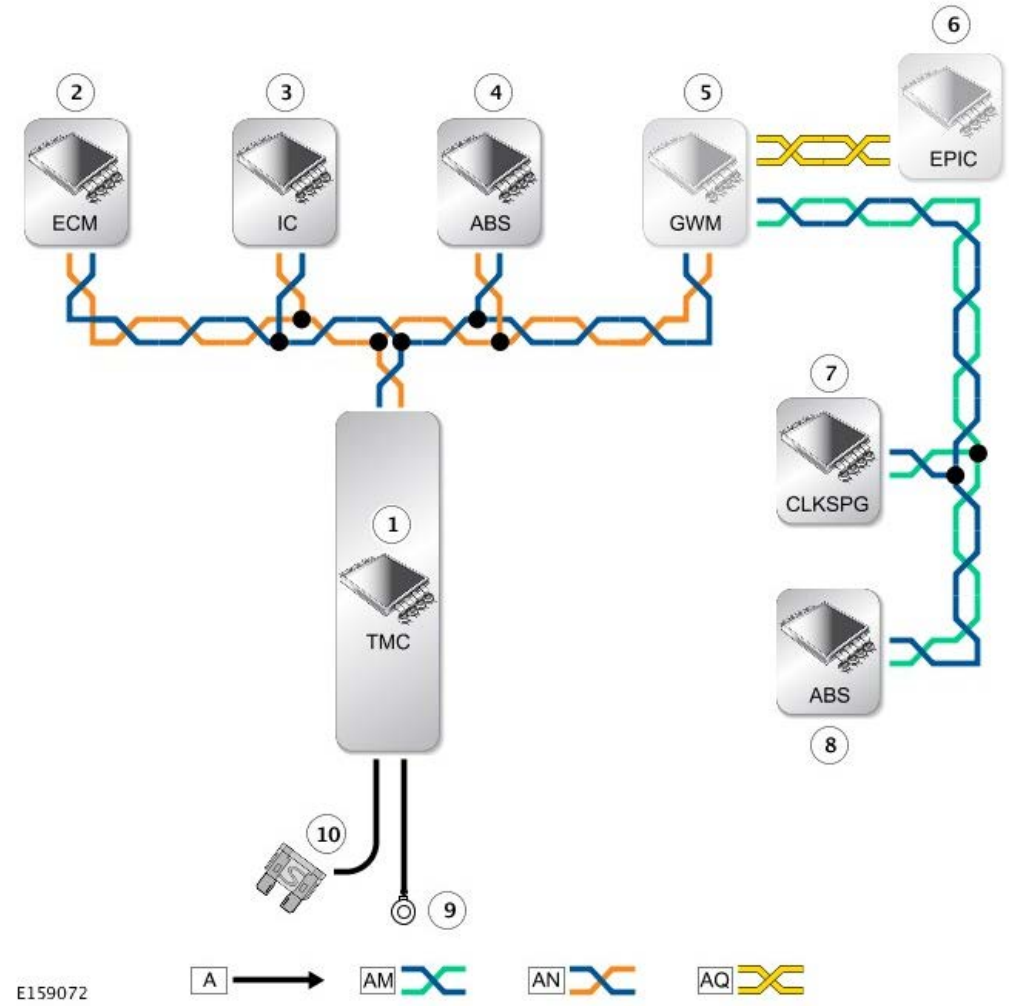
bus. From the received signal inputs and pre-programmed data, the TCM calculates the correct gear, disconnect and launch clutch settings and optimum pressure settings for gear shift and lock-up clutch control.

Over Temperature Messages

The transmission clutch temperatures are modelled within the TCM. The HEV 8P70H incorporates additional monitoring of the B clutch as this is worked hard on low speed crawl situations. The TCM uses algorithms to detect high load on the launch clutch and when detected provides a message to the driver to select low range. Further monitoring then provides a critical warning to the driver with a notification sound from the instrument cluster to select low range if this first message is ignored.

CONTROL DIAGRAM

NOTE: **A** = Hardwired; **AM** = High speed CAN chassis systems bus; **AN** = High speed CAN powertrain systems bus; **AQ** = High speed CAN Hybrid systems bus



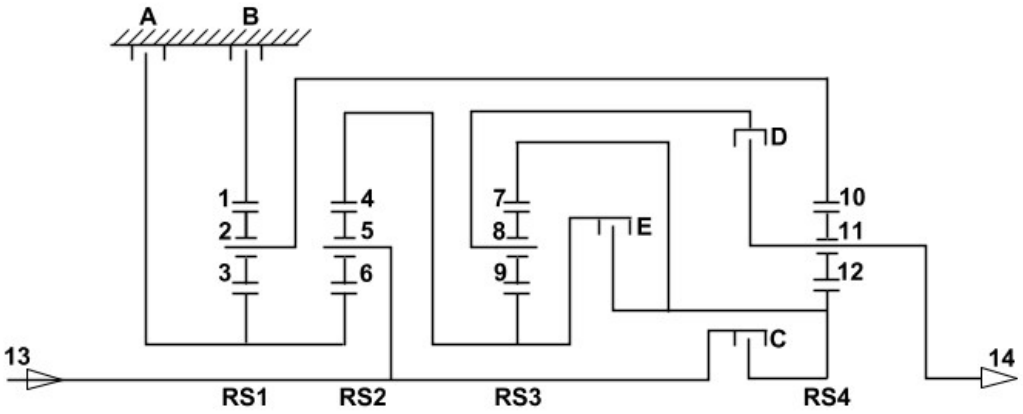
Item	Part Number	Description
1	-	Transmission Control Module (TCM)
2	-	Engine Control Module (ECM)
3	-	Instrument Cluster (IC)
4	-	Anti-lock Brake System (ABS) control module
5	-	Gateway Module (GWM)
6	-	Electric Power Inverter Converter (EPIC)
7	-	Clockspring (CLKSPG)
8	-	Anti-lock Brake System (ABS) control module
9	-	Ground
10	-	Power supply from Engine Junction Box (EJB)

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.



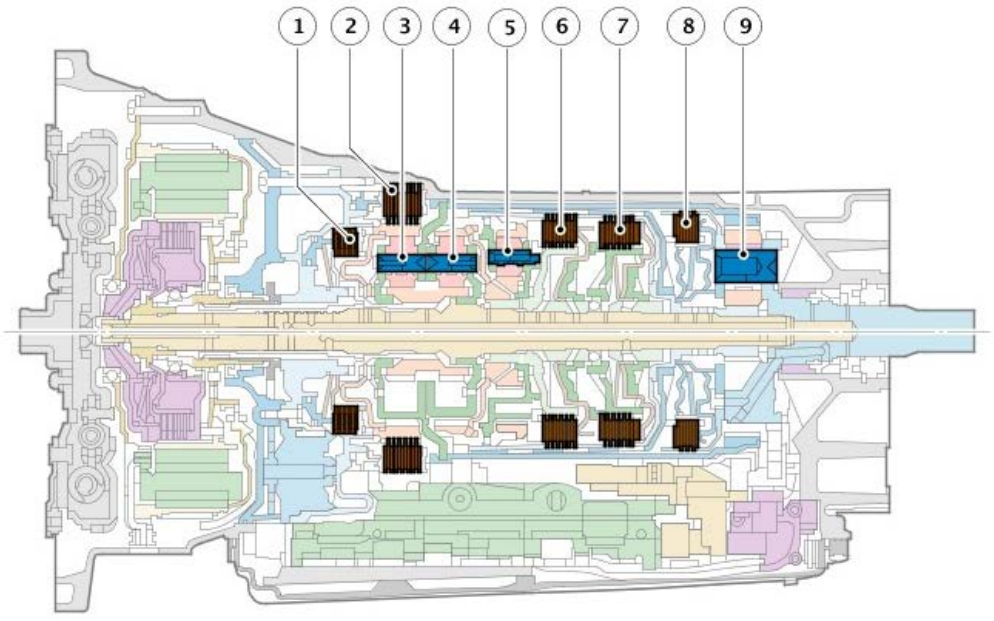
E131258

Item	Part Number	Description
A	-	Multiplate launch clutch
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

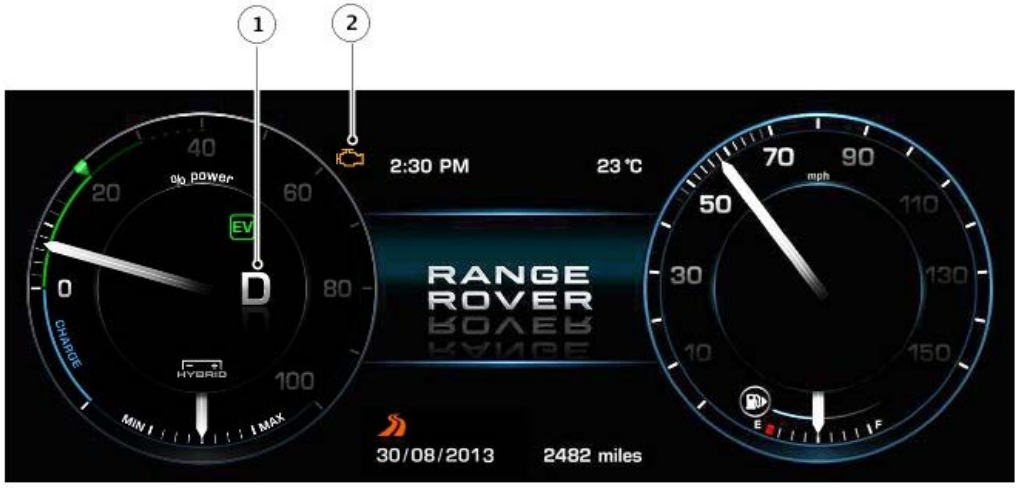


E159073

Item	Part Number	Description
1	-	Brake A
2	-	Launch clutch
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



E159074

Item	Part Number	Description
1	-	Malfunction Indicator Lamp (MIL)
2	-	Transmission status display

The Thin Film Transistor (TFT) display instrument cluster is connected to the TCM via the high speed CAN powertrain systems 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 - TDV6 3.0L Diesel - Hybrid Electric Vehicle (413-01, Description and Operation).

Malfunction Indicator Lamp

The MIL (malfunction indicator lamp) is located at the upper left of the instrument cluster display. 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 powertrain systems bus. 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 and in the message center when in sport mode. The display shows the Transmission Control Switch (TCS) 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
S	Sport mode selected
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 - TDV6 3.0L Diesel - Hybrid Electric Vehicle (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 TCS, the ECM and other vehicle systems. From the received signal inputs and pre-programmed data, the TCM calculates the correct gear, disconnect and launch clutch settings and optimum pressure settings for gear shift and

clutch control.

The ECM supplies the engine management data over the high speed CAN powertrain systems bus. The TCM requires engine data to efficiently control the transmission operation, for example; flywheel torque, engine speed, MG speed, accelerator pedal angle, engine temperature, engine disconnect request. The steering angle sensor and the ABS (anti-lock brake system) control module also supply data to the TCM on the high speed CAN powertrain systems 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 chassis systems bus to the Gateway Module (GWM). The GWM converts the massages and transmits them on the high speed CAN powertrain systems bus to the TCM. The TCM uses the signals to schedule driver requested upshifts and downshifts.

Using the signal inputs and the memorized data, the TCM control program computes the correct gear and disconnect and launch clutch settings and the optimum pressure settings for gear shift and 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 high speed CAN powertrain systems bus.

The TCM determines the position of the TCS using signals from the electronic TCS on the high speed CAN powertrain systems bus.

The TCM transmits the position of the TCS and any manual gear selected on the high speed CAN powertrain systems 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 transmission input shaft 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 ECO stop/start switch is pressed or the gear shift paddle switches are operated (manual Commandshift mode), the engine will start and the engine disconnect clutch will close to provide parallel mode operation (engine and MG operation) only.

Published: 26-Sep-2013

Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed - Hybrid Electric Vehicle - Automatic Transmission – AWD - Diagnostics SDV6 3.0L Diesel - Hybrid Electric Vehicle

Diagnosis and Testing

Principles of Operation

For a detailed description of the Automatic Transmission, refer to the relevant Description and Operation section in the workshop manual.
REFER to: Transmission Description (307-01B Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed - Hybrid Electric Vehicle - Automatic Transmission – AWD, Description and Operation).

Inspection and Verification

WARNINGS:

A risk assessment must be performed before any work is undertaken.

All hybrid electric vehicle work must be performed by a suitably qualified person.

Appropriate Personal Protection Equipment (PPE) must be worn when working on or near a hybrid electric vehicle high voltage system.

The hybrid electric vehicle battery pack casing must not be opened due to the risk of exposure to hazardous voltage, which may cause serious injury or death.

The electric power inverter converter casing must not be disassembled due to the risk of exposure to hazardous voltage, which may cause serious injury or death.

If the hybrid electric vehicle battery pack is damaged or overcharged, there is a risk of exposure to hazardous voltage and/or highly corrosive electrolyte mist. If liquid or vapour is observed leaking from the hybrid electric vehicle battery pack, take the following action:

- **Evacuate the area**
- **Notify manager**
- **Do not breathe smoke/vapour**
- **Contain spillage using spill kit**
- **Wash any spillage off body and clothing (remove contaminated clothing)**

If the hybrid electric vehicle warning indicator is illuminated, the Battery Energy Control Module (BECM) cannot isolate the high voltage cables. Live working will be necessary to rectify the fault.

The motor generator can generate a voltage if the wheels are rotated, even if the hybrid electric vehicle system has been made safe.

CAUTIONS:

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.

When probing connectors to take measurements in the course of the pinpoint tests, use the adaptor kit, part number 3548-1358-00.

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).

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.

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.

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.

1. Verify the customer concern
2. Visually inspect for obvious signs of damage and system integrity

Visual Inspection

Mechanical	Electrical	Hydraulic
• Transmission Control Switch (TCS) • Automatic transmission • Motor generator • Motor generator cooling system	• Fuses • Wiring harnesses and connectors • High voltage cables • Hybrid electric vehicle battery pack • Battery Energy Control Module (BECM) • Electric Power Inverter Converter Module (EPICM) • Motor generator • Motor generator coolant pump	• Automatic transmission fluid level/condition • Automatic transmission fluid cooler pipes • Automatic transmission fluid cooler

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

Automatic Transmission Fluid

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.

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) - Hybrid Electric Vehicle (100-00 General Information, Description and Operation).

Published: 16-Oct-2012

Automatic Transmission / Transaxle - Vehicles With: 8HP70 8-Speed - Hybrid Electric Vehicle - 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.

All vehicles

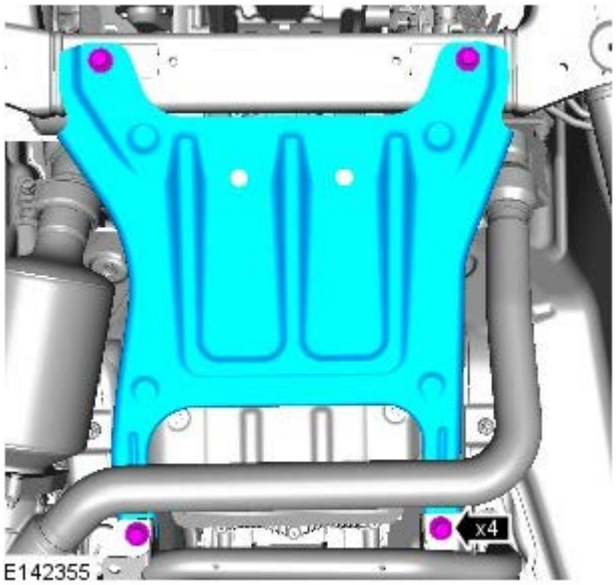
1. NOTE: For vehicles with oil cooler thermostat, ensure that transmission oil temperature, at least once has exceeded the opening temperature of the thermostat, which is 69°C. After that allow the oil temperature to drop below 30°C.
   - The following steps must be observed before starting the transmission 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 2000rpm for a minimum of 30 seconds. Move the TCS to the park and allow the engine to idle between 600rpm and 750rpm.
4. 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.
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.

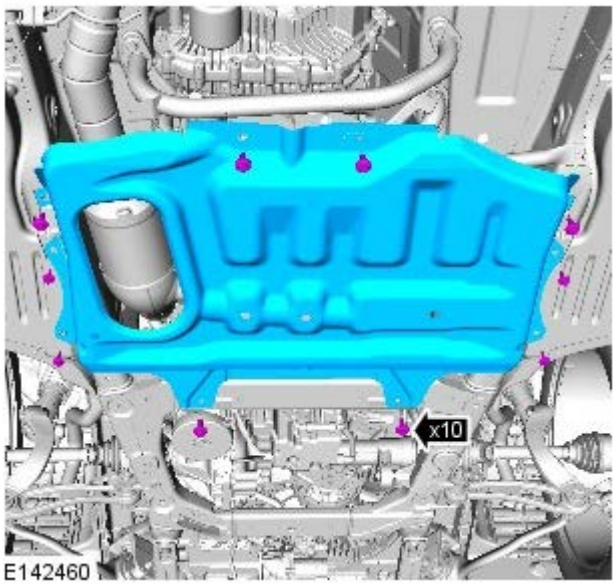
Vehicles with 4.4L diesel engine

7.



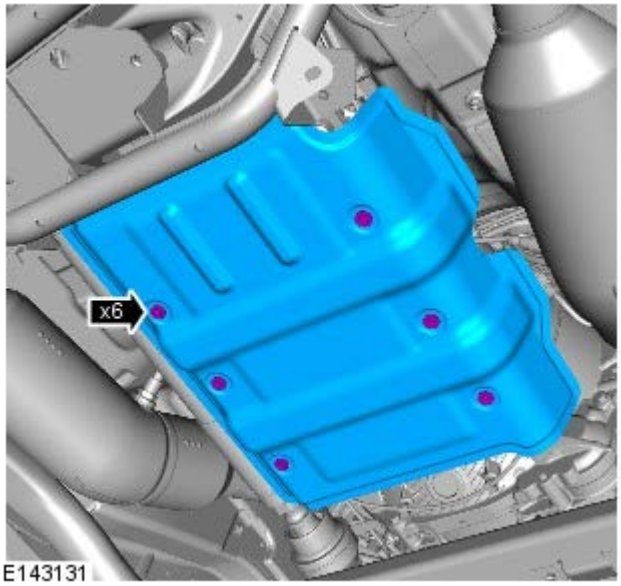
Vehicles with 3.0L diesel engine

8.

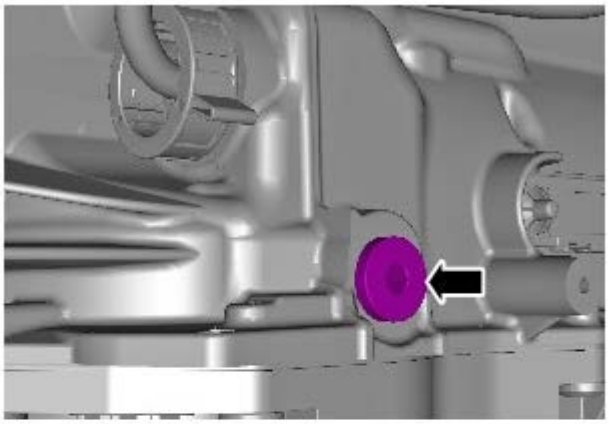


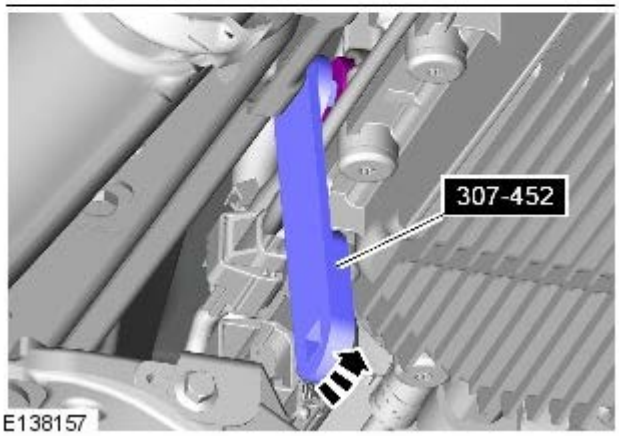
All vehicles

9.



10. Place a suitable container under the transmission fluid fill plug.





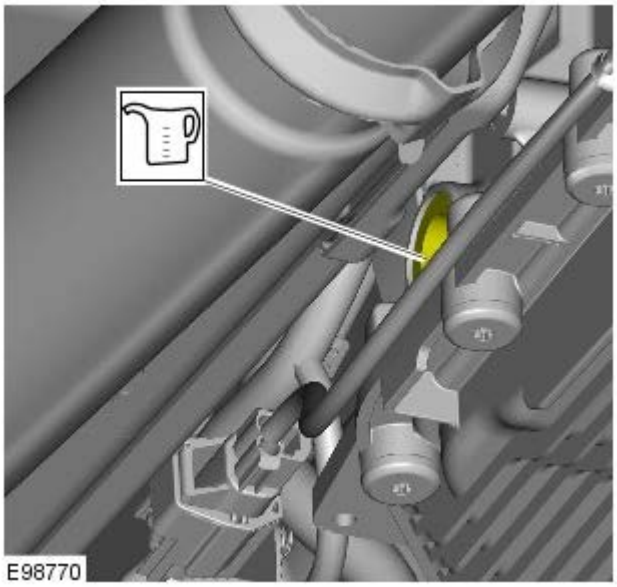
11. CAUTION: The transmission fluid level must only be checked when the temperature of the fluid is between 30 degrees and 50 degrees. The fluid level obtained will be incorrect if the reading is outside this temperature range.

    Clean the area around the transmission fluid level plug.

    Special Tool(s): 307-452

Adjustment

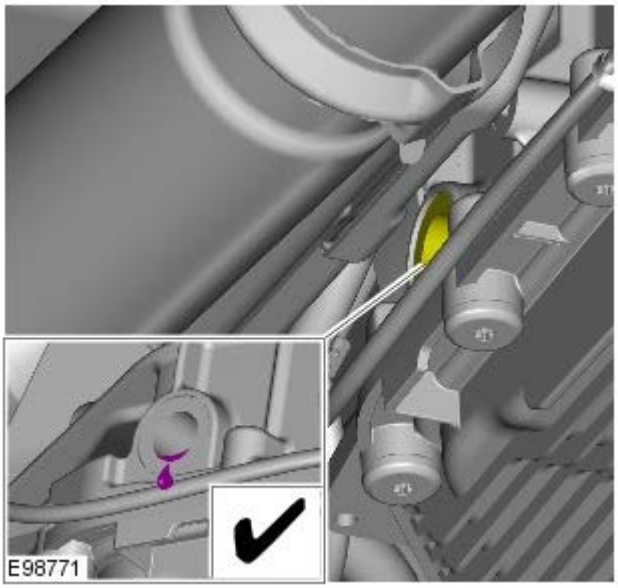
All vehicles



1. NOTE: Use transmission fluid meeting Land Rover specification.
   - Refer to: Specifications (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, Specifications).
   - Start the engine and idle between 600 rpm and 750 rpm.
   - Remove the oil fill plug.
   - 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.
   - Refit the plug.
   - Confirm that the transmission oil temperature is still below 30 deg C. This will ensure that the transmission is overfilled, which is necessary to prevent air suction.

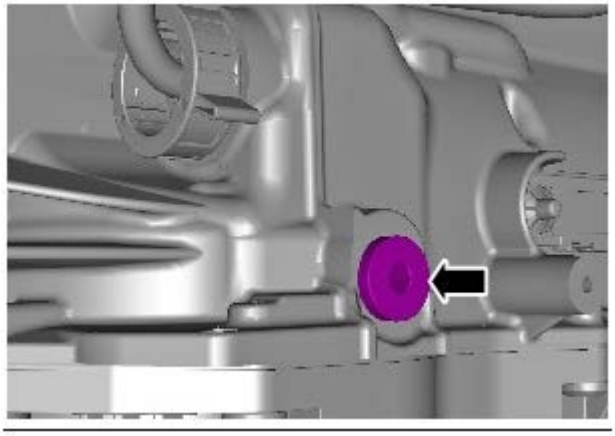
2.
   - All clutches and brakes must be filled, output speed must be 0 rpm, therefore:
   - Apply and hold the footbrake.
   - Engage Pos. R and wait 5 seconds.
   - Engage Pos. D and wait 5 seconds.
   - Tip Up to second gear and wait 5 seconds.
   - Engage Pos. N.

3. To ensure that the torque converter is filled with oil, rev up the engine in Pos. N to 2000 RPM for a minimum of 30 seconds, then engage Pos. P and ensure that the engine is idling between 600 RPM and 750 RPM.



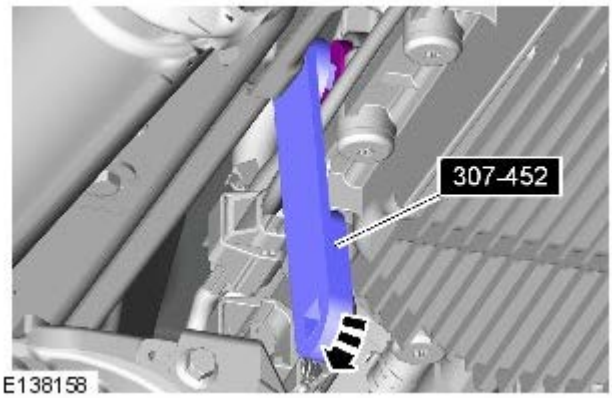
4. NOTE: If the temperature has exceeded 50°C (ideally 40°) before the plug was re-fitted you must start again with the procedure.

   With oil sump temperature between 30°C and 50°C (target 40°C) open lateral filling plug again. If the temperature is still below 40°C, allow oil to drain until 40°C are reached. If the temperature is between 40°C and 50°C, allow oil to drain, until the stream becomes a slow dribbling, then re-fit the plug.

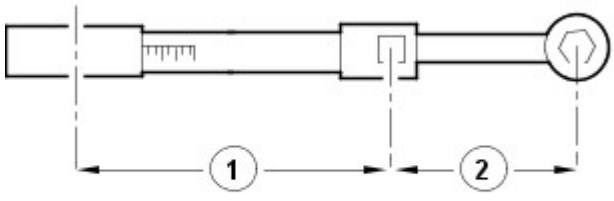


5. NOTE: Install a new fluid level filler plug.

   Special Tool(s): 307-452



6. 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.

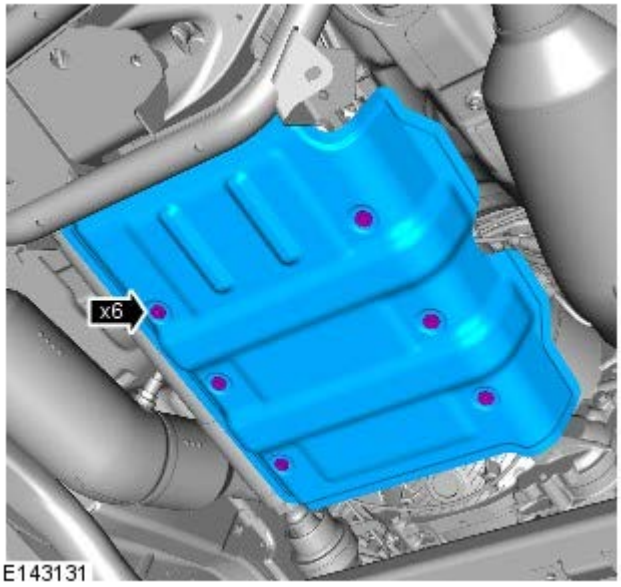


- To make sure the transmission fill plug is torqued to the correct specification. Using the special tool and torque wrench the following calculation steps must be followed.
- Step 1. Multiply 35 Nm by the effective length of the torque wrench (1).
- Step 2. Add the effective length of the special tool (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.

7. Remove the special tool.

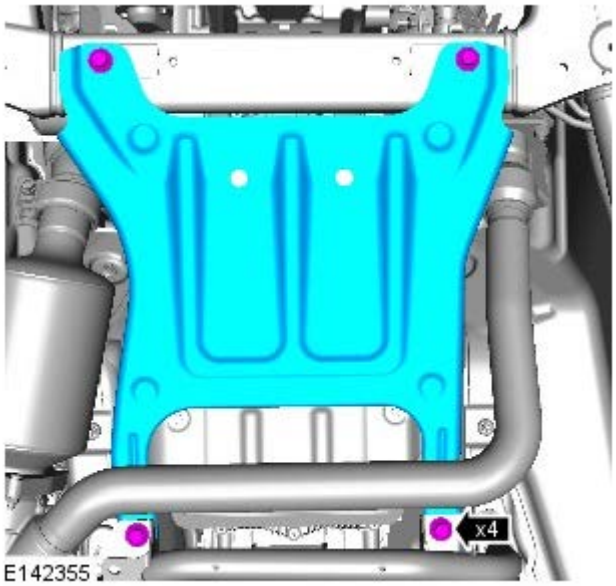
8. Remove the container.

9. *Torque:* 10 Nm



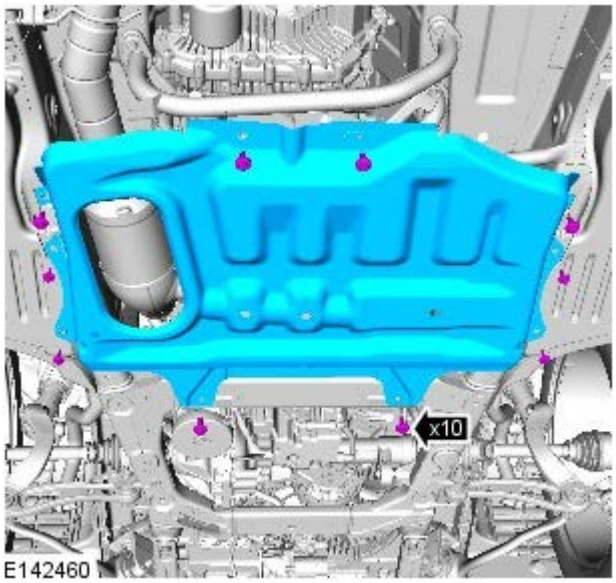
Vehicles with 4.4L diesel engine

10. *Torque:* 60 Nm



Vehicles with 3.0L diesel engine

11. *Torque:*
    M10 60 Nm
    M6 10 Nm



12. Lower the vehicle.
13. Disconnect the diagnostic tool.

Published: 06-Sep-2013

Automatic Transmission / Transaxle - Vehicles With: 8HP70 8-Speed - Hybrid Electric Vehicle - Automatic Transmission – AWD - Transmission Fluid Drain and Refill

General Procedures

Draining

WARNINGS:

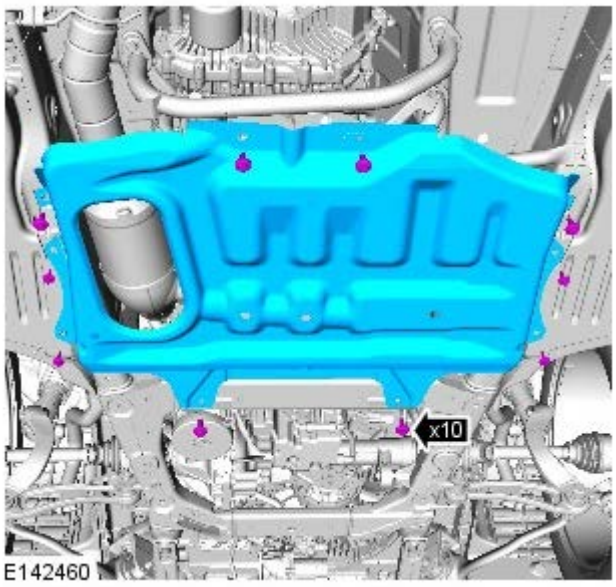
Observe due care when draining, as the fluid can be very hot.

Observe due care when working near a hot exhaust system.

1. WARNING: Make sure to support the vehicle with axle stands.

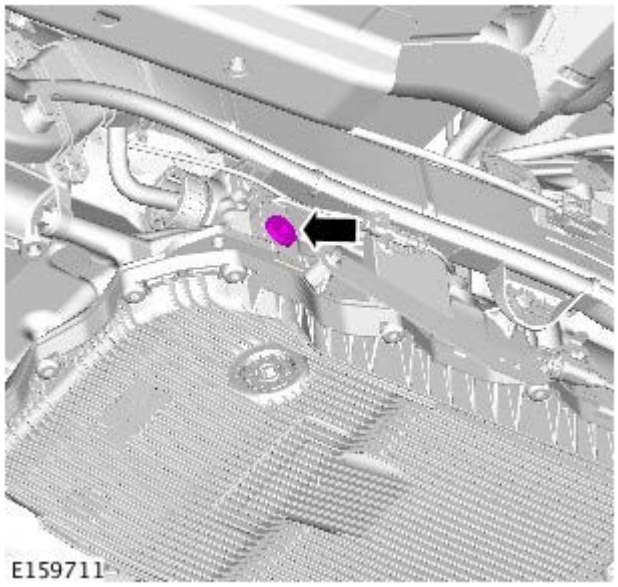
   Raise and support the vehicle.

2.

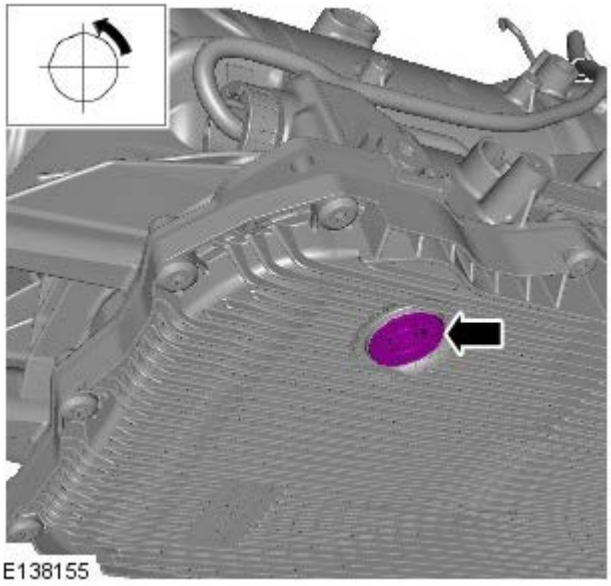


3. NOTE: Drain the fluid into a suitable container.

   Clean the area around the transmission fluid level plug.



4.
   - Allow the fluid to drain.
   - Discard the component.



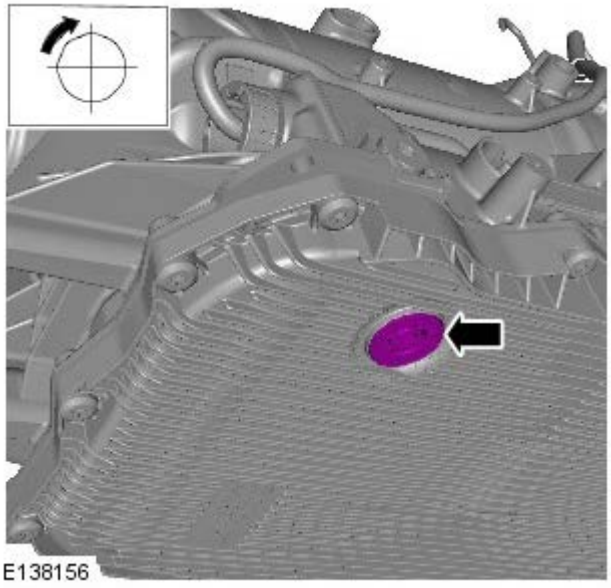
Filling

WARNINGS:

Observe due care when draining, as the fluid can be very hot.

Observe due care when working near a hot exhaust system.

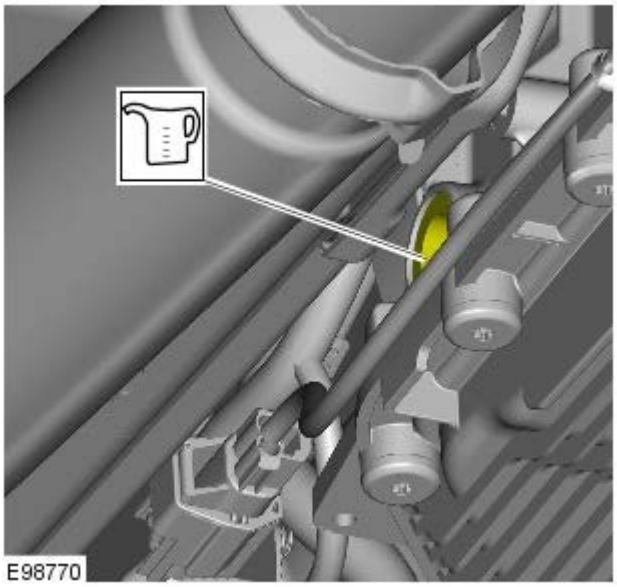
1. *Torque:* 8 Nm



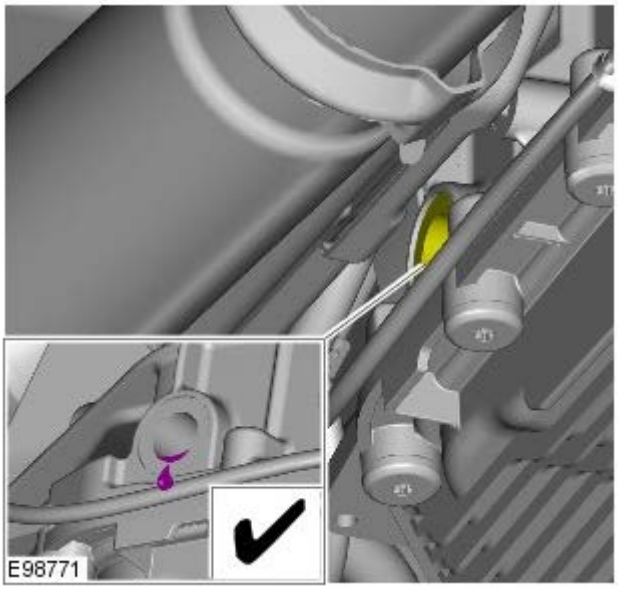
2. CAUTION: Make sure the correct specification and quanity of oil is used.

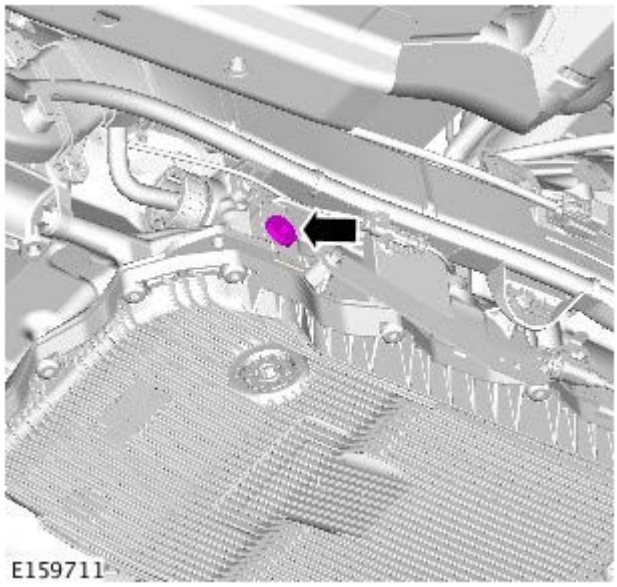
   NOTE: Use transmission fluid meeting Land Rover specification.

   - Refill the transmission with fluid.



3. Allow the transmission fluid to drain from the transmission fluid filler plug hole until the flow almost stops.



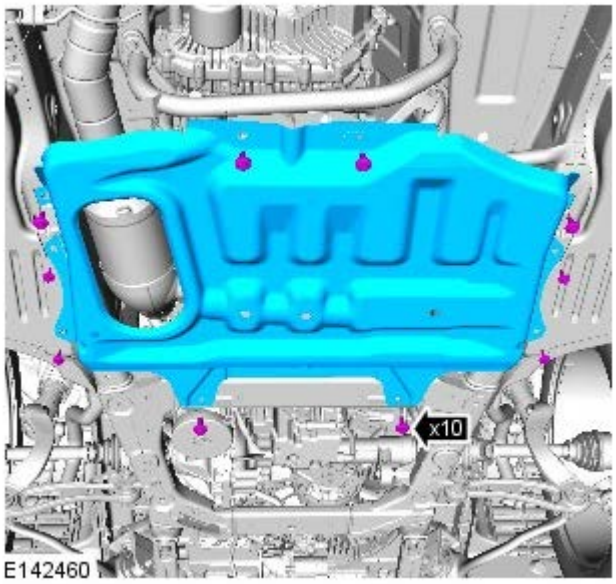


4. NOTE: Install a new fluid level filler plug.

   Torque: 35 Nm

5. Carry out a transmission fluid level check.

   Refer to: Transmission Fluid Level Check - TDV6 3.0L Diesel /TDV8 4.4L Diesel (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, General Procedures).



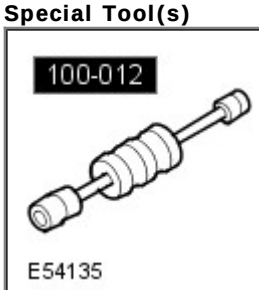
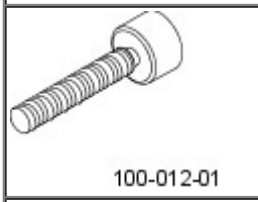
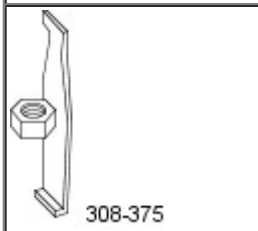
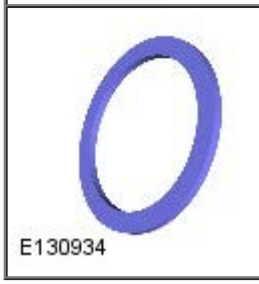
6. *Torque:*
   M10 60 Nm
   M6 10 Nm

Published: 04-Oct-2013

Automatic Transmission / Transaxle - Vehicles With: 8HP70 8-Speed - Hybrid Electric Vehicle - 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

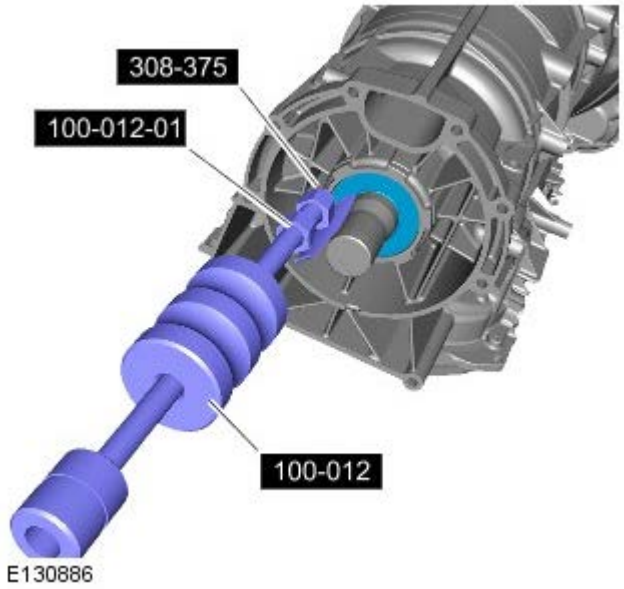
Removal

NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. Refer to: Transfer Case - TDV6 3.0L Diesel (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, Removal).
   Refer to: Transfer Case - TDV8 4.4L Diesel (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, Removal).
   Refer to: Transfer Case - V8 5.0L Petrol/V8 S/C 5.0L Petrol (308-07 Transfer Case, Removal).

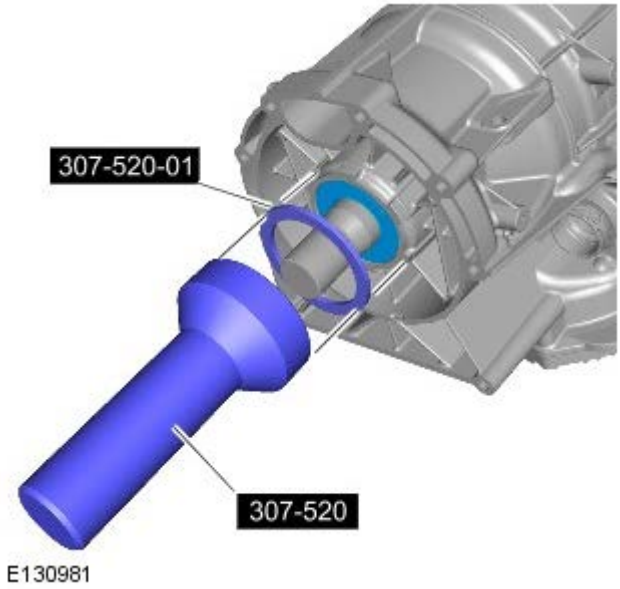
2. CAUTION: Care must be taken to avoid damage to the seal register and running surface.

   Special Tool(s): 100-012, 100-012-01, 308-375



E130886

Installation



E130981

1. CAUTIONS:

   Oil seals must be installed 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 (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, Installation).
   Refer to: Transfer Case - TDV8 4.4L Diesel (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, Installation).
   Refer to: Transfer Case - V8 5.0L Petrol/V8 S/C 5.0L Petrol (308-07 Transfer Case, Installation).

3. Carry out a transmission fluid level check.

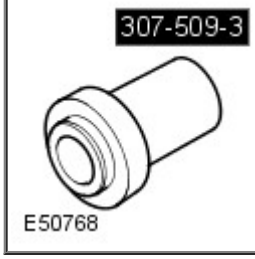
   Refer to: Transmission Fluid Level Check - V8 5.0L Petrol/V8 S/C 5.0L Petrol (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, General Procedures).
   Refer to: Transmission Fluid Level Check - TDV6 3.0L Diesel /TDV8 4.4L Diesel (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, General Procedures).

Published: 07-Sep-2012

Automatic Transmission / Transaxle - Vehicles With: 8HP70 8-Speed - Hybrid Electric Vehicle - Automatic Transmission – AWD - Selector Shaft Seal

Removal and Installation

Special Tool(s)

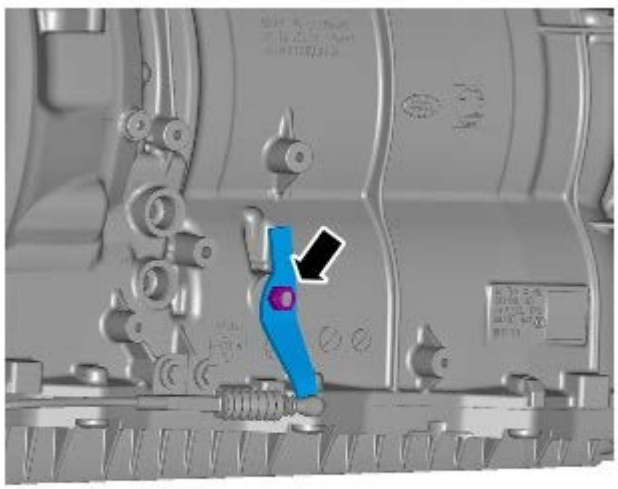
 E50766	Seal extractor 307-509-1(LRT-44-033/1)
 E50767	Seal extractor 307-509-2(LRT-44-033/2)
 E50768	Seal installer 307-509-3(LRT-44-033/3)

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. TORQUE: 12 Nm



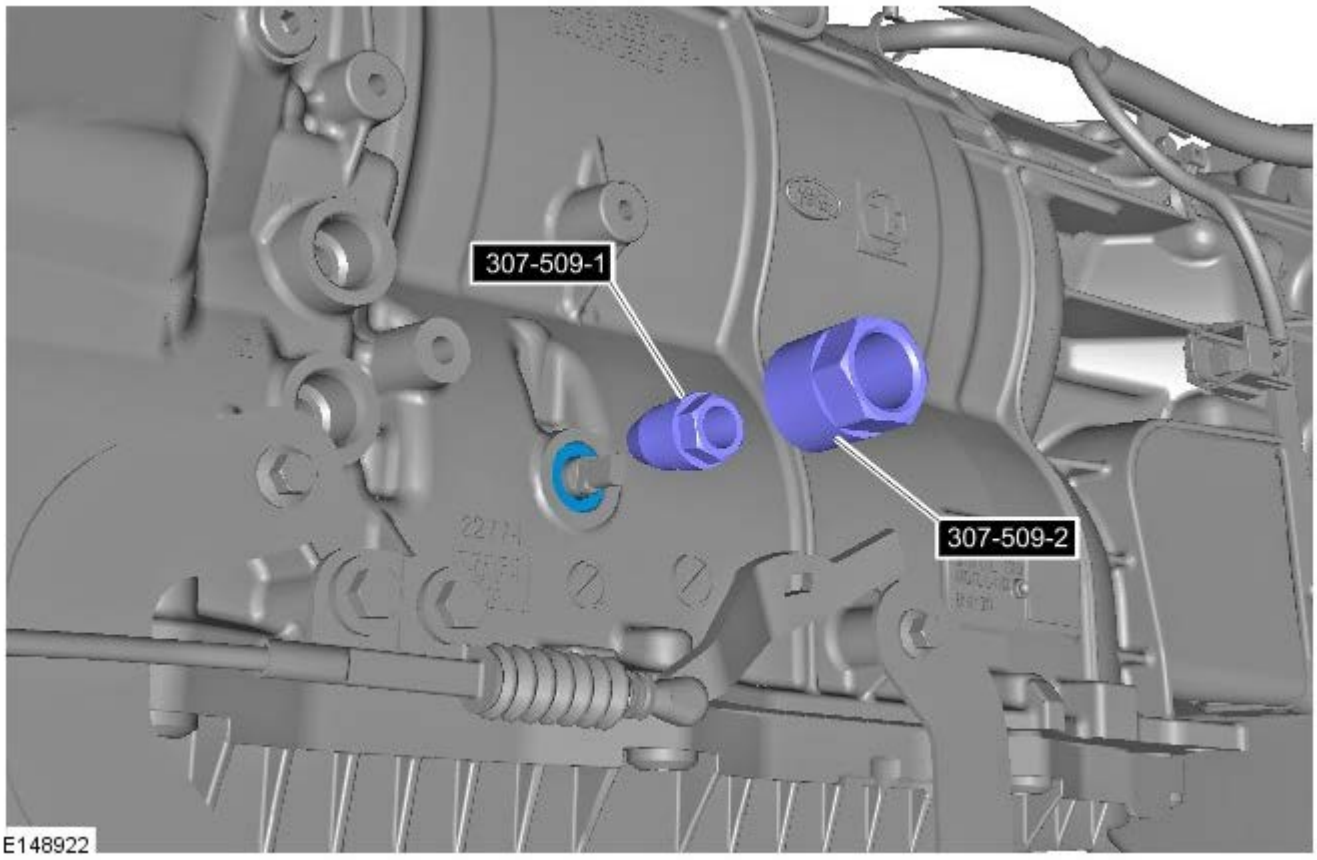
E149590

3. Release the selector cable and lever.
   - Remove the nut.

4. CAUTION: Before the disconnection or removal of any components, make sure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

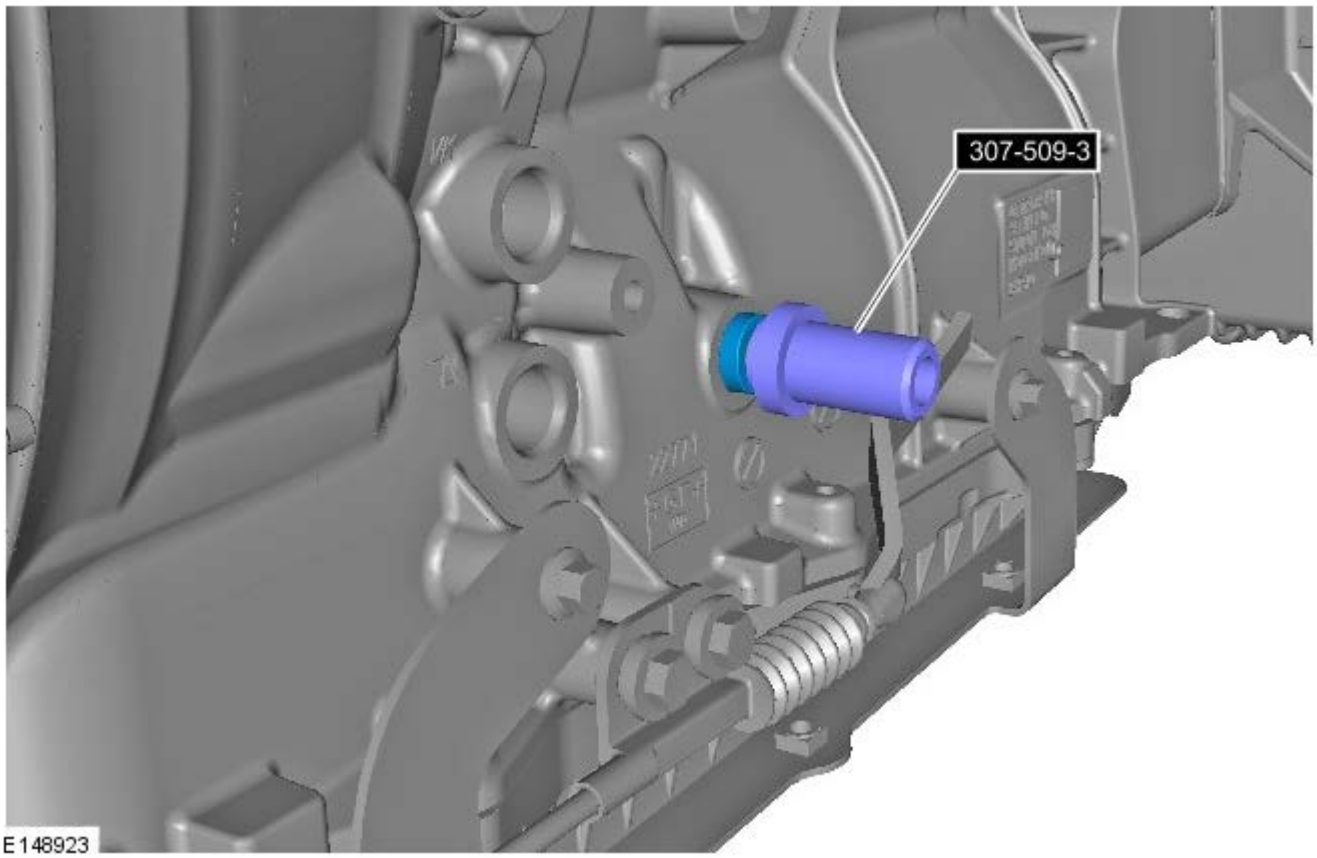
Remove the selector shaft seal.

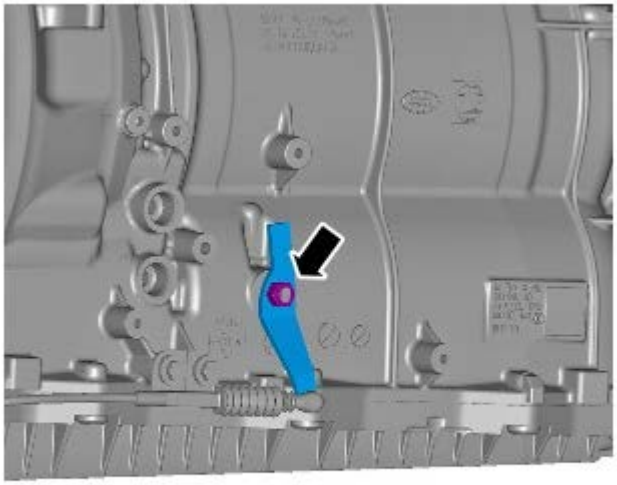
- Install 307-509-1 to the seal.
- Install 307-509-2 to 307-509-1 and extract the seal.



Installation

1. Using 307-509-3, install the selector shaft seal.
   - Clean the components.





E149590

2. Install the selector cable and lever.
    - Secure with the clip.
    - TORQUE: 12 Nm

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Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed - Hybrid Electric Vehicle - Automatic Transmission – AWD - Transmission Support Insulator

Removal and Installation

Removal

NOTES:

Some variation in the illustrations may occur, but the essential information is always correct.

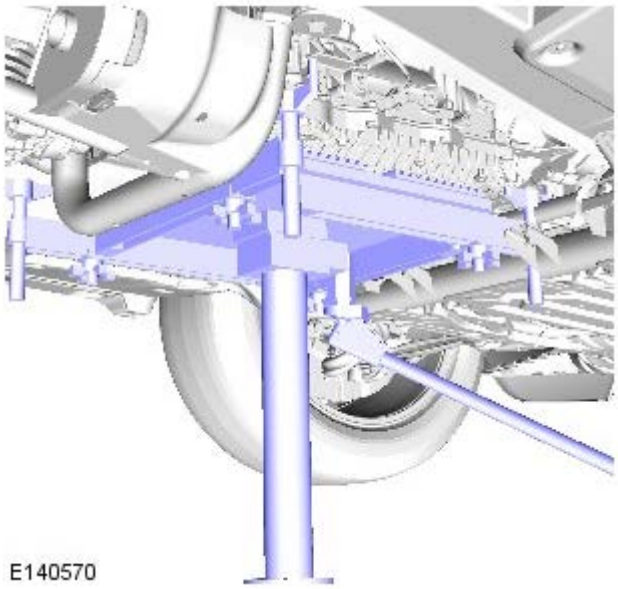
Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.
   For additional information, refer to: Specifications (414-00, Specifications).

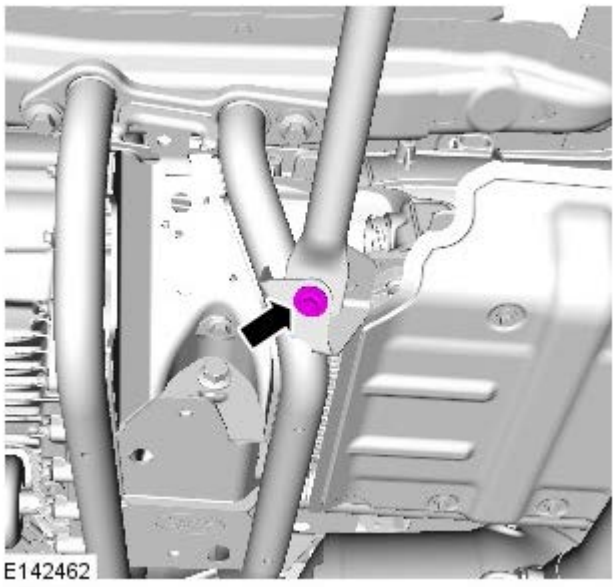
2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

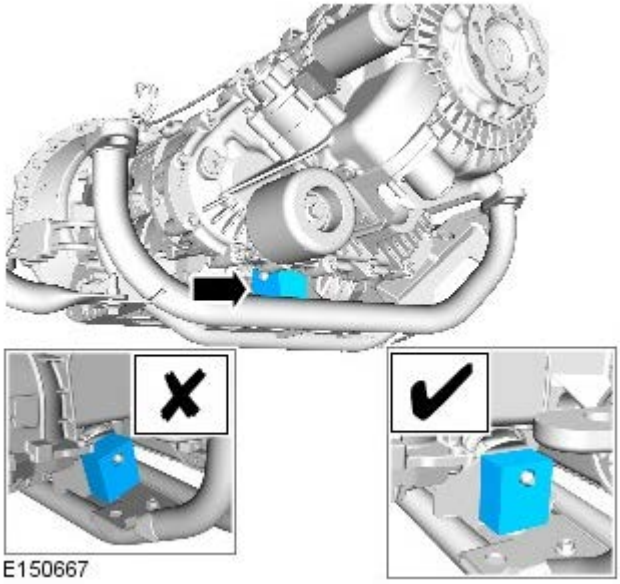
3. Using a suitable hydraulic jack, support the transmission.



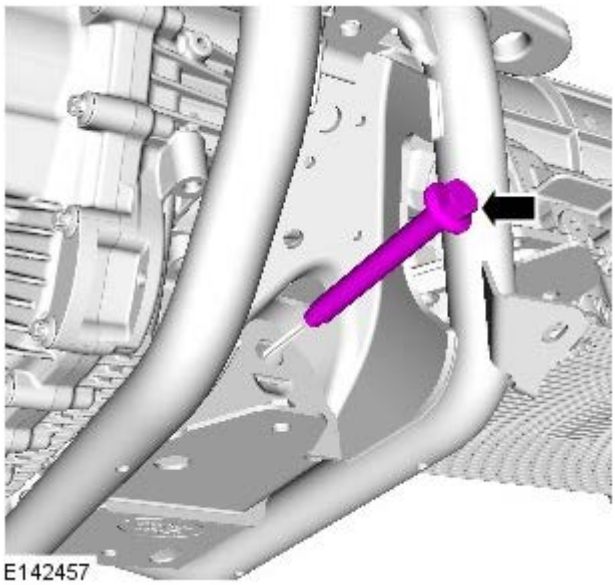
4. TORQUE: 24 Nm



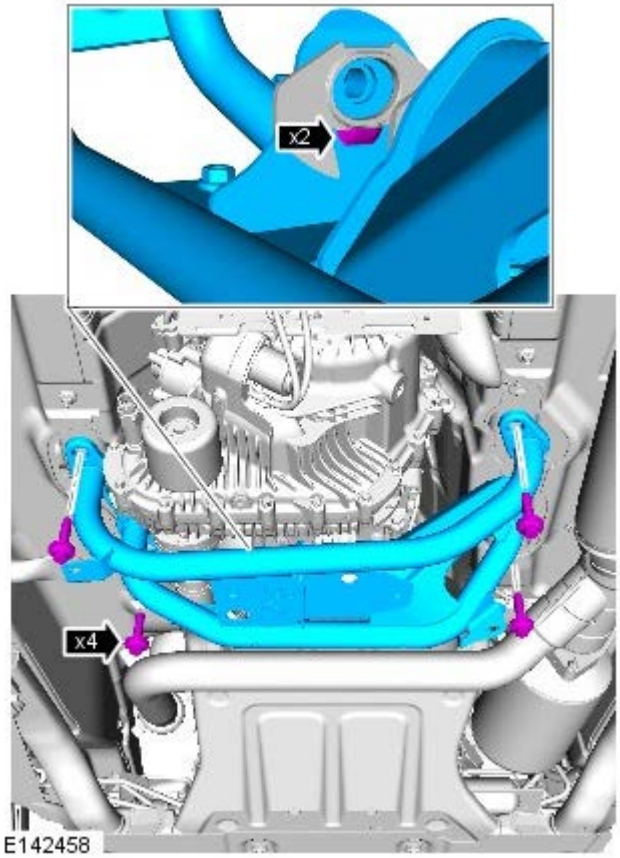
5. CAUTION: Note the fitted position of the component prior to removal.



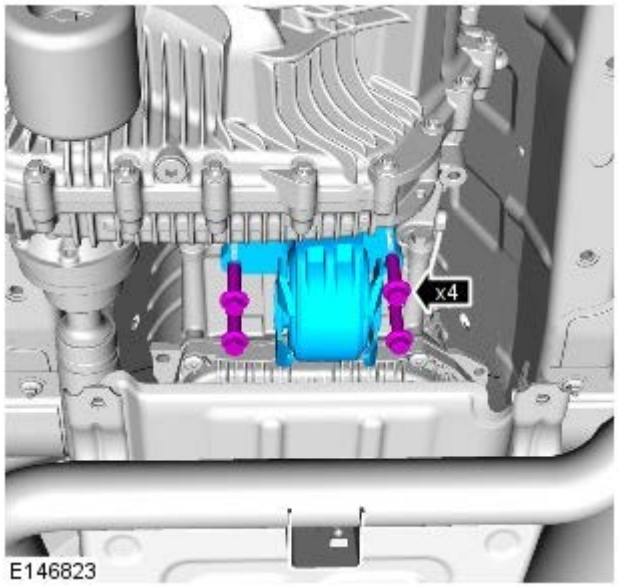
6. TORQUE: 175 Nm



7. TORQUE: 110 Nm



8. TORQUE: 60 Nm



Installation

1. To install, reverse the removal procedure.

Published: 06-Sep-2013

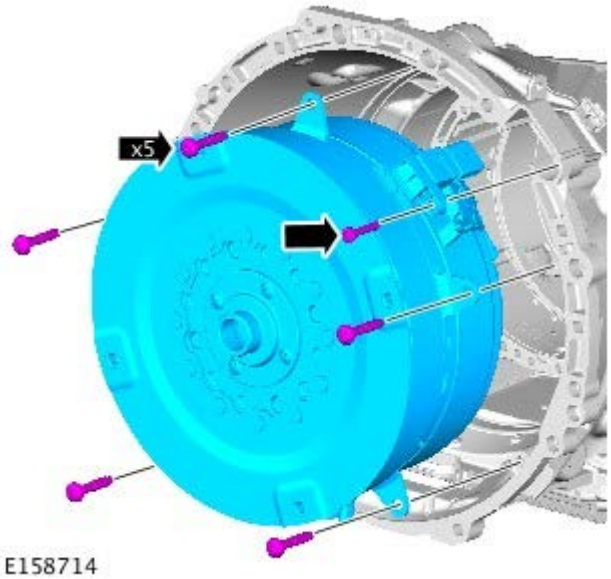
Automatic Transmission / Transaxle - Vehicles With: 8HP70 8-Speed - Hybrid Electric Vehicle - Automatic Transmission – AWD - Hybrid Drive Assembly

Removal and Installation

Removal

NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. Refer to: Transmission (307-01B Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed - Hybrid Electric Vehicle - Automatic Transmission – AWD, Removal).



E158714

2. CAUTIONS:

   It is essential that absolute cleanliness is observed when working on the hybrid drive assembly. Always cover any open orifices using lint free non-flocking material to prevent the ingress of foreign matter. Failure to follow this instruction may result damage to the components.

   Note the installed position of the component prior to removal.

   NOTE: This step requires the aid of another technician.

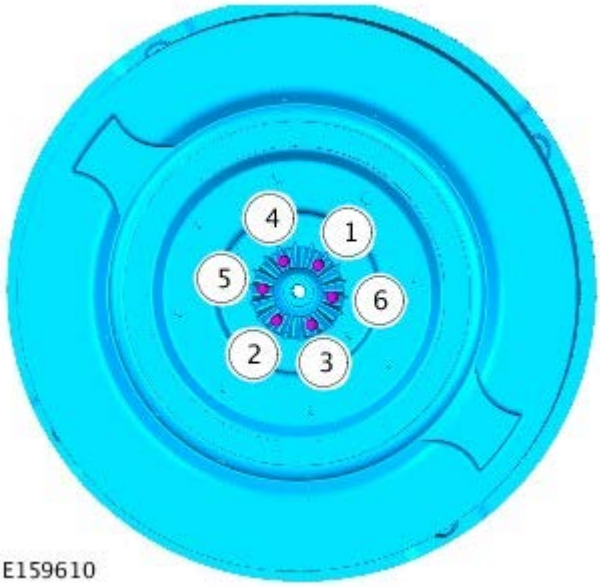


E159641

3. CAUTION: Discard the component.

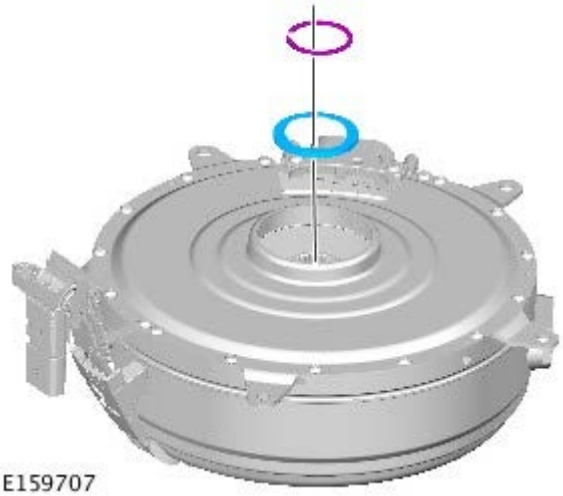
4. CAUTION: Remove the bolts in the indicated sequence.

   NOTE: This step requires the aid of another technician.



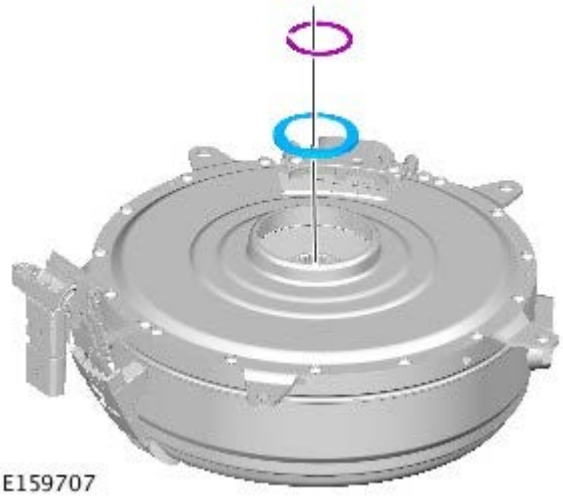
E159610

5. CAUTION: Discard the components.

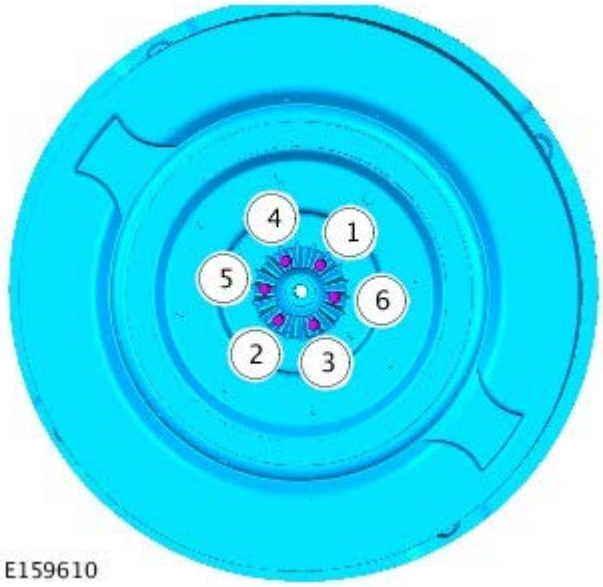

E159707

Installation

1. CAUTION: Make sure that new components are installed.


E159707

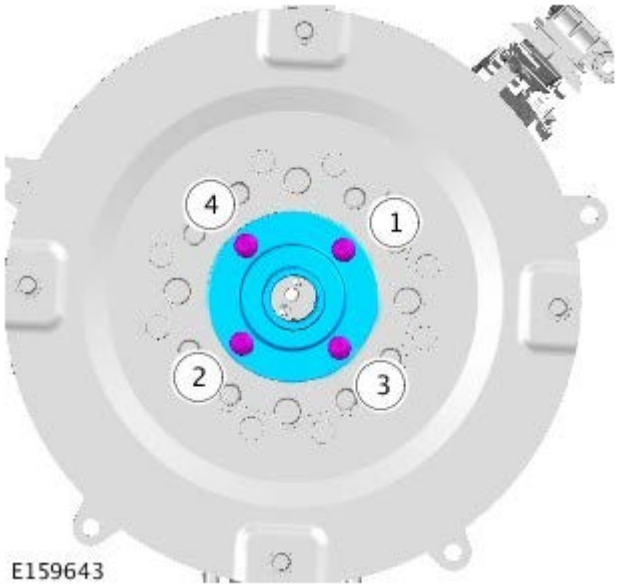
2. CAUTION: Tighten the bolts in the sequence shown.



E159610

NOTE: This step requires the aid of another technician.

Torque: 15 Nm



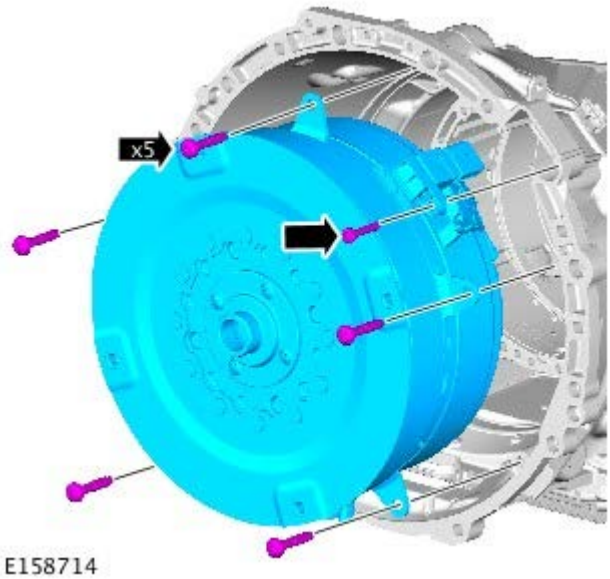
E159643

3. CAUTIONS:

Make sure that a new component is installed.

Tighten the bolts in the sequence shown.

Torque: 15 Nm



E158714

4. CAUTION: Take extra care not to damage the component.

NOTES:

Make sure that the components are installed to the noted removal position.

This step requires the aid of another technician.

Make sure that the hybrid drive assembly is fully engaged to the transmission.

Torque:

M6 bolt 10 Nm
M8 bolts
Stage 1: 5 Nm
Stage 2: 60°

5. NOTE: Make sure that the hybrid drive assembly is fully engaged to the transmission.



E138283

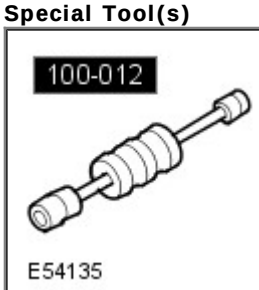
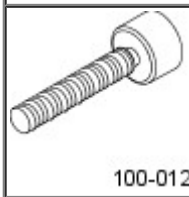
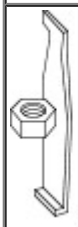
6. Refer to: Transmission (307-01B Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed - Hybrid Electric Vehicle - Automatic Transmission – AWD, Installation).

Published: 06-Sep-2013

Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed - Hybrid Electric Vehicle - Automatic Transmission – AWD - Input Shaft Seal

Removal and Installation

Special Tool(s)

	100-012 Slide Hammer
	100-012-01 Slide Hammer Adapter
	308-375 Remover, Input and Output Seal
	JLR-308-845 Installer, Input Shaft Seal

Removal

NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. Decommission the vehicle.

   Refer to: Hybrid Electric Vehicle (HEV) Decommission (414-01 Battery, Mounting and Cables, General Procedures).

2. WARNING: Make sure to support the vehicle with axle stands.

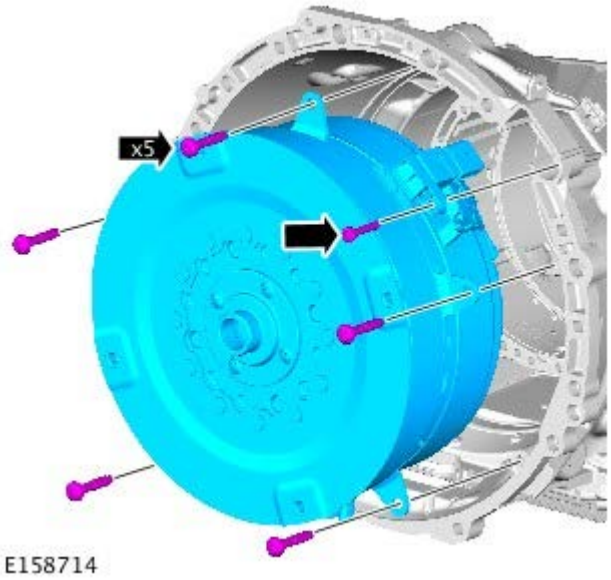
   Raise and support the vehicle.

3. Refer to: Transmission (307-01B Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed - Hybrid Electric Vehicle - Automatic Transmission – AWD, Removal).

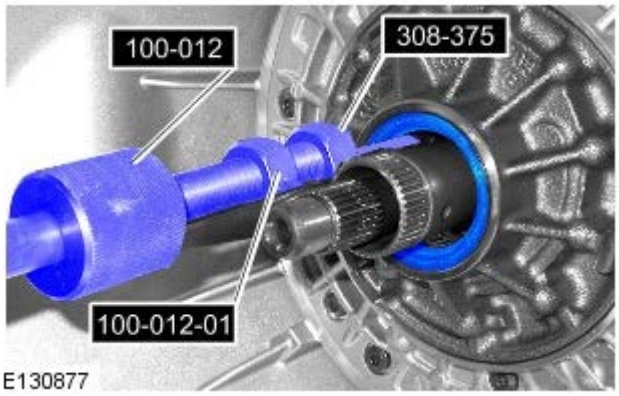
4. CAUTIONS:

   It is essential that absolute cleanliness is observed when working on the hybrid drive assembly. Always cover any open orifices using lint free non-flocking material to prevent the ingress of foreign matter. Failure to follow this instruction may result damage to the components.

   Note the installed position of the component prior to removal.



NOTE: This step requires the aid of another technician.



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

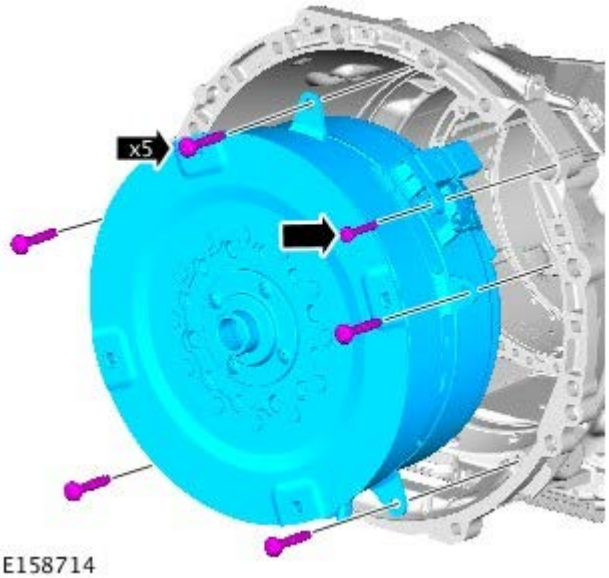
2. CAUTION: Take extra care not to damage the component.

NOTES:

Make sure that the components are installed to the noted removal position.

This step requires the aid of another technician.

Torque:
- M6 bolt 10 Nm
- M8 bolts
  - Stage 1: 5 Nm
  - Stage 2: 60°



E158714

3. NOTE: Make sure that the hybrid drive assembly is fully engaged to the transmission.



E138283

4. Install the transmission and transfer gearbox.

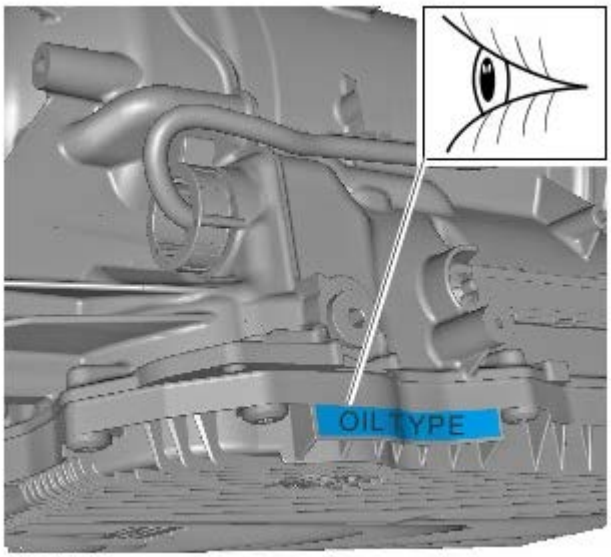
   Refer to: Transmission (307-01B Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed - Hybrid Electric Vehicle - Automatic Transmission – AWD, Installation).

5. Refer to: Hybrid Electric Vehicle (HEV) Decommission (414-01 Battery, Mounting and Cables, General Procedures).

6. CAUTIONS:

   Make sure the correct specification and quantity 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.



E138154

NOTE: Install a new fluid level filler plug.

Carry out a transmission fluid level check.

Torque: 35 Nm

Published: 06-Sep-2013

Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed - Hybrid Electric Vehicle - 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 fluids.

CAUTION: Make sure all suitable safety precautions are taken to protect the TCM and main control valve body electrical connector pins against electrostatic discharge.

NOTES:

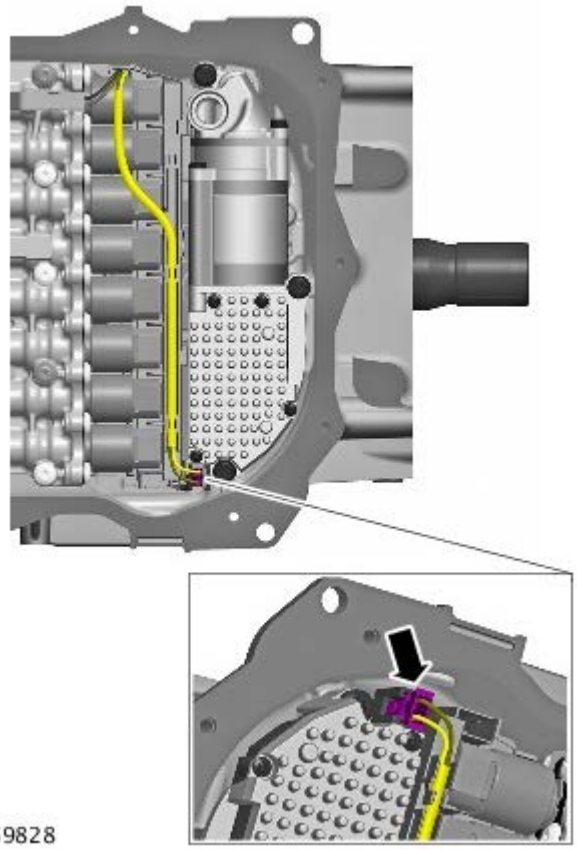
The transmission control module (TCM) is part of the main control valve body and cannot be serviced separately.

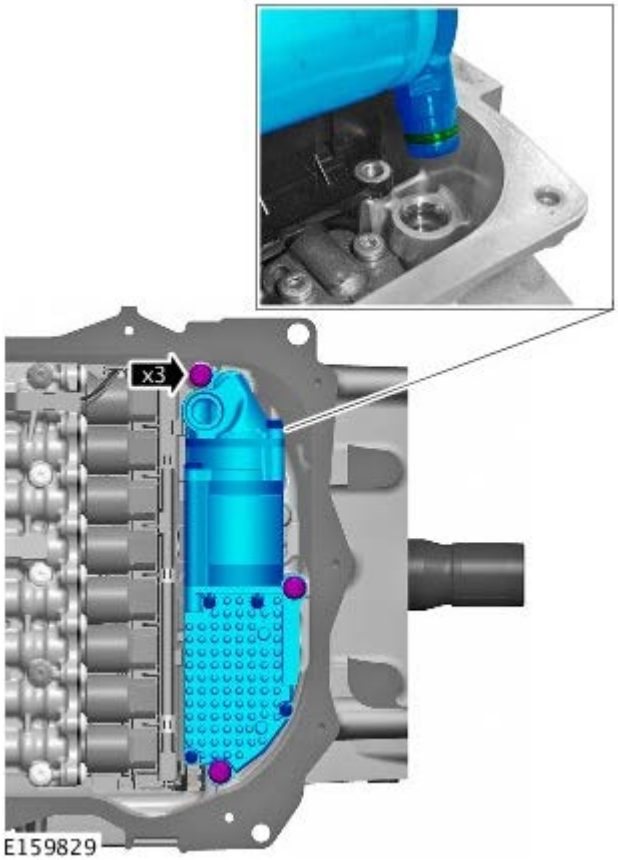
Some variation in the illustrations may occur, but the essential information is always correct.

1. Remove the transmission fluid pan.

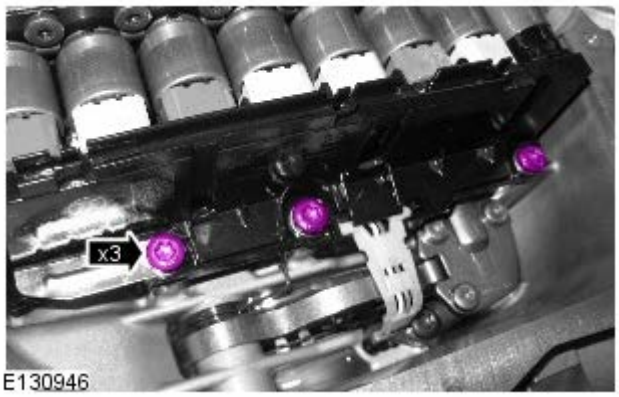
   Refer to: Transmission Fluid Pan, Gasket and Filter (307-01B Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed - Hybrid Electric Vehicle - Automatic Transmission – AWD, Removal and Installation).

2.


E159828



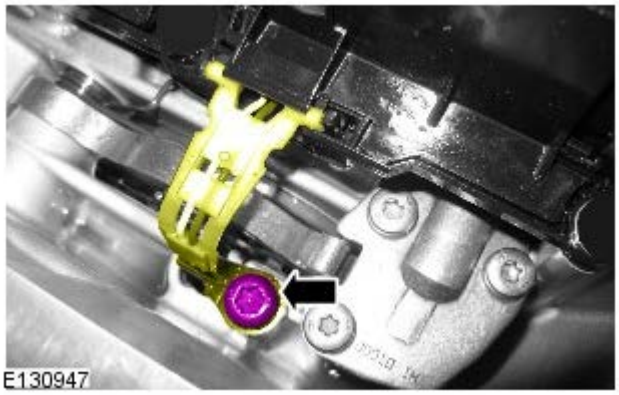
3. NOTE: Remove and discard the O-ring seal.



4. CAUTIONS:

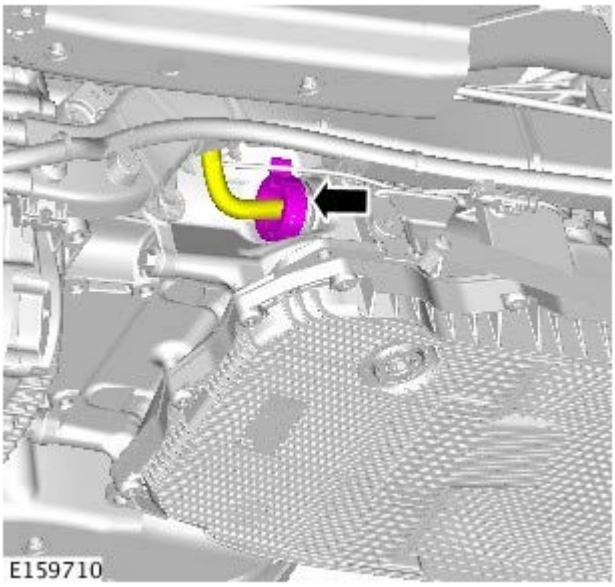
   Discard the bolts.

   Take precautions to avoid any electrostatic charging, which could damage this component.

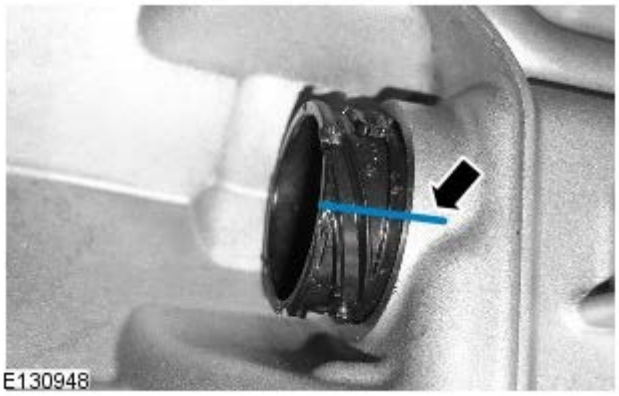


5. CAUTION: Discard the bolt.

6.



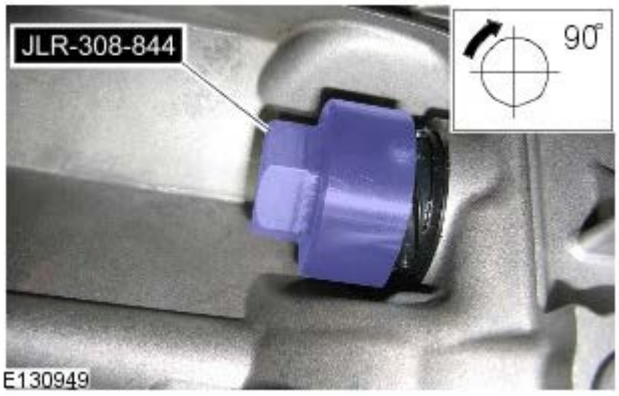
7. NOTE: Note the orientation of the component prior to removal.



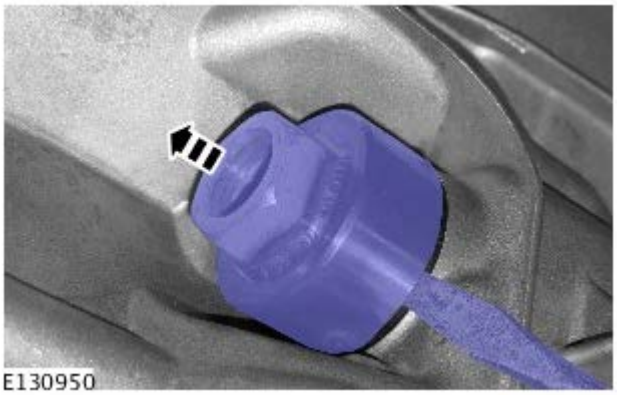
8.

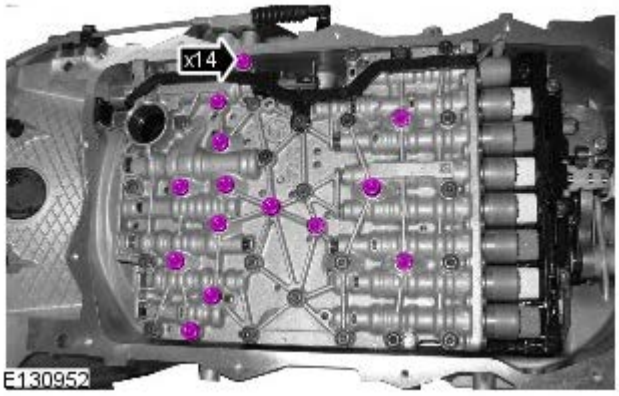


9. *Special Tool(s):* JLR-308-844



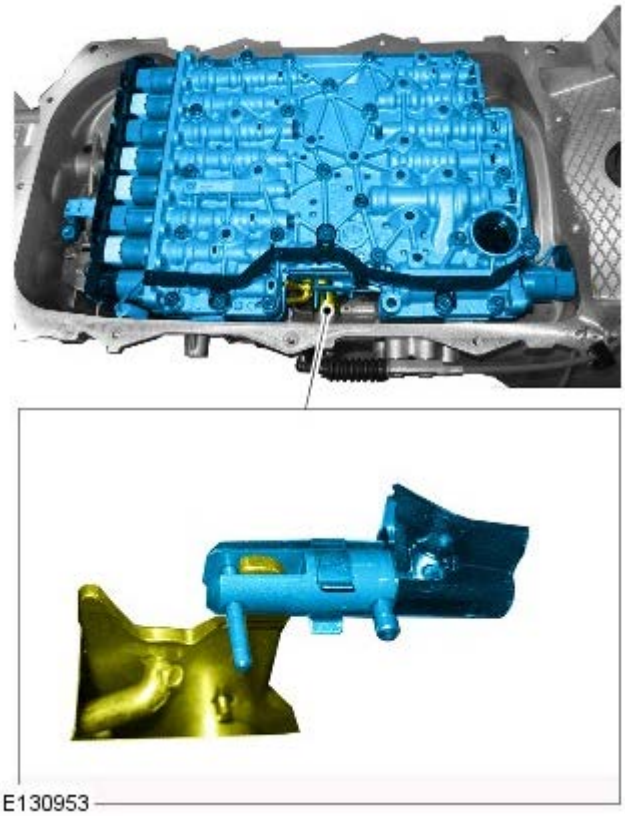
10.





11. CAUTION: Discard the bolts.

    Torque: 8 Nm



12. NOTE: Note the position of the manual park brake release.

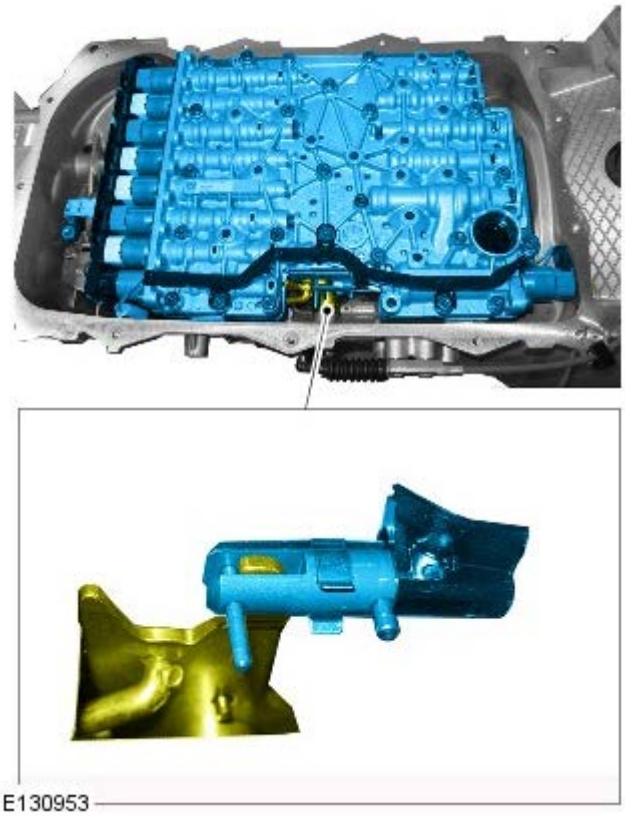
Installation

1.



E150701

2. NOTE: Make sure that the component is installed to the noted removal position.



E130953

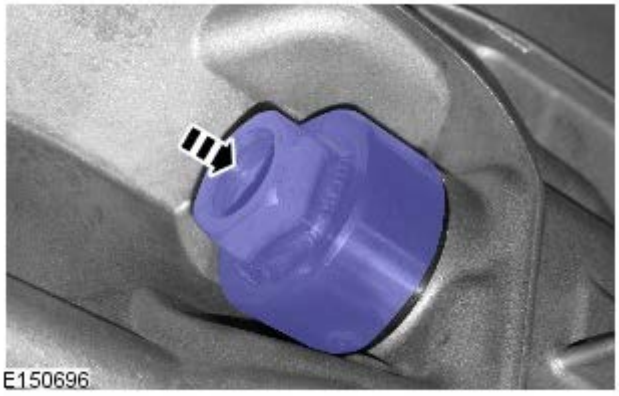
3.

- *Special Tool(s):* JLR-308-844



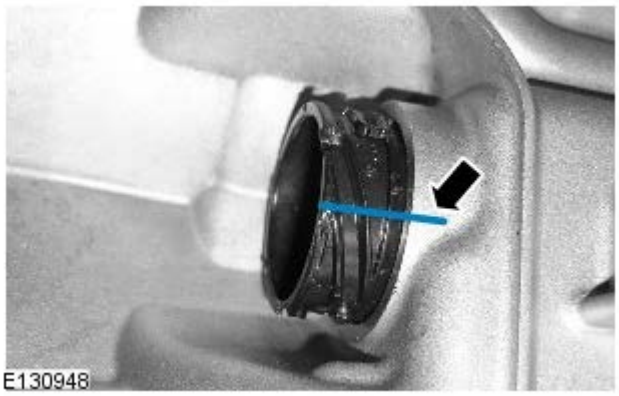
E150812

4.



E150696

5. CAUTION: Make sure that the electrical connector is installed in the correct orientation as noted in the removal step.



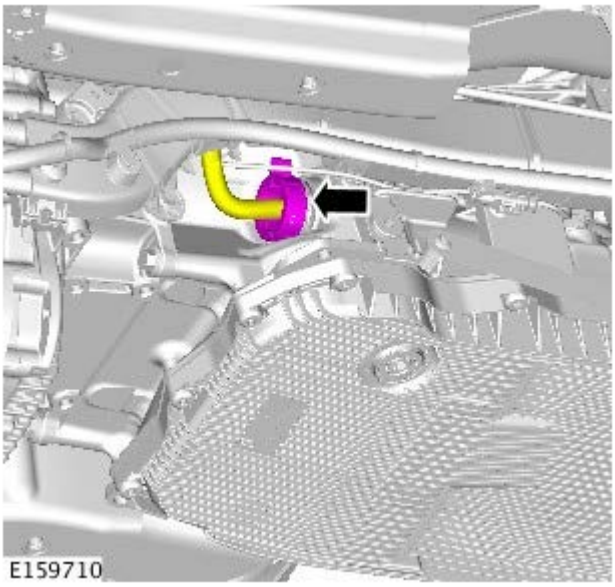
E130948

6.



E150697

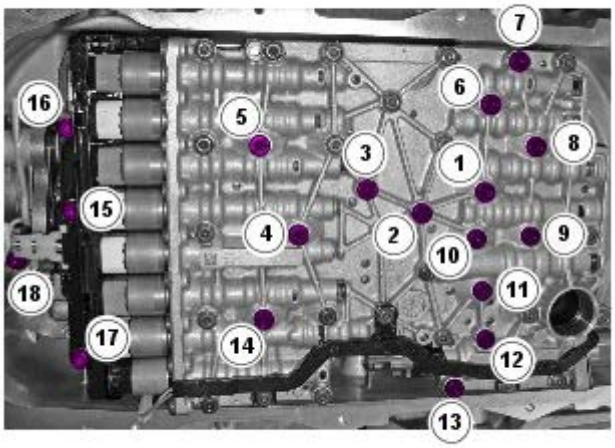
7.



8. CAUTION: Make sure that new bolts are installed.

NOTE: Tighten the retaining bolts evenly and progressively.

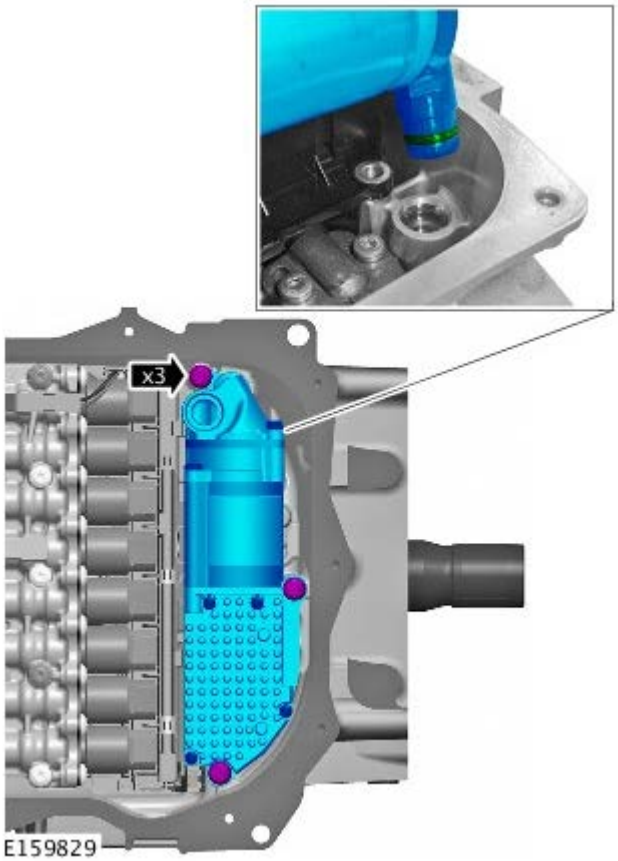
Torque: 8 Nm



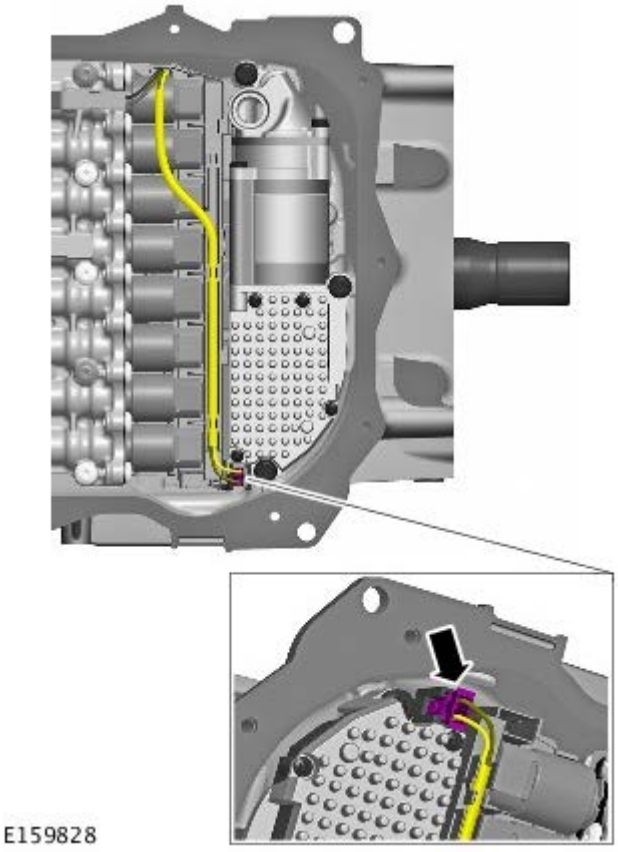
E130933

9. NOTE: Install a new O-ring seal.

Torque: 8 Nm



10.



11. Refer to: Transmission Fluid Pan, Gasket and Filter (307-01B Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed - Hybrid Electric Vehicle - Automatic Transmission – AWD, Removal and Installation).

12. Using the diagnostic tool, calibrate the main control valve body and the transmission control module (TCM).

Published: 06-Sep-2013

Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed - Hybrid Electric Vehicle - Automatic Transmission – AWD - Transmission Fluid Pan, Gasket and Filter

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

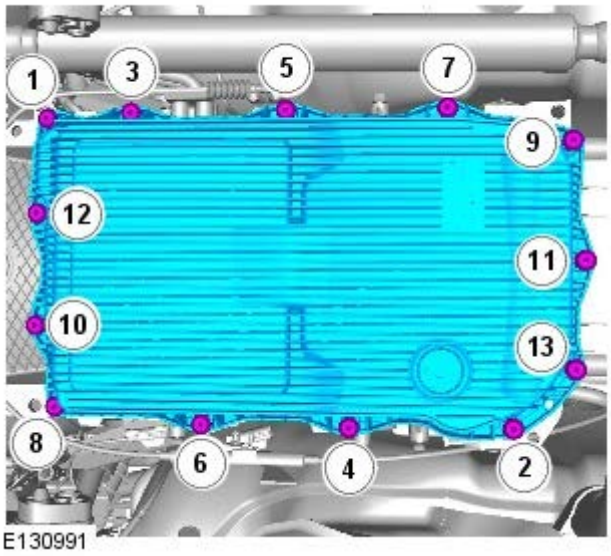
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Refer to: Transmission Fluid Drain and Refill (307-01B Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed - Hybrid Electric Vehicle - Automatic Transmission – AWD, General Procedures).

4. Refer to: Transmission Support Insulator (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, Removal and Installation).



5. 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 the components.

   Torque: 10 Nm

Installation

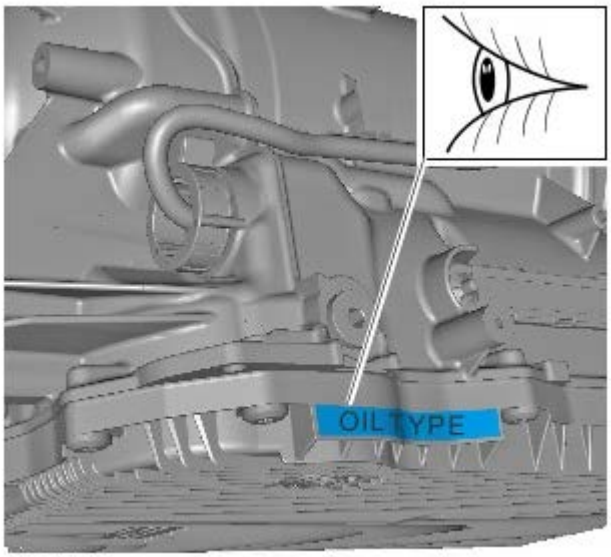
1. CAUTIONS:

   Make sure that new components are installed.

   Make sure that the mating faces are clean and free of foreign material.

   Make sure the correct specification and quantity of oil is used.

   To install, reverse the removal procedure.



E138154

Published: 06-Sep-2013

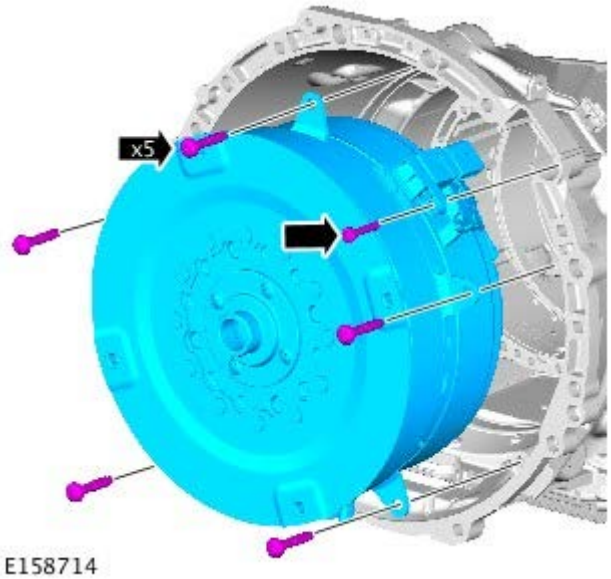
Automatic Transmission / Transaxle - Vehicles With: 8HP70 8-Speed - Hybrid Electric Vehicle - Automatic Transmission – AWD - Motor Generator

Removal and Installation

Removal

NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. Refer to: Transmission (307-01B Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed - Hybrid Electric Vehicle - Automatic Transmission – AWD, Removal).



E158714

2. CAUTIONS:

   It is essential that absolute cleanliness is observed when working on the hybrid drive assembly. Always cover any open orifices using lint free non-flocking material to prevent the ingress of foreign matter. Failure to follow this instruction may result damage to the components.

   Note the installed position of the component prior to removal.

   NOTE: This step requires the aid of another technician.

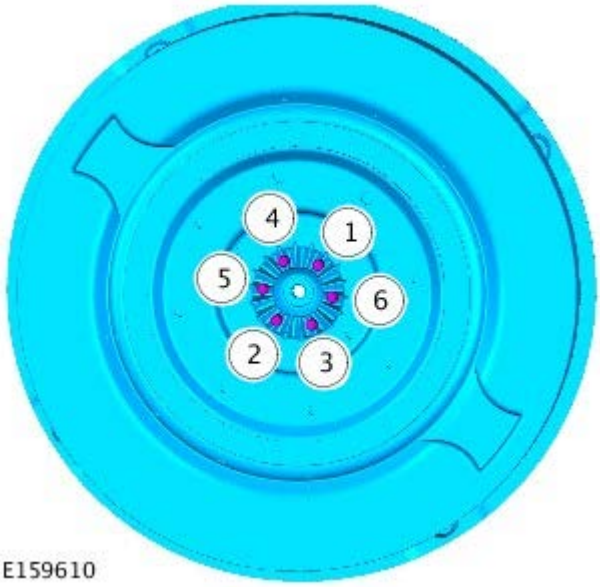


E159641

3. CAUTION: Discard the component.

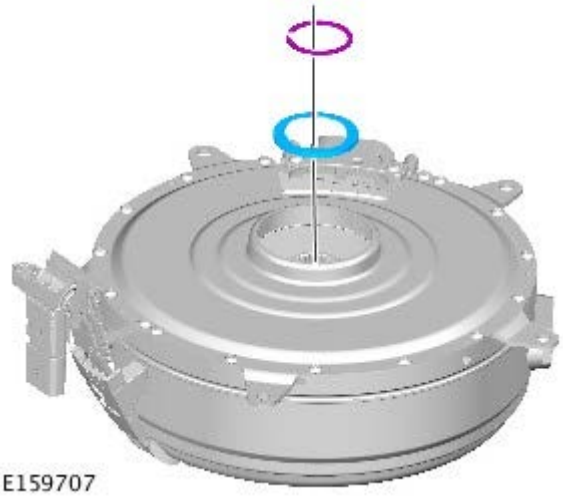
4. CAUTION: Remove the bolts in the indicated sequence.

   NOTE: This step requires the aid of another technician.



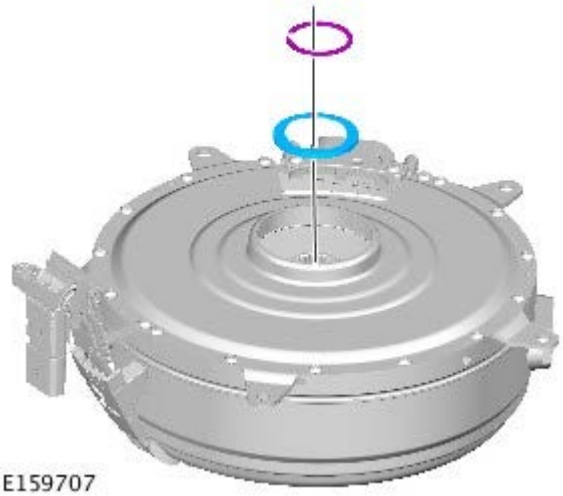
E159610

5. CAUTION: Discard the components.

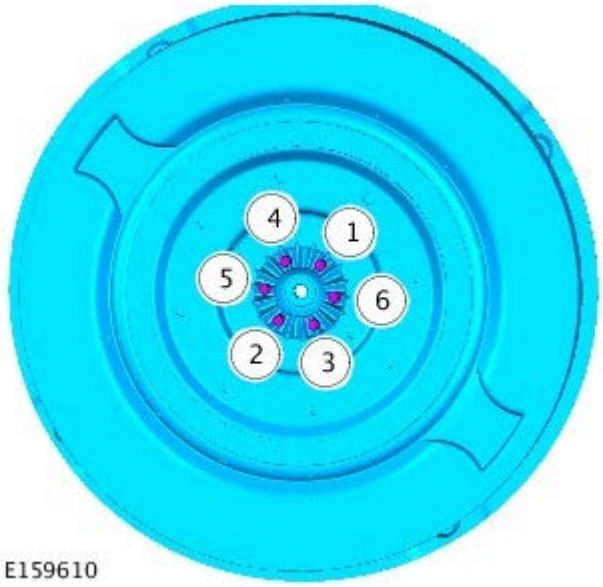

E159707

Installation

1. CAUTION: Make sure that new components are installed.


E159707

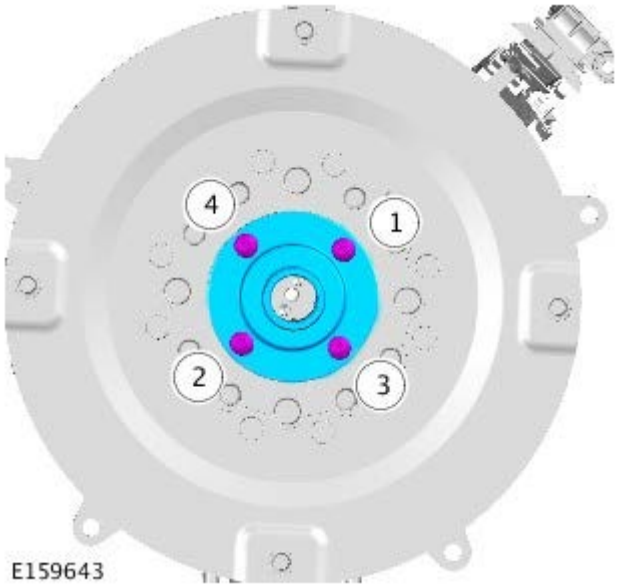
2. CAUTION: Tighten the bolts in the sequence shown.



E159610

NOTE: This step requires the aid of another technician.

Torque: 15 Nm



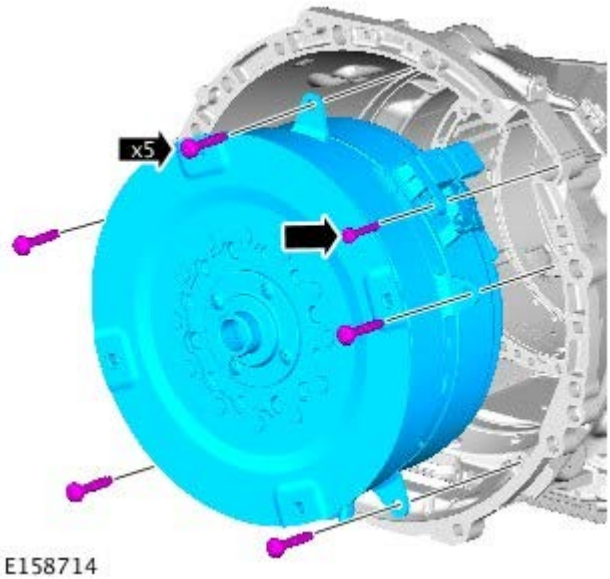
E159643

3. CAUTIONS:

Make sure that a new component is installed.

Tighten the bolts in the sequence shown.

Torque: 15 Nm



E158714

4. CAUTION: Take extra care not to damage the component.

NOTES:

Make sure that the components are installed to the noted removal position.

This step requires the aid of another technician.

Make sure that the hybrid drive assembly is fully engaged to the transmission.

Torque:

M6 bolt 10 Nm
M8 bolts
Stage 1: 5 Nm
Stage 2: 60°

5. NOTE: Make sure that the hybrid drive assembly is fully engaged to the transmission.



E138283

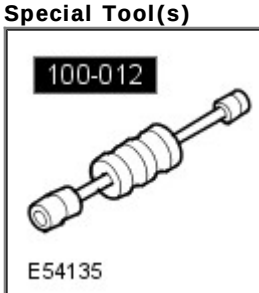
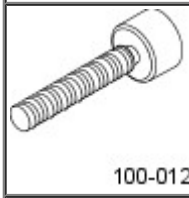
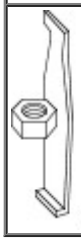
6. Refer to: Transmission (307-01B Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed - Hybrid Electric Vehicle - Automatic Transmission – AWD, Installation).

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Automatic Transmission / Transaxle - Vehicles With: 8HP70 8-Speed - Hybrid Electric Vehicle - Automatic Transmission – AWD - Transmission

Removal

Special Tool(s)

	100-012 Slide Hammer
	100-012-01 Slide Hammer Adapter
	303-1069 Adapter, Wrench
	308-375 Remover, Input and Output Seal

General Equipment
Transmission jack

WARNING: This procedure can only be carried out after the vehicle has been decommissioned, by an approved person.

NOTES:

Some variation in the illustrations may occur, but the essential information is always correct.

Some illustrations may show the transmission removed for clarity.

1. Decommission the vehicle.

   Refer to: Hybrid Electric Vehicle (HEV) Decommission (414-01 Battery, Mounting and Cables, General Procedures).

2. WARNING: Make sure to support the vehicle with axle stands.
   - Raise and support the vehicle.

3. Refer to: Secondary Bulkhead Center Panel - TDV6 3.0L Diesel (501-02, Removal and Installation).

4. Refer to: Cooling System Partial Draining, Filling and Bleeding (303-03A Engine Cooling - TDV6 3.0L Diesel, General Procedures).

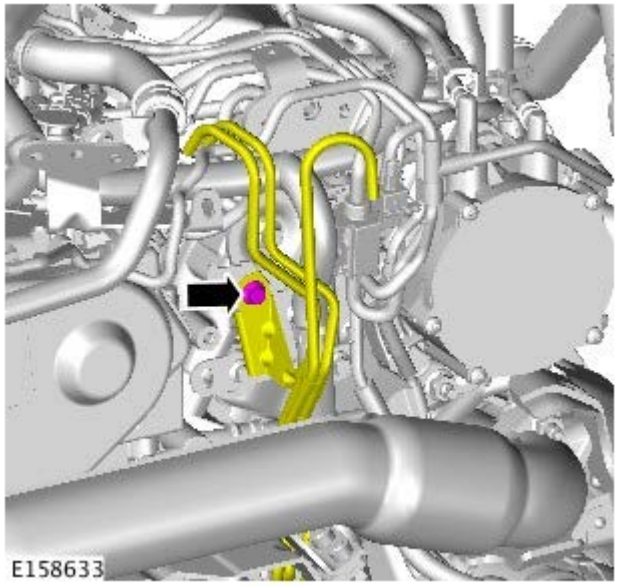
5. Refer to: Starter Motor (303-06A Starting System - TDV6 3.0L Diesel, Removal and Installation).

6. Refer to: Exhaust System - Vehicles Without: Diesel Particulate Filter (DPF) (309-00A, Removal and Installation).
   Refer to: Exhaust System - Vehicles With: Diesel Particulate Filter (DPF) (309-00A, Removal and Installation).

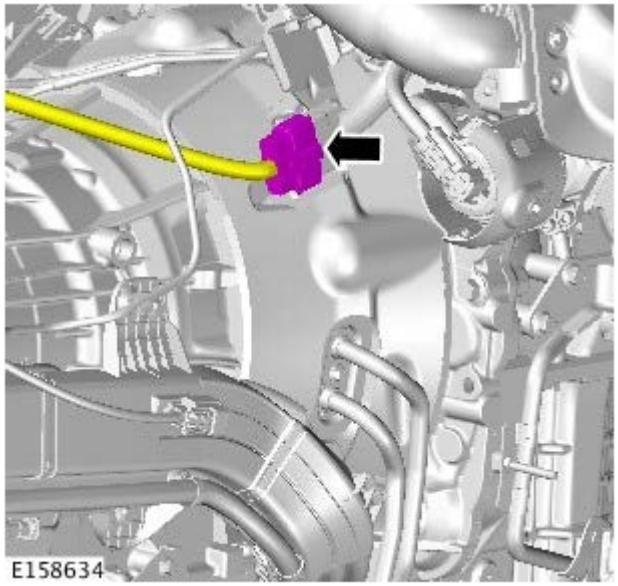
7. Refer to: Front Driveshaft - TDV6 3.0L Diesel (205-01 Driveshaft, Removal and Installation).

8. Refer to: Rear Driveshaft - TDV6 3.0L Diesel (205-01 Driveshaft, Removal and Installation).

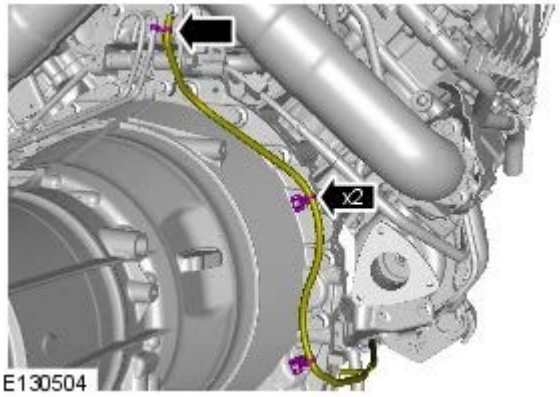
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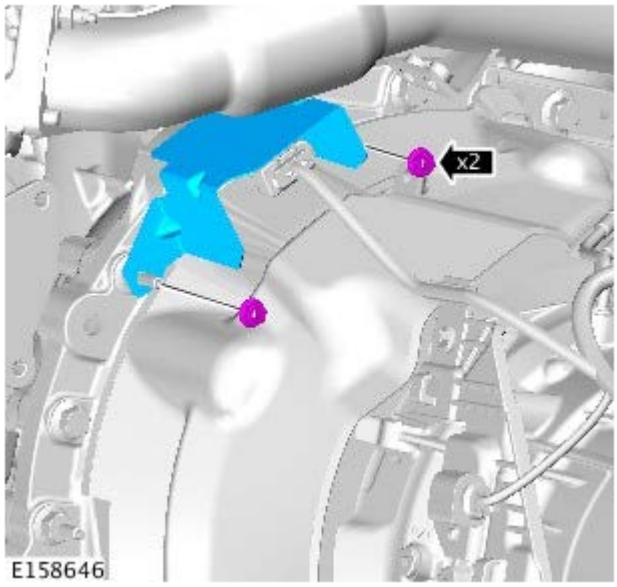
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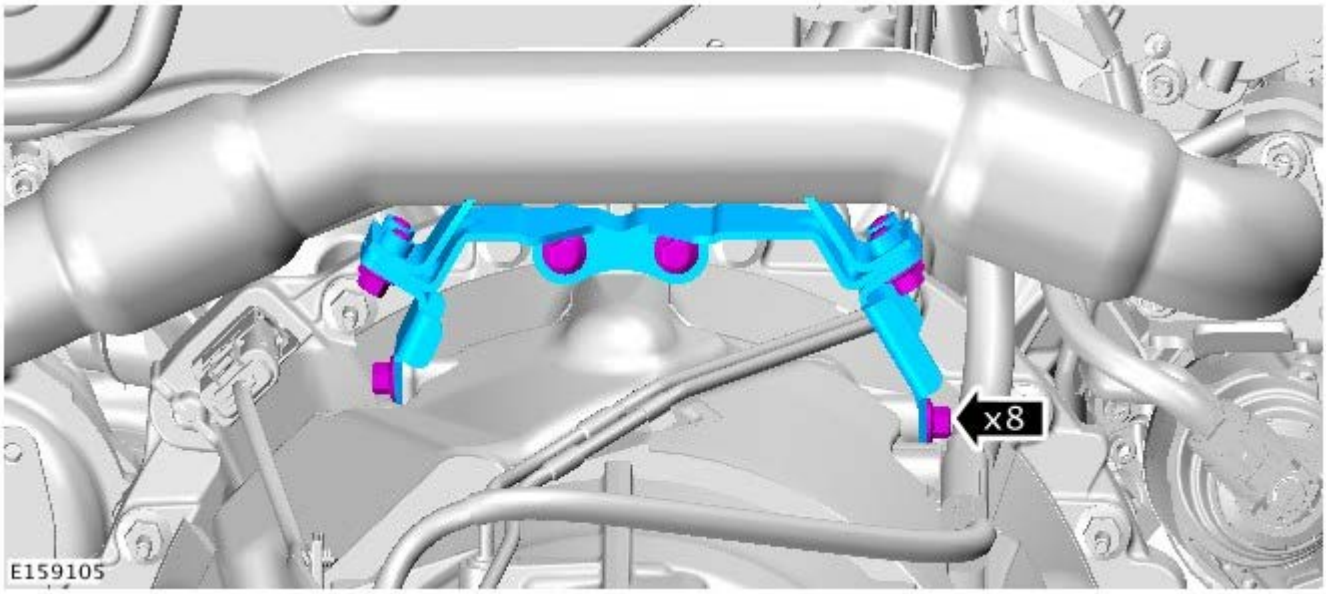
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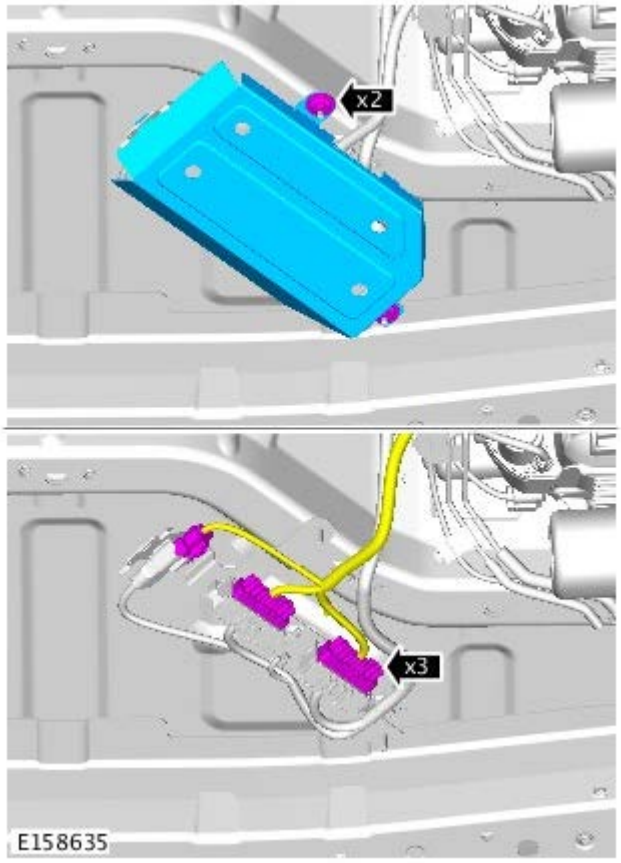
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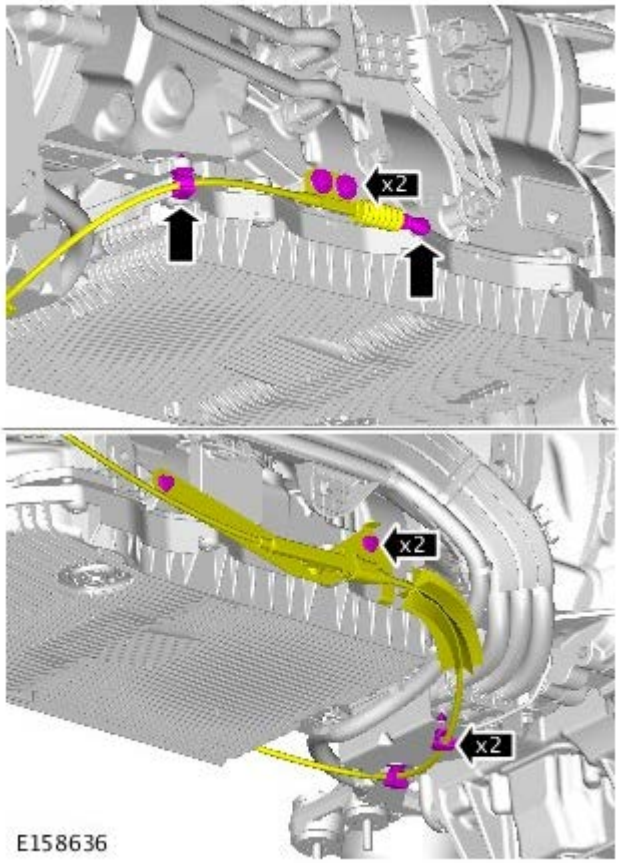
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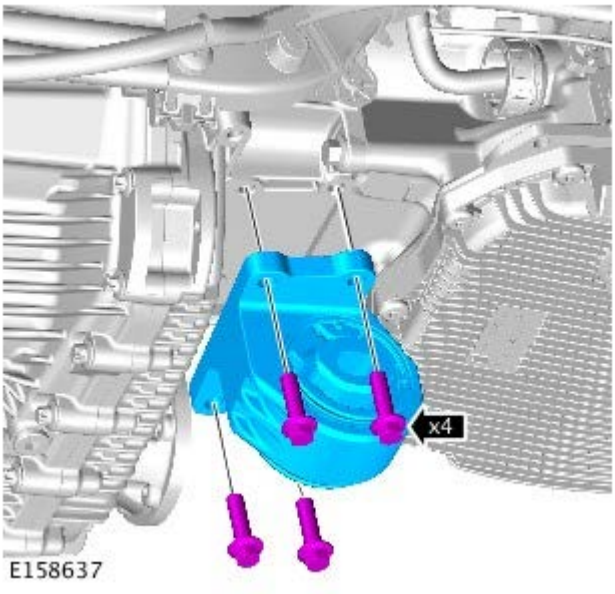
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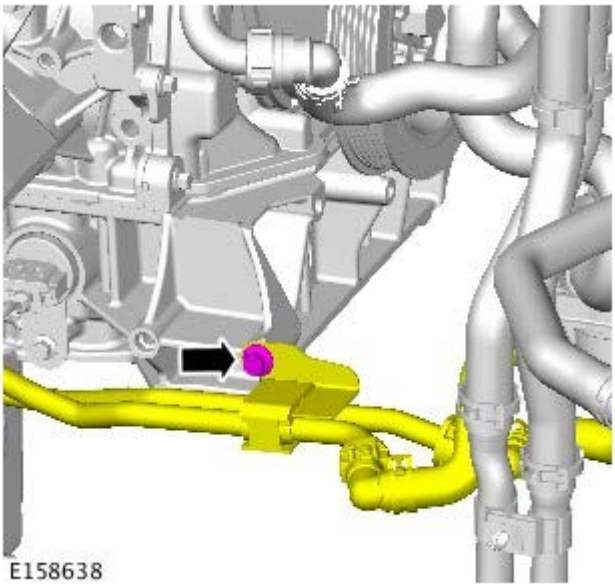
15. NOTE: Secure with cable ties.



16.



17.



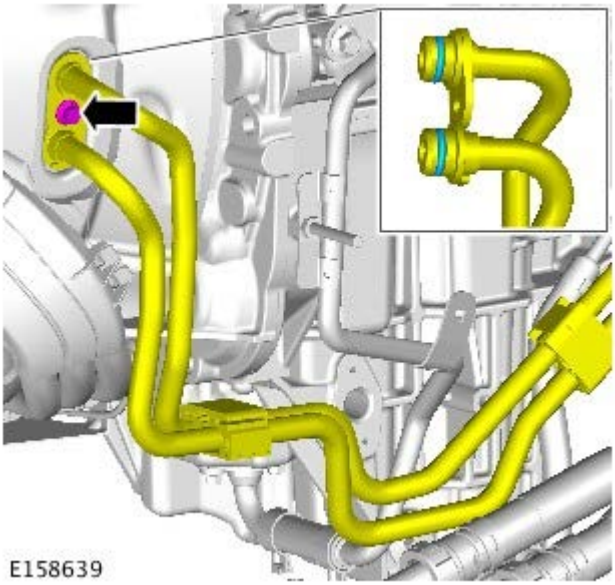
18. CAUTIONS:

Make sure that all openings are sealed. Use new blanking caps.

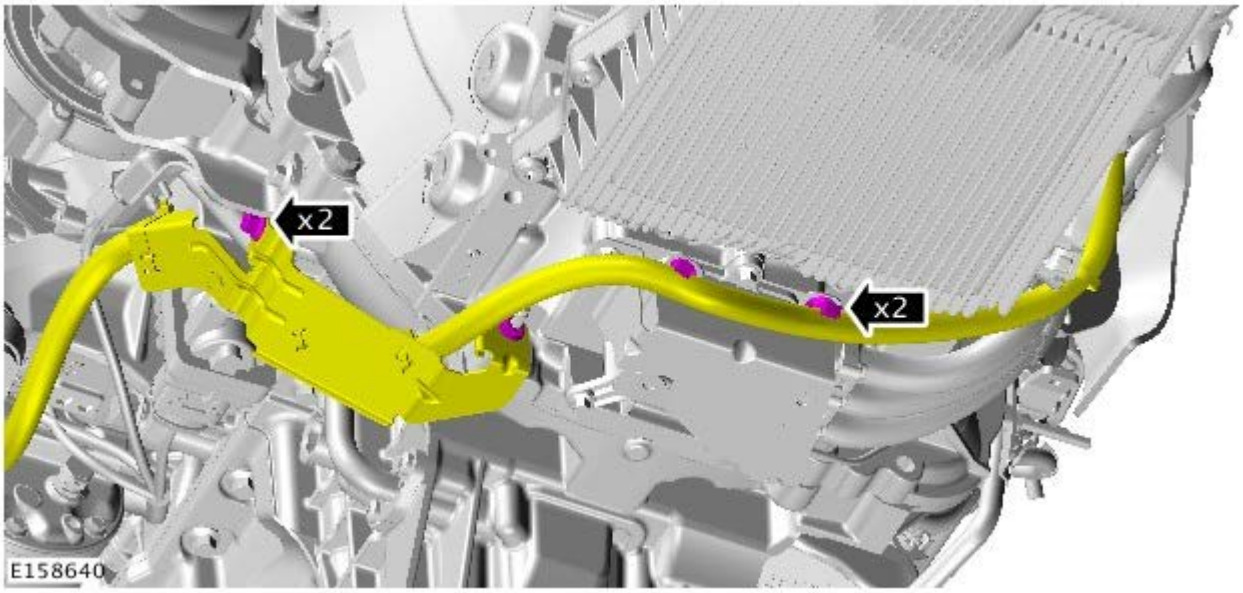
Remove and discard the O-ring seals.

NOTE: Be prepared to collect escaping coolant.

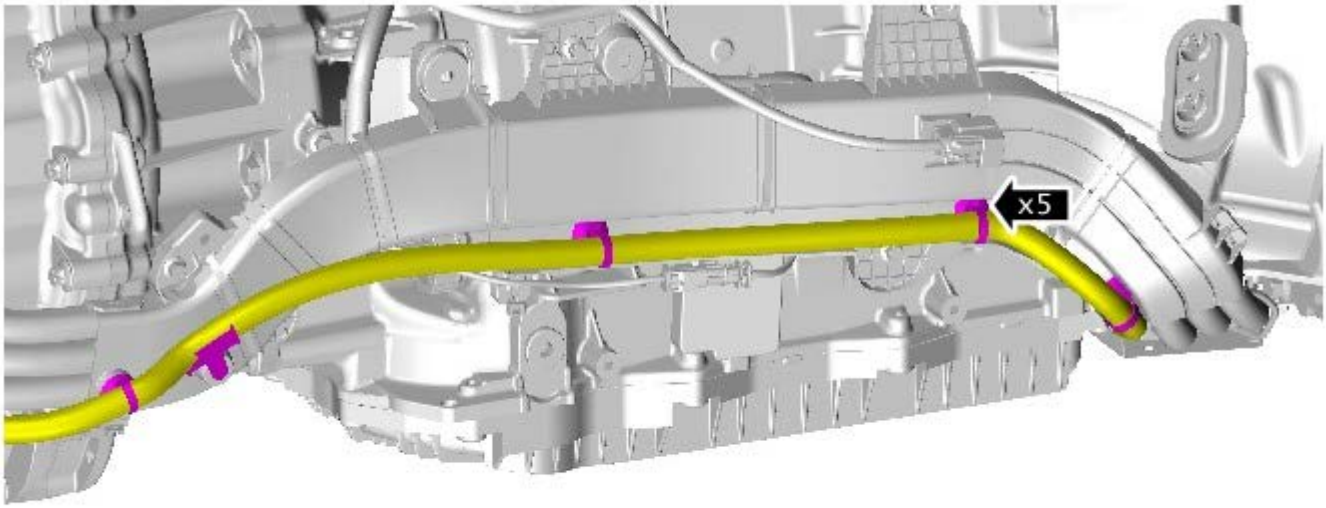
Make sure that the area around the component is clean and free of foreign material.



19.

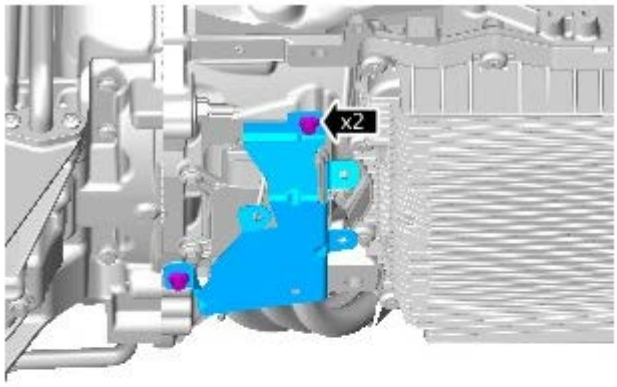


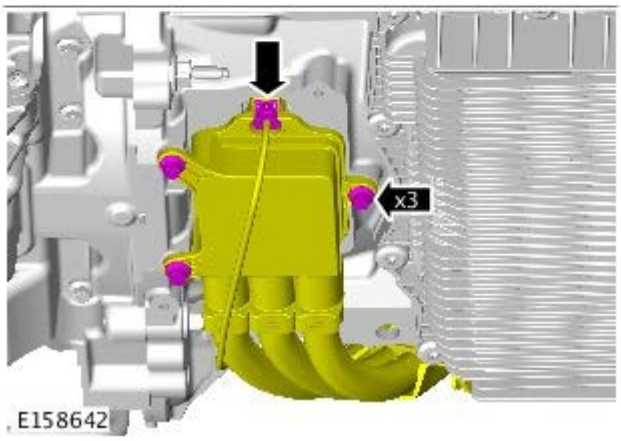
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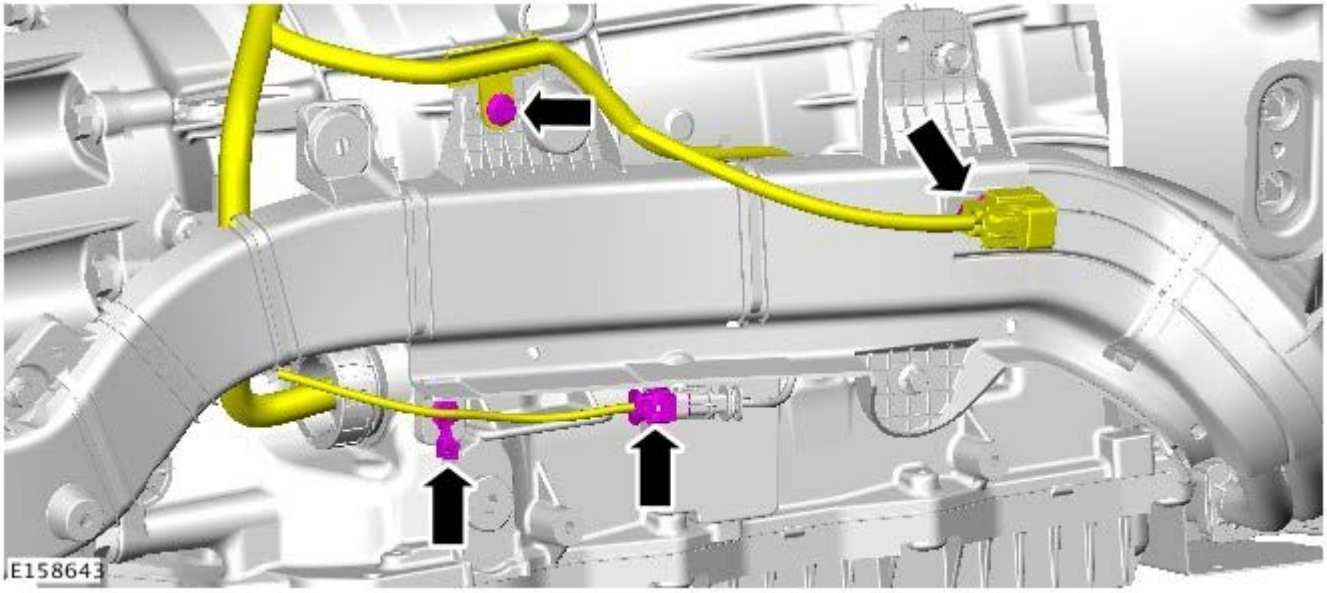
21. CAUTION: Make sure that all disconnected electrical connectors and sockets are sealed.

NOTE: Secure with cable ties.

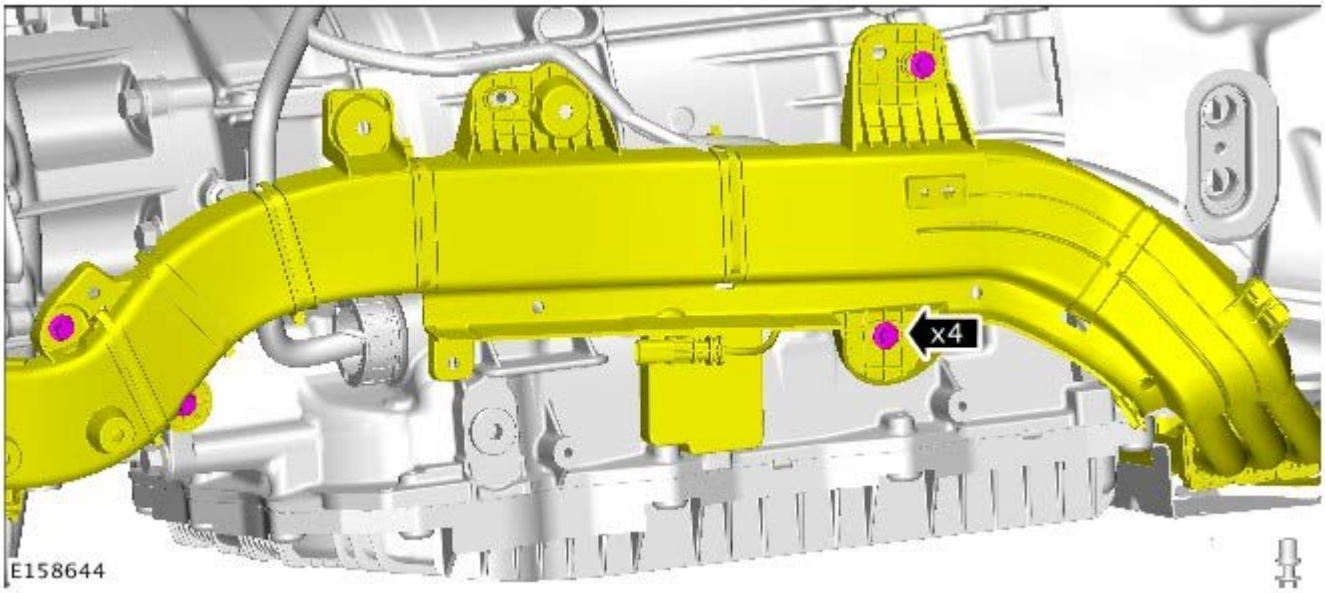




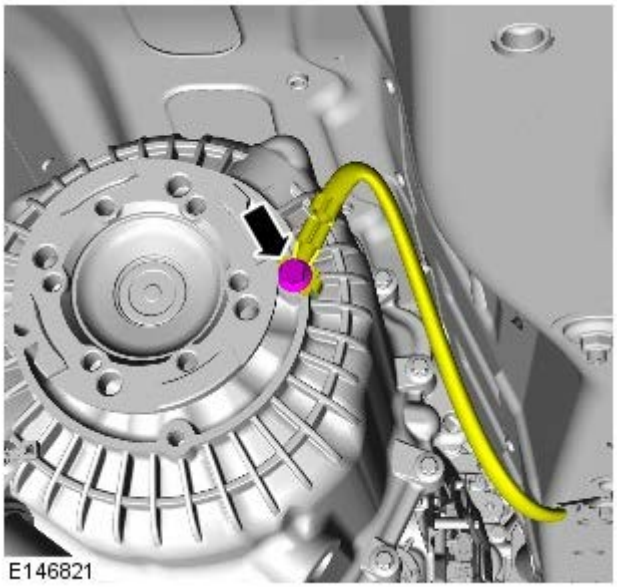
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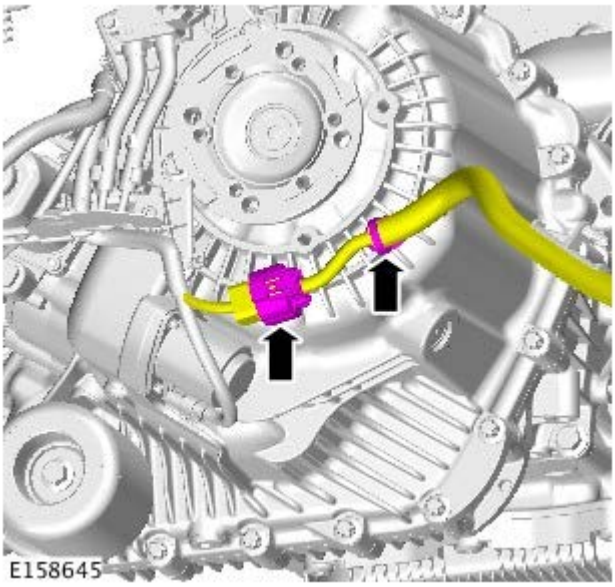
23. NOTE: Secure with cable ties.



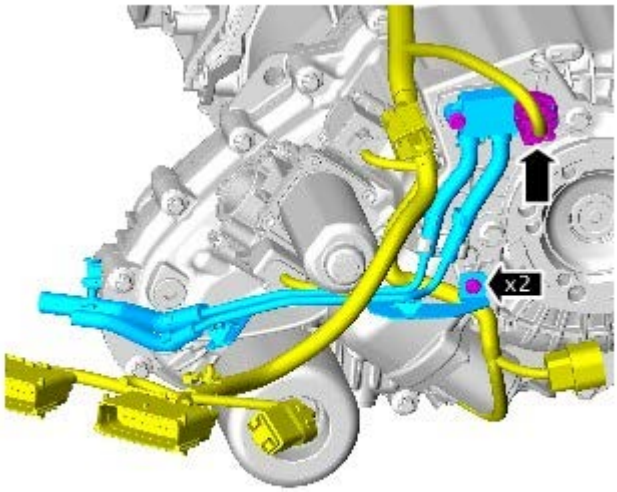
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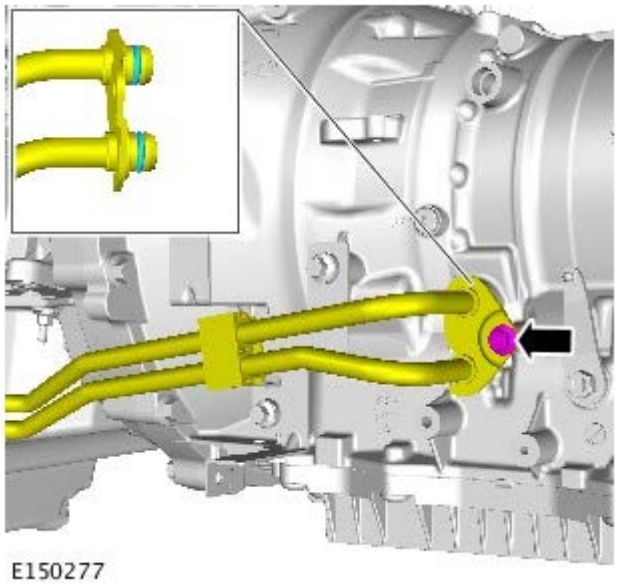
25.



26.



E158686



E150277

27. WARNING: Be prepared to collect escaping fluids.

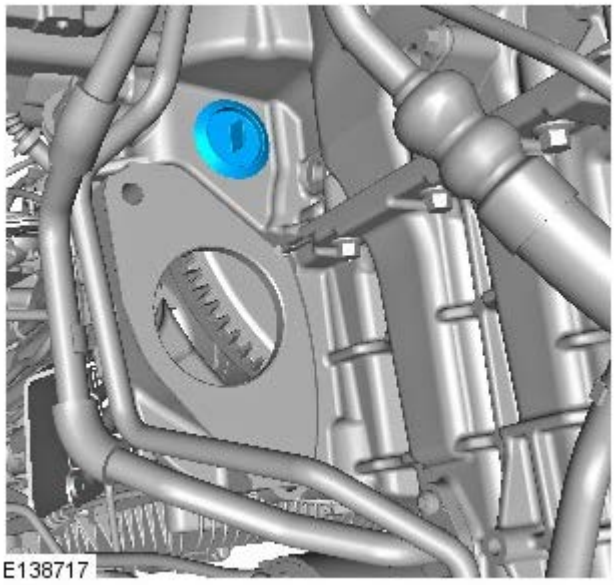
CAUTION: Make sure that all openings are sealed. Use new blanking caps.

NOTES:

Remove and discard the O-ring seals.

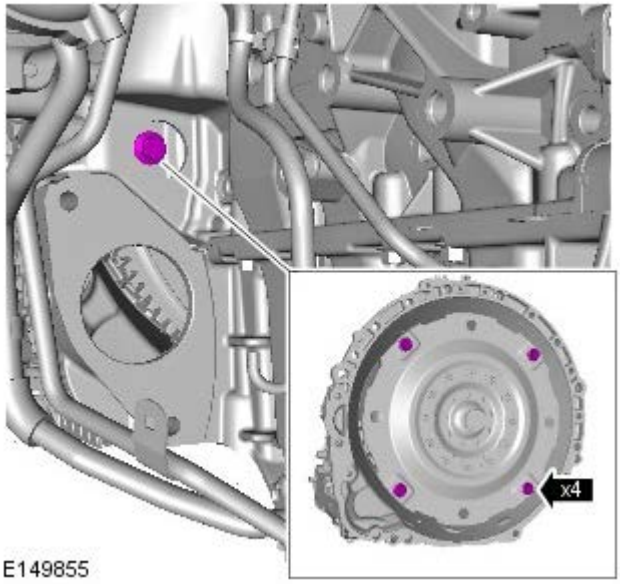
Make sure that the area around the component is clean and free of foreign material.

28.

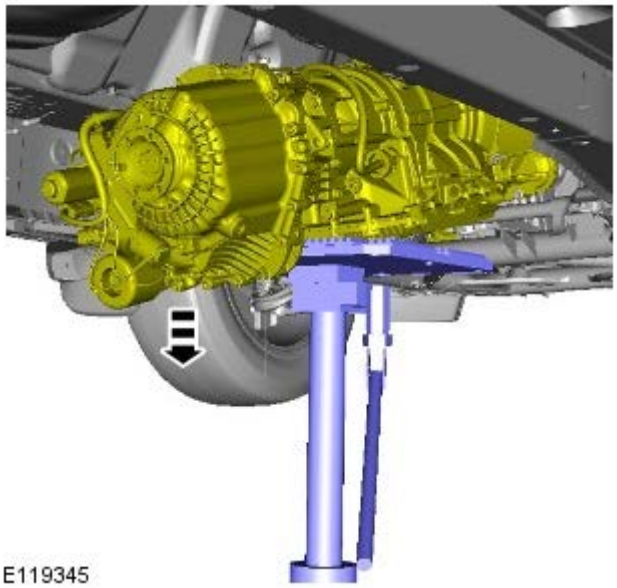


E138717

29. CAUTION: Only rotate the crankshaft clockwise.



E149855

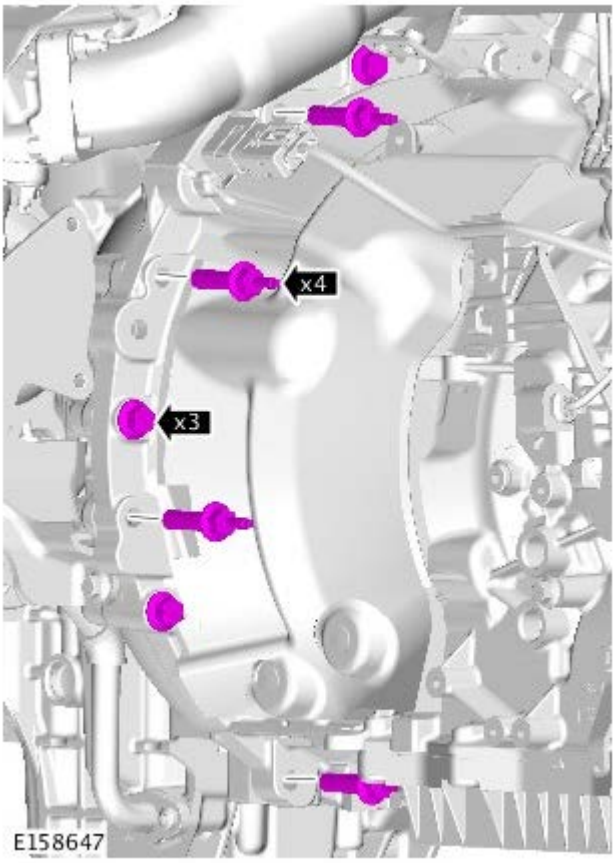


E119345

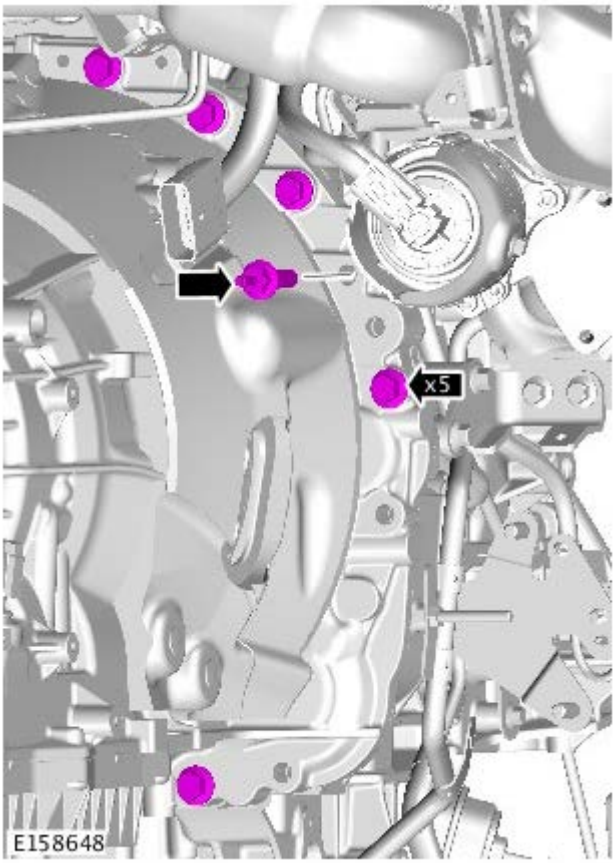
30. WARNING: Make sure that the transmission is secured with suitable retaining straps.

Lower the rear of the transmission for access.

31.



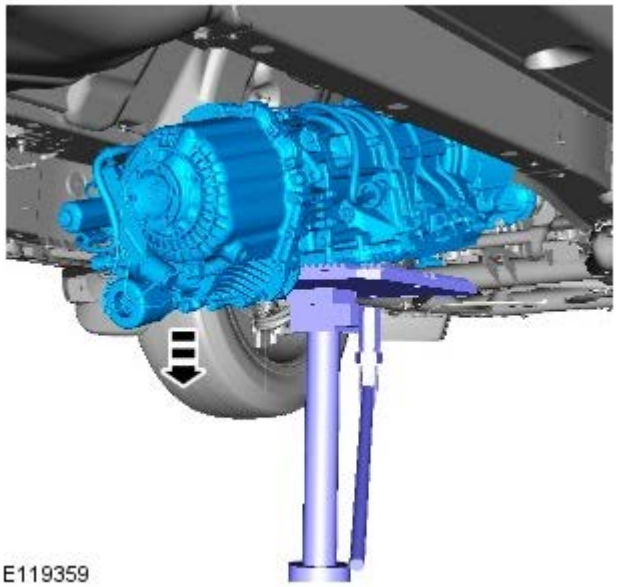
32.



33. WARNING: This step requires the aid of another technician.

CAUTIONS:

Using suitable tape or cable ties, make sure the hybrid drive assembly remains fully engaged to the transmission.

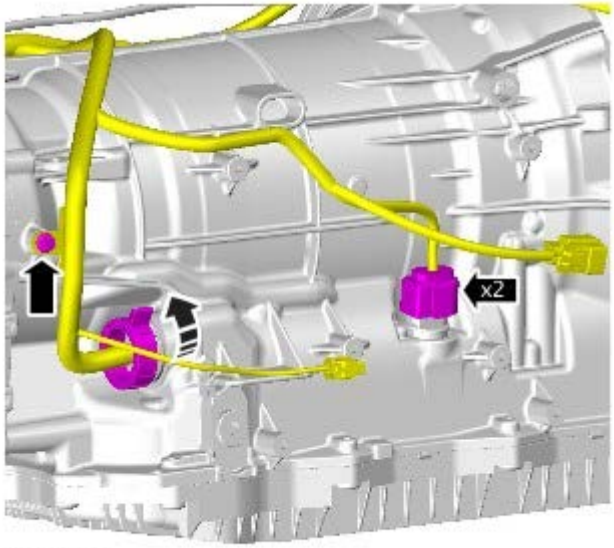

E119359

Support the engine.

NOTE: Do not disassemble further if the component is removed for access only.

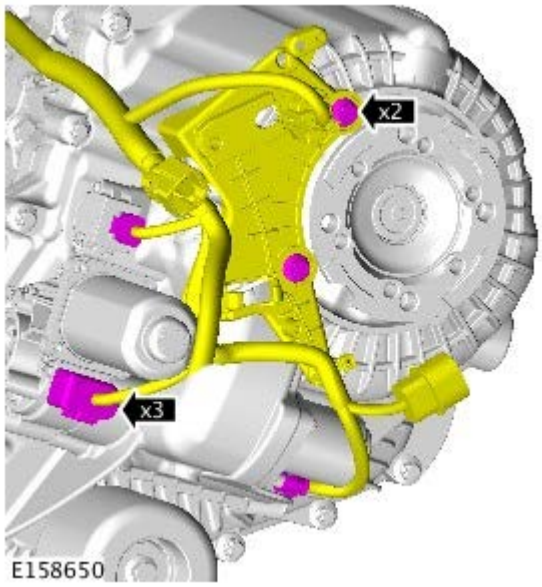
General Equipment: Transmission jack

34.



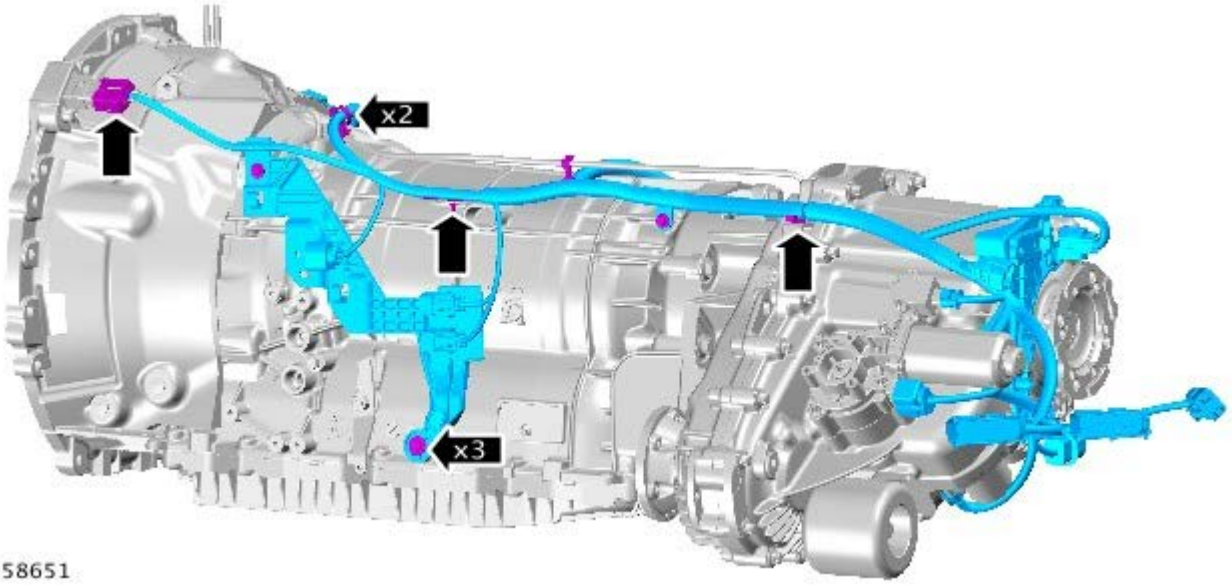
E159789

35.



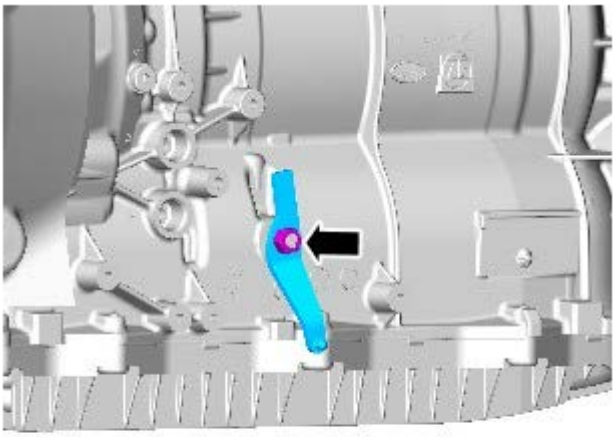
E158650

36.



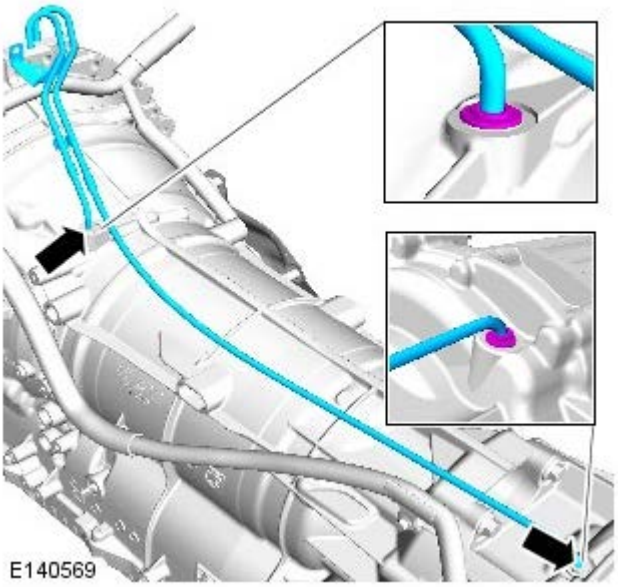
E158651

37.



E159773

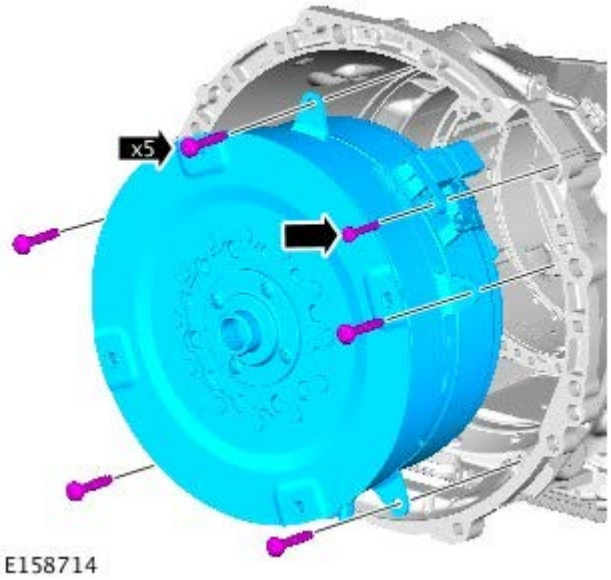
38. CAUTION: Always plug any open connections to prevent contamination.



E140569

39. CAUTIONS:

It is essential that absolute cleanliness is observed when working on the hybrid drive assembly. Always



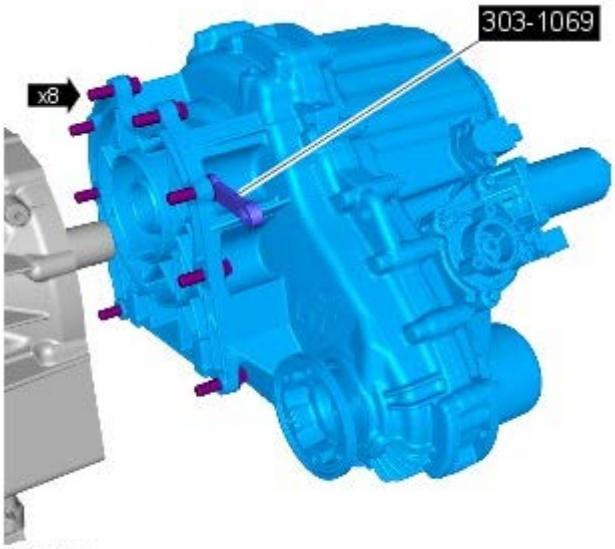
E158714

cover any open orifices using lint free non-flocking material to prevent the ingress of foreign matter. Failure to follow this instruction may result damage to the components.

Note the installed position of the component prior to removal.

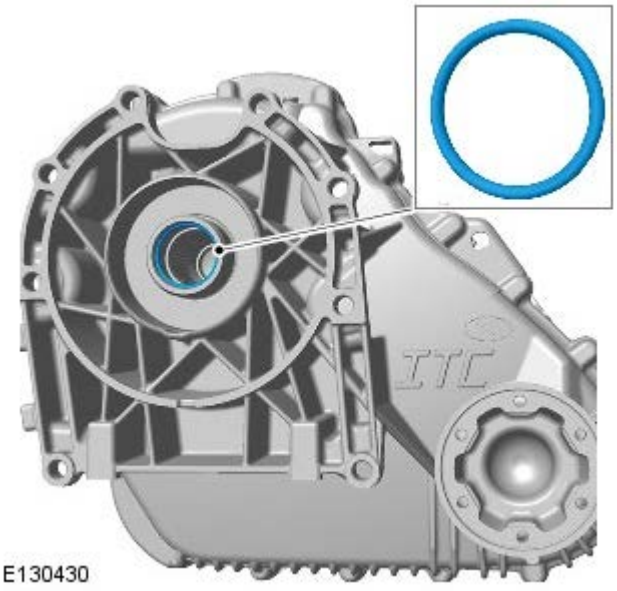
NOTE: This step requires the aid of another technician.

40. *Special Tool(s):* 303-1069



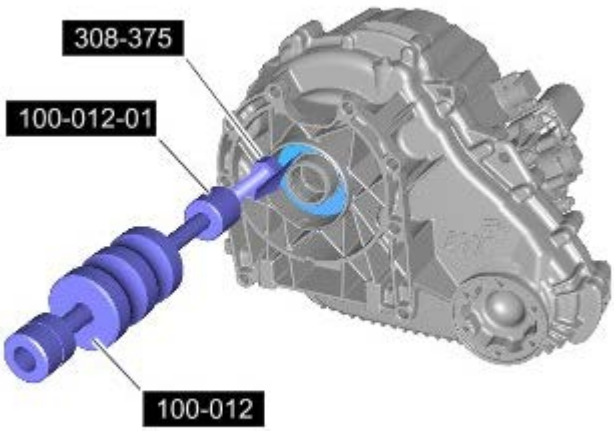
E130188

41. CAUTION: Do not carry out this step if a new transfer box is to be installed.


E130430

42. CAUTION: Care must be taken to avoid damage to the seal register and running surface.

Do not carry out this step if a new transfer box is to be installed.



E131138

Note the installed position of the component prior to removal.

Special Tool(s): 100-012, 100-012-01, 308-375

Published: 06-Sep-2013

Automatic Transmission / Transaxle - Vehicles With: 8HP70 8-Speed - Hybrid Electric Vehicle - Automatic Transmission – AWD - Transmission

Installation

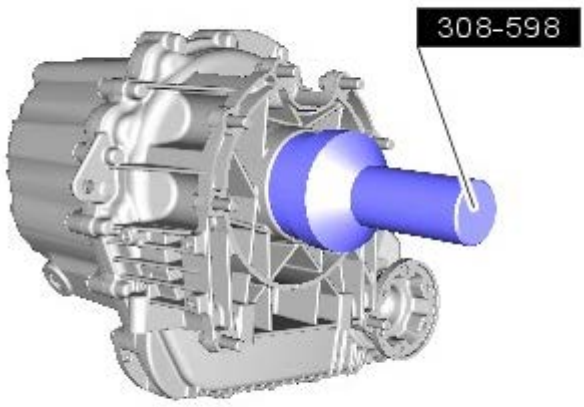
Special Tool(s)

303-1069  E53727	303-1069 Adapter, Wrench
308-598  E50941	308-598 Installer, Oil Seal

General Equipment

Transmission jack

NOTE: Some variation in the illustrations may occur, but the essential information is always correct.



E50943

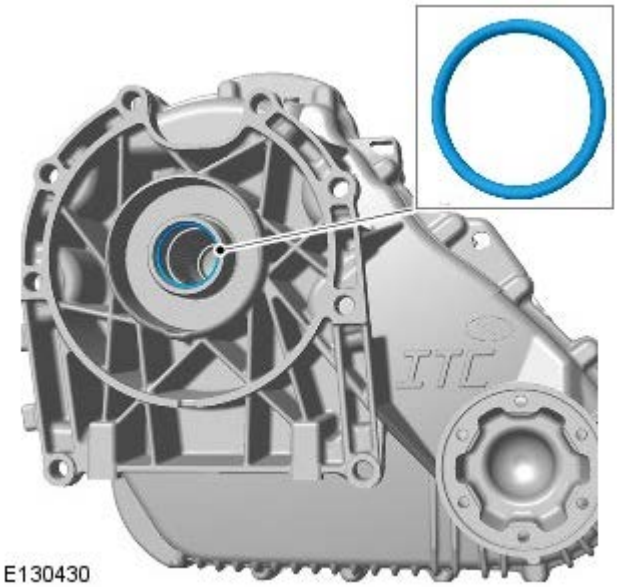
1. CAUTION: Oil seals must be installed dry.

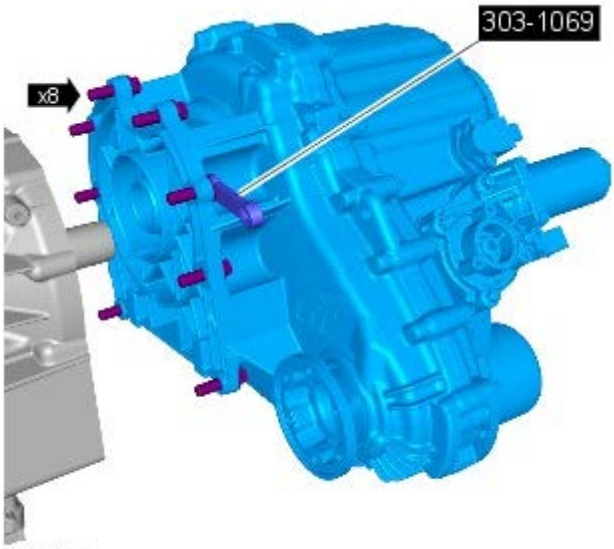
   NOTE: This step is only required if previously removed.

   Make sure that this component is installed to the noted removal position.

   Special Tool(s): 308-598

2. NOTE: This step is only required if previously removed.


E130430



E130188

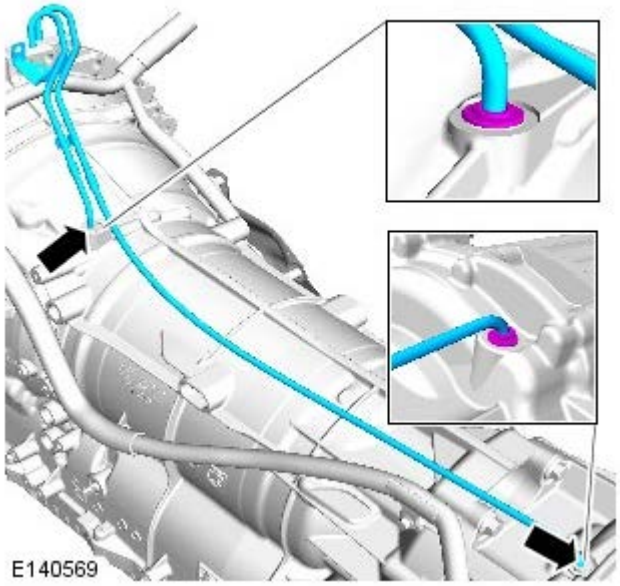
3. NOTE: This step is only required if previously removed.

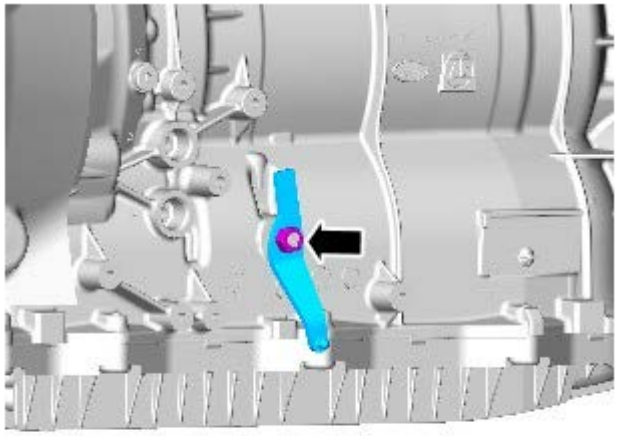
- *Special Tool(s):* 303-1069
- •Clean the component mating faces.
- •Lubricate input shaft splines with 'Weicon TL7391' grease.

Torque: 45 Nm

4. NOTE: This step is only required if previously removed.

- •To prevent water ingress and subsequent transmission damage, make sure that the breather is fully pushed home into the transmission casing. The white line around the circumference of the pipe should not be visible when correctly installed.



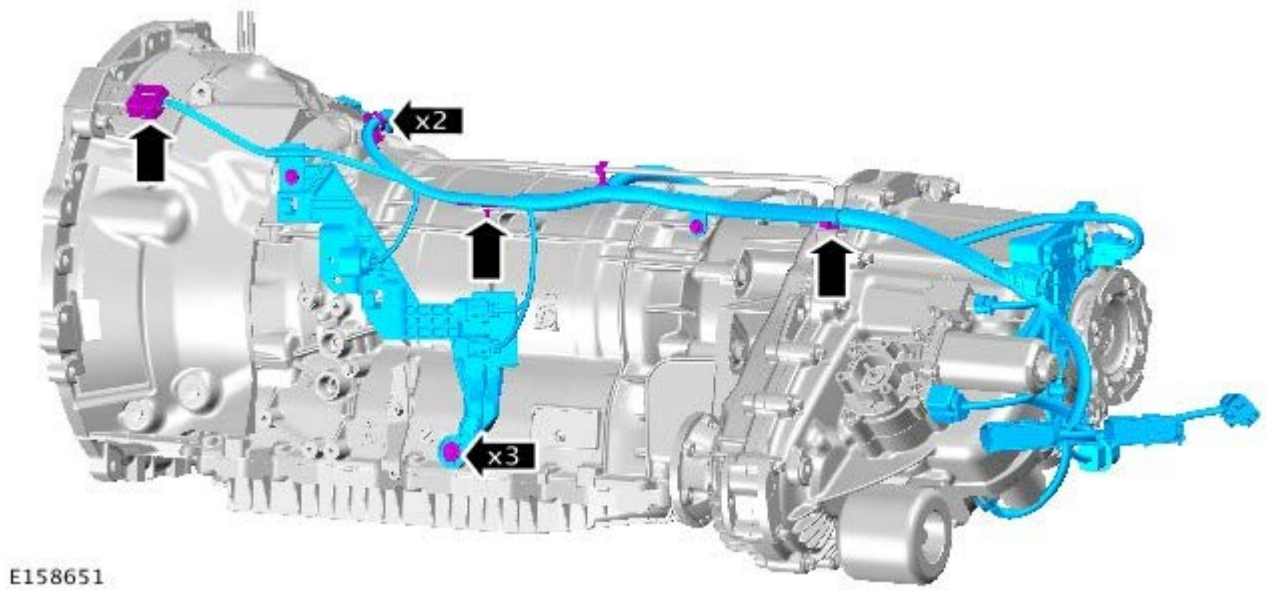


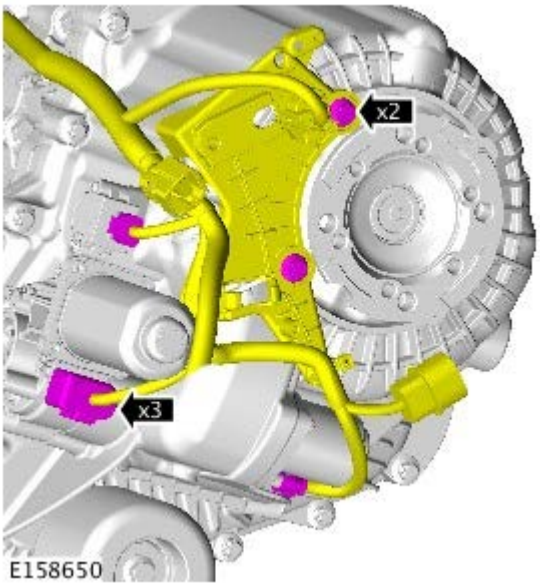
5. NOTE: This step is only required if previously removed.

   Torque: 12 Nm

6. NOTE: This step is only required if previously removed.

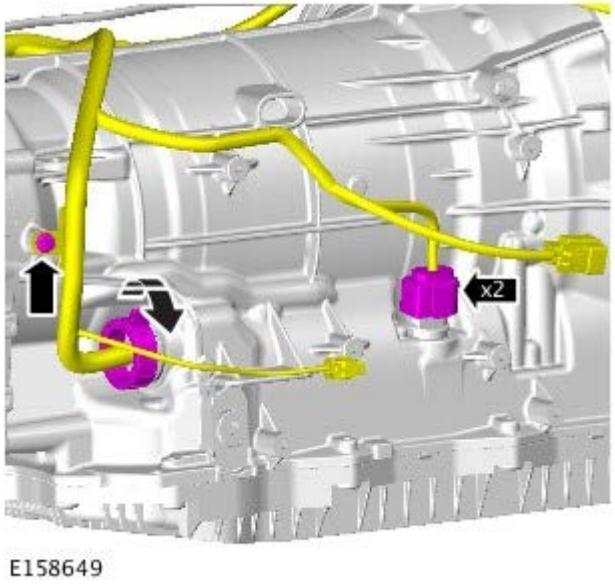
   Torque: 10 Nm





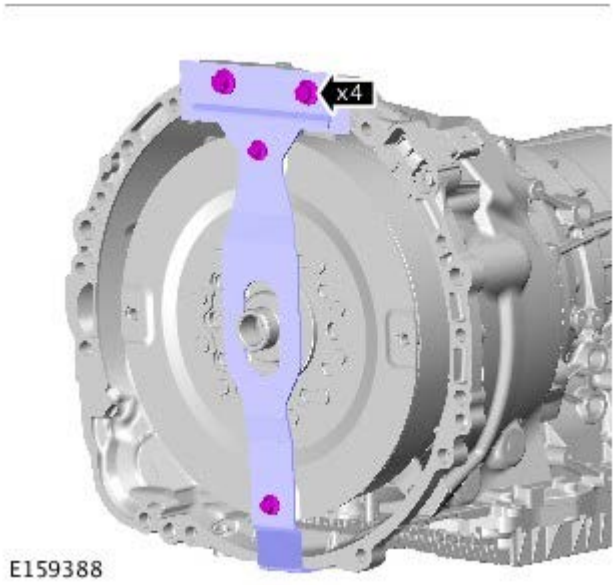
7. NOTE: This step is only required if previously removed.

   Torque: 25 Nm



8. NOTE: This step is only required if previously removed.

   Torque: 10 Nm

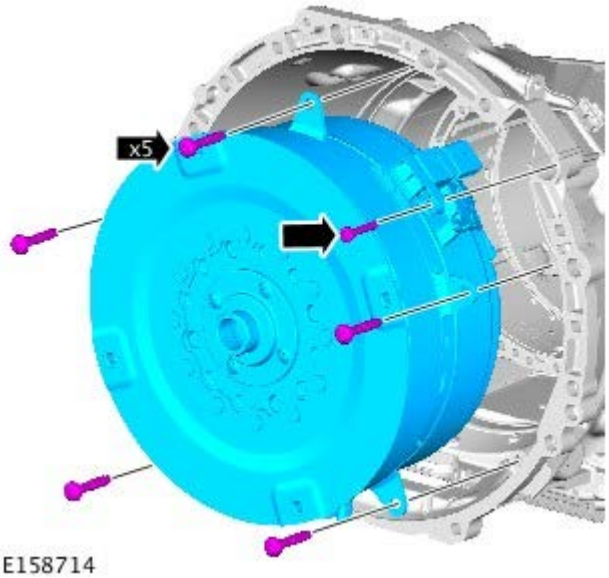


9. NOTE: This step is only required if a new component is installed.

   Remove the transmission shipping strap.

10. CAUTION: Take extra care not to damage the component.

    NOTES:



E158714

Make sure that the components are installed to the noted removal position.

This step is only required if previously removed.

This step requires the aid of another technician.

Torque:
M6 bolt 10 Nm
M8 bolts
Stage 1:5 Nm
Stage 2:60°

11. NOTE: Make sure that the hybrid drive assembly is fully engaged to the transmission.



E138283

12. WARNINGS:

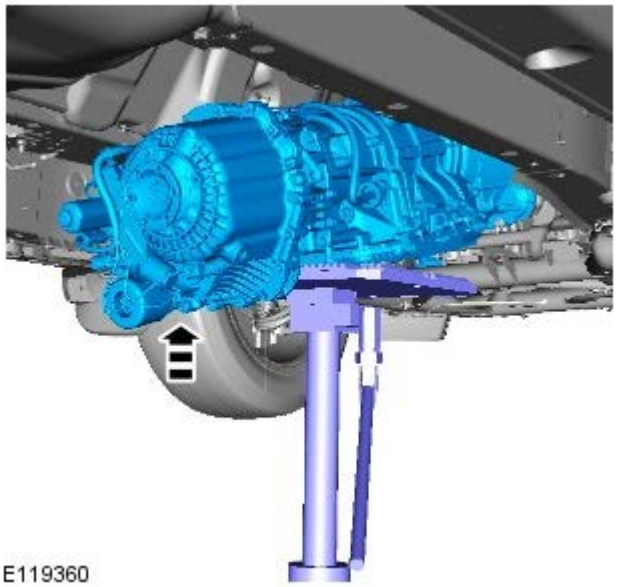
This step requires the aid of another technician.

Make sure that the transmission is secured with suitable retaining straps.

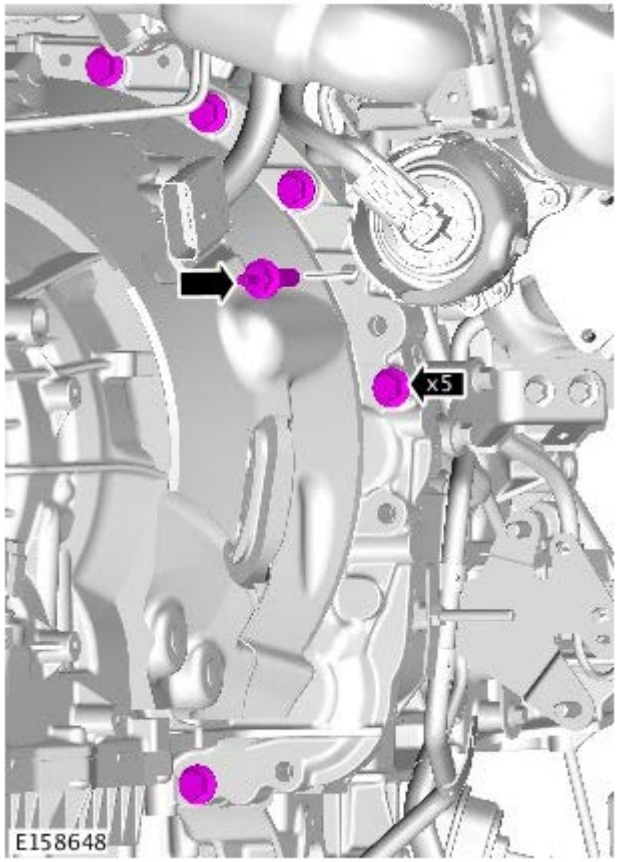
CAUTION: Apply grease of the correct specification to the hybrid drive assembly spigot.

Using a suitable hydraulic jack, support the transmission.

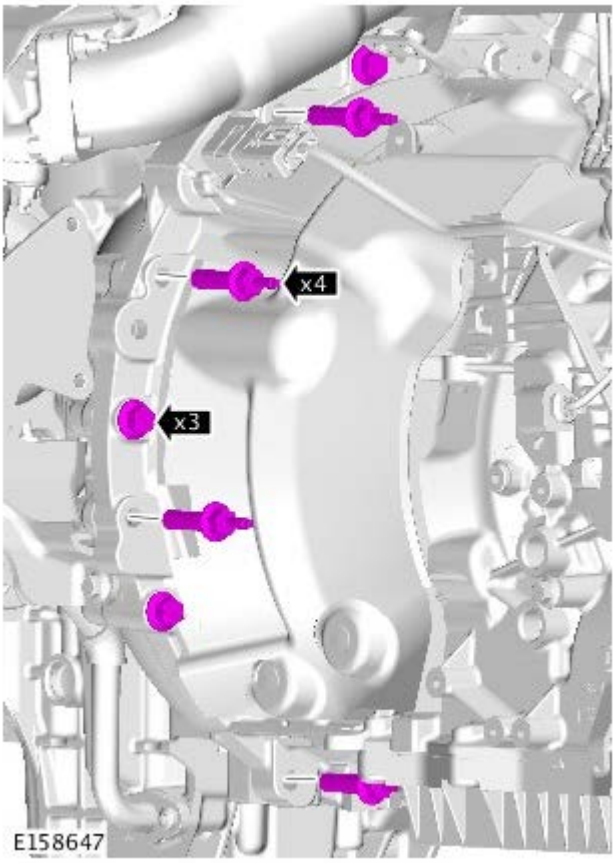
General Equipment: Transmission jack

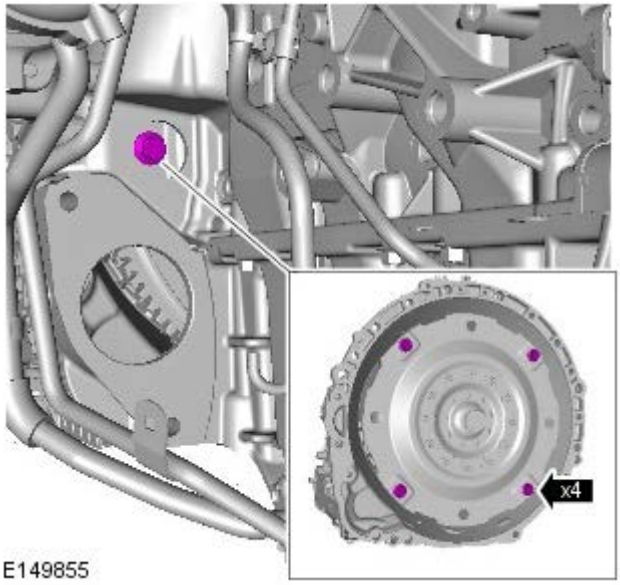


13. *Torque:* 40 Nm



14. *Torque:* 40 Nm

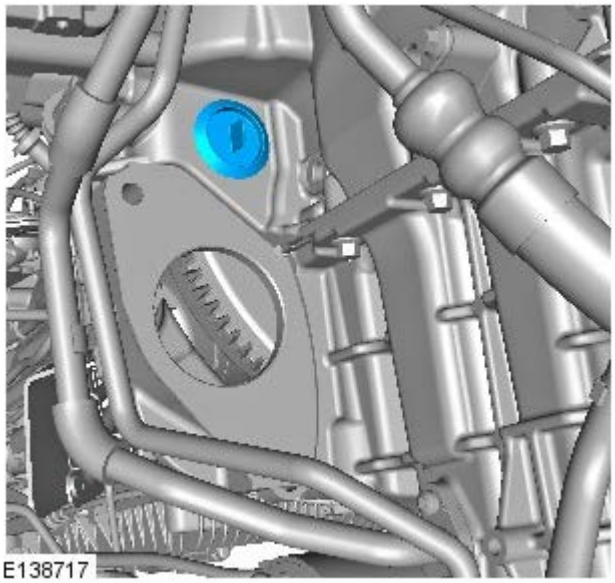




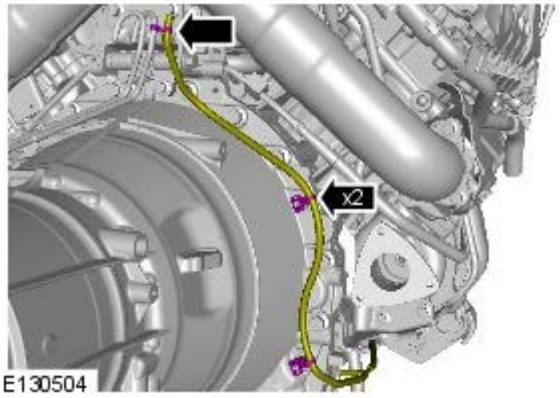
15. CAUTION: Only rotate the crankshaft clockwise.

Torque: 63 Nm

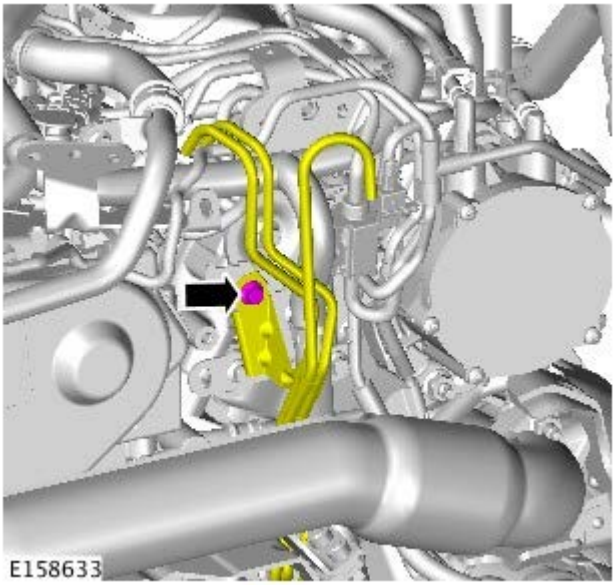
16.



17.



18. *Torque:* 12 Nm



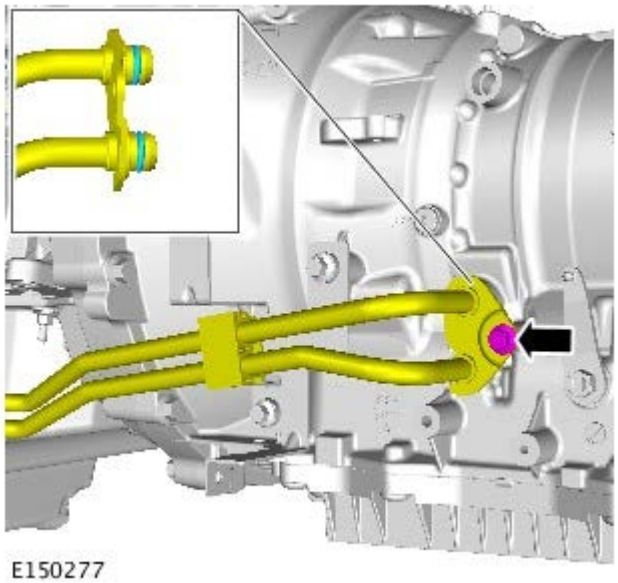
19. WARNING: Be prepared to collect escaping fluids.

NOTES:

Make sure that the area around the component is clean and free of foreign material.

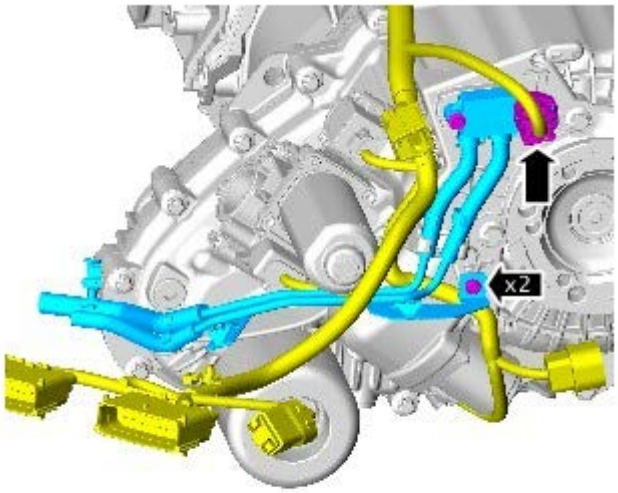
Install new O-ring seals.

Torque: 22 Nm



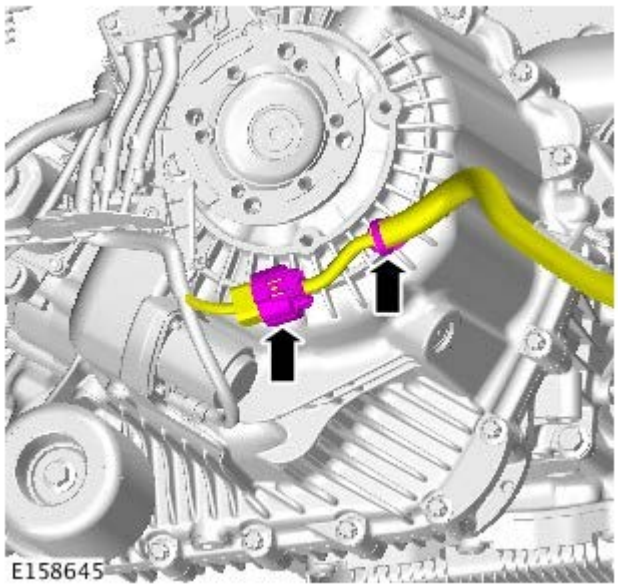
E150277

20. *Torque:*
    M5 6 Nm
    M6 10 Nm



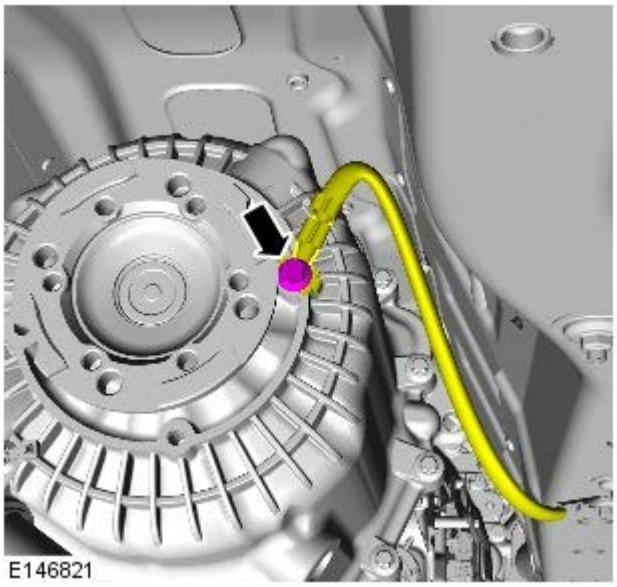
E158686

21.

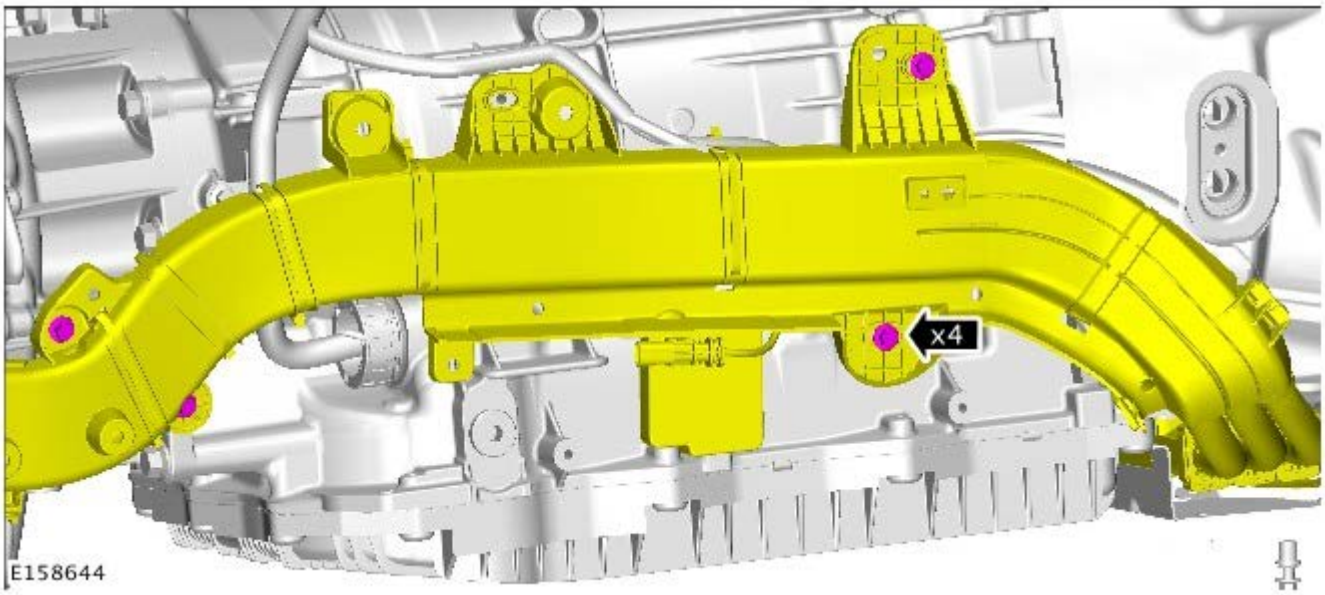


E158645

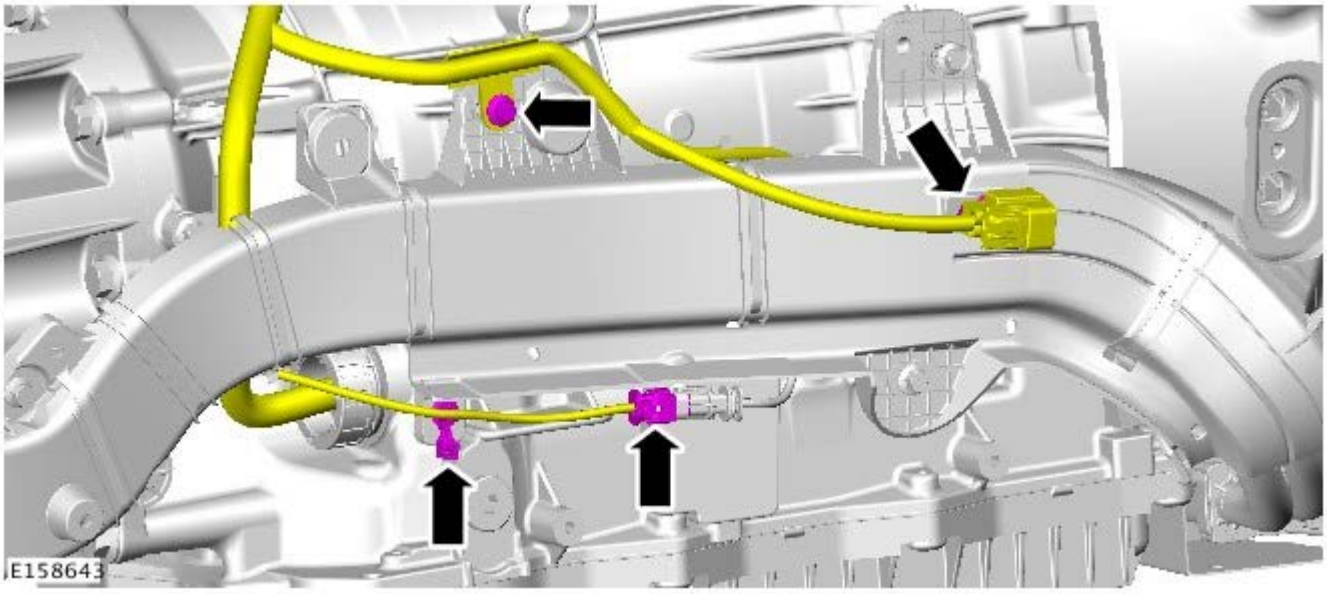
22. *Torque:* 25 Nm



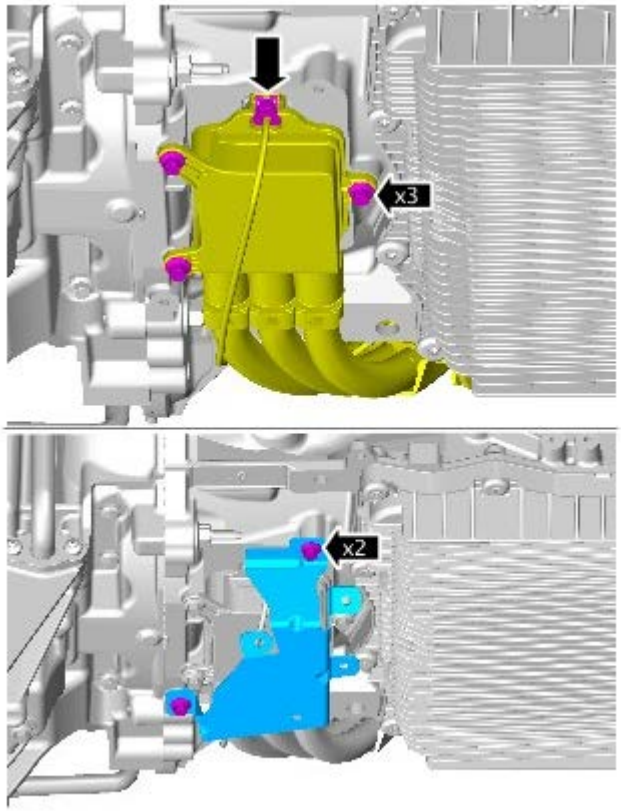
23. *Torque:* 10 Nm



24. *Torque:* 10 Nm

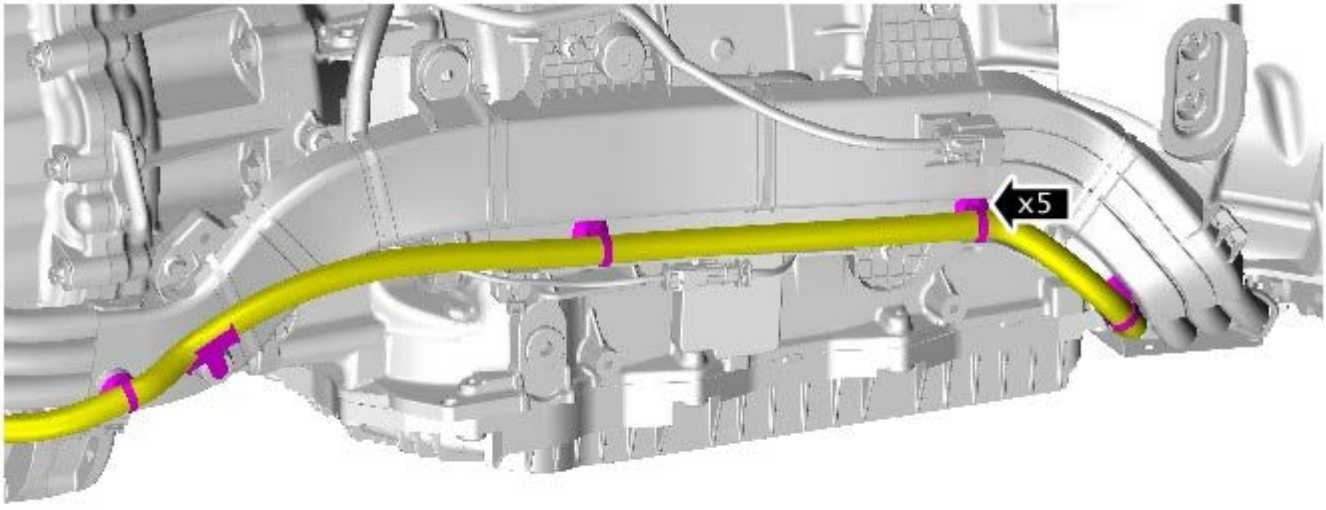


25. *Torque:* 10 Nm



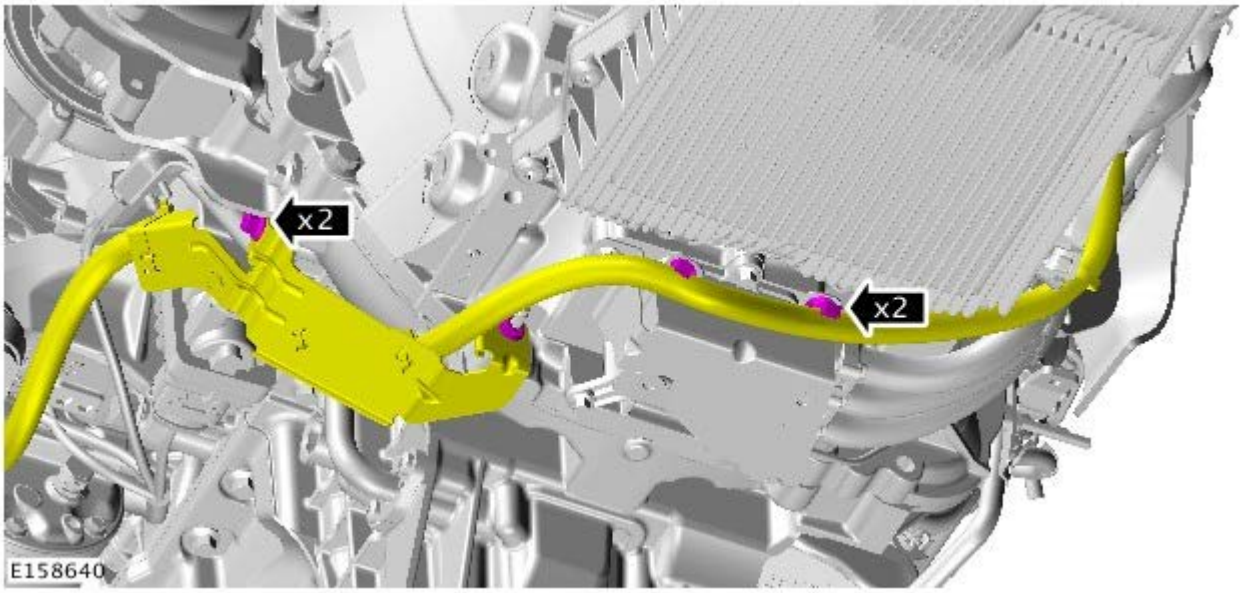
E159106

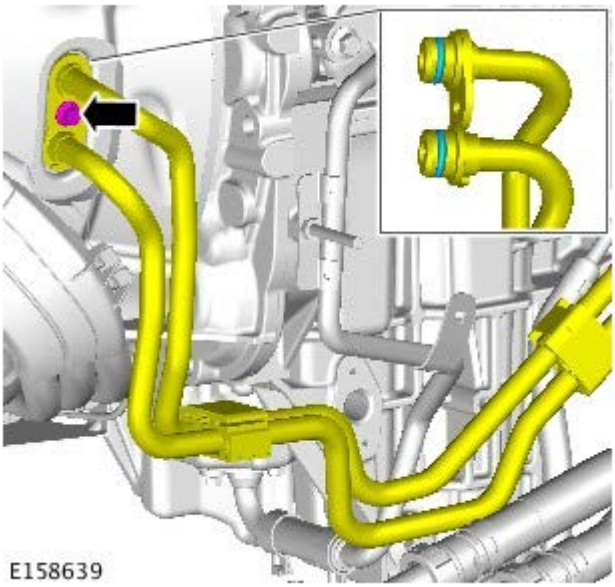
26.



E158641

27. *Torque:* 10 Nm





28. WARNING: Be prepared to collect escaping fluids.

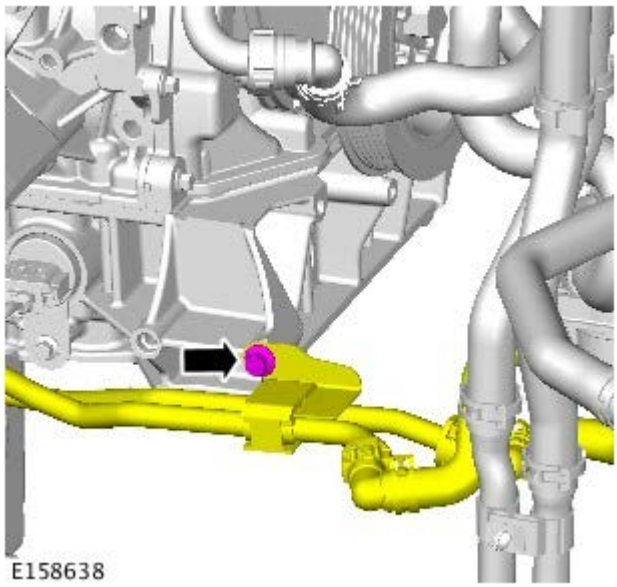
NOTES:

Make sure that the area around the component is clean and free of foreign material.

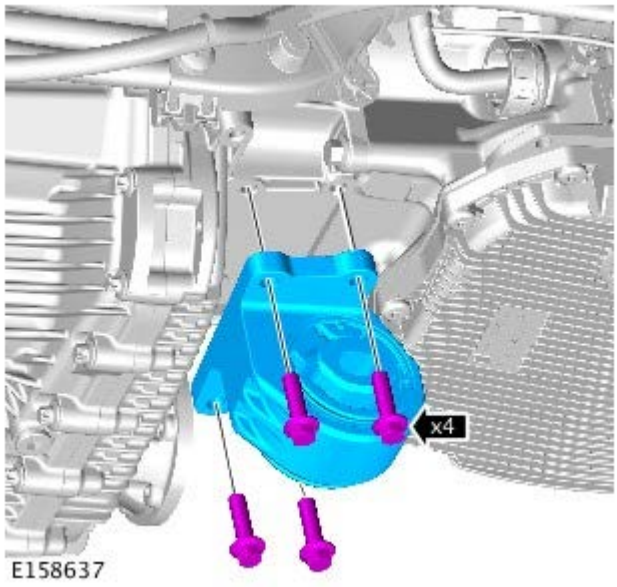
Install new O-ring seals.

Torque: 10 Nm

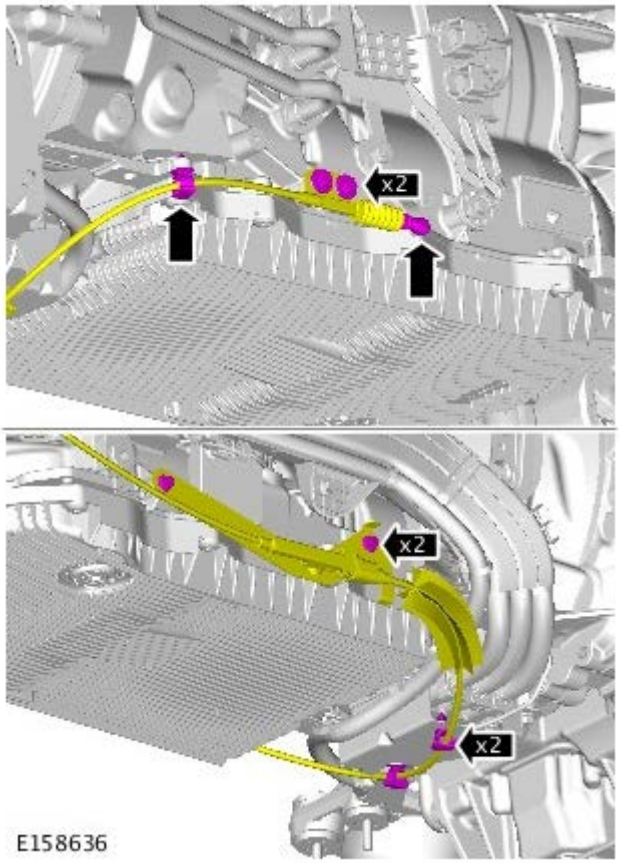
29. *Torque:* 25 Nm



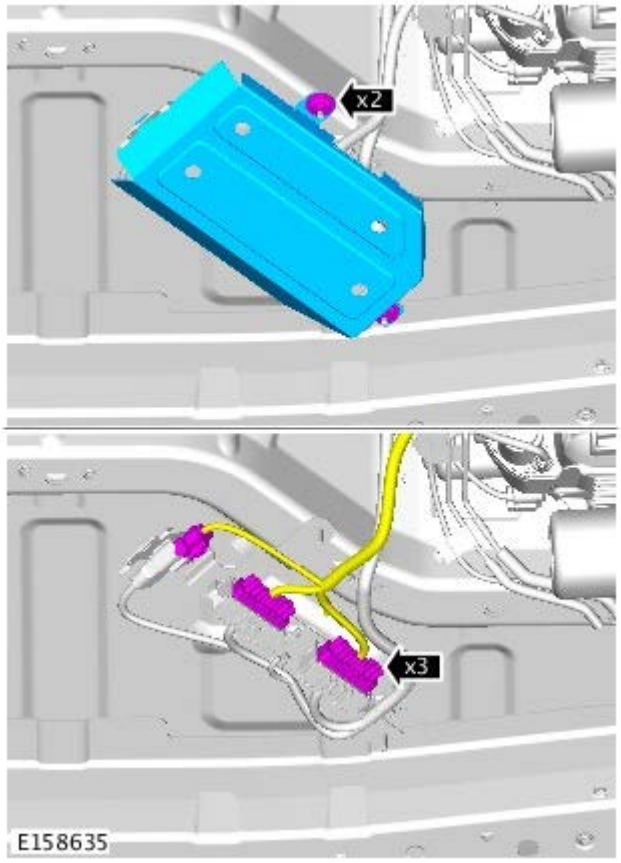
30. *Torque:* 62 Nm



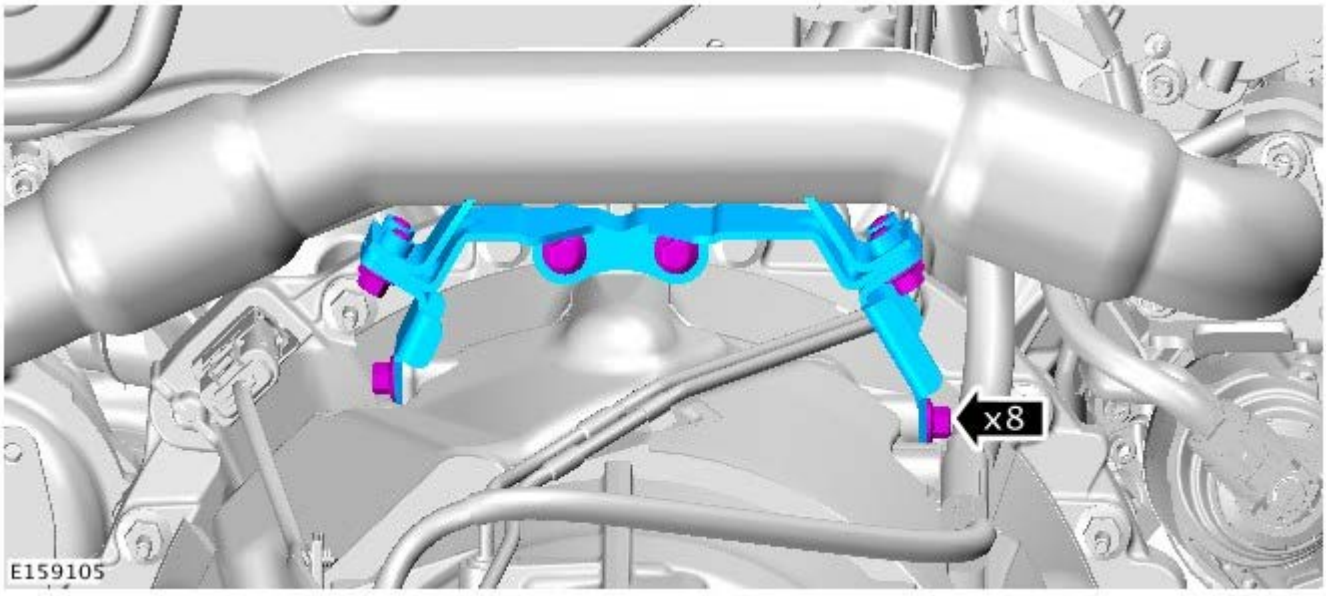
31. *Torque:*
    M8 bolts on LH 10 Nm
    M8 bolts on RH 9 Nm



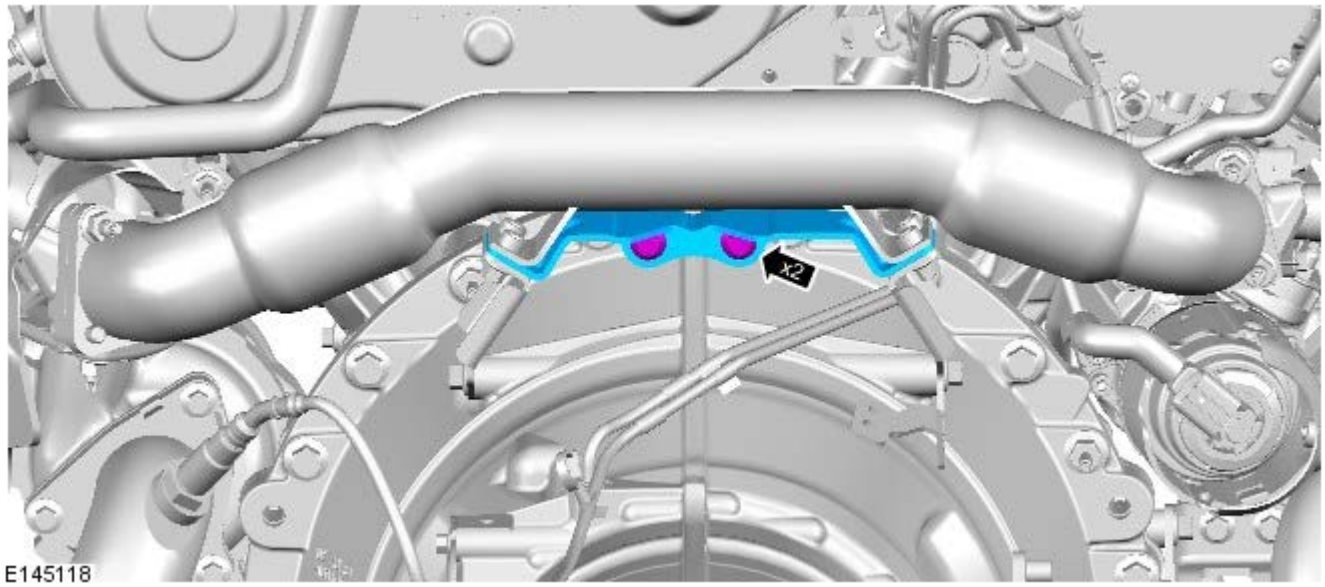
32. *Torque:* 10 Nm



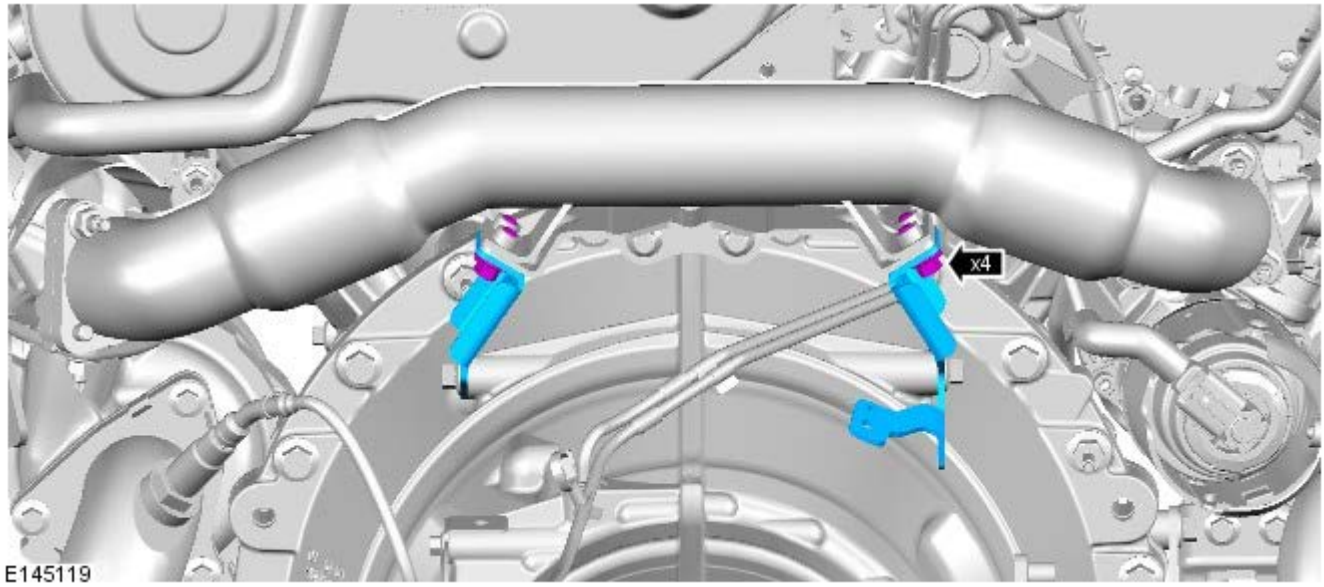
33. CAUTION: Only tighten the bolts finger-tight at this stage.



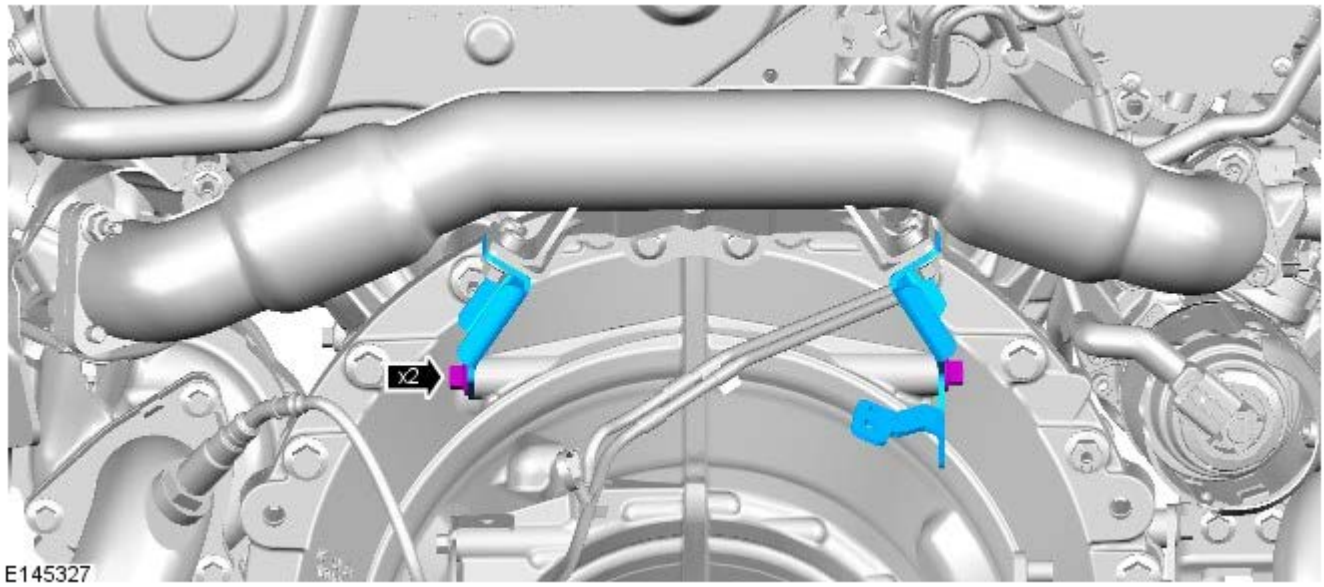
34. *Torque:* 23 Nm



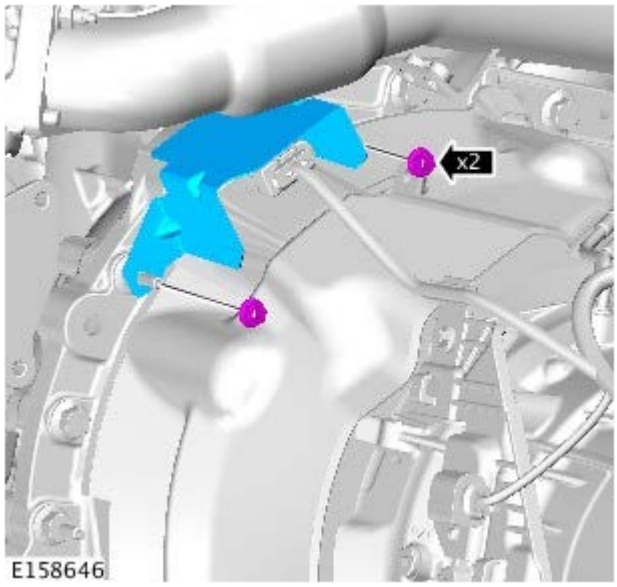
35. *Torque:* 23 Nm



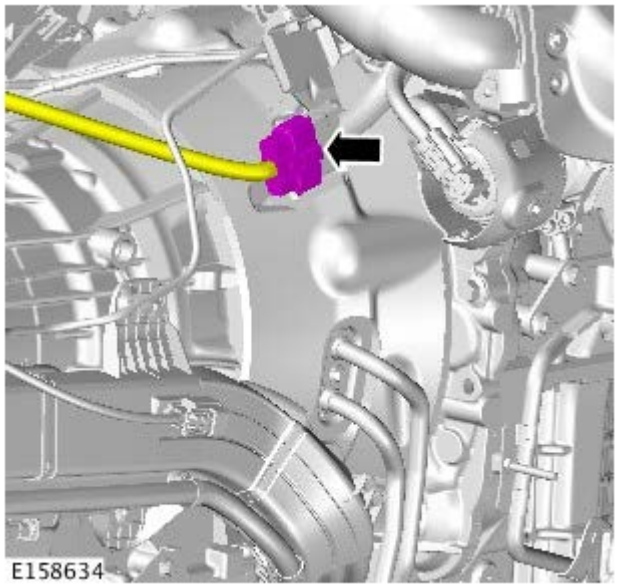
36. *Torque:* 23 Nm



37. *Torque:* 13 Nm



38.



39. Refer to: Rear Driveshaft - TDV6 3.0L Diesel (205-01 Driveshaft, Removal and Installation).

40. Refer to: Front Driveshaft - TDV6 3.0L Diesel (205-01 Driveshaft, Removal and Installation).

41. Refer to: Exhaust System - Vehicles Without: Diesel Particulate Filter (DPF) (309-00 Exhaust System - TDV6 3.0L Diesel, Removal and Installation).
Refer to: Exhaust System - Vehicles With: Diesel Particulate Filter (DPF) (309-00 Exhaust System - TDV6 3.0L Diesel, Removal and Installation).

42. Refer to: Starter Motor (303-06A Starting System - TDV6 3.0L Diesel, Removal and Installation).

43. Refer to: Cooling System Partial Draining, Filling and Bleeding (303-03A Engine Cooling - TDV6 3.0L Diesel, General Procedures).

44. Refer to: Secondary Bulkhead Center Panel - TDV6 3.0L Diesel (501-02 Front End Body Panels, Removal and Installation).

45. Refer to: Hybrid Electric Vehicle (HEV) System Bonding Test (414-01 Battery, Mounting and Cables, General Procedures).

46. Refer to: Hybrid Electric Vehicle (HEV) Decommission (414-01 Battery, Mounting and Cables, General Procedures).

47. Refer to: Transmission Fluid Level Check - TDV6 3.0L Diesel /TDV8 4.4L Diesel (307-01A Automatic Transmission/Transaxle - Vehicles

With: 8HP70 8-Speed Automatic Transmission AWD, General Procedures).

Published: 11-Sep-2012

Transmission / Transaxle Cooling - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD -

Item	Specification
Transmission fluid	Shell L12108

Torque Specifications

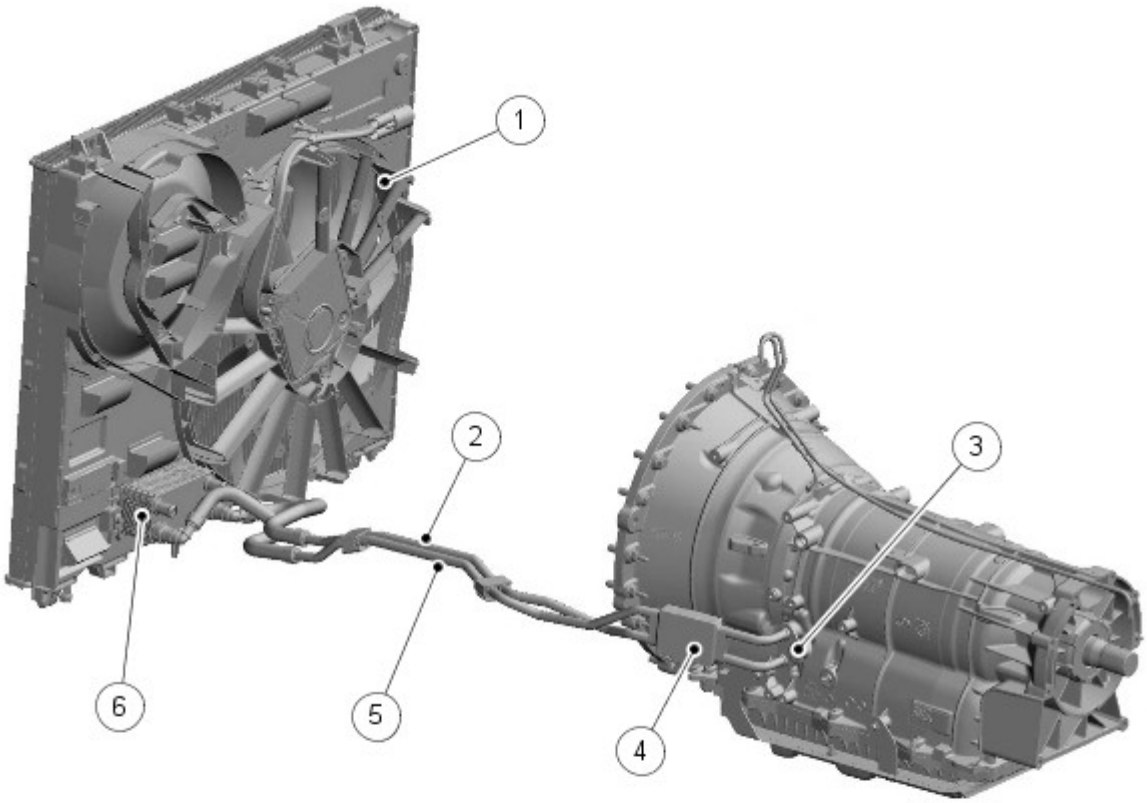
Description	Nm	lb-ft	lb-in
Transmission fluid cooler bolt	6	4	-
Transmission fluid cooler tubes to transmission housing bolt	25	19	-
Transmission fluid cooler tube bracket to engine oil pan retaining nut	9	7	-
Turbocharger bypass valve bracket bolts 3.0 TD V6	9	7	-
Turbocharger bypass valve clamp 3.0 TD V6	3.5	-	31
Transmission fluid level check bolt	35	26	-

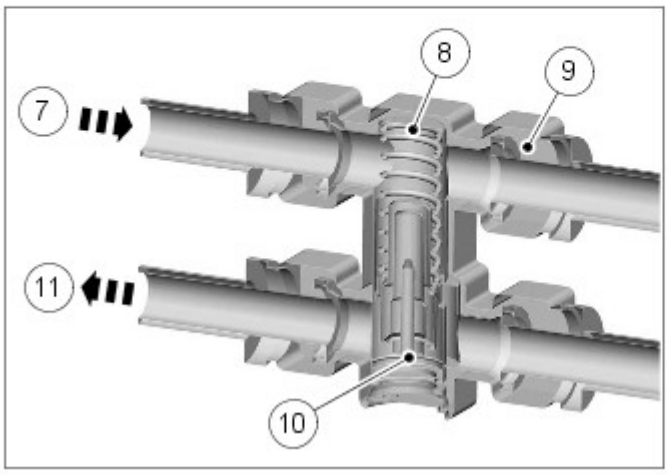
Published: 02-May-2013

Transmission / Transaxle Cooling - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - Transmission Cooling

Description and Operation

4.4L TDV8 FLUID COOLING COMPONENT LOCATION





E152496

Item	Part Number	Description
1	-	Engine cooling radiator
2	-	Return pipe (To transmission)
3	-	Transmission cooling pipe connection
4	-	Thermostatic valve
5	-	Supply pipe (From transmission)
6	-	Automatic Transmission Fluid (ATF) cooler
7	-	Fluid return flow
8	-	Spring
9	-	Thermostatic valve body
10	-	Thermostatic wax element
11	-	Fluid supply flow

INTRODUCTION

The ATF 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 ATF cooler is a dedicated cooler which is connected into the engine cooling system circuit. The ATF is cooled by the temperature differential between the ATF and the engine coolant flowing through the cooler.

Fluid is supplied from the ATF 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 wax element which is closed when ATF temperatures are below 69 ºC (156.2 ºF). At temperatures 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 temperatures of 79 ºC (174.2 ºF)

Published: 11-May-2011

Transmission / Transaxle Cooling - 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 (307-02A Transmission/Transaxle Cooling - 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
Over heating of the automatic transmission	Obstruction in the automatic transmission fluid cooler	Flush out the automatic transmission fluid cooler with new automatic transmission fluid. If the flushing is unsuccessful, install a new transmission fluid cooler.
Over heating of the automatic transmission	Obstruction in the automatic transmission fluid tubes	Flush out the automatic transmission fluid cooler tubes with new automatic transmission fluid. If the flushing is unsuccessful install new automatic transmission fluid cooler tubes.
Loss of automatic transmission fluid	Connections to the automatic transmission and the automatic transmission fluid cooler	Check the integrity of the tubes, connections and seals. Check the torque of the tube fixings.
Loss of automatic transmission fluid	Leak at oil cooler	Check the integrity of tubes, connections and seals. Check the torque of the tube 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: Module Name: Transmission Control Module - Bosch (100-00, Description and Operation).

Published: 03-Aug-2012

Transmission / Transaxle Cooling - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - Transmission Fluid Cooler TDV6 3.0L Diesel

Removal and Installation

Removal

CAUTIONS:

Make sure that all openings are sealed. Use new blanking caps.

Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Be prepared to collect escaping fluids.

NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

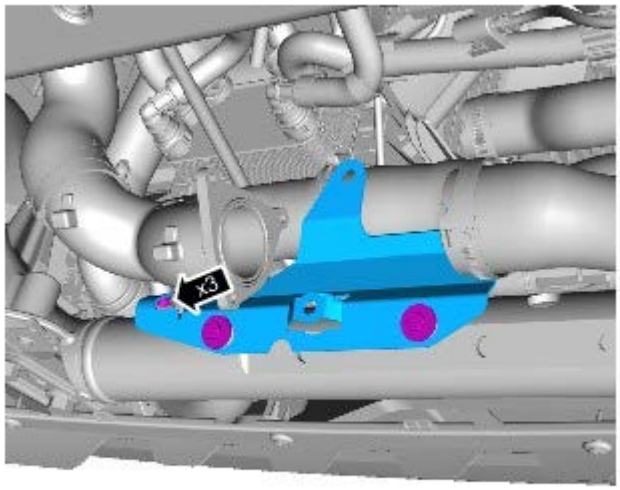
   Raise and support the vehicle.

2. Refer to: Cooling System Partial Draining, Filling and Bleeding (303-03A Engine Cooling - TDV6 3.0L Diesel, General Procedures).

3. Refer to: Transmission Fluid Level Check - TDV6 3.0L Diesel /TDV8 4.4L Diesel (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, General Procedures).

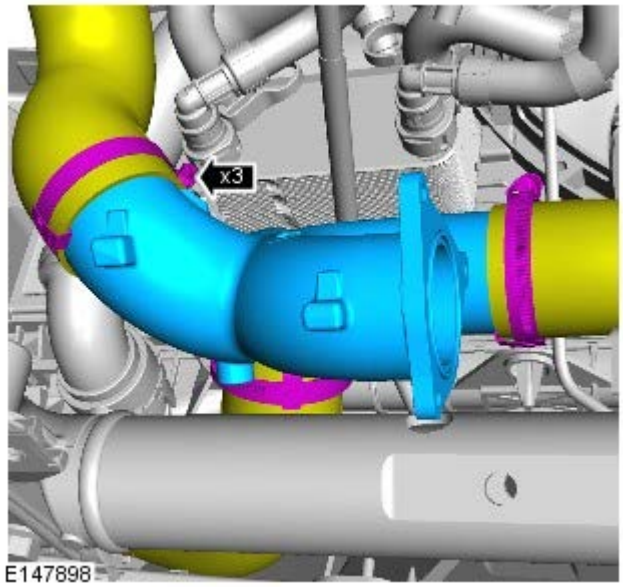
4. Refer to: Turbocharger Bypass Valve (303-04B Fuel Charging and Controls - Turbocharger - SDV6 3.0L Diesel - Hybrid Electric Vehicle/TDV6 3.0L Diesel, Removal and Installation).

5. *Torque:* 9 Nm

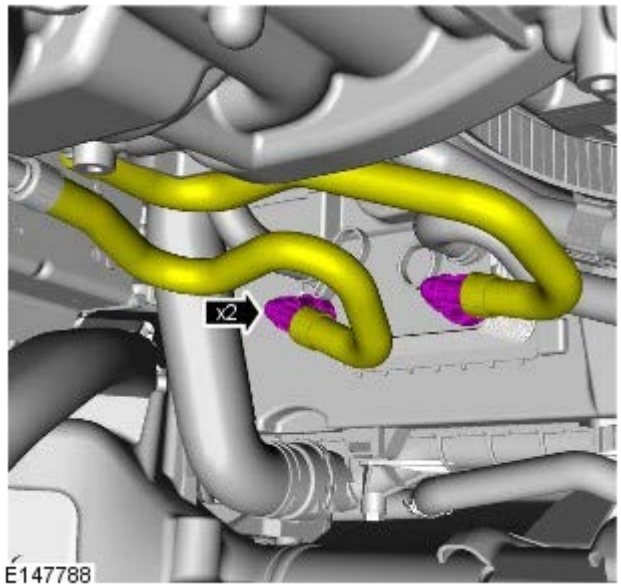


E147897

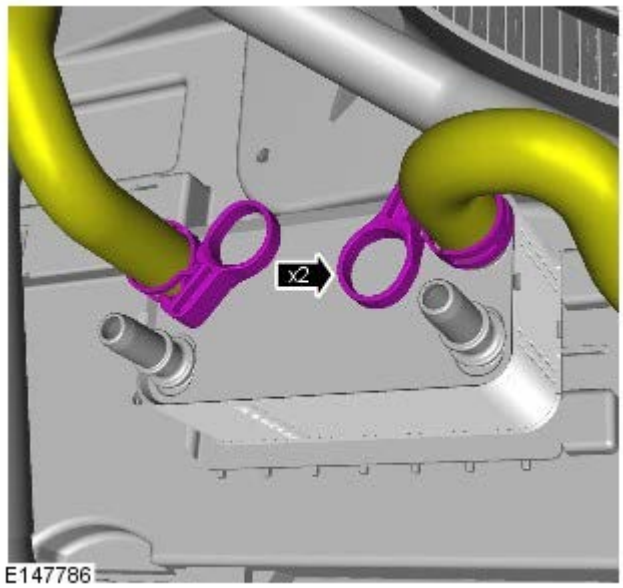
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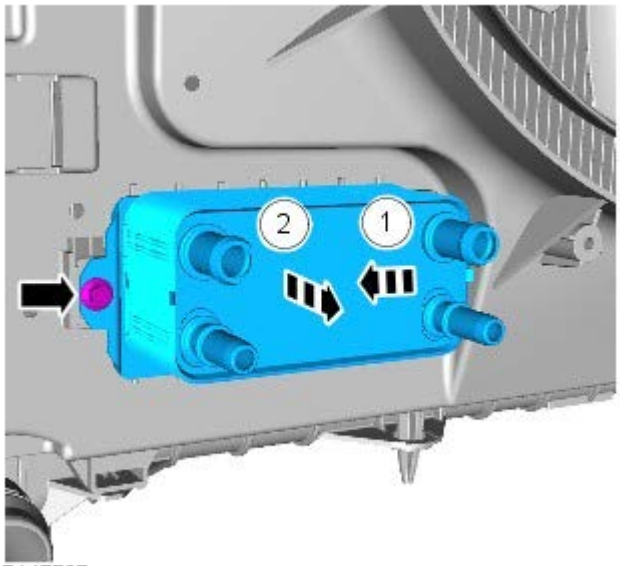
7.



8.



9. *Torque:* 6 Nm



E147787

Installation

1. To install reverse the removal procedure.

Published: 03-Aug-2012

Transmission / Transaxle Cooling - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - Transmission Fluid Cooler TDV8 4.4L Diesel

Removal and Installation

Removal

CAUTIONS:

Make sure that all openings are sealed. Use new blanking caps.

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.

Be prepared to collect escaping fluids.

NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

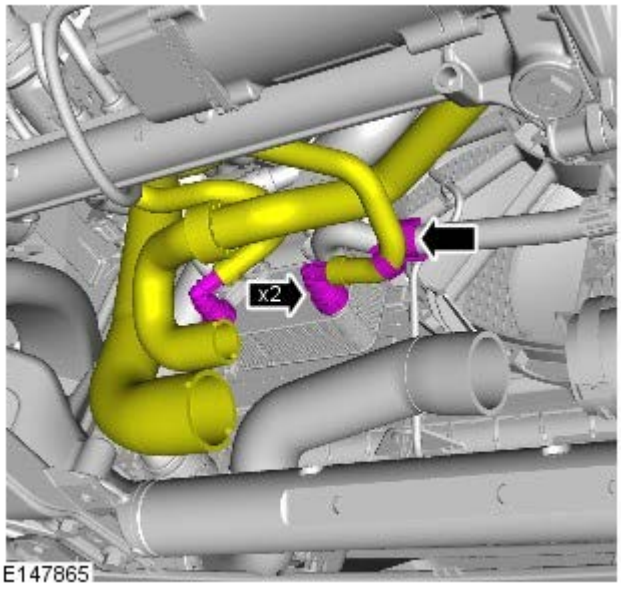
   Raise and support the vehicle.

2. Refer to: Cooling System Partial Draining, Filling and Bleeding (303-03F Engine Cooling - TDV8 4.4L Diesel, General Procedures).

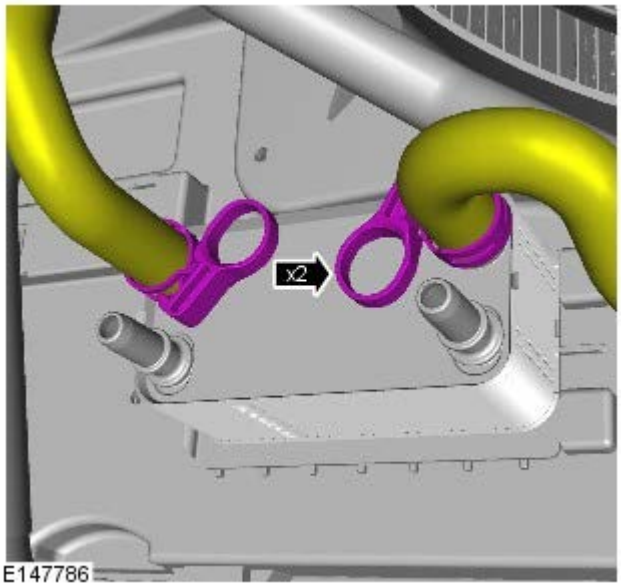
3. Refer to: Transmission Fluid Level Check - TDV6 3.0L Diesel /TDV8 4.4L Diesel (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, General Procedures).

4. Refer to: Turbocharger Bypass Valve (303-04F Fuel Charging and Controls - Turbocharger - TDV8 4.4L Diesel, Removal and Installation).

5.

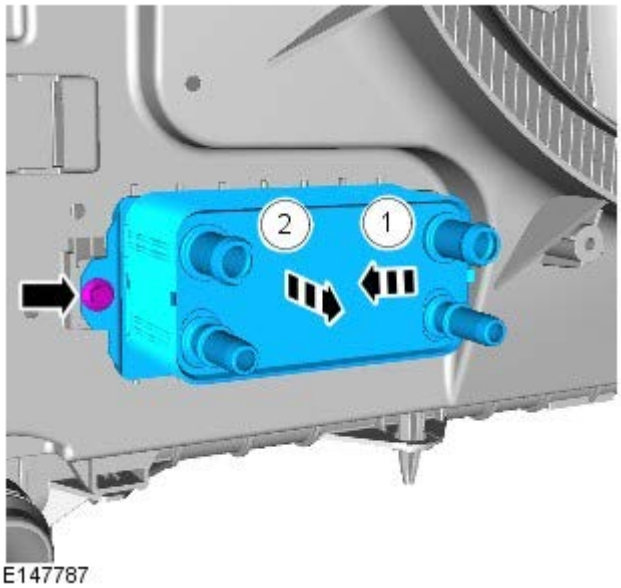


6.



E147786

7. *Torque:* 6 Nm



E147787

Installation

1. To install reverse the removal procedure.

Published: 09-Aug-2012

Transmission / Transaxle Cooling - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - Transmission Fluid Cooler V6 S/C 3.0L Petrol / V8 S/C 5.0L Petrol

Removal and Installation

Removal

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.

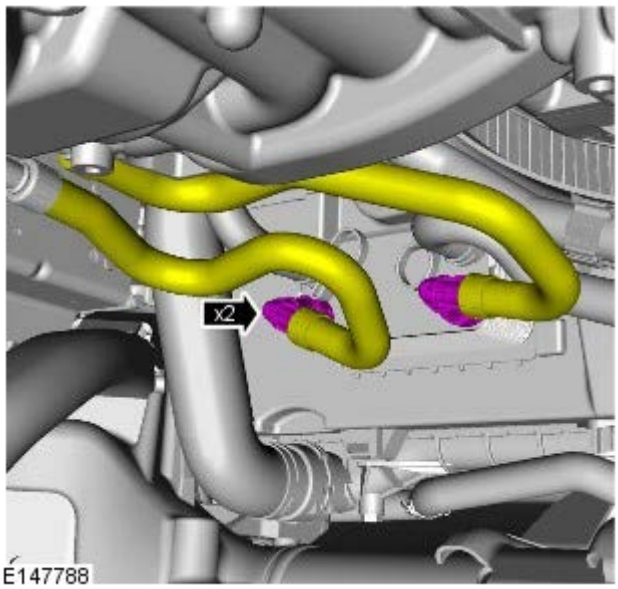
NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

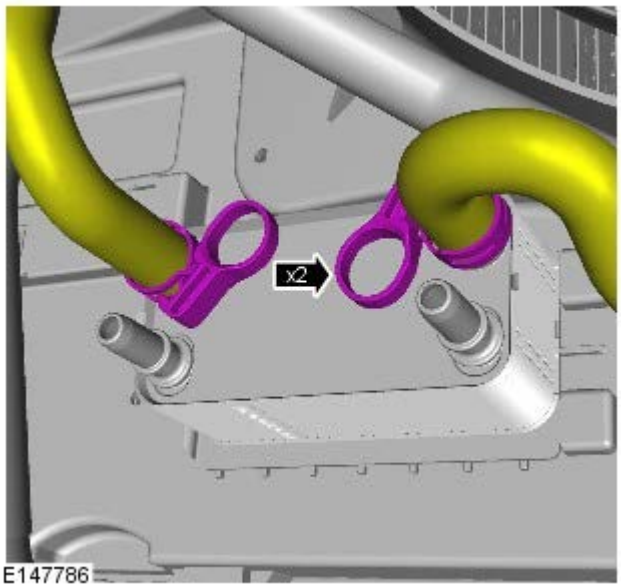
   Raise and support the vehicle.

2. Refer to: Cooling System Partial Draining, Filling and Bleeding - V8 5.0L Petrol (303-03C, General Procedures).
   Refer to: Cooling System Partial Draining, Filling and Bleeding - V8 S/C 5.0L Petrol (303-03, General Procedures).

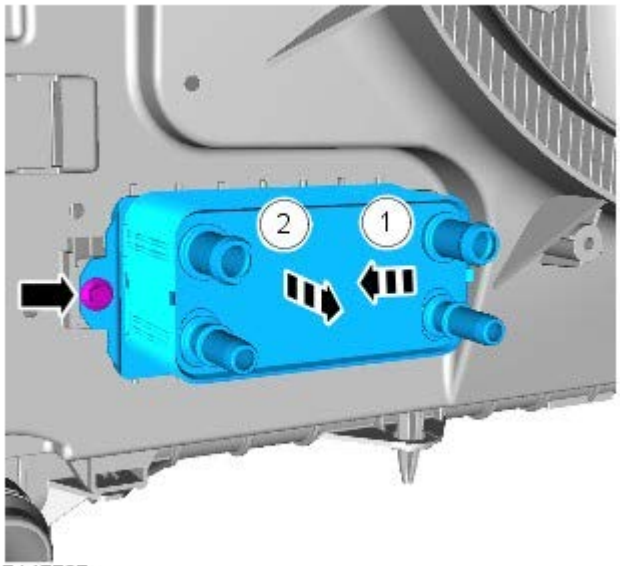
3.



4.



5. *Torque:* 7 Nm



E147787

Installation

1. To install reverse the removal procedure.
2. Refer to: Transmission Fluid Level Check - V8 5.0L Petrol/V8 S/C 5.0L Petrol (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, General Procedures).

Published: 02-Aug-2012

Transmission / Transaxle Cooling - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - Transmission Fluid Cooler Tubes TDV6 3.0L Diesel

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.

Some components shown removed for clarity.

1. Disconnect the battery ground cable.

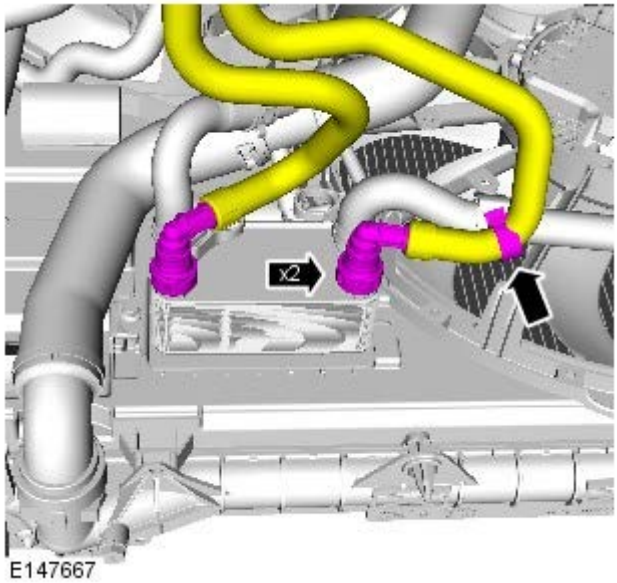
   Refer to: Specifications (414-00, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Refer to: Engine Undershield (501-02, Removal and Installation).

4. Refer to: Front Driveshaft - TDV6 3.0L Diesel (205-01, Removal and Installation).

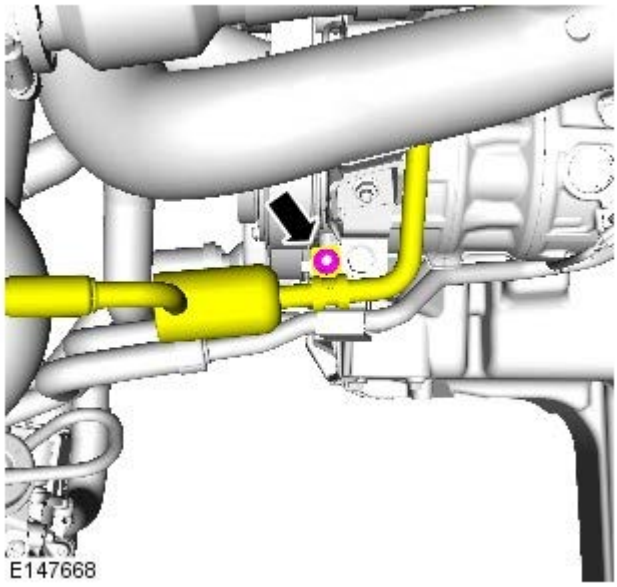


E147667

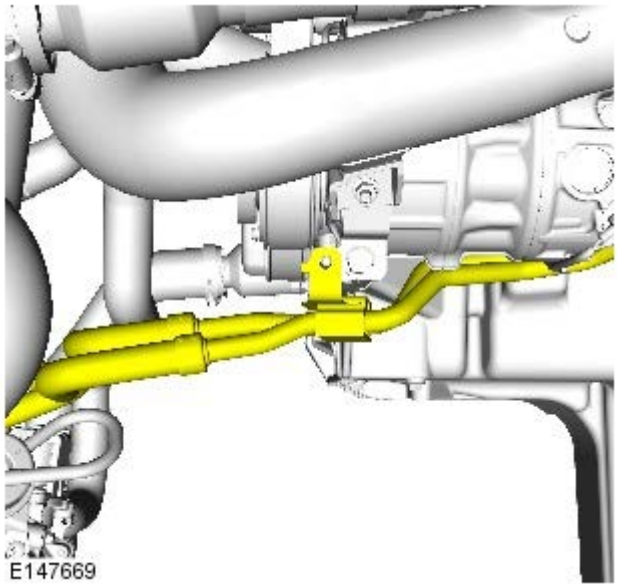
5. WARNING: Be prepared to collect escaping fluids.

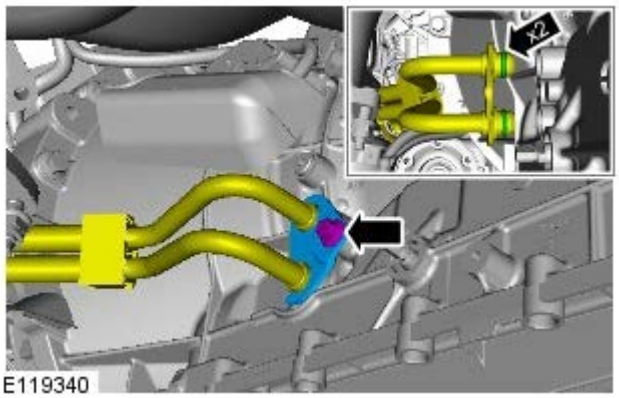
   CAUTION: Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean and dry. Plug open connections to prevent contamination.

6. *Torque:* 9 Nm



7.





8. CAUTIONS:

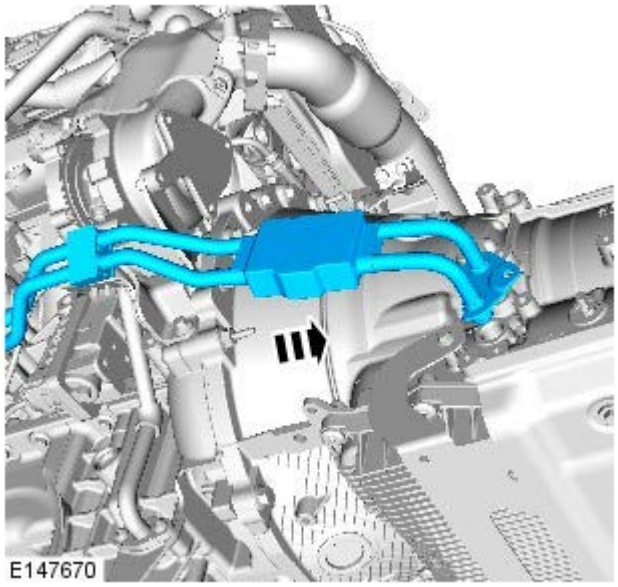
Be prepared to collect escaping fluids.

Make sure that all openings are sealed. Use new blanking caps.

Remove and discard the O-ring seals.

Torque: 25 Nm

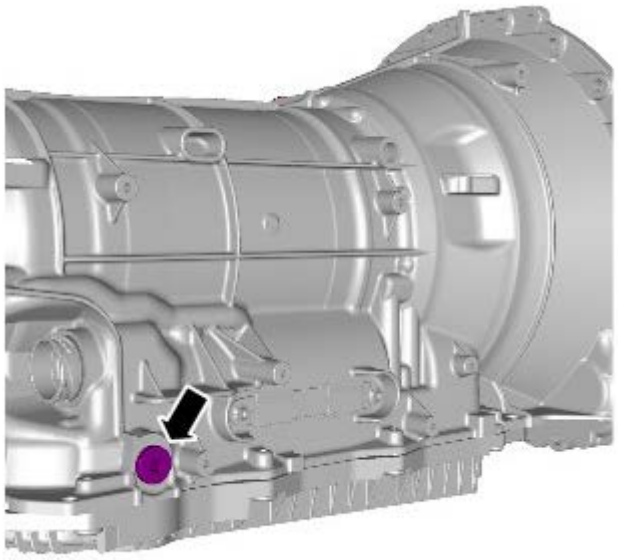
9.


E147670

Installation

1. To install, reverse the removal procedure.

2.
   - Check and top-up the transmission fluid level.
   - *Torque:* 35 Nm


E131143

Published: 02-Aug-2012

Transmission / Transaxle Cooling - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - Transmission Fluid Cooler Tubes TDV8 4.4L Diesel

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.

Some components shown removed for clarity.

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

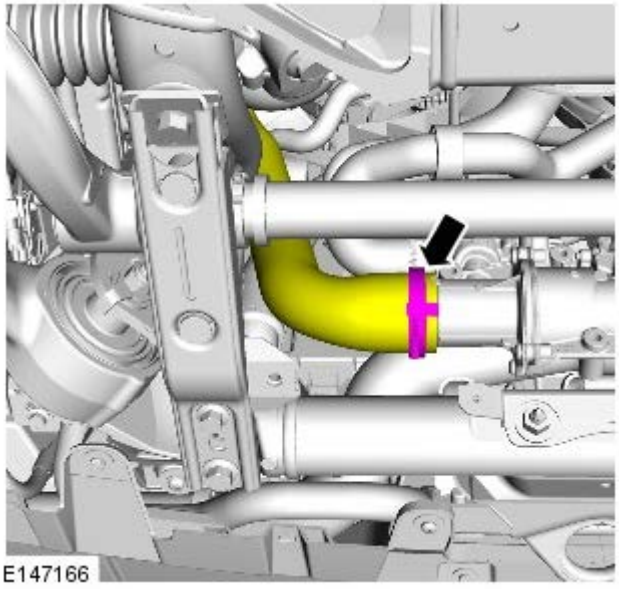
2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

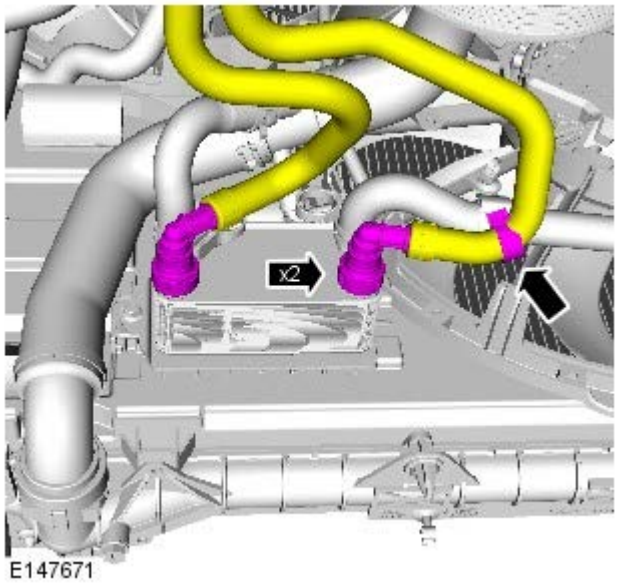
4. Refer to: Front Driveshaft - TDV8 4.4L Diesel (205-01 Driveshaft, Removal and Installation).

5. *Torque:* 3.5 Nm

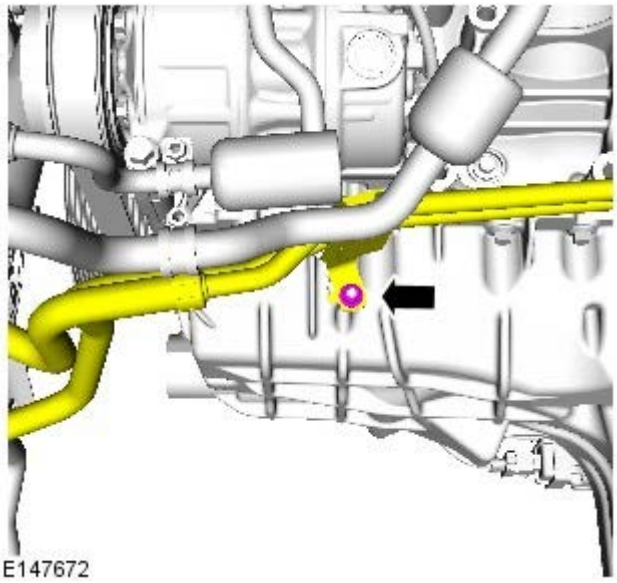

E147166

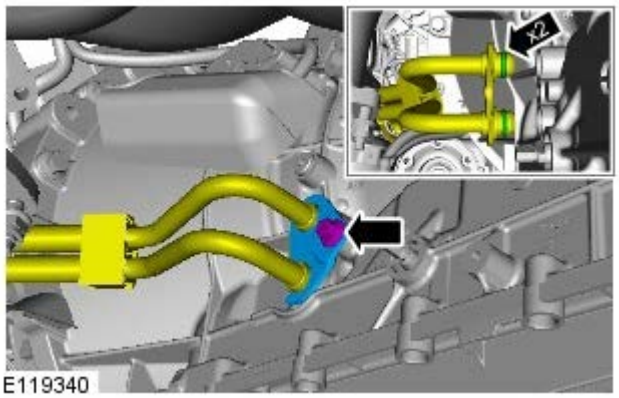
6. WARNING: Be prepared to collect escaping fluids.

   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.



7. *Torque:* 9 Nm





8. CAUTIONS:

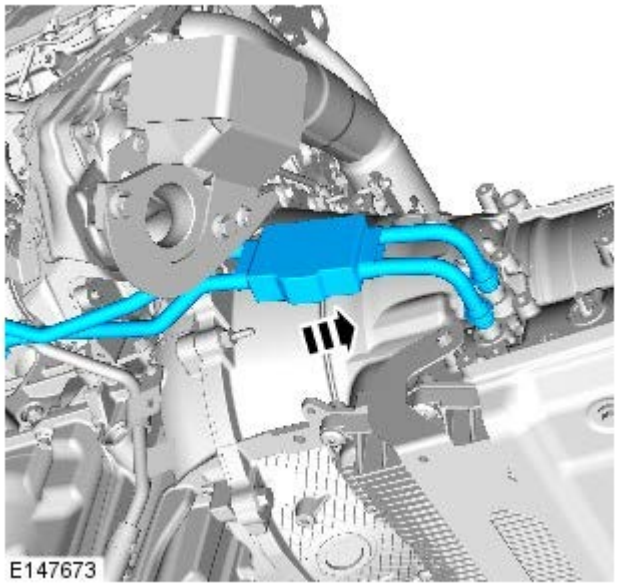
   Be prepared to collect escaping fluids.

   Make sure that all openings are sealed. Use new blanking caps.

   Remove and discard the O-ring seals.

   Torque: 25 Nm

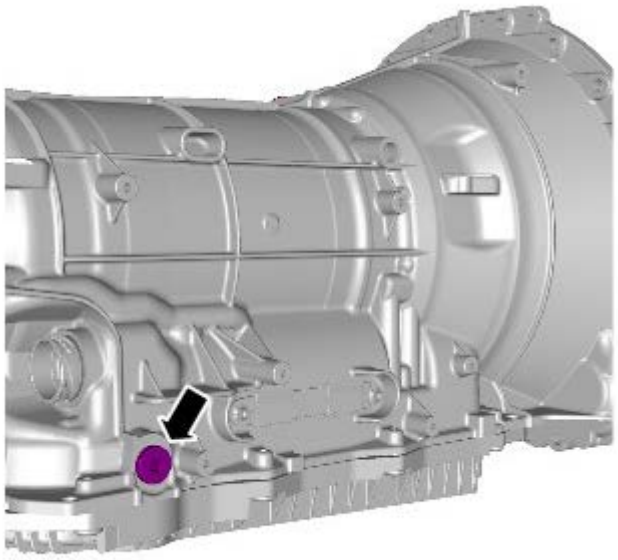
9.


E147673

Installation

1. To install, reverse the removal procedure.

2.
   - Check and top-up the transmission fluid level.
   - *Torque:* 35 Nm


E131143

Published: 02-Aug-2012

Transmission / Transaxle Cooling - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - Transmission Fluid Cooler Tubes V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol

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.

Some components shown removed for clarity.

1. Disconnect the battery ground cable.

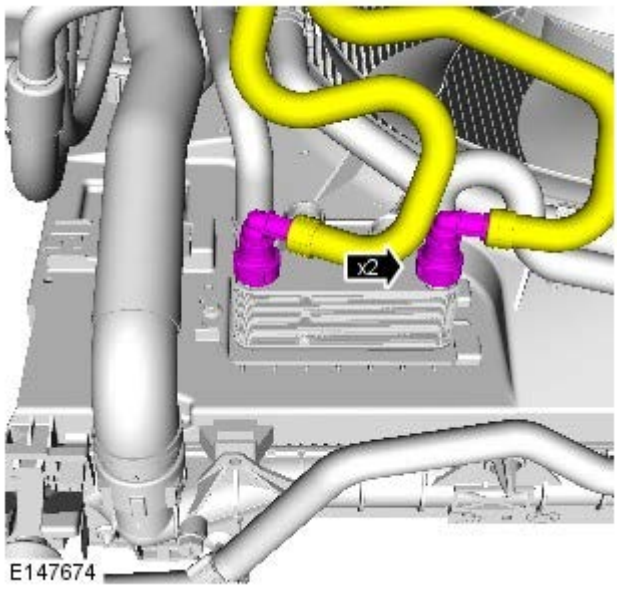
   Refer to: Specifications (414-00, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Refer to: Engine Undershield (501-02, Removal and Installation).

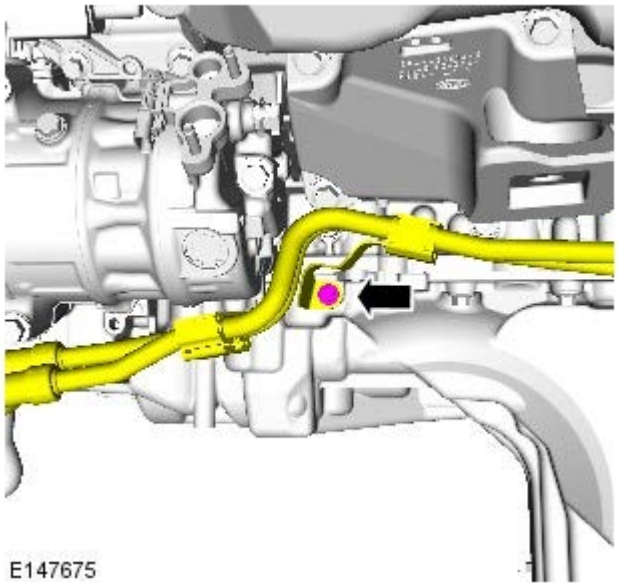
4. Refer to: Front Driveshaft - V8 5.0L Petrol/V8 S/C 5.0L Petrol (205-01, Removal and Installation).

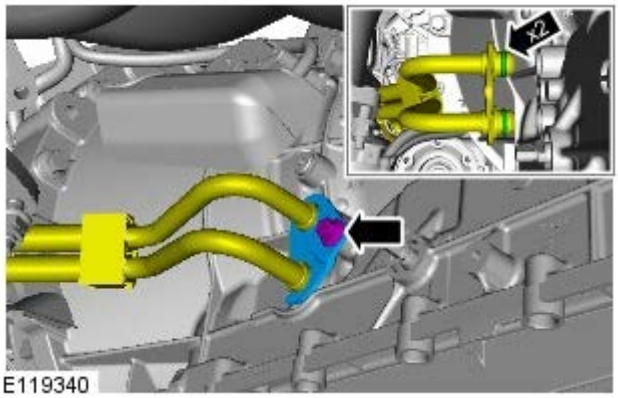


5. WARNING: Be prepared to collect escaping fluids.

   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:* 9 Nm





7. CAUTIONS:

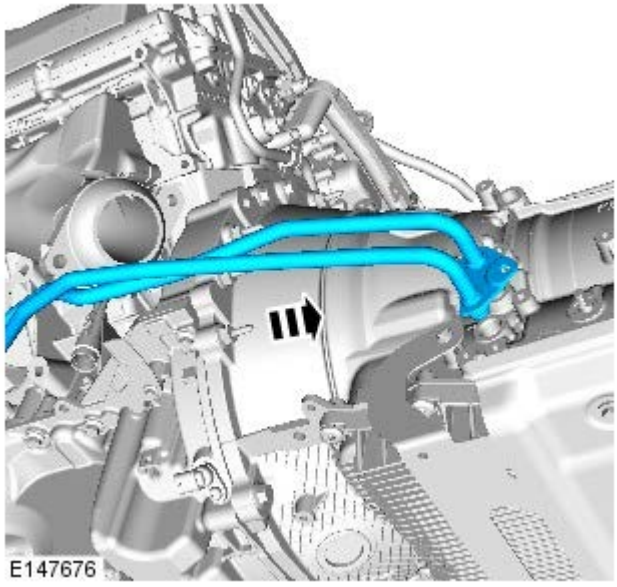
   Be prepared to collect escaping fluids.

   Make sure that all openings are sealed. Use new blanking caps.

   Remove and discard the O-ring seals.

   Torque: 25 Nm

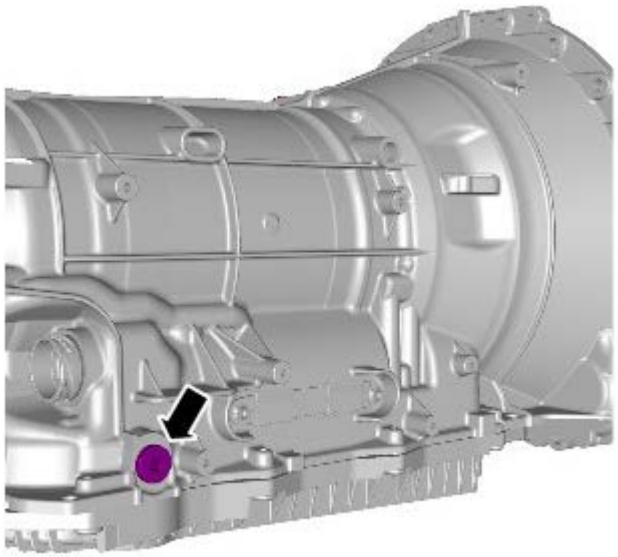
8.



Installation

1. To install, reverse the removal procedure.

2.
   - Check and top-up the transmission fluid level.
   - *Torque:* 35 Nm



E131143

Published: 11-Sep-2012

Transmission / Transaxle Cooling - Vehicles With: 8HP70 8-Speed - Hybrid Electric Vehicle - Automatic Transmission – AWD -

Item	Specification
Transmission fluid	Shell L12108

Torque Specifications

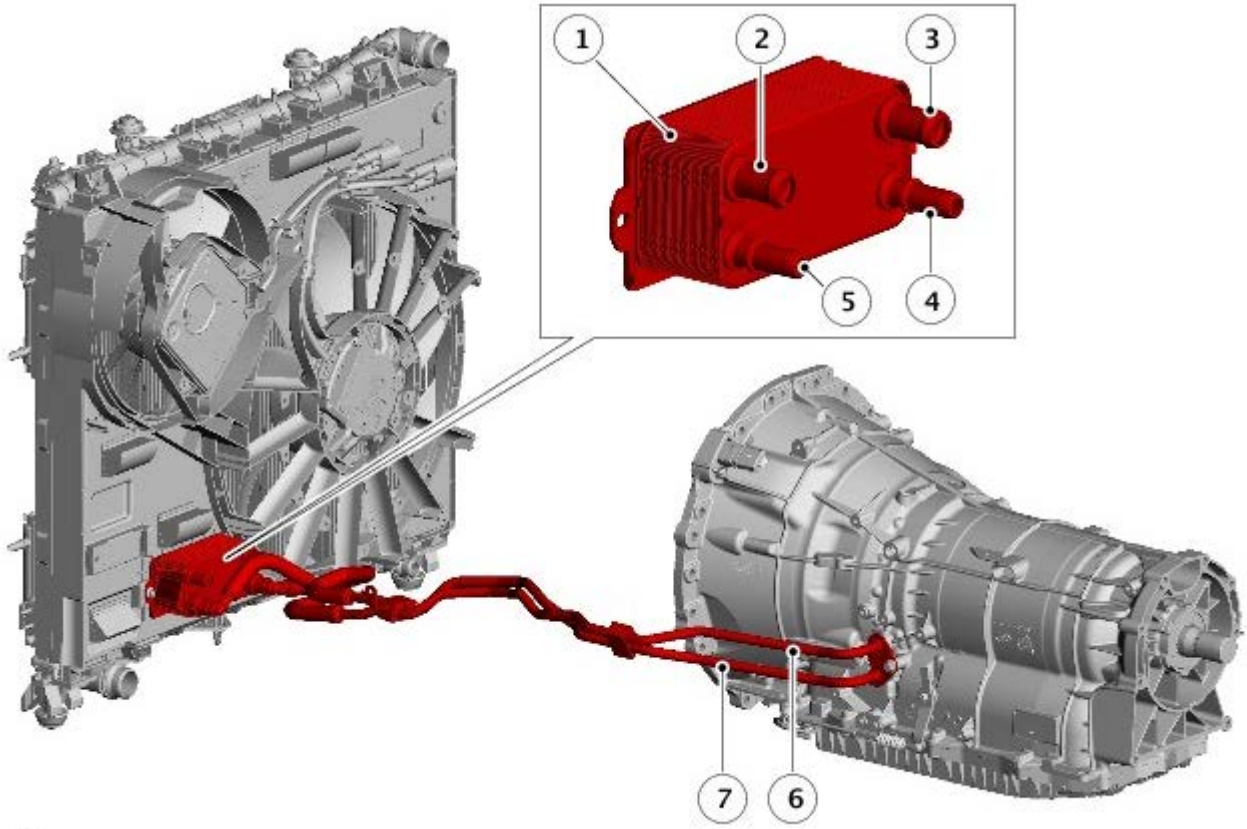
Description	Nm	lb-ft	lb-in
Transmission fluid cooler bolt	6	4	-
Transmission fluid cooler tubes to transmission housing bolt	25	19	-
Transmission fluid cooler tube bracket to engine oil pan retaining nut	9	7	-
Turbocharger bypass valve bracket bolts 3.0 TD V6	9	7	-
Turbocharger bypass valve clamp 3.0 TD V6	3.5	-	31
Transmission fluid level check bolt	35	26	-

Published: 06-Sep-2013

Transmission / Transaxle Cooling - Vehicles With: 8HP70 8-Speed - Hybrid Electric Vehicle - Automatic Transmission – AWD - Transmission Cooling

Description and Operation

COMPONENT LOCATION - HYBRID ELECTRIC VEHICLE (HEV)



E159376

Item	Part Number	Description
1	-	Automatic Transmission Fluid (ATF) cooler
2	-	Engine coolant outlet
3	-	Engine coolant inlet
4	-	ATF inlet
5	-	ATF outlet
6	-	Return pipe (To transmission)
7	-	Supply pipe (From transmission)

OVERVIEW

The ATF (automatic transmission fluid) cooler is a separate cooling unit located behind the engine cooling radiator. The unit is attached to the rear of the cooling fan shroud. The transmission is connected to the ATF cooler via flexible hoses and metal pipes.

The ATF cooler is a dedicated cooler which is connected into the engine cooling system circuit. The ATF is cooled by the temperature differential between the ATF and the engine coolant flowing through the ATF cooler.

For details of the Hybrid Electric Vehicle (HEV) cooling systems, refer to HEV Battery, Mounting and Cables
For additional information, refer to: Battery and Cables - TDV6 3.0L Diesel - Hybrid Electric Vehicle (414-01, Description and Operation).

Published: 03-Aug-2012

Transmission / Transaxle Cooling - Vehicles With: 8HP70 8-Speed - Hybrid Electric Vehicle - Automatic Transmission – AWD - Transmission Fluid Cooler TDV6 3.0L Diesel

Removal and Installation

Removal

CAUTIONS:

Make sure that all openings are sealed. Use new blanking caps.

Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Be prepared to collect escaping fluids.

NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

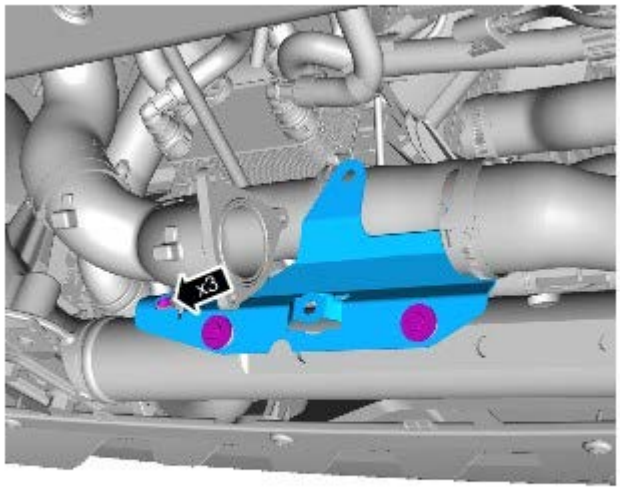
   Raise and support the vehicle.

2. Refer to: Cooling System Partial Draining, Filling and Bleeding (303-03A Engine Cooling - TDV6 3.0L Diesel, General Procedures).

3. Refer to: Transmission Fluid Level Check - TDV6 3.0L Diesel /TDV8 4.4L Diesel (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, General Procedures).

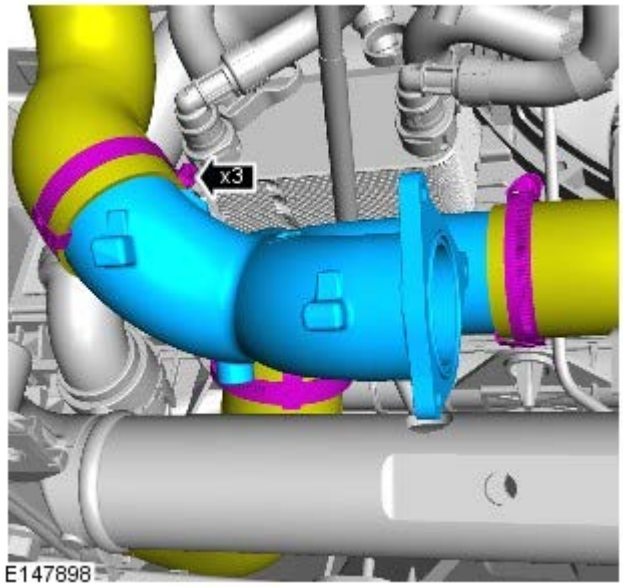
4. Refer to: Turbocharger Bypass Valve (303-04B Fuel Charging and Controls - Turbocharger - SDV6 3.0L Diesel - Hybrid Electric Vehicle/TDV6 3.0L Diesel, Removal and Installation).

5. *Torque:* 9 Nm

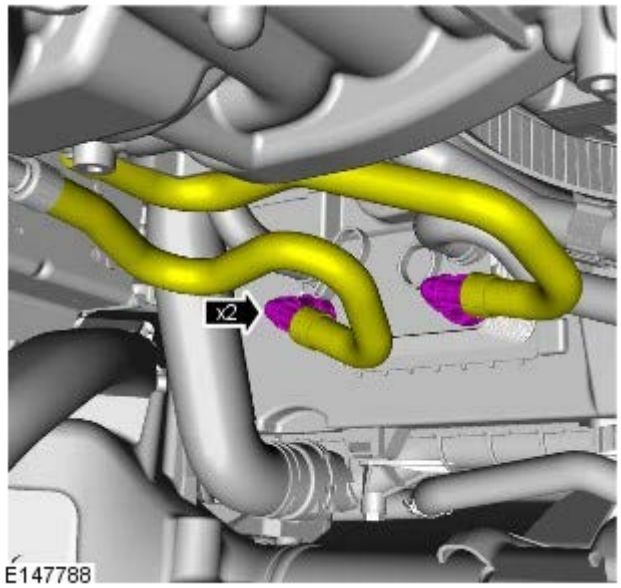


E147897

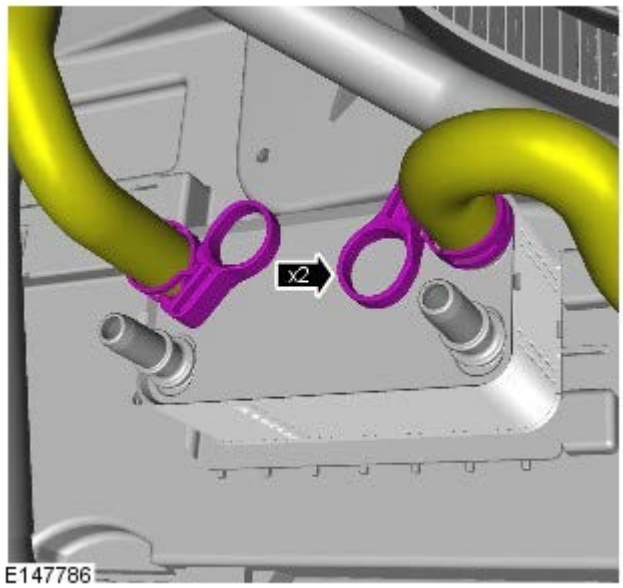
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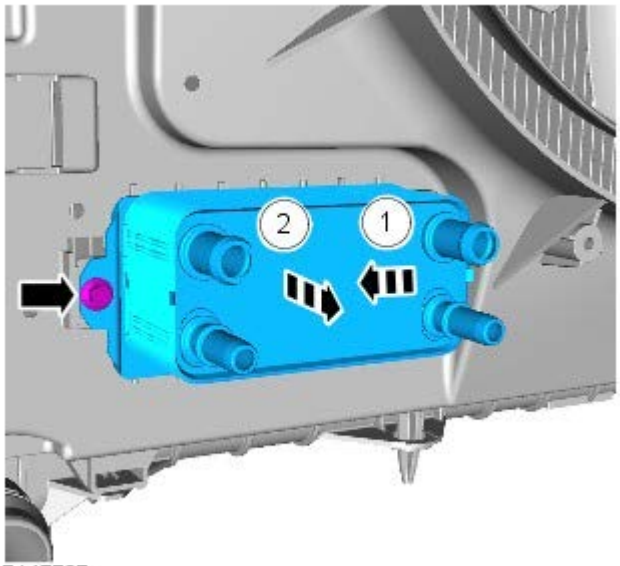
7.



8.



9. *Torque:* 6 Nm



E147787

Installation

1. To install reverse the removal procedure.

Published: 03-Aug-2012

Transmission / Transaxle Cooling - Vehicles With: 8HP70 8-Speed - Hybrid Electric Vehicle - Automatic Transmission – AWD - Transmission Fluid Cooler TDV8 4.4L Diesel

Removal and Installation

Removal

CAUTIONS:

Make sure that all openings are sealed. Use new blanking caps.

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.

Be prepared to collect escaping fluids.

NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

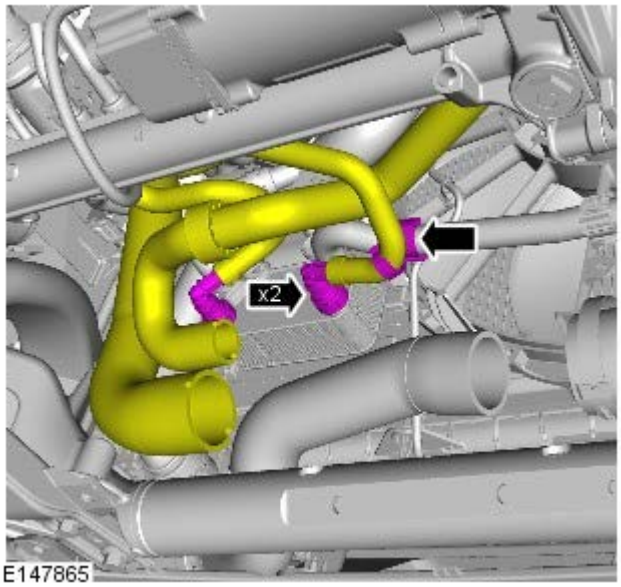
   Raise and support the vehicle.

2. Refer to: Cooling System Partial Draining, Filling and Bleeding (303-03F Engine Cooling - TDV8 4.4L Diesel, General Procedures).

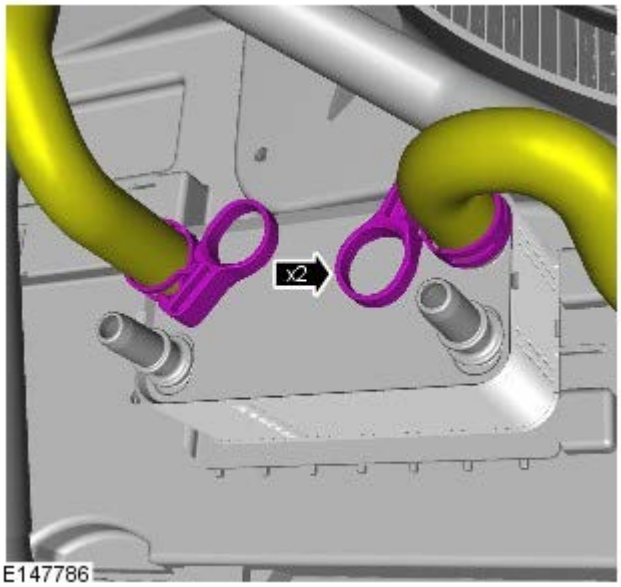
3. Refer to: Transmission Fluid Level Check - TDV6 3.0L Diesel /TDV8 4.4L Diesel (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, General Procedures).

4. Refer to: Turbocharger Bypass Valve (303-04F Fuel Charging and Controls - Turbocharger - TDV8 4.4L Diesel, Removal and Installation).

5.

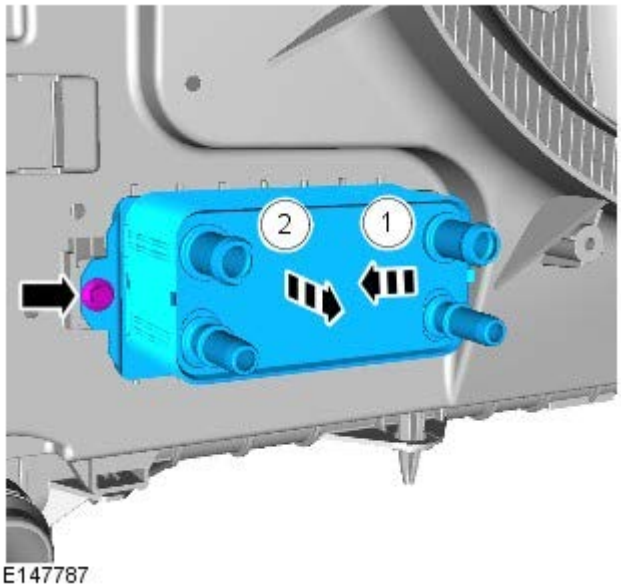


6.



E147786

7. *Torque:* 6 Nm



E147787

Installation

1. To install reverse the removal procedure.

Published: 09-Aug-2012

Transmission / Transaxle Cooling - Vehicles With: 8HP70 8-Speed - Hybrid Electric Vehicle - Automatic Transmission – AWD - Transmission Fluid Cooler V8 5.0L Petrol / V8 S/C 5.0L Petrol

Removal and Installation

Removal

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.

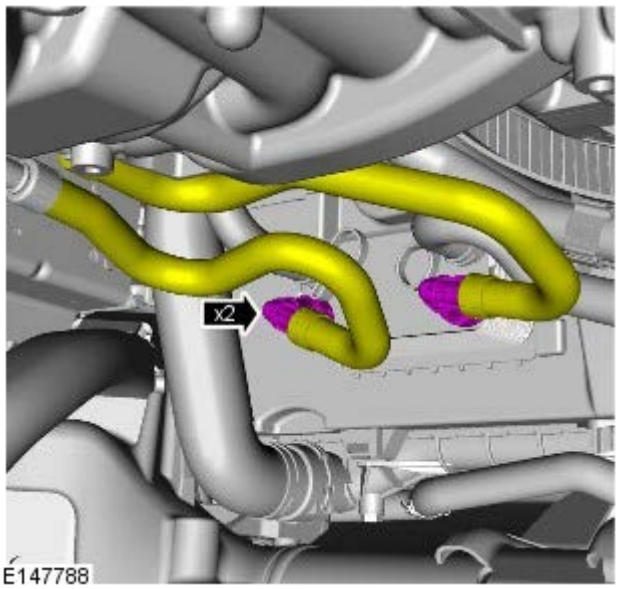
NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

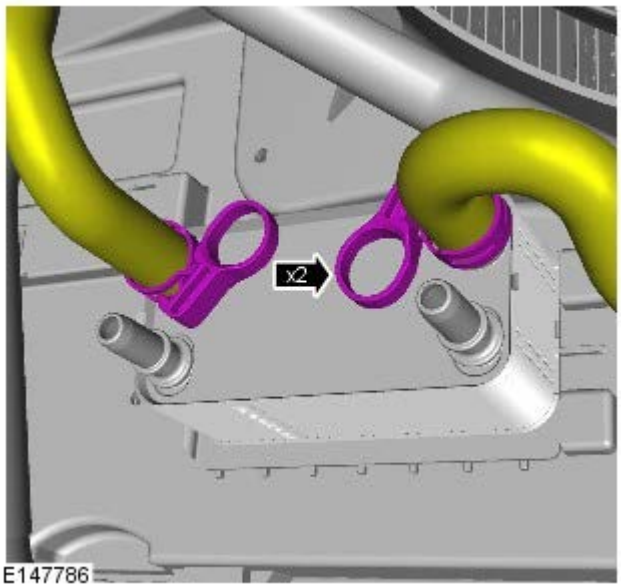
   Raise and support the vehicle.

2. Refer to: Cooling System Partial Draining, Filling and Bleeding - V8 5.0L Petrol (303-03C, General Procedures).
   Refer to: Cooling System Partial Draining, Filling and Bleeding - V8 S/C 5.0L Petrol (303-03, General Procedures).

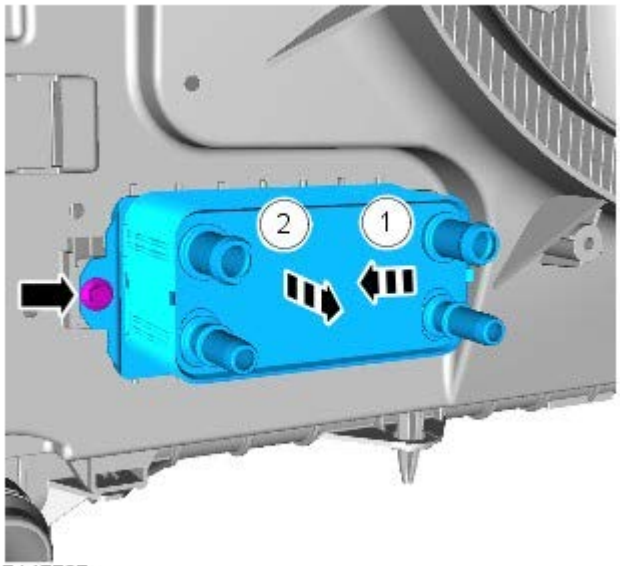
3.



4.



5. *Torque:* 7 Nm



E147787

Installation

1. To install reverse the removal procedure.
2. Refer to: Transmission Fluid Level Check - V8 5.0L Petrol/V8 S/C 5.0L Petrol (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, General Procedures).

Published: 02-Aug-2012

Transmission / Transaxle Cooling - Vehicles With: 8HP70 8-Speed - Hybrid Electric Vehicle - Automatic Transmission – AWD - Transmission Fluid Cooler Tubes TDV6 3.0L Diesel

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.

Some components shown removed for clarity.

1. Disconnect the battery ground cable.

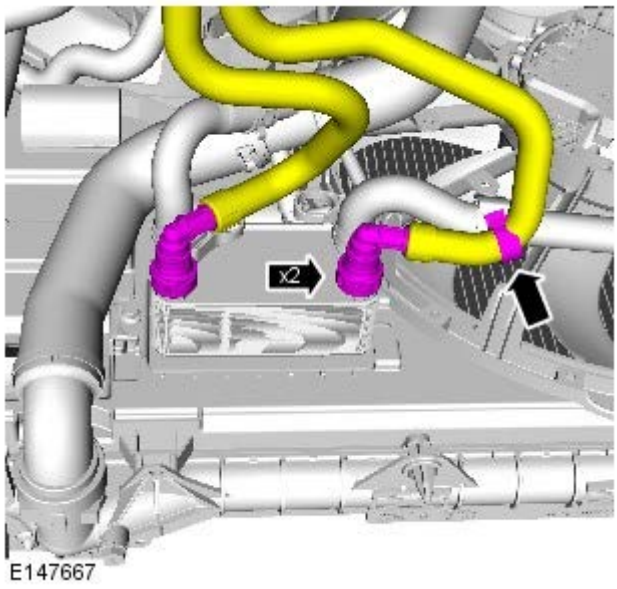
   Refer to: Specifications (414-00, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Refer to: Engine Undershield (501-02, Removal and Installation).

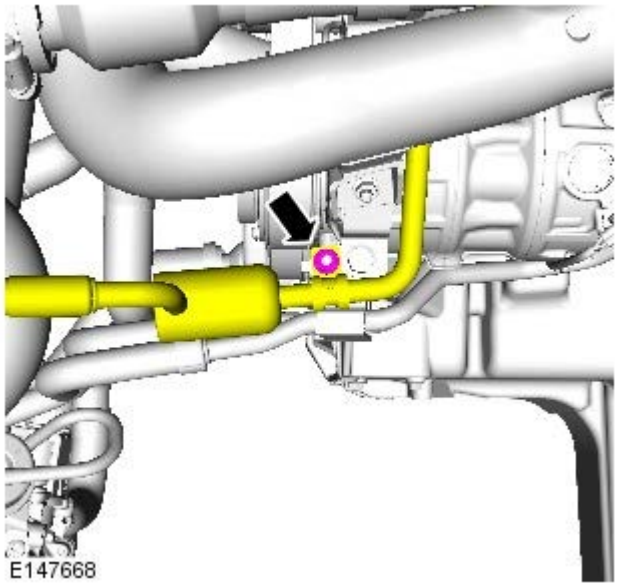
4. Refer to: Front Driveshaft - TDV6 3.0L Diesel (205-01, Removal and Installation).



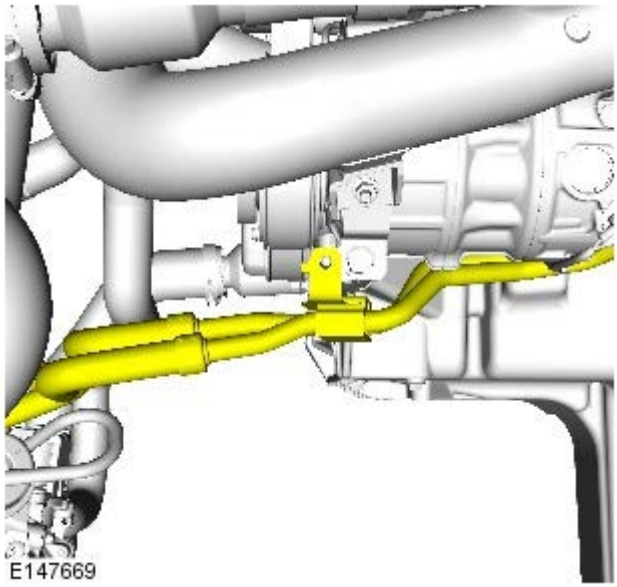
5. WARNING: Be prepared to collect escaping fluids.

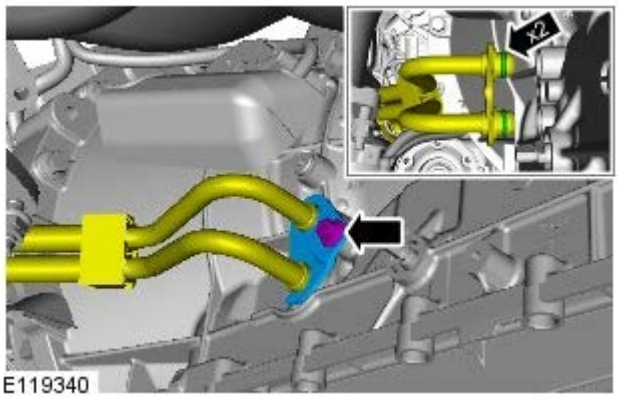
   CAUTION: Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean and dry. Plug open connections to prevent contamination.

6. *Torque:* 9 Nm



7.





8. CAUTIONS:

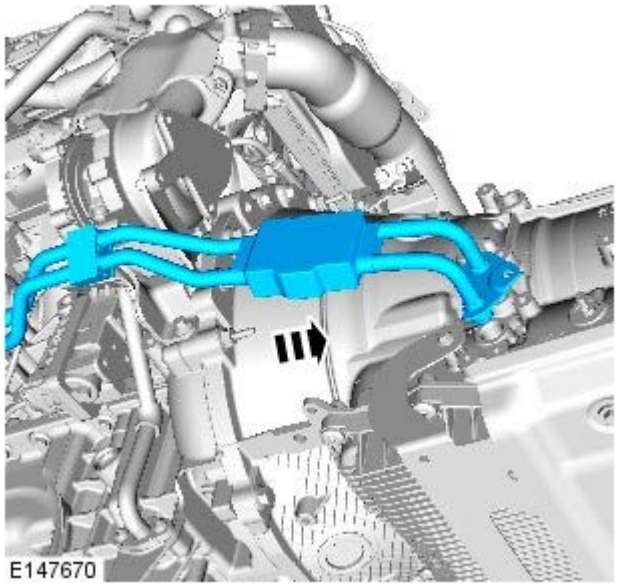
Be prepared to collect escaping fluids.

Make sure that all openings are sealed. Use new blanking caps.

Remove and discard the O-ring seals.

Torque: 25 Nm

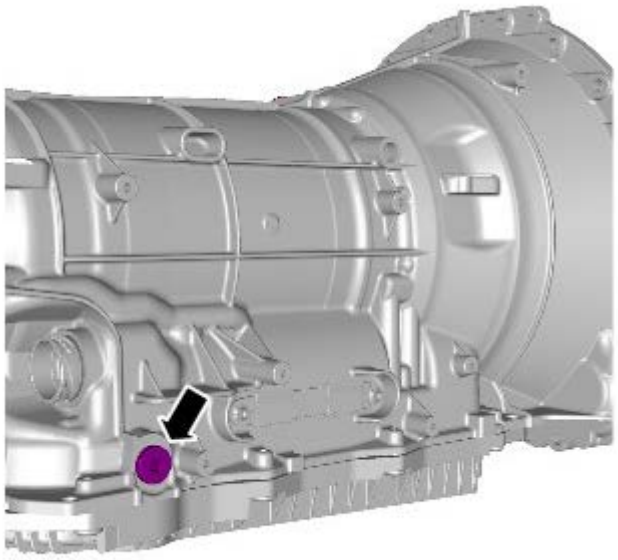
9.


E147670

Installation

1. To install, reverse the removal procedure.

2.
   - Check and top-up the transmission fluid level.
   - *Torque:* 35 Nm


E131143

Published: 02-Aug-2012

Transmission / Transaxle Cooling - Vehicles With: 8HP70 8-Speed - Hybrid Electric Vehicle - Automatic Transmission – AWD - Transmission Fluid Cooler Tubes TDV8 4.4L Diesel

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.

Some components shown removed for clarity.

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

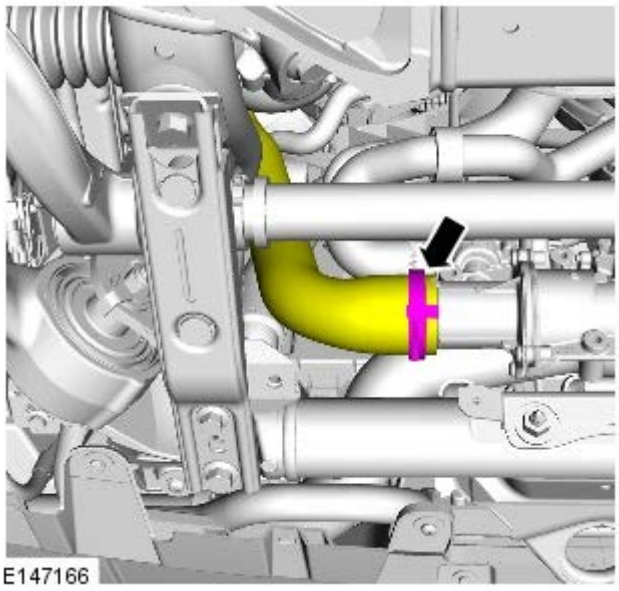
2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

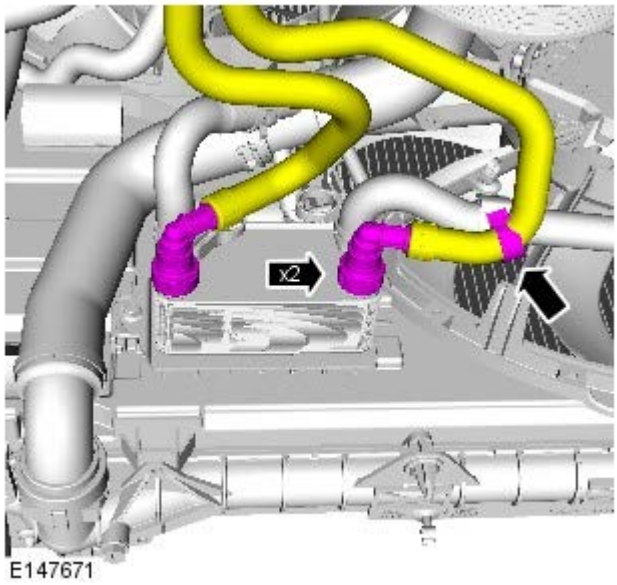
4. Refer to: Front Driveshaft - TDV8 4.4L Diesel (205-01 Driveshaft, Removal and Installation).

5. *Torque:* 3.5 Nm

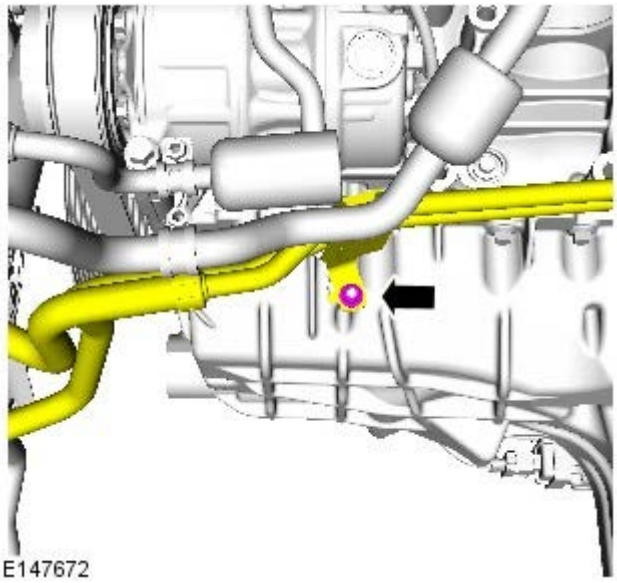


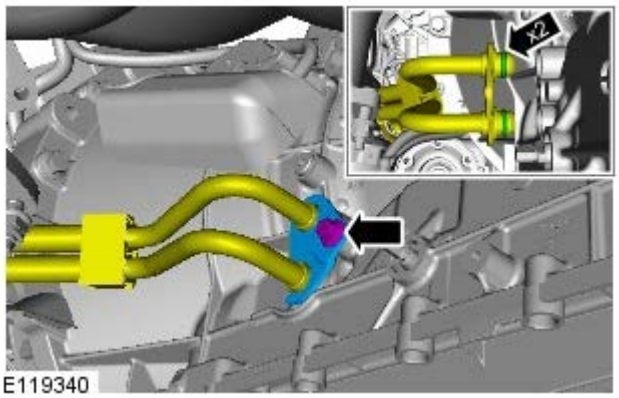
6. WARNING: Be prepared to collect escaping fluids.

   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.



7. *Torque:* 9 Nm





8. CAUTIONS:

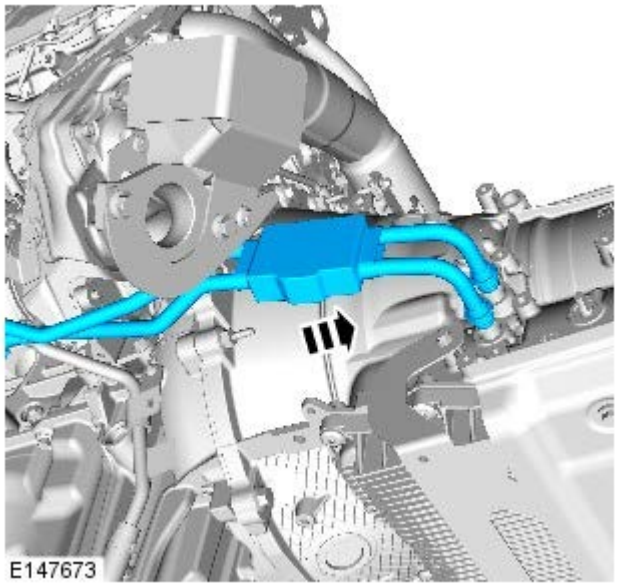
   Be prepared to collect escaping fluids.

   Make sure that all openings are sealed. Use new blanking caps.

   Remove and discard the O-ring seals.

   Torque: 25 Nm

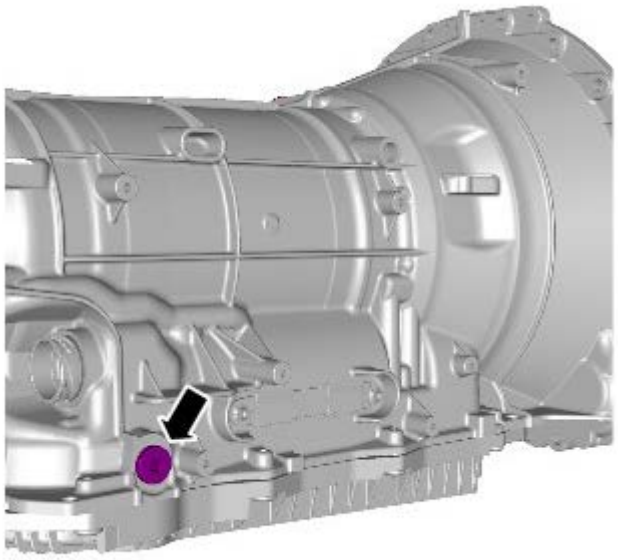
9.


E147673

Installation

1. To install, reverse the removal procedure.

2.
   - Check and top-up the transmission fluid level.
   - *Torque:* 35 Nm


E131143

Published: 02-Aug-2012

Transmission / Transaxle Cooling - Vehicles With: 8HP70 8-Speed - Hybrid Electric Vehicle - Automatic Transmission – AWD - Transmission Fluid Cooler Tubes V8 5.0L Petrol / V8 S/C 5.0L Petrol

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.

Some components shown removed for clarity.

1. Disconnect the battery ground cable.

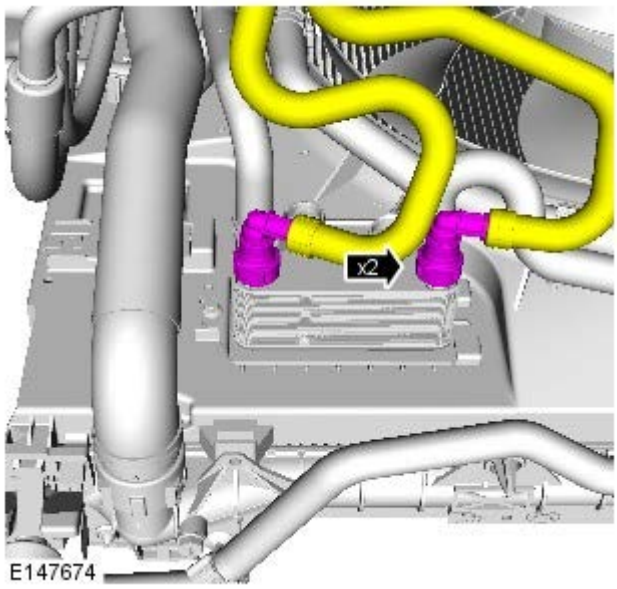
   Refer to: Specifications (414-00, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Refer to: Engine Undershield (501-02, Removal and Installation).

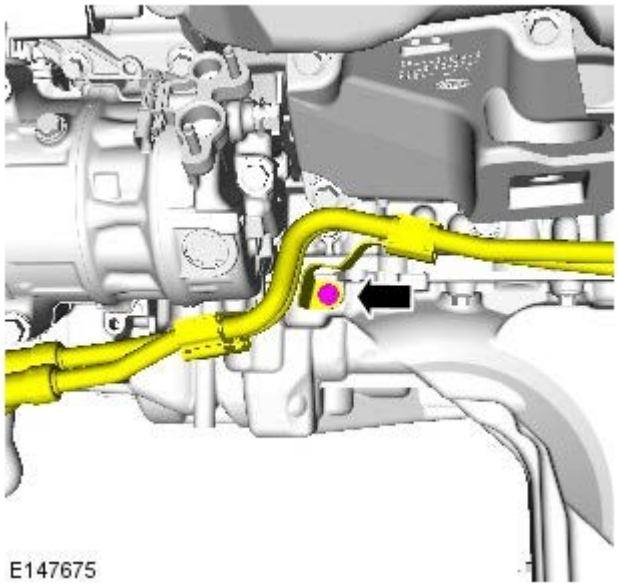
4. Refer to: Front Driveshaft - V8 5.0L Petrol/V8 S/C 5.0L Petrol (205-01, Removal and Installation).

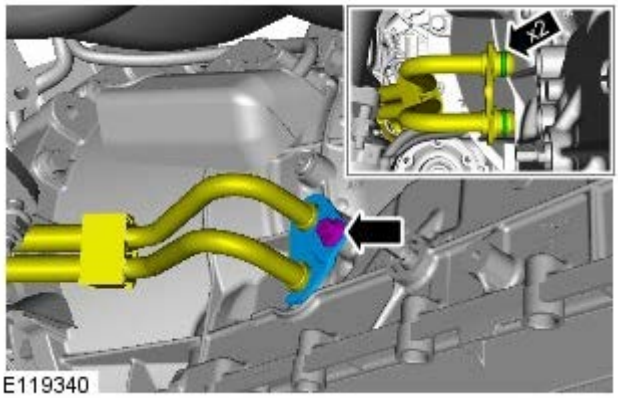


5. WARNING: Be prepared to collect escaping fluids.

   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:* 9 Nm





7. CAUTIONS:

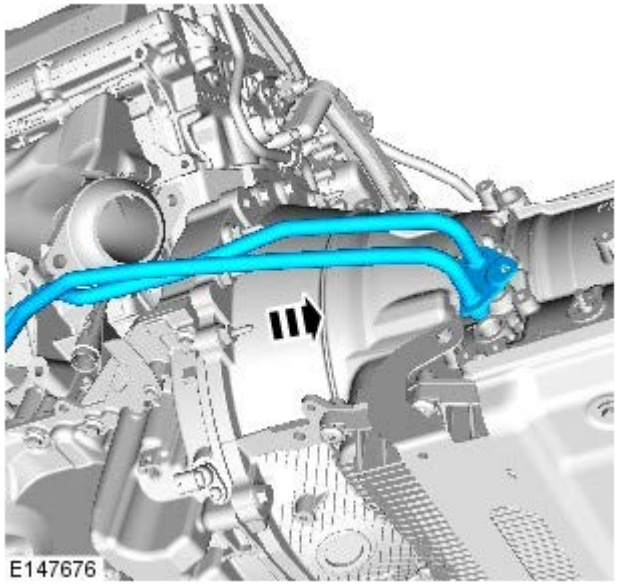
   Be prepared to collect escaping fluids.

   Make sure that all openings are sealed. Use new blanking caps.

   Remove and discard the O-ring seals.

   Torque: 25 Nm

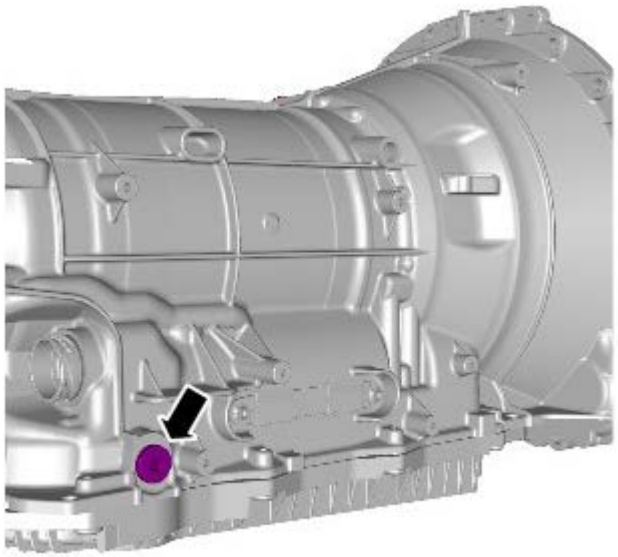
8.



Installation

1. To install, reverse the removal procedure.

2.
   - Check and top-up the transmission fluid level.
   - *Torque:* 35 Nm



E131143

Published: 06-Sep-2013

Transmission / Transaxle Cooling - Vehicles With: 8HP70 8-Speed - Hybrid Electric Vehicle - Automatic Transmission – AWD - Motor Generator Coolant Pump

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

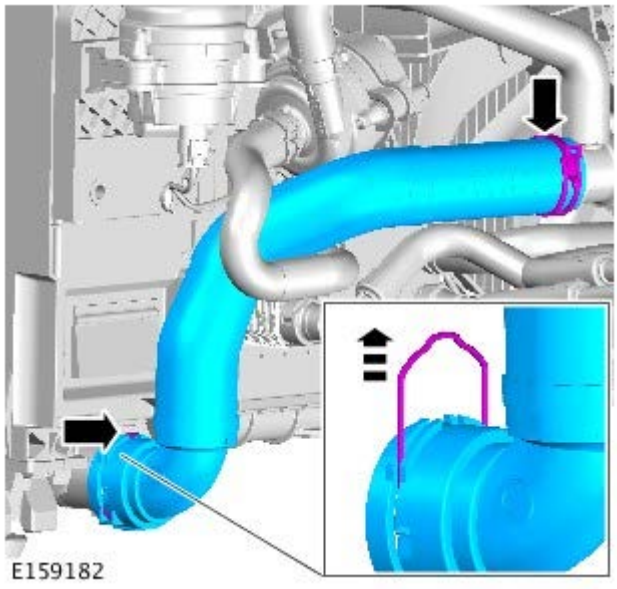
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

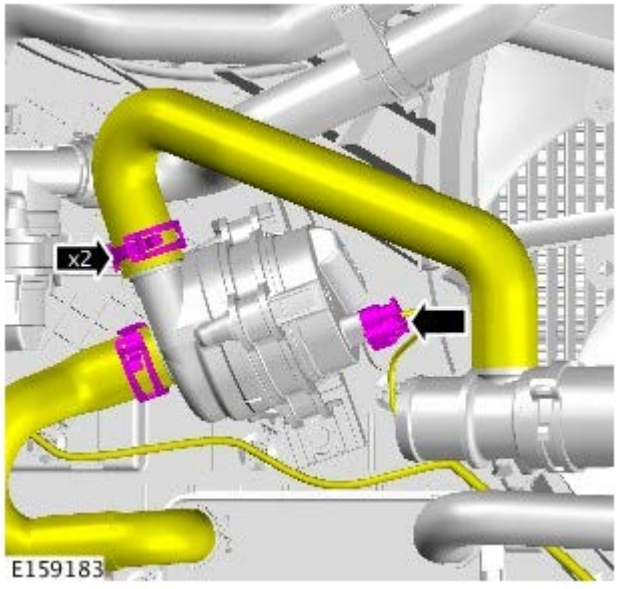
   Raise and support the vehicle.

3. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

4. Refer to: Cooling System Partial Draining, Filling and Bleeding (303-03A Engine Cooling - TDV6 3.0L Diesel, General Procedures).

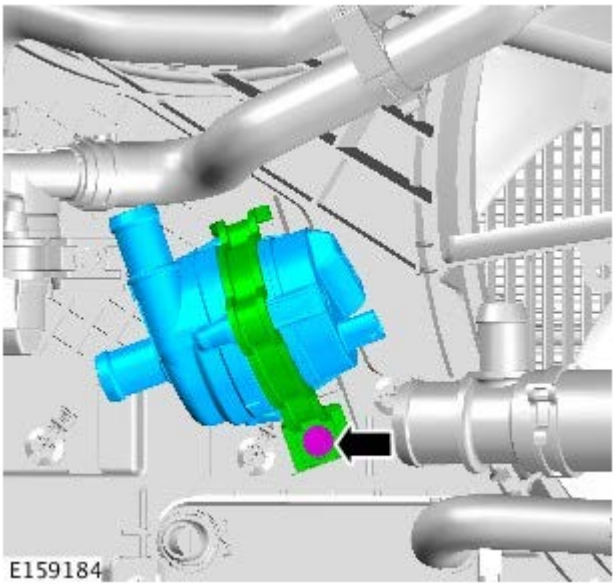


5. CAUTION: Be prepared to collect escaping coolant.



6. CAUTION: Be prepared to collect escaping coolant.

7. *Torque:* 6 Nm



Installation

1. To install, reverse the removal procedure.

Published: 15-Oct-2012

Automatic Transmission / Transaxle External Controls - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD -

Torque Specifications

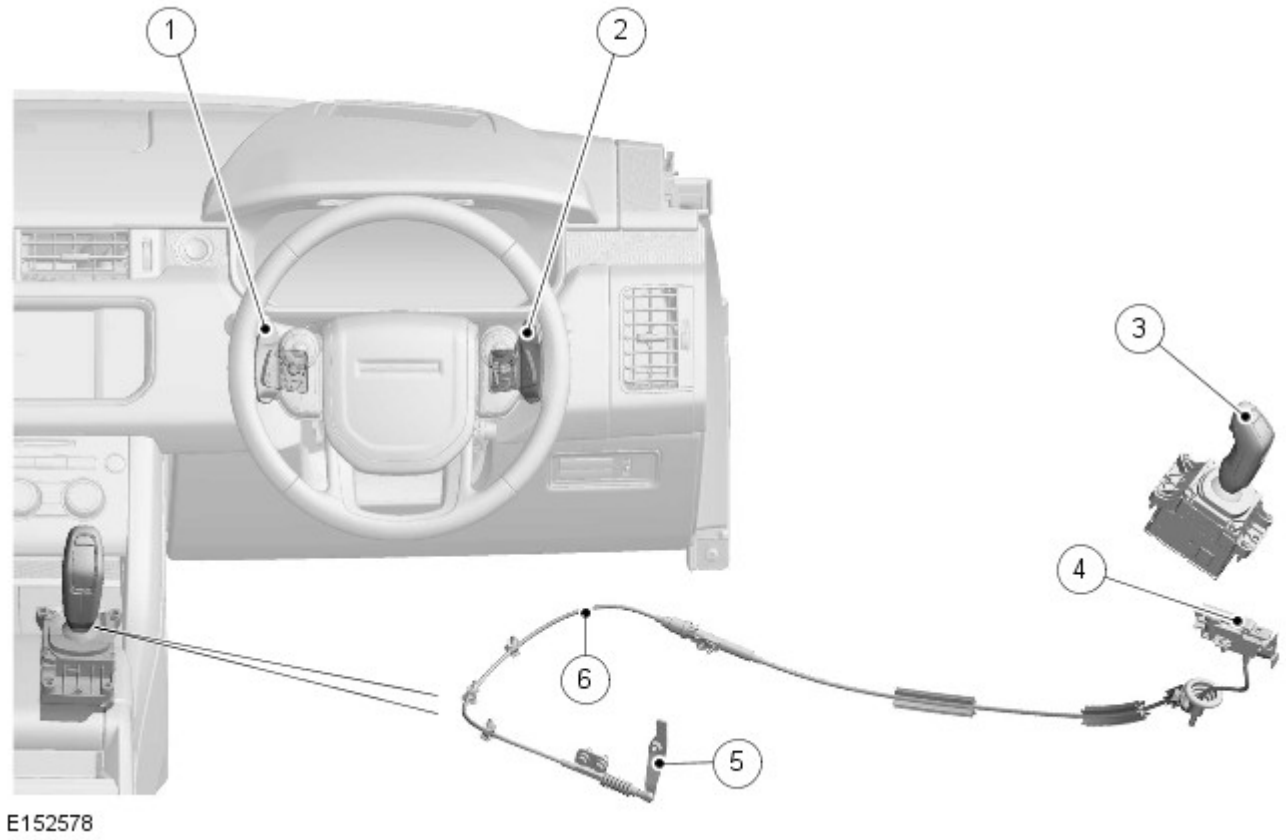
Description	Nm	lb-ft	lb-in
Emergency park position release lever cable bracket to floor console bolt	3	-	27

Published: 24-Oct-2013

Automatic Transmission / Transaxle External Controls - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - External Controls

Description and Operation

TRANSMISSION EXTERNAL CONTROLS COMPONENT LOCATION



E152578

Item	Part Number	Description
1	-	Downshift paddle switch
2	-	Upshift paddle switch
3	-	Transmission Control Switch (TCS)
4	-	Emergency Park Release (EPR) lever
5	-	Emergency park lock transmission lever
6	-	Cable

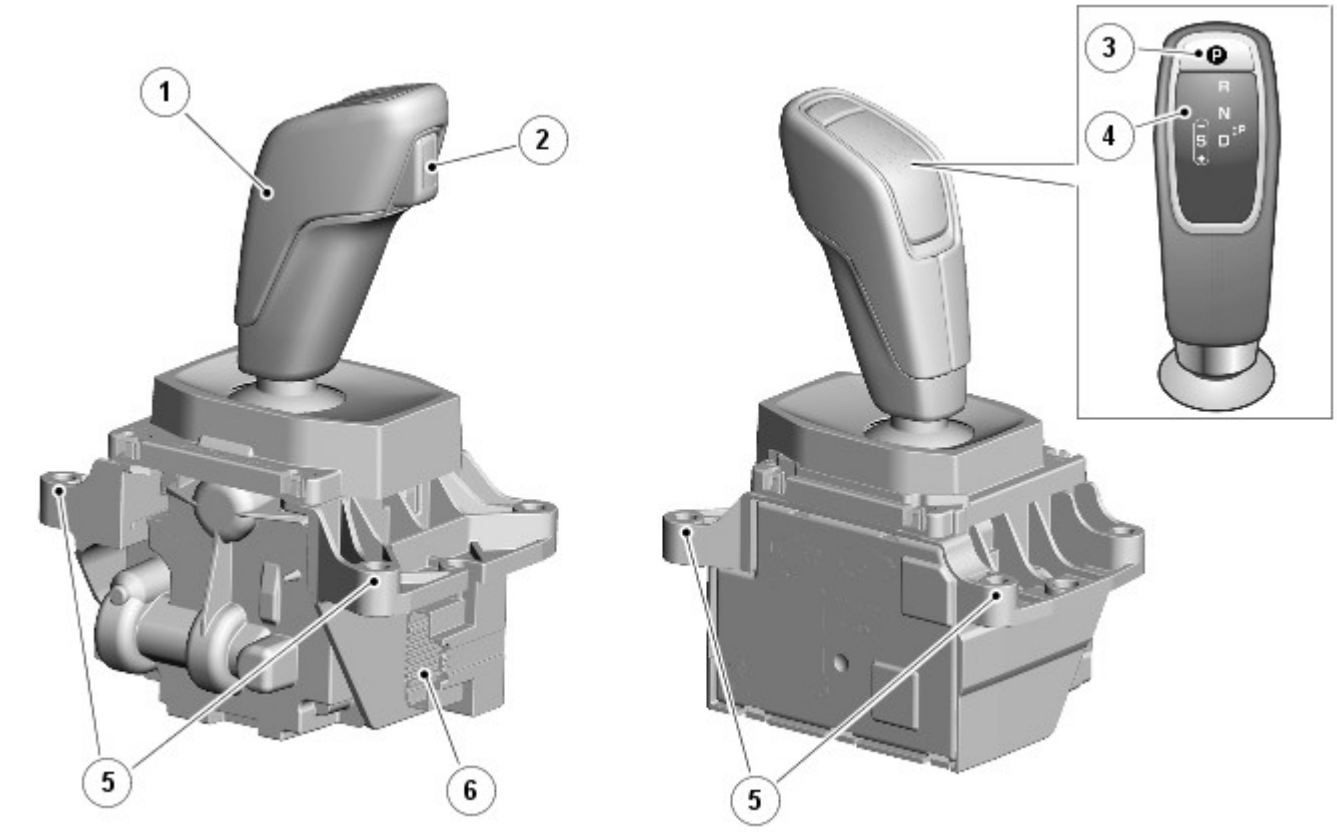
OVERVIEW

The external controls for the transmission consist of a TCS (transmission control switch), two paddle switches and an Emergency Park Release (EPR).

The linear TCS transmits driver transmission selections to the TCM (transmission control module) on the high speed CAN (controller area network) powertrain bus. The steering wheel mounted paddle switches can be used to initiate gear changes, with the TCS in either the D or S position, causing a change of operating mode from automatic gear selection to manual gear selection.

The EPR cable ensures the transmission park lock remains disengaged during vehicle recovery operations.

DESCRIPTION



E153113

Item	Part Number	Description
1	-	Lever
2	-	Unlock trigger
3	-	Park 'P' switch
4	-	LED display
5	-	Mounting holes
6	-	Electrical connector

The TCS is 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, R, N, D on the TCS. Shifting with the TCS allows the selection of P, R, N and D. The TCS is fully electronic stick transmission selector with no mechanical connection to the transmission.

Movement of the TCS to any of the four positions or operation of the 'Park' switch is sensed by the TCS. The sensed position is passed to the TCM via the high speed CAN powertrain bus. The TCM then reacts according to the new selection request made by the driver. The linear movement of the TCS is sensed by a magnetic system using multiple Hall effect sensors to determine the position of the selector. The TCS (P) park and the unlock trigger use double pole pill switches

The S (sport) position selection allows the TCM to operate the transmission using the semi-automatic sequential shift. Gear selections are sensed by the TCM when the driver operates the steering wheel paddle switches or moves the TCS to the '+' or '-' positions. The TCS allows the driver to operate the transmission similar to a sequential transmission. Once the TCS position is confirmed, the TCM outputs appropriate information on the high speed CAN powertrain bus which is received by the instrument cluster to display the gear selection information in the message center.

UNLOCK TRIGGER

The TCS unlock trigger must be pressed to select any gear, including (N) neutral, from the (P) park position.

The unlock trigger must also be pressed to select any driving gear from the (R) reverse, (N) neutral or (D) drive positions. Pressing the unlock trigger is not required to select (P) park.

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.

The paddles can also be used on a temporary basis when the TCS is in the 'D' (drive) position to override the automatic gear selection if required.

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 EPR mechanism in order to prevent vehicle roll-away.

If the vehicle requires recovery/transportation, the EPR mechanism is used to manually disengage the park lock and engage the transmission in neutral. The EPR 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 trim panel in the base of the drinks holder. To access the lever, the trim panel must be removed. The park interlock lever is attached to the transmission selector shaft via a Bowden cable.

OPERATION

Shifting of the TCS selector to any of the five positions is sensed by the TCM via thehigh speed CAN powertrain bus. The TCM then reacts according to the selected position.

The TCS 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 TCS position is confirmed, the TCM outputs appropriate information on the high speed CAN powertrain bus which is received by the IC (Instrument Cluster) to display the gear selection information in the message center. The paddles can also be used on a temporary basis when the TCS is in the D (Drive) position to override the automatic gear selection if required.

PARK INTERLOCK AND NEUTRAL LOCK

Neutral lock is a requirement for the TCS. 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 (park) or N (neutral). If, when driving with the TCS in S, D or R (reverse) at a speed of more than 5 km/h (3 mph), the driver selects P or N: Without the brake pedal pressed, the TCS will be immediately locked once the vehicle speed falls to below 5 km/h (3 mph).

With the brake pedal pressed, the TCS 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 TCS 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.

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 TCS
- 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 manoeuvring, 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 TCS and the brake pedal is not pressed.

Intermediate Position

If the TCS is shifted 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 TCS is shifted 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 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 powertrain bus signal to the TCM.

Pulling the left downshift - paddle provides down changes and pulling the right 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 TCS back to the D position, returns the transmission to conventional automatic operation. Temporary operation of Commandshift mode can also be operated with the TCS in the D position. Operation of either the upshift or downshift paddles activates the manual mode operation. If the TCS 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 EPR 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: Open the cubby box lid and the drinks holder lid. Remove the trim panel from between the drinks holder and the cubby box. Rotate the locking mechanism of the EPR 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 EPR 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 trim panel. Close the cubby box lid and the drinks holder lid.

Published: 11-May-2011

Automatic Transmission/Transaxle External Controls - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - 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. REFER to: External Controls (307-05A Automatic Transmission/Transaxle External Controls - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, 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.

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 damaged or worn components • Loose or missing fasteners	• Fuse(s) • Loose or corroded electrical connector(s)

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, 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 Index: Transmission Control Switch (100-00 General Information, Description and Operation).

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.

Published: 19-Sep-2012

Automatic Transmission / Transaxle External Controls - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - Emergency Park Position Release Lever

Removal and Installation

Removal

NOTES:

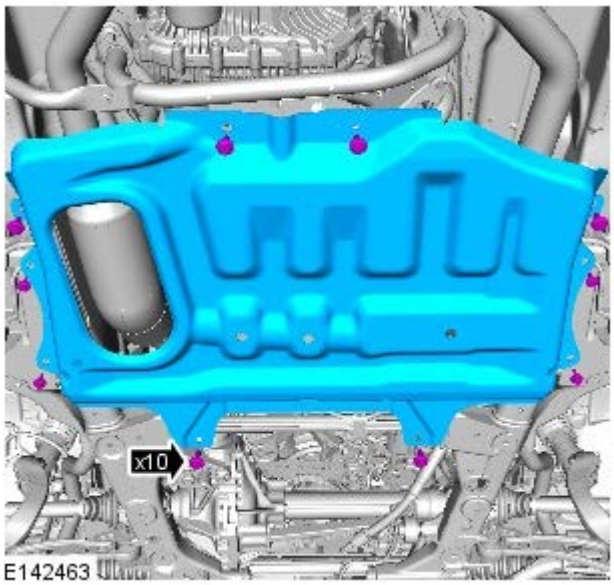
Removal steps in this procedure may contain installation details.

Some variation in the illustrations may occur, but the essential information is always correct.

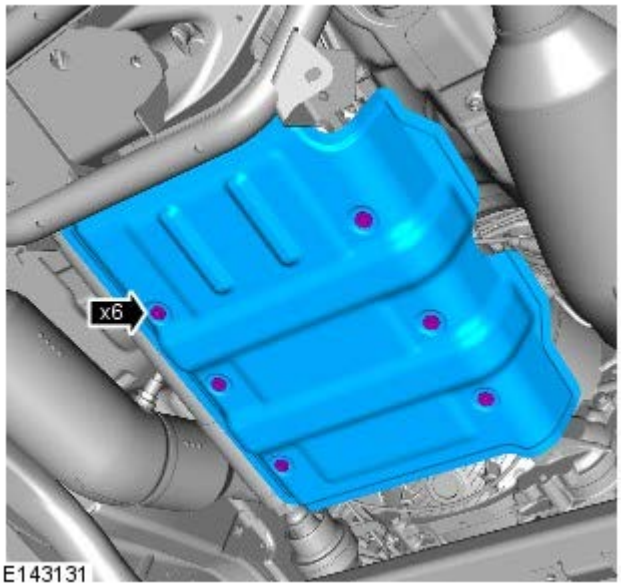
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

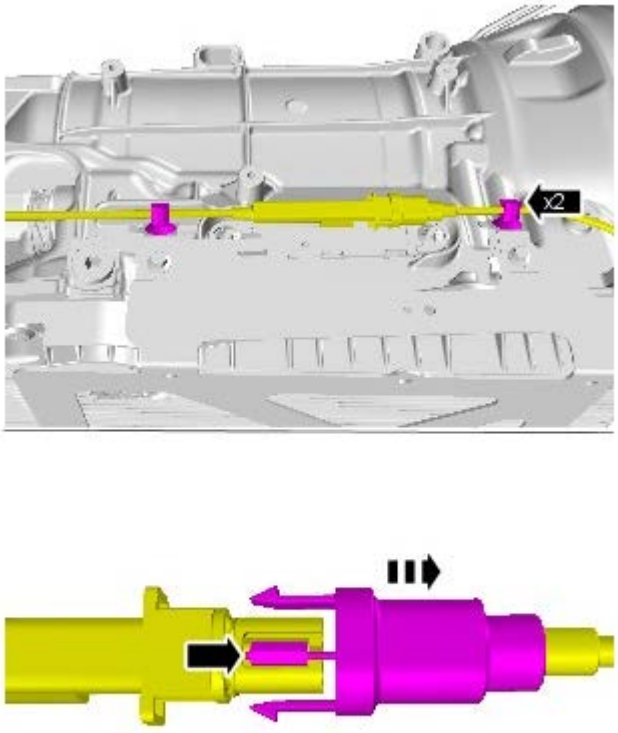


3. *Torque:*
   M10 60 Nm
   M6 10 Nm



4. *Torque:* 10 Nm

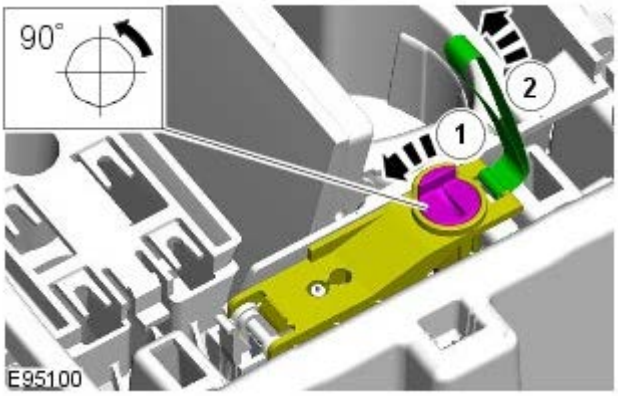
5. CAUTION: Care must be taken to avoid damaging the surrounding components.



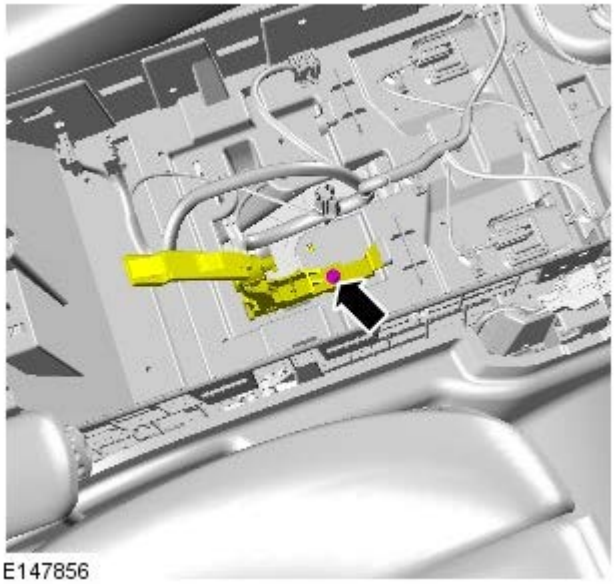
E148741

6. Refer to: Floor Console Upper Section (501-12 Instrument Panel and Console, Removal and Installation).

7.

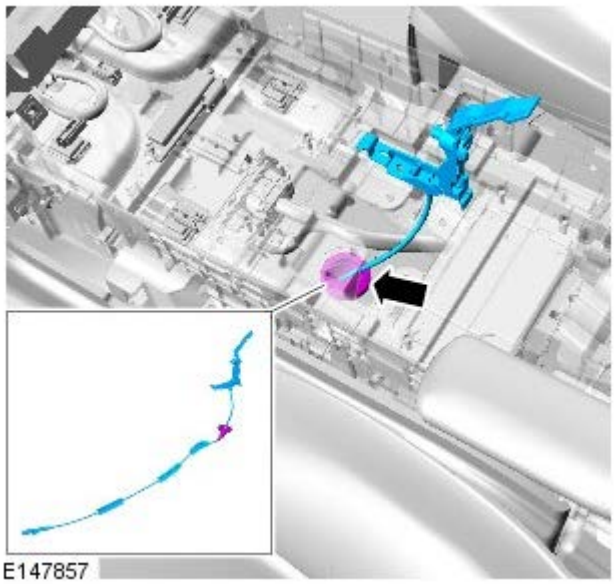


8. *Torque:* 3 Nm



E147856

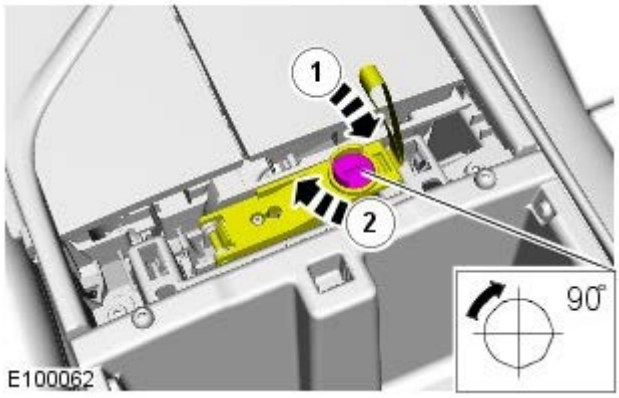
9.



Installation

NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. To install, reverse the removal procedure.



Published: 02-May-2013

Automatic Transmission / Transaxle External Controls - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - Transmission Control Switch (TCS)

Removal and Installation

Removal

NOTES:

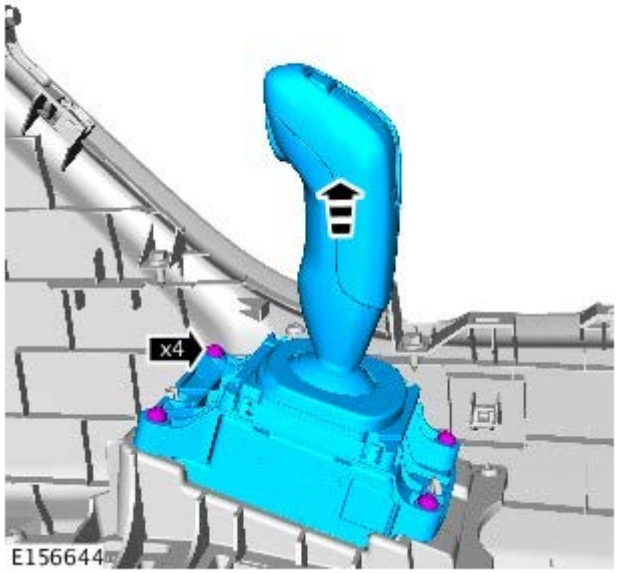
Removal steps in this procedure may contain installation details.

Some components shown removed for clarity.

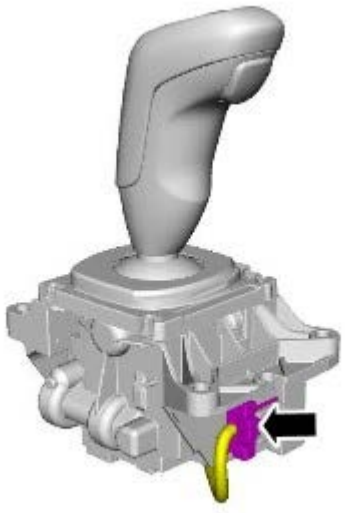
Some variation in the illustrations may occur, but the essential information is always correct.

1. Refer to: Floor Console Upper Section (501-12 Instrument Panel and Console, Removal and Installation).

2.



3.



Installation

1. To install reverse the removal procedure.

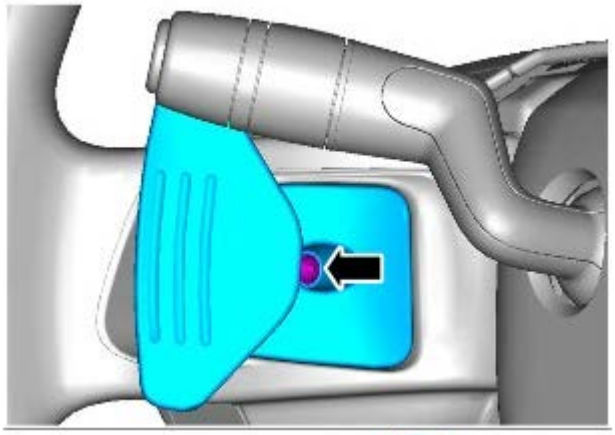
Published: 12-Sep-2012

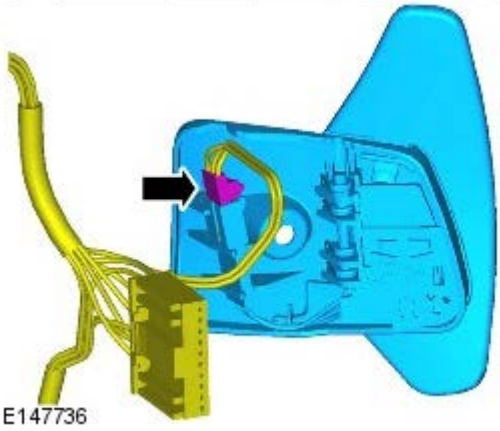
Automatic Transmission / Transaxle External Controls - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - Upshift Paddle Switch

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.





1. NOTE: Make sure that the harness is routed to the position noted on removal.

   Torque: 3 Nm

Installation

1. To install, reverse the removal procedure.

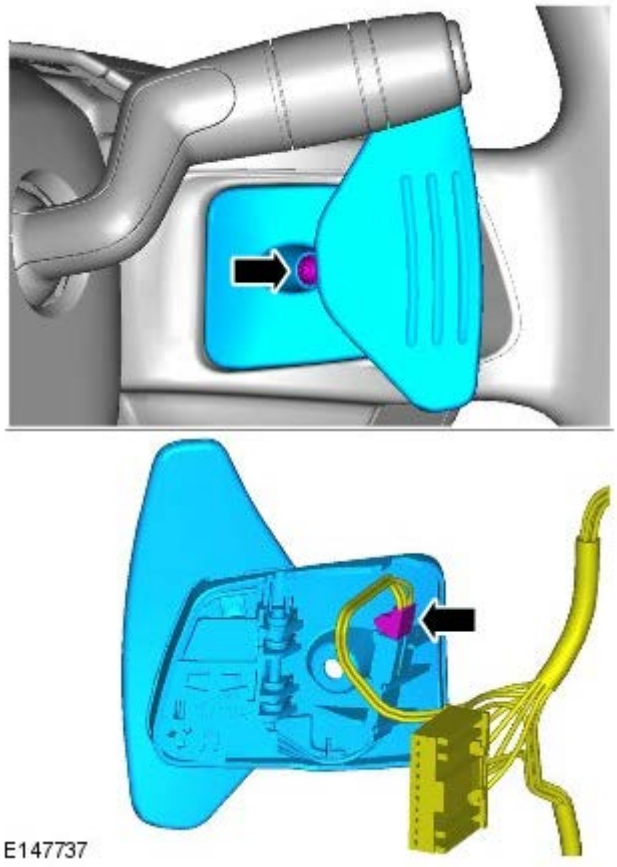
Published: 12-Sep-2012

Automatic Transmission / Transaxle External Controls - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - Downshift Paddle Switch

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.



1. NOTE: Make sure that the harness is routed to the position noted on removal.

   Torque: 3 Nm

Installation

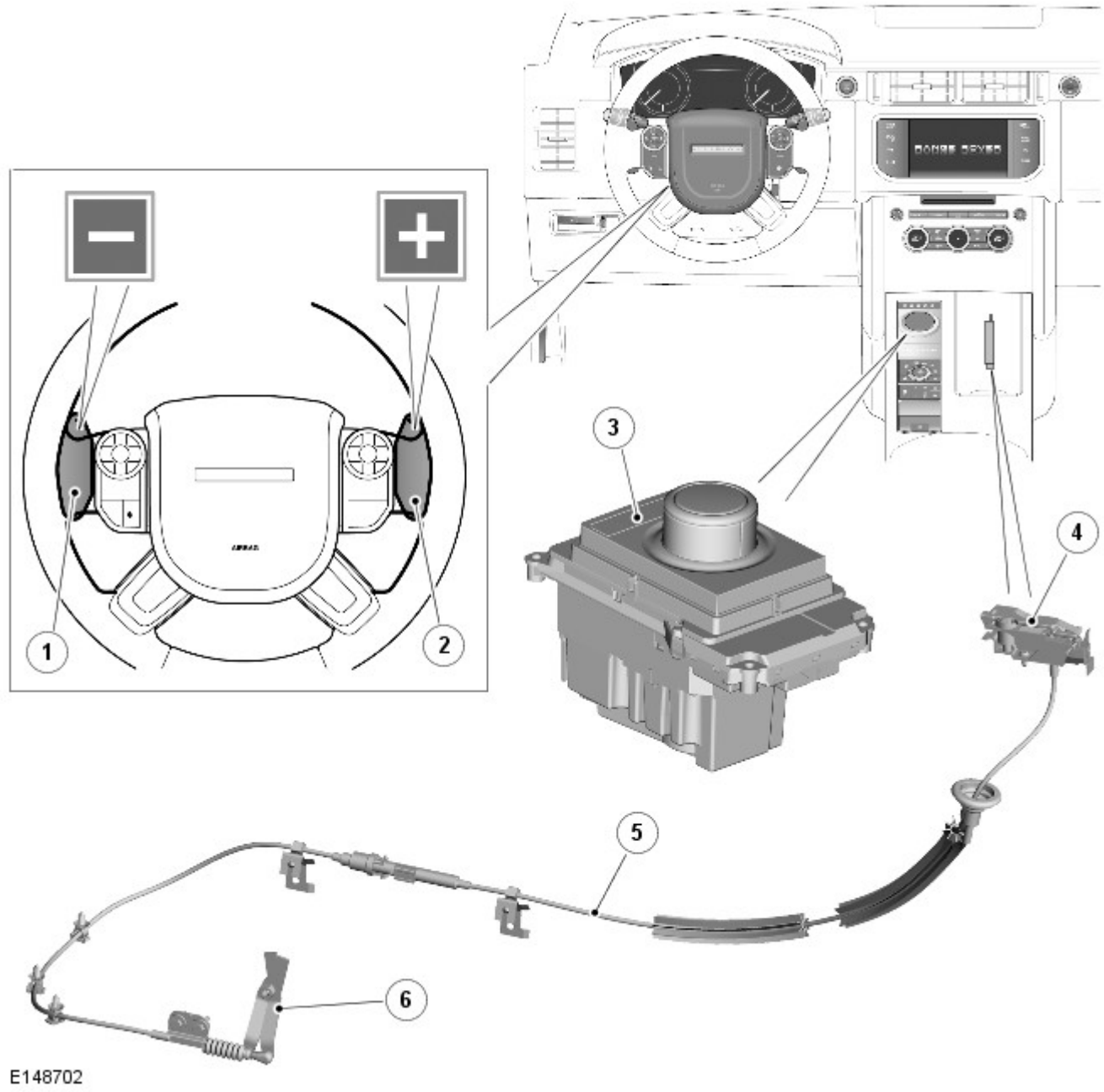
1. To install, reverse the removal procedure.

Published: 02-Aug-2013

Automatic Transmission / Transaxle External Controls - Vehicles With: 8HP70 8-Speed - Hybrid Electric Vehicle - Automatic Transmission – AWD - External Controls

Description and Operation

COMPONENT LOCATION



Item	Part Number	Description
1	-	Downshift paddle switch
2	-	Upshift paddle switch
3	-	Transmission Control Switch (TCS)
4	-	Emergency park release lever
5	-	Emergency park release cable
6	-	Park interlock transmission lever

OVERVIEW

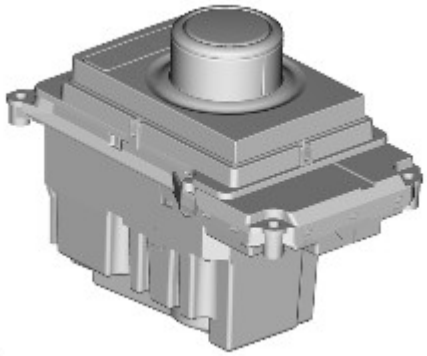
The transmission external controls comprise a Transmission Control Switch (TCS), two steering wheel mounted paddle switches and an emergency park release lever and cable. The TCS transmits driver transmission selections to the TCM (transmission control module). The paddle switches allow the driver to initiate gear shifts in all transmission modes; 'D' drive, 'S' sport and 'S' manual CommandShift.

The emergency park release cable ensures the transmission park lock remains disengaged during vehicle recovery

operations.

DESCRIPTION

Transmission Control Switch (TCS)



E148705

The Transmission Control Switch (TCS) is a rotary switch installed in the floor console and controls the driver transmission selections.

Rotation of the TCS to any of the five positions is sensed by the TCM via the high speed CAN (controller area network) bus. A LIN (local interconnect network) bus connection is also provided, but is only used in the event of a CAN bus failure as a back-up. The TCM then reacts according to the selected position. The TCS is a magnetic system using Hall effect sensors to determine the position of the switch.

The TCM allows the transmission to be operated as a conventional automatic unit by selecting P, R, N, D on the TCS. Rotation of the TCS allows the selection of P, R, N and D. By depressing the TCS and rotating clockwise from the D position, S mode can be selected. The TCS is fully electronic rotary transmission selector with no mechanical connection to the transmission.

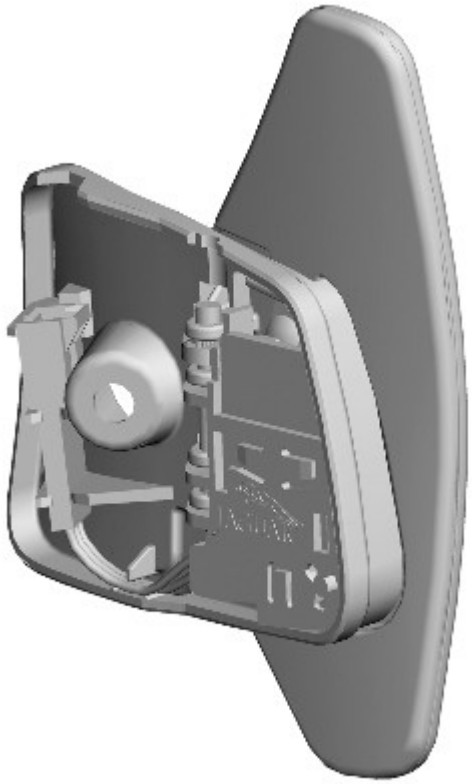
The TCS rises once the engine is running. When the engine is stopped with the TCS in any position other than N, it retracts into the console again. If the TCS is in position N when the engine is stopped, it remains in the raised position for up to 10 minutes, for use in a drive through car wash for example. After 10 minutes the TCS automatically retracts. The TCS also retracts if P is selected within the 10 minute period. If the TCS does not rise from the console when the engine is started, but electrical power is supplied to the TCS, the retracted TCS can still be rotated to make selections.

If electrical power to the TCS is lost, the TCS will not rise from the console when the engine is started and the retracted selector will not rotate. The TCS 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 TCS in any position. Once the engine is stopped the TCS will automatically reset to the P position and the transmission park lock will be engaged, except if the selector is moved to the 'N' position when the engine is stopped.

The S (sport) position selection allows the TCM to operate the transmission using the semi-automatic CommandShift mode. Gear selections are sensed by the TCM when the driver operates the steering wheel paddle switches. Once the TCS 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 TCS is in the D (drive) position to override the automatic gear selection if required.

Paddle Switches

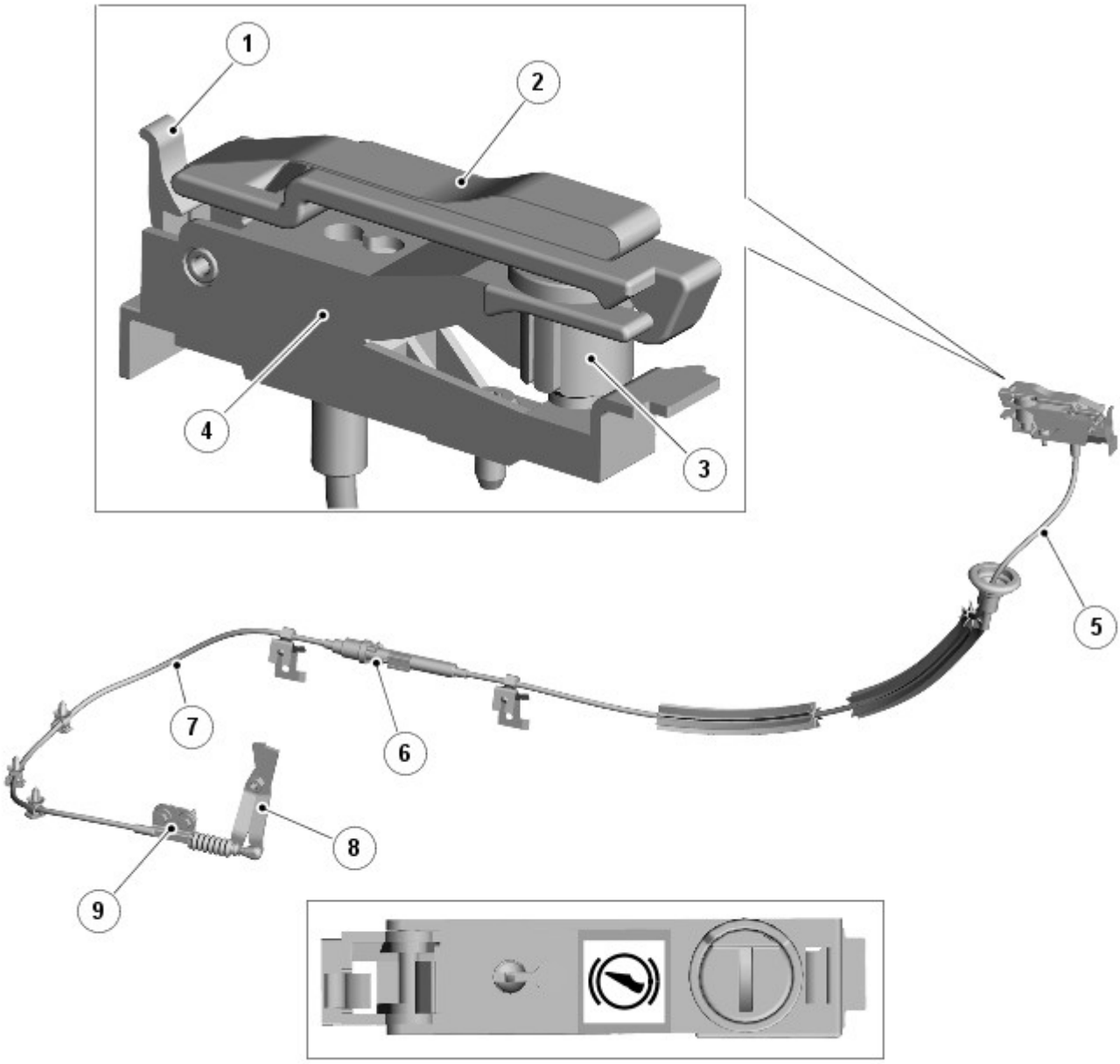


E115235

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.

Emergency Park Release

NOTE: Left Hand Drive (LHD) shown, Right Hand Drive (RHD) similar



E148703

Item	Part Number	Description
1	-	Latch
2	-	Strap
3	-	Locking cylinder
4	-	Operating lever
5	-	Upper cable
6	-	Cable joint
7	-	Lower cable
8	-	Cable bracket
9	-	Park interlock lever

If the vehicle requires recovery/transportation, the emergency park release mechanism is used to manually disengage the transmission park lock and engage 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 trim panel in the base of the drinks holder. To access the lever, the trim panel must be removed. The park interlock lever is attached to the transmission selector shaft via a Bowden cable.

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 to the neutral position.

To disengage the park lock:

- Slide open the drinks compartment lid in the floor console.
- Remove the trim from the base of the drinks compartment.
- Rotate the locking cylinder 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 cylinder 90 degrees clockwise.
- Install the trim panel in the base of the drinks compartment.
- Close the drinks compartment lid.

OPERATION

Rotation of the TCS to any of the five positions is sensed by the TCM via the high speed CAN bus. A LIN bus connection is also provided, but is only used in the event of a CAN bus failure as a back-up. The TCM then reacts according to the selected position.

The TCS 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 TCS 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 TCS is in the D (drive) position to override the automatic gear selection if required.

PARK INTERLOCK AND NEUTRAL LOCK

Neutral lock is a requirement for the TCS. The TCS is always locked at ignition on when the engine is not running, except after an engine stall when the selector is not in P (park) or N (neutral). If, when driving with the TCS in S, D or R (reverse) at a speed of more than 5 km/h (3 mph), the driver selects P or N, without the brake pedal pressed, the TCS will be immediately locked once the vehicle speed falls to below 5 km/h (3 mph).

With the brake pedal pressed, the TCS 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 TCS will be locked 2 seconds after N is selected. The TCS 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.

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 TCS
- 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 manoeuvring, 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 TCS and the brake pedal is not pressed.

Intermediate Position

If the TCS 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 TCS. If the brake pedal is released when R or D is flashing in the message center and the TCS 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.

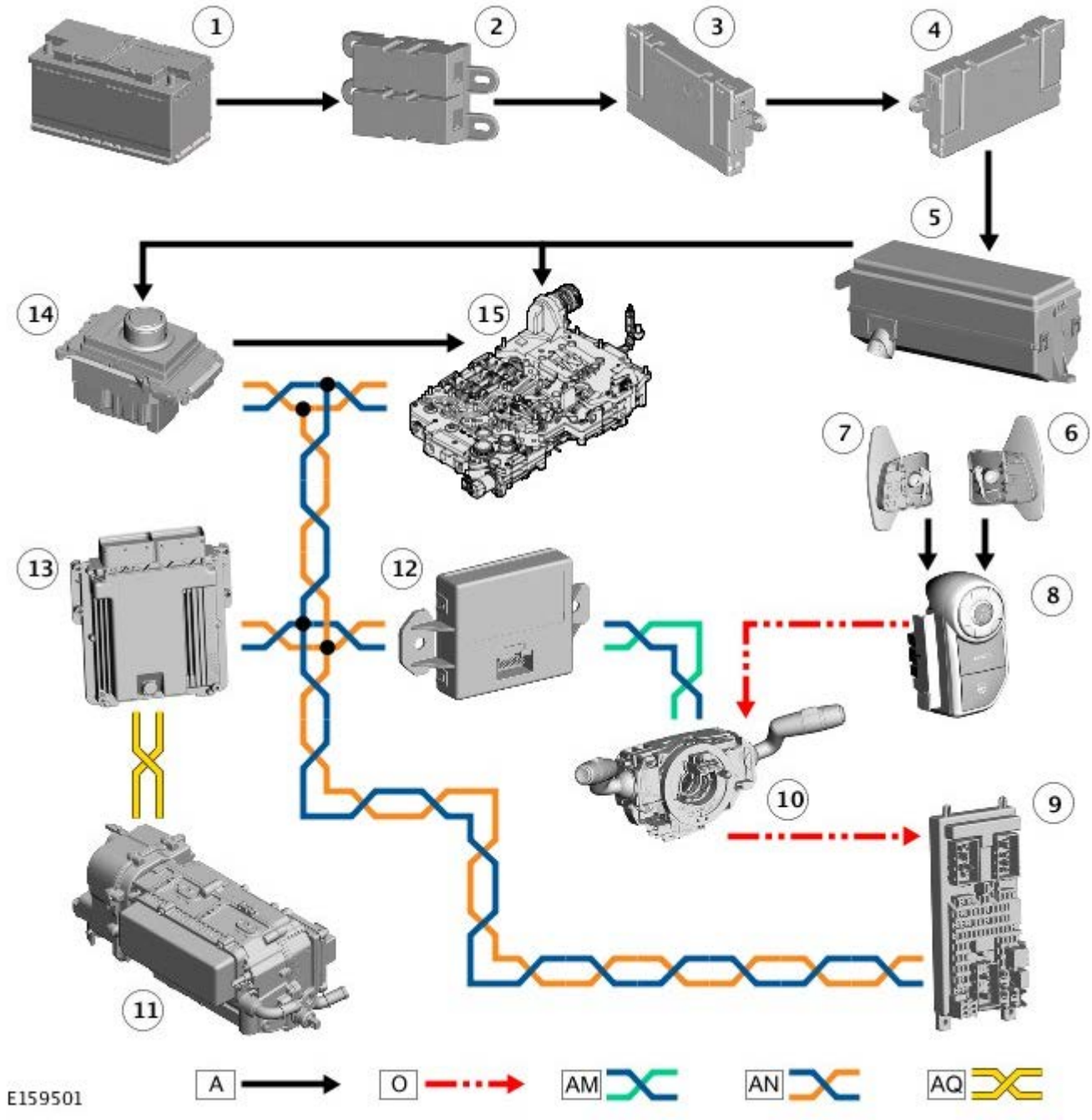
PADDLE SWITCHES

The paddle switches are hardwired to the steering wheel audio switches. Operation of the paddle switch completes a ground path to the audio switch assembly. The right steering wheel switchpack converts the completed ground signal into a LIN bus signal which is passed via the clockspring to the Central Junction Box (CJB). The CJB converts the signal into a high speed CAN bus signal to the TCM.

Pulling the left downshift (-) paddle provides down changes and pulling the right upshift (+) paddle provides up changes. The first operation of either paddle, after sport mode is selected, puts the transmission into permanent manual Commandshift mode. Rotation of the TCS back to the D position, returns the transmission to conventional automatic operation. Temporary operation of Commandshift mode can also be operated with the TCS in the D position. Operation of either the upshift or downshift paddles activates the manual mode operation. If the TCS is in D, Commandshift will cancel after a time period or can be cancelled by pressing and holding the + paddle for approximately 2 seconds.

CONTROL DIAGRAM

NOTE: **A** = Hardwired; **O** = Local Interconnect Network (LIN); **AM** = High speed CAN Chassis systems; **AN** = High speed CAN Powertrain systems; **AQ** = High speed CAN Hybrid systems



Item	Part Number	Description
1	-	Primary battery
2	-	Battery Junction Box 2 (BJB2)
3	-	Battery Junction Box (BJB)
4	-	Auxiliary Junction Box (AJB)
5	-	Engine Junction Box (EJB)
6	-	Right paddle switch - upshift
7	-	Left paddle switch - downshift
8	-	Right steering wheel switchpack
9	-	Central Junction Box (CJB)
10	-	Clockspring
11	-	Electrical Power Inverter Converter (EPIC)
12	-	Gateway Module (GWM)
13	-	Engine Control Module (ECM)
14	-	Transmission Control Switch (TCS)
15	-	Transmission Control Module (TCM)

Published: 16-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 bolts	35	26
* Transfer case clutch control solenoid bolts	5	4
* High/Low range position sensor bolts	5	4
Transmission undershield M10 bolts	60	44
Transmission undershield M6 bolts	10	7
Transmission support crossmember M12 bolts	110	81
Transmission support crossmember M8 bolt	24	17

Published: 17-Oct-2013

Four-Wheel Drive Systems - High/Low Range Sensor

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

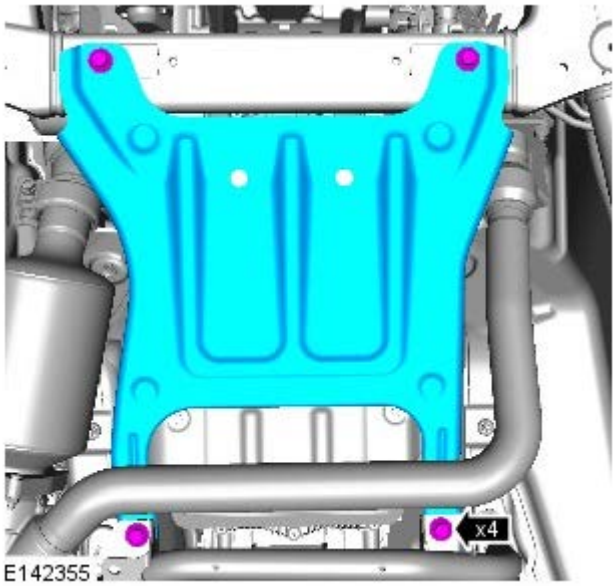
All vehicles

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

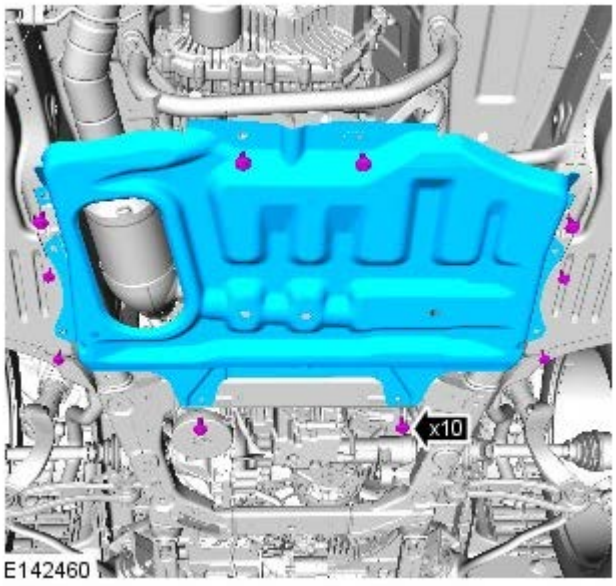
Vehicles with 4.4L diesel engine

2. *Torque:* 60 Nm



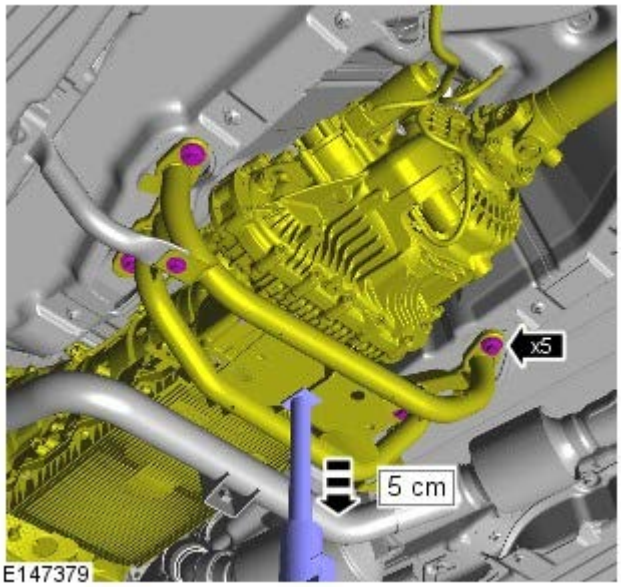
All other engine types

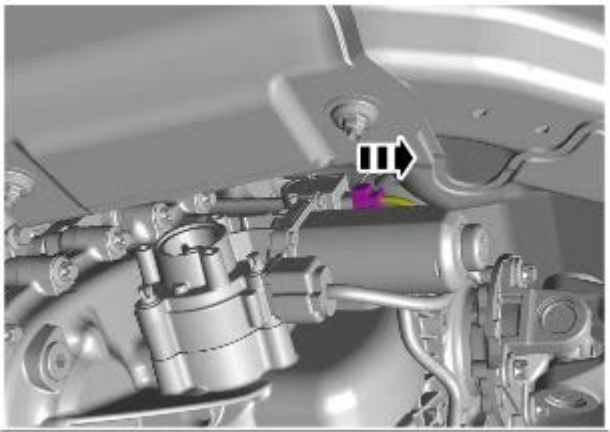
3. *Torque:*
   M10 60 Nm
   M6 10 Nm

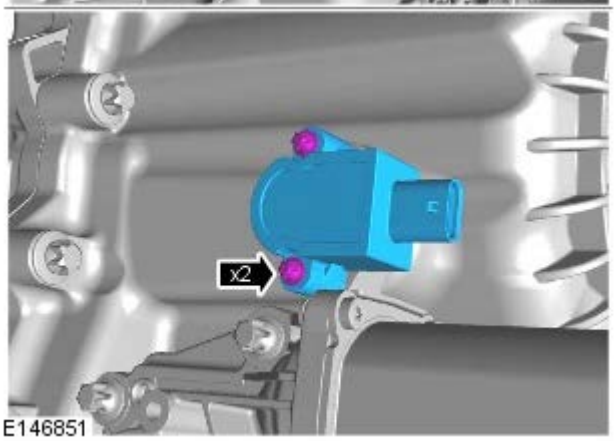


All vehicles

4. WARNING: Secure the component to the transmission jack.







5. CAUTION: Make sure that new bolts are installed.

   NOTE: The transmission is lowered for access.

   Torque: 5 Nm

Installation

1. NOTE: Lubricate the new O ring seal with transmission fluid.

   To install, reverse the removal procedure.

2.
   1. Connect the Land Rover approved diagnostic equipment.
   2. Start the service function "transfer case-absolute position sensor replacement".
   3. 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 (308-07 Transfer Case - Vehicles With: Twin Speed Transfer Case, General Procedures).



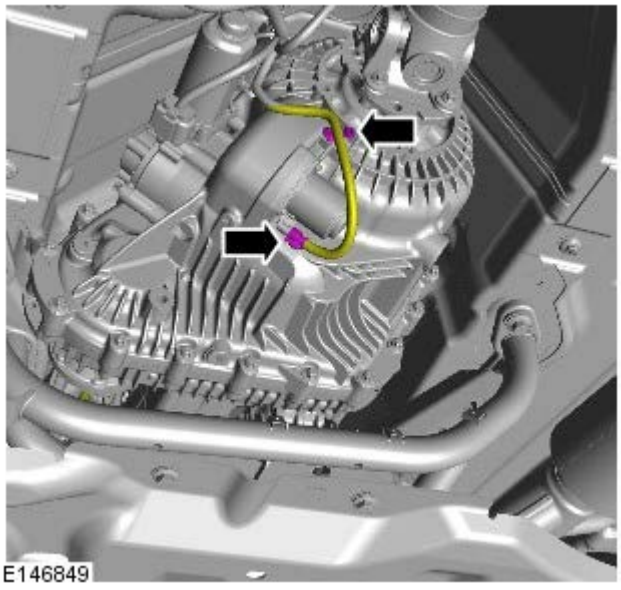
3. CAUTION: Connect the diagnostic tool, prior to removal of the solenoid. Carry out the diagnostic service function **transfer case – solenoid replacement**.

   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.

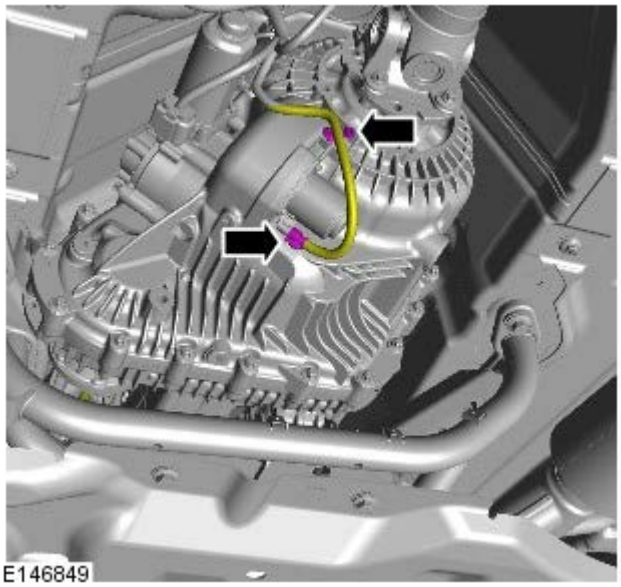
   Make sure that the component sits flush to the transfer case.

   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 (308-07 Transfer Case - Vehicles With: Twin Speed Transfer Case, General Procedures).

4. Using the approved diagnostic equipment, clear all diagnostic trouble code(s) (DTCs) and check for correct operation.

Published: 17-Oct-2013

Four-Wheel Drive Systems - Transfer Case Shift Motor

Removal and Installation

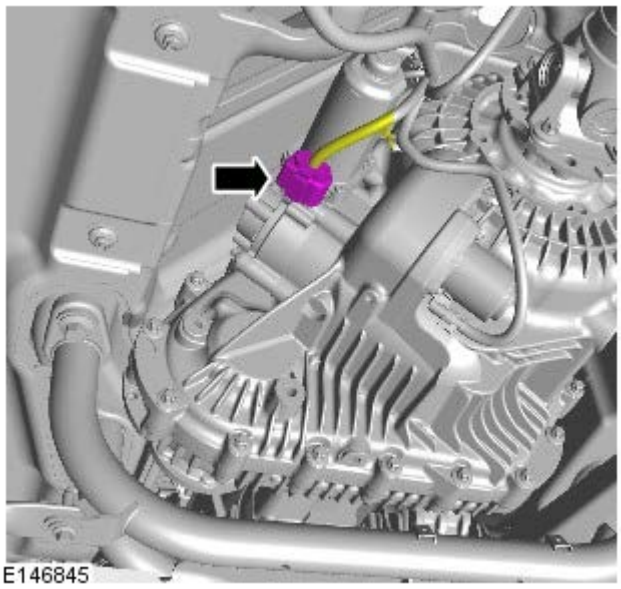
Removal

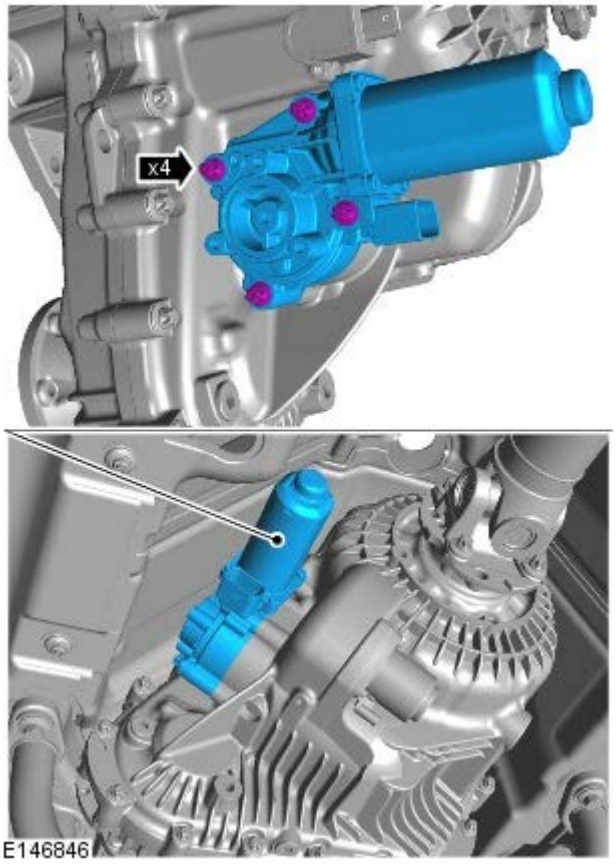
NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2.





3. CAUTION: Make sure that new bolts are installed.

   NOTE: Some fluid spillage is inevitable during this operation.

   Torque: 35 Nm

Installation

1. To install, reverse the removal procedure.

2.

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: 17-Oct-2013

Four-Wheel Drive Systems - Four-Wheel Drive (4WD) Control Module

Removal and Installation

Removal

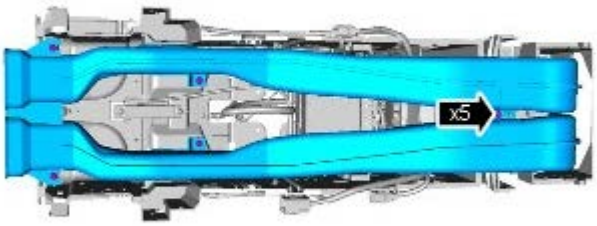
NOTE: Removal steps in this procedure may contain installation details.

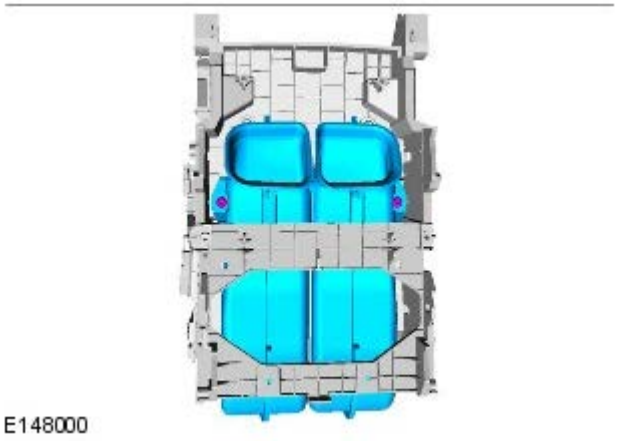
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

2. Refer to: Floor Console (501-12 Instrument Panel and Console, Removal and Installation).

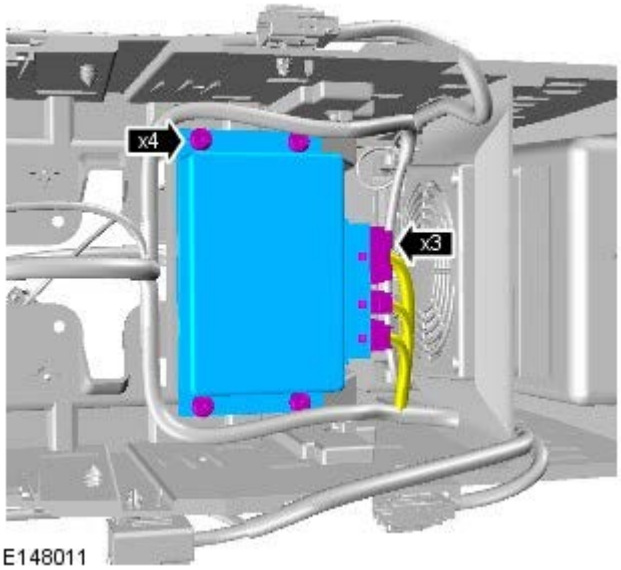
3.





E148000

4.



E148011

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 Diagnostic Trouble Codes (DTCs) after calibration and check for correct operation.

Published: 16-Oct-2013

Transfer Case - Vehicles With: Single Speed Transfer Case -

Sealants and Lubricants

Item	Specification
* Recommended oil	Castrol BOT850
Capacity - Wet and dry fill	0.75 litres, (1.3 pints) (0.8 US quarts)
Input shaft splines grease	Weicon TL7391

CAUTION: * Do not use any lubricant other than that specified

Item	Specification
Model	ITC Torsen
Type	Single speed, permanent four wheel drive transfer box with 42 front / 58 rear (± 20% to either axle, dependant on traction) torque split across the centre differential
Ratio	1:1

Torque Specifications

Description	Nm	lb-ft
Transfer case fluid drain plug	28	21
Transfer case fluid filler/level plug	28	21
Transmission support insulator to transfer case bolts	60	44
Transfer case to transmission bolts	45	33
Transfer case bolts	35	26
Wiring bracket bolts	25	18
Earth strap bolt	25	18
*** Front driveshaft to transfer case output flange:**		
Stage 1	45	33
Stage 2	Further 90°	Further 90°

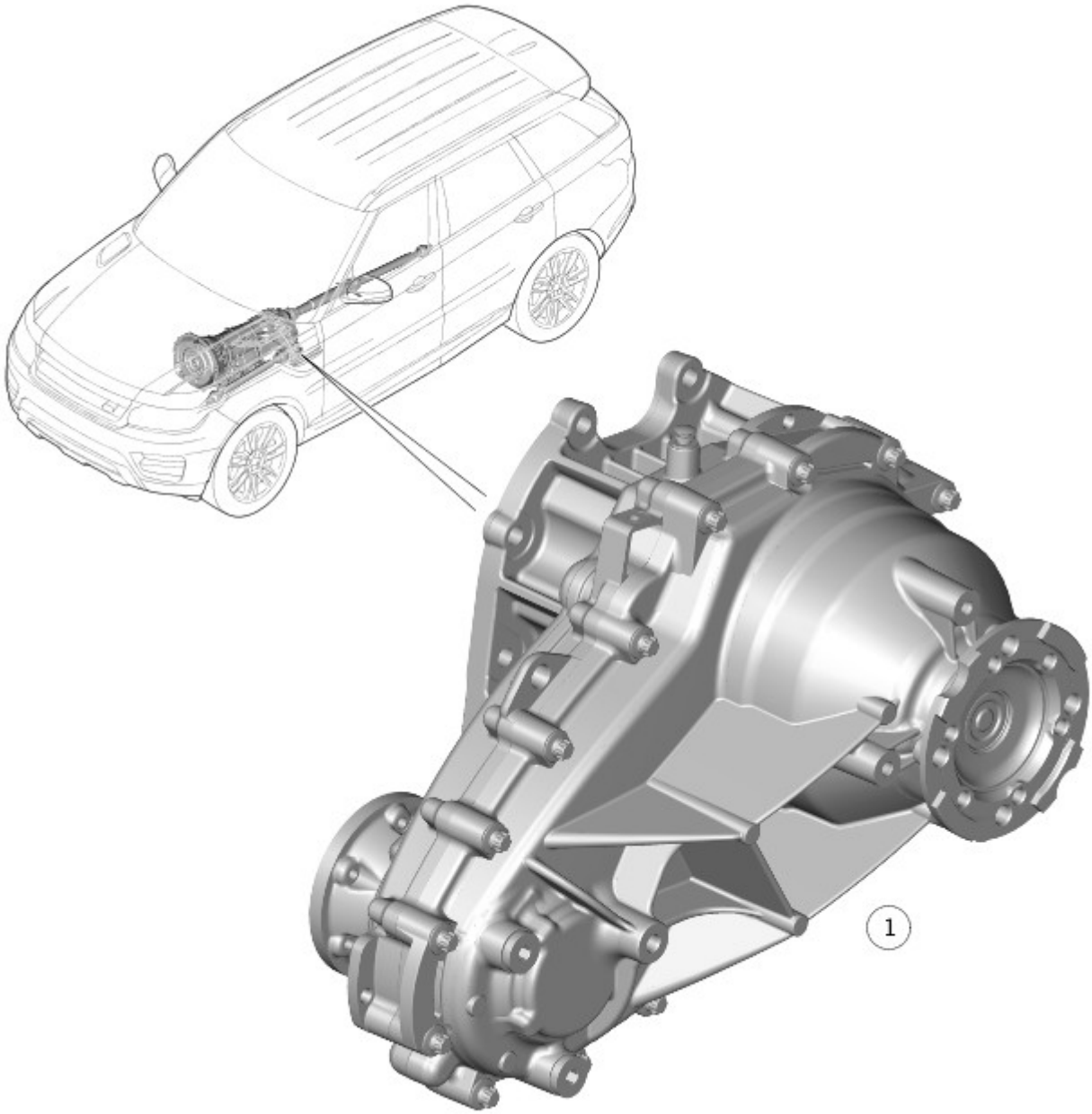
*** New 'patched' Torx bolts must be installed**

Published: 26-Feb-2014

Transfer Case - Vehicles With: Single Speed Transfer Case - Transfer Case

Description and Operation

COMPONENT LOCATION



E164178

Item	Part Number	Description
1	-	Single speed transfer case

OVERVIEW

The new Single speed Transfer Case is standard fitted for V6 Petrol and V6 Diesel engines. (Twin speed Transfer Case is optional.)

The Single speed transfer case is full time, permanent four-wheel-drive unit, with 40/60 torque distribution to the front and rear driveshafts.

Common components with Twin-speed Transfer Case:

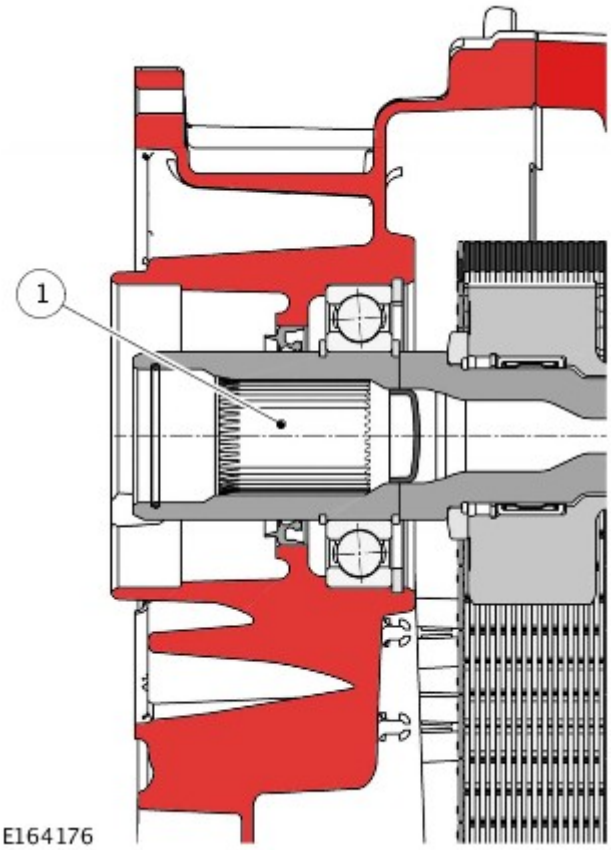
- Front and Rear Flanges
- Main Seals
- Main Bearings
- Fill/Drain Plugs
- Fixings and Torques
- Breather
- Tachograph encoder (optional)

The improvements of the new Single speed Transfer Case are the following:

- Different oil specification - Castrol BOT850 with friction modifier
- Reduced Complexity
- No electronic controls
- Optimized dynamic vehicle behavior

The Single speed TC consists of 25 components, the weight and inertia were reduced for improved economy.

A unique type of grease, Weicon anti-seize montagepaste grau TL 7391, must be applied to the transfer case input shaft spline when installing the transfer case.



Item	Part Number	Description
1	-	Input shaft spline

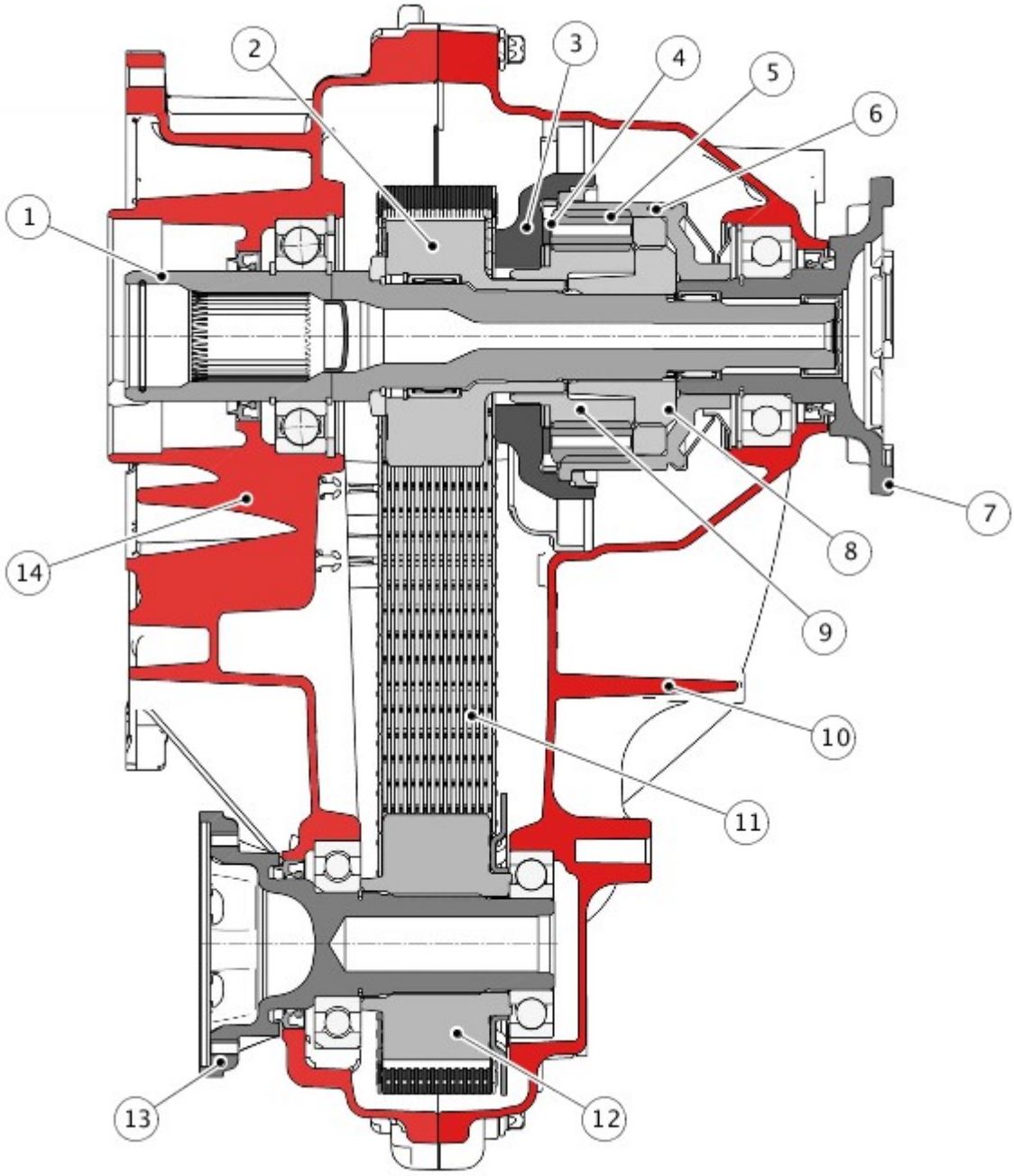
SYSTEM OPERATION

The torque input from the transmission is passed to the transfer case input shaft. The input shaft connected directly to the differential coupling. The differential coupling connects to the housing which splits the torque between the internal gear and the sun gear by the six planetary gears. The internal gear is connected and passes the torque to the rear output flange. The sun gear is connected to the chain drive sprocket and passes the torque to the front output flange via the chain.

The center differential responds to the torque changes at the axles. The basic torque distribution between the front and rear axles is 40/60% at normal drive conditions. If an axle loses traction, the driving torque is redirected instantaneously to the other axle between 65/35% Front/Rear and 20/80% Front/Rear.

DESCRIPTION

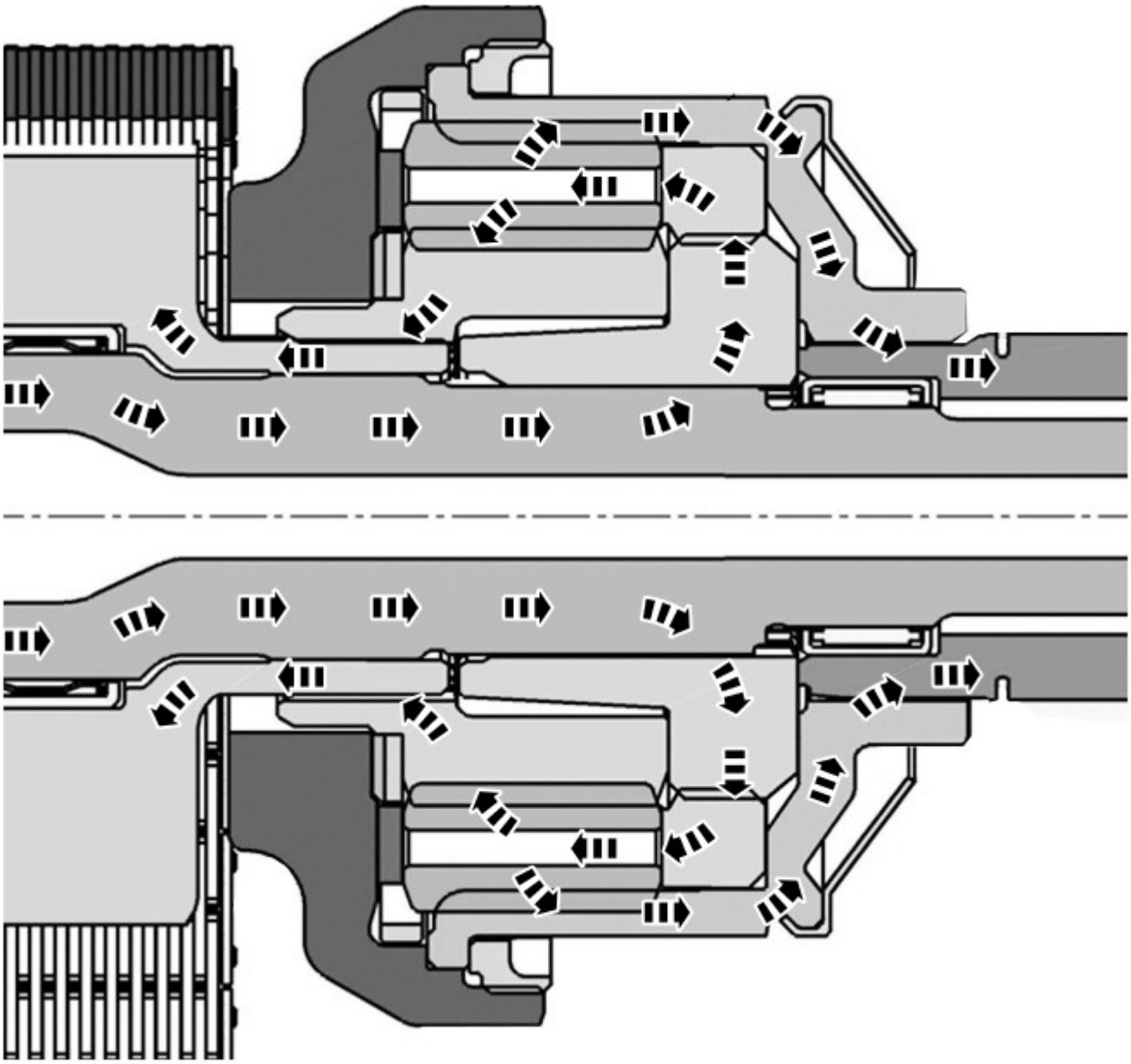
Transfer Case - Sectional View



E164179

Item	Part Number	Description
1	-	Input shaft
2	-	Drive chain sprocket
3	-	Center differential cap
4	-	Friction washer
5	-	Planetary gear (6 off)
6	-	Center differential internal gear
7	-	Rear output flange
8	-	Center differential coupling
9	-	Center differential sun gear
10	-	Rear housing assembly
11	-	Drive chain
12	-	Drive chain sprocket - Front output
13	-	Front output flange
14	-	Front housing assembly

Transfer Case Power Flow



E164180

Input torque from the transmission is transferred to the input shaft of the transfer case and then onto the differential coupling. The coupling is connected to the differential housing. The planetary gears are held in place by the differential housing, which are connected to the differential internal gear, and the sun gear. The torque is then distributed to both the differential internal gear, and the sun gear, which are connected to the outputs of the transfer case. The internal gear is connected directly to the rear output flange, the sun gear is connected directly to the drive chain sprocket and therefore to the chain drive, which provides front output flange rotation.

Front Casing Assembly

The front casing assembly provides the location for the input shaft bearing and the front output flange bearing. It is also equipped with threaded holes to mount the chassis mounting bush, 2 lifting eyes and a breather cartridge for the transfer case breather pipe. The breather pipe allows equalization between atmospheric and internal transfer case pressure.

The front casing has an additional boss cast on the inside. The boss is used to mount two snubbers - one on drive side of the chain and one on the coast side - which are secured with 2 screws. The snubbers are suppressing chain vibrations which can occur under medium acceleration conditions, therefore improving NVH (Noise, Vibration and Harshness) issues. During normal operation the chain does not contact the snubbers.

Rear Casing Assembly

The rear casing assembly provides the location for the rear output flange bearing, the oil fill and drain plug. Fins are cast into the rear casing assembly to improve heat dissipation. The part number & serial number are printed on a bar code label.

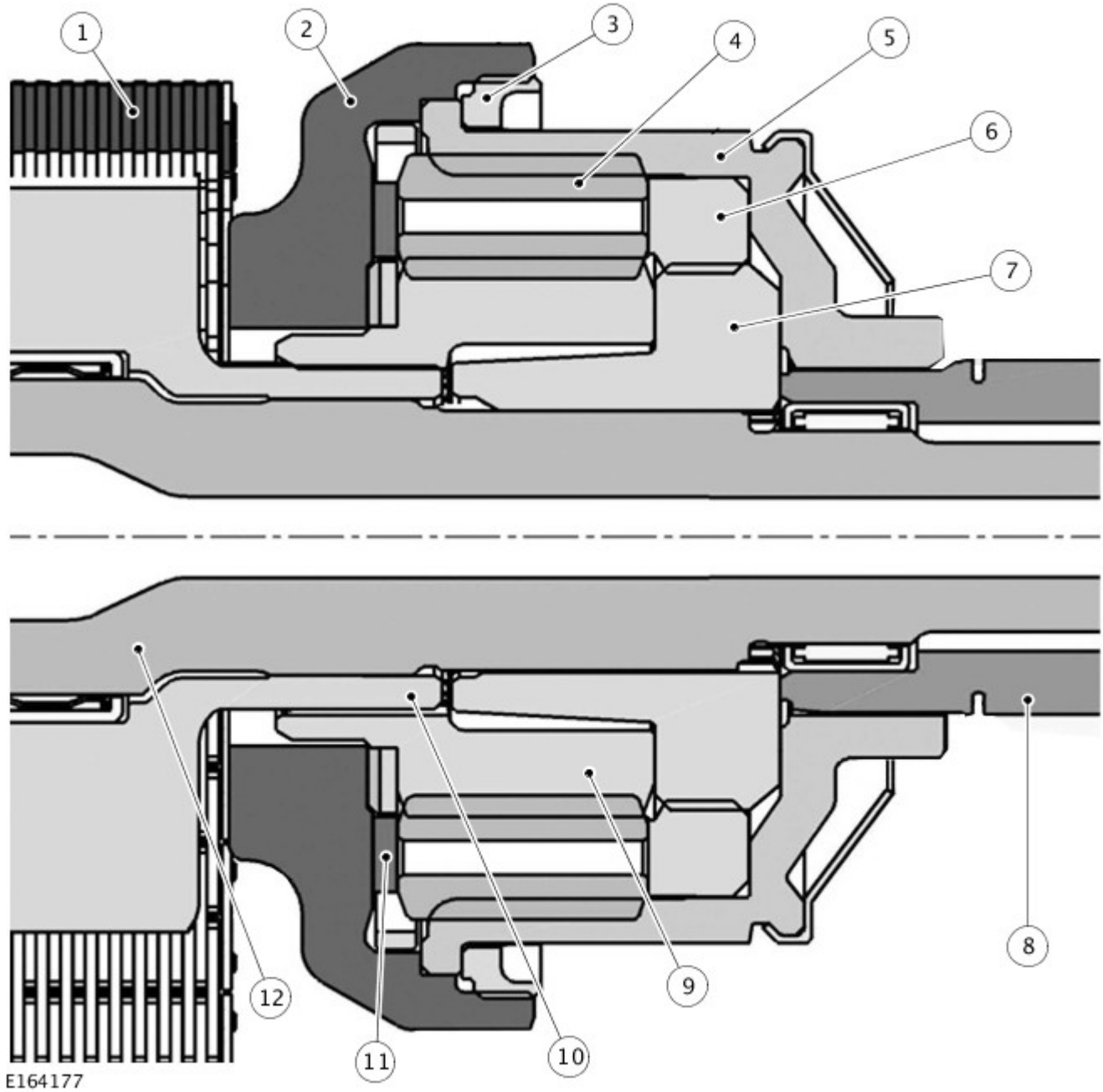
Chain Drive

The chain-drive transfers drive from the center differential to the front output flange. A 3/8" pitch chain connects the sprocket on the transfer case 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. During the vehicle operation the chain delivers the oil upwards and provides the lubrication for the input shaft, the output flange bearings, and the center differential assembly.

NOTE: When installing or replacing the chain, the BLUE guide links must be facing the center differential, towards the rear output flange.

Center differential



Item	Part Number	Description
1	-	Drive chain
2	-	Center differential cover
3	-	Fixing nut
4	-	Planetary gear (6 off)
5	-	Center differential internal gear
6	-	Center differential housing
7	-	Coupling
8	-	Rear output shaft
9	-	Center differential sun gear
10	-	Drive chain sprocket
11	-	Friction washer
12	-	Input shaft

The center differential assembly is the primary feature of the transfer case. Torque is transmitted through the center differential coupling and housing, and distributed by the planetary gear set to the differential gears and the front and

rear output flanges.

The assembly comprises 6 planetary gears, which are equally spaced within the center differential housing. The planetary gears are supported in both directions by the differential casing and the differential cap.

The different basic torque distribution results from the different circle diameters of the internal gear and the sun gear. If an axle loses traction, the bias between the casing, the planetary gears and the cap generates internal friction inside the differential, and the torque directed to the other axle.

Published: 29-Oct-2013

Transfer Case - Vehicles With: Single Speed Transfer Case - Transfer Case

Diagnosis and Testing

Principles of Operation

For a detailed description of the Transfer Case - Single speed, refer to the relevant Description and Operation section in the workshop manual.
REFER to: Transfer Case (308-07B Transfer Case - Vehicles With: Single Speed 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
• Transfer case • Driveshafts • Differentials • Halfshafts • Fluid leaks

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

Published: 30-May-2013

Transfer Case - Vehicles With: Single Speed Transfer Case - Transfer Case Draining and Filling

General Procedures

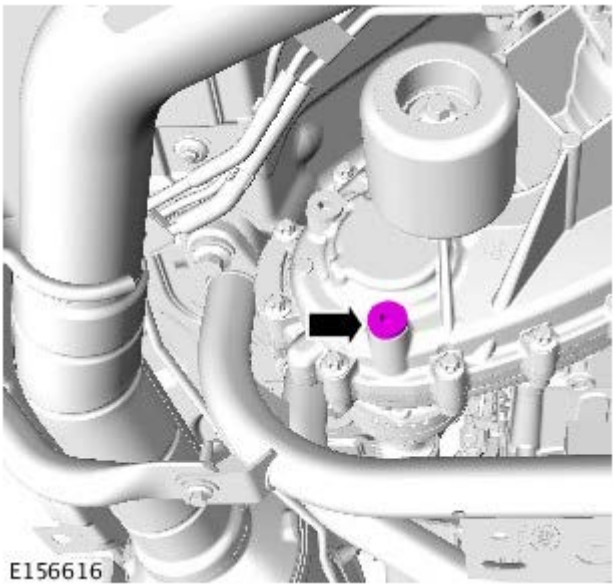
Draining

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.

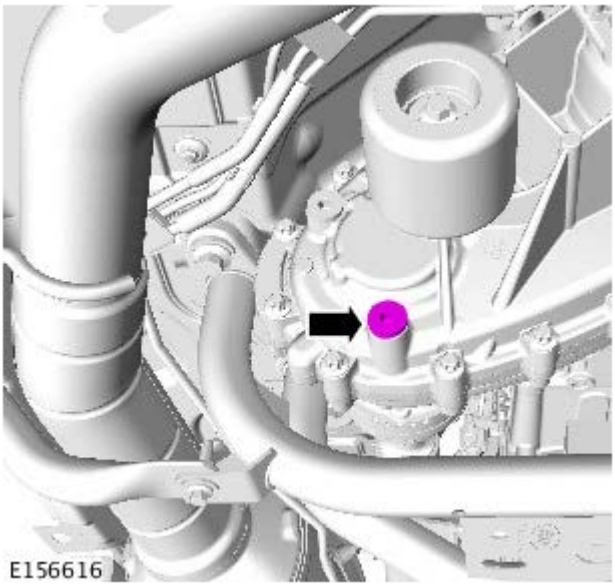
2. Position a container to collect the fluid.



3. CAUTION: Make sure that the area around the component is clean and free of foreign material.

   NOTE: Remove and discard the sealing washer.

4. Allow the fluid to drain.



5. NOTES:

   Make sure that all the component mating faces are clean.

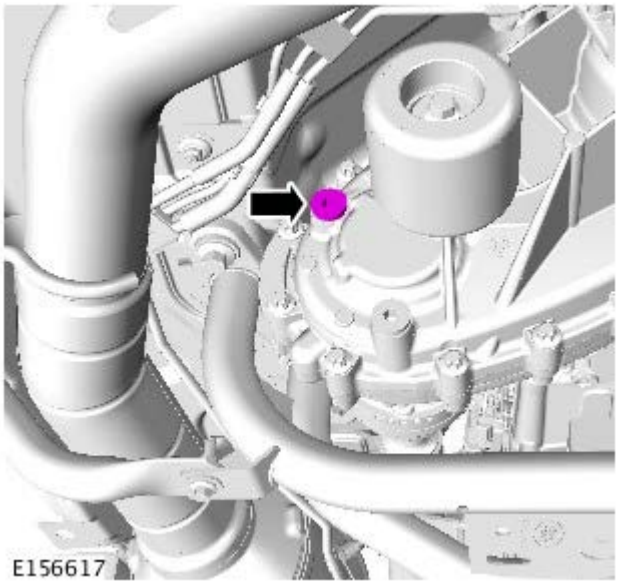
   Install a new sealing washer.

   Torque: 28 Nm

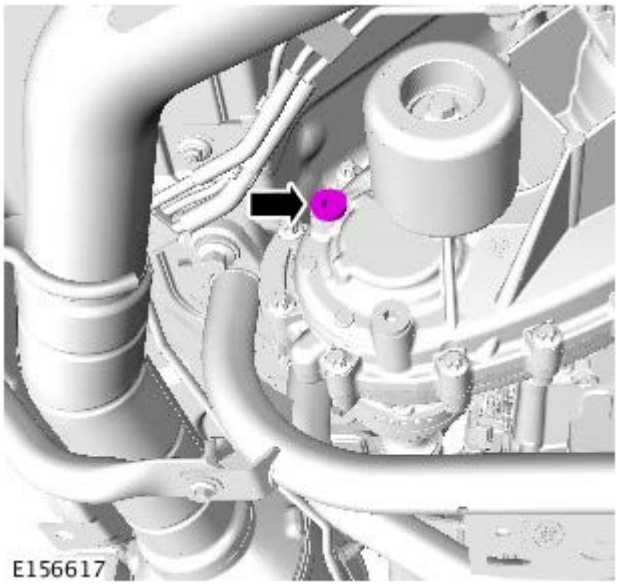
Filling

1. CAUTION: Make sure that the area around the component is clean and free of foreign material.

   NOTE: Remove and discard the sealing washer.



2. Refill transfer case with the recommended fluid, until the fluid is level with bottom of filler/level plug hole.



3. NOTES:

   Make sure that all the component mating faces are clean.

   Install a new sealing washer.

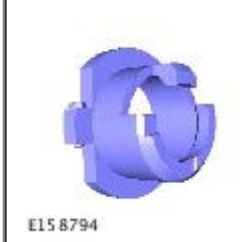
   Torque: 28 Nm

Published: 11-Oct-2013

Transfer Case - Vehicles With: Single Speed 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. 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: Transfer Case Draining and Filling (308-07B Transfer Case - Vehicles With: Single Speed Transfer Case, General Procedures).

4. Refer to: Transfer Case - V6 S/C 3.0L Petrol (308-07B Transfer

Case - Vehicles With: Single Speed Transfer Case, Removal). Refer to: Transfer Case - TDV6 3.0L Diesel (308-07B Transfer Case - Vehicles With: Single Speed Transfer Case, Removal).

5. WARNING: Eye protection must be worn.

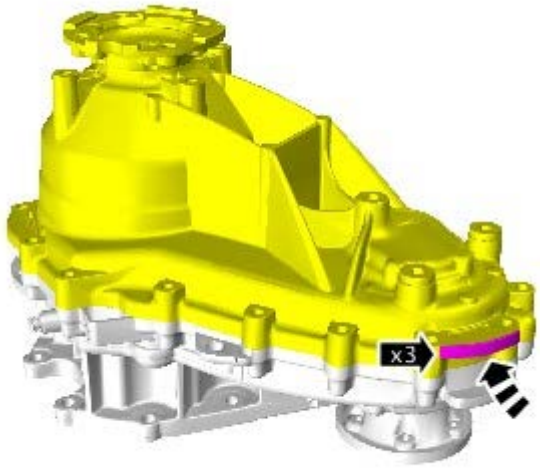
   CAUTION: Make sure the bolt holes are clean and free from swarf.



E156694

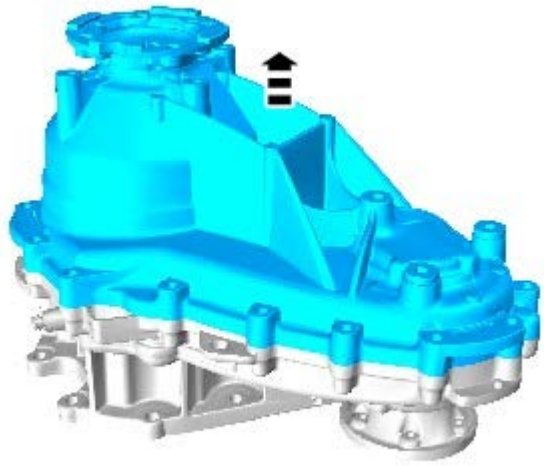
6. CAUTION: Care must be taken to avoid damage to the mating surfaces.

   Using a soft faced mallet, release the rear casing.



E156613

7.



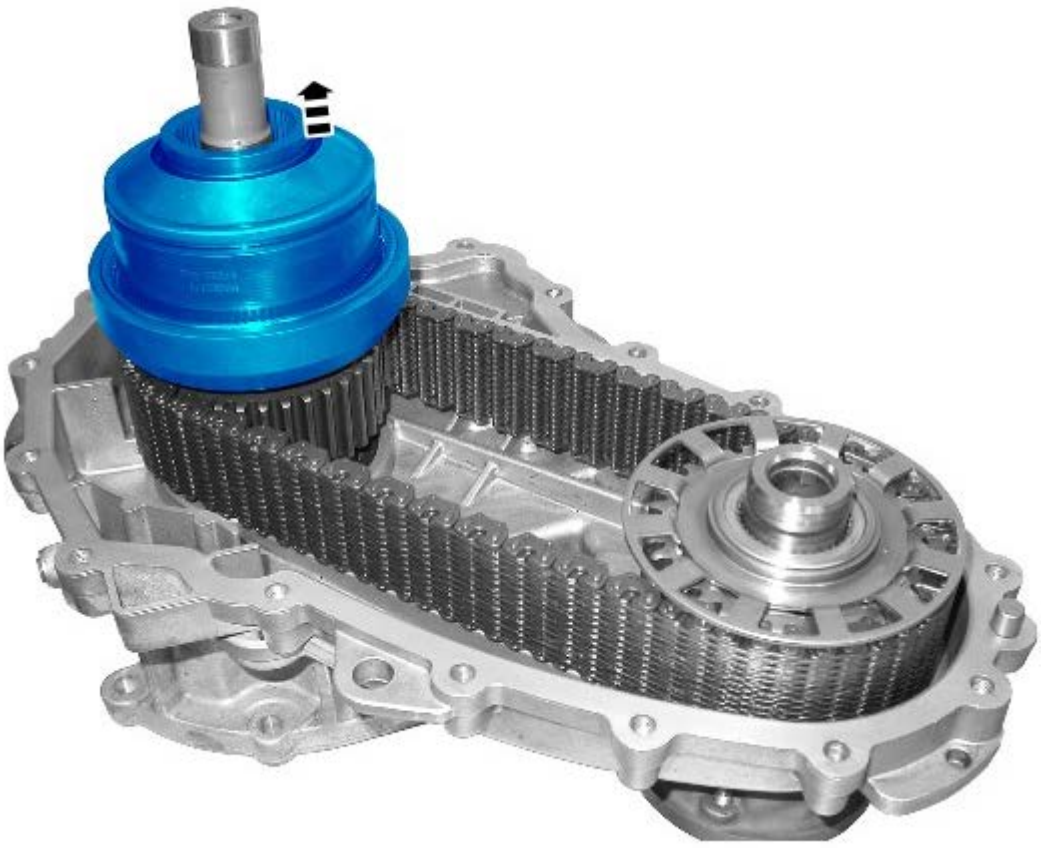
E156614

8. CAUTION: Make sure that the mating faces are clean and free

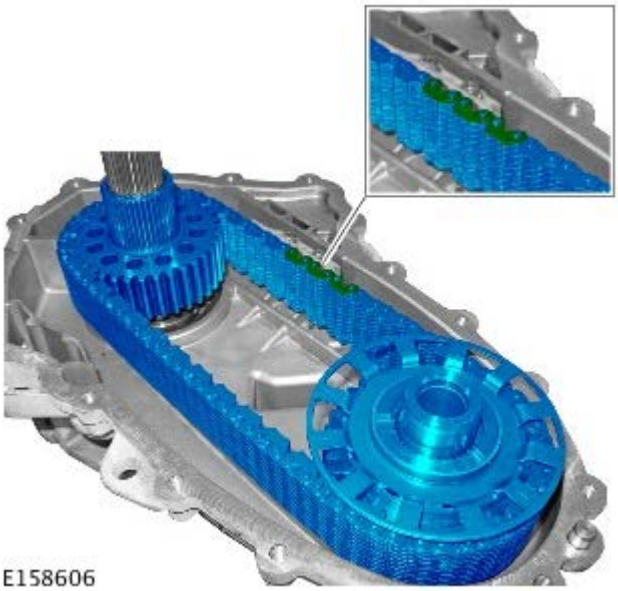
of foreign material.

Remove the sealant from the transfer case mating faces.

9. CAUTION: Note the installed position of the component prior to removal.



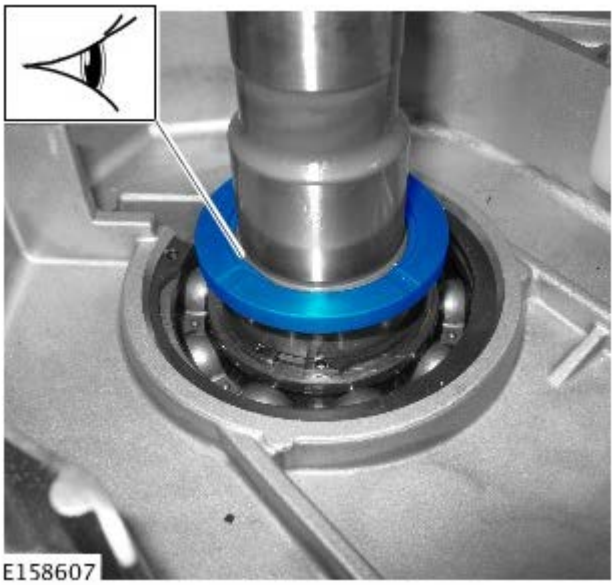
E156773



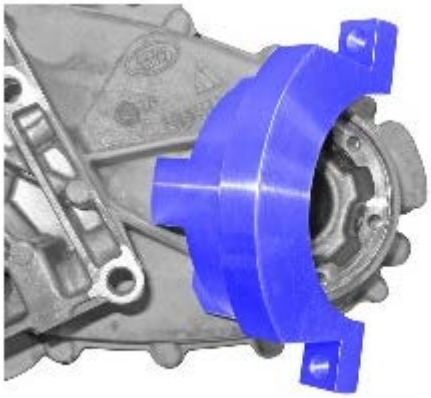
E158606

10. CAUTION: Note the installed position of the components prior to removal.

11. CAUTION: Note the installed position of the component prior to removal.


E158607

12. *Special Tool(s):* JLR-308-926





E158608

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



14. CAUTIONS:

    Do not use excessive force whilst removing the flange assembly.

    Discard the snap ring.

    Special Tool(s): JLR-308-933



15.



16.



E158612

Installation

CAUTION: During the installation, make sure that all components are clean and free from foreign material.



E158613

1. Position the special tool as shown, to support the transfer casing during the next step.

   Special Tool(s): JLR-308-926

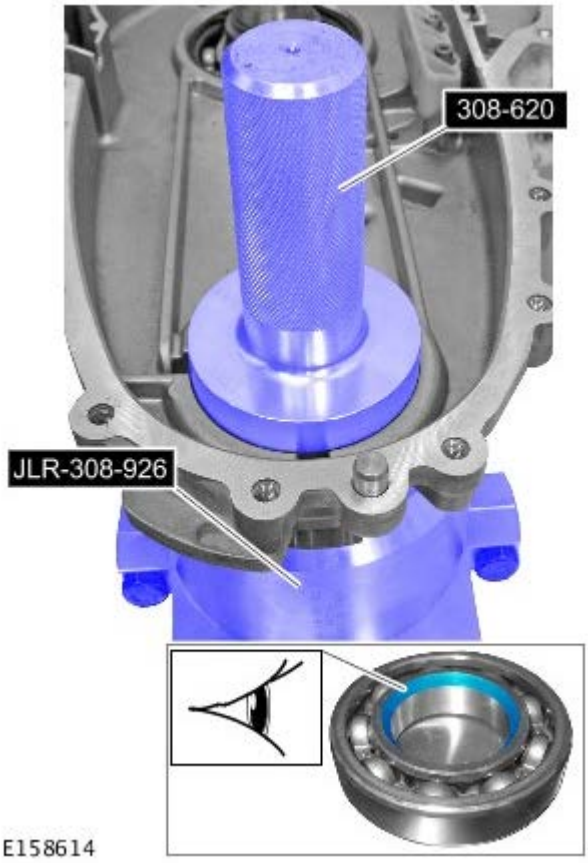
2. CAUTIONS:

   The chamfer on the bearing inner track must face the seal.

   The transfer casing must be supported by the special tool on a flat surface during the next step.

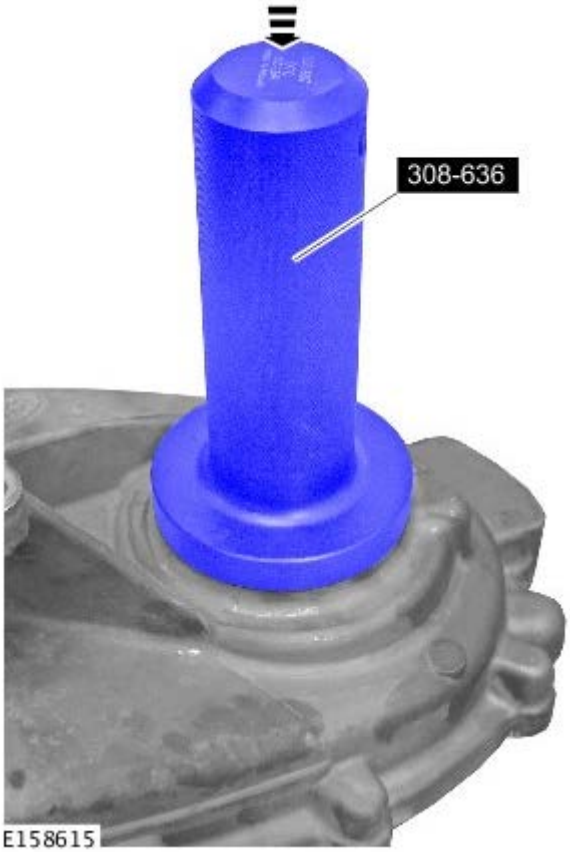
   Install the bearing.

   Special Tool(s): 308-620, JLR-308-926



3. Install the seal.

   Special Tool(s): 308-636



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.

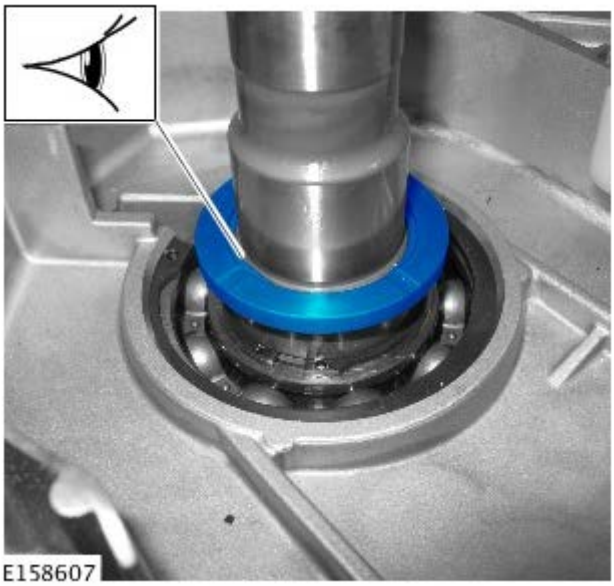


E158616

Install a new snap ring.

Using the special tool and with assistance, install the drive flange.

Special Tool(s): 205-818

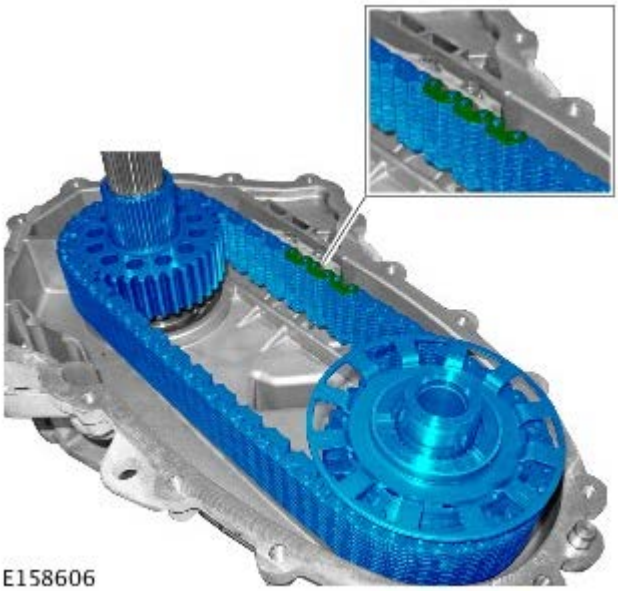

E158607

5. CAUTION: Make sure that the component is installed to the noted removal position.

6. CAUTIONS:

Make sure that the components are installed to the noted removal position.

The dark links in the chain face up as shown.



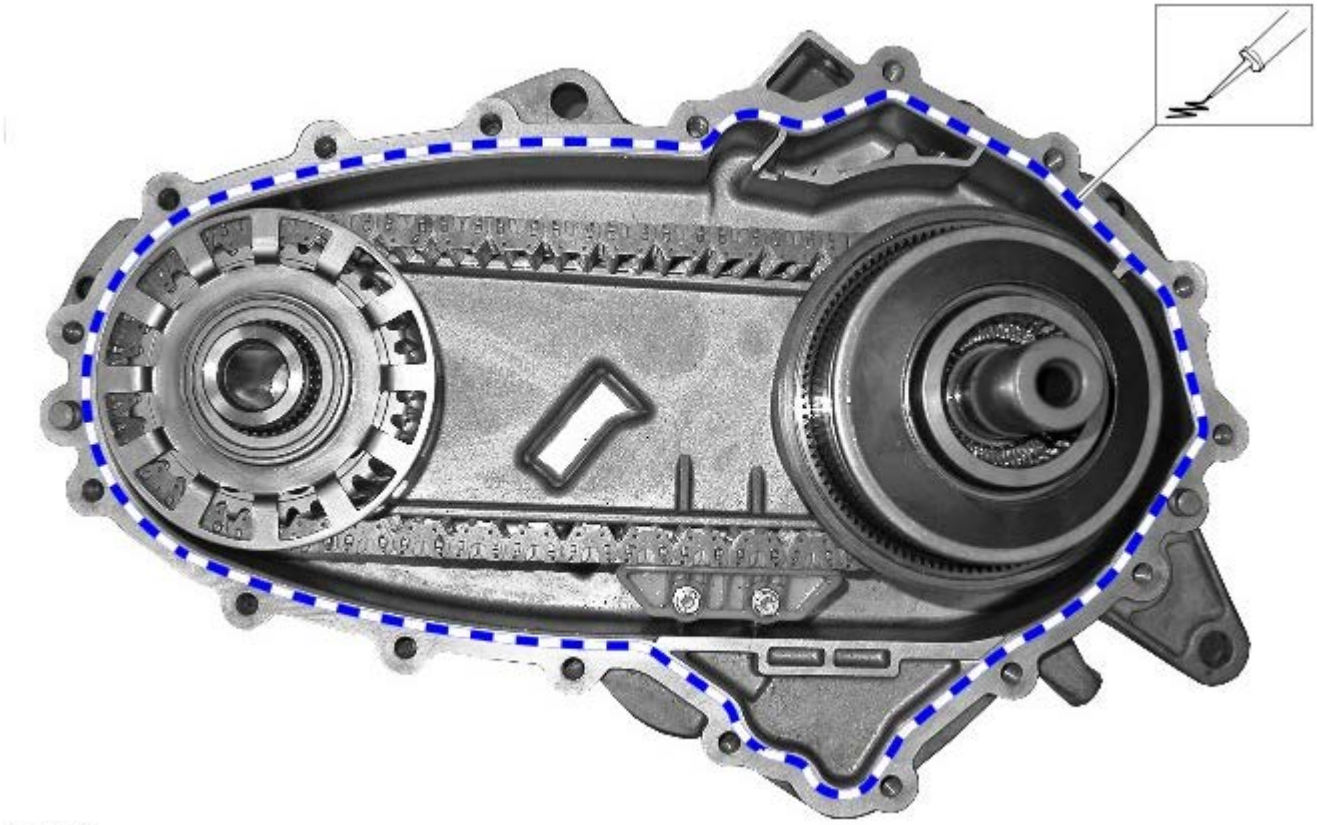
E158606

7. CAUTION: Make sure that the component is installed to the noted removal position.



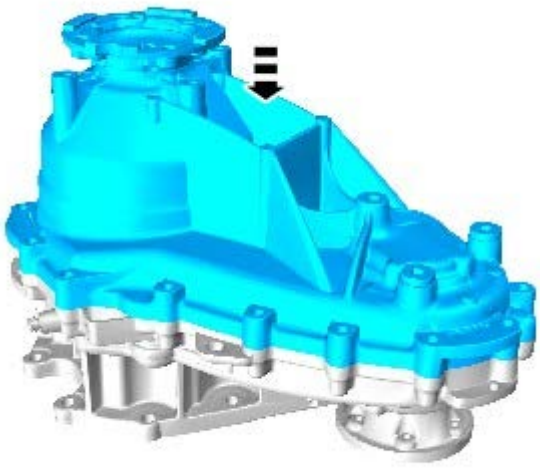
E156807

8. Apply a 2 mm bead of sealant to one surface of the transfer case mating face, as shown.



E156774

9.



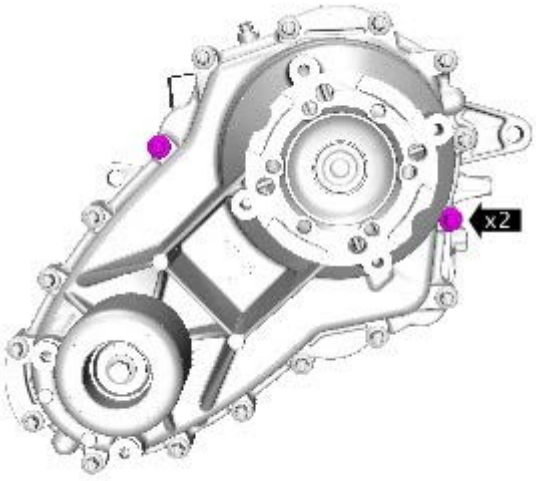
E156785

10. CAUTION: Only tighten the bolts finger-tight at this stage.



E156694

11. *Torque:* 10 Nm



E157851

12. *Torque:* 35 Nm



E156694

13. Refer to: Transfer Case - V6 S/C 3.0L Petrol (308-07B Transfer Case - Vehicles With: Single Speed Transfer Case, Installation). Refer to: Transfer Case - TDV6 3.0L Diesel (308-07B Transfer Case - Vehicles With: Single Speed Transfer Case, Installation).

14. Refer to: Transfer Case Draining and Filling (308-07B Transfer Case - Vehicles With: Single Speed Transfer Case, General Procedures).

15. Connect the battery ground cable.

    Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 27-Jun-2013

Transfer Case - Vehicles With: Single Speed Transfer Case - Transfer Case Front Output Shaft Bearing

Removal and Installation

Removal

1. Refer to: Transfer Case Front Output Seal (308-07B Transfer Case - Vehicles With: Single Speed Transfer Case, Removal and Installation).

Installation

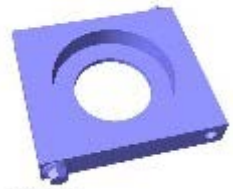
1. Refer to: Transfer Case Front Output Seal (308-07B Transfer Case - Vehicles With: Single Speed Transfer Case, Removal and Installation).

Published: 11-Oct-2013

Transfer Case - Vehicles With: Single Speed Transfer Case - Transfer Case Rear Output Seal

Removal and Installation

Special Tool(s)

 E159758	204-525-1 Replacer, Drive Flange
 E87692	205-726 Remover/Installer, Wheel Hub Bearing
 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. 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: Transfer Case Draining and Filling (308-07B Transfer Case - Vehicles With: Single Speed Transfer Case, General Procedures).

4. Refer to: Transfer Case - V6 S/C 3.0L Petrol (308-07B Transfer

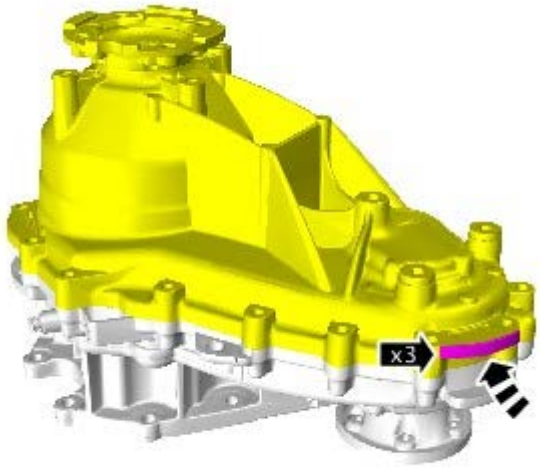
Case - Vehicles With: Single Speed Transfer Case, Removal).
Refer to: Transfer Case - TDV6 3.0L Diesel (308-07B Transfer Case - Vehicles With: Single Speed Transfer Case, Removal).



E156694

5. WARNING: Eye protection must be worn.

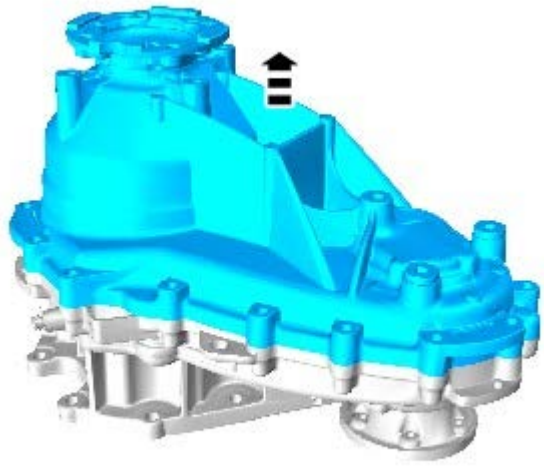
   CAUTION: Make sure the bolt holes are clean and free of swarf.



E156613

6. CAUTION: Care must be taken to avoid damage to the mating surfaces.

   Using a soft faced mallet, release the rear casing.


E156614

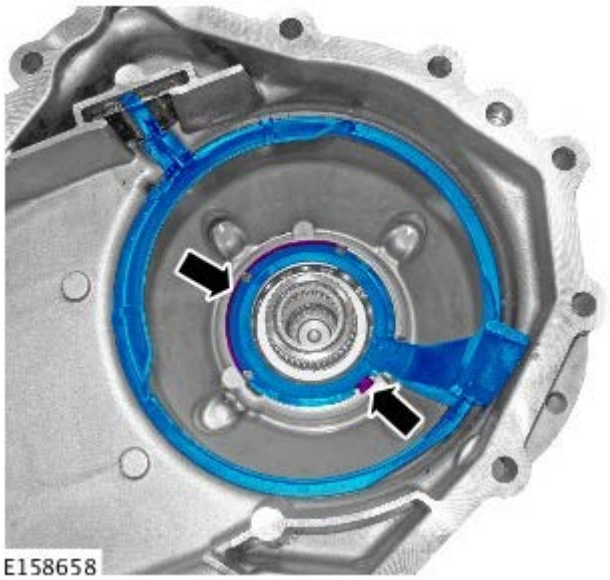
7.

8. CAUTION: Make sure that the mating faces are clean and free

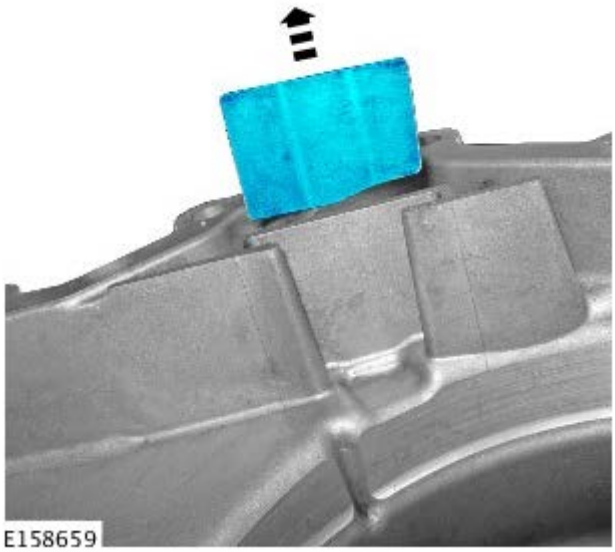
of foreign material.

Remove the sealant from the transfer case mating faces.

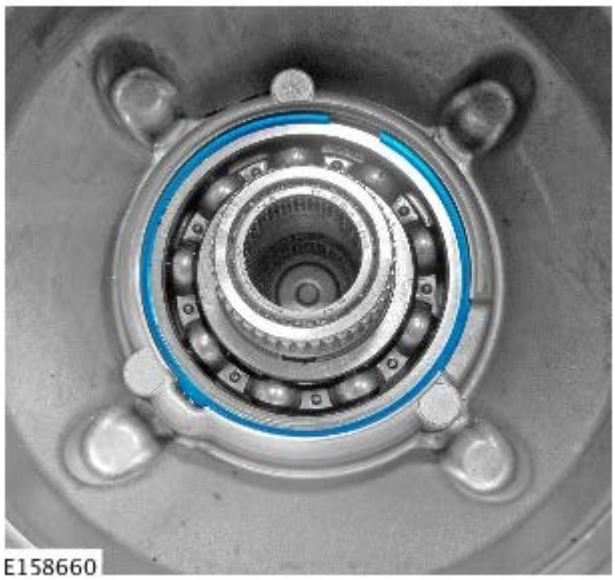
9.



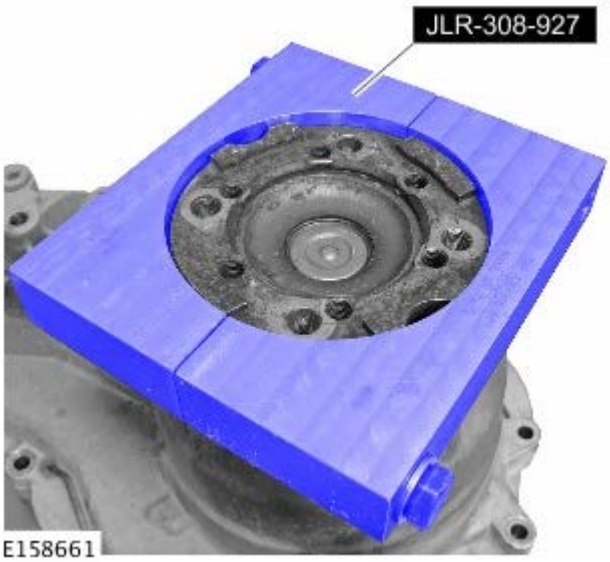
10. NOTE: Note the orientation of the component prior to removal.

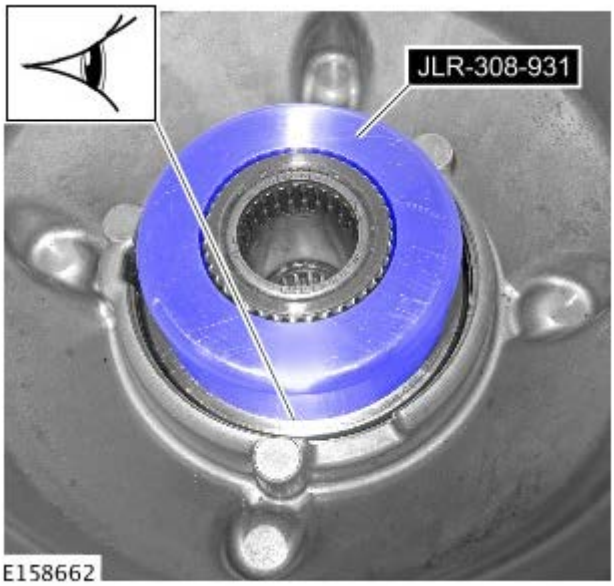


11.



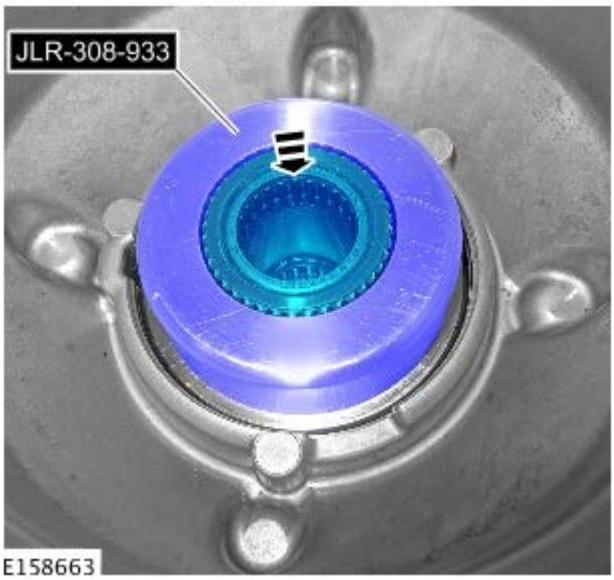
12. *Special Tool(s):* JLR-308-927





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-308-931



14. CAUTIONS:

Do not use excessive force whilst removing the flange assembly.

Discard the snap ring.

Special Tool(s): JLR-308-931

15.



E158664

16.



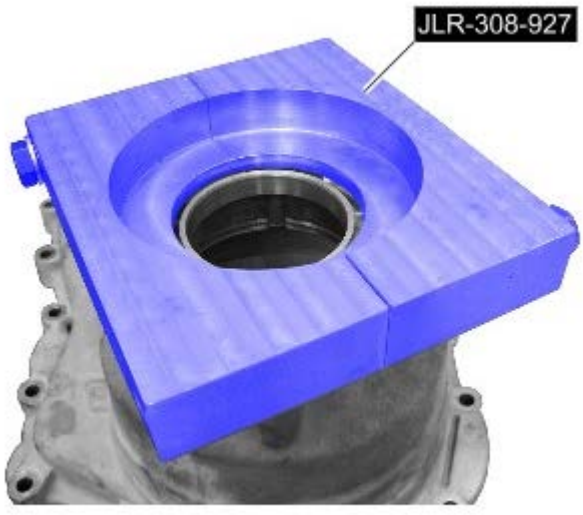
E158665

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 casing during the next step.

   Special Tool(s): JLR-308-927



E158666

2. CAUTION: The chamfer on the bearing inner track must face the seal.

   Install the bearing.

   Special Tool(s): 205-726



3. Install the seal.

   Special Tool(s): 308-637



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.

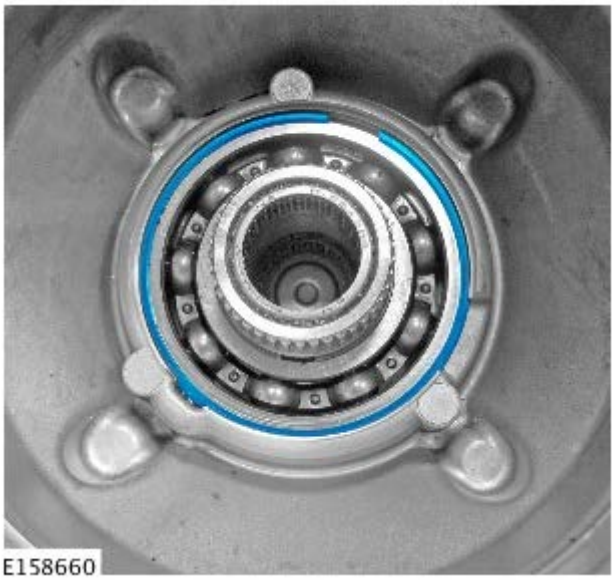
   Using the special tool and with assistance, install the drive flange.

   Special Tool(s): 204-525-1



E158669

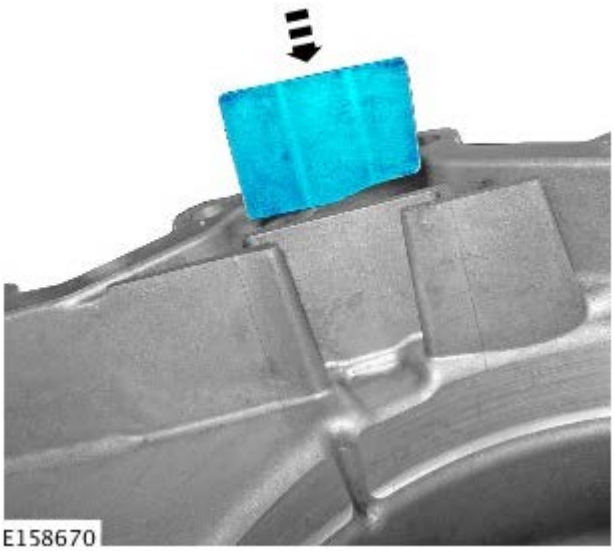
5.


E158660

6. CAUTIONS:

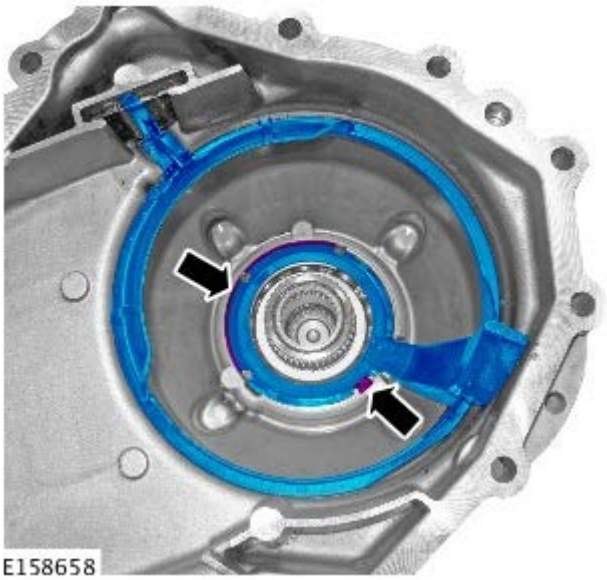
Make sure that the component is installed to the noted removal position.

Make sure that the component is clean and free of foreign material.


E158670

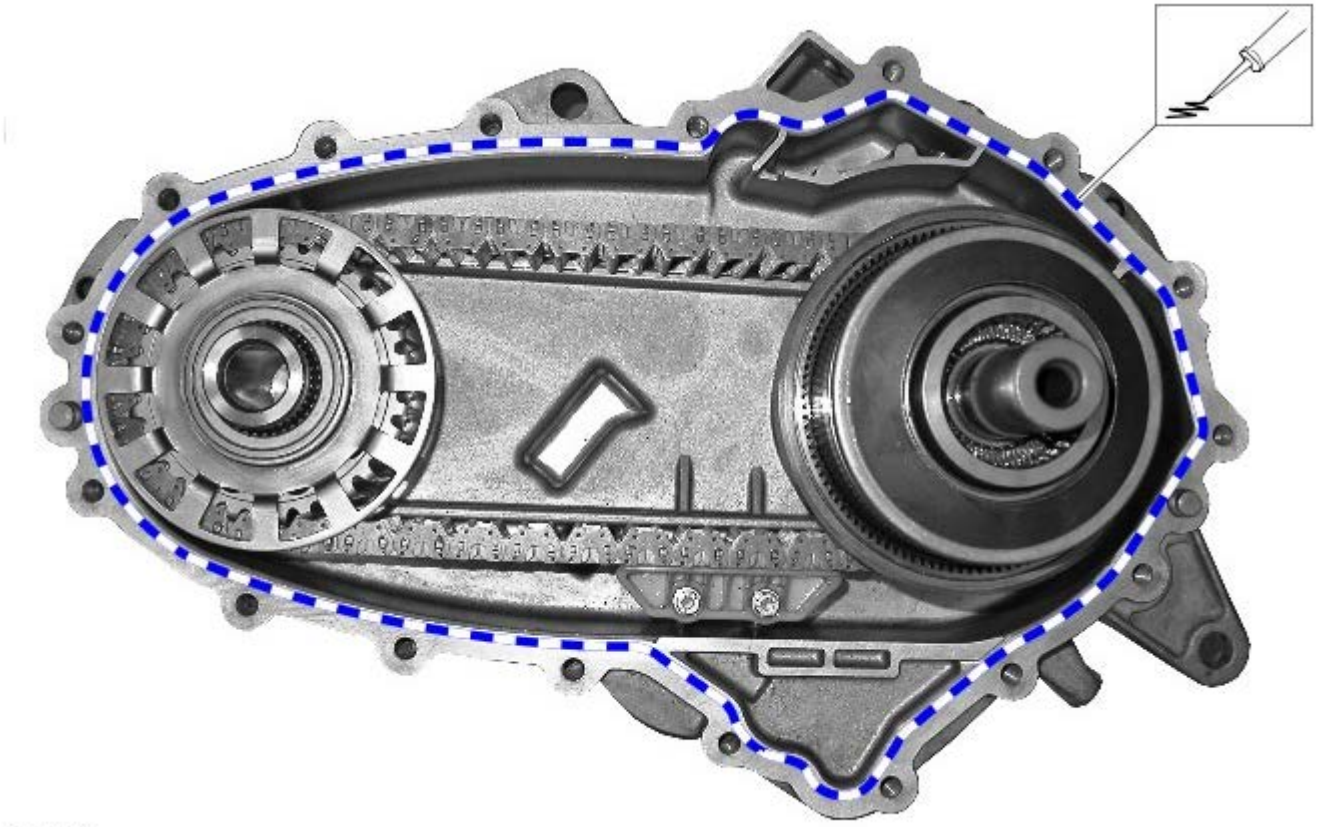
7. CAUTION: Make sure that the retaining tangs are installed correctly.

NOTE: Make sure that the component is correctly

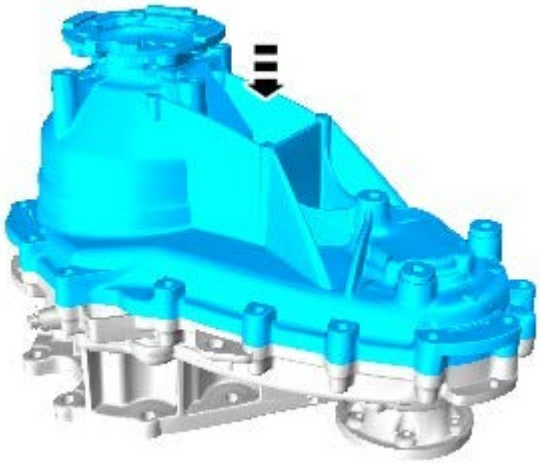

E158658

installed.

8. Apply a 2 mm bead of sealant to one surface of the transfer case mating face, as shown.

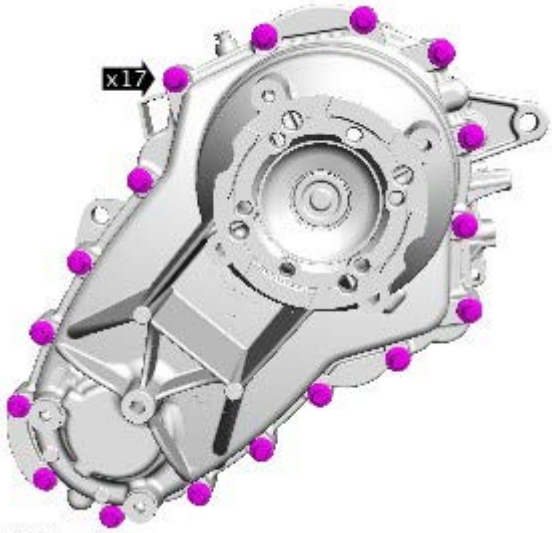

E156774

9.



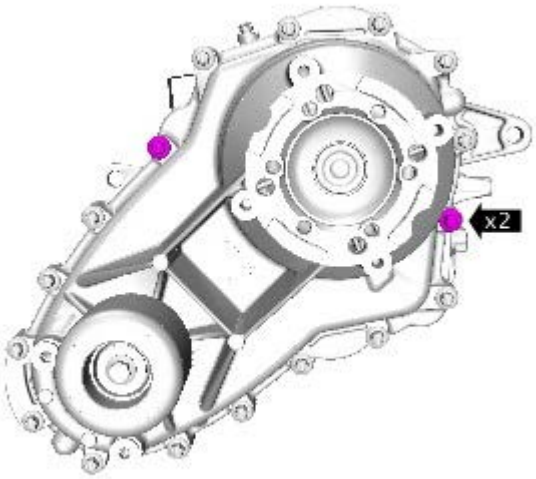
E156785

10. CAUTION: Only tighten the bolts finger-tight at this stage.



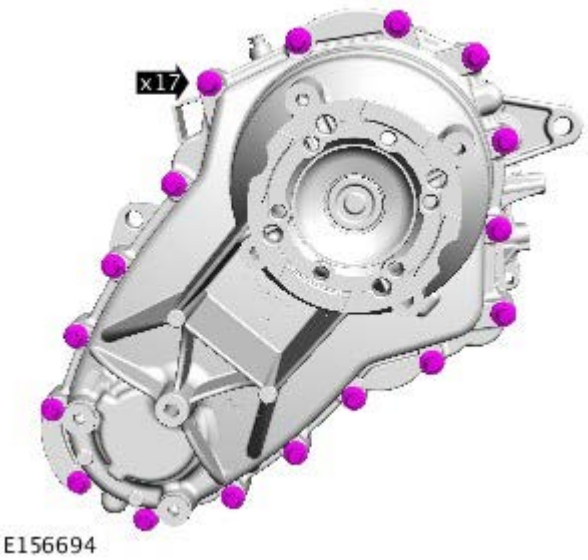
E156694

11. *Torque:* 10 Nm



E157851

12. *Torque:* 35 Nm



13. Refer to: Transfer Case - V6 S/C 3.0L Petrol (308-07B Transfer Case - Vehicles With: Single Speed Transfer Case, Installation). Refer to: Transfer Case - TDV6 3.0L Diesel (308-07B Transfer Case - Vehicles With: Single Speed Transfer Case, Installation).

14. Refer to: Transfer Case Draining and Filling (308-07B Transfer Case - Vehicles With: Single Speed Transfer Case, General Procedures).

15. Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 06-Jul-2013

Transfer Case - Vehicles With: Single Speed Transfer Case - Transfer Case Rear Output Shaft Bearing

Removal and Installation

Removal

1. Refer to: Transfer Case Rear Output Seal (308-07B Transfer Case - Vehicles With: Single Speed Transfer Case, Removal and Installation).

Installation

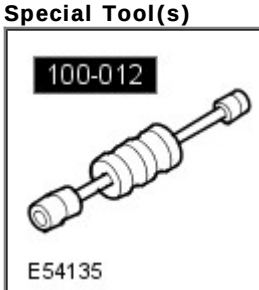
1. Refer to: Transfer Case Rear Output Seal (308-07B Transfer Case - Vehicles With: Single Speed Transfer Case, Removal and Installation).

Published: 19-Aug-2013

Transfer Case - Vehicles With: Single Speed Transfer Case - Transfer Case Connecting Sleeve Seals

Removal and Installation

Special Tool(s)

	100-012 Slide Hammer
	307-520 Installer, Output Shaft Seal
	JLR-308-930 Installer, Oil Seal
	JLR-308-932 Remover, Oil 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 (414-00 Battery and Charging System - General Information, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

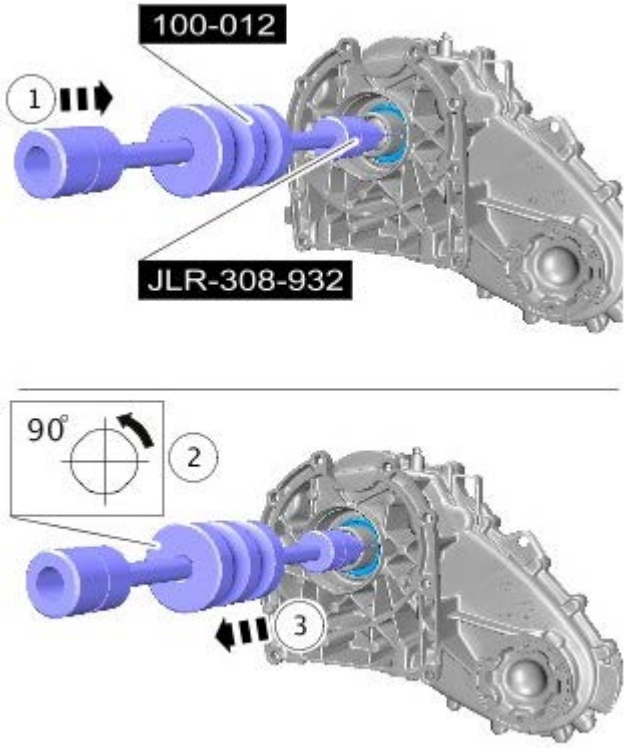
   Raise and support the vehicle.

3. Remove the transfer case.

   Refer to: Transfer Case - V6 S/C 3.0L Petrol (308-07B Transfer Case - Vehicles With: Single Speed Transfer Case, Installation).
   Refer to: Transfer Case - TDV6 3.0L Diesel (308-07B Transfer Case - Vehicles With: Single Speed Transfer Case, Removal).

4. CAUTION: Care must be taken to avoid damage to the seal register and running surface.

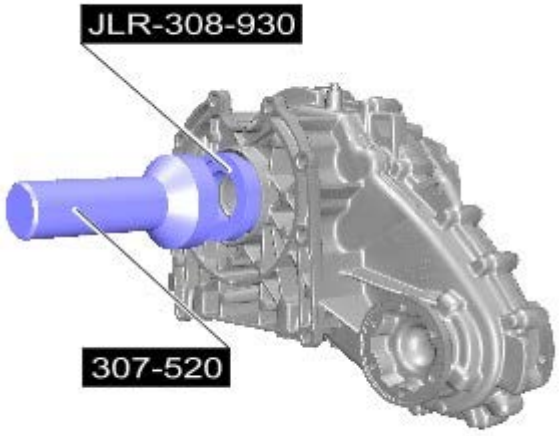
   Special Tool(s): 100-012, JLR-308-932



E156808

Installation

1. *Special Tool(s):* 307-520, JLR-308-930



E158632

2. Install the transfer case.

   Refer to: Transfer Case - V6 S/C 3.0L Petrol (308-07B Transfer Case - Vehicles With: Single Speed Transfer Case, Installation).
   Refer to: Transfer Case - TDV6 3.0L Diesel (308-07B Transfer Case - Vehicles With: Single Speed Transfer Case, Installation).

3. Connect the battery ground cable.

   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 10-Jul-2013

Transfer Case - Vehicles With: Single Speed Transfer Case - Transfer Case Differential

Removal and Installation

Removal

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: Transfer Case Draining and Filling (308-07B Transfer Case - Vehicles With: Single Speed Transfer Case, General Procedures).

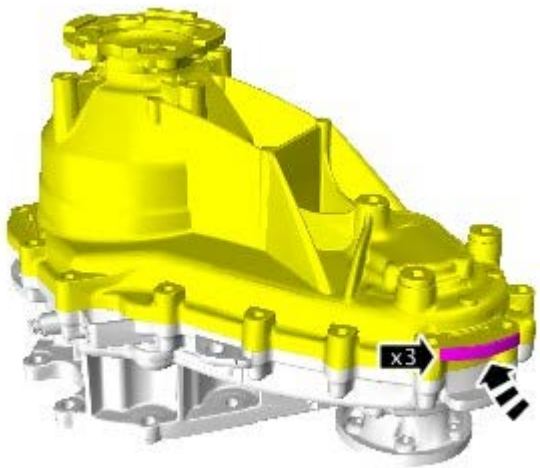
4. Refer to: Transfer Case - TDV6 3.0L Diesel (308-07B Transfer Case - Vehicles With: Single Speed Transfer Case, Removal).
   Refer to: Transfer Case - V6 S/C 3.0L Petrol (308-07B Transfer Case - Vehicles With: Single Speed Transfer Case, Removal).



E156694

5. WARNING: Eye protection must be worn.

   CAUTION: Make sure the bolt holes are clean and free of swarf.

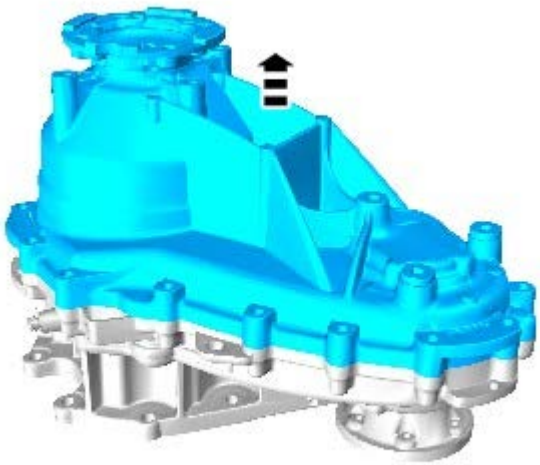


E156613

6. CAUTION: Care must be taken to avoid damage to the mating surfaces.

   Using a soft faced mallet, release the rear casing.

7.

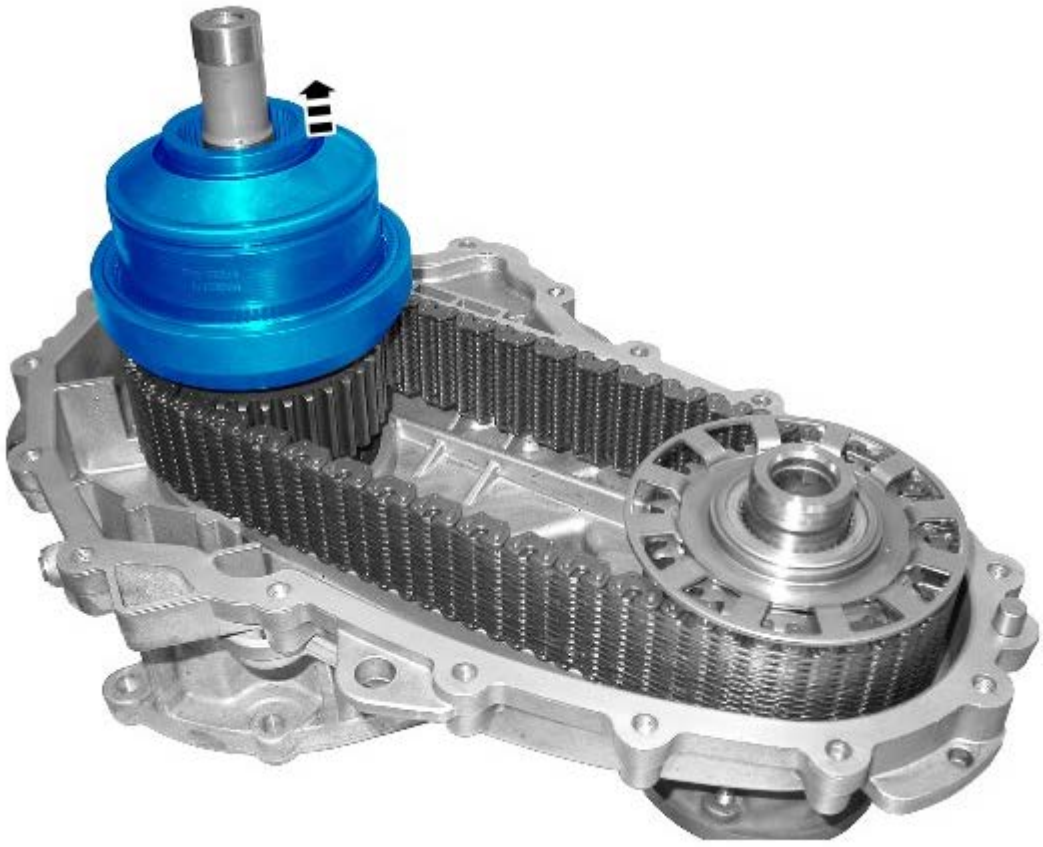


E156614

8. CAUTION: Make sure that the mating faces are clean and free of foreign material.

   Remove the sealant from the transfer case mating faces.

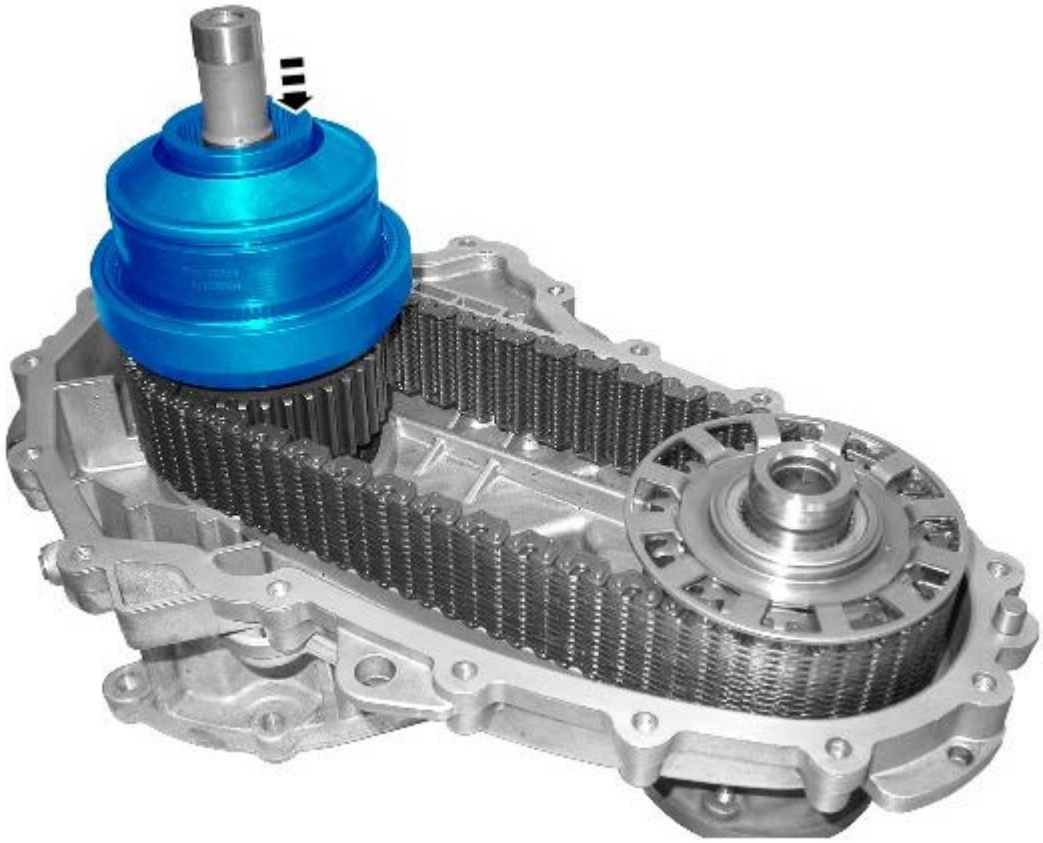
9. CAUTION: Note the fitted position of the component prior to removal.



E156773

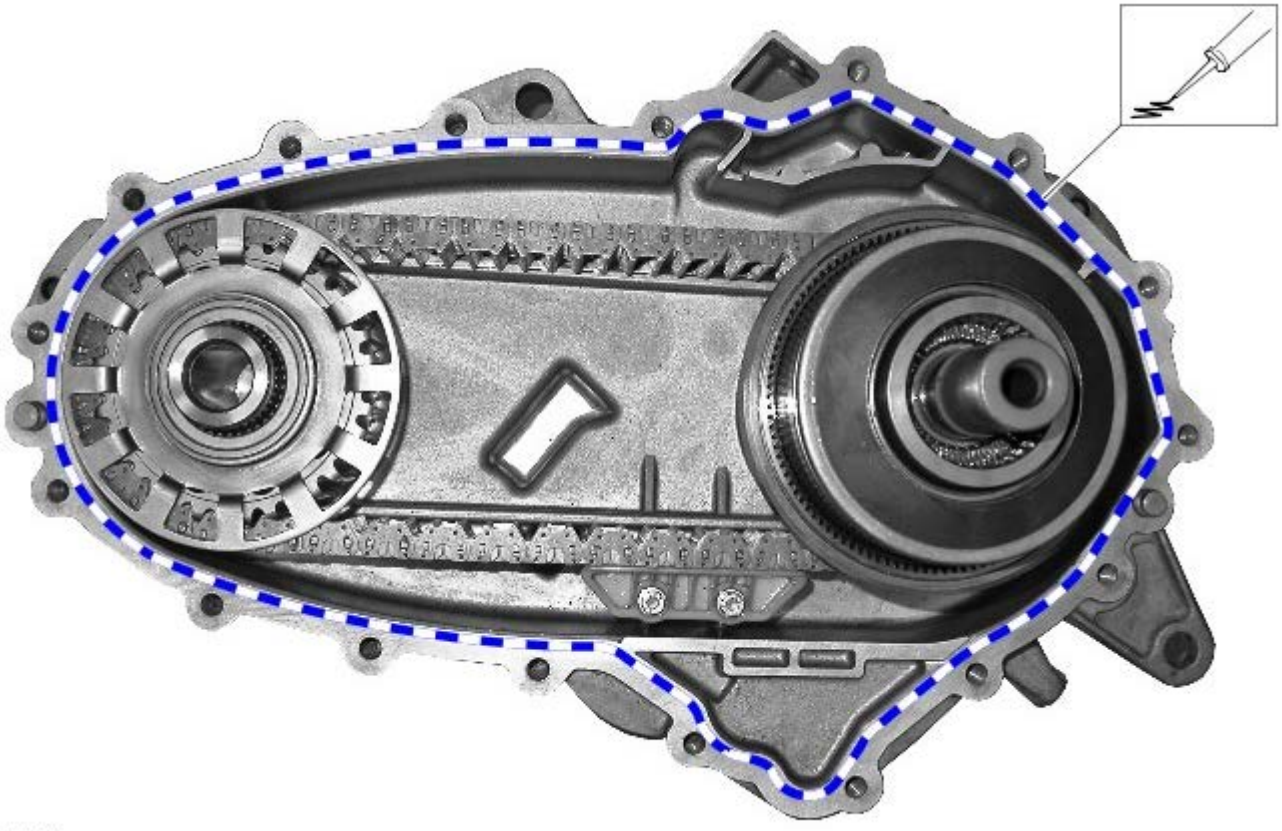
Installation

1.



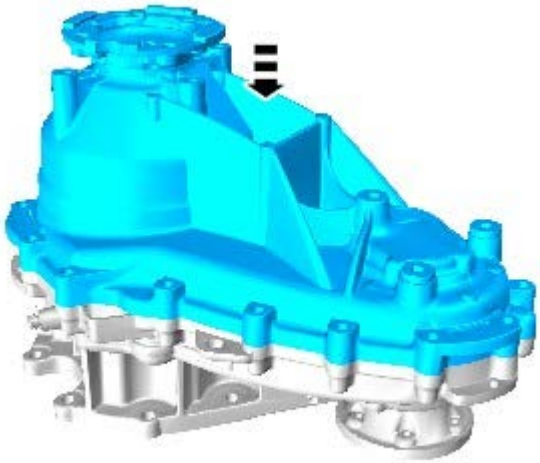
E156807

2. Apply a 2 mm bead of sealant to one surface of the transfer case mating face, as shown.



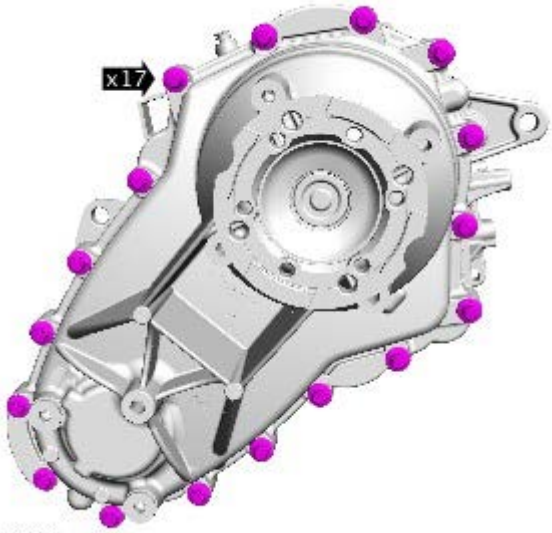
E156774

3.



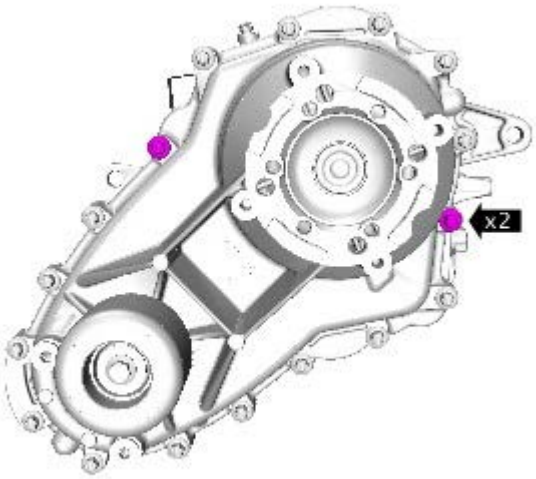
E156785

4. CAUTION: Only tighten the bolts finger-tight at this stage.



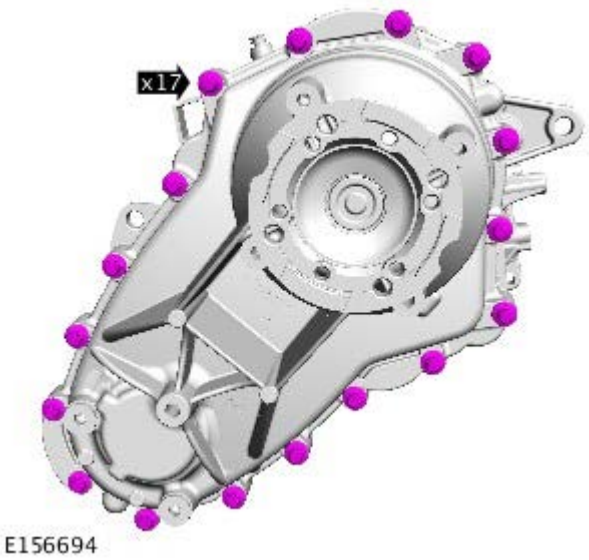
E156694

5. *Torque:* 10 Nm



E157851

6. *Torque:* 35 Nm



7. Refer to: Transfer Case - TDV6 3.0L Diesel (308-07B Transfer Case - Vehicles With: Single Speed Transfer Case, Installation).
   Refer to: Transfer Case - V6 S/C 3.0L Petrol (308-07B Transfer Case - Vehicles With: Single Speed Transfer Case, Installation).

8. Refer to: Transfer Case Draining and Filling (308-07B Transfer Case - Vehicles With: Single Speed Transfer Case, General Procedures).

9. Connect the battery ground cable.

   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 09-Nov-2013

Transfer Case - Vehicles With: Single Speed Transfer Case - Transfer Case TDV6 3.0L Diesel

Removal

Special Tool(s)

	100-012 Slide Hammer
	303-1069 Adapter, Wrench
	JLR-308-932 Remover, Oil Seal

General Equipment

Transmission jack
Vehicle/axle stands
Wooden Block

NOTES:

Some variation in the illustrations may occur, but the essential information is always correct.

Component shown removed for clarity.

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.

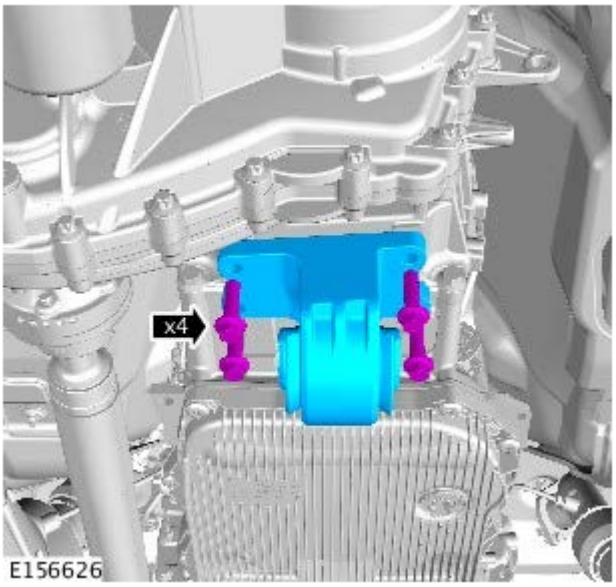
   Raise and support the vehicle.

3. NOTE: Do not carry out this step if the component removed for access only.

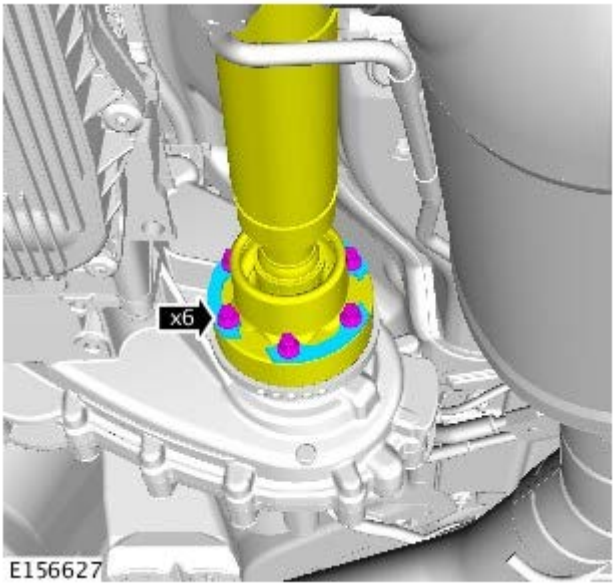
   Refer to: Transfer Case Draining and Filling (308-07B Transfer Case - Vehicles With: Single Speed Transfer Case, General Procedures).

4. Refer to: Transmission Support Crossmember - TDV6 3.0L Diesel (502-02 Full Frame and Body Mounting, Removal and Installation).

5.



6. Refer to: Rear Driveshaft - TDV6 3.0L Diesel (205-01 Driveshaft, Removal and Installation).



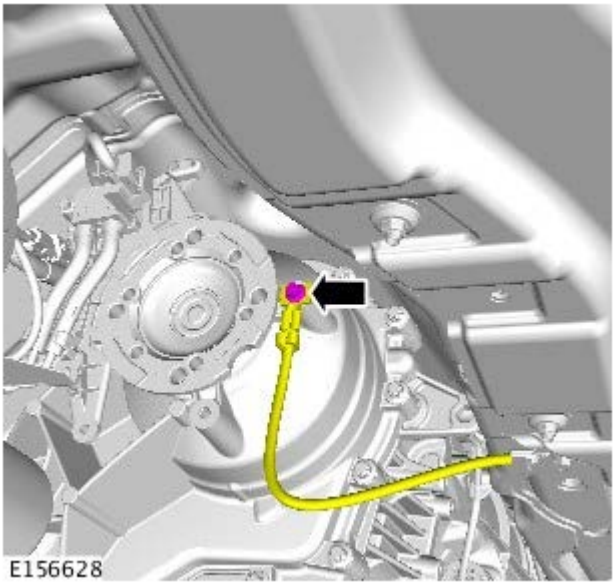
7. CAUTIONS:

   Mark the position of the driveshaft flange in relation to the drive pinion flange.

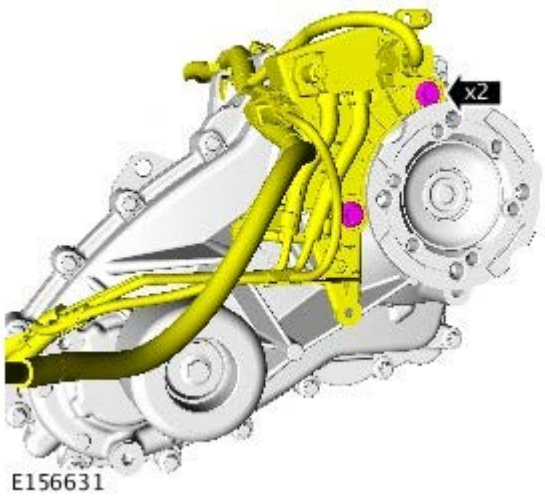
   To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

   Discard the bolts.

8.

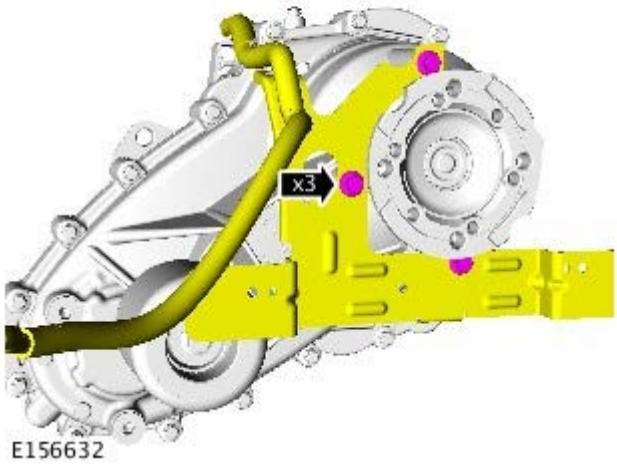


9. Vehicles with diesel particulate filter (DPF).



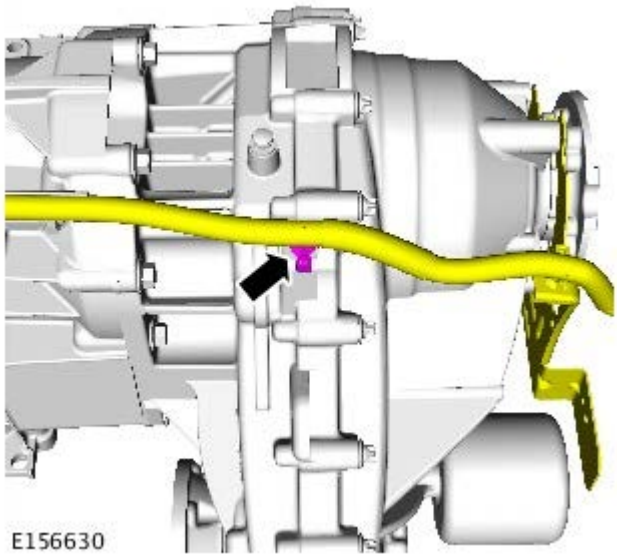
E156631

10. Vehicles without diesel particulate filter (DPF).

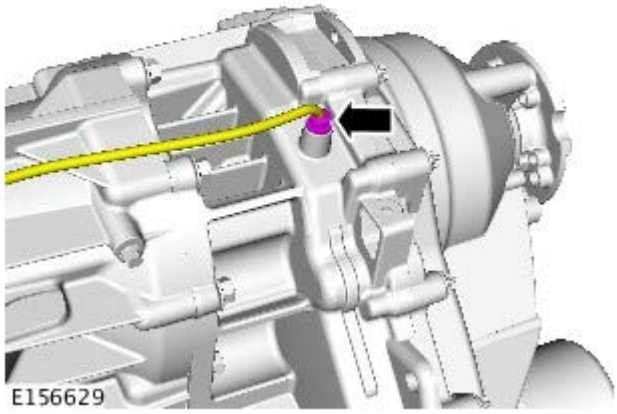


E156632

11.

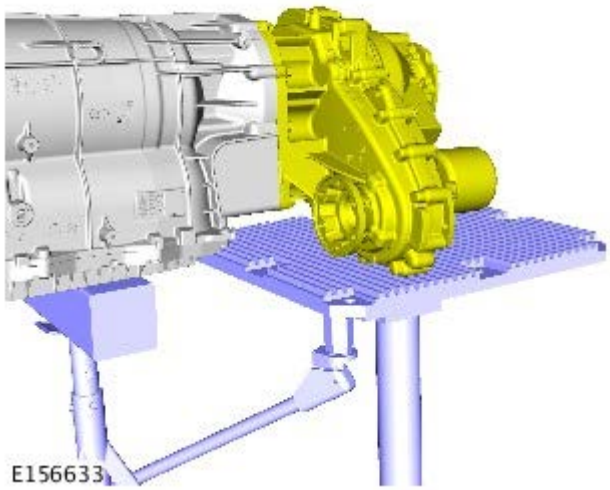

E156630

12. CAUTION: Always plug any open connections to prevent contamination.

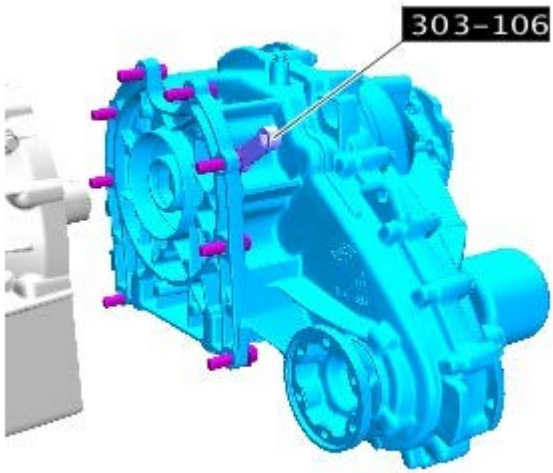


13. WARNING: Secure the component to the transmission jack.

- *General Equipment:* Wooden Block
- *General Equipment:* Transmission jack
- *General Equipment:* Vehicle/axle stands



14. *Special Tool(s):* 303-1069

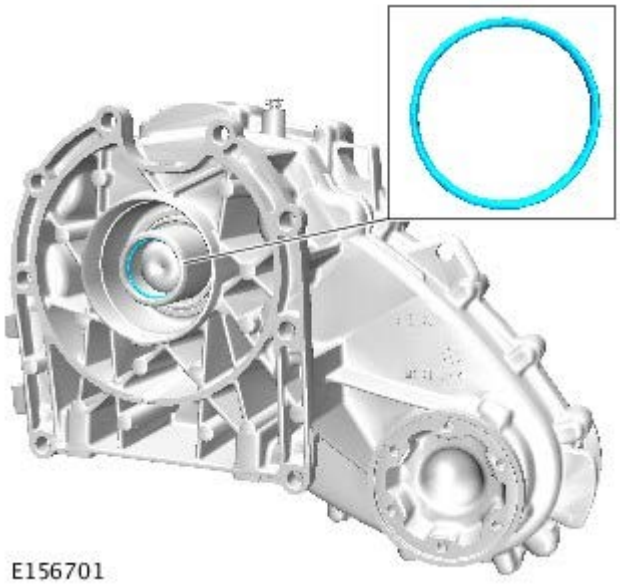


E156634

15. NOTE: Do not carry out this step, if the component removed for access only.



E156693



E156701

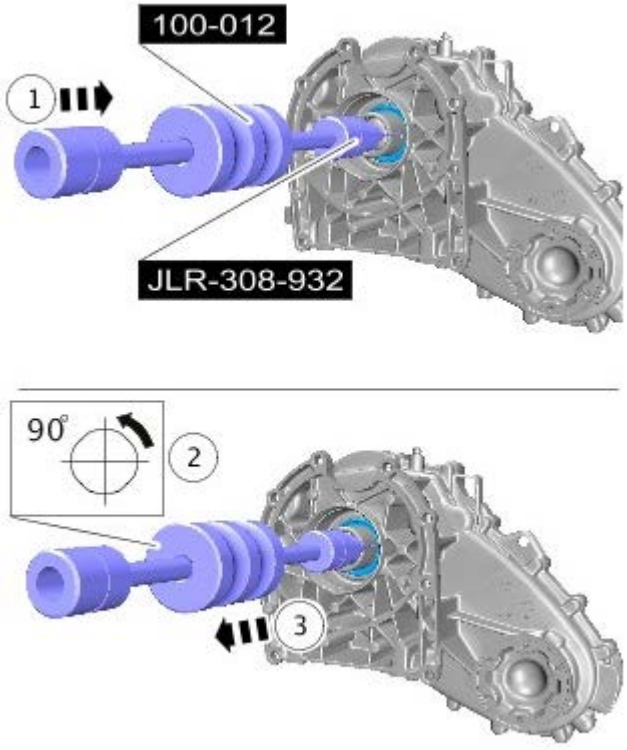
16. CAUTION: Do not carry out this step if a new transfer box is to be installed.

17. CAUTIONS:

    Care must be taken to avoid damage to the seal register and running surface.

    Do not carry out this step if a new transfer box is to be installed.

    Special Tool(s): 100-012, JLR-308-932



E156808

Published: 09-Nov-2013

Transfer Case - Vehicles With: Single Speed Transfer Case - Transfer Case V6 S/C 3.0L Petrol

Removal

Special Tool(s)

	100-012 Slide Hammer
	303-1069 Adapter, Wrench
	JLR-308-932 Remover, Oil Seal

General Equipment

Transmission jack
Vehicle/axle stands
Wooden Block

NOTES:

Some variation in the illustrations may occur, but the essential information is always correct.

Component shown removed for clarity.

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.

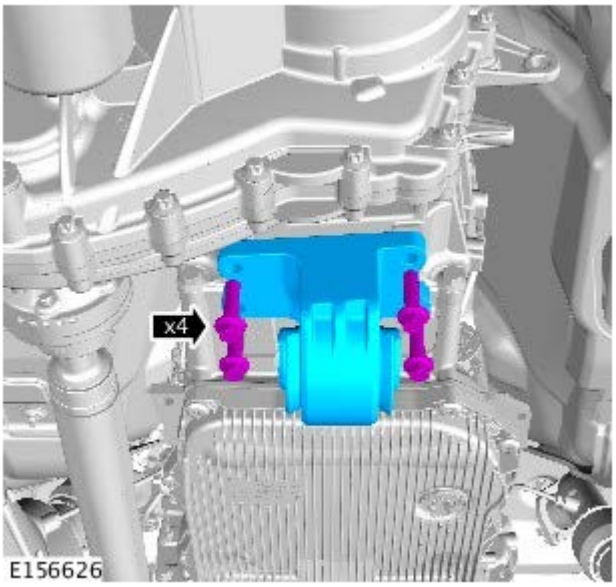
   Raise and support the vehicle.

3. NOTE: Do not carry out this step if the component removed for access only.

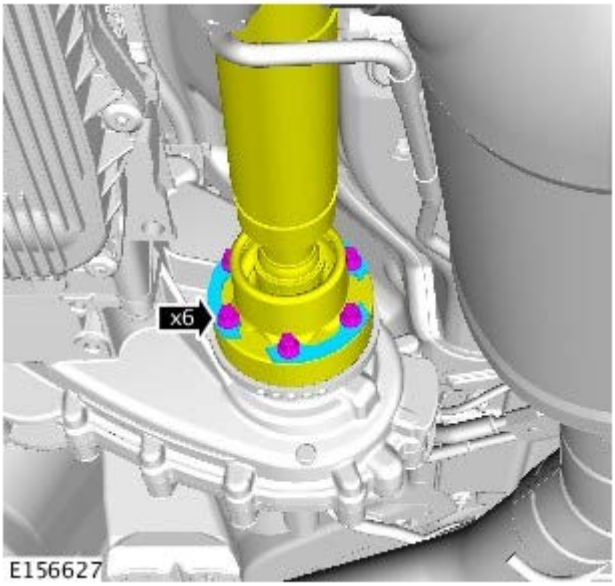
   Refer to: Transfer Case Draining and Filling (308-07B Transfer Case - Vehicles With: Single Speed Transfer Case, General Procedures).

4. Refer to: Transmission Support Crossmember - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (502-02 Full Frame and Body Mounting, Removal and Installation).

5.



6. Refer to: Rear Driveshaft - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (205-01 Driveshaft, Removal and Installation).



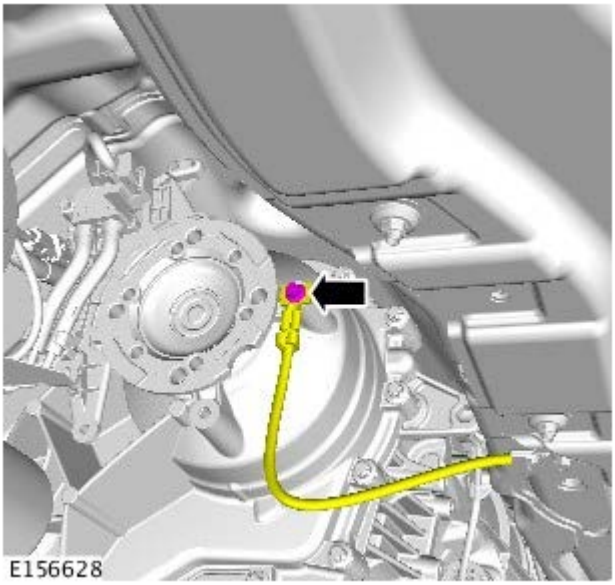
7. CAUTIONS:

   Mark the position of the driveshaft flange in relation to the drive pinion flange.

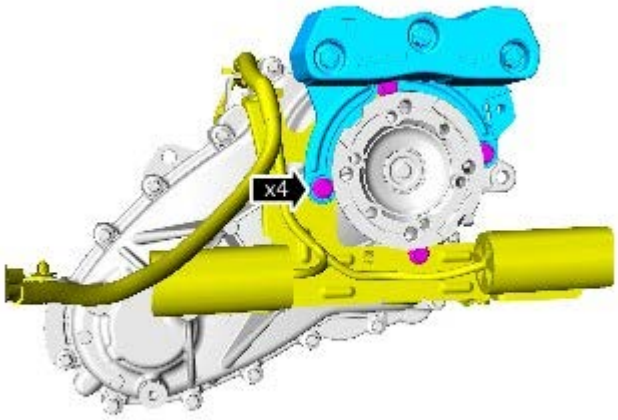
   To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

   Discard the bolts.

8.

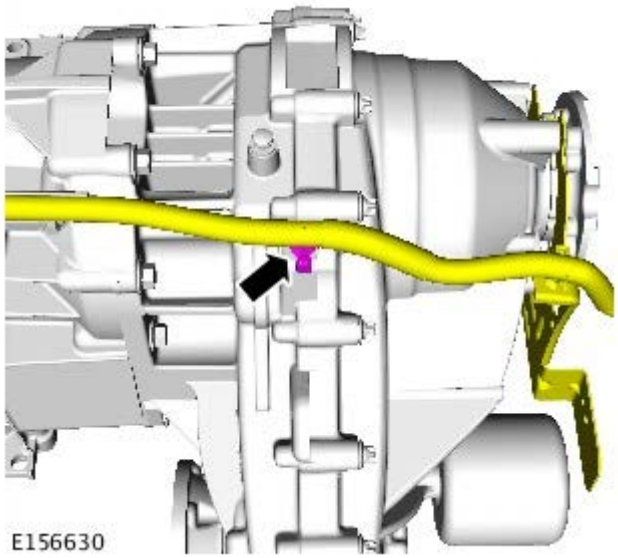


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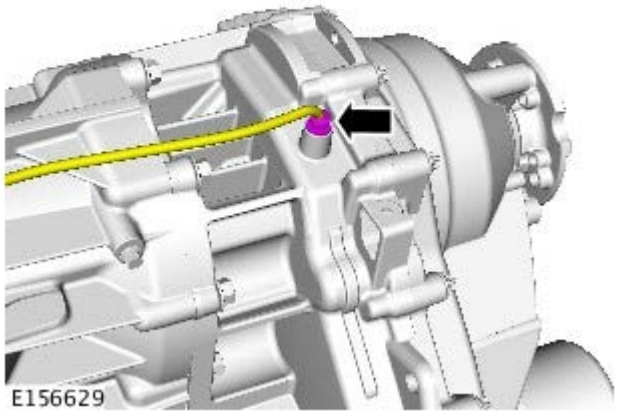
E156639

10.



E156630

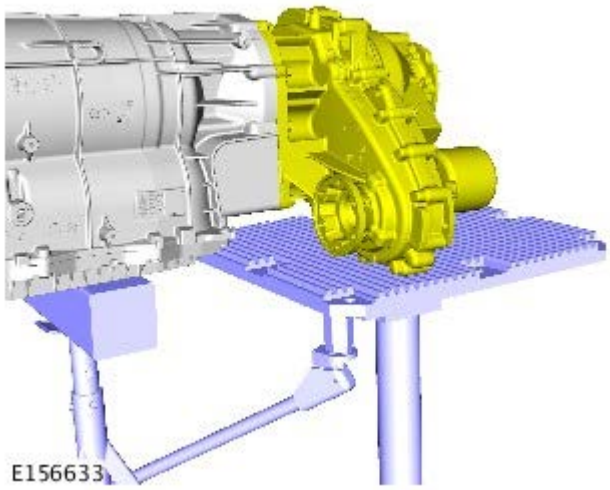
11. CAUTION: Always plug any open connections to prevent contamination.



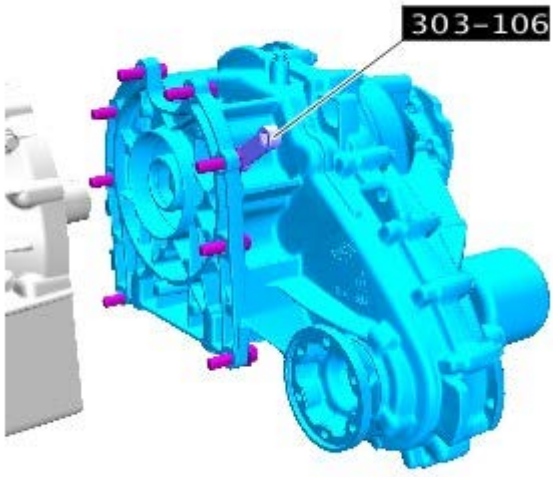
E156629

12. WARNING: Secure the component to the transmission jack.

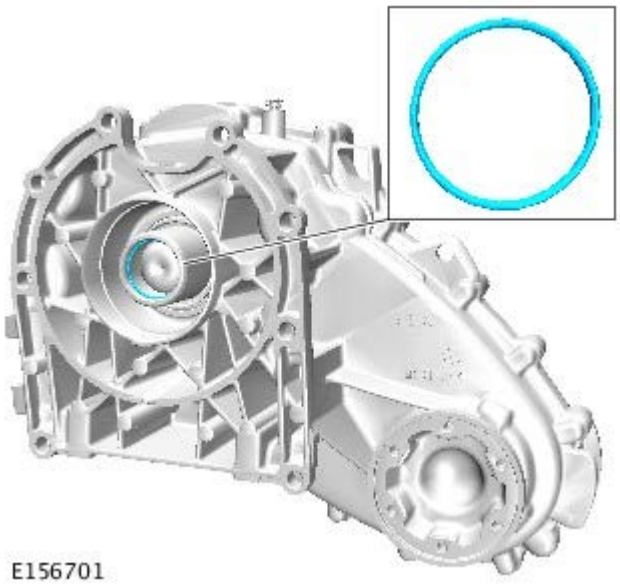
- *General Equipment:* Wooden Block
- *General Equipment:* Transmission jack
- *General Equipment:* Vehicle/axle stands



13. *Special Tool(s):* 303-1069

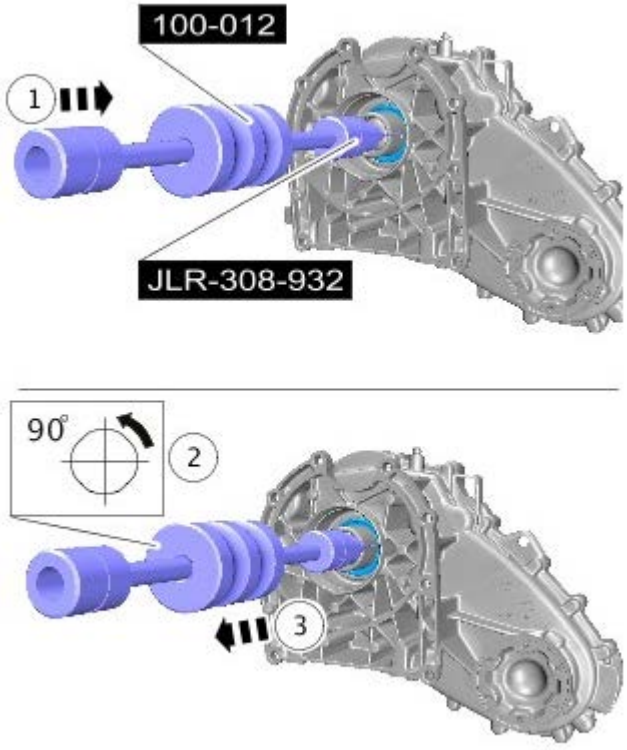


14. CAUTION: Do not carry out this step if a new transfer box is to be installed.



15. CAUTIONS:

Care must be taken to avoid damage to the seal register and running surface.



E156808

Do not carry out this step if a new transfer box is to be installed.

Special Tool(s): 100-012, JLR-308-932

Published: 09-Nov-2013

Transfer Case - Vehicles With: Single Speed Transfer Case - Transfer Case TDV6 3.0L Diesel

Installation

Special Tool(s)

	303-1069 Adapter, Wrench
	307-520 Installer, Output Shaft Seal
	JLR-308-930 Installer, Oil Seal

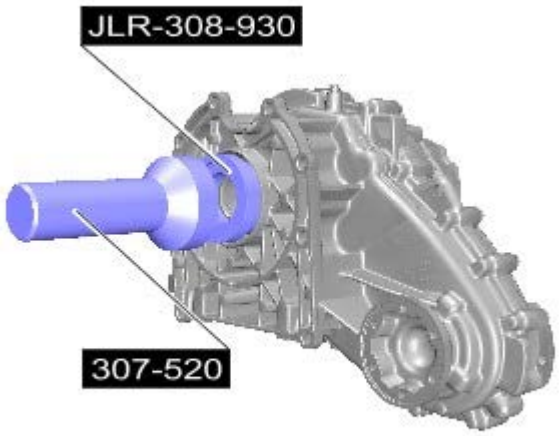
General Equipment

Transmission jack
Vehicle/axle stands
Wooden Block

NOTES:

Some variation in the illustrations may occur, but the essential information is always correct.

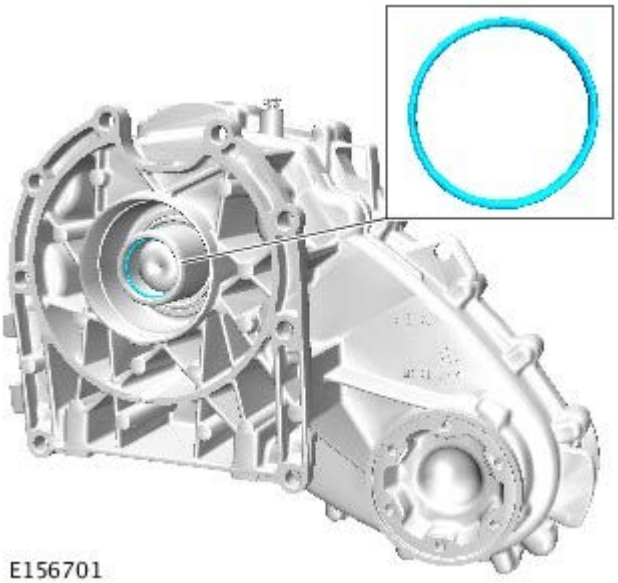
Component shown removed for clarity.



1. NOTE: This step is only required if previously removed.

   Special Tool(s): 307-520, JLR-308-930

2. NOTE: This step is only required if previously



E156701

removed.

3. NOTE: Do not carry out this step, if the component removed for access only.

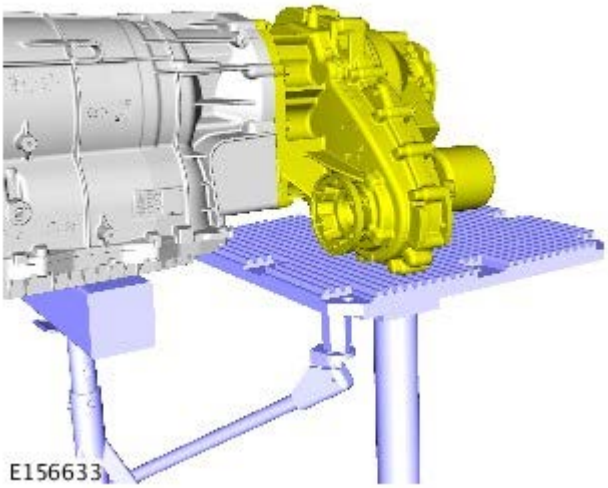
Torque: 75 Nm



E156693

4.

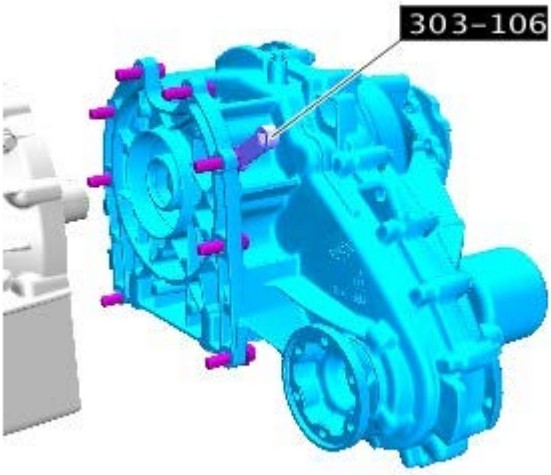
- Clean the component mating faces.
- Lubricate input shaft splines with 'Weicon TL7391' grease.
- *General Equipment:* Wooden Block
- *General Equipment:* Transmission jack
- *General Equipment:* Vehicle/axle stands



E156633

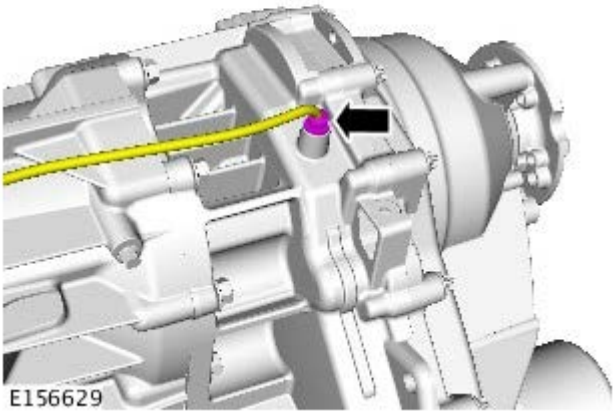
5.

- *Special Tool(s):* 303-1069
- *Torque:* 45 Nm



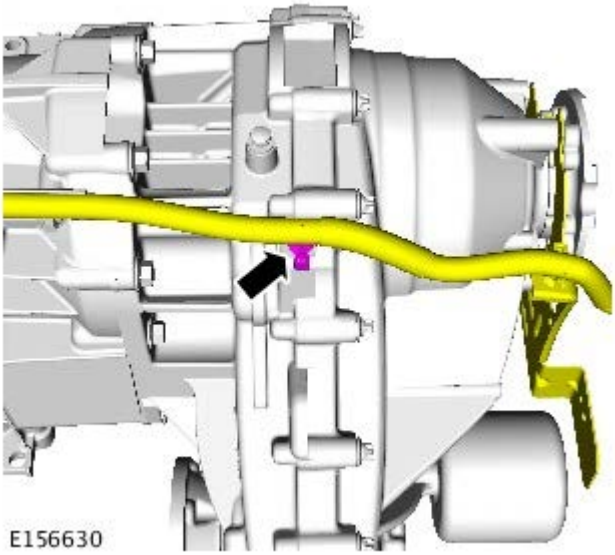
E156634

6.



E156629

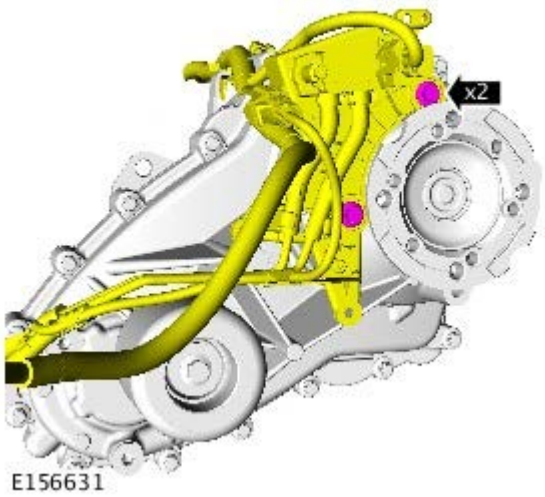
7.



E156630

8. Vehicles with diesel particulate filter (DPF).

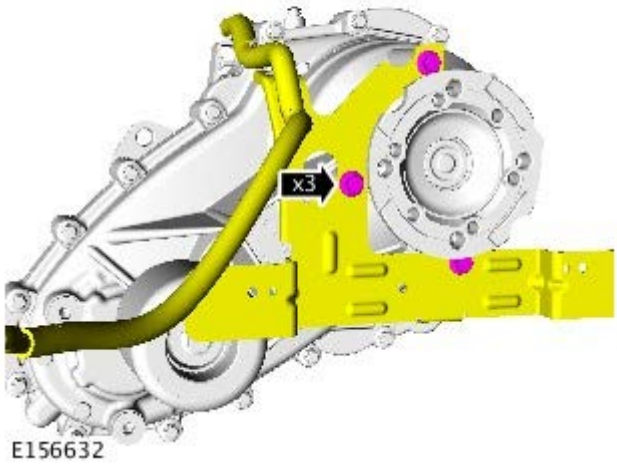
Torque: 25 Nm



E156631

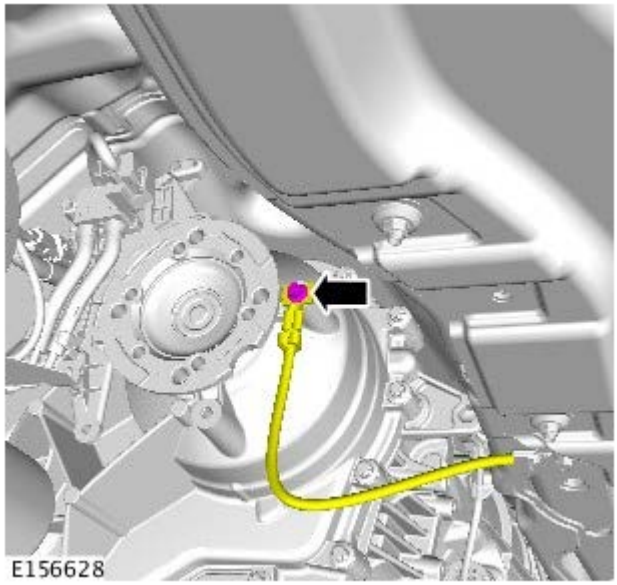
9. Vehicles without diesel particulate filter (DPF).

   Torque: 25 Nm



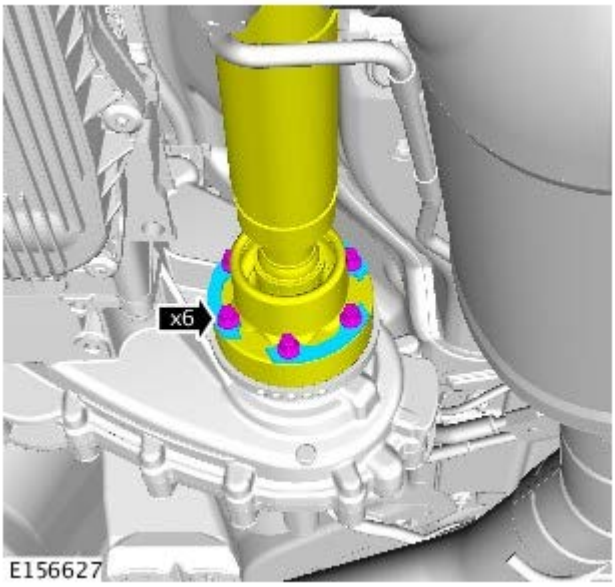
E156632

10. *Torque:* 25 Nm


E156628

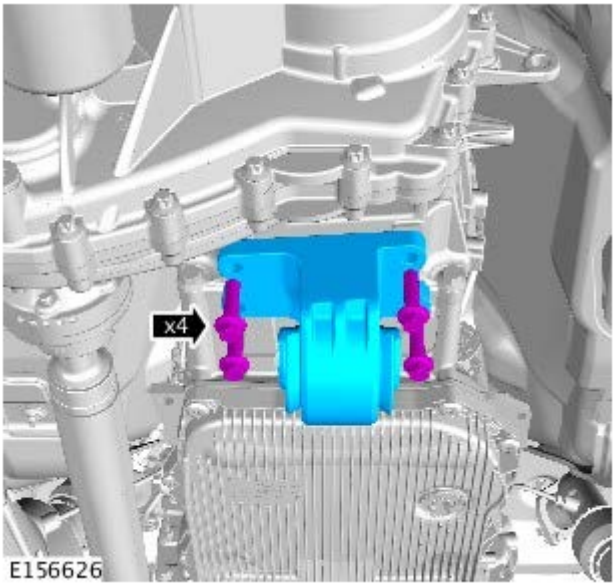
11. CAUTION: Make sure that new bolts are installed.

    Torque:
    Stage 1 45 Nm
    Stage 2 90 Nm



12. Refer to: Rear Driveshaft - TDV6 3.0L Diesel (205-01 Driveshaft, Removal and Installation).

13. *Torque:* 60 Nm



14. Refer to: Transmission Support Crossmember - TDV6 3.0L Diesel (502-02 Full Frame and Body Mounting, Removal and Installation).

15. NOTE: Do not carry out this step if the component removed for access only.

    Refer to: Transfer Case Draining and Filling (308-07B Transfer Case - Vehicles With: Single Speed Transfer Case, General Procedures).

16. Connect the battery ground cable.

    Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 09-Nov-2013

Transfer Case - Vehicles With: Single Speed Transfer Case - Transfer Case V6 S/C 3.0L Petrol

Installation

Special Tool(s)

	303-1069 Adapter, Wrench
	307-520 Installer, Output Shaft Seal
	JLR-308-930 Installer, Oil Seal

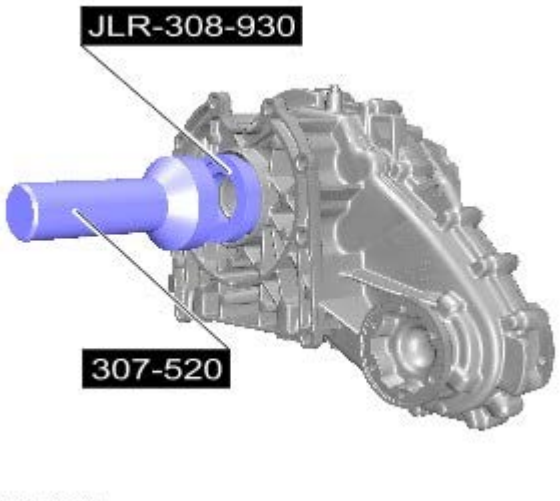
General Equipment

Transmission jack
Vehicle/axle stands
Wooden Block

NOTES:

Some variation in the illustrations may occur, but the essential information is always correct.

Component shown removed for clarity.

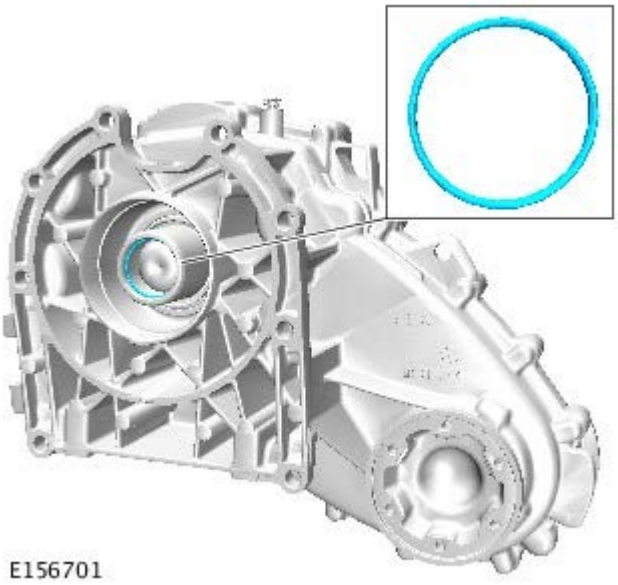


1. NOTE: This step is only required if previously removed.

   Special Tool(s): 307-520, JLR-308-930

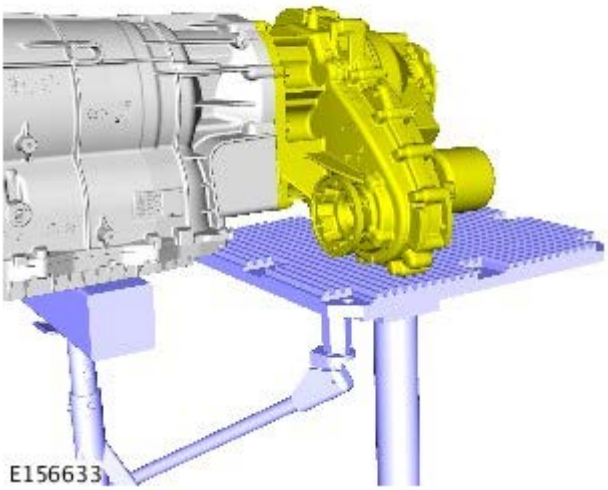
2. NOTE: This step is only required if previously

removed.


E156701

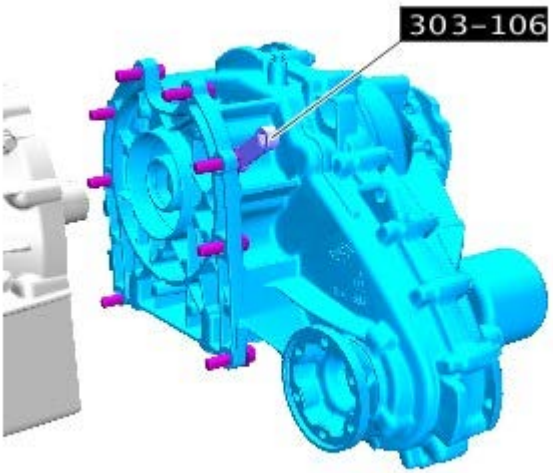
3.

- Clean the component mating faces.
- Lubricate input shaft splines with 'Weicon TL7391' grease.
- *General Equipment:* Wooden Block
- *General Equipment:* Transmission jack
- *General Equipment:* Vehicle/axle stands


E156633

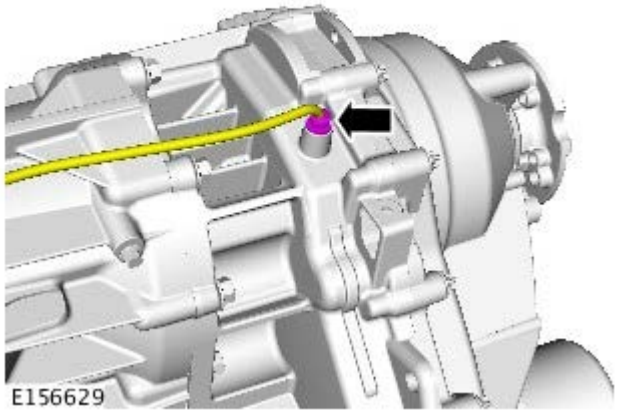
4.

- *Special Tool(s):* 303-1069
- *Torque:* 45 Nm

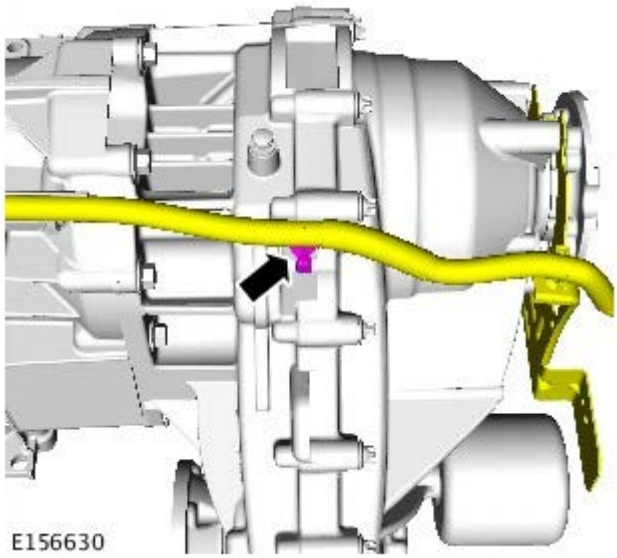


E156634

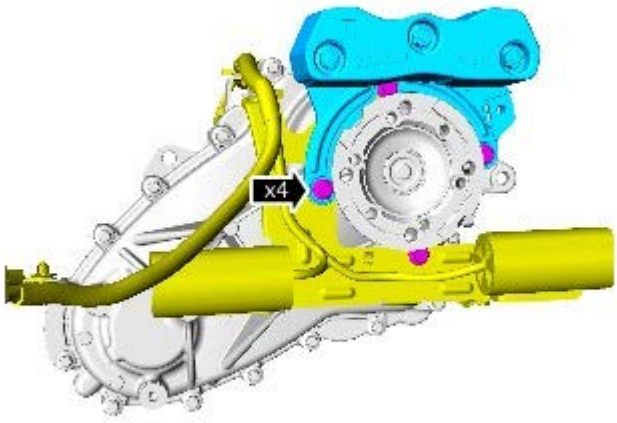
5.



6.

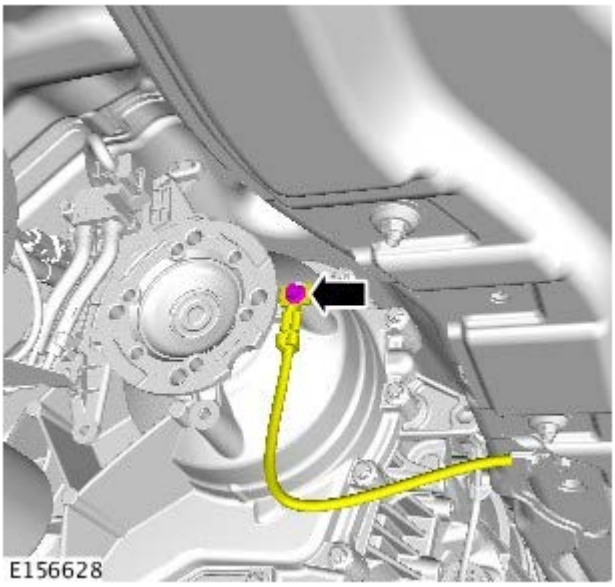


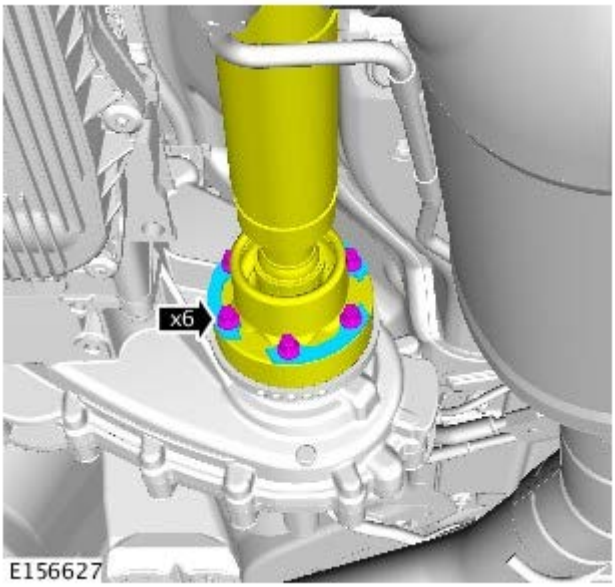
7. *Torque:* 25 Nm



E156639

8. *Torque:* 25 Nm



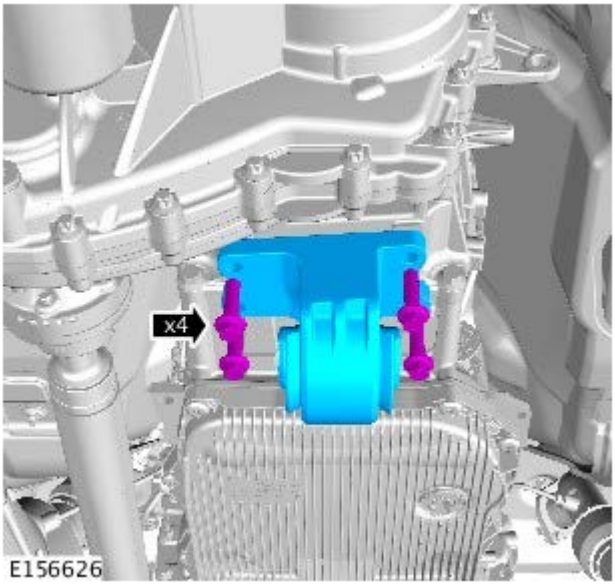


9. CAUTION: Make sure that new bolts are installed.

   Torque:
   Stage 1 45 Nm
   Stage 2 90 Nm

10. Refer to: Rear Driveshaft - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (205-01 Driveshaft, Removal and Installation).

11. *Torque:* 60 Nm



12. Refer to: Transmission Support Crossmember - V6 S/C 3.0L 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.

    Refer to: Transfer Case Draining and Filling (308-07B Transfer Case - Vehicles With: Single Speed Transfer Case, General Procedures).

14. Connect the battery ground cable.

    Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 17-Oct-2013

Transfer Case - Vehicles With: Twin Speed 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

CAUTION: * Do not use any lubricant other than that specified

Item	Specification
Model	DD295
Type	Two speed, permanent four wheel drive transfer box having synchronised low to high ratio 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 kph (0 mph)
Low to high ratio	60 kph (37.2 mph)

Torque Specifications

Description	Nm	lb-ft
Transfer case fluid drain plug	28	21
Transfer case fluid filler/level plug	28	21
Transmission support insulator to transfer case bolts	60	44
Transfer case to transmission bolts	45	33
Wiring bracket bolts	25	18
Earth strap bolt	25	18
+ Transfer case shift motor bolts	35	26
+ Transfer case clutch control solenoid bolts	5	4
+ Transfer case high / low range position sensor bolts	5	4
*** Front driveshaft to transfer case output flange:**		
Stage 1	45	33
Stage 2	Further 90°	Further 90°

*** New 'patched' Torx bolts must be installed.**

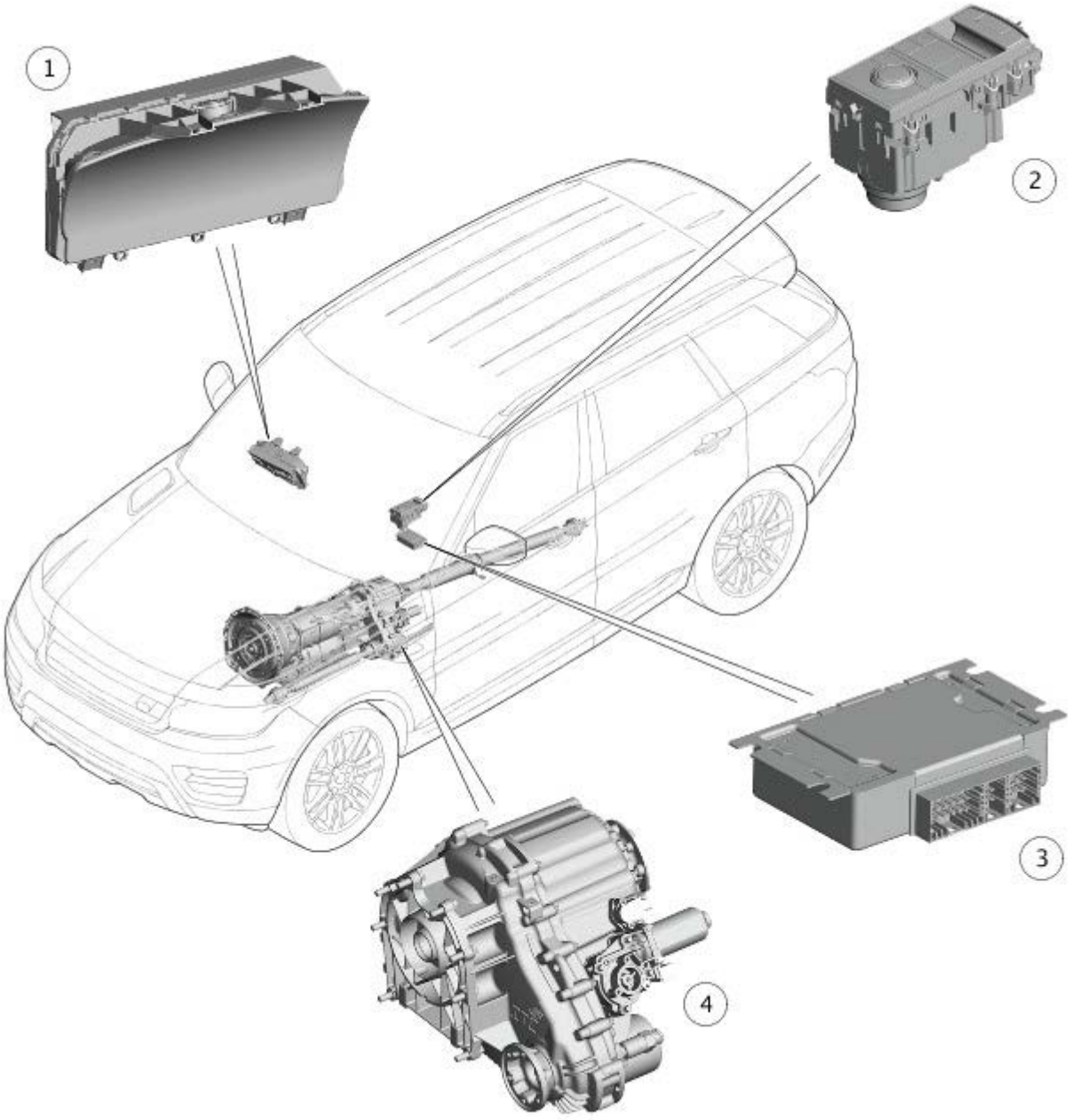
+ New bolts must be used when a new component is installed.

Published: 23-Jan-2014

Transfer Case - Vehicles With: Twin Speed Transfer Case - Transfer Case

Description and Operation

COMPONENT LOCATION



E161331

Item	Part Number	Description
1	-	Instrument Cluster (IC)
2	-	Terrain Response switchpack
3	-	Transfer Case Control Module (TCCM)
4	-	Transfer Case

OVERVIEW

The DD295 transfer case is full time, permanent four-wheel-drive unit, with 50/50 torque distribution to the front and rear driveshafts. The transfer case is identical for all engine derivatives and supports the following features:

- Permanent four-wheel-drive with a bevel gear center differential, providing a 50:50 torque split
- Selectable high and low range for optimum on-road and off-road performance
- 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.

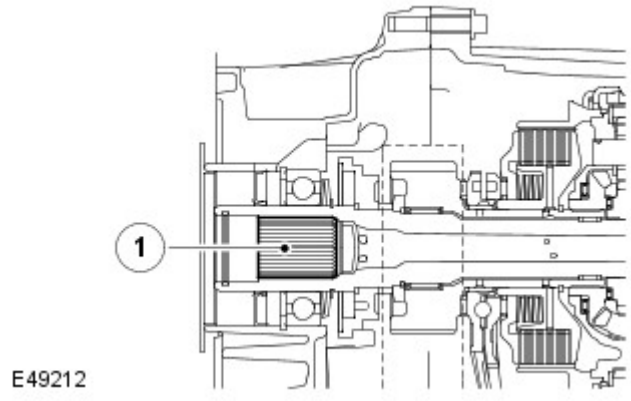
The unit is located under the vehicle and is mounted on the cross-member, behind the transmission.

The 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 transfer case is equipped with an electronically controlled locking and torque-biasing device. This device detects wheel slip via various vehicle system inputs to the Transfer Case Control Module (TCCM) 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. 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.

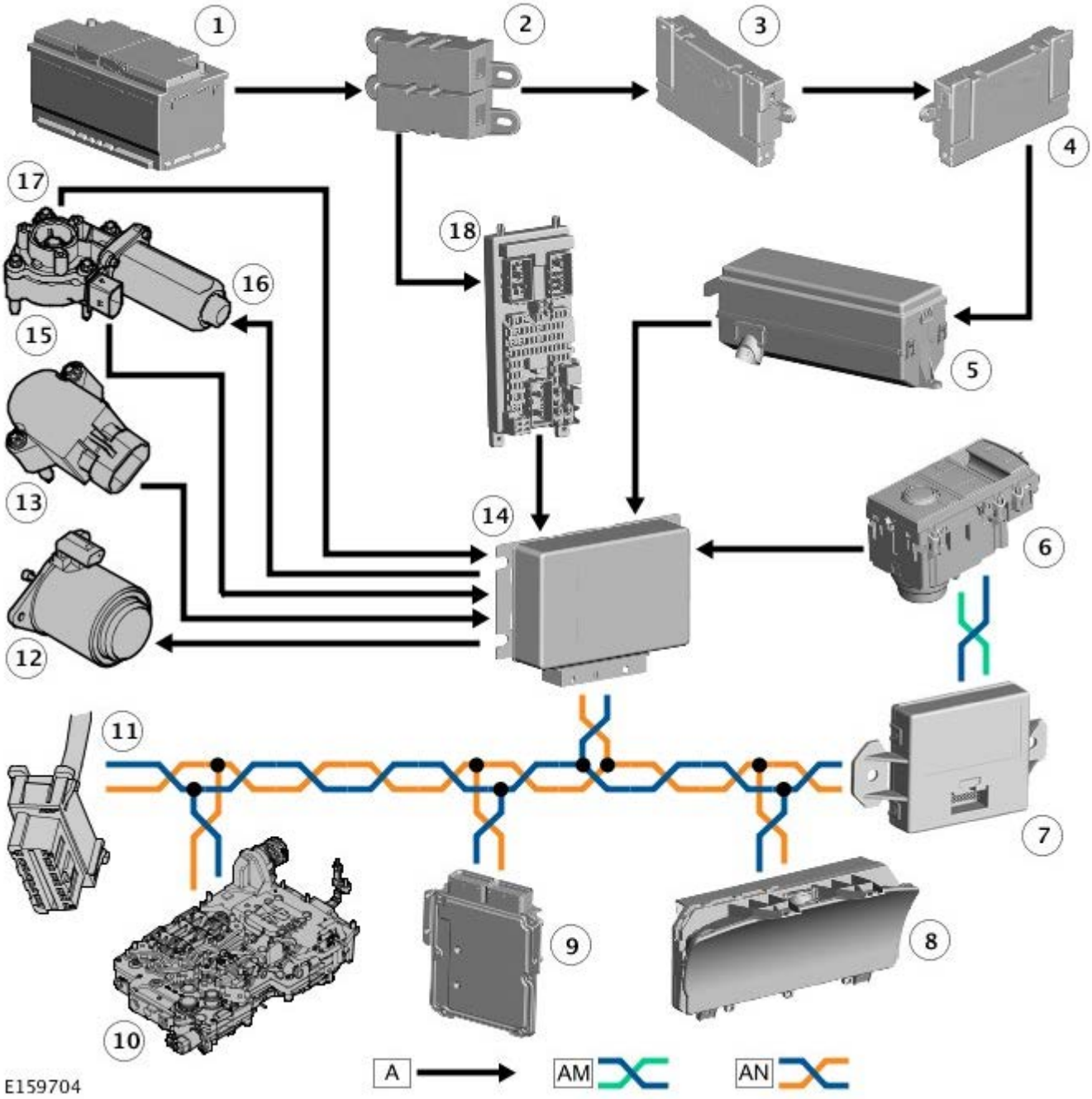
The oil used in the transfer case is specially developed and contains unique additives, which enhance the transfer case operation. No other oil must be used in the transfer case.

A unique type of grease, Weicon anti-seize montagepaste grau TL 7391, must be applied to the transfer case input shaft spline when installing the transfer case.



Item	Part Number	Description
1	-	Input shaft spline

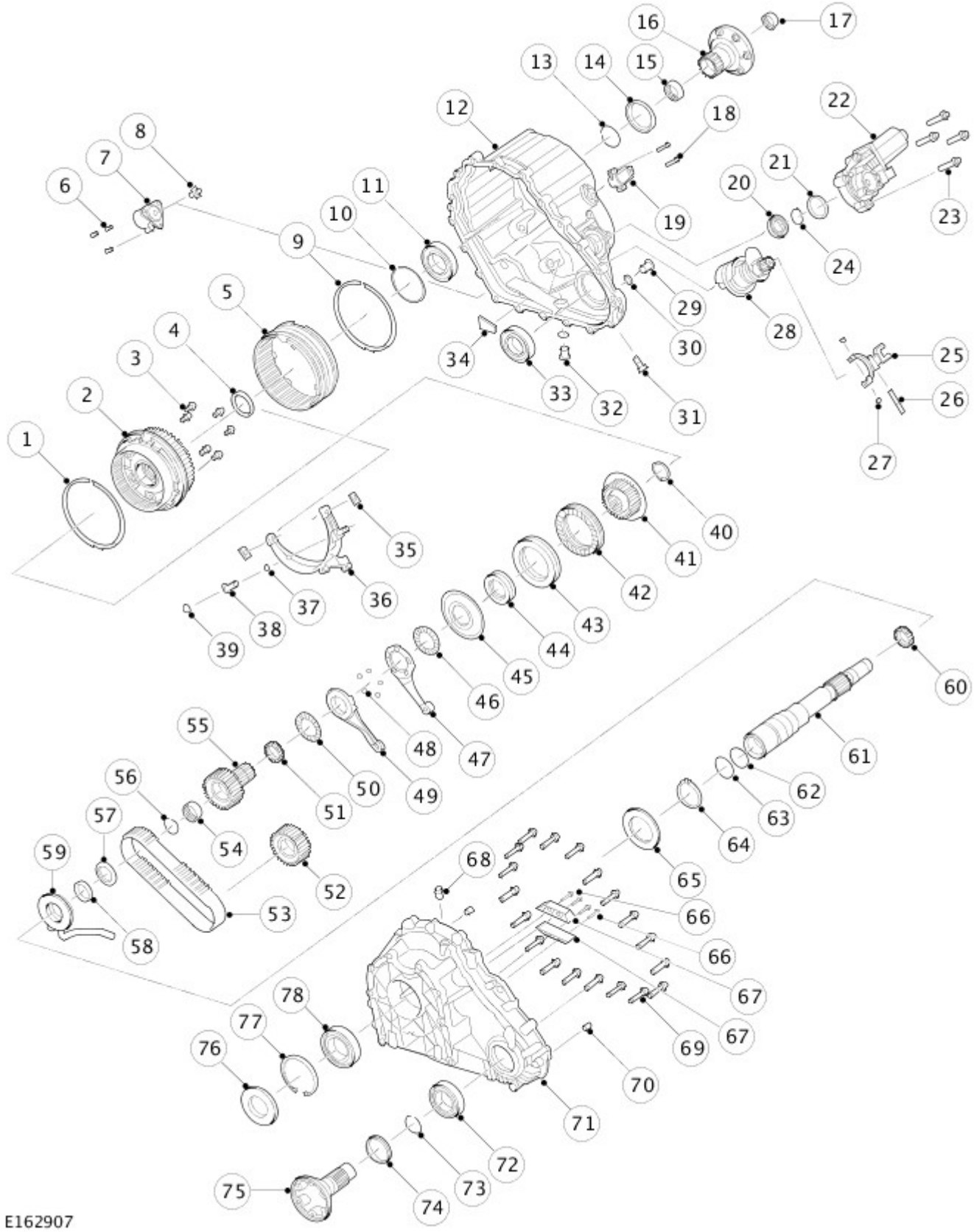
Control Diagram



Item	Part Number	Description
1	-	Battery
2	-	Battery Junction Box 2 (BJB2)
3	-	Battery Junction Box (BJB)
4	-	Auxiliary Junction Box (AJB)
5	-	Engine Junction Box (EJB)
6	-	Terrain Response® Switchpack (TRS) (incorporating range switch)
7	-	Gateway Module (GWM)
8	-	Instrument Cluster (IC)
9	-	Engine Control Module (ECM)
10	-	Transmission Control Module (TCM)
11	-	Diagnostic socket
12	-	Solenoid
13	-	High/Low range position sensor
14	-	Transfer Case Control Module (TCCM)
15	-	Temperature sensor
16	-	Transfer case motor
17	-	Transfer case motor Hall sensors (speed and direction)
18	-	Central Junction Box (CJB)

DESCRIPTION

Transfer Case Exploded View

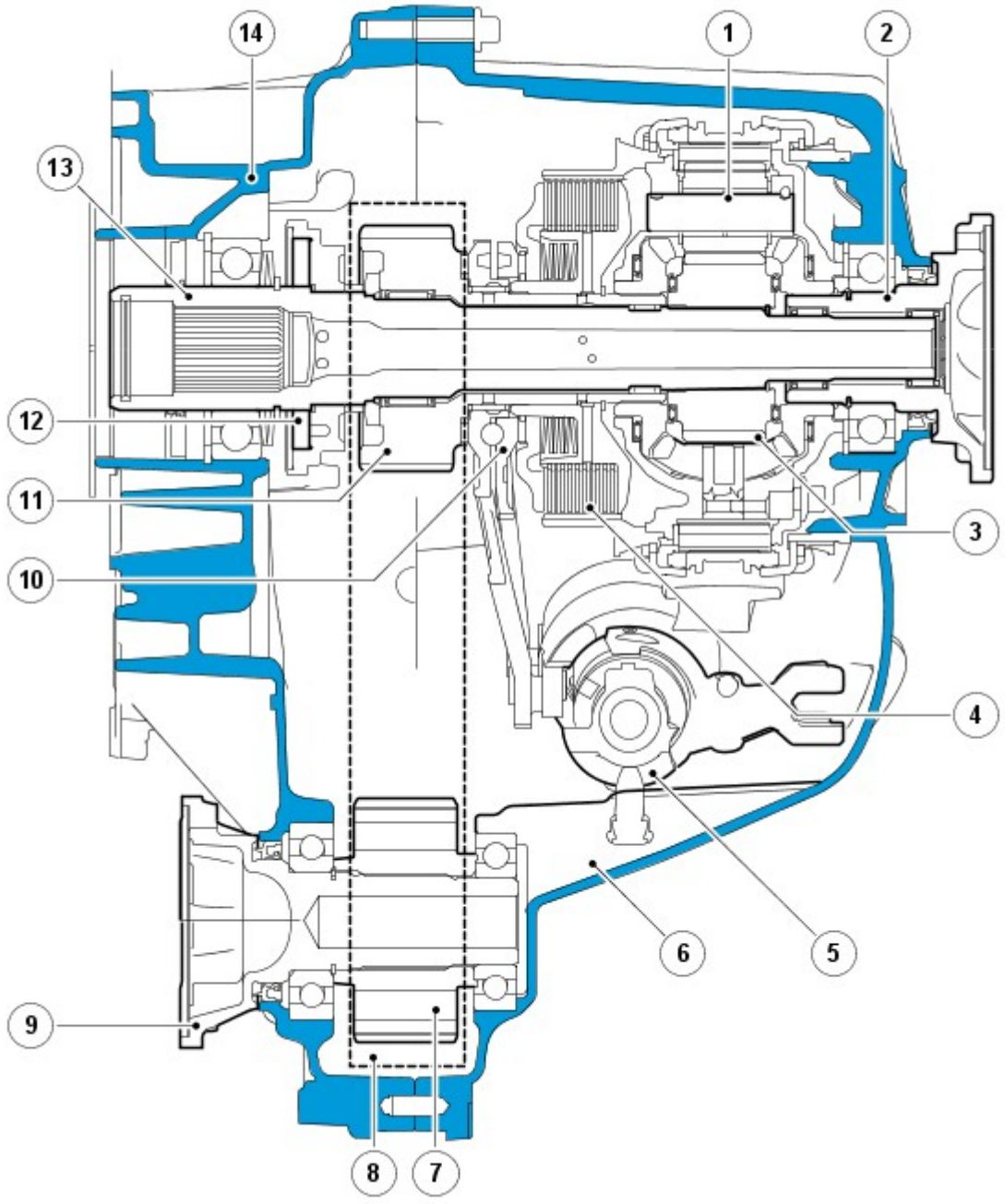


Item	Part Number	Description
1	-	Synchronisation spring
2	-	Differential assembly
3	-	Bolt, 6 off
4	-	Spacer ring
5	-	Shifting sleeve
6	-	Bolt, 3 off
7	-	Solenoid
8	-	Shifting element

9	-	Synchronisation spring
10	-	Circlip
11	-	Ball bearing
12	-	Rear casing
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 case 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 case motor lever assembly
48	-	Ball, 5 off
49	-	Transfer case 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	-	Retaining ring
63	-	O-ring
64	-	Circlip
65	-	Shim
66	-	Screw (2 off)
67	-	Snubber
68	-	Breather cartridge
69	-	Bolt, 19 off

70	-	Dowel pin (2 off)
71	-	Front casing
72	-	Bearing
73	-	Circlip
74	-	Seal ring
75	-	Front output flange
76	-	Seal ring
77	-	Circlip
78	-	Bearing

Transfer Case - Sectional View

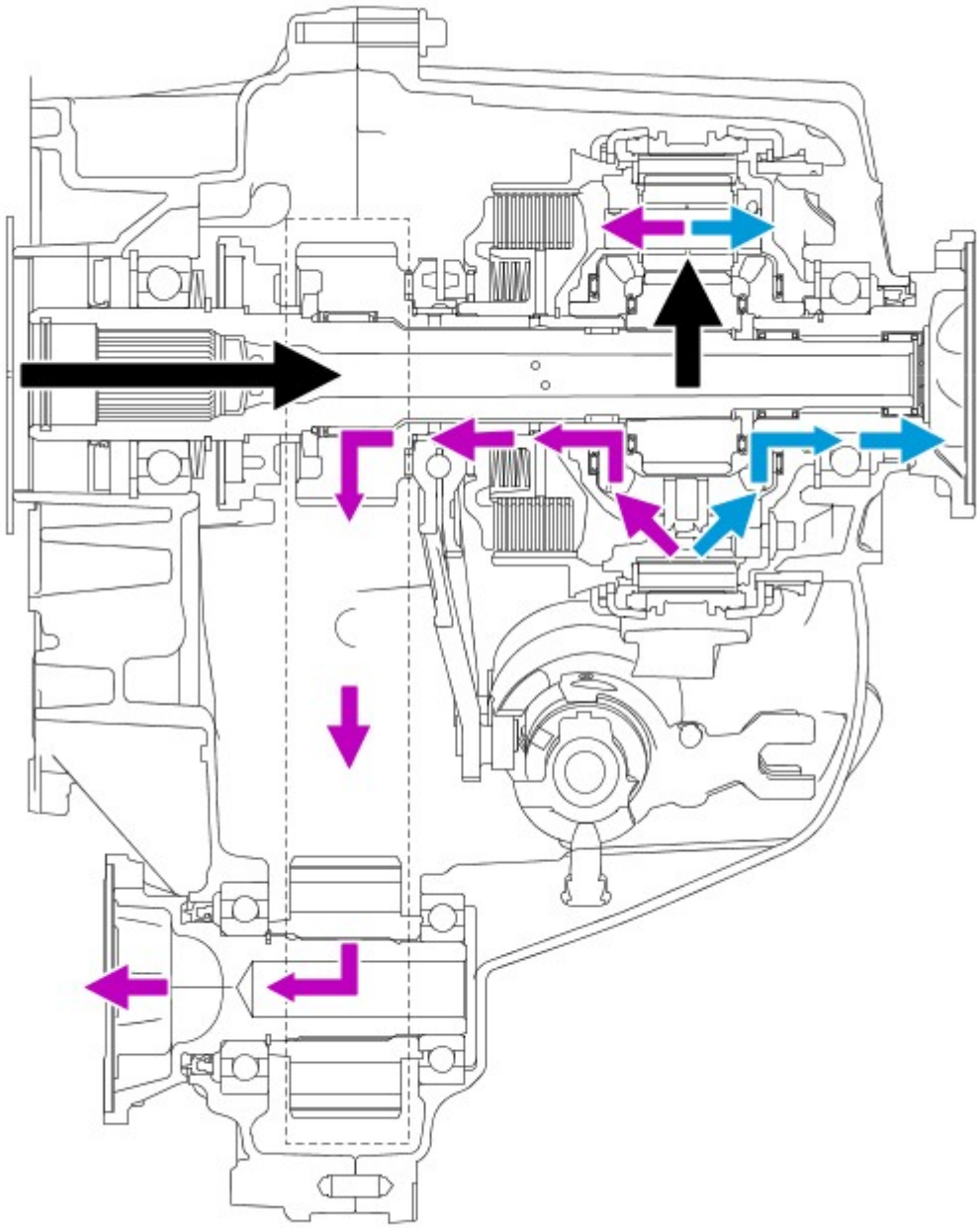


E49191

Item	Part Number	Description
1	-	Planetary gear set
2	-	Rear output flange
3	-	Center differential assembly
4	-	Multi-plate clutch
5	-	Transfer case motor
6	-	Rear housing assembly
7	-	Front output sprocket
8	-	Chain drive
9	-	Front output flange

10	-	Transfer case motor levers
11	-	Sprocket
12	-	Oil pump assembly
13	-	Input shaft
14	-	Front housing assembly

Transfer Case Power Flow



E49192

Input torque from the transmission is transferred to the input shaft of the transfer case 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 case. 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.

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, 2 lifting eyes and a breather cartridge for the transfer case breather pipe. The breather pipe allows an equalization between atmospheric and internal transfer case pressure.

The front casing has an additional boss cast on the inside. The boss is used to mount two snubbers - one on drive side of the chain and one on the coast side - which are secured with 2 screws. The snubbers are suppressing chain vibrations which can occur under medium acceleration conditions, therefore improving NVH (Noise, Vibration and Harshness) issues. During normal operation the chain does not contact the snubbers.

Rear Casing Assembly

The rear casing assembly provides the location for the rear output flange bearing, the transfer case motor and the oil fill and drain plug. Fins are cast into the rear casing assembly to improve heat dissipation. The part number & serial number are printed on a bar code label.

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 2 casing assemblies. The collector magnet in the suction area of the pump collects any metallic debris.

Chain Drive

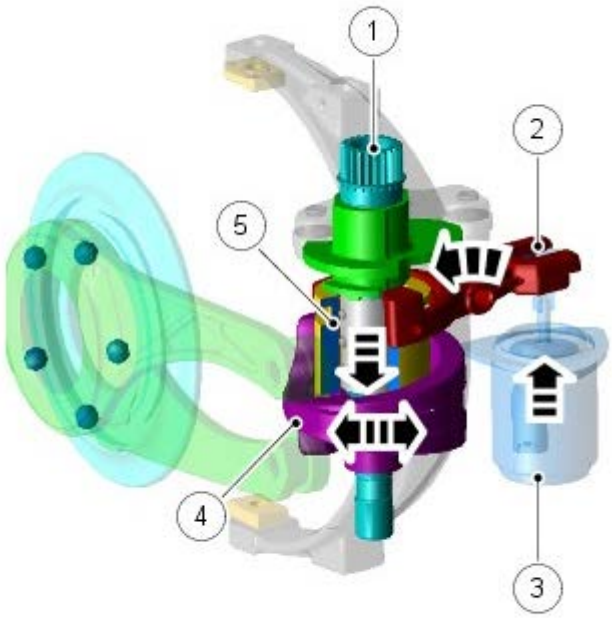
The chain-drive transfers drive from the center differential to the front output flange. A 3/8" pitch chain connects the sprocket on the transfer case input shaft with the sprocket on the front output flange. As both sprockets have the same number of teeth, the rotational speed of both sprockets is identical.

NOTE: When installing or replacing the chain, the BLUE guide links must be facing the clutch pack, towards the rear output flange.

Transfer Case 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 2 functions, while the motor provides the rotational movement for both operations.

Transfer Case Motor Position For Clutch Control Mode



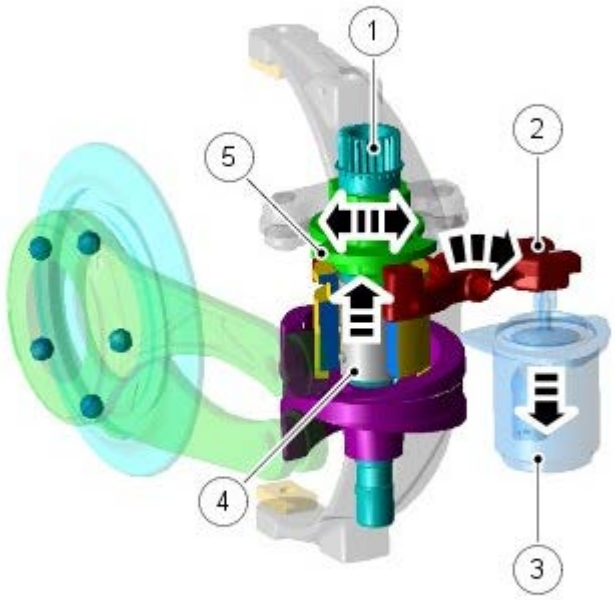
E49193

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 TCCM energizes the solenoid. The solenoid pin pivots the solenoid shift fork, which engages the shifting sleeve into the dog teeth on the clutch control disc. The rotational movement of the motor shaft is then linked to the clutch control disc via the shifting sleeve.

This is the normal operating mode of the transfer case. In this position, the range change function is disengaged and mechanically locked.

Transfer Case Motor Position For High/Low Range Mode

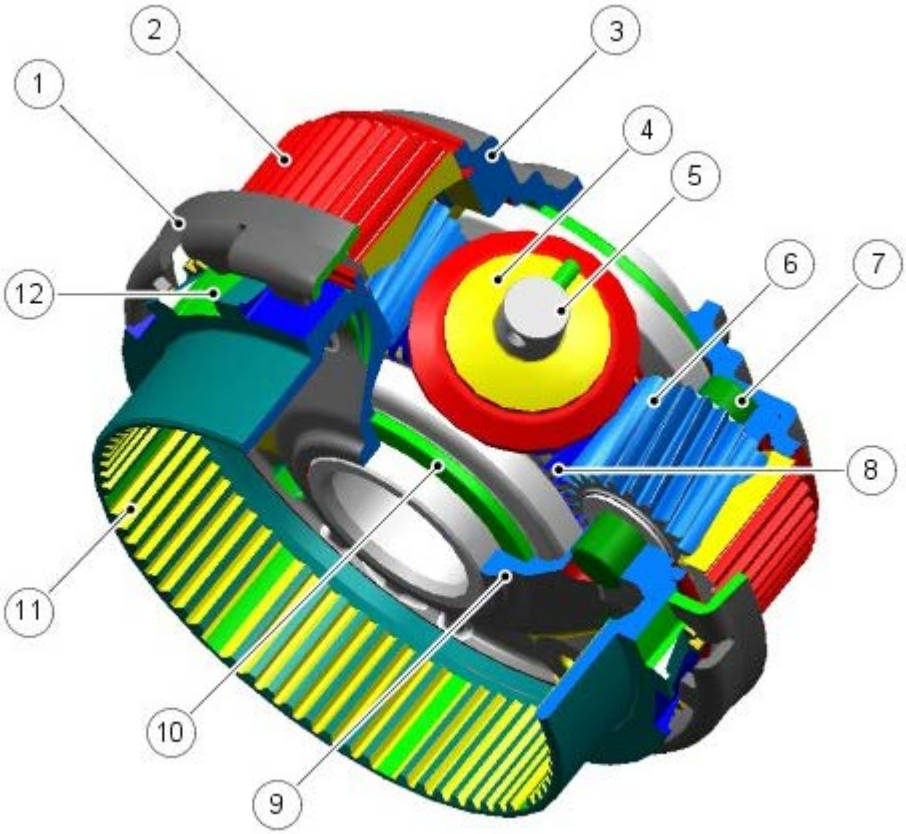


E49194

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 TCCM de-energizes the solenoid. A spring in the solenoid retracts the solenoid pin and rotates the solenoid shift fork. This engages the shifting sleeve to the dog teeth on the high/low actuation cam. The rotational movement of the motor shaft 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.



E49195

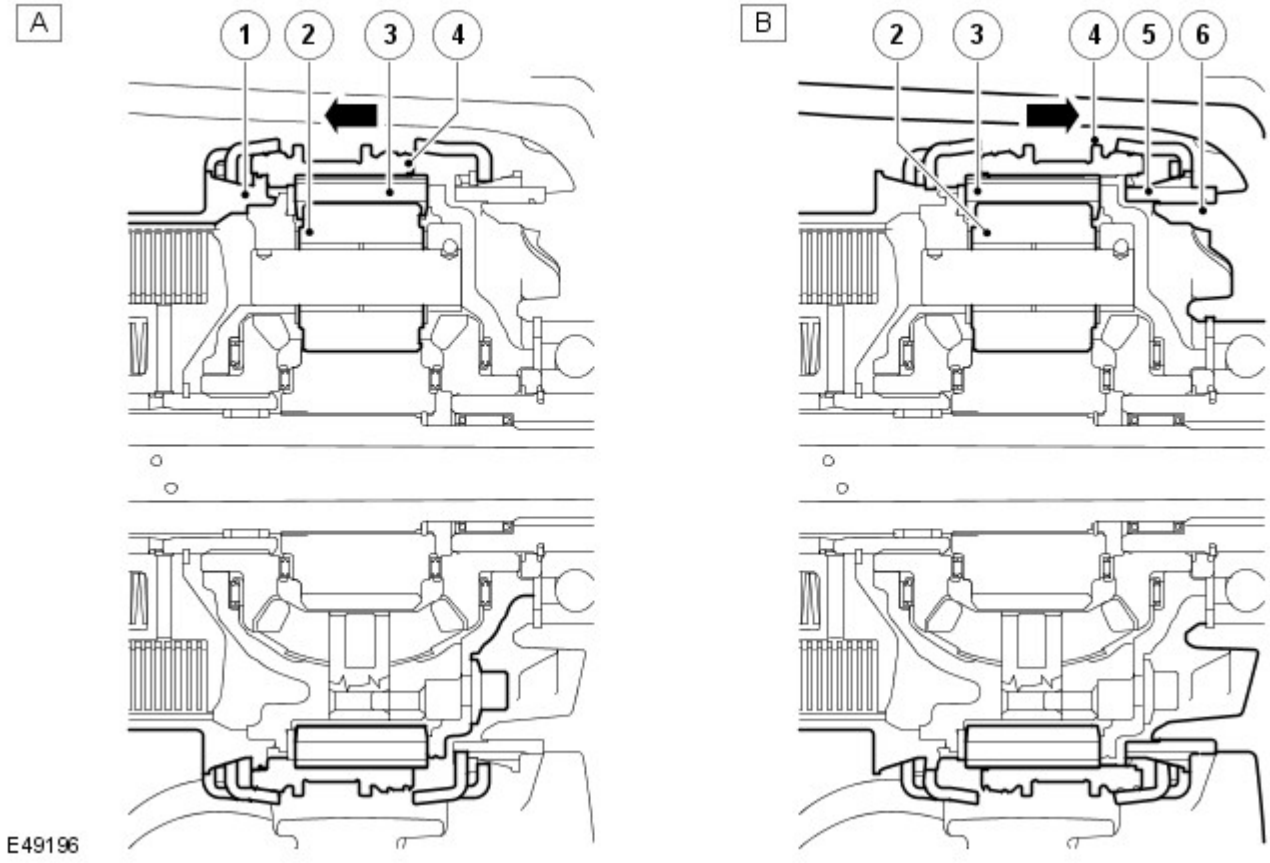
Item	Part Number	Description
1	-	Synchronisation cup and spring
2	-	Planetary ring gear
3	-	Differential carrier
4	-	Pinion gears
5	-	Pinion gear shafts
6	-	Planetary pinion gears
7	-	Planetary pinion gear shafts
8	-	Planetary sun gear
9	-	Differential cover
10	-	Differential side gears
11	-	Multi-plate clutch basket
12	-	Dogteeth

The center differential assembly is the primary feature of the transfer case. 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 center differential assembly.

The assembly comprises 3 differential pinion gears and shafts, which are equally spaced within the center differential carrier. The differential shafts have a rigid connection to the differential carrier. Located between the pinion gears are 3 planetary pinion gears and shafts. The planetary sun gear and 2 differential side gears are located in the center line of the carrier.

The planetary ring gear is supported in both directions by the differential casing and the differential cover. The planetary ring gear is connected to a shifting sleeve, which is engaged in either high or low range.

The multi-plate clutch basket, which is welded to the differential casing, supports the friction plates, the dogteeth for high range engagement and the synchronisation cup and spring for the 'shift-on-the-move' function.

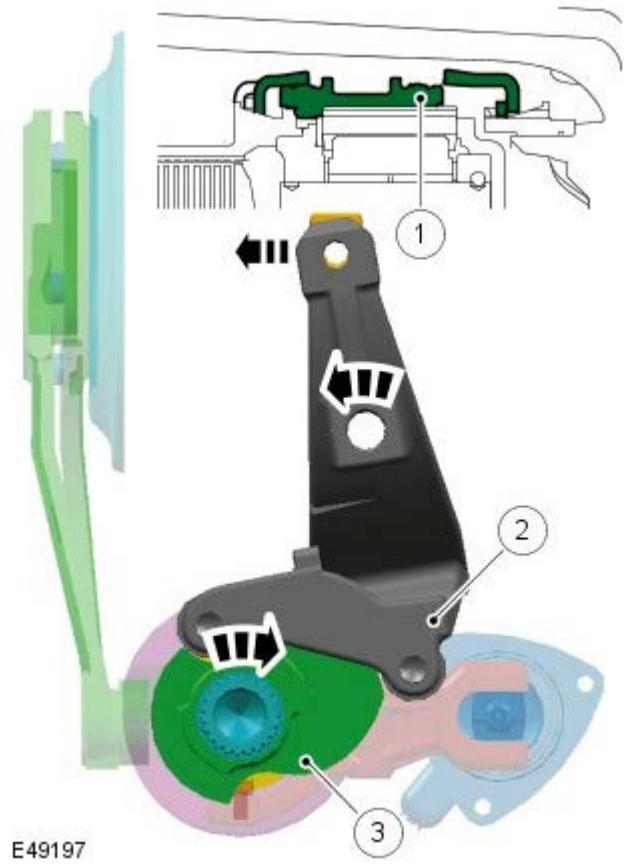


Item	Part Number	Description
A	-	High range position
B	-	Low range position
1	-	Dogteeth
2	-	Planetary pinion gears
3	-	Planetary ring gear
4	-	Shifting sleeve
5	-	Low range dogteeth
6	-	Rear carrier assembly

When high range is engaged, the shifting sleeve connects to the differential carrier via dog teeth. The planetary ring gear, via the shifting sleeve, and the planetary pinion gears, 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 in the direction of the low range dog teeth. The low range dog teeth, with the synchronisation cup and spring, are fixed to the rear carrier assembly. When the shifting sleeve is engaged with the low range dogteeth, the planetary ring gear, via the shifting sleeve, is stationary and the planetary pinion gears, via the planetary bolts, turn the differential side gears with 2.93: 1 ratio.

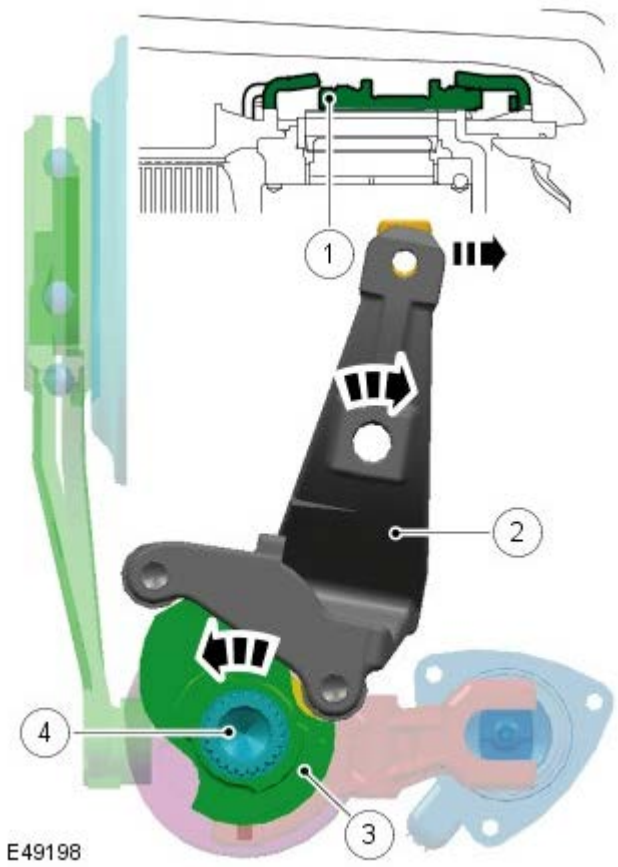
High Range Actuation Sequence



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 to high range position. The shifting cam then moves the shifting sleeve, via the high/low shifting fork, into the high range position. After the synchronisation sequence, the planetary ring gear is connected to the high range dog teeth, 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.

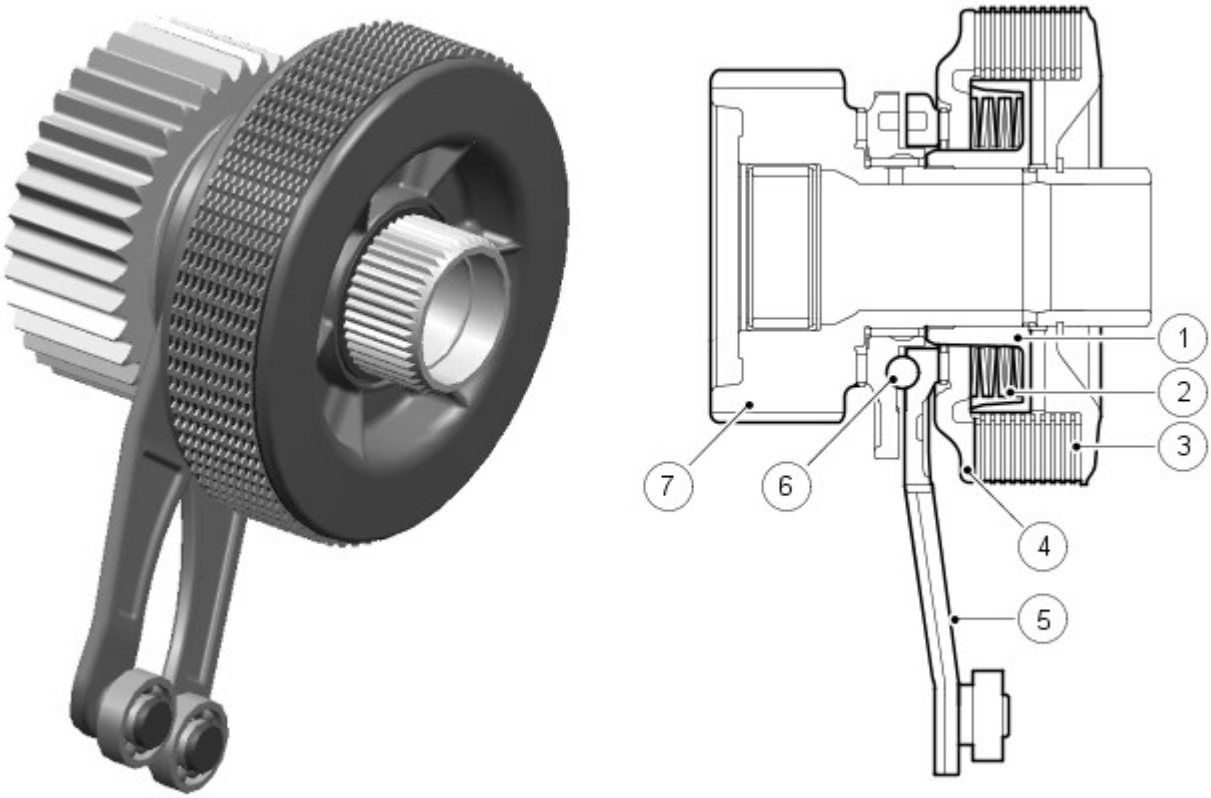
Low Range Actuation Sequence



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 turns the shifting cam into low range position. The shifting cam then moves the shifting sleeve of the center differential assembly via the high/low shifting fork into low range position. After the synchronisation sequence, the planetary ring gear is connected to the low range dog teeth, via the shifting sleeve, on the rear carrier assembly. The output speed is then reduced to a ratio of 2.93:1.

Multiplate 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 multiplate clutch assembly for both center and rear differentials act in a similar way. The aim of the multiplate clutch assembly is to prevent excessive differential slip and therefore maximize 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 ABS (Anti-lock Brake System). The TCCM 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.

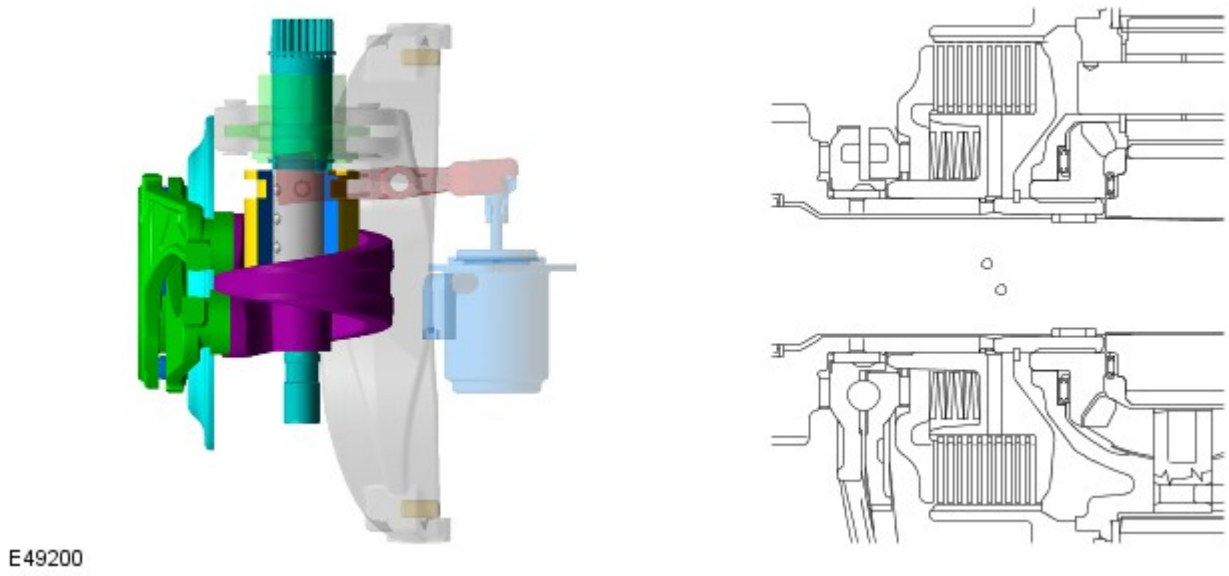
The multiplate clutch assembly actively controls the torque flow through the center differential and optimizes the torque distribution in the driveline. The clutch assembly biases the torque from the transmission to the axle and wheels with the higher grip and prevents the wheels with the lower grip from spinning.

The multiplate clutch assembly comprises the sprocket, which is connected to the front differential side gear, the motor levers with the ball ramp mechanism, the clutch hub as support for the clutch plates, the clutch piston to generate friction between the clutch plates, and a pack of cup springs 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 center differential housing.

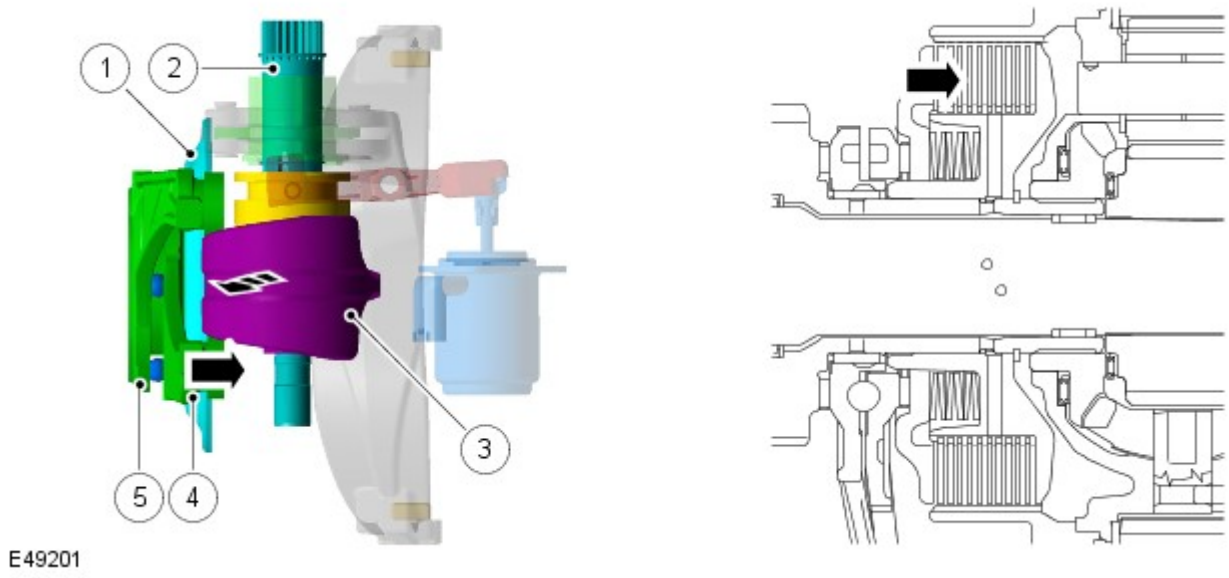
Multiplate Clutch Actuation

Transfer Case Motor Levers in initial position, multiplate clutch open condition



E49200

Transfer Case Motor in end position, multiplate clutch closed condition

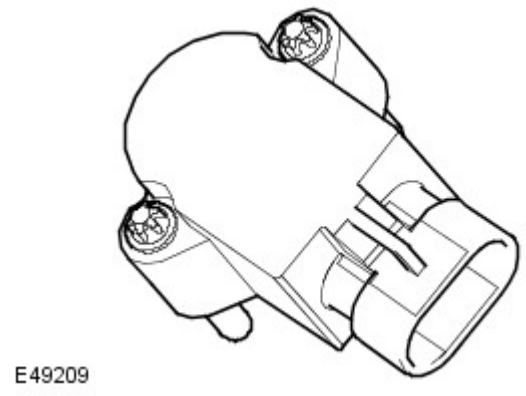


E49201

Item	Part Number	Description
1	-	Clutch piston
2	-	Motor shaft
3	-	Clutch control disc
4	-	Motor levers
5	-	Ramp mechanism balls

High/Low Range Position Sensor

By turning the clutch control disc, via the motor shaft, the motor levers are rotated relative to each other. This relative movement acts on 5 balls in a ramp mechanism between the 2 levers and give a defined axial movement. The movement forces the clutch piston 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.



The high/low range 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 TCCM checks this signal and informs the driver, via the IC and the range change switch Light Emitting Diode (LED), if a range change is in progress or has been completed.

The high/low range position sensor is connected to the TCCM via a 3-pin connector.

Transfer Case Motor

The transfer case motor provides the necessary movement to perform the high/low range change and the multiplate 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 TCCM with an 8-pin connector; the power supply of the motor is maintained through 2 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. the sensor is connected to the TCCM.

Solenoid

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 retracts 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 the Land Rover approved diagnostic system.

The solenoid is connected to the TCCM with a 2-pin connector.

Range Status Indication

The low range status indicator has an LED illuminated mountain symbol on the switch and has the following logic:

- LED on = low range
- LED off = high range
- LED flashing = range change in progress/range undefined/range fault.

There will also be a message displayed in the message center, which can also inform the driver of any faults with the transfer case.

The following table shows the messages that can be displayed in the message center relating to the transfer case:

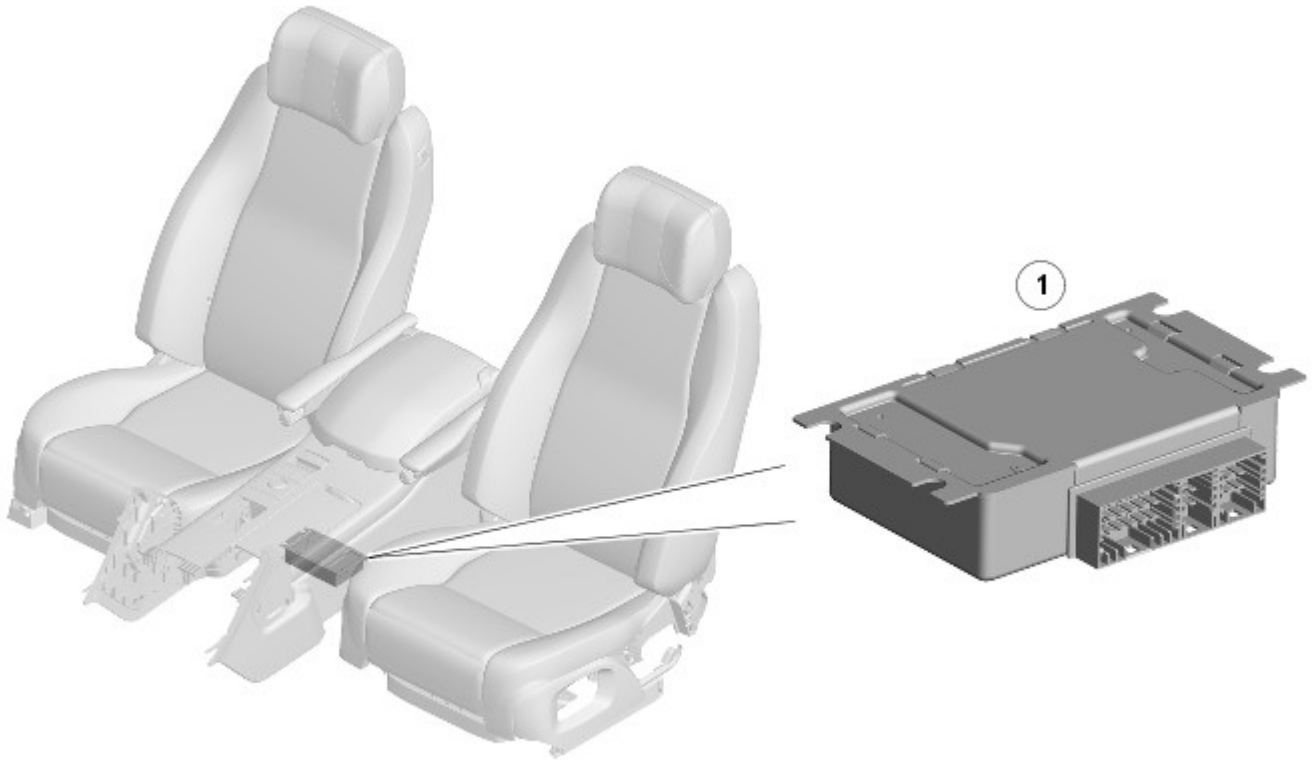
Message	Description	Chime
'LOW RANGE SELECTED'	Transfer case has engaged low range after a range change request	None
'HIGH RANGE SELECTED'	Transfer case has engaged high range after a range change request	None
'SPEED TOO HIGH FOR RANGE CHANGE'	Range change request when vehicle speed too high	Single
'SELECT NEUTRAL FOR RANGE CHANGE'	Range change request when lever not in neutral	Single
'APPLY PARK BRAKE' (PARKING BRAKE US/CAN)	This alerts the driver that the transmission park lock function is inoperative due to transfer case out of high or low range.	Continuous
	TCCM has stopped transmitting on the CAN bus during a range change or while in neutral and as a result the transmission park lock function is inoperative.	
'GEARBOX OVERHEATING'	Center differential temperature is approaching the over heated threshold.	None
'GEARBOX FAULT'	Center differential has failed - operating as an open differential.	None
	TCCM has stopped transmitting on the CAN bus and defaults to open center differential.	

The following conditions may generate a message and/or a warning indicator and may be accompanied by a chime:

TRANSFER CASE CONTROL MODULE (TCCM)

The TCCM controls the high/low 'shift-on-the-move' actuation and the multiplate clutch actuation. The TCCM is located

below the floor console stowage compartment.



E148820

Item	Part Number	Description
1	-	Transfer Case Control Module (TCCM)

The TCCM is connected to the High Speed (HS) Controller Area Network (CAN) chassis systems and controls transfer case operation using HS (HS) CAN messages from other system control modules. The TCCM receives a permanent power supply via a 30A fusible link located in the Engine Junction Box (EJB), and an ignition supply via a 5A fuse and the ignition relay in the Central Junction Box (CJB).

The TCCM memorizes the position of the transfer case motor when the ignition is off (power mode 0).

The TCCM uses the same actuator to control both range change functions and application of center differential locking torque. The TCCM 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 TCCM uses 3 connectors for all inputs and outputs.

The TCCM uses a series of programmed shift maps to control the synchronization speed and ensure that a maximum shift time of approximately 1 second is achieved.

If the TCCM is replaced, the Land Rover approved diagnostic system must be connected to the vehicle and the TCCM self-calibration procedure must be performed. This procedure must also be performed if the transfer case motor assembly is replaced.

Default/Limp-home Strategy

If a fault occurs with the transfer case, the TCCM or one of the required input signals (for example road speed signal), the TCCM records a DTC (diagnostic trouble 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	Warning indicator and/or 'GEARBOX OVERHEATING' message in message center
Clutch control not possible. Permanent fault	The tractive capability of the vehicle, off road, is reduced	Warning indicator and/or 'GEARBOX FAULT' message in message center

Stuck in Transfer case neutral	The transfer case is stuck between high and low range resulting in no drive to wheels	Flash low range indicator plus 'APPLY PARK BRAKE' (PARKING BRAKE US/CAN) message in message center to apply electric park brake. The message will only display at times when it is deemed safe or necessary for the electric park brake to be applied. It will not display during normal driving for example

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 two range changes are attempted (high range to low range and low range to high range) within 1 minute and ambient temperature is below 0ºC (32ºF), the TCCM will inhibit further range changes for 1 minute. This is to protect the transfer case due to the high current required to change range due high viscosity of the transmission oil in cold temperatures. This is correct operation and is not due to a fault, a warning indicator or message will not be displayed.

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 case to fail in neutral, the TCCM 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 LED 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, turn the ignition off (power mode 0) for 30 seconds, restart the engine and request range change again while stationary. The driver must seek service assistance at the earliest opportunity.

Transfer Case Control Module Inputs/Outputs

The TCCM receives the following inputs:

- Range change selection switch
- High/low position sensor
- Transfer case motor temperature
- Transfer case motor position sensor
- HS CAN bus messages.

The TCCM sends the following outputs:

- HS CAN bus messages
- High/low range change LED
- Transfer case motor
- Solenoid.

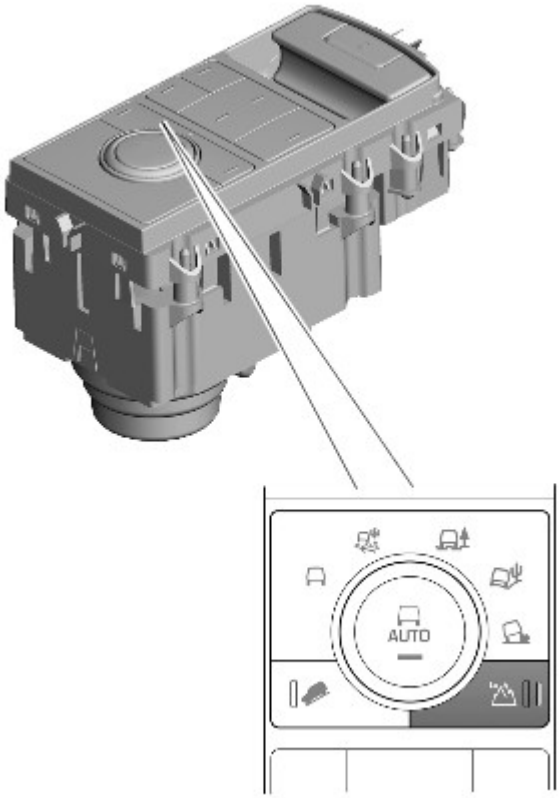
CAN Messages

The TCCM is connected on the HS CAN chassis systems and controls transfer case operation using HS CAN messages received via the gateway module from other system control modules. 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 TCCM.

In the event of a HS CAN bus failure, the following symptoms may be observed:

- Shift from high to low or low to high inoperative
- IC low range warning lamp inoperative
- Warning messages or indicator lamps displayed in IC.

Range Change Selection Switch



E148819

The range change selection switch is located in the Terrain Response (TR) switchpack, in the floor console. The switch is a momentary switch. A single press of the switch will initiate the range change, the transfer case will then change to the other available range. A second press of the switch will revert back to the previously selected range.

When the switch is pressed, it completes a momentary connection to 12V with the TCCM. The TCCM receives this momentary signal and attempts a range change.

The switch is also connected to the HS CAN bus to the TCCM for control of the switch LED.

High/Low Range Change LED

The LED is connected to the Terrain Response switchpack and the TCCM is responsible for illuminating the range change LED in the switch via the HS CAN bus.

When the transfer case is in high range, the switch LED is not illuminated.

When changing range, the LED will flash on until the new range status has been achieved.

When changing range the LED will start flashing only when the range change has commenced (for example speed and neutral conditions have been met). If low range is selected, the LED will be illuminated continuously once the change to low range is complete. The LED flash rate is 2 Hz with a 50% duty cycle.

The LED has 2 levels of intensity, high when the vehicle lights are switch off and low when they are switched on.

If LED is flashing at 0.5 Hz, this would indicate a transfer case fault or that the transfer case is in undefined range and may require calibration.

OPERATION

High Range Operation

In high range, the torque input from the transmission is passed to the transfer case input shaft. The position of the synchronizer sleeve couples the shaft directly to the differential housing. The differential splits the torque between the 2 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 case input shaft. The synchronizer 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 synchronizer sleeve, to the differential housing where it is split between the 2 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.

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 an ignition off/on sequence.

Range Change Procedure

 NOTE: Changing from Hi to Lo can be performed only with the vehicle stationary.

Neutral must be selected on the transmission before requesting a range change and then select the appropriate gear following completion of the range change. During the range change the 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 IC message center.

The range change process can take several seconds to complete following a request being accepted. The actual time is dependent on a number of factors; including the transfer case temperature, component wear and if the first attempt was unsuccessful.

Published: 23-Feb-2014

Transfer Case - Vehicles With: Twin Speed 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 (308-07C Transfer Case - Vehicles With: Twin Speed 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 check 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	• 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

		halfshaft failure • 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 wear	• 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

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: 21-Oct-2013

Transfer Case - Vehicles With: Twin Speed Transfer Case - Transfer Case Draining and Filling

General Procedures

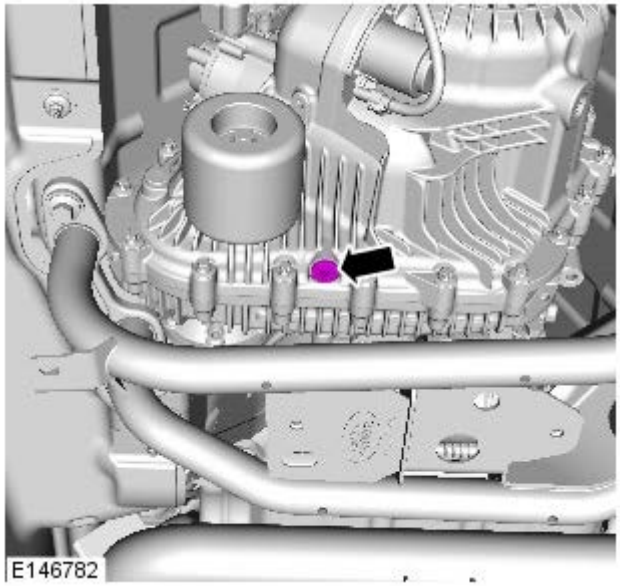
Draining

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. Position a container to collect the fluid.

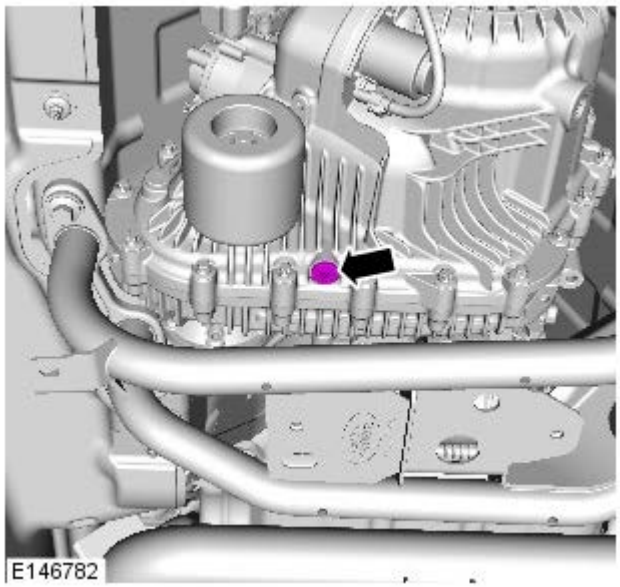


3. CAUTION: Make sure that the area around the component is clean and free of foreign material.

   NOTE: Remove and discard the sealing washer.

4. Allow the fluid to drain.

Filling



1. NOTES:

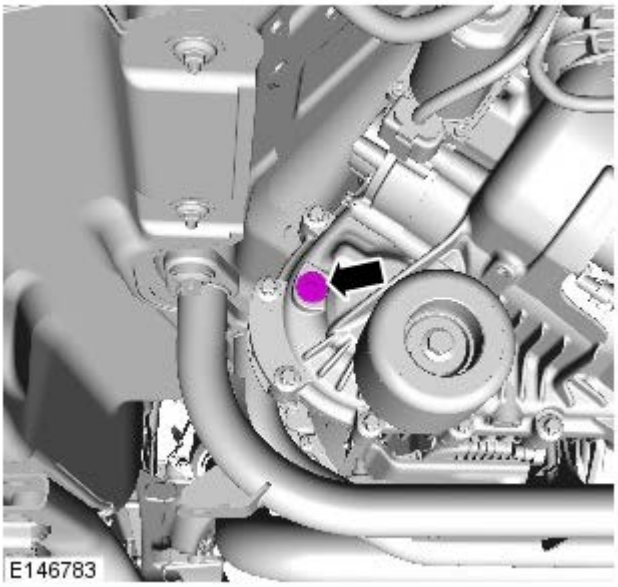
   Make sure that all the component mating faces are clean.

   Install a new sealing washer.

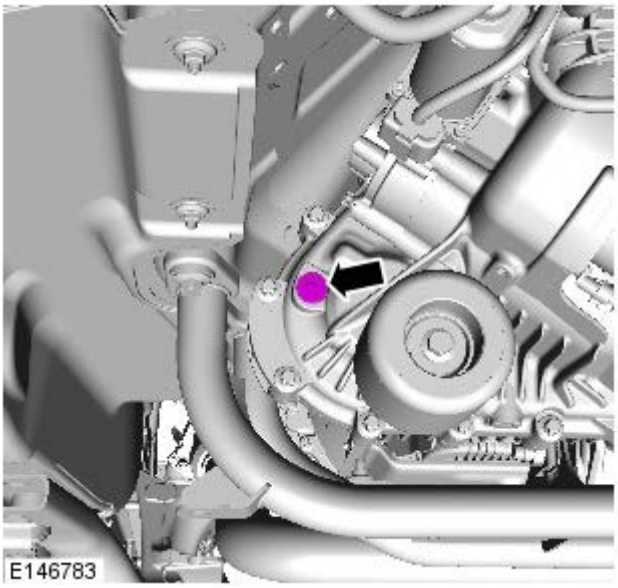
   Torque: 28 Nm

2. CAUTION: Make sure that the area around the component is clean and free of foreign material.

   NOTE: Remove and discard the sealing washer.



3. Refill transfer case with the recommended fluid, until the fluid is level with bottom of filler/level plug hole.



4. NOTES:

   Make sure that all the component mating faces are clean.

   Install a new sealing washer.

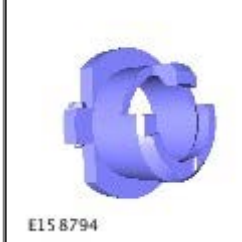
   Torque: 28 Nm

Published: 17-Oct-2013

Transfer Case - Vehicles With: Twin Speed 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.

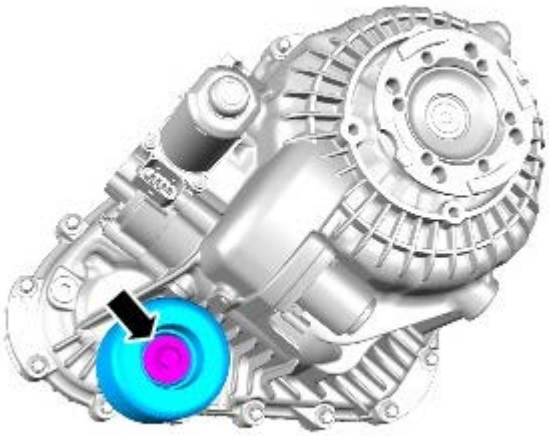
2. Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

3. Refer to: Transfer Case - TDV6 3.0L Diesel (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, Removal).
   Refer to: Transfer Case - TDV8 4.4L Diesel (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, Removal).
   Refer to: Transfer Case - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol

(308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, Removal).
Refer to: Transfer Case - SDV6 3.0L Diesel - Hybrid Electric Vehicle (308-07C Transfer Case - Vehicles With: Twin Speed 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

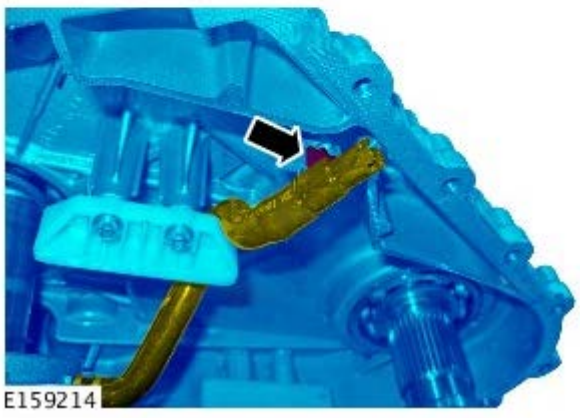
8. CAUTION: Care must be taken when turning the transfer case over. The transfer case halves must not be allowed to separate.

   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

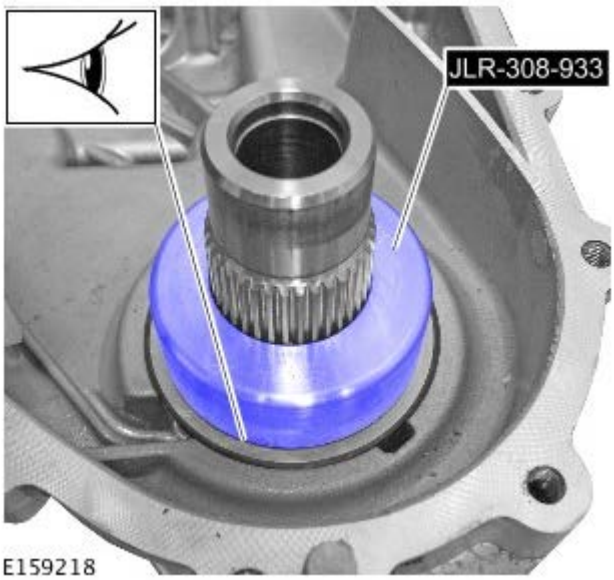
12. *Special Tool(s):* JLR-308-926



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.

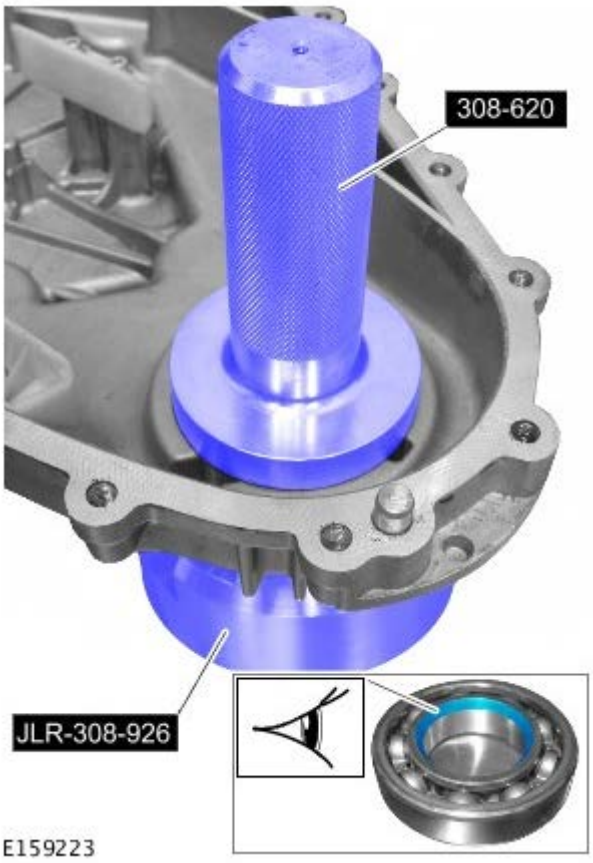
1. Position the special tool as shown, to support the



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.

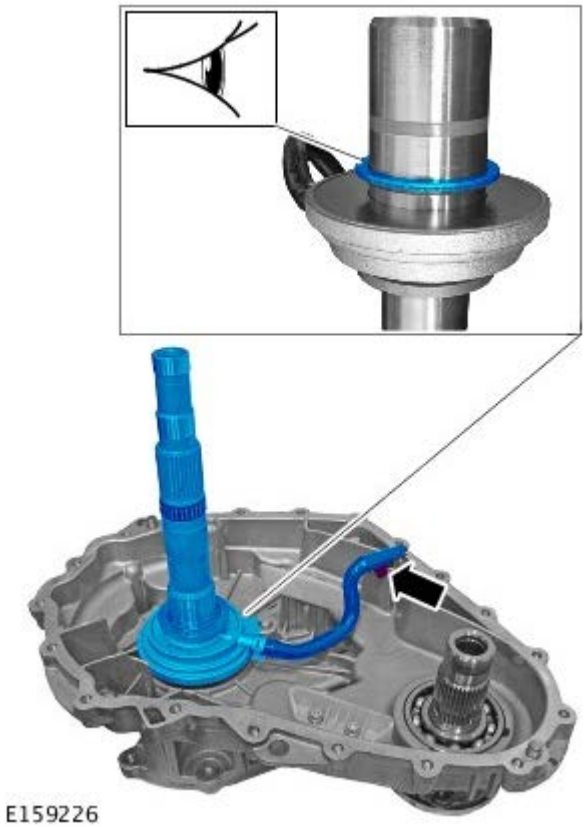
   Extreme care is necessary to make sure the snap ring enters the bearing squarely.

   Install a new snap ring.

   Using the special tool and with assistance, install the drive flange.

   Special Tool(s): 205-818

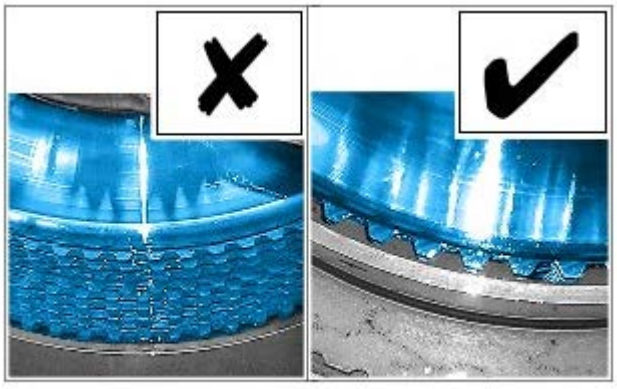
5. CAUTION: Make sure that the oil pump is installed over its location peg.



E159226

6. Clean the magnetic filter.





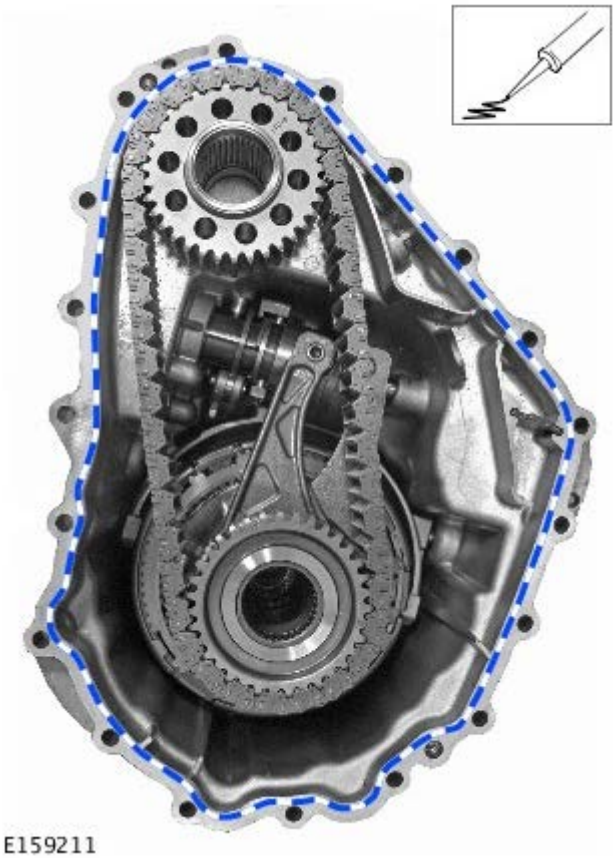
E149289

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.


E149286

9. Apply a 2 mm bead of sealant to one surface of the transfer case mating face, as shown.

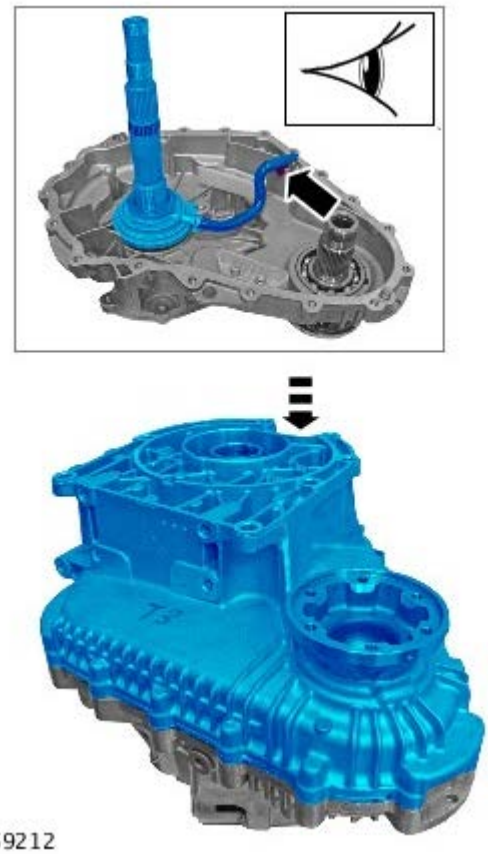

E159211

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



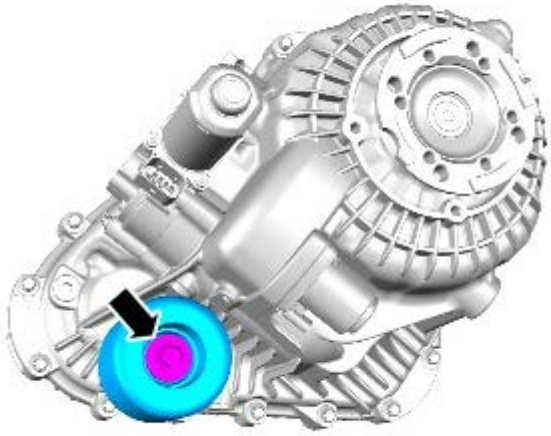
E159191

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 - TDV6 3.0L Diesel (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, Installation).
Refer to: Transfer Case - TDV8 4.4L Diesel (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, Installation).
Refer to: Transfer Case - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, Installation).
Refer to: Transfer Case - SDV6 3.0L Diesel - Hybrid Electric Vehicle (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, Installation).

19. Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 09-Oct-2013

Transfer Case - Vehicles With: Twin Speed 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 (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, Removal and Installation).

Installation

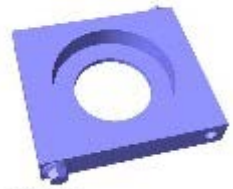
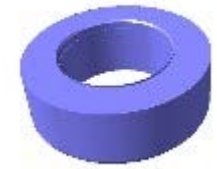
1. To install, reverse the removal procedure.

Published: 17-Oct-2013

Transfer Case - Vehicles With: Twin Speed 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.

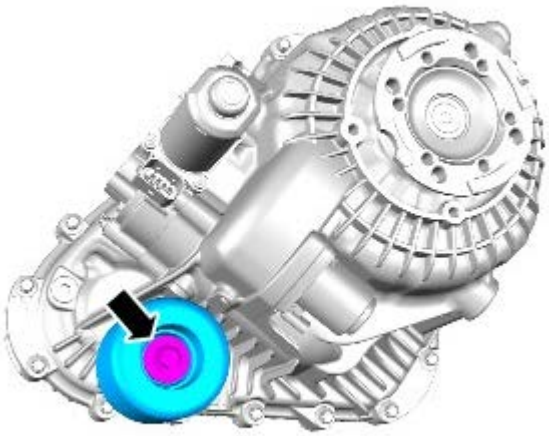
2. Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

3. Refer to: Transfer Case - TDV6 3.0L Diesel (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, Removal).
   Refer to: Transfer Case - TDV8 4.4L Diesel (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, Removal).
   Refer to: Transfer Case - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol

(308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, Removal).
Refer to: Transfer Case - SDV6 3.0L Diesel - Hybrid Electric Vehicle (308-07C Transfer Case - Vehicles With: Twin Speed 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.



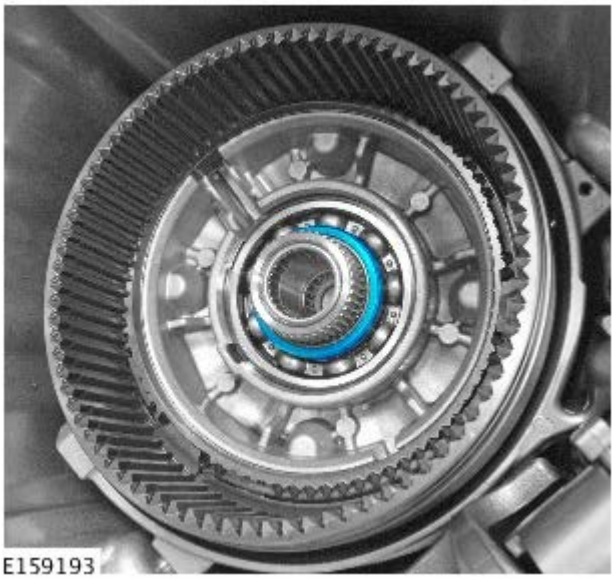


E159213

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

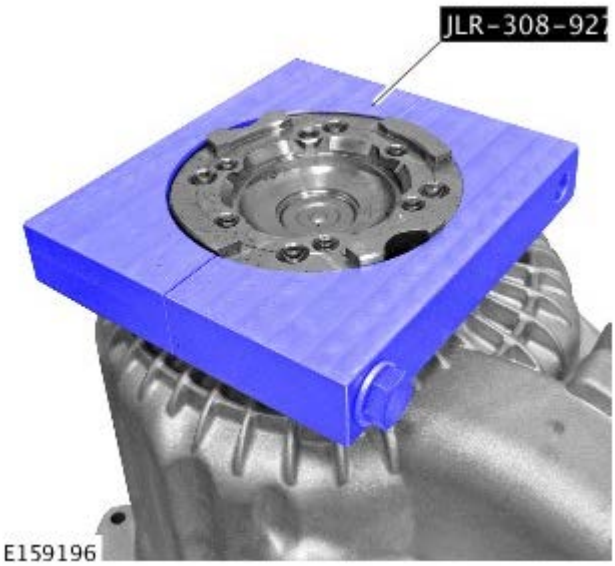
13.


E159194

14. NOTE: Remove as an assembly.


E159195

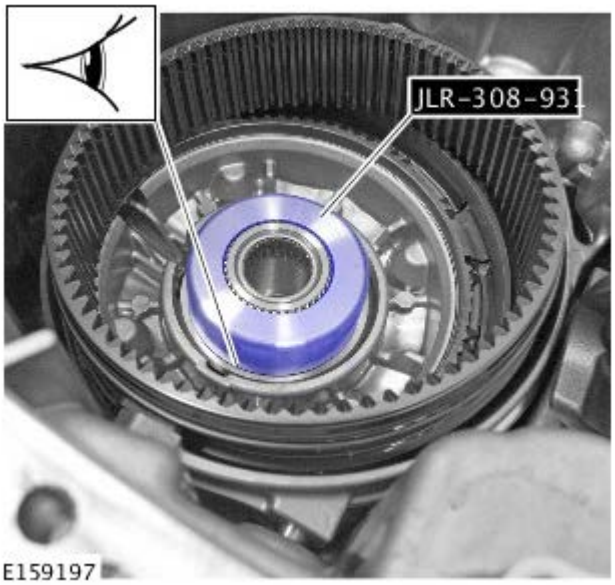
15. *Special Tool(s):* JLR-308-927



E159196

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.

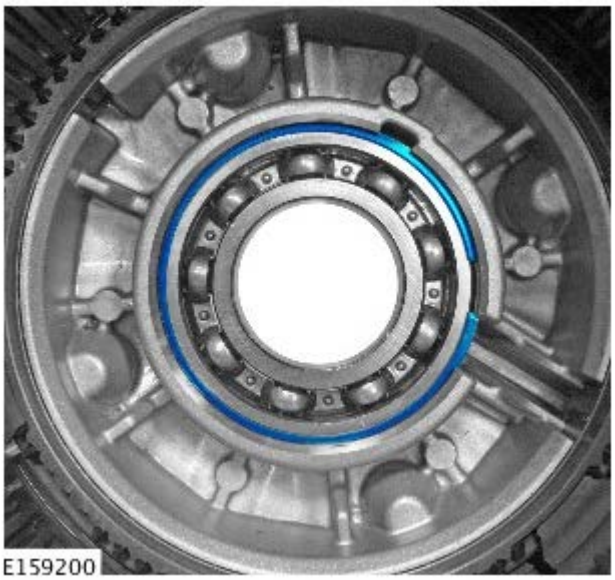
    Special Tool(s): JLR-308-931



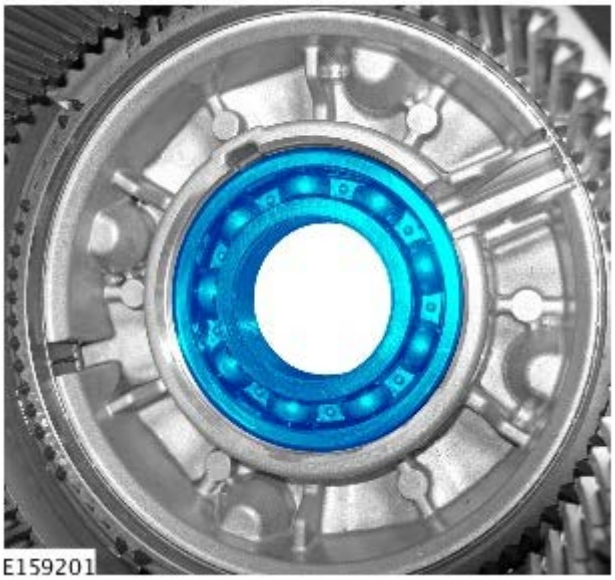
18.



19.



20.



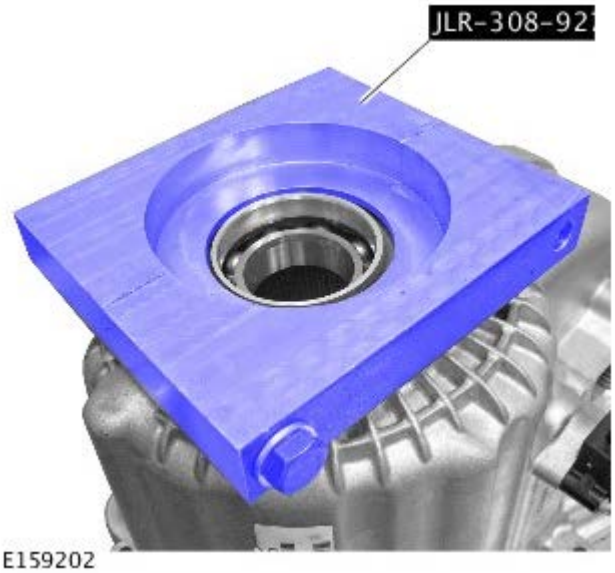
21. With assistance, release the transfer case from the flat surface.

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



E159202





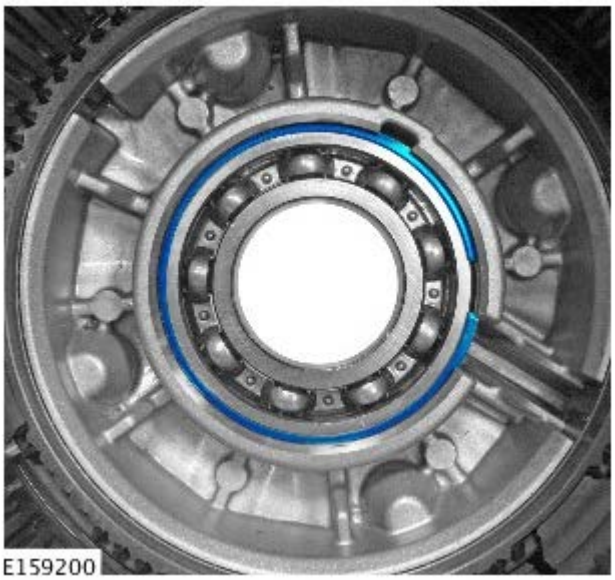
E159203

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



E159204

5. CAUTIONS:

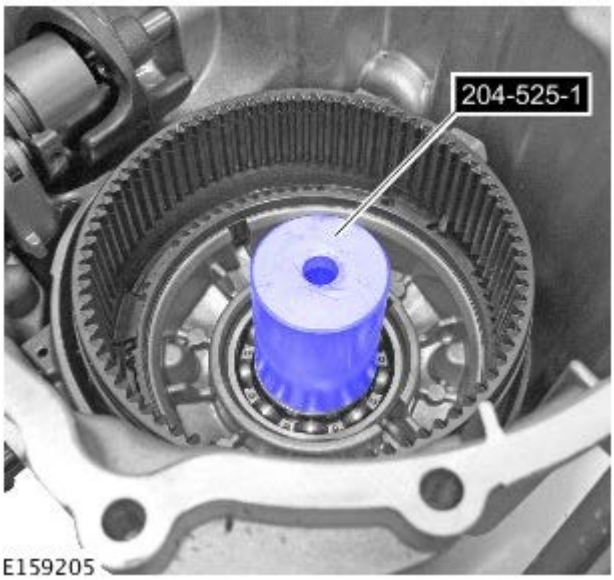
Centralise the snap ring in the snap ring groove before installing the output flange.

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.

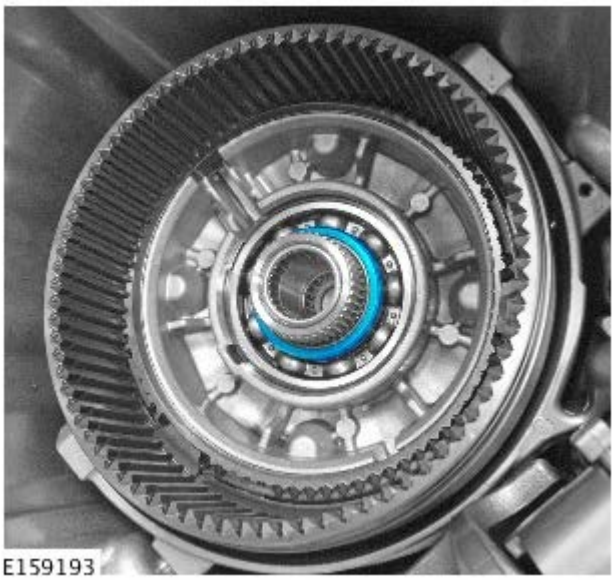
Special Tool(s): 204-525-1



E159205

6. With assistance, secure the rear half of the transfer case with it's rear face down on a flat surface.

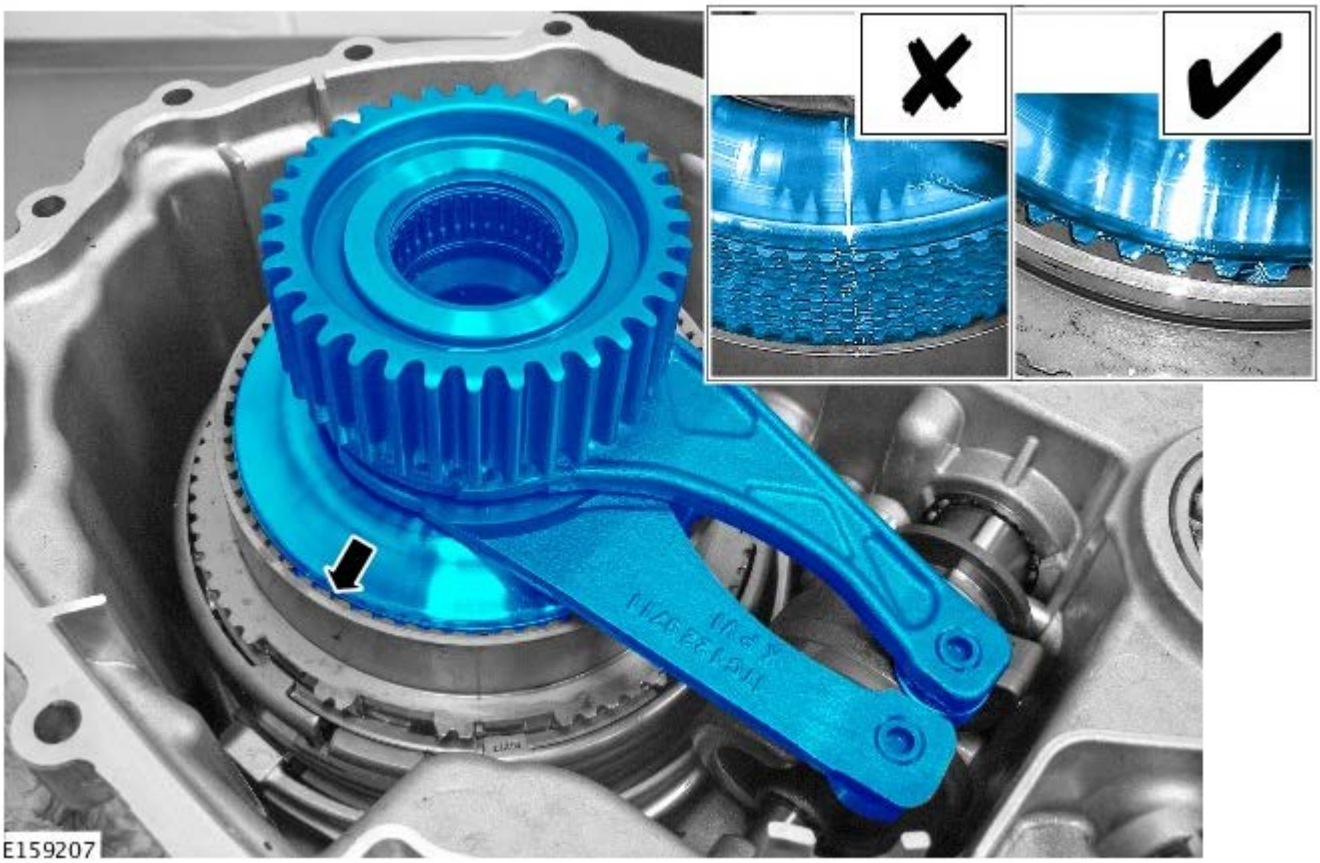
7. Install the spacer.


E159193

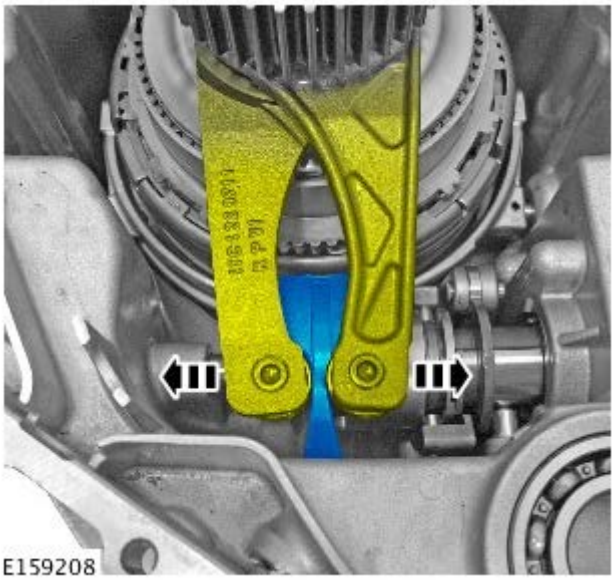

E159206

8. NOTE: Rotate the differential to engage the splines.

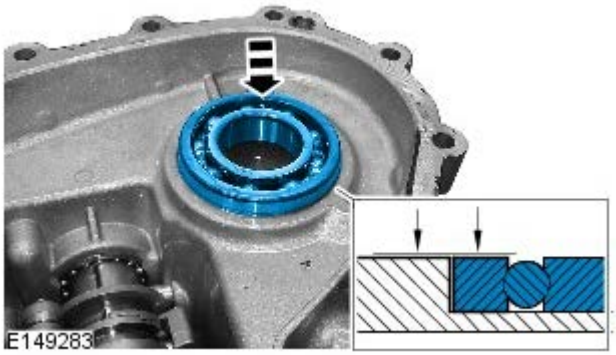
9. NOTE: Rotate the assembly to engage the clutch plates.



10.

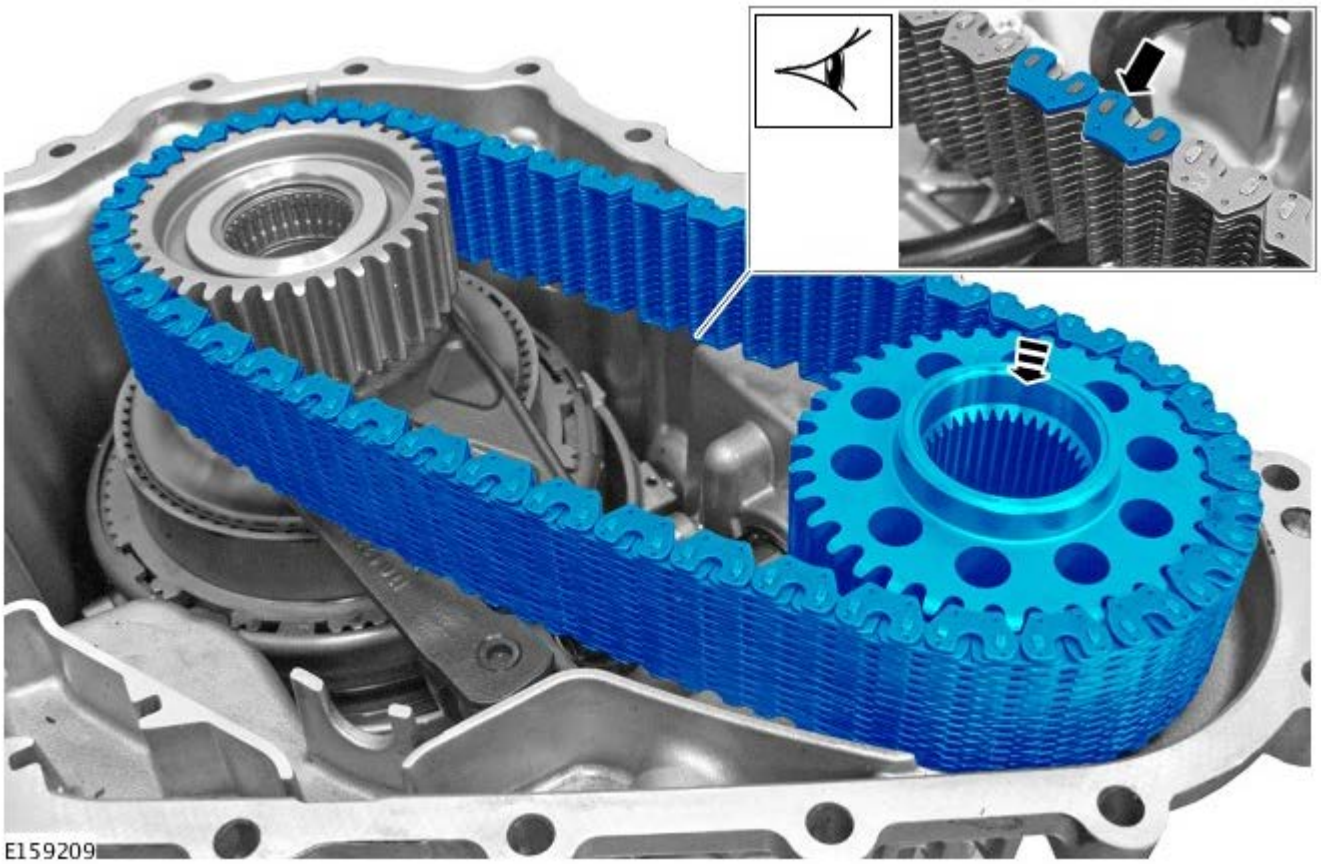


11. CAUTION: Make sure that the front driveshaft gear bearing is fully seated before installing the chain and gear.

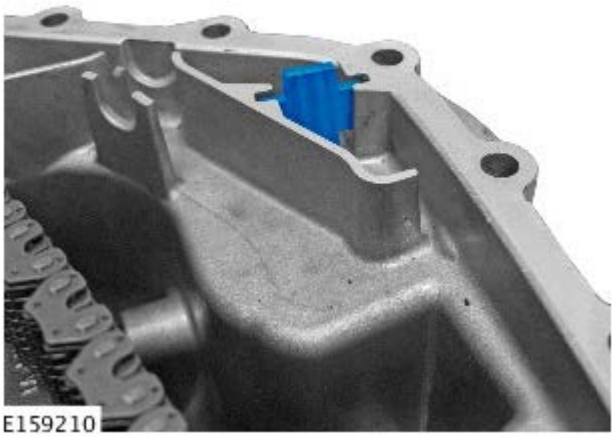


12. CAUTION: Make sure that the chain is installed with the dark links facing down.

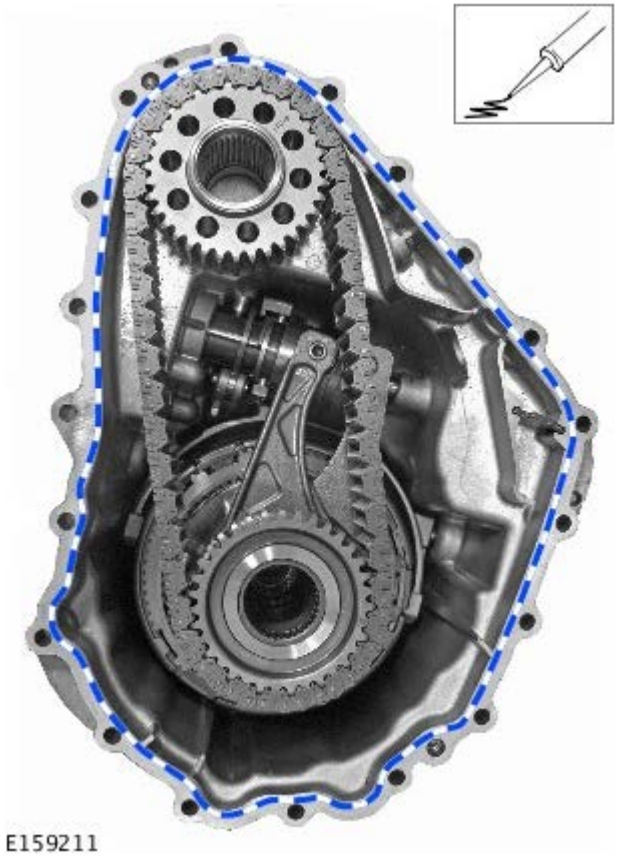
NOTE: The relieved splined inner diameter of the sprocket must face up as shown.



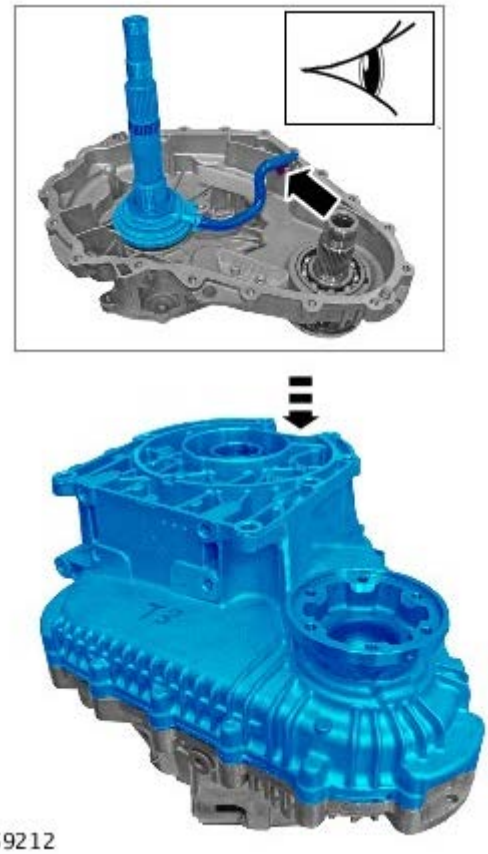
13. CAUTION: Make sure that the component is clean and free of foreign material .



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



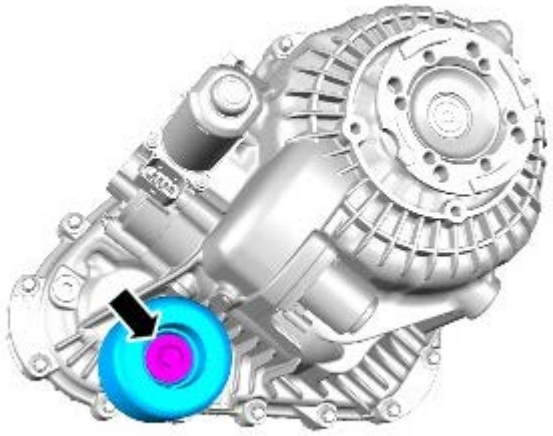
E159191

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 - TDV6 3.0L Diesel (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, Installation).
Refer to: Transfer Case - TDV8 4.4L Diesel (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, Installation).
Refer to: Transfer Case - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, Installation).
Refer to: Transfer Case - SDV6 3.0L Diesel - Hybrid Electric Vehicle (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, Installation).

24. Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 09-Oct-2013

Transfer Case - Vehicles With: Twin Speed 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 (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, Removal and Installation).

Installation

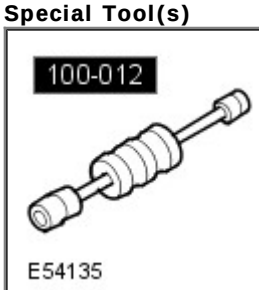
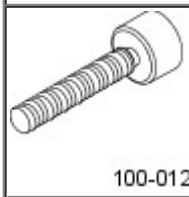
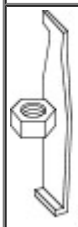
1. To install, reverse the removal procedure.

Published: 23-Oct-2013

Transfer Case - Vehicles With: Twin Speed Transfer Case - Transfer Case Connecting Sleeve Seals

Removal and Installation

Special Tool(s)

	100-012 Slide Hammer
	100-012-01 Slide Hammer Adapter
	308-375 Remover, Input and Output Seal
	308-598 Installer, Oil 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 (414-00 Battery and Charging System - General Information, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

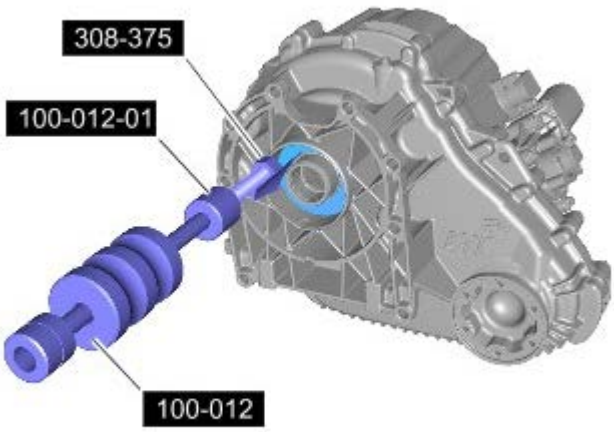
   Raise and support the vehicle.

3. Remove the transfer case.

   Refer to: Transfer Case - TDV6 3.0L Diesel (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, Removal).
   Refer to: Transfer Case - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, Removal).
   Refer to: Transfer Case - TDV8 4.4L Diesel (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, Removal).
   Refer to: Transfer Case - SDV6 3.0L Diesel - Hybrid Electric Vehicle (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, Removal).

4. CAUTION: Care must be taken to avoid damage to the seal register and running surface.

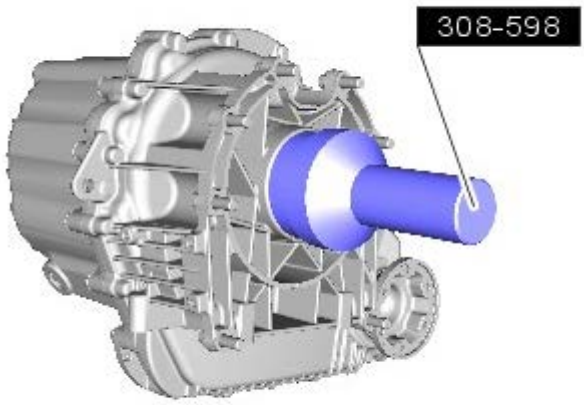
   Carefully remove and discard the oil seal.



E131138

Special Tool(s): 308-375, 100-012, 100-012-01

Installation



E50943

1. CAUTIONS:

   Make sure that the area around the component is clean and free of foreign material.

   Oil seals must be fitted dry.

   Install a new seal.

   Special Tool(s): 308-598

2. Install the transfer case.

   Refer to: Transfer Case - TDV6 3.0L Diesel (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, Installation).
   Refer to: Transfer Case - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, Installation).
   Refer to: Transfer Case - TDV8 4.4L Diesel (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, Installation).
   Refer to: Transfer Case - SDV6 3.0L Diesel - Hybrid Electric Vehicle (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, Installation).

3. Connect the battery ground cable.

   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 16-Dec-2013

Transfer Case - Vehicles With: Twin Speed Transfer Case - Transfer Case Chain

Removal and Installation

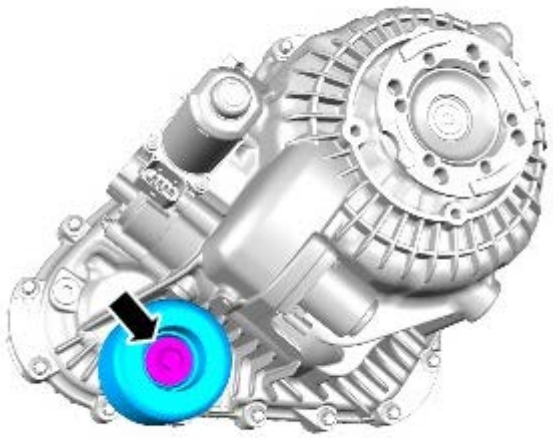
Removal

1. Refer to: Transfer Case Draining and Filling (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, General Procedures).

2. Refer to: Transfer Case - TDV6 3.0L Diesel (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, Removal).
   Refer to: Transfer Case - TDV8 4.4L Diesel (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, Removal).
   Refer to: Transfer Case - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, Removal).
   Refer to: Transfer Case - SDV6 3.0L Diesel - Hybrid Electric Vehicle (308-07C Transfer Case - Vehicles With: Twin Speed 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.



E159191

CAUTION: Make sure the bolt holes are clean and free from swarf.

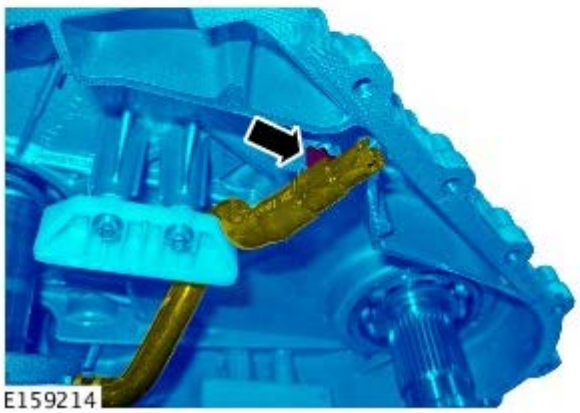
7. CAUTION: Care must be taken when turning the transfer case over. The transfer case halves must not be allowed to separate.

   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

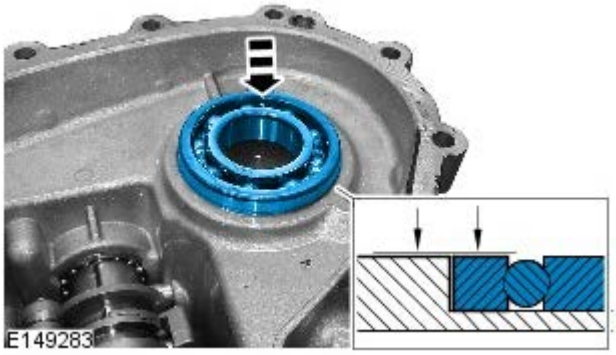
9.



10. CAUTION: The shaft may be tight on the bearing. Care must be taken when removing the component.



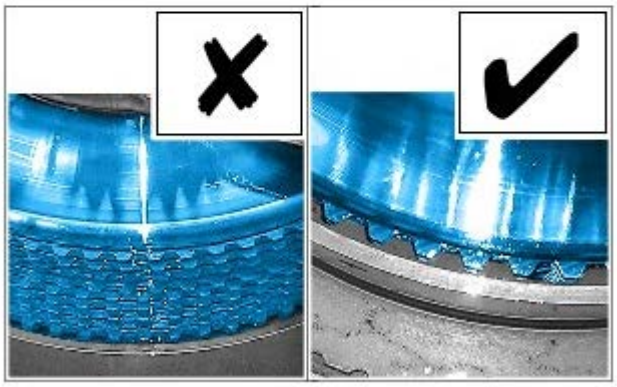
Installation



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.



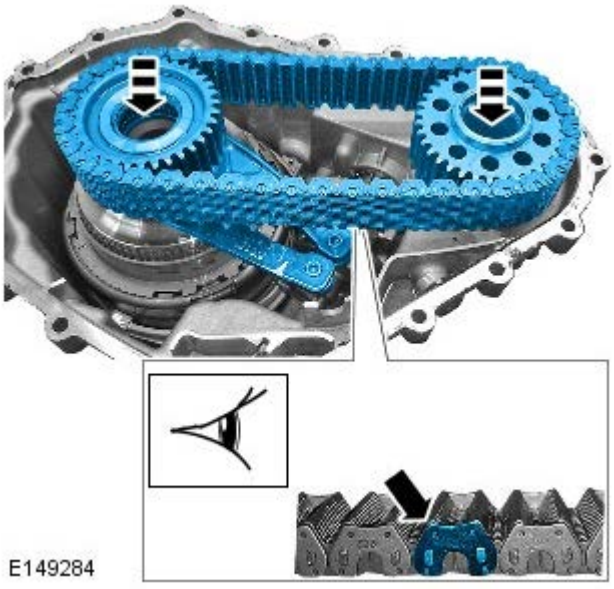


E149289



E149286

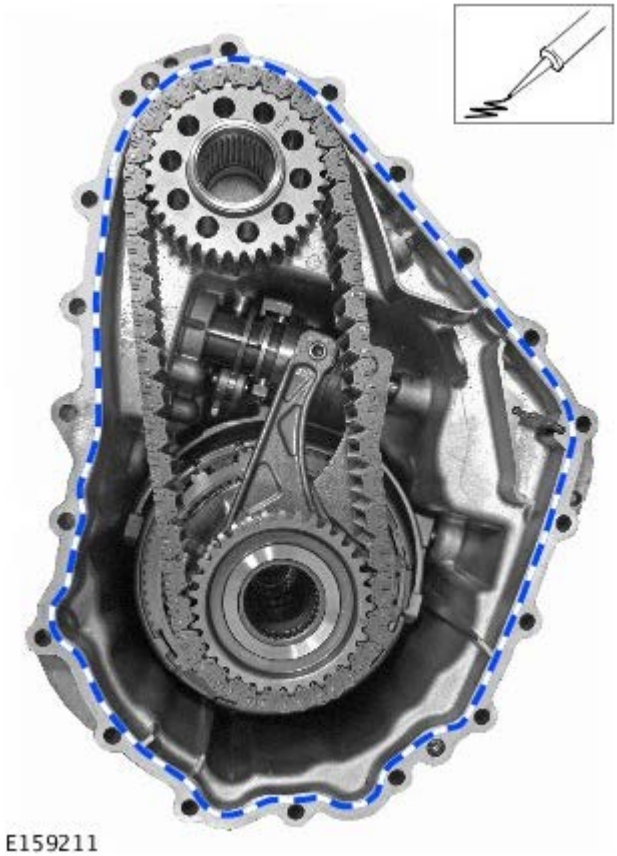
3. CAUTION: Make sure that the clutch assembly is correctly located as illustrated.



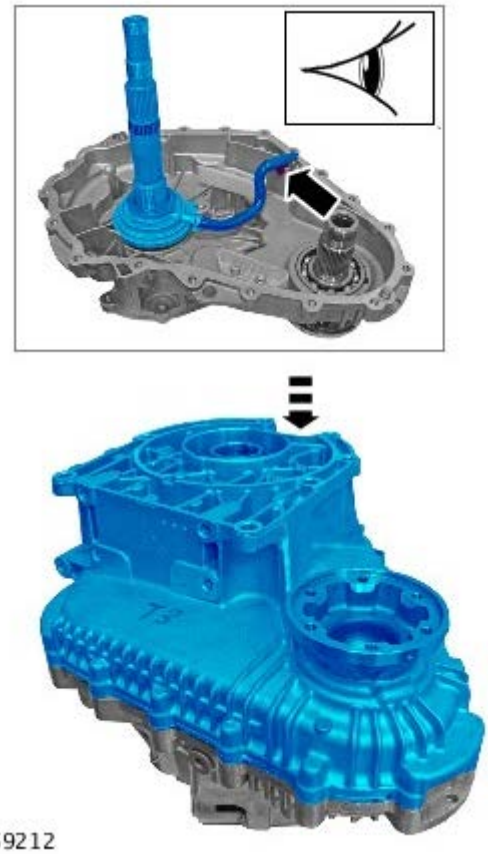
E149284

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



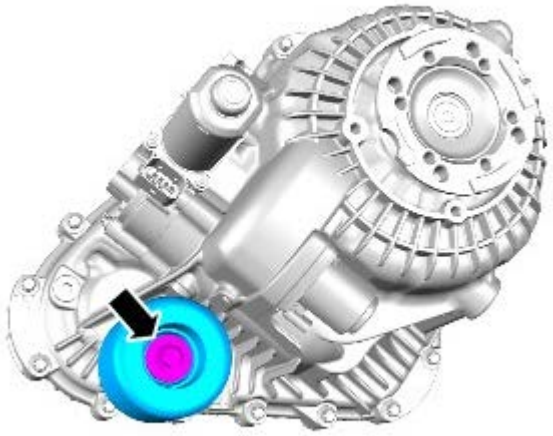
E159191

11. *Torque:* 35 Nm



E159190

12. *Torque:* 75 Nm



E159189

13. Refer to: Transfer Case - TDV6 3.0L Diesel (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, Installation).
    Refer to: Transfer Case - TDV8 4.4L Diesel (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, Installation).
    Refer to: Transfer Case - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, Installation).
    Refer to: Transfer Case - SDV6 3.0L Diesel - Hybrid Electric Vehicle (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, Installation).

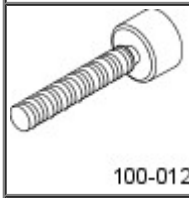
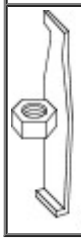
14. Refer to: Transfer Case Draining and Filling (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, General Procedures).

Published: 09-Nov-2013

Transfer Case - Vehicles With: Twin Speed Transfer Case - Transfer Case TDV6 3.0L Diesel

Removal

Special Tool(s)

	100-012 Slide Hammer
	100-012-01 Slide Hammer Adapter
	303-1069 Adapter, Wrench
	308-375 Remover, Input and Output Seal

General Equipment

Transmission jack
Vehicle/axle stands
Wooden Block

NOTES:

Some variation in the illustrations may occur, but the essential information is always correct.

Component shown removed for clarity.

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.

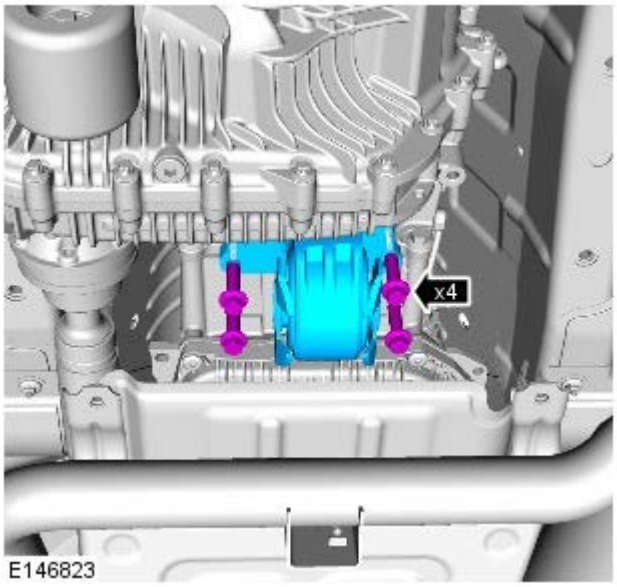
   Raise and support the vehicle.

3. NOTE: Do not carry out this step if the component removed for access only.

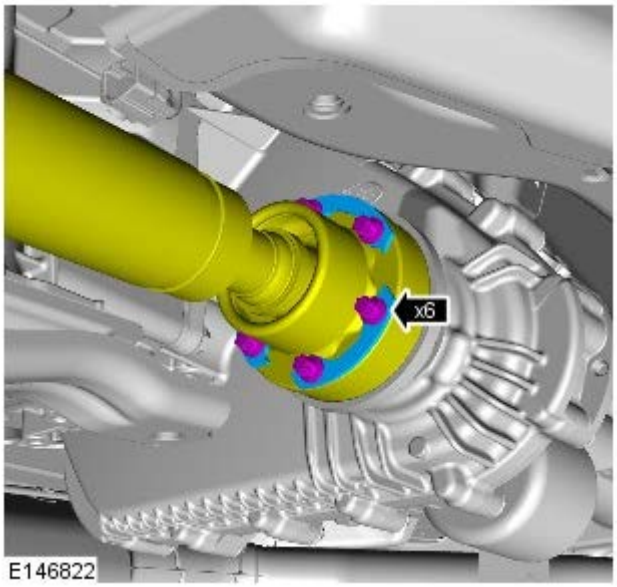
   Refer to: Transfer Case Draining and Filling (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, General Procedures).

4. Refer to: Transmission Support Crossmember - TDV6 3.0L Diesel (502-02 Full Frame and Body Mounting, Removal and Installation).

5.



6. Refer to: Rear Driveshaft - TDV6 3.0L Diesel (205-01 Driveshaft, Removal and Installation).



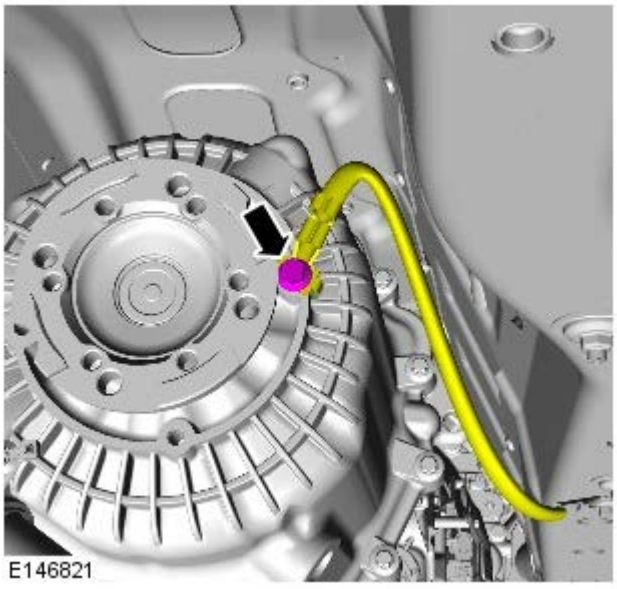
7. CAUTIONS:

   Mark the position of the driveshaft flange in relation to the drive pinion flange.

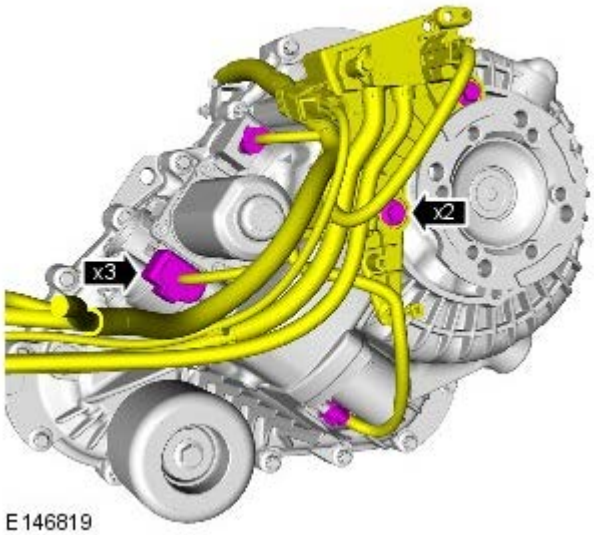
   To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

   Discard the bolts.

8.

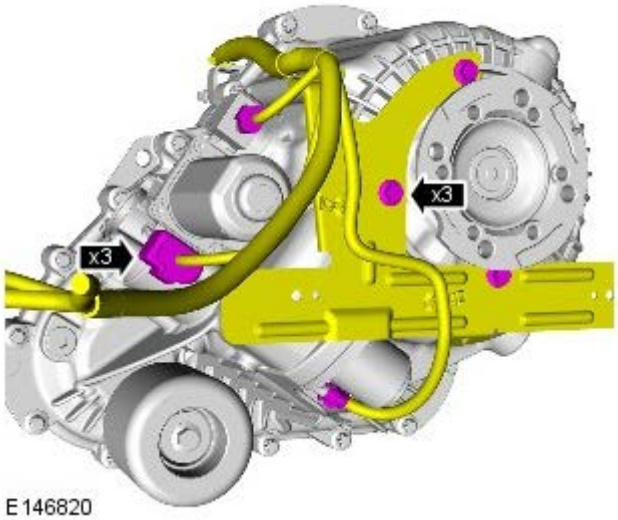


9. Vehicles with diesel particulate filter (DPF).



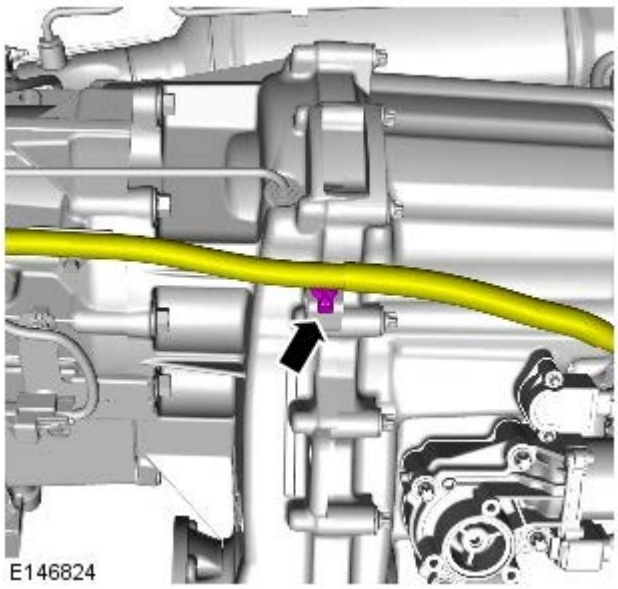
E146819

10. Vehicles without diesel particulate filter (DPF).

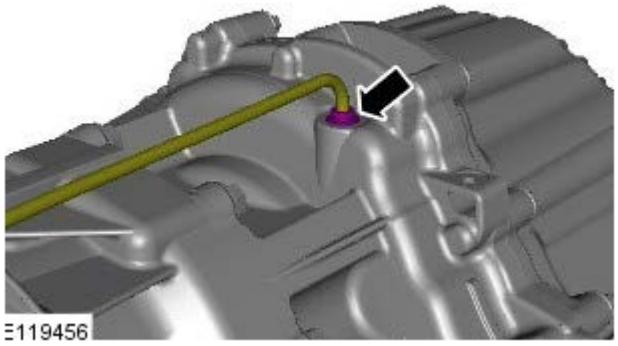


E146820

11.

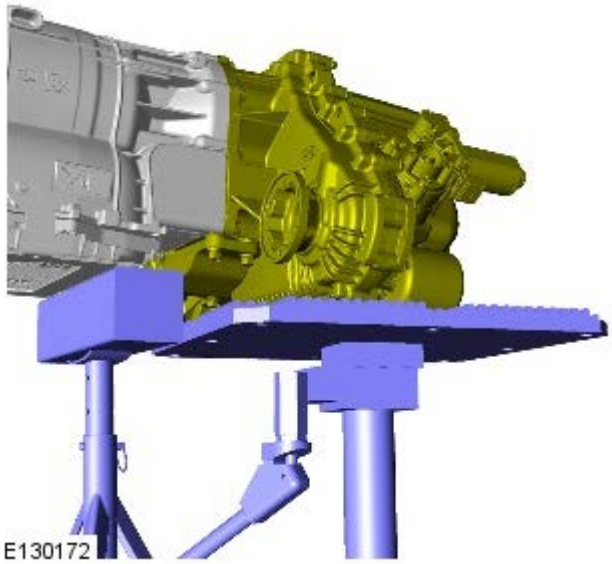

E146824

12. CAUTION: Always plug any open connections to prevent contamination.

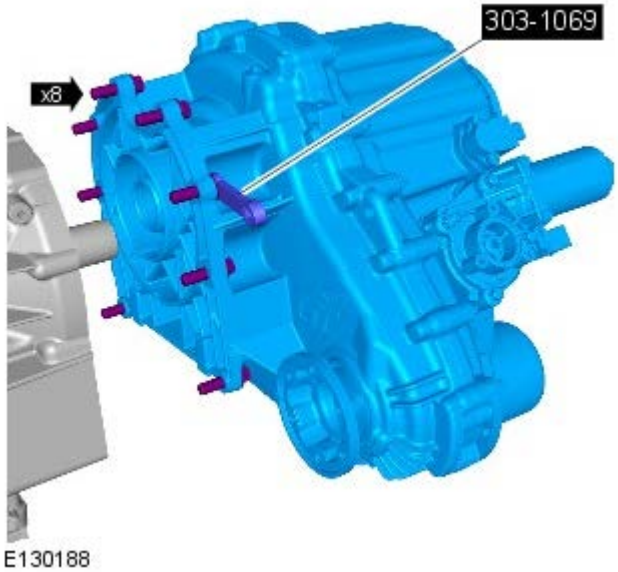


13. WARNING: Secure the component to the transmission jack.

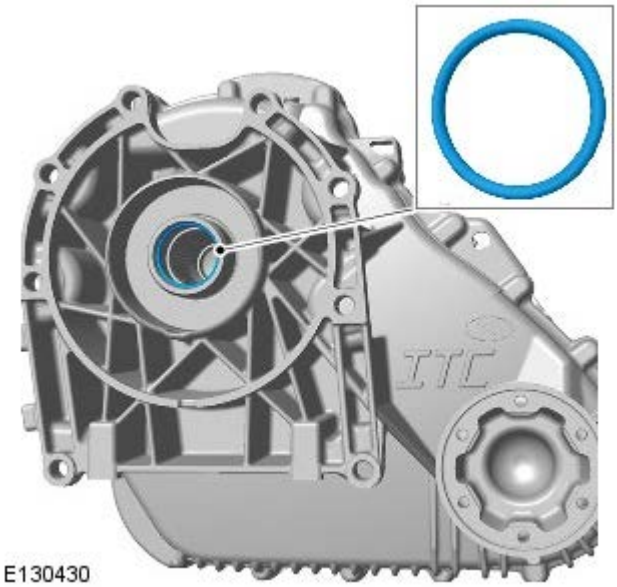
- *General Equipment:* Wooden Block
- *General Equipment:* Transmission jack
- *General Equipment:* Vehicle/axle stands



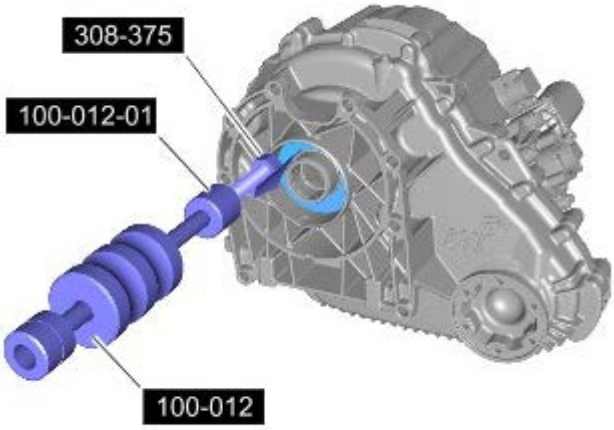
14. *Special Tool(s):* 303-1069



15. CAUTION: Do not carry out this step if a new transfer box is to be installed.



E130430



E131138

16. CAUTIONS:

⚠ Care must be taken to avoid damage to the seal register and running surface.

⚠ Do not carry out this step if a new transfer box is to be installed.

⚠ Note the fitted position of the component prior to removal.

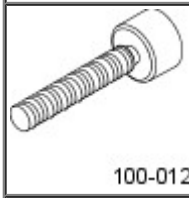
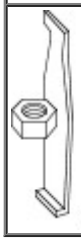
- *Special Tool(s):* 100-012, 100-012-01, 308-375

Published: 09-Nov-2013

Transfer Case - Vehicles With: Twin Speed Transfer Case - Transfer Case TDV8 4.4L Diesel

Removal

Special Tool(s)

	100-012 Slide Hammer
	100-012-01 Slide Hammer Adapter
	303-1069 Adapter, Wrench
	308-375 Remover, Input and Output Seal

General Equipment

Transmission jack
Vehicle/axle stands
Wooden Block

NOTES:

Some variation in the illustrations may occur, but the essential information is always correct.

Component shown removed for clarity.

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.

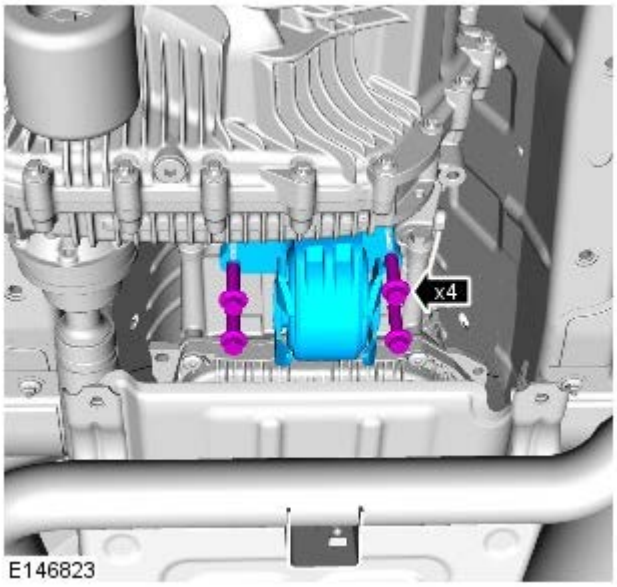
   Raise and support the vehicle.

3. NOTE: Do not carry out this step if the component removed for access only.

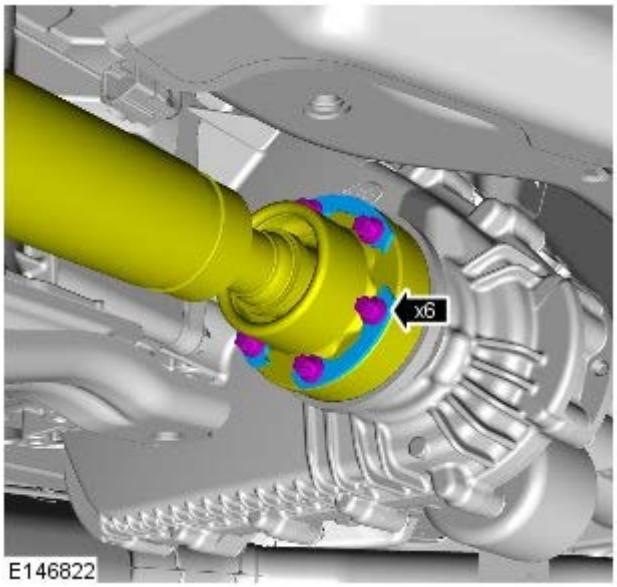
   Refer to: Transfer Case Draining and Filling (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, General Procedures).

4. Refer to: Transmission Support Crossmember - TDV8 4.4L Diesel (502-02 Full Frame and Body Mounting, Removal and Installation).

5.



6. Refer to: Rear Driveshaft - TDV8 4.4L Diesel (205-01 Driveshaft, Removal and Installation).



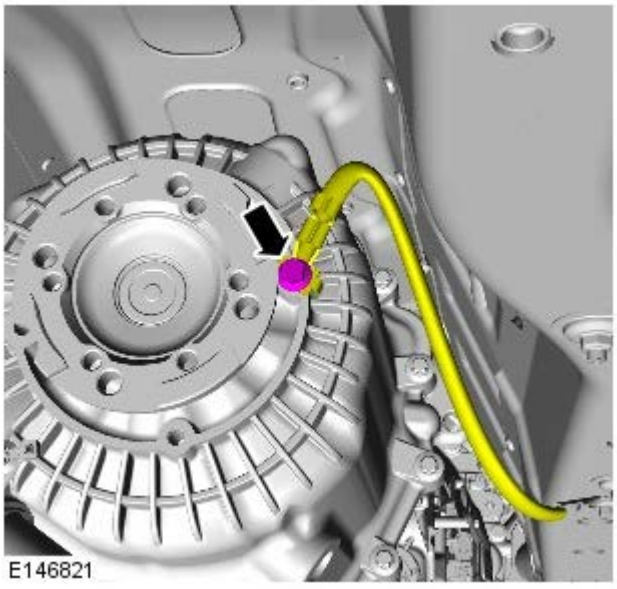
7. CAUTIONS:

   Mark the position of the driveshaft flange in relation to the drive pinion flange.

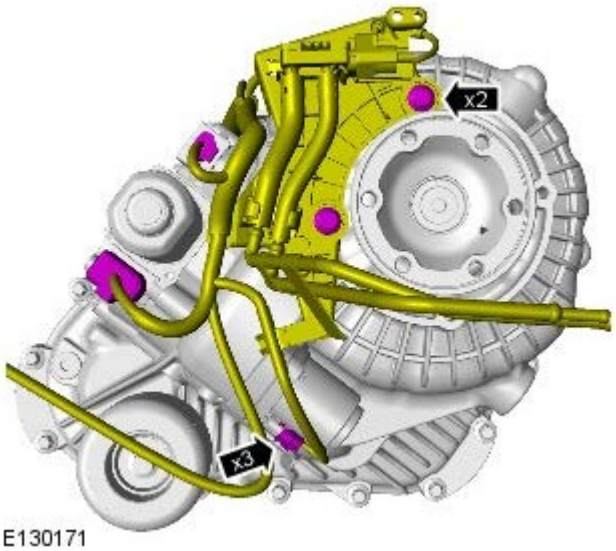
   To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

   Discard the bolts.

8.

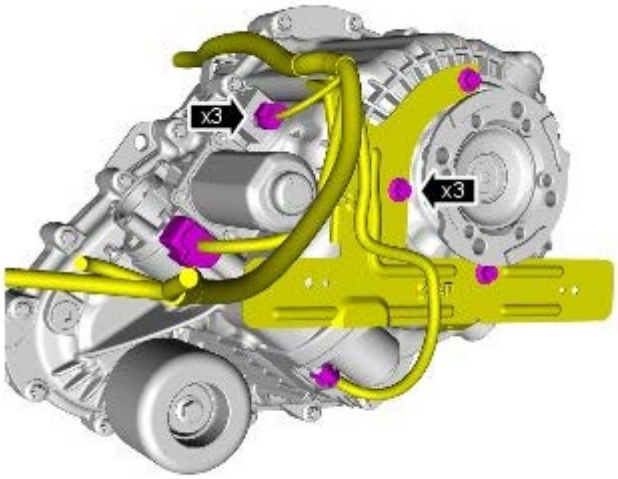


9. Vehicles with diesel particulate filter (DPF).



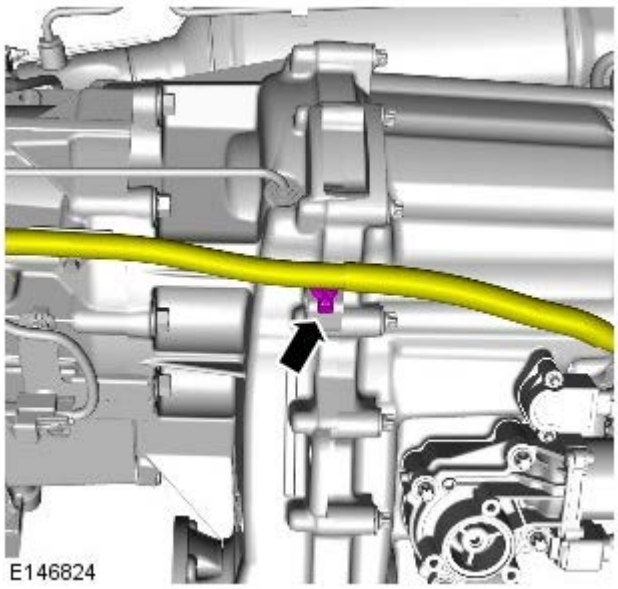
E130171

10. Vehicles without diesel particulate filter (DPF).

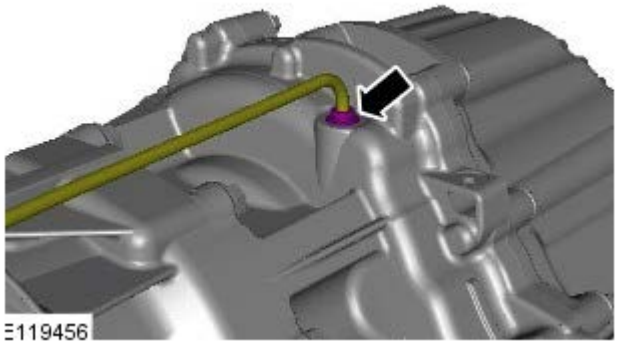


E146825

11.

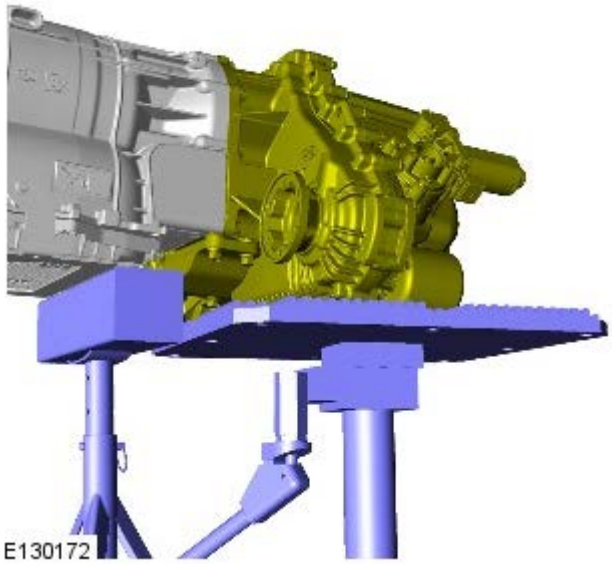

E146824

12. CAUTION: Always plug any open connections to prevent contamination.

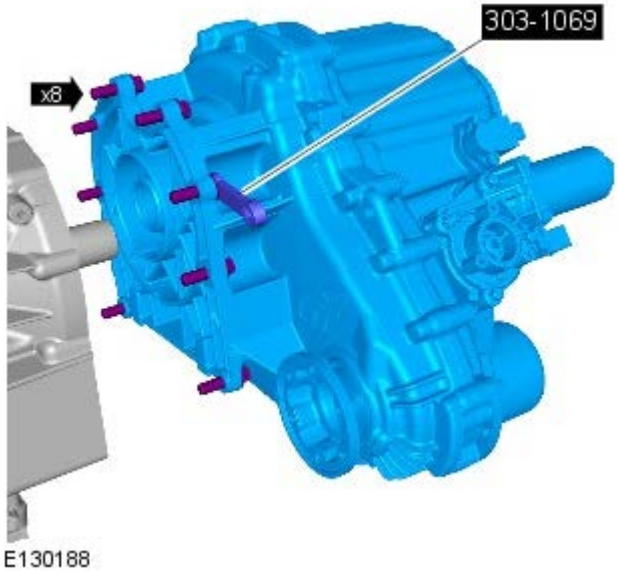


13. WARNING: Secure the component to the transmission jack.

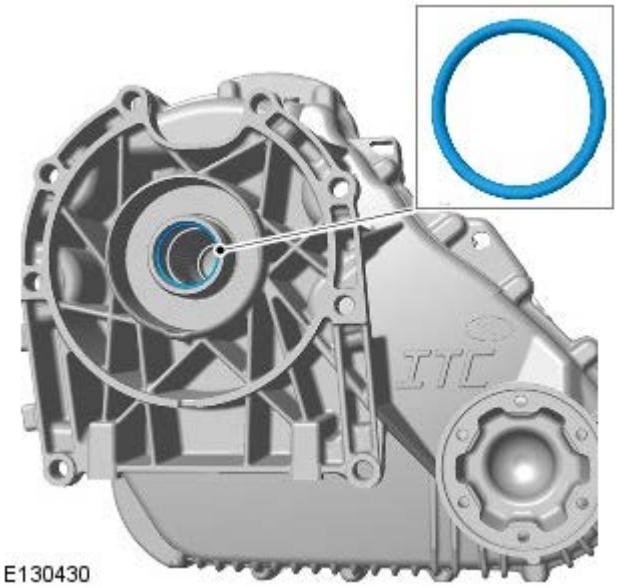
- *General Equipment:* Wooden Block
- *General Equipment:* Transmission jack
- *General Equipment:* Vehicle/axle stands



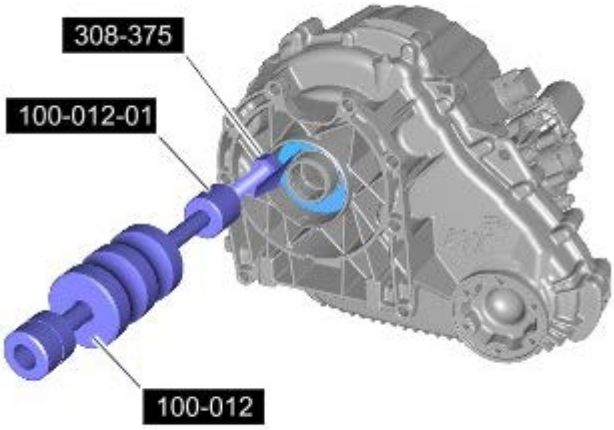
14. *Special Tool(s):* 303-1069



15. CAUTION: Do not carry out this step if a new transfer box is to be installed.



E130430



E131138

16. CAUTIONS:

⚠ Care must be taken to avoid damage to the seal register and running surface.

⚠ Do not carry out this step if a new transfer box is to be installed.

⚠ Note the fitted position of the component prior to removal.

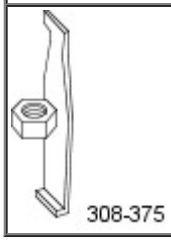
- *Special Tool(s):* 100-012, 100-012-01, 308-375

Published: 09-Nov-2013

Transfer Case - Vehicles With: Twin Speed Transfer Case - Transfer Case V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol

Removal

Special Tool(s)

	100-012 Slide Hammer
	100-012-01 Slide Hammer Adapter
	303-1069 Adapter, Wrench
	308-375 Remover, Input and Output Seal

General Equipment

Transmission jack
Vehicle/axle stands
Wooden Block

NOTES:

Some variation in the illustrations may occur, but the essential information is always correct.

Component shown removed for clarity.

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.

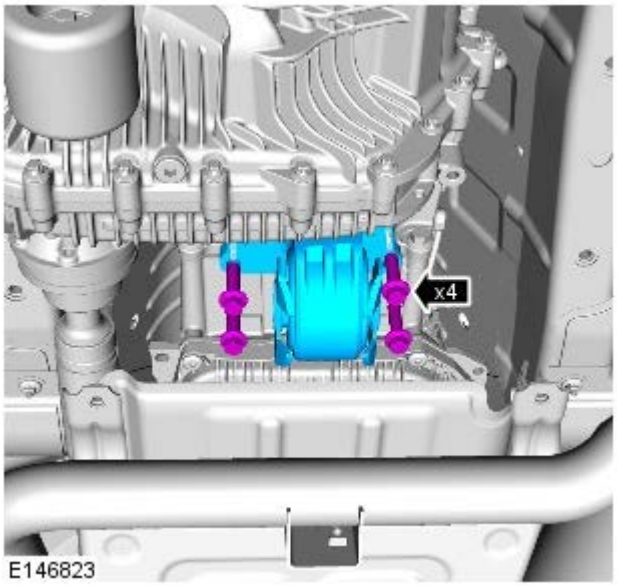
   Raise and support the vehicle.

3. NOTE: Do not carry out this step if the component removed for access only.

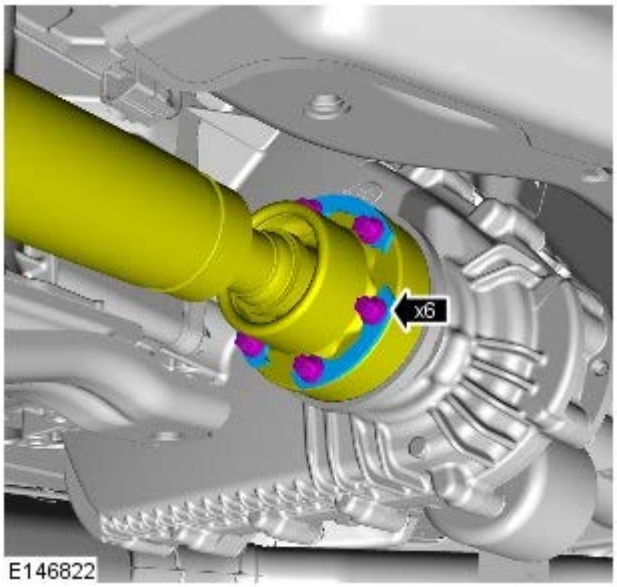
   Refer to: Transfer Case Draining and Filling (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, General Procedures).

4. Refer to: Transmission Support Crossmember - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (502-02 Full Frame and Body Mounting, Removal and Installation).

5.



6. Refer to: Rear Driveshaft - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (205-01 Driveshaft, Removal and Installation).



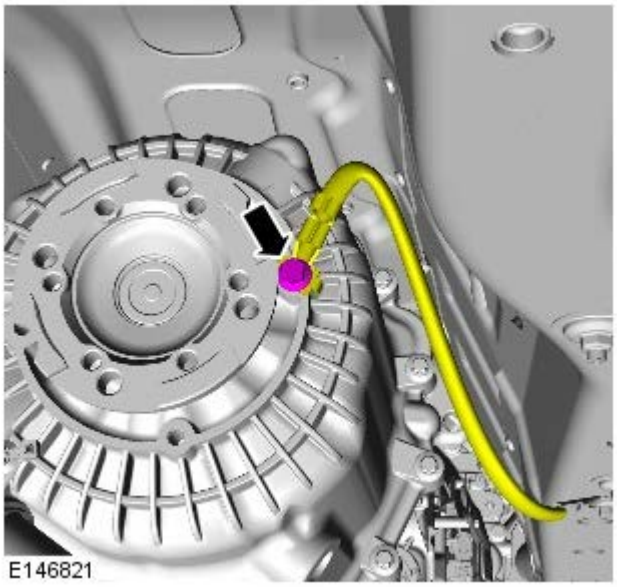
7. CAUTIONS:

Mark the position of the driveshaft flange in relation to the drive pinion flange.

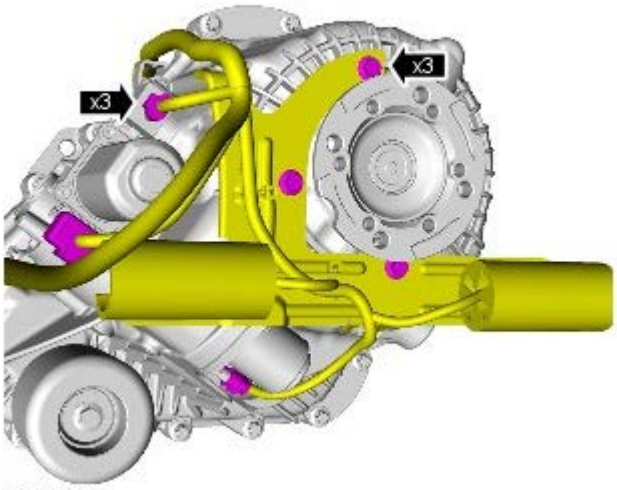
To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

Discard the bolts.

8.

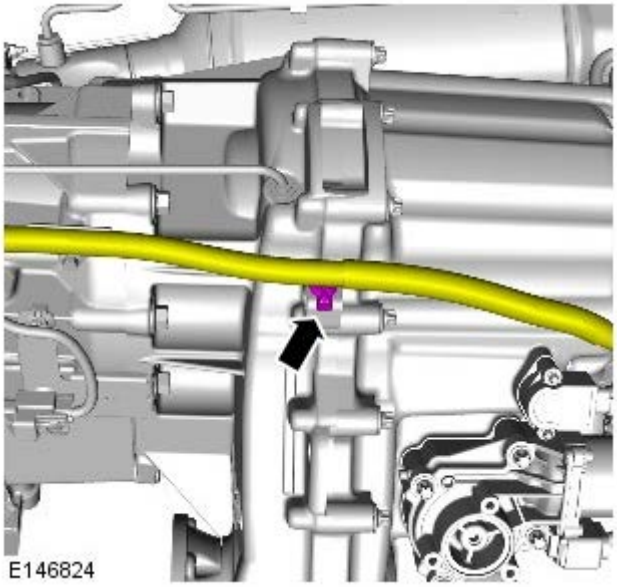


9.

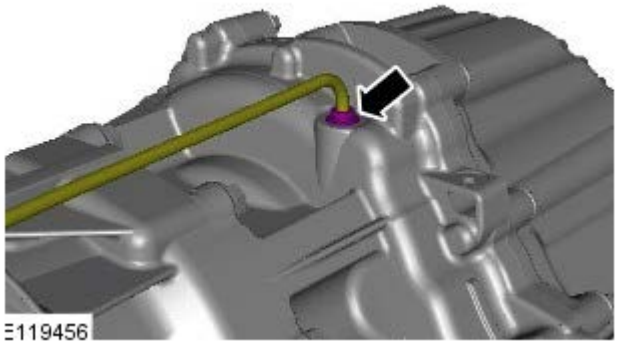


E146818

10.

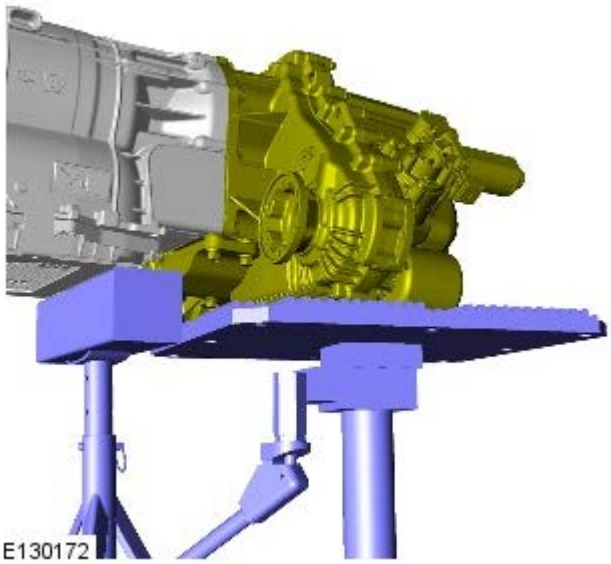

E146824

11. CAUTION: Always plug any open connections to prevent contamination.

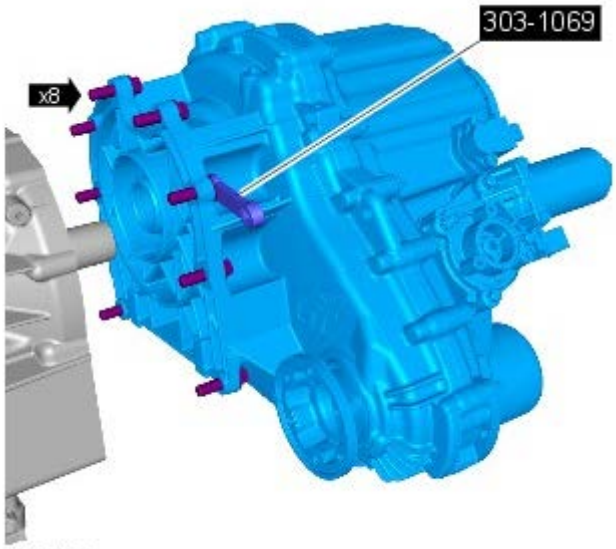

E119456

12. WARNING: Secure the component to the transmission jack.

- *General Equipment:* Wooden Block
- *General Equipment:* Transmission jack
- *General Equipment:* Vehicle/axle stands

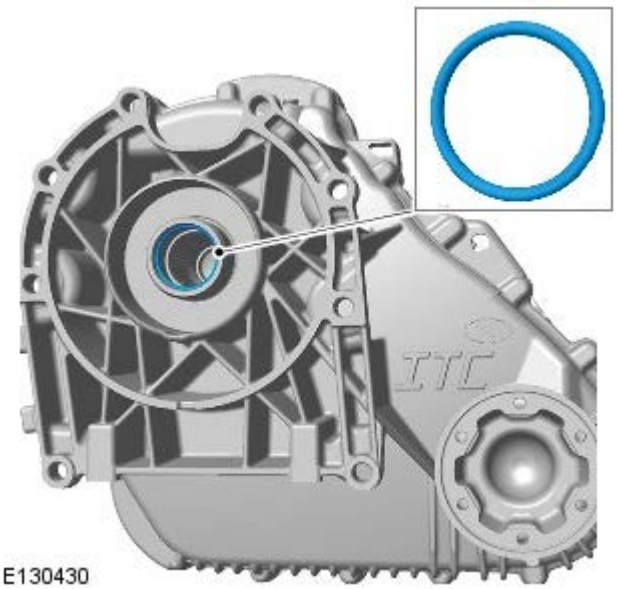

E130172

13. *Special Tool(s):* 303-1069



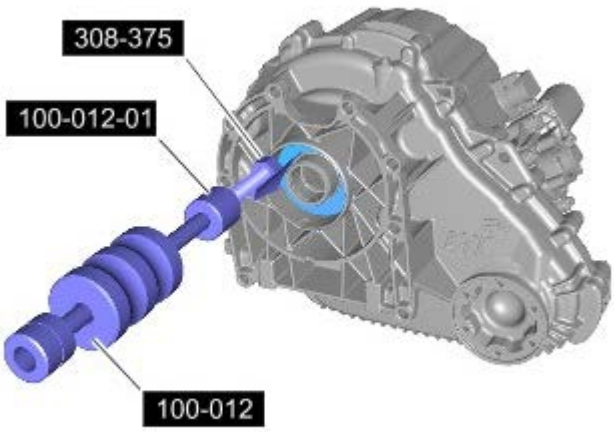
E130188

14. CAUTION: Do not carry out this step if a new transfer box is to be installed.


E130430

15. CAUTIONS:

Care must be taken to avoid damage to the seal register and running surface.



E131138

Do not carry out this step if a new transfer box is to be installed.

Note the fitted position of the component prior to removal.

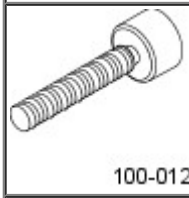
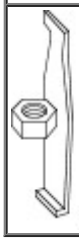
- *Special Tool(s):* 100-012, 100-012-01, 308-375

Published: 11-Nov-2013

Transfer Case - Vehicles With: Twin Speed Transfer Case - Transfer Case SDV6 3.0L Diesel - Hybrid Electric Vehicle

Removal

Special Tool(s)

	100-012 Slide Hammer
	100-012-01 Slide Hammer Adapter
	303-1069 Adapter, Wrench
	308-375 Remover, Input and Output Seal

General Equipment

Transmission jack
Vehicle/axle stands
Wooden Block

NOTES:

Some variation in the illustrations may occur, but the essential information is always correct.

Component shown removed for clarity.

1. Refer to: Hybrid Electric Vehicle (HEV) Decommission (414-01 Battery, Mounting and Cables, General Procedures).

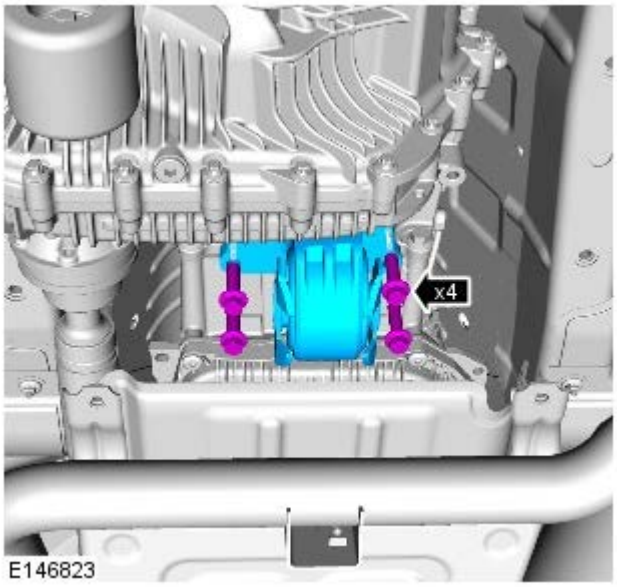
2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

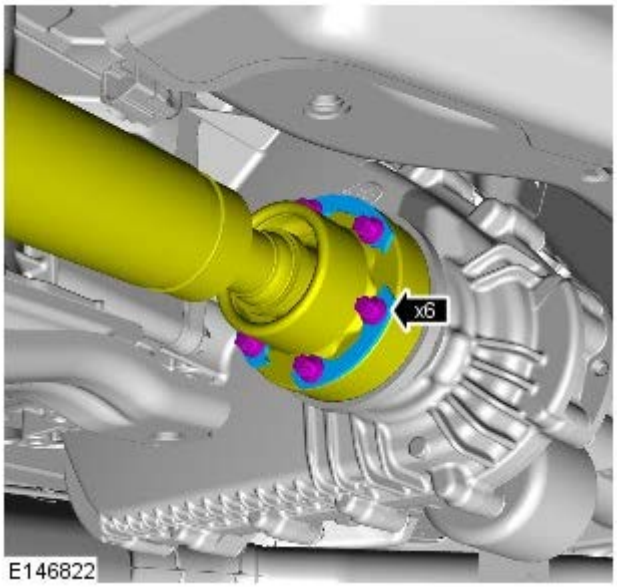
3. NOTE: Do not carry out this step if the component removed for access only.

   Refer to: Transfer Case Draining and Filling (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, General Procedures).

4. Refer to: Transmission Support Crossmember - TDV6 3.0L Diesel (502-02 Full Frame and Body Mounting, Removal and Installation).



6. Refer to: [Rear Driveshaft - SDV6 3.0L Diesel - Hybrid Electric Vehicle] (205-01 Driveshaft, Removal and Installation).



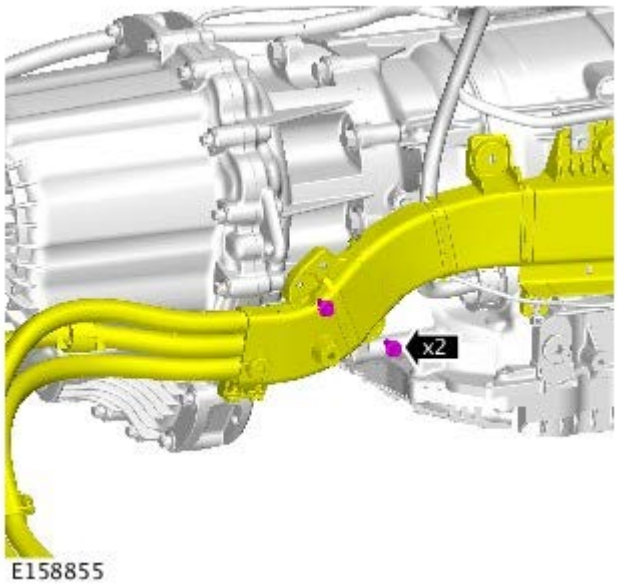
7. CAUTIONS:

   Mark the position of the driveshaft flange in relation to the drive pinion flange.

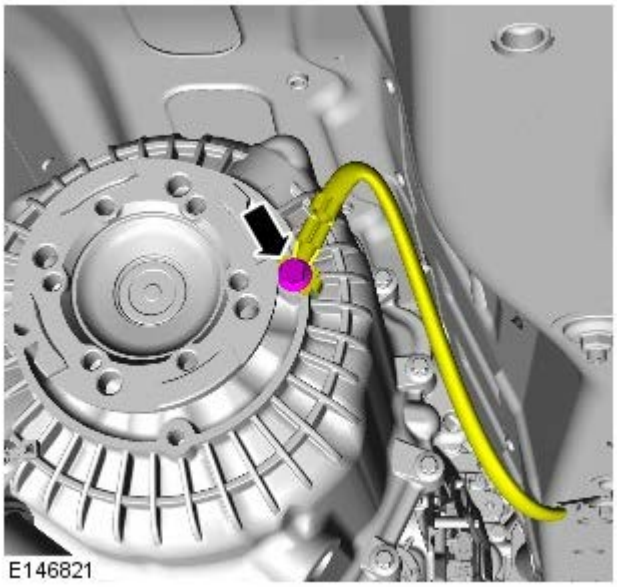
   To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

   Discard the bolts.

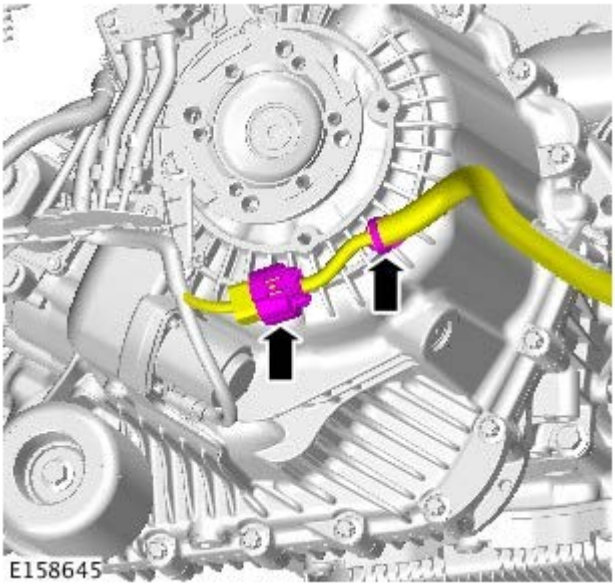
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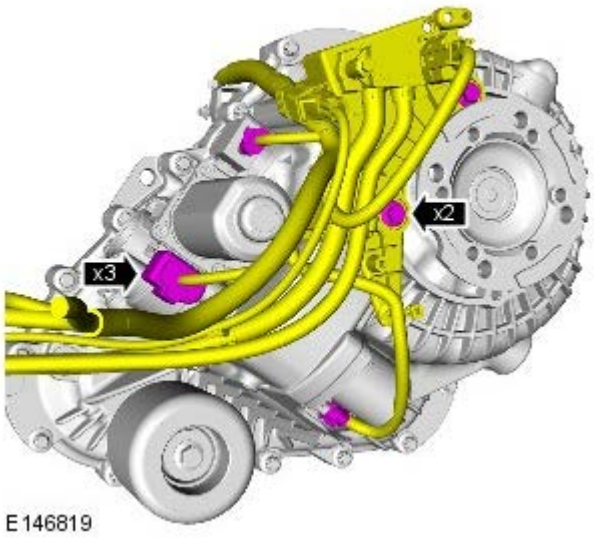
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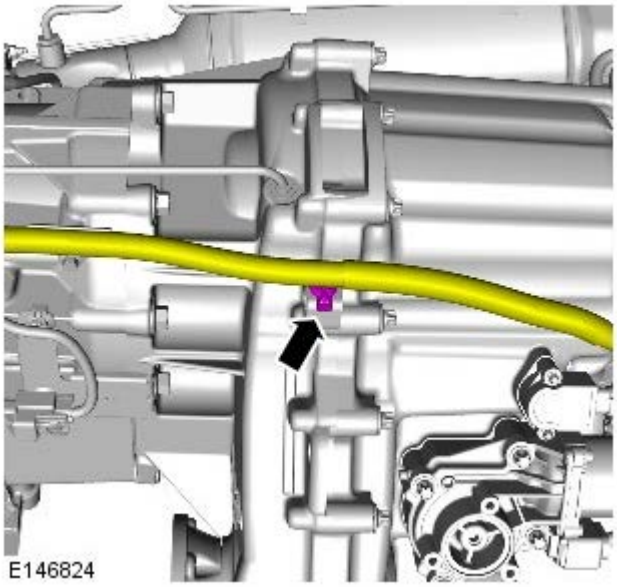
10.



11.

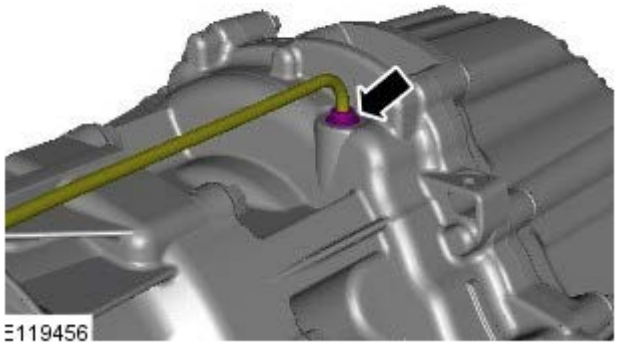


12.



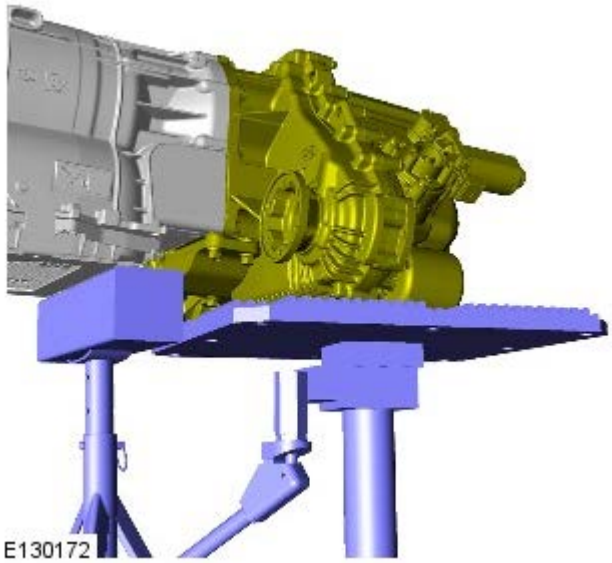
13. CAUTION: Always plug any open connections to prevent contamination.

- Disconnect the breather line.
- Depress the locking ring.

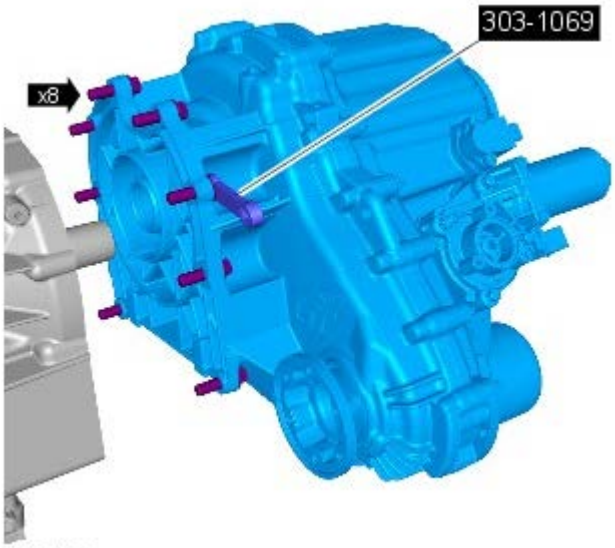


14. WARNING: Secure the component to the transmission jack.

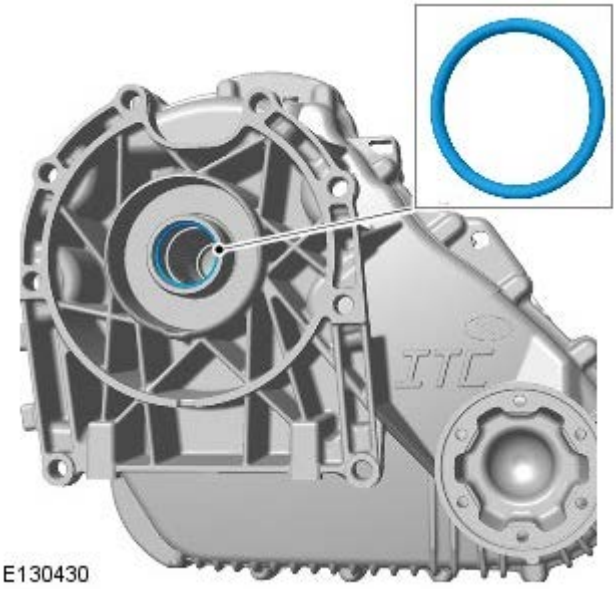
- *General Equipment:* Wooden Block
- *General Equipment:* Transmission jack
- *General Equipment:* Vehicle/axle stands



15. *Special Tool(s):* 303-1069



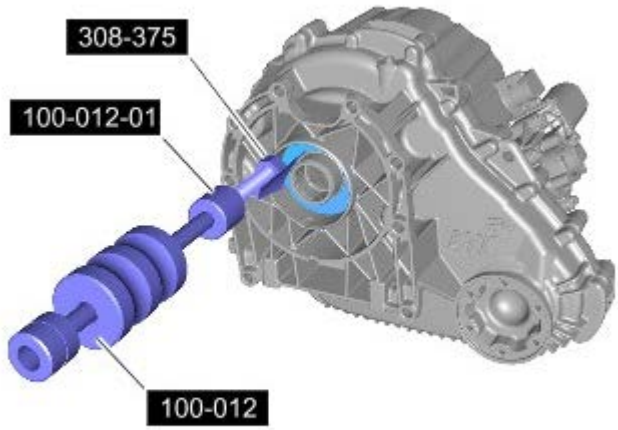
E130188


E130430

16. CAUTIONS:

Do not carry out this step if a new transfer box is to be installed.

Remove and discard the O-ring seal.



E131138

17. CAUTIONS:

Care must be taken to avoid damage to the seal register and running surface.

Do not carry out this step if a new transfer box is to be installed.

Note the fitted position of the component prior to removal.

- *Special Tool(s):* 100-012, 100-012-01, 308-375

Published: 09-Nov-2013

Transfer Case - Vehicles With: Twin Speed Transfer Case - Transfer Case TDV6 3.0L Diesel

Installation

Special Tool(s)

303-1069  E53727	303-1069 Adapter, Wrench
308-598  E50941	308-598 Installer, Oil Seal

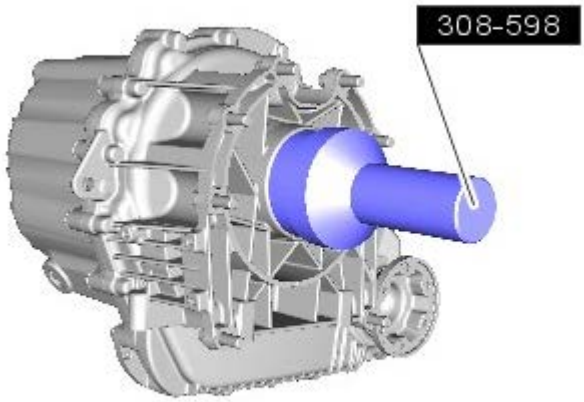
General Equipment

Powertrain Jack
Vehicle/axle stands
Wooden Block

NOTES:

Some variation in the illustrations may occur, but the essential information is always correct.

Component shown removed for clarity.



E50943

1. CAUTION: Oil seals must be fitted dry.

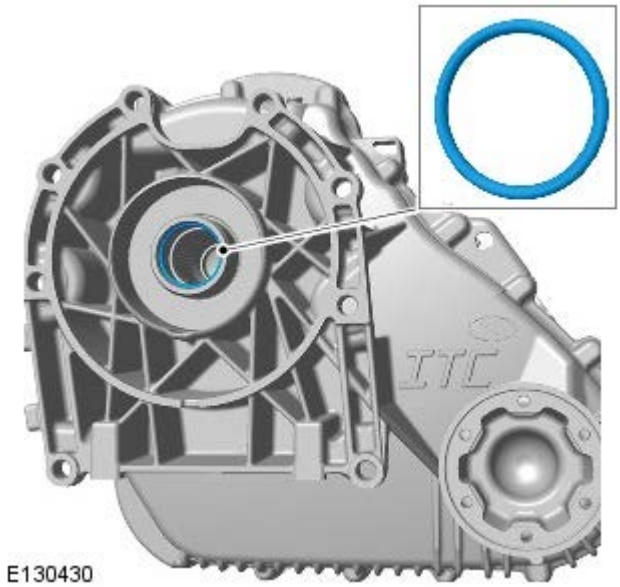
   NOTES:

   This step is only required if previously removed.

   Make sure that this component is installed to the noted removal position.

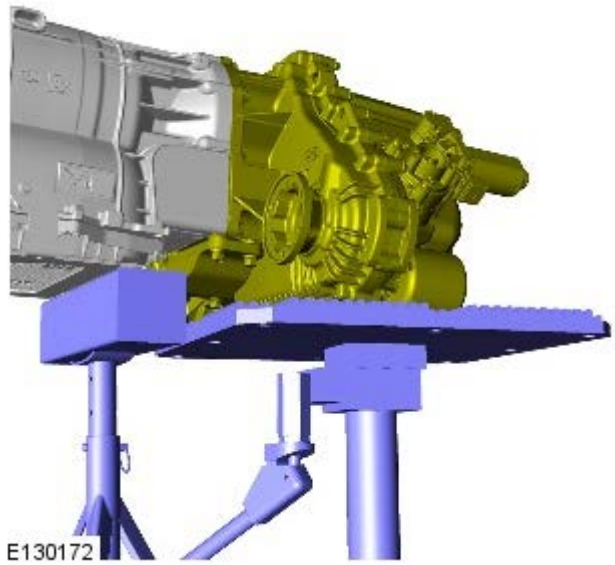
   Special Tool(s): 308-598

2. NOTE: This step is only required if previously removed.



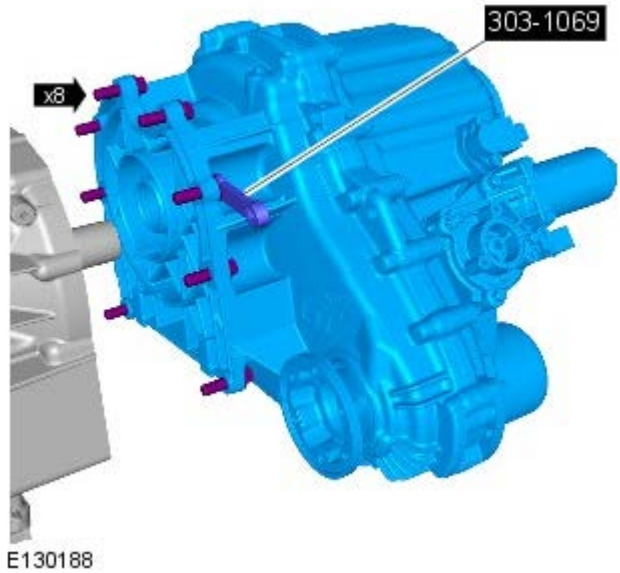
3.

- Clean the component mating faces.
- Lubricate input shaft splines with 'Weicon TL7391' grease.
- *General Equipment:* Powertrain Jack
  General Equipment: Vehicle/axle stands
  General Equipment: Wooden Block

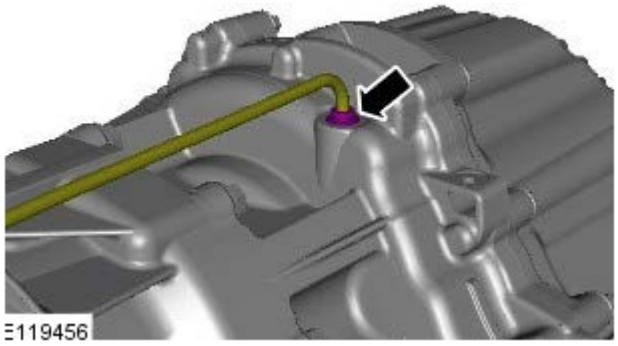


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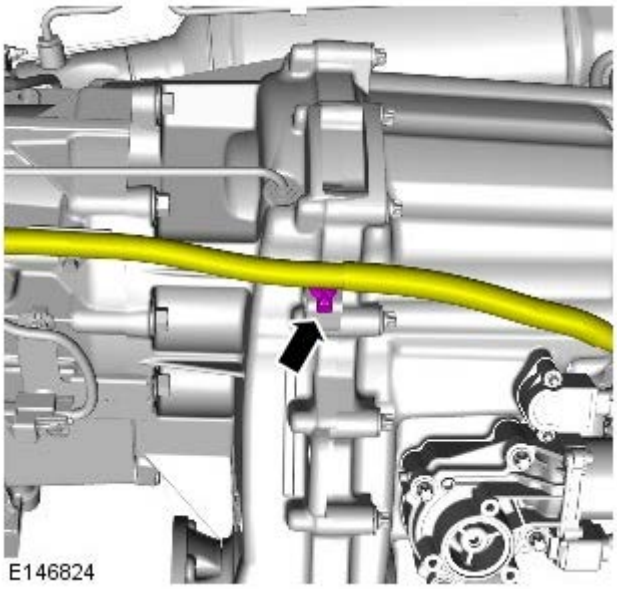
- *Special Tool(s):* 303-1069
- *Torque:* 45 Nm



5.

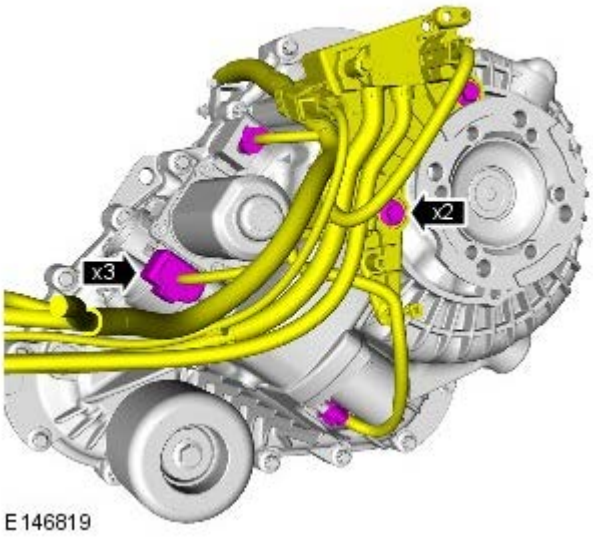


6.



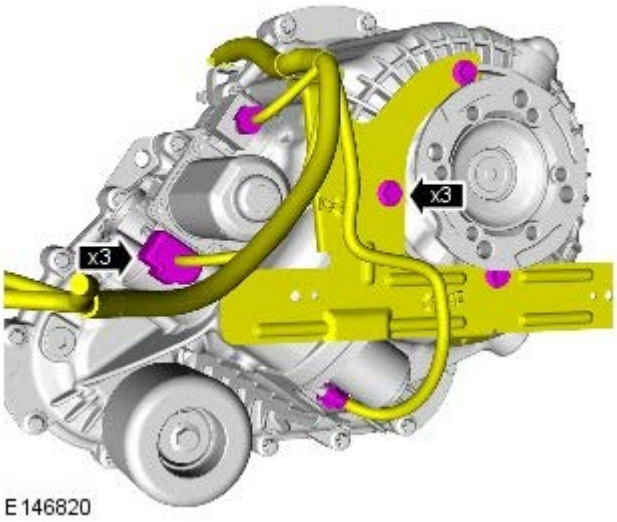
7. Vehicles with diesel particulate filter (DPF).

   Torque: 25 Nm



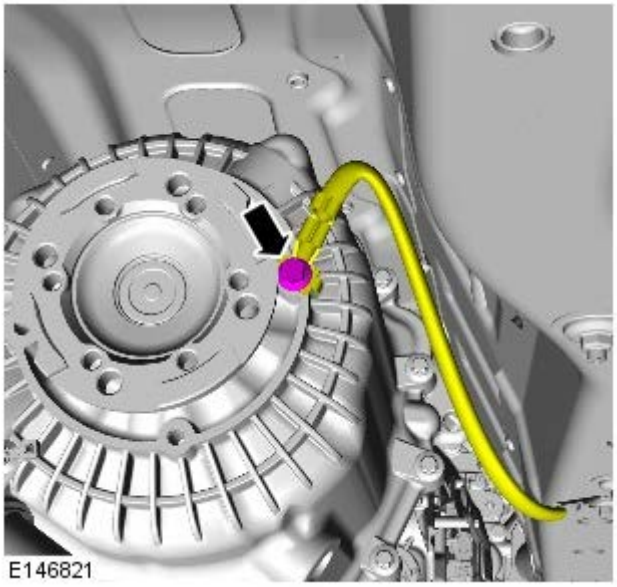
8. Vehicles without diesel particulate filter (DPF).

   Torque: 25 Nm



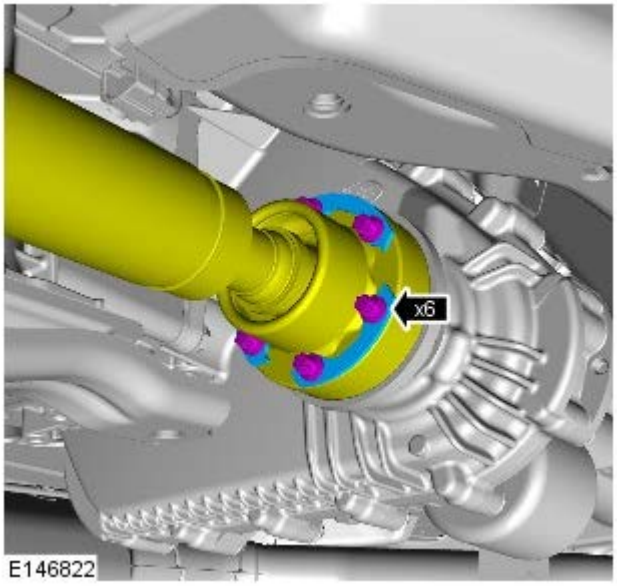
E146820

9. *Torque:* 25 Nm


E146821

10. CAUTION: Make sure that new bolts are installed.

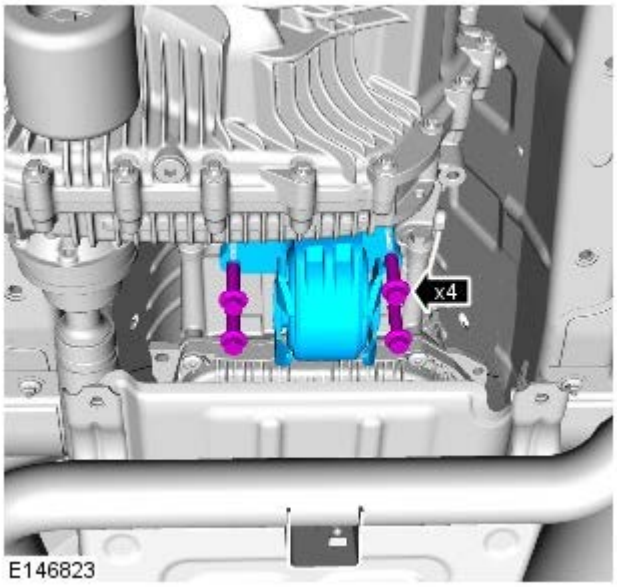
Torque:
Stage 1 45 Nm
Stage 2 90°



E146822

11. Refer to: Rear Driveshaft - TDV6 3.0L Diesel (205-01 Driveshaft, Removal and Installation).

12. *Torque:* 60 Nm



13. Refer to: Rear Driveshaft - TDV6 3.0L Diesel (205-01 Driveshaft, Removal and Installation).

14. NOTE: Do not carry out this step if the component removed for access only.

    Refer to: Transfer Case Draining and Filling (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, General Procedures).

15. Connect the battery ground cable.

    Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

16. NOTE: Do not carry out this step if the component was 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: 09-Nov-2013

Transfer Case - Vehicles With: Twin Speed Transfer Case - Transfer Case TDV8 4.4L Diesel

Installation

Special Tool(s)

303-1069  E53727	303-1069 Adapter, Wrench
308-598  E50941	308-598 Installer, Oil Seal

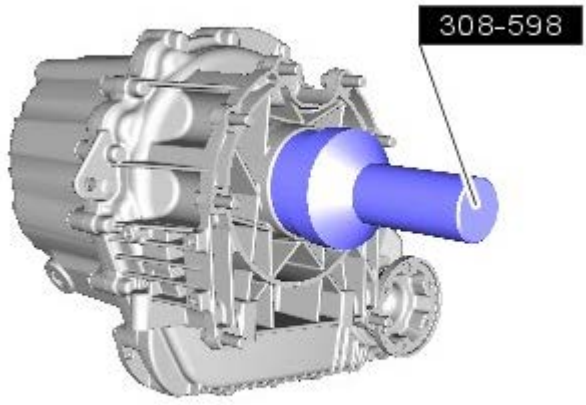
General Equipment

Powertrain Jack
Vehicle/axle stands
Wooden Block

NOTES:

Some variation in the illustrations may occur, but the essential information is always correct.

Component shown removed for clarity.



E50943

1. CAUTION: Oil seals must be fitted dry.

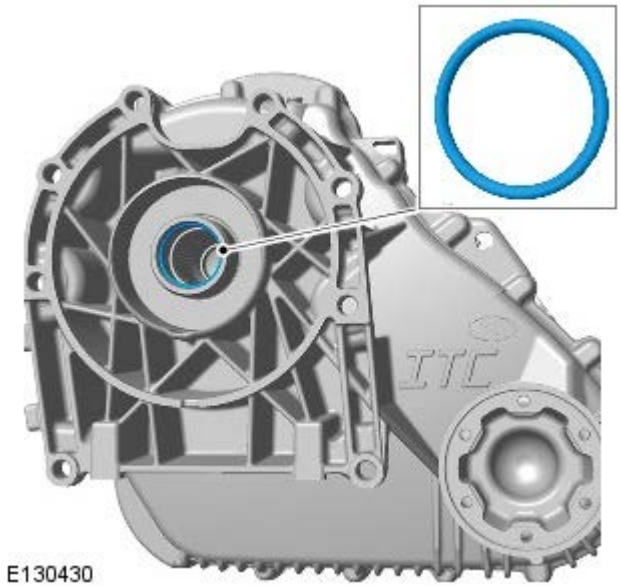
   NOTES:

   This step is only required if previously removed.

   Make sure that this component is installed to the noted removal position.

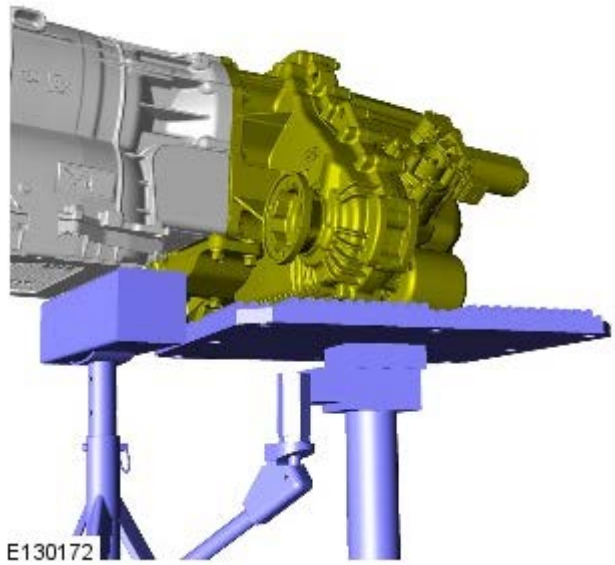
   Special Tool(s): 308-598

2. NOTE: This step is only required if previously removed.



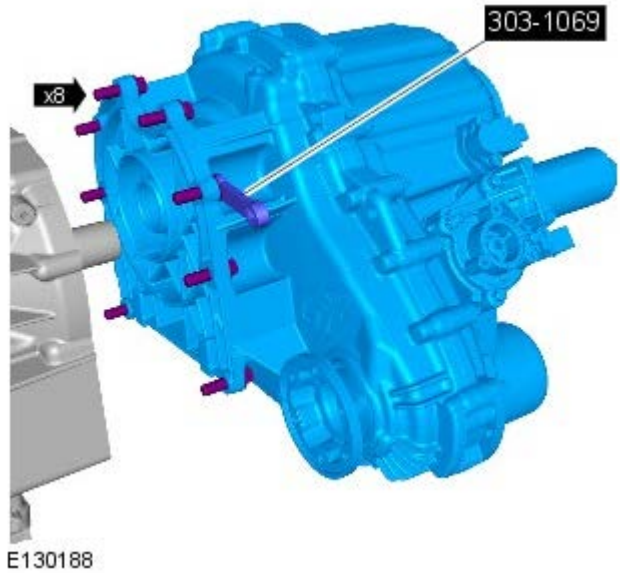
3.

- Clean the component mating faces.
- Lubricate input shaft splines with 'Weicon TL7391' grease.
- *General Equipment:* Powertrain Jack
  General Equipment: Vehicle/axle stands
  General Equipment: Wooden Block

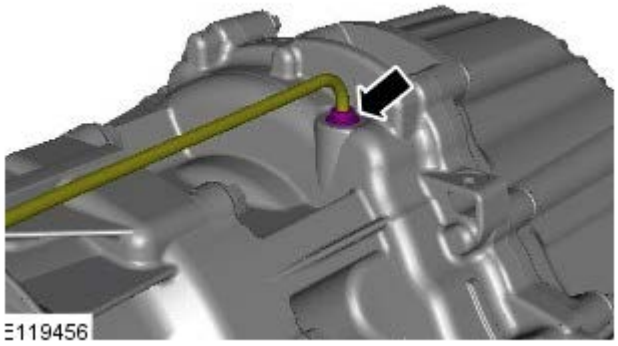


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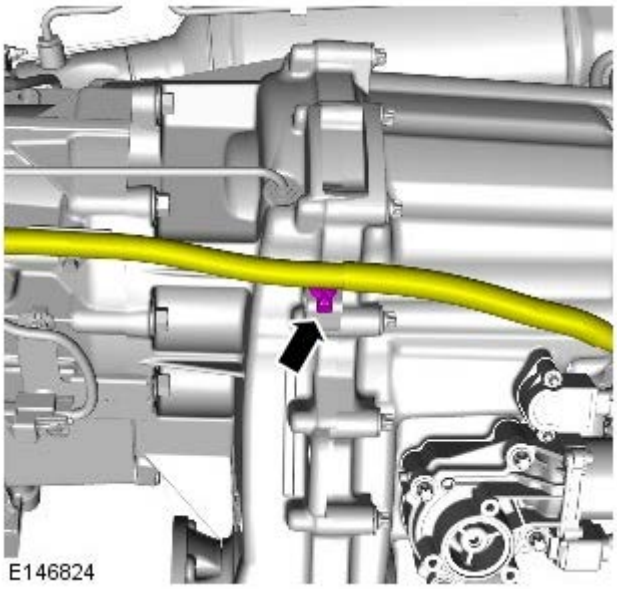
- *Special Tool(s):* 303-1069
- *Torque:* 45 Nm



5.

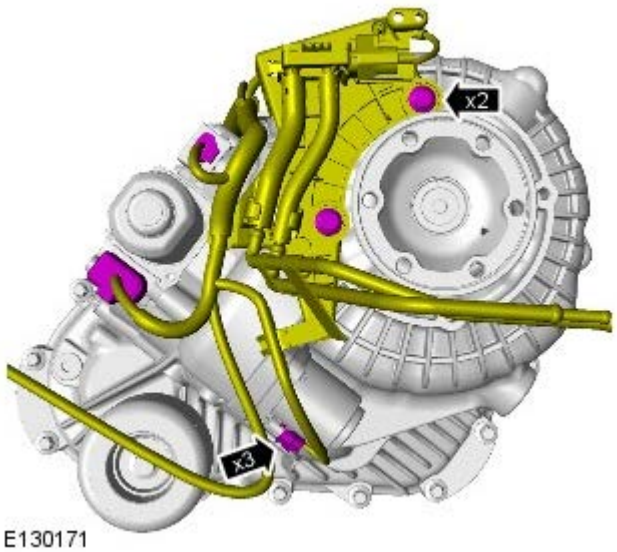


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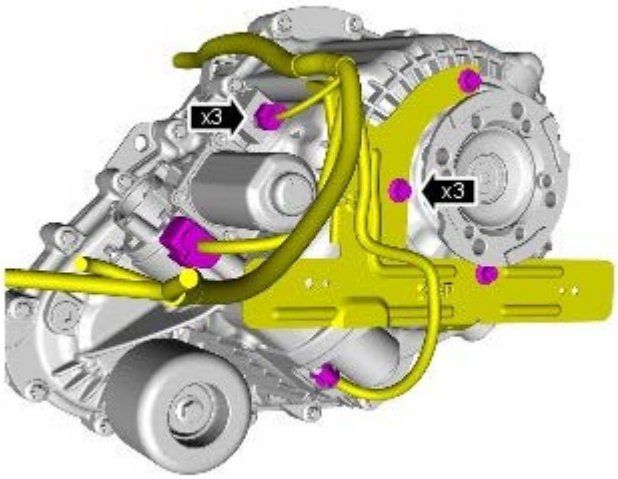
7. Vehicles with diesel particulate filter (DPF).

   Torque: 25 Nm



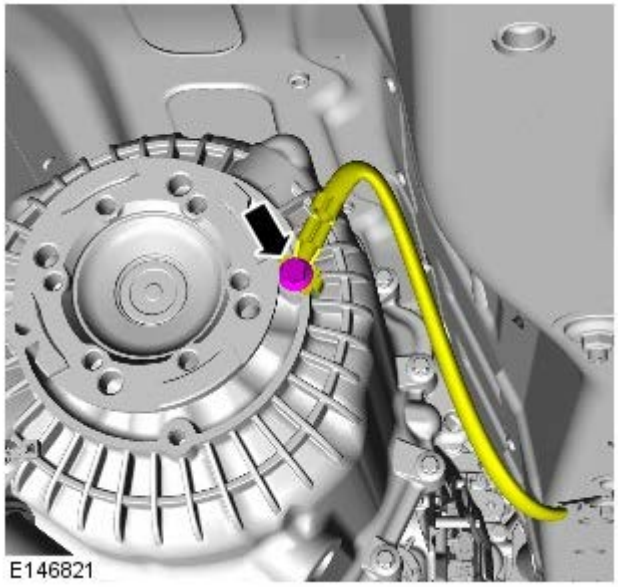
8. Vehicles without diesel particulate filter (DPF).

   Torque: 25 Nm



E146825

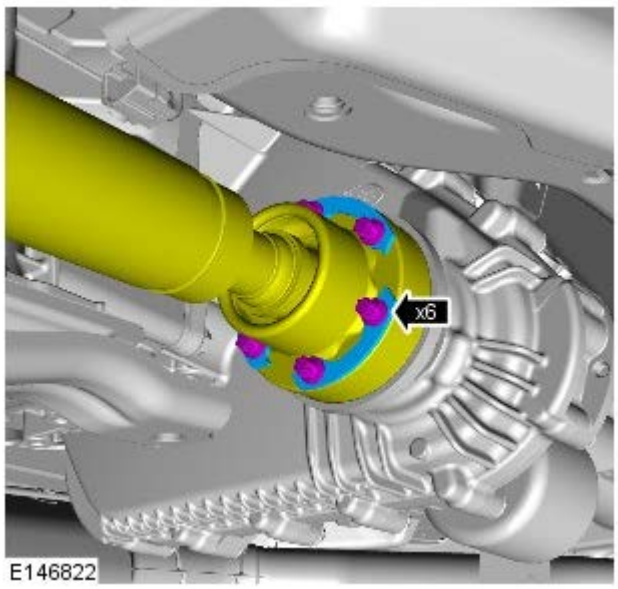
9. *Torque:* 25 Nm



E146821

10. CAUTION: Make sure that new bolts are installed.

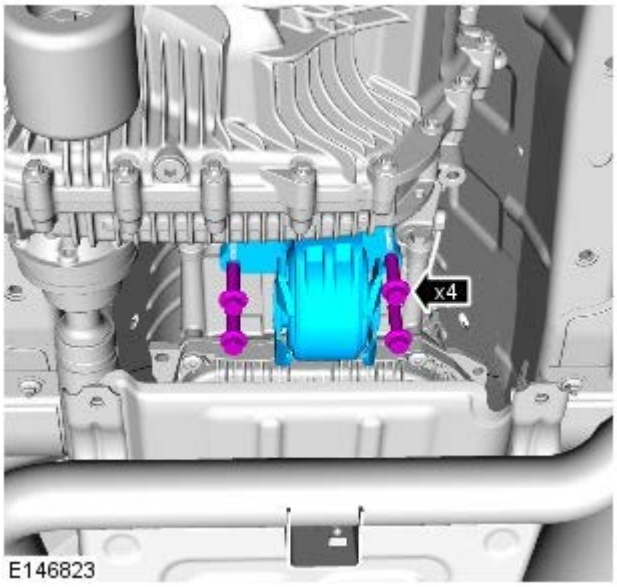
Torque:
Stage 1: 45 Nm
Stage 2: 90°



E146822

11. Refer to: Rear Driveshaft - TDV8 4.4L Diesel (205-01 Driveshaft, Removal and Installation).

12. *Torque:* 60 Nm



13. Refer to: Transmission Support Crossmember - TDV8 4.4L Diesel (502-02 Full Frame and Body Mounting, Removal and Installation).

14. NOTE: Do not carry out this step if the component removed for access only.

    Refer to: Transfer Case Draining and Filling (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, General Procedures).

15. Connect the battery ground cable.

    Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

16. NOTE: Do not carry out this step if the component was 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: 09-Nov-2013

Transfer Case - Vehicles With: Twin Speed Transfer Case - Transfer Case V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol

Installation

Special Tool(s)

 E53727	303-1069 Adapter, Wrench
 E50941	308-598 Installer, Oil Seal

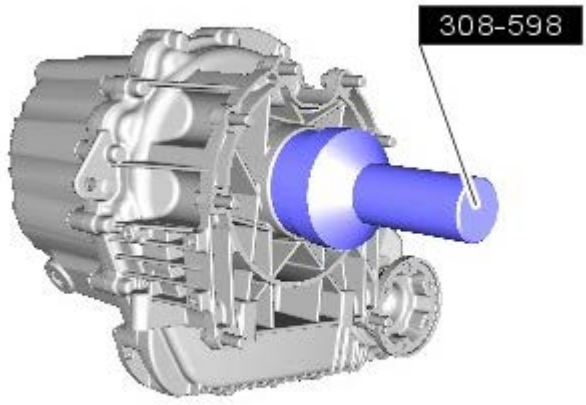
General Equipment

Powertrain Jack
Vehicle/axle stands
Wooden Block

NOTES:

Some variation in the illustrations may occur, but the essential information is always correct.

Component shown removed for clarity.



E50943

1. CAUTION: Oil seals must be fitted dry.

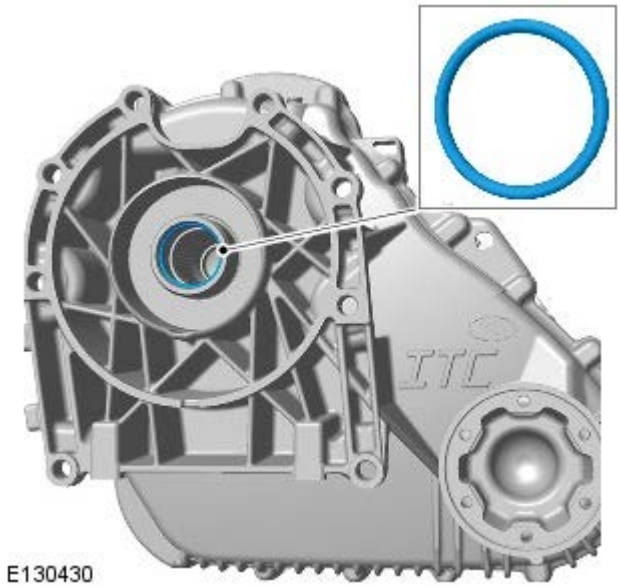
   NOTES:

   This step is only required if previously removed.

   Make sure that this component is installed to the noted removal position.

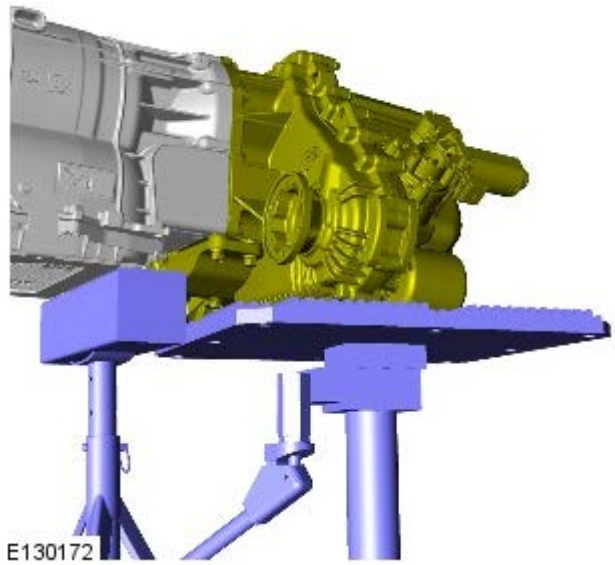
   Special Tool(s): 308-598

2. NOTE: This step is only required if previously removed.



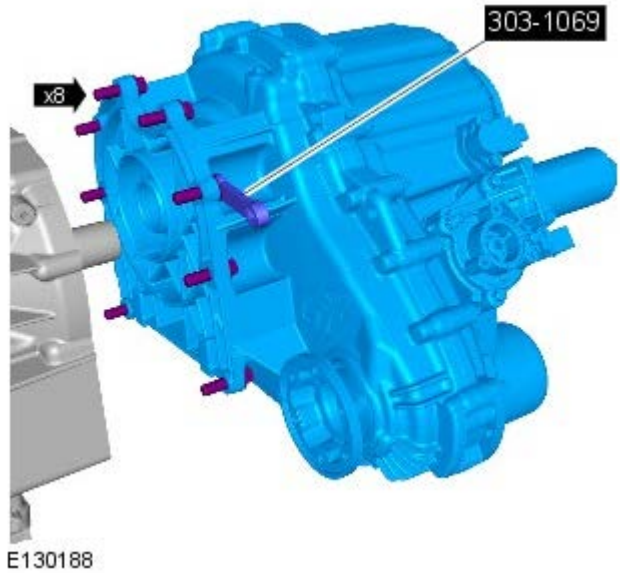
3.

- Clean the component mating faces.
- Lubricate input shaft splines with 'Weicon TL7391' grease.
- *General Equipment:* Powertrain Jack
  General Equipment: Vehicle/axle stands
  General Equipment: Wooden Block

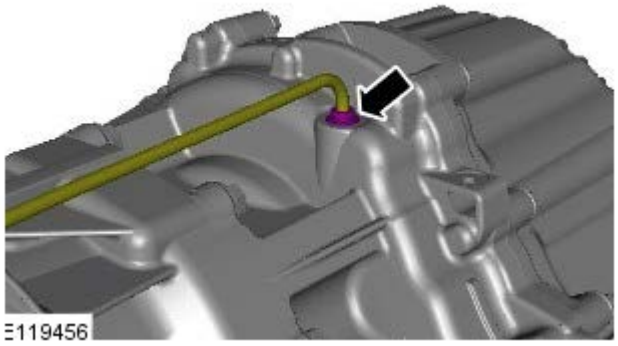


4.

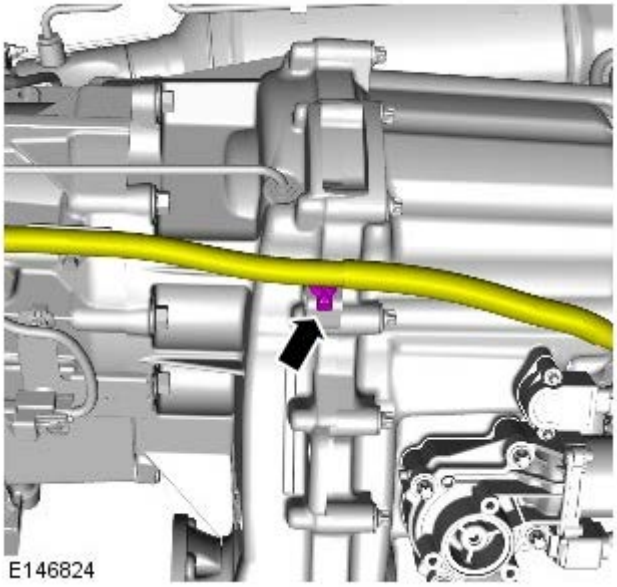
- *Special Tool(s):* 303-1069
- *Torque:* 45 Nm



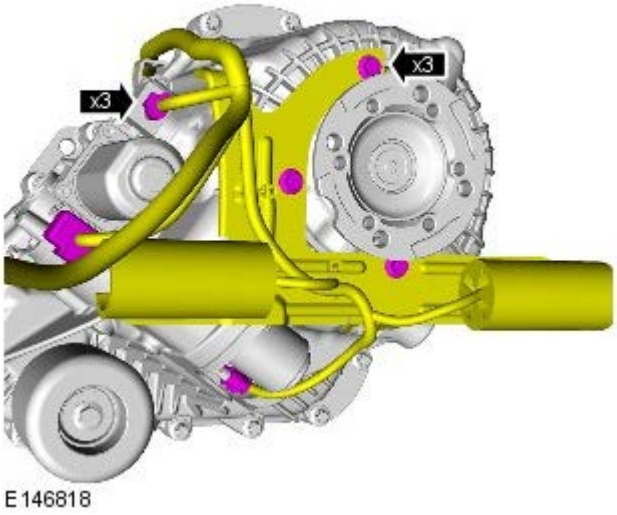
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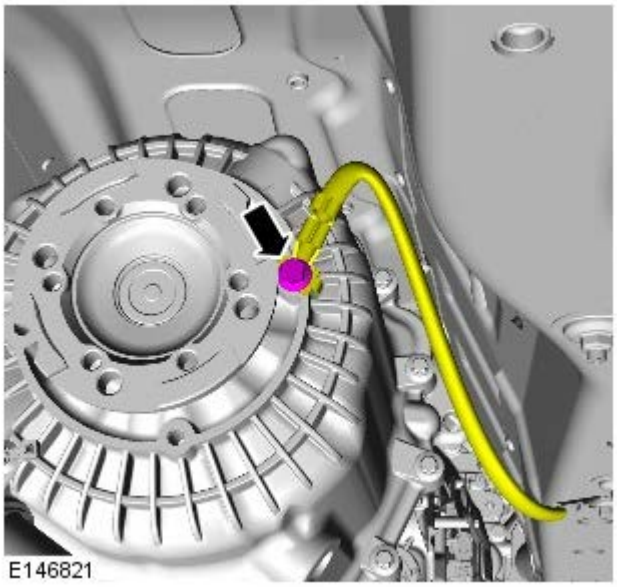
6.

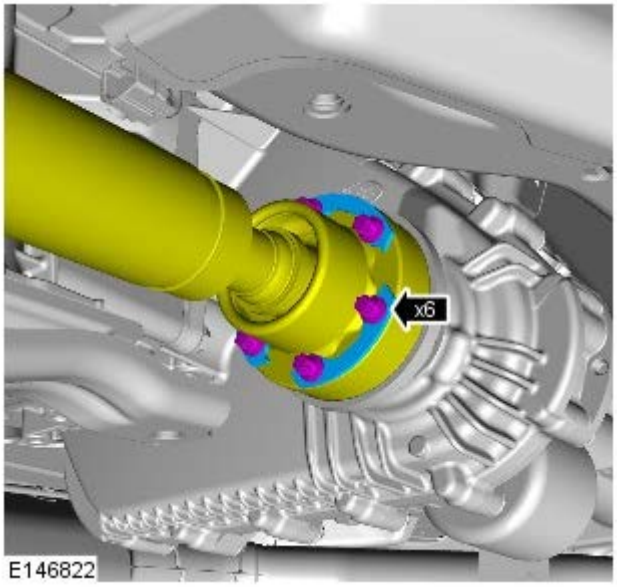


7. *Torque:* 25 Nm



8. *Torque:* 25 Nm



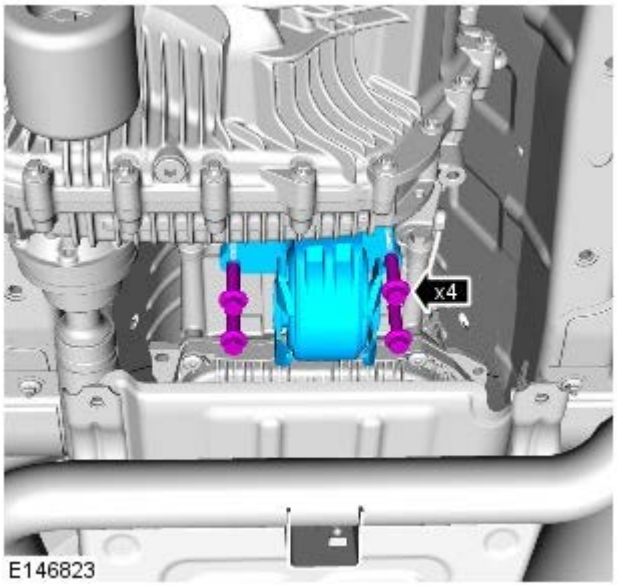


9. CAUTION: Make sure that new bolts are installed.

   Torque:
   Stage 1 45 Nm
   Stage 2 90°

10. Refer to: Rear Driveshaft - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (205-01 Driveshaft, Removal and Installation).

11. *Torque:* 60 Nm



12. Refer to: Transmission Support Crossmember - V6 S/C 3.0L 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.

    Refer to: Transfer Case Draining and Filling (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, General Procedures).

14. Connect the battery ground cable.

    Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

15.  NOTE: Do not carry out this step if the component was 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 - Vehicles With: Twin Speed Transfer Case - Transfer Case SDV6 3.0L Diesel - Hybrid Electric Vehicle

Installation

Special Tool(s)

303-1069  E53727	303-1069 Adapter, Wrench
308-598  E50941	308-598 Installer, Oil Seal

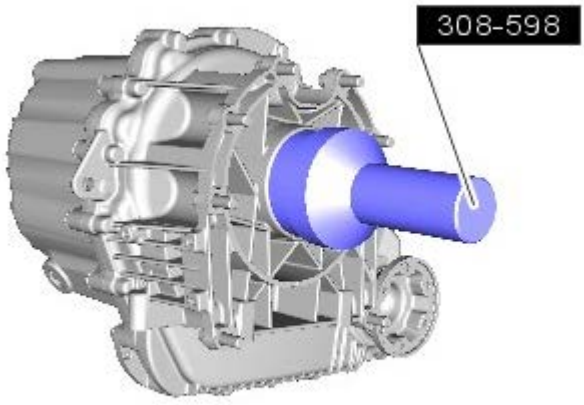
General Equipment

Powertrain Jack
Vehicle/axle stands
Wooden Block

NOTES:

Some variation in the illustrations may occur, but the essential information is always correct.

Component shown removed for clarity.



E50943

1. CAUTION: Oil seals must be fitted dry.

   NOTES:

   This step is only required if previously removed.

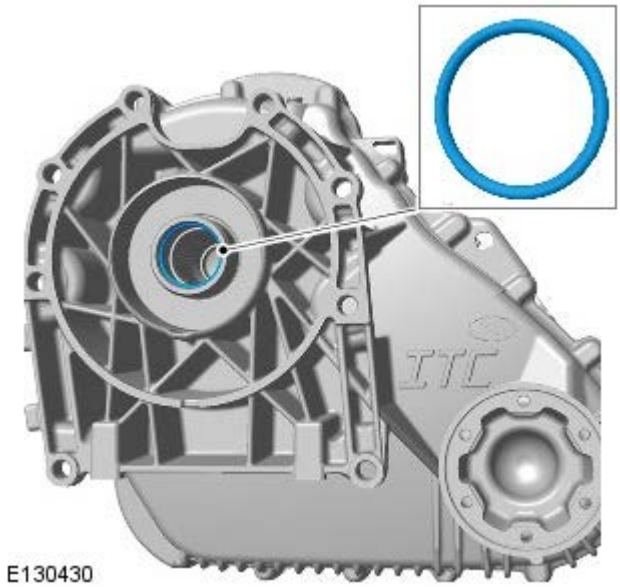
   Make sure that this component is installed to the noted removal position.

   Special Tool(s): 308-598

2. NOTES:

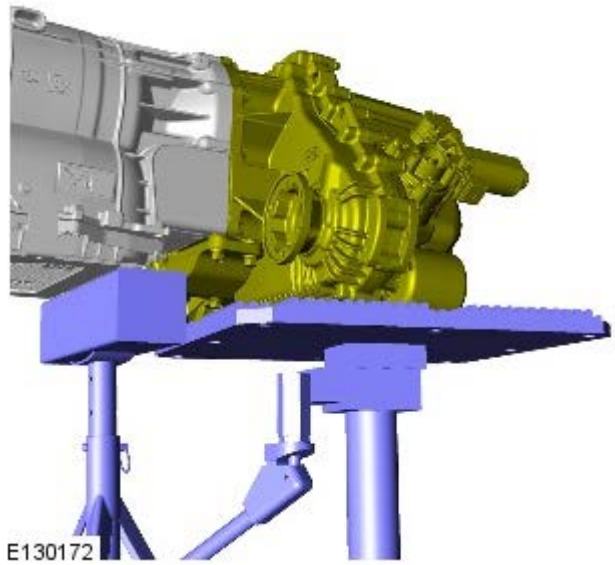
   This step is only required if previously removed.

   Install a new O-ring seal.



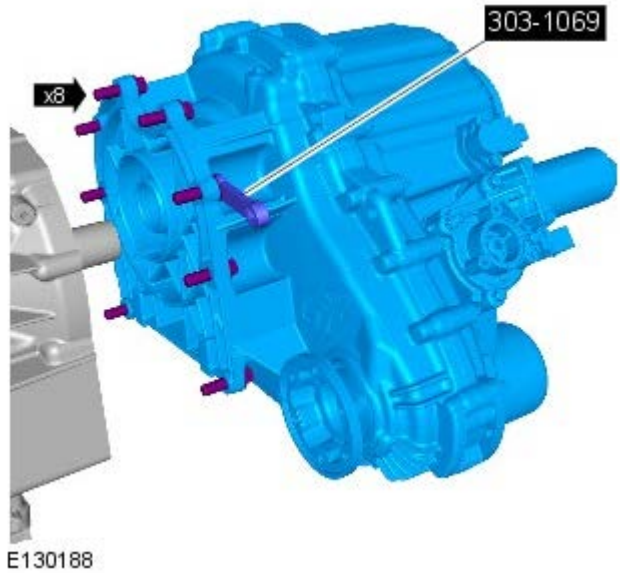
3.

- Clean the component mating faces.
- Lubricate input shaft splines with 'Weicon TL7391' grease.
- *General Equipment:* Powertrain Jack
  General Equipment: Vehicle/axle stands
  General Equipment: Wooden Block

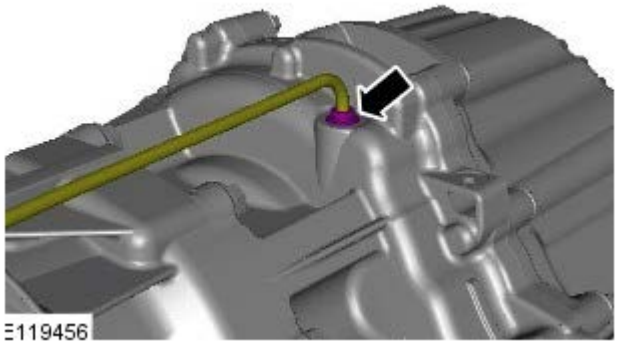


4.

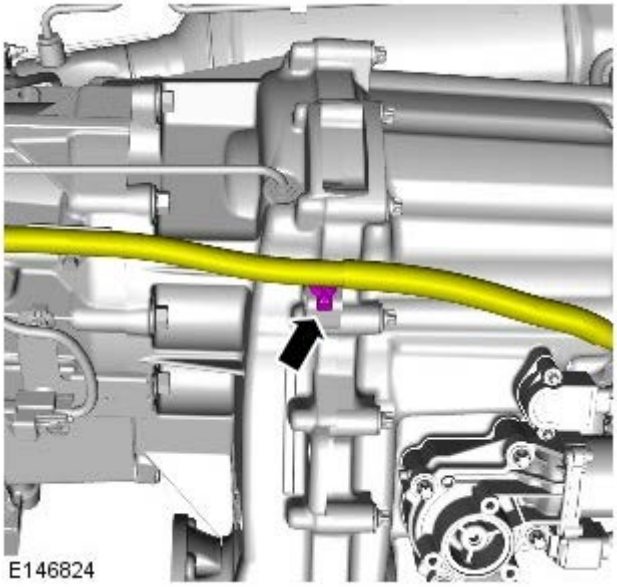
- *Special Tool(s):* 303-1069
- *Torque:* 45 Nm



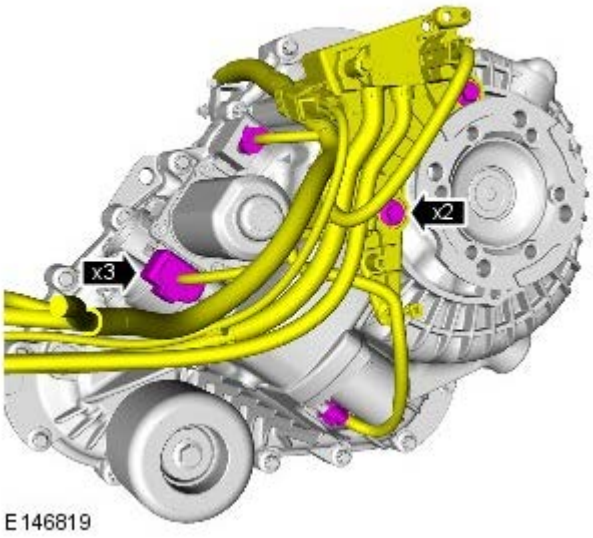
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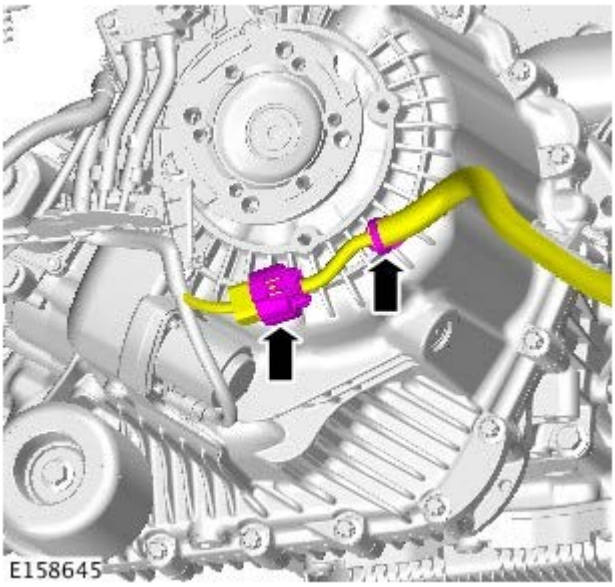
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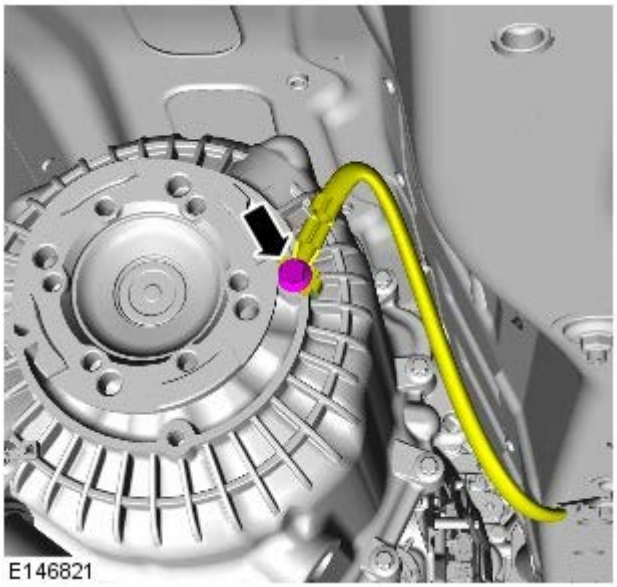
7. *Torque:* 25 Nm



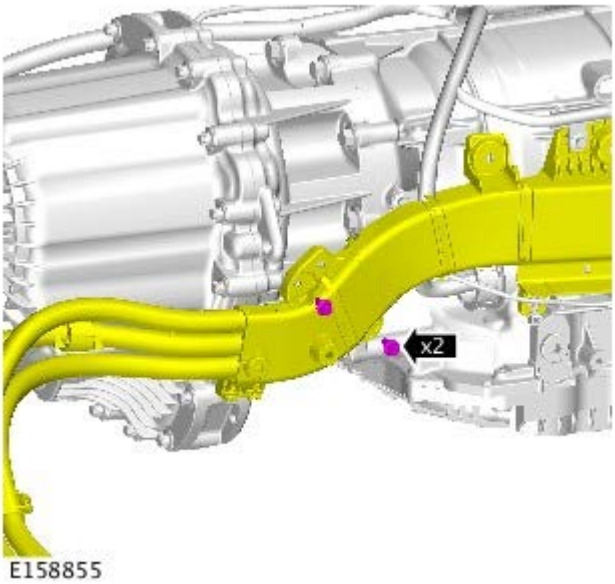
8.



9. *Torque:* 25 Nm

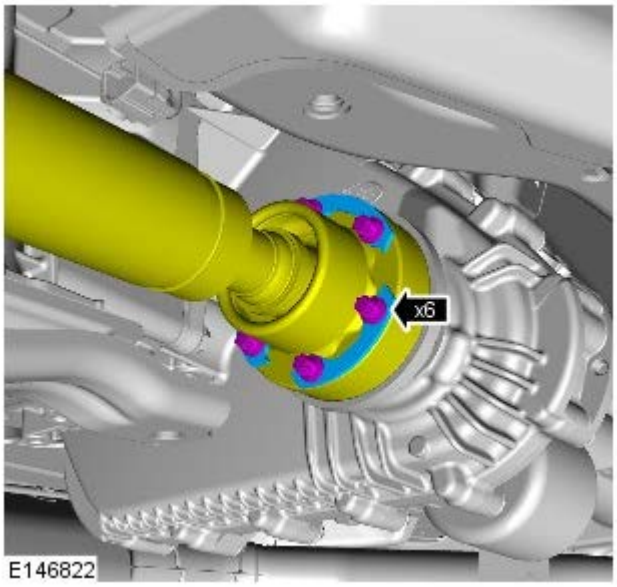


10. *Torque:* 10 Nm



11. CAUTION: Make sure that new bolts are installed.

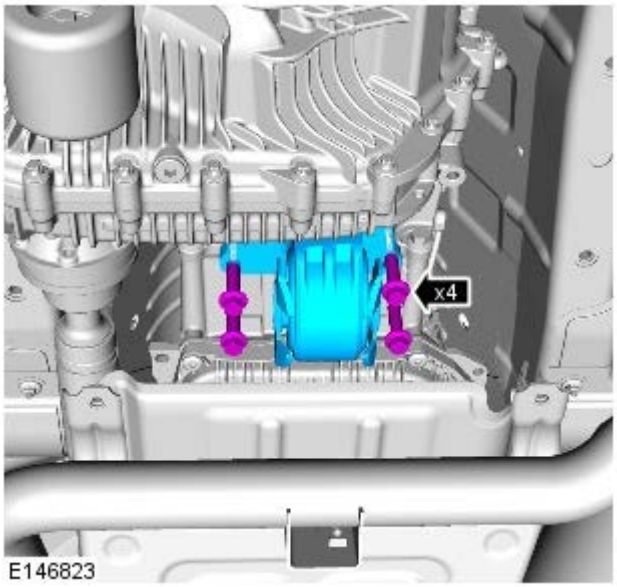
NOTE: Make sure that the component aligns with the installation mark noted in the removal step.



Torque:
Stage 1 45 Nm
Stage 2 90°

12. Refer to: Rear Driveshaft - SDV6 3.0L Diesel - Hybrid Electric Vehicle (205-01 Driveshaft, Removal and Installation).

13. *Torque:* 60 Nm



14. Refer to: Transmission Support Crossmember - TDV6 3.0L Diesel (502-02 Full Frame and Body Mounting, Removal and Installation).

15. NOTE: Do not carry out this step if the component was removed for access only.

    Refer to: Transfer Case Draining and Filling (308-07C Transfer Case - Vehicles With: Twin Speed Transfer Case, General Procedures).

16. Refer to: Hybrid Electric Vehicle (HEV) System Bonding Test (414-01 Battery, Mounting and Cables, General Procedures).

17. Refer to: Hybrid Electric Vehicle (HEV) Decommission (414-01 Battery, Mounting and Cables, General Procedures).

18. NOTE: Do not carry out this step if the component was 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: 06-Sep-2012

Exhaust System - TDV6 3.0L Diesel -

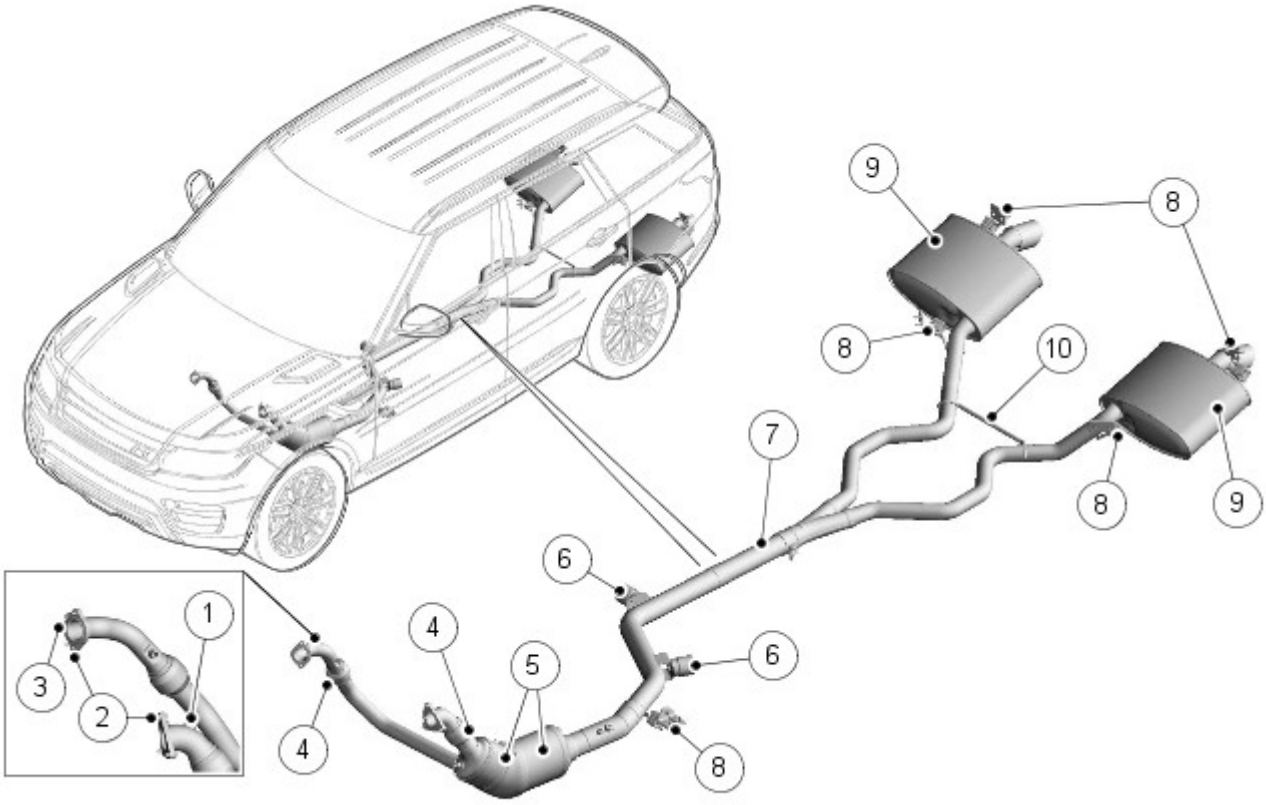
Description	Nm	lb-ft
Turbocharger to LH downpipe retaining bolts	28	21
Turbocharger to RH downpipe retaining bolts	28	21
Rear muffler clamp	55	41
RH link exhaust pipe clamp	55	35
Diesel particulate filter (DPF) pressure sensor pipe unions	17	12
DPF temperature sensor	35	26
Catalytic converter temperature sensor	35	26
Heated oxygen sensor (HO2S)	48	35
Exhaust heat shield retaining bolts	10	7

Published: 22-May-2013

Exhaust System - TDV6 3.0L Diesel - Exhaust System

Description and Operation

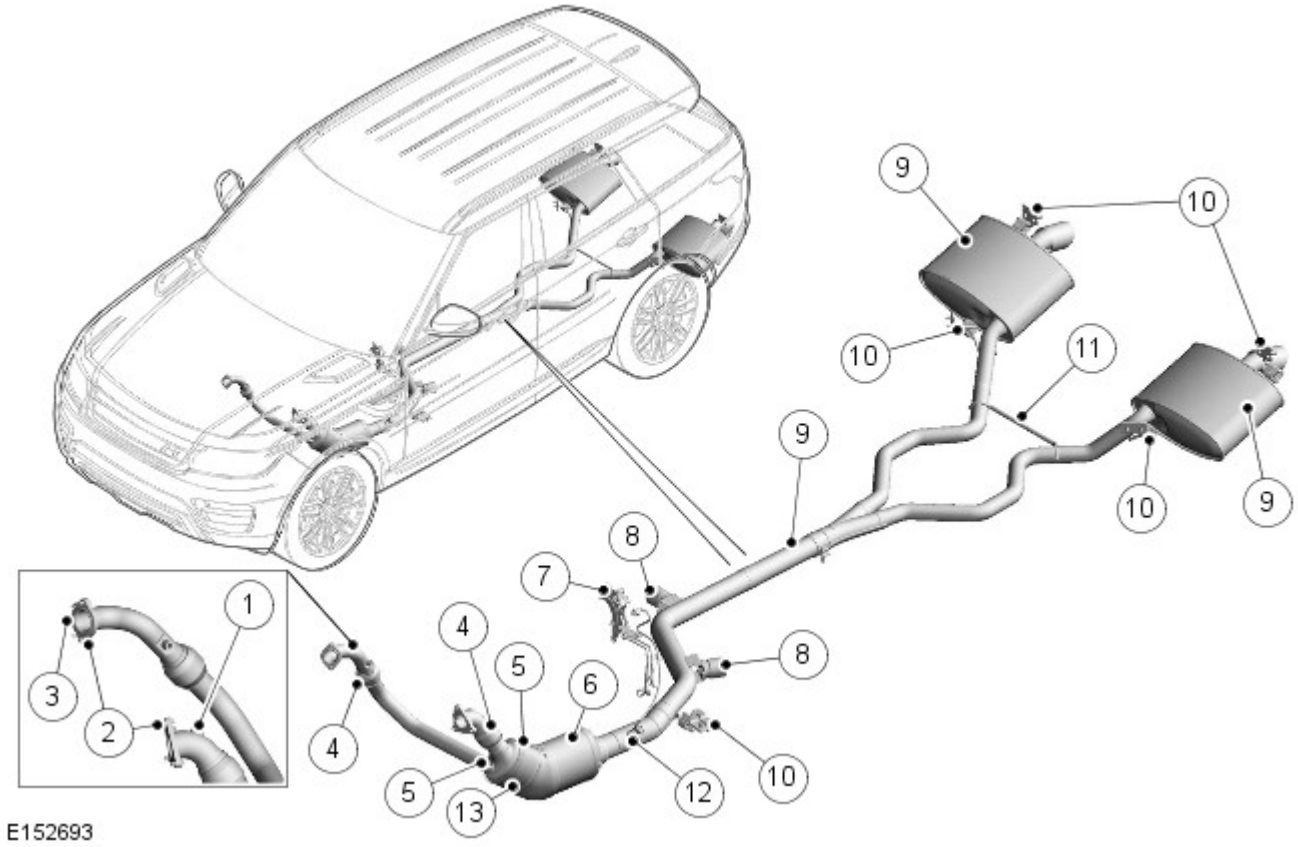
TDV6 3.0L DIESEL - EXHAUST SYSTEM COMPONENT LOCATION – WITHOUT DIESEL PARTICULATE FILTER



E152692

Item	Part Number	Description
1	-	HO2S Mounting Boss
2	-	Bolts (5 Off)
3	-	Gasket
4	-	Flexible Coupling
5	-	Catalytic converter
6	-	Mass Damper (2 Off)
7	-	Clamp
8	-	Mounting rubber (5 Off)
9	-	Rear silencer
10	-	Exhaust brace

TDV6 3.0L DIESEL - EXHAUST SYSTEM COMPONENT LOCATION – WITH DIESEL PARTICULATE FILTER



Item	Part Number	Description
1	-	HO2S Mounting Boss
2	-	Bolts (5 Off)
3	-	Gasket
4	-	Flexible coupling
5	-	Exhaust Gas Temperature Sensor (EGTS) mounting boss
6	-	Diesel Particulate Filter (DPF)
7	-	Differential pressure sensor
8	-	Mass Damper (2 Off)
9	-	Clamp
10	-	Mounting Rubber (5 Off)
11	-	Exhaust Brace
12	-	Exhaust Gas Temperature Sensor (EGTS) mounting boss
13	-	Catalytic Converter

OVERVIEW

There are two variants that are available on the TDV6 3.0L Exhaust System:

- Non DPF System – EU4 Emission regulations.
- DPF System – EU5 Emissions regulations.

On vehicles with a DPF fitted, a single catalytic converter is located in the bank 2 exhaust downpipe from the manifold. On vehicles without a DPF, a second catalytic converter is fitted in place of the DPF.

The system is attached to the underside of the body with 5 mounting rubbers which are located on hanger brackets that are welded to the system.

The mounting rubbers locate on corresponding hanger brackets which are bolted to the underside of the vehicle body.

CAUTIONS:

The use of bio fuels is approved up to the EU specification of 7%. Values higher than this are not approved as are not EU approved bio sources.

If the vehicle is waded in deep water and the engine is stopped with the rear silencers submerged, the water, which can enter the system, can also contaminate both the DPF and catalytic converter. This 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 of two catalytic converters or, if a DPF is fitted, one catalytic converter and Diesel Particulate Filter (DPF). The bank 2 inlet pipe connects to the catalytic converter and bank 1 inlet pipe will connect to a half shell that is located between the two catalytic converters or catalytic converter and DPF (if DPF fitted).

Each inlet pipe is fitted with a flange that connects to the turbocharger for each cylinder bank. The bank 2 inlet flange uses a 3 bolt fixing and the bank 1 inlet flange uses a 2 bolt fixing that are screwed into threaded holes in each of the turbochargers. Each flange is sealed using a gasket and both inlet pipes are fitted with flexible couplings.

The catalytic converters or DPF (if fitted) have an outlet pipe that is secured by a clamp to the centre section. The outlet pipe has 2 mass dampers which will absorb resonance from the system. The outlet pipe also has one hanger bracket which is welded to the pipe.

REAR SECTION

The rear section comprises a single pipe, which separates into two pipes that connect to the rear silencers. The rear section is connected to the front section with a torca clamp.

The two rear silencers are attached to the body by two exhaust hanger brackets on each of the rear silencers.

A brace is welded between the pipes to retain system in position and reduce exhaust flexing.

CATALYTIC CONVERTER

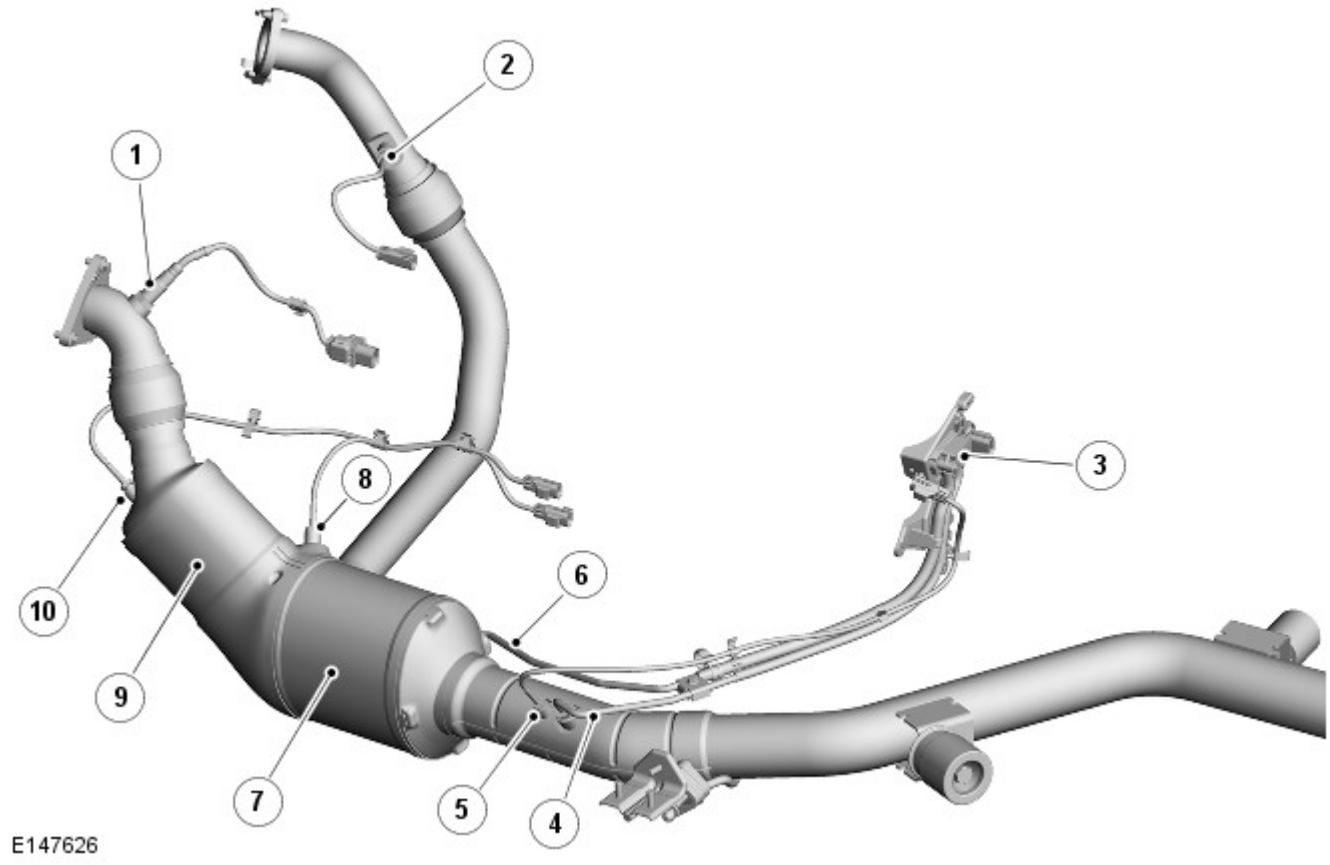
The oxidizing catalytic converter is located in the front section of the bank 2 inlet pipe, after the pre-catalyst exhaust temperature sensor (vehicles with DPF only) and the Heated Oxygen Sensor (HO2S).

NOTE: On vehicles fitted with DPF: The Pre and Post DPF Temperature Sensors are used by the engine management system to monitor the DPF regeneration purposes.

On vehicles without a DPF, a second catalytic converter is fitted in place of the DPF.

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. On vehicles without a DPF, the second catalytic converter is fitted to further reduce the carbon monoxide and the hydrocarbon content of the gases. 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. The 'washcoat' is a coating containing platinum and palladium, which are active constituents for converting harmful emissions into inert by-products. The platinum and palladium catalytically oxidise the carbon monoxide and the hydrocarbons in the exhaust gases, and converts them into carbon dioxide and water.

DIESEL PARTICULATE FILTER



Item	Part Number	Description
1	-	Heated Oxygen Sensor

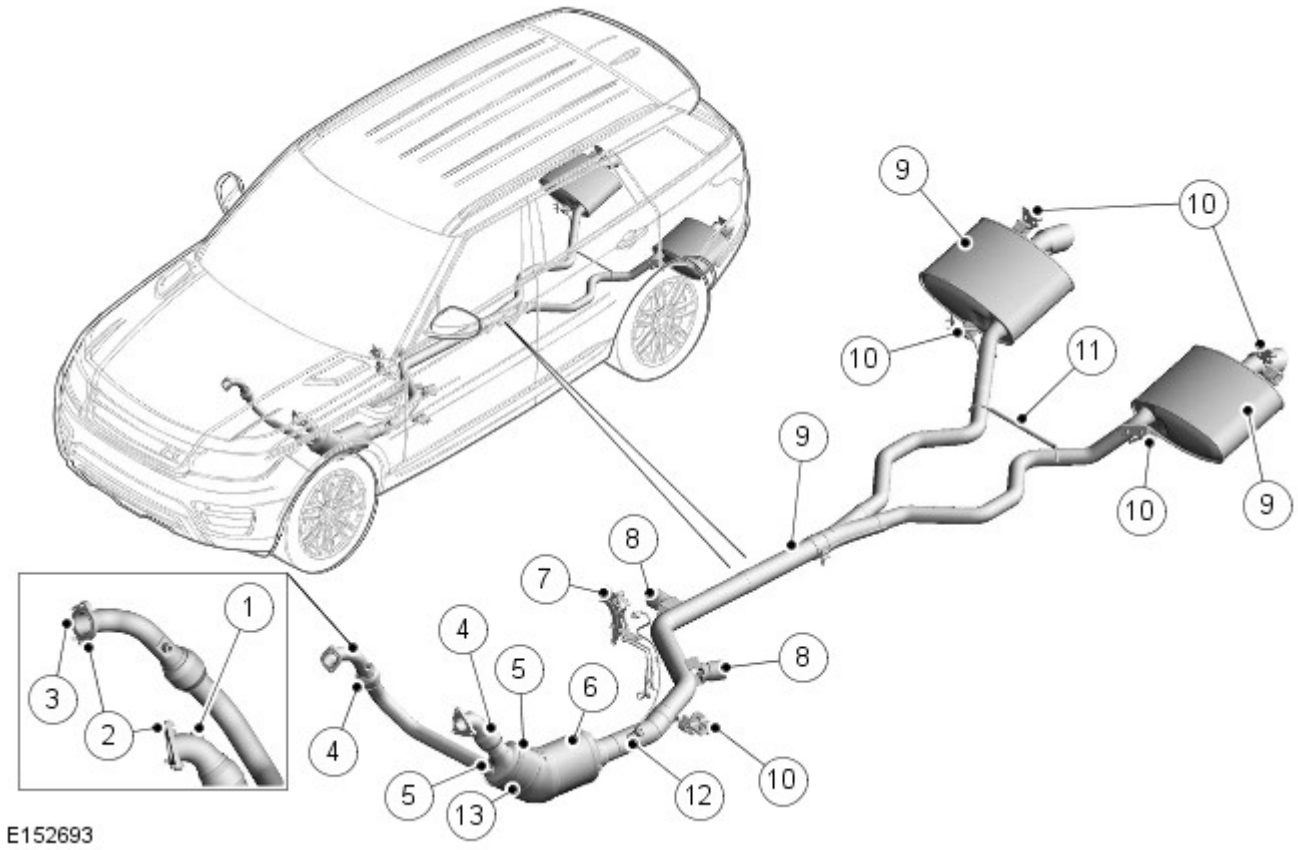
2	-	Pre-DPF Temperature Sensor
3	-	Differential Pressure Sensor
4	-	Low Pressure Pipe
5	-	Post-DPF Temperature Sensor
6	-	High Pressure Pipe
7	-	Diesel Particulate Filter (DPF)
8	-	Post-Catalyst Temperature Sensor
9	-	Catalytic Converter
10	-	Pre-Catalyst Temperature Sensor

For further information regarding DPF refer to Exhaust System (309-00A: Exhaust System - TDV6 3.0L Diesel, Diesel Particulate Filter (System Operation and Component Description)

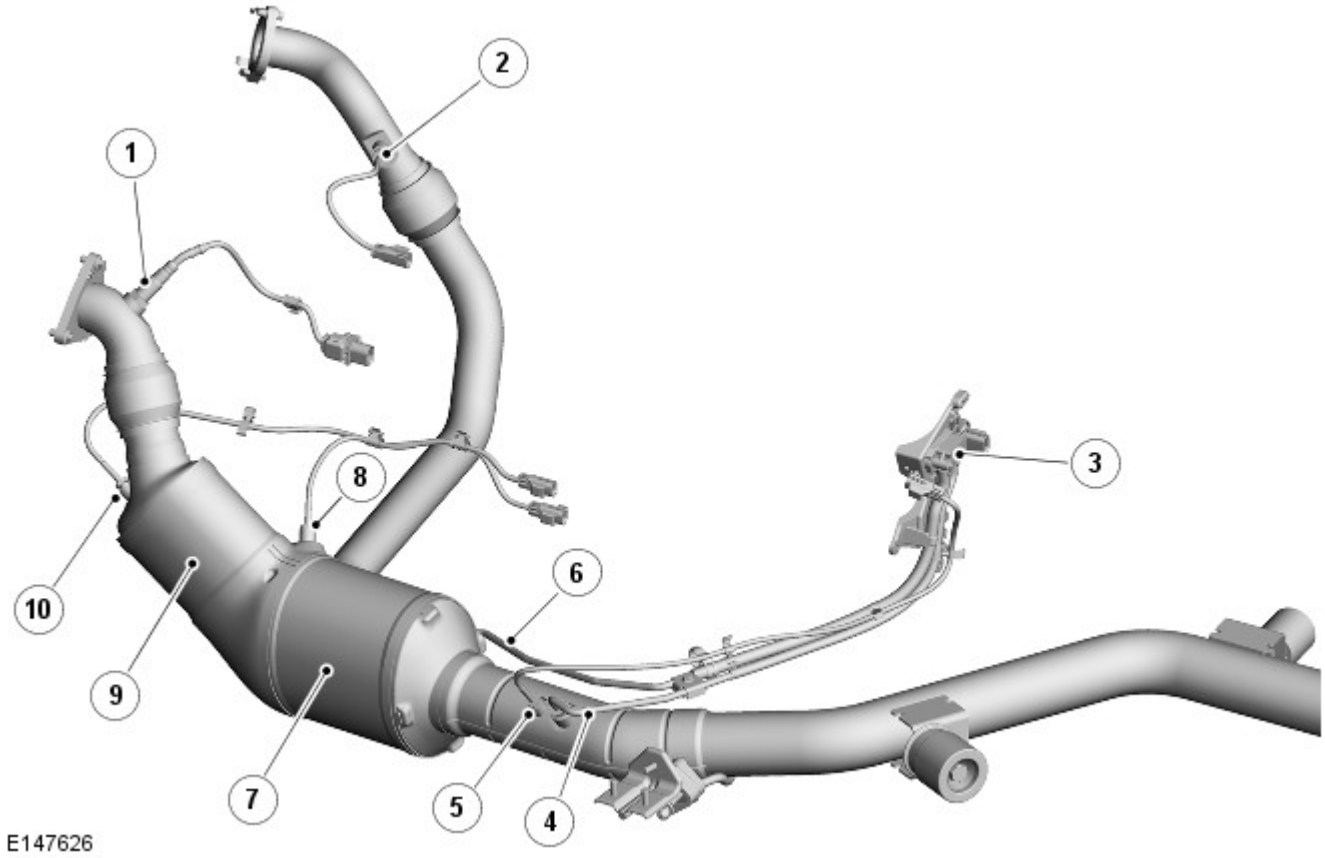
Published: 22-May-2013

Exhaust System - TDV6 3.0L Diesel - Diesel Particulate Filter - Component Location

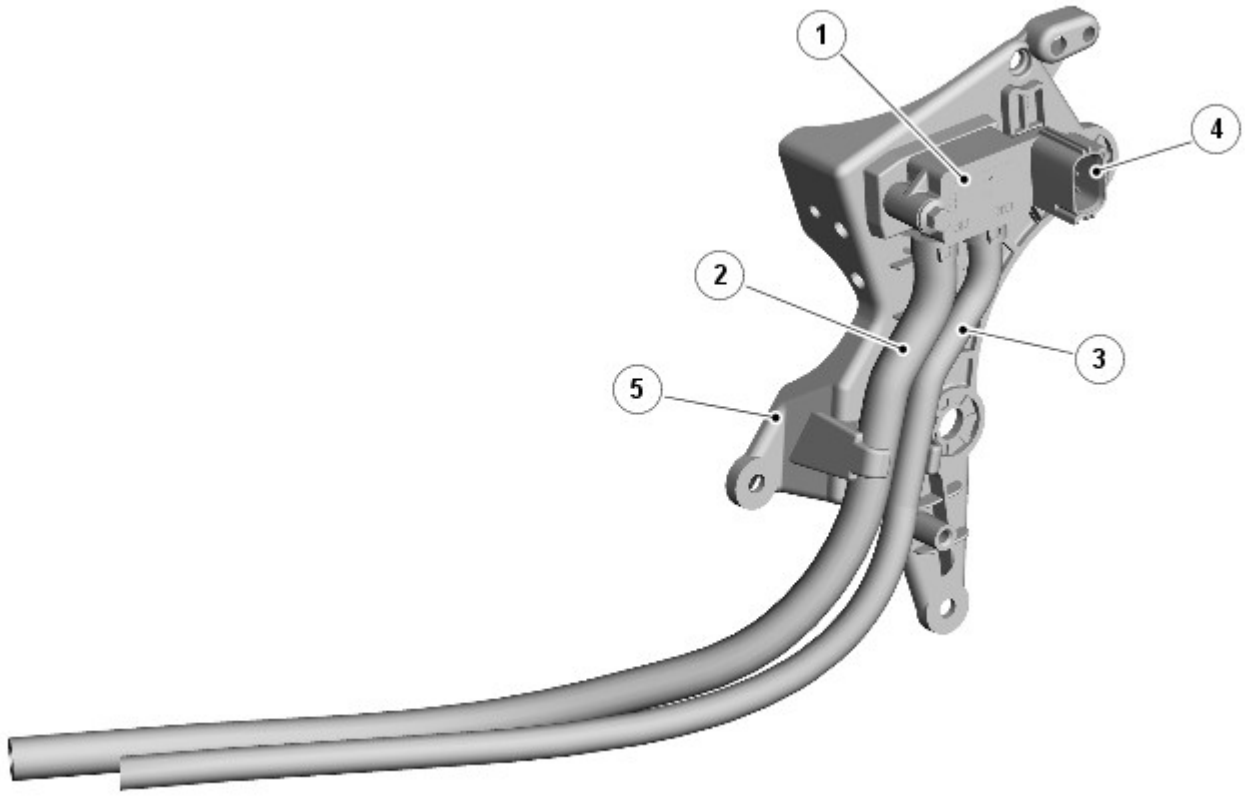
Description and Operation



Item	Description
1	HO2S Mounting Boss
2	Bolts (5 Off)
3	Gasket
4	Flexible coupling
5	Exhaust Gas Temperature Sensor (EGTS) mounting boss
6	Diesel Particulate Filter (DPF)
7	Differential pressure sensor
8	Mass Damper (2 Off)
9	Clamp
10	Mounting Rubber (5 Off)
11	Exhaust Brace
12	Exhaust Gas Temperature Sensor (EGTS) mounting boss
13	Catalytic Converter



Item	Description
1	Heated Oxygen Sensor
2	Pre-DPF Temperature Sensor
3	Differential Pressure Sensor
4	Low Pressure Pipe
5	Post-DPF Temperature Sensor
6	High Pressure Pipe
7	Diesel Particulate Filter
8	Post-Catalyst Temperature Sensor
9	Catalytic Converter
10	Pre-Catalyst Temperature Sensor



E147627

Item Description

1 Differential Pressure Sensor
2 High Pressure Pipe
3 Low Pressure Pipe
4 Electrical Connector
5 Bracket

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: 02-May-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.
REFER to: Exhaust System (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
• 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.
REFER to: Diagnostic Trouble Code (DTC) Index - TDV6 3.0L Diesel , DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation).

Published: 02-May-2013

Exhaust System - TDV6 3.0L Diesel - Diesel Particulate Filter

Diagnosis and Testing

Principles of Operation

For a detailed description of the exhaust system, refer to the relevant description and operation section of the workshop manual. REFER to: (309-00A Exhaust System - TDV6 3.0L Diesel)

Exhaust System (Description and Operation),
Diesel Particulate Filter (Description and Operation),
Diesel Particulate Filter (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
• 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

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.

Symptom chart

Symptom	Possible Causes	Action
Amber warning message on instrument cluster - DPF FULL REFER TO HANDBOOK -	• Diesel particulate filter has more than 24.5g of soot & a poor drive cycle	• If AMBER DPF FULL REFER TO HANDBOOK message is displayed or customer advises of amber, with no other reported messages the customer needs to be advised that the message is advisory only and that their current drive cycle does not allow the system to clean the particulate filter. 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. The message is illuminated when the diesel particulate filter has more than 24.5g of soot & a poor drive cycle, but the vehicles current drive cycle is predominately urban, or engine temperature does not reach 50degC this inhibits diesel particulate filter regeneration • Diesel particulate filter regeneration procedure is described at the bottom of this section

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00

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	NOTE: - Circuit LPPH_A - • The engine control module has detected a ground measurement for a period longer than expected or has detected a ground measurement when another value was expected • Harness failure - Heated oxygen sensor heater control circuit short circuit to ground • Heated oxygen sensor failure	• 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 heated oxygen sensor heater control (heater ground) circuit for short circuit to ground. Repair harness as required. Clear DTC and retest • Check and install new heated oxygen sensor as required
P0030-12	HO2S Heater Control Circuit (Bank 1, Sensor 1) - Circuit short to battery	NOTE: - Circuit LPPH_A - • The engine control module has detected a vehicle power measurement for a period longer than expected or has detected a vehicle power measurement when another value was expected • Harness failure - Heated oxygen sensor heater control circuit short circuit to power • Heated oxygen sensor failure	• 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 heated oxygen sensor heater control (heater ground) circuit for short circuit to power. Repair harness as required. Clear DTC and retest • Check and install new heated oxygen sensor as required
P0030-13	HO2S Heater Control Circuit (Bank 1, Sensor 1) - Circuit open	NOTE: - Circuit LPPH_A - • The engine control module has determined an open circuit via lack of bias voltage, low current flow, no change in the state of	• 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 heated oxygen sensor heater control (heater ground) circuit for open circuit. Repair harness as required. Clear DTC and retest • Check and install new heated oxygen sensor as required

		an input in response to an output • Harness failure - Heated oxygen sensor heater control circuit open circuit • Heated oxygen sensor failure	
P0030-4B	HO2S Heater Control Circuit (Bank 1, Sensor 1) - Over temperature	• The engine control module detected an internal temperature above the expected range • Harness failure - Heated oxygen sensor heater control circuit short circuit to power • Heated oxygen sensor failure	• 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 heated oxygen sensor heater control (heater ground) circuit for short circuit to power. Repair harness as required. Clear DTC and retest • Check and install new heated oxygen sensor as required
P0130-11	O2 Sensor Circuit (Bank 1 Sensor 1) - Circuit short to ground	NOTE: - Circuit LPV_A - • The engine control module has detected a ground measurement for a period longer than expected or has detected a ground measurement when another value was expected • Harness failure - Heated oxygen sensor circuit short circuit to ground • Heated oxygen sensor component failure	• Refer to the electrical circuit diagrams and check the heated oxygen sensor circuits for short circuit to ground. Repair harness as required. Clear DTC and retest • Check and install new heated oxygen sensor as required
P0130-12	O2 Sensor Circuit (Bank 1 Sensor 1) - Circuit short to battery	NOTE: - Circuit LPV_A - • The engine control module has detected a vehicle power measurement for a period longer than expected or	• Refer to the electrical circuit diagrams and check the heated oxygen sensor circuits for short circuit to power. Repair harness as required. Clear DTC and retest • Check and install new heated oxygen sensor as required

		has detected a vehicle power measurement when another value was expected • Harness failure - Heated oxygen sensor circuit short circuit to power • Heated oxygen sensor component failure	
P0130-13	O2 Sensor Circuit (Bank 1 Sensor 1) - Circuit open	 NOTE: - Circuit LPPC_A - LPV_A - • The engine control module has determined an open circuit via lack of bias voltage, low current flow, no change in the state of an input in response to an output • Harness failure - Heated oxygen sensor circuit open circuit • Heated oxygen sensor component failure	• Refer to the electrical circuit diagrams and check the heated oxygen sensor circuits for open circuit. Repair harness as required. Clear DTC and retest • Check and install new heated oxygen sensor as required
P0130-26	O2 Sensor Circuit (Bank 1 Sensor 1) - Signal rate of change below threshold	• The signal transitions more slowly than is reasonably allowed • Exhaust system leak • Fuel control system failure • Heated oxygen sensor to engine control module circuit short circuit to ground, short circuit to power, high resistance • Heated oxygen sensor failure	• Check for and rectify any exhaust leak between cylinder head and catalytic converter. Check heated 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 heated oxygen sensor to engine control module circuit for short circuit to ground, short circuit to power, high resistance, open circuit. Repair harness as required. Clear DTC and retest • Check and install new heated oxygen sensor as required
P0133-00	O2 Sensor Circuit Slow Response (Bank 1 Sensor 1) - No sub type information	• Exhaust system leak • Fuel control system failure • Heated	• Check for and rectify any exhaust leak between cylinder head and catalytic converter. Check heated oxygen sensor is correctly installed in exhaust manifold • Check fuel control system for related DTCs and refer to the relevant DTC index

		oxygen sensor to engine control module wiring shield high resistance • Heated oxygen sensor failure	Refer to the electrical circuit diagrams and check heated oxygen sensor to engine control module wiring shield for high resistance. Repair harness as required. Clear DTC and retest • Check and install new heated oxygen sensor as required
P0426-00	Catalyst Temperature Sensor Circuit Range/Performance (Bank 1, Sensor Circuit 1) - No sub type information	 NOTE: - Circuit CCCIT_A - • Exhaust gas temperature sensor pre catalytic converter circuit, short circuit to ground, open circuit, high resistance • Exhaust gas temperature sensor pre catalytic converter failure	• Refer to the electrical circuit diagrams and check exhaust gas temperature sensor pre catalytic converter circuit for short circuit to ground, open circuit, high resistance • Clear the DTC and retest • Check and install new exhaust gas temperature sensor pre catalytic converter as required
P0427-00	Catalyst Temperature Sensor Circuit Low (Bank 1, Sensor Circuit 1) - No sub type information	 NOTE: - Circuit CCCIT_A - • Exhaust gas temperature sensor pre catalytic converter circuit, short circuit to ground • Exhaust gas temperature sensor pre catalytic converter failure	• Refer to the electrical circuit diagrams and check exhaust gas temperature sensor pre catalytic converter circuit for short circuit to ground • Clear the DTC and retest • Check and install new exhaust gas temperature sensor pre catalytic converter as required
P0428-00	Catalyst Temperature Sensor Circuit High (Bank 1, Sensor Circuit 1) - No sub type information	 NOTE: - Circuit CCCIT_A - • Exhaust gas temperature sensor pre catalytic converter circuit, short circuit to power, open circuit, high resistance • Exhaust gas temperature sensor pre catalytic converter failure	• Refer to the electrical circuit diagrams and check exhaust gas temperature sensor pre catalytic converter circuit for short circuit to power, open circuit, high resistance • Clear the DTC and retest • Check and install new exhaust gas temperature sensor pre catalytic converter as required
P042B-00	Catalyst Temperature Sensor Circuit Range/Performance (Bank1, Sensor Circuit 2) - No sub type information	 NOTE: - Circuit CCCOT_A - • Exhaust gas temperature sensor post catalytic converter	• Refer to the electrical circuit diagrams and check exhaust gas temperature sensor post catalytic converter circuit for short circuit to ground, open circuit, high resistance • Check and install new exhaust gas temperature sensor post catalytic converter as required

		short circuit to ground, open circuit, high resistance • Exhaust gas temperature sensor post catalytic converter failure	
P042C-00	Catalyst Temperature Sensor Circuit Low (Bank 1, Sensor Circuit 2) - No sub type information	 NOTE: - Circuit CCCOT_A - • Exhaust gas temperature sensor post catalytic converter short circuit to ground, open circuit, high resistance • Exhaust gas temperature sensor post catalytic converter failure	• Refer to the electrical circuit diagrams and check exhaust gas temperature sensor post catalytic converter circuit for short circuit to ground, open circuit, high resistance • Check and install new exhaust gas temperature sensor post catalytic converter as required
P042D-00	Catalyst Temperature Sensor Circuit High (Bank 1, Sensor Circuit 2) - No sub type information	 NOTE: - Circuit CCCOT_A - • Exhaust gas temperature sensor post catalytic converter short circuit to power, open circuit, high resistance • Exhaust gas temperature sensor post catalytic converter failure	• Refer to the electrical circuit diagrams and check exhaust gas temperature sensor post catalytic converter circuit for short circuit to power, open circuit, high resistance • Check and install new exhaust gas temperature sensor post catalytic converter as required
P0435-00	Catalyst Temperature Sensor Circuit (Bank 2, Sensor Circuit 1) - No sub type information	 NOTE: - Circuit STOT - • Exhaust gas temperature sensor post turbocharger circuit, short circuit to power • Exhaust gas temperature sensor post turbocharger circuit, short circuit to ground • Exhaust gas temperature sensor post turbocharger circuit, open circuit • Exhaust gas temperature	• Refer to the electrical circuit diagrams and check exhaust gas temperature sensor post turbocharger circuit, for short circuit to power • Refer to the electrical circuit diagrams and check exhaust gas temperature sensor post turbocharger circuit, for short circuit to ground • Refer to the electrical circuit diagrams and check exhaust gas temperature sensor post turbocharger circuit, for open circuit • Refer to the electrical circuit diagrams and check exhaust gas temperature sensor post turbocharger circuit, for high resistance • Refer to the electrical circuit diagrams and check exhaust gas temperature sensor post turbocharger circuit, for disconnected • Check and install new exhaust gas temperature sensor post turbocharger as required

		sensor post turbocharger circuit, high resistance • Exhaust gas temperature sensor post turbocharger circuit, disconnected • Exhaust gas temperature sensor post turbocharger failure	
P0436-00	Catalyst Temperature Sensor Circuit Range/Performance (Bank 2, Sensor Circuit 1) - No sub type information	 NOTE: - Circuit STOT - • Exhaust gas temperature sensor post turbocharger circuit, short circuit to power, short circuit to ground, open circuit • Exhaust gas temperature sensor post turbocharger failure	• Refer to the electrical circuit diagrams and check exhaust gas temperature sensor post turbocharger circuit for short circuit to power, short circuit to ground, open circuit • Check and install new exhaust gas temperature sensor post turbocharger as required
P0436-16	Catalyst Temperature Sensor Circuit Range/Performance (Bank 2, Sensor Circuit 1) - Circuit voltage below threshold	 NOTE: - Circuit STOT - • The engine control module measured a voltage below a specified range but not necessarily a short circuit to ground • Exhaust gas temperature sensor post turbocharger circuit, short circuit ground • Exhaust gas temperature sensor post turbocharger failure	• Refer to the electrical circuit diagrams and check exhaust gas temperature sensor post turbocharger circuit for short circuit to ground • Check and install new exhaust gas temperature sensor post turbocharger as required
P0437-00	Catalyst Temperature Sensor Circuit Low (Bank 2, Sensor Circuit 1) - No sub type information	 NOTE: - Circuit STOT - • Exhaust gas temperature sensor post turbocharger circuit, short circuit to ground • Exhaust gas temperature sensor post turbocharger failure	• Refer to the electrical circuit diagrams and check exhaust gas temperature sensor post turbocharger circuit for short circuit to ground • Check and install new exhaust gas temperature sensor post turbocharger required
P0438-	Catalyst		• Refer to the electrical circuit diagrams and check exhaust gas

00	Temperature Sensor Circuit High (Bank 2, Sensor Circuit 1) - No sub type information	NOTE: - Circuit STOT - • Exhaust gas temperature sensor post turbocharger circuit, short circuit to power • Exhaust gas temperature sensor post turbocharger failure	temperature sensor post turbocharger circuit, for short circuit to power • Check and install new exhaust gas temperature sensor post turbocharger as required
P0544-00	Exhaust Gas Temperature Sensor Circuit - Bank 1 Sensor 1 - No sub type information	NOTE: - Circuit CCCIT_A - • Exhaust gas temperature sensor pre catalytic converter circuit, short circuit to ground, open circuit, high resistance • Exhaust gas temperature sensor pre catalytic converter failure	• Refer to the electrical circuit diagrams and check exhaust gas temperature sensor pre catalytic converter circuit for short circuit to ground, open circuit, high resistance • Clear the DTC and retest • Check and install new exhaust gas temperature sensor pre catalytic converter as required
P0547-00	Exhaust Gas Temperature Sensor Circuit - Bank 2 Sensor 1 - No sub type information	NOTE: - Circuit STOT - • Exhaust gas temperature sensor post turbocharger short circuit to ground • Exhaust gas temperature sensor post turbocharger failure	• Refer to the electrical circuit diagrams and check exhaust gas temperature sensor post turbocharger circuit for short circuit to ground • Clear the DTC and retest • Check and install new exhaust gas temperature sensor post turbocharger as required
P0548-00	Exhaust Gas Temperature Sensor Circuit Low - Bank 2 Sensor 1 - No sub type information	NOTE: - Circuit STOT - • Exhaust gas temperature sensor post turbocharger short circuit to ground • Exhaust gas temperature sensor post turbocharger failure	• Refer to the electrical circuit diagrams and check exhaust gas temperature sensor post turbocharger circuit for short circuit to ground • Clear the DTC and retest • Check and install new exhaust gas temperature sensor post turbocharger as required
P0549-00	Exhaust Gas Temperature Sensor Circuit High - Bank 2 Sensor 1 - No sub type information	NOTE: - Circuit STOT - • Exhaust gas temperature sensor post turbocharger short circuit short circuit	• Refer to the electrical circuit diagrams and check exhaust gas temperature sensor post turbocharger circuit for short circuit to power, open circuit, high resistance • Clear the DTC and retest • Check and install new exhaust gas temperature sensor post turbocharger as required

		to power, open circuit, high resistance • Exhaust gas temperature sensor post turbocharger failure	
P2031-00	Exhaust Gas Temperature Sensor Circuit Bank 1 Sensor 2 - No sub type information	 NOTE: - Circuit CCCOT_A - • Exhaust gas temperature sensor post catalytic converter short circuit to ground • Exhaust gas temperature sensor post catalytic converter failure	• Refer to the electrical circuit diagrams and check exhaust gas temperature sensor post catalytic converter circuit for short circuit to ground • Check and install new exhaust gas temperature sensor post catalytic converter as required
P2080-16	Exhaust Gas Temperature Sensor Circuit Range/Performance Bank 1 Sensor 1 - Circuit voltage below threshold	 NOTE: - Circuit CCCIT_A - • The engine control module measured a voltage below a specified range but not necessarily a short circuit to ground • Harness failure - Exhaust gas temperature sensor pre catalytic converter • Exhaust gas temperature sensor pre catalytic converter failure	• This DTC is set when there is a plausibility error on the signal from the exhaust gas temperature sensor pre catalytic converter. Refer to the workshop manual and check the exhaust gas temperature sensor pre catalytic converter and wiring harness for obvious signs of mechanical damage due to chaffing or heat. The exhaust gas temperature sensor pre catalytic converter 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 • Check and install new exhaust gas temperature sensor pre catalytic converter as required
P2082-00	Exhaust Gas Temperature Sensor Circuit Range/Performance Bank 2 Sensor 1 - No sub type information	 NOTE: - Circuit STOT - • Exhaust gas temperature sensor post turbocharger short circuit short circuit to ground, open circuit, high resistance • Exhaust gas temperature sensor post turbocharger failure	• Refer to the electrical circuit diagrams and check exhaust gas temperature sensor post turbocharger circuit for short circuit to ground, open circuit, high resistance • Clear the DTC and retest • Check and install new exhaust gas temperature sensor post turbocharger as required
P2084-16	Exhaust Gas Temperature Sensor Circuit Range/Performance	 NOTE: - Circuit CCCOT_A -	• Refer to the electrical circuit diagrams and check exhaust gas temperature sensor post catalytic converter circuit for short circuit to ground • Check and install new exhaust gas temperature sensor post

	Bank 1 Sensor 2 - Circuit voltage below threshold	• The engine control module measured a voltage below a specified range but not necessarily a short circuit to ground • Exhaust gas temperature sensor post catalytic converter circuit, short circuit to ground • Exhaust gas temperature sensor post catalytic converter failure	catalytic converter as required
P2177-00	System Too Lean Off Idle - Bank 1 - No sub type information	• Oxygen concentration implausibly high • Heated oxygen sensor circuit short circuit to ground, short circuit to power, high resistance, open circuit • Heated oxygen sensor failure	• Check for excess fuel at exhaust manifold, downpipe, heated oxygen sensor • Check for fuel / injector related DTCs and repair these first. Clear DTC and retest • Refer to the electrical circuit diagrams and check heated oxygen sensor for short circuit to ground, high resistance, open circuit. Repair harness as required. Clear DTC and retest • Check and install new heated oxygen sensor as required
P2178-00	System Too Rich Off Idle - Bank 1 - No sub type information	• Oxygen concentration implausibly low • Heated oxygen sensor circuit short circuit to ground, short circuit to power, high resistance, open circuit • Heated oxygen sensor failure	• Check for air leaks at exhaust manifold, downpipe, heated oxygen sensor • Check for fuel / injector related DTCs and repair these first. Clear DTC and retest • Refer to the electrical circuit diagrams and check heated oxygen sensor for short circuit to ground, high resistance, open circuit. Repair harness as required. Clear DTC and retest • Check and install new heated oxygen sensor as required
P2191-00	System Too Lean at Higher Load - Bank 1 - No sub type information	• Oxygen concentration implausibly high • Heated oxygen sensor circuit short circuit to ground, short circuit to power, high resistance, open circuit • Heated oxygen sensor failure	• Check for excess fuel at exhaust manifold, downpipe, heated oxygen sensor • Check for fuel / injector related DTCs and repair these first. Clear DTC and retest • Refer to the electrical circuit diagrams and check heated oxygen sensor for short circuit to ground, high resistance, open circuit. Repair harness as required. Clear DTC and retest • Check and install new heated oxygen sensor as required
P2192-	System Too Rich at	• Oxygen	• Check for air leaks at exhaust manifold, downpipe, heated

00	Higher Load - Bank 1 - No sub type information	concentration implausibly low • Heated oxygen sensor circuit short circuit to ground, short circuit to power, high resistance, open circuit • Heated oxygen sensor failure	oxygen sensor • Check for fuel / injector related DTCs and repair these first. Clear DTC and retest • Refer to the electrical circuit diagrams and check heated oxygen sensor for short circuit to ground, high resistance, open circuit. Repair harness as required. Clear DTC and retest • Check and install new heated oxygen sensor as required
P2195-00	O2 Sensor Signal Biassed/Stuck Lean - Bank 1, Sensor 1 - No sub type information	• Air leak at exhaust manifold, downpipe, heated oxygen sensor bank 1 • Heated oxygen sensor circuit short circuit to ground, short circuit to power, high resistance, open circuit • Heated oxygen sensor failure	• Check for fuel / injector related DTCs and repair these first. Clear DTC and retest • Check for air leaks at exhaust manifold, downpipe, heated oxygen sensor • Refer to the electrical circuit diagrams and check heated oxygen sensor for short circuit to ground, high resistance, open circuit. Repair harness as required. Clear DTC and retest • Check and install new heated oxygen sensor as required
P2245-00	O2 Sensor Reference Voltage Circuit Low - Bank 1, Sensor 1 - No sub type information	 NOTE: - Circuit LPV_A - • Harness failure - Heated oxygen sensor circuit • Oxygen sensor failure	• This DTC is set if the engine control module detects the bank 1, heated oxygen sensor 1 reference voltage is lower than expected. Refer to the electrical circuit diagrams and check the heated oxygen sensor circuits for open circuits, high resistance, short circuit to ground. Repair harness as required. Clear DTC and retest • Check and install new heated oxygen sensor as required
P2246-00	O2 Sensor Reference Voltage Circuit High - Bank 1, Sensor 1 - No sub type information	 NOTE: - Circuit LPV_A - • Harness failure - Heated oxygen sensor circuit • Oxygen sensor failure	• This DTC is set if the engine control module detects the bank 1, heated oxygen sensor 1 reference voltage is greater than expected. Refer to the electrical circuit diagrams and check the heated oxygen sensor circuits for open circuits, high resistance, short circuit to power. Repair harness as required. Clear DTC and retest • Check and install new heated oxygen sensor as required
P2297-00	O2 Sensor Out of Range During Deceleration Bank 1, Sensor 1 - No sub type information	• Heated oxygen sensor circuit short circuit to ground, short circuit to power, high resistance, open circuit • Heated oxygen sensor failure	• Check for fuel / injector related DTCs and repair these first. Clear DTC and retest. Refer to the electrical circuit diagrams and check heated oxygen sensor for short circuit to ground, high resistance, open circuit. Repair harness as required. Clear DTC and retest • Check and install new heated oxygen sensor as required
P242A-00	Exhaust Gas Temperature Sensor Circuit Bank 1 Sensor 3 -	 NOTE: - Circuit PFOT -	• Using the manufacturer approved diagnostic system check datalogger signals, Exhaust Gas Temperature Bank 1 Sensor 3 (0x03C8), Exhaust Gas Temperature Bank 1 Sensor 3 Voltage (0x03F6). This DTC is set if the exhaust gas temperature sensor

	No sub type information	Harness failure - Exhaust gas temperature sensor post DPF • Exhaust gas temperature sensor post DPF failure	post DPF fails a cold start diagnostic check by the engine control module. Refer to the electrical circuit diagrams and check the exhaust gas temperature sensor post DPF signal circuit for open circuit, short circuit to ground, short circuit to other circuits. Check the sensor ground circuit for open circuit, short circuit to power, high resistance. Repair harness as required • Check and install new exhaust gas temperature sensor post DPF as required
P242B-16	Exhaust Gas Temperature Sensor Circuit Range/Performance Bank 1 Sensor 3 - Circuit voltage below threshold	 NOTE: - Circuit PFOT - • The engine control module measured a voltage below a specified range but not necessarily a short circuit to ground • Harness failure - Exhaust gas temperature sensor post DPF • exhaust gas temperature sensor post DPF failure	• This DTC is set if the exhaust gas temperature sensor post DPF fails a cold start diagnostic check by the engine control module • Refer to the workshop manual and check the exhaust gas temperature sensor post DPF for obvious signs of damage • Check the sensor harness for chaffing or heat damage • 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 (0x03C8) • Refer to the electrical circuit diagrams and check the exhaust gas temperature sensor post DPF signal circuit for open circuit, short circuit to ground, short to other circuits. Check the sensor ground circuit for open circuit, short circuit to power, high resistance. Repair wiring as required • Check and install new exhaust gas temperature sensor post DPF as required
P242B-64	Exhaust Gas Temperature Sensor Circuit Range/Performance Bank 1 Sensor 3 - Signal plausibility failure	 NOTE: - Circuit PFOT - • Harness failure - Exhaust gas temperature sensor post DPF • Exhaust gas temperature sensor post DPF failure	• Using the manufacturer approved diagnostic system check datalogger signals, Exhaust Gas Temperature Bank 1 Sensor 3 (0x03C8), Exhaust Gas Temperature Bank 1 Sensor 3 Voltage (0x03F6). This DTC is set if the exhaust gas temperature sensor post DPF fails a cold start diagnostic check by the engine control module. Refer to the electrical circuit diagrams and check the exhaust gas temperature sensor post DPF signal circuit for open circuit, short circuit to ground, short circuit to other circuits. Check the sensor ground circuit for open circuit, short circuit to power, high resistance. Repair harness as required • Check and install new exhaust gas temperature sensor post DPF as required
P242C-00	Exhaust Gas Temperature Sensor Circuit Low Bank 1 Sensor 3 - No sub type information	 NOTE: - Circuit PFOT - • Harness failure - Exhaust gas temperature sensor post DPF • Exhaust gas temperature sensor post DPF failure	• Using the manufacturer approved diagnostic system check datalogger signals, Exhaust Gas Temperature Bank 1 Sensor 3 (0x03C8), Exhaust Gas Temperature Bank 1 Sensor 3 Voltage (0x03F6). This DTC is set if the exhaust gas temperature sensor post DPF signal voltage is less than the engine control module was expecting. Refer to the electrical circuit diagrams and check the exhaust gas temperature sensor post DPF signal circuit for open circuit, short circuit to ground, short circuit to other circuits. Check the sensor ground circuit for open circuit, short circuit to power, high resistance. Repair harness as required • Check and install new exhaust gas temperature sensor post DPF as required
P242D-17	Exhaust Gas Temperature Sensor Circuit High Bank 1 Sensor 3 - Circuit voltage above threshold	 NOTE: - Circuit PFOT - • The engine control module measured a voltage above a specified range but not necessarily a short circuit to power	• Using the manufacturer approved diagnostic system check datalogger signals, Exhaust Gas Temperature Bank 1 Sensor 3 (0x03C8), Exhaust Gas Temperature Bank 1 Sensor 3 Voltage (0x03F6) • Refer to the electrical circuit diagrams and check the exhaust gas temperature sensor post DPF circuit, for short circuit to power, open circuit • Check and install new exhaust gas temperature sensor post DPF as required

		• Exhaust gas temperature sensor post DPF circuit, short circuit to power, open circuit • Exhaust gas temperature sensor post DPF failure	
P244A-00	Diesel Particulate Filter Differential Pressure Too Low(Bank 1) - No sub type information	• Diagnostic failure check for minimum pressure differential characteristics • Diesel particulate filter internal components are missing or destroyed	• Using the manufacturer approved diagnostic system, check for related DTCs and refer to the relevant DTC index • Clear DTC and re-test • Check and install new diesel particulate filter as required
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
P2452-95	Diesel Particulate Filter Pressure Sensor A Circuit - Incorrect assembly	NOTE: In cold climates differential pressure sensor hose lines or metal pipes may be frozen • Differential pressure sensor hoses connected incorrectly • Differential 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 differential pressure sensor hoses are installed correctly • Check differential pressure sensor hoses for crushed, blockage, split
P2453-00	Diesel Particulate Filter Pressure Sensor A Circuit Range/Performance - No sub type information	NOTE: - Circuit DPS - • Harness failure - Differential pressure sensor • 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

			• 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 electrical circuit diagrams and check the differential pressure sensor signal circuit for open circuit, short circuit to ground, short circuit to other circuits. Check the sensor ground circuit for open circuit, short circuit to power, high resistance. Check the sensor power supply circuit for open circuit, short circuit to ground, high resistance. Repair harness as required • Check and install new differential pressure sensor as required
P2454-00	Diesel Particulate Filter Pressure Sensor A Circuit Low - No sub type information	NOTE: - Circuit DPS - • Harness failure - Differential pressure sensor • Differential pressure sensor crossed hose lines • 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 • 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 diagnostic check. Refer to the electrical circuit diagrams and check the differential pressure sensor signal circuit for open circuit, short circuit to ground, short circuit to other circuits. Check the sensor ground circuit for open circuit, short circuit to power, high resistance. Check the sensor power supply circuit for open circuit, short circuit to ground, high resistance. Repair harness as required • Check differential pressure sensor hose lines are installed correctly • Check and install new differential pressure sensor as required
P2455-00	Diesel Particulate Filter Pressure Sensor A Circuit High - No sub type information	NOTE: - Circuit DPS - • Harness failure - Differential pressure sensor • Differential pressure sensor failure • Exhaust back pressure is too high	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 engine control module, for related DTCs and refer to the relevant DTC index • 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 diagnostic check. Refer to the electrical circuit diagrams and check the differential pressure sensor signal circuit for open circuit, short circuit to power, short circuit to other circuits. Check the sensor ground circuit for open circuit, short circuit to power, high resistance. Check the sensor power supply circuit for open circuit, short circuit to ground, high resistance. Repair harness as required • Check and install new differential pressure sensor as required
P2456-	Diesel Particulate	• Differential	

00	Filter Pressure Sensor A Circuit Intermittent/Erratic - No sub type information	pressure sensor circuit short circuit to ground, short circuit to power, open circuit, high resistance • In cold climate or off road driving differential pressure sensor hoses crushed, blocked, split • 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 • Refer to the electrical circuit diagrams and check differential pressure sensor circuit for short circuit to ground, short circuit to power, open circuit, high resistance • Inspect connectors for signs of water ingress, and pins for damage and/or corrosion • Check differential pressure sensor hoses for crushed, blocked, split • Check and replace diesel particulate filter differential pressure sensor as required
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 and carry out a diesel particulate filter regeneration • Advise customer of driving routine required to regenerate diesel particulate filter as stated in the vehicle handbook
P2463-00	Diesel Particulate Filter Restriction - Soot Accumulation (Bank 1) - No sub type information	• Maximum soot mass	• GO to Pinpoint Test A.
P2A00-16	O2 Circuit Range / Performance (Bank 1, Sensor 1) - Circuit voltage below threshold	NOTE: - Circuit LPTR_A - • The engine control module measured a voltage below a specified range but not necessarily a short circuit to ground • Harness failure - Heated oxygen sensor failure • Heated oxygen sensor failure	• This DTC is set when the engine control module detects the voltage on the trim resistor circuit of the heated oxygen sensor is less than the voltage threshold. This may be caused by the heated oxygen sensor being too hot to operate correctly. Refer to the workshop manual and check the exhaust system and heated oxygen sensor harness for sign of mechanical damage. Refer to the electrical circuit diagrams and check all the heated oxygen sensor circuits for open circuits, short circuit to power, short circuit to ground, short circuit to other circuits. Check all engine control module power and ground supplies. Repair harness as required. Clear DTC and retest • Check and install new heated oxygen sensor as required
P2A00-17	O2 Circuit Range / Performance (Bank 1, Sensor 1) - Circuit voltage above threshold	NOTE: - Circuit LPTR_A - • The engine	• This DTC is set when the engine control module detects the voltage on the trim resistor circuit of the heated oxygen sensor is greater than the voltage threshold. This may be caused by the heated oxygen sensor being too hot to operate correctly. Refer to the workshop manual and check the exhaust system

		control module measured a voltage above a specified range but not necessarily a short circuit to power • Harness failure - Heated oxygen sensor failure • Heated oxygen sensor failure	and heated oxygen sensor harness for sign of mechanical damage. Refer to the electrical circuit diagrams and check all the heated oxygen sensor circuits for open circuits, short circuit to power, short circuit to ground, short circuit to other circuits. Check all engine control module power and ground supplies. Repair harness as required. Clear DTC and retest • Check and install new heated oxygen sensor as required

Pinpoint Tests

PINPOINT TEST A : RED WARNING MESSAGE DPF FULL VISIT DEALER IS DISPLAYED AND DTC P2463-00 IS LOGGED	
TEST CONDITIONS	**DETAILS/RESULTS/ACTIONS**
A1: 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
A2: 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
A3: RECORD ALL ENGINE CONTROL MODULE DTCS	
	1 Using the manufacturer approved diagnostic system, check engine control module, for DTCs
	Are any other DTCs logged? **Yes** Using the manufacturer approved diagnostic system refer to the relevant DTC index and repair all DTCs as requiredProceed to the next step **No** Proceed to step 7
A4: AMBER/RED DPF FULL MESSAGE	
	1 Verify with the customer the approximate time and mileage between the AMBER DPF FULL message being displayed and the RED DPF FULL message being displayed
	Was a mileage up to 625 miles (1000KM) driven between the AMBER DPF FULL message being displayed and the RED DPF FULL message being displayed? **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
A5: OTHER RELATED ENGINE CONTROL MODULE DTCS	
	1 Related engine control module DTCs other than P2463-00 are logged
	Are related engine control module DTCs other than P2463-00 logged? **Yes** Refer to the relevant DTC index. Repair as required. Using the manufacturer approved diagnostic system clear the DTCs and re-test **No** Proceed to step 7
A6: 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 ~ 0.3 volts • Accelerate to 4500RPM (stationary) and close throttle, should read 1.1 ~ 1.3 volts
	Does the pre catalyst oxygen sensor meet 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 re-test. Return vehicle to the customer
A7: 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 or maximum possible RPM and record value • Note: 1volt = 100mbar, 1.5volts = 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
A8: 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 1 - (0x03F4) • Exhaust Gas Temperature Bank 1 Sensor 2 - (0x03F5) • Exhaust Gas Temperature Bank 1 Sensor 3 - (0x03F6)
	2 Hold engine speed at 2000RPM for 2 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 re-test
A9: 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 32.5 grams the diesel particulate filter is recoverable.	
	1 Using the results from step 7 check soot mass is less than 32.5 grams
	2 Using the results from step 8 check particulate filter differential pressure sensor voltage at 4000RPM is less than 1 Volt (100mbar)
	Is diesel particulate filter soot mass value less than 32.5 grams and particulate filter differential pressure sensor voltage at 4000RPM less than 1 Volts (100mbar)? **Yes** If the diesel particulate filter soot mass value is greater than 31.5 grams and the differential pressure sensor voltage is between 0.5Volts and 0.9 Volt 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 32.5 grams and the differential pressure sensor voltage greater than 1 Volt 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.Using the manufacturer approved smoke tester carry out a boost system leakage checkRemove the diesel particulate filter from the secondary turbo charger, lower the exhaust system and inspect for oil contaminationContact dealer technical support with all of the recorded values from the above tests
A10: SOOT MASS REDUCTION	
	1 With the vehicle fully up to temperature and in Park maintain 2500RPM for 3 minutes
	2 Return to step 7, check diesel particulate filter soot mass value
	Has the diesel particulate filter soot mass reduced from the original reading?

	Yes Proceed to next step **No** Proceed to step 12
A11: 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 6 grams? **Yes** Using the manufacturer approved diagnostic system clear the DTC and re-test. Return vehicle to the customer **No** Contact dealer technical support with all of the recorded values from the above tests
A12: 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 6 grams? **Yes** Using the manufacturer approved diagnostic system clear the DTC and re-test. Return vehicle to the customer **No** Contact dealer technical support with all of the recorded values from the above tests

Diesel particulate filter soot level information

Soot level symptom	Values
Soot level accumulation in diesel particulate filter is stopped	32.5g
Maximum soot level accumulation before regeneration process is inhibited	28.5g
RED warning lamp ON	31.5g
RED warning lamp OFF	24.5g
AMBER warning lamp ON	24.5g
AMBER warning lamp OFF	22.5g

Diesel particulate filter regeneration procedure

CAUTION: 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

If DPF FULL SEE HANDBOOK appears in the message centre, carry out the following procedure

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
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)

NOTE: 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

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

NOTE: When driving off-road during the regeneration process, greater accelerator pedal use may be required

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 - TDV6 3.0L Diesel , DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation).

Published: 02-May-2013

Exhaust System - TDV6 3.0L Diesel - Catalytic Converter

Removal and Installation

Special Tool(s)

 E130266	100-051 Cutter, Exhaust Pipe

Removal

WARNING: Observe due care when working near a hot exhaust system.

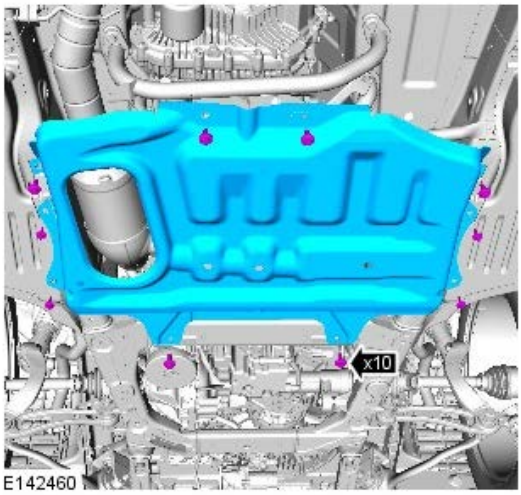
NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

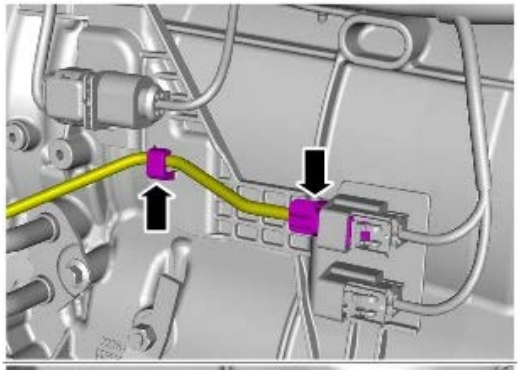
2. Refer to: Rear Muffler (309-00A Exhaust System - TDV6 3.0L Diesel, Removal and Installation).

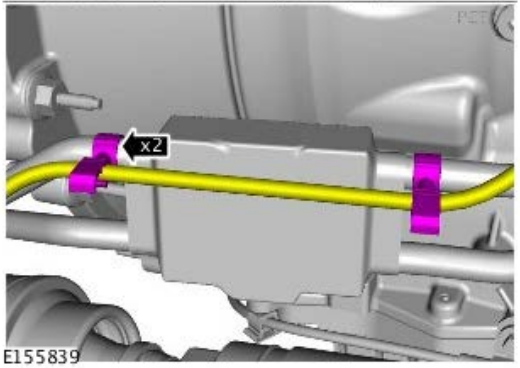
3. *Torque:*
   M10 60 Nm
   M6 10 Nm



E142460

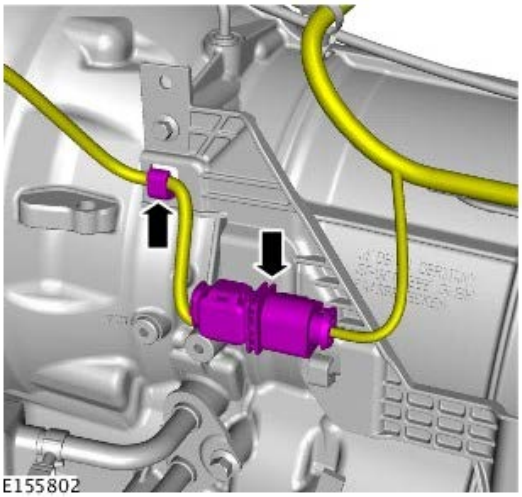
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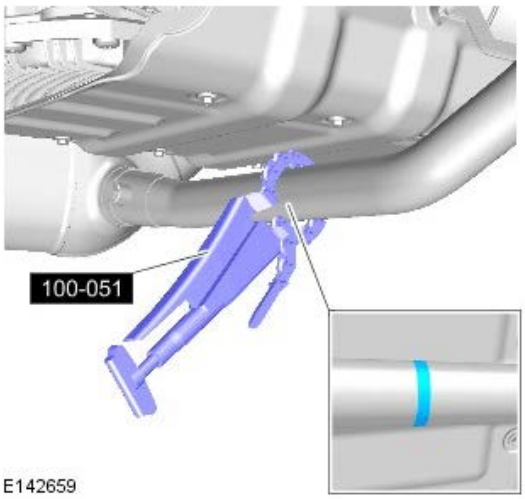


E155839

5.

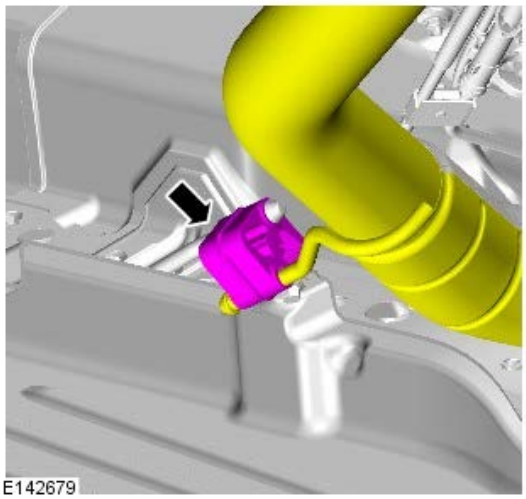

E155802

6.
- *Special Tool(s):* 100-051



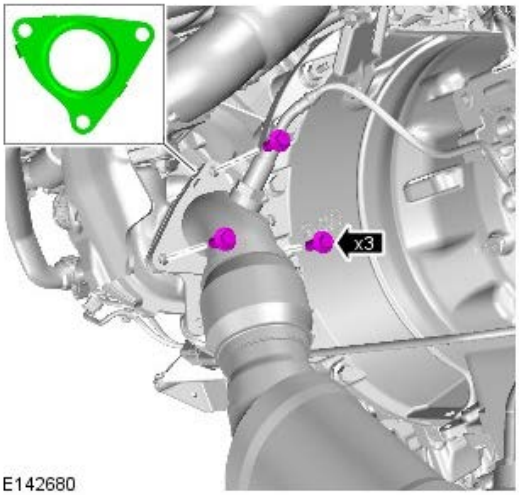
E142659

7. CAUTION: Make sure that the exhaust system is supported with a suitable transmission stand.

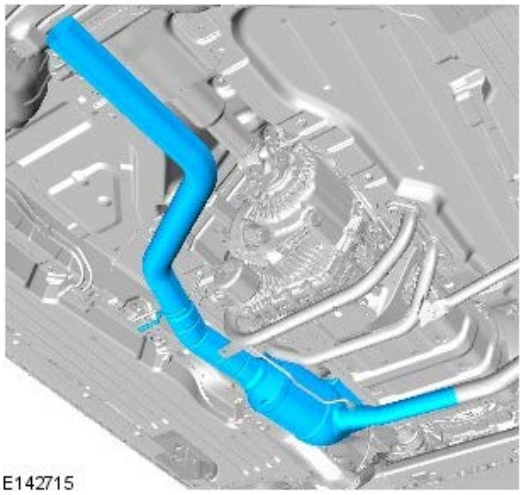

E142679

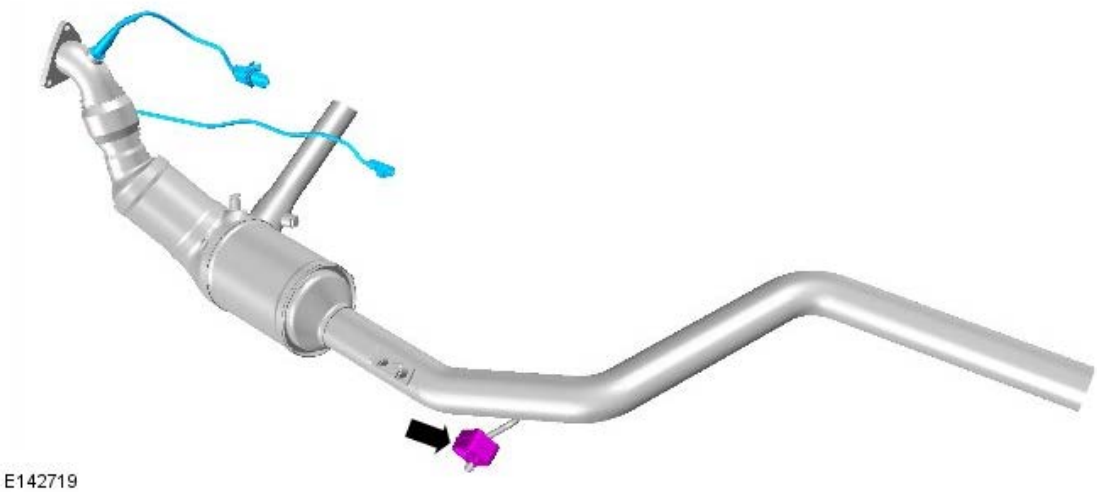
8. NOTE: Install a new gasket.

Torque: 28 Nm



E142680


E142715


E142719

9. NOTE: This step requires the aid of another technician.

10. NOTE: Do not disassemble further if the component is removed for access only.

Torque:
- Temperature sensor 35 Nm
- Heated oxygen sensor 48 Nm

Installation

1. CAUTION: Make sure the anti-seize compound does not contact the heated oxygen sensor (HO2S) tip.

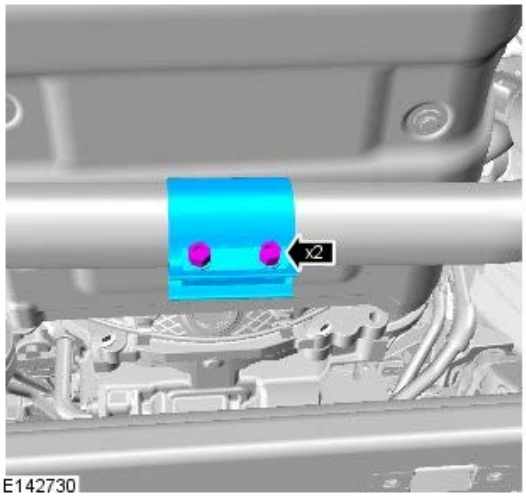
   NOTE: If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.

   To install, reverse the removal procedure.

2. NOTES:

   Make sure that all the component mating faces are clean.

   Check for leaks, when engine is warm.



Torque: 55 Nm

Published: 02-May-2013

Exhaust System - TDV6 3.0L Diesel - Diesel Particulate Filter (DPF)

Removal and Installation

Special Tool(s)

 E130266	100-051 Cutter, Exhaust Pipe

Removal

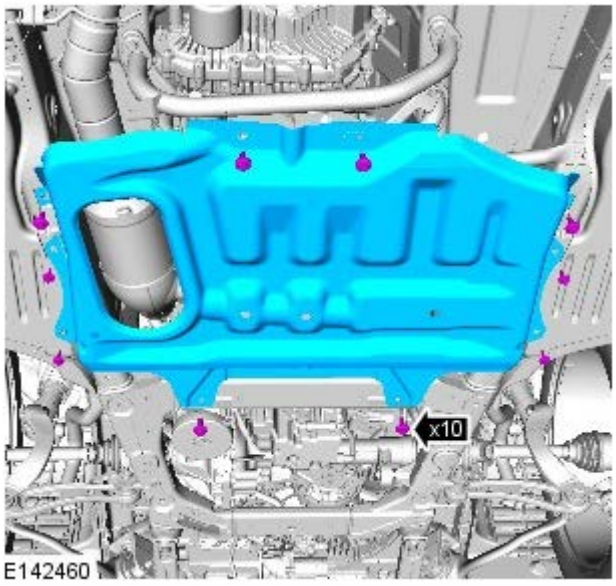
WARNING: Observe due care when working near a hot exhaust system.

NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

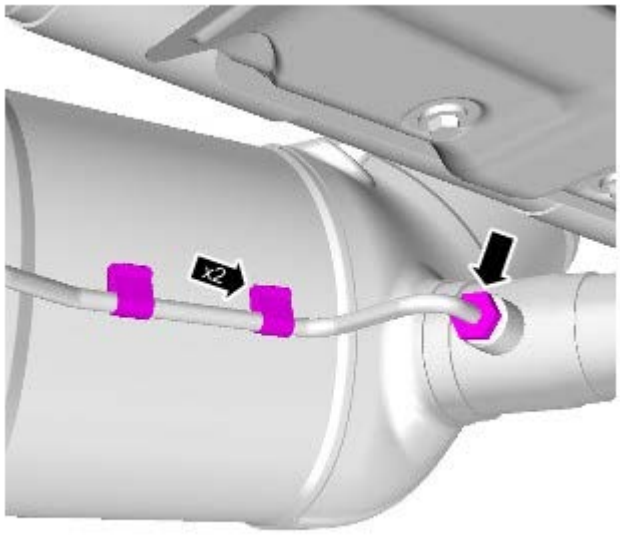
   Raise and support the vehicle.

2. Refer to: Rear Muffler (309-00A Exhaust System - TDV6 3.0L Diesel, Removal and Installation).



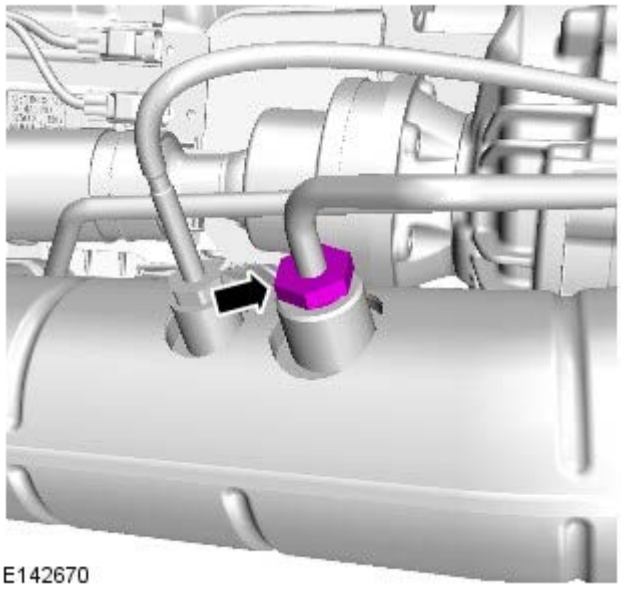
3. *Torque:*
   M10 60 Nm
   M6 10 Nm

4. *Torque:* 25 Nm



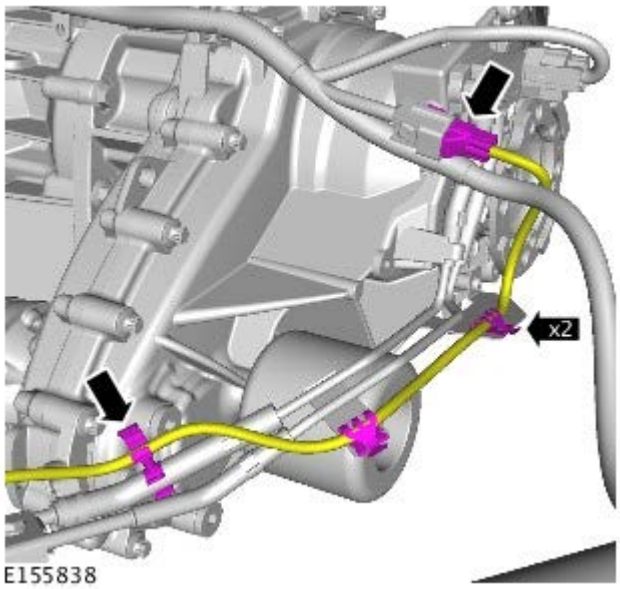
E142671

5. *Torque:* 25 Nm



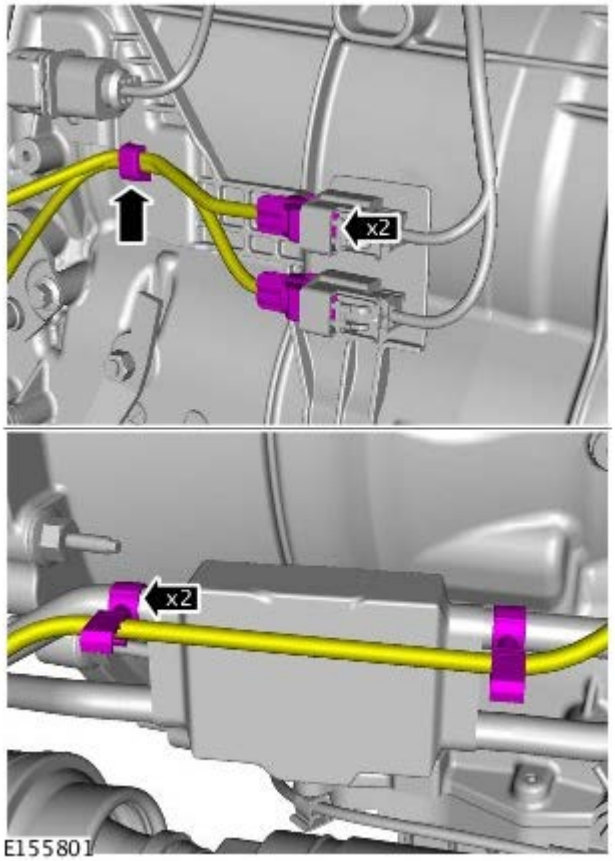
E142670

6.

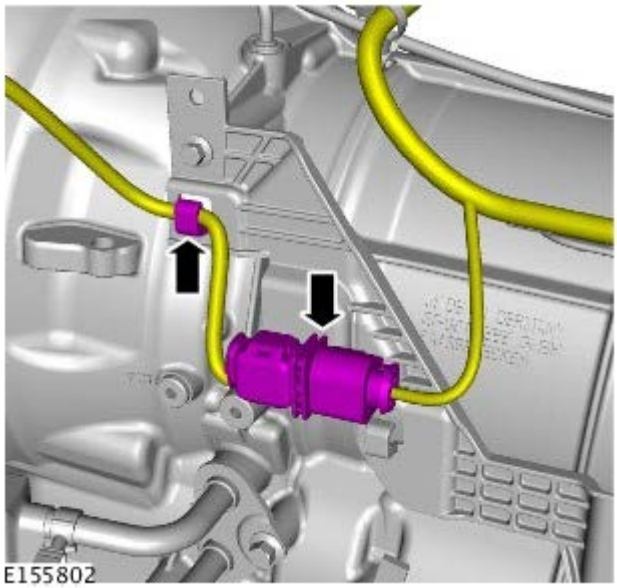


E155838

7.

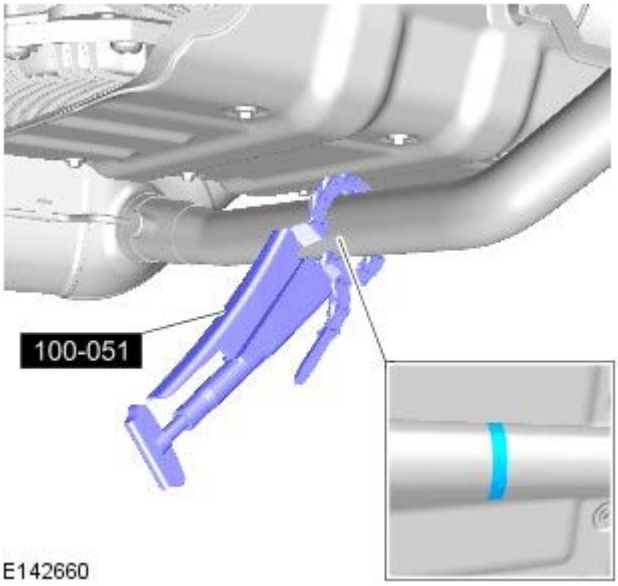


8.



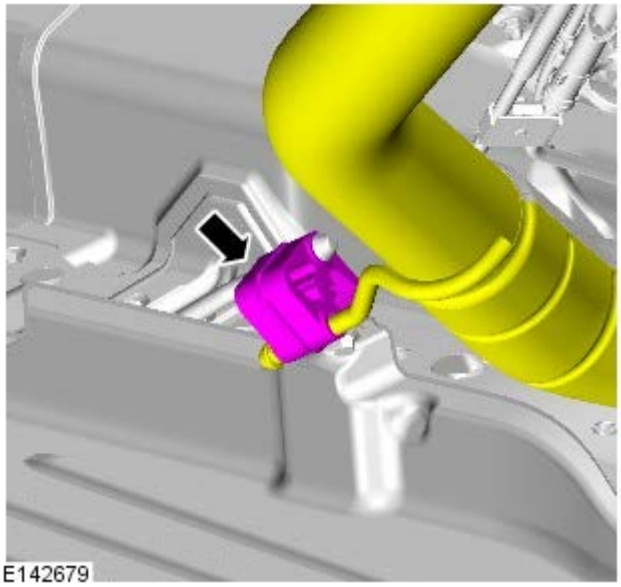
9.

- *Special Tool(s):* 100-051



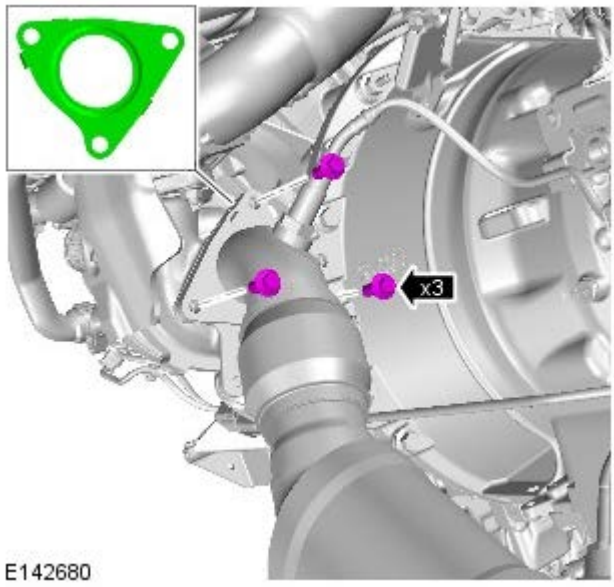
E142660

10. CAUTION: Make sure that the exhaust system is supported with a suitable transmission stand.


E142679

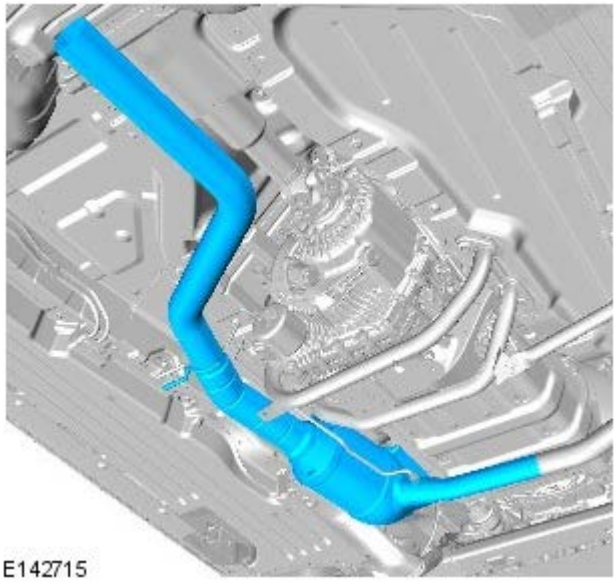
11. NOTE: Install a new gasket.

Torque: 28 Nm



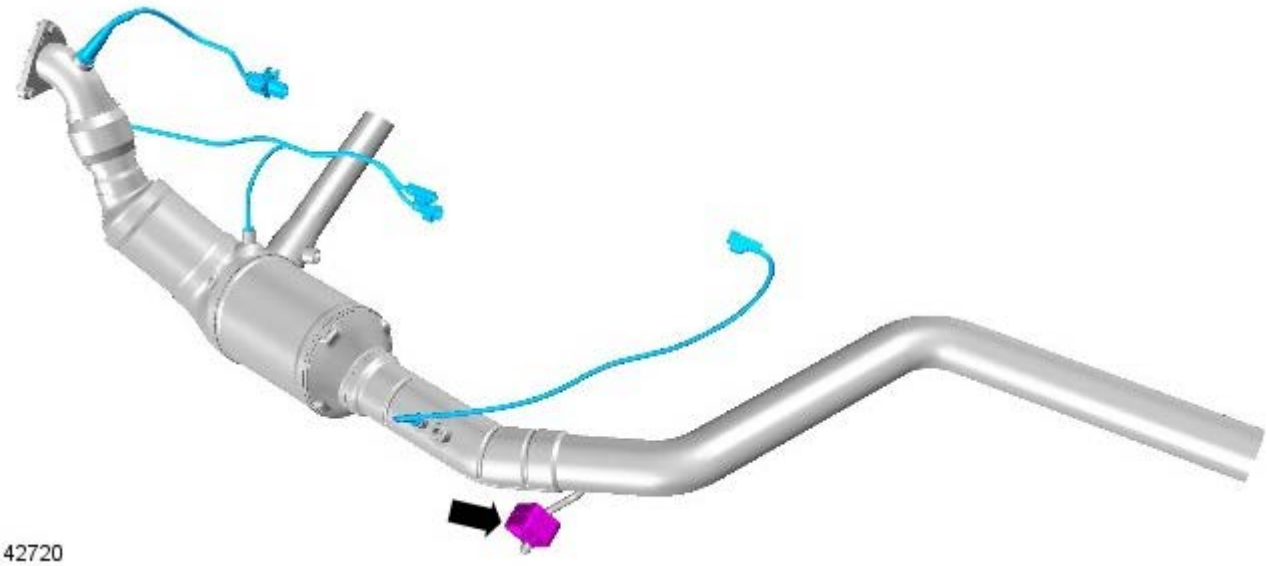
E142680

12. NOTE: This step requires the aid of another technician.


E142715

13. NOTE: Do not disassemble further if the component is removed for access only.

Torque:
Temperature sensor 35 Nm
Heated oxygen sensor 48 Nm


E142720

Installation

1. CAUTION: Make sure the anti-seize compound does not contact the heated oxygen sensor (HO2S) tip.

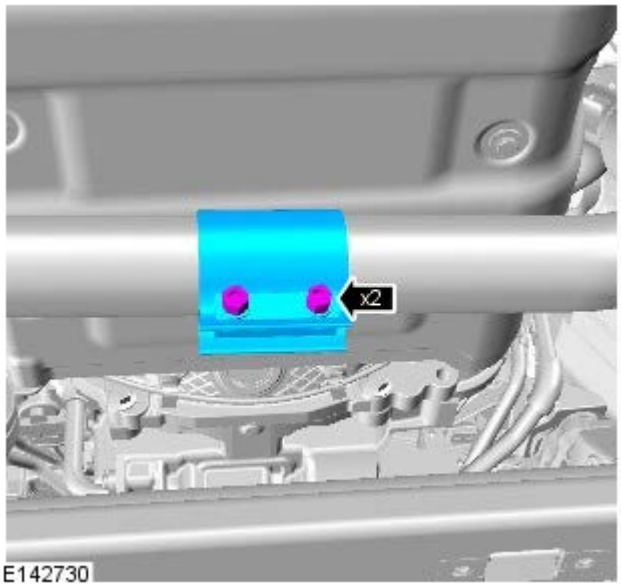
NOTE: If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.

To install, reverse the removal procedure.

2. NOTES:

Make sure that all the component mating faces are clean.

Check for leaks, when engine is warm.



Torque: 55 Nm

3. If a new component has been installed, configure using Land Rover approved diagnostic equipment.

Published: 02-May-2013

Exhaust System - TDV6 3.0L Diesel - Exhaust System Vehicles Without: Diesel Particulate Filter (DPF)

Removal and Installation

Removal

WARNING: Observe due care when working near a hot exhaust system.

NOTES:

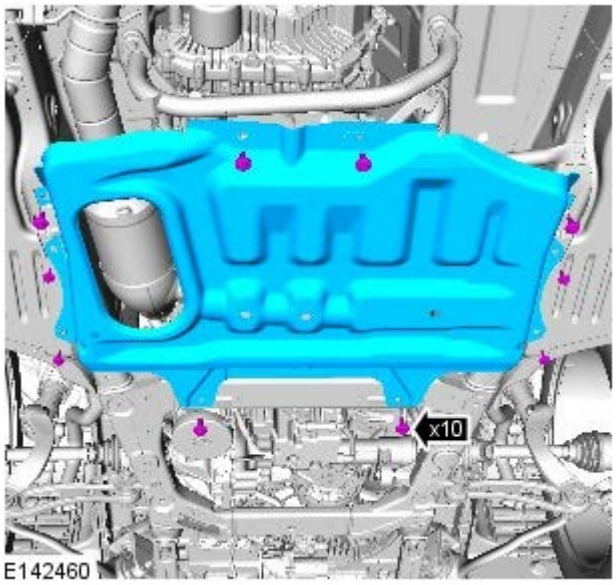
Removal steps in this procedure may contain installation details.

Some variation in the illustrations may occur, but the essential information is always correct.

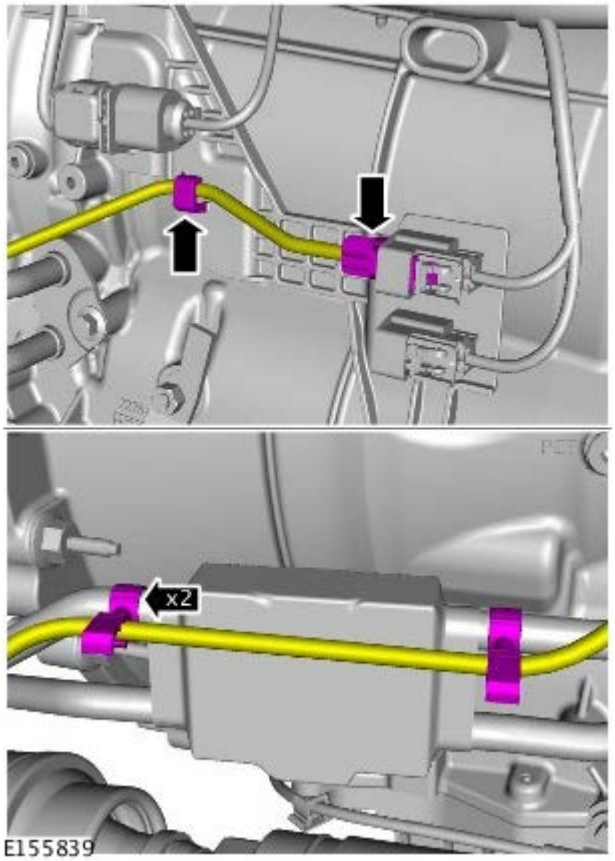
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

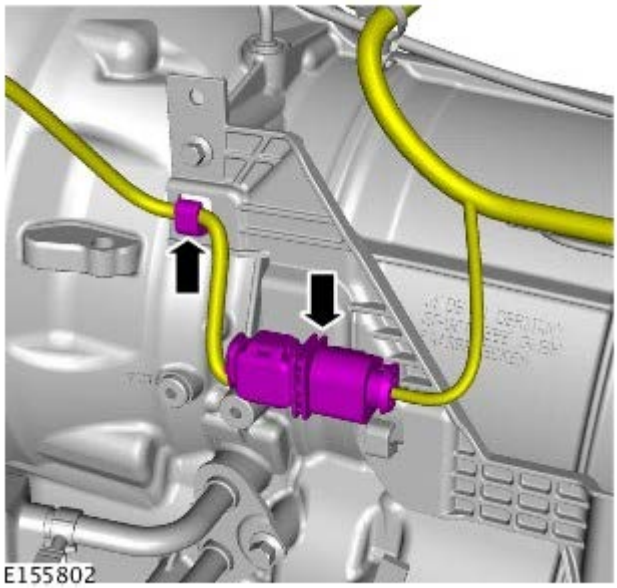
2. *Torque:*
   M10 60 Nm
   M6 10 Nm



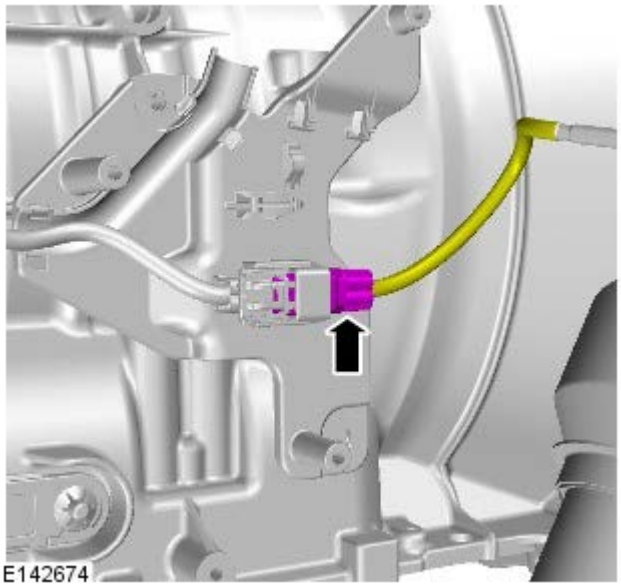
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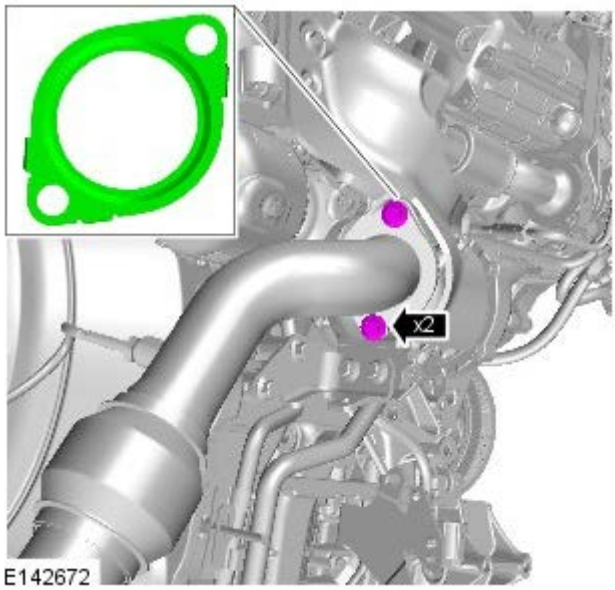


4.



5.

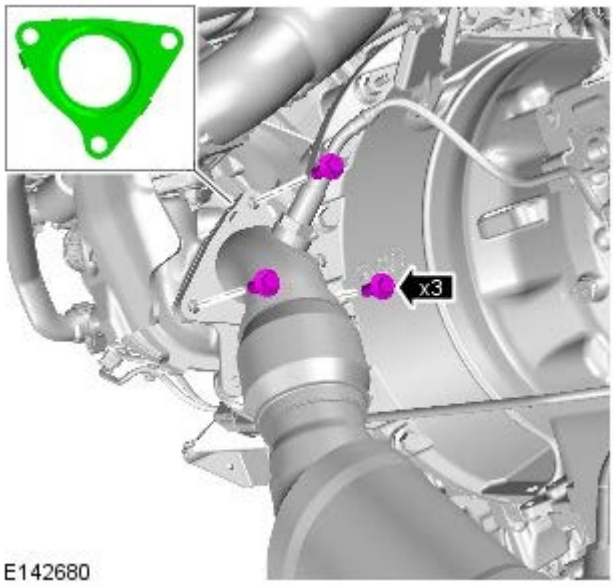

E142674



E142672

6. NOTE: Install a new gasket.

Torque: 28 Nm

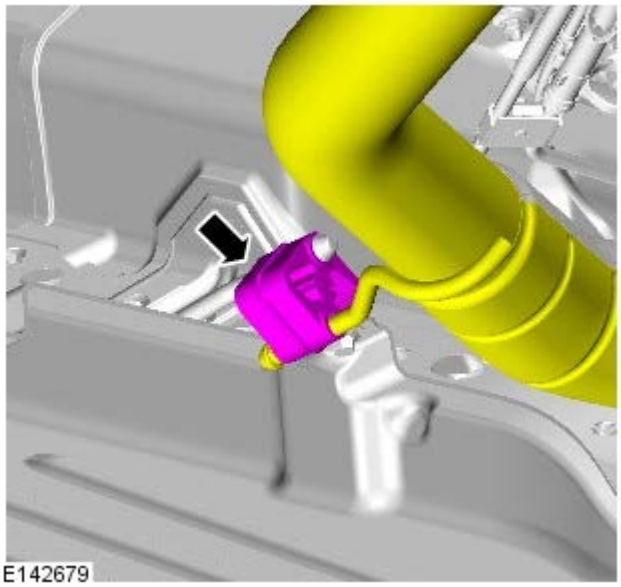


E142680

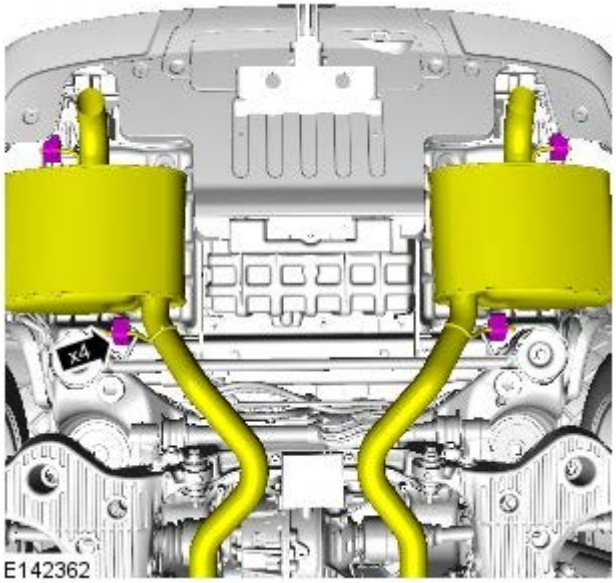
7. NOTE: Install a new gasket.

Torque: 28 Nm

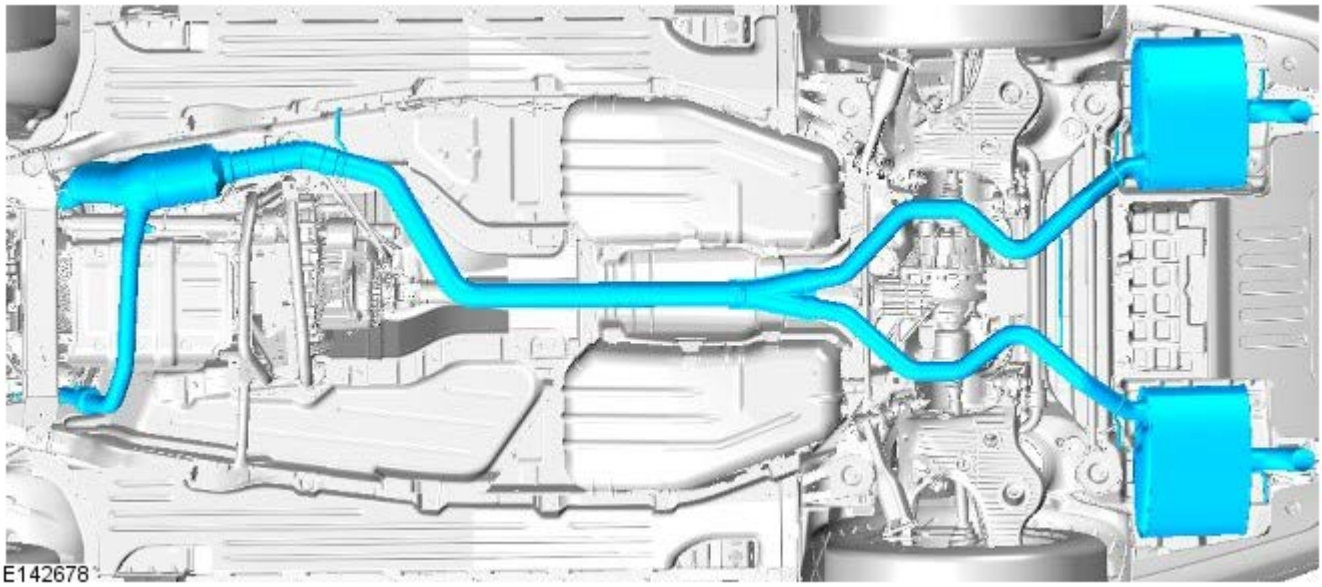
8. CAUTION: Make sure that the exhaust system is supported with suitable retaining straps.


E142679

9.

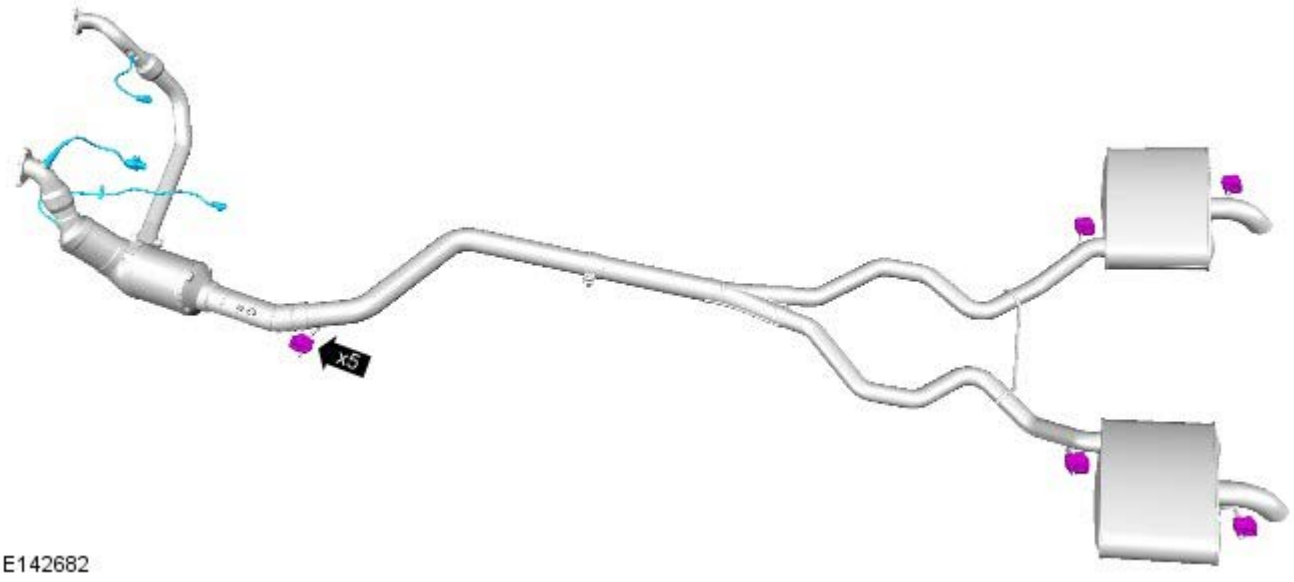

E142362

10. NOTE: This step requires the aid of another technician.


E142678

11. NOTE: Do not disassemble further if the component is removed for access only.

Torque:
Temperature sensor 35 Nm
Heated oxygen sensor 48 Nm



E142682

Installation

1. To install, reverse the removal procedure.

Published: 02-May-2013

Exhaust System - TDV6 3.0L Diesel - Exhaust System Vehicles With: Diesel Particulate Filter (DPF)

Removal and Installation

Removal

WARNING: Observe due care when working near a hot exhaust system.

NOTES:

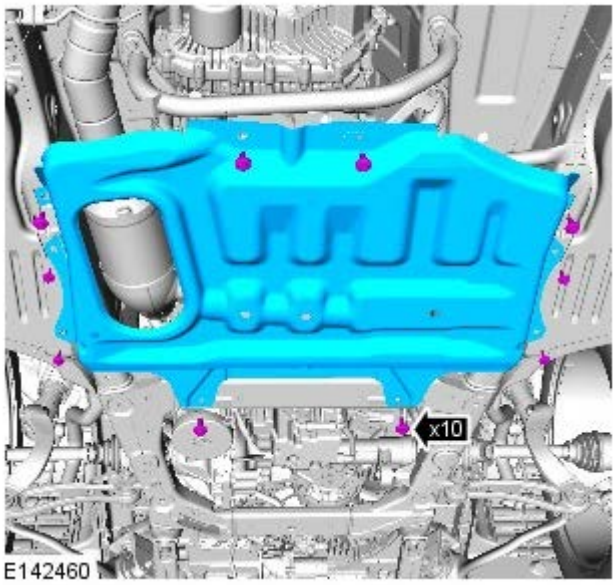
Removal steps in this procedure may contain installation details.

Some variation in the illustrations may occur, but the essential information is always correct.

1. WARNING: Make sure to support the vehicle with axle stands.

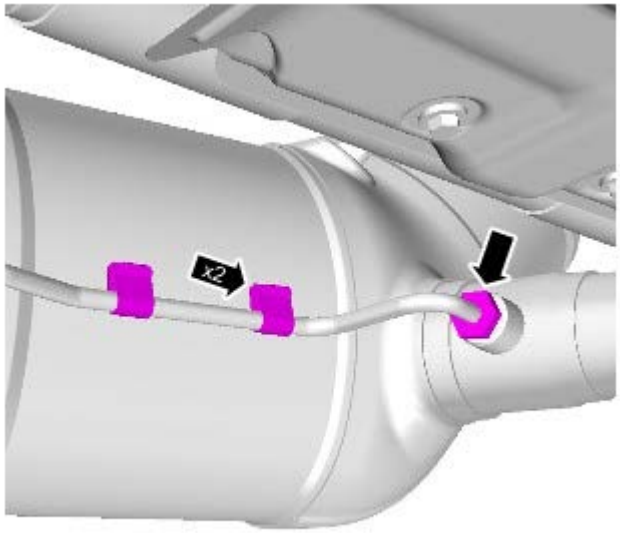
   Raise and support the vehicle.

2. *Torque:*
   M10 60 Nm
   M6 10 Nm



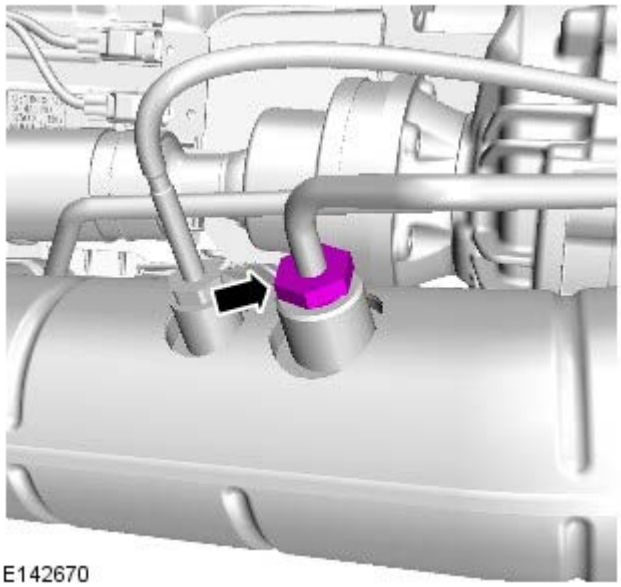
E142460

3. *Torque:* 25 Nm



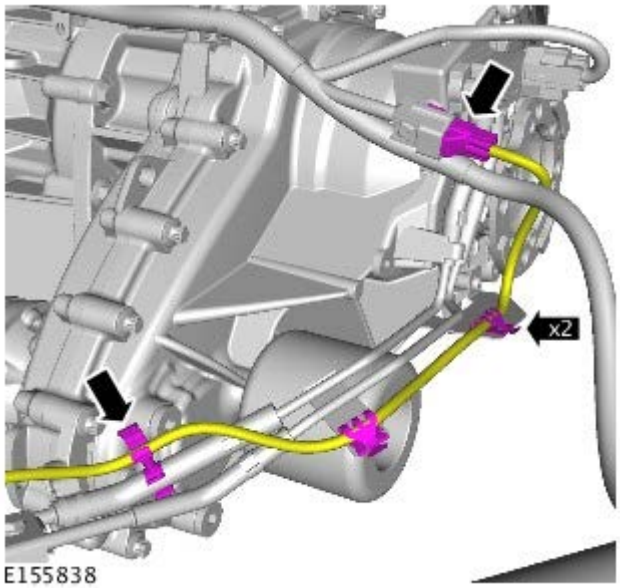
E142671

4. *Torque:* 25 Nm



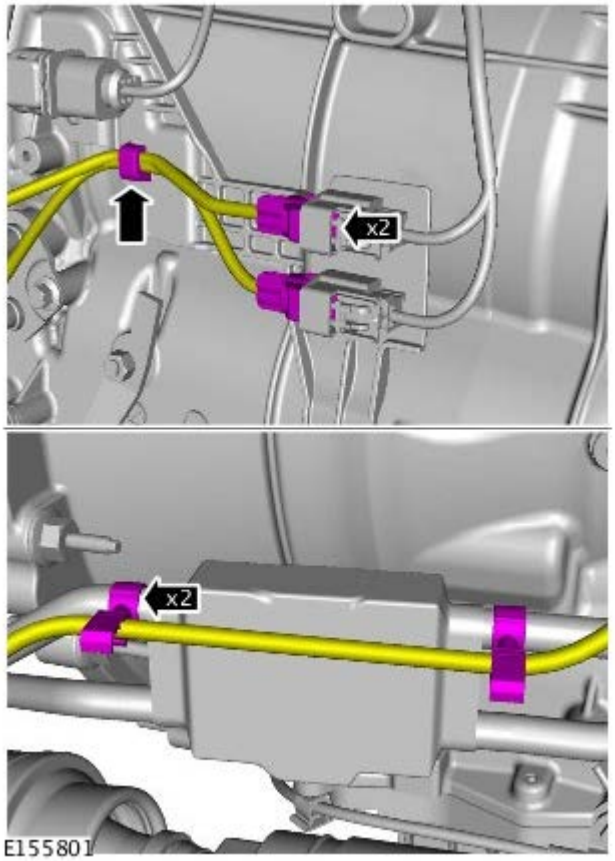
E142670

5.

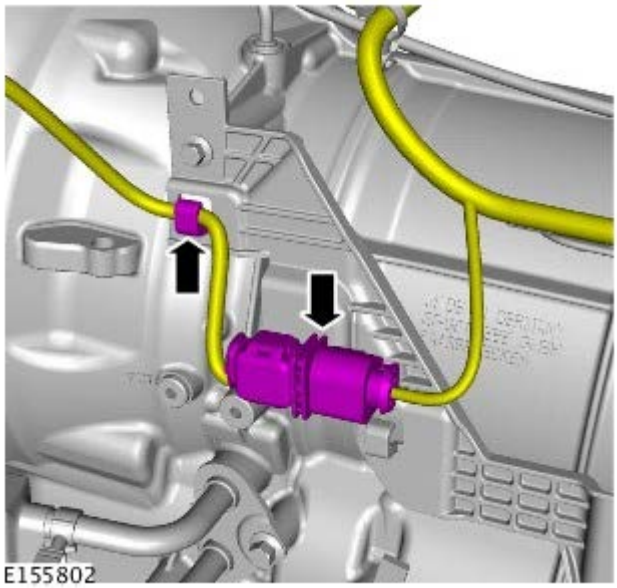


E155838

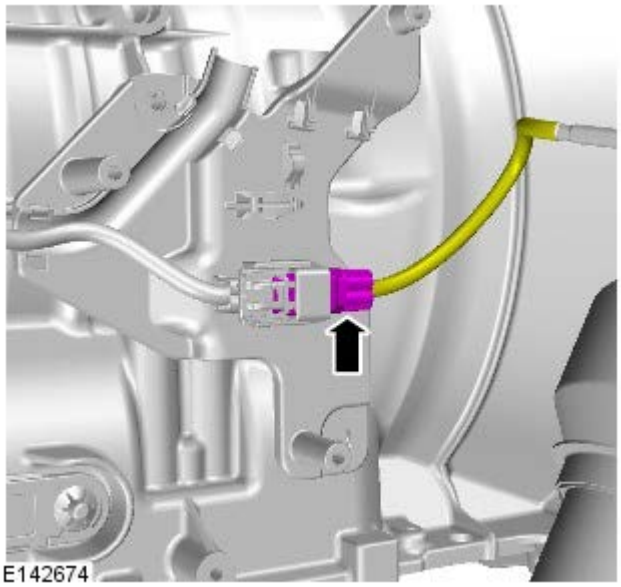
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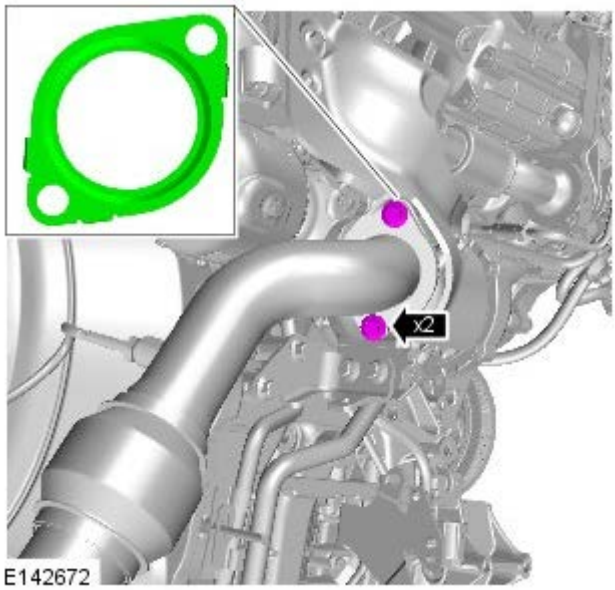


7.



8.

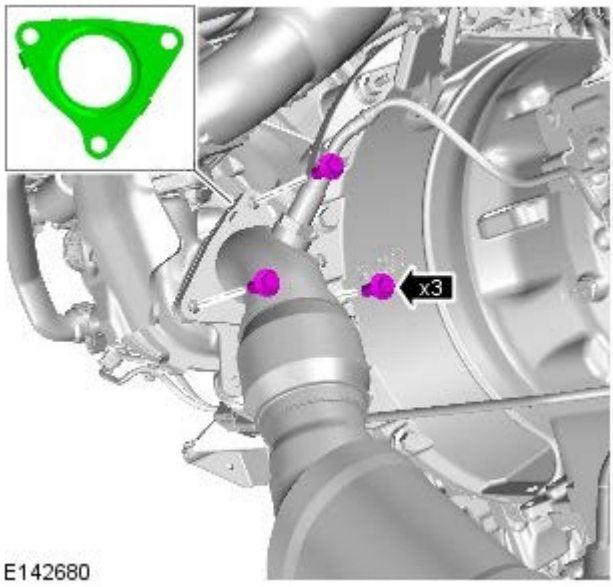

E142674



E142672

9. NOTE: Install a new gasket.

Torque: 28 Nm

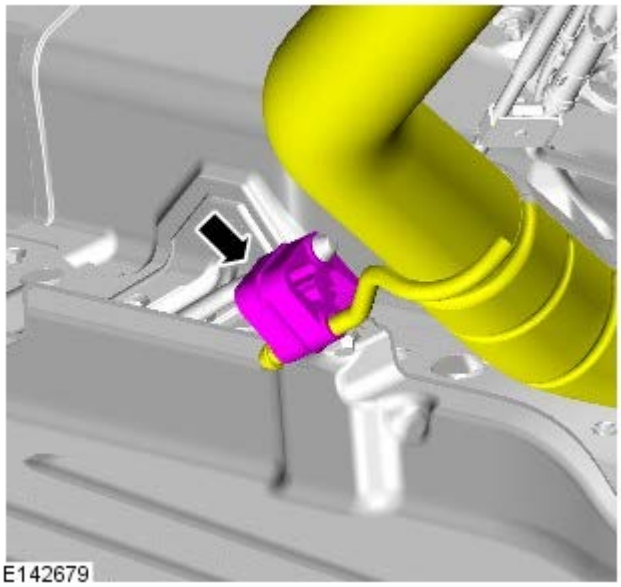


E142680

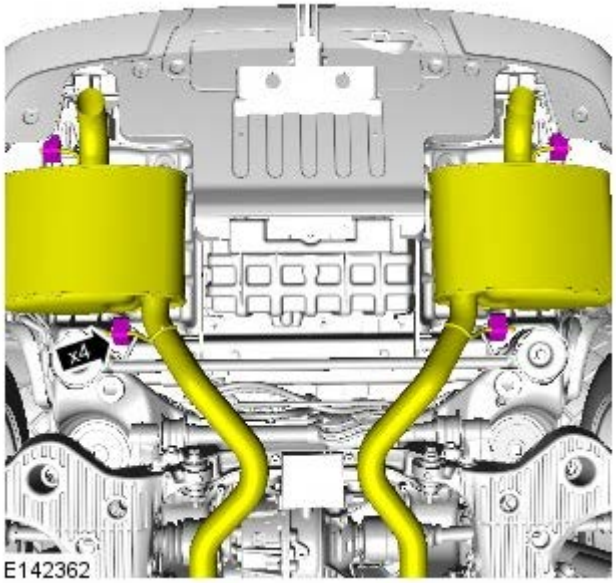
10. NOTE: Install a new gasket.

Torque: 28 Nm

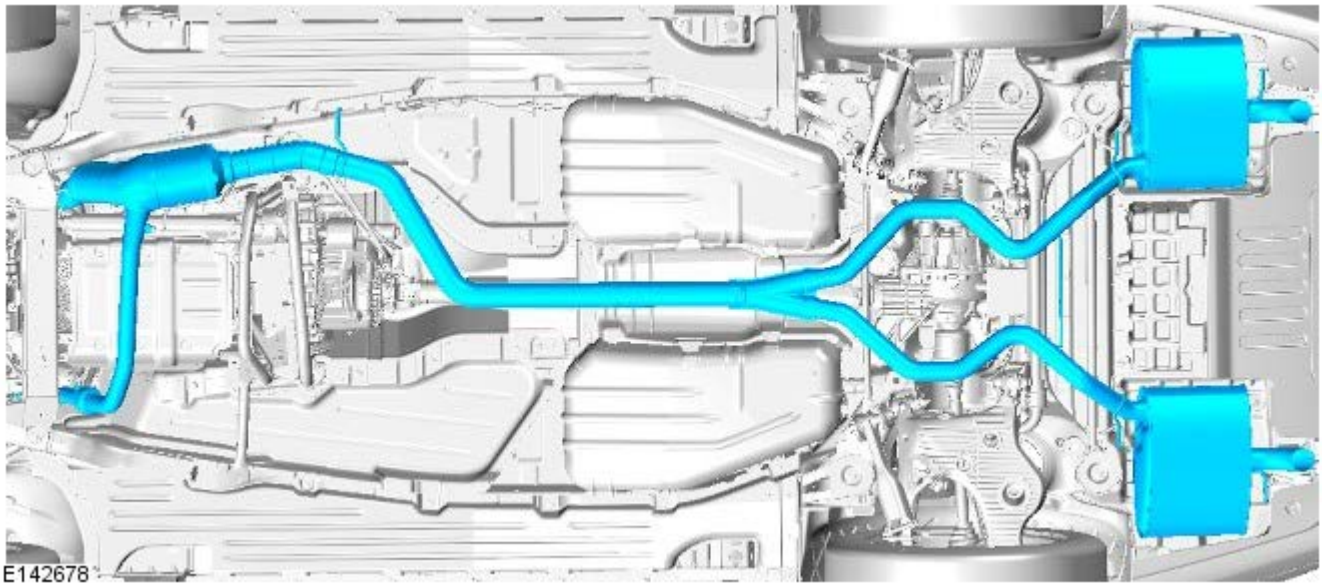
11. CAUTION: Make sure that the exhaust system is supported with suitable retaining straps.


E142679

12.

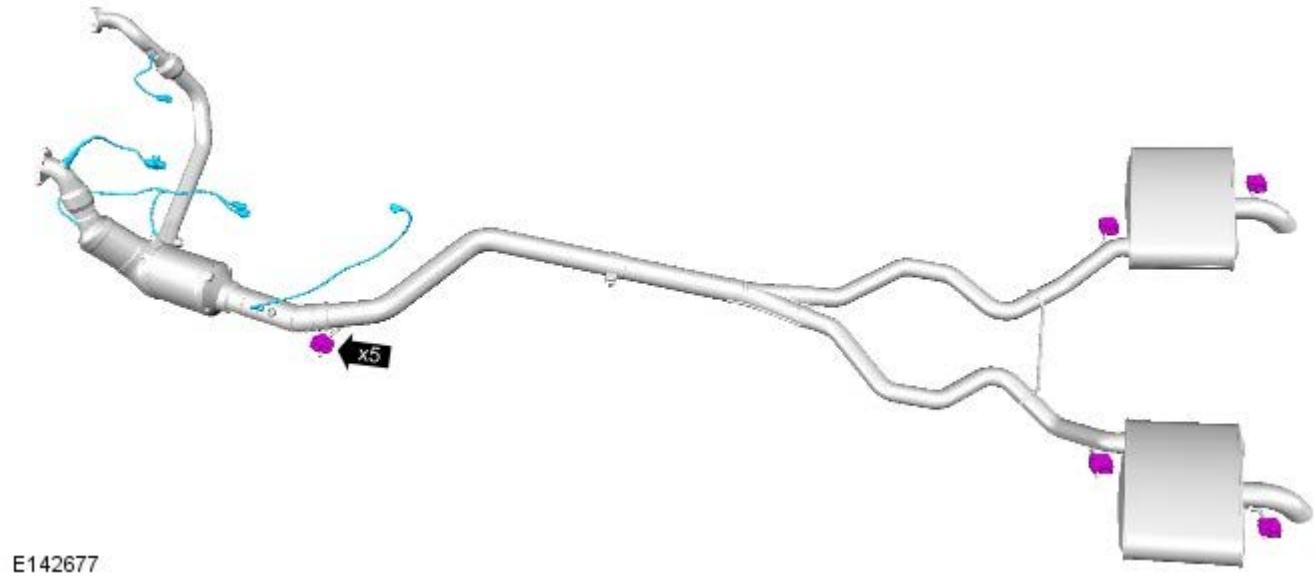

E142362

13. NOTE: This step requires the aid of another technician.


E142678

14. NOTE: Do not disassemble further if the component is removed for access only.

Torque:
Temperature sensor 35 Nm
Heated oxygen sensor 48 Nm



E142677

Installation

1. To install, reverse the removal procedure.

Published: 24-Aug-2012

Exhaust System - TDV6 3.0L Diesel - Rear Muffler

Removal and Installation

Removal

WARNING: Observe due care when working near a hot exhaust system.

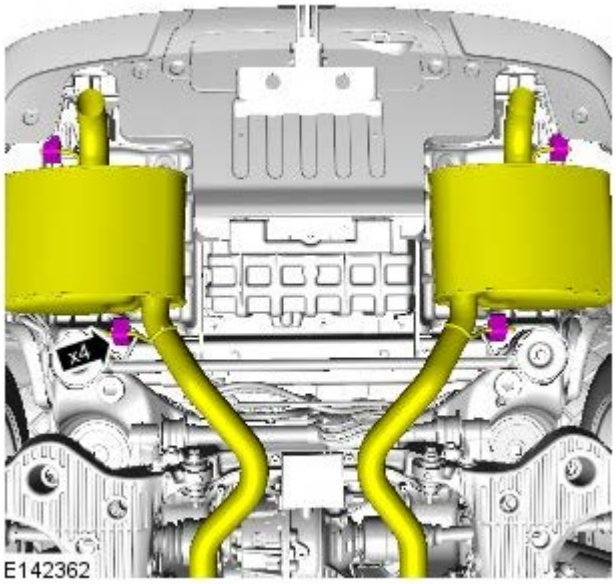
NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

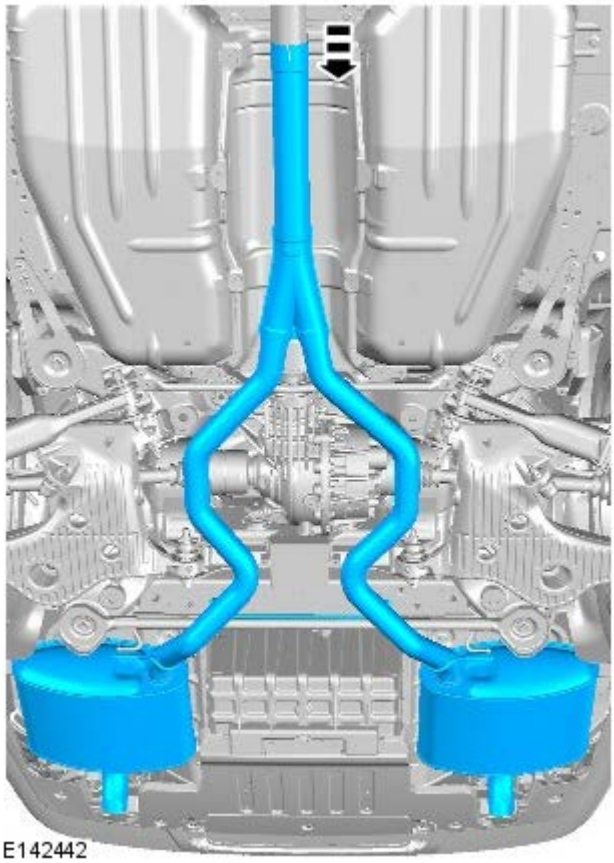
2. *Torque:* 55 Nm





3. NOTE: Make sure that the exhaust system is supported with a suitable transmission stand.

4. NOTE: This step requires the aid of another technician.


E142442

Installation

1. To install, reverse the installation procedure.

Published: 07-Aug-2012

Exhaust System - V6 S/C 3.0L Petrol -

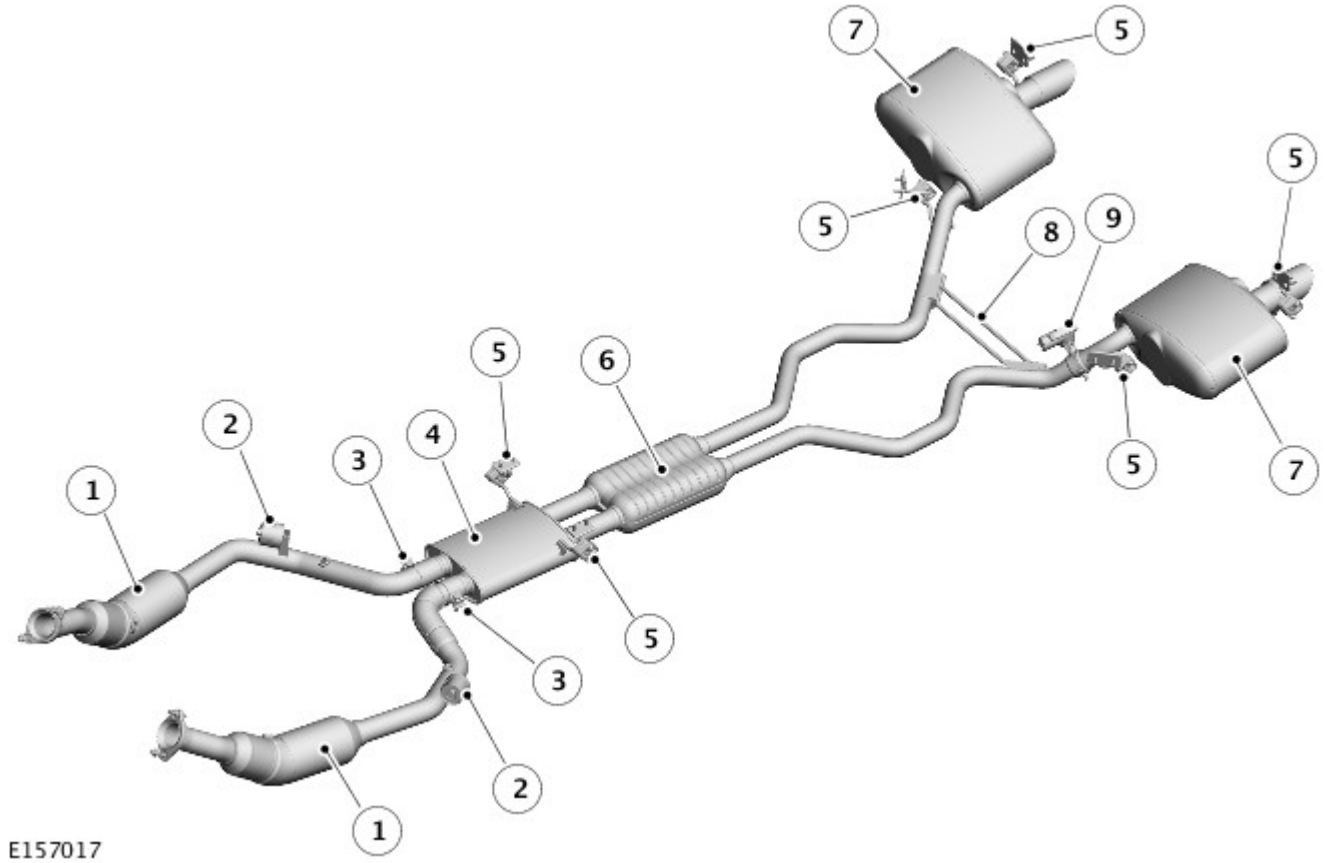
Torque Specifications

Description	Nm	lb-ft	lb-in
Catalytic converter retaining studs to exhaust manifold	40	29	-
Catalytic converter retaining nuts to exhaust manifold	40	29	-
Heated oxygen sensor (HO2S)	48	35	-
Rear muffler Torca clamp	55	40	-
Exhaust manifold retaining bolts	18	13	-
Catalytic converter Torca clamp	55	40	-
Resonator mounting bracket retaining bolts	28	21	-
Front muffler mounting bracket retaining bolts	28	21	-
Rear muffler mounting bracket retaining bolts	30	22	-

Published: 22-May-2013

Exhaust System - V6 S/C 3.0L Petrol - Exhaust System

Description and Operation



Item	Part Number	Description
1	-	Catalytic Converter
2	-	Mass Damper
3	-	Clamp
4	-	Center Silencer
5	-	Mounting Rubber (6 Off)
6	-	Center Resonator
7	-	Rear Silencer
8	-	Exhaust Brace
9	-	Exhaust Valve

Overview

In the catalytic converters, 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. The washcoat contains palladium and rhodium, which are the active constituents for converting harmful emissions into inert by-products. The palladium and rhodium convert carbon monoxide and hydrocarbons into carbon dioxide and water.

System Operation

Component Description

FRONT SECTION

The front section comprises two separate pipes each incorporating a catalytic converter. Each catalytic converter has a welded pipe with a flange, which is flared into a cone which mates with the exhaust manifold. Each flange has two holes which locate on studs in the exhaust manifold and are secured with nuts. Each catalytic converter is fitted with a mid-catalyst HO2S.

A curved pipe from each catalytic converter locates into the front silencer inlet pipes of the center section. Each pipe is fitted with a mass damper which absorbs resonance from the system. Each pipe has a boss for location of the post catalyst HO2S.

REAR SECTION

Two pipes from the front silencer connect directly into the center Helmholtz resonators. The Helmholtz resonator houses perforated tubes separated by baffle plates and it is specifically tuned to reduce a specific tuned acoustic frequency in the exhaust system. Exhaust gasses exit the resonators via two outlet pipes. Each pipe has a welded hanger bracket

which allow the rear section to be supported on mounting rubbers. A further bracket is welded to each pipe which braces the two pipes together.

The system is a one piece construction therefore all the silencer boxes are welded in to the design. There are no clamps on the system other than two securing the downpipe assemblies to it.

The fabricated rear silencers have two perforated tubes which are supported on two baffle plates. The exhaust gasses are expelled from the rear silencer via a single outlet pipe. The outlet pipe from each silencer has a welded hanger bar which supports the rear silencer on mounting rubbers. The outlet pipe is fitted with a polished stainless steel finisher. The tailpipe finishers are welded on to tailpipe.

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 minimize the exhaust emissions. Threaded bosses are located on each manifold, between the starter and the main catalysts on the catalytic converters and on the pipes between the catalytic converters and the front silencer to house the pre, mid and post catalyst HO2S's.

The pre catalyst HO2S's primarily control the engine fueling, whilst the mid-catalyst and post catalyst HO2S's are primarily used to monitor the conversion efficiency of the catalytic converters and perform further trimming of fueling. The engine management system monitors the sensors and uses the information to further improve the fueling and exhaust emissions.

Published: 02-May-2013

Exhaust System - V6 S/C 3.0L 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 - V6 S/C 3.0L 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. Refer to the relevant section of the workshop manual.

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 - V6 S/C 3.0L Petrol , DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation).

Published: 02-May-2013

Exhaust System - V6 S/C 3.0L Petrol - Catalytic Converter LH

Removal and Installation

Special Tool(s)

	Wrench, HO2S 310-121(LRT-19-014)

Removal

WARNING: Observe due care when working near a hot exhaust system.

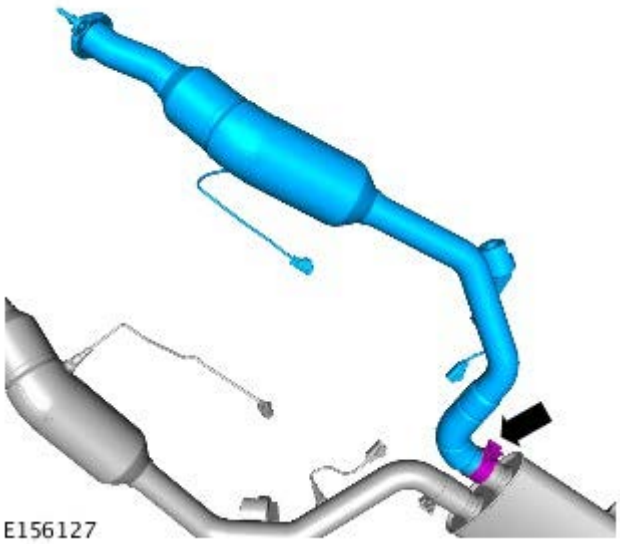
NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

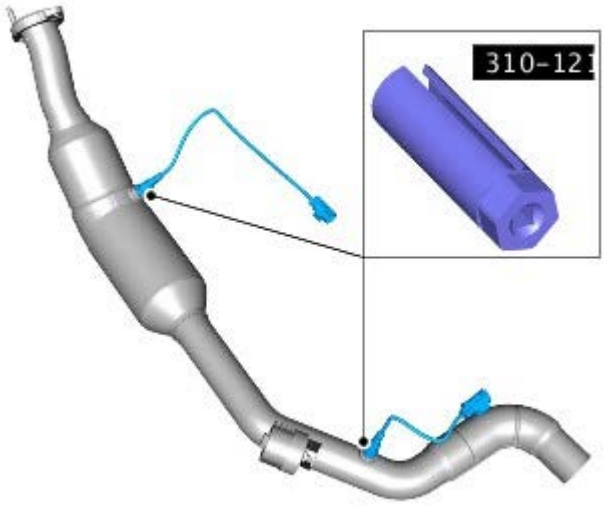
2. For additional information, refer to: Exhaust System (309-00B Exhaust System - V6 S/C 3.0L Petrol, Removal and Installation).

3. TORQUE: 55 Nm



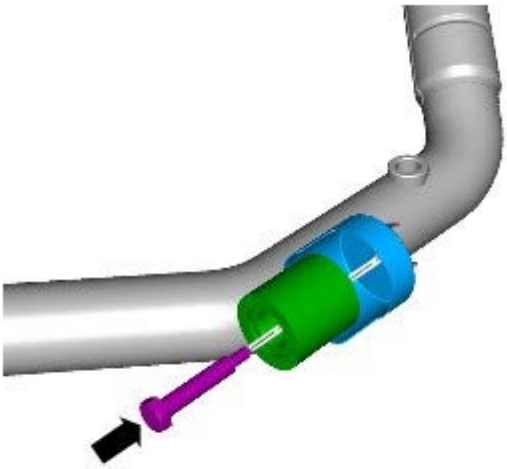
4. NOTE: Do not disassemble further if the component is removed for access only.

   TORQUE: 48 Nm



E156128

5. TORQUE: 18 Nm



E156051

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: 02-May-2013

Exhaust System - V6 S/C 3.0L Petrol - Catalytic Converter RH

Removal and Installation

Special Tool(s)

	Wrench, HO2S 310-121(LRT-19-014)

Removal

WARNING: Observe due care when working near a hot exhaust system.

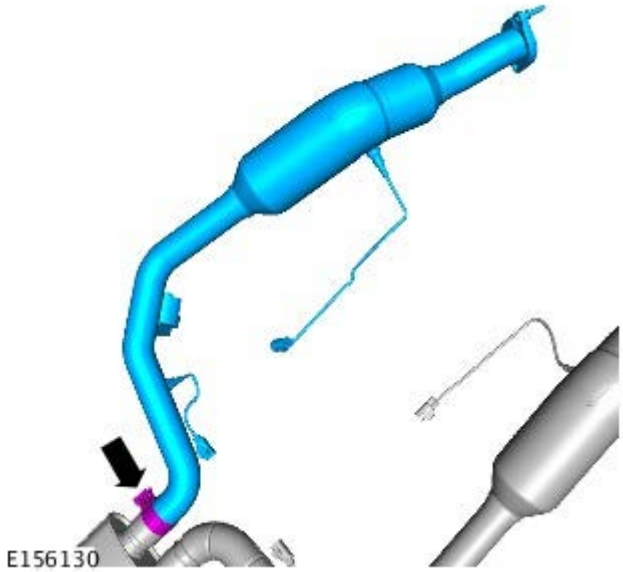
NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

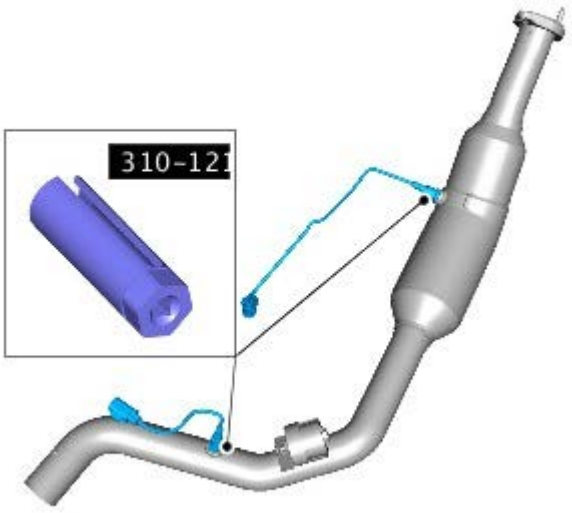
2. For additional information, refer to: Exhaust System (309-00B Exhaust System - V6 S/C 3.0L Petrol, Removal and Installation).

3. TORQUE: 55 Nm



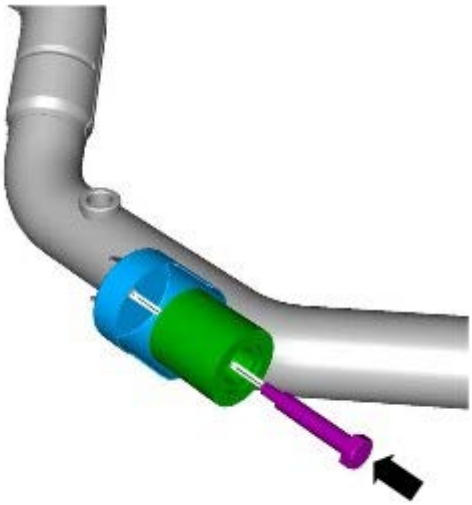
4. NOTE: Do not disassemble further if the component is removed for access only.

   TORQUE: 48 Nm



E156131

5. TORQUE: 18 Nm



E156129

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.

This section contains no data

Published: 02-May-2013

Exhaust System - V6 S/C 3.0L Petrol - Front Muffler

Removal and Installation

Special Tool(s)

 E130266	100-051 Cutter, Exhaust Pipe

Removal

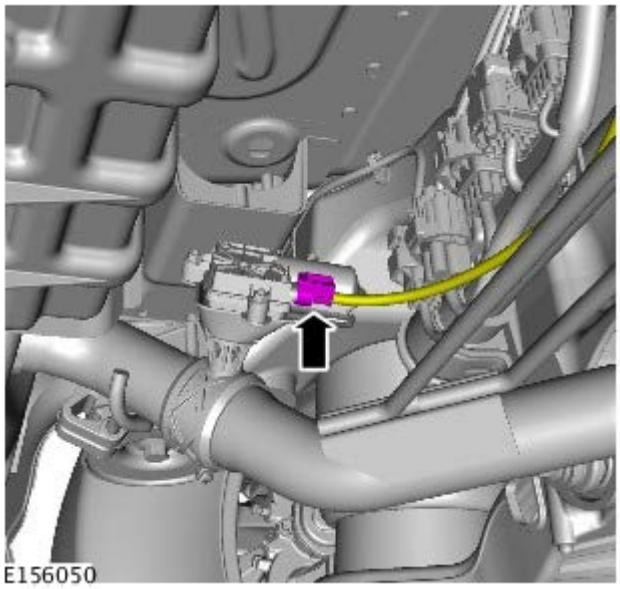
WARNING: Observe due care when working near a hot exhaust system.

NOTE: Removal steps in this procedure may contain installation details.

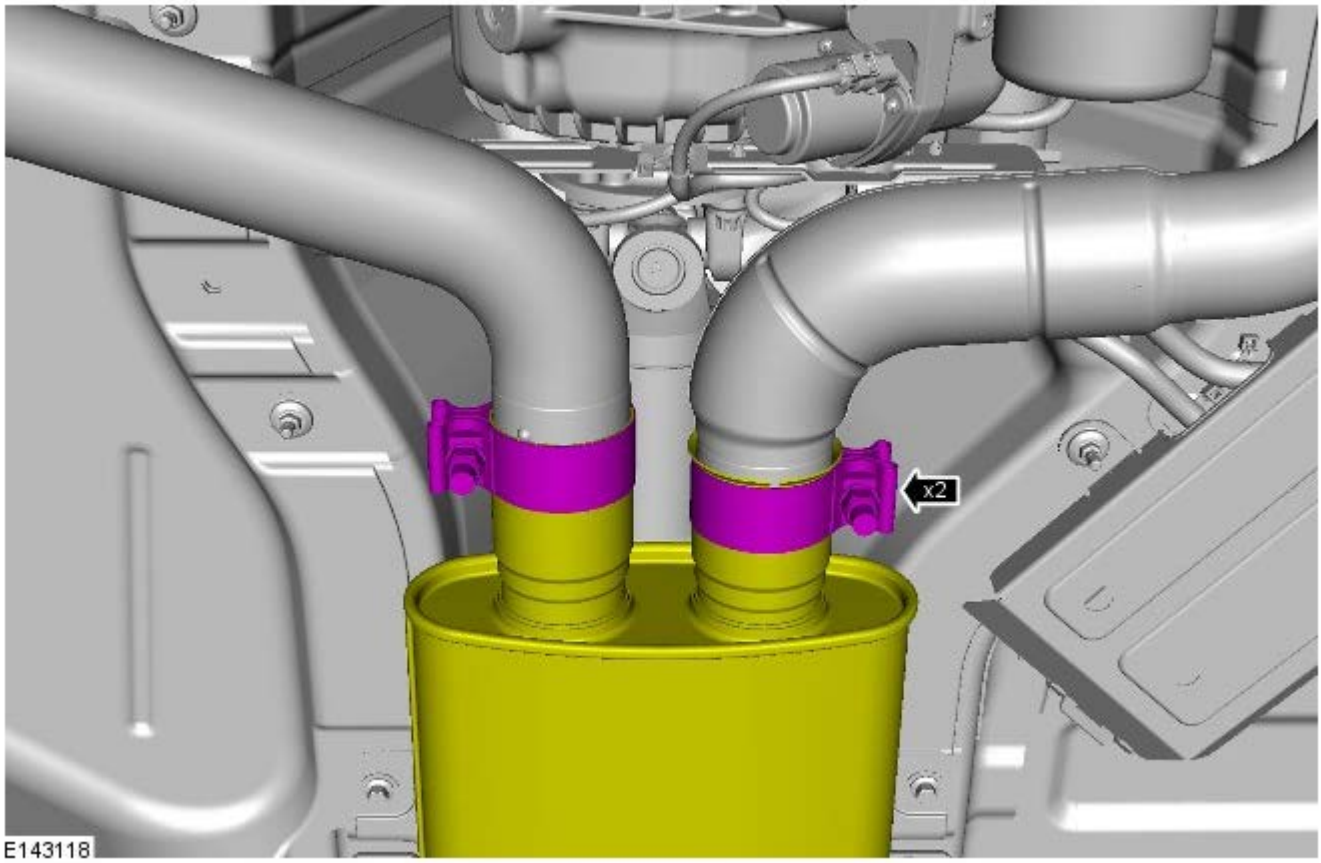
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

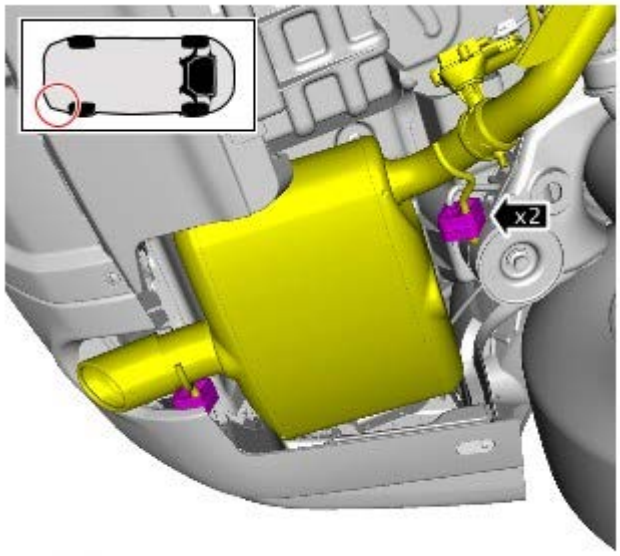
2.



3. *Torque:* 55 Nm



E143118

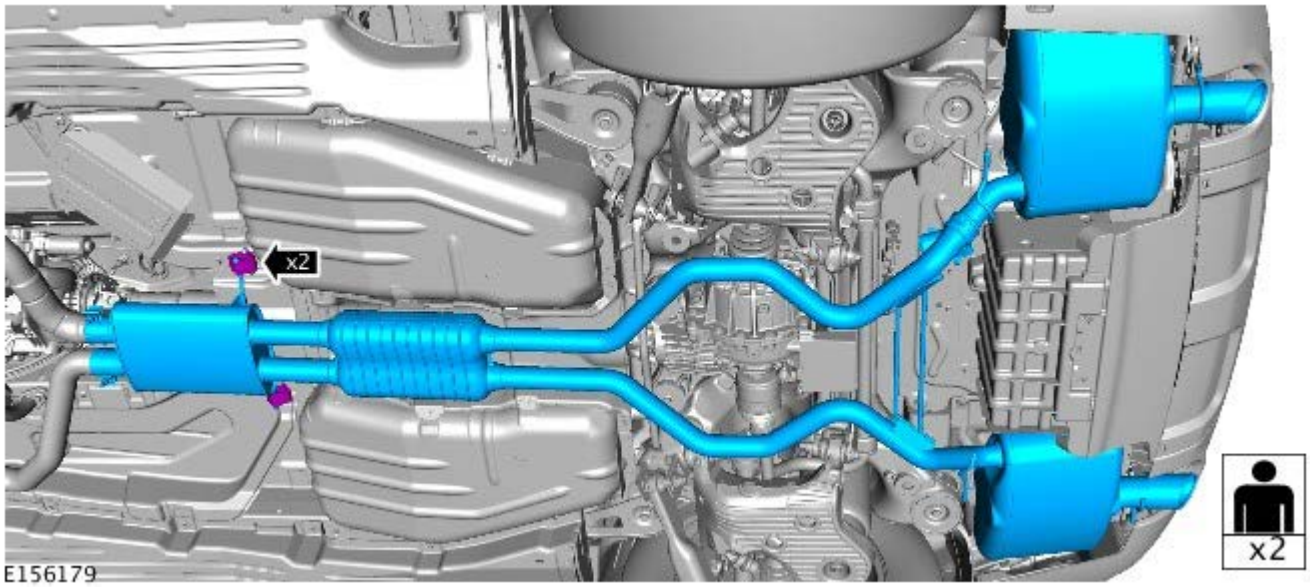


E156052

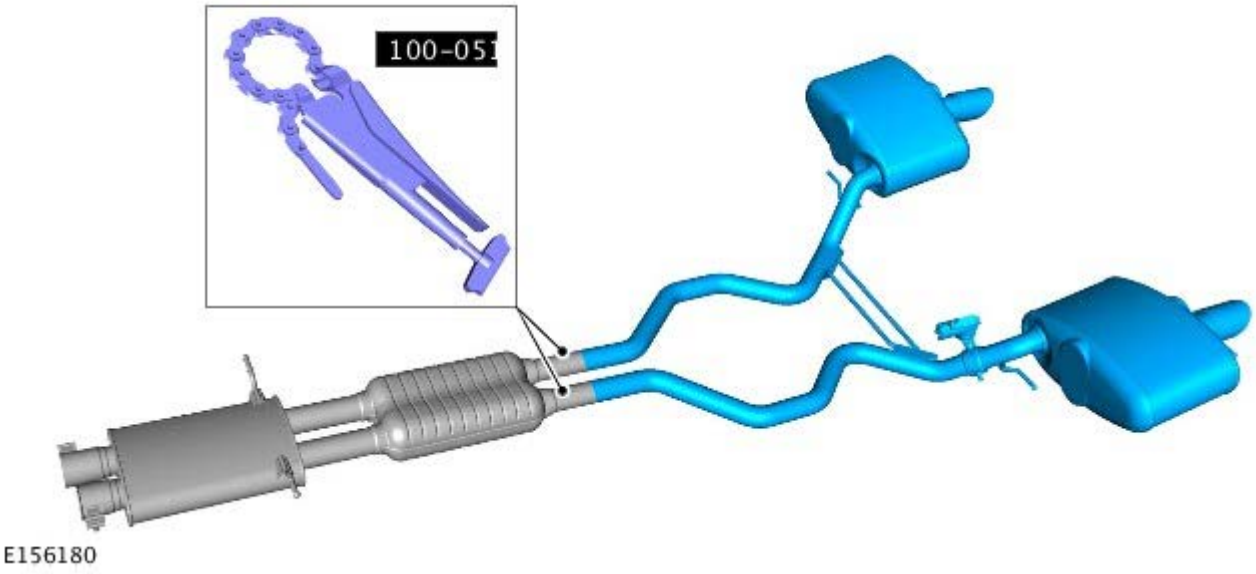
4. CAUTION: Make sure that the exhaust system is supported with suitable retaining straps.

NOTE: The step must be carried out on both sides.

5.



6. NOTE: Do not disassemble further if the component is removed for access only.
   - *Special Tool(s):* 100-051

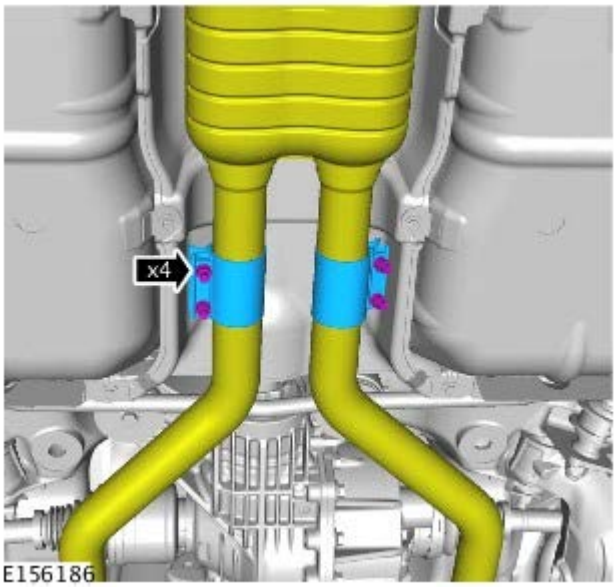


Installation

1. WARNING: Make sure that any corrosion or dirt is removed from the mating surfaces.

   To install, reverse the removal procedure.

   Torque: 55 Nm


x4
E156186

Published: 02-May-2013

Exhaust System - V6 S/C 3.0L Petrol - Rear Muffler

Removal and Installation

Special Tool(s)

 E130266	100-051 Cutter, Exhaust Pipe

Removal

WARNING: Observe due care when working near a hot exhaust system.

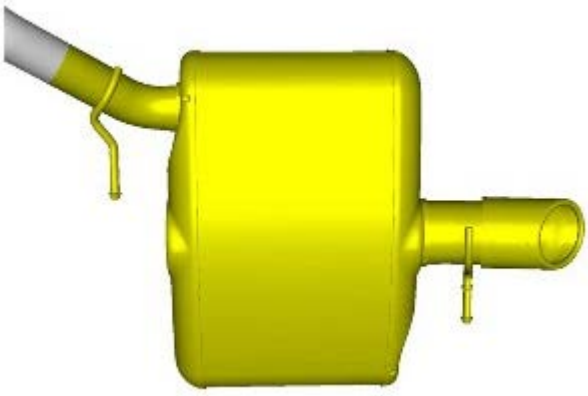
NOTES:

Removal steps in this procedure may contain installation details.

RH side only.

1. WARNING: Make sure to support the vehicle with axle stands.

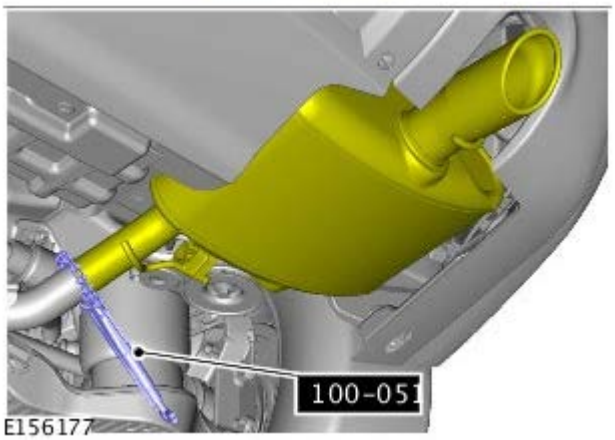
   Raise and support the vehicle.



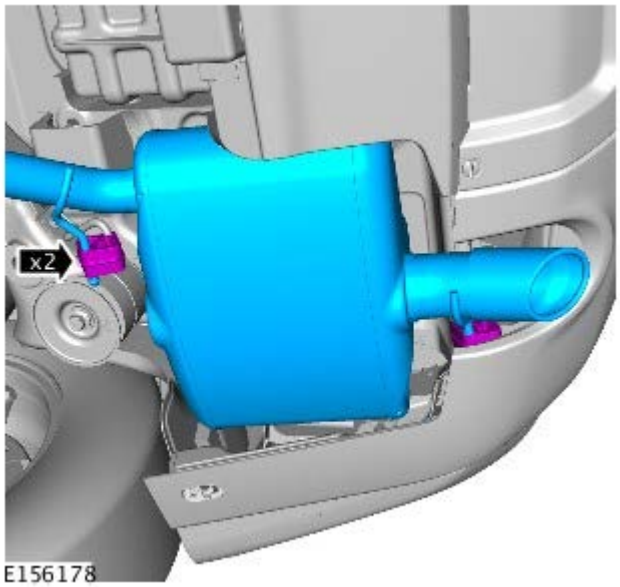
2. CAUTION: Make sure that the exhaust system is supported with suitable retaining straps.

   NOTE: Using the special tool, cut the exhaust pipe at the marked position.

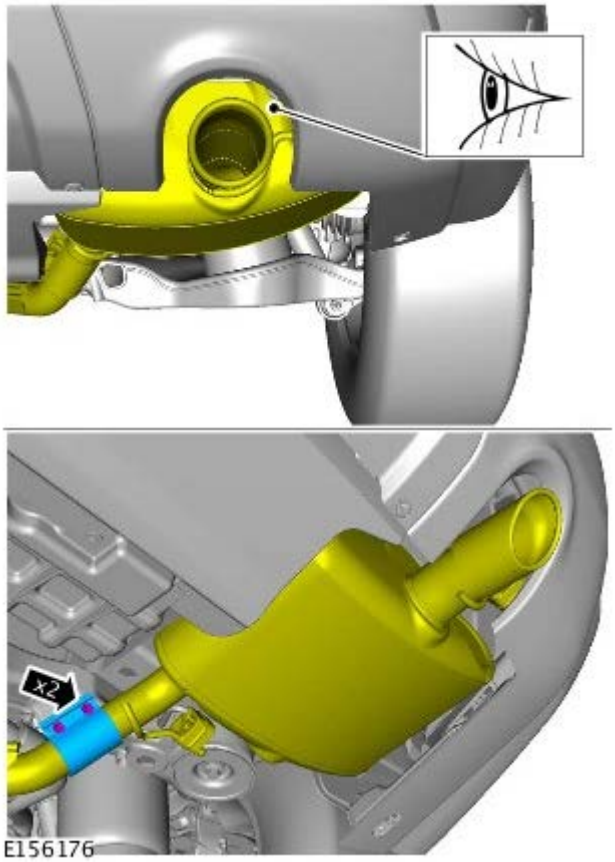
   Special Tool(s): 100-051



3.



Installation



1. WARNING: Make sure that any corrosion or dirt is removed from the mating surfaces.

   To install, reverse the removal procedure.

   Torque: 55 Nm

Published: 07-Aug-2012

Exhaust System - V8 S/C 5.0L Petrol -

Torque Specifications

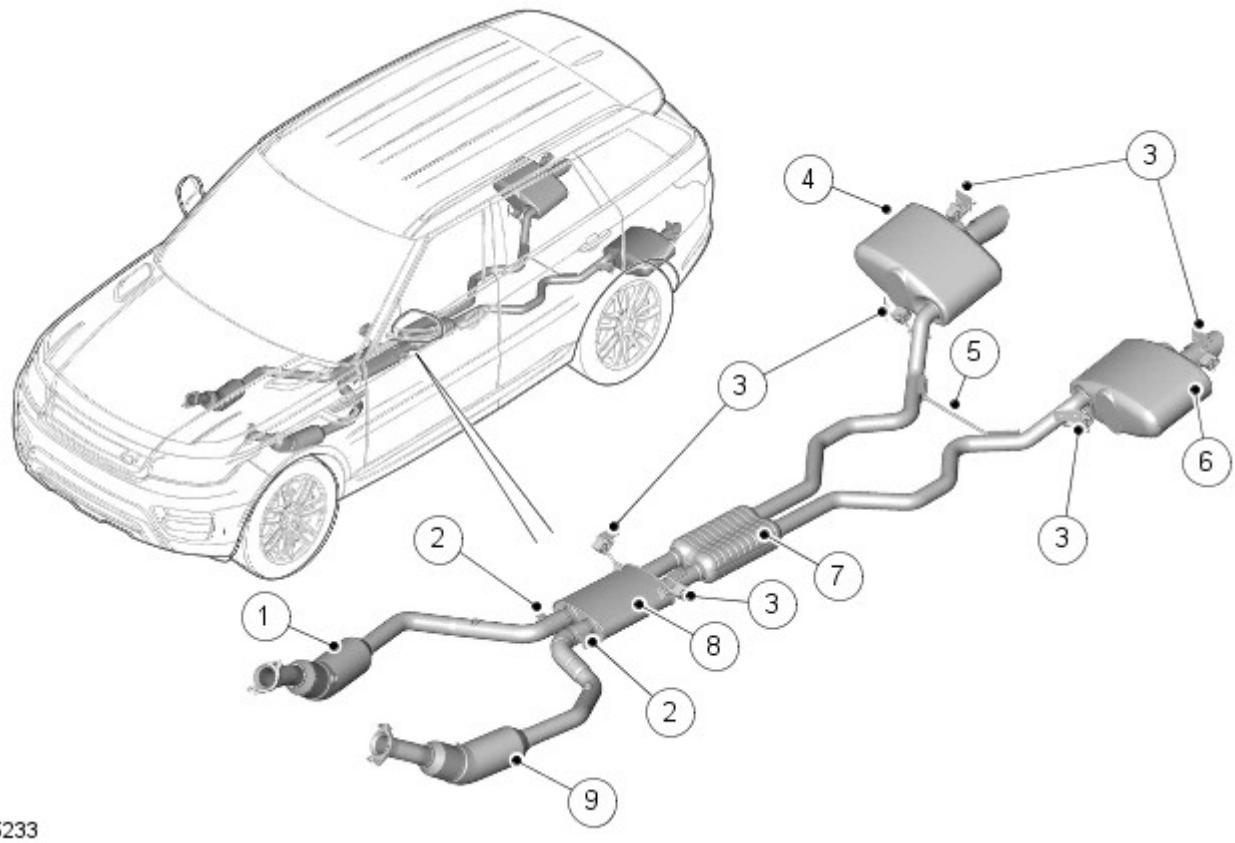
Description	Nm	lb-ft	lb-in
Catalytic converter retaining studs to exhaust manifold	40	29	-
Catalytic converter retaining nuts to exhaust manifold	40	29	-
Heated oxygen sensor (HO2S)	48	35	-
Rear muffler Torca clamp	55	40	-
Exhaust manifold retaining bolts	18	13	-
Catalytic converter Torca clamp	55	40	-
Resonator mounting bracket retaining bolts	28	21	-
Front muffler mounting bracket retaining bolts	28	21	-
Rear muffler mounting bracket retaining bolts	30	22	-

Published: 14-May-2013

Exhaust System - V8 S/C 5.0L Petrol - Exhaust System

Description and Operation

COMPONENT LOCATION - EXHAUST SYSTEM - V8 S/C 5.0L PETROL



E155233

Item	Part Number	Description
1	-	Catalytic converter - (Bank 1)
2	-	Clamp (2 off)
3	-	Mounting Rubber (6 Off)
4	-	Rear right silencer
5	-	Exhaust brace
6	-	Rear left silencer
7	-	Center resonator silencer
8	-	Front resonator silencer
9	-	Catalytic converter - (Bank 2)

EXHAUST SYSTEM

The V8 S/C 5.0L Petrol exhaust system is supplied from the factory as a two-piece assembly and is attached to the underside of the body with six mounting rubbers.

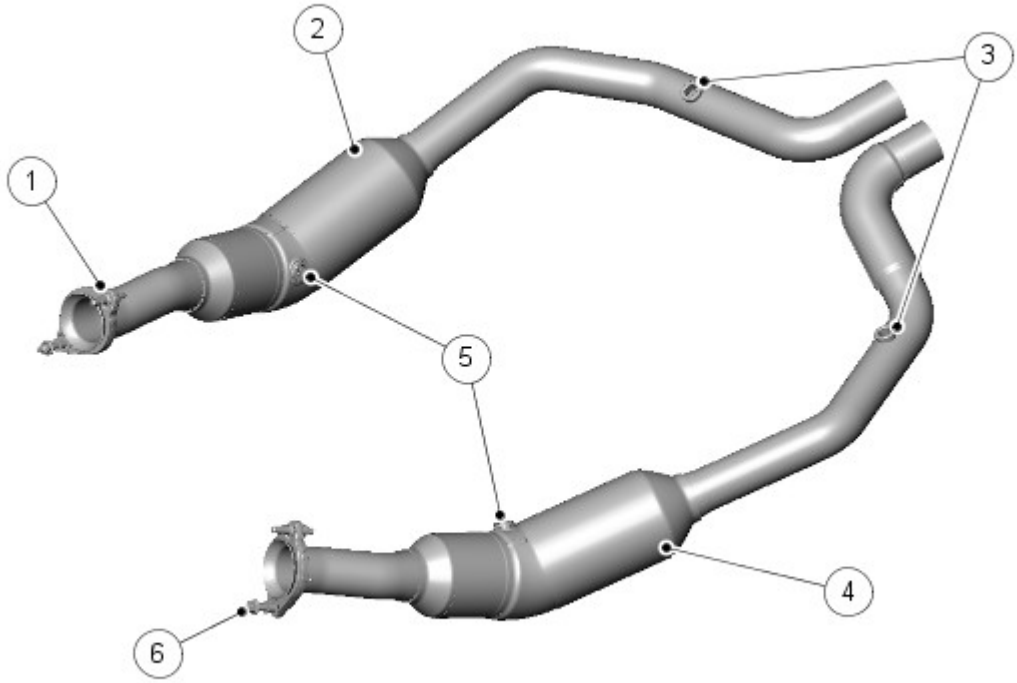
The exhaust front section comprises of two pipes each incorporating a catalytic converter. Each catalytic converter is joined to an inlet pipe with a flange that is attached to each of the exhaust manifold.

The front section is fitted with both mid-catalyst and post-catalyst HO2S (Heated Oxygen Sensor) sensors, on each of the pipes.
For additional information, refer to: Electronic Engine Controls (303-14C Electronic Engine Controls - V8 S/C 5.0L Petrol, Description and Operation).

The two outlet pipes from the front section connect to the inlet pipes of the front silencer and are secured by two clamps. The two pipes from the front silencer connect directly into the centre resonator silencer. The centre resonator silencer houses perforated tubes that are separated by baffle plates and allows the exhaust gasses to exit the resonator silencer via 2 outlet pipes. The two pipes from the centre resonator split the rear system in to two separate rear silencers.

The rear silencers have two perforated tubes which are supported on two baffle plates. The exhaust gasses are expelled from the rear silencer via a single outlet pipe on each of the rear silencers.

CATALYTIC CONVERTER



E155234

Item	Part Number	Description
1	-	Stud (4 off)
2	-	Catalytic converter - (Bank 1)
3	-	Post-Catalyst Heated Oxygen Sensor (HO2S) Mounting Boss (2 off)
4	-	Catalytic converter - (Bank 2)
5	-	Mid-Catalyst Heated Oxygen Sensor (HO2S) Mounting Boss (2 off)
6	-	Nut (4 off)

The engine management system provides accurately metered quantities of fuel to the combustion chambers to ensure the most efficient use of fuel and to minimize the exhaust emissions. Two threaded bosses are located on exhaust manifolds (one on Bank 1, and one on Bank 2), for the Pre-Catalyst HO2S sensors. Further threaded bosses are fitted on front section of the exhaust system, for the two Mid - Catalyst HO2S, and two Post - Catalyst HO2S 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 'wash coat'. The wash coat increases the surface area of the ceramic elements by a factor of approximately 7000. On top of the 'wash coat' 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.

Published: 11-May-2011

Exhaust System - 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 (309-00C Exhaust System - 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. Refer to the relevant section of the workshop manual.

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 - V8 S/C 5.0L Petrol, DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation).

Published: 31-Jul-2012

Exhaust System - V8 S/C 5.0L Petrol - Catalytic Converter LH

Removal and Installation

Special Tool(s)

	Wrench, HO2S 310-121(LRT-19-014)

Removal

WARNING: Observe due care when working near a hot exhaust system.

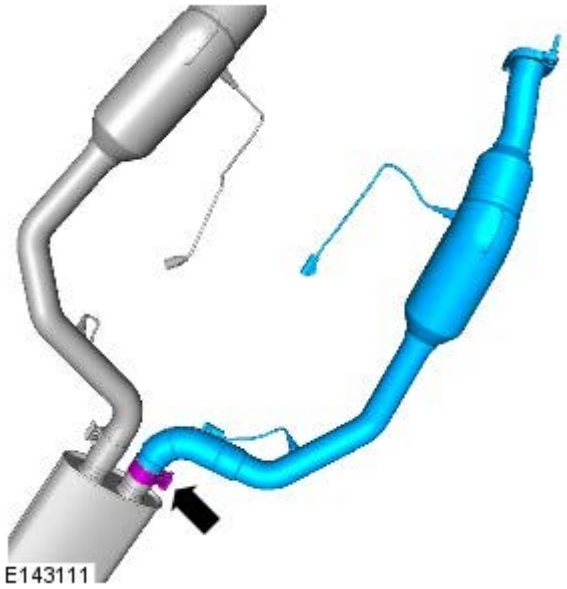
NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

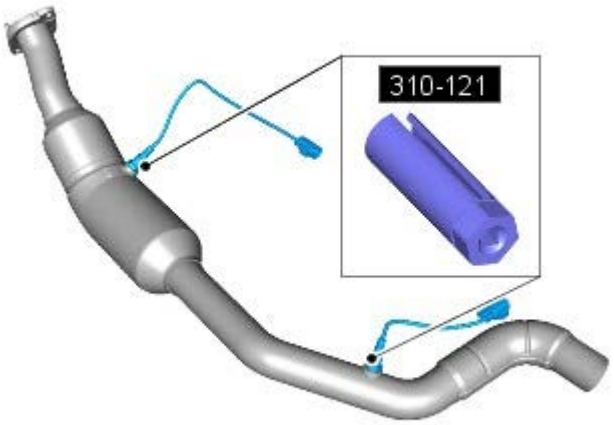
2. For additional information, refer to: Exhaust System (309-00C Exhaust System - V8 S/C 5.0L Petrol, Removal and Installation).

3. TORQUE: 55 Nm



4. NOTE: Do not disassemble further if the component is removed for access only.

   TORQUE: 48 Nm



E143112

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: 31-Jul-2012

Exhaust System - V8 S/C 5.0L Petrol - Catalytic Converter RH

Removal and Installation

Special Tool(s)

 E53465	Wrench, HO2S 310-121(LRT-19-014)

Removal

WARNING: Observe due care when working near a hot exhaust system.

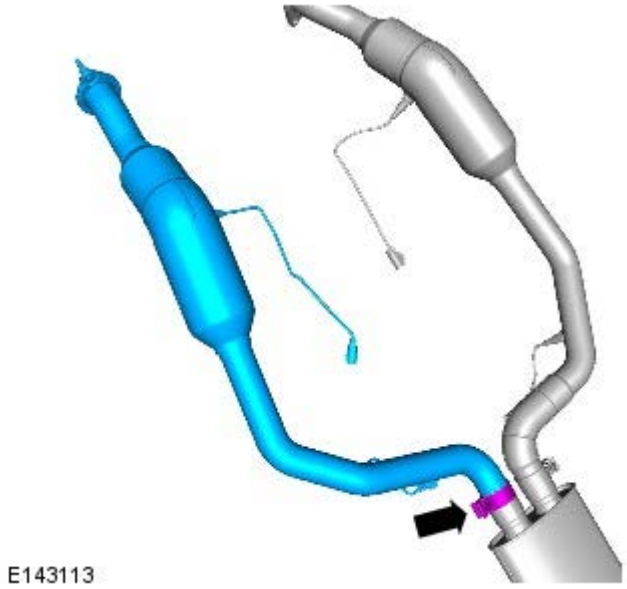
NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. For additional information, refer to: Exhaust System (309-00C Exhaust System - V8 S/C 5.0L Petrol, Removal and Installation).

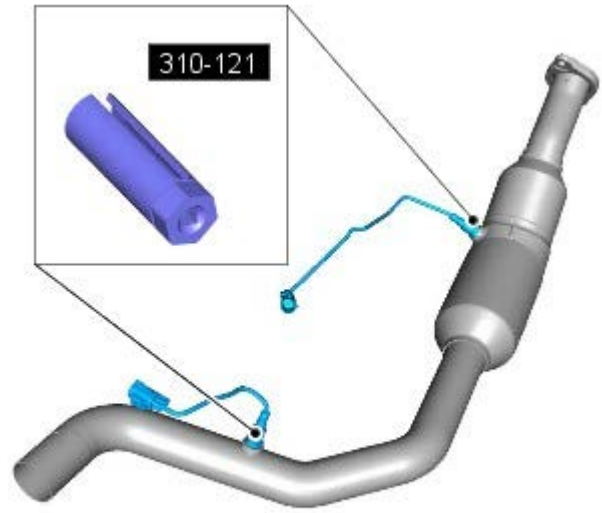
3. TORQUE: 55 Nm



E143113

4. NOTE: Do not disassemble further if the component is removed for access only.

   TORQUE: 48 Nm



E143114

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.

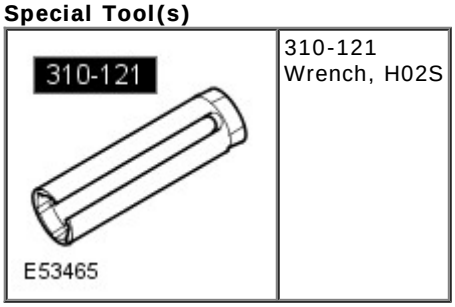
   To install, reverse the removal procedure.

Published: 06-Sep-2012

Exhaust System - V8 S/C 5.0L Petrol - Exhaust System

Removal and Installation

Special Tool(s)

	310-121 Wrench, H02S

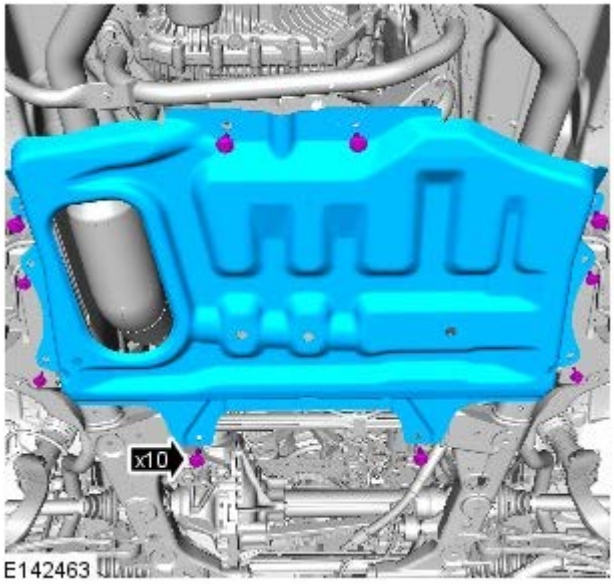
Removal

WARNING: Observe due care when working near a hot exhaust system.

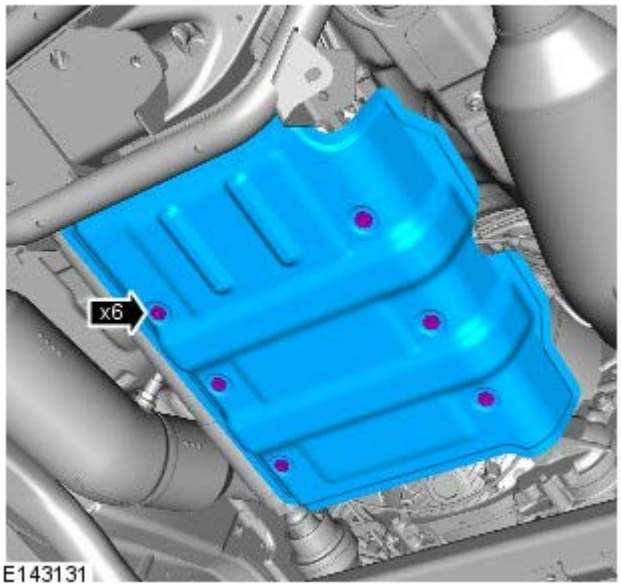
NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

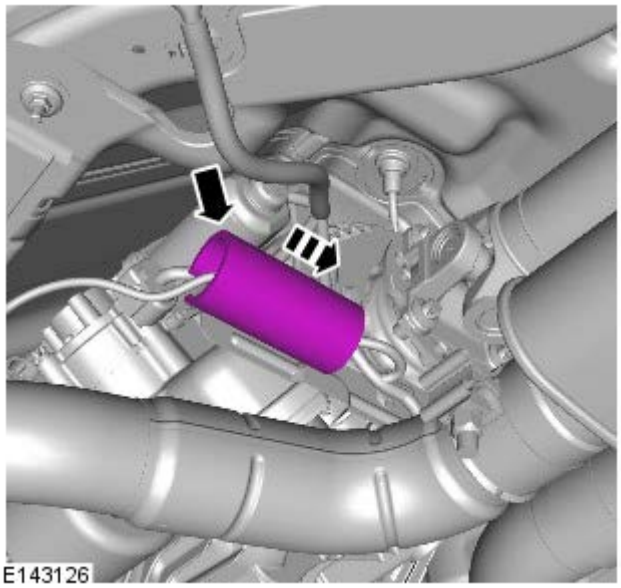
   Raise and support the vehicle.
2. Refer to: Engine Undershield (501-02, Removal and Installation).
3. Refer to: Rear Rocker Panel Moulding (501-08, Removal and Installation).



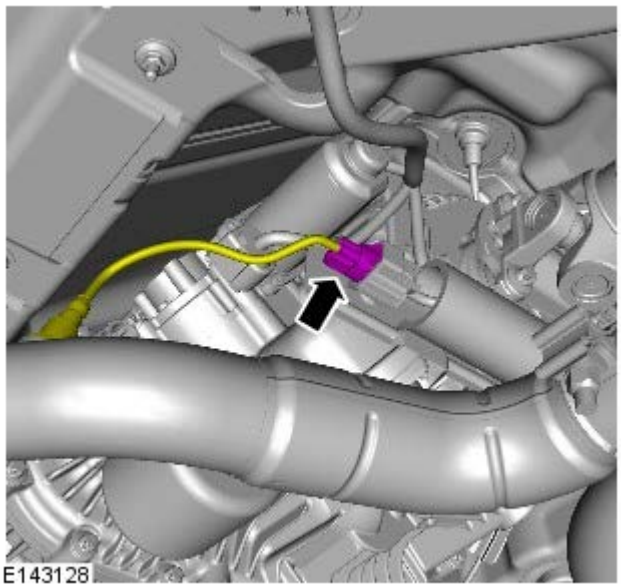
4. *Torque:*
   M10 60 Nm
   M6 10 Nm
5. *Torque:* 10 Nm



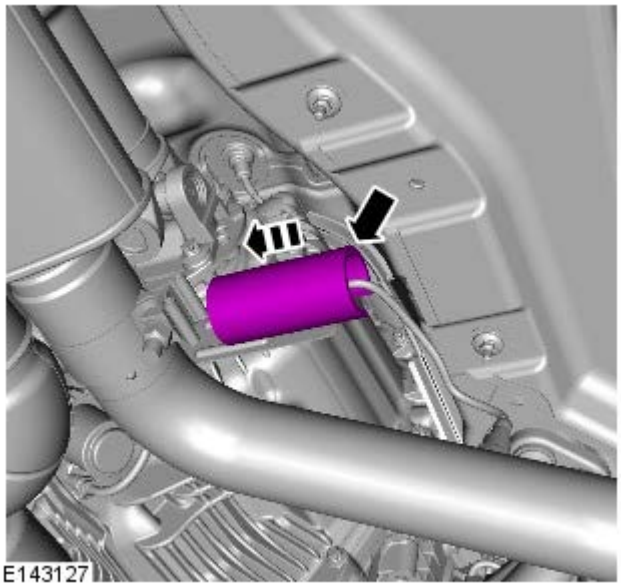
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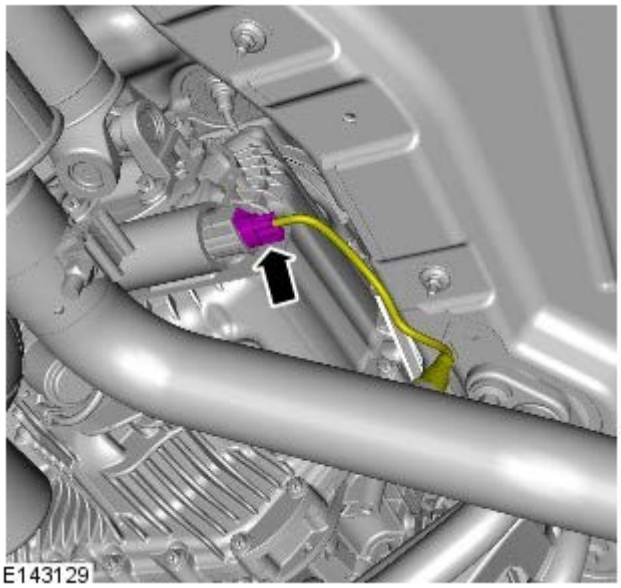
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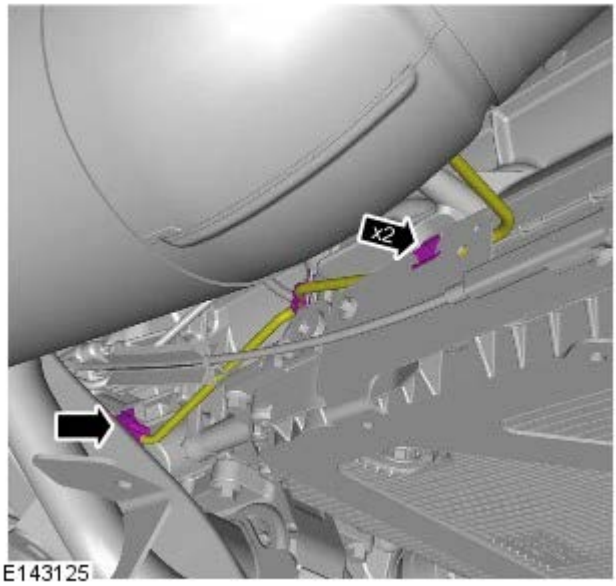
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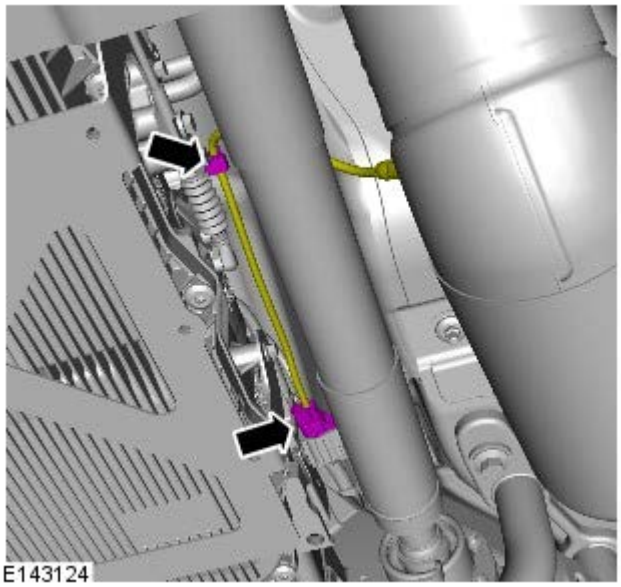
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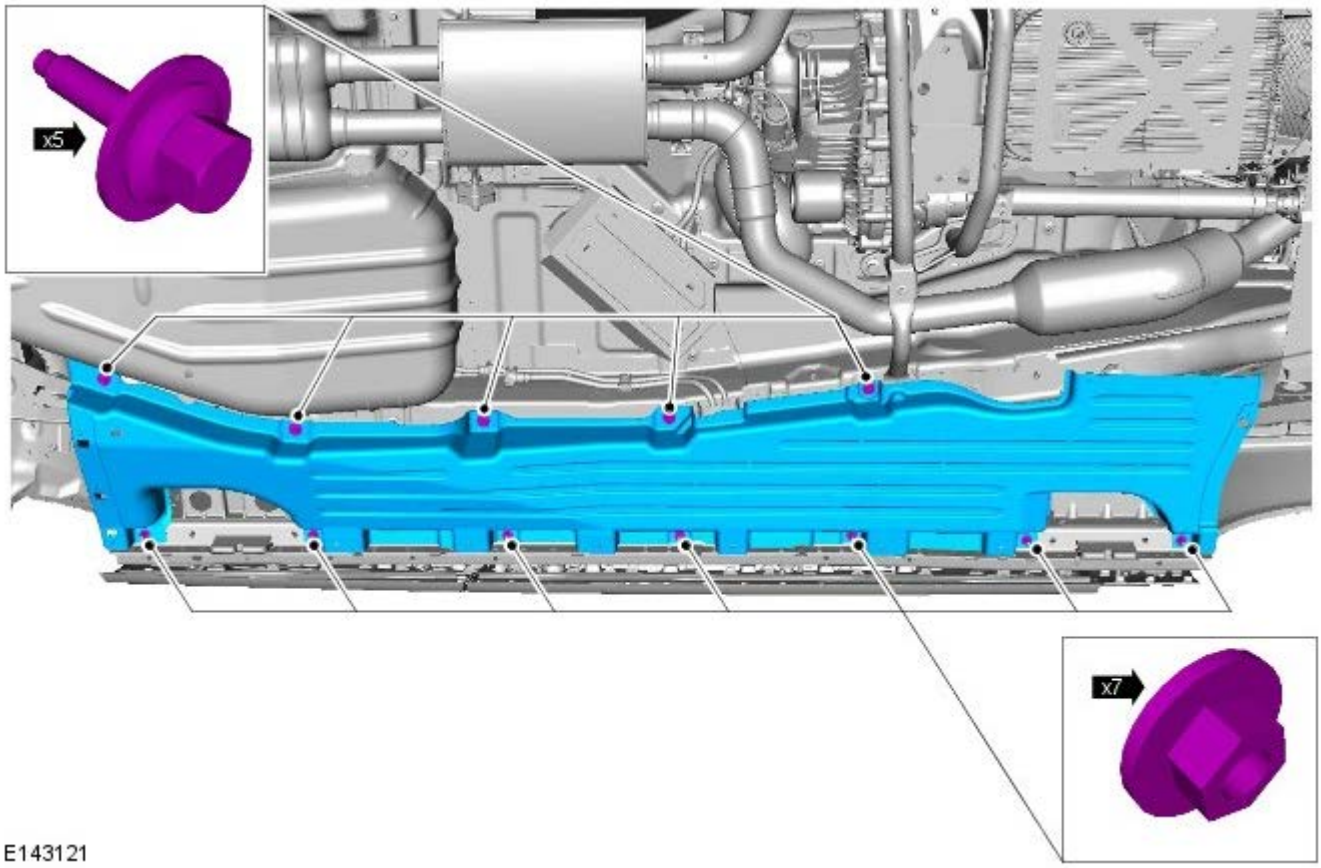
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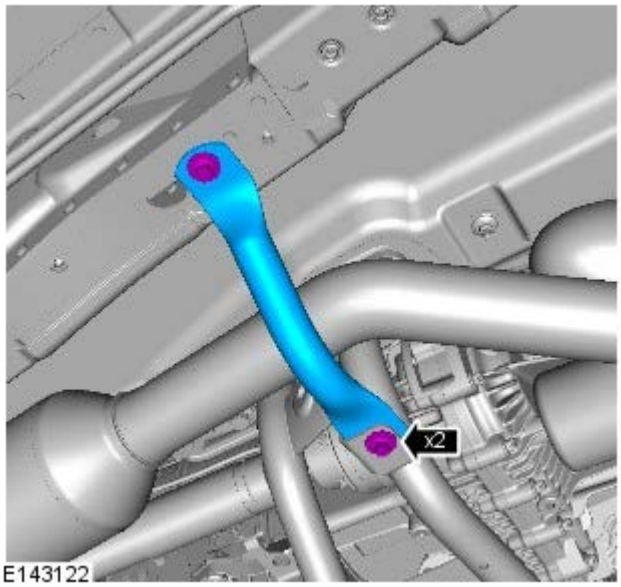
11.



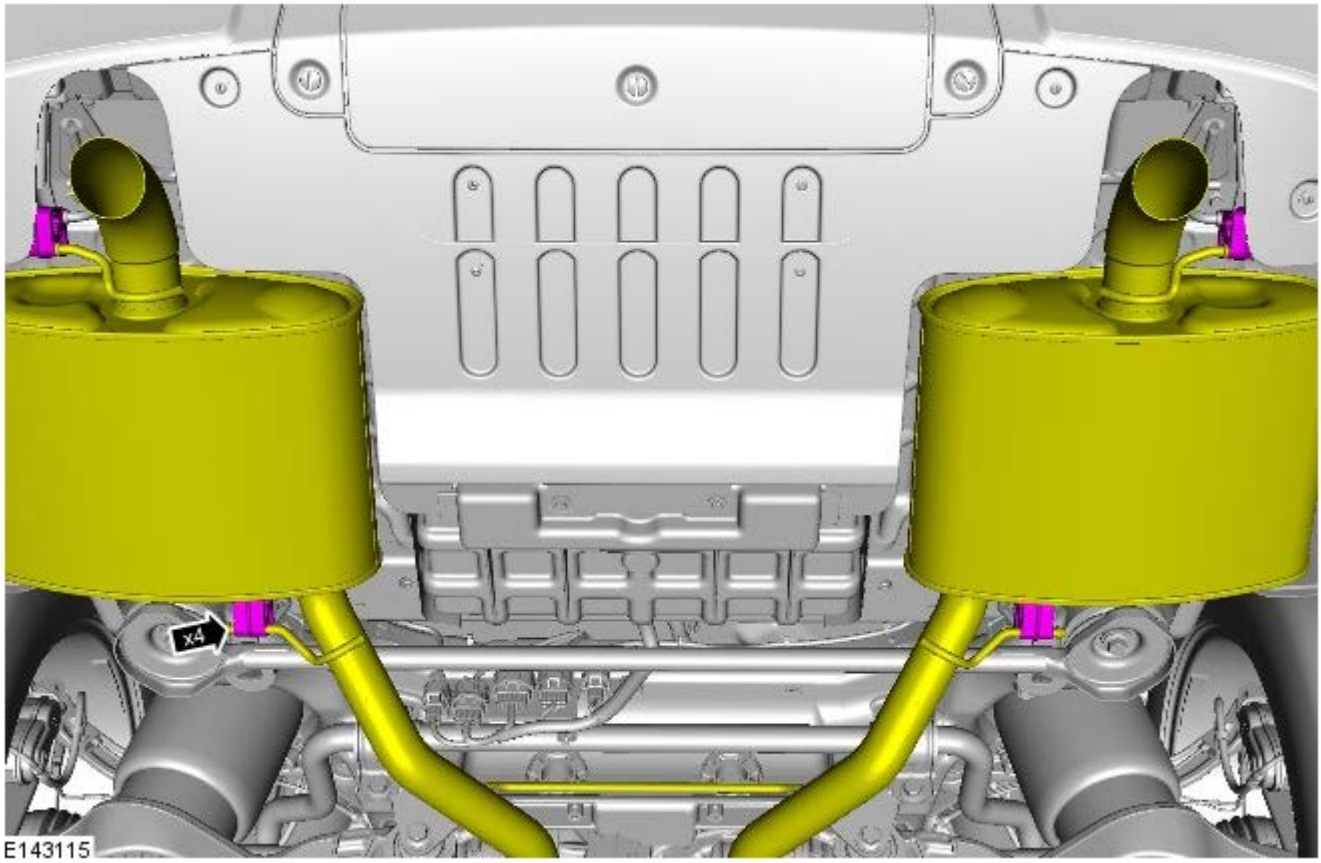
12.



13. *Torque:* 24 Nm



14. CAUTION: Make sure that the exhaust system is supported with suitable retaining straps.

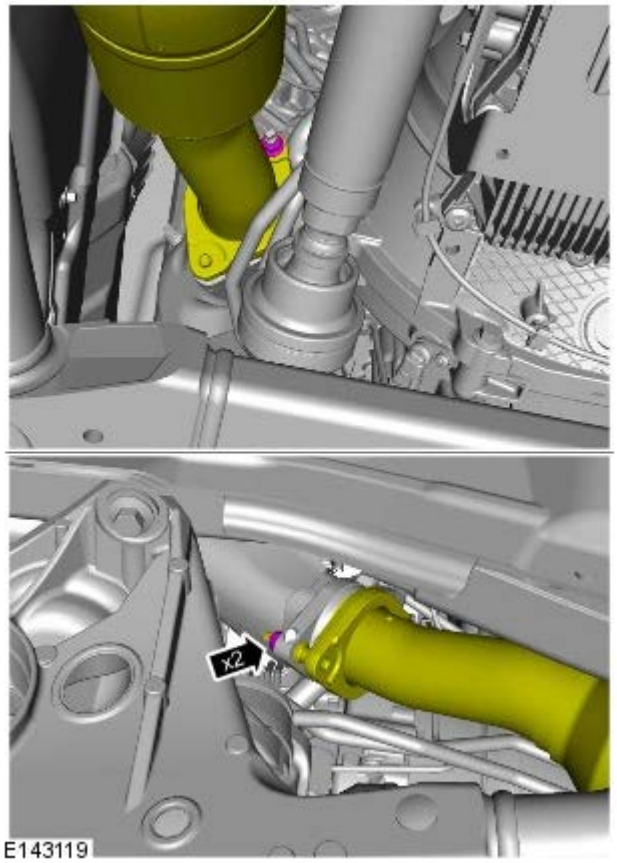


15. NOTES:

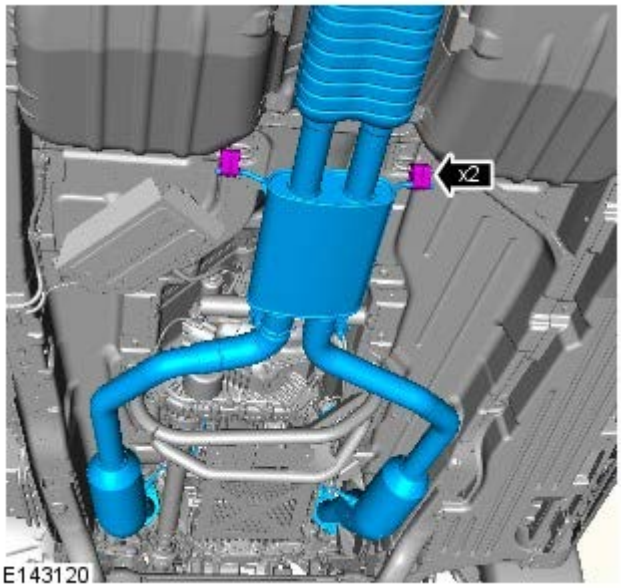
LH illustration shown, RH is similar.

The step must be carried out on both sides.

Torque: 40 Nm

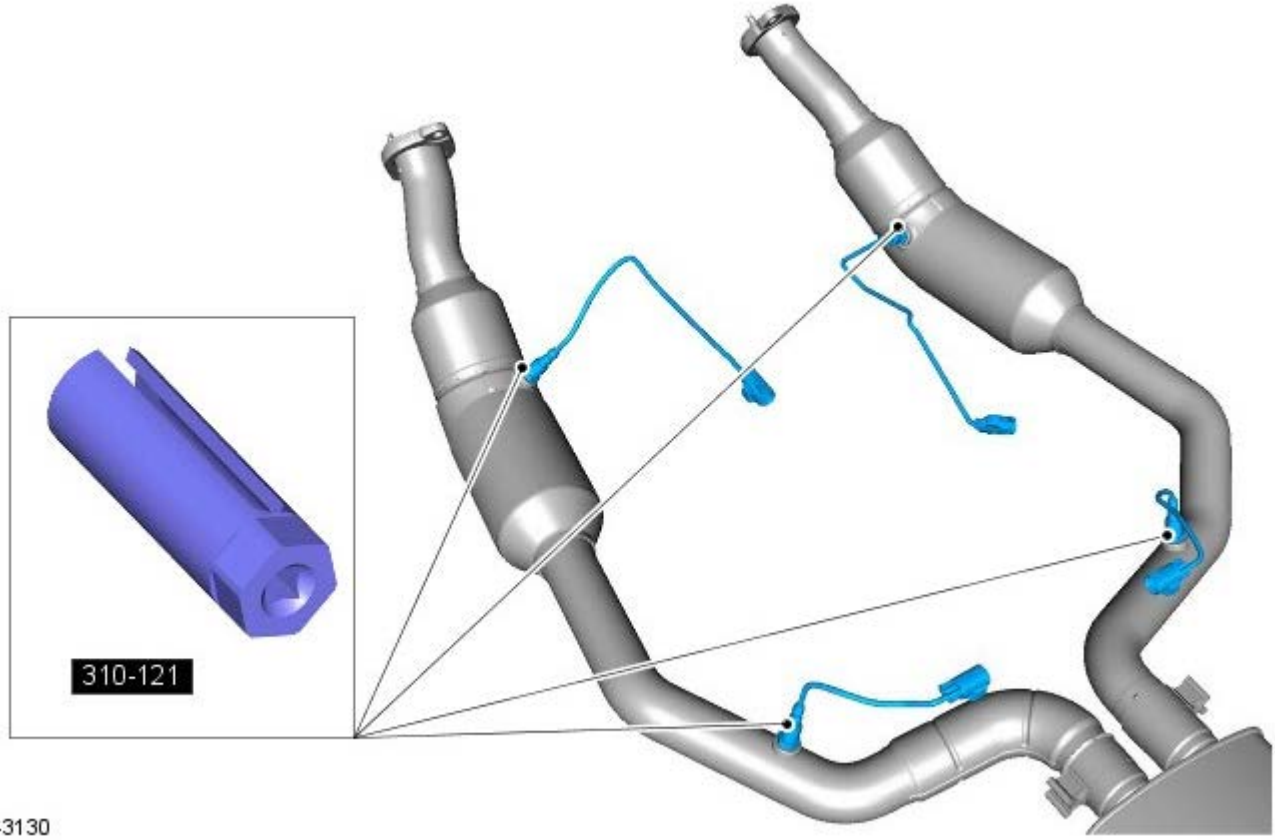


16.



17. NOTE: Do not disassemble further if the component is removed for access only.

Special Tool(s): 310-121
Torque: 48 Nm



E143130

Installation

1. To install, reverse the removal procedure.

Published: 31-Jul-2012

Exhaust System - V8 S/C 5.0L Petrol - Front Muffler

Removal and Installation

Special Tool(s)

 E130266	100-051 Cutter, Exhaust Pipe

Removal

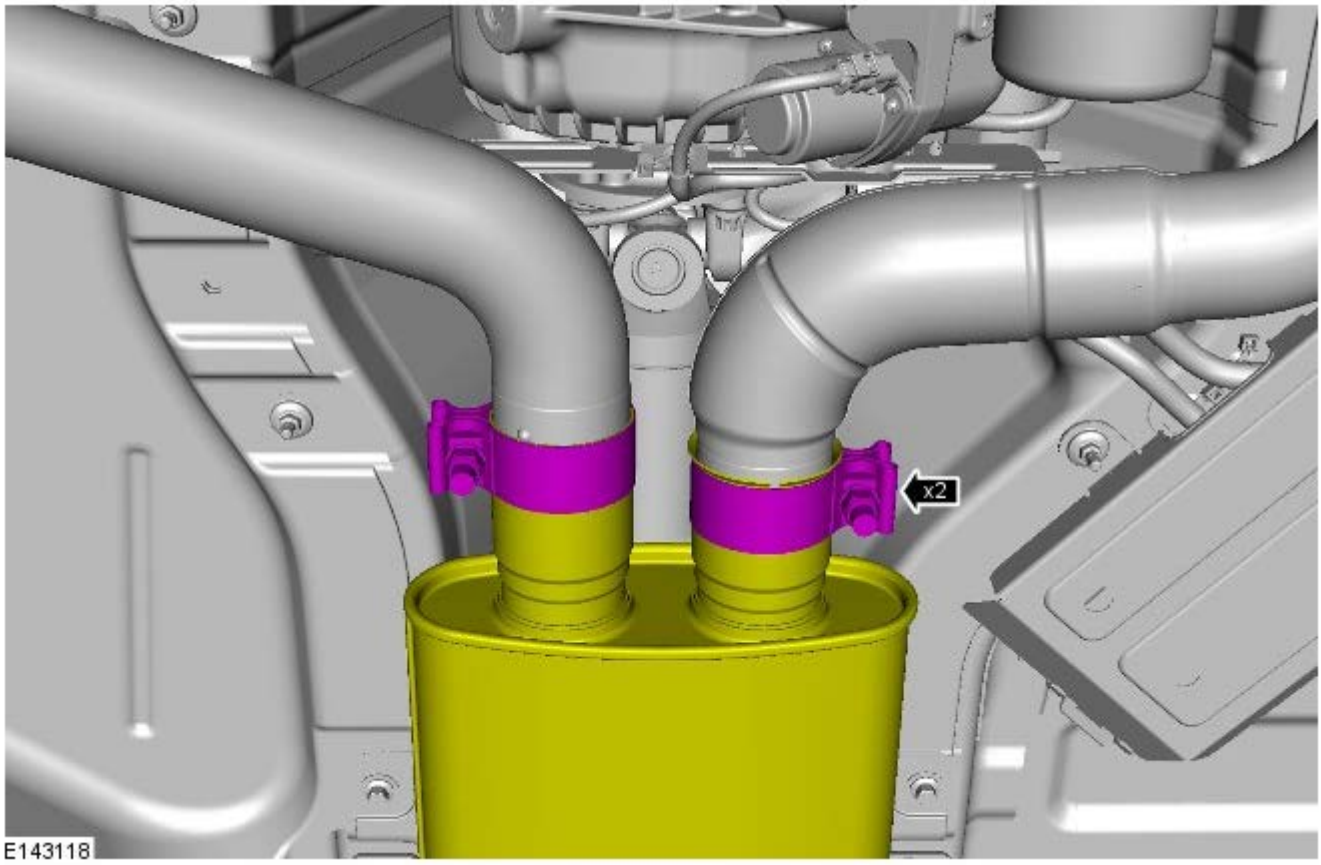
WARNING: Observe due care when working near a hot exhaust system.

NOTE: Removal steps in this procedure may contain installation details.

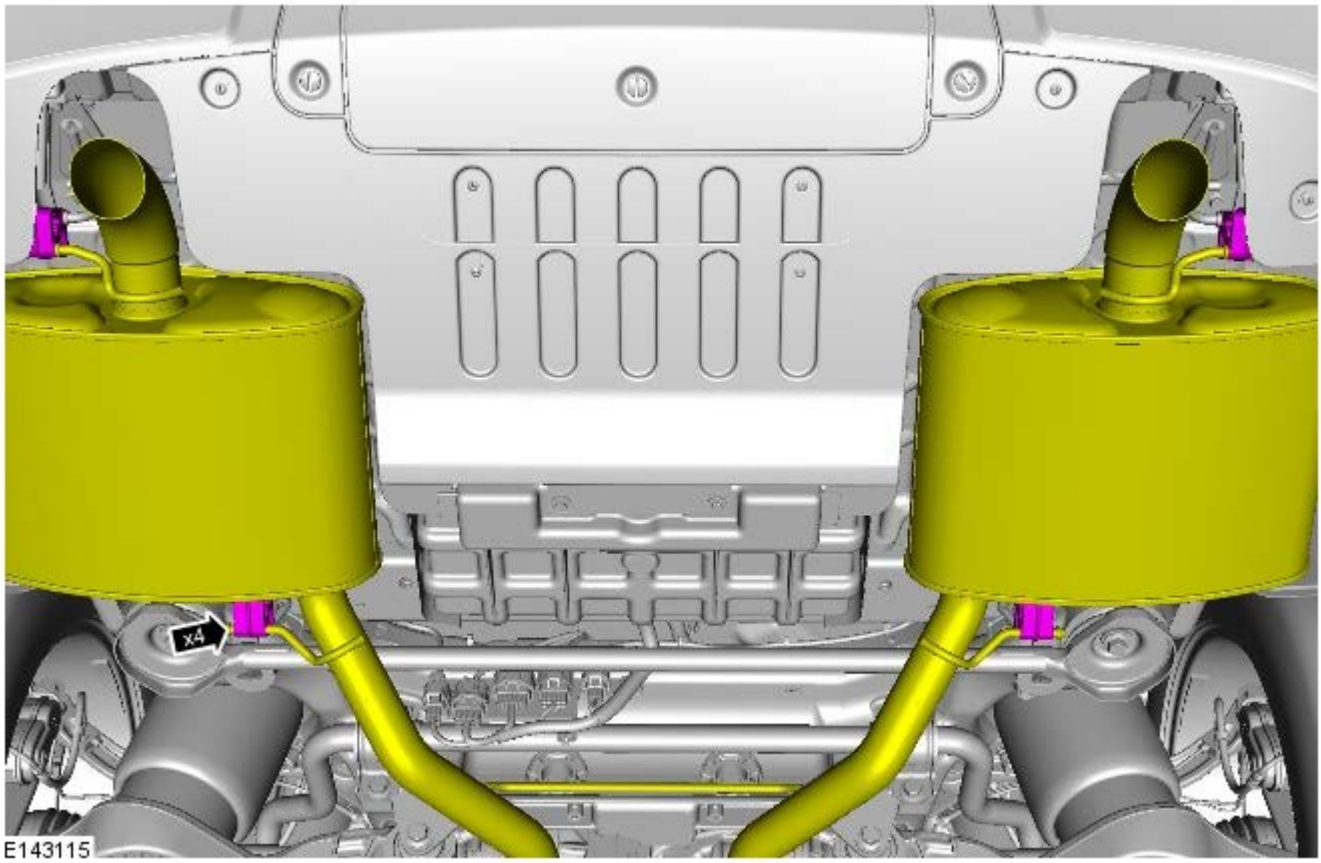
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

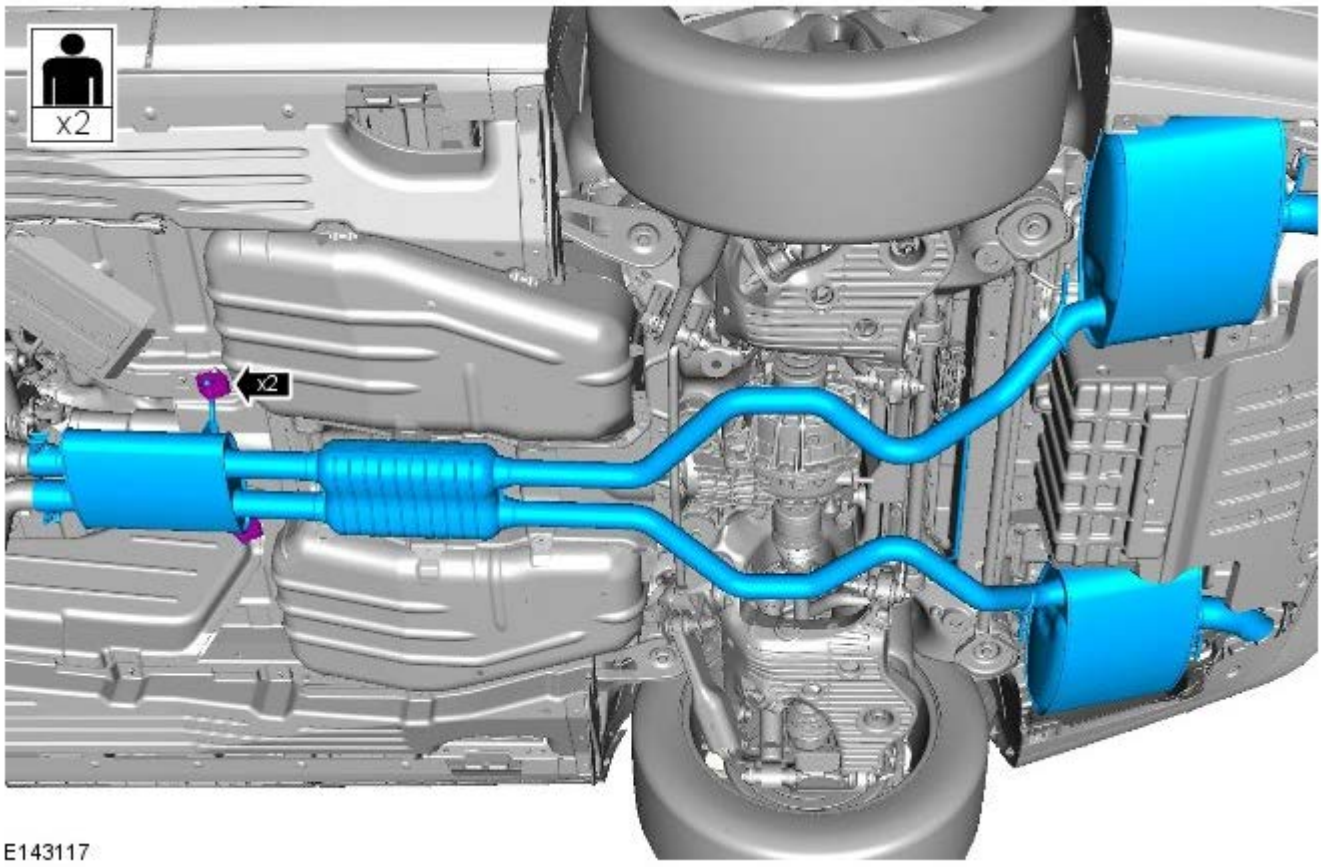
2. *Torque:* 55 Nm



3. CAUTION: Make sure that the exhaust system is supported with suitable retaining straps.

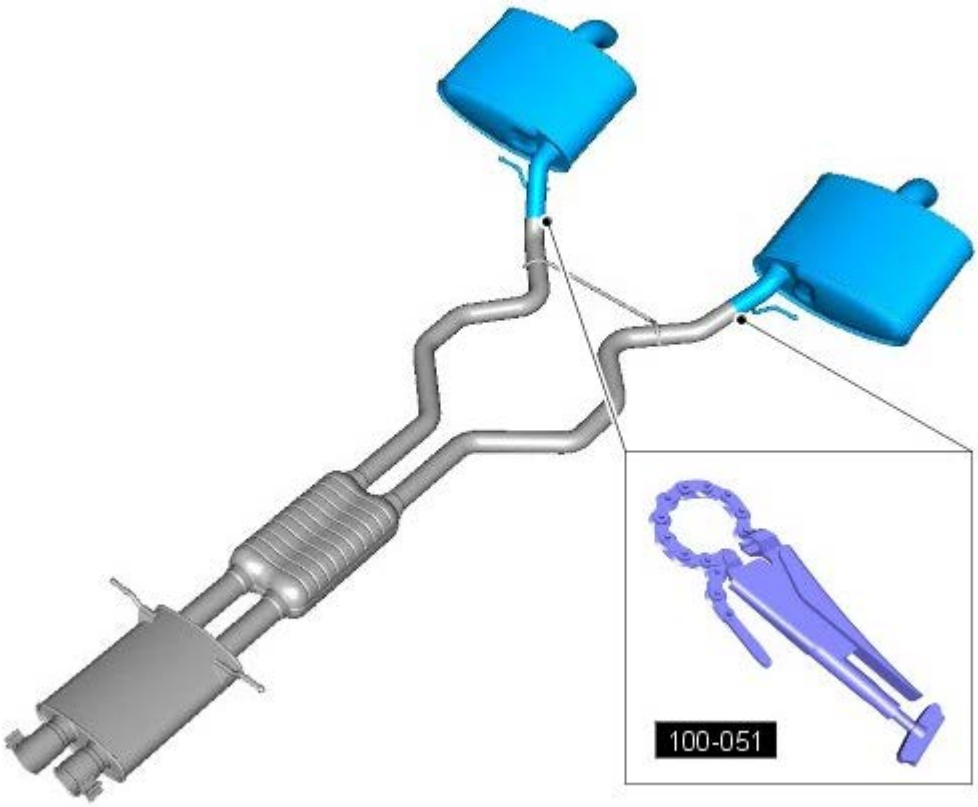


4.



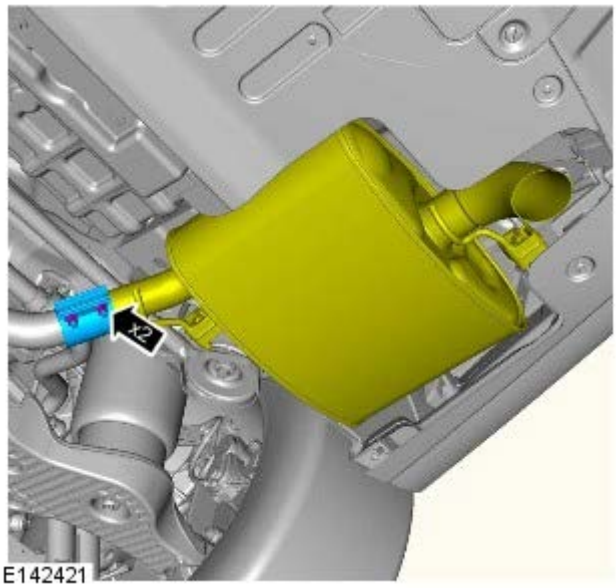
5. NOTE: Do not disassemble further if the component is removed for access only.

Special Tool(s): 100-051



E143116

Installation



E142421

1. WARNING: Make sure that any corrosion or dirt is removed from the mating surfaces.

   NOTE: The step must be carried out on both sides.

   To install, reverse the removal procedure.

   Torque: 55 Nm

Published: 31-Jul-2012

Exhaust System - V8 S/C 5.0L Petrol - Rear Muffler

Removal and Installation

Special Tool(s)

 E130266	100-051 Cutter, Exhaust Pipe

Removal

WARNING: Observe due care when working near a hot exhaust system.

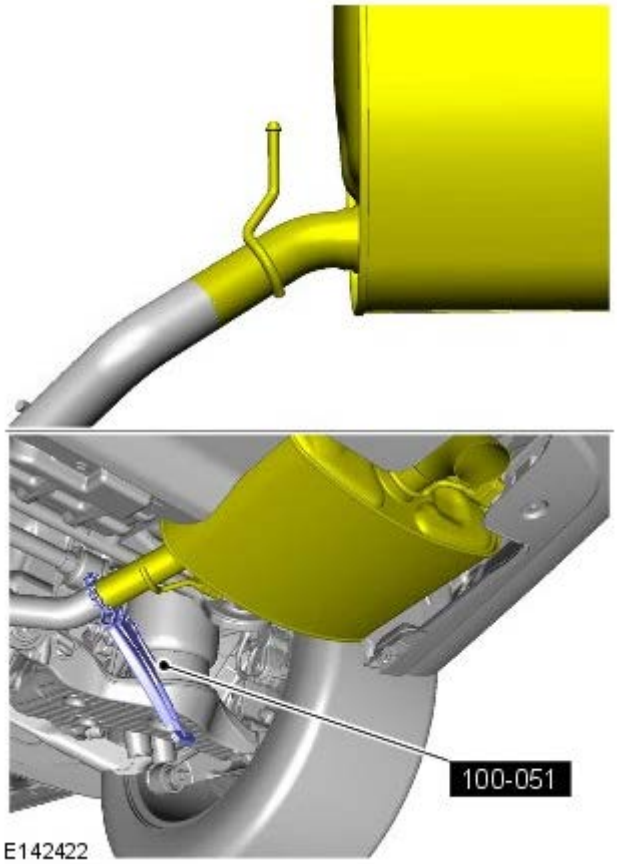
NOTES:

Removal steps in this procedure may contain installation details.

RH illustration shown, LH is similar.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

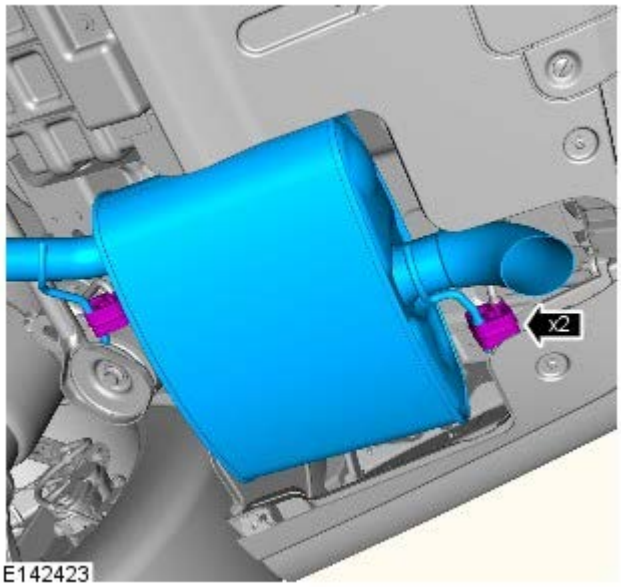


2. CAUTION: Make sure that the exhaust system is supported with suitable retaining straps.

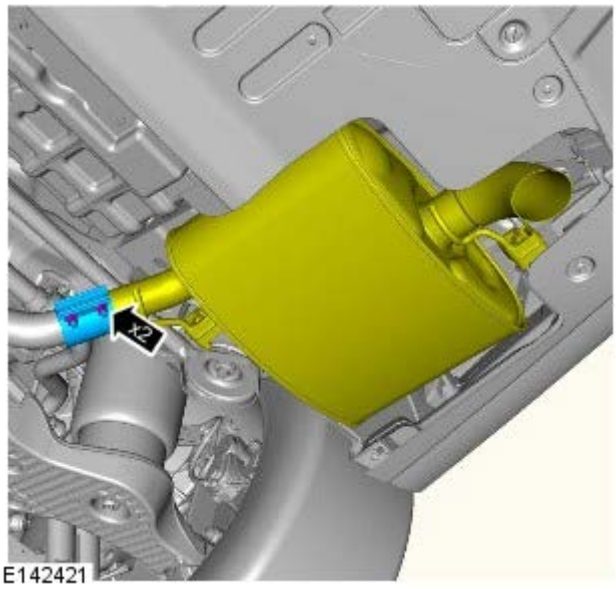
   NOTE: Using the special tool, cut the exhaust pipe at the marked position.

   Special Tool(s): 100-051

3. NOTE: With assistance remove the component.



Installation



1. WARNING: Make sure that any corrosion or dirt is removed from the mating surfaces.

   To install, reverse the removal procedure.

   Torque: 55 Nm

Published: 07-Aug-2012

Exhaust System - TDV8 4.4L Diesel -

Torque Specifications

Description	Nm	lb-ft
Rear muffler to diesel particulate filter (DPF) clamp nuts	55	41
Downpipe LH nuts	47	35
Downpipe RH to catalytic converter clamp nut	47	35
Catalytic converter to diesel particulate filter retaining nuts	30	22
DPF pressure sensor pipe unions	25	18
Exhaust gas temperature sensors**	35	22

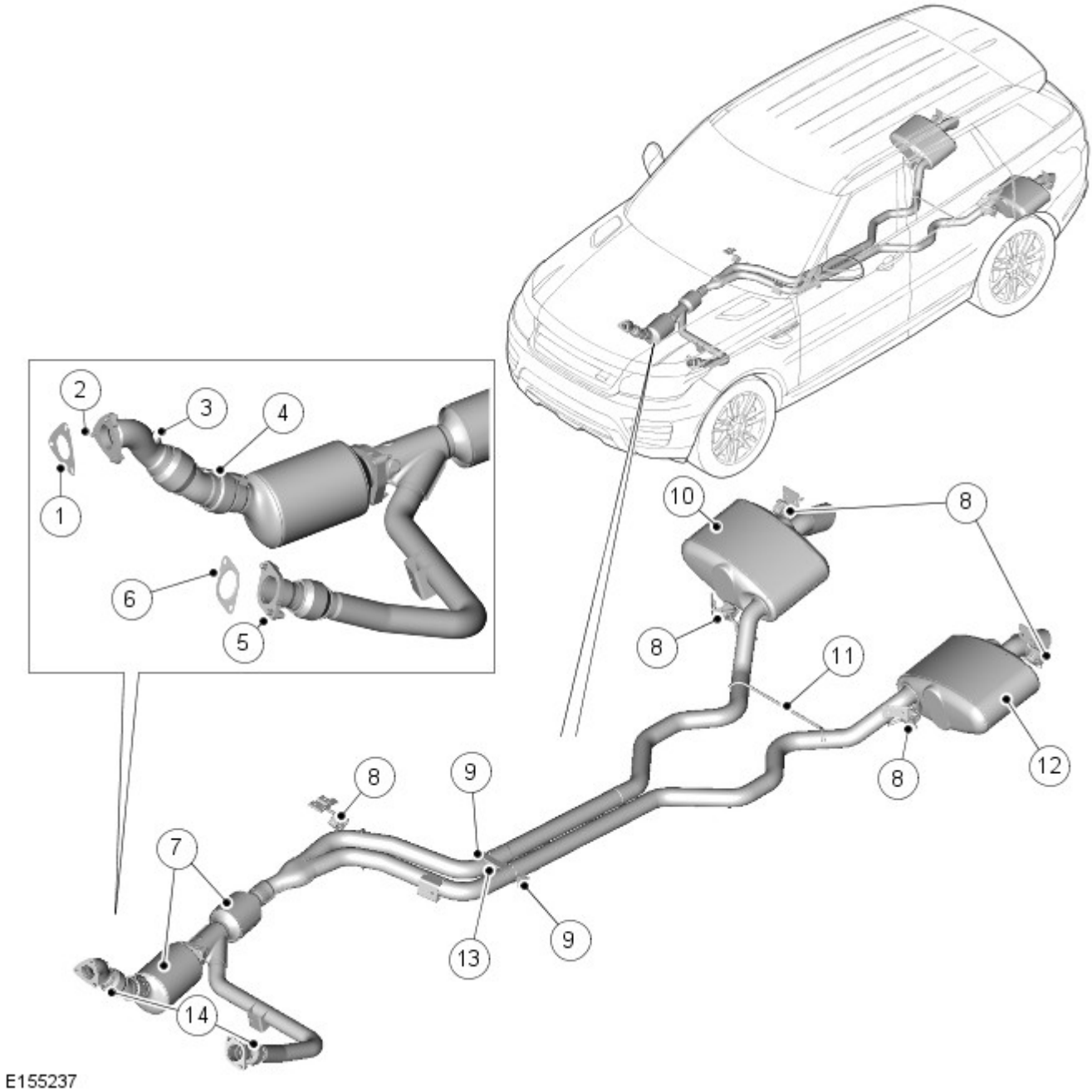
**** Apply suitable high temperature resistant anti-seize compound**

Published: 02-Dec-2013

Exhaust System - TDV8 4.4L Diesel - Exhaust System

Description and Operation

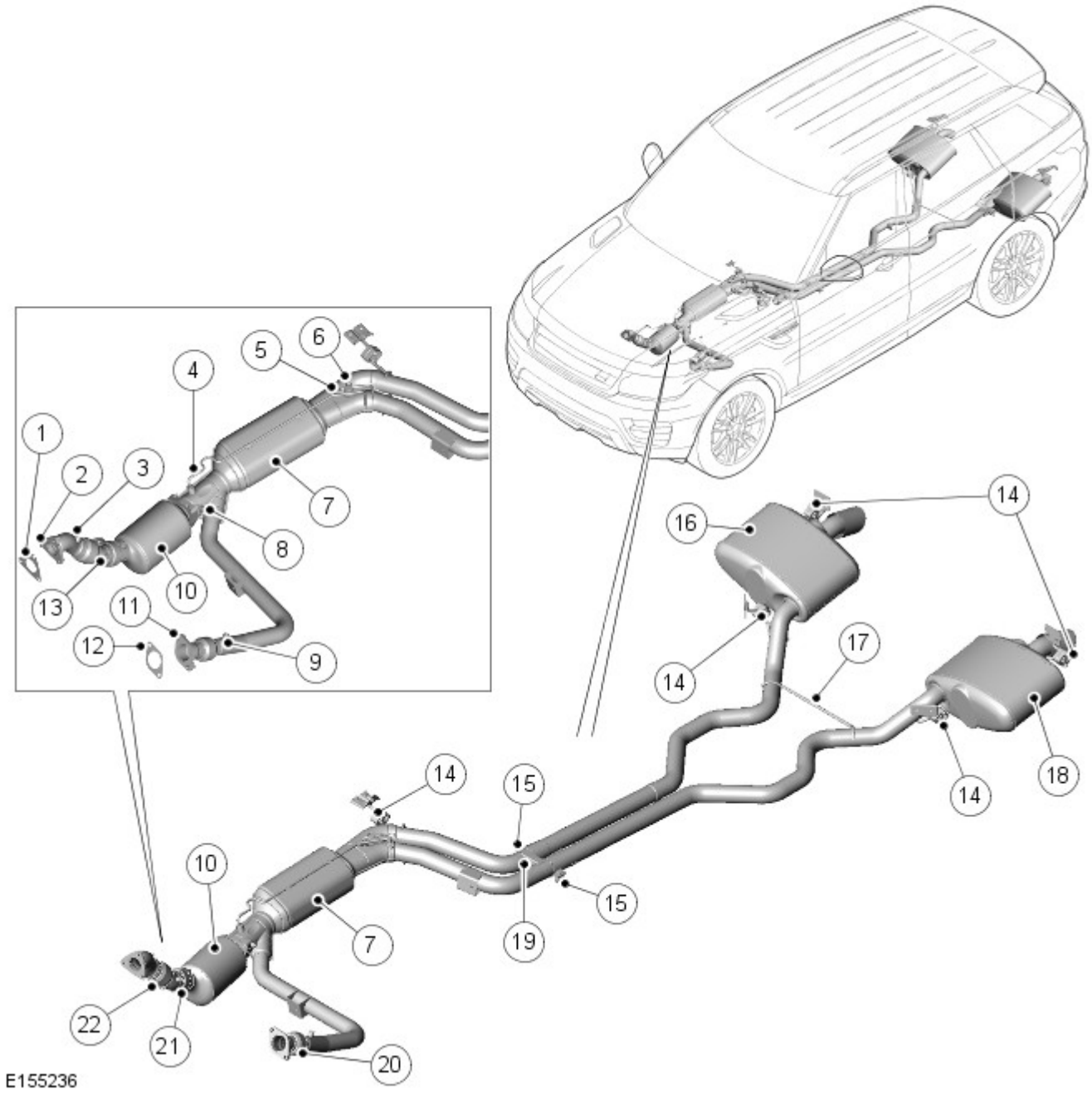
COMPONENT LOCATION - EXHAUST SYSTEM TDV8 4.4L DIESEL - VEHICLES WITHOUT DIESEL PARTICULATE FILTER.



E155237

Item	Part Number	Description
1	-	Gasket to primary turbocharger outlet connection
2	-	Bolt (3 off)
3	-	Heated Oxygen Sensor (HO2S) Mounting Boss
4	-	Clamp
5	-	Bolt (2 off)
6	-	Gasket to secondary turbocharger outlet connection
7	-	Catalytic Converter
8	-	Mounting rubber (5 off)
9	-	Clamp (2 off)
10	-	Right silencer
11	-	Exhaust brace rear
12	-	Left silencer
13	-	Exhaust brace front
14	-	Flexible Coupling

COMPONENT LOCATION - EXHAUST SYSTEM TDV8 4.4L DIESEL - VEHICLES WITH DIESEL PARTICULATE FILTER.



Item	Part Number	Description
1	-	Gasket to primary turbocharger outlet connection
2	-	Bolt (3 off)
3	-	Heated Oxygen Sensor (HO2S) Mounting Boss
4	-	High pressure pipe to Differential Pressure sensor
5	-	Low pressure pipe to Differential Pressure sensor
6	-	Post-Diesel Particulate Filter (DPF) Temperature Sensor mounting boss
7	-	Diesel Particulate Filter (DPF)
8	-	Pre-DPF Temperature Sensor mounting boss
9	-	Secondary Turbocharger temperature sensor mounting boss
10	-	Catalytic Converter
11	-	Bolt (2 off)
12	-	Gasket to secondary turbocharger outlet connection
13	-	Pre-Catalyst Temperature Sensor mounting boss (adjacent to the HO2S)
14	-	Mounting rubber (5 off)
15	-	Clamp (2 off)
16	-	Right silencer
17	-	Rear exhaust brace

18	-	Left silencer
19	-	Front exhaust brace
20	-	Left flexible coupling
21	-	Clamp
22	-	Right flexible coupling

OVERVIEW

There are two variants of the TDV8 4.4L diesel exhaust system:

- Non DPF (Diesel Particulate Filter) system – EU4 Emission regulations.
- DPF System – EU5 Emission regulations.

On vehicles with a DPF fitted, a single catalytic converter is located in the bank 1 exhaust downpipe from the manifold. On vehicles without a DPF, a second catalytic converter is fitted in place of the DPF.

The system is attached to the underside of the body with 5 mounting rubbers which are located on hanger brackets that are welded to the system. The mounting rubbers locate on hanger brackets which are bolted to the underside of the vehicle body.

CAUTIONS:

 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 rear silencer 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 rear silencers submerged, the water, which can enter the system, can also contaminate both the DPF and the catalytic converter. This can result in catalytic converter damage and damaging the ability for the DPF to regenerate therefore requiring both components to be replaced.

COMPONENT DESCRIPTION

FRONT SECTION

The front section comprises of two catalytic converters or if a DPF is fitted a catalytic converter and the DPF. The bank 1 exhaust inlet pipe connects to the catalytic converter and the bank 2 exhaust inlet pipe connects in between the two catalytic converters or the catalytic converter and DPF (if fitted).

Each inlet pipe is fitted with a flange that connects to the turbocharger for each cylinder bank. The bank 1 inlet flange uses a 3 bolt fixing and the bank 2 inlet flange uses a 2 bolt fixing that are screwed into threaded holes in each of the turbochargers. Each flange is sealed using a gasket and both inlet pipes are fitted with flexible couplings.

The catalytic converter is joined to either a second catalytic converter or a diesel particulate filter using a 3 bolt fixing. The front section of the exhaust also has 2 mass dampers which absorbs resonance from the system.

Vehicles without DPF: The catalytic converter outlet pipe is connected to a 'Y' joint which splits the outlet pipe into 2 separate pipes which connect to the rear silencer.

Vehicles with DPF: The diesel particulate filter outlet pipe is connected to a 'Y' joint which splits outlet pipe into 2 separate pipes which connect to the rear silencer.

REAR SECTION

The rear section comprises of two pipes from the catalytic converter or diesel particulate filter that go into each of the rear silencers. They are joined at the centre point of the exhaust using a torca clamp.

The two rear silencers are attached to the body using two exhaust hanging brackets on both sides of the silencers.

There are 2 brace's that are welded between the pipes, to retain system in position and reduce exhaust flexing.

CATALYTIC CONVERTER

The oxidizing catalytic converter is located in the front section of bank 1 inlet pipe from the turbocharger, after the pre-catalyst exhaust temperature sensor (vehicles with DPF only) and the Heated Oxygen Sensor (HO2S).

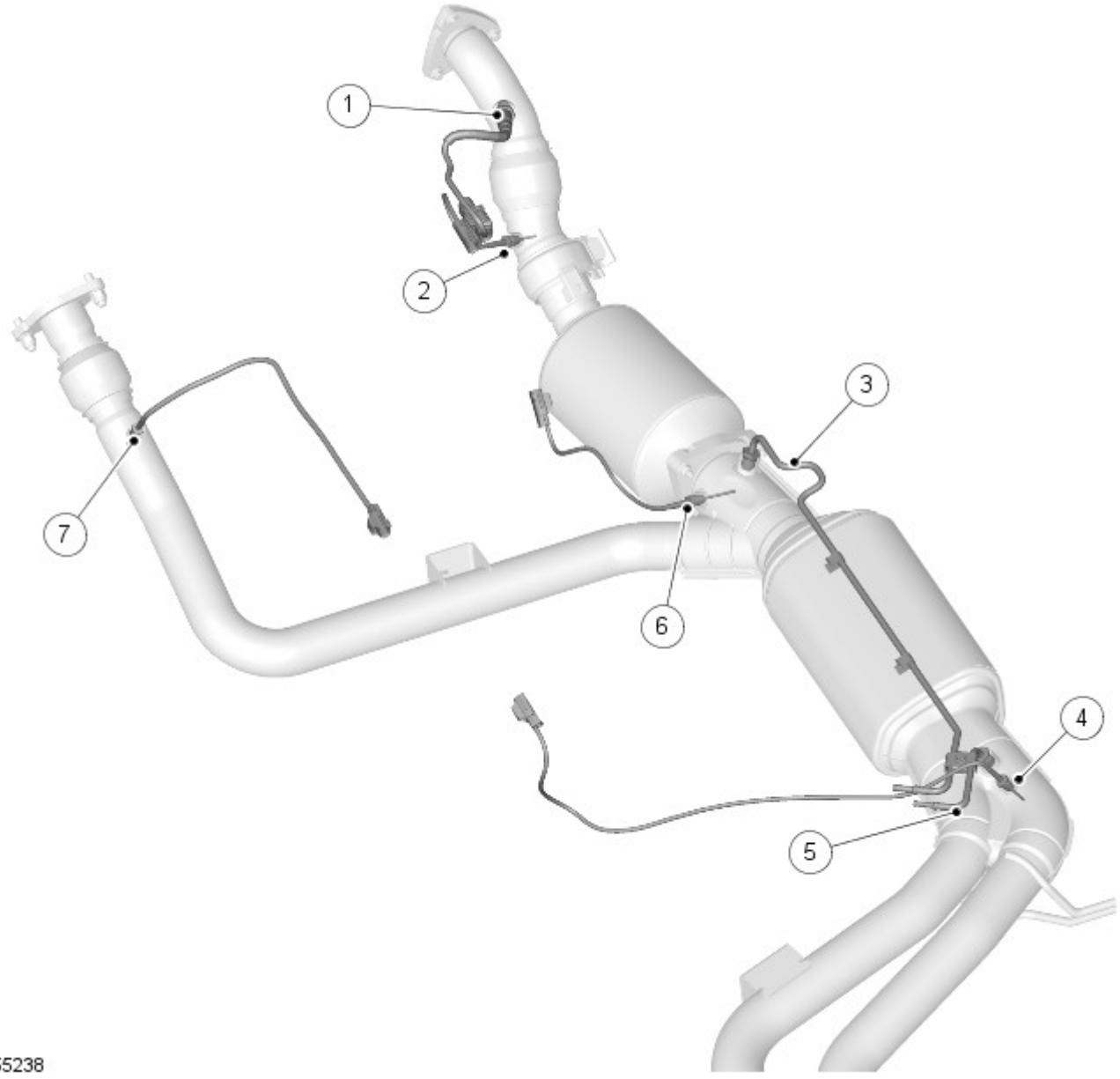
 NOTE: On vehicles fitted with DPF: The Pre and Post DPF Temperature Sensors are used by the engine management system to monitor the DPF regeneration purposes.

On vehicles without a DPF, a second catalytic converter is fitted in place of the DPF.

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. On vehicles without DPF, a second catalytic converter is fitted to further reduce the carbon monoxide and the hydrocarbons content of the gases. In the catalytic converter the exhaust gases are passed through honeycombed ceramic elements coated with a special surface treatment called 'wash coat'. The wash coat increases the surface area of the ceramic elements by a factor of approximately 7000. The washcoat is a coating containing platinum and palladium, which are 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 and convert them into carbon dioxide and water respectively.

DIESEL PARTICULATE FILTER



E155238

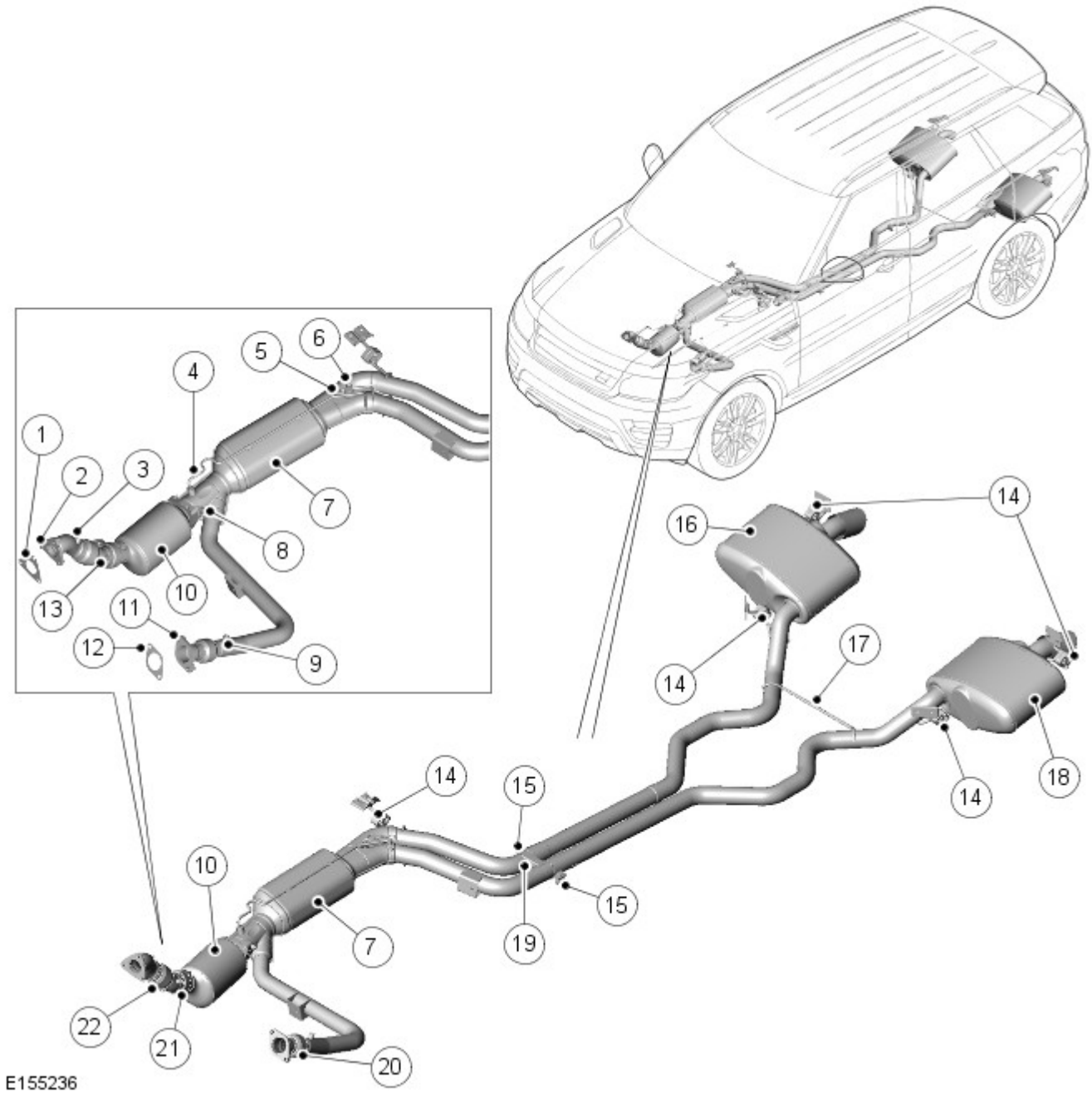
Item	Part Number	Description
1	-	Heated Oxygen Sensor (HO2S)
2	-	Pre-Catalyst Temperature sensor
3	-	High pressure pipe to Differential Pressure Sensor
4	-	Post-DPF Temperature sensor
5	-	Low pressure pipe to Differential Pressure Sensor
6	-	Pre-DPF Temperature sensor
7	-	Post secondary turbocharger temperature sensor

For additional information, refer to: Diesel Particulate Filter (309-00D Exhaust System - TDV8 4.4L Diesel, Description and Operation) / Diesel Particulate Filter (309-00D Exhaust System - TDV8 4.4L Diesel, Description and Operation) / Electronic Engine Controls (303-14D Electronic Engine Controls - TDV8 4.4L Diesel, Description and Operation).

Published: 02-Dec-2013

Exhaust System - TDV8 4.4L Diesel - Diesel Particulate Filter - Component Location

Description and Operation

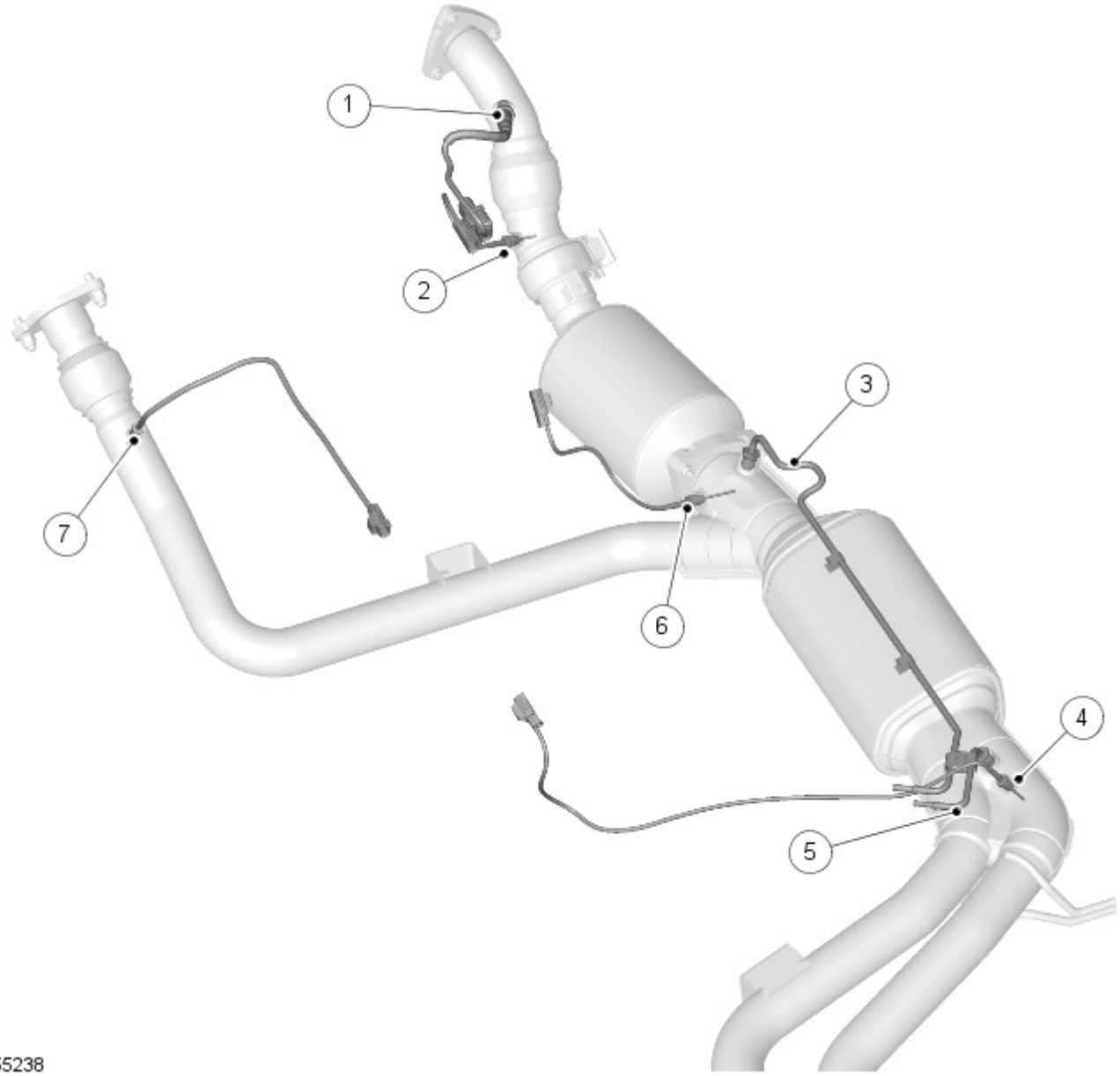


Item Description

1 Gasket to primary turbocharger outlet connection
2 Bolt (3 off)
3 Heated Oxygen Sensor (HO2S) Mounting Boss
4 High pressure pipe to Differential Pressure sensor
5 Low pressure pipe to Differential Pressure sensor
6 Post-Diesel Particulate Filter (DPF) Temperature Sensor mounting boss
7 Diesel Particulate Filter (DPF)
8 Pre-DPF Temperature Sensor mounting boss
9 Secondary Turbocharger temperature sensor mounting boss
10 Catalytic Converter
11 Bolt (2 off)
12 Gasket to secondary turbocharger outlet connection
13 Pre-Catalyst Temperature Sensor mounting boss (adjacent to the HO2S)
14 Mounting rubber (5 off)
15 Clamp (2 off)

16 Right silencer
17 Rear exhaust brace
18 Left silencer
19 Front exhaust brace
20 Left flexible coupling
21 Clamp
22 Right flexible coupling

DIESEL PARTICULATE FILTER

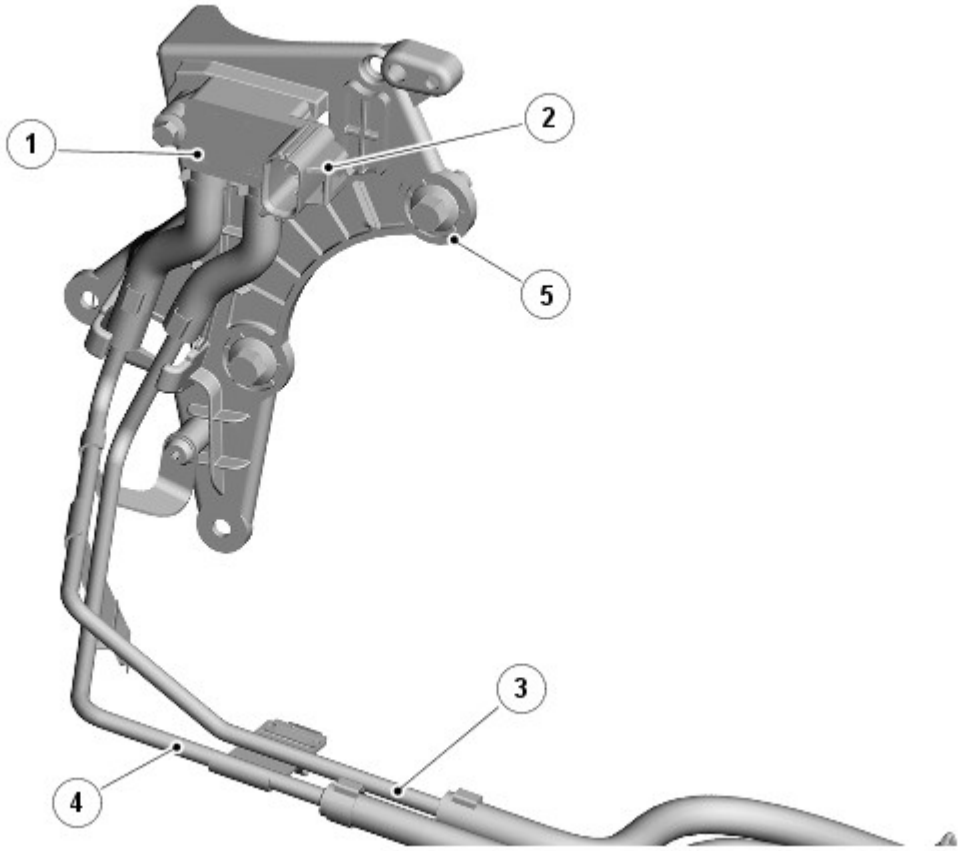


E155238

Item Description

1 Heated Oxygen Sensor (HO2S)
2 Pre-Catalyst Temperature sensor
3 High pressure pipe to Differential Pressure Sensor
4 Post-DPF Temperature sensor
5 Low pressure pipe to Differential Pressure Sensor
6 Pre-DPF Temperature sensor
7 Post secondary turbocharger temperature sensor

DIFFERENTIAL PRESSURE SENSOR



Item Description

1 Differential Pressure sensor
2 Electrical Connector
3 Low Pressure Hose
4 High Pressure hose
5 Bracket

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Exhaust System - TDV8 4.4L 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: 05-Sep-2012

Exhaust System - TDV8 4.4L Diesel - Diesel Particulate Filter

Diagnosis and Testing

Principles of Operation

For a detailed description of the exhaust system, refer to the relevant description and operation section of the workshop manual. REFER to: (309-00D Exhaust System - TDV8 4.4L Diesel)

Exhaust System (Description and Operation),
Diesel Particulate Filter (Description and Operation),
Diesel Particulate Filter (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
• 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

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.

Symptom chart

Symptom	Possible Causes	Action
Amber warning message on instrument cluster - DPF FULL REFER TO HANDBOOK -	• Diesel particulate filter has more than 24.5g of soot & a poor drive cycle	• If AMBER DPF FULL REFER TO HANDBOOK message is displayed or customer advises of amber, with no other reported messages the customer needs to be advised that the message is advisory only and that their current drive cycle does not allow the system to clean the particulate filter. 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. The message is illuminated when the diesel particulate filter has more than 24.5g of soot & a poor drive cycle, but the vehicles current drive cycle is predominately urban, or engine temperature does not reach 50degC this inhibits diesel particulate filter regeneration • Diesel particulate filter regeneration procedure is described at the bottom of this section

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00

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	NOTE: - Circuit LPPH_A - • The engine control module has detected a ground measurement for a period longer than expected or has detected a ground measurement when another value was expected • Harness failure - Heated oxygen sensor heater control circuit short circuit to ground • Heated oxygen sensor failure	• 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 heated oxygen sensor heater control (heater ground) circuit for short circuit to ground. Repair harness as required. Clear DTC and retest • Check and install new heated oxygen sensor as required
P0030-12	HO2S Heater Control Circuit (Bank 1, Sensor 1) - Circuit short to battery	NOTE: - Circuit LPPH_A - • The engine control module has detected a vehicle power measurement for a period longer than expected or has detected a vehicle power measurement when another value was expected • Harness failure - Heated oxygen sensor heater control circuit short circuit to power • Heated oxygen sensor failure	• 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 heated oxygen sensor heater control (heater ground) circuit for short circuit to power. Repair harness as required. Clear DTC and retest • Check and install new heated oxygen sensor as required
P0030-13	HO2S Heater Control Circuit (Bank 1, Sensor 1) - Circuit open	NOTE: - Circuit LPPH_A - • The engine control module has determined an open circuit via lack of bias voltage, low current flow, no change in the state of	• 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 heated oxygen sensor heater control (heater ground) circuit for open circuit. Repair harness as required. Clear DTC and retest • Check and install new heated oxygen sensor as required

		an input in response to an output • Harness failure - Heated oxygen sensor heater control circuit open circuit • Heated oxygen sensor failure	
P0030-4B	HO2S Heater Control Circuit (Bank 1, Sensor 1) - Over temperature	• The engine control module detected an internal temperature above the expected range • Harness failure - Heated oxygen sensor heater control circuit short circuit to power • Heated oxygen sensor failure	• 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 heated oxygen sensor heater control (heater ground) circuit for short circuit to power. Repair harness as required. Clear DTC and retest • Check and install new heated oxygen sensor as required
P0130-11	O2 Sensor Circuit (Bank 1 Sensor 1) - Circuit short to ground	NOTE: - Circuit LPV_A - • The engine control module has detected a ground measurement for a period longer than expected or has detected a ground measurement when another value was expected • Harness failure - Heated oxygen sensor circuit short circuit to ground • Heated oxygen sensor component failure	• Refer to the electrical circuit diagrams and check the heated oxygen sensor circuits for short circuit to ground. Repair harness as required. Clear DTC and retest • Check and install new heated oxygen sensor as required
P0130-12	O2 Sensor Circuit (Bank 1 Sensor 1) - Circuit short to battery	NOTE: - Circuit LPV_A - • The engine control module has detected a vehicle power measurement for a period longer than expected or	• Refer to the electrical circuit diagrams and check the heated oxygen sensor circuits for short circuit to power. Repair harness as required. Clear DTC and retest • Check and install new heated oxygen sensor as required

		has detected a vehicle power measurement when another value was expected • Harness failure - Heated oxygen sensor circuit short circuit to power • Heated oxygen sensor component failure	
P0130-13	O2 Sensor Circuit (Bank 1 Sensor 1) - Circuit open	 NOTE: - Circuit LPPC_A - LPV_A - • The engine control module has determined an open circuit via lack of bias voltage, low current flow, no change in the state of an input in response to an output • Harness failure - Heated oxygen sensor circuit open circuit • Heated oxygen sensor component failure	• Refer to the electrical circuit diagrams and check the heated oxygen sensor circuits for open circuit. Repair harness as required. Clear DTC and retest • Check and install new heated oxygen sensor as required
P0130-26	O2 Sensor Circuit (Bank 1 Sensor 1) - Signal rate of change below threshold	• The signal transitions more slowly than is reasonably allowed • Exhaust system leak • Fuel control system failure • Heated oxygen sensor to engine control module circuit short circuit to ground, short circuit to power, high resistance • Heated oxygen sensor failure	• Check for and rectify any exhaust leak between cylinder head and catalytic converter. Check heated 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 heated oxygen sensor to engine control module circuit for short circuit to ground, short circuit to power, high resistance, open circuit. Repair harness as required. Clear DTC and retest • Check and install new heated oxygen sensor as required
P0133-00	O2 Sensor Circuit Slow Response (Bank 1 Sensor 1) - No sub type information	• Exhaust system leak • Fuel control system failure • Heated	• Check for and rectify any exhaust leak between cylinder head and catalytic converter. Check heated oxygen sensor is correctly installed in exhaust manifold • Check fuel control system for related DTCs and refer to the relevant DTC index

		oxygen sensor to engine control module wiring shield high resistance • Heated oxygen sensor failure	Refer to the electrical circuit diagrams and check heated oxygen sensor to engine control module wiring shield for high resistance. Repair harness as required. Clear DTC and retest • Check and install new heated oxygen sensor as required
P0426-00	Catalyst Temperature Sensor Circuit Range/Performance (Bank 1, Sensor Circuit 1) - No sub type information	 NOTE: - Circuit CCCIT_A - • Exhaust gas temperature sensor pre catalytic converter circuit, short circuit to ground, open circuit, high resistance • Exhaust gas temperature sensor pre catalytic converter failure	• Refer to the electrical circuit diagrams and check exhaust gas temperature sensor pre catalytic converter circuit for short circuit to ground, open circuit, high resistance • Clear the DTC and retest • Check and install new exhaust gas temperature sensor pre catalytic converter as required
P0427-00	Catalyst Temperature Sensor Circuit Low (Bank 1, Sensor Circuit 1) - No sub type information	 NOTE: - Circuit CCCIT_A - • Exhaust gas temperature sensor pre catalytic converter circuit, short circuit to ground • Exhaust gas temperature sensor pre catalytic converter failure	• Refer to the electrical circuit diagrams and check exhaust gas temperature sensor pre catalytic converter circuit for short circuit to ground • Clear the DTC and retest • Check and install new exhaust gas temperature sensor pre catalytic converter as required
P0428-00	Catalyst Temperature Sensor Circuit High (Bank 1, Sensor Circuit 1) - No sub type information	 NOTE: - Circuit CCCIT_A - • Exhaust gas temperature sensor pre catalytic converter circuit, short circuit to power, open circuit, high resistance • Exhaust gas temperature sensor pre catalytic converter failure	• Refer to the electrical circuit diagrams and check exhaust gas temperature sensor pre catalytic converter circuit for short circuit to power, open circuit, high resistance • Clear the DTC and retest • Check and install new exhaust gas temperature sensor pre catalytic converter as required
P042B-00	Catalyst Temperature Sensor Circuit Range/Performance (Bank1, Sensor Circuit 2) - No sub type information	 NOTE: - Circuit CCCOT_A - • Exhaust gas temperature sensor post catalytic converter	• Refer to the electrical circuit diagrams and check exhaust gas temperature sensor post catalytic converter circuit for short circuit to ground, open circuit, high resistance • Check and install new exhaust gas temperature sensor post catalytic converter as required

		short circuit to ground, open circuit, high resistance • Exhaust gas temperature sensor post catalytic converter failure	
P042C-00	Catalyst Temperature Sensor Circuit Low (Bank 1, Sensor Circuit 2) - No sub type information	 NOTE: - Circuit CCCOT_A - • Exhaust gas temperature sensor post catalytic converter short circuit to ground, open circuit, high resistance • Exhaust gas temperature sensor post catalytic converter failure	• Refer to the electrical circuit diagrams and check exhaust gas temperature sensor post catalytic converter circuit for short circuit to ground, open circuit, high resistance • Check and install new exhaust gas temperature sensor post catalytic converter as required
P042D-00	Catalyst Temperature Sensor Circuit High (Bank 1, Sensor Circuit 2) - No sub type information	 NOTE: - Circuit CCCOT_A - • Exhaust gas temperature sensor post catalytic converter short circuit to power, open circuit, high resistance • Exhaust gas temperature sensor post catalytic converter failure	• Refer to the electrical circuit diagrams and check exhaust gas temperature sensor post catalytic converter circuit for short circuit to power, open circuit, high resistance • Check and install new exhaust gas temperature sensor post catalytic converter as required
P0435-00	Catalyst Temperature Sensor Circuit (Bank 2, Sensor Circuit 1) - No sub type information	 NOTE: - Circuit STOT - • Exhaust gas temperature sensor post turbocharger circuit, short circuit to power • Exhaust gas temperature sensor post turbocharger circuit, short circuit to ground • Exhaust gas temperature sensor post turbocharger circuit, open circuit • Exhaust gas temperature	• Refer to the electrical circuit diagrams and check exhaust gas temperature sensor post turbocharger circuit, for short circuit to power • Refer to the electrical circuit diagrams and check exhaust gas temperature sensor post turbocharger circuit, for short circuit to ground • Refer to the electrical circuit diagrams and check exhaust gas temperature sensor post turbocharger circuit, for open circuit • Refer to the electrical circuit diagrams and check exhaust gas temperature sensor post turbocharger circuit, for high resistance • Refer to the electrical circuit diagrams and check exhaust gas temperature sensor post turbocharger circuit, for disconnected • Check and install new exhaust gas temperature sensor post turbocharger as required

		sensor post turbocharger circuit, high resistance • Exhaust gas temperature sensor post turbocharger circuit, disconnected • Exhaust gas temperature sensor post turbocharger failure	
P0436-00	Catalyst Temperature Sensor Circuit Range/Performance (Bank 2, Sensor Circuit 1) - No sub type information	 NOTE: - Circuit STOT - • Exhaust gas temperature sensor post turbocharger circuit, short circuit to power, short circuit to ground, open circuit • Exhaust gas temperature sensor post turbocharger failure	• Refer to the electrical circuit diagrams and check exhaust gas temperature sensor post turbocharger circuit for short circuit to power, short circuit to ground, open circuit • Check and install new exhaust gas temperature sensor post turbocharger as required
P0436-16	Catalyst Temperature Sensor Circuit Range/Performance (Bank 2, Sensor Circuit 1) - Circuit voltage below threshold	 NOTE: - Circuit STOT - • The engine control module measured a voltage below a specified range but not necessarily a short circuit to ground • Exhaust gas temperature sensor post turbocharger circuit, short circuit ground • Exhaust gas temperature sensor post turbocharger failure	• Refer to the electrical circuit diagrams and check exhaust gas temperature sensor post turbocharger circuit for short circuit to ground • Check and install new exhaust gas temperature sensor post turbocharger as required
P0437-00	Catalyst Temperature Sensor Circuit Low (Bank 2, Sensor Circuit 1) - No sub type information	 NOTE: - Circuit STOT - • Exhaust gas temperature sensor post turbocharger circuit, short circuit to ground • Exhaust gas temperature sensor post turbocharger failure	• Refer to the electrical circuit diagrams and check exhaust gas temperature sensor post turbocharger circuit for short circuit to ground • Check and install new exhaust gas temperature sensor post turbocharger required
P0438-	Catalyst		• Refer to the electrical circuit diagrams and check exhaust gas

00	Temperature Sensor Circuit High (Bank 2, Sensor Circuit 1) - No sub type information	NOTE: - Circuit STOT - • Exhaust gas temperature sensor post turbocharger circuit, short circuit to power • Exhaust gas temperature sensor post turbocharger failure	temperature sensor post turbocharger circuit, for short circuit to power • Check and install new exhaust gas temperature sensor post turbocharger as required
P0544-00	Exhaust Gas Temperature Sensor Circuit - Bank 1 Sensor 1 - No sub type information	NOTE: - Circuit CCCIT_A - • Exhaust gas temperature sensor pre catalytic converter circuit, short circuit to ground, open circuit, high resistance • Exhaust gas temperature sensor pre catalytic converter failure	• Refer to the electrical circuit diagrams and check exhaust gas temperature sensor pre catalytic converter circuit for short circuit to ground, open circuit, high resistance • Clear the DTC and retest • Check and install new exhaust gas temperature sensor pre catalytic converter as required
P0547-00	Exhaust Gas Temperature Sensor Circuit - Bank 2 Sensor 1 - No sub type information	NOTE: - Circuit STOT - • Exhaust gas temperature sensor post turbocharger short circuit to ground • Exhaust gas temperature sensor post turbocharger failure	• Refer to the electrical circuit diagrams and check exhaust gas temperature sensor post turbocharger circuit for short circuit to ground • Clear the DTC and retest • Check and install new exhaust gas temperature sensor post turbocharger as required
P0548-00	Exhaust Gas Temperature Sensor Circuit Low - Bank 2 Sensor 1 - No sub type information	NOTE: - Circuit STOT - • Exhaust gas temperature sensor post turbocharger short circuit to ground • Exhaust gas temperature sensor post turbocharger failure	• Refer to the electrical circuit diagrams and check exhaust gas temperature sensor post turbocharger circuit for short circuit to ground • Clear the DTC and retest • Check and install new exhaust gas temperature sensor post turbocharger as required
P0549-00	Exhaust Gas Temperature Sensor Circuit High - Bank 2 Sensor 1 - No sub type information	NOTE: - Circuit STOT - • Exhaust gas temperature sensor post turbocharger short circuit short circuit	• Refer to the electrical circuit diagrams and check exhaust gas temperature sensor post turbocharger circuit for short circuit to power, open circuit, high resistance • Clear the DTC and retest • Check and install new exhaust gas temperature sensor post turbocharger as required

		to power, open circuit, high resistance • Exhaust gas temperature sensor post turbocharger failure	
P2031-00	Exhaust Gas Temperature Sensor Circuit Bank 1 Sensor 2 - No sub type information	 NOTE: - Circuit CCCOT_A - • Exhaust gas temperature sensor post catalytic converter short circuit to ground • Exhaust gas temperature sensor post catalytic converter failure	• Refer to the electrical circuit diagrams and check exhaust gas temperature sensor post catalytic converter circuit for short circuit to ground • Check and install new exhaust gas temperature sensor post catalytic converter as required
P2080-16	Exhaust Gas Temperature Sensor Circuit Range/Performance Bank 1 Sensor 1 - Circuit voltage below threshold	 NOTE: - Circuit CCCIT_A - • The engine control module measured a voltage below a specified range but not necessarily a short circuit to ground • Harness failure - Exhaust gas temperature sensor pre catalytic converter • Exhaust gas temperature sensor pre catalytic converter failure	• This DTC is set when there is a plausibility error on the signal from the exhaust gas temperature sensor pre catalytic converter. Refer to the workshop manual and check the exhaust gas temperature sensor pre catalytic converter and wiring harness for obvious signs of mechanical damage due to chaffing or heat. The exhaust gas temperature sensor pre catalytic converter 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 • Check and install new exhaust gas temperature sensor pre catalytic converter as required
P2082-00	Exhaust Gas Temperature Sensor Circuit Range/Performance Bank 2 Sensor 1 - No sub type information	 NOTE: - Circuit STOT - • Exhaust gas temperature sensor post turbocharger short circuit short circuit to ground, open circuit, high resistance • Exhaust gas temperature sensor post turbocharger failure	• Refer to the electrical circuit diagrams and check exhaust gas temperature sensor post turbocharger circuit for short circuit to ground, open circuit, high resistance • Clear the DTC and retest • Check and install new exhaust gas temperature sensor post turbocharger as required
P2084-16	Exhaust Gas Temperature Sensor Circuit Range/Performance	 NOTE: - Circuit CCCOT_A -	• Refer to the electrical circuit diagrams and check exhaust gas temperature sensor post catalytic converter circuit for short circuit to ground • Check and install new exhaust gas temperature sensor post

	Bank 1 Sensor 2 - Circuit voltage below threshold	• The engine control module measured a voltage below a specified range but not necessarily a short circuit to ground • Exhaust gas temperature sensor post catalytic converter circuit, short circuit to ground • Exhaust gas temperature sensor post catalytic converter failure	catalytic converter as required
P2177-00	System Too Lean Off Idle - Bank 1 - No sub type information	• Oxygen concentration implausibly high • Heated oxygen sensor circuit short circuit to ground, short circuit to power, high resistance, open circuit • Heated oxygen sensor failure	• Check for excess fuel at exhaust manifold, downpipe, heated oxygen sensor • Check for fuel / injector related DTCs and repair these first. Clear DTC and retest • Refer to the electrical circuit diagrams and check heated oxygen sensor for short circuit to ground, high resistance, open circuit. Repair harness as required. Clear DTC and retest • Check and install new heated oxygen sensor as required
P2178-00	System Too Rich Off Idle - Bank 1 - No sub type information	• Oxygen concentration implausibly low • Heated oxygen sensor circuit short circuit to ground, short circuit to power, high resistance, open circuit • Heated oxygen sensor failure	• Check for air leaks at exhaust manifold, downpipe, heated oxygen sensor • Check for fuel / injector related DTCs and repair these first. Clear DTC and retest • Refer to the electrical circuit diagrams and check heated oxygen sensor for short circuit to ground, high resistance, open circuit. Repair harness as required. Clear DTC and retest • Check and install new heated oxygen sensor as required
P2191-00	System Too Lean at Higher Load - Bank 1 - No sub type information	• Oxygen concentration implausibly high • Heated oxygen sensor circuit short circuit to ground, short circuit to power, high resistance, open circuit • Heated oxygen sensor failure	• Check for excess fuel at exhaust manifold, downpipe, heated oxygen sensor • Check for fuel / injector related DTCs and repair these first. Clear DTC and retest • Refer to the electrical circuit diagrams and check heated oxygen sensor for short circuit to ground, high resistance, open circuit. Repair harness as required. Clear DTC and retest • Check and install new heated oxygen sensor as required
P2192-	System Too Rich at	• Oxygen	• Check for air leaks at exhaust manifold, downpipe, heated

00	Higher Load - Bank 1 - No sub type information	concentration implausibly low • Heated oxygen sensor circuit short circuit to ground, short circuit to power, high resistance, open circuit • Heated oxygen sensor failure	oxygen sensor • Check for fuel / injector related DTCs and repair these first. Clear DTC and retest • Refer to the electrical circuit diagrams and check heated oxygen sensor for short circuit to ground, high resistance, open circuit. Repair harness as required. Clear DTC and retest • Check and install new heated oxygen sensor as required
P2195-00	O2 Sensor Signal Biassed/Stuck Lean - Bank 1, Sensor 1 - No sub type information	• Air leak at exhaust manifold, downpipe, heated oxygen sensor bank 1 • Heated oxygen sensor circuit short circuit to ground, short circuit to power, high resistance, open circuit • Heated oxygen sensor failure	• Check for fuel / injector related DTCs and repair these first. Clear DTC and retest • Check for air leaks at exhaust manifold, downpipe, heated oxygen sensor • Refer to the electrical circuit diagrams and check heated oxygen sensor for short circuit to ground, high resistance, open circuit. Repair harness as required. Clear DTC and retest • Check and install new heated oxygen sensor as required
P2245-00	O2 Sensor Reference Voltage Circuit Low - Bank 1, Sensor 1 - No sub type information	 NOTE: - Circuit LPV_A - • Harness failure - Heated oxygen sensor circuit • Oxygen sensor failure	• This DTC is set if the engine control module detects the bank 1, heated oxygen sensor 1 reference voltage is lower than expected. Refer to the electrical circuit diagrams and check the heated oxygen sensor circuits for open circuits, high resistance, short circuit to ground. Repair harness as required. Clear DTC and retest • Check and install new heated oxygen sensor as required
P2246-00	O2 Sensor Reference Voltage Circuit High - Bank 1, Sensor 1 - No sub type information	 NOTE: - Circuit LPV_A - • Harness failure - Heated oxygen sensor circuit • Oxygen sensor failure	• This DTC is set if the engine control module detects the bank 1, heated oxygen sensor 1 reference voltage is greater than expected. Refer to the electrical circuit diagrams and check the heated oxygen sensor circuits for open circuits, high resistance, short circuit to power. Repair harness as required. Clear DTC and retest • Check and install new heated oxygen sensor as required
P2297-00	O2 Sensor Out of Range During Deceleration Bank 1, Sensor 1 - No sub type information	• Heated oxygen sensor circuit short circuit to ground, short circuit to power, high resistance, open circuit • Heated oxygen sensor failure	• Check for fuel / injector related DTCs and repair these first. Clear DTC and retest. Refer to the electrical circuit diagrams and check heated oxygen sensor for short circuit to ground, high resistance, open circuit. Repair harness as required. Clear DTC and retest • Check and install new heated oxygen sensor as required
P242A-00	Exhaust Gas Temperature Sensor Circuit Bank 1 Sensor 3 -	 NOTE: - Circuit PFOT -	• Using the manufacturer approved diagnostic system check datalogger signals, Exhaust Gas Temperature Bank 1 Sensor 3 (0x03C8), Exhaust Gas Temperature Bank 1 Sensor 3 Voltage (0x03F6). This DTC is set if the exhaust gas temperature sensor

	No sub type information	Harness failure - Exhaust gas temperature sensor post DPF • Exhaust gas temperature sensor post DPF failure	post DPF fails a cold start diagnostic check by the engine control module. Refer to the electrical circuit diagrams and check the exhaust gas temperature sensor post DPF signal circuit for open circuit, short circuit to ground, short circuit to other circuits. Check the sensor ground circuit for open circuit, short circuit to power, high resistance. Repair harness as required • Check and install new exhaust gas temperature sensor post DPF as required
P242B-16	Exhaust Gas Temperature Sensor Circuit Range/Performance Bank 1 Sensor 3 - Circuit voltage below threshold	 NOTE: - Circuit PFOT - • The engine control module measured a voltage below a specified range but not necessarily a short circuit to ground • Harness failure - Exhaust gas temperature sensor post DPF • exhaust gas temperature sensor post DPF failure	• This DTC is set if the exhaust gas temperature sensor post DPF fails a cold start diagnostic check by the engine control module • Refer to the workshop manual and check the exhaust gas temperature sensor post DPF for obvious signs of damage • Check the sensor harness for chaffing or heat damage • 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 (0x03C8) • Refer to the electrical circuit diagrams and check the exhaust gas temperature sensor post DPF signal circuit for open circuit, short circuit to ground, short to other circuits. Check the sensor ground circuit for open circuit, short circuit to power, high resistance. Repair wiring as required • Check and install new exhaust gas temperature sensor post DPF as required
P242B-64	Exhaust Gas Temperature Sensor Circuit Range/Performance Bank 1 Sensor 3 - Signal plausibility failure	 NOTE: - Circuit PFOT - • Harness failure - Exhaust gas temperature sensor post DPF • Exhaust gas temperature sensor post DPF failure	• Using the manufacturer approved diagnostic system check datalogger signals, Exhaust Gas Temperature Bank 1 Sensor 3 (0x03C8), Exhaust Gas Temperature Bank 1 Sensor 3 Voltage (0x03F6). This DTC is set if the exhaust gas temperature sensor post DPF fails a cold start diagnostic check by the engine control module. Refer to the electrical circuit diagrams and check the exhaust gas temperature sensor post DPF signal circuit for open circuit, short circuit to ground, short circuit to other circuits. Check the sensor ground circuit for open circuit, short circuit to power, high resistance. Repair harness as required • Check and install new exhaust gas temperature sensor post DPF as required
P242C-00	Exhaust Gas Temperature Sensor Circuit Low Bank 1 Sensor 3 - No sub type information	 NOTE: - Circuit PFOT - • Harness failure - Exhaust gas temperature sensor post DPF • Exhaust gas temperature sensor post DPF failure	• Using the manufacturer approved diagnostic system check datalogger signals, Exhaust Gas Temperature Bank 1 Sensor 3 (0x03C8), Exhaust Gas Temperature Bank 1 Sensor 3 Voltage (0x03F6). This DTC is set if the exhaust gas temperature sensor post DPF signal voltage is less than the engine control module was expecting. Refer to the electrical circuit diagrams and check the exhaust gas temperature sensor post DPF signal circuit for open circuit, short circuit to ground, short circuit to other circuits. Check the sensor ground circuit for open circuit, short circuit to power, high resistance. Repair harness as required • Check and install new exhaust gas temperature sensor post DPF as required
P242D-17	Exhaust Gas Temperature Sensor Circuit High Bank 1 Sensor 3 - Circuit voltage above threshold	 NOTE: - Circuit PFOT - • The engine control module measured a voltage above a specified range but not necessarily a short circuit to power	• Using the manufacturer approved diagnostic system check datalogger signals, Exhaust Gas Temperature Bank 1 Sensor 3 (0x03C8), Exhaust Gas Temperature Bank 1 Sensor 3 Voltage (0x03F6) • Refer to the electrical circuit diagrams and check the exhaust gas temperature sensor post DPF circuit, for short circuit to power, open circuit • Check and install new exhaust gas temperature sensor post DPF as required

		• Exhaust gas temperature sensor post DPF circuit, short circuit to power, open circuit • Exhaust gas temperature sensor post DPF failure	
P244A-00	Diesel Particulate Filter Differential Pressure Too Low(Bank 1) - No sub type information	• Diagnostic failure check for minimum pressure differential characteristics • Diesel particulate filter internal components are missing or destroyed	• Using the manufacturer approved diagnostic system, check for related DTCs and refer to the relevant DTC index • Clear DTC and re-test • Check and install new diesel particulate filter as required
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
P2452-95	Diesel Particulate Filter Pressure Sensor A Circuit - Incorrect assembly	NOTE: In cold climates differential pressure sensor hose lines or metal pipes may be frozen • Differential pressure sensor hoses connected incorrectly • Differential 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 differential pressure sensor hoses are installed correctly • Check differential pressure sensor hoses for crushed, blockage, split
P2453-00	Diesel Particulate Filter Pressure Sensor A Circuit Range/Performance - No sub type information	NOTE: - Circuit DPS - • Harness failure - Differential pressure sensor • 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

			• 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 electrical circuit diagrams and check the differential pressure sensor signal circuit for open circuit, short circuit to ground, short circuit to other circuits. Check the sensor ground circuit for open circuit, short circuit to power, high resistance. Check the sensor power supply circuit for open circuit, short circuit to ground, high resistance. Repair harness as required • Check and install new differential pressure sensor as required
P2454-00	Diesel Particulate Filter Pressure Sensor A Circuit Low - No sub type information	NOTE: - Circuit DPS - • Harness failure - Differential pressure sensor • Differential pressure sensor crossed hose lines • 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 • 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 diagnostic check. Refer to the electrical circuit diagrams and check the differential pressure sensor signal circuit for open circuit, short circuit to ground, short circuit to other circuits. Check the sensor ground circuit for open circuit, short circuit to power, high resistance. Check the sensor power supply circuit for open circuit, short circuit to ground, high resistance. Repair harness as required • Check differential pressure sensor hose lines are installed correctly • Check and install new differential pressure sensor as required
P2455-00	Diesel Particulate Filter Pressure Sensor A Circuit High - No sub type information	NOTE: - Circuit DPS - • Harness failure - Differential pressure sensor • Differential pressure sensor failure • Exhaust back pressure is too high	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 engine control module, for related DTCs and refer to the relevant DTC index • 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 diagnostic check. Refer to the electrical circuit diagrams and check the differential pressure sensor signal circuit for open circuit, short circuit to power, short circuit to other circuits. Check the sensor ground circuit for open circuit, short circuit to power, high resistance. Check the sensor power supply circuit for open circuit, short circuit to ground, high resistance. Repair harness as required • Check and install new differential pressure sensor as required
P2456-	Diesel Particulate	• Differential	

00	Filter Pressure Sensor A Circuit Intermittent/Erratic - No sub type information	pressure sensor circuit short circuit to ground, short circuit to power, open circuit, high resistance • In cold climate or off road driving differential pressure sensor hoses crushed, blocked, split • 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 • Refer to the electrical circuit diagrams and check differential pressure sensor circuit for short circuit to ground, short circuit to power, open circuit, high resistance • Inspect connectors for signs of water ingress, and pins for damage and/or corrosion • Check differential pressure sensor hoses for crushed, blocked, split • Check and replace diesel particulate filter differential pressure sensor as required
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 and carry out a diesel particulate filter regeneration • Advise customer of driving routine required to regenerate diesel particulate filter as stated in the vehicle handbook
P2463-00	Diesel Particulate Filter Restriction - Soot Accumulation (Bank 1) - No sub type information	• Maximum soot mass	• GO to Pinpoint Test A.
P2A00-16	O2 Circuit Range / Performance (Bank 1, Sensor 1) - Circuit voltage below threshold	NOTE: - Circuit LPTR_A - • The engine control module measured a voltage below a specified range but not necessarily a short circuit to ground • Harness failure - Heated oxygen sensor failure • Heated oxygen sensor failure	• This DTC is set when the engine control module detects the voltage on the trim resistor circuit of the heated oxygen sensor is less than the voltage threshold. This may be caused by the heated oxygen sensor being too hot to operate correctly. Refer to the workshop manual and check the exhaust system and heated oxygen sensor harness for sign of mechanical damage. Refer to the electrical circuit diagrams and check all the heated oxygen sensor circuits for open circuits, short circuit to power, short circuit to ground, short circuit to other circuits. Check all engine control module power and ground supplies. Repair harness as required. Clear DTC and retest • Check and install new heated oxygen sensor as required
P2A00-17	O2 Circuit Range / Performance (Bank 1, Sensor 1) - Circuit voltage above threshold	NOTE: - Circuit LPTR_A - • The engine	• This DTC is set when the engine control module detects the voltage on the trim resistor circuit of the heated oxygen sensor is greater than the voltage threshold. This may be caused by the heated oxygen sensor being too hot to operate correctly. Refer to the workshop manual and check the exhaust system

		control module measured a voltage above a specified range but not necessarily a short circuit to power • Harness failure - Heated oxygen sensor failure • Heated oxygen sensor failure	and heated oxygen sensor harness for sign of mechanical damage. Refer to the electrical circuit diagrams and check all the heated oxygen sensor circuits for open circuits, short circuit to power, short circuit to ground, short circuit to other circuits. Check all engine control module power and ground supplies. Repair harness as required. Clear DTC and retest • Check and install new heated oxygen sensor as required

Pinpoint Tests

PINPOINT TEST A : RED WARNING MESSAGE DPF FULL VISIT DEALER IS DISPLAYED AND DTC P2463-00 IS LOGGED	
TEST CONDITIONS	**DETAILS/RESULTS/ACTIONS**
A1: 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
A2: 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
A3: RECORD ALL ENGINE CONTROL MODULE DTCS	
	1 Using the manufacturer approved diagnostic system, check engine control module, for DTCs
	Are any other DTCs logged? **Yes** Using the manufacturer approved diagnostic system refer to the relevant DTC index and repair all DTCs as requiredProceed to the next step **No** Proceed to step 7
A4: AMBER/RED DPF FULL MESSAGE	
	1 Verify with the customer the approximate time and mileage between the AMBER DPF FULL message being displayed and the RED DPF FULL message being displayed
	Was a mileage up to 625 miles (1000KM) driven between the AMBER DPF FULL message being displayed and the RED DPF FULL message being displayed? **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
A5: OTHER RELATED ENGINE CONTROL MODULE DTCS	
	1 Related engine control module DTCs other than P2463-00 are logged
	Are related engine control module DTCs other than P2463-00 logged? **Yes** Refer to the relevant DTC index. Repair as required. Using the manufacturer approved diagnostic system clear the DTCs and re-test **No** Proceed to step 7
A6: 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 ~ 0.3 volts • Accelerate to 4500RPM (stationary) and close throttle, should read 1.1 ~ 1.3 volts
	Does the pre catalyst oxygen sensor meet 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 re-test. Return vehicle to the customer
A7: 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 or maximum possible RPM and record value • Note: 1volt = 100mbar, 1.5volts = 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
A8: 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 1 - (0x03F4) • Exhaust Gas Temperature Bank 1 Sensor 2 - (0x03F5) • Exhaust Gas Temperature Bank 1 Sensor 3 - (0x03F6)
	2 Hold engine speed at 2000RPM for 2 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 re-test
A9: 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 32.5 grams the diesel particulate filter is recoverable.	
	1 Using the results from step 7 check soot mass is less than 32.5 grams
	2 Using the results from step 8 check particulate filter differential pressure sensor voltage at 4000RPM is less than 1 Volt (100mbar)
	Is diesel particulate filter soot mass value less than 32.5 grams and particulate filter differential pressure sensor voltage at 4000RPM less than 1 Volts (100mbar)? **Yes** If the diesel particulate filter soot mass value is greater than 31.5 grams and the differential pressure sensor voltage is between 0.5Volts and 0.9 Volt 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 32.5 grams and the differential pressure sensor voltage greater than 1 Volt 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.Using the manufacturer approved smoke tester carry out a boost system leakage checkRemove the diesel particulate filter from the secondary turbo charger, lower the exhaust system and inspect for oil contaminationContact dealer technical support with all of the recorded values from the above tests
A10: SOOT MASS REDUCTION	
	1 With the vehicle fully up to temperature and in Park maintain 2500RPM for 3 minutes
	2 Return to step 7, check diesel particulate filter soot mass value
	Has the diesel particulate filter soot mass reduced from the original reading?

	Yes Proceed to next step **No** Proceed to step 12
A11: 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 6 grams? **Yes** Using the manufacturer approved diagnostic system clear the DTC and re-test. Return vehicle to the customer **No** Contact dealer technical support with all of the recorded values from the above tests
A12: 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 6 grams? **Yes** Using the manufacturer approved diagnostic system clear the DTC and re-test. Return vehicle to the customer **No** Contact dealer technical support with all of the recorded values from the above tests

Diesel particulate filter soot level information

Soot level symptom	Values
Soot level accumulation in diesel particulate filter is stopped	32.5g
Maximum soot level accumulation before regeneration process is inhibited	28.5g
RED warning lamp ON	31.5g
RED warning lamp OFF	24.5g
AMBER warning lamp ON	24.5g
AMBER warning lamp OFF	22.5g

Diesel particulate filter regeneration procedure

CAUTION: 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

If DPF FULL SEE HANDBOOK appears in the message centre, carry out the following procedure

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
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)

NOTE: 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

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

NOTE: When driving off-road during the regeneration process, greater accelerator pedal use may be required

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 - TDV8 4.4L Diesel, DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation).

Published: 21-Jun-2013

Exhaust System - TDV8 4.4L 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: 16-Aug-2012

Exhaust System - TDV8 4.4L Diesel - Catalytic Converter

Removal and Installation

Removal

WARNING: Observe due care when working near a hot exhaust system.

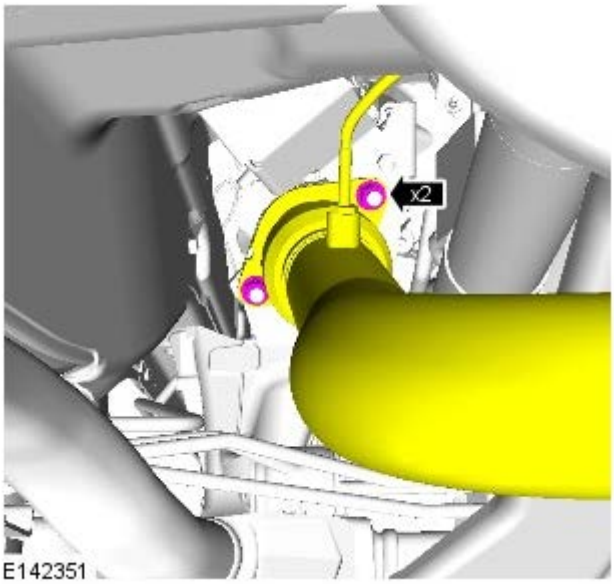
NOTES:

Removal steps in this procedure may contain installation details.

Some variation in the illustrations may occur, but the essential information is always correct.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

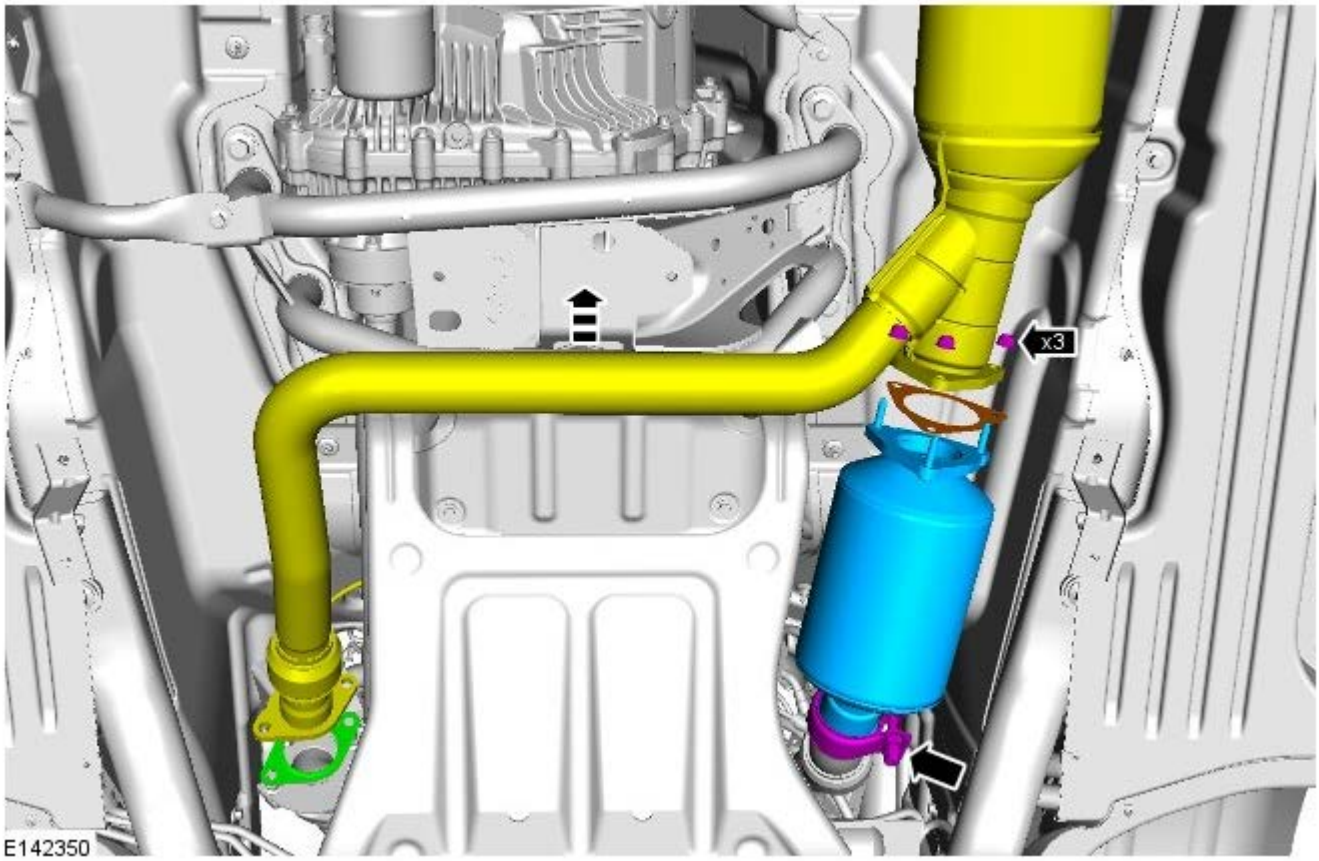


2. CAUTION: Make sure that the exhaust system is supported with suitable retaining straps.

   Torque: 47 Nm

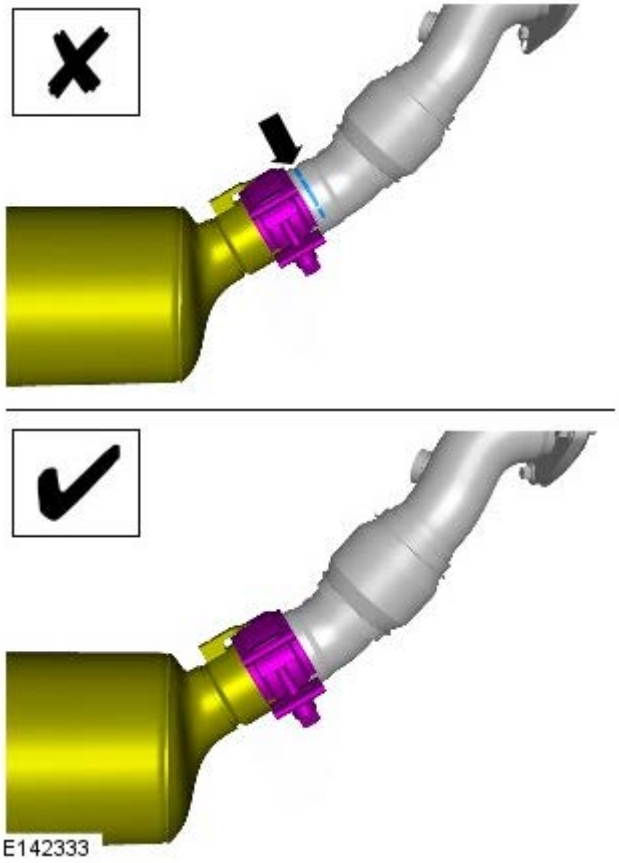
3. CAUTION: Make sure that the exhaust system is supported with suitable retaining straps.

   Torque:
   Clamp 47 Nm
   M8 Nuts 30 Nm



Installation

1. To install, reverse the removal procedure.



Published: 16-Aug-2012

Exhaust System - TDV8 4.4L Diesel - Diesel Particulate Filter (DPF)

Removal and Installation

Special Tool(s)

 E130266	100-051 Cutter, Exhaust Pipe

Removal

WARNING: Observe due care when working near a hot exhaust system.

NOTES:

Removal steps in this procedure may contain installation details.

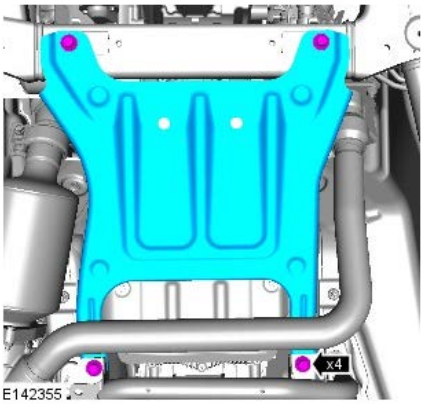
Some variation in the illustrations may occur, but the essential information is always correct.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

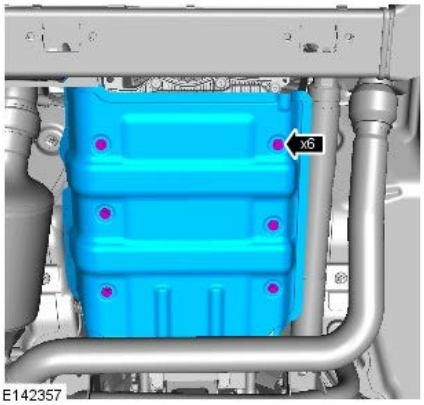
2. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

3. *Torque:* 60 Nm



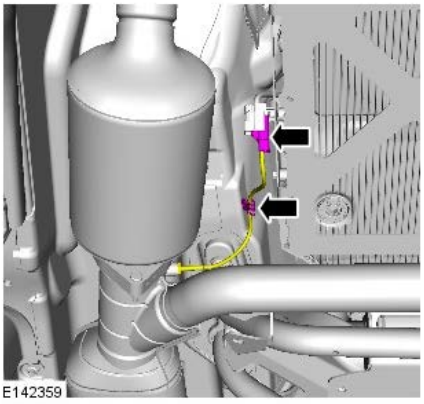
E142355

4. *Torque:* 10 Nm

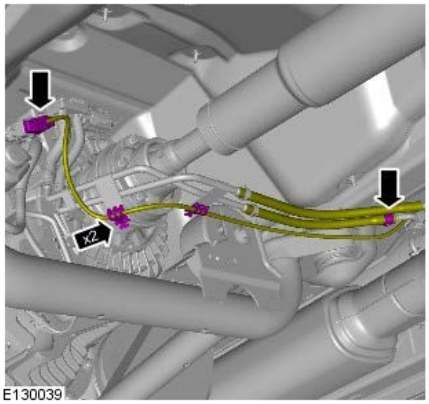


E142357

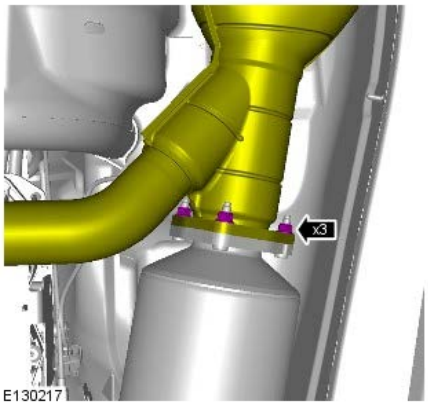
5.


E142359

6.

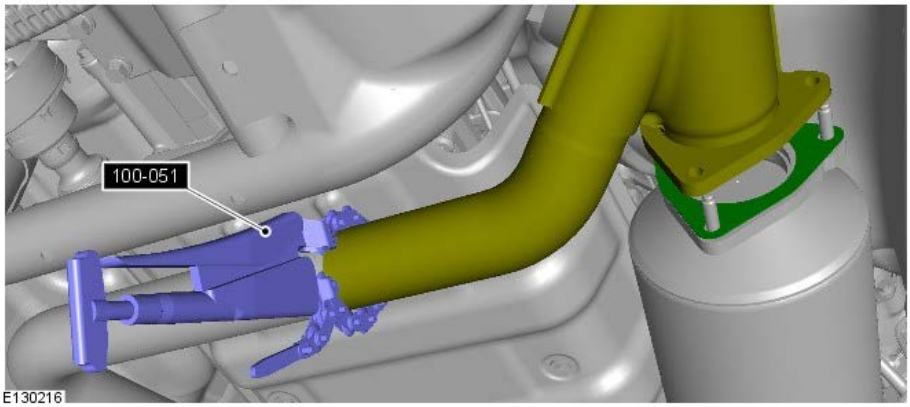


7. Refer to: Rear Muffler (309-00 Exhaust System - TDV8 4.4L Diesel, Removal and Installation).



8. CAUTION: Make sure that the exhaust system is supported with suitable retaining straps.

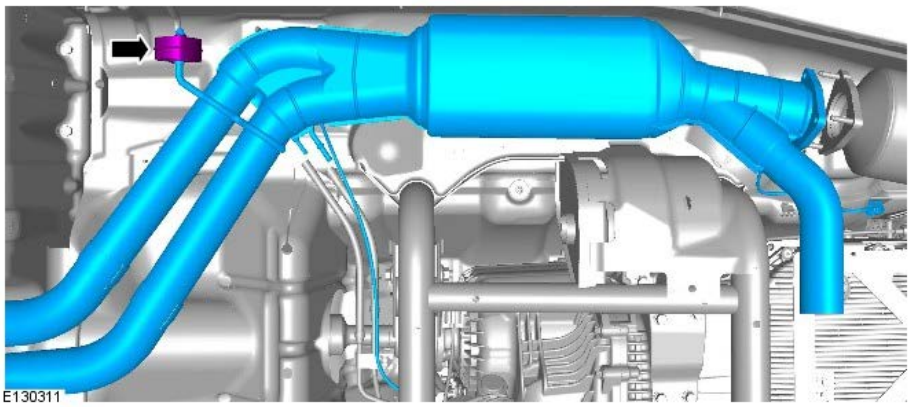
Torque: 30 Nm



9. CAUTION: Make sure that the exhaust system is supported with suitable retaining straps.

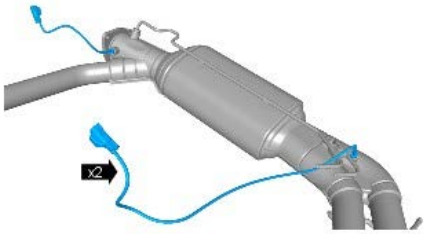
Special Tool(s): 100-051

10.



11. NOTE: Do not disassemble further if the component is removed for access only.

Torque: 35 Nm

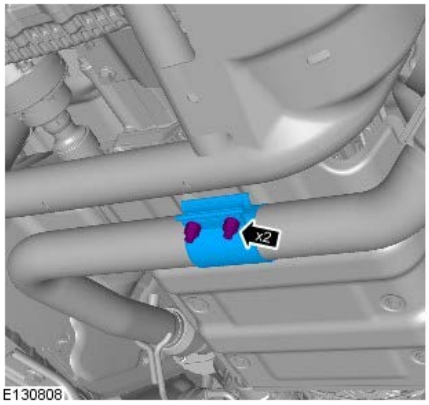


E130256

Installation

1. To install, reverse the removal procedure.

   Torque: 55 Nm



E130808

2. If a new unit is installed, configure using the approved diagnostic tool.

Published: 24-Aug-2012

Exhaust System - TDV8 4.4L Diesel - Exhaust System Vehicles Without: Diesel Particulate Filter (DPF)

Removal and Installation

Removal

WARNING: Observe due care when working near a hot exhaust system.

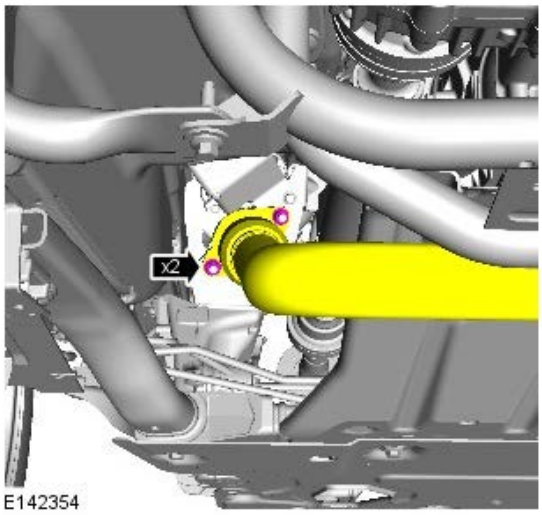
NOTES:

Removal steps in this procedure may contain installation details.

Some variation in the illustrations may occur, but the essential information is always correct.

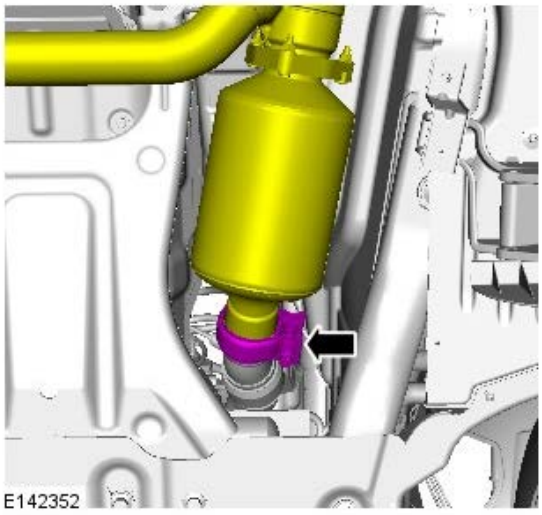
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.



2. CAUTION: Make sure that the exhaust system is supported with suitable retaining straps.

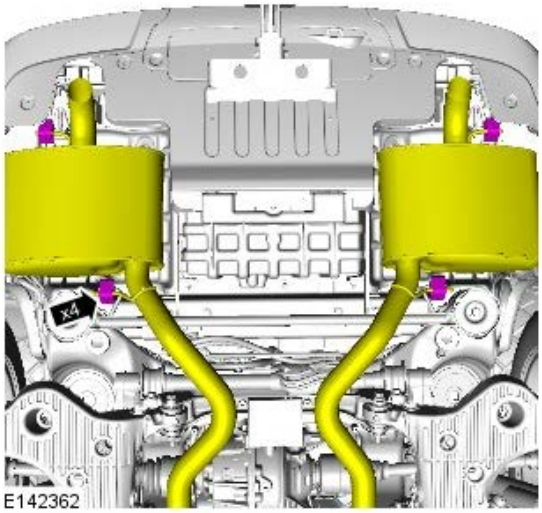
   Torque: 47 Nm

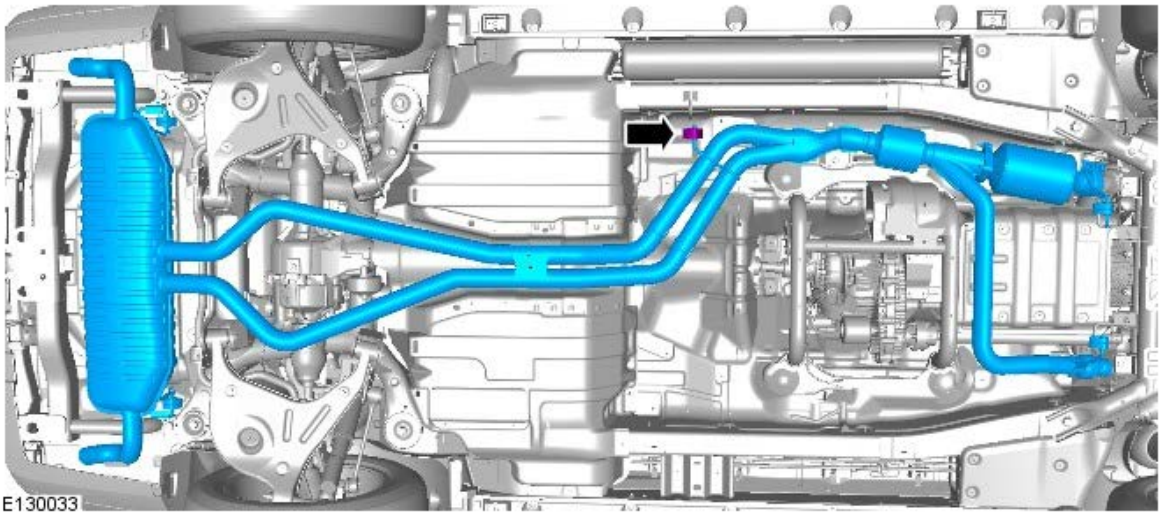


3. CAUTION: Make sure that the exhaust system is supported with suitable retaining straps.

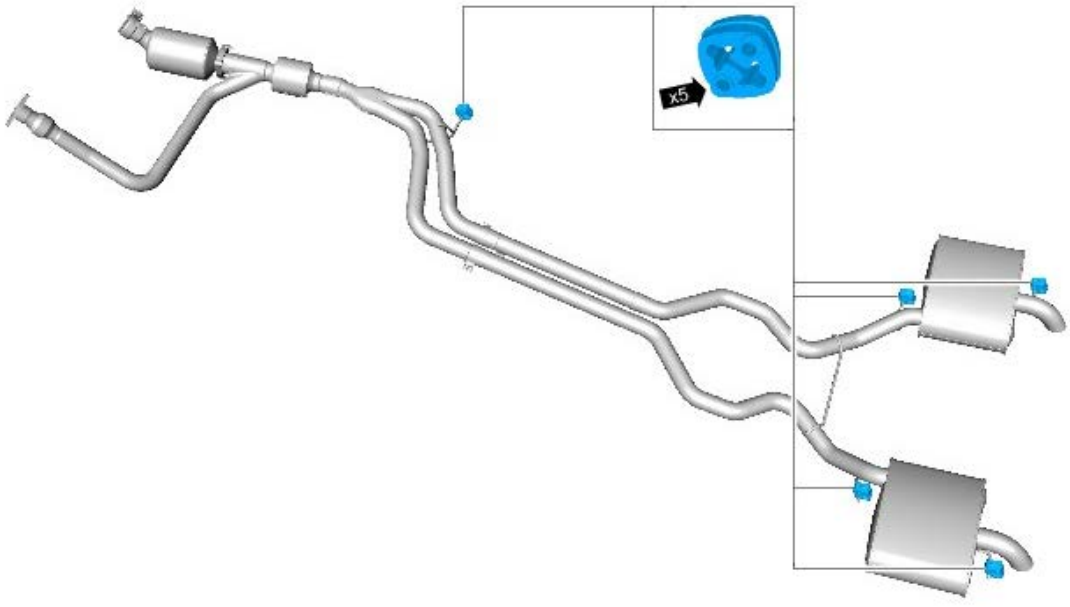
   Torque: 47 Nm

4. CAUTION: Make sure that the exhaust system is supported with suitable retaining straps.





5. With assistance, remove the exhaust system.



6. NOTE: Do not disassemble further if the component is removed for access only.

Installation

1. To install, reverse the removal procedure.

Published: 24-Aug-2012

Exhaust System - TDV8 4.4L Diesel - Exhaust System Vehicles With: Diesel Particulate Filter (DPF)

Removal and Installation

Removal

WARNING: Observe due care when working near a hot exhaust system.

NOTES:

Removal steps in this procedure may contain installation details.

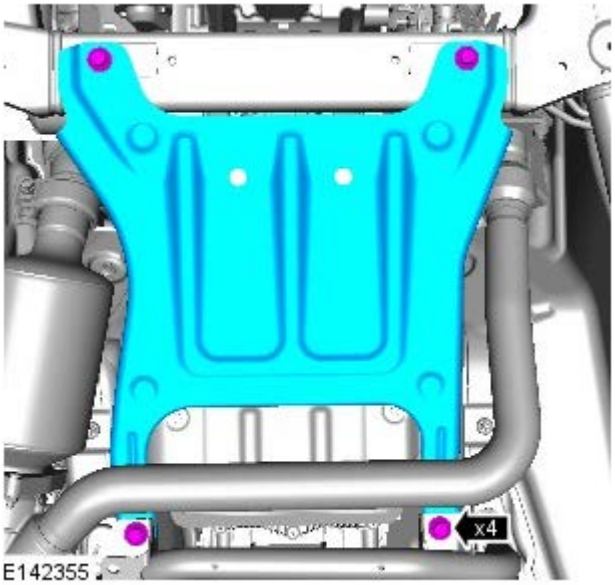
Some variation in the illustrations may occur, but the essential information is always correct.

1. WARNING: Make sure to support the vehicle with axle stands.

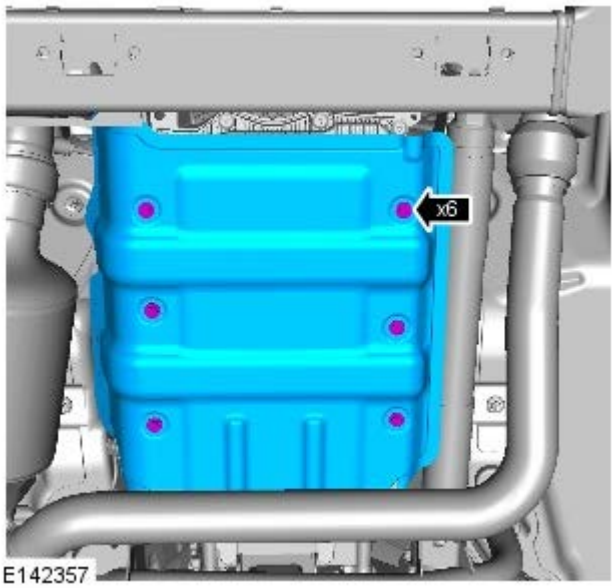
   Raise and support the vehicle.

2. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

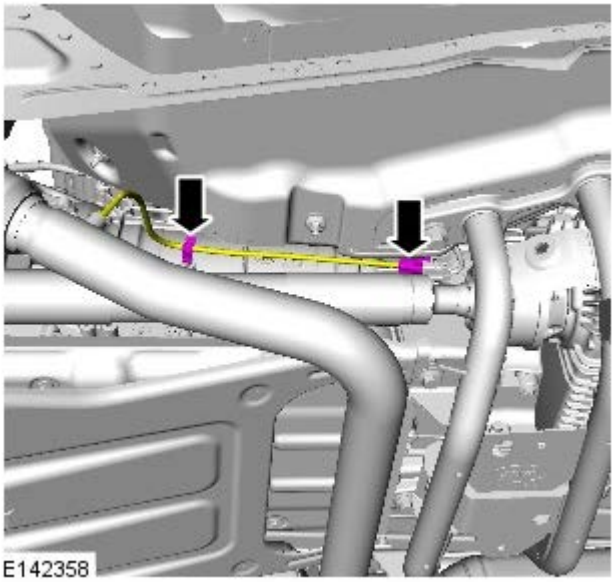
3. *Torque:* 60 Nm



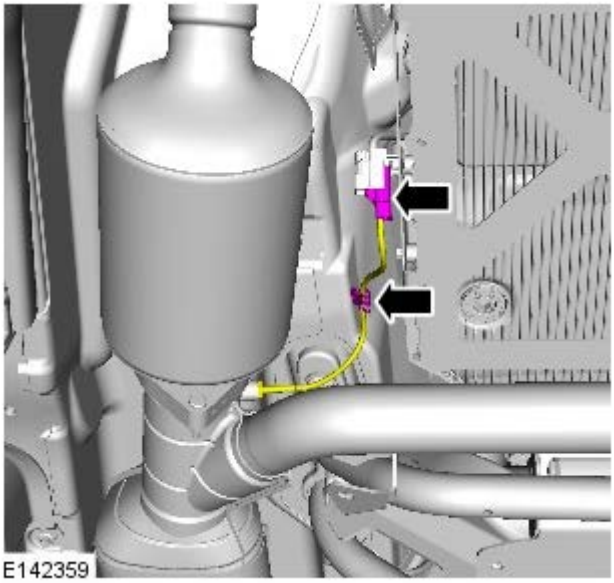
4. *Torque:* 10 Nm



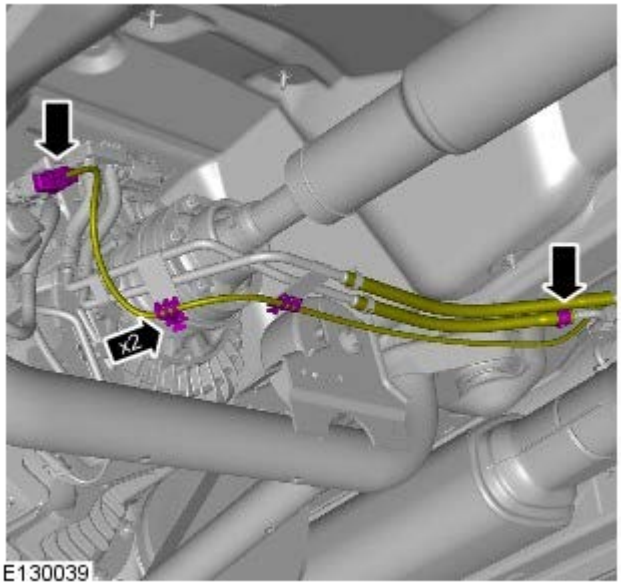
5.



6.

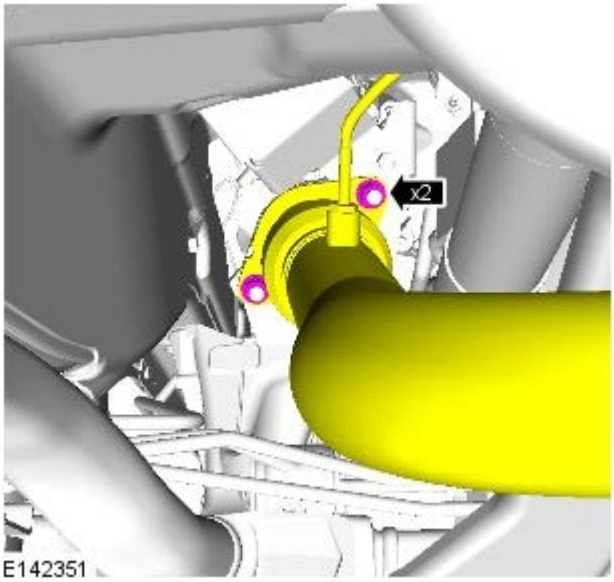


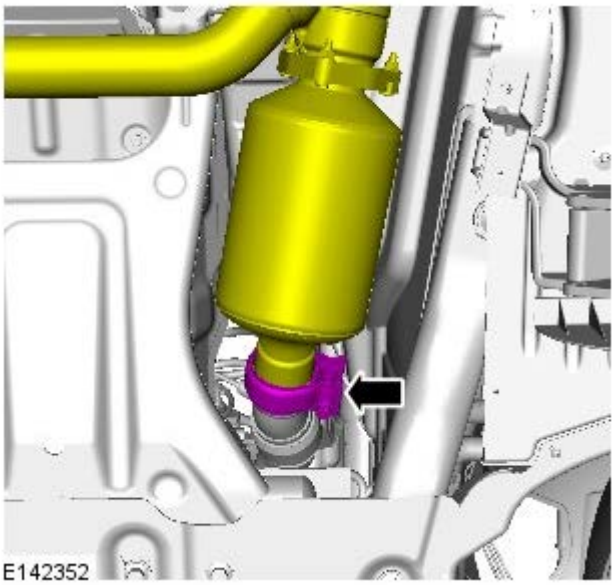
7.



8. CAUTION: Make sure that the exhaust system is supported with suitable retaining straps.

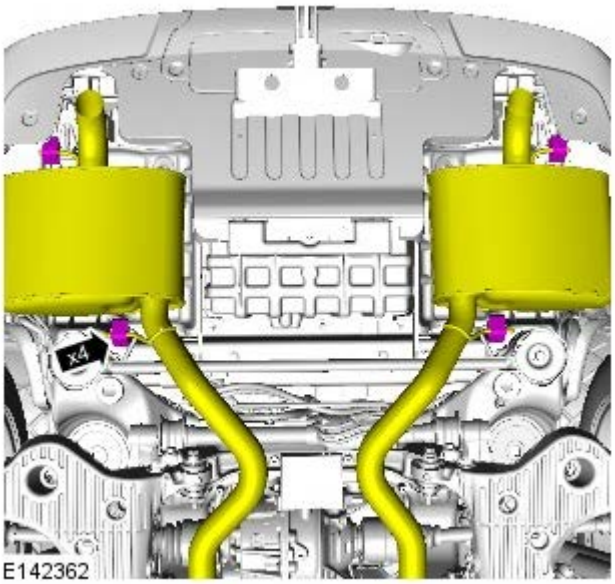
Torque: 47 Nm





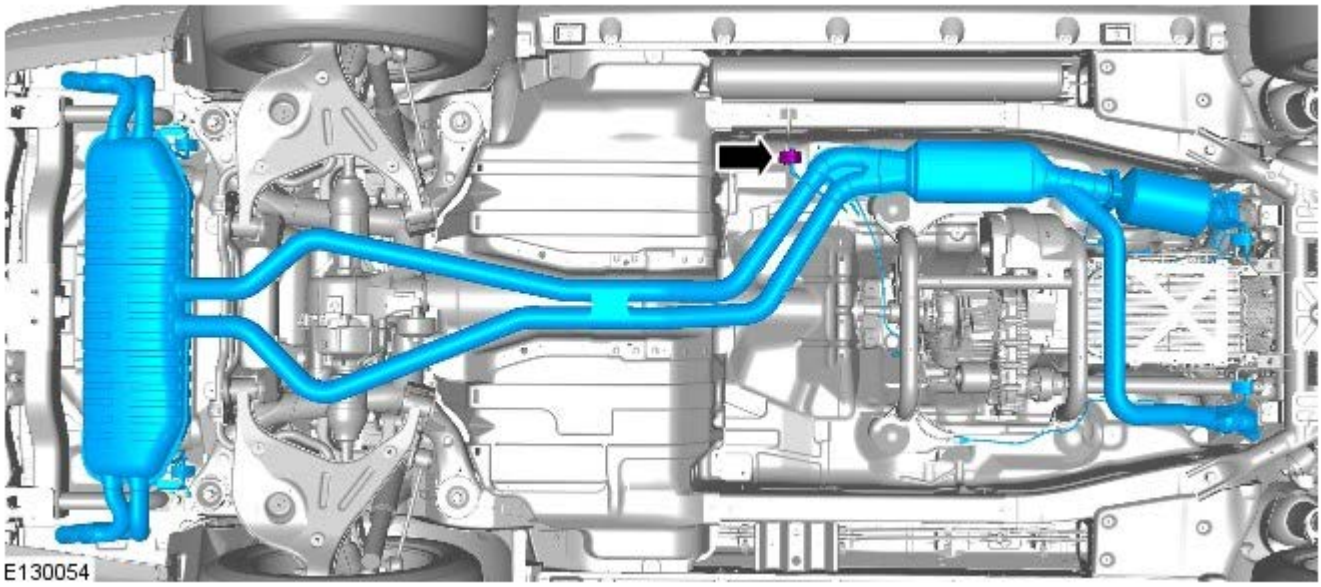
9. CAUTION: Make sure that the exhaust system is supported with suitable retaining straps.

   Torque: 47 Nm



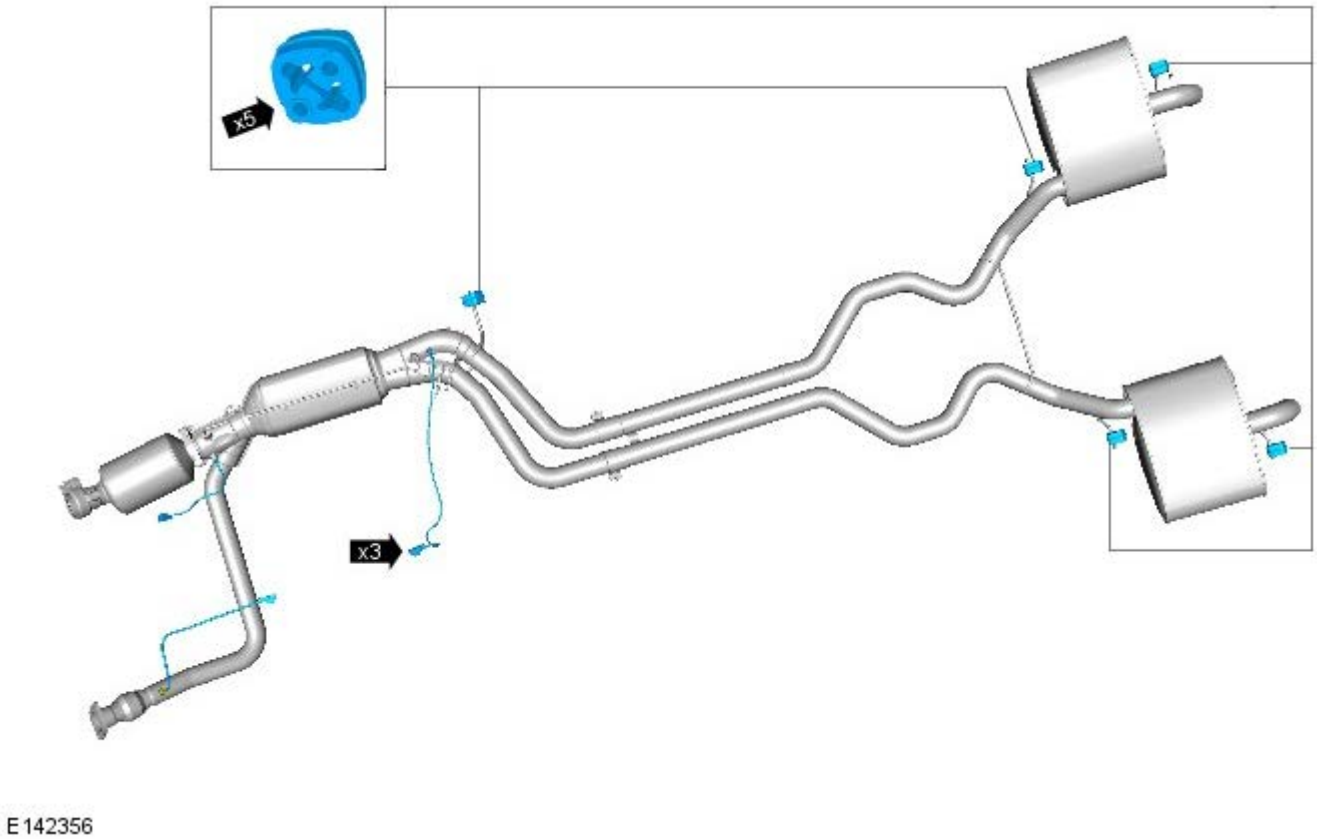
10. CAUTION: Make sure that the exhaust system is supported with suitable retaining straps.

11. With assistance, remove the exhaust system.



12. NOTE: Do not disassemble further if the component is removed for access only.

    Torque: 35 Nm



Installation

1. To install, reverse the removal procedure.

Published: 09-Aug-2012

Exhaust System - TDV8 4.4L Diesel - Rear Muffler

Removal and Installation

Removal

WARNING: Observe due care when working near a hot exhaust system.

NOTES:

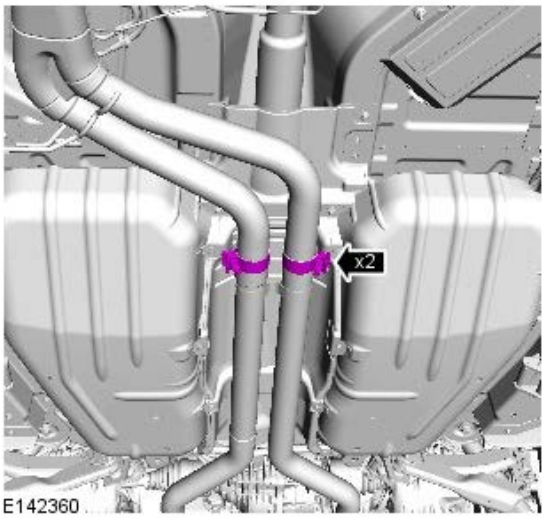
Removal steps in this procedure may contain installation details.

Some variation in the illustrations may occur, but the essential information is always correct.

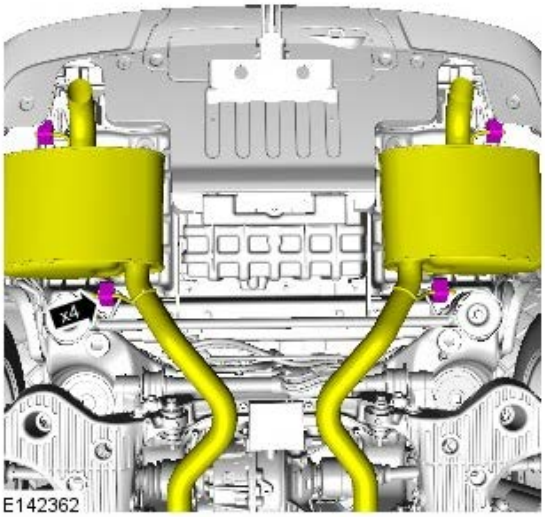
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

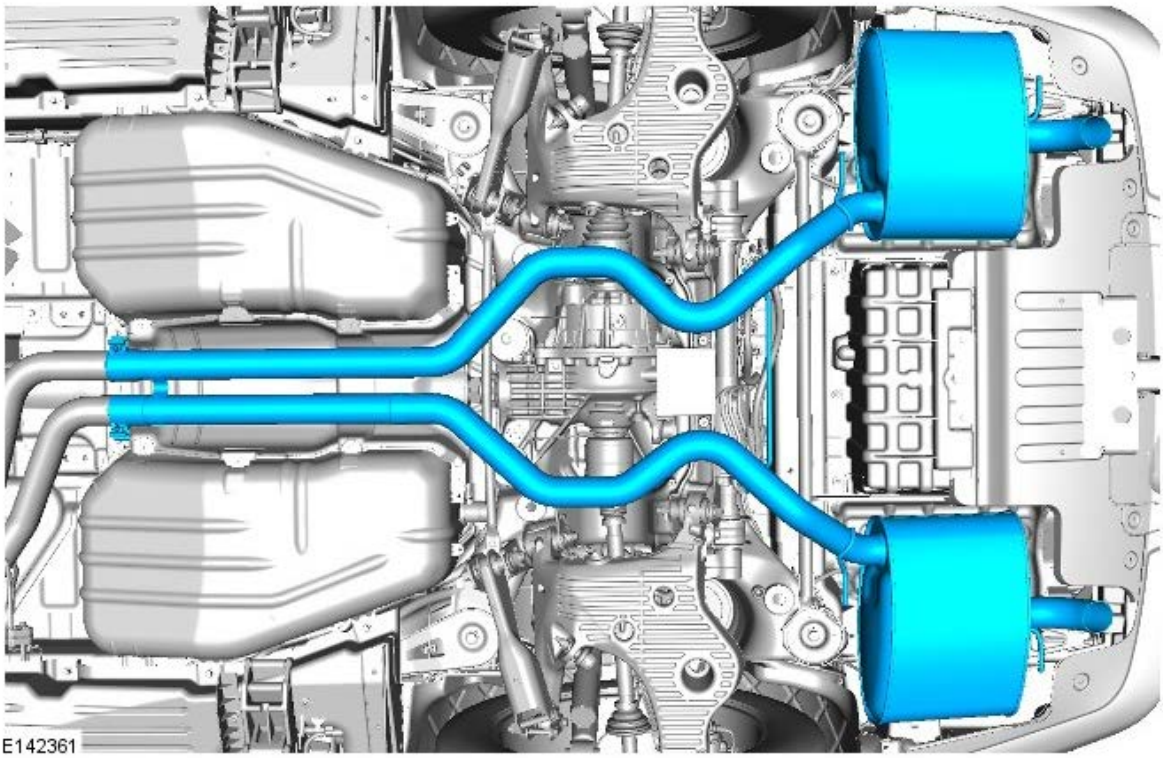
2. *Torque:* 55 Nm



3. CAUTION: Make sure that the exhaust system is supported with a suitable transmission stand.



4. WARNING: This step requires the aid of another technician.



Installation

1. To install, reverse the removal procedure.

Published: 24-Oct-2012

Fuel System - General Information -

Torque Specifications

Item	Nm	lb-ft	lb-in
Rear seat to body bolts	50	37	-
Fuel line to fuel flange locking ring bolt	7	-	62

Published: 31-Jul-2012

Fuel System - General Information - Diesel Filter Water Drain-Off TDV6 3.0L Diesel

General Procedures

WARNINGS:

The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.

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.

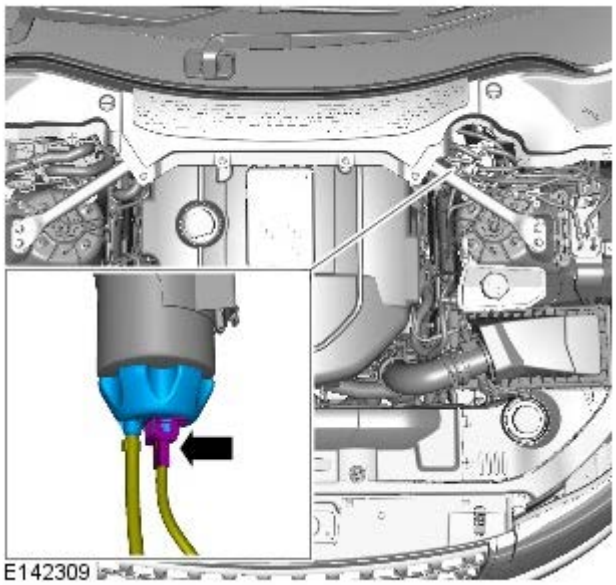
Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

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.

CAUTION: 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.

1. Disconnect the battery ground cable.
   For additional information, refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).


E142309

2. Drain the fuel filter element.
   - Disconnect the water-in-fuel sensor electrical connector.
   - Loosen the water-in-fuel sensor one complete turn and allow the fuel to drain into a container.
   - Remove the container.
3. Tighten the water-in-fuel sensor.
4. Connect the water-in-fuel sensor electrical connector.
5. Connect the battery ground cable.
   For additional information, refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).
6. Bleed the fuel system.
   For additional information, refer to: Low-Pressure Fuel System Bleeding (310-00 Fuel System - General Information, General Procedures).

Published: 31-Jul-2012

Fuel System - General Information - Fuel System Pressure Release V6 S/C 3.0L 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.

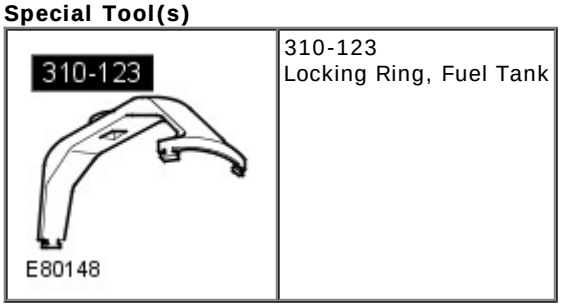
2. Install the fuel filler cap.
3. Read and clear stored DTC fault codes.

Published: 28-Oct-2013

Fuel System - General Information - Fuel Tank Draining

General Procedures

Special Tool(s)

	310-123 Locking Ring, Fuel Tank

Draining

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.

All vehicles

1. Refer to: Diesel Fuel System Health and Safety Precautions (100-00 General Information, Description and Operation).
   Refer to: Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions (100-00 General Information, Description and Operation).

Vehicles with petrol engine

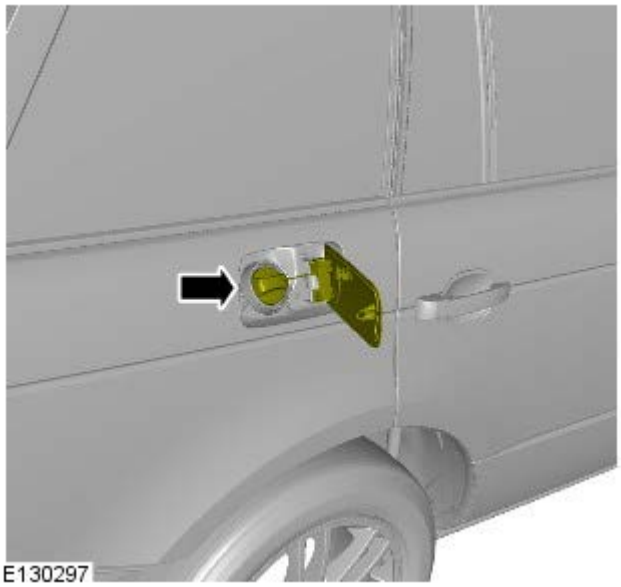
2. Refer to: Fuel System Pressure Release - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (310-00 Fuel System - General Information, General Procedures).

All vehicles

3. Disconnect the battery ground cable.

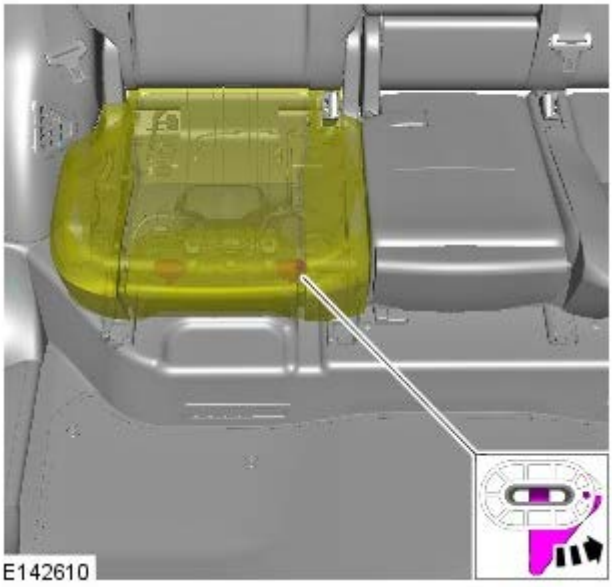
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

4. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

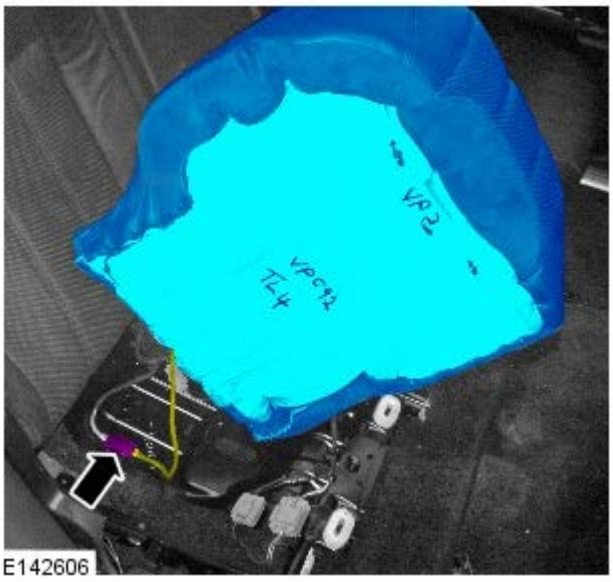


Vehicles without business seats

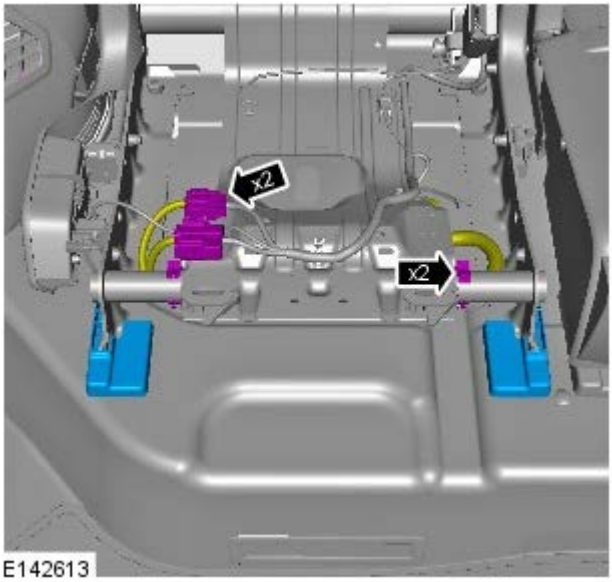
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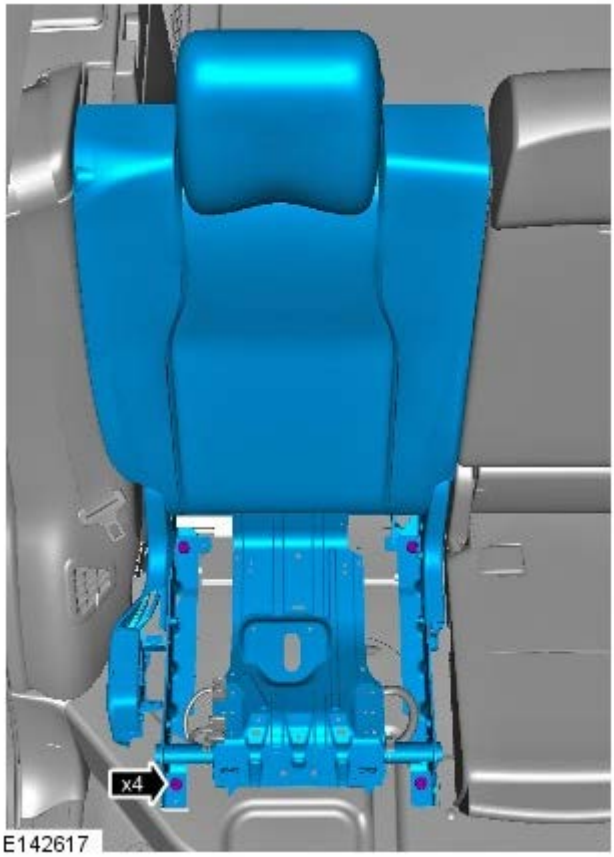
6.



7.



8. *Torque:* 50 Nm



Vehicles with business seats

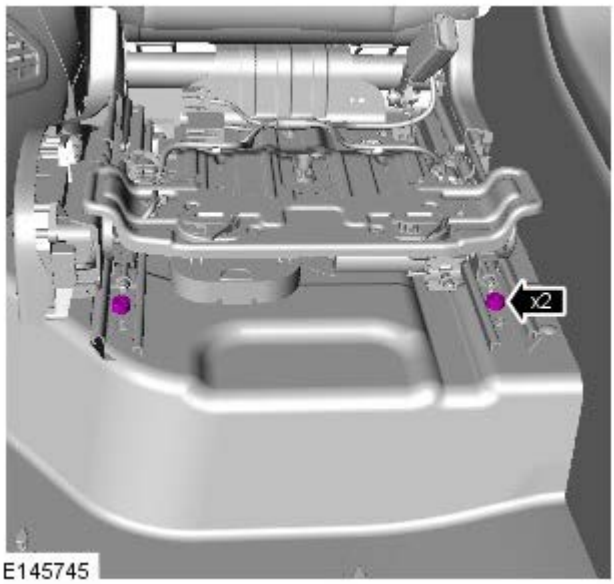
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10.



11. *Torque:* 50 Nm



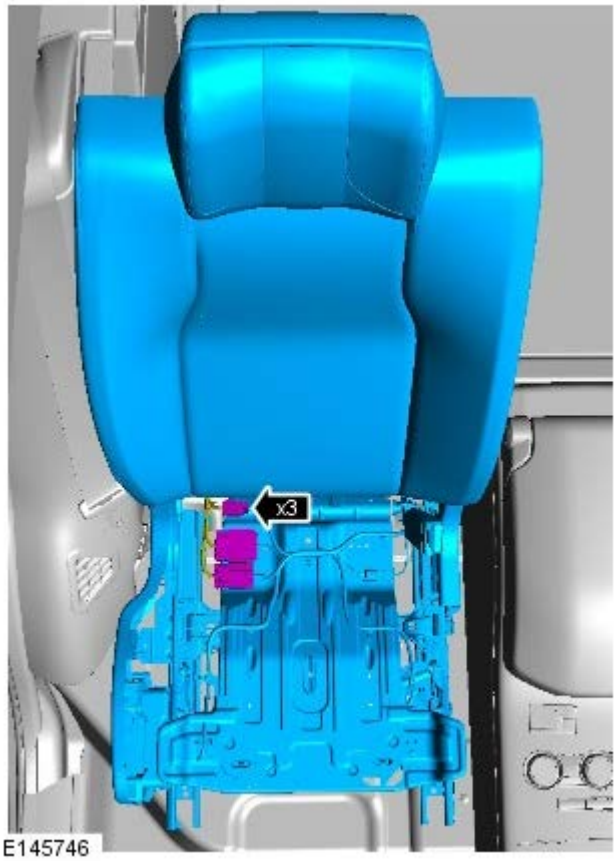
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13. *Torque:* 50 Nm

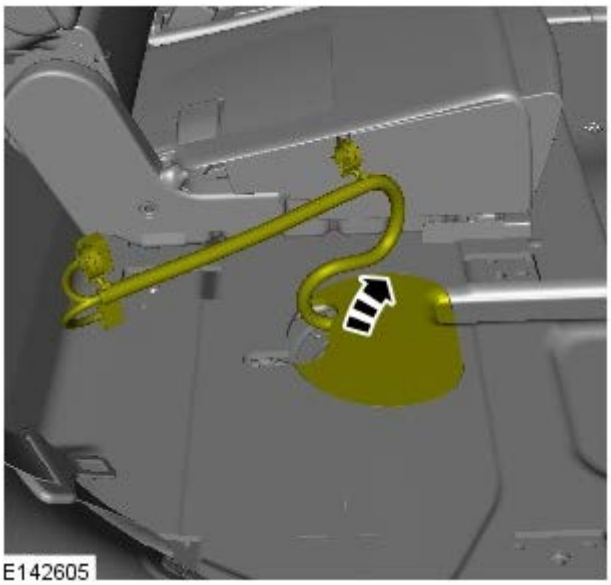


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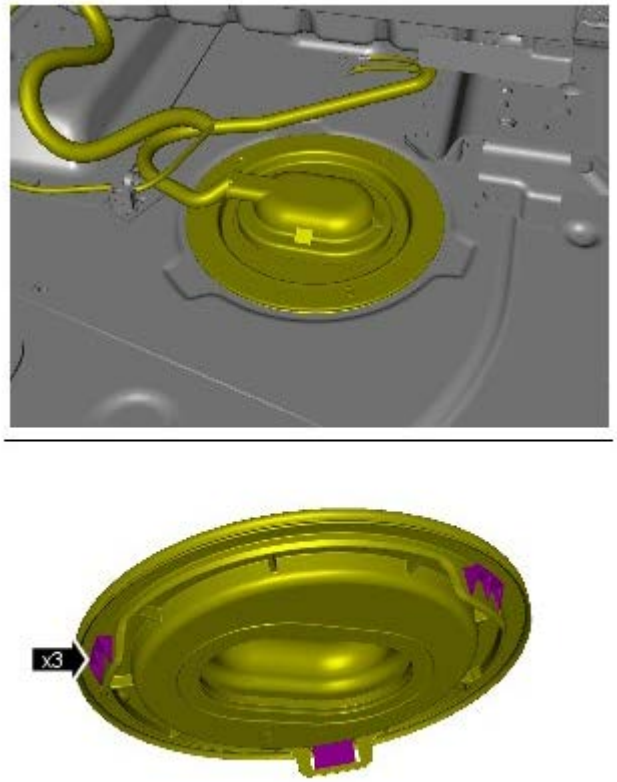


All vehicles

15.



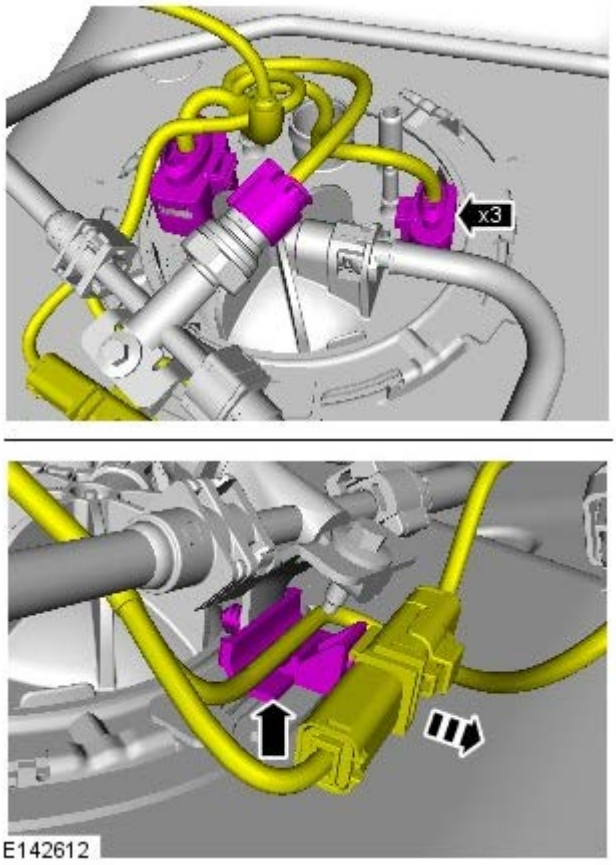
16.



E142604

Vehicles with petrol engine

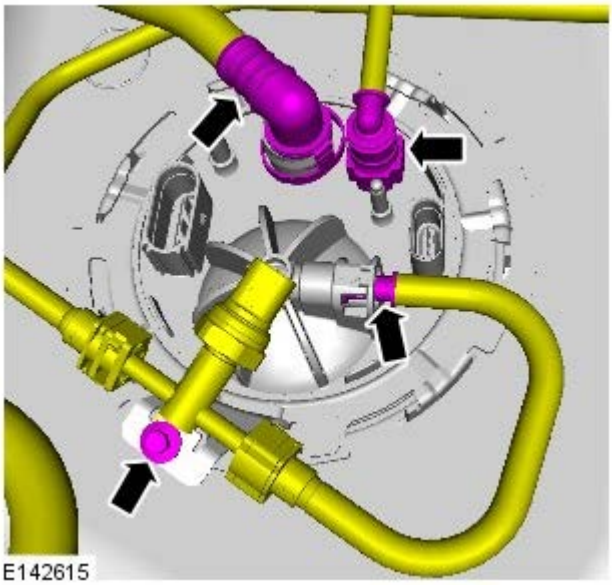
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E142612

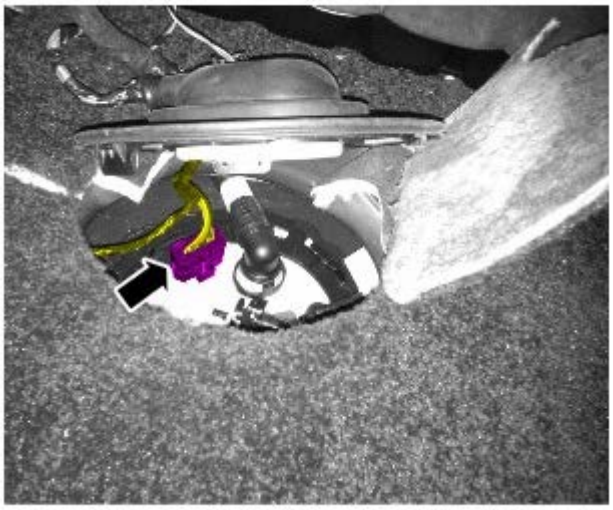
18. CAUTION: Be prepared to collect escaping fuel.

Torque: 7 Nm

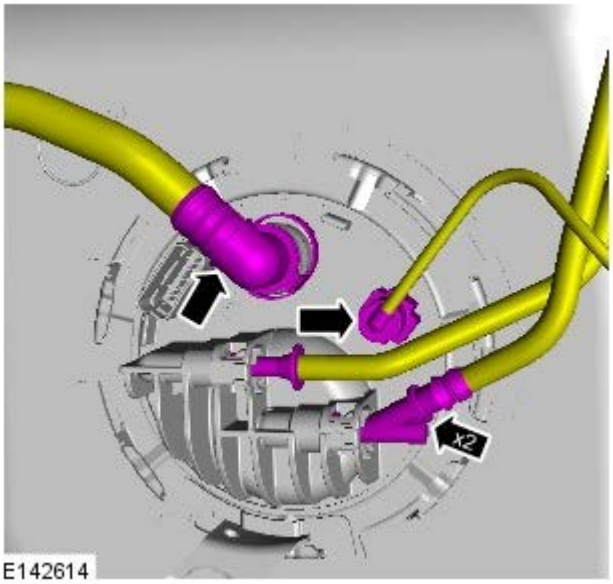

E142615

Vehicles with diesel engine

19.


E142611

20. CAUTION: Be prepared to collect escaping fuel.



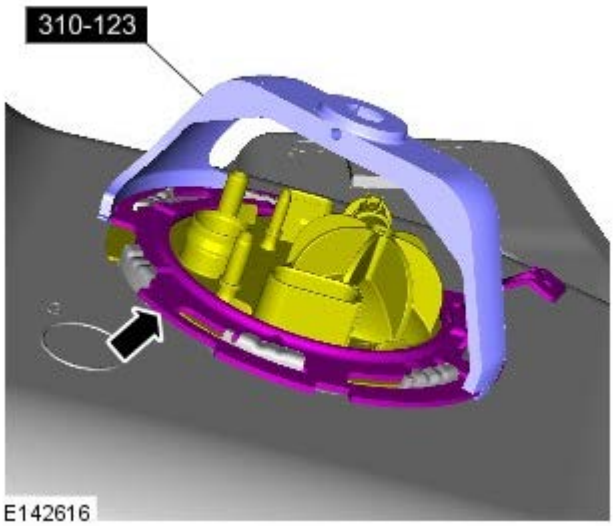
E142614

All vehicles

21. NOTE: Some variation in the illustrations may

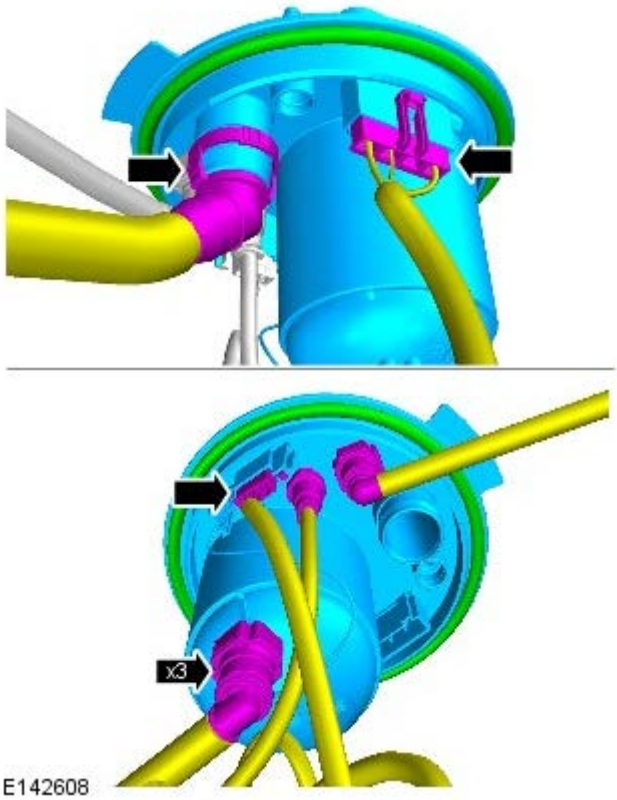
occur, but the essential information is always correct.

Special Tool(s): 310-123



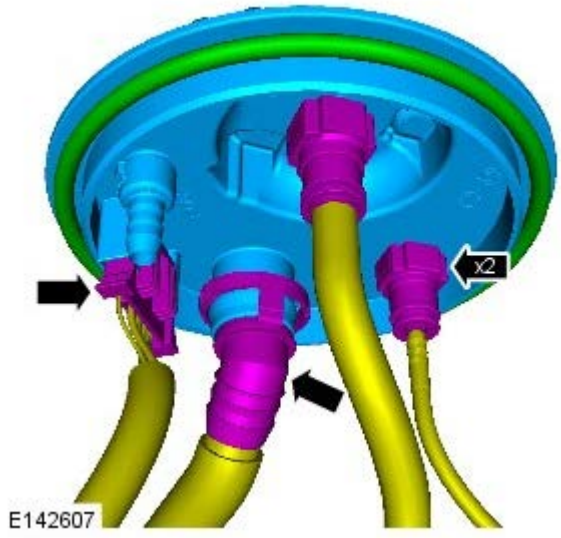
Vehicles with petrol engine

22. CAUTION: A new O-ring seal is to be installed.

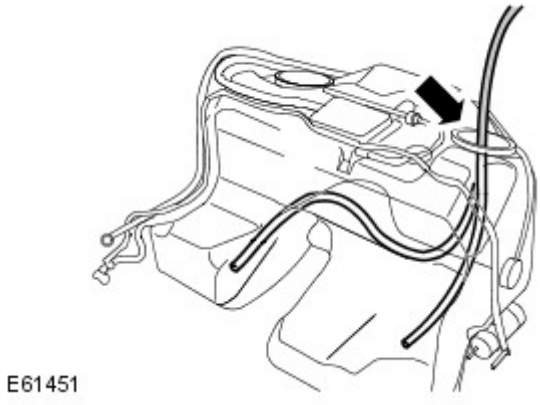


Vehicles with diesel engine

23. CAUTION: A new O-ring seal is to be installed.



24. Connect the fuel tank drain equipment ground cable to the vehicle.



25. CAUTION: Follow the manufacturer's instructions.

NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Filling

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. To install, reverse the removal procedure.

Published: 31-Jul-2012

Fuel System - General Information - High-Pressure Fuel System Bleeding

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 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.

 If fuel contacts the eyes, flush the eyes with cold water or eyewash solution and seek immediate medical attention.

 If fuel contacts the eyes, flush the eyes with cold water or eyewash solution and seek immediate medical attention.

 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:

 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.

1. Set the ignition to the ON position.
2.  CAUTION: Do not crank the engine for more than 20 seconds.

   Start the engine.
3.  NOTE: If the engine does not start, wait for 5 seconds and repeat step 2.

   Set the ignition to the OFF position.

Published: 31-Jul-2012

Fuel System - General Information - Low-Pressure Fuel System Bleeding

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 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.

 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:

 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.

1. Set the ignition to the ON position.
   - Wait for 30 seconds.
2. Set the ignition to the OFF position.

Published: 02-May-2013

Fuel Tank and Lines - TDV6 3.0L Diesel -

Capacities

	Liters
Fuel tank capacity	80 (usable)

General Specifications

Item	Specification
Fuel system	Mechanical - recirculating
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	Dual stage electric - submersible - located in fuel tank
Fuel cooler	Located on the left front suspension top mount assembly
Fuel filter	Remotely located on the left front suspension top mount assembly - fitted with a renewable element
Fuel tank sender units	Two - active and passive - passive sender unit is attached to the removable retaining bracket and the active sender unit 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

Torque Specifications

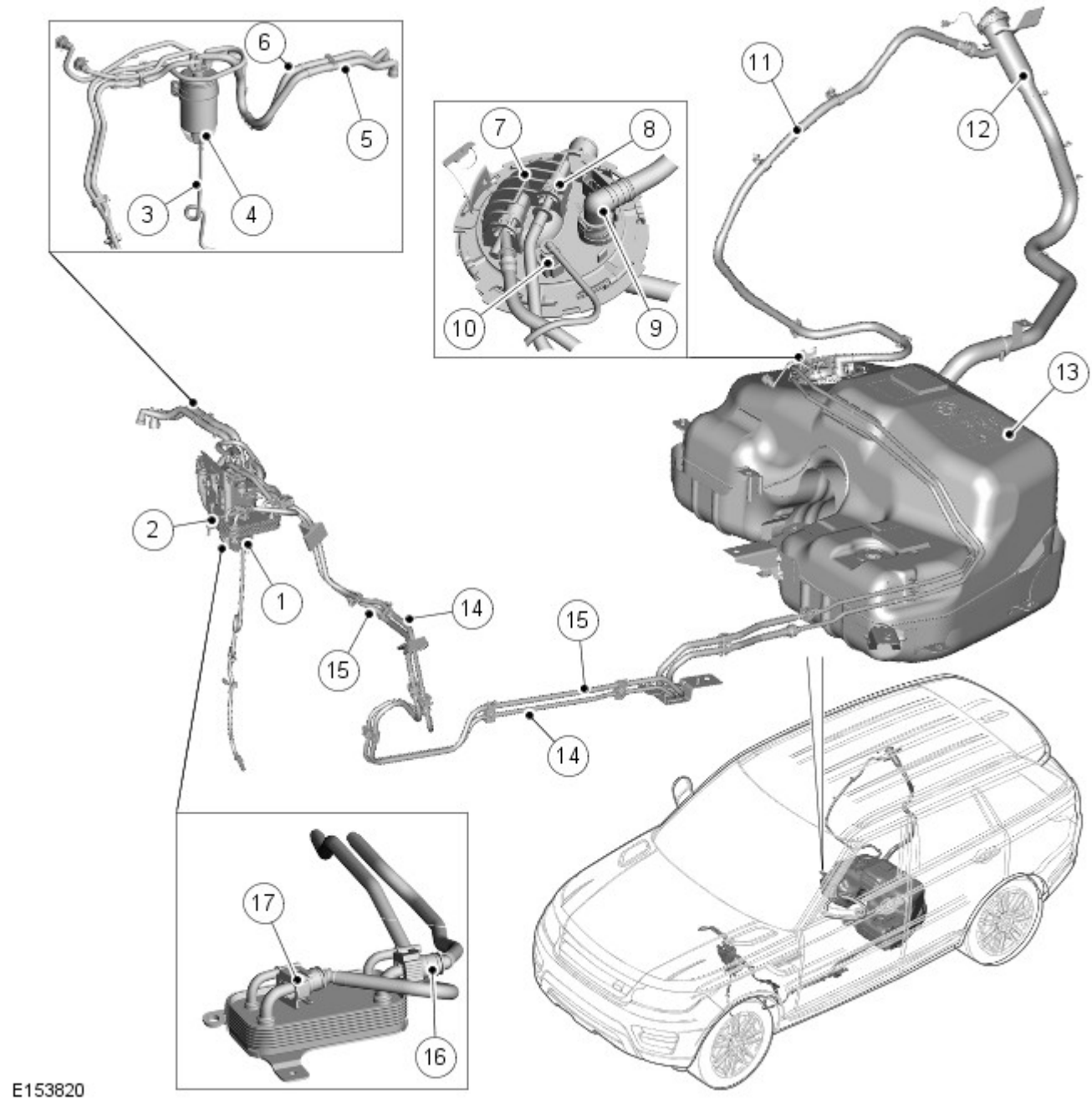
Description	Nm	lb-ft	lb-in
Air conditioning (A/C) refrigerant lines retaining bolts	10	7	-
Fuel cooler retaining bolts	9	-	80
Fuel tank internal bracket retaining bolt	7	-	62
Fuel tank filler pipe retaining nuts	9	-	80
Fuel tank filler pipe hose clamp	3.5	-	31
Fuel tank shield retaining bolts	45	33	-
Fuel tank shield to fuel tank bolt	10	7	-

Published: 21-Jan-2014

Fuel Tank and Lines - TDV6 3.0L Diesel - Fuel Tank and Lines

Description and Operation

TDV6 3.0L DIESEL - FUEL TANK AND LINES - COMPONENT LOCATION



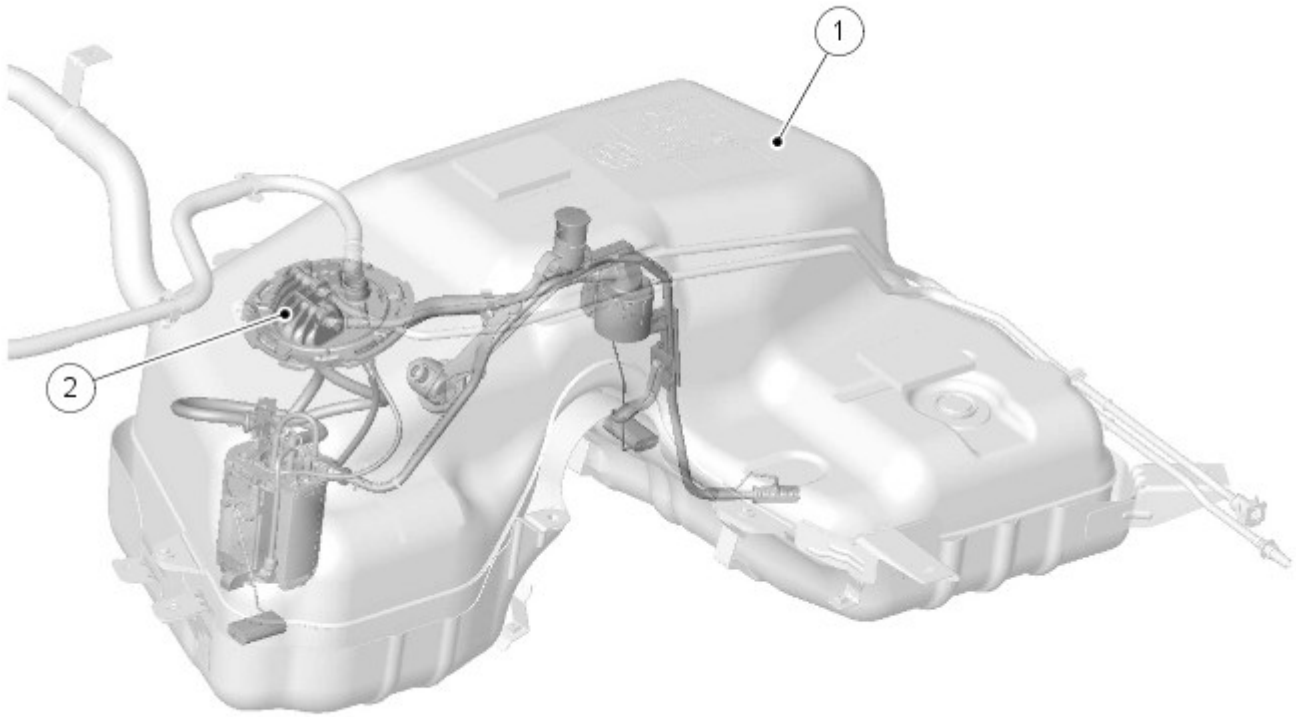
Item	Part Number	Description
1	-	Fuel Filter
2	-	Fuel Cooler
3	-	Water/Fuel Mix Drain Hose
4	-	Water/Fuel Mix Drain Turn Wheel
5	-	Fuel Supply to High Pressure (HP) fuel pump
6	-	Fuel Return from High Pressure (HP) fuel pump to Fuel Cooler
7	-	Fuel Supply to Fuel Filter
8	-	Fuel Return from Fuel Filter
9	-	Fuel Tank Refueling Breather Pipe Connection
10	-	Fuel Fired Booster Heater (FFBH) Supply
11	-	Fuel Tank Refueling Breather Pipe
12	-	Fuel Filler Pipe
13	-	Fuel Tank
14	-	Fuel Supply Line
15	-	Fuel Return Line

16	-	Fuel Cooler to Fuel Filter Pipe
17	-	High Pressure (HP) fuel pump to Fuel Cooler Pipe

INTRODUCTION

The TDV6 3.0L diesel engine LP (Low Pressure) fuel system is designed to supply fuel to the HP (High Pressure) fuel pump, it can supply a uniform level of pressure to the common rails which supply's the fuel injectors.

FUEL TANK



E154567

Item	Part Number	Description
1	-	Fuel tank
2	-	Fuel tank module tank flange

The fuel tank has a storage capacity of 80 litres (usable).

Inside the fuel tank, you will find the location of the low pressure fuel pump module assembly.

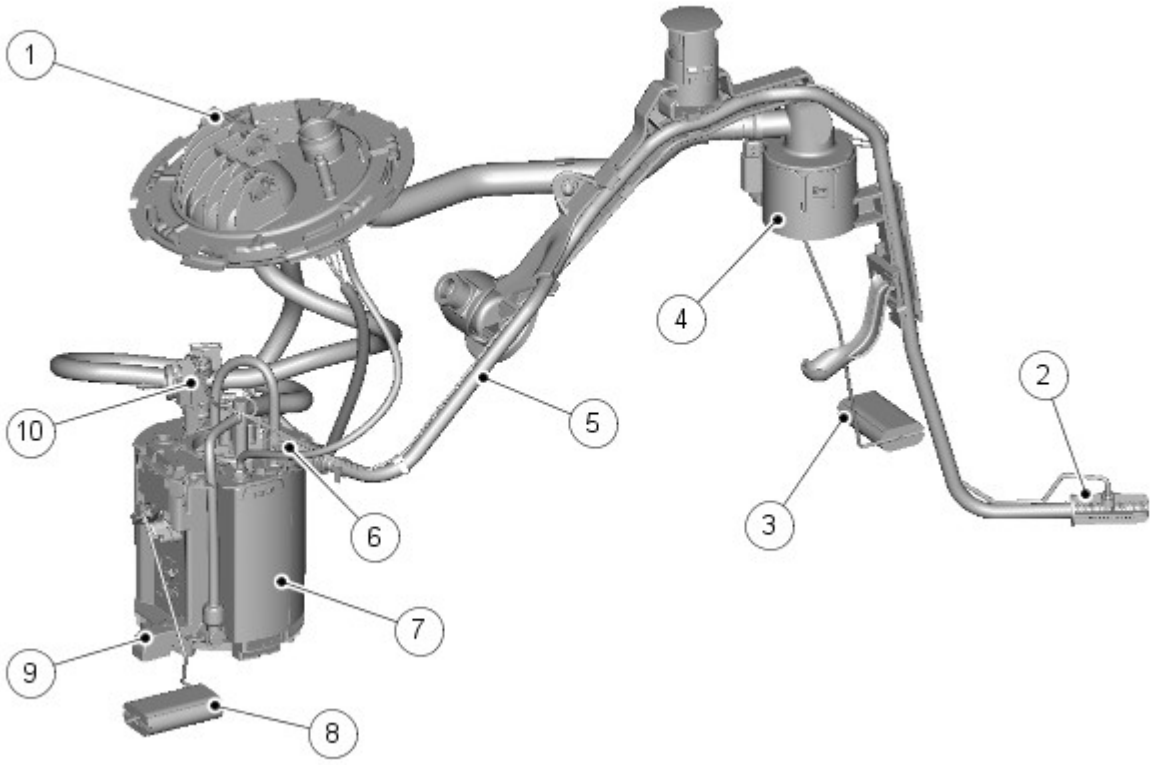
Access to the fuel tank is via the removal of the rear seat, and removal of the LP pump module flange located on the right side of the tank.

Within the fuel tank in the upper left side centre section, a fuel cut-off is integrated into the center bracket. This is to control the fuel fill volume of the tank. During the refuelling process, air/vapour is displaced (by the fuel entering the tank) and exits the tank via the cut-off and is conveyed by the fuel tank refuelling breather pipe to exit the system. During filling, as the tank reaches its full level, the fuel cut-off is closed by the rising fuel and prevents air/vapour passing through to the refuelling breather pipe. The resulting back pressure causes refuelling to stop automatically.

The fuel cut-off is always open when the fuel tank is below full, providing an unrestricted air/vapour outlet to the refuelling breather pipe.

Fuel level inside the tank is monitored by two level sensors that are connected top the IC (Instrument Cluster).

FUEL PUMP MODULE



E154566

Item	Part Number	Description
1	-	Fuel Pump Module Tank Flange
2	-	Suction Port Filter
3	-	Fuel Level Sensor Float 'B'
4	-	Fuel Cut-Off
5	-	Suction Port Pipe
6	-	Venturi Pump
7	-	Swirl Pot
8	-	Fuel Level Sensor Float 'A'
9	-	Fuel Pump Coarse Filter
10	-	Pressure Relief Valve (PRV)

The fuel pump module is controlled by the ECM (Engine Control Module) via the fuel pump relay located in the RJB (Rear Junction Box).

The electric pump collects fuel from the swirl pot at the base of the pump and passes it from the tank to the fuel supply line to the engine mounted, HP pump at a pressure of 0.5 bar.

Fuel is collected from the left side of the tank to the right side of the tank by using a single suction tube that transfers the fuel using a venturi pump which is powered by the fuel feed from the fuel pump.

Should the fuel pump electrical connection need to be disconnected, it is important that the ignition is switched off. If the ignition is on in positions I or II, the instrument cluster will store its last fuel gauge needle position prior to power down. Once power is restored the gauge will display the last stored position regardless of the actual level of fuel in the tank.

This could result in incorrect fuel gauge readings if the fuel tank has been drained and not filled with exactly the same quantity of fuel that was removed.

Low Fuel Strategy

The ECM is programmed with a strategy which shuts the engine off before the fuel tank runs dry. This is to prevent fuel system damage by air being drawn into the HP fuel pump.

A misfire is induced with increasing magnitude when the fuel in the tank reaches approximately 2.5 litres of useable fuel remaining to alert the driver to this condition. The engine is shut down when the fuel in the tank reaches 0.00 litres of useable fuel remaining in the tank and 4.0 litres of un-useable fuel remaining.

To reset the fuel strategy after engine shutdown, it is required that a minimum of 4 litres of fuel is added to the fuel tank, when the vehicle is on level ground.

FUEL LEVEL SENSORS

There are two fuel level sensors located inside the fuel tank. Fuel level sensor 'A' is attached to the swirl pot and monitors fuel level on the right side of the tank. Fuel Level sensor 'B' is attached to the suction pipe carrier and monitors fuel level on the left side of the tank.

Both level sensors are (MAPPS) MAgnetic Passive Position Sensor which provide a variable resistance to ground for the output from the fuel gauge.

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 IC 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.

Fuel Level Sensors - Resistance/Fuel Gauge Read Out Table

NOTE: These figures are with the vehicle on level ground. Sensor readings will defer with varying vehicle inclinations.

Fuel Level Sensor 'A':-

Sender Unit Resistance, Ohms	Nominal Gauge Reading
992	Empty
51	Full

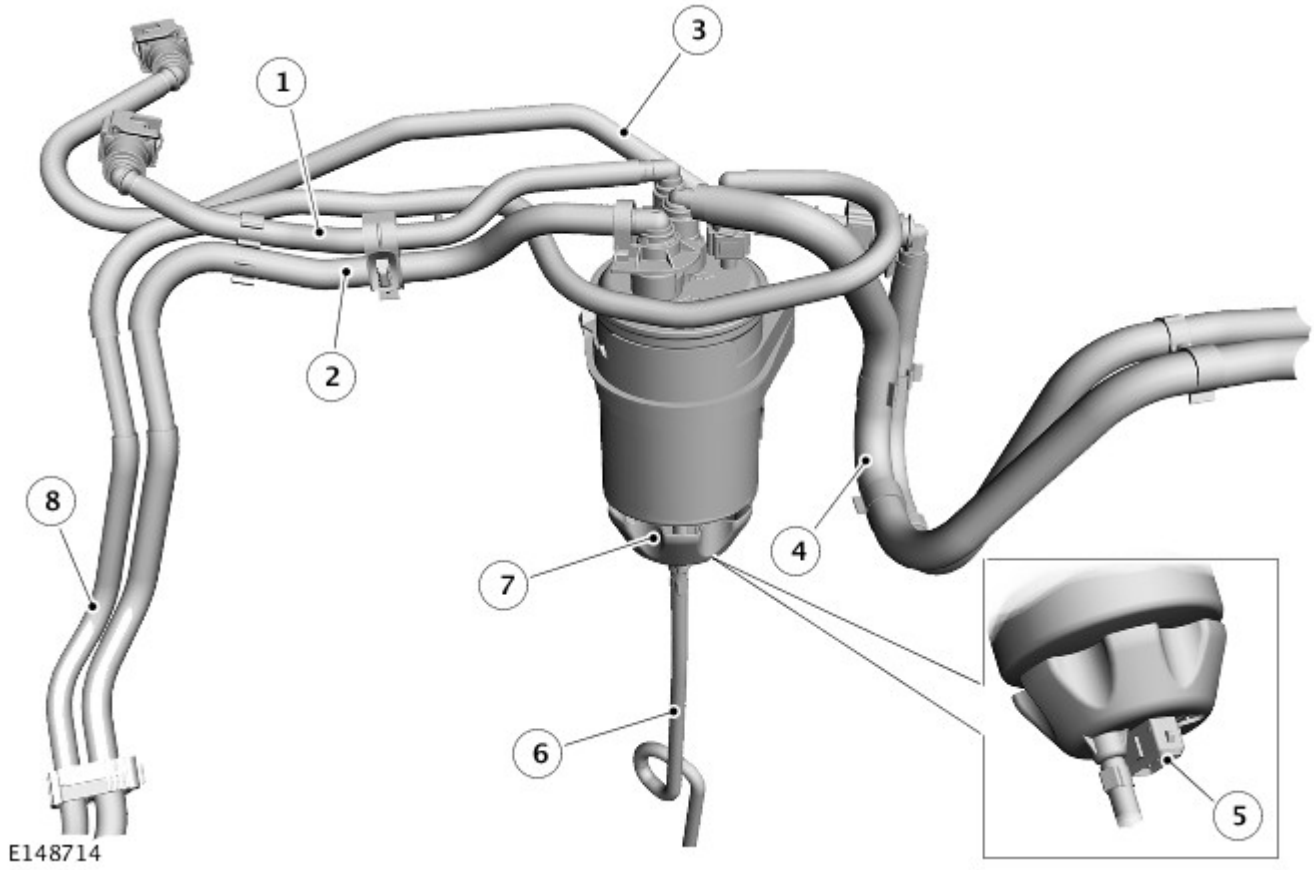
Fuel Level Sensor 'B':-

Sender Unit Resistance, Ohms	Nominal Gauge Reading
992	Empty
181	Full

When the fuel level becomes low, a fuel warning lamp in the IC is illuminated and message is displayed.

The fuel level sender signal is converted into a high speed CAN (Controller Area Network) Powertrain bus message by the IC as a direct interpretation of the fuel tank contents in litres.

FUEL FILTER



Item	Part Number	Description
1	-	Fuel Cooler to Fuel Filter Pipe
2	-	Fuel Supply to Fuel Filter Pipe
3	-	High Pressure Fuel Pump to Fuel Cooler Pipe
4	-	Fuel Filter to High Pressure Fuel Pump Pipe
5	-	Water/Fuel Mix Drain Turn Wheel
6	-	Water/Fuel Mix Drain Hose
7	-	Water in fuel sensor

8	-	Fuel return to Fuel tank

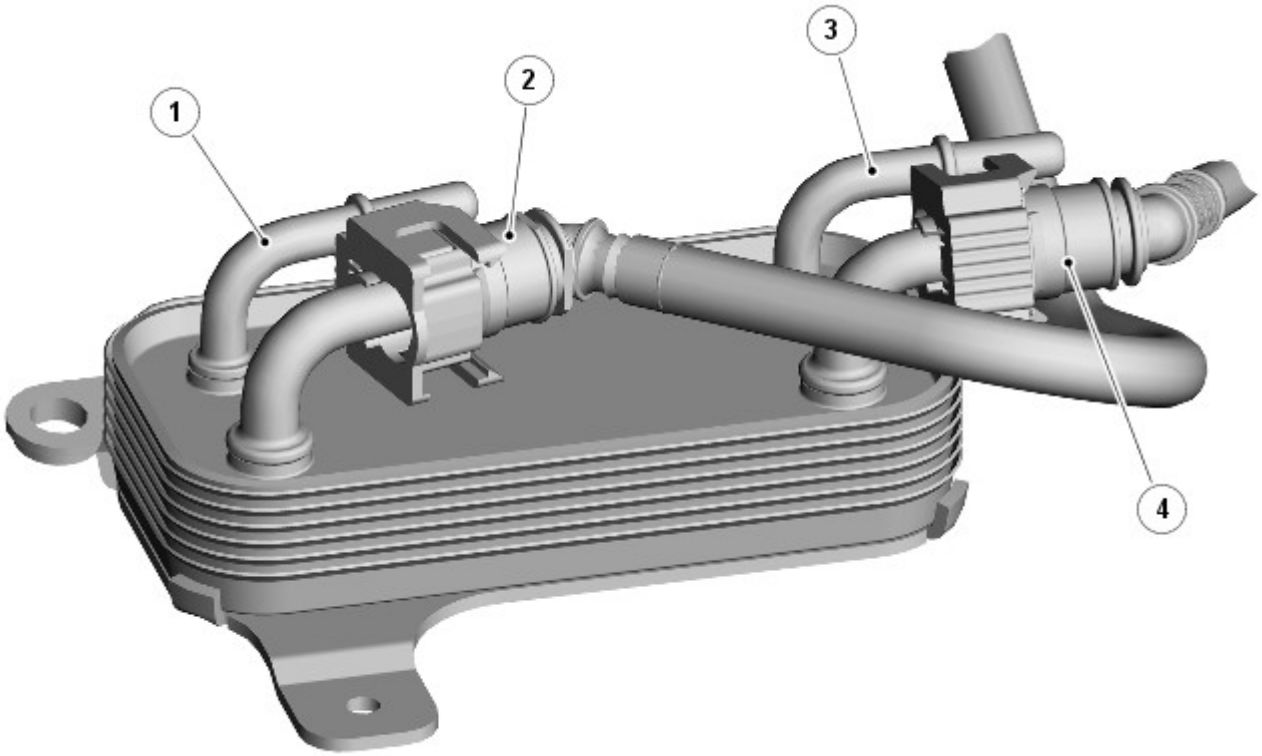
The fuel filter is disposable canister that has four quick release connections.

The fuel filter is fitted with a removable water sensor which is secured at the base of the filter. The sensor can be unscrewed and fitted to a new filter.

The water in fuel sensor housing also incorporates a water drain plastic turn wheel that allows the water/fuel mix to be drained from the filter via the drain hose to the underside of the vehicle.

Water in the fuel filter is sensed by the ECM, the ECM transmits a message on the high speed CAN Powertrain bus to the IC which displays a message 'WATER IN FUEL' in the message centre.

FUEL COOLER



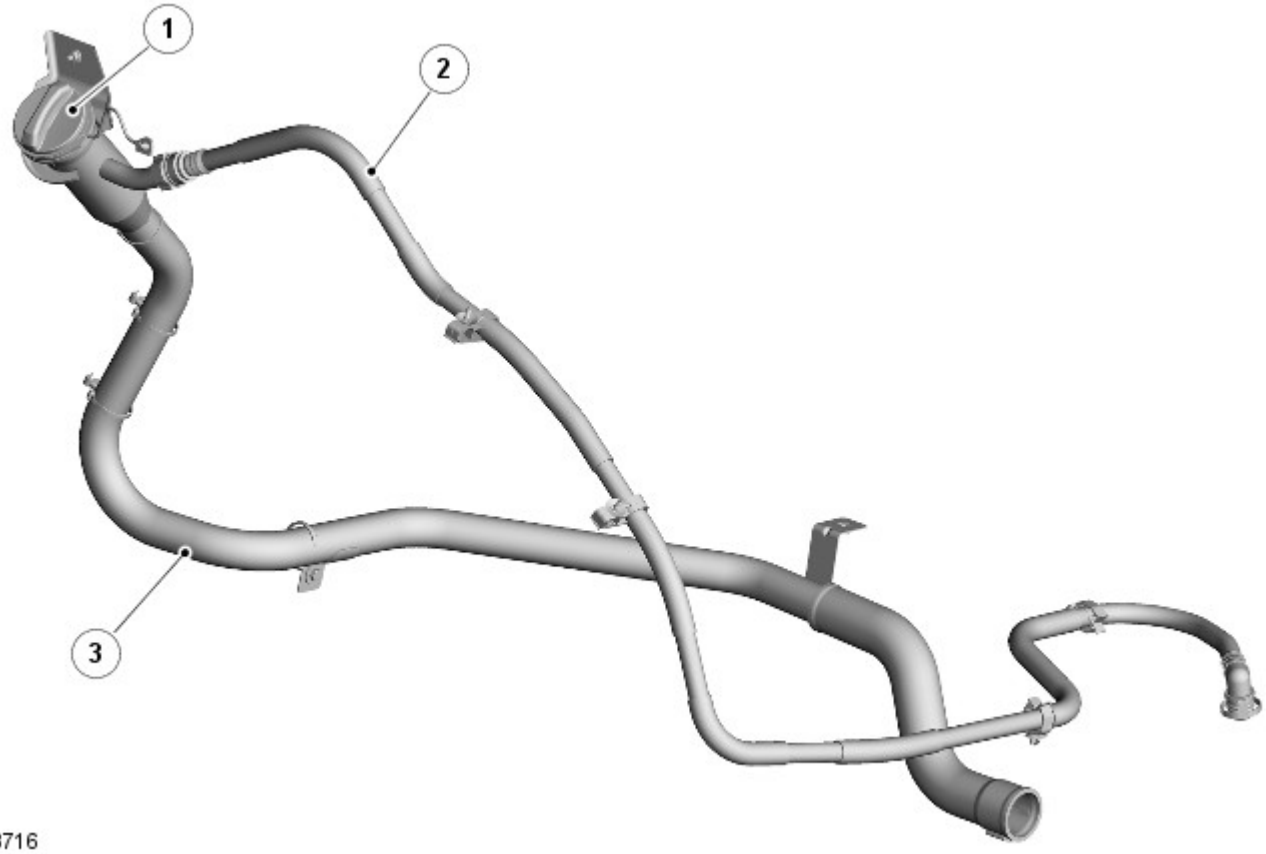
E148715

Item	Part Number	Description
1	-	Coolant Inlet Connection
2	-	Fuel Inlet Connection
3	-	Coolant Outlet Connection
4	-	Fuel Outlet Connection

The fuel cooler is designed to cool fuel returning from the HP pump before it is sent back to the fuel tank via the return line. Fuel is cooled by heat transfer through the internal galleries within the coolant assisted fuel cooler.

The fuel cooler is connected to the cooling system. The fuel cooler receives cooled coolant from a dedicated cooler located in front of the engine coolant radiator. This allows for engine coolant to be cooled before it passes through the fuel cooler improving the efficiency of the fuel cooler.
For additional information, refer to: Engine Cooling (303-03A Engine Cooling - TDV6 3.0L Diesel, Description and Operation).

FUEL FILLER PIPE



E148716

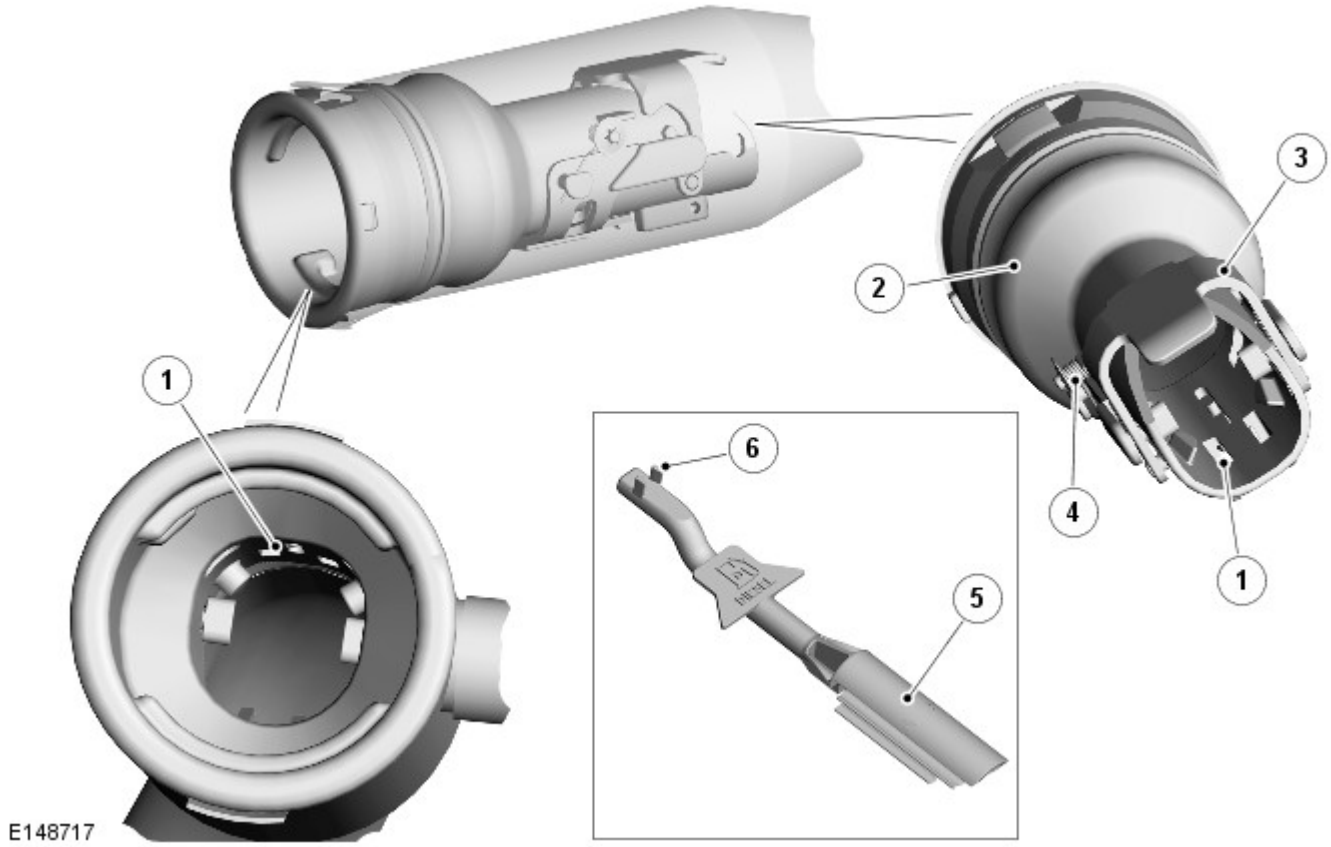
Item	Part Number	Description
1	-	Fuel Cap
2	-	Fuel Refuelling Breather Pipe
3	-	Fuel Filler Pipe

The fuel filler pipe locates into the tank and incorporates a spit back flap in the tank end of the pipe. The flap is spring loaded cover which acts as a one way valve, allowing the tank to be filled but preventing fuel leaving the tank into the filler pipe.

A connection at the top right side of the filler head allows for the connection of the fuel tank refuelling breather pipe.

The filler pipe incorporates a fuel guard system to prevent accidental filling of the tank with petrol.

FUEL GUARD



Item	Part Number	Description
1	-	Reset Slots
2	-	Filler Neck
3	-	Flap
4	-	Spring
5	-	Reset Tool
6	-	Spigots

The fuel guard system is developed to prevent the accidental filling of a diesel vehicle with petrol.

The petrol fuel guard comprises a mechanically operated flap which is triggered when the smaller diameter filler nozzle tube, used on petrol 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.

A reset tool is provided and stored in the luggage compartment. The tool is used to reset the petrol fuel guard device if triggered.

Two spigots on the tool locate into slots in the filler neck and then pull outwards, which then will release a latch and then allow the flap to open by its own spring pressure. The flap is coloured yellow so that it is clearly visible when activated and has 'Handbook' symbol on it.

Published: 26-Feb-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 mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
• Fuel level • Contaminated fuel • Fuel supply line(s) • Fuel return line(s) • High-pressure fuel supply line(s) • Fuel tank filler pipe • Fuel leak(s) • Fuel tank • Fuel filler cap • Fuel filter • Push connect fittings • Fuel rail • Fuel injection pump • Exhaust gas recirculation system	• Battery charge and condition • Fuse(s) • Fuel pump module relay • Fuel pump module • Electrical connector(s) • Damaged or corroded wiring harness • Fuel volume control valve • Fuel pressure control valve • 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.

Symptom Chart

Symptom	Possible Causes	Action
Engine cranks, but does not start	• 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 sensor	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, check for DTCs indicating a fuel volume or pressure control valve fault. Check the fuel pump. Check the crankshaft position sensor circuits. Refer to the electrical guides
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 valve(s) fault	Check the glow plug circuits. Refer to the electrical guides. 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, check for DTCs indicating a fuel volume or pressure control valve fault. Check the exhaust gas recirculation system
Rough idle	• Intake air system fault • Low/contaminated	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

	• fuel • Low-pressure fuel system fault • Blocked fuel filter • Fuel volume control valve blocked/contaminated • Fuel pressure control valve blocked/contaminated • Exhaust gas recirculation valve(s) fault	in the fuel. Check the low-pressure fuel system for leaks/damage. Check the fuel filter, check for DTCs indicating a fuel volume or pressure control valve fault. Check the exhaust gas recirculation system
Lack of power when accelerating	• Intake air system fault • Restricted exhaust system • Low fuel pressure • Exhaust gas recirculation 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. Check for DTCs indicating a fuel pressure fault. Check the exhaust gas recirculation 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 valve(s) 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: Check for DTCs indicating a fuel volume or pressure control valve fault. Check the exhaust gas recirculation 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. Check the intake air system for leaks. Check the low-pressure fuel system for leaks/damage. Check the high pressure fuel system for leaks, check for DTCs indicating a fuel volume or pressure control valve fault. Check the fuel pump
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 valve(s) fault	Check the low-pressure fuel system for leaks/damage. Check for DTCs indicating a fuel volume or pressure control valve fault. Check the fuel temperature sensor, fuel pump, etc for leaks. Check for injector DTCs. Check the exhaust gas recirculation 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: 13-Sep-2012

Fuel Tank and Lines - TDV6 3.0L Diesel - Fuel Cooler

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.

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 mixtures 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 medical attention.

CAUTION: 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.

NOTES:

Removal steps in this procedure may contain installation details.

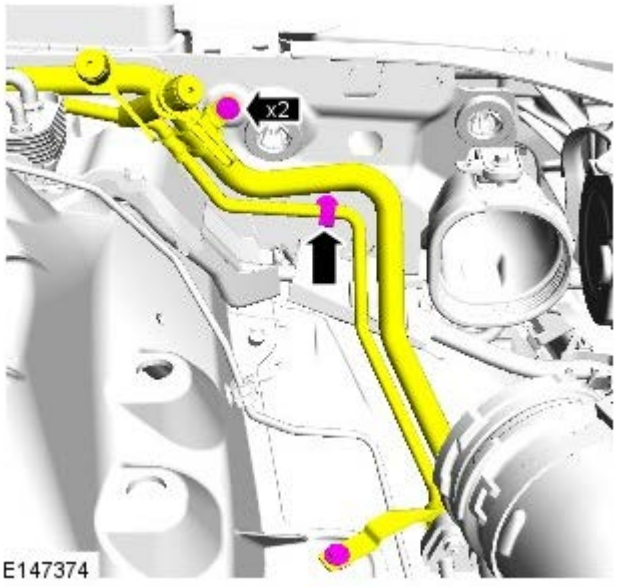
Some variation in the illustrations may occur, but the essential information is always correct.

1. Disconnect the battery ground cable.

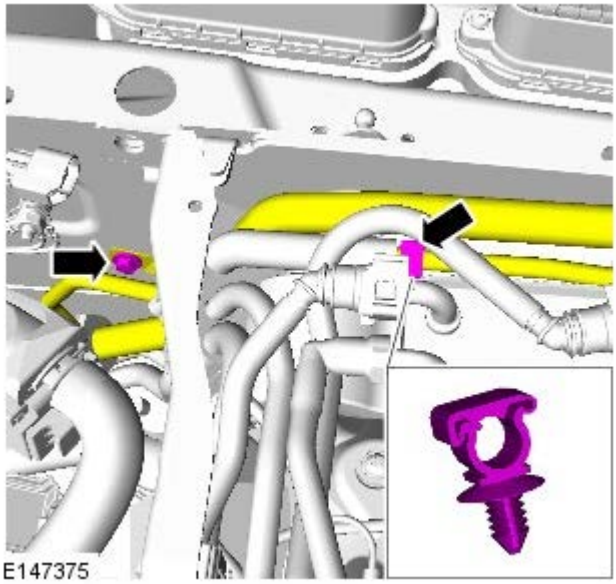
   Refer to: Specifications (414-00, Specifications).

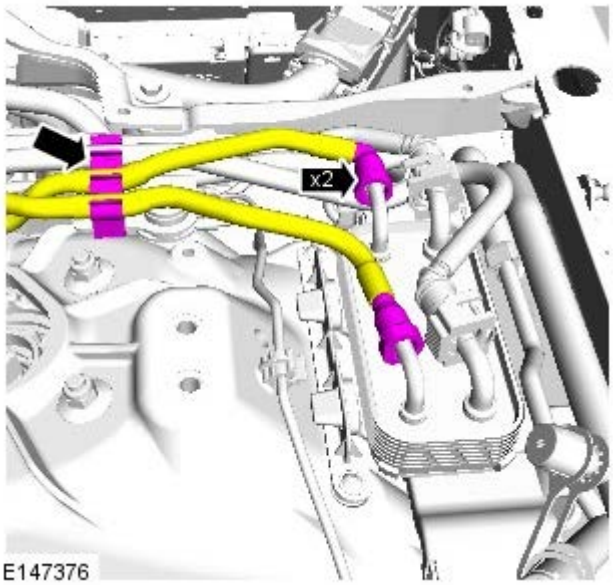
2. Refer to: Air Cleaner LH (303-12A Intake Air Distribution and Filtering - TDV6 3.0L Diesel, Removal and Installation).

3. *Torque:* 10 Nm



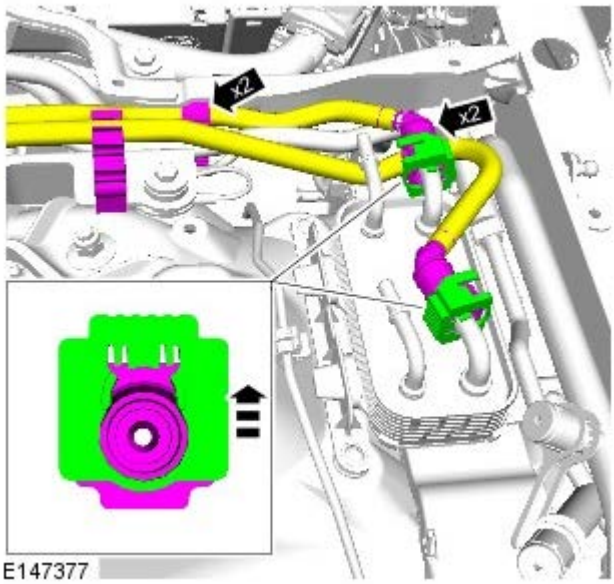
4. *Torque:* 10 Nm





5. CAUTION: Be prepared to collect escaping coolant.

NOTE: Make sure that all openings are sealed. Use new blanking caps.

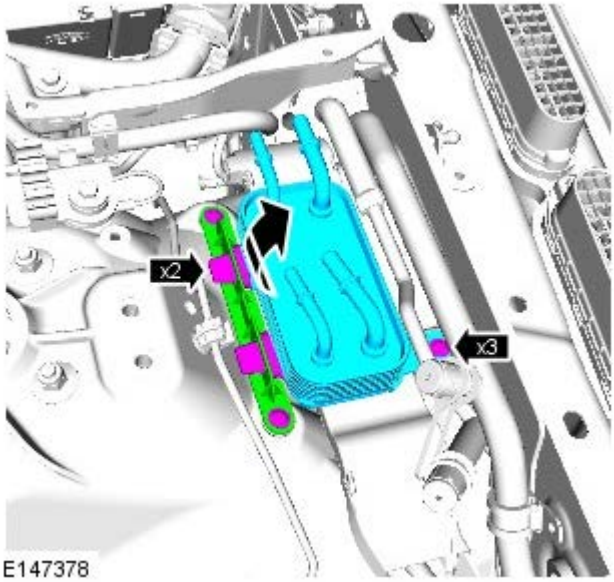


6. CAUTIONS:

Make sure that all openings are sealed. Use new blanking caps.

Be prepared to collect escaping fuel.

7. *Torque:* 10 Nm



Installation

1. To install, reverse the removal procedure.

Published: 09-Aug-2012

Fuel Tank and Lines - TDV6 3.0L Diesel - Fuel Filter Element

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.

The spilling of fuel is unavoidable during this operation. Make sure that all necessary precautions are taken to prevent fire and explosion.

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.

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.

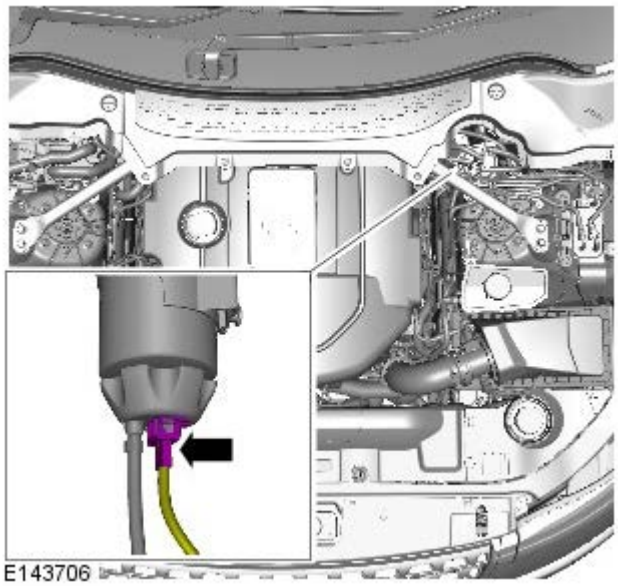
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Diesel Fuel System Health and Safety Precautions (100-00 General Information, Description and Operation).

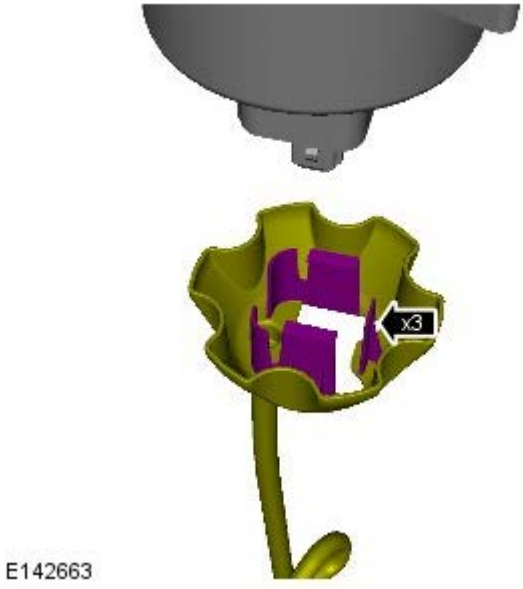
2. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

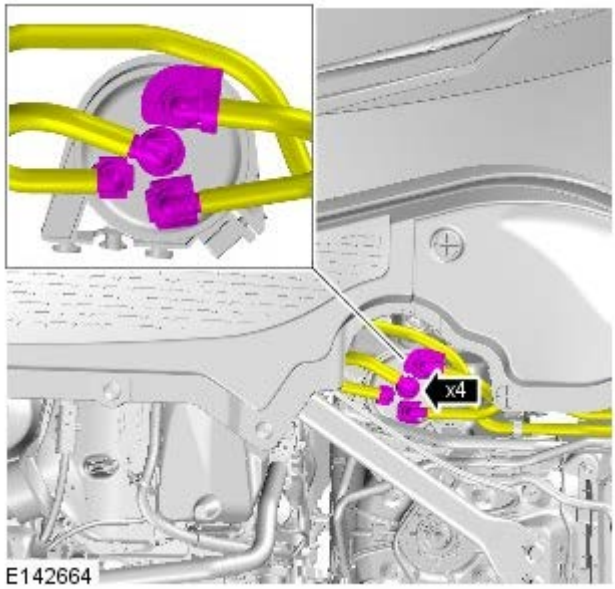
3.



4.



E142663



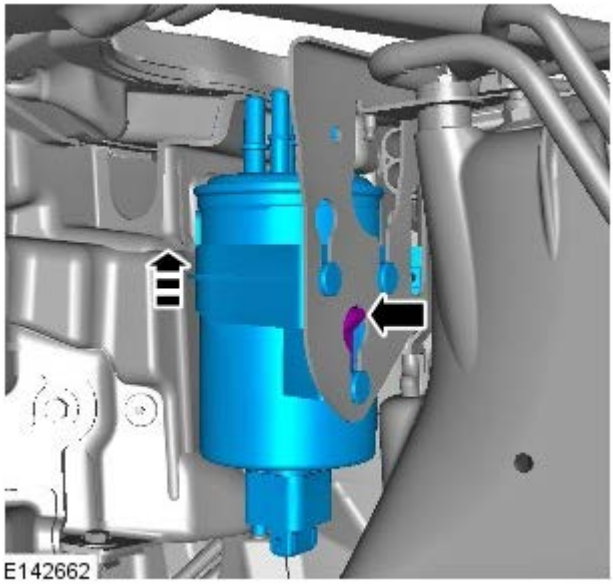
E142664

5. CAUTIONS:

   Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

   Be prepared to collect escaping fuel.

6.


E142662

7. CAUTION: Note the fitted position of the component prior to removal.



E142661

Installation

1. CAUTION: Make sure that the fuel filter is correctly aligned. Failure to follow this instruction may result in damage to the vehicle.

   To install, reverse the removal procedure.

2. Refer to: Low-Pressure Fuel System Bleeding (310-00 Fuel System - General Information, General Procedures).

Published: 12-Sep-2012

Fuel Tank and Lines - TDV6 3.0L Diesel - Fuel Level Sender

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.

 The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.

 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.

 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.

 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.

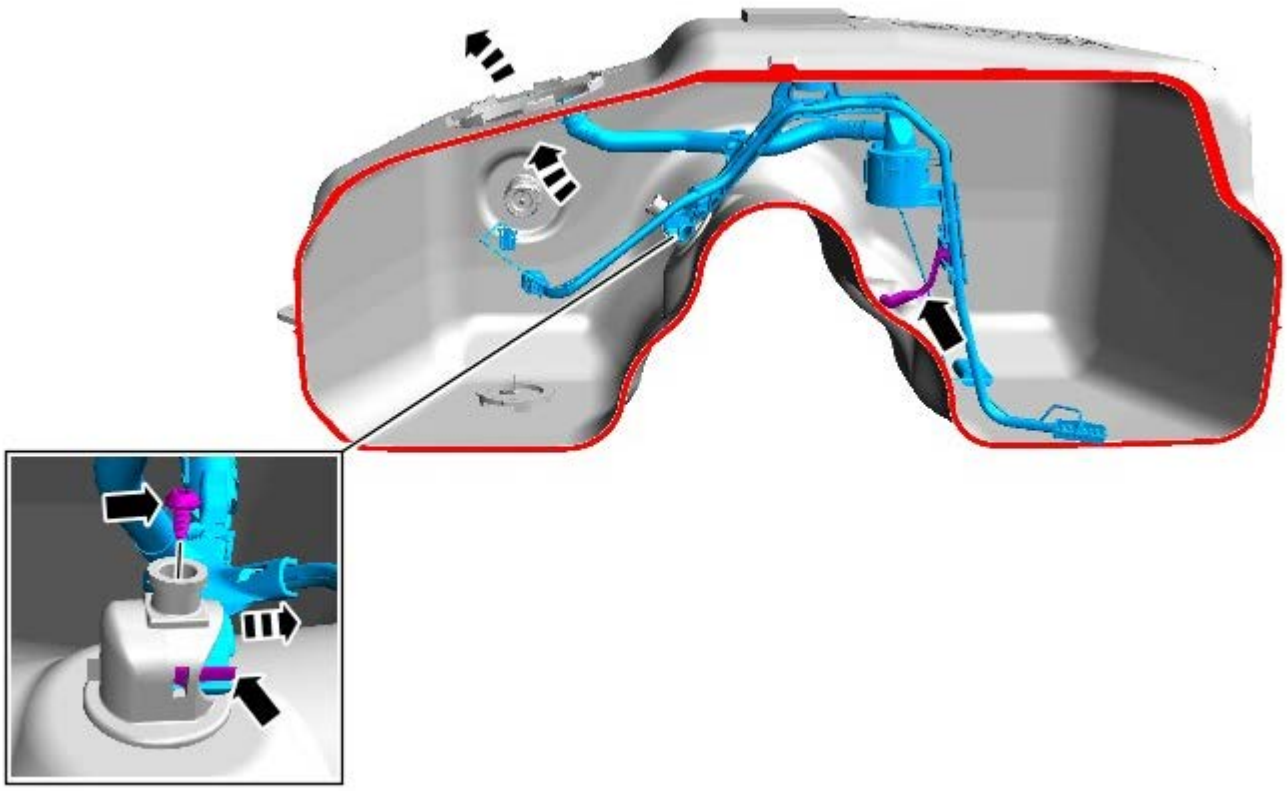
2. Refer to: Diesel Fuel System Health and Safety Precautions (100-00 General Information, Description and Operation).

3. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

4. Refer to: Fuel Pump and Sender Unit (310-01A Fuel Tank and Lines - TDV6 3.0L Diesel, Removal and Installation).

5. *Torque:* 7 Nm



E147440

Installation

1. To install, reverse the removal procedure.

Published: 13-Sep-2012

Fuel Tank and Lines - TDV6 3.0L Diesel - Fuel Pump and Sender Unit

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.

 The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.

 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.

 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.

 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.

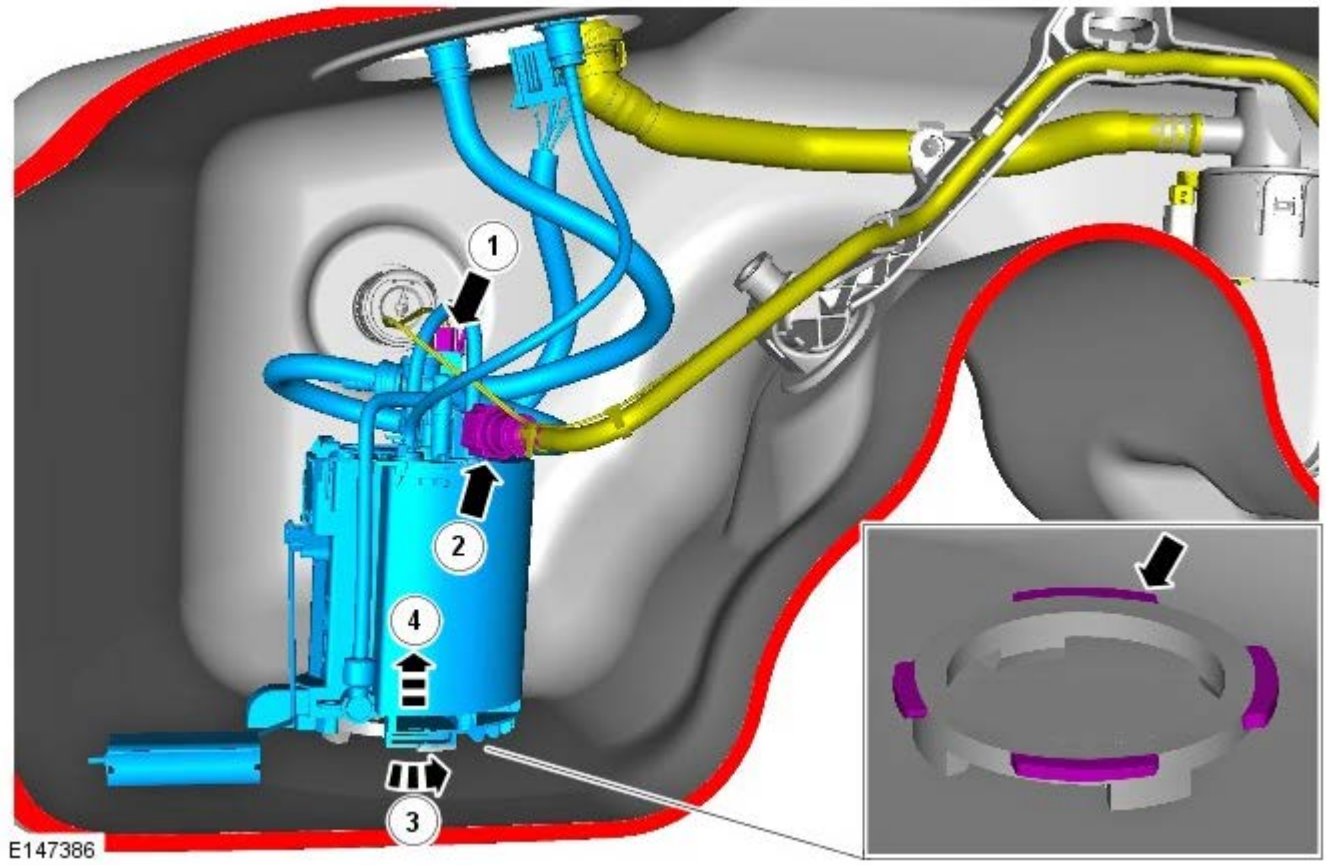
2. Refer to: Diesel Fuel System Health and Safety Precautions (100-00 General Information, Description and Operation).

3. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

4. Refer to: Fuel Tank Draining (310-00 Fuel System - General Information, General Procedures).

5.



Installation

1. To install, reverse the removal procedure.

Published: 05-Dec-2013

Fuel Tank and Lines - TDV6 3.0L Diesel - Fuel Tank

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.

The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.

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.

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.

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: Diesel Fuel System Health and Safety Precautions (100-00 General Information, Description and Operation).

3. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

4. Refer to: Fuel Tank Draining (310-00 Fuel System - General Information, General Procedures).

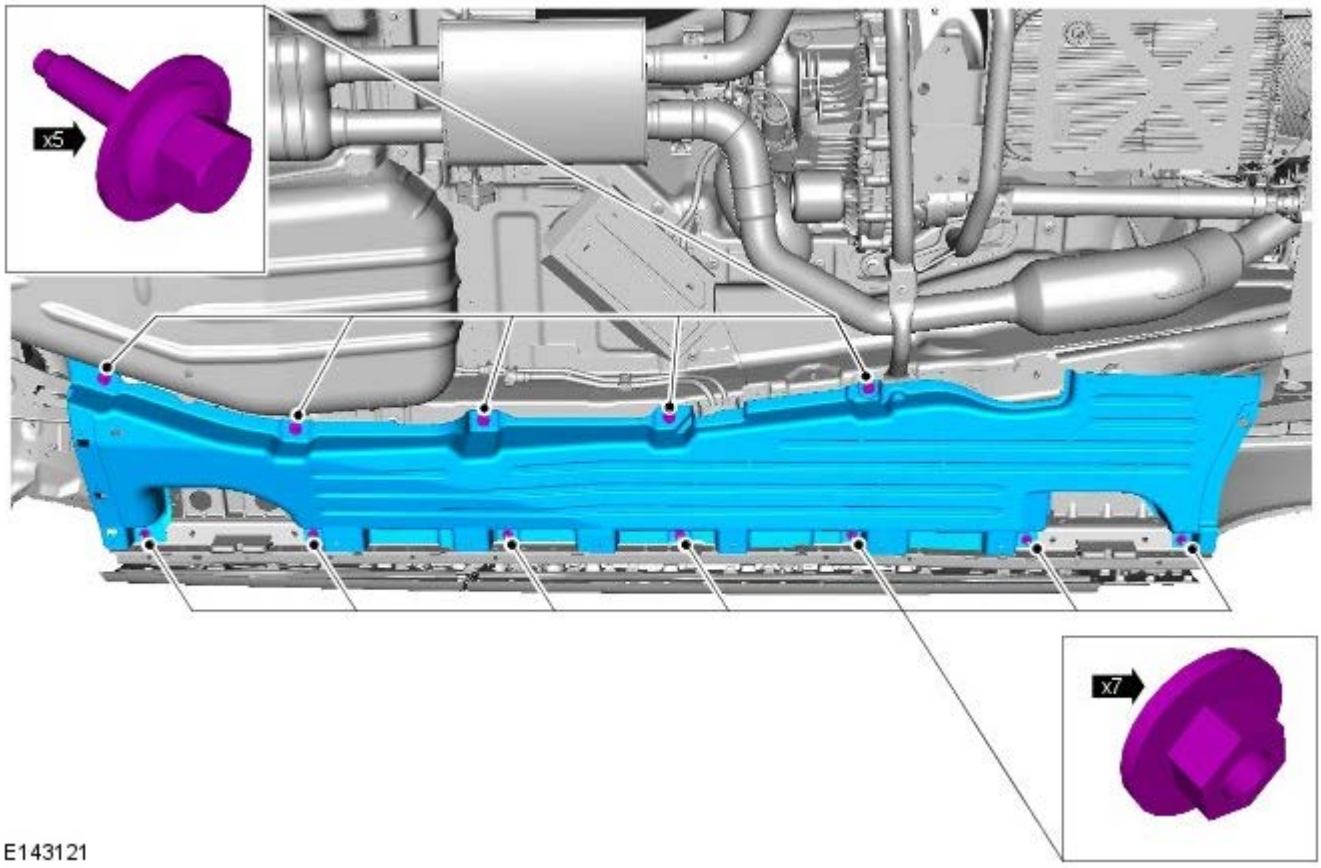
5. NOTE: Repeat the procedure for the other side.

   Refer to: Rear Rocker Panel Moulding (501-08 Exterior Trim and Ornamentation, Removal and Installation).

6. Refer to: Rear Driveshaft - TDV6 3.0L Diesel (205-01 Driveshaft, Removal and Installation).
   Refer to: Rear Driveshaft - SDV6 3.0L Diesel - Hybrid Electric Vehicle (205-01 Driveshaft, Removal and Installation).
   Refer to: Rear Driveshaft - TDV8 4.4L Diesel (205-01 Driveshaft, Removal and Installation).

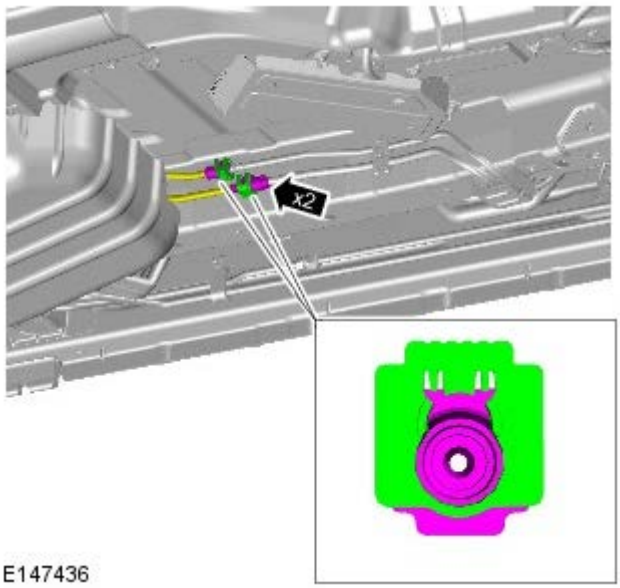
7. CAUTION: LH illustration shown, RH is similar.

NOTE: Repeat the procedure for the other side.



E143121

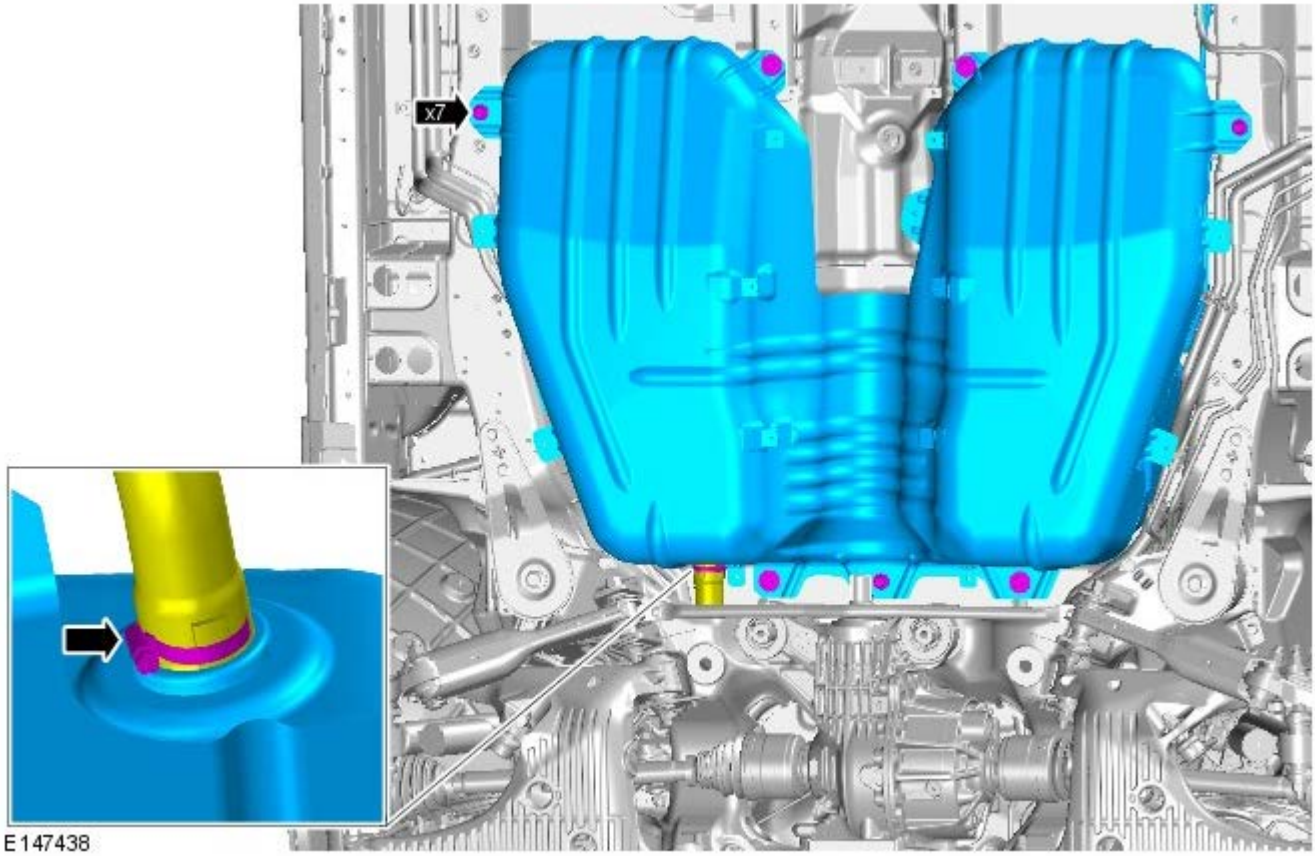
8. CAUTION: Be prepared to collect escaping fuel.



E147436

9. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Torque: 45 Nm



E147438

10. NOTE: Do not disassemble further if the component is removed for access only.



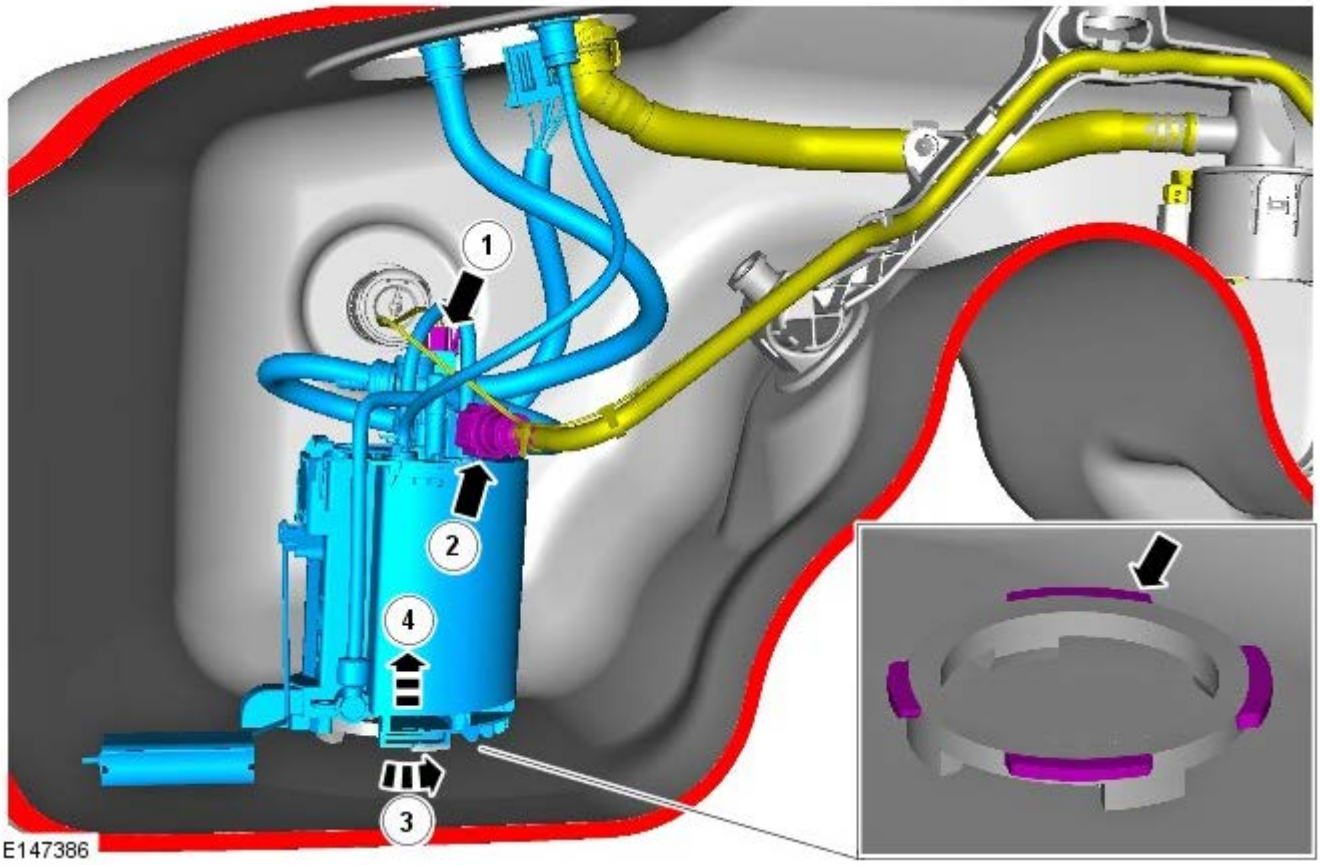
E147439

11. *Torque:* 10 Nm



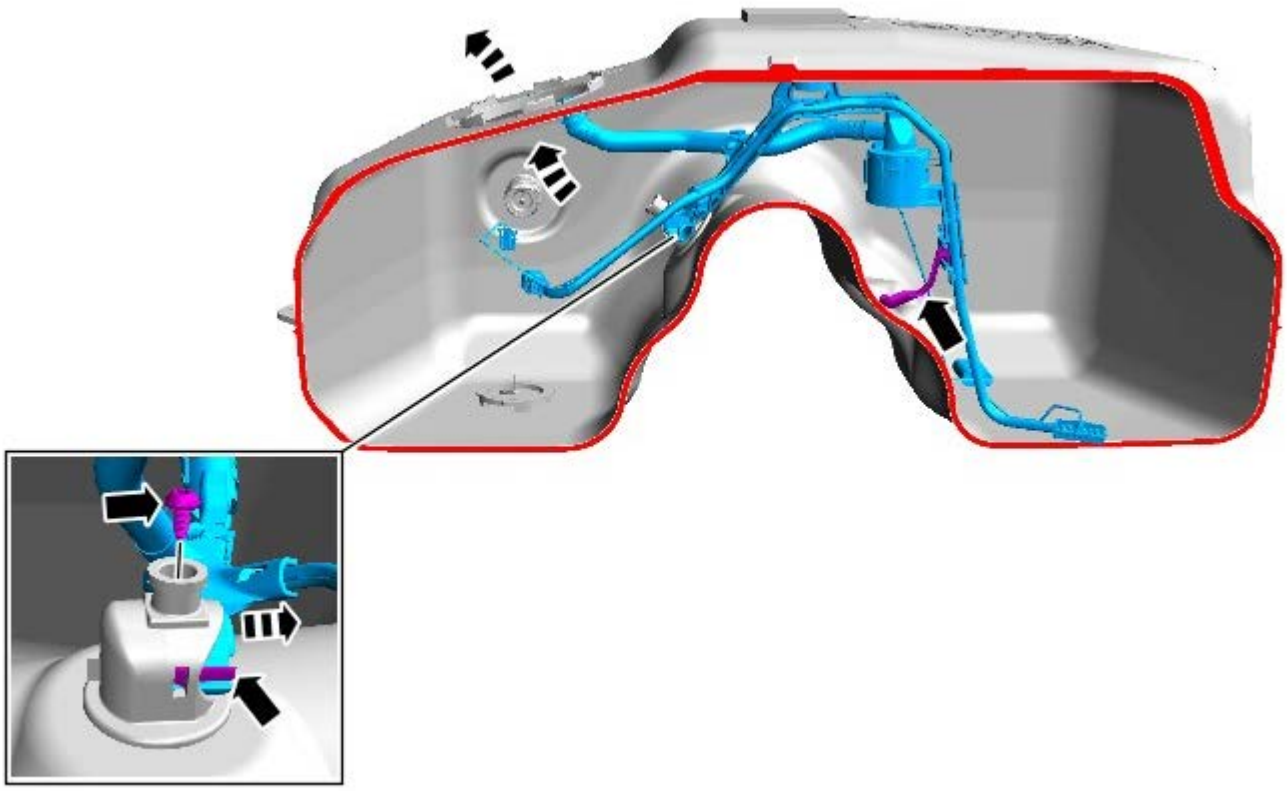
E147442

12.



E147386

13. *Torque:* 7 Nm



E147440

Installation

1. To install, reverse the removal procedure.

Published: 25-Oct-2013

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.

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.

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.

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: Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions (100-00 General Information, Description and Operation).
   Refer to: Diesel Fuel System Health and Safety Precautions (100-00 General Information, Description and Operation).

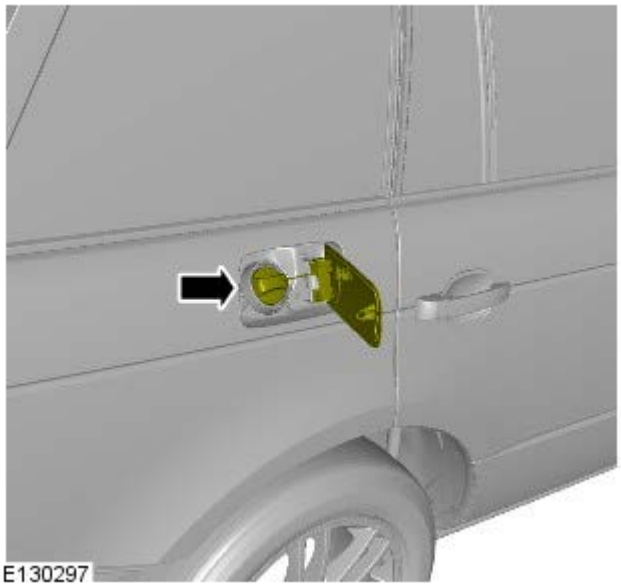
Vehicles with petrol engine

3. Refer to: Fuel System Pressure Release - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (310-00 Fuel System - General Information, General Procedures).

All vehicles

4. Refer to: Rear Subframe (502-00 Uni-Body, Subframe and Mounting System, Removal and Installation).

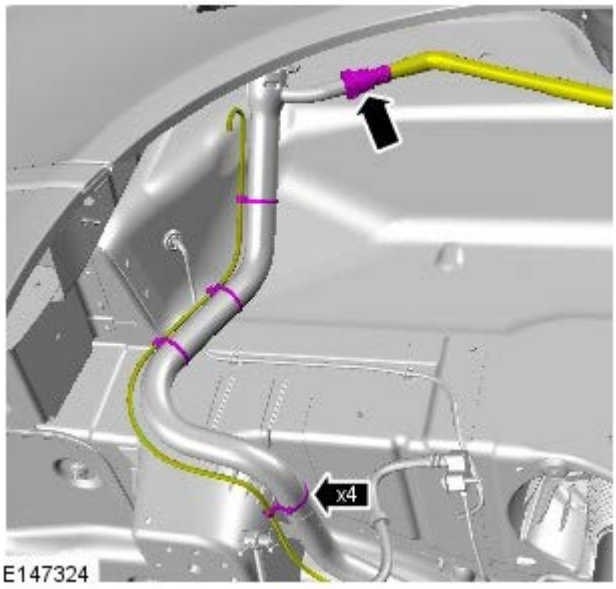
5. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.



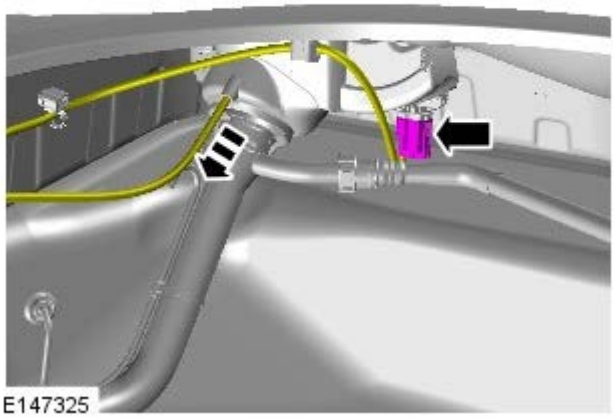
6.



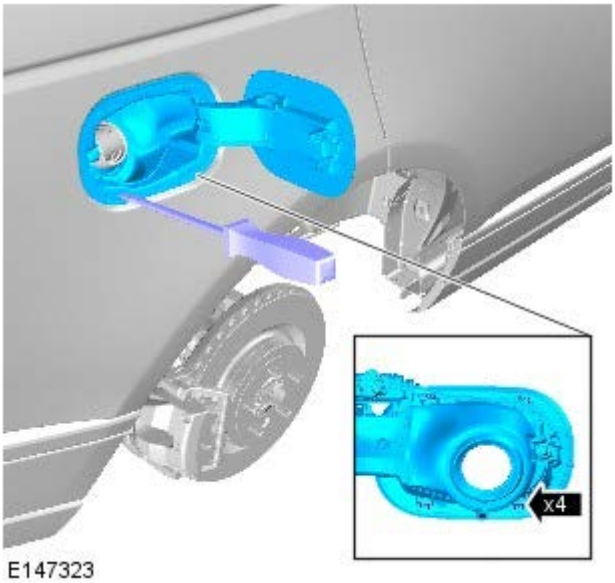
7.



8.

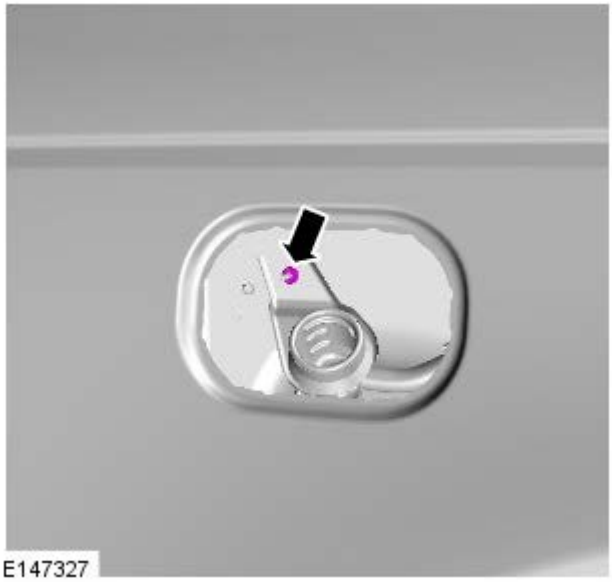

E147325

9.



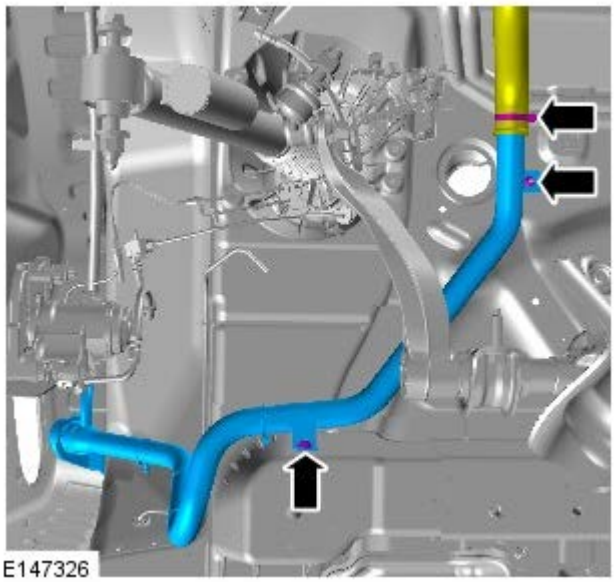
E147323

10. *Torque:* 10 Nm


E147327

11. CAUTION: Be prepared to collect escaping fuel.

Torque:
M6 10 Nm
Clamp 3.5 Nm



Installation

1. To install, reverse the removal procedure.

Published: 04-Dec-2012

Fuel Tank and Lines - V6 S/C 3.0L Petrol -

Capacity

Item	Liters
Fuel tank capacity	105 (usable)

General Specifications

Item	Specifications
Fuel system	Electronic - returnless
Fuel tank	Multi layer plastic
Fuel pump	Dual stage electric - submersible - located in fuel tank
Fuel filter	Located in the fuel tank - if the fuel filter becomes blocked a new fuel pump and sender unit must be installed
Fuel tank sender units	Two - active and passive - passive sender unit is attached to the removable retaining bracket and the active sender unit is attached to the fuel pump swirl pot
System pressure	4.5 bar - 65.3 lbf/in2
Starting pressure	6.3 bar - 91.4 lbf/in2

Torque Specifications

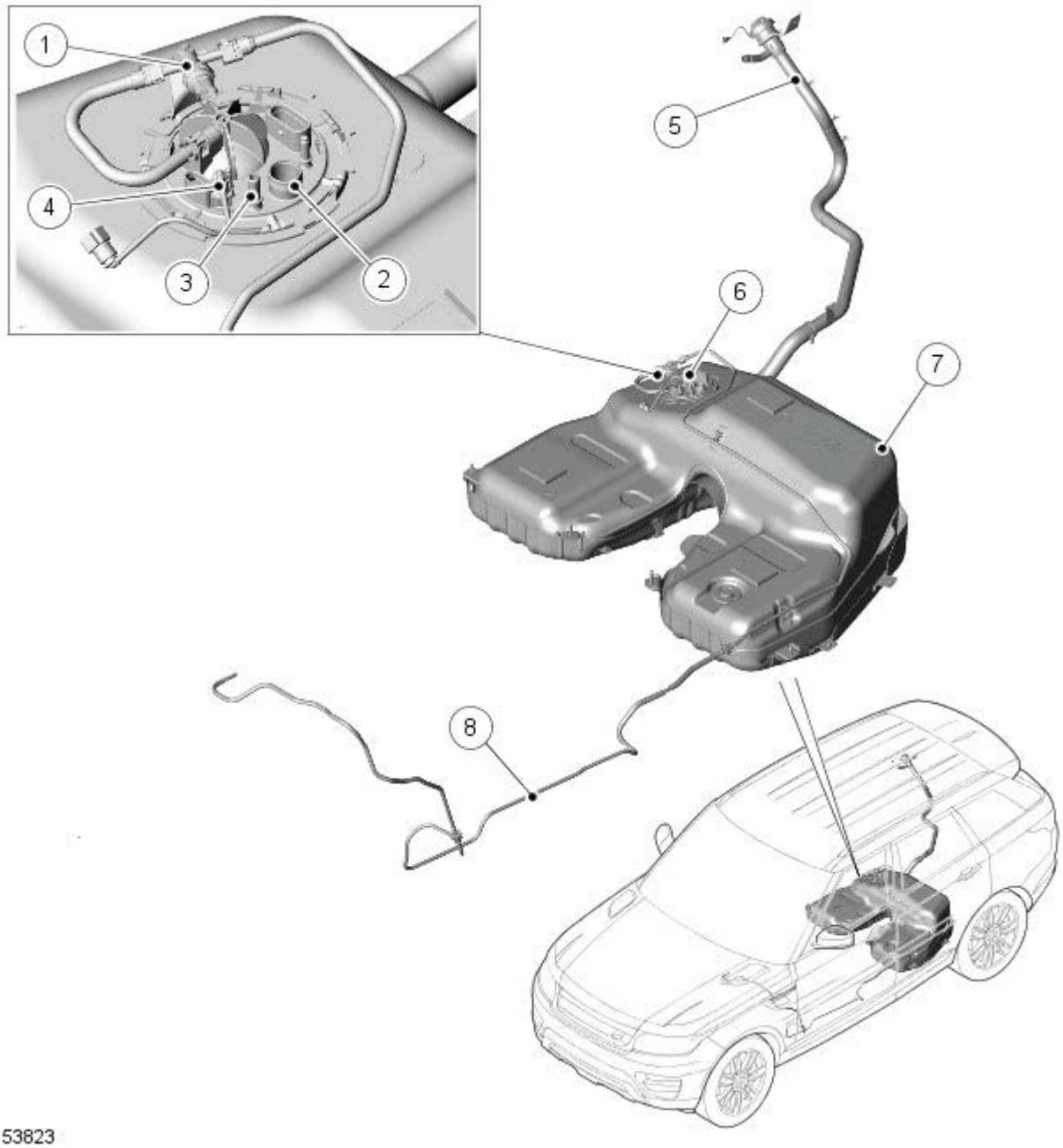
Description	Nm	lb-ft	lb-in
Fuel tank internal bracket retaining bolt	7	-	62
Fuel tank filler pipe retaining nuts	9	-	80
Fuel tank filler pipe hose clamp	3.5	-	31
Fuel tank shield retaining bolts	45	33	-
Fuel tank shield to fuel tank bolt	10	7	-

Published: 21-Jan-2014

Fuel Tank and Lines - V6 S/C 3.0L Petrol - Fuel Tank and Lines

Description and Operation

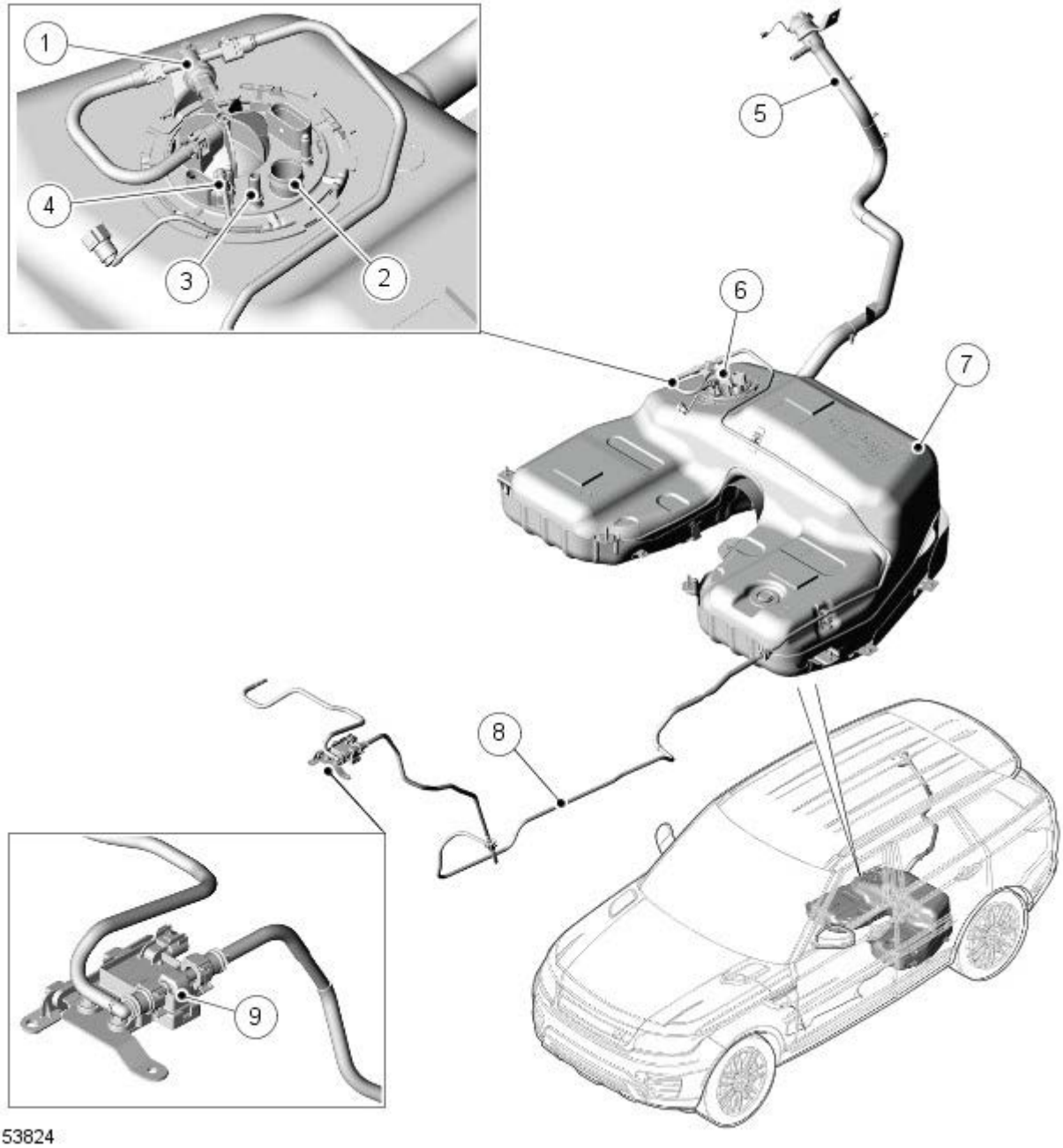
FUEL TANK AND LINES COMPONENT LOCATION (All except NAS)



E153823

Item	Part Number	Description
1	-	Fuel Low Pressure Sensor
2	-	Fuel Tank Refuelling Breather Connection
3	-	Fuel Tank Ventilation Pipe Connection
4	-	Fuel Fired Booster Heater (FFBH) Pipe Connection
5	-	Fuel Filler Pipe
6	-	Low Pressure Fuel Pump Flange
7	-	Fuel Tank
8	-	Fuel Supply Line

FUEL TANK AND LINES COMPONENT LOCATION (NAS ONLY)



E153824

Item	Part Number	Description
1	-	Fuel Low Pressure Sensor
2	-	Fuel Tank Refuelling Breather Connection
3	-	Fuel Tank Ventilation Pipe Connection
4	-	Fuel Fired Booster Heater Pipe Connection
5	-	Fuel Filler Pipe
6	-	Fuel Pump Module
7	-	Fuel Tank
8	-	Fuel Supply Line
9	-	Fuel Flex Sensor

INTRODUCTION

The V6 S/C 3.0L (Supercharged) low pressure fuel system is designed to supply fuel to the HP (High Pressure) fuel pumps, mounted on the engine.

The fuel system uses an electronically controlled return less fuel system; this will allow the LP (Low Pressure) pump to deliver fuel to the HP pumps, dependant on engine demand. The in-tank LP pump's pressure and flow is varied by the ECM (Engine Control Module), with increased system pressure up to 7.3 bar absolute at high temperature and matches the flow in support of engine fuelling requirements.

The fuel pump operation is regulated by a FPDM (Fuel Pump Driver module) 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 PWM (Pulse Width Modulation) output.

FUEL TANK

The fuel tank has a capacity of 105 litres usable (27.7 US Gallons).

Inside the fuel tank, you will find the location of the low pressure fuel pump module assembly.

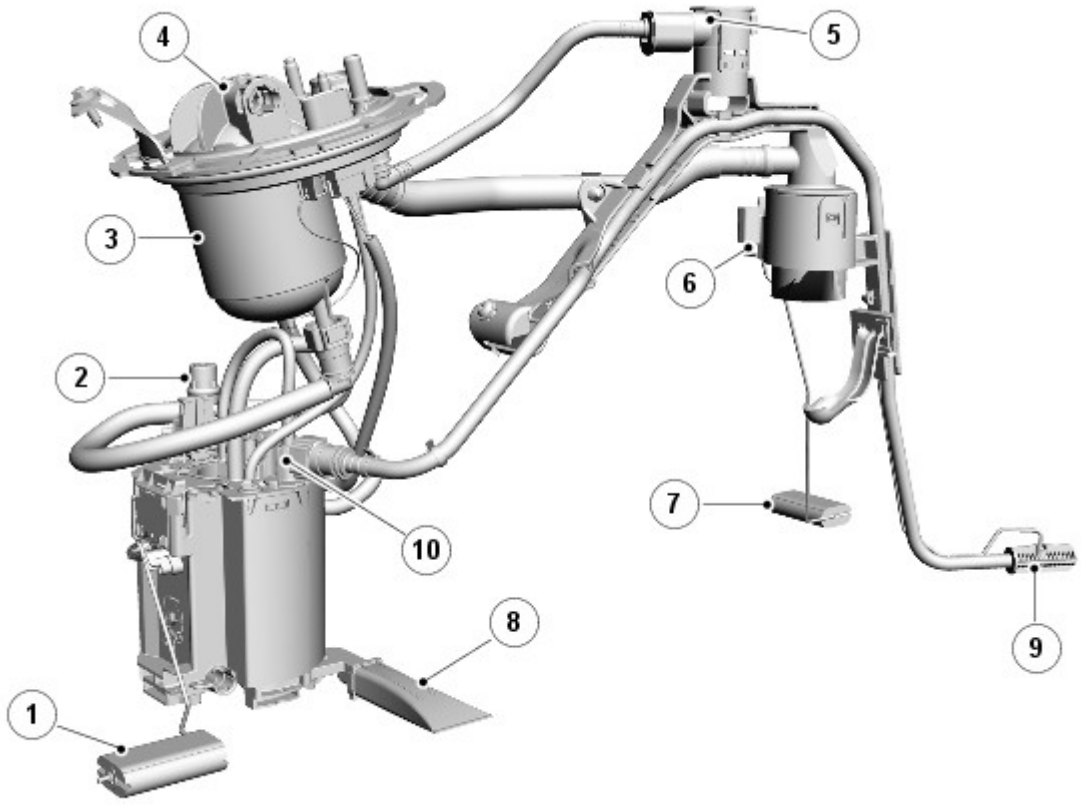
Access to the fuel tank is via the removal of the rear seat and removal of the LP pump module flange located on the right side of the tank.

Within the fuel tank, in the upper left side centre section, a Fill Limit Vent Valve (FLVV) is positioned. This is to control the fuel fill volume into the tank. During the refuelling process, air/vapour is displaced (by the fuel entering the tank) and exits the tank via the Fill Limit Vent Valve and is conveyed by the fuel tank refuelling breather pipe to exit the system either by the filler head for the EURO or ROW vehicles and via the charcoal canister for NAS vehicles. During filling, as the tank reaches its full level, the float in the Fill Limit Vent Valve is closed by the rising fuel and prevents air/vapour passing through to the refuelling breather pipe. The resulting back pressure causes refuelling to stop automatically.

Also within the fuel tank is a vent/gradient and roll over valve (ROV) in the upper centre section, which allows vapour to escape to prevent tank pressurisation in normal vehicle operating modes; however this valve is designed to close to prevent fuel leakage through the vent in the event of a vehicle roll over.

Fuel level inside the tank is monitored by two level sensors that are connected to the instrument cluster.

FUEL PUMP MODULE



E149003

Item	Part Number	Description
1	-	Fuel Level Sensor Float 'A'
2	-	Pressure Relief Valve (PRV)
3	-	Intank Fuel Filter
4	-	Fuel Pump Module Tank Flange
5	-	Fuel Tank Roll Over Valve
6	-	Fuel Fill Limit Vent Valve
7	-	Fuel Level Sensor Float 'B'
8	-	Fuel Pump Coarse Filter
9	-	Suction Port Filter
10	-	Venturi Transfer Pump

The fuel pump module is controlled by the ECM via the fuel pump relay located in the RJB (Rear Junction Box).

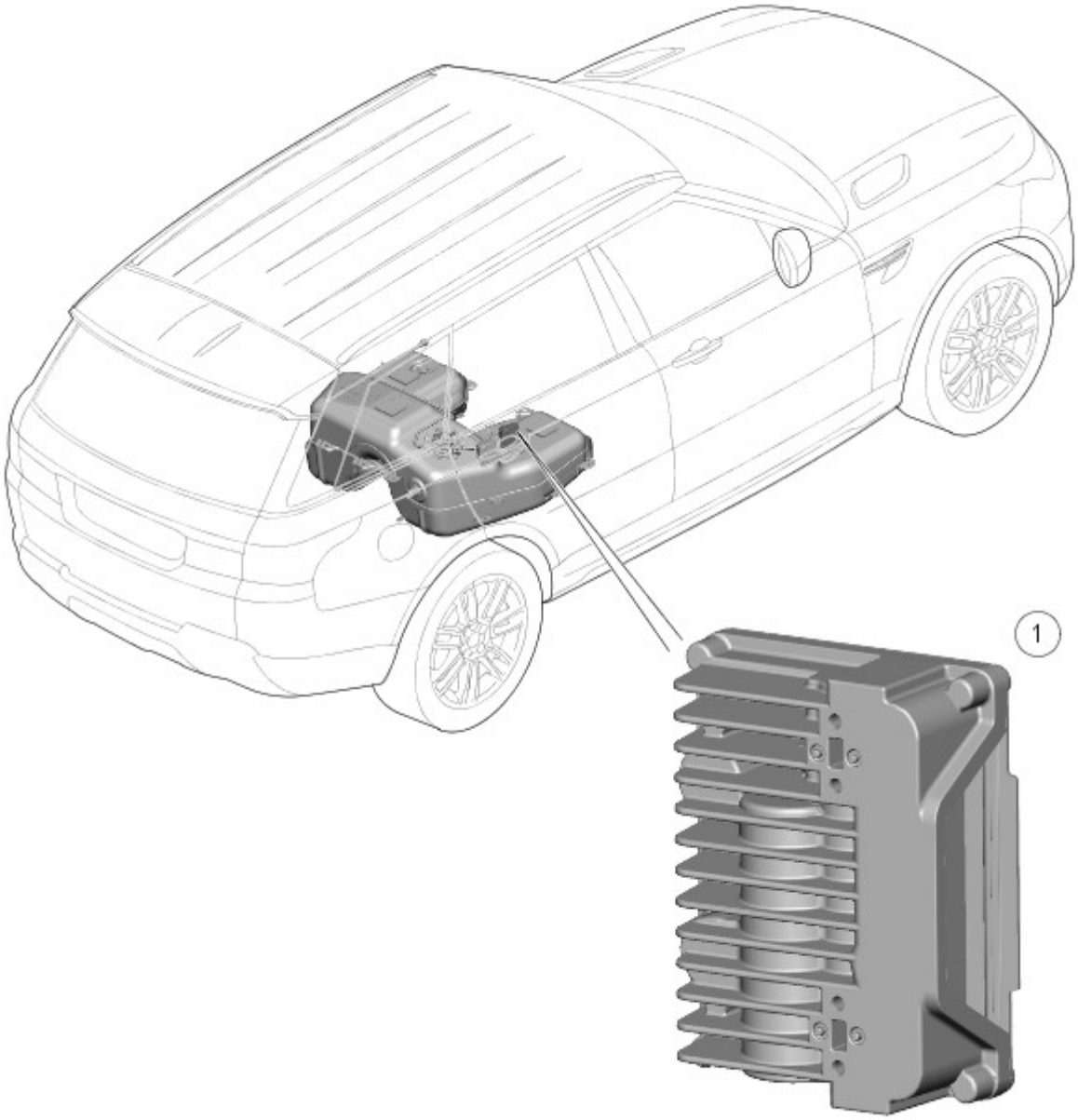
The electric pump collects fuel from the swirl pot and passes it from the tank to the fuel supply line via the fuel filter, to the engine mounted, HP pump at a pressure of 5.5 to 7.3 bar.

Fuel is collected from the left side of the tank to the right side of the tank by using a single suction tube that transfers fuel using a venturi transfer pump which is powered by the fuel feed from the fuel pump.

Should the fuel pump electrical connection need to be disconnected, it is important that the ignition is switched off. If the ignition is in position I or II, the IC (Instrument Cluster) will store its last fuel gauge needle position prior to power down. Once power is restored the gauge will display the last stored position regardless of the actual level in the tank.

This could result in incorrect fuel gauge readings if the fuel tank has been drained and not filled with exactly the same quantity of fuel that was removed.

FUEL PUMP DRIVER MODULE (FPDM)



E153825

Item	Part Number	Description
1	-	Fuel Pump Driver Module (FPDM)

The FPDM (Fuel Pump Driver Module) is attached to the right side rear floor member.

The fuel pump operation is regulated by the FPDM which is controlled by the 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 RJB. The fuel pump relay is energized on opening the driver's door or when power mode 9 engine crank is initiates using the stop/start button. The FPDM supplies power to the fuel pump, and adjust the power to control the speed of the fuel pump and thus the pressure and flow in the delivery line.

A 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 pump speed, e.g. if the PWM signal with 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 fuel rail low pressure sensor and adjusts the speed of the fuel pump as necessary to maintain an ECM requested output pressure of 5.5 bar to 7.5 bar absolute, during engine start up and engine shut down. Target pressure for the fuel low pressure delivery line is raised to 7.3 bar absolute.

If the RCM (Restrainst Control Module) outputs a crash signal on the high speed CAN (Controller Area Network) Powertrain 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 DTC (Diagnostic Trouble Code).

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

There are two fuel level sensors located inside the fuel tank. Fuel level sensor 'A' is attached to the swirl pot and monitors fuel level on the right side of the tank. Fuel Level sensor 'B' is attached to the suction pipe carrier and monitors fuel level on the left side of the tank.

Both level sensors are MAPPS (MAgnetic Passive Position Sensors) which provide a variable resistance to ground for the output from the fuel gauge.

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 IC to implement an anti-slosh function. This monitors the signal and updates the pointer position at regular intervals, preventing constant pointer movement caused by fuel movement in the tank due to cornering and braking.

Fuel Level Sensors - Resistance/Fuel Gauge Read Out Table

NOTE: These figures are with vehicle on level ground. Sensor readings will defer with varying vehicle inclinations.

Fuel Level Sensor 'A':-

Sender Unit Resistance, Ohms	Nominal Gauge Reading
992	Empty
51	Full

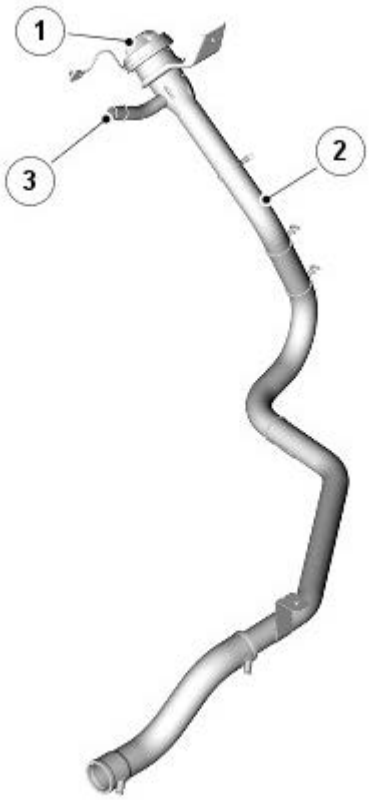
Fuel Level Sensor 'B':-

Sender Unit Resistance, Ohms	Nominal Gauge Reading
992	Empty
182	Full

When the fuel level becomes low, a fuel warning lamp in the IC is illuminated and a message is displayed.

The fuel level sender signal is converted into a high speed CAN Powertrain message by the IC as a direct interpretation of the fuel tank contents in litres.

FUEL FILLER PIPE



E149005

Item	Part Number	Description
1	-	Fuel Filler Cap
2	-	Fuel Filler Pipe
3	-	Refuelling Breather Pipe Connection

The fuel filler pipe locates into the tank and incorporates a spit back flap in the tank end of the pipe. The flap is spring loaded cover which acts as one way valve, allowing the tank to be filled but preventing fuel leaving the tank into the filler pipe.

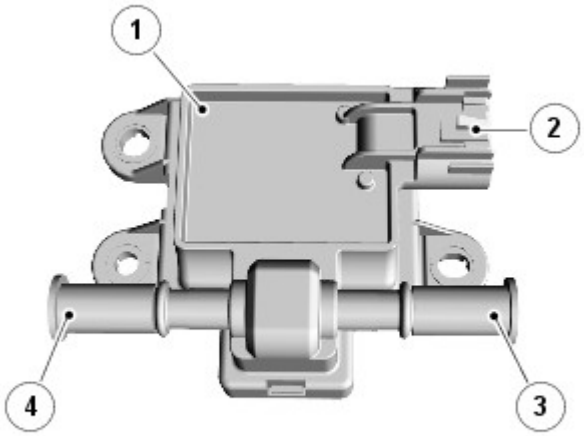
A connection at the top right side of the filler head allows for the connection of the fuel tank ventilation/breather pipe which goes to the tank. **On NAS vehicles only**, this connection will only be used for EVAP (Evaporative emission) System, as the refuelling breather is routed to the charcoal canister.
For additional information, refer to: Evaporative Emissions (303-13A Evaporative Emissions - V6 S/C 3.0L Petrol, Description and Operation).

FUEL LOW PRESSURE SENSOR


E112870

The fuel low pressure sensor supplies a pressure signal to the ECM to enable closed loop control of the fuel pump.

FUEL FLEX SENSOR



E149006

Item	Part Number	Description
1	-	Fuel Flex Sensor
2	-	Electrical Connection
3	-	Fuel Inlet
4	-	Fuel Outlet

The fuel flex sensor is designed to detect whether the vehicle is operating on ethanol/gasoline fuel and is only **on NAS Vehicles Only**.

The fuel flex sensor is attached to the fuel supply line, and as fuel flows through the sensor, it will determine the ethanol content of the fuel and the temperature of the fuel being delivered to the engine.

The fuel flex sensor is a serviceable part and requires no maintenance.

The output signal from the sensor will be delivered to the ECM in units of frequency (Hz). A pulsated frequency signal (50Hz - 100Hz) corresponds to ethanol percentage (0 - 100%) within an ambient temperature range of 40°C to 125°C.

If measured frequency exceeds that of 170Hz error codes will be displayed.

- Error Codes between 170Hz and 180Hz indicates sensor internal failure and will require replacement.
- Error Code 190Hz indicates fuel composition is outside sensor measurement range and recommend action is to check and replace fuel and retest.

Published: 02-May-2013

Fuel Tank and Lines - V6 S/C 3.0L 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 (310-01B Fuel Tank and Lines - V6 S/C 3.0L Petrol, Description and Operation),
Fuel Tank and Lines (310-01B, Description and Operation),
Fuel Tank and Lines (310-01B, 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 1600 bar (23,206 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 mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
• Fuel level • Contaminated fuel • Fuel supply line(s) • Fuel return line(s) • High-pressure fuel supply line(s) • Fuel tank filler pipe • Fuel leak(s) • Fuel tank • Fuel filler cap • Fuel filter • Push connect fittings • Fuel rail • Fuel injection pump	• Battery charge and condition • Fuse(s) • Fuel pump module (lift pump) • Fuel pump module relay • Electrical connector(s) • Damaged or corroded wiring harness • Fuel volume control valve • Fuel pressure control valve • 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.

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. Check for ignition system, fuel system and electronic engine control DTCs and refer to the relevant DTC index
Engine cranks and fires, but will not start	• 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. Check for electronic engine controls, engine emissions, fuel system and evaporative emissions system related DTCs and refer to the relevant DTC index
Difficult hot start	• Injector leak • Electronic engine control • Purge valve • Fuel pump • Ignition system	Check for injector leak, install new injector as required. Check for electronic engine controls, evaporative emissions, fuel system, ignition system and engine emission system related DTCs and refer to the relevant DTC index
Difficult to start after hot soak (vehicle standing, engine off, after engine has reached operating temperature)	• Injector leak • Electronic engine control • Purge valve • Fuel pump • Ignition system	Check for injector leak, install new injector as required. Check for electronic engine controls, evaporative emissions, fuel system, ignition system and engine emission system related DTCs and refer to the relevant DTC index

Engine stalls soon after start	• Breather system disconnected/restricted • Engine control module relay • Electronic engine control • Ignition system • Air intake system restricted • Air leakage • Fuel lines	Ensure the engine breather system is free from restriction and is correctly installed. Check for electronic engine control, ignition system and fuel system related DTCs and refer to the relevant DTC index. Check for blockage in air filter element and air intake system. Check for air leakage in air intake system
Engine hesitates/poor acceleration	• 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	Check for fuel system related DTCs and refer to the relevant DTC index. Check for injector leak, install new injector as required. Check for air leakage in air intake system. Ensure accelerator pedal is free from restriction. Check for electronic engine controls, ignition, engine emission system and transmission related DTCs and refer to the relevant DTC index
Engine backfires	• Fuel pump/lines • Air leakage • Electronic engine controls • Ignition system • Sticking variable camshaft timing hub	Check for fuel system failures. Check for air leakage in intake air system. Check for electronic engine controls, ignition system and variable camshaft timing system 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. Check for electronic engine controls, throttle system and ignition system related DTCs and refer to the relevant DTC index
Engine detonates/knocks	• Fuel pump/lines • Air leakage • Electronic engine controls • Sticking variable camshaft timing hub	Check for fuel system failures. Check for air leakage in intake air system. Check for electronic engine controls and variable camshaft timing system related DTCs and refer to the relevant DTC index
No throttle response	• Electronic engine controls • Throttle motor	Check for electronic engine controls and throttle system related DTCs and refer to the relevant DTC index
Poor throttle response	• 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. Check for electronic engine controls, transmission and traction control related DTCs and refer to the related DTC index. Check for air leakage in intake air system

DTC index

For a 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 - V6 S/C 3.0L Petrol , DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation).

Published: 13-Sep-2012

Fuel Tank and Lines - V6 S/C 3.0L Petrol - Fuel Pump and Sender Unit

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.

 The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.

 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.

 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.

 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.

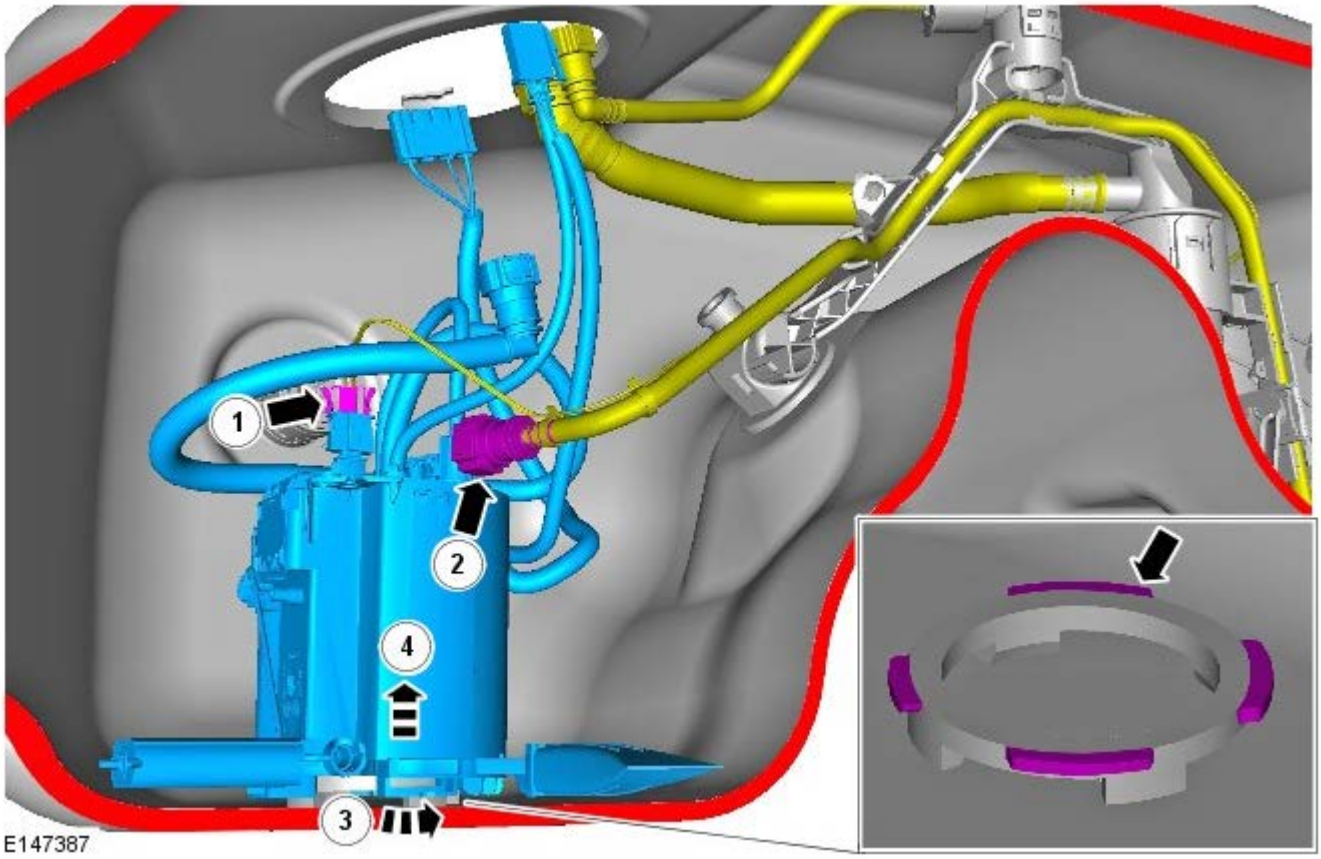
2. Refer to: Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions (100-00 General Information, Description and Operation).

3. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

4. Refer to: Fuel Tank Draining (310-00 Fuel System - General Information, General Procedures).

5.



Installation

1. To install, reverse the removal procedure.

Published: 12-Sep-2012

Fuel Tank and Lines - V6 S/C 3.0L Petrol - Fuel Level Sender

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.

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 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: Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions (100-00 General Information, Description and Operation).

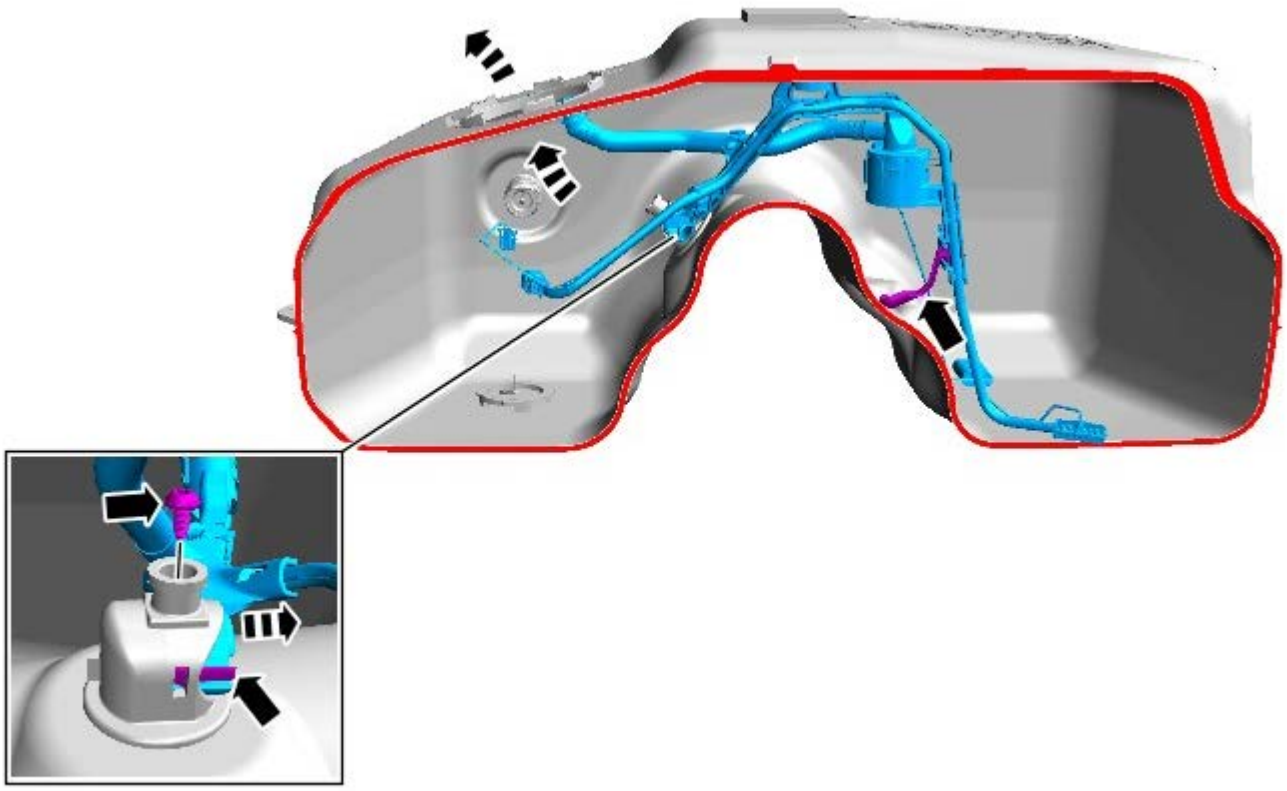
3. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

4. Refer to: Fuel Pump and Sender Unit (310-01C Fuel Tank and Lines - V8 S/C 5.0L Petrol, Removal and Installation).

5.  NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

   Torque: 7 Nm



E147440

Installation

1. To install, reverse the removal procedure.

Published: 02-May-2013

Fuel Tank and Lines - V6 S/C 3.0L Petrol - Fuel Filter

Removal and Installation

Special Tool(s)

 E80148	310-123 Locking Ring, Fuel Tank

Removal

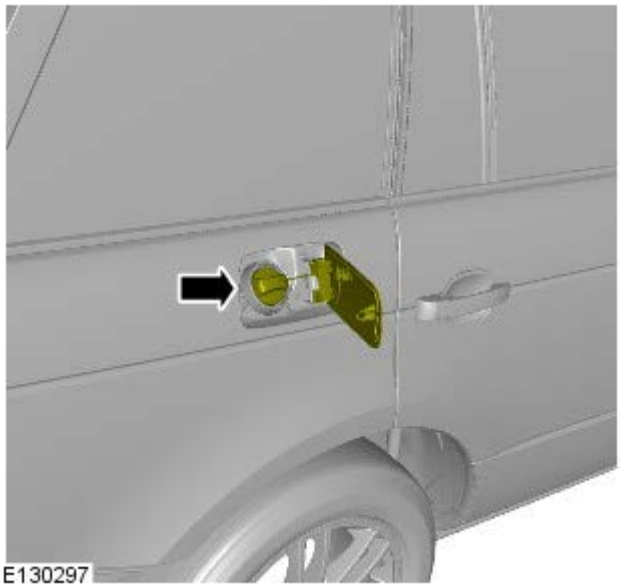
All vehicles

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 - V6 S/C 3.0L 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).


E130297

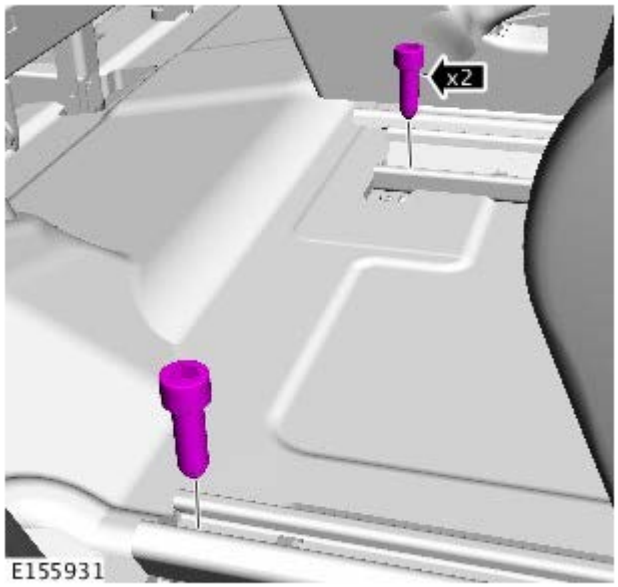
4. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Vehicles with occasional rear seats

5.



6. *Torque:* 50 Nm



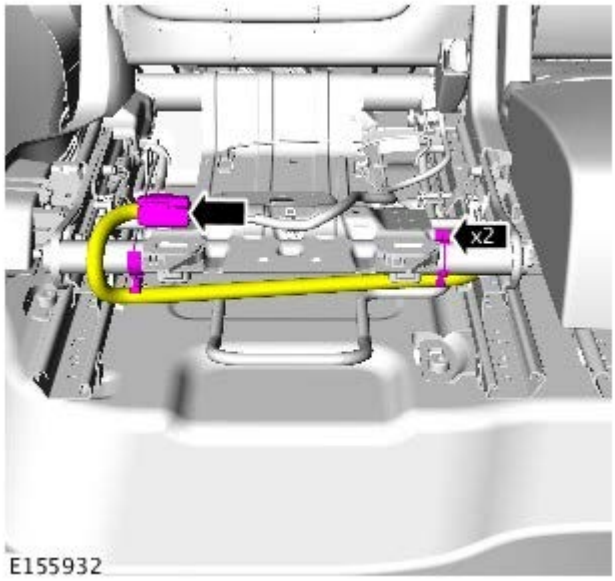
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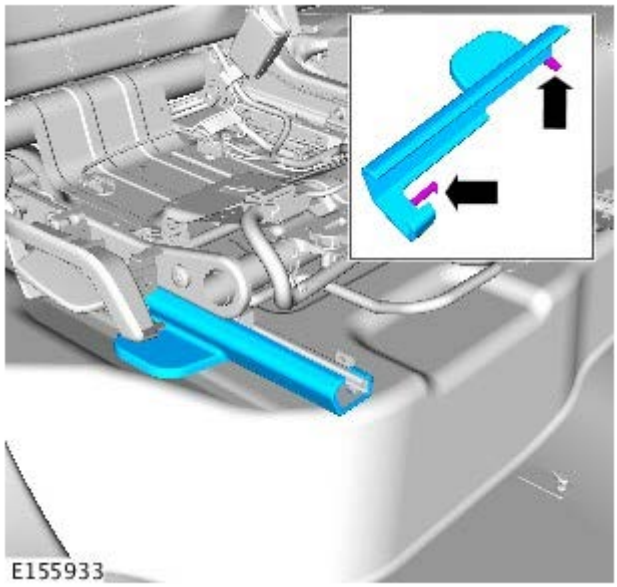
8.



9.



10.



11. *Torque:* 50 Nm

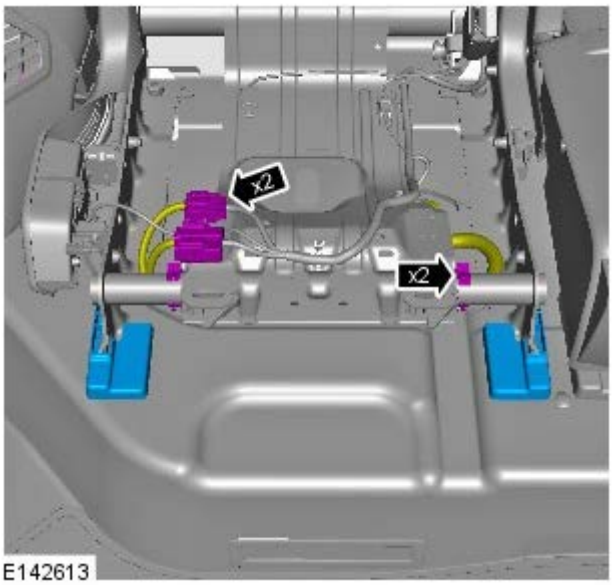


Vehicles without occasional rear seats

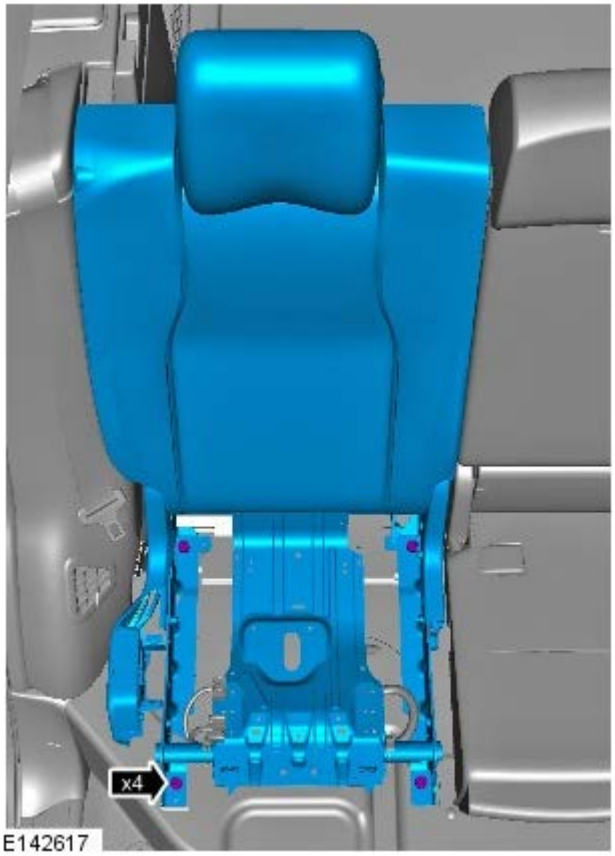
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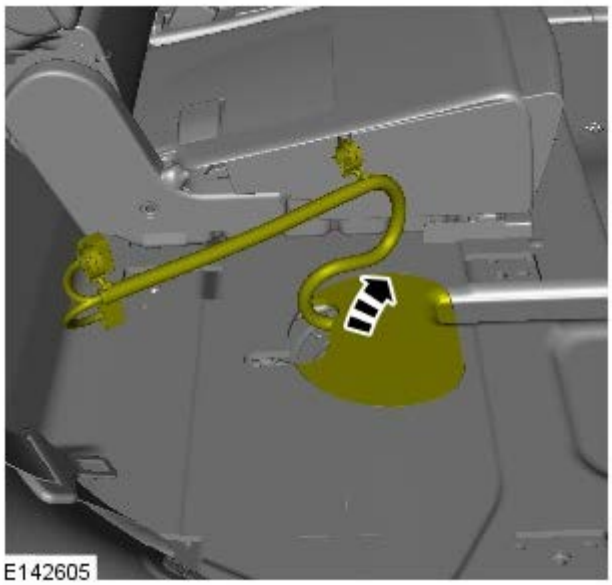


14. *Torque:* 50 Nm

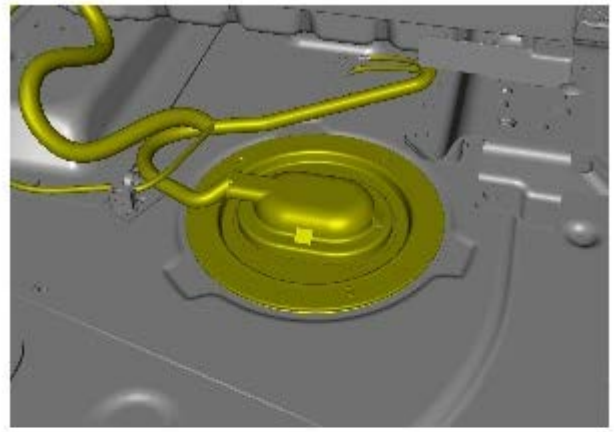


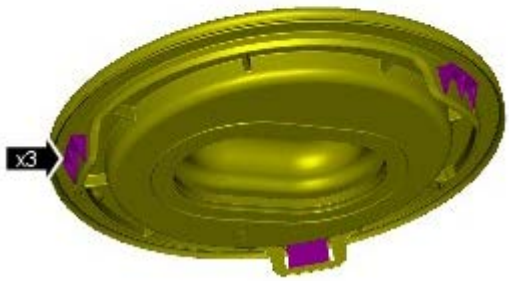
All vehicles

15.



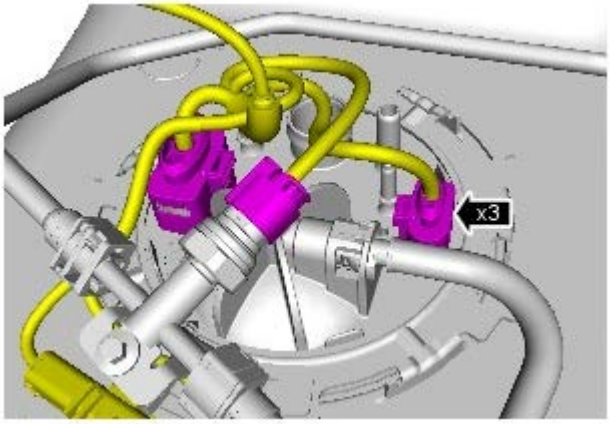
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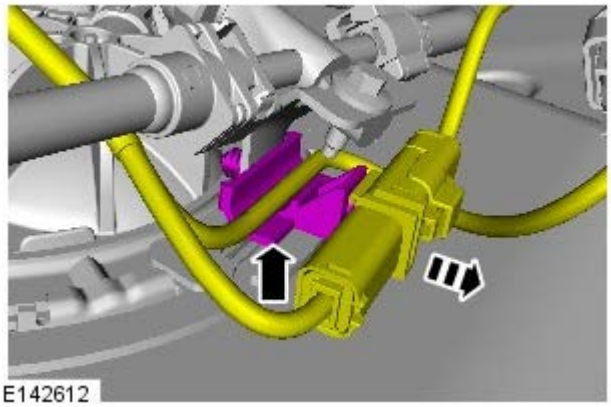




E142604

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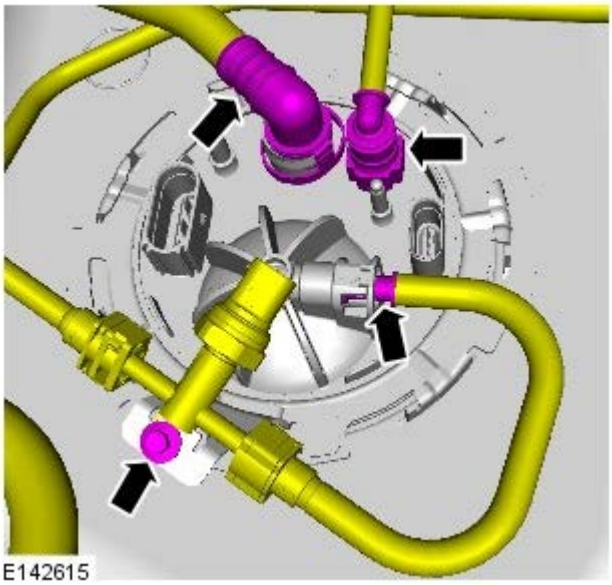




E142612

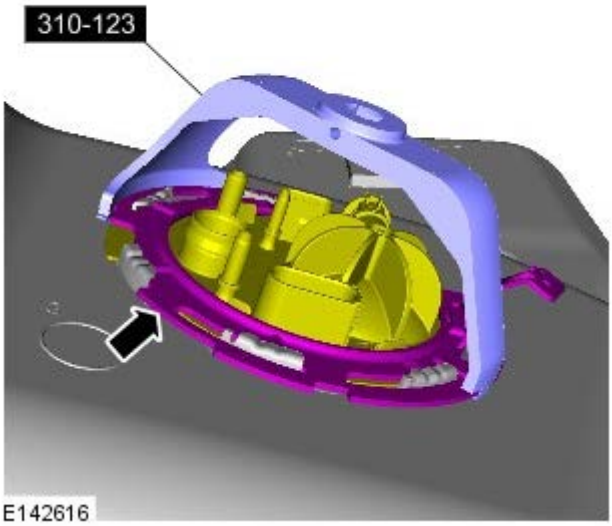
18. CAUTION: Be prepared to collect escaping fuel.

Torque: 7 Nm

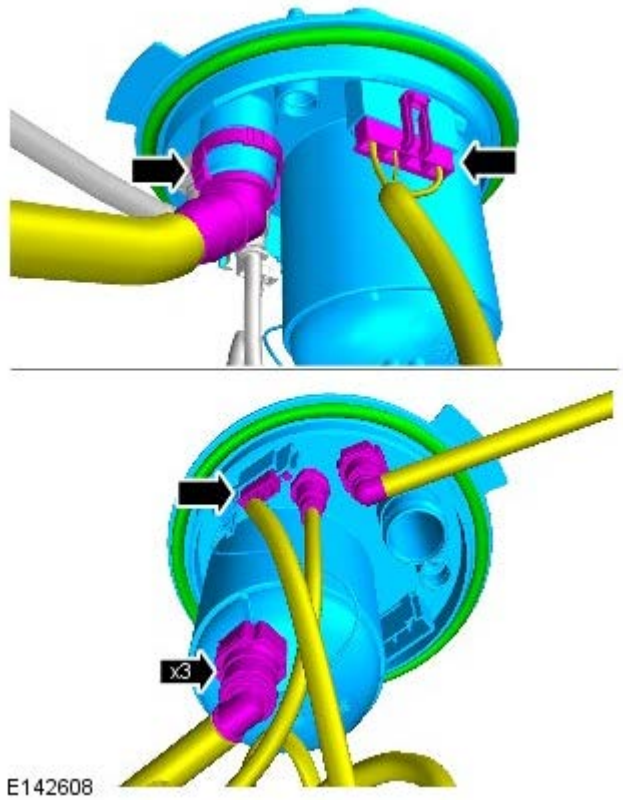


19. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

- *Special Tool(s):* 310-123



20. CAUTION: A new O-ring seal is to be installed.



Installation

1. To install, reverse the removal procedure.

Published: 25-Oct-2013

Fuel Tank and Lines - V6 S/C 3.0L 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.

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.

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.

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: Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions (100-00 General Information, Description and Operation).
   Refer to: Diesel Fuel System Health and Safety Precautions (100-00 General Information, Description and Operation).

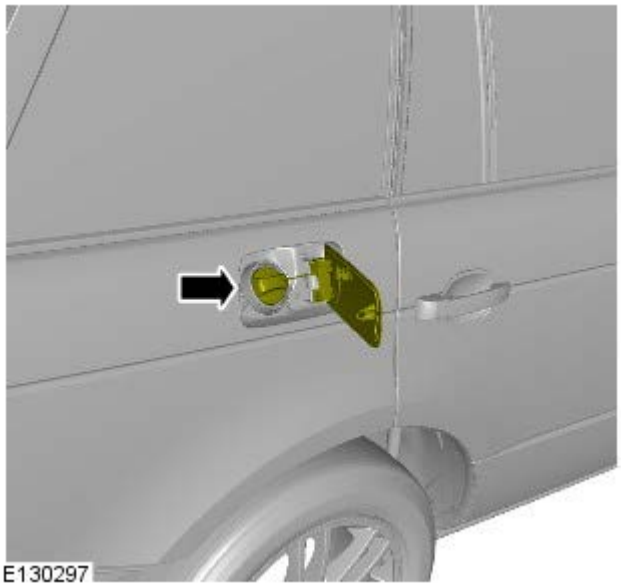
Vehicles with petrol engine

3. Refer to: Fuel System Pressure Release - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (310-00 Fuel System - General Information, General Procedures).

All vehicles

4. Refer to: Rear Subframe (502-00 Uni-Body, Subframe and Mounting System, Removal and Installation).

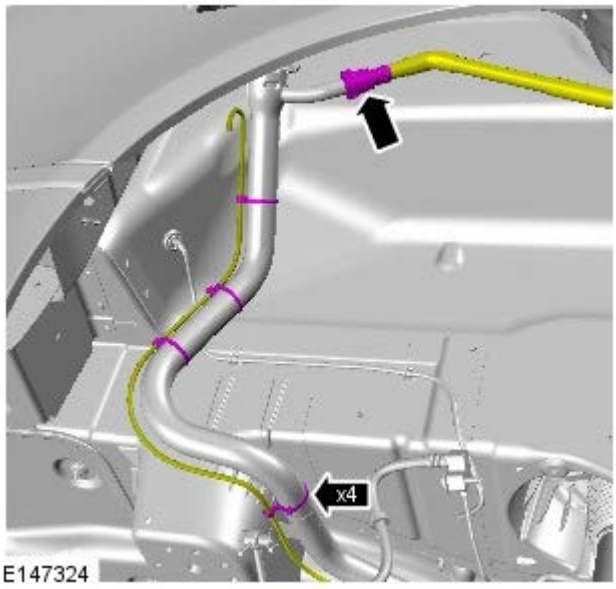
5. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.



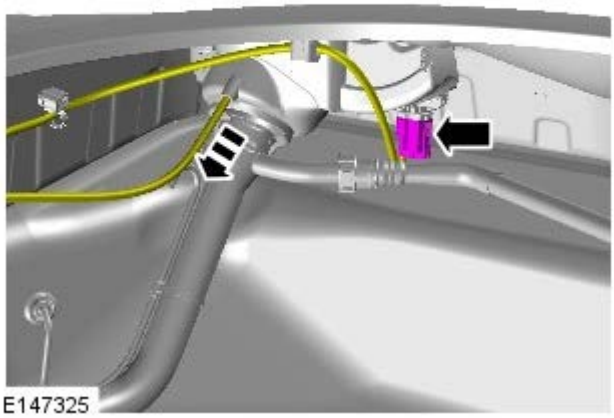
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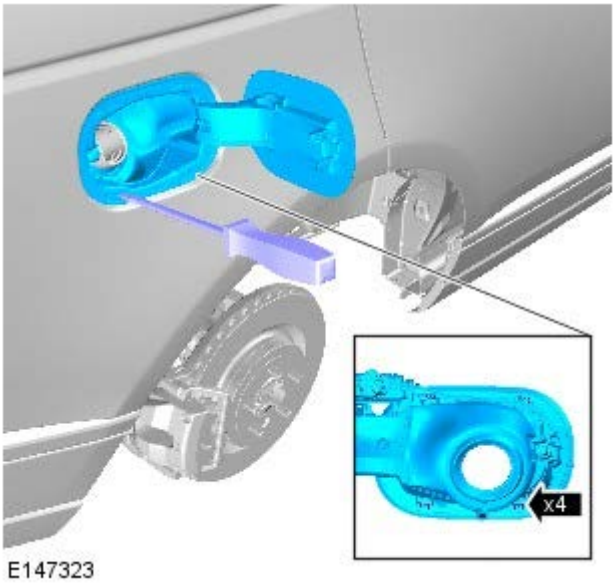
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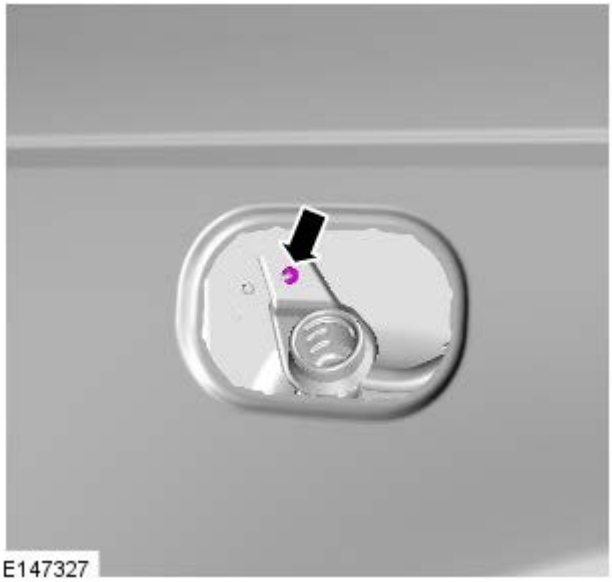

E147325

9.



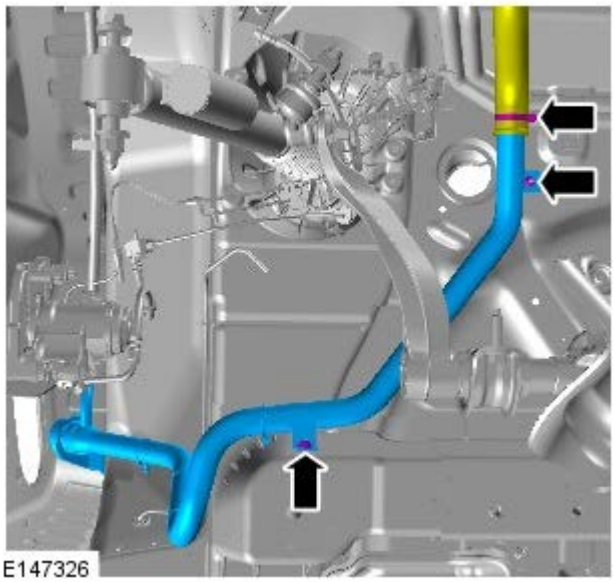
E147323

10. *Torque:* 10 Nm


E147327

11. CAUTION: Be prepared to collect escaping fuel.

Torque:
M6 10 Nm
Clamp 3.5 Nm



Installation

1. To install, reverse the removal procedure.

Published: 05-Dec-2013

Fuel Tank and Lines - V6 S/C 3.0L Petrol - Fuel Tank

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.

 The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.

 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.

 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.

 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: Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions (100-00 General Information, Description and Operation).

3. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

4. Refer to: Fuel Tank Draining (310-00 Fuel System - General Information, General Procedures).

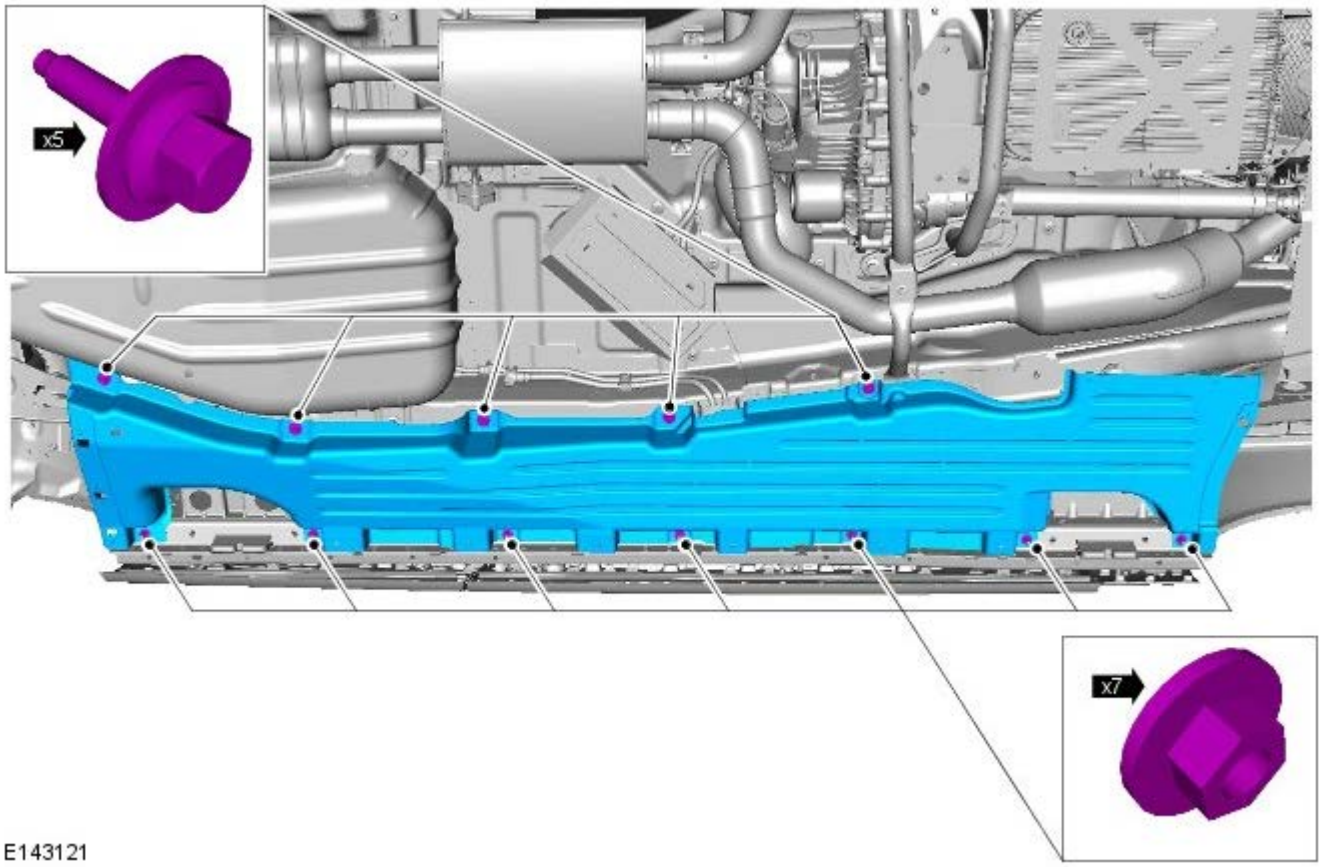
5.  NOTE: Repeat the procedure for the other side.

   Refer to: Rear Rocker Panel Moulding (501-08 Exterior Trim and Ornamentation, Removal and Installation).

6. Refer to: Rear Driveshaft - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (205-01 Driveshaft, Removal and Installation).

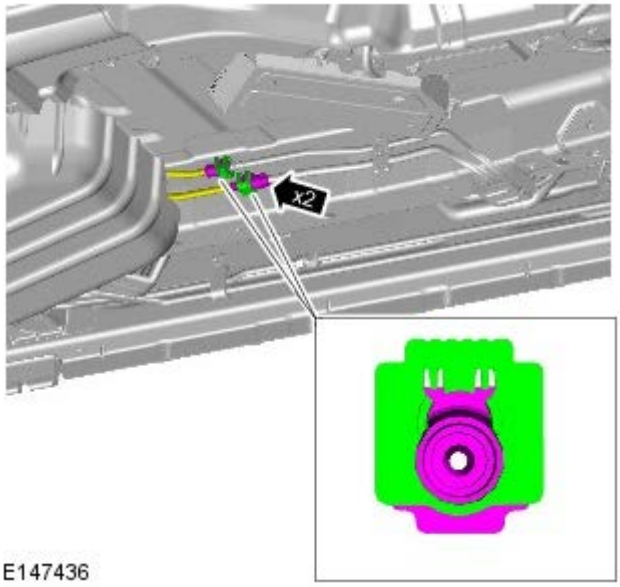
7.  CAUTION: LH illustration shown, RH is similar.

    NOTE: Repeat the procedure for the other side.



E143121

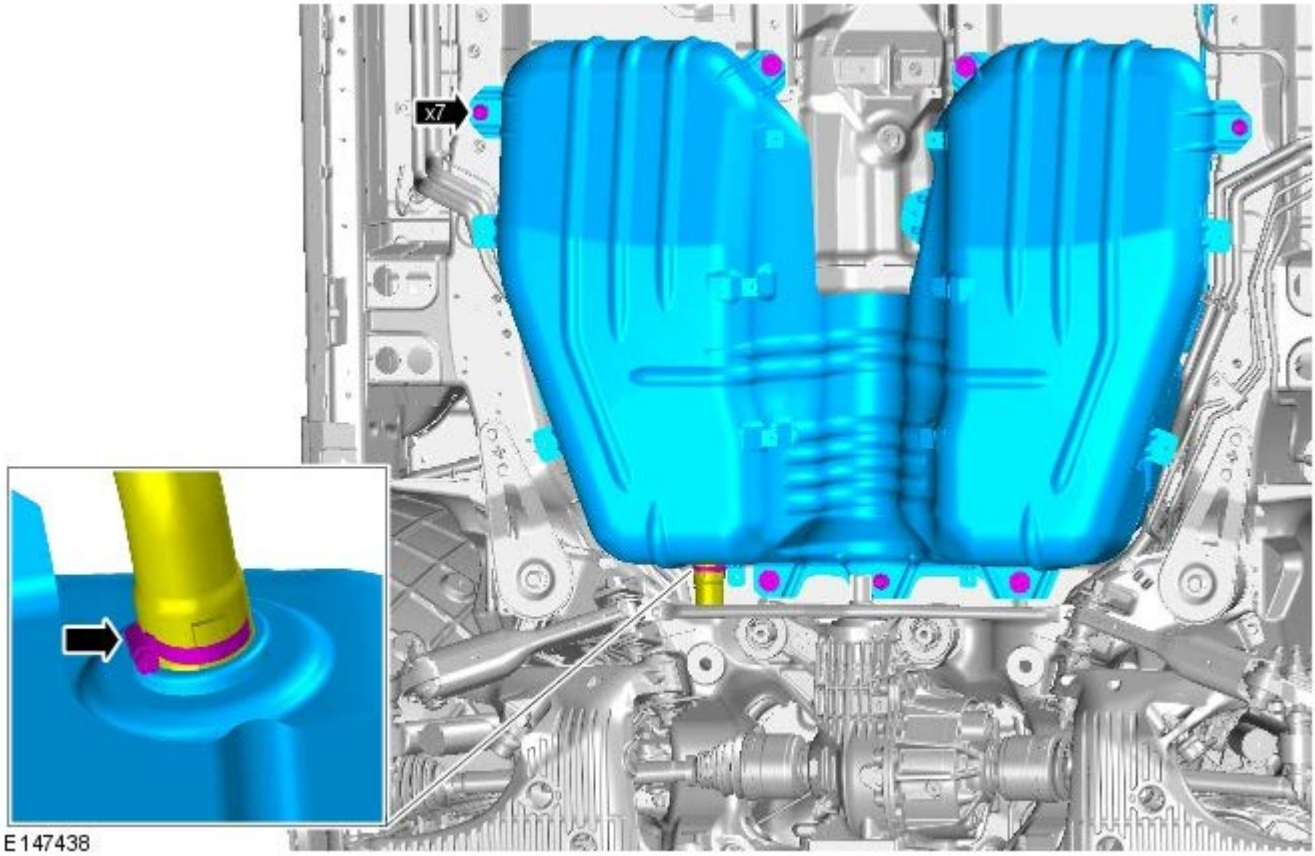
8. CAUTION: Be prepared to collect escaping fuel.



E147436

9. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Torque: 45 Nm



E147438

10. NOTE: Do not disassemble further if the component is removed for access only.



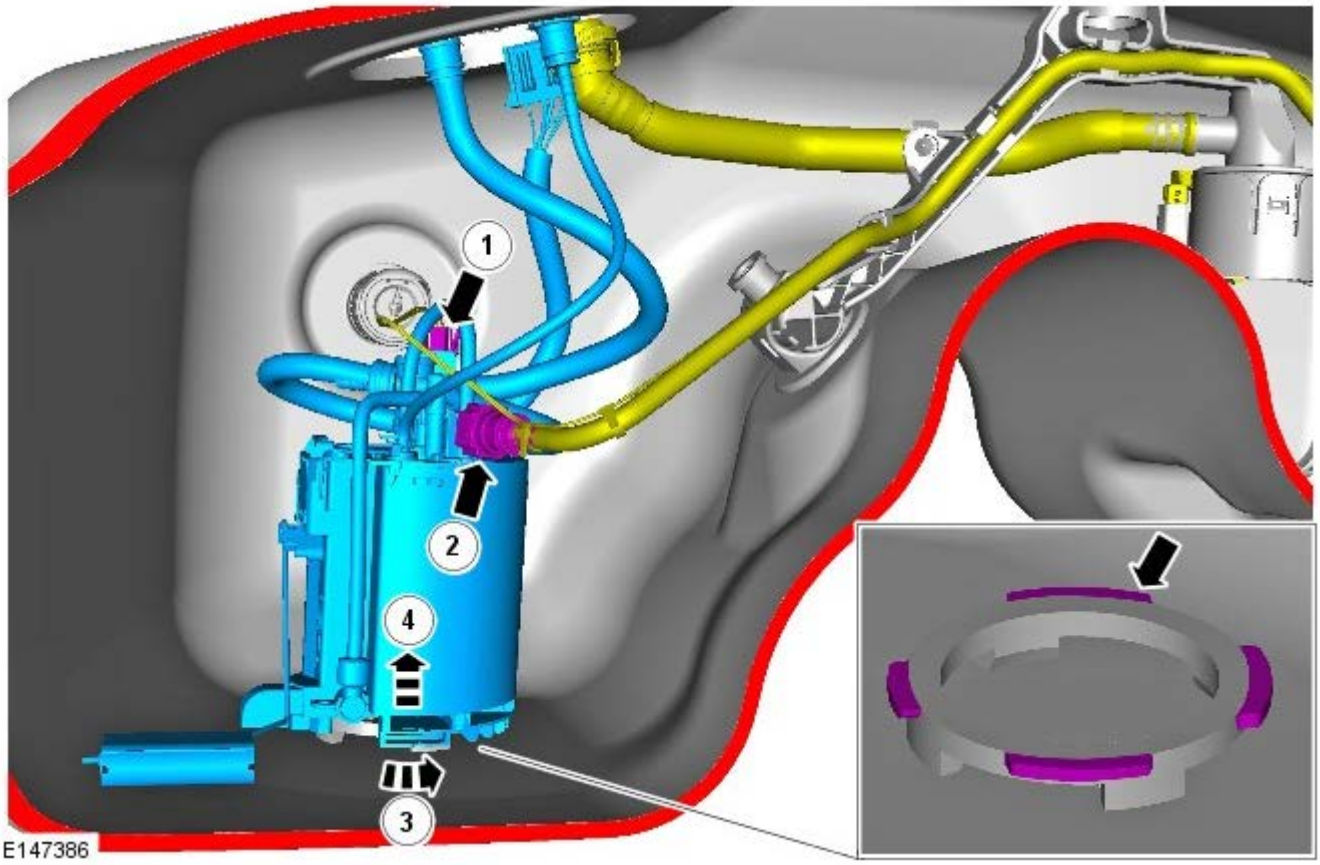
E147439

11. *Torque:* 10 Nm



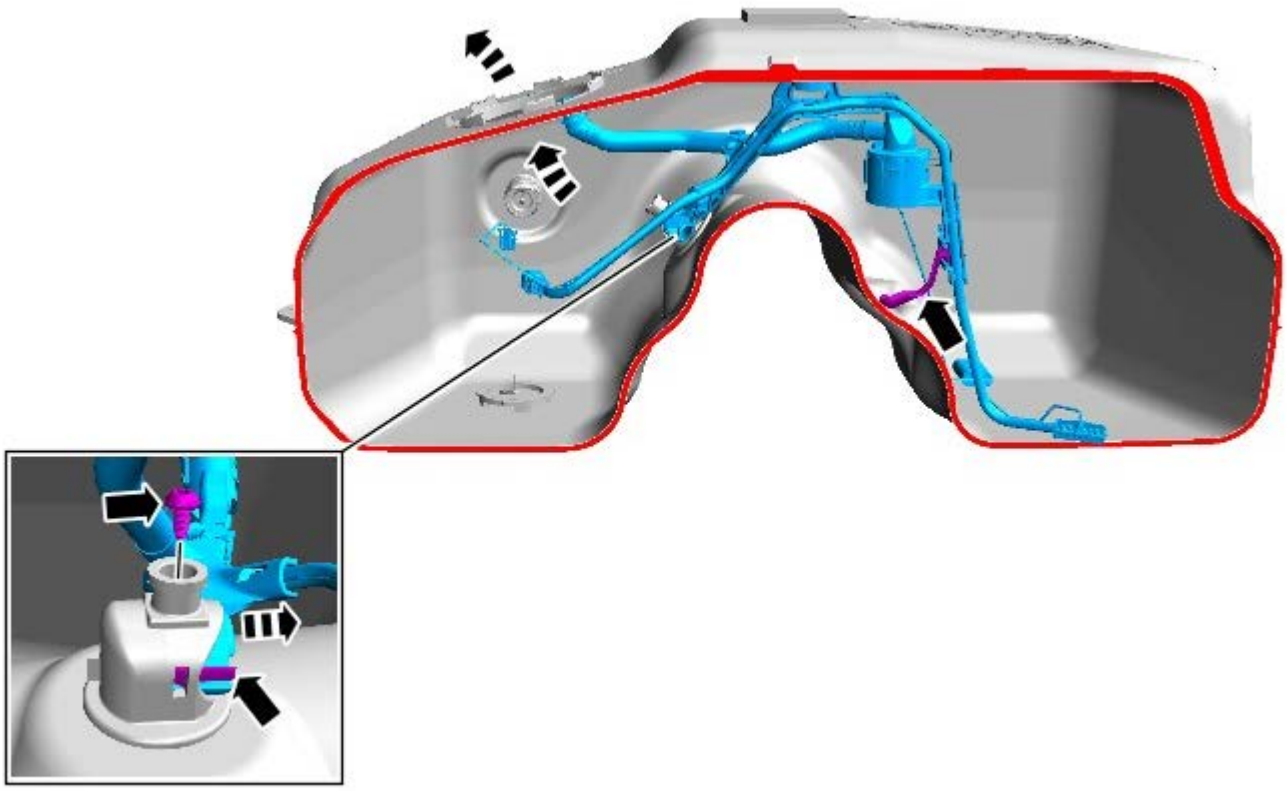
E147442

12.



E147386

13. *Torque:* 7 Nm



E147440

Installation

1. To install, reverse the removal procedure.

Published: 04-Dec-2012

Fuel Tank and Lines - V8 S/C 5.0L Petrol -

Capacity

Item	Liters
Fuel tank capacity	105 (usable)

General Specifications

Item	Specifications
Fuel system	Electronic - returnless
Fuel tank	Multi layer plastic
Fuel pump	Dual stage electric - submersible - located in fuel tank
Fuel filter	Located in the fuel tank - if the fuel filter becomes blocked a new fuel pump and sender unit must be installed
Fuel tank sender units	Two - active and passive - passive sender unit is attached to the removable retaining bracket and the active sender unit is attached to the fuel pump swirl pot
System pressure	4.5 bar - 65.3 lbf/in2
Starting pressure	6.3 bar - 91.4 lbf/in2

Torque Specifications

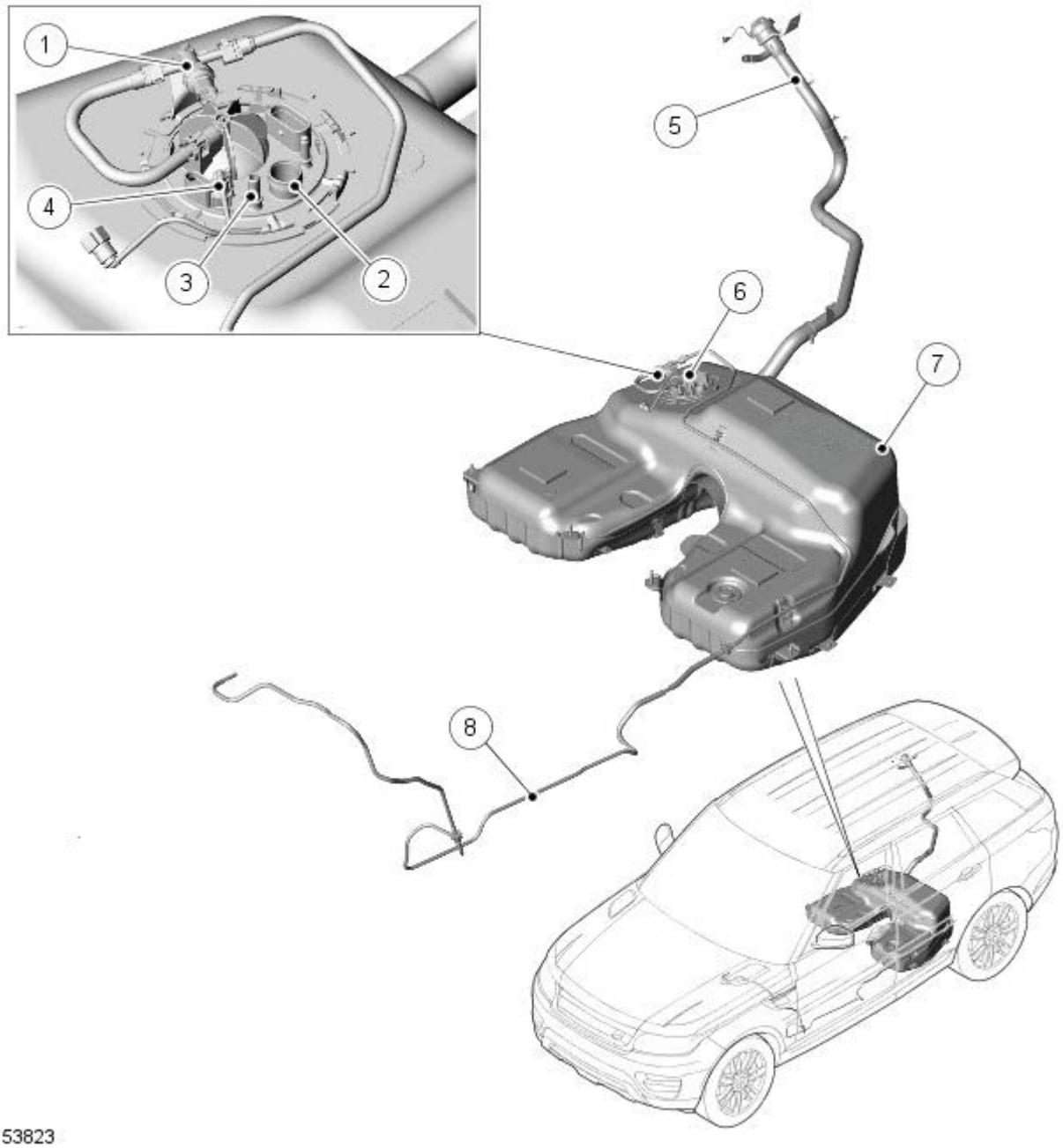
Description	Nm	lb-ft	lb-in
Fuel tank internal bracket retaining bolt	7	-	62
Fuel tank filler pipe retaining nuts	9	-	80
Fuel tank filler pipe hose clamp	3.5	-	31
Fuel tank shield retaining bolts	45	33	-
Fuel tank shield to fuel tank bolt	10	7	-

Published: 21-Jan-2014

Fuel Tank and Lines - V8 S/C 5.0L Petrol - Fuel Tank and Lines

Description and Operation

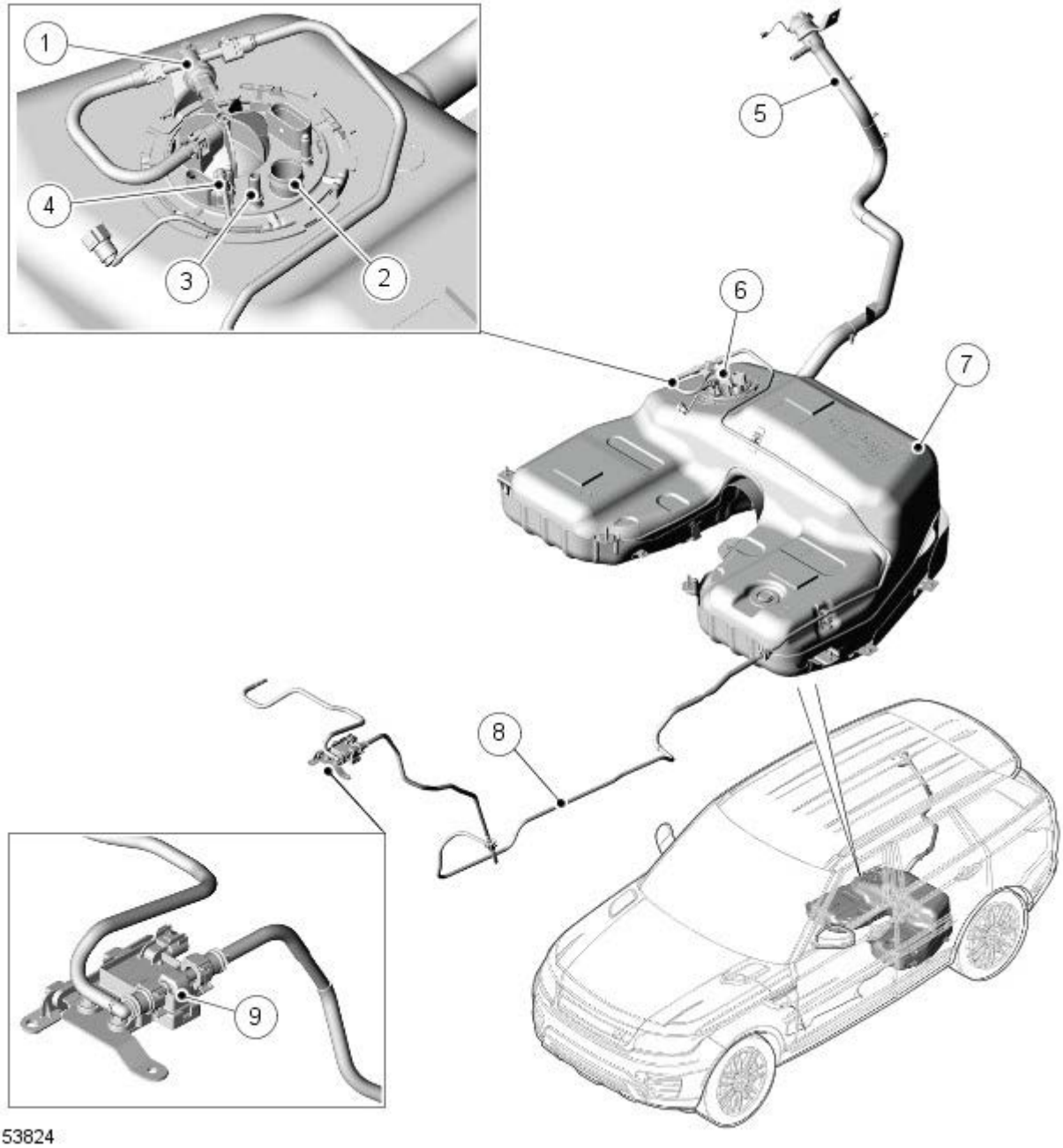
FUEL TANK AND LINES COMPONENT LOCATION (All except NAS)



E153823

Item	Part Number	Description
1	-	Fuel Low Pressure Sensor
2	-	Fuel Tank Refuelling Breather Connection
3	-	Fuel Tank Ventilation Pipe Connection
4	-	Fuel Fired Booster Heater (FFBH) Pipe Connection
5	-	Fuel Filler Pipe
6	-	Low Pressure Fuel Pump Flange
7	-	Fuel Tank
8	-	Fuel Supply Line

FUEL TANK AND LINES COMPONENT LOCATION (NAS ONLY)



E153824

Item	Part Number	Description
1	-	Fuel Low Pressure Sensor
2	-	Fuel Tank Refuelling Breather Connection
3	-	Fuel Tank Ventilation Pipe Connection
4	-	Fuel Fired Booster Heater Pipe Connection
5	-	Fuel Filler Pipe
6	-	Fuel Pump Module
7	-	Fuel Tank
8	-	Fuel Supply Line
9	-	Fuel Flex Sensor

INTRODUCTION

The V8 S/C 5.0L (Supercharged) low pressure fuel system is designed to supply fuel to the HP (High Pressure) fuel pumps, mounted on the engine.

The fuel system uses an electronically controlled return less fuel system; this will allow the LP (Low Pressure) pump to deliver fuel to the HP pumps, dependant on engine demand. The in-tank LP pump's pressure and flow is varied by the ECM (Engine Control Module), with increased system pressure up to 7.3 bar absolute at high temperature and matches the flow in support of engine fuelling requirements.

The fuel pump operation is regulated by a FPDM (Fuel Pump Driver module) 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 PWM (Pulse Width Modulation) output.

FUEL TANK

The fuel tank has a capacity of 105 litres (usable) (27.7 US Gallons).

Inside the fuel tank, you will find the location of the low pressure fuel pump module assembly.

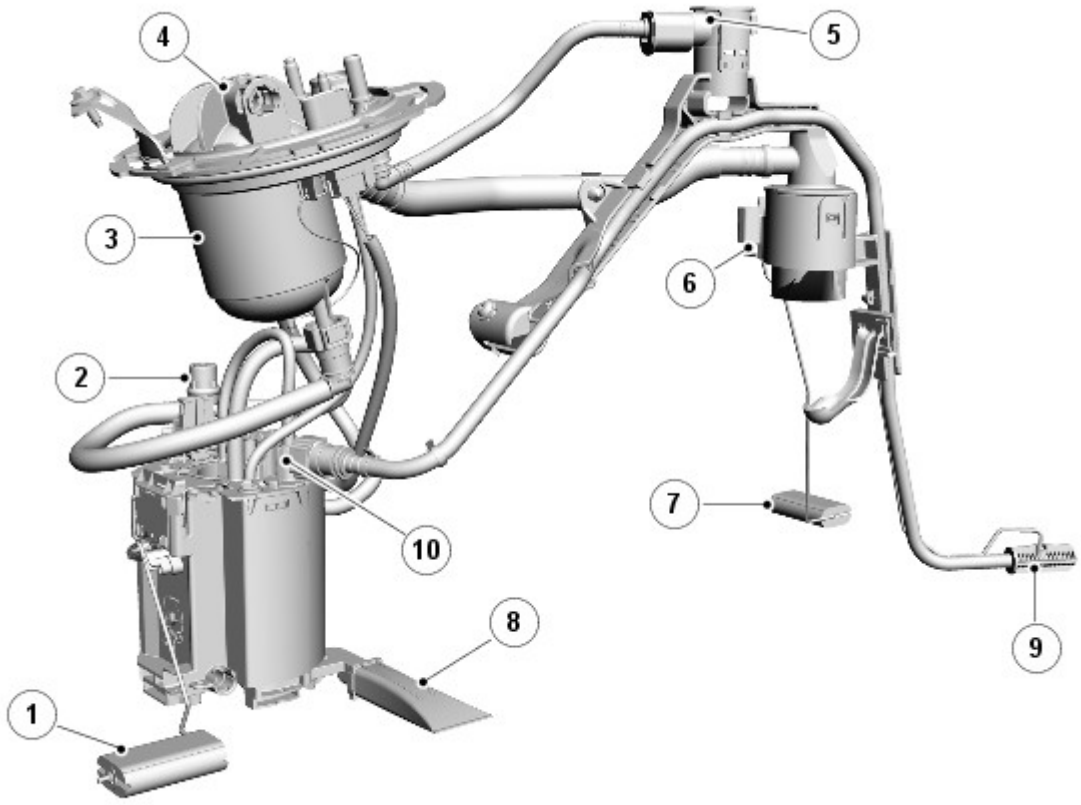
Access to the fuel tank is via the removal of the rear seat and removal of the LP pump module flange located on the right side of the tank.

Within the fuel tank, in the upper left side centre section, a Fill Limit Vent Valve (FLVV) is positioned. This is to control the fuel fill volume into the tank. During the refuelling process, air/vapour is displaced (by the fuel entering the tank) and exits the tank via the Fill Limit Vent Valve and is conveyed by the fuel tank refuelling breather pipe to exit the system either by the filler head for the EURO or ROW vehicles and via the charcoal canister for NAS vehicles. During filling, as the tank reaches its full level, the float in the Fill Limit Vent Valve is closed by the rising fuel and prevents air/vapour passing through to the refuelling breather pipe. The resulting back pressure causes refuelling to stop automatically.

Also within the fuel tank is a vent/gradient and roll over valve in the upper centre section, which allows vapour to escape to prevent tank pressurisation in normal vehicle operating modes; however this valve is designed to close to prevent fuel leakage through the vent in the event of a vehicle roll over.

Fuel level inside the tank is monitored by two level sensors that are connected to the instrument cluster.

FUEL PUMP MODULE



E149003

Item	Part Number	Description
1	-	Fuel Level Sensor Float 'A'
2	-	Pressure Relief Valve (PRV)
3	-	Intank Fuel Filter
4	-	Fuel Pump Module Tank Flange
5	-	Fuel Tank Roll Over Valve
6	-	Fuel Fill Limit Vent Valve
7	-	Fuel Level Sensor Float 'B'
8	-	Fuel Pump Coarse Filter
9	-	Suction Port Filter
10	-	Venturi Transfer Pump

The fuel pump module is controlled by the ECM via the fuel pump relay located in the RJB (Rear Junction Box).

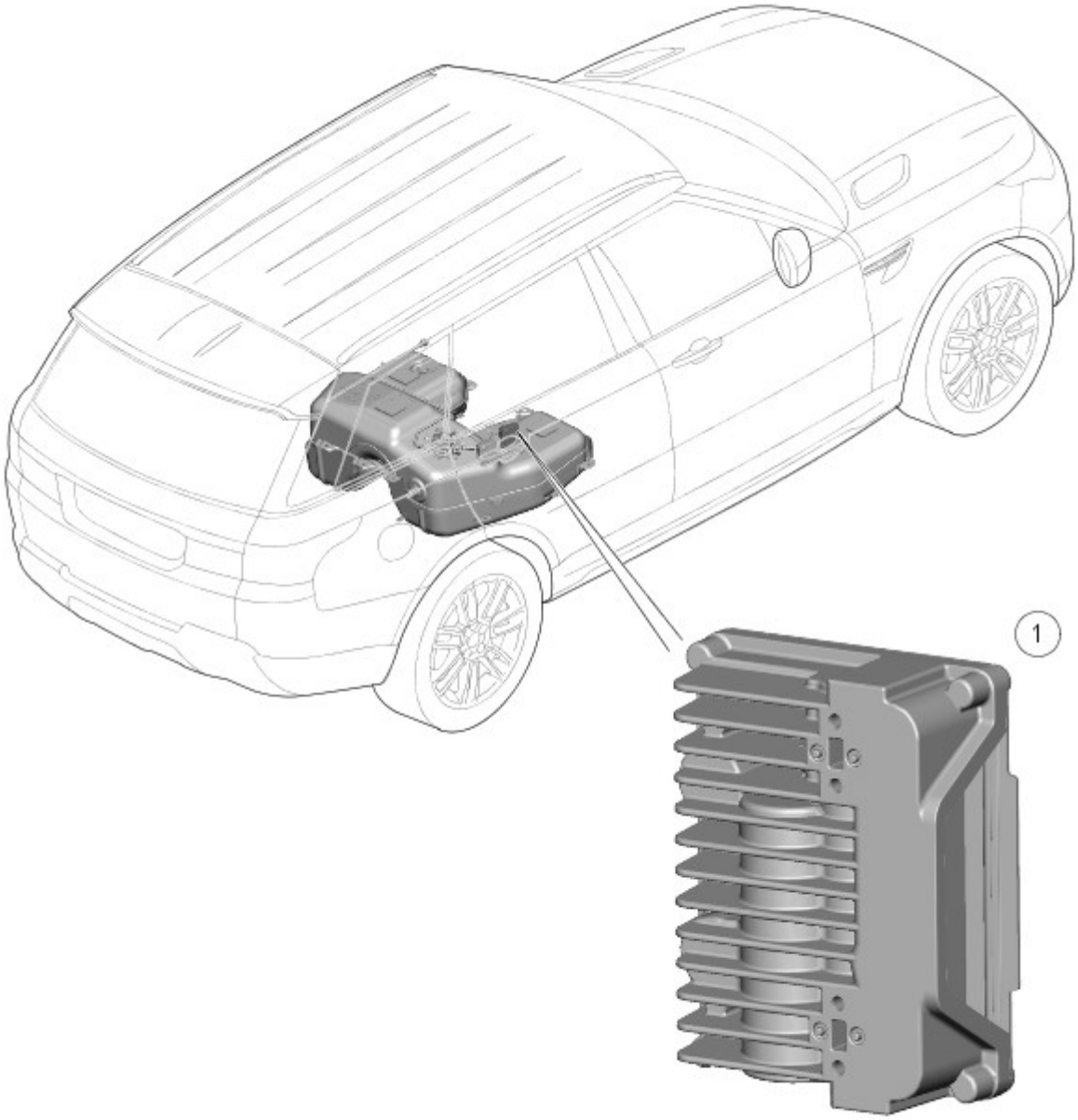
The electric pump collects fuel from the swirl pot and passes it from the tank to the fuel supply line via the fuel filter, to the engine mounted, HP pump at a pressure of 5.5 to 7.3 bar.

Fuel is collected from the left side of the tank to the right side of the tank by using a single suction tube that transfers fuel using a venturi transfer pump which is powered by the fuel feed from the fuel pump.

Should the fuel pump electrical connection need to be disconnected, it is important that the ignition is switched off. If the ignition is in position I or II, the IC (Instrument Cluster) will store its last fuel gauge needle position prior to power down. Once power is restored the gauge will display the last stored position regardless of the actual level in the tank.

This could result in incorrect fuel gauge readings if the fuel tank has been drained and not filled with exactly the same quantity of fuel that was removed.

FUEL PUMP DRIVER MODULE (FPDM)



E153825

Item	Part Number	Description
1	-	Fuel Pump Driver Module (FPDM)

The FPDM (Fuel Pump Driver Module) is attached to the right side rear floor member.

The fuel pump operation is regulated by the FPDM which is controlled by the 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 RJB. The fuel pump relay is energized on opening the driver's door or when power mode 9 engine crank is initiates using the stop/start button. The FPDM supplies power to the fuel pump, and adjust the power to control the speed of the fuel pump and thus the pressure and flow in the delivery line.

A 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 pump speed, e.g. if the PWM signal with 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 fuel rail low pressure sensor and adjusts the speed of the fuel pump as necessary to maintain an ECM requested output pressure of 5.5 bar to 7.5 bar absolute, during engine start up and engine shut down. Target pressure for the fuel low pressure delivery line is raised to 7.3 bar absolute.

If the RCM (Restrainst Control Module) outputs a crash signal on the high speed CAN (Controller Area Network) Powertrain 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 DTC (Diagnostic Trouble Code).

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

There are two fuel level sensors located inside the fuel tank. Fuel level sensor 'A' is attached to the swirl pot and monitors fuel level on the right side of the tank. Fuel Level sensor 'B' is attached to the suction pipe carrier and monitors fuel level on the left side of the tank.

Both level sensors are MAPPS (MAgnetic Passive Position Sensors) which provide a variable resistance to ground for the output from the fuel gauge.

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 IC to implement an anti-slosh function. This monitors the signal and updates the pointer position at regular intervals, preventing constant pointer movement caused by fuel movement in the tank due to cornering and braking.

Fuel Level Sensors - Resistance/Fuel Gauge Read Out Table

NOTE: These figures are with vehicle on level ground. Sensor readings will defer with varying vehicle inclinations.

Fuel Level Sensor 'A':-

Sender Unit Resistance, Ohms	Nominal Gauge Reading
992	Empty
51	Full

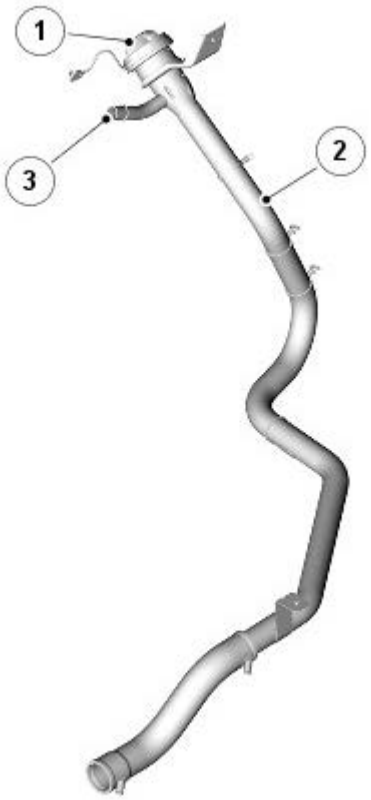
Fuel Level Sensor 'B':-

Sender Unit Resistance, Ohms	Nominal Gauge Reading
992	Empty
182	Full

When the fuel level becomes low, a fuel warning lamp in the IC is illuminated and a message is displayed.

The fuel level sender signal is converted into a high speed CAN Powertrain message by the IC as a direct interpretation of the fuel tank contents in litres.

FUEL FILLER PIPE



E149005

Item	Part Number	Description
1	-	Fuel Filler Cap
2	-	Fuel Filler Pipe
3	-	Refuelling Breather Pipe Connection

The fuel filler pipe locates into the tank and incorporates a spit back flap in the tank end of the pipe. The flap is spring loaded cover which acts as one way valve, allowing the tank to be filled but preventing fuel leaving the tank into the filler pipe.

A connection at the top right side of the filler head allows for the connection of the fuel tank ventilation/breather pipe which goes to the tank. **On NAS vehicles only**, this connection will only be used for EVAP (Evaporative emission) System, as the refuelling breather is routed to the charcoal canister.
For additional information, refer to: Evaporative Emissions (303-13B Evaporative Emissions - V8 S/C 5.0L Petrol, Description and Operation).

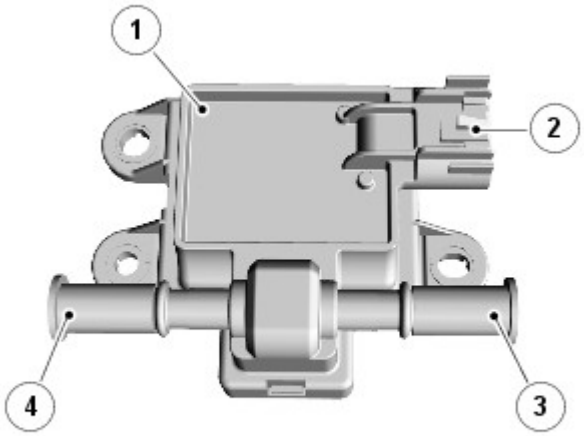
FUEL LOW PRESSURE SENSOR



E112870

The fuel low pressure sensor supplies a pressure signal to the ECM to enable closed loop control of the fuel pump.

FUEL FLEX SENSOR



E149006

Item	Part Number	Description
1	-	Fuel Flex Sensor
2	-	Electrical Connection
3	-	Fuel Inlet
4	-	Fuel Outlet

The fuel flex sensor is designed to detect whether the vehicle is operating on ethanol/gasoline fuel and is only **on NAS Vehicles Only**.

The fuel flex sensor is attached to the fuel supply line, and as fuel flows through the sensor, it will determine the ethanol content of the fuel and the temperature of the fuel being delivered to the engine.

The fuel flex sensor is a serviceable part and requires no maintenance.

The output signal from the sensor will be delivered to the ECM in units of frequency (Hz). A pulsated frequency signal (50Hz - 100Hz) corresponds to ethanol percentage (0 - 100%) within an ambient temperature range of 40°C to 125°C.

If measured frequency exceeds that of 170Hz error codes will be displayed.

- Error Codes between 170Hz and 180Hz indicates sensor internal failure and will require replacement.
- Error Code 190Hz indicates fuel composition is outside sensor measurement range and recommend action is to check and replace fuel and retest.

Published: 26-Feb-2013

Fuel Tank and Lines - 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 (310-01C Fuel Tank and Lines - V8 S/C 5.0L Petrol, 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 1600 bar (23,206 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 mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
• Fuel level • Contaminated fuel • Fuel supply line(s) • Fuel return line(s) • High-pressure fuel supply line(s) • Fuel tank filler pipe • Fuel leak(s) • Fuel tank • Fuel filler cap • Fuel filter • Push connect fittings • Fuel rail • Fuel injection pump • Exhaust gas recirculation system	• Battery charge and condition • Fuse(s) • Fuel pump module (lift pump) • Fuel pump module relay • Electrical connector(s) • Damaged or corroded wiring harness • Fuel volume control valve • Fuel pressure control valve • 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.

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. Check for ignition system, fuel system and electronic engine control DTCs and refer to the relevant DTC index
Engine cranks and fires, but will not start	• 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 • Exhaust gas recirculation valve stuck open • Fuel pump • Purge valve	Check the engine coolant level and condition. Ensure the battery is in a fully charged and serviceable condition. Check for electronic engine controls, engine emissions, fuel system and evaporative emissions system related DTCs and refer to the relevant DTC index
Difficult hot start	• Injector leak • Electronic engine control • Purge valve • Fuel pump • Ignition system • Exhaust gas recirculation valve stuck open	Check for injector leak, install new injector as required. Check for electronic engine controls, evaporative emissions, fuel system, ignition system and engine emission system related DTCs and refer to the relevant DTC index
Difficult to start after hot soak (vehicle	• Injector leak • Electronic engine	Check for injector leak, install new injector as required. Check for electronic engine controls, evaporative emissions, fuel system,

standing, engine off, after engine has reached operating temperature)	control • Purge valve • Fuel pump • Ignition system • Exhaust gas recirculation valve stuck open	ignition system and engine emission system related DTCs and refer to the relevant DTC index
Engine stalls soon after start	• Breather system disconnected/restricted • Engine control module relay • Electronic engine control • Ignition system • Air intake system restricted • Air leakage • Fuel lines	Ensure the engine breather system is free from restriction and is correctly installed. Check for electronic engine control, ignition system and fuel system related DTCs and refer to the relevant DTC index. Check for blockage in air filter element and air intake system. Check for air leakage in air intake system
Engine hesitates/poor acceleration	• 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 valve stuck open • Transmission malfunction	Check for fuel system related DTCs and refer to the relevant DTC index. Check for injector leak, install new injector as required. Check for air leakage in air intake system. Ensure accelerator pedal is free from restriction. Check for electronic engine controls, ignition, engine emission system and transmission related DTCs and refer to the relevant DTC index
Engine backfires	• Fuel pump/lines • Air leakage • Electronic engine controls • Ignition system • Sticking variable camshaft timing hub	Check for fuel system failures. Check for air leakage in intake air system. Check for electronic engine controls, ignition system and variable camshaft timing system 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. Check for electronic engine controls, throttle system and ignition system related DTCs and refer to the relevant DTC index
Engine detonates/knocks	• Fuel pump/lines • Air leakage • Electronic engine controls • Sticking variable camshaft timing hub	Check for fuel system failures. Check for air leakage in intake air system. Check for electronic engine controls and variable camshaft timing system related DTCs and refer to the relevant DTC index
No throttle response	• Electronic engine controls • Throttle motor	Check for electronic engine controls and throttle system related DTCs and refer to the relevant DTC index
Poor throttle response	• 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. Check for electronic engine controls, transmission and traction control related DTCs and refer to the related DTC index. Check for air leakage in intake air system

DTC index

For a 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 - V8 S/C 5.0L Petrol, DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation).

Published: 13-Sep-2012

Fuel Tank and Lines - V8 S/C 5.0L Petrol - Fuel Pump and Sender Unit

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.

 The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.

 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.

 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.

 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.

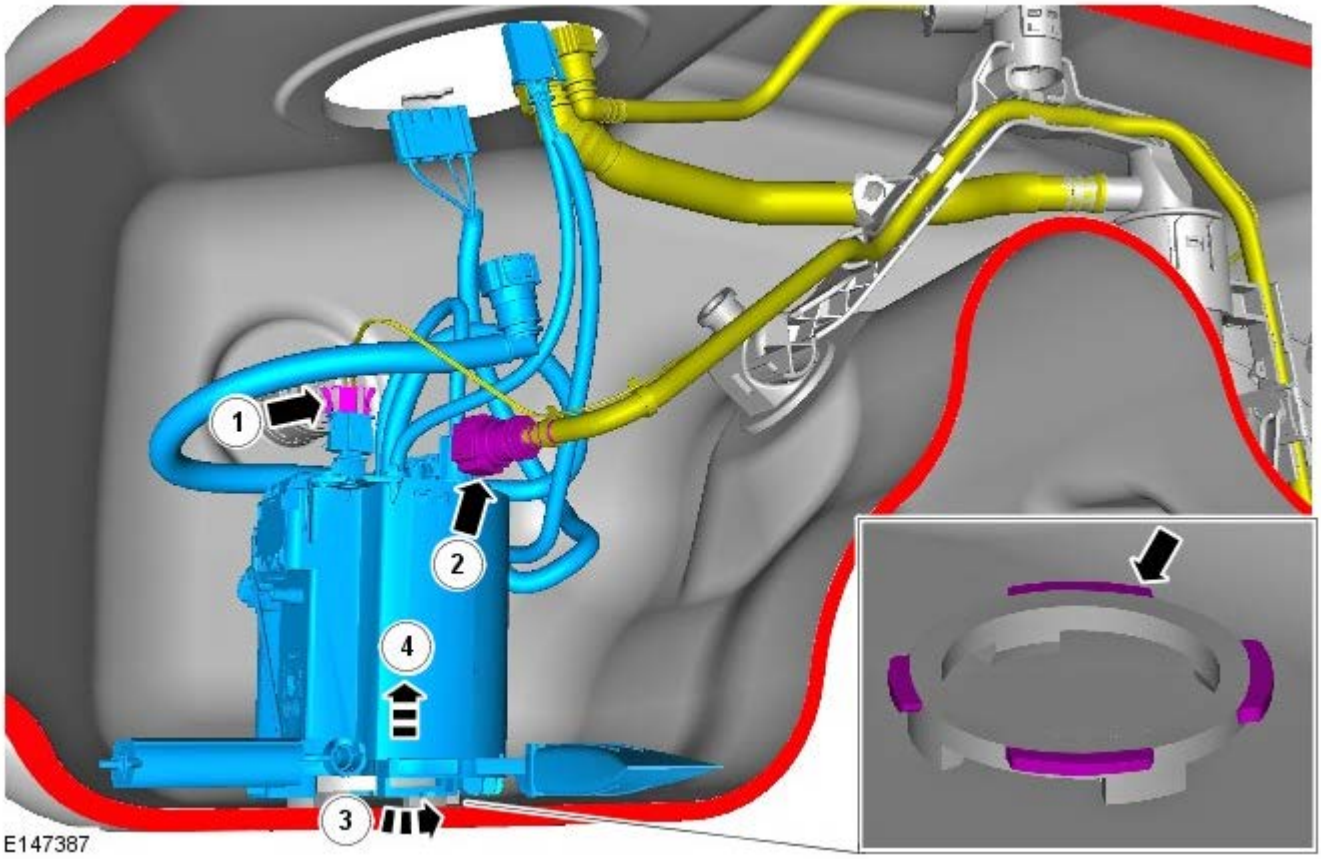
2. Refer to: Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions (100-00 General Information, Description and Operation).

3. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

4. Refer to: Fuel Tank Draining (310-00 Fuel System - General Information, General Procedures).

5.



Installation

1. To install, reverse the removal procedure.

Published: 12-Sep-2012

Fuel Tank and Lines - V8 S/C 5.0L Petrol - Fuel Level Sender

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.

 The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.

 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.

 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.

 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: Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions (100-00 General Information, Description and Operation).

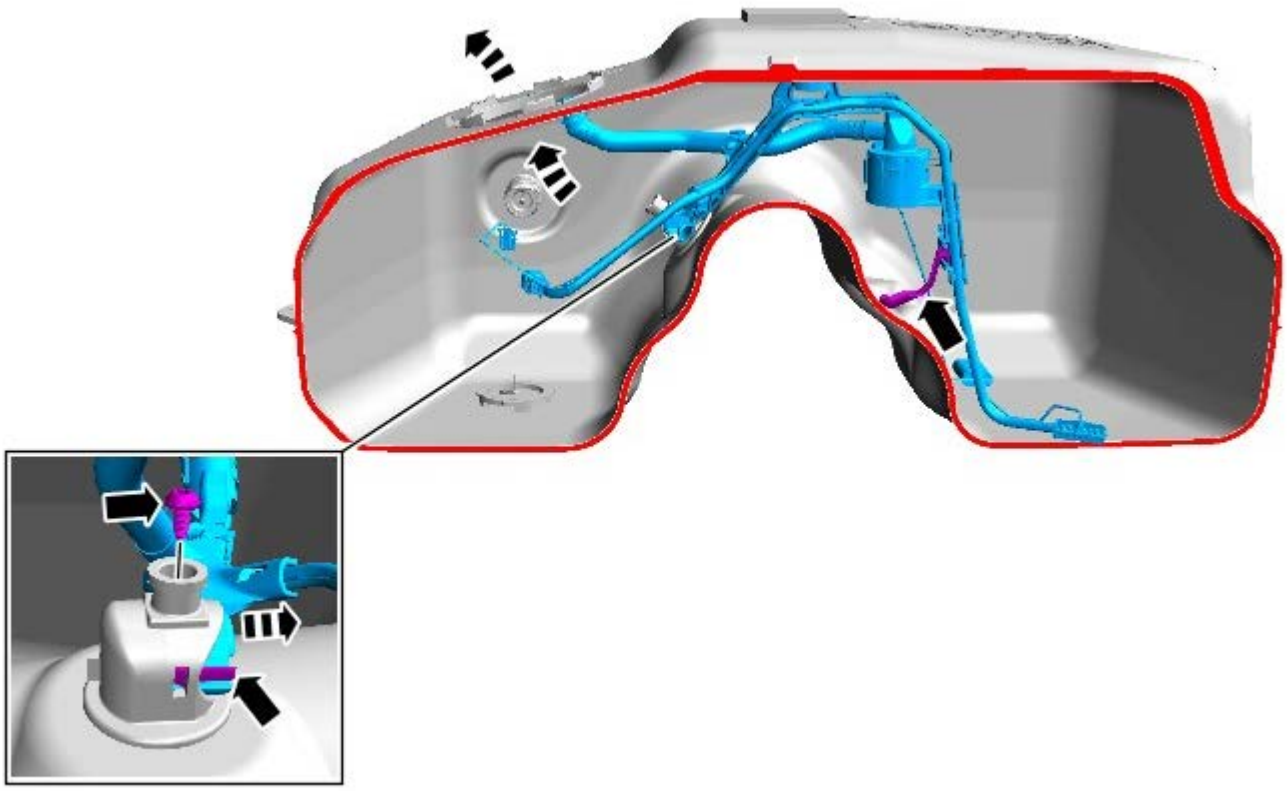
3. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

4. Refer to: Fuel Pump and Sender Unit (310-01C Fuel Tank and Lines - V8 S/C 5.0L Petrol, Removal and Installation).

5.  NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

   Torque: 7 Nm



E147440

Installation

1. To install, reverse the removal procedure.

Published: 02-May-2013

Fuel Tank and Lines - V8 S/C 5.0L Petrol - Fuel Filter

Removal and Installation

Special Tool(s)

 E80148	310-123 Locking Ring, Fuel Tank

Removal

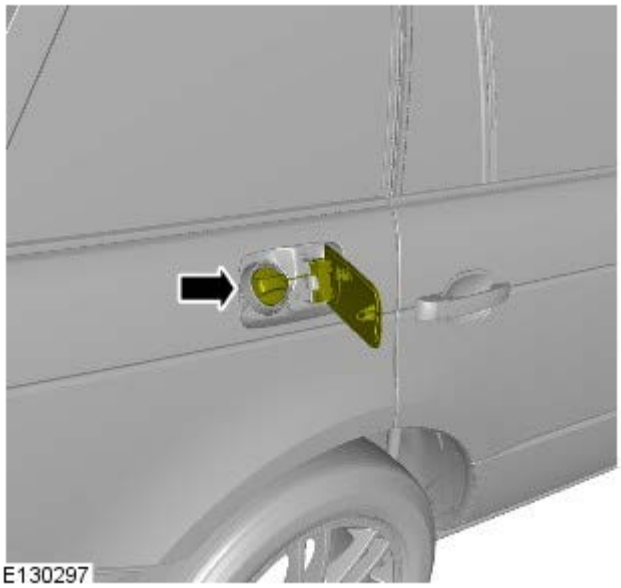
All vehicles

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 - V6 S/C 3.0L 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).


E130297

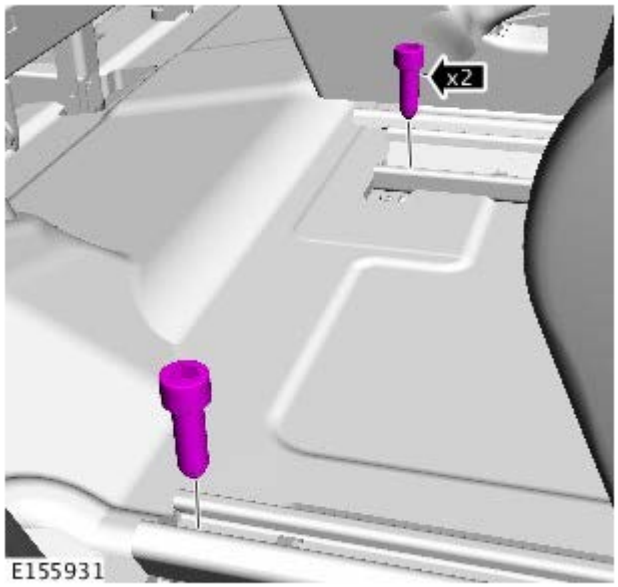
4. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Vehicles with occasional rear seats

5.



6. *Torque:* 50 Nm



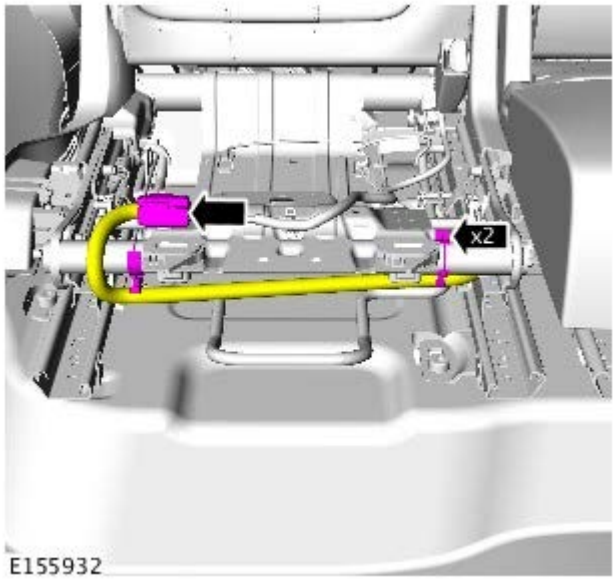
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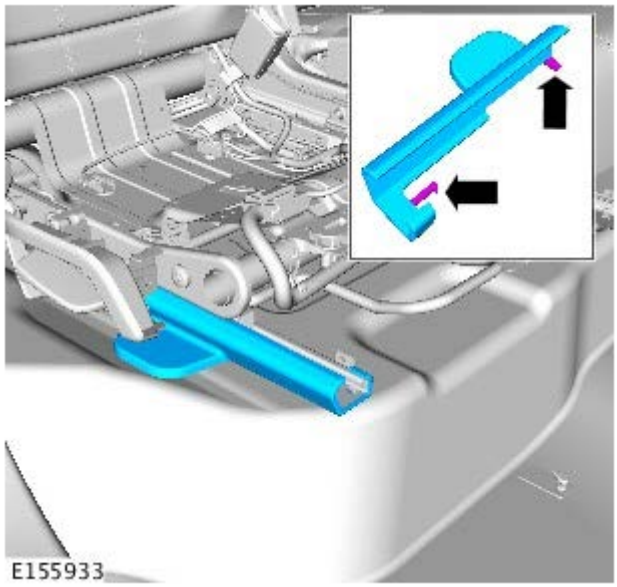
8.



9.



10.



11. *Torque:* 50 Nm

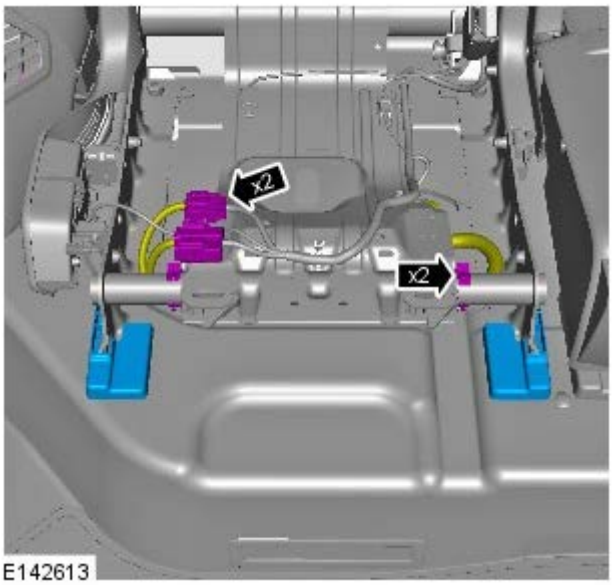


Vehicles without occasional rear seats

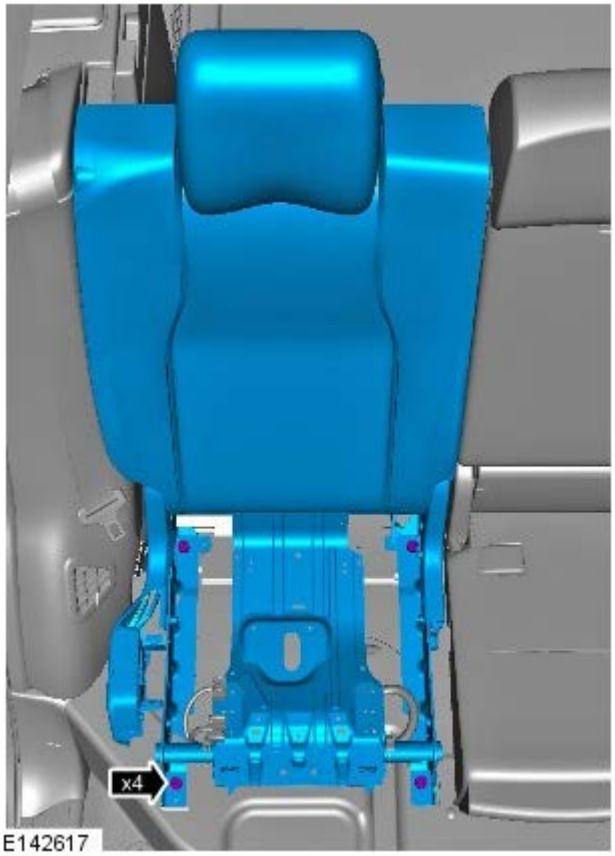
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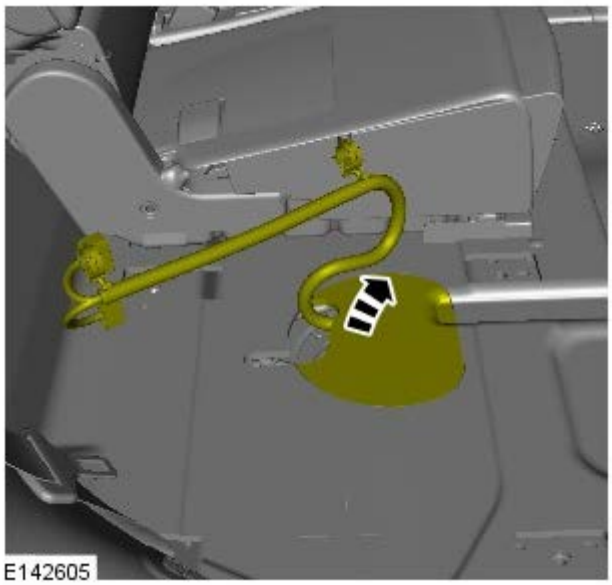


14. *Torque:* 50 Nm

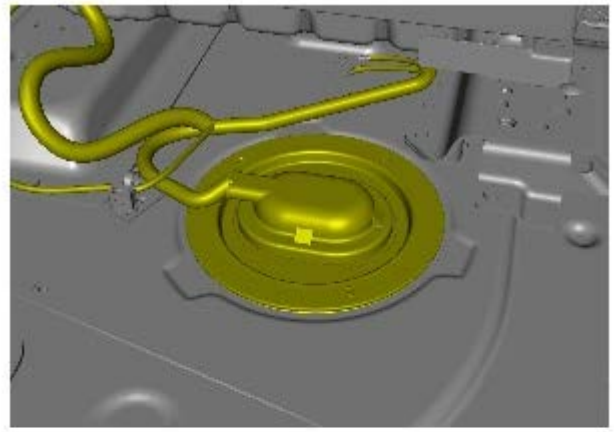


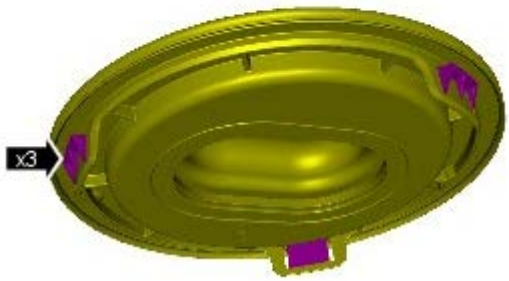
All vehicles

15.



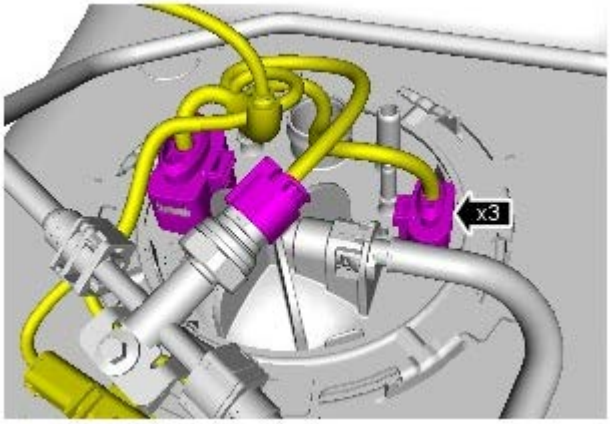
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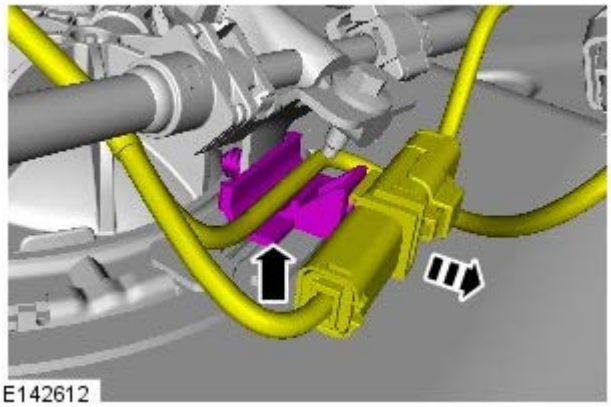




E142604

17.

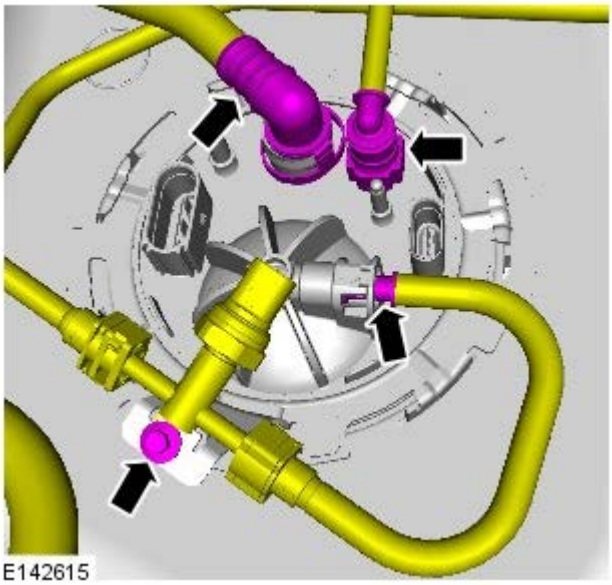




E142612

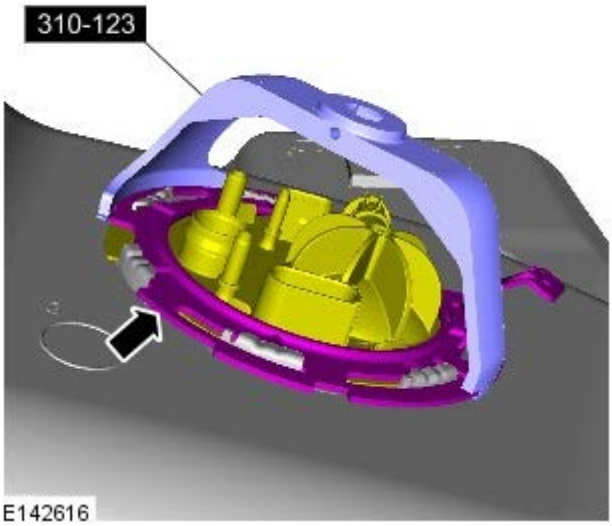
18. CAUTION: Be prepared to collect escaping fuel.

Torque: 7 Nm

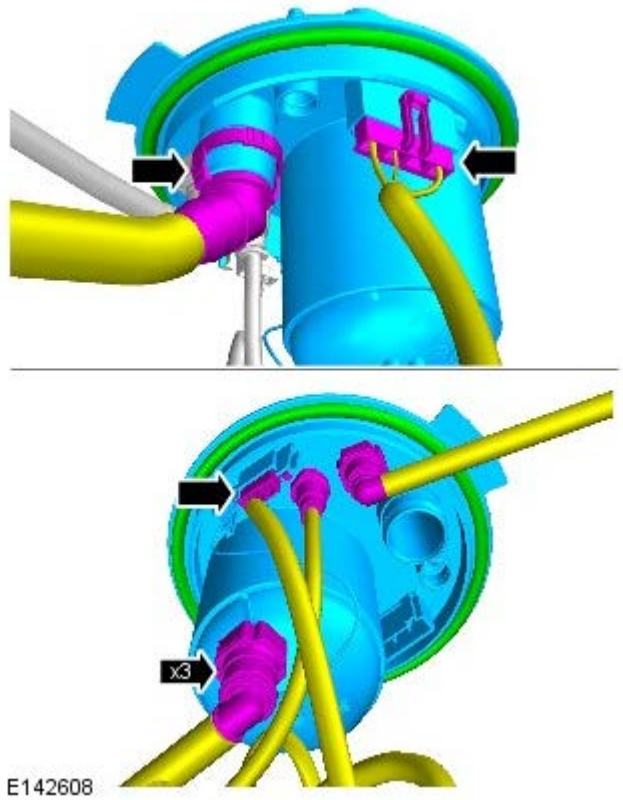


19. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

- *Special Tool(s):* 310-123



20. CAUTION: A new O-ring seal is to be installed.



Installation

1. To install, reverse the removal procedure.

Published: 25-Oct-2013

Fuel Tank and Lines - 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.

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.

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.

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: Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions (100-00 General Information, Description and Operation).
   Refer to: Diesel Fuel System Health and Safety Precautions (100-00 General Information, Description and Operation).

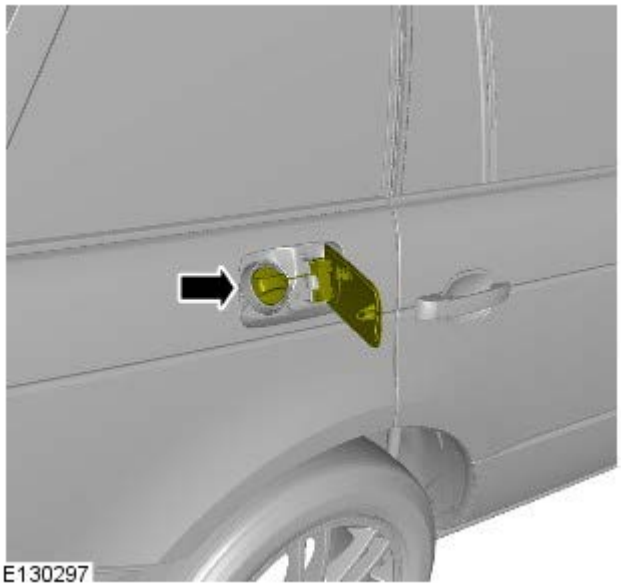
Vehicles with petrol engine

3. Refer to: Fuel System Pressure Release - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (310-00 Fuel System - General Information, General Procedures).

All vehicles

4. Refer to: Rear Subframe (502-00 Uni-Body, Subframe and Mounting System, Removal and Installation).

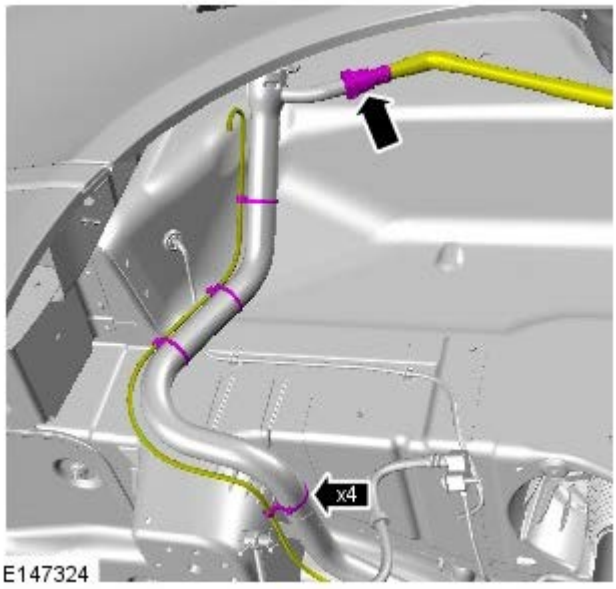
5. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.



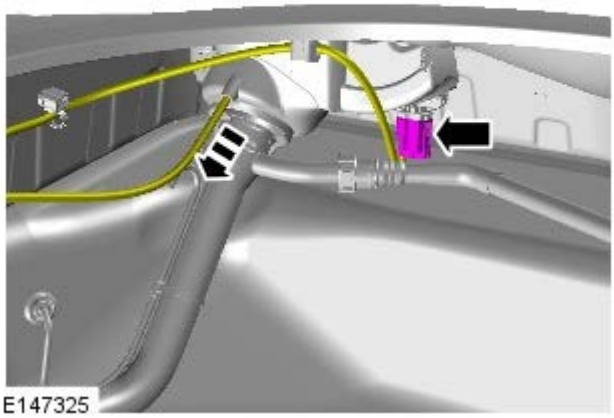
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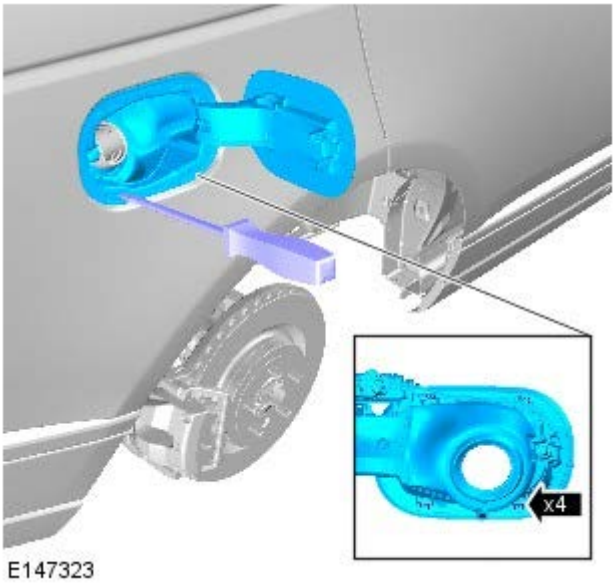
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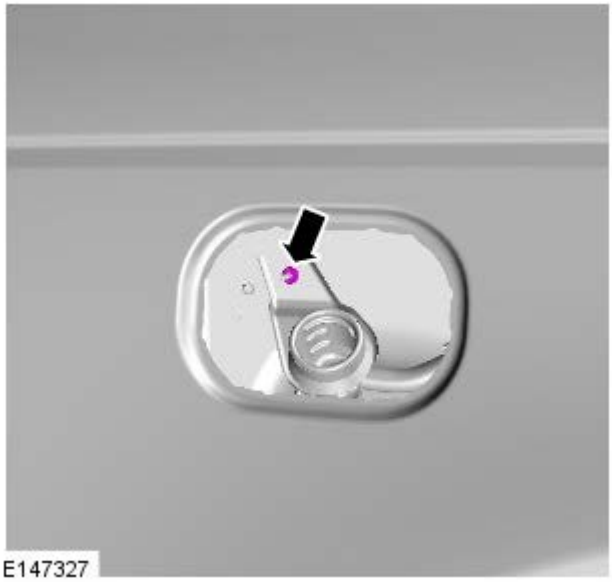

E147325

9.



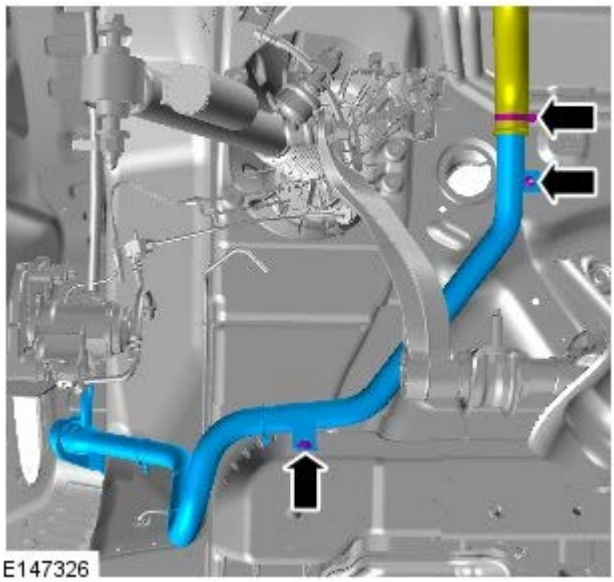
E147323

10. *Torque:* 10 Nm


E147327

11. CAUTION: Be prepared to collect escaping fuel.

Torque:
M6 10 Nm
Clamp 3.5 Nm



Installation

1. To install, reverse the removal procedure.

Published: 05-Dec-2013

Fuel Tank and Lines - V8 S/C 5.0L Petrol - Fuel Tank

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.

 The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.

 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.

 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.

 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: Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions (100-00 General Information, Description and Operation).

3. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

4. Refer to: Fuel Tank Draining (310-00 Fuel System - General Information, General Procedures).

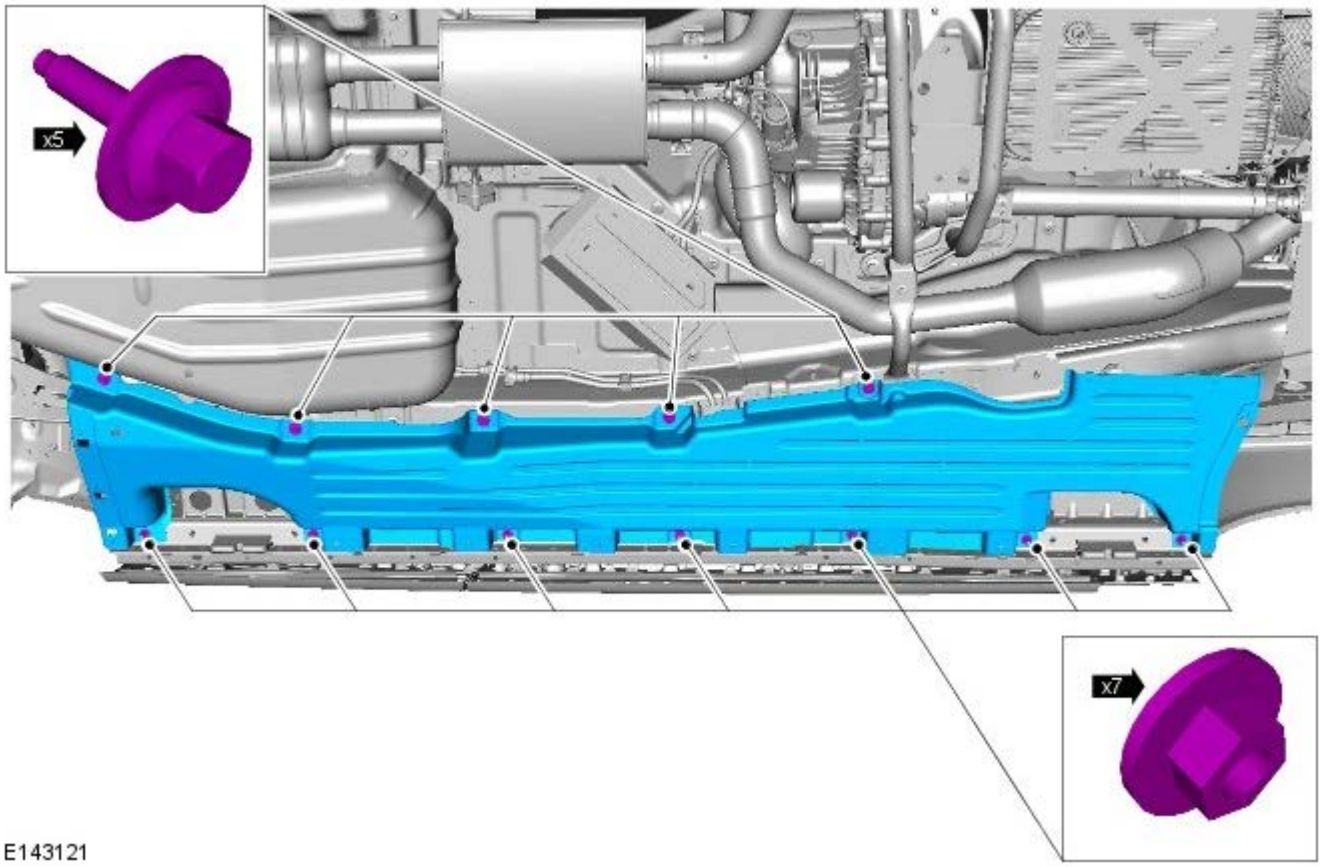
5.  NOTE: Repeat the procedure for the other side.

   Refer to: Rear Rocker Panel Moulding (501-08 Exterior Trim and Ornamentation, Removal and Installation).

6. Refer to: Rear Driveshaft - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (205-01 Driveshaft, Removal and Installation).

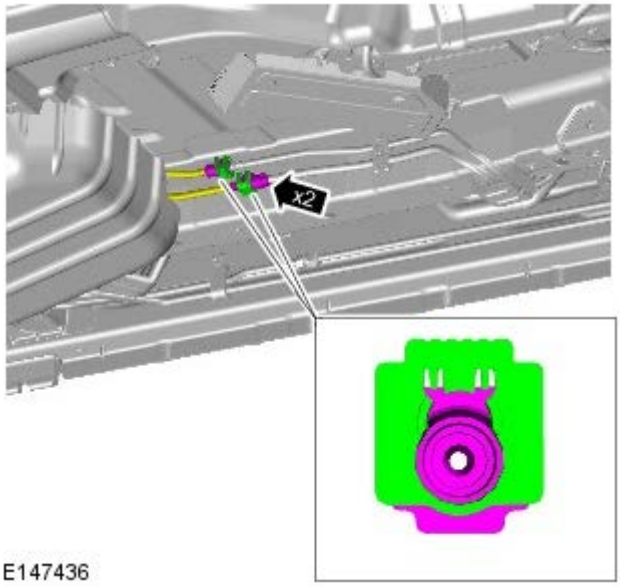
7.  CAUTION: LH illustration shown, RH is similar.

    NOTE: Repeat the procedure for the other side.



E143121

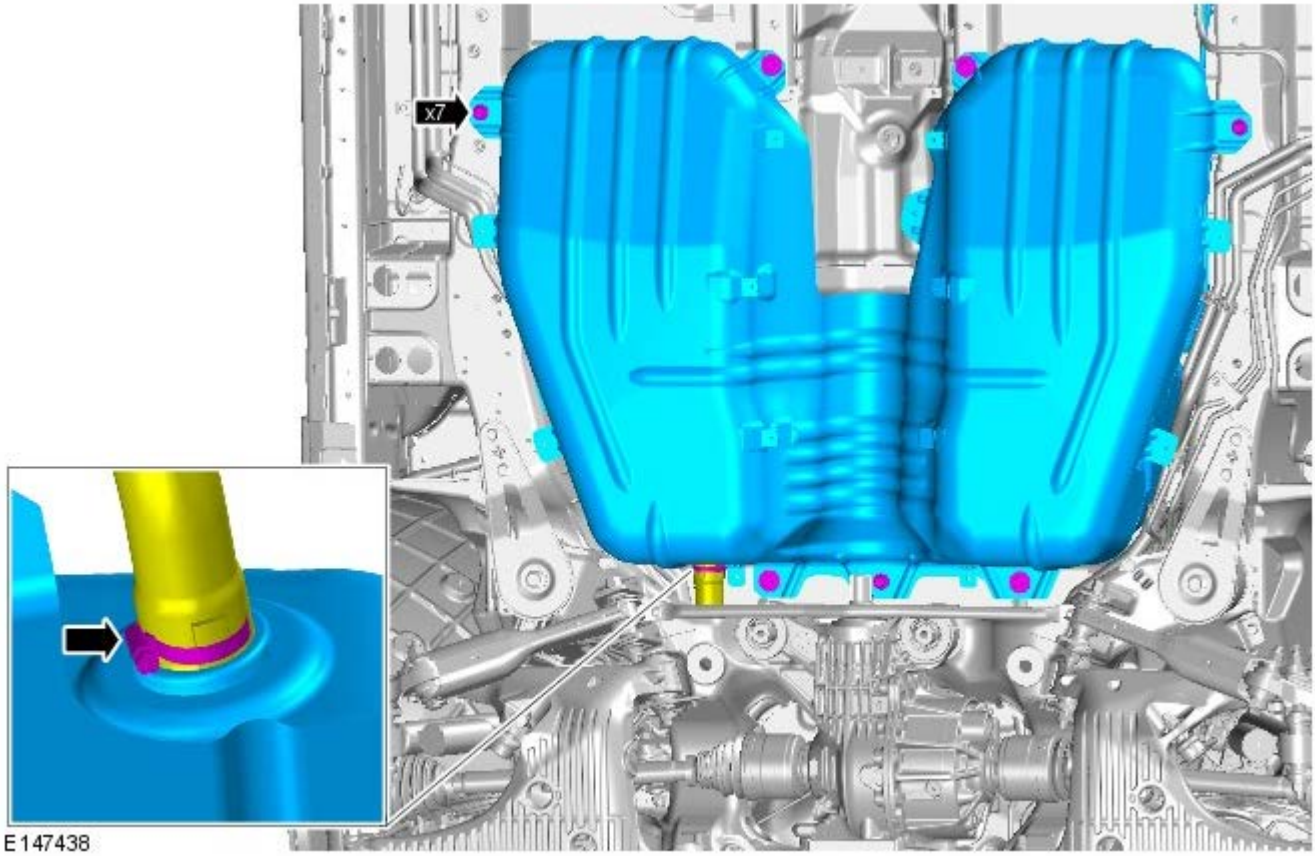
8. CAUTION: Be prepared to collect escaping fuel.



E147436

9. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Torque: 45 Nm



E147438

10. NOTE: Do not disassemble further if the component is removed for access only.



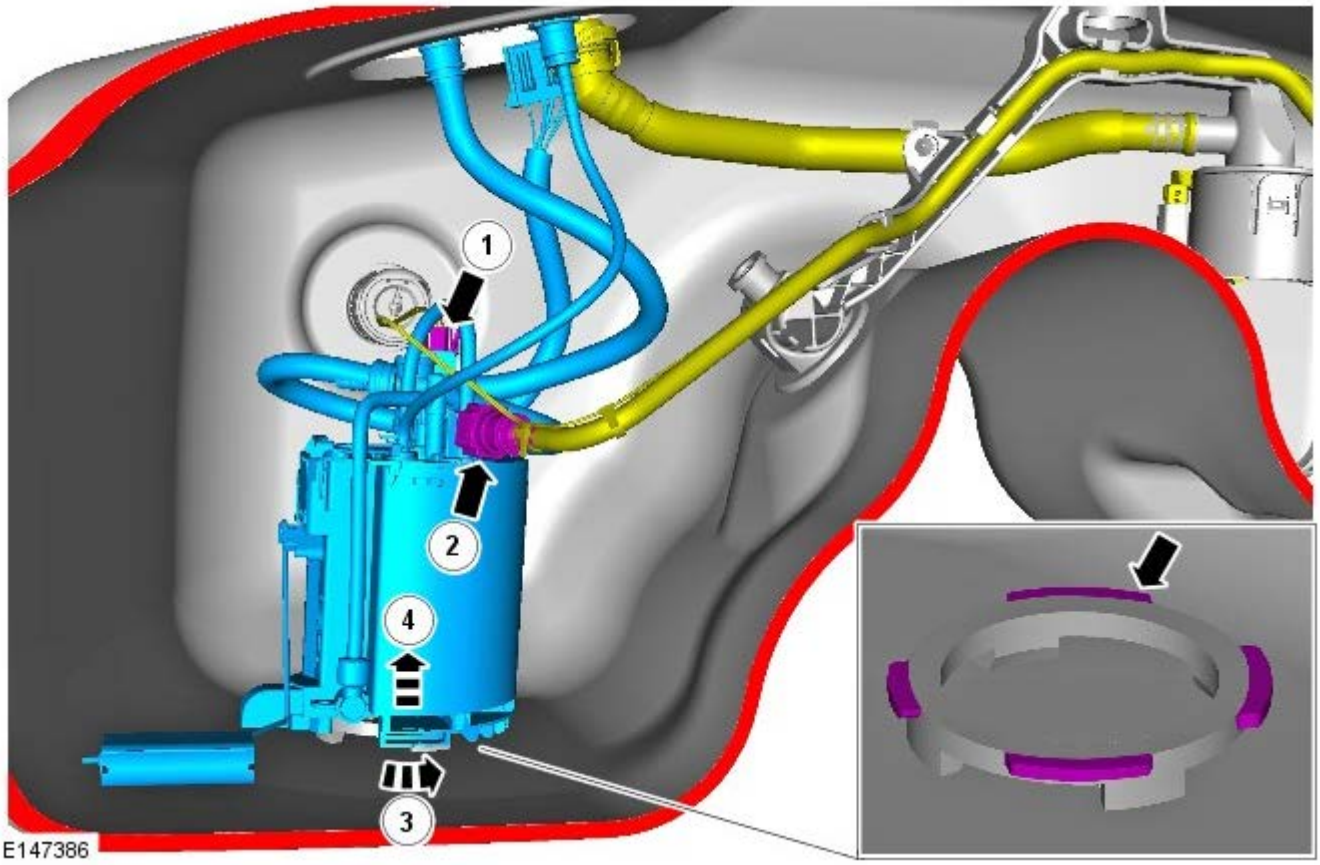
E147439

11. *Torque:* 10 Nm



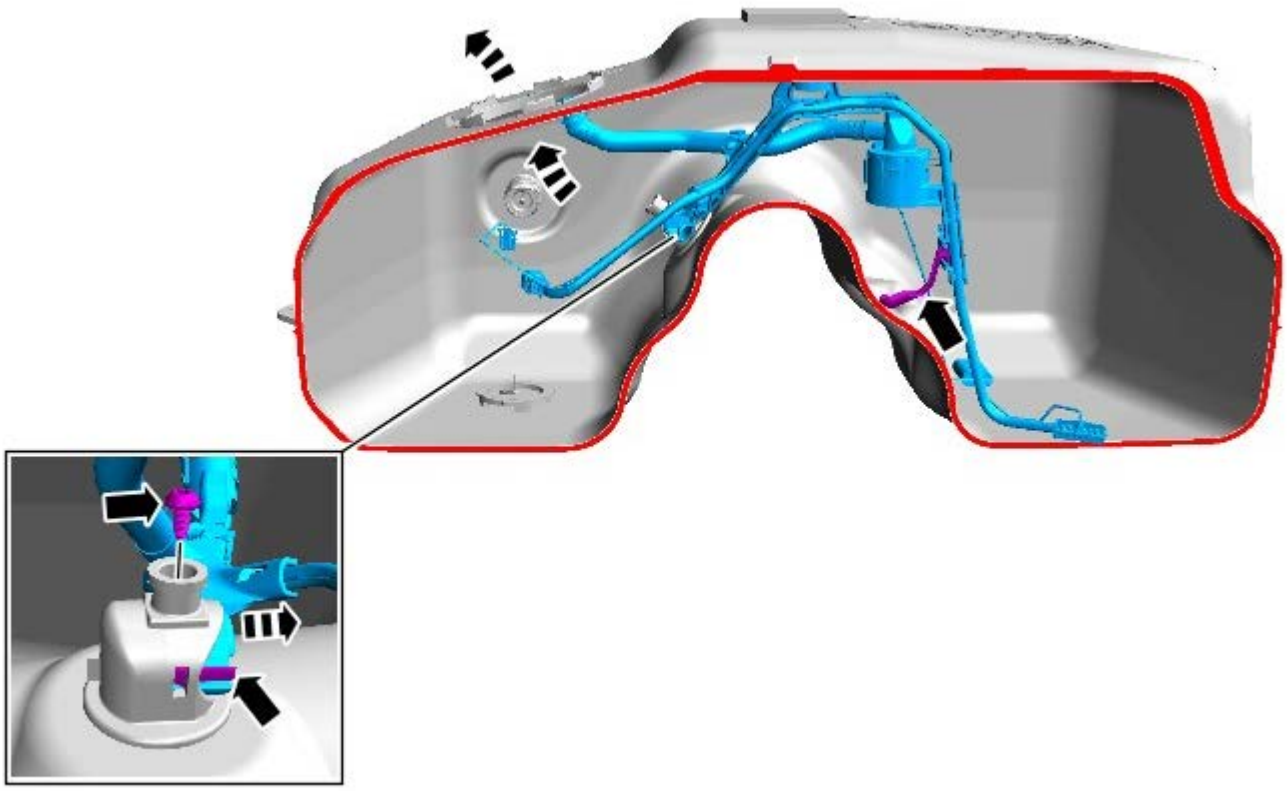
E147442

12.



E147386

13. *Torque:* 7 Nm



E147440

Installation

1. To install, reverse the removal procedure.

Published: 04-Dec-2012

Fuel Tank and Lines - TDV8 4.4L Diesel -

Capacities

	Liters
Fuel tank capacity	105 (usable)

General Specifications

Item	Specification
Fuel system	Mechanical - recirculating
Fuel tank	Multi layer plastic
High pressure fuel pump	Located at the front of left cylinder head, gear driven from the camshaft
Low pressure fuel pump	Dual stage electric - submersible - located in fuel tank
Auxiliary low pressure fuel pump	Located on the left front wheelhouse panel
Fuel cooler	Located on the left front suspension top mount assembly
Fuel filter	Remotely located on the left front suspension top mount assembly - fitted with a renewable element
Fuel tank sender units	Two - active and passive - passive sender unit is attached to the removable retaining bracket and the active sender unit 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
Auxiliary low pressure fuel pump	5.5 - bar

Torque Specifications

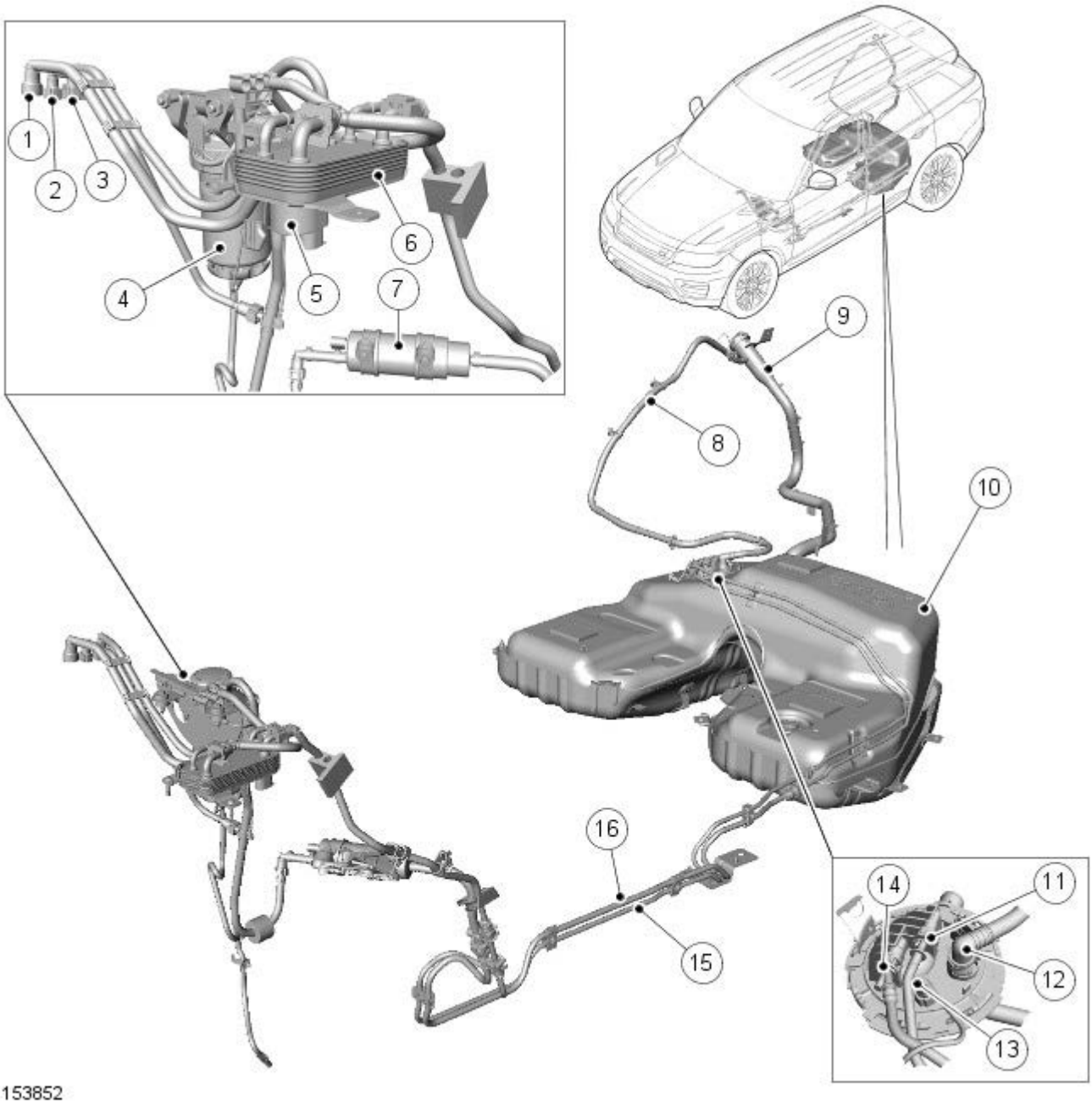
Description	Nm	lb-ft	lb-in
Air conditioning (A/C) refrigerant lines retaining bolts	10	7	-
Fuel cooler retaining bolts	9	-	80
Fuel tank internal bracket retaining bolt	7	-	62
Fuel tank filler pipe retaining nuts	9	-	80
Fuel tank filler pipe hose clamp	3.5	-	31
Fuel tank shield retaining bolts	45	33	-
Fuel tank shield to fuel tank bolt	10	7	-

Published: 21-Jan-2014

Fuel Tank and Lines - TDV8 4.4L Diesel - Fuel Tank and Lines

Description and Operation

FUEL TANK AND LINES - COMPONENT LOCATION



E153852

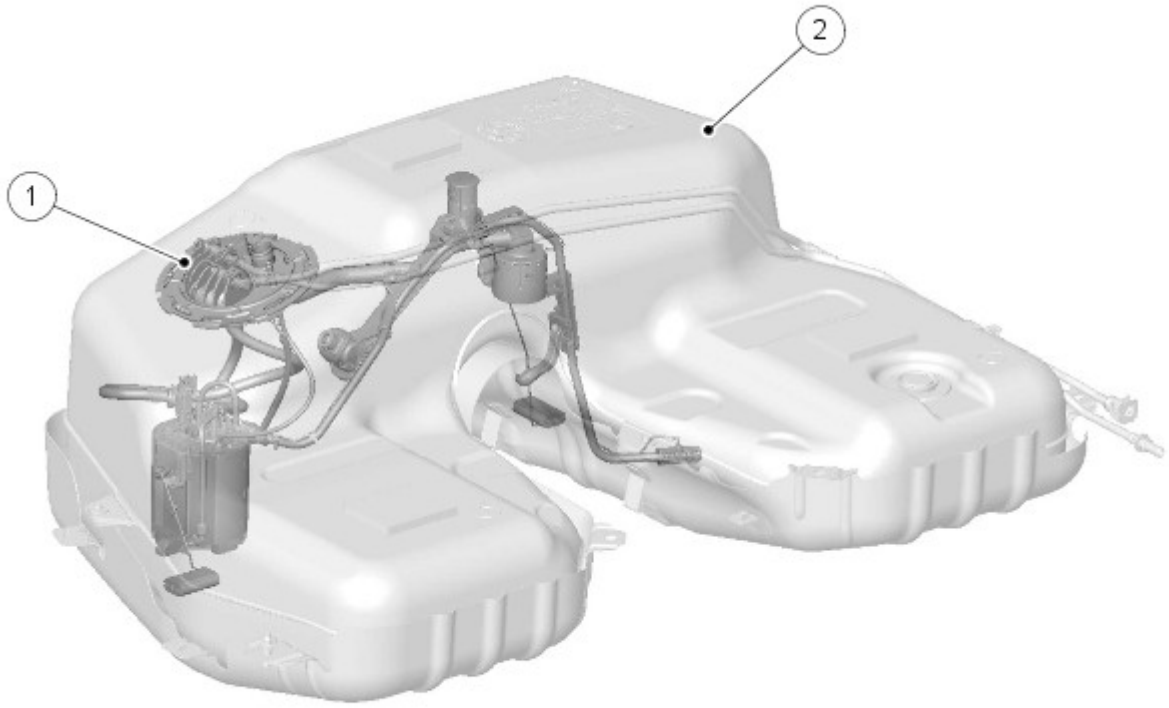
Item	Part Number	Description
1	-	Fuel Supply To High Pressure (HP) fuel pump
2	-	Fuel Injector Leak Off Pipe
3	-	Fuel Return From High Pressure (HP) fuel pump to Fuel Cooler
4	-	Fuel Filter
5	-	Fuel Heater Module
6	-	Fuel Cooler
7	-	Secondary Fuel Pump
8	-	Fuel Tank Refuelling Breather Pipe
9	-	Fuel Filler Pipe
10	-	Fuel Tank
11	-	Fuel Return from Fuel Cooler
12	-	Fuel Tank Refuelling Breather Connection
13	-	Fuel Fired Booster Heater (FFBH) Supply
14	-	Fuel Supply to Secondary Fuel Pump
15	-	Fuel Return Line

16	-	Fuel Supply Line

INTRODUCTION

The TDV8 4.4L diesel engine low pressure fuel system is designed to supply fuel to the HP (High Pressure) fuel pump via a secondary fuel pump, it can supply a uniform level of pressure to the common rails which supply's the fuel injectors.

FUEL TANK



E154571

Item	Part Number	Description
1	-	Fuel Pump Module Tank Flange
2	-	Fuel Tank

The fuel tank has a storage capacity of 103.5 litres (usable).

Inside the fuel tank, you will find the location of the low pressure fuel pump module assembly.

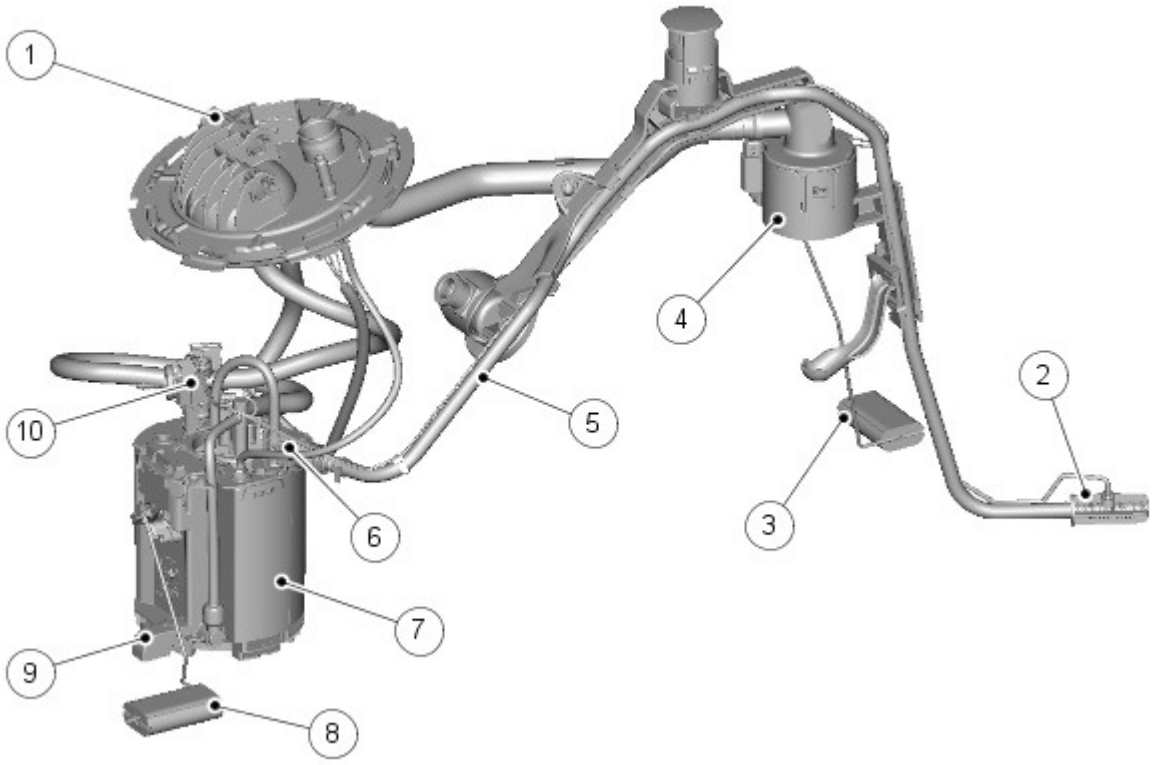
Access to the tank is via the removal of the right rear seat and removal of the low pressure pump module flange located on the right side of the tank.

Within the fuel tank, in the upper left side centre section is the fuel cut-off, molded into the centre bracket. This is to control the fuel fill volume of the tank. During the refuelling process, air/vapour is displaced (by the fuel entering the tank) and exits the tank via the cut-off and is conveyed by the fuel tank breather pipe to exit the system. During filling, as the tank reaches its full level, the fuel cut-off is closed by the rising fuel and prevents air/vapour passing through to the refuelling breather pipe. The resulting back pressure causes refuelling to stop automatically.

The fuel cut-off is always open when the fuel tank is below full, providing an unrestricted air/vapour outlet to the refuelling breather.

The fuel level inside the tank is monitored by two level sensors that are connected to the (IC) Instrument Cluster.

FUEL PUMP MODULE



E154566

Item	Part Number	Description
1	-	Fuel Pump Module Tank Flange
2	-	Suction Port Filter
3	-	Fuel Level Sensor Float 'B'
4	-	Fuel Cut-Off
5	-	Suction Port Pipe
6	-	Venturi Pump
7	-	Swirl Pot
8	-	Fuel Level Sensor Float 'A'
9	-	Fuel Pump Coarse Filter
10	-	Pressure Relief Valve (PRV)

The fuel pump module is controlled by the ECM (Engine Control Module) via the fuel pump relay located in the RJB (Rear Junction Box).

The electric pump in the tank collects fuel from the swirl pot at the base of the pump and passes it from the tank to the fuel supply line at 0.5 bar to the engine bay mounted inline electric fuel pump which lifts the fuel pressure to 4.5 bar prior sending the fuel to the engine HP (High Pressure) fuel pump.

Fuel is collected from the left side of the tank to the right side of the tank by using a single suction port pipe that transfers the fuel using a venturi pump which is powered by the fuel feed from the fuel pump.

Should the fuel pump electrical connection need to be disconnected, it is important that the ignition is switched off, If the ignition is on in positions I or II, the IC (Instrument Cluster) will store its last fuel gauge needle position prior to power down. Once power is restored the gauge will display the last stored position regardless of the actual level of fuel in the tank.

This could result in incorrect fuel gauge readings if the fuel tank has been drained and not filled with exactly the same quantity of fuel that was removed.

Low Fuel Strategy

The ECM is programmed with a strategy which shuts the engine off before the fuel tank runs dry. This is to prevent fuel system damage by air being drawn into the high pressure fuel pump.

A misfire is induced with increasing magnitude when the fuel in the tank reaches approximately 2.5 litres of useable fuel remaining to alert the driver to this condition. The engine is shut down when the fuel in the tank reaches 0.00 litres of useable fuel remaining in the tank and 4.0 litres of un-useable fuel remaining.

To reset the fuel strategy after engine shutdown, it is required that a minimum of 4 litres of fuel is added to the fuel tank, when the vehicle is on level ground.

FUEL LEVEL SENSORS

There are two fuel level sensors located inside the fuel tank. Fuel level sensor 'A' is attached to the swirl pot and

monitors fuel level on the right side of the tank. Fuel Level sensor 'B' is attached to the suction pipe carrier and monitors fuel level on the left side of the tank.

Both level sensors are MAAPS (MAgnetic Passive Position Sensor) which provide a variable resistance to ground for the output from the fuel gauge.

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 IC 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.

Fuel Level Sensors - Resistance /Fuel Gauge Read Out Table

 NOTE: These figures are with the vehicle on level ground. Sensor readings will defer with varying vehicle inclinations.

Fuel Level Sensor 'A':-

Sender Unit Resistance, Ohms	Nominal Gauge Reading
992	Empty
51	Full

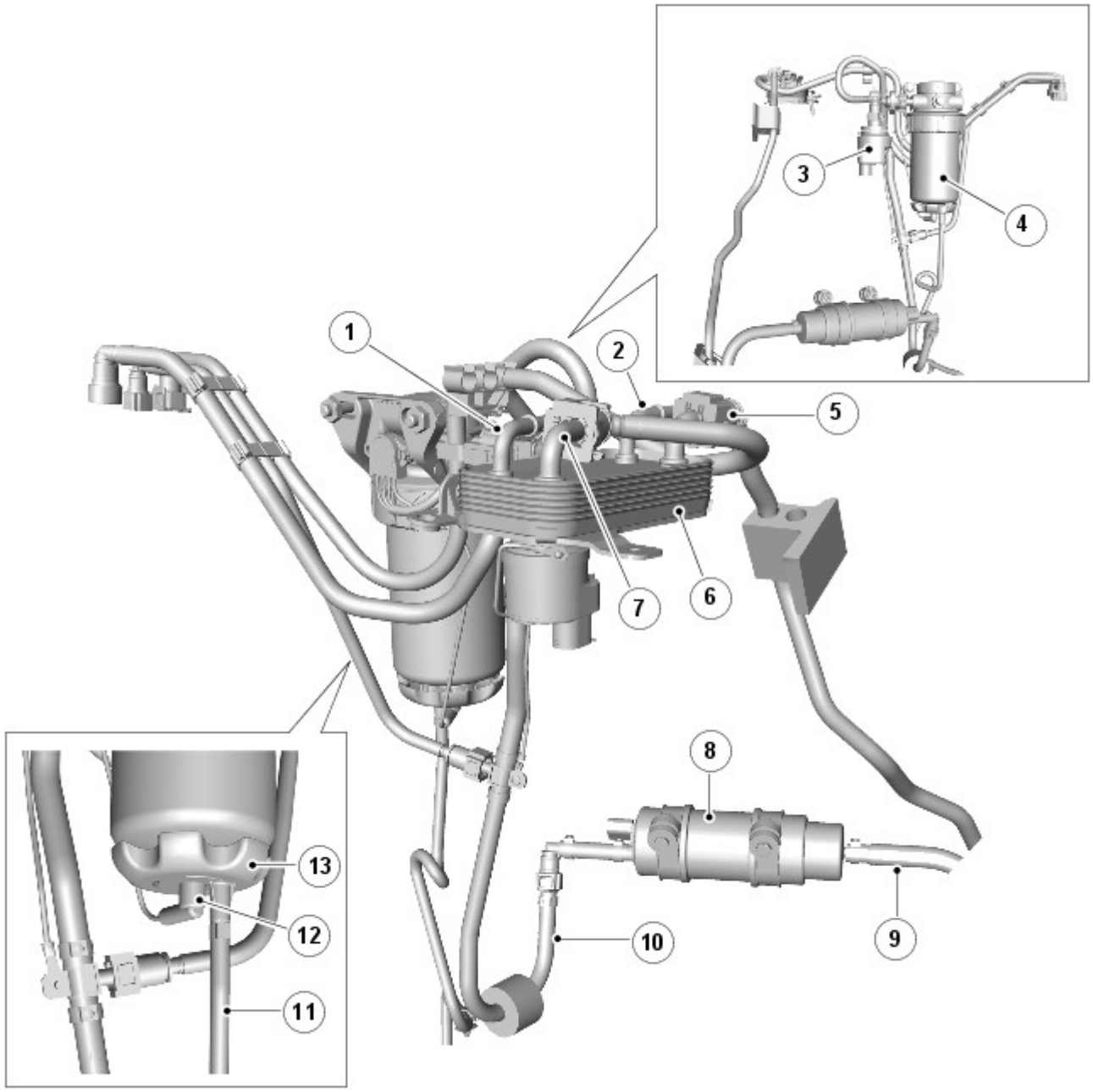
Fuel Level Sensor 'B':-

Sender Unit Resistance, Ohms	Nominal Gauge Reading
992	Empty
120	Full

When the fuel level becomes low, a warning lamp in the instrument cluster is illuminated and message displayed.

The fuel level sender signal is converted into high speed CAN (Controller Area Network) Powertrain message by the IC as a direct interpretation of the fuel tank contents in litres.

FUEL COOLER, SECONDARY FUEL PUMP AND FILTER ASSEMBLY



E148796

Item	Part Number	Description
1	-	Coolant Inlet
2	-	Coolant Outlet
3	-	Fuel Heater Module
4	-	Fuel Filter
5	-	Fuel Cooler Return Pipe to Fuel Tank
6	-	Fuel Cooler
7	-	Fuel Cooler Supply Pipe from High Pressure (HP) fuel Pump
8	-	Secondary Fuel Pump
9	-	Fuel Supply to Secondary Fuel Pump
10	-	Fuel Outlet from Secondary Fuel Pump
11	-	Water/Fuel Mix Drain Hose
12	-	Water in Fuel Sensor
13	-	Water/Fuel Mix Drain Turn Wheel

Fuel Filter

The fuel filter element is located on the underside of the filter housing and is secured into position with a locking ring.

The fuel filter is fitted with a removable water sensor which is secured at the base of the filter. The sensor can be unscrewed and fitted to a new filter.

The water sensor housing also incorporates a water drain plastic turn wheel that allows the water/fuel mix to be drained from the filter via the drain hose to underside of the vehicle.

Water in fuel is sensed by the ECM, the ECM transmits a message on the high speed CAN Powertrain bus to the IC which displays a message 'WATER IN FUEL' in the message centre.

Fuel Heater Module

The fuel heater module is connected upstream to the inlet port of the fuel filter. The heater module is a self-controlled unit and is activated in to respond to low fuel temperature and increasing system pressure and is powered when the ignition is on.

If the temperature is at or below 2°C ± 2°C (35.6° ± 3.6°F) and the fuel pressure is more than 0.5 bar, the fuel heater module will be activated. When the fuel temperature reaches or exceeds 7°± 2°C (44.6°F ± 3.6°F) or the fuel pressure is at or less than 5.5 bar the ECM will switch off the fuel heater module.

If, during the start of the heating process, the operating voltage is less than 7.5 Volts the heater module will be deactivated.

Fuel Cooler

The fuel cooler is designed to cool fuel returning from the HP pump before it is sent back to the fuel tank via the return line. Fuel is cooled by heat transfer through the internal galleries within the coolant assisted fuel cooler.

The fuel cooler is connected to the cooling system. The fuel cooler receives cooled coolant from a dedicated cooler located in front of the engine coolant radiator. This allows for engine coolant to be cooled before it passes through fuel cooler improving the efficiency of the fuel cooling.

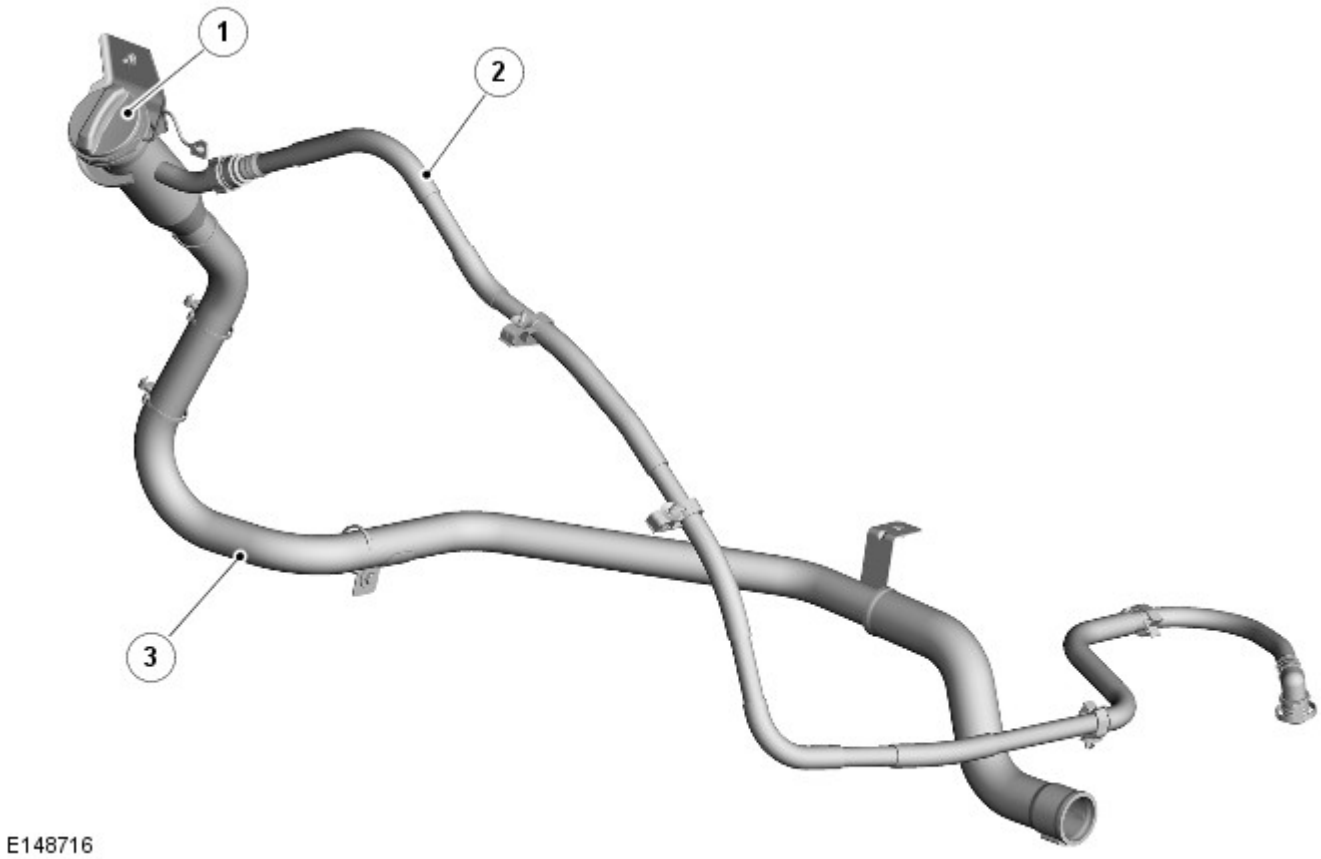
Secondary Fuel Pump

The secondary fuel pump is located at the front left side wheel housing and is attached to a mounting bracket. The pump has a fuel inlet from the fuel tank mounted fuel pump module and a pressure outlet to the fuel heater module.

A 2 pin connection provides the connection to the fuel pump relay in the RJB. The pump is active at all times when the fuel pump relay is energised.

The pump has a nominal flow rate of 180 l/hour at a pressure of 5.0 bar, when supply voltage is 12 volts.

FUEL FILLER PIPE



E148716

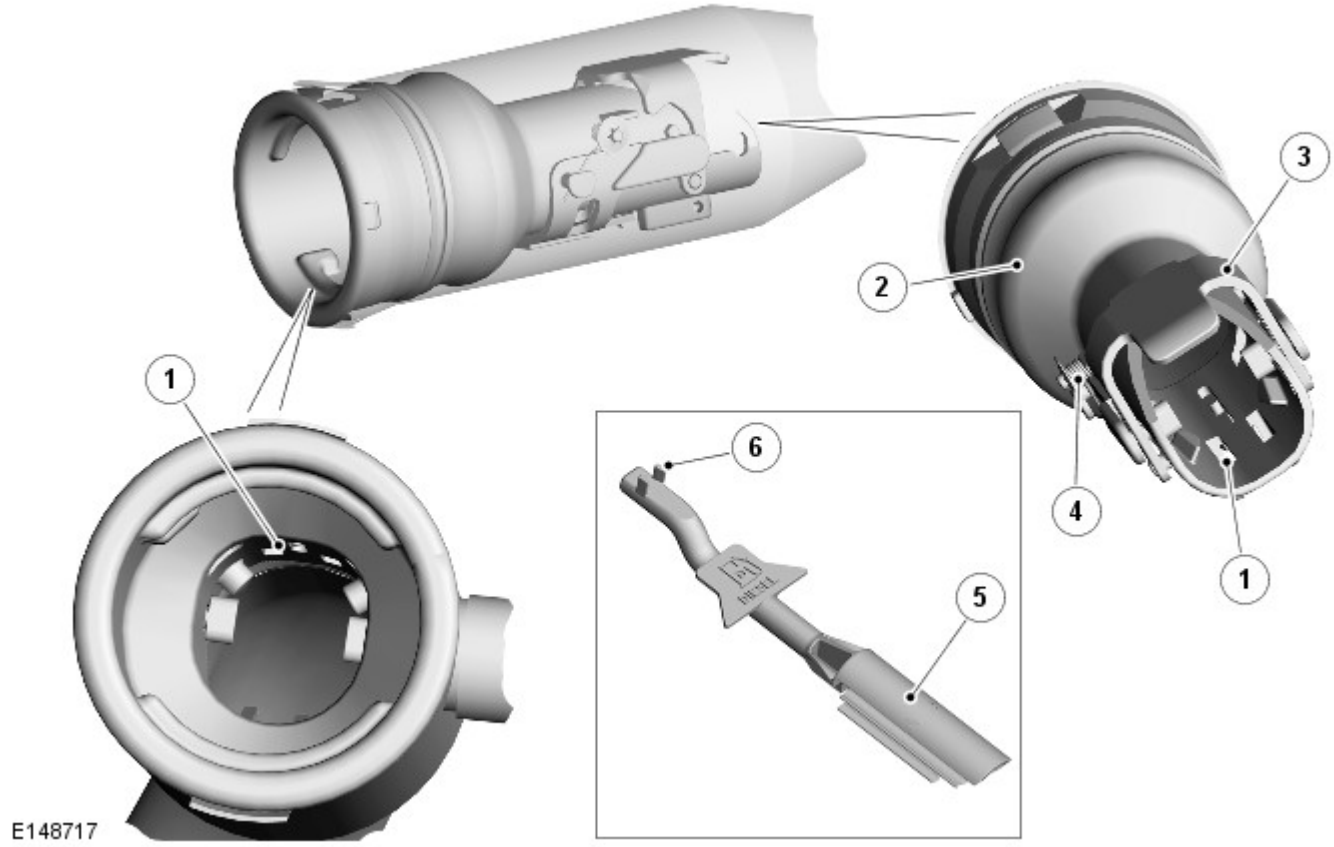
Item	Part Number	Description
1	-	Fuel Cap
2	-	Fuel Refuelling Breather Pipe
3	-	Fuel filler Pipe

The fuel filler pipe locates into the tank and incorporates a spit back flap in the tank end of the pipe. The flap is spring loaded cover which acts as one way valve, allowing the tank to be filled but preventing fuel leaving the tank into the filler pipe.

A connection at the top right side of the filler head allows for the connection of the fuel tank refuelling breather pipe.

The filler pipe incorporates a fuel guard system to prevent accidental filling of the tank with petrol.

FUEL GUARD



Item	Part Number	Description
1	-	Reset Slots
2	-	Filler Neck
3	-	Flap
4	-	Spring
5	-	Reset Tool
6	-	Spigots

The fuel guard system is to prevent the accidental filling of a diesel vehicle with petrol.

The petrol fuel guard comprises a mechanically operated flap which is triggered when the smaller diameter filler nozzle tube, used on petrol 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.

A reset tool is provided and stored in the luggage compartment. The tool is used to reset the petrol fuel guard device if triggered.

Two spigots on the tool locate in slots in the filler neck and then pull outwards, which then will release a latch and then allows the flap to open by its own spring pressure. The flap is coloured yellow so that it is clearly visible when activated and has ‘Handbook’ symbol on it.

Published: 26-Feb-2013

Fuel Tank and Lines - TDV8 4.4L 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 (310-01D Fuel Tank and Lines - TDV8 4.4L 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 1600 bar (23,206 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 mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
• Fuel level • Contaminated fuel • Fuel supply line(s) • Fuel return line(s) • High-pressure fuel supply line(s) • Fuel tank filler pipe • Fuel leak(s) • Fuel tank • Fuel filler cap • Fuel filter • Push connect fittings • Fuel rail • Fuel injection pump • Exhaust gas recirculation system	• Battery charge and condition • Fuse(s) • Fuel pump module relay • Fuel pump module • Electrical connector(s) • Damaged or corroded wiring harness • Fuel volume control valve • Fuel pressure control valve • 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.

Symptom Chart

Symptom	Possible Causes	Action
Engine cranks, but does not start	• 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 sensor	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, check for DTCs indicating a fuel volume or pressure control valve fault. Check the fuel pump. Check the crankshaft position sensor circuits. Refer to the electrical guides
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 valve(s) fault	Check the glow plug circuits. Refer to the electrical guides. 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, check for DTCs indicating a fuel volume or pressure control valve fault. Check the exhaust gas recirculation system
Rough idle	• Intake air system fault • Low/contaminated	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

	• fuel • Low-pressure fuel system fault • Blocked fuel filter • Fuel volume control valve blocked/contaminated • Fuel pressure control valve blocked/contaminated • Exhaust gas recirculation valve(s) fault	in the fuel. Check the low-pressure fuel system for leaks/damage. Check the fuel filter, check for DTCs indicating a fuel volume or pressure control valve fault. Check the exhaust gas recirculation system
Lack of power when accelerating	• Intake air system fault • Restricted exhaust system • Low fuel pressure • Exhaust gas recirculation 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. Check for DTCs indicating a fuel pressure fault. Check the exhaust gas recirculation 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 valve(s) 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: Check for DTCs indicating a fuel volume or pressure control valve fault. Check the exhaust gas recirculation 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. Check the intake air system for leaks. Check the low-pressure fuel system for leaks/damage. Check the high pressure fuel system for leaks, check for DTCs indicating a fuel volume or pressure control valve fault. Check the fuel pump
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 valve(s) fault	Check the low-pressure fuel system for leaks/damage. Check for DTCs indicating a fuel volume or pressure control valve fault. Check the fuel temperature sensor, fuel pump, etc for leaks. Check for injector DTCs. Check the exhaust gas recirculation system

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 - TDV8 4.4L Diesel, DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation).

Published: 12-Sep-2012

Fuel Tank and Lines - TDV8 4.4L Diesel - Auxiliary Fuel Cooler

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.

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 mixtures 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 medical attention.

CAUTION: 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.

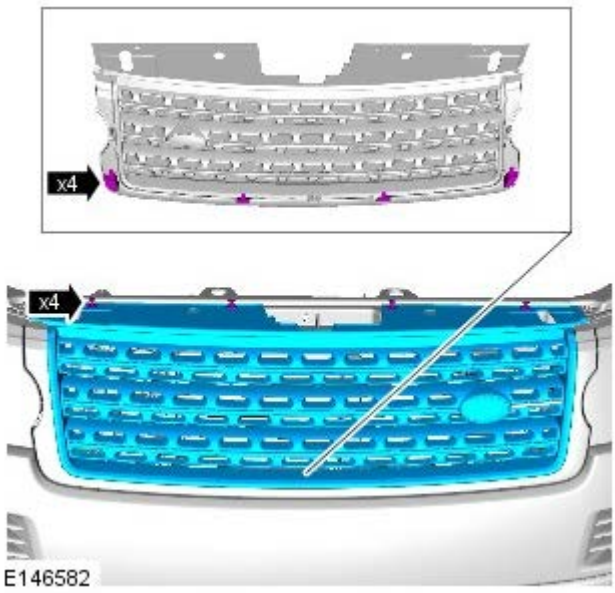
NOTES:

Removal steps in this procedure may contain installation details.

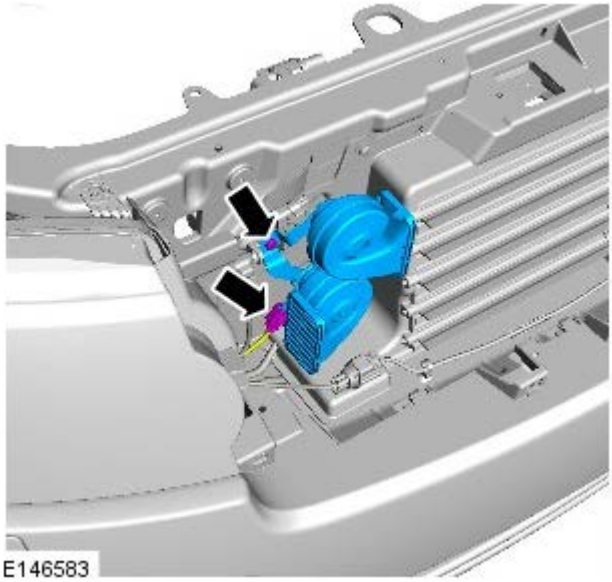
Some variation in the illustrations may occur, but the essential information is always correct.

1. For additional information, refer to: Cooling System Partial Draining, Filling and Bleeding (303-03, General Procedures).

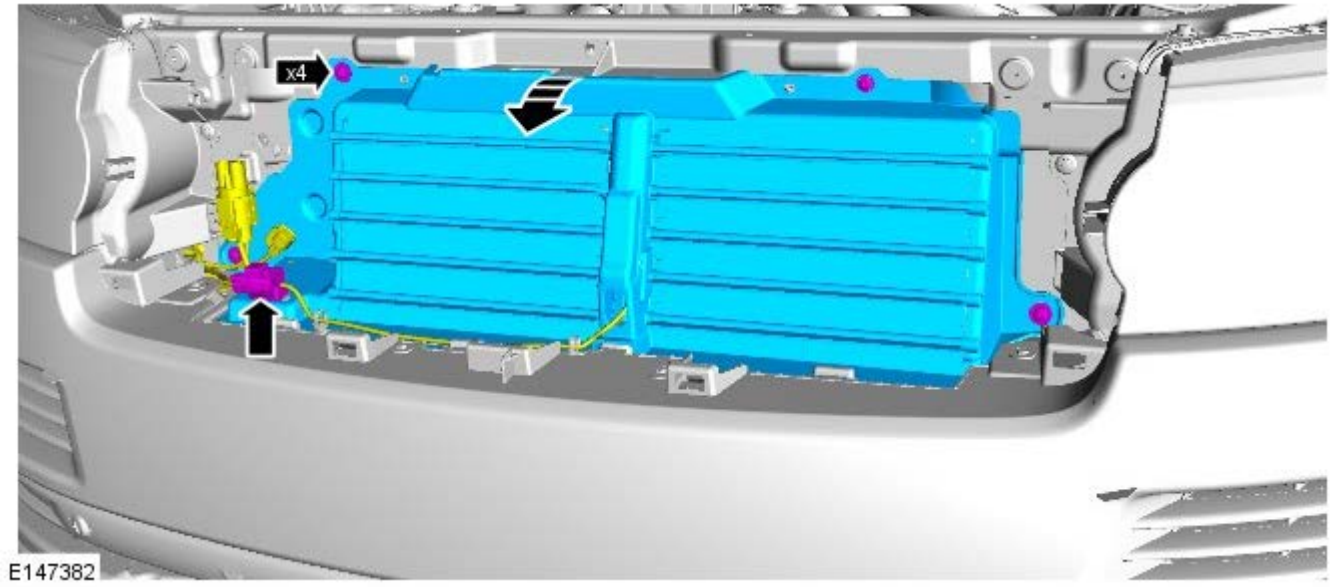
2.



3.

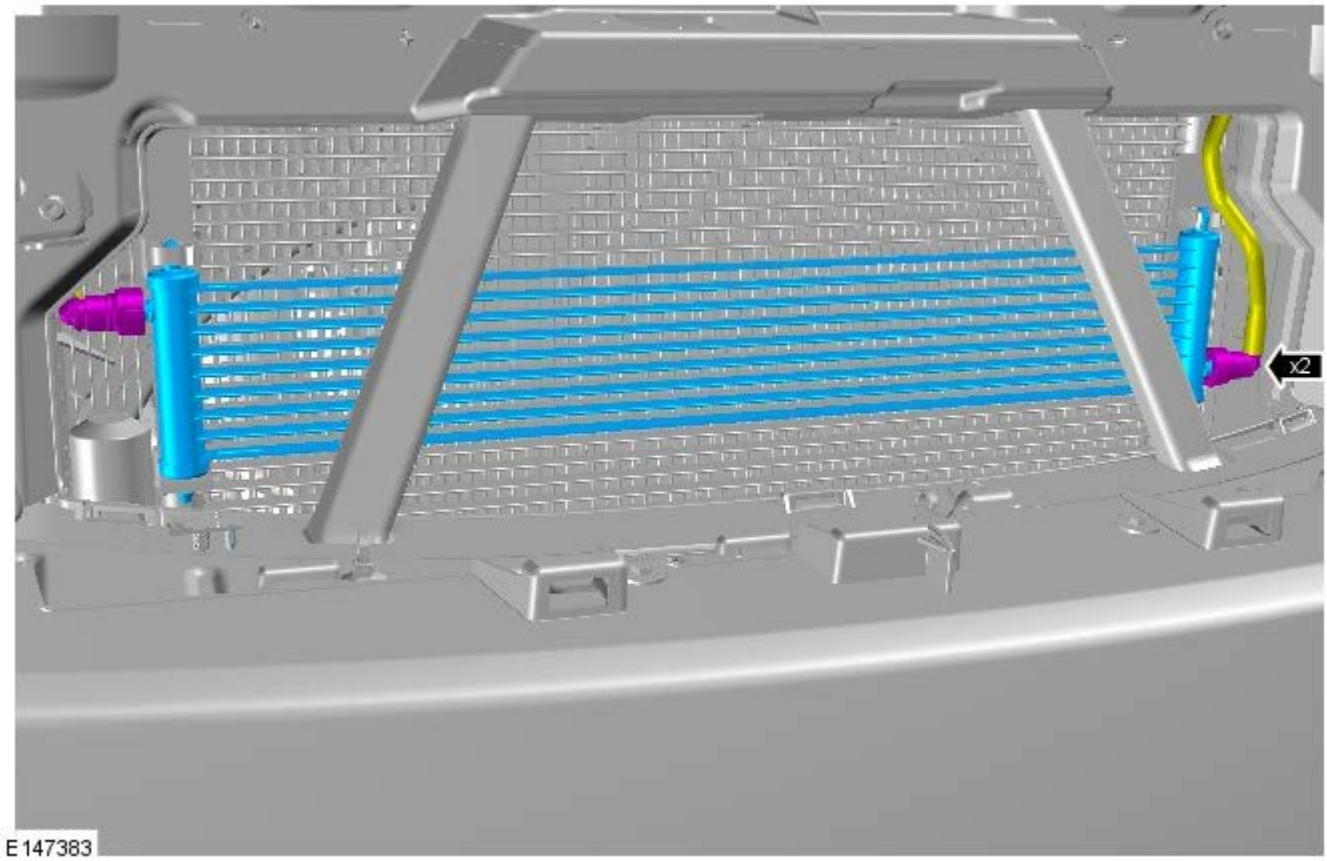


4.



5. WARNING: The spilling of fuel is unavoidable during this operation. Make sure that all necessary precautions are taken to prevent fire and explosion.

NOTE: Make sure that all openings are sealed. Use new blanking caps.



Installation

1. To install reverse the removal procedure.

Published: 30-Aug-2012

Fuel Tank and Lines - TDV8 4.4L Diesel - Fuel Cooler

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.

Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

Do not carry or operate cellular phones when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

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:

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.

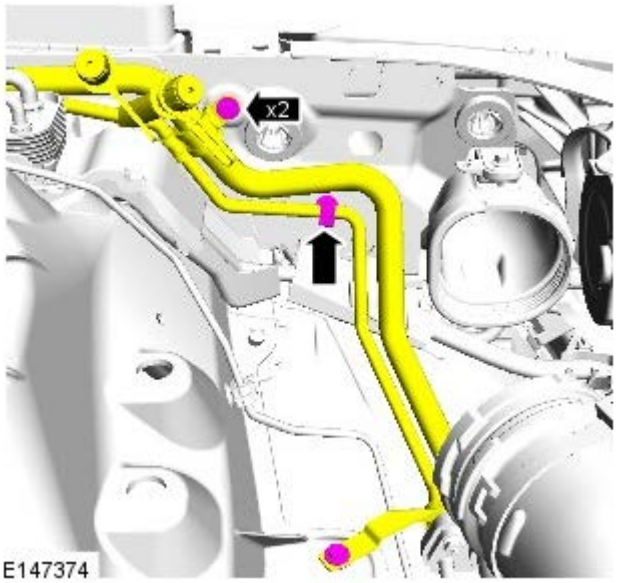
NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

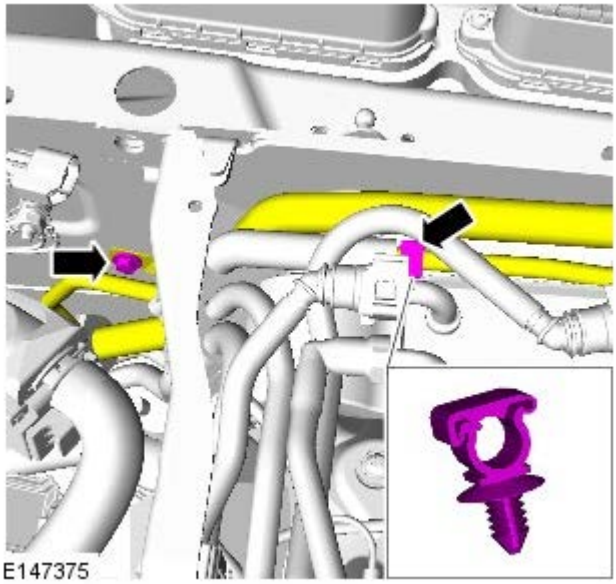
   Refer to: Specifications (414-00, Specifications).

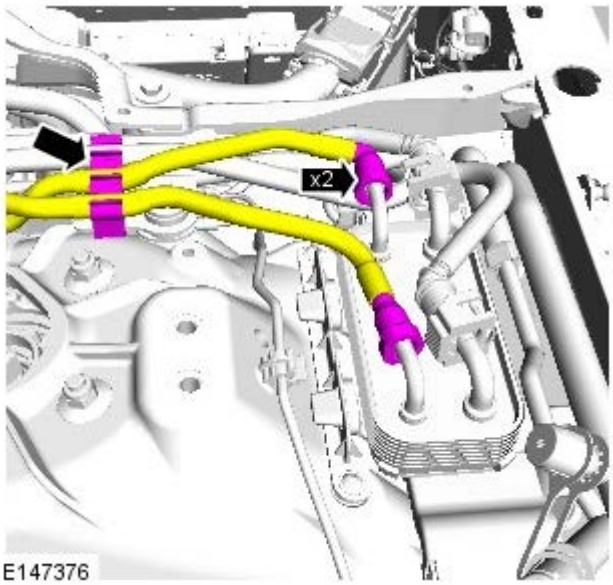
2. Refer to: Air Cleaner LH (303-12, Removal and Installation).

3. *Torque:* 10 Nm



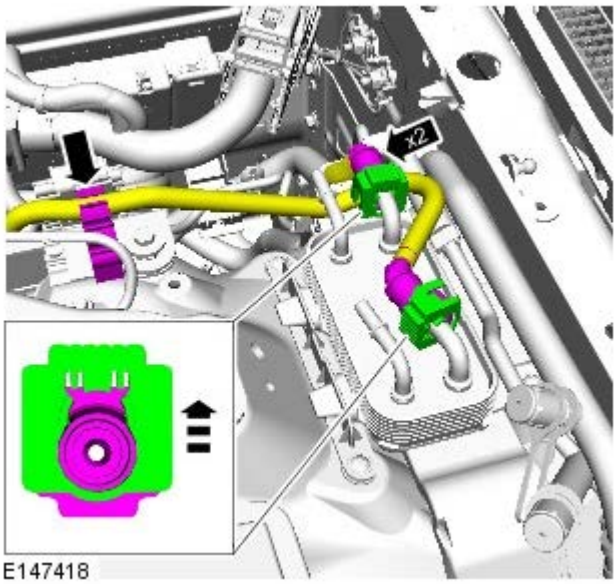
4. *Torque:* 10 Nm





5. CAUTION: Be prepared to collect escaping coolant.

NOTE: Make sure that all openings are sealed. Use new blanking caps.

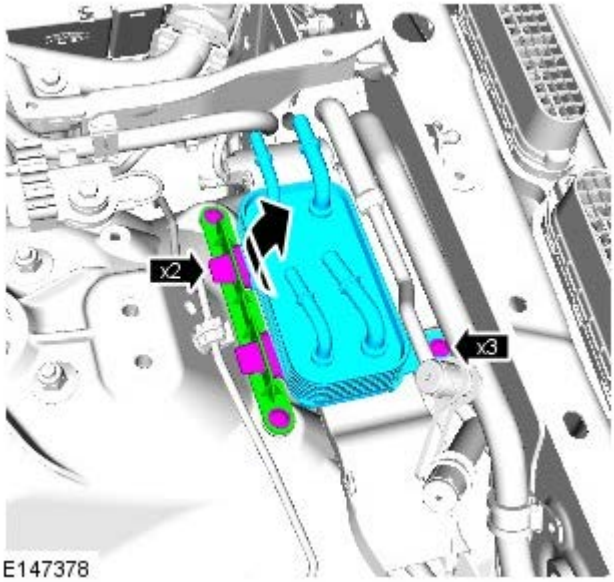


6. CAUTIONS:

Make sure that all openings are sealed. Use new blanking caps.

Be prepared to collect escaping fuel.

7. *Torque:* 10 Nm



Installation

1. To install reverse the removal procedure.

Published: 09-Aug-2012

Fuel Tank and Lines - TDV8 4.4L Diesel - Fuel Filter Element

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.

The spilling of fuel is unavoidable during this operation. Make sure that all necessary precautions are taken to prevent fire and explosion.

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.

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.

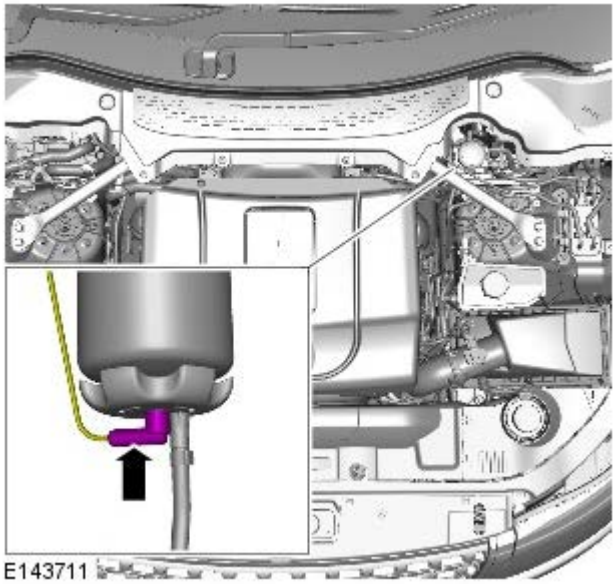
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Diesel Fuel System Health and Safety Precautions (100-00 General Information, Description and Operation).

2. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

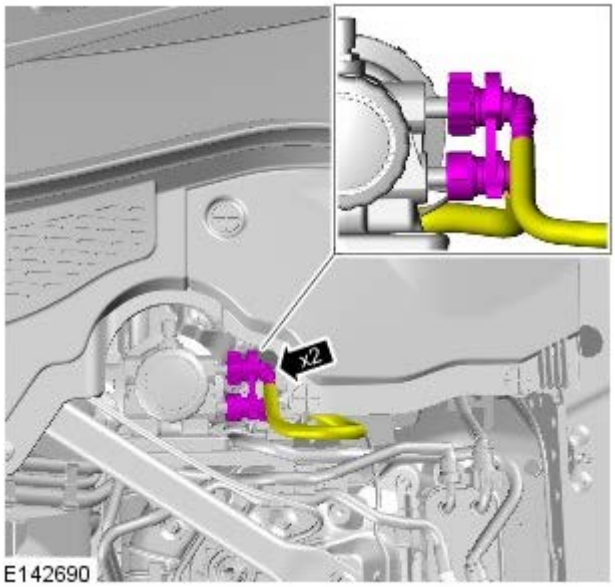
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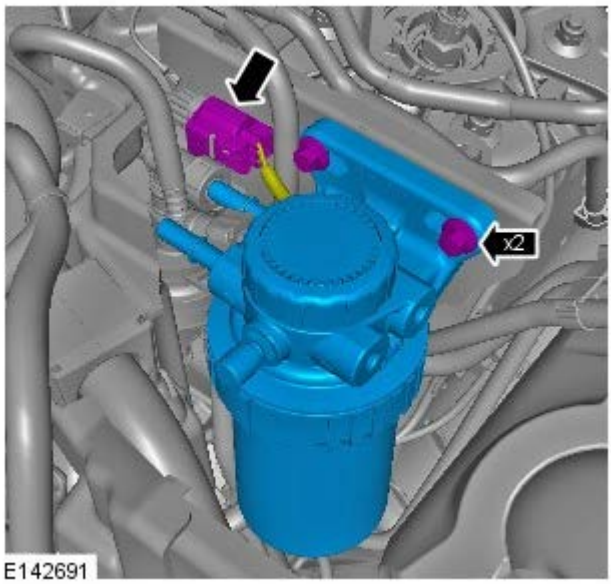
4.



E142688



E142690



E142691

5. CAUTIONS:

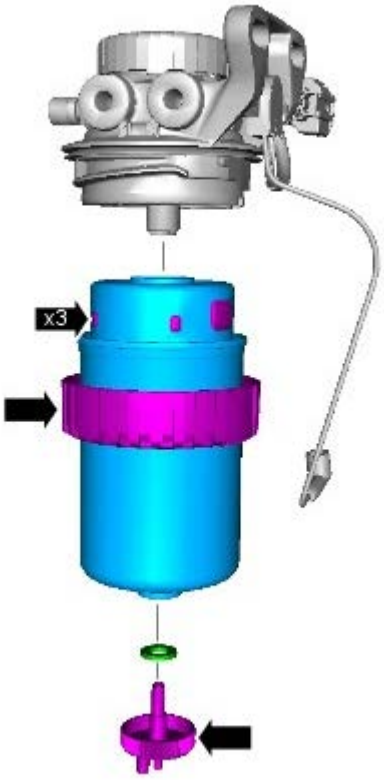
   Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

   Be prepared to collect escaping fuel.

6. *Torque:* 25 Nm

7. WARNING: Fluid loss is unavoidable, use absorbent cloth or a container to collect the fluid.

   CAUTION: Note the fitted position of the



E142689

component prior to removal.

Installation

1. CAUTION: Make sure that the fuel filter is correctly aligned. Failure to follow this instruction may result in damage to the vehicle.

   To install, reverse the removal procedure.

2. Refer to: Low-Pressure Fuel System Bleeding (310-00 Fuel System - General Information, General Procedures).

Published: 12-Sep-2012

Fuel Tank and Lines - TDV8 4.4L Diesel - Fuel Level Sender

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.

 The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.

 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.

 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.

 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.

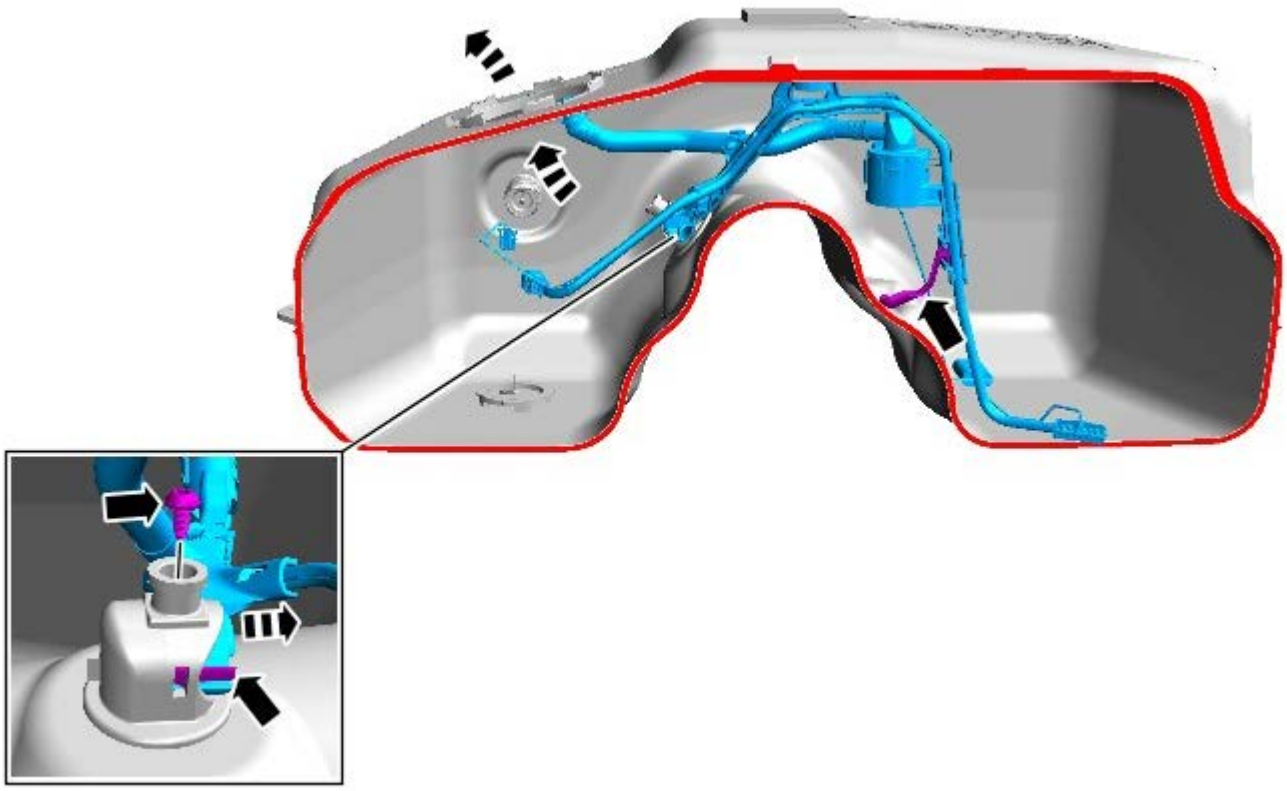
2. Refer to: Diesel Fuel System Health and Safety Precautions (100-00 General Information, Description and Operation).

3. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

4. Refer to: Fuel Pump and Sender Unit (310-01A Fuel Tank and Lines - TDV6 3.0L Diesel, Removal and Installation).

5. *Torque:* 7 Nm



E147440

Installation

1. To install, reverse the removal procedure.

Published: 13-Sep-2012

Fuel Tank and Lines - TDV8 4.4L Diesel - Fuel Pump and Sender Unit

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.

 The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.

 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.

 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.

 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.

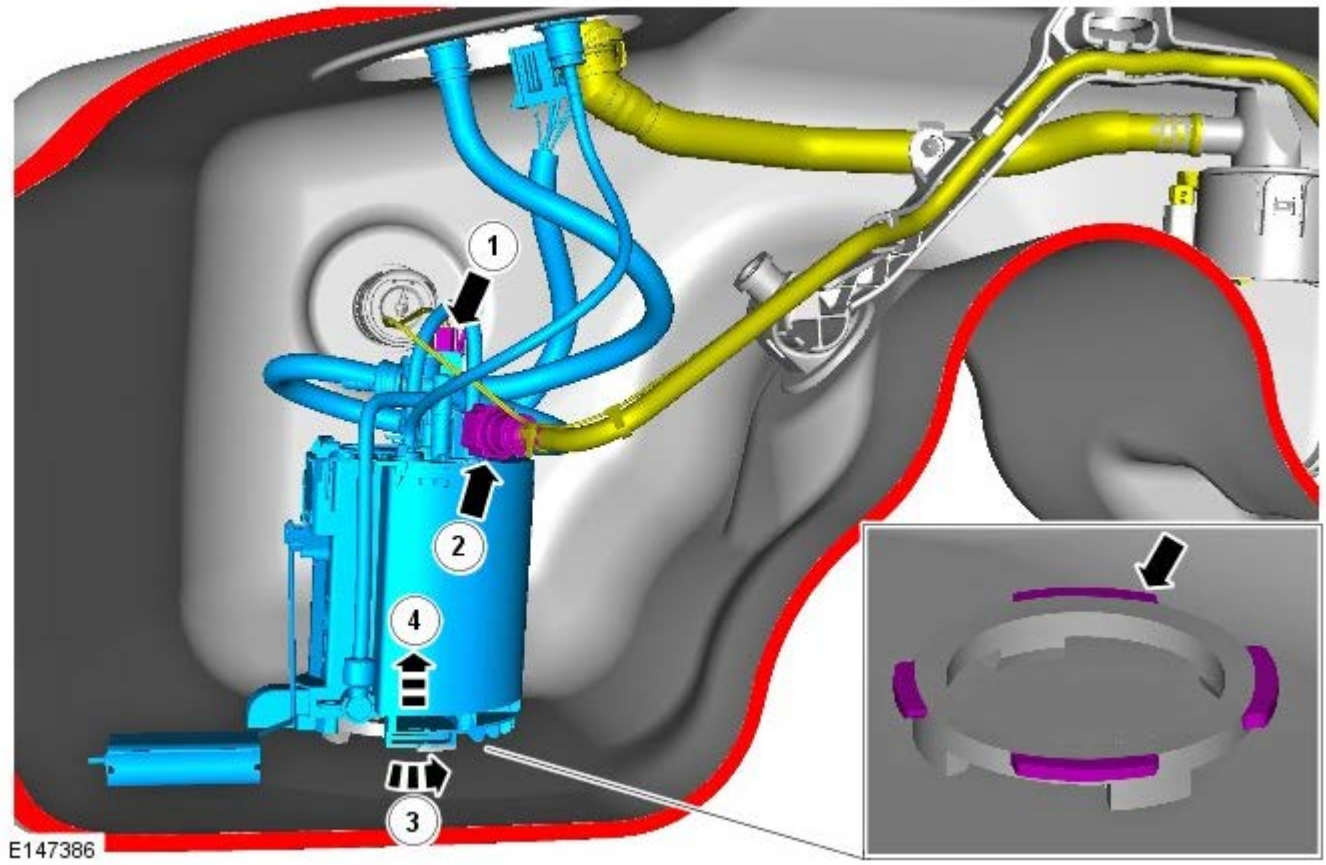
2. Refer to: Diesel Fuel System Health and Safety Precautions (100-00 General Information, Description and Operation).

3. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

4. Refer to: Fuel Tank Draining (310-00 Fuel System - General Information, General Procedures).

5.



Installation

1. To install, reverse the removal procedure.

Published: 25-Oct-2013

Fuel Tank and Lines - TDV8 4.4L 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.

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.

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.

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: Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions (100-00 General Information, Description and Operation).
   Refer to: Diesel Fuel System Health and Safety Precautions (100-00 General Information, Description and Operation).

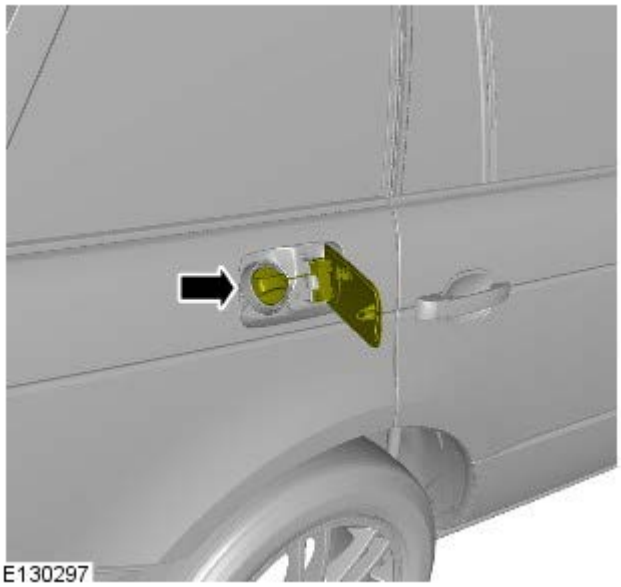
Vehicles with petrol engine

3. Refer to: Fuel System Pressure Release - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (310-00 Fuel System - General Information, General Procedures).

All vehicles

4. Refer to: Rear Subframe (502-00 Uni-Body, Subframe and Mounting System, Removal and Installation).

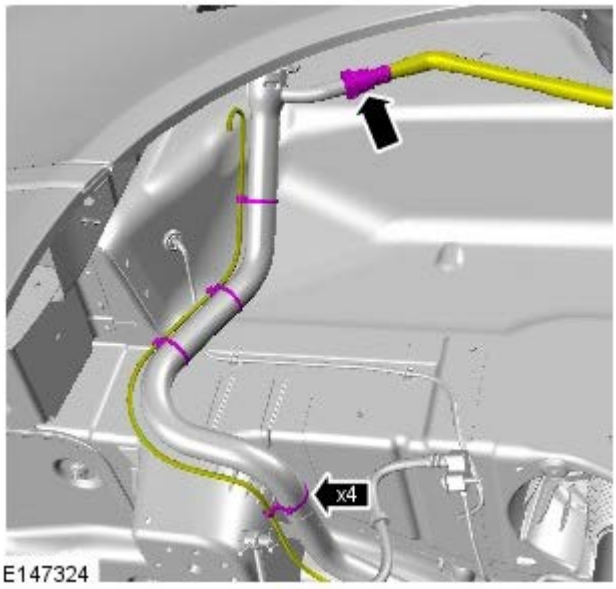
5. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.



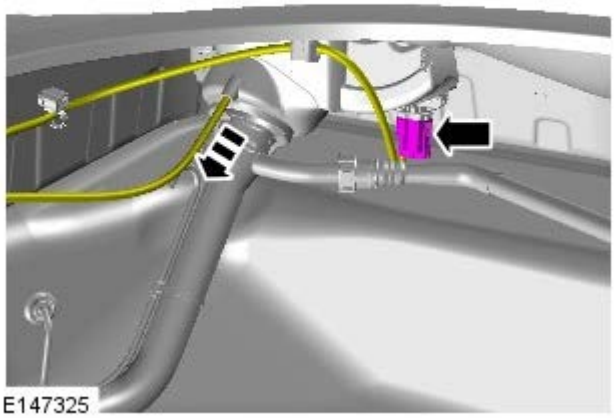
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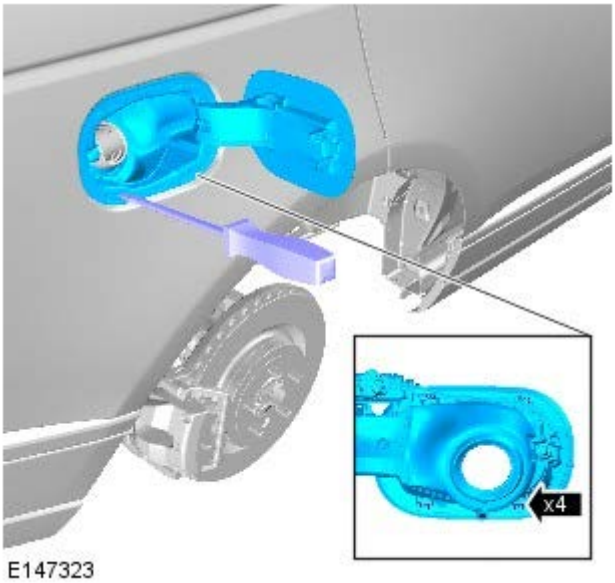
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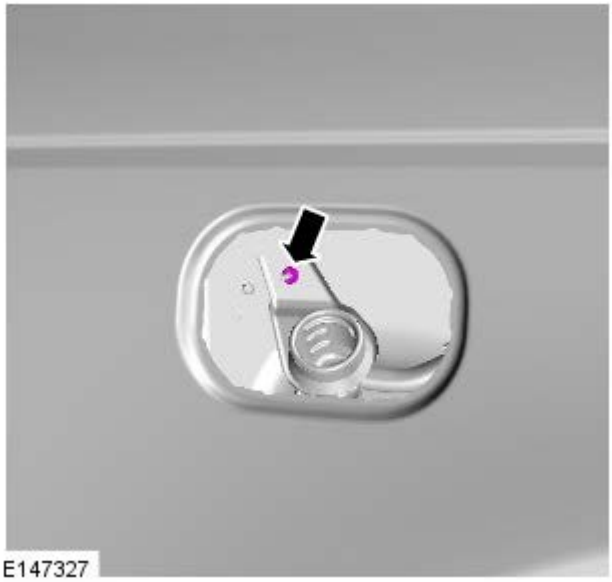

E147325

9.



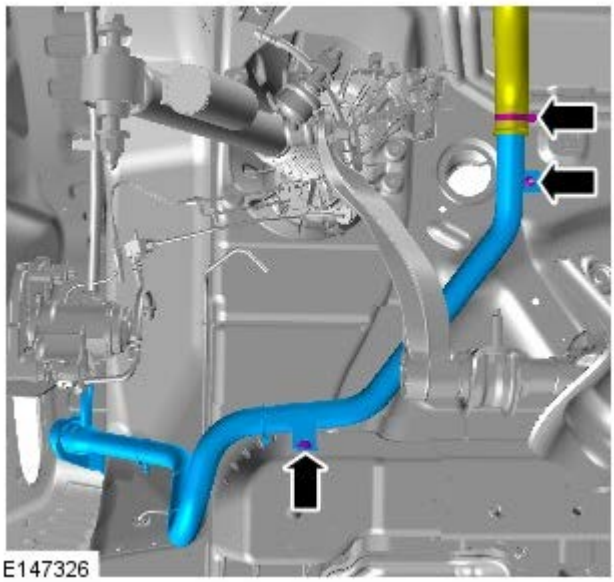
E147323

10. *Torque:* 10 Nm


E147327

11. CAUTION: Be prepared to collect escaping fuel.

Torque:
M6 10 Nm
Clamp 3.5 Nm



Installation

1. To install, reverse the removal procedure.

Published: 05-Dec-2013

Fuel Tank and Lines - TDV8 4.4L Diesel - Fuel Tank

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.

The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.

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.

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.

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: Diesel Fuel System Health and Safety Precautions (100-00 General Information, Description and Operation).

3. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

4. Refer to: Fuel Tank Draining (310-00 Fuel System - General Information, General Procedures).

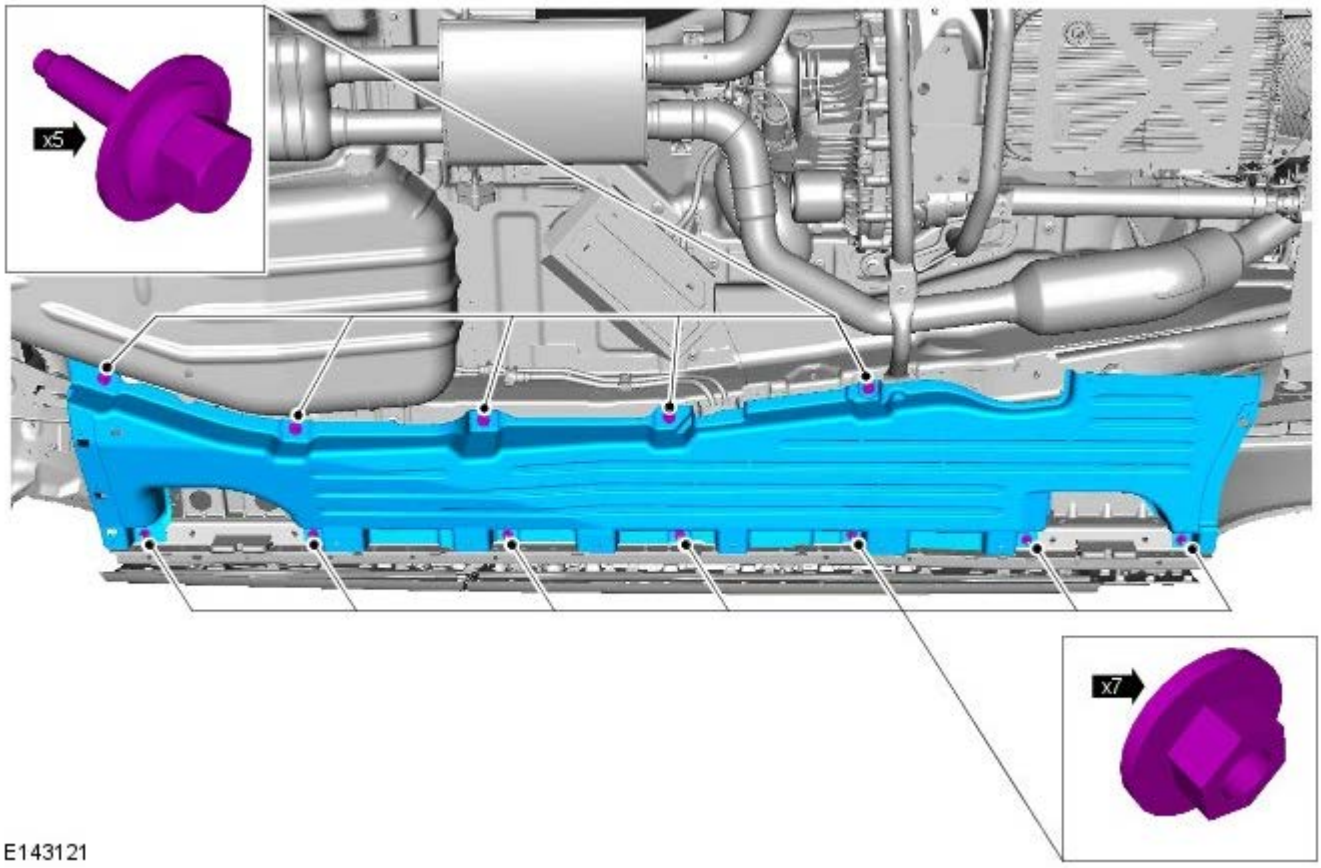
5. NOTE: Repeat the procedure for the other side.

   Refer to: Rear Rocker Panel Moulding (501-08 Exterior Trim and Ornamentation, Removal and Installation).

6. Refer to: Rear Driveshaft - TDV6 3.0L Diesel (205-01 Driveshaft, Removal and Installation).
   Refer to: Rear Driveshaft - SDV6 3.0L Diesel - Hybrid Electric Vehicle (205-01 Driveshaft, Removal and Installation).
   Refer to: Rear Driveshaft - TDV8 4.4L Diesel (205-01 Driveshaft, Removal and Installation).

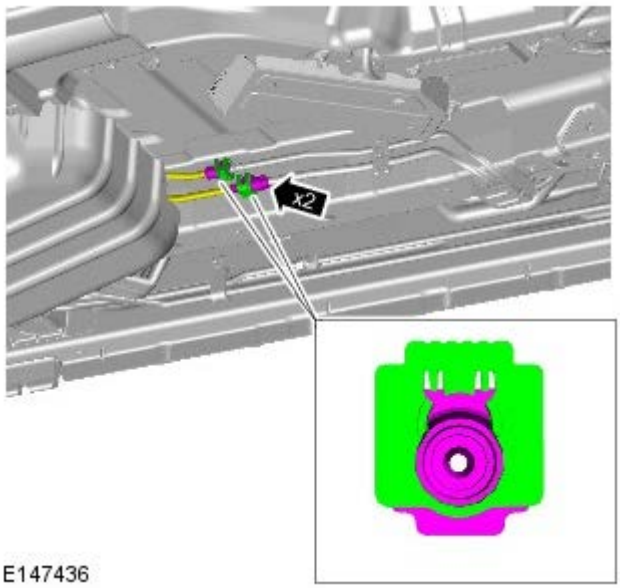
7. CAUTION: LH illustration shown, RH is similar.

NOTE: Repeat the procedure for the other side.



E143121

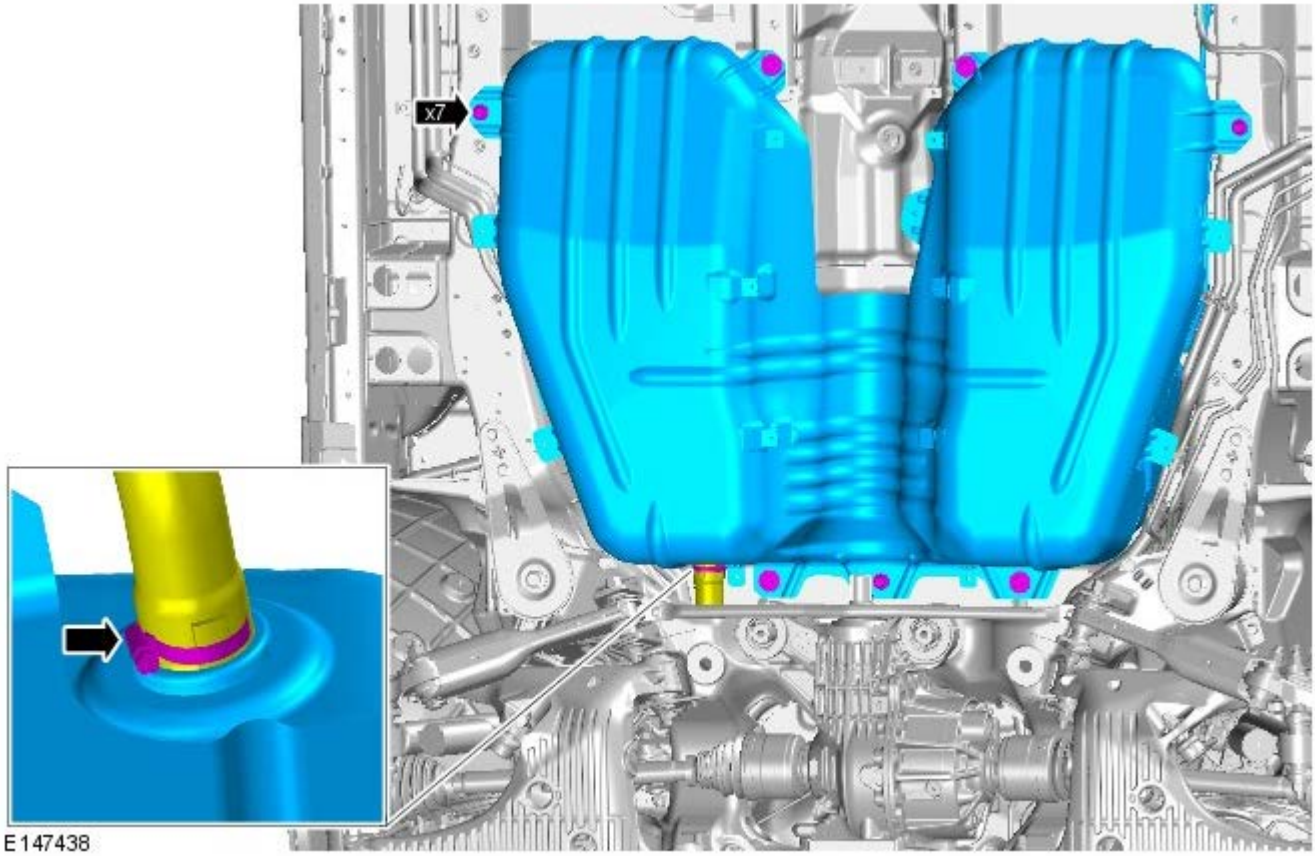
8. CAUTION: Be prepared to collect escaping fuel.



E147436

9. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Torque: 45 Nm



E147438

10. NOTE: Do not disassemble further if the component is removed for access only.



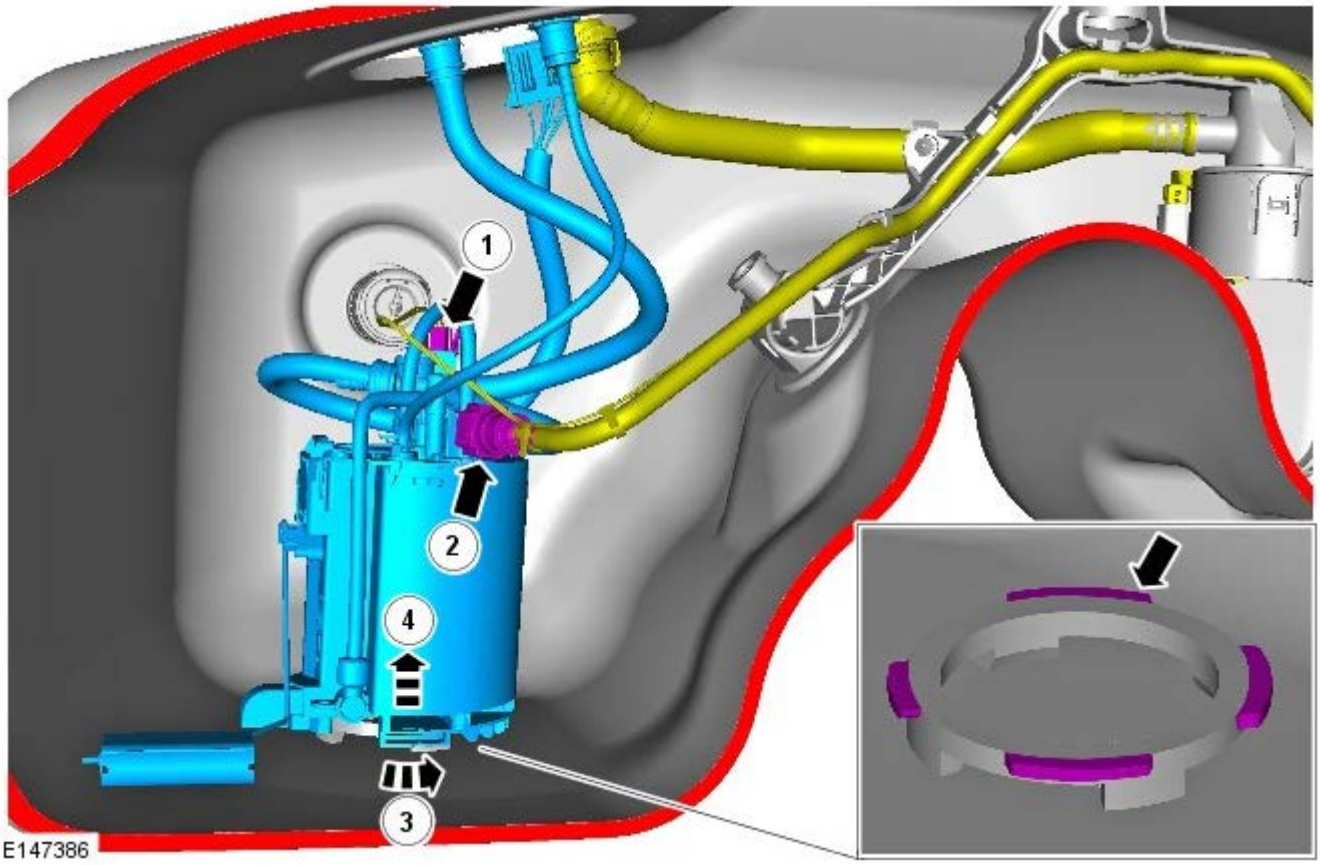
E147439

11. *Torque:* 10 Nm



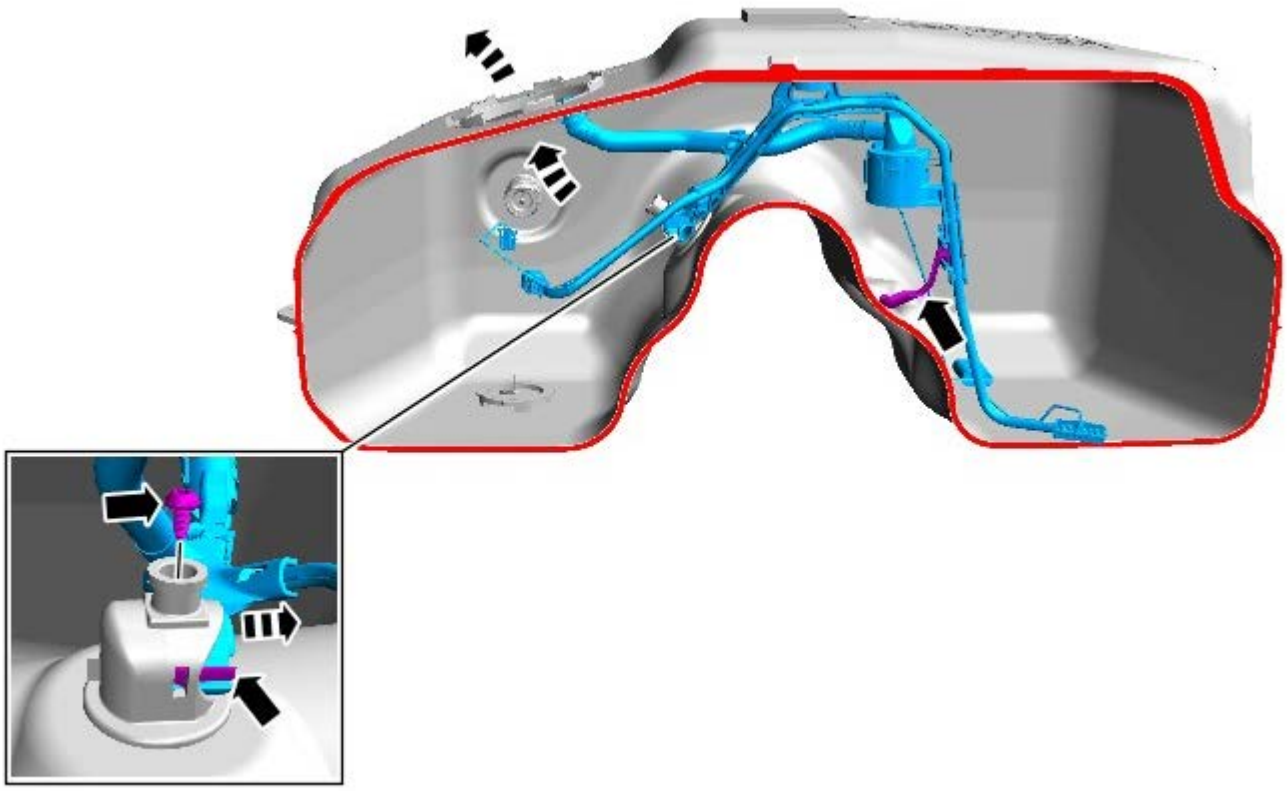
E147442

12.



E147386

13. *Torque:* 7 Nm



E147440

Installation

1. To install, reverse the removal procedure.

Published: 02-May-2013

Fuel Tank and Lines - SDV6 3.0L Diesel - Hybrid Electric Vehicle -

Capacities

	Liters
Fuel tank capacity	80 (usable)

General Specifications

Item	Specification
Fuel system	Mechanical - recirculating
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	Dual stage electric - submersible - located in fuel tank
Fuel cooler	Located on the left front suspension top mount assembly
Fuel filter	Remotely located on the left front suspension top mount assembly - fitted with a renewable element
Fuel tank sender units	Two - active and passive - passive sender unit is attached to the removable retaining bracket and the active sender unit 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

Torque Specifications

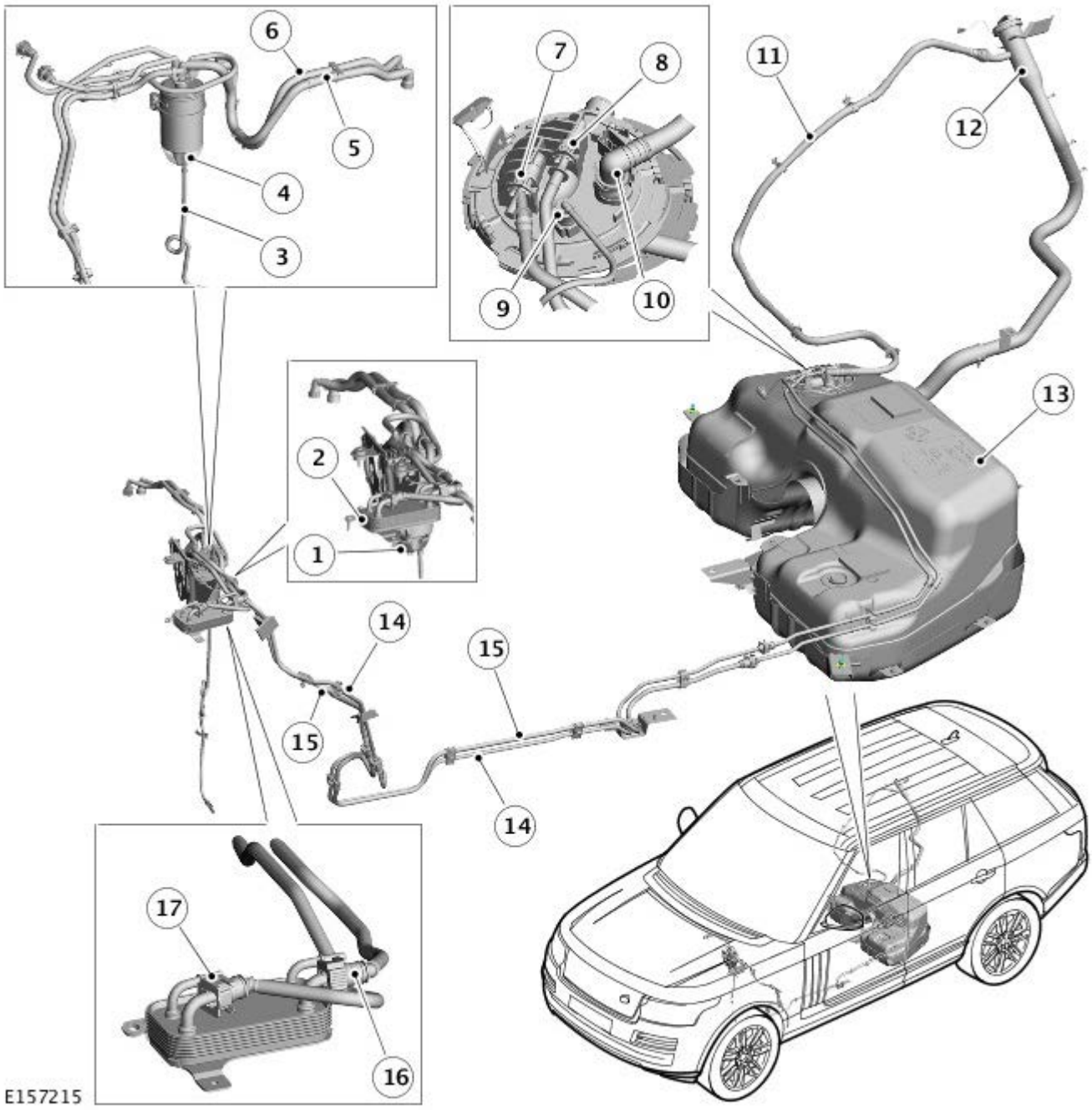
Description	Nm	lb-ft	lb-in
Air conditioning (A/C) refrigerant lines retaining bolts	10	7	-
Fuel cooler retaining bolts	9	-	80
Fuel tank internal bracket retaining bolt	7	-	62
Fuel tank filler pipe retaining nuts	9	-	80
Fuel tank filler pipe hose clamp	3.5	-	31
Fuel tank shield retaining bolts	45	33	-
Fuel tank shield to fuel tank bolt	10	7	-

Published: 25-Jun-2013

Fuel Tank and Lines - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Fuel Tank and Lines

Description and Operation

COMPONENT LOCATION



Item	Part Number	Description
1	-	Fuel filter
2	-	Fuel cooler
3	-	Water/Fuel mix drain hose
4	-	Water/Fuel mix drain turn wheel
5	-	Fuel supply to high pressure fuel pump
6	-	Fuel return from high pressure fuel pump to fuel cooler
7	-	Fuel supply to fuel filter
8	-	Fuel return from fuel filter
9	-	Fuel fired booster heater supply
10	-	Fuel tank refueling breather pipe connection
11	-	Fuel tank refueling breather pipe
12	-	Fuel filler pipe
13	-	Fuel tank

14	-	Fuel supply line
15	-	Fuel return line
16	-	Fuel cooler to fuel filter pipe
17	-	High pressure fuel pump to fuel cooler pipe

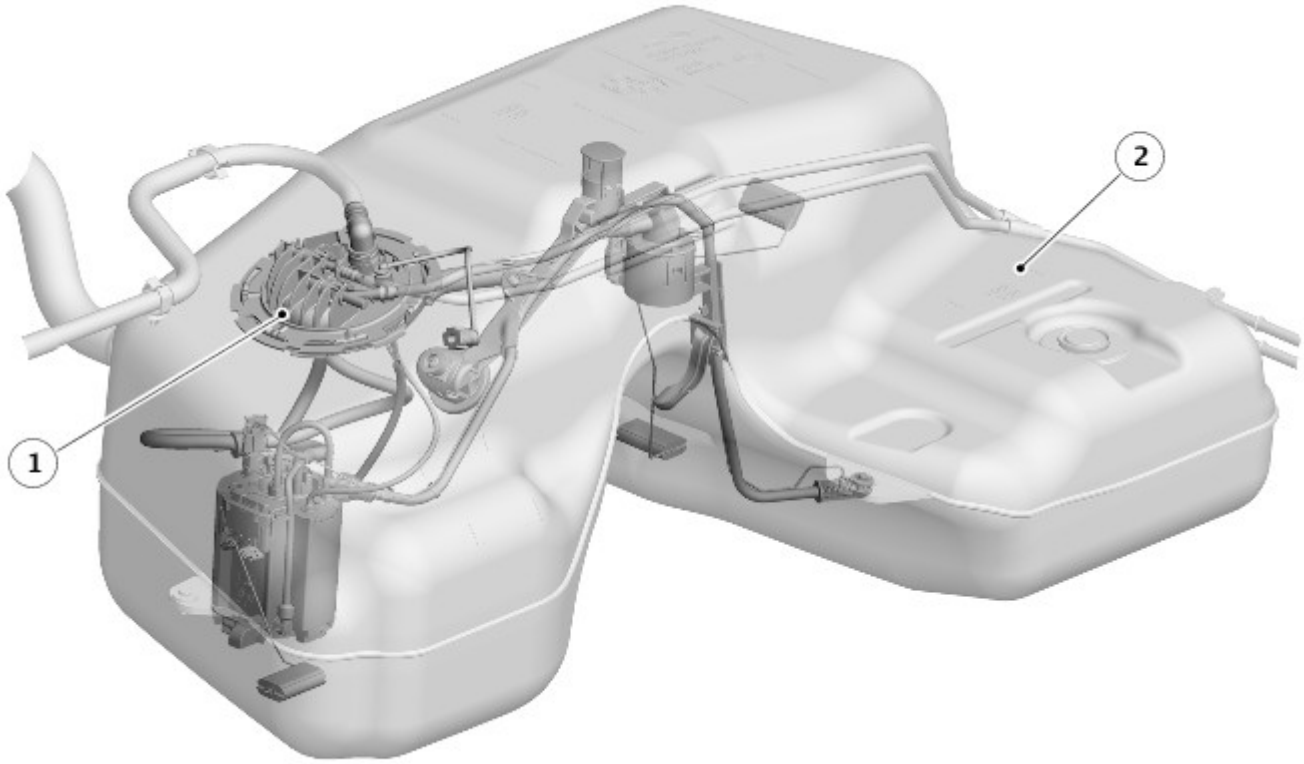
OVERVIEW

The fuel tank and lines system supplies the high pressure fuel pump on the engine with sufficient fuel for all operating conditions. The system comprises:

- Molded plastic saddle type fuel tank
- Fuel pump module
- Two fuel level sensors
- Fuel delivery and return lines
- Fuel filter
- Fuel cooler.

DESCRIPTION

Fuel Tank



E157216

Item	Part Number	Description
1	-	Fuel tank flange
2	-	Fuel tank

The fuel tank has a useable capacity of 77 liters.

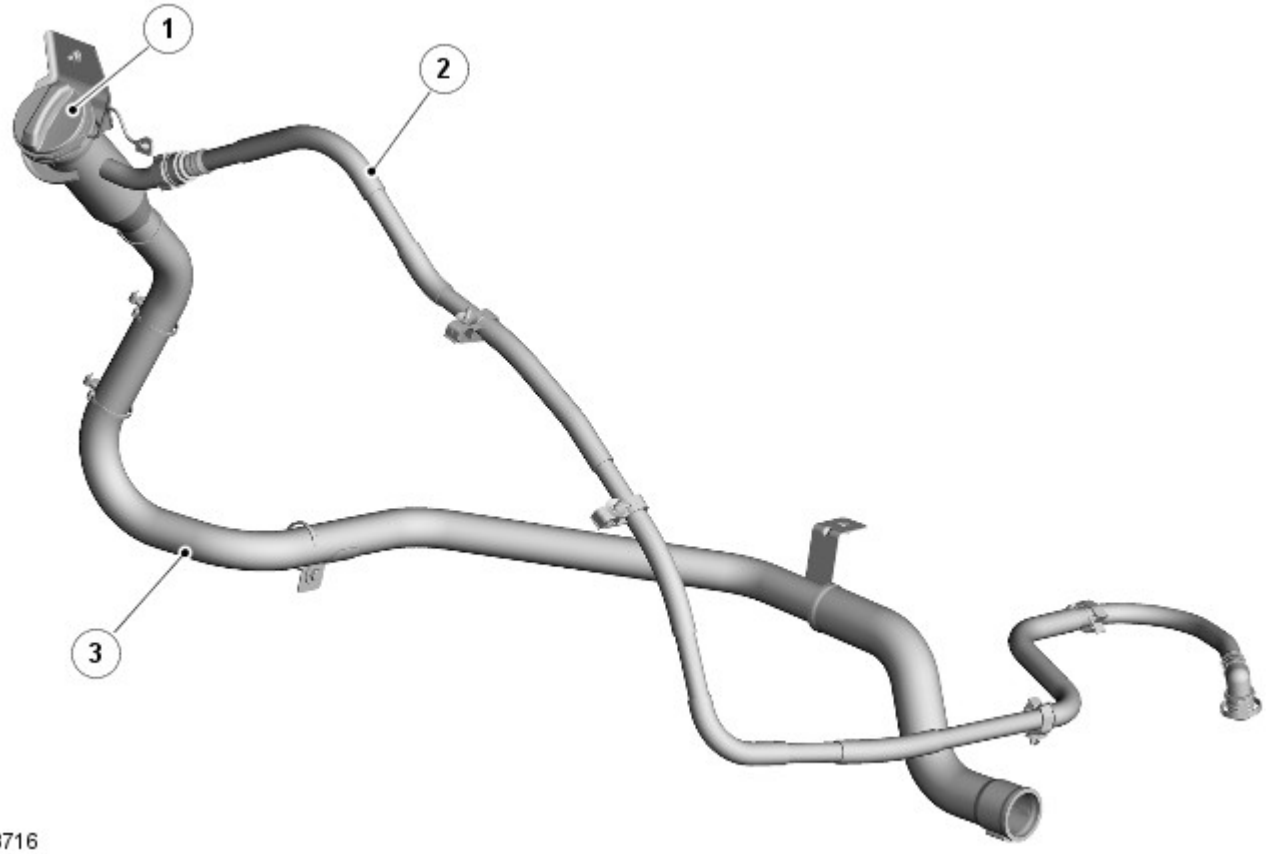
Inside the fuel tank, you will find the location of the low pressure fuel pump module.

Access to the fuel tank interior is via an aperture in the floor, under the rear right seat, and removal of the fuel tank flange located on the right side of the tank.

Within the fuel tank in the upper left side center section, a fuel cut-off elbow is positioned. This is to control the fuel fill volume of the tank. During the refueling process, air/vapor is displaced (by the fuel entering the tank) and exits the tank via the cut-off elbow and is conveyed by the fuel tank refueling breather pipe to exit the system. During filling, as the tank reaches its full level, the fuel cut-off elbow is closed by the rising fuel and prevents air/vapor passing through to the refueling breather pipe. 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 refueling breather pipe.

FUEL FILLER PIPE



E148716

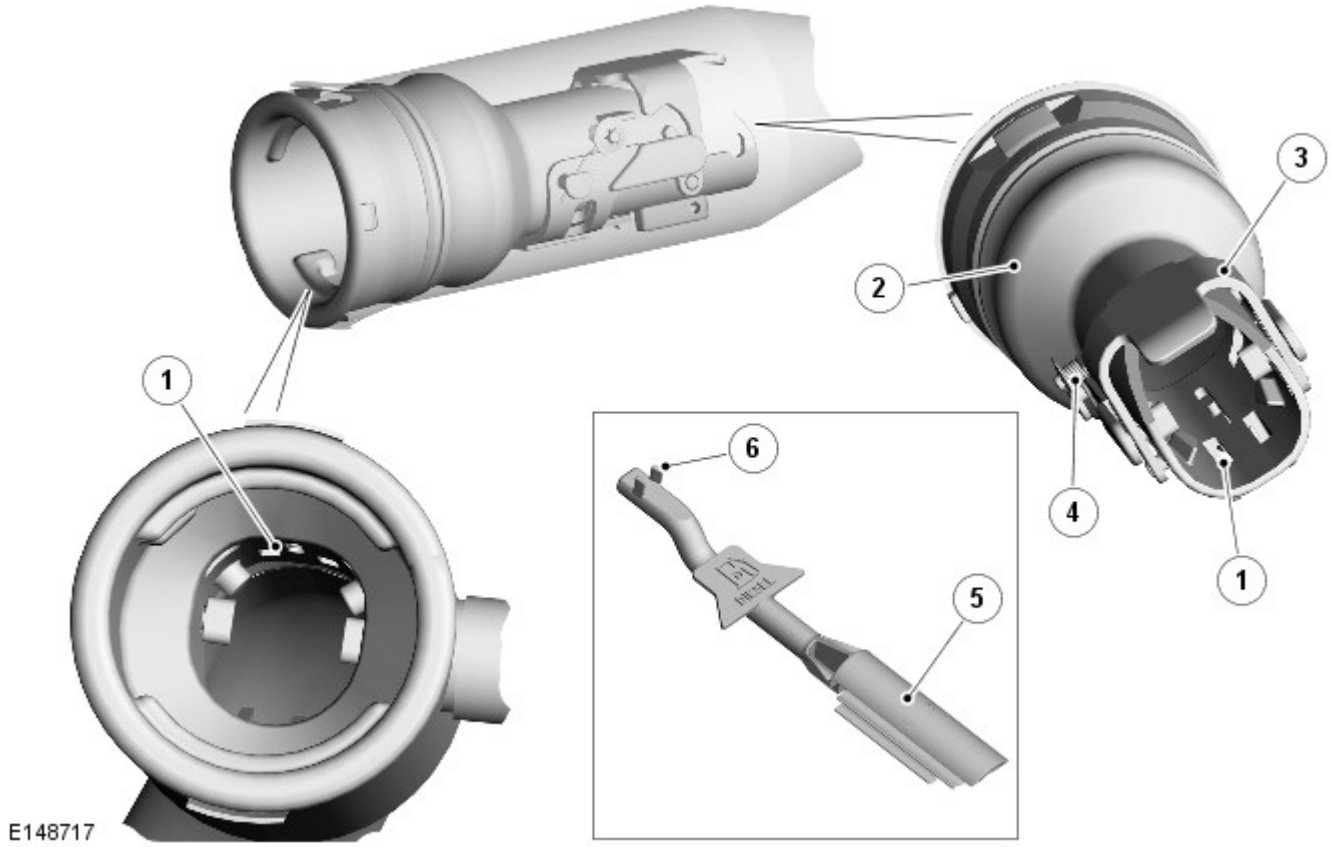
Item	Part Number	Description
1	-	Fuel filler cap
2	-	Refueling breather pipe
3	-	Fuel filler pipe

The fuel filler pipe locates into the tank and incorporates a spit back flap in the tank end of the pipe. The flap is a spring loaded cover which acts as a one way valve, allowing the tank to be filled but preventing fuel leaving the tank into the fuel filler pipe.

A connection at the top of the fuel filler pipe allows for the connection of the refueling breather pipe.

The fuel filler pipe incorporates a misfueling protection device to prevent accidental filling of the tank with petrol.

MISFUELING PROTECTION DEVICE



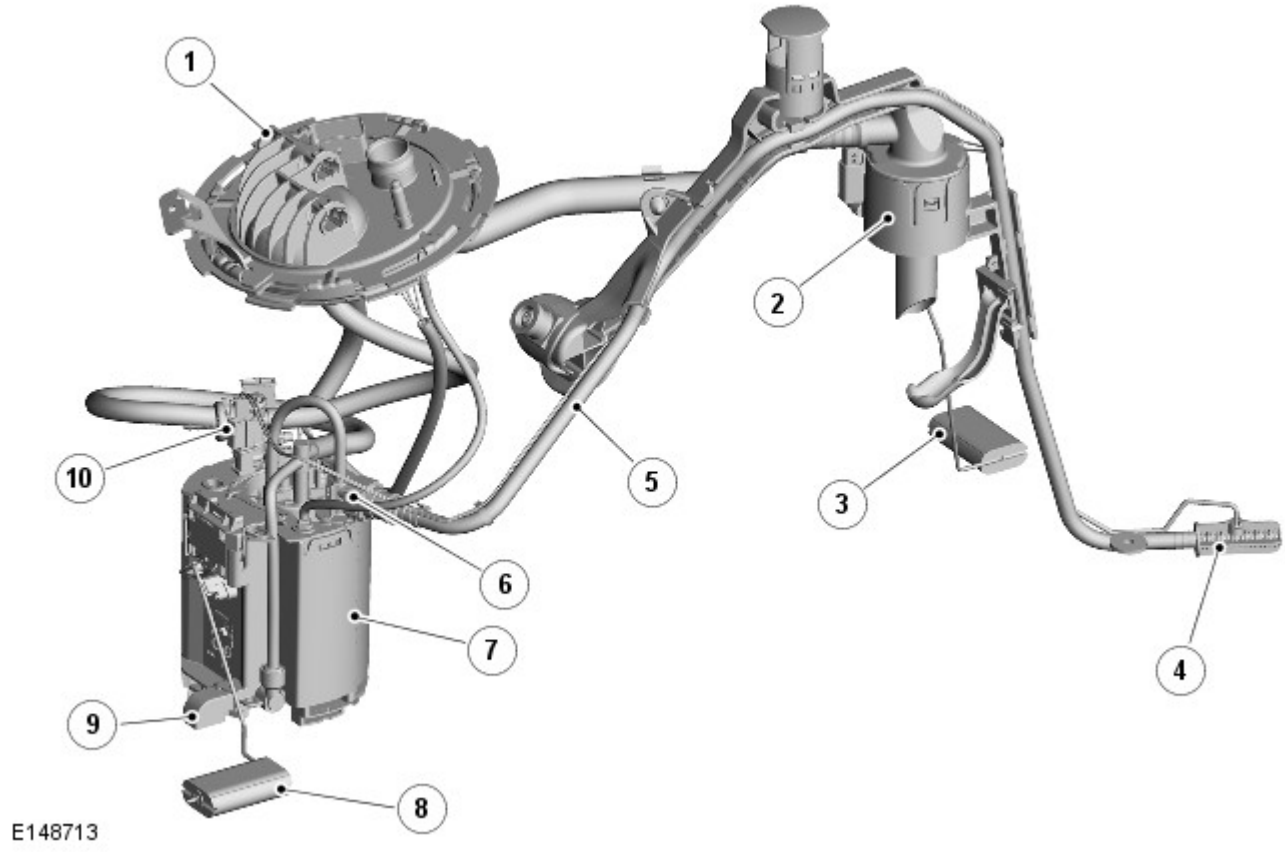
Item	Part Number	Description
1	-	Reset slots
2	-	Fuel filler neck
3	-	Flap
4	-	Spring
5	-	Reset tool
6	-	Spigots

The misfueling protection device comprises a mechanically operated flap which is triggered when the smaller diameter filler nozzle tube, used on petrol pumps, is inserted in the fuel filler neck. The flap is actuated and blocks the sensor port on the fuel pump nozzle, causing it to automatically switch off.

A reset tool is provided and stored in the luggage compartment. The tool is used to reset the misfueling protection device if triggered.

Two spigots on the tool locate into slots in the fuel filler neck and then pull outwards, which then will release a latch and allow the flap to open by its own spring pressure. The flap is colored yellow so that it is clearly visible when activated and has a 'Handbook' symbol on it.

Fuel Pump Module



Item	Part Number	Description
1	-	Fuel tank flange
2	-	Fuel cut-off elbow
3	-	Left fuel level sensor float
4	-	Suction port filter
5	-	Suction port pipe
6	-	Jet pump
7	-	Swirl pot
8	-	Right fuel level sensor float
9	-	Fuel pump coarse filter
10	-	Pressure relief valve

The fuel pump module is controlled by the ECM (engine control module) via the fuel pump relay located in the rear junction box RJB (rear junction box).

The fuel pump collects fuel from the swirl pot at the base of the pump and passes it from the tank to the fuel supply line to the engine mounted, high pressure fuel pump at a pressure of 0.5 bar.

Fuel is collected from the left side of the tank to the right side of the tank by using a single suction tube that transfers the fuel using a jet pump which is powered by the fuel feed from the fuel pump.

Should the fuel pump electrical connection need to be disconnected, it is important that the ignition is switched off. When the ignition is switched off, the instrument cluster will store its last fuel gauge needle position prior to power down. Once power is restored the gauge will display the last stored position regardless of the actual level of fuel in the tank.

This could result in incorrect fuel gauge readings if the fuel tank has been drained and not filled with exactly the same quantity of fuel that was removed.

LOW FUEL STRATEGY

The ECM is programmed with a strategy which shuts the engine off before the fuel tank runs dry. This is to prevent fuel system damage by air being drawn into the high pressure fuel pump.

A misfire is induced with increasing magnitude when the fuel in the tank reaches approximately 2.5 liters of useable fuel remaining to alert the driver to this condition. The engine is shut down when the fuel in the tank reaches 0.00 liters of useable fuel remaining in the tank and 4.0 liters of un-useable fuel remaining.

To reset the fuel strategy after engine shutdown, it is required that a minimum of 4 liters of fuel is added to the fuel tank, when the vehicle is on level ground.

Fuel Level Sensors

There are two fuel level sensors located inside the fuel tank. One sensor is attached to the swirl pot and monitors fuel level on the right side of the tank. The second sensor is attached to the suction pipe carrier and monitors fuel level on

the left side of the tank. Both sensors are connected to the vehicle wiring harness via the external electrical connector on the fuel tank flange.

The electrical output signal from each fuel level sensor is proportional to the amount of fuel in the tank and the position of the float arm. The measured resistance is processed by the CJB (central junction box), which also implements an anti-slosh function. The CJB updates the fuel level at regular intervals and transmits the result to the instrument cluster. The anti-slosh function prevents constant movement of the fuel gauge pointer caused by fuel movement in the tank due to cornering or braking.

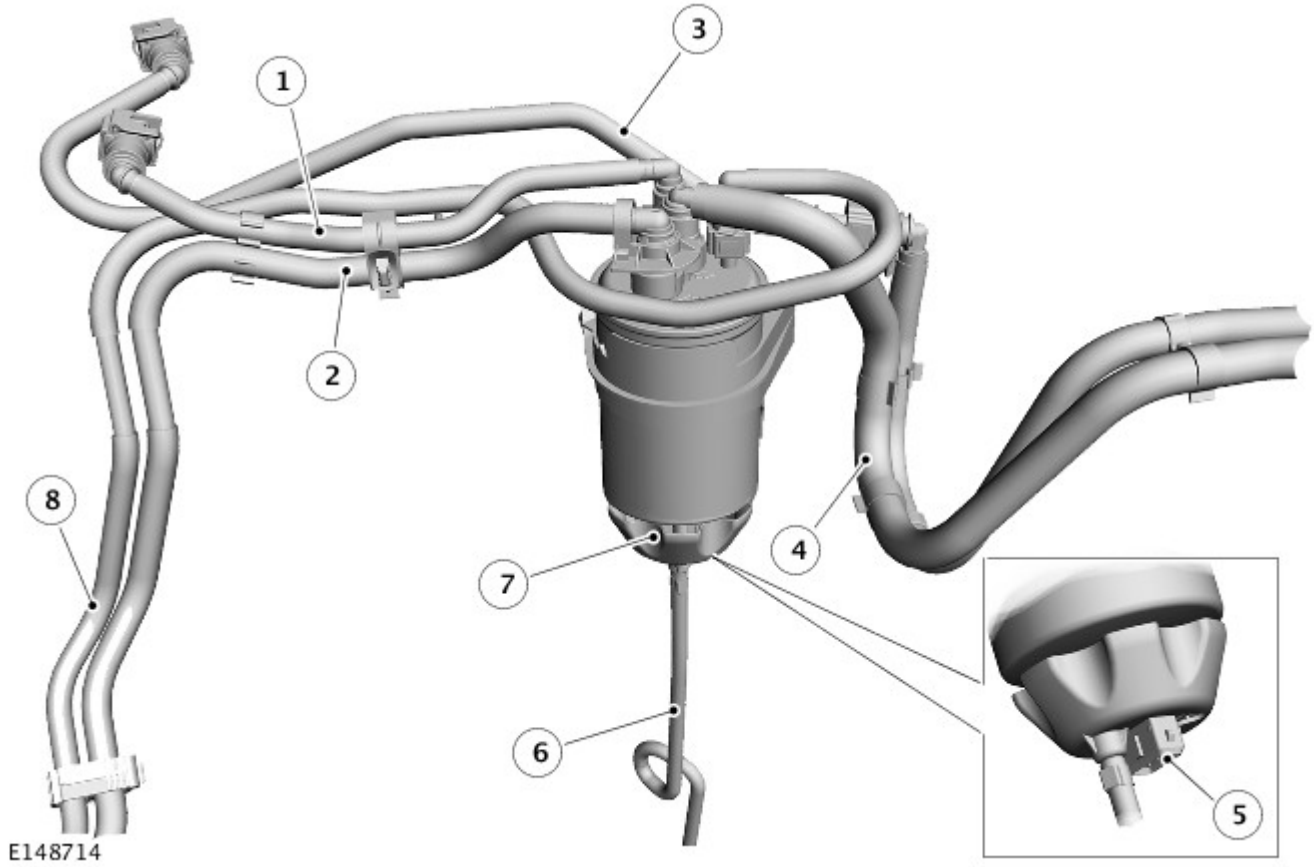
A low fuel warning indicator in the instrument cluster illuminates if the fuel level in the tank falls below a predetermined level.

Fuel Level Sensors - Resistance/Fuel Gauge Read Out Table

NOTE: These figures are with the vehicle on level ground. Sensor readings will differ with varying vehicle inclinations.

Left (Active) Fuel Level Sensor	
Sensor Resistance, Ohms	**Nominal Gauge Reading**
992	Empty
51	Full
Right (Passive) Fuel Level Sensor	
Sensor Resistance, Ohms	**Nominal Gauge Reading**
992	Empty
281	Full

Fuel Filter



Item	Part Number	Description
1	-	Fuel cooler to fuel filter pipe
2	-	Fuel supply to fuel filter pipe
3	-	High pressure fuel pump to fuel cooler pipe
4	-	Fuel filter to high pressure fuel pump pipe
5	-	Water in fuel sensor
6	-	Water/Fuel mix drain hose
7	-	Water/Fuel mix drain turn wheel
8	-	Fuel return to tank pipe

The fuel filter is a disposable canister that has four quick release connections.

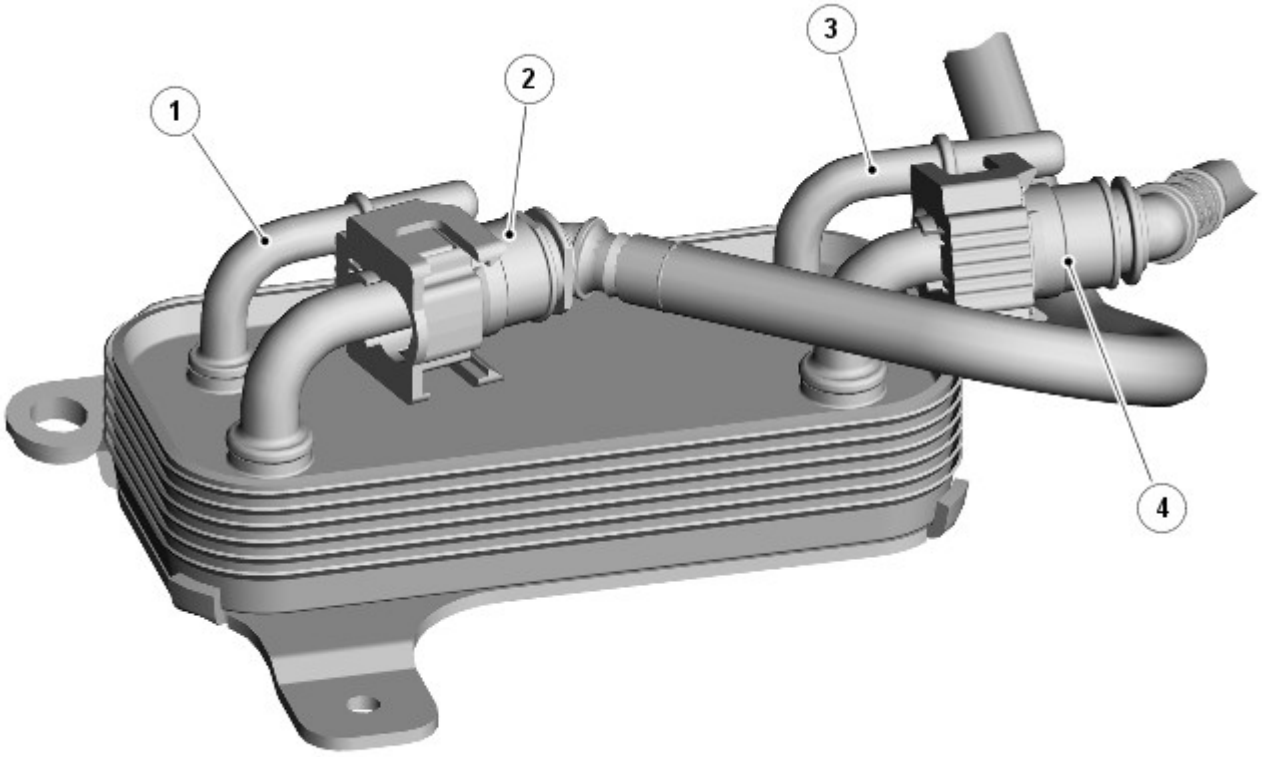
The fuel filter is fitted with a removable water in fuel sensor, which is installed in the base of the filter. The sensor can be unscrewed and fitted to a new filter.

The water in fuel sensor also incorporates a drain valve, operated by a turn wheel, to allow the filter housing to be

drained. When the drain valve is open a drain tube directs the filter housing contents to the underside of the vehicle.

Water in the fuel filter is sensed by the ECM. The ECM then transmits a message on the high speed CAN (controller area network) powertrain systems to the instrument cluster, which displays a message 'WATER IN FUEL' in the message center.

Fuel Cooler



E148715

Item	Part Number	Description
1	-	Coolant inlet connection
2	-	Fuel inlet connection
3	-	Coolant outlet connection
4	-	Fuel outlet connection

The fuel cooler is designed to cool fuel returning from the high pressure fuel pump before it is sent back to the fuel tank via the return line. Fuel is cooled by heat transfer through the internal galleries within the coolant assisted fuel cooler.

The fuel cooler is connected to the EPIC (electric power inverter converter) cooling system. The coolant supplied to the fuel cooler is cooled by two auxiliary fuel coolers located in the cooling pack.
For additional information, refer to: Battery and Cables - TDV6 3.0L Diesel - Hybrid Electric Vehicle (414-01, Description and Operation).

Published: 13-Sep-2012

Fuel Tank and Lines - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Fuel Cooler

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.

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 mixtures 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 medical attention.

CAUTION: 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.

NOTES:

Removal steps in this procedure may contain installation details.

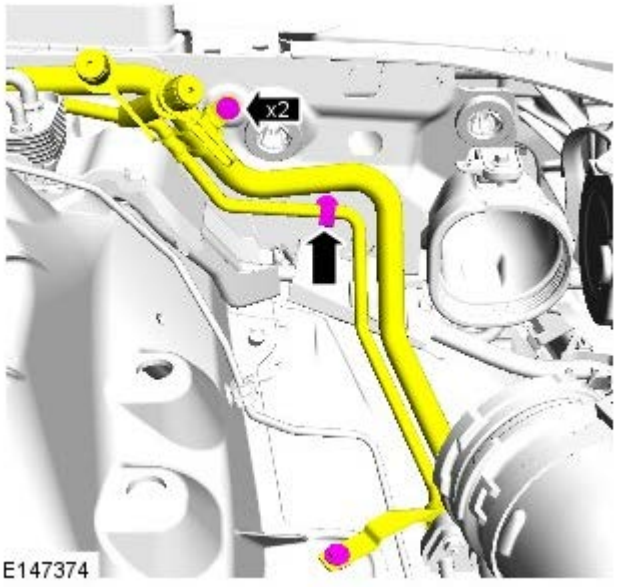
Some variation in the illustrations may occur, but the essential information is always correct.

1. Disconnect the battery ground cable.

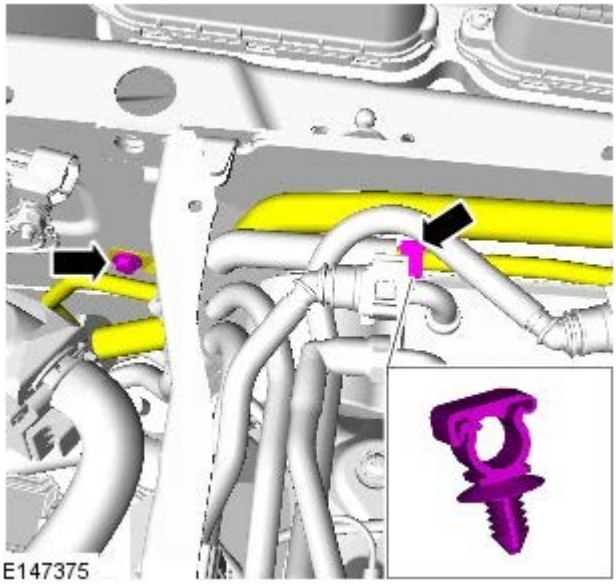
   Refer to: Specifications (414-00, Specifications).

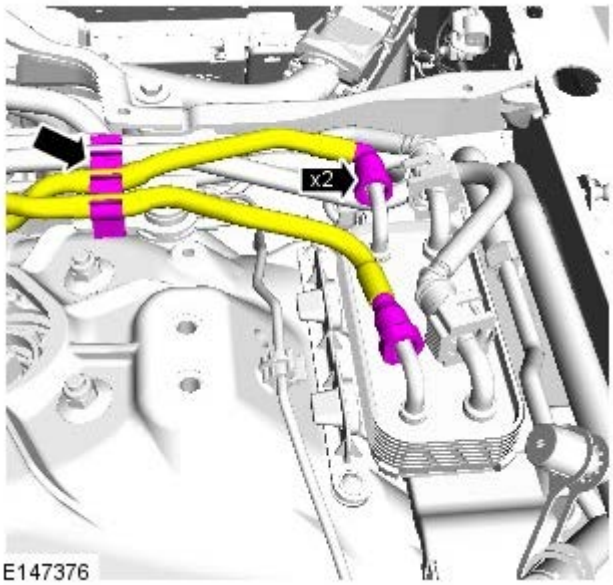
2. Refer to: Air Cleaner LH (303-12A Intake Air Distribution and Filtering - TDV6 3.0L Diesel, Removal and Installation).

3. *Torque:* 10 Nm



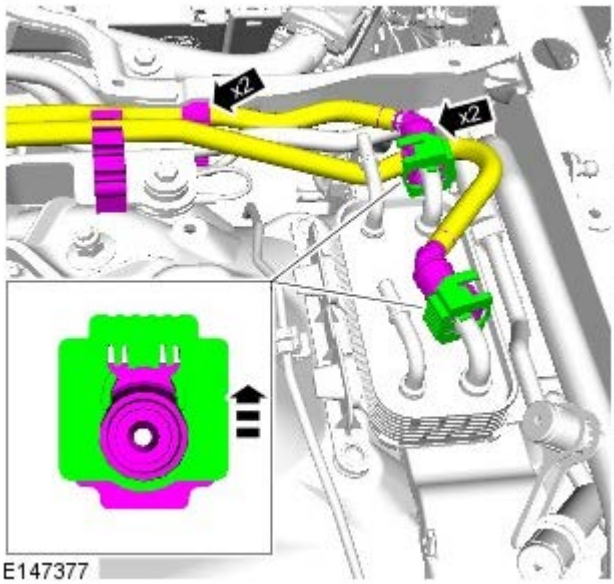
4. *Torque:* 10 Nm





5. CAUTION: Be prepared to collect escaping coolant.

NOTE: Make sure that all openings are sealed. Use new blanking caps.

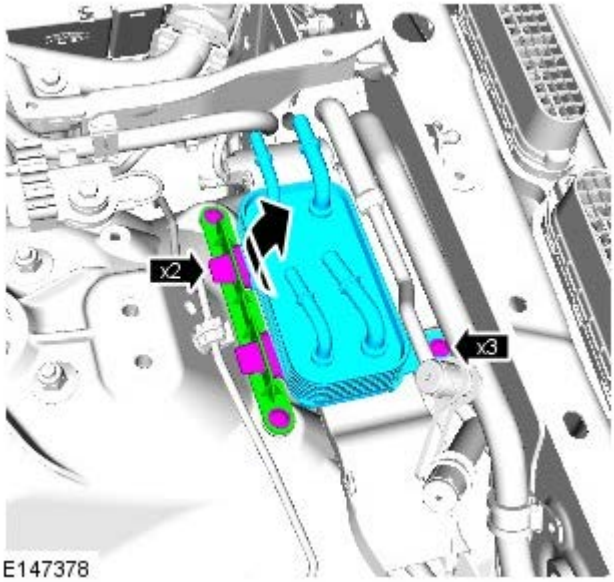


6. CAUTIONS:

Make sure that all openings are sealed. Use new blanking caps.

Be prepared to collect escaping fuel.

7. *Torque:* 10 Nm



Installation

1. To install, reverse the removal procedure.

Published: 09-Aug-2012

Fuel Tank and Lines - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Fuel Filter Element

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.

The spilling of fuel is unavoidable during this operation. Make sure that all necessary precautions are taken to prevent fire and explosion.

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.

If fuel contacts the eyes, flush the eyes with cold water or eyewash solution and seek immediate medical attention.

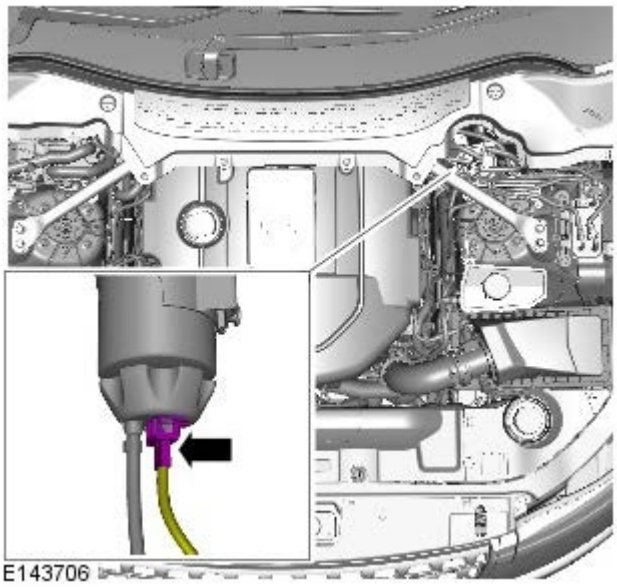
Wash hands thoroughly after fuel handling, as prolonged contact may cause irritation. Should irritation develop, seek medical attention.

NOTE: Removal steps in this procedure may contain installation details.

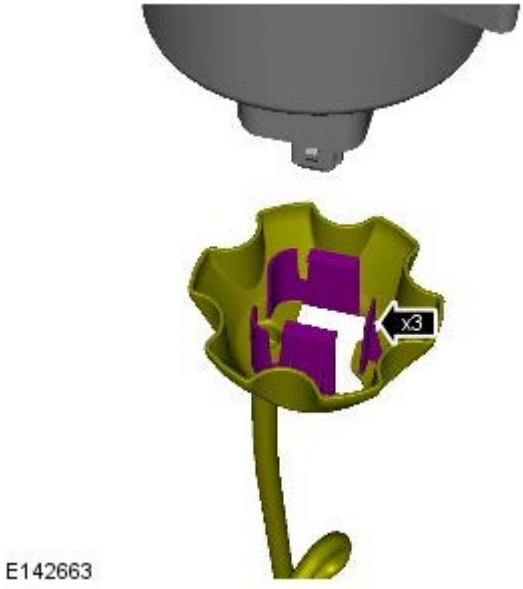
1. Refer to: Diesel Fuel System Health and Safety Precautions (100-00 General Information, Description and Operation).
2. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

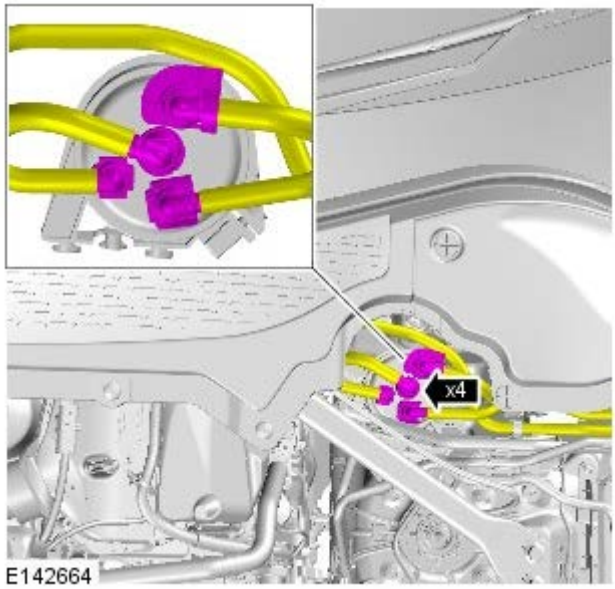
3.



4.



E142663



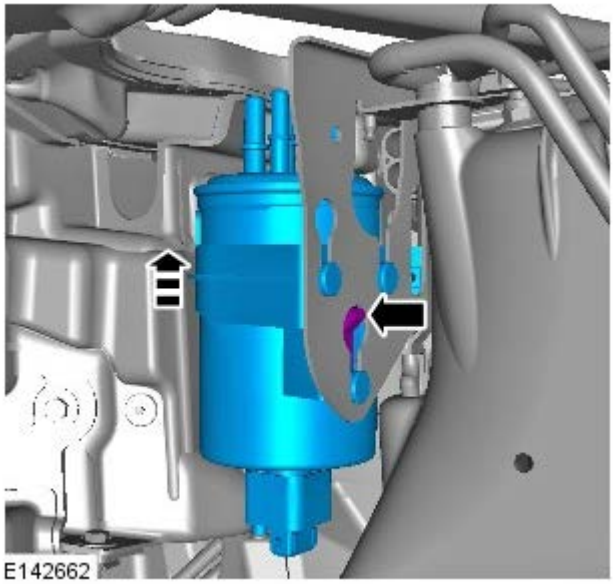
E142664

5. CAUTIONS:

   Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

   Be prepared to collect escaping fuel.

6.


E142662

7. CAUTION: Note the fitted position of the component prior to removal.



E142661

Installation

1. CAUTION: Make sure that the fuel filter is correctly aligned. Failure to follow this instruction may result in damage to the vehicle.

   To install, reverse the removal procedure.

2. Refer to: Low-Pressure Fuel System Bleeding (310-00 Fuel System - General Information, General Procedures).

Published: 12-Sep-2012

Fuel Tank and Lines - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Fuel Level Sender

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.

 The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.

 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.

 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.

 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.

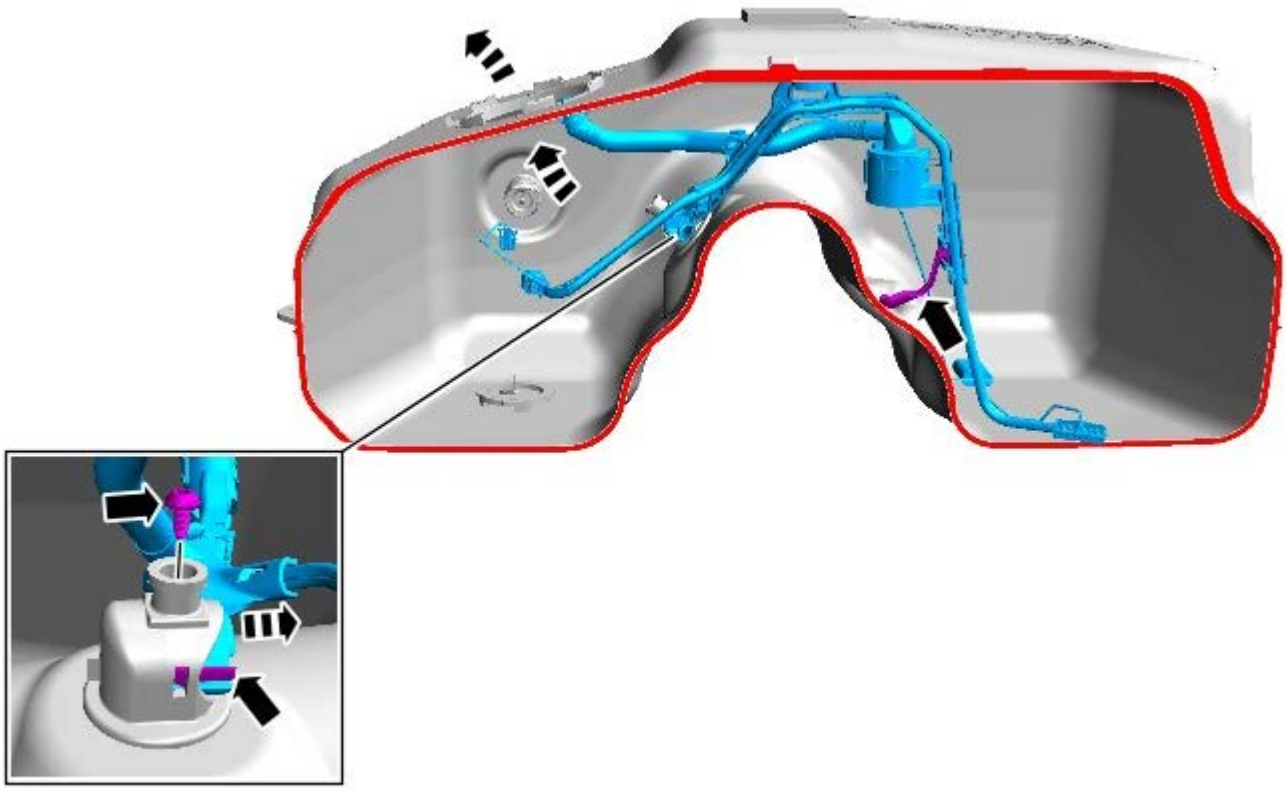
2. Refer to: Diesel Fuel System Health and Safety Precautions (100-00 General Information, Description and Operation).

3. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

4. Refer to: Fuel Pump and Sender Unit (310-01A Fuel Tank and Lines - TDV6 3.0L Diesel, Removal and Installation).

5. *Torque:* 7 Nm



E147440

Installation

1. To install, reverse the removal procedure.

Published: 13-Sep-2012

Fuel Tank and Lines - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Fuel Pump and Sender Unit

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.

 The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.

 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.

 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.

 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.

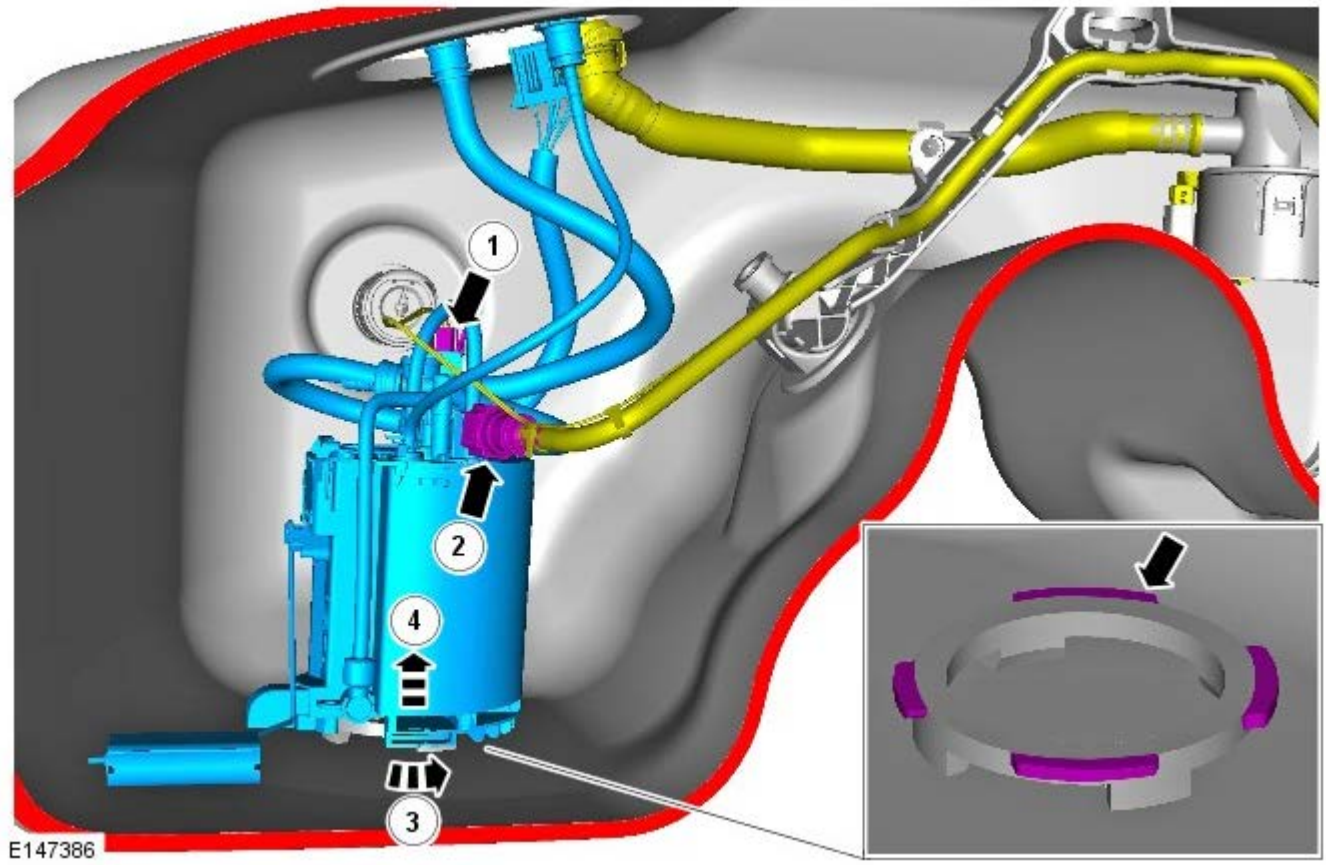
2. Refer to: Diesel Fuel System Health and Safety Precautions (100-00 General Information, Description and Operation).

3. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

4. Refer to: Fuel Tank Draining (310-00 Fuel System - General Information, General Procedures).

5.



Installation

1. To install, reverse the removal procedure.

Published: 05-Dec-2013

Fuel Tank and Lines - SDV6 3.0L Diesel - Hybrid Electric Vehicle - Fuel Tank

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.

 The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.

 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.

 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.

 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: Diesel Fuel System Health and Safety Precautions (100-00 General Information, Description and Operation).

3. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

4. Refer to: Fuel Tank Draining (310-00 Fuel System - General Information, General Procedures).

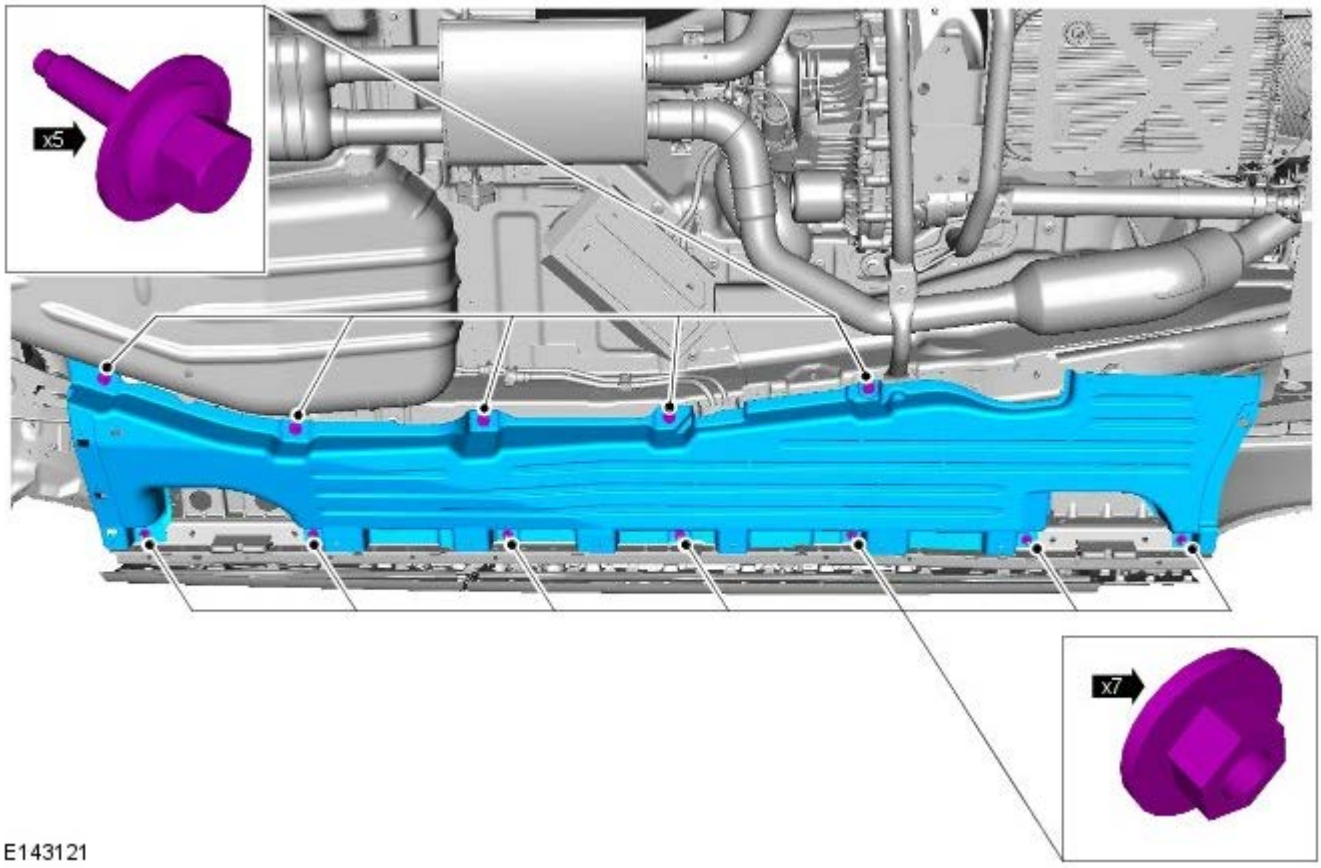
5.  NOTE: Repeat the procedure for the other side.

   Refer to: Rear Rocker Panel Moulding (501-08 Exterior Trim and Ornamentation, Removal and Installation).

6. Refer to: Rear Driveshaft - TDV6 3.0L Diesel (205-01 Driveshaft, Removal and Installation).
   Refer to: Rear Driveshaft - SDV6 3.0L Diesel - Hybrid Electric Vehicle (205-01 Driveshaft, Removal and Installation).
   Refer to: Rear Driveshaft - TDV8 4.4L Diesel (205-01 Driveshaft, Removal and Installation).

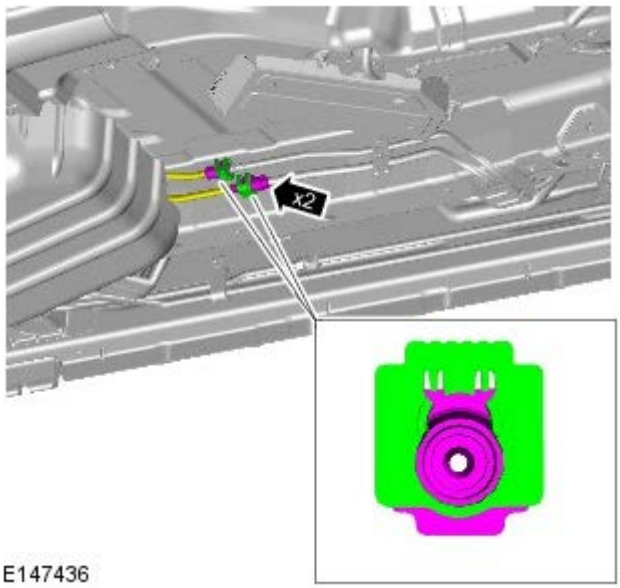
7.  CAUTION: LH illustration shown, RH is similar.

NOTE: Repeat the procedure for the other side.



E143121

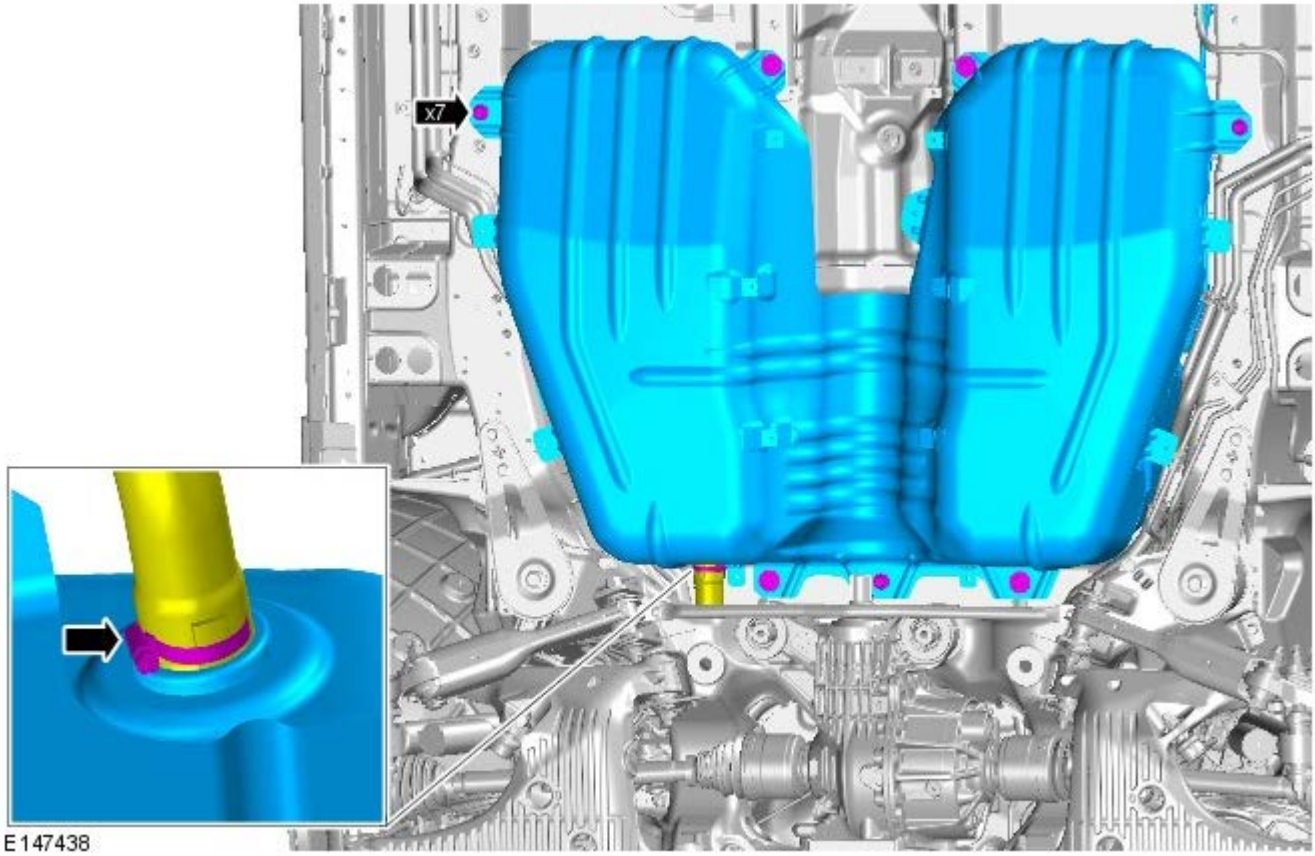
8. CAUTION: Be prepared to collect escaping fuel.



E147436

9. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Torque: 45 Nm



E147438

10. NOTE: Do not disassemble further if the component is removed for access only.



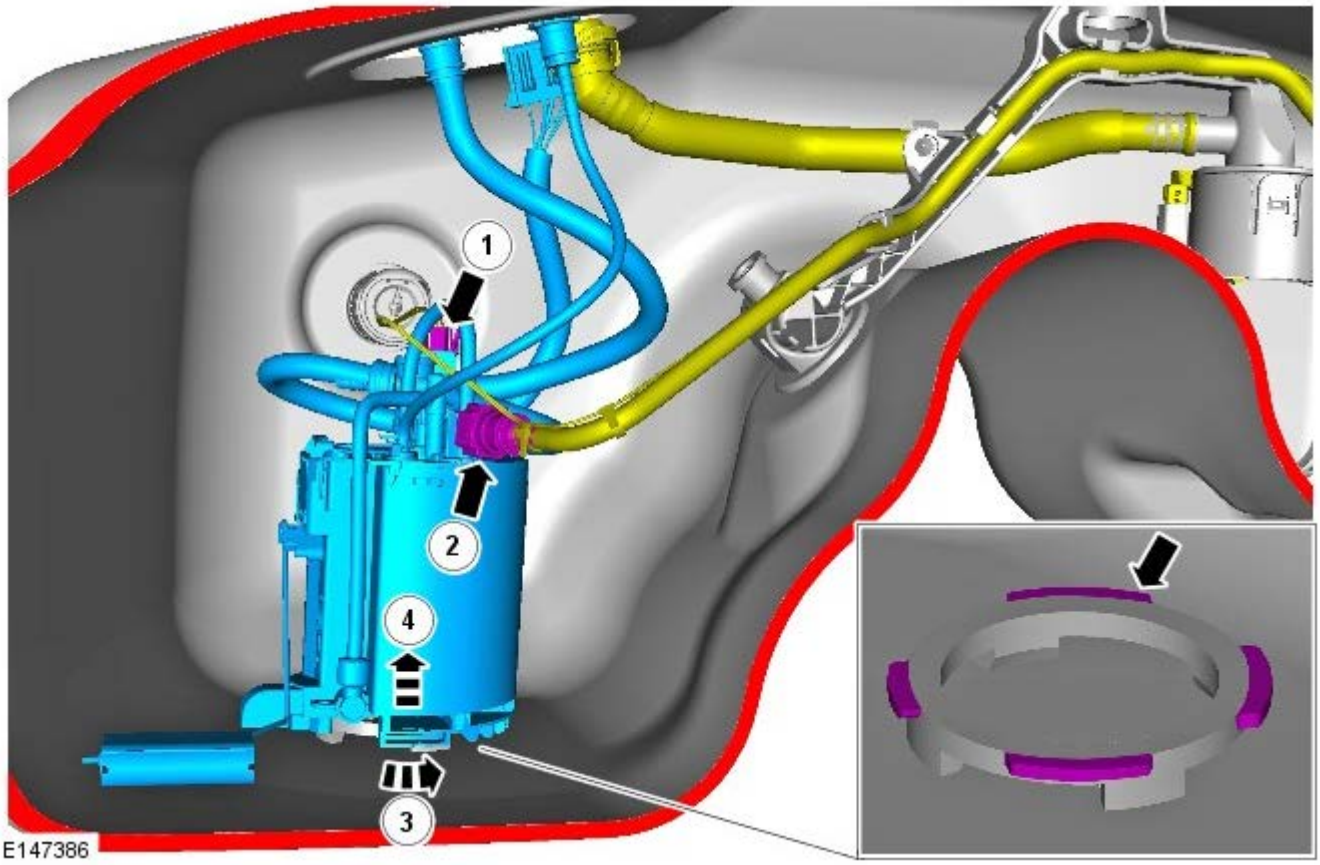
E147439

11. *Torque:* 10 Nm



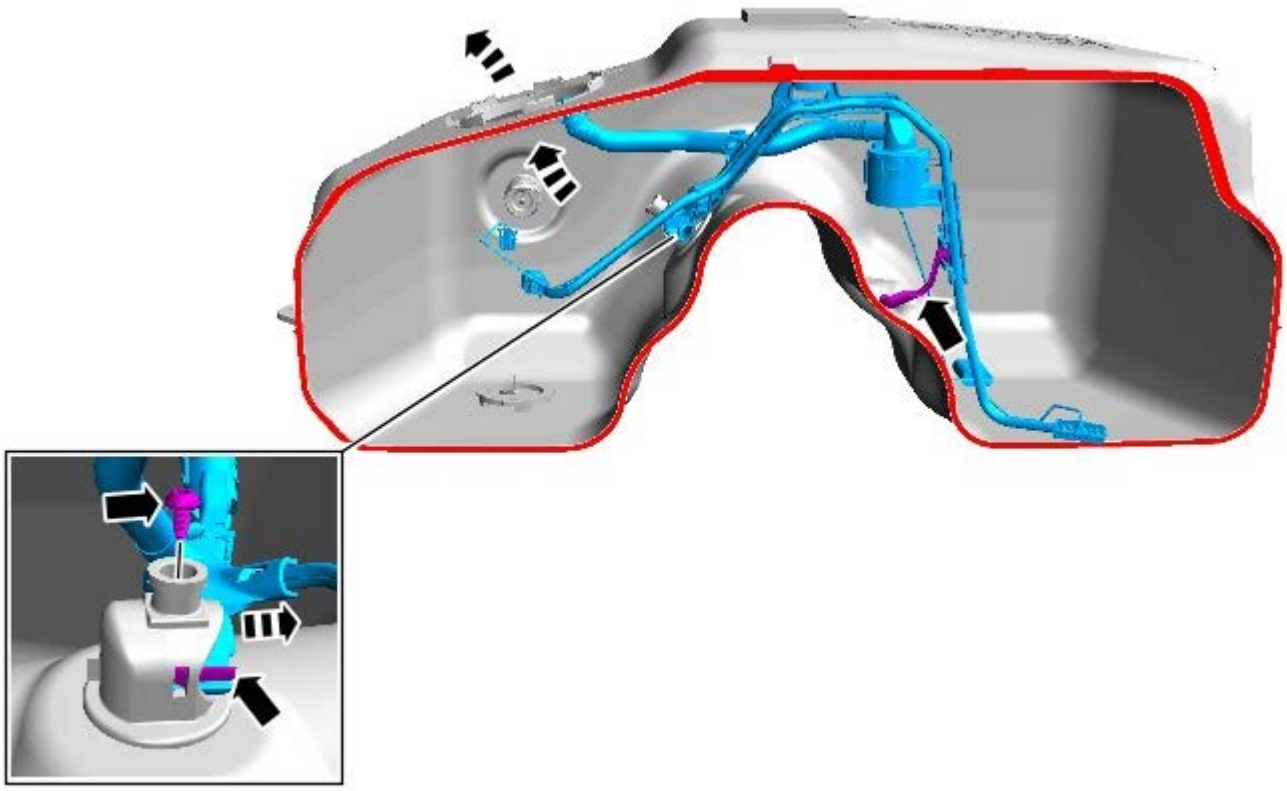
E147442

12.



E147386

13. *Torque:* 7 Nm



E147440

Installation

1. To install, reverse the removal procedure.

Published: 25-Oct-2013

Fuel Tank and Lines - SDV6 3.0L Diesel - Hybrid Electric Vehicle - 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.

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.

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.

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: Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions (100-00 General Information, Description and Operation).
   Refer to: Diesel Fuel System Health and Safety Precautions (100-00 General Information, Description and Operation).

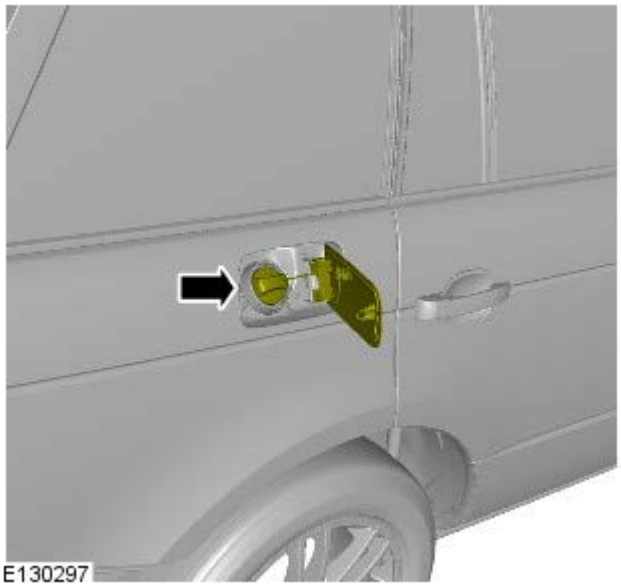
Vehicles with petrol engine

3. Refer to: Fuel System Pressure Release - V6 S/C 3.0L Petrol /V8 S/C 5.0L Petrol (310-00 Fuel System - General Information, General Procedures).

All vehicles

4. Refer to: Rear Subframe (502-00 Uni-Body, Subframe and Mounting System, Removal and Installation).

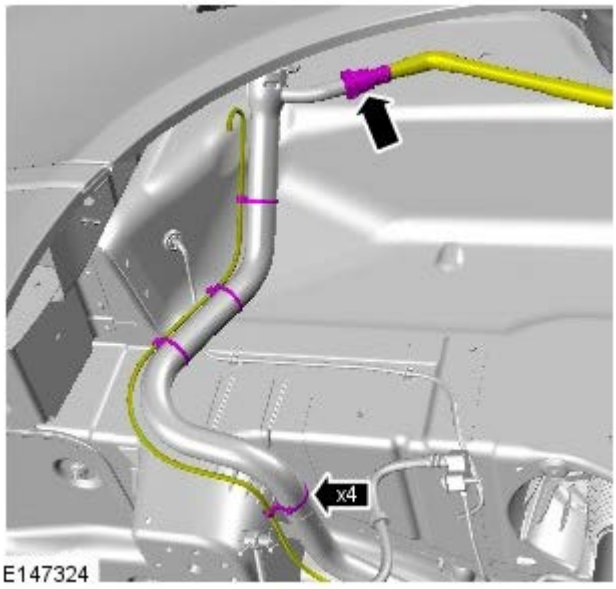
5. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.



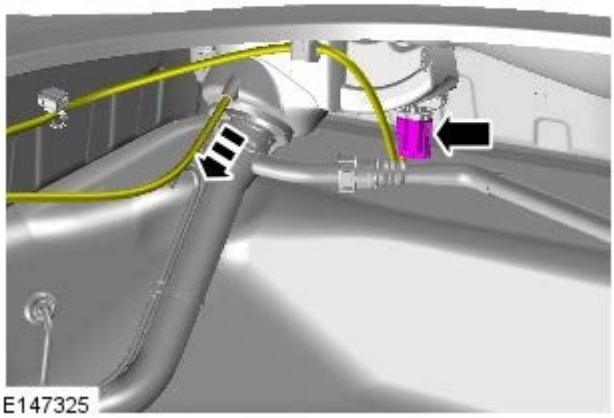
6.



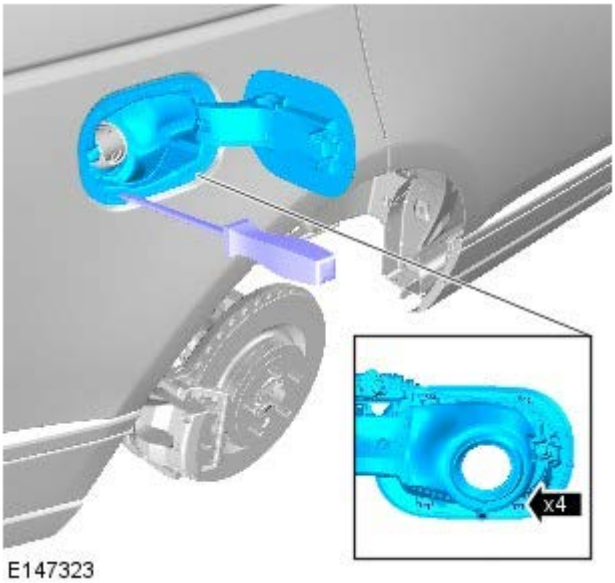
7.



8.

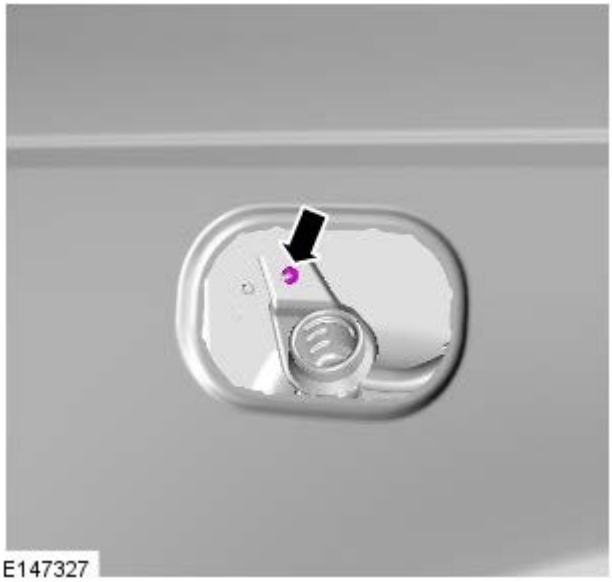

E147325

9.



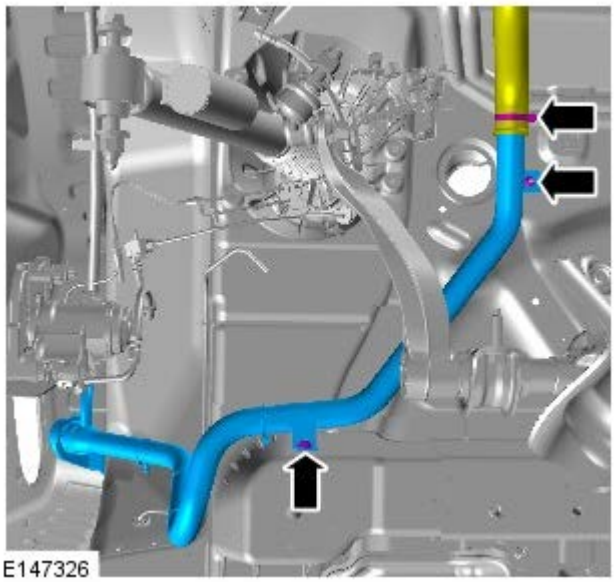
E147323

10. *Torque:* 10 Nm


E147327

11. CAUTION: Be prepared to collect escaping fuel.

Torque:
M6 10 Nm
Clamp 3.5 Nm



Installation

1. To install, reverse the removal procedure.

Published: 11-Sep-2012

Acceleration Control -

Torque Specifications

Description	Nm	lb-in
Accelerator pedal assembly nuts	9	80

Published: 10-Sep-2012

Acceleration Control - Accelerator Pedal

Removal and Installation

Removal

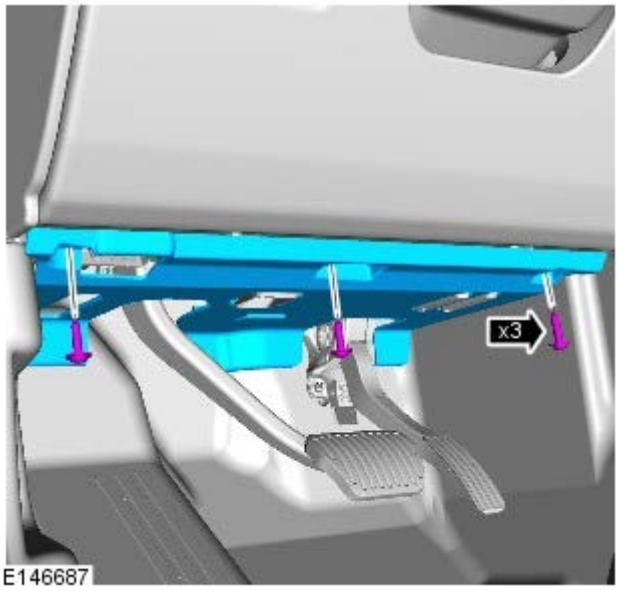
NOTES:

Removal steps in this procedure may contain installation details.

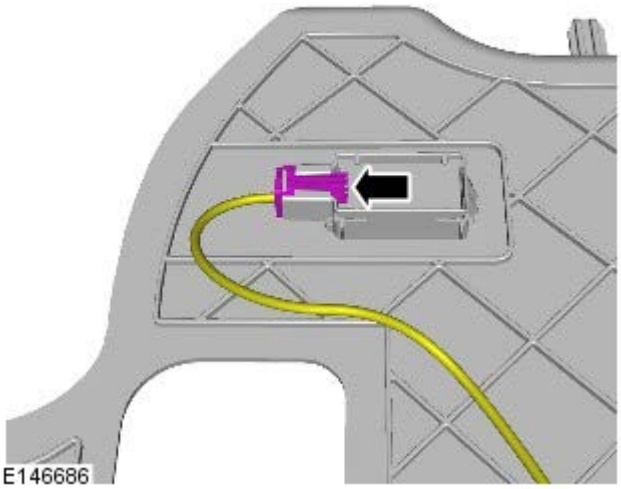
LHD illustration shown, RHD is similar.

1. Remove the battery ground cable.
   For additional information, refer to: Specifications (414-00, Specifications).

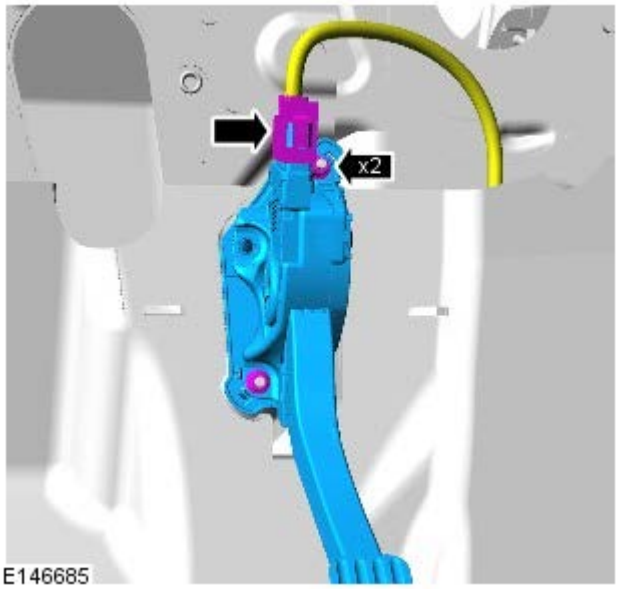
2.



3.



4. TORQUE: 9 Nm



Installation

1. To install reverse the removal procedure.

Published: 11-Sep-2012

Speed Control - TDV6 3.0L Diesel -

Item	Specification
Speed control sensor assembly vertical alignment	90° ± 1.2°

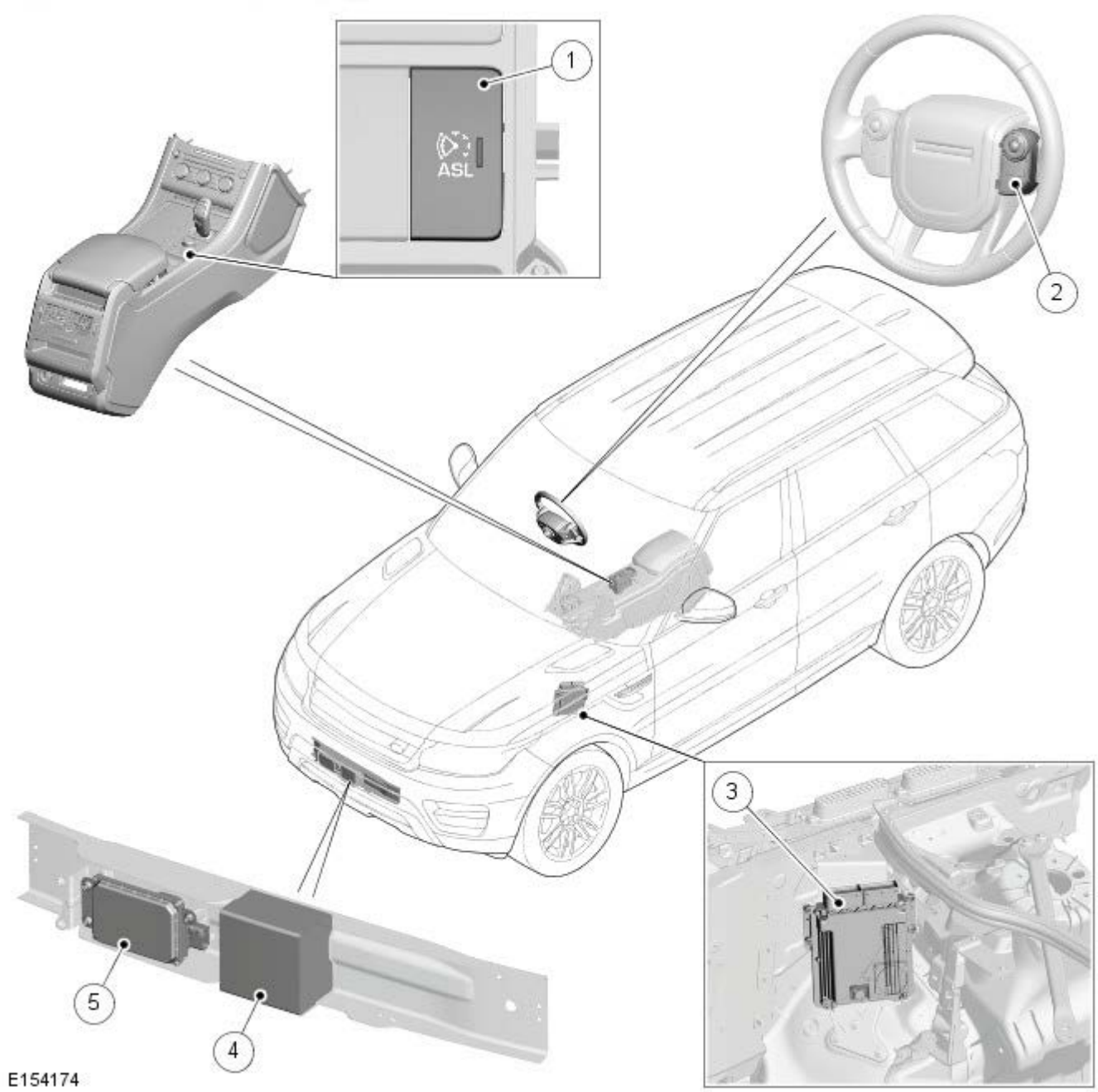
Description	Nm	lb-ft	lb-in
Speed control sensor assembly retaining bolts	9	-	7

Published: 31-Jul-2013

Speed Control - TDV6 3.0L Diesel - Speed Control

Description and Operation

COMPONENT LOCATION



Item	Part Number	Description
1	-	Automatic Speed Limiter (ASL) switch
2	-	Right steering wheel switchpack
3	-	Engine Control Module (ECM) (V8 S/C 5.0L petrol shown)
4	-	Foam block
5	-	Adaptive Speed Control Module (ASCM)

OVERVIEW

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. The adaptive system includes the same functionality as the standard system, and has the following additional functions:

- Follow Mode: Reduces vehicle speed, to less than the set speed, in order to maintain a selected distance behind a slower moving vehicle, then resumes the set speed once the way ahead is clear
- Queue Assist: Stops the vehicle a set distance behind the vehicle in front if it comes to a halt. When the vehicle in front moves away, a brief press of the accelerator pedal resumes adaptive speed control operation
- Forward Alert: Alerts the driver when rapidly approaching a slower moving vehicle
- Advanced Emergency Brake Assist: Partially applies the brakes in preparation for a sudden braking action, to

improve brake response
- Intelligent Emergency Braking: Applies the brakes to reduce the impact velocity if a collision is unavoidable.

The standard speed control system is controlled by the ECM (Engine Control Module) and switches on the right steering wheel switchpack. The adaptive speed control system is controlled by the ECM, the switches on the right steering wheel switchpack and the ASCM (Adaptive Speed Control Module). Both systems also use the:

- Brake pedal switch.
  For additional information, refer to: Braking Control System (206-11 Brake Controls, Description and Operation).
- APP (Accelerator Pedal Position) sensor. For additional information, refer to:
  Electronic Engine Controls (303-14A Electronic Engine Controls - TDV6 3.0L Diesel, Description and Operation),
  Electronic Engine Controls (303-14B Electronic Engine Controls - V6 S/C 3.0L Petrol, Description and Operation),
  Electronic Engine Controls (303-14C Electronic Engine Controls - V8 S/C 5.0L Petrol, Description and Operation),
  Electronic Engine Controls (303-14D Electronic Engine Controls - TDV8 4.4L Diesel, Description and Operation).
- ABS (Anti-lock brake system) control module.
  For additional information, refer to: Braking Control System (206-11 Brake Controls, Description and Operation).
- TCS (Transmission Control Switch).
  For additional information, refer to: External Controls (307-05A Automatic Transmission/Transaxle External Controls - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, Description and Operation).
- TCM (Transmission Control Module).
  For additional information, refer to: Transmission Description (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, Description and Operation).
- Terrain Response® switchpack.
  For additional information, refer to: Ride and Handling Optimization (204-06 Ride and Handling Optimization, Description and Operation).
- Instrument Cluster (IC). For additional information, refer to:
  Instrument Cluster (413-01 Instrument Cluster, Description and Operation),
  Information and Message Center (413-08 Information and Message Center, Description and Operation).

During speed control operation, the ECM controls vehicle speed by adjusting the engine throttle and fuel injection. The adaptive speed control system also uses the ASCM to scan the road ahead and, if necessary, signal the ABS control module to apply the brakes to slow the vehicle.

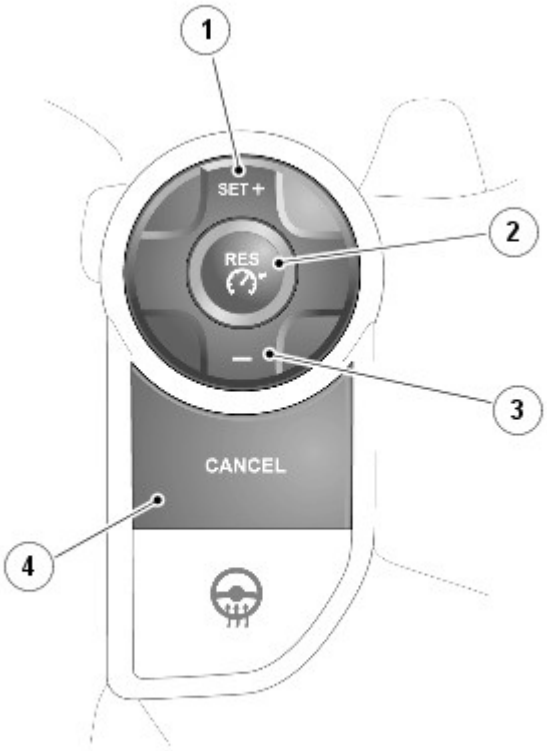
All vehicles also incorporate an ASL (Automatic Speed Limiter) system. When a speed has been set, the engine will respond normally up to the set speed. Further accelerator pressure will not increase the speed beyond the set speed unless sudden, rapid acceleration (kickdown) is applied. The ASL system is controlled by the ECM, the speed control switches on the right steering wheel switchpack and an ASL switch.

The ASL system and the speed control system cannot be used simultaneously. The system in use when the ignition is turned off is automatically enabled when the ignition is turned back on. However the speed settings are not remembered and will have to be set again.

DESCRIPTION

Standard Speed Control

SPEED CONTROL SWITCHES



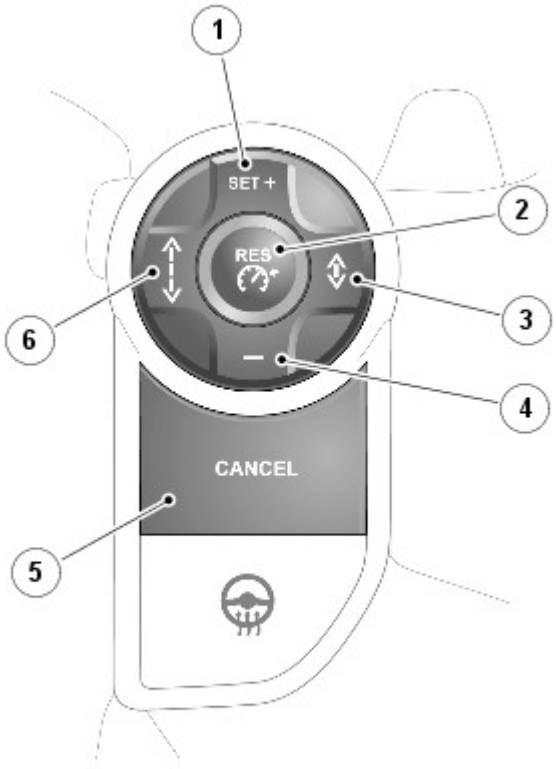
E147361

Item	Part Number	Description
1	-	Set + (engage/accelerate) switch
2	-	RES (resume) switch
3	-	- (decelerate) switch
4	-	CANCEL switch

The standard speed control switches are located on the right steering wheel switchpack. The switches are resistive ladder type switches which vary the resistance of a 5 volt signal sent to them. The resistive ladder is wired to a LIN (Local Interconnect Network) node which transmits the data to the CJB (Central Junction Box) via the clockspring. The CJB then transmits the data on the high speed CAN (Controller Area Network) Powertrain bus.

Adaptive Speed Control

SPEED CONTROL SWITCHES



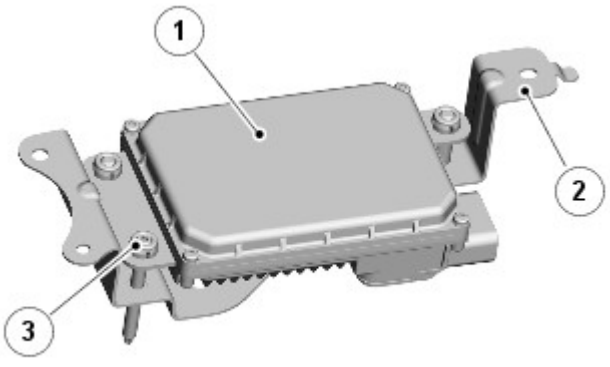
E147362

Item	Part Number	Description
1	-	Set + (engage/accelerate) switch
2	-	RES (resume) switch
3	-	Time gap decrease switch
4	-	- (decelerate) switch
5	-	CANCEL switch
6	-	Time gap increase switch

The adaptive speed control switches are the same as used for standard speed control, with the addition of two time gap switches. The time gap switches allow the driver to adjust the follow mode and forward alert functions to one of four pre-set time gaps (gap 1 = 1 second; gap 2 = 1.4 seconds; gap 3 = 1.8 seconds; gap 4 = 2.2 seconds). The selected time gap is displayed in the message center when the time gap switches are operated.

When adaptive speed control is engaged, the switches adjust the follow mode time gap. When adaptive speed control is disengaged, the switches adjust the forward alert time gap (provided forward alert is enabled in the instrument cluster menu). The follow mode function defaults to the gap 3 setting each time the ignition is switched on. The forward alert function recalls the last selected time gap when the ignition is switched on.

ADAPTIVE SPEED CONTROL MODULE



E148863

Item	Part Number	Description
1	-	Adaptive Speed Control Module (ASCM)
2	-	Mounting bracket
3	-	Adjuster screw

The ASCM is attached to a bracket located in the armature of the front bumper, to the right of the vehicle centerline. A foam block in the bumper armature eliminates radar signal reflections within the armature.

The ASCM contains a forward looking radar transceiver together with related controlling hardware and software. A high speed CAN Powertrain bus connection allows the ASCM to communicate with other system control modules. Power supplies to the ASCM are from the extended ignition relay in the RJB (Rear Junction Box) and the ignition relay in the EJB (Engine Junction Box).

The adaptive speed control module is active whenever the ignition is on, even if speed control is not engaged, in order to operate the forward alert, advanced emergency brake assist and intelligent emergency braking functions. With the ignition on, the adaptive speed control module is powered up but no radar transmissions are emitted until the vehicle is in motion.

The adaptive speed control module 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 control module detects the range, relative velocity and angle of objects within the scanned arc for up to a distance of approximately 130 meters (426.5 feet).

The ASCM compares vehicle speed data from the ABS control module with the relative speed of an external object as detected by the radar 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 module, 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.

The ASCM continuously monitors both moving vehicles and stationary objects to determine if it can 'see' normally. If the control module can detect only a few objects, because it is physically blocked (for example by an accumulation of snow or mud on the lower grill of the front bumper, or an incorrectly located number plate), or there are few roadside objects or other vehicles in the area, it may determine that it is blocked. The control module then inhibits adaptive speed control and records a DTC (Diagnostic Trouble Code). The system will reset after the ignition is cycled. In this case the control module is not faulty and should not be replaced.

If the ASCM is replaced in service it must be mechanically aligned vertically. Horizontal alignment is achieved by putting the control module into service mode using approved Land Rover diagnostic equipment. The vehicle then needs to be driven for a short period while the control module calibrates itself. Calibration is complete when the follow mode warning indicator in the instrument cluster stops flashing.For additional information, refer to:

Speed Control Sensor Adjustment (310-03B Speed Control - V6 S/C 3.0L Petrol, General Procedures),
Speed Control Sensor Adjustment (310-03B, General Procedures),
Speed Control Sensor Adjustment (310-03B Speed Control - V6 S/C 3.0L Petrol, General Procedures),
Speed Control Sensor Adjustment (310-03B Speed Control - V6 S/C 3.0L Petrol, General Procedures).

Automatic Speed Limiter

ASL SWITCH

The ASL switch is integrated into the Terrain Response® switchpack in the floor console. An amber LED (Light Emitting Diode) in the ASL switch remains illuminated while the ASL is selected on. Selection of the ASL switch is transmitted on high speed CAN Chassis bus from the Terrain Response® switchpack to the ECM through the GWM (Gateway Module), since the ECM is connected to the high speed CAN Powertrain bus.

Instrument Cluster Warning Indicators

SPEED CONTROL WARNING INDICATOR



E147363

The speed control warning indicator illuminates when standard or adaptive speed control is engaged.

FOLLOW MODE WARNING INDICATOR



E122343

The follow mode warning indicator illuminates when the adaptive speed control system is engaged and goes into follow mode. When the system is engaged, the time gap setting is displayed in the message center in the form of a vehicle with 1 to 4 bars in front of it, where the number of bars correspond to the current time gap setting.

FORWARD ALERT WARNING INDICATOR



E122344

The forward alert warning indicator illuminates if forward alert is enabled in the IC menu.

ASL WARNING INDICATOR



E147868

The speed control warning indicator illuminates when ASL is selected on and a speed limit is set in the message center.

OPERATION

For standard or adaptive speed control to engage, the vehicle must be in the following configuration:

- Transmission in D (drive)
- Transfer case in high range
- Terrain Response® in the general (special programs off) or grass/gravel/snow program
- HDC (Hill Descent Control) off
- ASL off
- Traveling at 20 mph (32 km/h) or more.

Standard Speed Control

ENGAGE SPEED CONTROL

Speed control is engaged by pressing the SET + switch. On receipt of the switch input, the ECM adopts the current vehicle speed as the speed control set speed. When speed control is engaged, the IC illuminates the speed control warning indicator and the set speed is displayed in the message center.

The set speed is cleared when the ignition is switched off or if the speed control system develops a fault.

SET SPEED ADJUSTMENT

Once engaged the set speed can be increased by one of 3 methods:

- Press and hold the SET + switch which will cause the vehicle to accelerate. When the switch is released the attained speed will be the new set speed.
- Repeatedly pressing the SET + switch. Each press increases the vehicle speed by 1 mph (2 km/h).
- Use the accelerator pedal to increase the vehicle speed. Once the required speed is reached, a single press of the SET + switch will set the cruise speed.

The set speed can be reduced by pressing and holding the decelerate - switch until the required speed is reached. When the switch is released the speed is reset at that value. The set speed can be reduced incrementally by pressing and releasing the decelerate - switch. Each press will reduce the speed by 1 mph (2 km/h).

Speed control adjustment is limited around the current vehicle speed. This means speed adjustment won't occur when resuming or if the vehicle speed is noticeably different to set speed. This is noticeable when resuming speed control and a large difference exists between the set speed and the current speed. The driver can set a new speed, but can't adjust the old speed.

SUSPENDING SPEED CONTROL

Suspending speed control means speed control has been deactivated without loss of the set speed. Speed control is suspended when one of the following occurs:

- Vehicle speed falls below 20 mph (32 km/h)
- The brake pedal is pressed
- The CANCEL switch is pressed
- N (neutral), R (reverse) or P (park) is selected on the TCS
- The EPB (Electric Park Brake) is applied
- If the accelerator pedal is used to accelerate beyond the set speed for too long (more than 5 minutes)
- Engine speed too high (cancel limit set just below red line)
- The ABS control module activates ETC (Electronic Traction Control) or DSC (Dynamic Stability Control)
- HDC is selected
- Terrain Response® adopts a special program other than grass/gravel/snow
- The transfer case is selected to low range.

RESUMING SPEED CONTROL

A single press of the RES switch will resume speed control at the memorized set speed.

Adaptive Speed Control

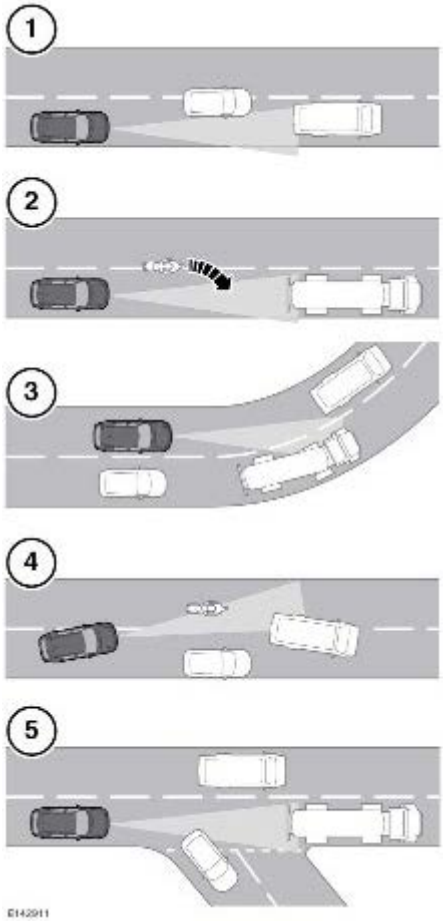
WARNING: Adaptive speed control system is not a collision warning or avoidance system. At all times the driver must be prepared to intervene to control the vehicle speed.

Adaptive speed control operation is similar to the standard speed control system for engaging, suspending and resuming speed control. The main differences between the two systems is that adaptive speed control remains engaged below 20 mph (32 km/h) and uses the brakes to slow the vehicle, to a halt if necessary.

If adaptive speed control is suspended by pressing the CANCEL switch or the brake pedal, it can be re-engaged by pressing the RES switch once vehicle speed is above 7 mph (11 km/h).

SYSTEM RESTRICTIONS

The adaptive speed control system is only intended to provide enhanced speed control in certain restricted conditions. 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.



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.
4. Moving around a stationary vehicle may cause uncertainty as to which vehicle is being followed.
5. A vehicle in front moving out of your lane may cause uncertainty as to which vehicle is being followed.

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 adaptive speed control module. 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.

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, the system identifies it as a target vehicle. To indicate that the system is in follow mode, the follow mode warning indicator illuminates. When the distance between the two vehicles closes to the set time gap, the adaptive speed control system reduces engine speed and, if necessary, applies the brakes to maintain the set time gap.

Automatic braking is limited to approximately 30% of full pressure (0.3 G deceleration) and is intended to provide a smooth, gradual deceleration in follow mode conditions.

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 extinguishes the follow mode warning indicator. The adaptive speed control system then increases vehicle speed back to the original set speed.

QUEUE ASSIST

When adaptive speed control is engaged, if the target vehicle comes to a halt the ASCM reduces engine speed and applies the brakes to halt the sensing vehicle and suspends speed control operation. The control module also applies the EPB if one of the following occurs:

- Adaptive speed control is disengaged with the CANCEL switch
- The vehicle is stationary for more than 2 minutes
- Driver exit is detected (assumed if the driver seatbelt is unbuckled and the driver door is opened)
- A system fault is detected.

When the target vehicle moves away, pressing the accelerator pedal for a minimum of 0.5 second resumes speed control operation. The sensing vehicle then follows the target vehicle in follow mode or until it stops again, or, if it can no longer detect a target, accelerates back up to the set speed.

FORWARD ALERT

If an object is detected close ahead, a warning tone will be emitted and a message will be displayed. The brakes will not be applied.

The forward alert system is active when the warning indicator in the instrument cluster is illuminated. Forward alert does not initiate any action, the driver must take the appropriate action when the message is displayed. The system monitors driver intervention and may not issue the warning if the driver has taken the appropriate action (braking, steering or indicating) early enough.

The sensitivity of the warning can be changed using the gap increase and decrease switches when the adaptive cruise control is not engaged. Confirmation of the gap change is given in the message center.

Forward alert can be switched on or off using the instrument cluster menu.

ADVANCED EMERGENCY BRAKE ASSIST

Advanced EBA (Emergency Brake Assist) improves braking response during emergency braking, and is an enhancement of the electronic brake prefill and emergency brake assist functions controlled by the ABS control module.
For additional information, refer to: Braking Control System (206-11 Brake Controls, Description and Operation).

With advanced EBA, if the risk of a collision increases after the vehicle passes the forward alert activation threshold, the ASCM signals the ABS control module to activate the electronic brake prefill and emergency brake assist functions. With advanced EBA, the electronic brake prefill function operates in two stages:

- Stage 1:
  - Applies a brake pressure of approximately 3 bar (43.5 lbf/in²) to all of the brakes
  - Lowers the EBA activation threshold in the ABS control module
  - Signals the CJB on the high speed CAN bus to activate the stop lamps
- Stage 2 increases the brake pressure to approximately 10 bar (145 lbf/in²).

Stage 1 is activated if the collision risk increases to a level considered as credible, with the accelerator pedal pressed. Stage 2 is activated when the accelerator pedal is released during an imminent risk of collision. If the accelerator pedal has already been released when the collision risk increased to the credible level, the two stages of electronic brake prefill are activated simultaneously, to give an immediate brake pressure of 10 bar (145 lbf/in²).

While the second stage of electronic brake prefill is active, if the brake pedal is then pressed quickly, the ABS control module activates EBA, even if only light pressure is applied to the pedal.

Advanced EBA is available at vehicle speeds 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 related message is displayed in the message center. Advanced EBA will not be available until the fault is rectified.

INTELLIGENT EMERGENCY BRAKING

Intelligent emergency braking reduces the impact velocity if the adaptive speed control module determines that a collision is unavoidable, even with driver intervention. It is not designed to prevent accidents from occurring. Typical activation of intelligent emergency braking is approximately 0.8 second before impact. During this 0.8 second period the speed of the sensing vehicle is reduced, thus reducing the impact energy.

If the ASCM determines a collision is unavoidable, it signals the ABS control module to apply emergency brake pressure to all of the brakes. On vehicles without active safety belts, emergency brake pressure is 50 bar (725 lbf/in²) maximum. On vehicles with active safety belts, emergency brake pressure is 100 bar (1450 lbf/in²) maximum.

When intelligent emergency braking is initiated the ASCM also signals the RCM (Restraints Control Module) to fire the front seatbelt retractors.
For additional information, refer to: Safety Belt System (501-20A Safety Belt System, Description and Operation).

After the intelligent emergency braking function has activated, it is then disabled, as the vehicle is assumed to be damaged. After the vehicle has been repaired, the intelligent emergency braking function can be re-enabled using Land Rover approved diagnostic equipment.

The intelligent emergency braking function operates at vehicle speeds down to zero, and will function even when forward

alert and adaptive cruise control are switched off.

If the intelligent emergency braking feature is disabled for any reason, a related message is displayed in the message center.

Automatic Speed Limiter

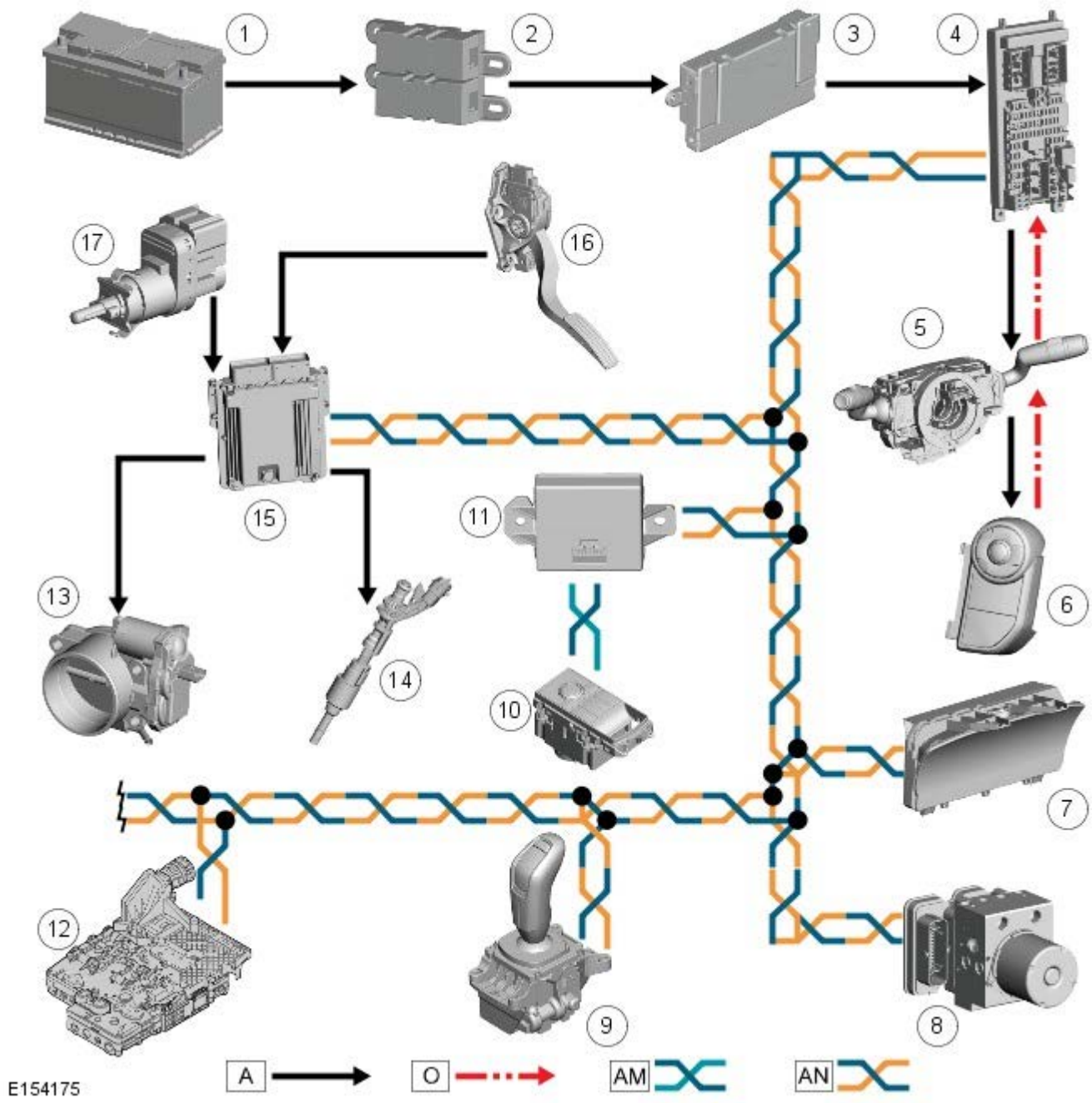
With the ASL switch selected on, the ASL system can be operated in a similar manner to the cruise control system. A speed limit between 18 and 150 mph (30 and 240 km/h) can be set, with the vehicle stationary or moving, using the speed control SET + and - switches (in ASL operation, the SET + and the - switches change the set speed limit in steps of 5 mph (8 km/h), instead of the 1 mph (2 km/h) steps of the cruise control system). The ASL warning indicator illuminates and the set speed limit is displayed in the message center.

If the vehicle reaches the set speed limit, the ECM intervenes to govern vehicle speed at the set speed limit.

NOTE: In certain conditions, such as a steep downhill gradient, the vehicle speed may exceed the set speed limit. This is because engine braking is unable to maintain or reduce the vehicle speed.

The ASL can be disengaged and re-engaged using the speed control CANCEL and RES switches respectively. ASL also disengages if kickdown is used on the accelerator pedal. Pressing the ASL switch cancels ASL operation and the speed limit will need to be reset the next time the switch is selected on.

Control Diagram - Standard Speed Control

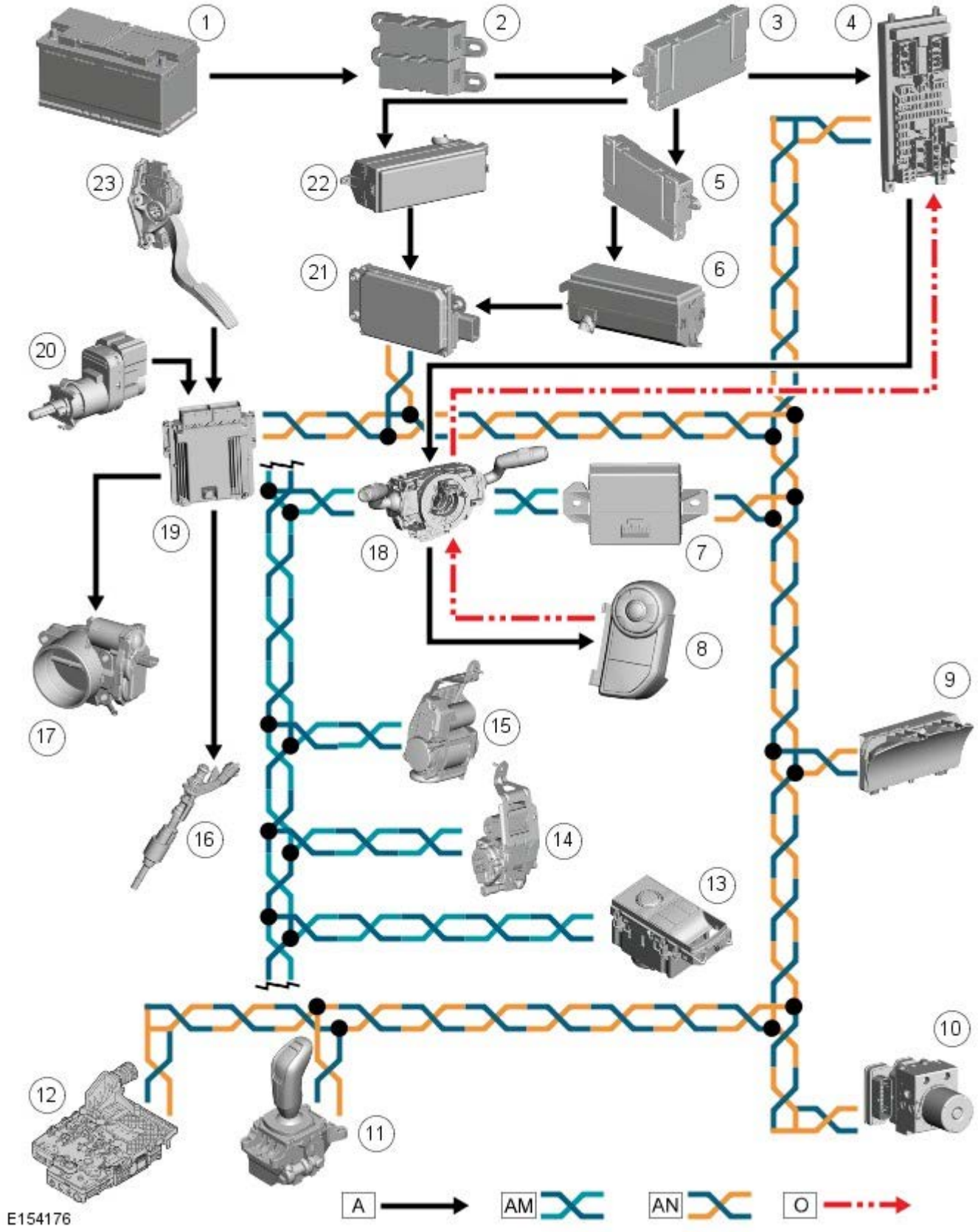


A = Hardwired, O = LIN (Local Interconnect Network) bus, AM = High speed CAN (Controller Area Network) Chassis bus, AN = High speed CAN Powertrain bus.

Item	Part Number	Description

1	-	Battery
2	-	Battery Junction Box 2 (BJB2)
3	-	Battery Junction Box (BJB)
4	-	Central Junction Box (CJB)
5	-	Clockspring
6	-	Right steering wheel switchpack
7	-	Instrument Cluster (IC)
8	-	Anti-lock Brake System (ABS) control module
9	-	Transmission Control Switch (TCS)
10	-	Terrain Response® switchpack
11	-	Gateway Module (GWM)
12	-	Transmission Control Module (TCM)
13	-	Electric throttle
14	-	Fuel injectors
15	-	Engine Control Module (ECM)
16	-	Accelerator Pedal Position (APP) sensor
17	-	Brake pedal switch

Control Diagram - Adaptive Speed Control



A = Hardwired, O = LIN (Local Interconnect Network) bus, AM = High speed CAN (Controller Area NetworkO Chassis bus, AN = High speed CAN Powertrain bus.

Item	Part Number	Description
1	-	Battery
2	-	Battery Junction Box 2 (BJB2)
3	-	Battery Junction Box (BJB)
4	-	Central Junction Box (CJB)
5	-	Auxiliary Junction Box (AJB)
6	-	Engine Junction Box (EJB)
7	-	Gateway Module (GWM)
8	-	Right steering wheel switchpack

9	-	Instrument Cluster (IC)
10	-	Anti-lock Brake System (ABS) control module
11	-	Transmission Control Switch (TCS)
12	-	Transmission Control Module (TCM)
13	-	Terrain Response® switchpack
14	-	Left active seatbelt retractor
15	-	Right active seatbelt retractor
16	-	Fuel injectors
17	-	Electric throttle
18	-	Clockspring and steering angle sensor
19	-	Engine Control Module (ECM)
20	-	Brake pedal switch
21	-	Adaptive Speed Control Module (ASCM)
22	-	Rear Junction Box (RJB)
23	-	Accelerator Pedal Position (APP) sensor

Published: 31-Jul-2012

Speed Control - TDV6 3.0L Diesel - Speed Control

Diagnosis and Testing

Principles of Operation

For a detailed description of the speed control system, refer to the relevant description and operation sections in the workshop manual.
REFER to: Speed Control (310-03A, 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 damage and system integrity

Visual Inspection

Mechanical	Electrical
• Ensure the speed control sensor is free from obstructions • Adaptive speed control module • Brake switch • Visibly damaged or worn components	• Fuse(s) • Damage to wiring loom, incorrect location of wiring, wiring stretched or taught • Loose or corroded electrical connector(s) • Steering wheel switches • Brake switch • Adaptive speed 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 DTCs and refer to the DTCs 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 speed control sensor for correct vertical alignment, and carry out speed control sensor alignment procedure using manufacturer approved diagnostic system

Symptom Chart

Symptom	Possible Cause	Action
Speed control inhibited or disabled	• Power or ground supply to adaptive speed control module • Steering wheel speed control switch/circuits • Throttle sensors • Brake switch • ABS fault • Speed control sensor obstructed	• Check for DTCs that could be caused by power or ground failure to the module and refer to DTC index • Check for sticking, jammed and broken speed control switches. Refer to the electrical circuit diagrams and check speed control switch circuits for short circuit, open circuit, high resistance • Check for engine throttle position sensor DTCs and refer to the relevant DTC index. For throttle position sensor tests REFER to: Electronic Engine Controls (303-14A Electronic Engine Controls - TDV6 3.0L Diesel, Diagnosis and Testing). • Check for correct installation and adjustment of brake switch. Refer to the electrical circuit diagrams and check brake switch circuits for short circuit, open circuit, high resistance • Check ABS system for related DTCs and refer to the relevant DTC index • Make sure there is no snow, ice or other obstruction on the fascia in front of the speed control radar. Adaptive cruise control will not engage until the radar has detected valid target(s)
Unable to regulate/adjust vehicle speed	• Steering wheel switch malfunction	• Check for sticking, jammed and broken speed control switches. Refer to the electrical circuit diagrams and check speed control switch circuits for short circuit, open circuit, high resistance
Unable to cancel speed control from steering wheel	• Steering wheel switch malfunction	• Check for sticking, jammed and broken speed control switches. Refer to the electrical circuit diagrams and check speed control switch circuits for short circuit, open circuit, high resistance
Unable to cancel speed control from brake pedal	• Brake switch malfunction	• Check for correct installation and adjustment of brake switch. Refer to the electrical circuit diagrams and check brake switch circuits for short, open circuit, high resistance

For a list of DTCs that could be logged on this vehicle, please refer to Section 100-00. REFER to:

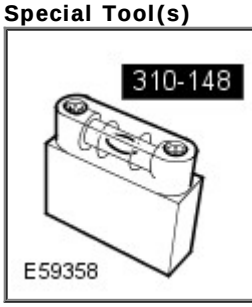
Diagnostic Trouble Code (DTC) Index - DTC: Adaptive Speed Control Module (100-00, Description and Operation), Diagnostic Trouble Code (DTC) Index - TDV6 3.0L Diesel , DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation).

Published: 02-Aug-2012

Speed Control - TDV6 3.0L Diesel - Speed Control Sensor Adjustment

General Procedures

Special Tool(s)

	310-148 Setting Tool, Speed Control

NOTES:

Special tool 310-148 is graduated in 0.5 degree increments.

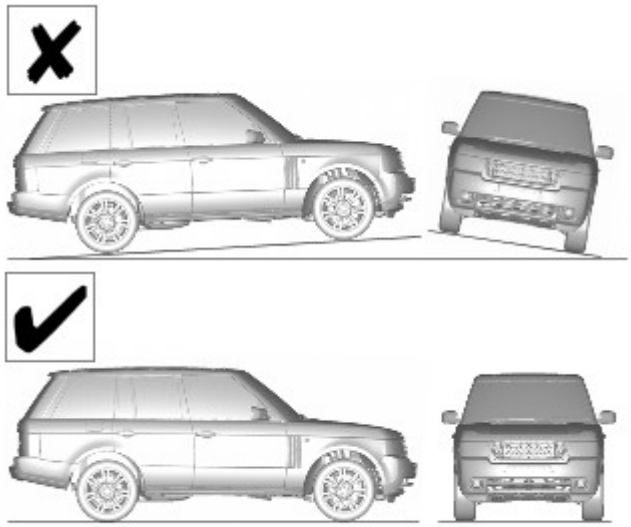
Removal steps in this procedure may contain installation details.

This procedure details how to adjust the speed control sensor vertically. There is no horizontal adjustment required.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Refer to: Front Bumper Cover (501-19, Removal and Installation).



E122311

3. NOTE: Make sure that the vehicle is standing on a level surface.

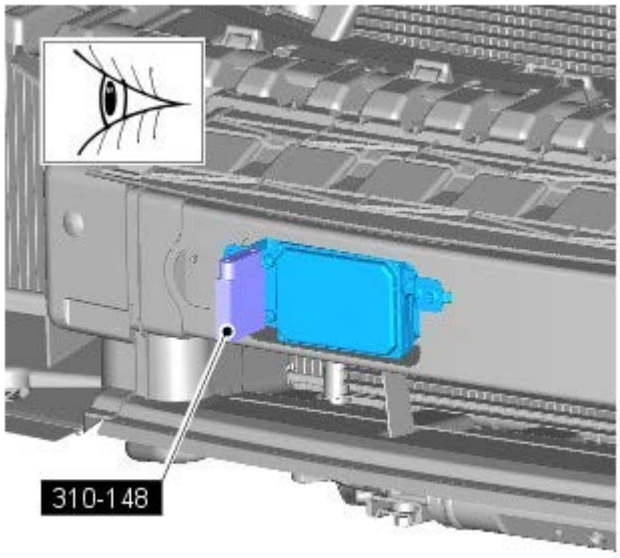
   Set the air suspension ride height to the STANDARD setting.

4. NOTES:

   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.

   If necessary, adjust the level of radar with the torx screw until the level gauge indicates that the radar is level.

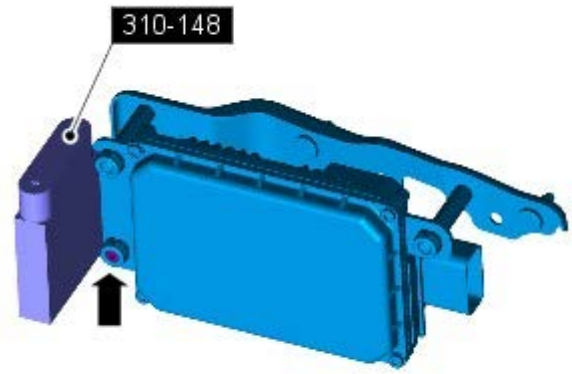
   Special Tool(s): 310-148



E146024

5. NOTE: The speed sensor has no mechanical horizontal adjustment.

   Special Tool(s): 310-148



E132168

6.

- From the diagnostic tool menu, select: Service Alignment Mode.
- The follow indicator will now be flashing, this indicates that the vehicle is in "service alignment" and now requires driving.
- The vehicle speed must be above 30 mph (48 kph).
- Choose a road with plenty of stationary objects, like street lights, road signs, or barriers. Use an inside or outside lane.
- Following vehicles too closely will obscure the stationary targets from the radar, a time gap of 2 seconds is recommended.
- A straight road will produce a quicker and better result, although the process will still operate on a curved road.
- When the flashing follow indicator light extinguishes, the ACC system is now functional, and a required vehicle speed can now be set by the driver and the ACC system will operate as normal.

Published: 12-Sep-2012

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 Exterior Lighting, Removal and Installation).

Installation

1. To install, reverse the removal procedure.

Published: 08-Aug-2012

Speed Control - TDV6 3.0L Diesel - Speed Control Sensor

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

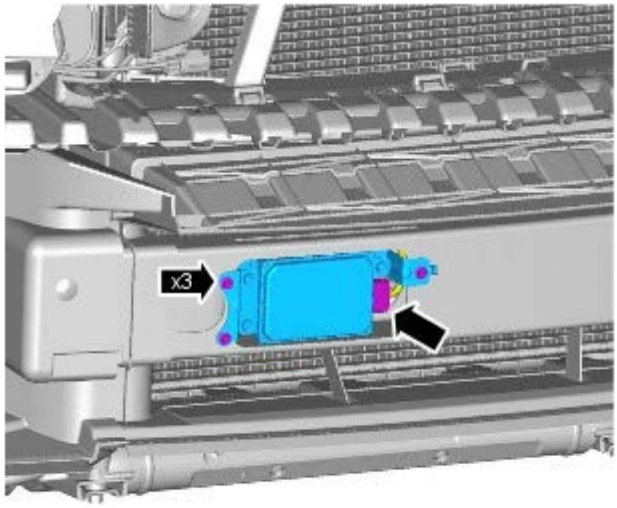
   Refer to: Specifications (414-00, Specifications).

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



E145878

Installation

1. To install, reverse the removal procedure.

2. Refer to: Speed Control Sensor Adjustment (310-03C Speed Control - V8 S/C 5.0L Petrol, General Procedures).

Published: 12-Sep-2012

Speed Control - TDV6 3.0L Diesel - Speed Control Switch

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

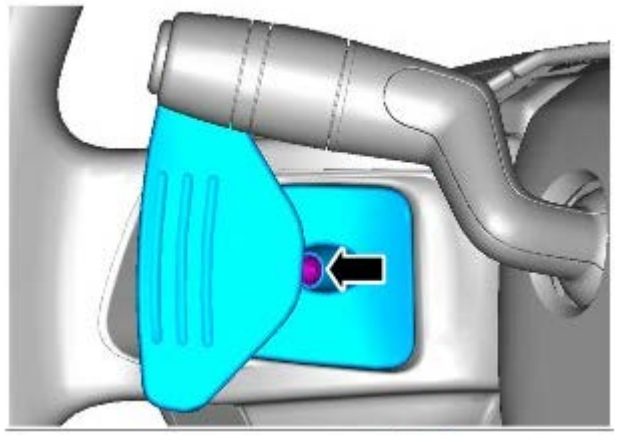
1. Make the air bag supplemental restraint system (SRS) safe.

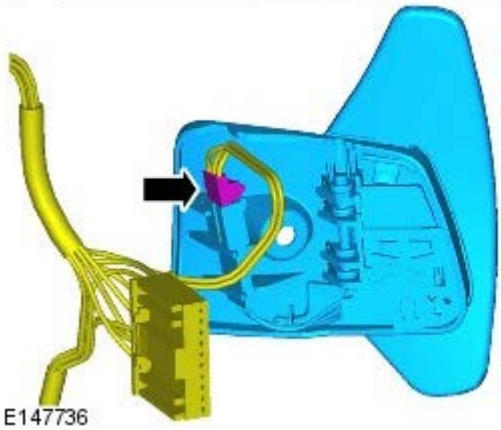
   Refer to: Standard Workshop Practices (100-00 General Information, Description and Operation).

2. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

3. Refer to: Driver Air Bag Module (501-20B Supplemental Restraint System, Removal and Installation).

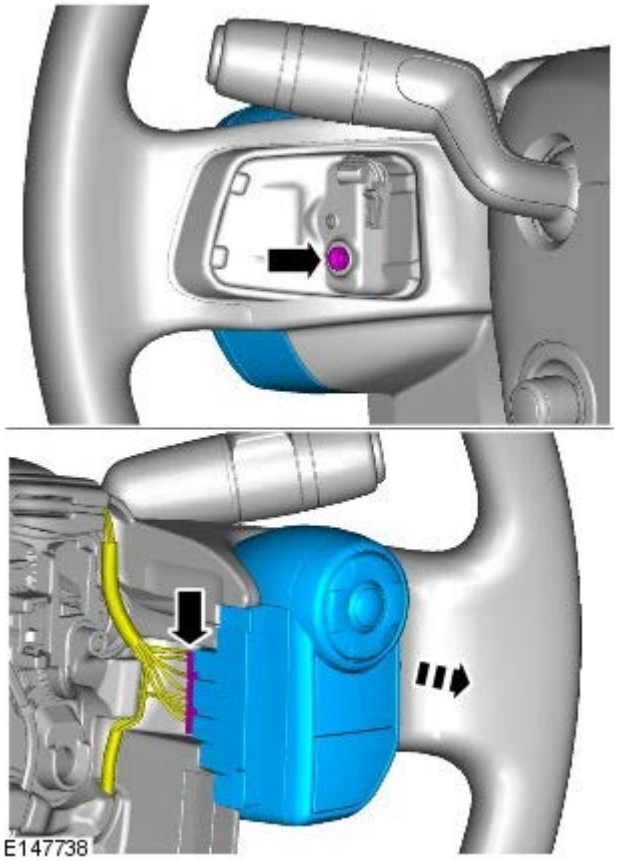




4. NOTE: Make sure that the harness is routed to the position noted on removal.

   Torque: 3 Nm

5. *Torque:* 3 Nm



Installation

1. To install, reverse the removal procedure.

Published: 11-Sep-2012

Speed Control - V6 S/C 3.0L Petrol -

Item	Specification
Speed control sensor assembly vertical alignment	90° ± 1.2°

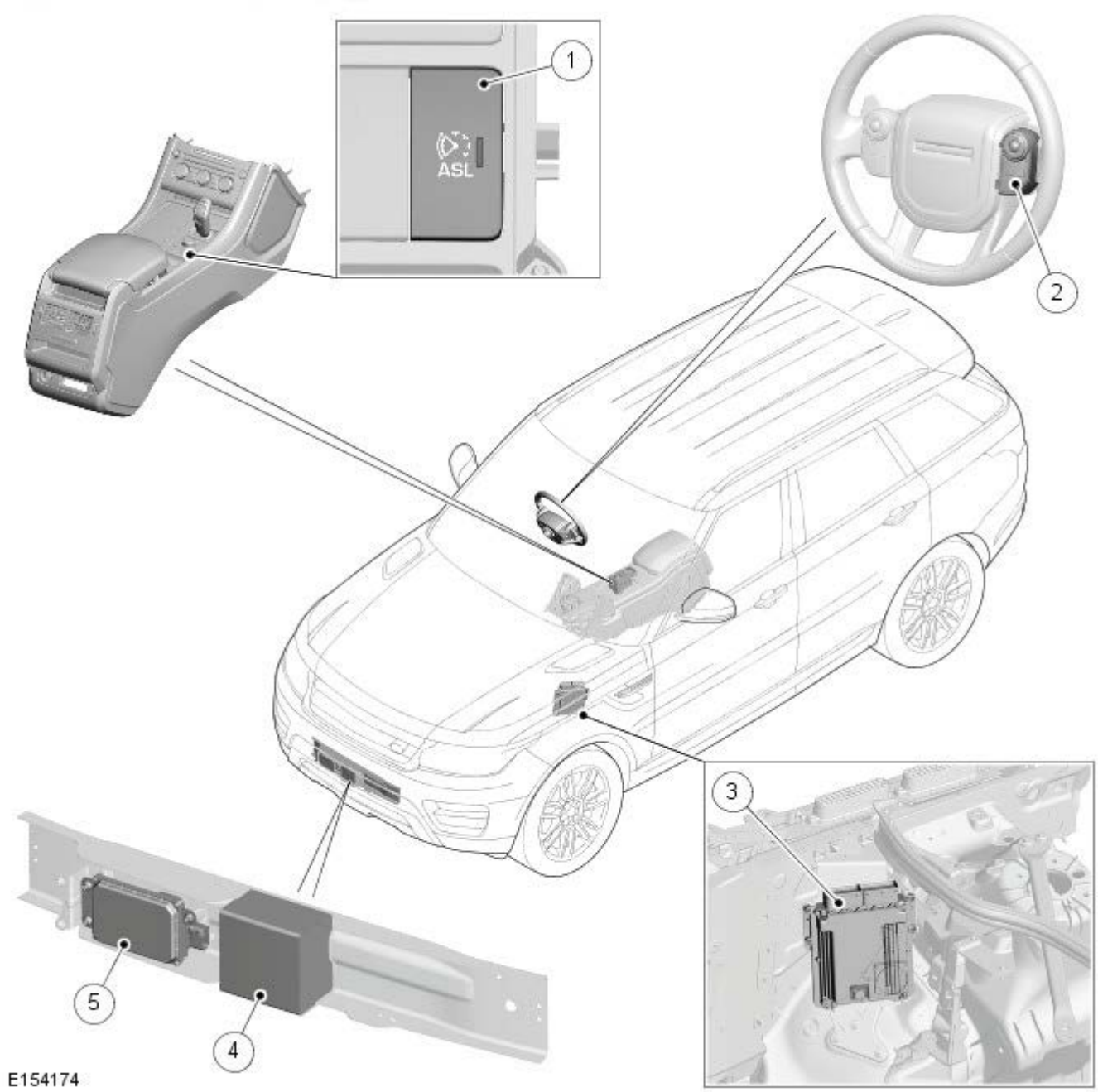
Description	Nm	lb-ft	lb-in
Speed control sensor assembly retaining bolts	9	-	7

Published: 31-Jul-2013

Speed Control - V6 S/C 3.0L Petrol - Speed Control

Description and Operation

COMPONENT LOCATION



Item	Part Number	Description
1	-	Automatic Speed Limiter (ASL) switch
2	-	Right steering wheel switchpack
3	-	Engine Control Module (ECM) (V8 S/C 5.0L petrol shown)
4	-	Foam block
5	-	Adaptive Speed Control Module (ASCM)

OVERVIEW

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. The adaptive system includes the same functionality as the standard system, and has the following additional functions:

- Follow Mode: Reduces vehicle speed, to less than the set speed, in order to maintain a selected distance behind a slower moving vehicle, then resumes the set speed once the way ahead is clear
- Queue Assist: Stops the vehicle a set distance behind the vehicle in front if it comes to a halt. When the vehicle in front moves away, a brief press of the accelerator pedal resumes adaptive speed control operation
- Forward Alert: Alerts the driver when rapidly approaching a slower moving vehicle
- Advanced Emergency Brake Assist: Partially applies the brakes in preparation for a sudden braking action, to

improve brake response
- Intelligent Emergency Braking: Applies the brakes to reduce the impact velocity if a collision is unavoidable.

The standard speed control system is controlled by the ECM (Engine Control Module) and switches on the right steering wheel switchpack. The adaptive speed control system is controlled by the ECM, the switches on the right steering wheel switchpack and the ASCM (Adaptive Speed Control Module). Both systems also use the:

- Brake pedal switch.
  For additional information, refer to: Braking Control System (206-11 Brake Controls, Description and Operation).
- APP (Accelerator Pedal Position) sensor. For additional information, refer to:
  Electronic Engine Controls (303-14A Electronic Engine Controls - TDV6 3.0L Diesel, Description and Operation),
  Electronic Engine Controls (303-14B Electronic Engine Controls - V6 S/C 3.0L Petrol, Description and Operation),
  Electronic Engine Controls (303-14C Electronic Engine Controls - V8 S/C 5.0L Petrol, Description and Operation),
  Electronic Engine Controls (303-14D Electronic Engine Controls - TDV8 4.4L Diesel, Description and Operation).
- ABS (Anti-lock brake system) control module.
  For additional information, refer to: Braking Control System (206-11 Brake Controls, Description and Operation).
- TCS (Transmission Control Switch).
  For additional information, refer to: External Controls (307-05A Automatic Transmission/Transaxle External Controls - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, Description and Operation).
- TCM (Transmission Control Module).
  For additional information, refer to: Transmission Description (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, Description and Operation).
- Terrain Response® switchpack.
  For additional information, refer to: Ride and Handling Optimization (204-06 Ride and Handling Optimization, Description and Operation).
- Instrument Cluster (IC). For additional information, refer to:
  Instrument Cluster (413-01 Instrument Cluster, Description and Operation),
  Information and Message Center (413-08 Information and Message Center, Description and Operation).

During speed control operation, the ECM controls vehicle speed by adjusting the engine throttle and fuel injection. The adaptive speed control system also uses the ASCM to scan the road ahead and, if necessary, signal the ABS control module to apply the brakes to slow the vehicle.

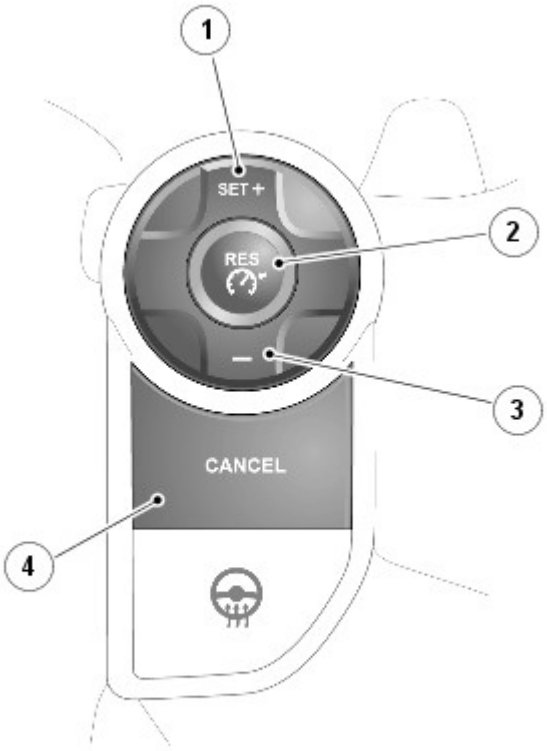
All vehicles also incorporate an ASL (Automatic Speed Limiter) system. When a speed has been set, the engine will respond normally up to the set speed. Further accelerator pressure will not increase the speed beyond the set speed unless sudden, rapid acceleration (kickdown) is applied. The ASL system is controlled by the ECM, the speed control switches on the right steering wheel switchpack and an ASL switch.

The ASL system and the speed control system cannot be used simultaneously. The system in use when the ignition is turned off is automatically enabled when the ignition is turned back on. However the speed settings are not remembered and will have to be set again.

DESCRIPTION

Standard Speed Control

SPEED CONTROL SWITCHES



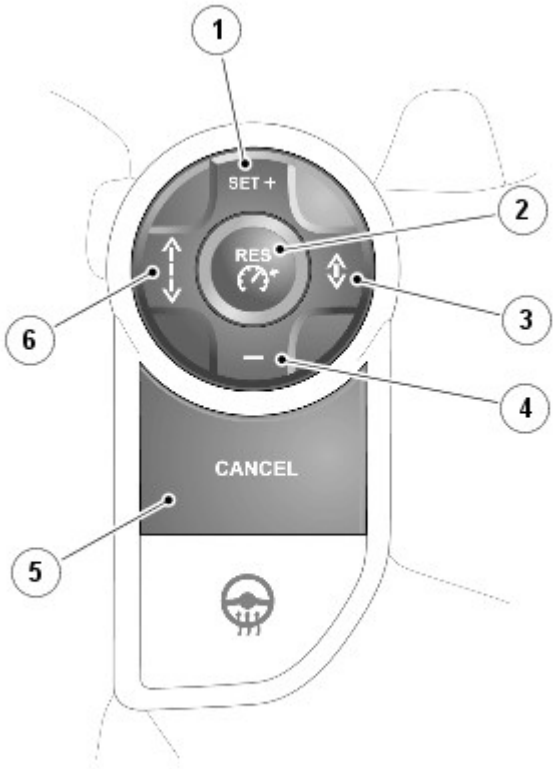
E147361

Item	Part Number	Description
1	-	Set + (engage/accelerate) switch
2	-	RES (resume) switch
3	-	- (decelerate) switch
4	-	CANCEL switch

The standard speed control switches are located on the right steering wheel switchpack. The switches are resistive ladder type switches which vary the resistance of a 5 volt signal sent to them. The resistive ladder is wired to a LIN (Local Interconnect Network) node which transmits the data to the CJB (Central Junction Box) via the clockspring. The CJB then transmits the data on the high speed CAN (Controller Area Network) Powertrain bus.

Adaptive Speed Control

SPEED CONTROL SWITCHES



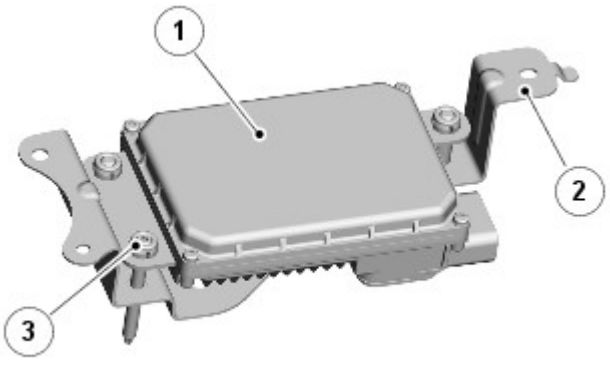
E147362

Item	Part Number	Description
1	-	Set + (engage/accelerate) switch
2	-	RES (resume) switch
3	-	Time gap decrease switch
4	-	- (decelerate) switch
5	-	CANCEL switch
6	-	Time gap increase switch

The adaptive speed control switches are the same as used for standard speed control, with the addition of two time gap switches. The time gap switches allow the driver to adjust the follow mode and forward alert functions to one of four pre-set time gaps (gap 1 = 1 second; gap 2 = 1.4 seconds; gap 3 = 1.8 seconds; gap 4 = 2.2 seconds). The selected time gap is displayed in the message center when the time gap switches are operated.

When adaptive speed control is engaged, the switches adjust the follow mode time gap. When adaptive speed control is disengaged, the switches adjust the forward alert time gap (provided forward alert is enabled in the instrument cluster menu). The follow mode function defaults to the gap 3 setting each time the ignition is switched on. The forward alert function recalls the last selected time gap when the ignition is switched on.

ADAPTIVE SPEED CONTROL MODULE



E148863

Item	Part Number	Description
1	-	Adaptive Speed Control Module (ASCM)
2	-	Mounting bracket
3	-	Adjuster screw

The ASCM is attached to a bracket located in the armature of the front bumper, to the right of the vehicle centerline. A foam block in the bumper armature eliminates radar signal reflections within the armature.

The ASCM contains a forward looking radar transceiver together with related controlling hardware and software. A high speed CAN Powertrain bus connection allows the ASCM to communicate with other system control modules. Power supplies to the ASCM are from the extended ignition relay in the RJB (Rear Junction Box) and the ignition relay in the EJB (Engine Junction Box).

The adaptive speed control module is active whenever the ignition is on, even if speed control is not engaged, in order to operate the forward alert, advanced emergency brake assist and intelligent emergency braking functions. With the ignition on, the adaptive speed control module is powered up but no radar transmissions are emitted until the vehicle is in motion.

The adaptive speed control module 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 control module detects the range, relative velocity and angle of objects within the scanned arc for up to a distance of approximately 130 meters (426.5 feet).

The ASCM compares vehicle speed data from the ABS control module with the relative speed of an external object as detected by the radar 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 module, 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.

The ASCM continuously monitors both moving vehicles and stationary objects to determine if it can 'see' normally. If the control module can detect only a few objects, because it is physically blocked (for example by an accumulation of snow or mud on the lower grill of the front bumper, or an incorrectly located number plate), or there are few roadside objects or other vehicles in the area, it may determine that it is blocked. The control module then inhibits adaptive speed control and records a DTC (Diagnostic Trouble Code). The system will reset after the ignition is cycled. In this case the control module is not faulty and should not be replaced.

If the ASCM is replaced in service it must be mechanically aligned vertically. Horizontal alignment is achieved by putting the control module into service mode using approved Land Rover diagnostic equipment. The vehicle then needs to be driven for a short period while the control module calibrates itself. Calibration is complete when the follow mode warning indicator in the instrument cluster stops flashing.For additional information, refer to:

Speed Control Sensor Adjustment (310-03B Speed Control - V6 S/C 3.0L Petrol, General Procedures),
Speed Control Sensor Adjustment (310-03B, General Procedures),
Speed Control Sensor Adjustment (310-03B Speed Control - V6 S/C 3.0L Petrol, General Procedures),
Speed Control Sensor Adjustment (310-03B Speed Control - V6 S/C 3.0L Petrol, General Procedures).

Automatic Speed Limiter

ASL SWITCH

The ASL switch is integrated into the Terrain Response® switchpack in the floor console. An amber LED (Light Emitting Diode) in the ASL switch remains illuminated while the ASL is selected on. Selection of the ASL switch is transmitted on high speed CAN Chassis bus from the Terrain Response® switchpack to the ECM through the GWM (Gateway Module), since the ECM is connected to the high speed CAN Powertrain bus.

Instrument Cluster Warning Indicators

SPEED CONTROL WARNING INDICATOR



E147363

The speed control warning indicator illuminates when standard or adaptive speed control is engaged.

FOLLOW MODE WARNING INDICATOR



E122343

The follow mode warning indicator illuminates when the adaptive speed control system is engaged and goes into follow mode. When the system is engaged, the time gap setting is displayed in the message center in the form of a vehicle with 1 to 4 bars in front of it, where the number of bars correspond to the current time gap setting.

FORWARD ALERT WARNING INDICATOR



E122344

The forward alert warning indicator illuminates if forward alert is enabled in the IC menu.

ASL WARNING INDICATOR



E147868

The speed control warning indicator illuminates when ASL is selected on and a speed limit is set in the message center.

OPERATION

For standard or adaptive speed control to engage, the vehicle must be in the following configuration:

- Transmission in D (drive)
- Transfer case in high range
- Terrain Response® in the general (special programs off) or grass/gravel/snow program
- HDC (Hill Descent Control) off
- ASL off
- Traveling at 20 mph (32 km/h) or more.

Standard Speed Control

ENGAGE SPEED CONTROL

Speed control is engaged by pressing the SET + switch. On receipt of the switch input, the ECM adopts the current vehicle speed as the speed control set speed. When speed control is engaged, the IC illuminates the speed control warning indicator and the set speed is displayed in the message center.

The set speed is cleared when the ignition is switched off or if the speed control system develops a fault.

SET SPEED ADJUSTMENT

Once engaged the set speed can be increased by one of 3 methods:

- Press and hold the SET + switch which will cause the vehicle to accelerate. When the switch is released the attained speed will be the new set speed.
- Repeatedly pressing the SET + switch. Each press increases the vehicle speed by 1 mph (2 km/h).
- Use the accelerator pedal to increase the vehicle speed. Once the required speed is reached, a single press of the SET + switch will set the cruise speed.

The set speed can be reduced by pressing and holding the decelerate - switch until the required speed is reached. When the switch is released the speed is reset at that value. The set speed can be reduced incrementally by pressing and releasing the decelerate - switch. Each press will reduce the speed by 1 mph (2 km/h).

Speed control adjustment is limited around the current vehicle speed. This means speed adjustment won't occur when resuming or if the vehicle speed is noticeably different to set speed. This is noticeable when resuming speed control and a large difference exists between the set speed and the current speed. The driver can set a new speed, but can't adjust the old speed.

SUSPENDING SPEED CONTROL

Suspending speed control means speed control has been deactivated without loss of the set speed. Speed control is suspended when one of the following occurs:

- Vehicle speed falls below 20 mph (32 km/h)
- The brake pedal is pressed
- The CANCEL switch is pressed
- N (neutral), R (reverse) or P (park) is selected on the TCS
- The EPB (Electric Park Brake) is applied
- If the accelerator pedal is used to accelerate beyond the set speed for too long (more than 5 minutes)
- Engine speed too high (cancel limit set just below red line)
- The ABS control module activates ETC (Electronic Traction Control) or DSC (Dynamic Stability Control)
- HDC is selected
- Terrain Response® adopts a special program other than grass/gravel/snow
- The transfer case is selected to low range.

RESUMING SPEED CONTROL

A single press of the RES switch will resume speed control at the memorized set speed.

Adaptive Speed Control

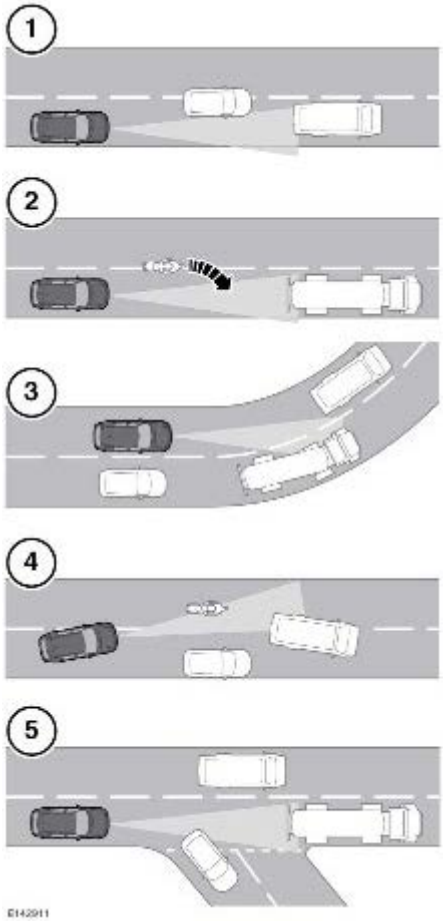
WARNING: Adaptive speed control system is not a collision warning or avoidance system. At all times the driver must be prepared to intervene to control the vehicle speed.

Adaptive speed control operation is similar to the standard speed control system for engaging, suspending and resuming speed control. The main differences between the two systems is that adaptive speed control remains engaged below 20 mph (32 km/h) and uses the brakes to slow the vehicle, to a halt if necessary.

If adaptive speed control is suspended by pressing the CANCEL switch or the brake pedal, it can be re-engaged by pressing the RES switch once vehicle speed is above 7 mph (11 km/h).

SYSTEM RESTRICTIONS

The adaptive speed control system is only intended to provide enhanced speed control in certain restricted conditions. 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.



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.
4. Moving around a stationary vehicle may cause uncertainty as to which vehicle is being followed.
5. A vehicle in front moving out of your lane may cause uncertainty as to which vehicle is being followed.

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 adaptive speed control module. 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.

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, the system identifies it as a target vehicle. To indicate that the system is in follow mode, the follow mode warning indicator illuminates. When the distance between the two vehicles closes to the set time gap, the adaptive speed control system reduces engine speed and, if necessary, applies the brakes to maintain the set time gap.

Automatic braking is limited to approximately 30% of full pressure (0.3 G deceleration) and is intended to provide a smooth, gradual deceleration in follow mode conditions.

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 extinguishes the follow mode warning indicator. The adaptive speed control system then increases vehicle speed back to the original set speed.

QUEUE ASSIST

When adaptive speed control is engaged, if the target vehicle comes to a halt the ASCM reduces engine speed and applies the brakes to halt the sensing vehicle and suspends speed control operation. The control module also applies the EPB if one of the following occurs:

- Adaptive speed control is disengaged with the CANCEL switch
- The vehicle is stationary for more than 2 minutes
- Driver exit is detected (assumed if the driver seatbelt is unbuckled and the driver door is opened)
- A system fault is detected.

When the target vehicle moves away, pressing the accelerator pedal for a minimum of 0.5 second resumes speed control operation. The sensing vehicle then follows the target vehicle in follow mode or until it stops again, or, if it can no longer detect a target, accelerates back up to the set speed.

FORWARD ALERT

If an object is detected close ahead, a warning tone will be emitted and a message will be displayed. The brakes will not be applied.

The forward alert system is active when the warning indicator in the instrument cluster is illuminated. Forward alert does not initiate any action, the driver must take the appropriate action when the message is displayed. The system monitors driver intervention and may not issue the warning if the driver has taken the appropriate action (braking, steering or indicating) early enough.

The sensitivity of the warning can be changed using the gap increase and decrease switches when the adaptive cruise control is not engaged. Confirmation of the gap change is given in the message center.

Forward alert can be switched on or off using the instrument cluster menu.

ADVANCED EMERGENCY BRAKE ASSIST

Advanced EBA (Emergency Brake Assist) improves braking response during emergency braking, and is an enhancement of the electronic brake prefill and emergency brake assist functions controlled by the ABS control module.
For additional information, refer to: Braking Control System (206-11 Brake Controls, Description and Operation).

With advanced EBA, if the risk of a collision increases after the vehicle passes the forward alert activation threshold, the ASCM signals the ABS control module to activate the electronic brake prefill and emergency brake assist functions. With advanced EBA, the electronic brake prefill function operates in two stages:

- Stage 1:
  - Applies a brake pressure of approximately 3 bar (43.5 lbf/in²) to all of the brakes
  - Lowers the EBA activation threshold in the ABS control module
  - Signals the CJB on the high speed CAN bus to activate the stop lamps
- Stage 2 increases the brake pressure to approximately 10 bar (145 lbf/in²).

Stage 1 is activated if the collision risk increases to a level considered as credible, with the accelerator pedal pressed. Stage 2 is activated when the accelerator pedal is released during an imminent risk of collision. If the accelerator pedal has already been released when the collision risk increased to the credible level, the two stages of electronic brake prefill are activated simultaneously, to give an immediate brake pressure of 10 bar (145 lbf/in²).

While the second stage of electronic brake prefill is active, if the brake pedal is then pressed quickly, the ABS control module activates EBA, even if only light pressure is applied to the pedal.

Advanced EBA is available at vehicle speeds 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 related message is displayed in the message center. Advanced EBA will not be available until the fault is rectified.

INTELLIGENT EMERGENCY BRAKING

Intelligent emergency braking reduces the impact velocity if the adaptive speed control module determines that a collision is unavoidable, even with driver intervention. It is not designed to prevent accidents from occurring. Typical activation of intelligent emergency braking is approximately 0.8 second before impact. During this 0.8 second period the speed of the sensing vehicle is reduced, thus reducing the impact energy.

If the ASCM determines a collision is unavoidable, it signals the ABS control module to apply emergency brake pressure to all of the brakes. On vehicles without active safety belts, emergency brake pressure is 50 bar (725 lbf/in²) maximum. On vehicles with active safety belts, emergency brake pressure is 100 bar (1450 lbf/in²) maximum.

When intelligent emergency braking is initiated the ASCM also signals the RCM (Restraints Control Module) to fire the front seatbelt retractors.
For additional information, refer to: Safety Belt System (501-20A Safety Belt System, Description and Operation).

After the intelligent emergency braking function has activated, it is then disabled, as the vehicle is assumed to be damaged. After the vehicle has been repaired, the intelligent emergency braking function can be re-enabled using Land Rover approved diagnostic equipment.

The intelligent emergency braking function operates at vehicle speeds down to zero, and will function even when forward

alert and adaptive cruise control are switched off.

If the intelligent emergency braking feature is disabled for any reason, a related message is displayed in the message center.

Automatic Speed Limiter

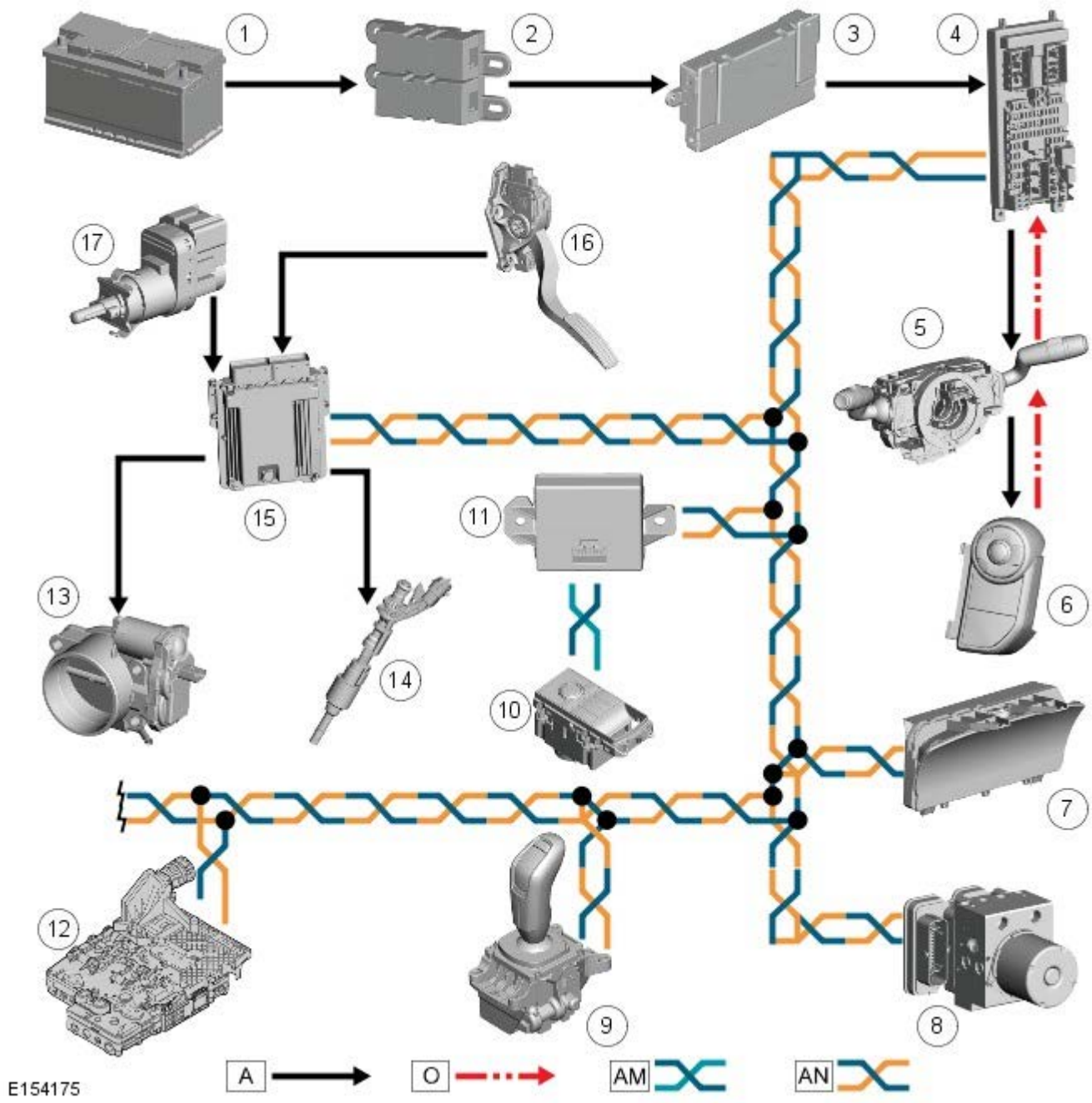
With the ASL switch selected on, the ASL system can be operated in a similar manner to the cruise control system. A speed limit between 18 and 150 mph (30 and 240 km/h) can be set, with the vehicle stationary or moving, using the speed control SET + and - switches (in ASL operation, the SET + and the - switches change the set speed limit in steps of 5 mph (8 km/h), instead of the 1 mph (2 km/h) steps of the cruise control system). The ASL warning indicator illuminates and the set speed limit is displayed in the message center.

If the vehicle reaches the set speed limit, the ECM intervenes to govern vehicle speed at the set speed limit.

NOTE: In certain conditions, such as a steep downhill gradient, the vehicle speed may exceed the set speed limit. This is because engine braking is unable to maintain or reduce the vehicle speed.

The ASL can be disengaged and re-engaged using the speed control CANCEL and RES switches respectively. ASL also disengages if kickdown is used on the accelerator pedal. Pressing the ASL switch cancels ASL operation and the speed limit will need to be reset the next time the switch is selected on.

Control Diagram - Standard Speed Control

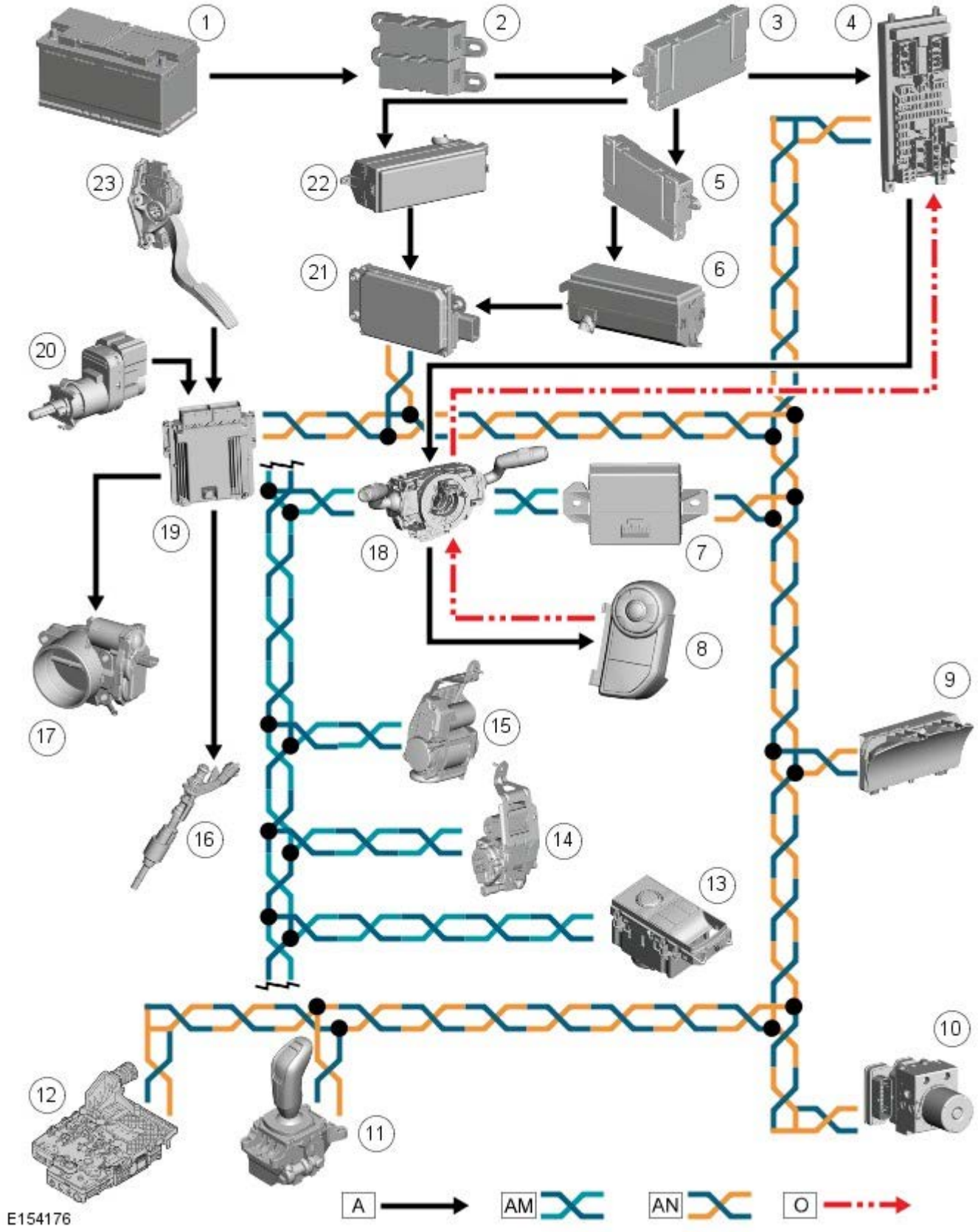


A = Hardwired, O = LIN (Local Interconnect Network) bus, AM = High speed CAN (Controller Area Network) Chassis bus, AN = High speed CAN Powertrain bus.

Item	Part Number	Description

1	-	Battery
2	-	Battery Junction Box 2 (BJB2)
3	-	Battery Junction Box (BJB)
4	-	Central Junction Box (CJB)
5	-	Clockspring
6	-	Right steering wheel switchpack
7	-	Instrument Cluster (IC)
8	-	Anti-lock Brake System (ABS) control module
9	-	Transmission Control Switch (TCS)
10	-	Terrain Response® switchpack
11	-	Gateway Module (GWM)
12	-	Transmission Control Module (TCM)
13	-	Electric throttle
14	-	Fuel injectors
15	-	Engine Control Module (ECM)
16	-	Accelerator Pedal Position (APP) sensor
17	-	Brake pedal switch

Control Diagram - Adaptive Speed Control



A = Hardwired, O = LIN (Local Interconnect Network) bus, AM = High speed CAN (Controller Area NetworkO Chassis bus, AN = High speed CAN Powertrain bus.

Item	Part Number	Description
1	-	Battery
2	-	Battery Junction Box 2 (BJB2)
3	-	Battery Junction Box (BJB)
4	-	Central Junction Box (CJB)
5	-	Auxiliary Junction Box (AJB)
6	-	Engine Junction Box (EJB)
7	-	Gateway Module (GWM)
8	-	Right steering wheel switchpack

9	-	Instrument Cluster (IC)
10	-	Anti-lock Brake System (ABS) control module
11	-	Transmission Control Switch (TCS)
12	-	Transmission Control Module (TCM)
13	-	Terrain Response® switchpack
14	-	Left active seatbelt retractor
15	-	Right active seatbelt retractor
16	-	Fuel injectors
17	-	Electric throttle
18	-	Clockspring and steering angle sensor
19	-	Engine Control Module (ECM)
20	-	Brake pedal switch
21	-	Adaptive Speed Control Module (ASCM)
22	-	Rear Junction Box (RJB)
23	-	Accelerator Pedal Position (APP) sensor

Published: 02-May-2013

Speed Control - V6 S/C 3.0L Petrol - Speed Control

Diagnosis and Testing

Principles of Operation

For a detailed description of the speed control system, refer to the relevant description and operation sections in the workshop manual. REFER to:

Speed Control (310-03A Speed Control - TDV6 3.0L Diesel, Description and Operation),
Speed Control - V6 S/C 3.0L Petrol (310-03B, Description and Operation),
Speed Control - V6 S/C 3.0L Petrol (310-03B, 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 damage and system integrity

Visual Inspection

Mechanical	Electrical
• Ensure the speed control sensor is free from obstructions • Adaptive speed control module • Brake switch • Visibly damaged or worn components	• Fuse(s) • Damage to wiring loom, incorrect location of wiring, wiring stretched or taught • Loose or corroded electrical connector(s) • Steering wheel switches • Brake switch • Adaptive speed 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 DTCs and refer to the DTCs 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 speed control sensor for correct vertical alignment, and carry out speed control sensor alignment procedure using manufacturer approved diagnostic system

Symptom Chart

Symptom	Possible Cause	Action
Speed control inhibited or disabled	• Power or ground supply to adaptive speed control module • Steering wheel speed control switch/circuits • Throttle sensors • Brake switch • ABS fault • Speed control sensor obstructed	• Check for DTCs that could be caused by power or ground failure to the module and refer to DTC index • Check for sticking, jammed and broken speed control switches. Refer to the electrical circuit diagrams and check speed control switch circuits for short circuit, open circuit, high resistance • Check for engine throttle position sensor DTCs and refer to the relevant DTC index. For throttle position sensor tests REFER to: Electronic Engine Controls (303-14B Electronic Engine Controls - V6 S/C 3.0L Petrol, Diagnosis and Testing). • Check for correct installation and adjustment of brake switch. Refer to the electrical circuit diagrams and check brake switch circuits for short circuit, open circuit, high resistance • Check ABS system for related DTCs and refer to the relevant DTC index • Make sure there is no snow, ice or other obstruction on the fascia in front of the speed control radar. Adaptive cruise control will not engage until the radar has detected valid target(s)
Unable to regulate/adjust vehicle speed	• Steering wheel switch malfunction	• Check for sticking, jammed and broken speed control switches. Refer to the electrical circuit diagrams and check speed control switch circuits for short circuit, open circuit, high resistance
Unable to cancel speed control from steering wheel	• Steering wheel switch malfunction	• Check for sticking, jammed and broken speed control switches. Refer to the electrical circuit diagrams and check speed control switch circuits for short circuit, open circuit, high resistance
Unable to cancel speed control from brake pedal	• Brake switch malfunction	• Check for correct installation and adjustment of brake switch. Refer to the electrical circuit diagrams and check brake switch circuits for short, open circuit, high resistance

For a list of DTCs that could be logged on this vehicle, please refer to Section 100-00. REFER to: (100-00 General Information)

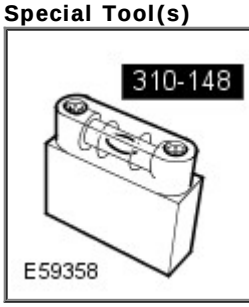
Diagnostic Trouble Code (DTC) Index - DTC: Adaptive Speed Control Module (ASCM) (Description and Operation), Diagnostic Trouble Code (DTC) Index - V8 S/C 5.0L Petrol, DTC: Engine Control Module (ECM) (Description and Operation).

Published: 02-Aug-2012

Speed Control - V6 S/C 3.0L Petrol - Speed Control Sensor Adjustment

General Procedures

Special Tool(s)

	310-148 Setting Tool, Speed Control

NOTES:

Special tool 310-148 is graduated in 0.5 degree increments.

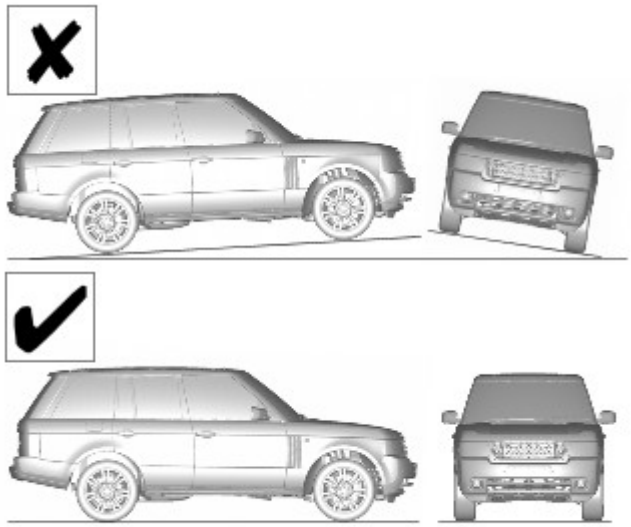
Removal steps in this procedure may contain installation details.

This procedure details how to adjust the speed control sensor vertically. There is no horizontal adjustment required.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Refer to: Front Bumper Cover (501-19, Removal and Installation).



E122311

3. NOTE: Make sure that the vehicle is standing on a level surface.

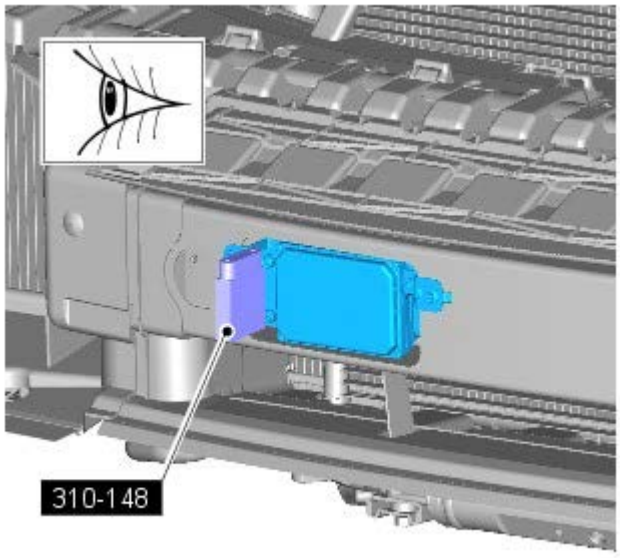
   Set the air suspension ride height to the STANDARD setting.

4. NOTES:

   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.

   If necessary, adjust the level of radar with the torx screw until the level gauge indicates that the radar is level.

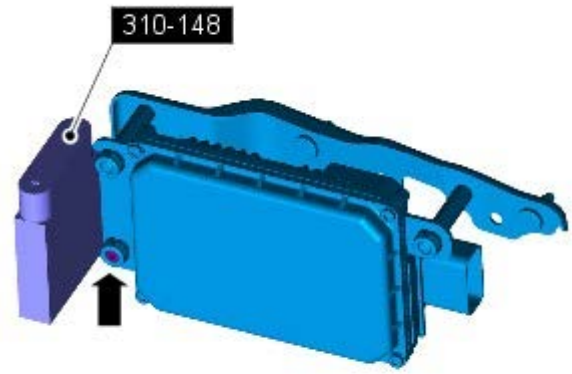
   Special Tool(s): 310-148



E146024

5. NOTE: The speed sensor has no mechanical horizontal adjustment.

   Special Tool(s): 310-148



E132168

6.

- From the diagnostic tool menu, select: Service Alignment Mode.
- The follow indicator will now be flashing, this indicates that the vehicle is in "service alignment" and now requires driving.
- The vehicle speed must be above 30 mph (48 kph).
- Choose a road with plenty of stationary objects, like street lights, road signs, or barriers. Use an inside or outside lane.
- Following vehicles too closely will obscure the stationary targets from the radar, a time gap of 2 seconds is recommended.
- A straight road will produce a quicker and better result, although the process will still operate on a curved road.
- When the flashing follow indicator light extinguishes, the ACC system is now functional, and a required vehicle speed can now be set by the driver and the ACC system will operate as normal.

Published: 12-Sep-2012

Speed Control - V6 S/C 3.0L 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 Exterior Lighting, Removal and Installation).

Installation

1. To install, reverse the removal procedure.

Published: 08-Aug-2012

Speed Control - V6 S/C 3.0L Petrol - Speed Control Sensor

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

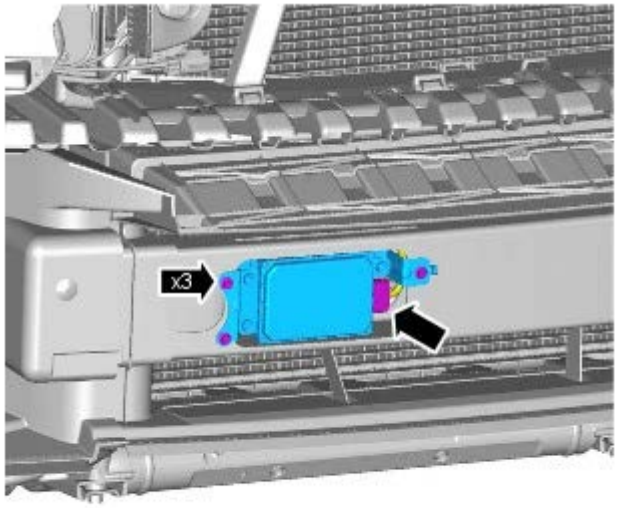
   Refer to: Specifications (414-00, Specifications).

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



E145878

Installation

1. To install, reverse the removal procedure.

2. Refer to: Speed Control Sensor Adjustment (310-03C Speed Control - V8 S/C 5.0L Petrol, General Procedures).

Published: 12-Sep-2012

Speed Control - V6 S/C 3.0L Petrol - Speed Control Switch

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

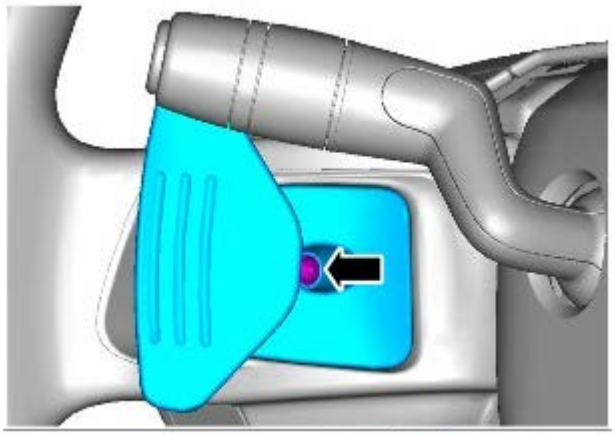
1. Make the air bag supplemental restraint system (SRS) safe.

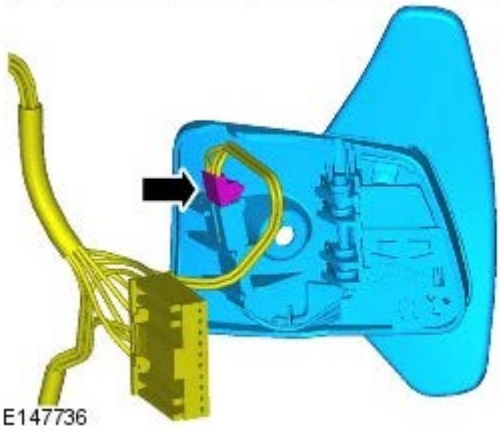
   Refer to: Standard Workshop Practices (100-00 General Information, Description and Operation).

2. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

3. Refer to: Driver Air Bag Module (501-20B Supplemental Restraint System, Removal and Installation).

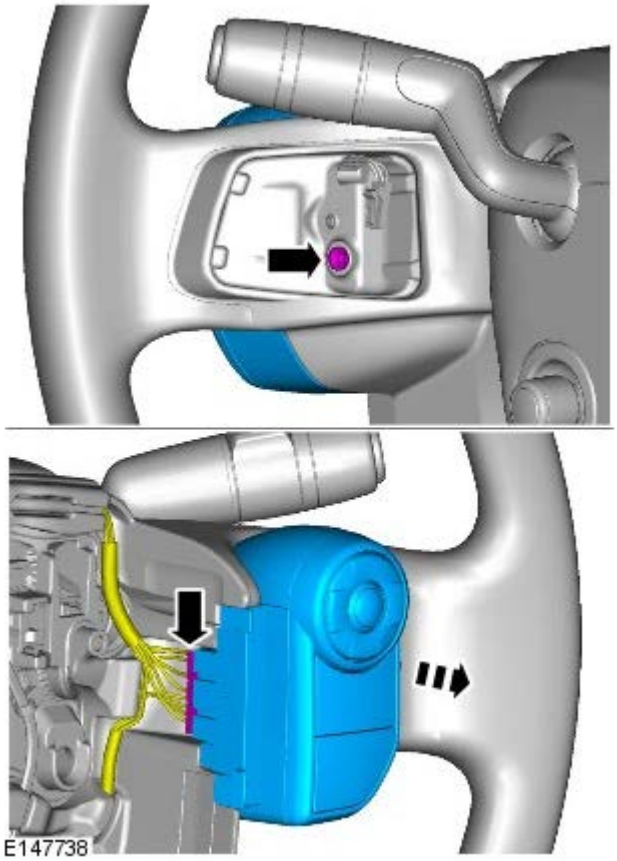




4. NOTE: Make sure that the harness is routed to the position noted on removal.

   Torque: 3 Nm

5. *Torque:* 3 Nm



Installation

1. To install, reverse the removal procedure.

Published: 11-Sep-2012

Speed Control - V8 S/C 5.0L Petrol -

Item	Specification
Speed control sensor assembly vertical alignment	90° ± 1.2°

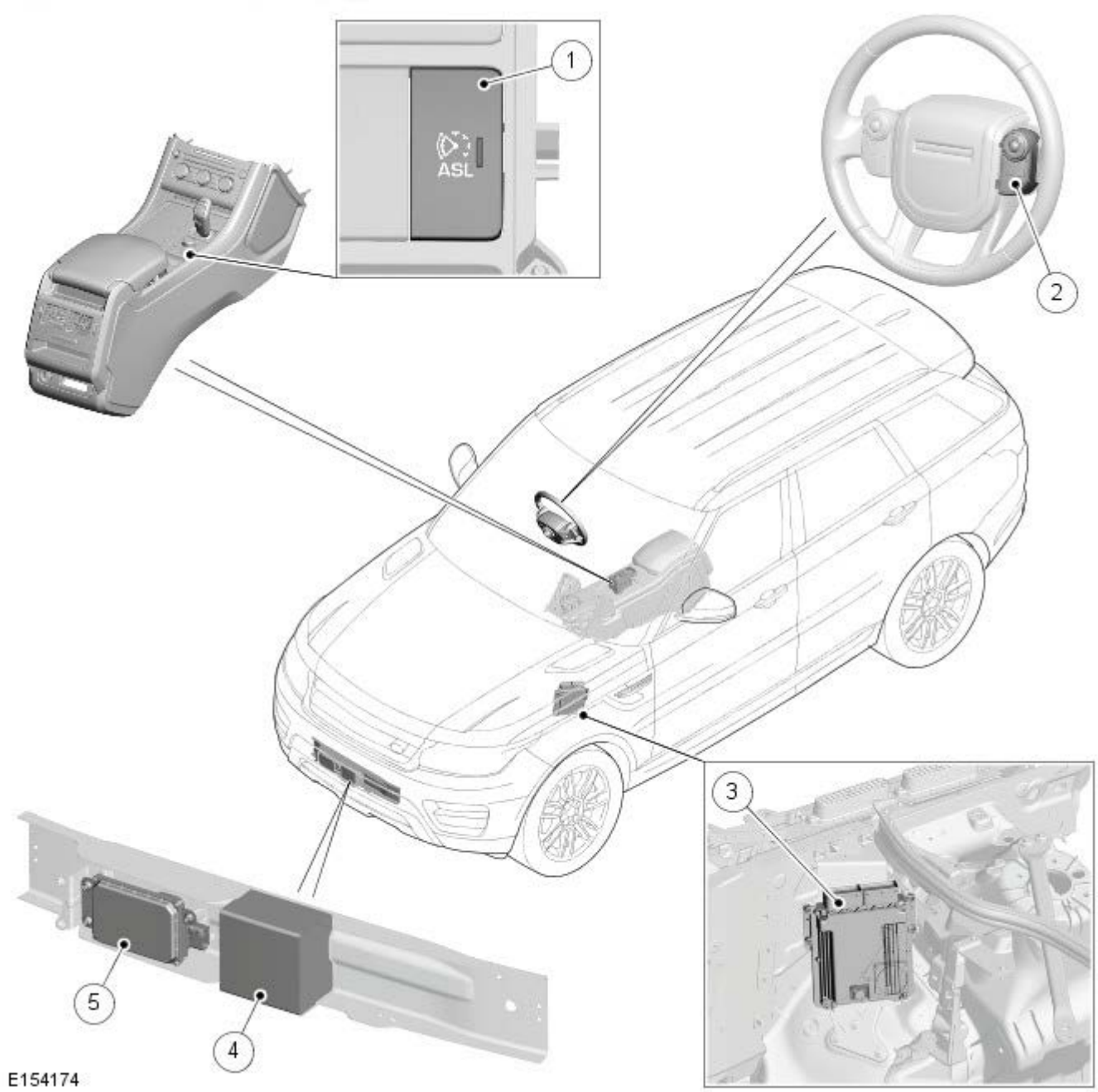
Description	Nm	lb-ft	lb-in
Speed control sensor assembly retaining bolts	9	-	7

Published: 31-Jul-2013

Speed Control - V8 S/C 5.0L Petrol - Speed Control

Description and Operation

COMPONENT LOCATION



Item	Part Number	Description
1	-	Automatic Speed Limiter (ASL) switch
2	-	Right steering wheel switchpack
3	-	Engine Control Module (ECM) (V8 S/C 5.0L petrol shown)
4	-	Foam block
5	-	Adaptive Speed Control Module (ASCM)

OVERVIEW

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. The adaptive system includes the same functionality as the standard system, and has the following additional functions:

- Follow Mode: Reduces vehicle speed, to less than the set speed, in order to maintain a selected distance behind a slower moving vehicle, then resumes the set speed once the way ahead is clear
- Queue Assist: Stops the vehicle a set distance behind the vehicle in front if it comes to a halt. When the vehicle in front moves away, a brief press of the accelerator pedal resumes adaptive speed control operation
- Forward Alert: Alerts the driver when rapidly approaching a slower moving vehicle
- Advanced Emergency Brake Assist: Partially applies the brakes in preparation for a sudden braking action, to

improve brake response
- Intelligent Emergency Braking: Applies the brakes to reduce the impact velocity if a collision is unavoidable.

The standard speed control system is controlled by the ECM (Engine Control Module) and switches on the right steering wheel switchpack. The adaptive speed control system is controlled by the ECM, the switches on the right steering wheel switchpack and the ASCM (Adaptive Speed Control Module). Both systems also use the:

- Brake pedal switch.
  For additional information, refer to: Braking Control System (206-11 Brake Controls, Description and Operation).
- APP (Accelerator Pedal Position) sensor. For additional information, refer to:
  Electronic Engine Controls (303-14A Electronic Engine Controls - TDV6 3.0L Diesel, Description and Operation),
  Electronic Engine Controls (303-14B Electronic Engine Controls - V6 S/C 3.0L Petrol, Description and Operation),
  Electronic Engine Controls (303-14C Electronic Engine Controls - V8 S/C 5.0L Petrol, Description and Operation),
  Electronic Engine Controls (303-14D Electronic Engine Controls - TDV8 4.4L Diesel, Description and Operation).
- ABS (Anti-lock brake system) control module.
  For additional information, refer to: Braking Control System (206-11 Brake Controls, Description and Operation).
- TCS (Transmission Control Switch).
  For additional information, refer to: External Controls (307-05A Automatic Transmission/Transaxle External Controls - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, Description and Operation).
- TCM (Transmission Control Module).
  For additional information, refer to: Transmission Description (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, Description and Operation).
- Terrain Response® switchpack.
  For additional information, refer to: Ride and Handling Optimization (204-06 Ride and Handling Optimization, Description and Operation).
- Instrument Cluster (IC). For additional information, refer to:
  Instrument Cluster (413-01 Instrument Cluster, Description and Operation),
  Information and Message Center (413-08 Information and Message Center, Description and Operation).

During speed control operation, the ECM controls vehicle speed by adjusting the engine throttle and fuel injection. The adaptive speed control system also uses the ASCM to scan the road ahead and, if necessary, signal the ABS control module to apply the brakes to slow the vehicle.

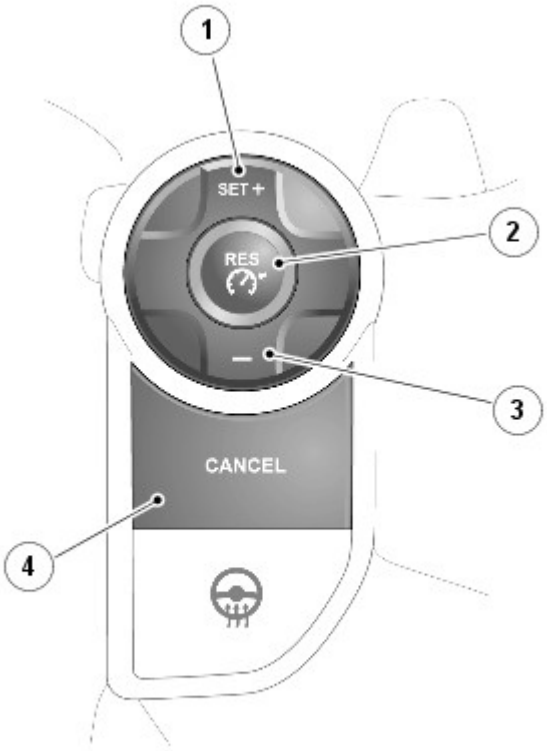
All vehicles also incorporate an ASL (Automatic Speed Limiter) system. When a speed has been set, the engine will respond normally up to the set speed. Further accelerator pressure will not increase the speed beyond the set speed unless sudden, rapid acceleration (kickdown) is applied. The ASL system is controlled by the ECM, the speed control switches on the right steering wheel switchpack and an ASL switch.

The ASL system and the speed control system cannot be used simultaneously. The system in use when the ignition is turned off is automatically enabled when the ignition is turned back on. However the speed settings are not remembered and will have to be set again.

DESCRIPTION

Standard Speed Control

SPEED CONTROL SWITCHES



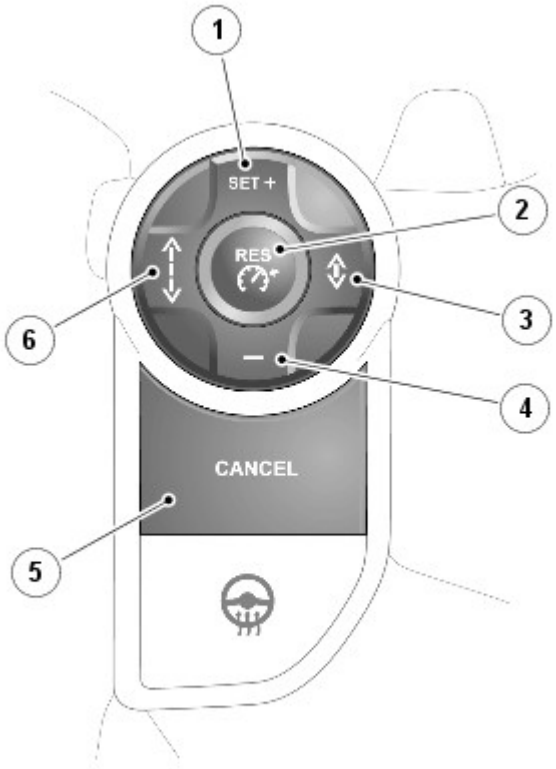
E147361

Item	Part Number	Description
1	-	Set + (engage/accelerate) switch
2	-	RES (resume) switch
3	-	- (decelerate) switch
4	-	CANCEL switch

The standard speed control switches are located on the right steering wheel switchpack. The switches are resistive ladder type switches which vary the resistance of a 5 volt signal sent to them. The resistive ladder is wired to a LIN (Local Interconnect Network) node which transmits the data to the CJB (Central Junction Box) via the clockspring. The CJB then transmits the data on the high speed CAN (Controller Area Network) Powertrain bus.

Adaptive Speed Control

SPEED CONTROL SWITCHES



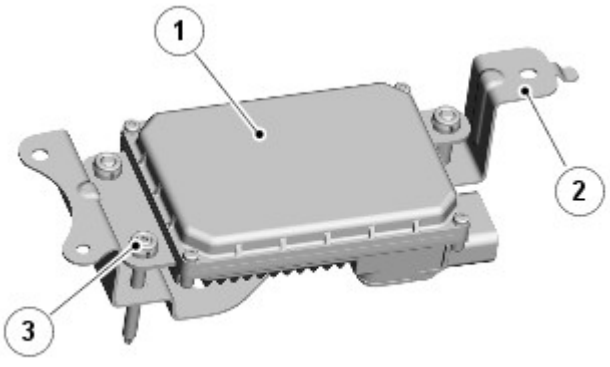
E147362

Item	Part Number	Description
1	-	Set + (engage/accelerate) switch
2	-	RES (resume) switch
3	-	Time gap decrease switch
4	-	- (decelerate) switch
5	-	CANCEL switch
6	-	Time gap increase switch

The adaptive speed control switches are the same as used for standard speed control, with the addition of two time gap switches. The time gap switches allow the driver to adjust the follow mode and forward alert functions to one of four pre-set time gaps (gap 1 = 1 second; gap 2 = 1.4 seconds; gap 3 = 1.8 seconds; gap 4 = 2.2 seconds). The selected time gap is displayed in the message center when the time gap switches are operated.

When adaptive speed control is engaged, the switches adjust the follow mode time gap. When adaptive speed control is disengaged, the switches adjust the forward alert time gap (provided forward alert is enabled in the instrument cluster menu). The follow mode function defaults to the gap 3 setting each time the ignition is switched on. The forward alert function recalls the last selected time gap when the ignition is switched on.

ADAPTIVE SPEED CONTROL MODULE



E148863

Item	Part Number	Description
1	-	Adaptive Speed Control Module (ASCM)
2	-	Mounting bracket
3	-	Adjuster screw

The ASCM is attached to a bracket located in the armature of the front bumper, to the right of the vehicle centerline. A foam block in the bumper armature eliminates radar signal reflections within the armature.

The ASCM contains a forward looking radar transceiver together with related controlling hardware and software. A high speed CAN Powertrain bus connection allows the ASCM to communicate with other system control modules. Power supplies to the ASCM are from the extended ignition relay in the RJB (Rear Junction Box) and the ignition relay in the EJB (Engine Junction Box).

The adaptive speed control module is active whenever the ignition is on, even if speed control is not engaged, in order to operate the forward alert, advanced emergency brake assist and intelligent emergency braking functions. With the ignition on, the adaptive speed control module is powered up but no radar transmissions are emitted until the vehicle is in motion.

The adaptive speed control module 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 control module detects the range, relative velocity and angle of objects within the scanned arc for up to a distance of approximately 130 meters (426.5 feet).

The ASCM compares vehicle speed data from the ABS control module with the relative speed of an external object as detected by the radar 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 module, 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.

The ASCM continuously monitors both moving vehicles and stationary objects to determine if it can 'see' normally. If the control module can detect only a few objects, because it is physically blocked (for example by an accumulation of snow or mud on the lower grill of the front bumper, or an incorrectly located number plate), or there are few roadside objects or other vehicles in the area, it may determine that it is blocked. The control module then inhibits adaptive speed control and records a DTC (Diagnostic Trouble Code). The system will reset after the ignition is cycled. In this case the control module is not faulty and should not be replaced.

If the ASCM is replaced in service it must be mechanically aligned vertically. Horizontal alignment is achieved by putting the control module into service mode using approved Land Rover diagnostic equipment. The vehicle then needs to be driven for a short period while the control module calibrates itself. Calibration is complete when the follow mode warning indicator in the instrument cluster stops flashing.For additional information, refer to:

Speed Control Sensor Adjustment (310-03B Speed Control - V6 S/C 3.0L Petrol, General Procedures),
Speed Control Sensor Adjustment (310-03B, General Procedures),
Speed Control Sensor Adjustment (310-03B Speed Control - V6 S/C 3.0L Petrol, General Procedures),
Speed Control Sensor Adjustment (310-03B Speed Control - V6 S/C 3.0L Petrol, General Procedures).

Automatic Speed Limiter

ASL SWITCH

The ASL switch is integrated into the Terrain Response® switchpack in the floor console. An amber LED (Light Emitting Diode) in the ASL switch remains illuminated while the ASL is selected on. Selection of the ASL switch is transmitted on high speed CAN Chassis bus from the Terrain Response® switchpack to the ECM through the GWM (Gateway Module), since the ECM is connected to the high speed CAN Powertrain bus.

Instrument Cluster Warning Indicators

SPEED CONTROL WARNING INDICATOR



E147363

The speed control warning indicator illuminates when standard or adaptive speed control is engaged.

FOLLOW MODE WARNING INDICATOR



E122343

The follow mode warning indicator illuminates when the adaptive speed control system is engaged and goes into follow mode. When the system is engaged, the time gap setting is displayed in the message center in the form of a vehicle with 1 to 4 bars in front of it, where the number of bars correspond to the current time gap setting.

FORWARD ALERT WARNING INDICATOR



E122344

The forward alert warning indicator illuminates if forward alert is enabled in the IC menu.

ASL WARNING INDICATOR



E147868

The speed control warning indicator illuminates when ASL is selected on and a speed limit is set in the message center.

OPERATION

For standard or adaptive speed control to engage, the vehicle must be in the following configuration:

- Transmission in D (drive)
- Transfer case in high range
- Terrain Response® in the general (special programs off) or grass/gravel/snow program
- HDC (Hill Descent Control) off
- ASL off
- Traveling at 20 mph (32 km/h) or more.

Standard Speed Control

ENGAGE SPEED CONTROL

Speed control is engaged by pressing the SET + switch. On receipt of the switch input, the ECM adopts the current vehicle speed as the speed control set speed. When speed control is engaged, the IC illuminates the speed control warning indicator and the set speed is displayed in the message center.

The set speed is cleared when the ignition is switched off or if the speed control system develops a fault.

SET SPEED ADJUSTMENT

Once engaged the set speed can be increased by one of 3 methods:

- Press and hold the SET + switch which will cause the vehicle to accelerate. When the switch is released the attained speed will be the new set speed.
- Repeatedly pressing the SET + switch. Each press increases the vehicle speed by 1 mph (2 km/h).
- Use the accelerator pedal to increase the vehicle speed. Once the required speed is reached, a single press of the SET + switch will set the cruise speed.

The set speed can be reduced by pressing and holding the decelerate - switch until the required speed is reached. When the switch is released the speed is reset at that value. The set speed can be reduced incrementally by pressing and releasing the decelerate - switch. Each press will reduce the speed by 1 mph (2 km/h).

Speed control adjustment is limited around the current vehicle speed. This means speed adjustment won't occur when resuming or if the vehicle speed is noticeably different to set speed. This is noticeable when resuming speed control and a large difference exists between the set speed and the current speed. The driver can set a new speed, but can't adjust the old speed.

SUSPENDING SPEED CONTROL

Suspending speed control means speed control has been deactivated without loss of the set speed. Speed control is suspended when one of the following occurs:

- Vehicle speed falls below 20 mph (32 km/h)
- The brake pedal is pressed
- The CANCEL switch is pressed
- N (neutral), R (reverse) or P (park) is selected on the TCS
- The EPB (Electric Park Brake) is applied
- If the accelerator pedal is used to accelerate beyond the set speed for too long (more than 5 minutes)
- Engine speed too high (cancel limit set just below red line)
- The ABS control module activates ETC (Electronic Traction Control) or DSC (Dynamic Stability Control)
- HDC is selected
- Terrain Response® adopts a special program other than grass/gravel/snow
- The transfer case is selected to low range.

RESUMING SPEED CONTROL

A single press of the RES switch will resume speed control at the memorized set speed.

Adaptive Speed Control

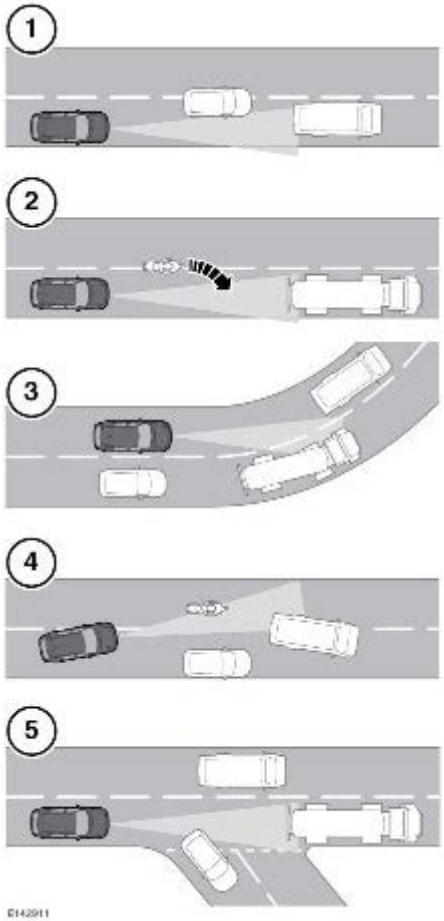
WARNING: Adaptive speed control system is not a collision warning or avoidance system. At all times the driver must be prepared to intervene to control the vehicle speed.

Adaptive speed control operation is similar to the standard speed control system for engaging, suspending and resuming speed control. The main differences between the two systems is that adaptive speed control remains engaged below 20 mph (32 km/h) and uses the brakes to slow the vehicle, to a halt if necessary.

If adaptive speed control is suspended by pressing the CANCEL switch or the brake pedal, it can be re-engaged by pressing the RES switch once vehicle speed is above 7 mph (11 km/h).

SYSTEM RESTRICTIONS

The adaptive speed control system is only intended to provide enhanced speed control in certain restricted conditions. 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.



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.
4. Moving around a stationary vehicle may cause uncertainty as to which vehicle is being followed.
5. A vehicle in front moving out of your lane may cause uncertainty as to which vehicle is being followed.

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 adaptive speed control module. 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.

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, the system identifies it as a target vehicle. To indicate that the system is in follow mode, the follow mode warning indicator illuminates. When the distance between the two vehicles closes to the set time gap, the adaptive speed control system reduces engine speed and, if necessary, applies the brakes to maintain the set time gap.

Automatic braking is limited to approximately 30% of full pressure (0.3 G deceleration) and is intended to provide a smooth, gradual deceleration in follow mode conditions.

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 extinguishes the follow mode warning indicator. The adaptive speed control system then increases vehicle speed back to the original set speed.

QUEUE ASSIST

When adaptive speed control is engaged, if the target vehicle comes to a halt the ASCM reduces engine speed and applies the brakes to halt the sensing vehicle and suspends speed control operation. The control module also applies the EPB if one of the following occurs:

- Adaptive speed control is disengaged with the CANCEL switch
- The vehicle is stationary for more than 2 minutes
- Driver exit is detected (assumed if the driver seatbelt is unbuckled and the driver door is opened)
- A system fault is detected.

When the target vehicle moves away, pressing the accelerator pedal for a minimum of 0.5 second resumes speed control operation. The sensing vehicle then follows the target vehicle in follow mode or until it stops again, or, if it can no longer detect a target, accelerates back up to the set speed.

FORWARD ALERT

If an object is detected close ahead, a warning tone will be emitted and a message will be displayed. The brakes will not be applied.

The forward alert system is active when the warning indicator in the instrument cluster is illuminated. Forward alert does not initiate any action, the driver must take the appropriate action when the message is displayed. The system monitors driver intervention and may not issue the warning if the driver has taken the appropriate action (braking, steering or indicating) early enough.

The sensitivity of the warning can be changed using the gap increase and decrease switches when the adaptive cruise control is not engaged. Confirmation of the gap change is given in the message center.

Forward alert can be switched on or off using the instrument cluster menu.

ADVANCED EMERGENCY BRAKE ASSIST

Advanced EBA (Emergency Brake Assist) improves braking response during emergency braking, and is an enhancement of the electronic brake prefill and emergency brake assist functions controlled by the ABS control module.
For additional information, refer to: Braking Control System (206-11 Brake Controls, Description and Operation).

With advanced EBA, if the risk of a collision increases after the vehicle passes the forward alert activation threshold, the ASCM signals the ABS control module to activate the electronic brake prefill and emergency brake assist functions. With advanced EBA, the electronic brake prefill function operates in two stages:

- Stage 1:
  - Applies a brake pressure of approximately 3 bar (43.5 lbf/in²) to all of the brakes
  - Lowers the EBA activation threshold in the ABS control module
  - Signals the CJB on the high speed CAN bus to activate the stop lamps
- Stage 2 increases the brake pressure to approximately 10 bar (145 lbf/in²).

Stage 1 is activated if the collision risk increases to a level considered as credible, with the accelerator pedal pressed. Stage 2 is activated when the accelerator pedal is released during an imminent risk of collision. If the accelerator pedal has already been released when the collision risk increased to the credible level, the two stages of electronic brake prefill are activated simultaneously, to give an immediate brake pressure of 10 bar (145 lbf/in²).

While the second stage of electronic brake prefill is active, if the brake pedal is then pressed quickly, the ABS control module activates EBA, even if only light pressure is applied to the pedal.

Advanced EBA is available at vehicle speeds 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 related message is displayed in the message center. Advanced EBA will not be available until the fault is rectified.

INTELLIGENT EMERGENCY BRAKING

Intelligent emergency braking reduces the impact velocity if the adaptive speed control module determines that a collision is unavoidable, even with driver intervention. It is not designed to prevent accidents from occurring. Typical activation of intelligent emergency braking is approximately 0.8 second before impact. During this 0.8 second period the speed of the sensing vehicle is reduced, thus reducing the impact energy.

If the ASCM determines a collision is unavoidable, it signals the ABS control module to apply emergency brake pressure to all of the brakes. On vehicles without active safety belts, emergency brake pressure is 50 bar (725 lbf/in²) maximum. On vehicles with active safety belts, emergency brake pressure is 100 bar (1450 lbf/in²) maximum.

When intelligent emergency braking is initiated the ASCM also signals the RCM (Restraints Control Module) to fire the front seatbelt retractors.
For additional information, refer to: Safety Belt System (501-20A Safety Belt System, Description and Operation).

After the intelligent emergency braking function has activated, it is then disabled, as the vehicle is assumed to be damaged. After the vehicle has been repaired, the intelligent emergency braking function can be re-enabled using Land Rover approved diagnostic equipment.

The intelligent emergency braking function operates at vehicle speeds down to zero, and will function even when forward

alert and adaptive cruise control are switched off.

If the intelligent emergency braking feature is disabled for any reason, a related message is displayed in the message center.

Automatic Speed Limiter

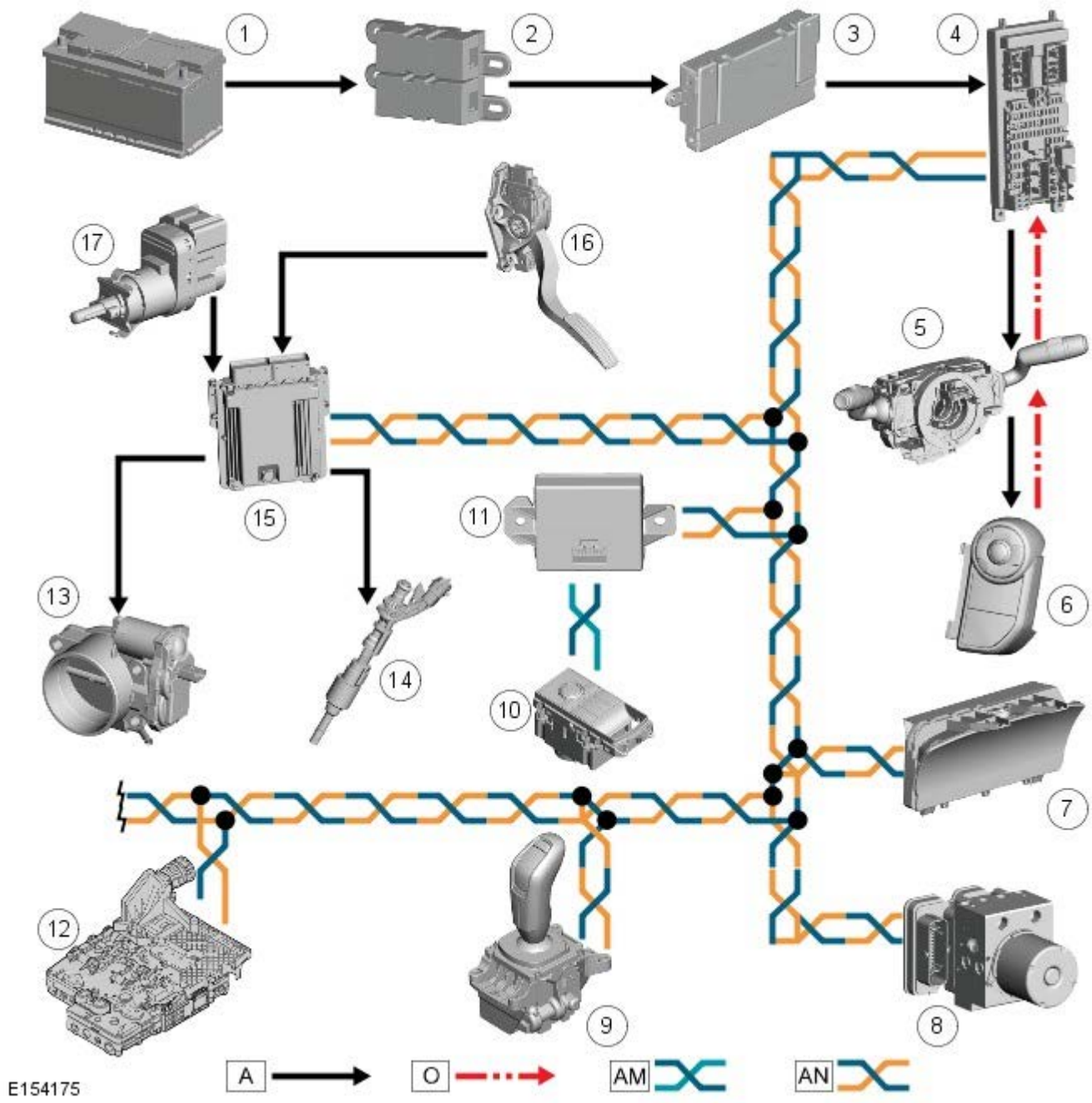
With the ASL switch selected on, the ASL system can be operated in a similar manner to the cruise control system. A speed limit between 18 and 150 mph (30 and 240 km/h) can be set, with the vehicle stationary or moving, using the speed control SET + and - switches (in ASL operation, the SET + and the - switches change the set speed limit in steps of 5 mph (8 km/h), instead of the 1 mph (2 km/h) steps of the cruise control system). The ASL warning indicator illuminates and the set speed limit is displayed in the message center.

If the vehicle reaches the set speed limit, the ECM intervenes to govern vehicle speed at the set speed limit.

NOTE: In certain conditions, such as a steep downhill gradient, the vehicle speed may exceed the set speed limit. This is because engine braking is unable to maintain or reduce the vehicle speed.

The ASL can be disengaged and re-engaged using the speed control CANCEL and RES switches respectively. ASL also disengages if kickdown is used on the accelerator pedal. Pressing the ASL switch cancels ASL operation and the speed limit will need to be reset the next time the switch is selected on.

Control Diagram - Standard Speed Control

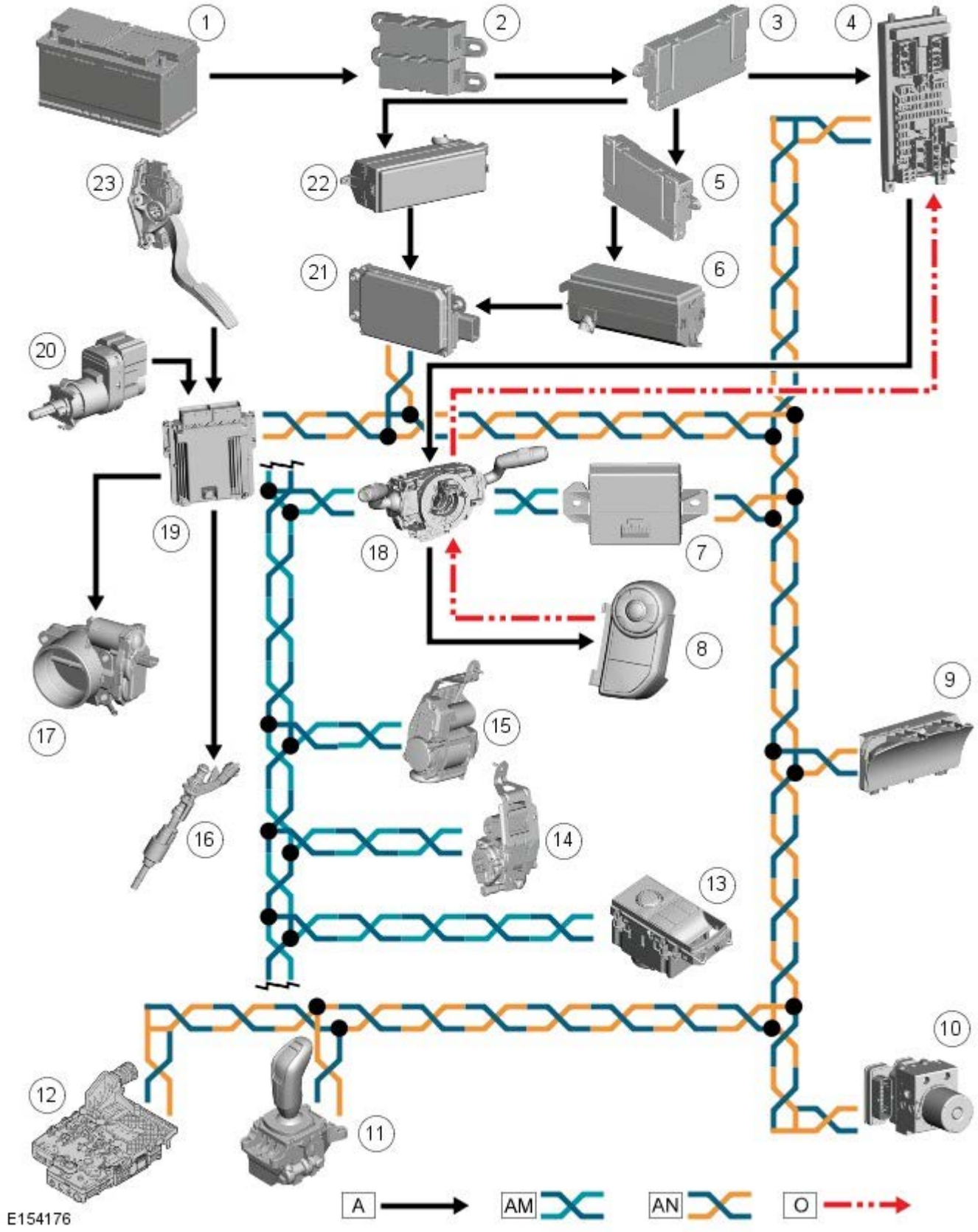


A = Hardwired, O = LIN (Local Interconnect Network) bus, AM = High speed CAN (Controller Area Network) Chassis bus, AN = High speed CAN Powertrain bus.

Item	Part Number	Description

1	-	Battery
2	-	Battery Junction Box 2 (BJB2)
3	-	Battery Junction Box (BJB)
4	-	Central Junction Box (CJB)
5	-	Clockspring
6	-	Right steering wheel switchpack
7	-	Instrument Cluster (IC)
8	-	Anti-lock Brake System (ABS) control module
9	-	Transmission Control Switch (TCS)
10	-	Terrain Response® switchpack
11	-	Gateway Module (GWM)
12	-	Transmission Control Module (TCM)
13	-	Electric throttle
14	-	Fuel injectors
15	-	Engine Control Module (ECM)
16	-	Accelerator Pedal Position (APP) sensor
17	-	Brake pedal switch

Control Diagram - Adaptive Speed Control



A = Hardwired, O = LIN (Local Interconnect Network) bus, AM = High speed CAN (Controller Area NetworkO Chassis bus, AN = High speed CAN Powertrain bus.

Item	Part Number	Description
1	-	Battery
2	-	Battery Junction Box 2 (BJB2)
3	-	Battery Junction Box (BJB)
4	-	Central Junction Box (CJB)
5	-	Auxiliary Junction Box (AJB)
6	-	Engine Junction Box (EJB)
7	-	Gateway Module (GWM)
8	-	Right steering wheel switchpack

9	-	Instrument Cluster (IC)
10	-	Anti-lock Brake System (ABS) control module
11	-	Transmission Control Switch (TCS)
12	-	Transmission Control Module (TCM)
13	-	Terrain Response® switchpack
14	-	Left active seatbelt retractor
15	-	Right active seatbelt retractor
16	-	Fuel injectors
17	-	Electric throttle
18	-	Clockspring and steering angle sensor
19	-	Engine Control Module (ECM)
20	-	Brake pedal switch
21	-	Adaptive Speed Control Module (ASCM)
22	-	Rear Junction Box (RJB)
23	-	Accelerator Pedal Position (APP) sensor

Published: 31-Jul-2012

Speed Control - V8 S/C 5.0L Petrol - Speed Control

Diagnosis and Testing

Principles of Operation

For a detailed description of the speed control system, refer to the relevant description and operation sections in the workshop manual.
REFER to: Speed Control (310-03C, 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 damage and system integrity

Visual Inspection

Mechanical	Electrical
• Ensure the speed control sensor is free from obstructions • Adaptive speed control module • Brake switch • Visibly damaged or worn components	• Fuse(s) • Damage to wiring loom, incorrect location of wiring, wiring stretched or taught • Loose or corroded electrical connector(s) • Steering wheel switches • Brake switch • Adaptive speed 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 DTCs and refer to the DTCs 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 speed control sensor for correct vertical alignment, and carry out speed control sensor alignment procedure using manufacturer approved diagnostic system

Symptom Chart

Symptom	Possible Cause	Action
Speed control inhibited or disabled	• Power or ground supply to adaptive speed control module • Steering wheel speed control switch/circuits • Throttle sensors • Brake switch • ABS fault • Speed control sensor obstructed	• Check for DTCs that could be caused by power or ground failure to the module and refer to DTC index • Check for sticking, jammed and broken speed control switches. Refer to the electrical circuit diagrams and check speed control switch circuits for short circuit, open circuit, high resistance • Check for engine throttle position sensor DTCs and refer to the relevant DTC index. For throttle position sensor tests REFER to: (303-14C Electronic Engine Controls - V8 S/C 5.0L Petrol) Electronic Engine Controls (Diagnosis and Testing), Electronic Engine Controls (Diagnosis and Testing). • Check for correct installation and adjustment of brake switch. Refer to the electrical circuit diagrams and check brake switch circuits for short circuit, open circuit, high resistance • Check ABS system for related DTCs and refer to the relevant DTC index • Make sure there is no snow, ice or other obstruction on the fascia in front of the speed control radar. Adaptive cruise control will not engage until the radar has detected valid target(s)
Unable to regulate/adjust vehicle speed	• Steering wheel switch malfunction	• Check for sticking, jammed and broken speed control switches. Refer to the electrical circuit diagrams and check speed control switch circuits for short circuit, open circuit, high resistance
Unable to cancel speed control from steering wheel	• Steering wheel switch malfunction	• Check for sticking, jammed and broken speed control switches. Refer to the electrical circuit diagrams and check speed control switch circuits for short circuit, open circuit, high resistance
Unable to cancel speed control from brake pedal	• Brake switch malfunction	• Check for correct installation and adjustment of brake switch. Refer to the electrical circuit diagrams and check brake switch circuits for short, open circuit, high resistance

For a list of DTCs that could be logged on this vehicle, please refer to Section 100-00. REFER to:

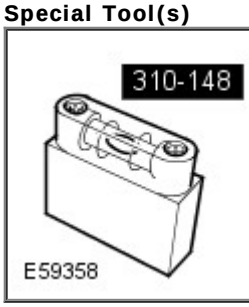
Diagnostic Trouble Code (DTC) Index - DTC: Adaptive Speed Control Module (100-00, Description and Operation), Diagnostic Trouble Code (DTC) Index - V8 S/C 5.0L Petrol, DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation).

Published: 02-Aug-2012

Speed Control - V8 S/C 5.0L Petrol - Speed Control Sensor Adjustment

General Procedures

Special Tool(s)

	310-148 Setting Tool, Speed Control

NOTES:

Special tool 310-148 is graduated in 0.5 degree increments.

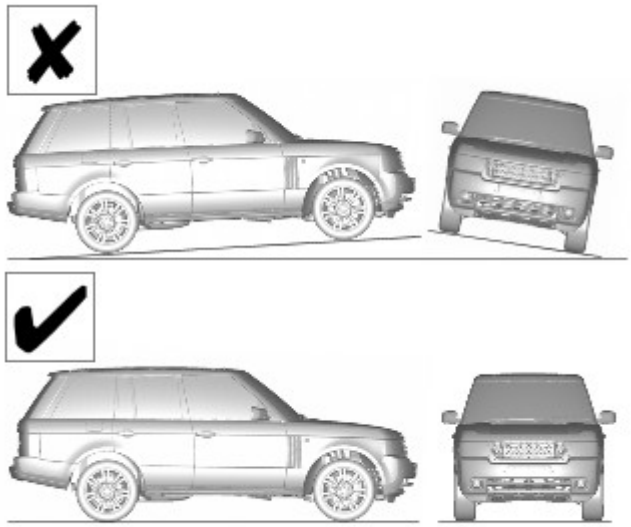
Removal steps in this procedure may contain installation details.

This procedure details how to adjust the speed control sensor vertically. There is no horizontal adjustment required.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Refer to: Front Bumper Cover (501-19, Removal and Installation).



E122311

3. NOTE: Make sure that the vehicle is standing on a level surface.

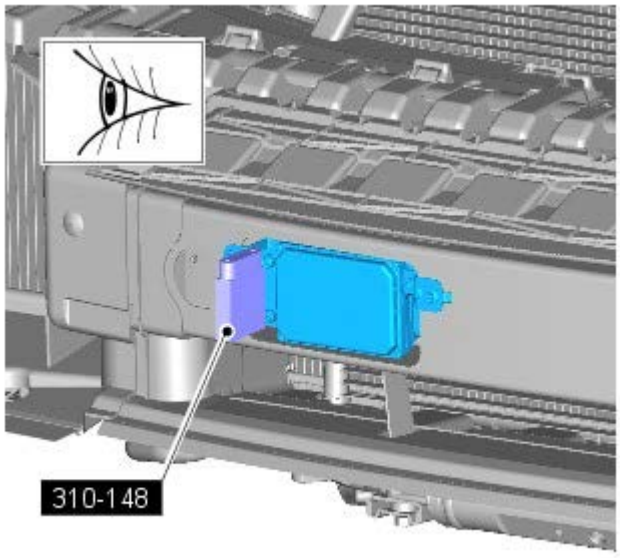
   Set the air suspension ride height to the STANDARD setting.

4. NOTES:

   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.

   If necessary, adjust the level of radar with the torx screw until the level gauge indicates that the radar is level.

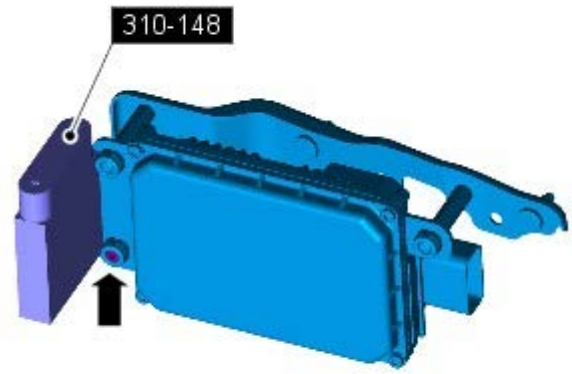
   Special Tool(s): 310-148



E146024

5. NOTE: The speed sensor has no mechanical horizontal adjustment.

   Special Tool(s): 310-148



E132168

6.

- From the diagnostic tool menu, select: Service Alignment Mode.
- The follow indicator will now be flashing, this indicates that the vehicle is in "service alignment" and now requires driving.
- The vehicle speed must be above 30 mph (48 kph).
- Choose a road with plenty of stationary objects, like street lights, road signs, or barriers. Use an inside or outside lane.
- Following vehicles too closely will obscure the stationary targets from the radar, a time gap of 2 seconds is recommended.
- A straight road will produce a quicker and better result, although the process will still operate on a curved road.
- When the flashing follow indicator light extinguishes, the ACC system is now functional, and a required vehicle speed can now be set by the driver and the ACC system will operate as normal.

Published: 12-Sep-2012

Speed Control - 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 Exterior Lighting, Removal and Installation).

Installation

1. To install, reverse the removal procedure.

Published: 08-Aug-2012

Speed Control - V8 S/C 5.0L Petrol - Speed Control Sensor

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

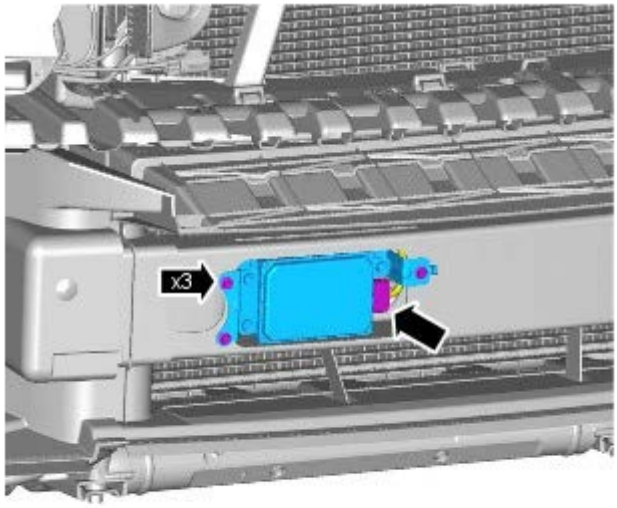
   Refer to: Specifications (414-00, Specifications).

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



E145878

Installation

1. To install, reverse the removal procedure.

2. Refer to: Speed Control Sensor Adjustment (310-03C Speed Control - V8 S/C 5.0L Petrol, General Procedures).

Published: 12-Sep-2012

Speed Control - V8 S/C 5.0L Petrol - Speed Control Switch

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

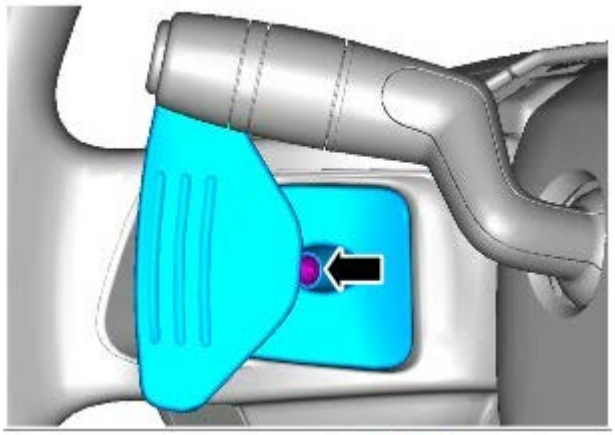
1. Make the air bag supplemental restraint system (SRS) safe.

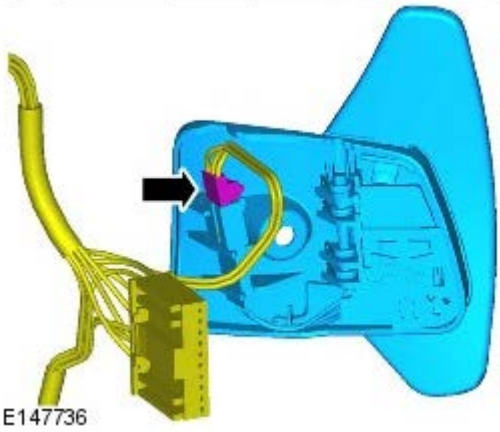
   Refer to: Standard Workshop Practices (100-00 General Information, Description and Operation).

2. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

3. Refer to: Driver Air Bag Module (501-20B Supplemental Restraint System, Removal and Installation).

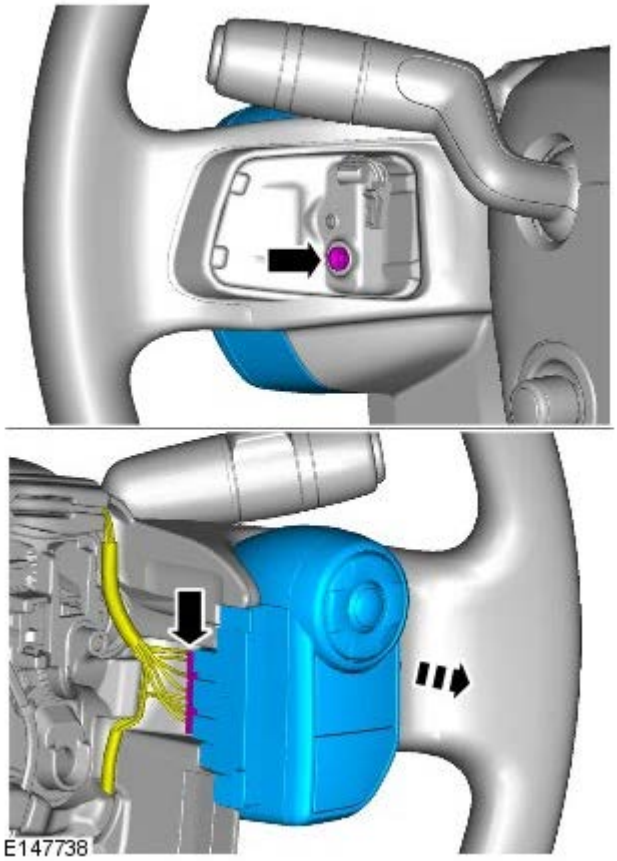




4. NOTE: Make sure that the harness is routed to the position noted on removal.

   Torque: 3 Nm

5. *Torque:* 3 Nm



Installation

1. To install, reverse the removal procedure.

Published: 11-Sep-2012

Speed Control - TDV8 4.4L Diesel -

Item	Specification
Speed control sensor assembly vertical alignment	90° ± 1.2°

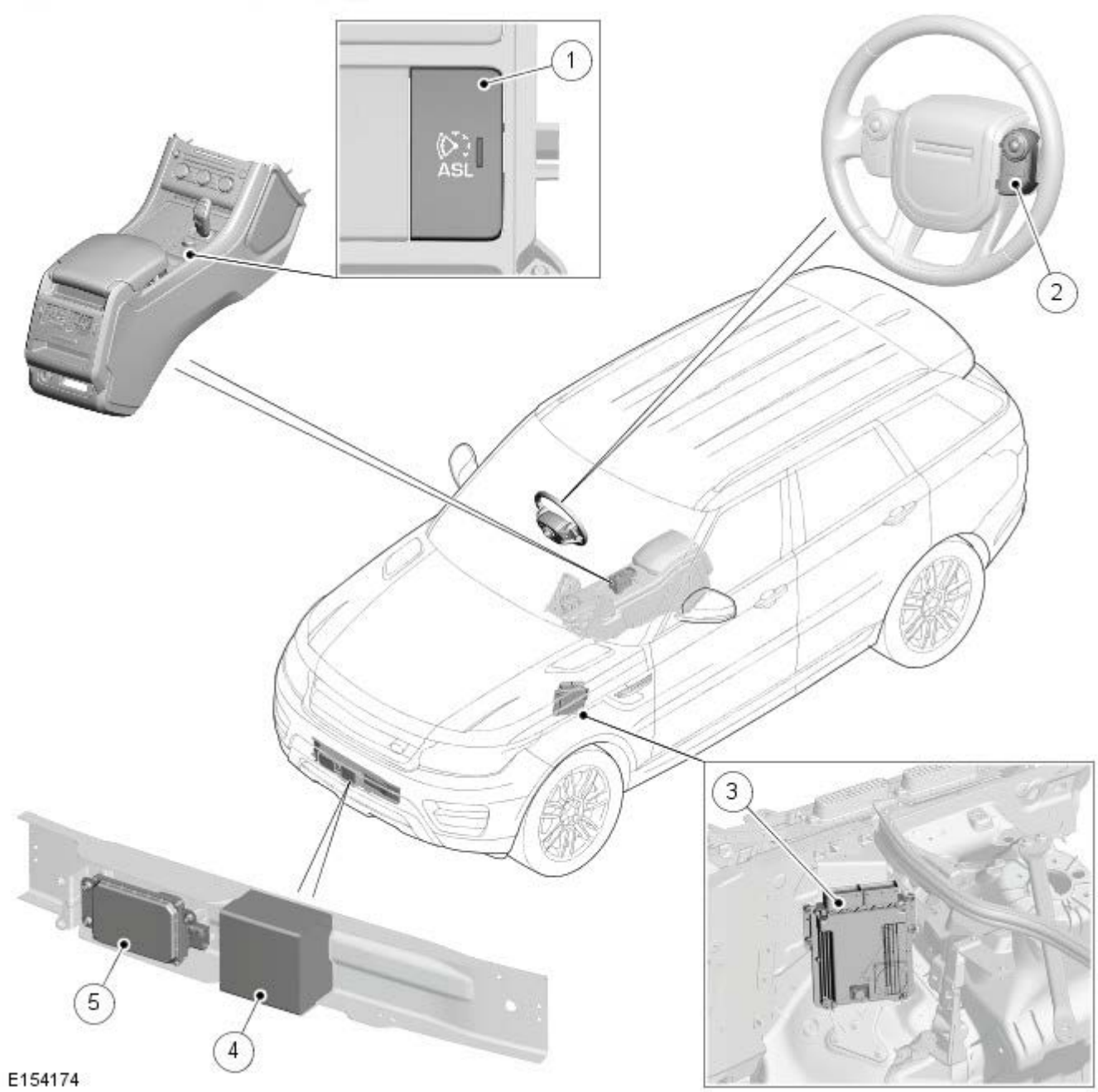
Description	Nm	lb-ft	lb-in
Speed control sensor assembly retaining bolts	9	-	7

Published: 31-Jul-2013

Speed Control - TDV8 4.4L Diesel - Speed Control

Description and Operation

COMPONENT LOCATION



Item	Part Number	Description
1	-	Automatic Speed Limiter (ASL) switch
2	-	Right steering wheel switchpack
3	-	Engine Control Module (ECM) (V8 S/C 5.0L petrol shown)
4	-	Foam block
5	-	Adaptive Speed Control Module (ASCM)

OVERVIEW

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. The adaptive system includes the same functionality as the standard system, and has the following additional functions:

- Follow Mode: Reduces vehicle speed, to less than the set speed, in order to maintain a selected distance behind a slower moving vehicle, then resumes the set speed once the way ahead is clear
- Queue Assist: Stops the vehicle a set distance behind the vehicle in front if it comes to a halt. When the vehicle in front moves away, a brief press of the accelerator pedal resumes adaptive speed control operation
- Forward Alert: Alerts the driver when rapidly approaching a slower moving vehicle
- Advanced Emergency Brake Assist: Partially applies the brakes in preparation for a sudden braking action, to

improve brake response
- Intelligent Emergency Braking: Applies the brakes to reduce the impact velocity if a collision is unavoidable.

The standard speed control system is controlled by the ECM (Engine Control Module) and switches on the right steering wheel switchpack. The adaptive speed control system is controlled by the ECM, the switches on the right steering wheel switchpack and the ASCM (Adaptive Speed Control Module). Both systems also use the:

- Brake pedal switch.
  For additional information, refer to: Braking Control System (206-11 Brake Controls, Description and Operation).
- APP (Accelerator Pedal Position) sensor. For additional information, refer to:
  Electronic Engine Controls (303-14A Electronic Engine Controls - TDV6 3.0L Diesel, Description and Operation),
  Electronic Engine Controls (303-14B Electronic Engine Controls - V6 S/C 3.0L Petrol, Description and Operation),
  Electronic Engine Controls (303-14C Electronic Engine Controls - V8 S/C 5.0L Petrol, Description and Operation),
  Electronic Engine Controls (303-14D Electronic Engine Controls - TDV8 4.4L Diesel, Description and Operation).
- ABS (Anti-lock brake system) control module.
  For additional information, refer to: Braking Control System (206-11 Brake Controls, Description and Operation).
- TCS (Transmission Control Switch).
  For additional information, refer to: External Controls (307-05A Automatic Transmission/Transaxle External Controls - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, Description and Operation).
- TCM (Transmission Control Module).
  For additional information, refer to: Transmission Description (307-01A Automatic Transmission/Transaxle - Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, Description and Operation).
- Terrain Response® switchpack.
  For additional information, refer to: Ride and Handling Optimization (204-06 Ride and Handling Optimization, Description and Operation).
- Instrument Cluster (IC). For additional information, refer to:
  Instrument Cluster (413-01 Instrument Cluster, Description and Operation),
  Information and Message Center (413-08 Information and Message Center, Description and Operation).

During speed control operation, the ECM controls vehicle speed by adjusting the engine throttle and fuel injection. The adaptive speed control system also uses the ASCM to scan the road ahead and, if necessary, signal the ABS control module to apply the brakes to slow the vehicle.

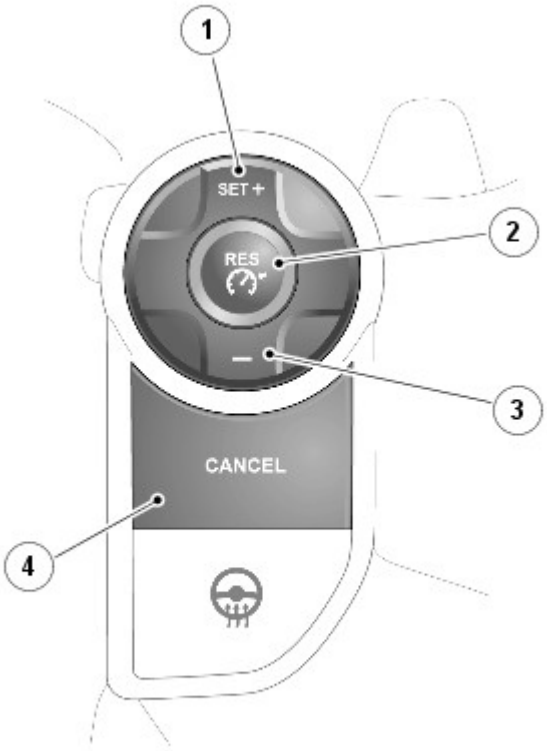
All vehicles also incorporate an ASL (Automatic Speed Limiter) system. When a speed has been set, the engine will respond normally up to the set speed. Further accelerator pressure will not increase the speed beyond the set speed unless sudden, rapid acceleration (kickdown) is applied. The ASL system is controlled by the ECM, the speed control switches on the right steering wheel switchpack and an ASL switch.

The ASL system and the speed control system cannot be used simultaneously. The system in use when the ignition is turned off is automatically enabled when the ignition is turned back on. However the speed settings are not remembered and will have to be set again.

DESCRIPTION

Standard Speed Control

SPEED CONTROL SWITCHES



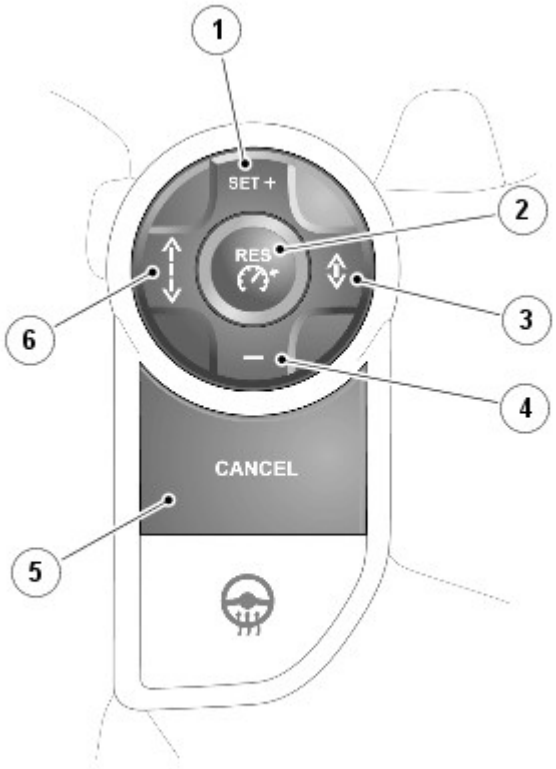
E147361

Item	Part Number	Description
1	-	Set + (engage/accelerate) switch
2	-	RES (resume) switch
3	-	- (decelerate) switch
4	-	CANCEL switch

The standard speed control switches are located on the right steering wheel switchpack. The switches are resistive ladder type switches which vary the resistance of a 5 volt signal sent to them. The resistive ladder is wired to a LIN (Local Interconnect Network) node which transmits the data to the CJB (Central Junction Box) via the clockspring. The CJB then transmits the data on the high speed CAN (Controller Area Network) Powertrain bus.

Adaptive Speed Control

SPEED CONTROL SWITCHES



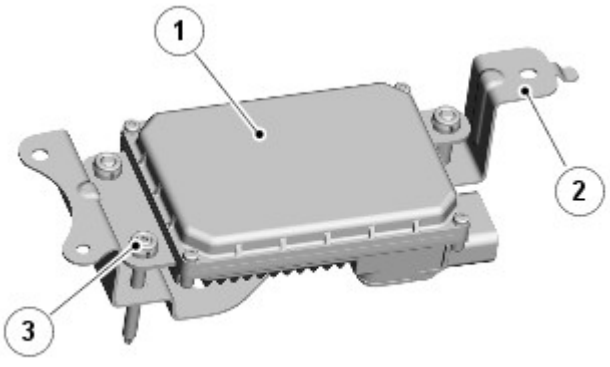
E147362

Item	Part Number	Description
1	-	Set + (engage/accelerate) switch
2	-	RES (resume) switch
3	-	Time gap decrease switch
4	-	- (decelerate) switch
5	-	CANCEL switch
6	-	Time gap increase switch

The adaptive speed control switches are the same as used for standard speed control, with the addition of two time gap switches. The time gap switches allow the driver to adjust the follow mode and forward alert functions to one of four pre-set time gaps (gap 1 = 1 second; gap 2 = 1.4 seconds; gap 3 = 1.8 seconds; gap 4 = 2.2 seconds). The selected time gap is displayed in the message center when the time gap switches are operated.

When adaptive speed control is engaged, the switches adjust the follow mode time gap. When adaptive speed control is disengaged, the switches adjust the forward alert time gap (provided forward alert is enabled in the instrument cluster menu). The follow mode function defaults to the gap 3 setting each time the ignition is switched on. The forward alert function recalls the last selected time gap when the ignition is switched on.

ADAPTIVE SPEED CONTROL MODULE



E148863

Item	Part Number	Description
1	-	Adaptive Speed Control Module (ASCM)
2	-	Mounting bracket
3	-	Adjuster screw

The ASCM is attached to a bracket located in the armature of the front bumper, to the right of the vehicle centerline. A foam block in the bumper armature eliminates radar signal reflections within the armature.

The ASCM contains a forward looking radar transceiver together with related controlling hardware and software. A high speed CAN Powertrain bus connection allows the ASCM to communicate with other system control modules. Power supplies to the ASCM are from the extended ignition relay in the RJB (Rear Junction Box) and the ignition relay in the EJB (Engine Junction Box).

The adaptive speed control module is active whenever the ignition is on, even if speed control is not engaged, in order to operate the forward alert, advanced emergency brake assist and intelligent emergency braking functions. With the ignition on, the adaptive speed control module is powered up but no radar transmissions are emitted until the vehicle is in motion.

The adaptive speed control module 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 control module detects the range, relative velocity and angle of objects within the scanned arc for up to a distance of approximately 130 meters (426.5 feet).

The ASCM compares vehicle speed data from the ABS control module with the relative speed of an external object as detected by the radar 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 module, 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.

The ASCM continuously monitors both moving vehicles and stationary objects to determine if it can 'see' normally. If the control module can detect only a few objects, because it is physically blocked (for example by an accumulation of snow or mud on the lower grill of the front bumper, or an incorrectly located number plate), or there are few roadside objects or other vehicles in the area, it may determine that it is blocked. The control module then inhibits adaptive speed control and records a DTC (Diagnostic Trouble Code). The system will reset after the ignition is cycled. In this case the control module is not faulty and should not be replaced.

If the ASCM is replaced in service it must be mechanically aligned vertically. Horizontal alignment is achieved by putting the control module into service mode using approved Land Rover diagnostic equipment. The vehicle then needs to be driven for a short period while the control module calibrates itself. Calibration is complete when the follow mode warning indicator in the instrument cluster stops flashing.For additional information, refer to:

Speed Control Sensor Adjustment (310-03B Speed Control - V6 S/C 3.0L Petrol, General Procedures),
Speed Control Sensor Adjustment (310-03B, General Procedures),
Speed Control Sensor Adjustment (310-03B Speed Control - V6 S/C 3.0L Petrol, General Procedures),
Speed Control Sensor Adjustment (310-03B Speed Control - V6 S/C 3.0L Petrol, General Procedures).

Automatic Speed Limiter

ASL SWITCH

The ASL switch is integrated into the Terrain Response® switchpack in the floor console. An amber LED (Light Emitting Diode) in the ASL switch remains illuminated while the ASL is selected on. Selection of the ASL switch is transmitted on high speed CAN Chassis bus from the Terrain Response® switchpack to the ECM through the GWM (Gateway Module), since the ECM is connected to the high speed CAN Powertrain bus.

Instrument Cluster Warning Indicators

SPEED CONTROL WARNING INDICATOR



E147363

The speed control warning indicator illuminates when standard or adaptive speed control is engaged.

FOLLOW MODE WARNING INDICATOR



E122343

The follow mode warning indicator illuminates when the adaptive speed control system is engaged and goes into follow mode. When the system is engaged, the time gap setting is displayed in the message center in the form of a vehicle with 1 to 4 bars in front of it, where the number of bars correspond to the current time gap setting.

FORWARD ALERT WARNING INDICATOR



E122344

The forward alert warning indicator illuminates if forward alert is enabled in the IC menu.

ASL WARNING INDICATOR



E147868

The speed control warning indicator illuminates when ASL is selected on and a speed limit is set in the message center.

OPERATION

For standard or adaptive speed control to engage, the vehicle must be in the following configuration:

- Transmission in D (drive)
- Transfer case in high range
- Terrain Response® in the general (special programs off) or grass/gravel/snow program
- HDC (Hill Descent Control) off
- ASL off
- Traveling at 20 mph (32 km/h) or more.

Standard Speed Control

ENGAGE SPEED CONTROL

Speed control is engaged by pressing the SET + switch. On receipt of the switch input, the ECM adopts the current vehicle speed as the speed control set speed. When speed control is engaged, the IC illuminates the speed control warning indicator and the set speed is displayed in the message center.

The set speed is cleared when the ignition is switched off or if the speed control system develops a fault.

SET SPEED ADJUSTMENT

Once engaged the set speed can be increased by one of 3 methods:

- Press and hold the SET + switch which will cause the vehicle to accelerate. When the switch is released the attained speed will be the new set speed.
- Repeatedly pressing the SET + switch. Each press increases the vehicle speed by 1 mph (2 km/h).
- Use the accelerator pedal to increase the vehicle speed. Once the required speed is reached, a single press of the SET + switch will set the cruise speed.

The set speed can be reduced by pressing and holding the decelerate - switch until the required speed is reached. When the switch is released the speed is reset at that value. The set speed can be reduced incrementally by pressing and releasing the decelerate - switch. Each press will reduce the speed by 1 mph (2 km/h).

Speed control adjustment is limited around the current vehicle speed. This means speed adjustment won't occur when resuming or if the vehicle speed is noticeably different to set speed. This is noticeable when resuming speed control and a large difference exists between the set speed and the current speed. The driver can set a new speed, but can't adjust the old speed.

SUSPENDING SPEED CONTROL

Suspending speed control means speed control has been deactivated without loss of the set speed. Speed control is suspended when one of the following occurs:

- Vehicle speed falls below 20 mph (32 km/h)
- The brake pedal is pressed
- The CANCEL switch is pressed
- N (neutral), R (reverse) or P (park) is selected on the TCS
- The EPB (Electric Park Brake) is applied
- If the accelerator pedal is used to accelerate beyond the set speed for too long (more than 5 minutes)
- Engine speed too high (cancel limit set just below red line)
- The ABS control module activates ETC (Electronic Traction Control) or DSC (Dynamic Stability Control)
- HDC is selected
- Terrain Response® adopts a special program other than grass/gravel/snow
- The transfer case is selected to low range.

RESUMING SPEED CONTROL

A single press of the RES switch will resume speed control at the memorized set speed.

Adaptive Speed Control

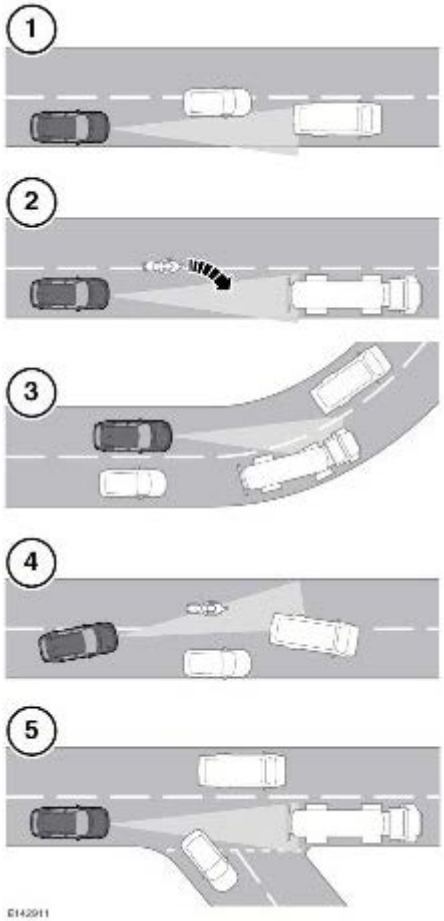
WARNING: Adaptive speed control system is not a collision warning or avoidance system. At all times the driver must be prepared to intervene to control the vehicle speed.

Adaptive speed control operation is similar to the standard speed control system for engaging, suspending and resuming speed control. The main differences between the two systems is that adaptive speed control remains engaged below 20 mph (32 km/h) and uses the brakes to slow the vehicle, to a halt if necessary.

If adaptive speed control is suspended by pressing the CANCEL switch or the brake pedal, it can be re-engaged by pressing the RES switch once vehicle speed is above 7 mph (11 km/h).

SYSTEM RESTRICTIONS

The adaptive speed control system is only intended to provide enhanced speed control in certain restricted conditions. 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.



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.
4. Moving around a stationary vehicle may cause uncertainty as to which vehicle is being followed.
5. A vehicle in front moving out of your lane may cause uncertainty as to which vehicle is being followed.

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 adaptive speed control module. 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.

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, the system identifies it as a target vehicle. To indicate that the system is in follow mode, the follow mode warning indicator illuminates. When the distance between the two vehicles closes to the set time gap, the adaptive speed control system reduces engine speed and, if necessary, applies the brakes to maintain the set time gap.

Automatic braking is limited to approximately 30% of full pressure (0.3 G deceleration) and is intended to provide a smooth, gradual deceleration in follow mode conditions.

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 extinguishes the follow mode warning indicator. The adaptive speed control system then increases vehicle speed back to the original set speed.

QUEUE ASSIST

When adaptive speed control is engaged, if the target vehicle comes to a halt the ASCM reduces engine speed and applies the brakes to halt the sensing vehicle and suspends speed control operation. The control module also applies the EPB if one of the following occurs:

- Adaptive speed control is disengaged with the CANCEL switch
- The vehicle is stationary for more than 2 minutes
- Driver exit is detected (assumed if the driver seatbelt is unbuckled and the driver door is opened)
- A system fault is detected.

When the target vehicle moves away, pressing the accelerator pedal for a minimum of 0.5 second resumes speed control operation. The sensing vehicle then follows the target vehicle in follow mode or until it stops again, or, if it can no longer detect a target, accelerates back up to the set speed.

FORWARD ALERT

If an object is detected close ahead, a warning tone will be emitted and a message will be displayed. The brakes will not be applied.

The forward alert system is active when the warning indicator in the instrument cluster is illuminated. Forward alert does not initiate any action, the driver must take the appropriate action when the message is displayed. The system monitors driver intervention and may not issue the warning if the driver has taken the appropriate action (braking, steering or indicating) early enough.

The sensitivity of the warning can be changed using the gap increase and decrease switches when the adaptive cruise control is not engaged. Confirmation of the gap change is given in the message center.

Forward alert can be switched on or off using the instrument cluster menu.

ADVANCED EMERGENCY BRAKE ASSIST

Advanced EBA (Emergency Brake Assist) improves braking response during emergency braking, and is an enhancement of the electronic brake prefill and emergency brake assist functions controlled by the ABS control module.
For additional information, refer to: Braking Control System (206-11 Brake Controls, Description and Operation).

With advanced EBA, if the risk of a collision increases after the vehicle passes the forward alert activation threshold, the ASCM signals the ABS control module to activate the electronic brake prefill and emergency brake assist functions. With advanced EBA, the electronic brake prefill function operates in two stages:

- Stage 1:
  - Applies a brake pressure of approximately 3 bar (43.5 lbf/in²) to all of the brakes
  - Lowers the EBA activation threshold in the ABS control module
  - Signals the CJB on the high speed CAN bus to activate the stop lamps
- Stage 2 increases the brake pressure to approximately 10 bar (145 lbf/in²).

Stage 1 is activated if the collision risk increases to a level considered as credible, with the accelerator pedal pressed. Stage 2 is activated when the accelerator pedal is released during an imminent risk of collision. If the accelerator pedal has already been released when the collision risk increased to the credible level, the two stages of electronic brake prefill are activated simultaneously, to give an immediate brake pressure of 10 bar (145 lbf/in²).

While the second stage of electronic brake prefill is active, if the brake pedal is then pressed quickly, the ABS control module activates EBA, even if only light pressure is applied to the pedal.

Advanced EBA is available at vehicle speeds 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 related message is displayed in the message center. Advanced EBA will not be available until the fault is rectified.

INTELLIGENT EMERGENCY BRAKING

Intelligent emergency braking reduces the impact velocity if the adaptive speed control module determines that a collision is unavoidable, even with driver intervention. It is not designed to prevent accidents from occurring. Typical activation of intelligent emergency braking is approximately 0.8 second before impact. During this 0.8 second period the speed of the sensing vehicle is reduced, thus reducing the impact energy.

If the ASCM determines a collision is unavoidable, it signals the ABS control module to apply emergency brake pressure to all of the brakes. On vehicles without active safety belts, emergency brake pressure is 50 bar (725 lbf/in²) maximum. On vehicles with active safety belts, emergency brake pressure is 100 bar (1450 lbf/in²) maximum.

When intelligent emergency braking is initiated the ASCM also signals the RCM (Restraints Control Module) to fire the front seatbelt retractors.
For additional information, refer to: Safety Belt System (501-20A Safety Belt System, Description and Operation).

After the intelligent emergency braking function has activated, it is then disabled, as the vehicle is assumed to be damaged. After the vehicle has been repaired, the intelligent emergency braking function can be re-enabled using Land Rover approved diagnostic equipment.

The intelligent emergency braking function operates at vehicle speeds down to zero, and will function even when forward

alert and adaptive cruise control are switched off.

If the intelligent emergency braking feature is disabled for any reason, a related message is displayed in the message center.

Automatic Speed Limiter

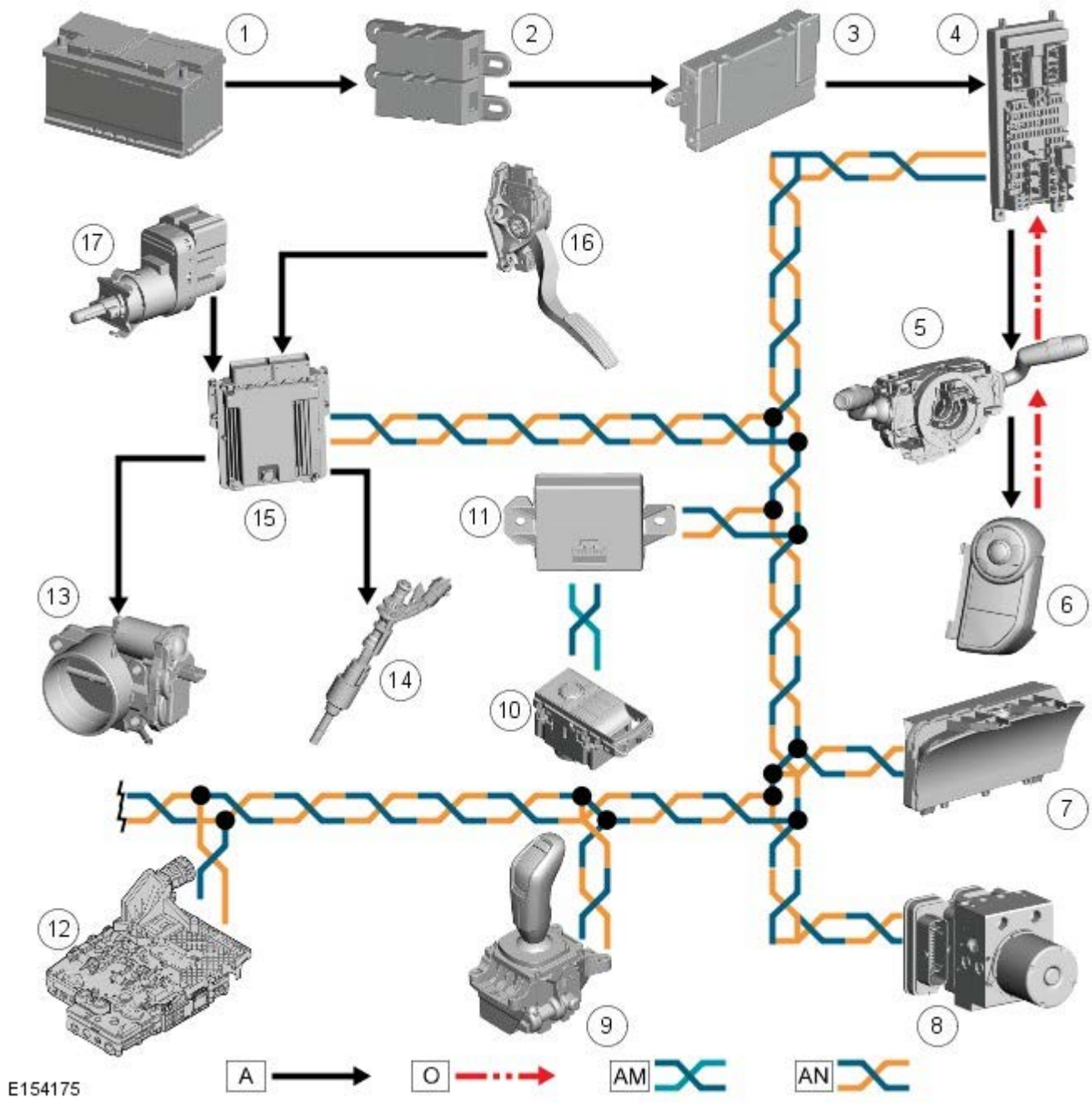
With the ASL switch selected on, the ASL system can be operated in a similar manner to the cruise control system. A speed limit between 18 and 150 mph (30 and 240 km/h) can be set, with the vehicle stationary or moving, using the speed control SET + and - switches (in ASL operation, the SET + and the - switches change the set speed limit in steps of 5 mph (8 km/h), instead of the 1 mph (2 km/h) steps of the cruise control system). The ASL warning indicator illuminates and the set speed limit is displayed in the message center.

If the vehicle reaches the set speed limit, the ECM intervenes to govern vehicle speed at the set speed limit.

NOTE: In certain conditions, such as a steep downhill gradient, the vehicle speed may exceed the set speed limit. This is because engine braking is unable to maintain or reduce the vehicle speed.

The ASL can be disengaged and re-engaged using the speed control CANCEL and RES switches respectively. ASL also disengages if kickdown is used on the accelerator pedal. Pressing the ASL switch cancels ASL operation and the speed limit will need to be reset the next time the switch is selected on.

Control Diagram - Standard Speed Control

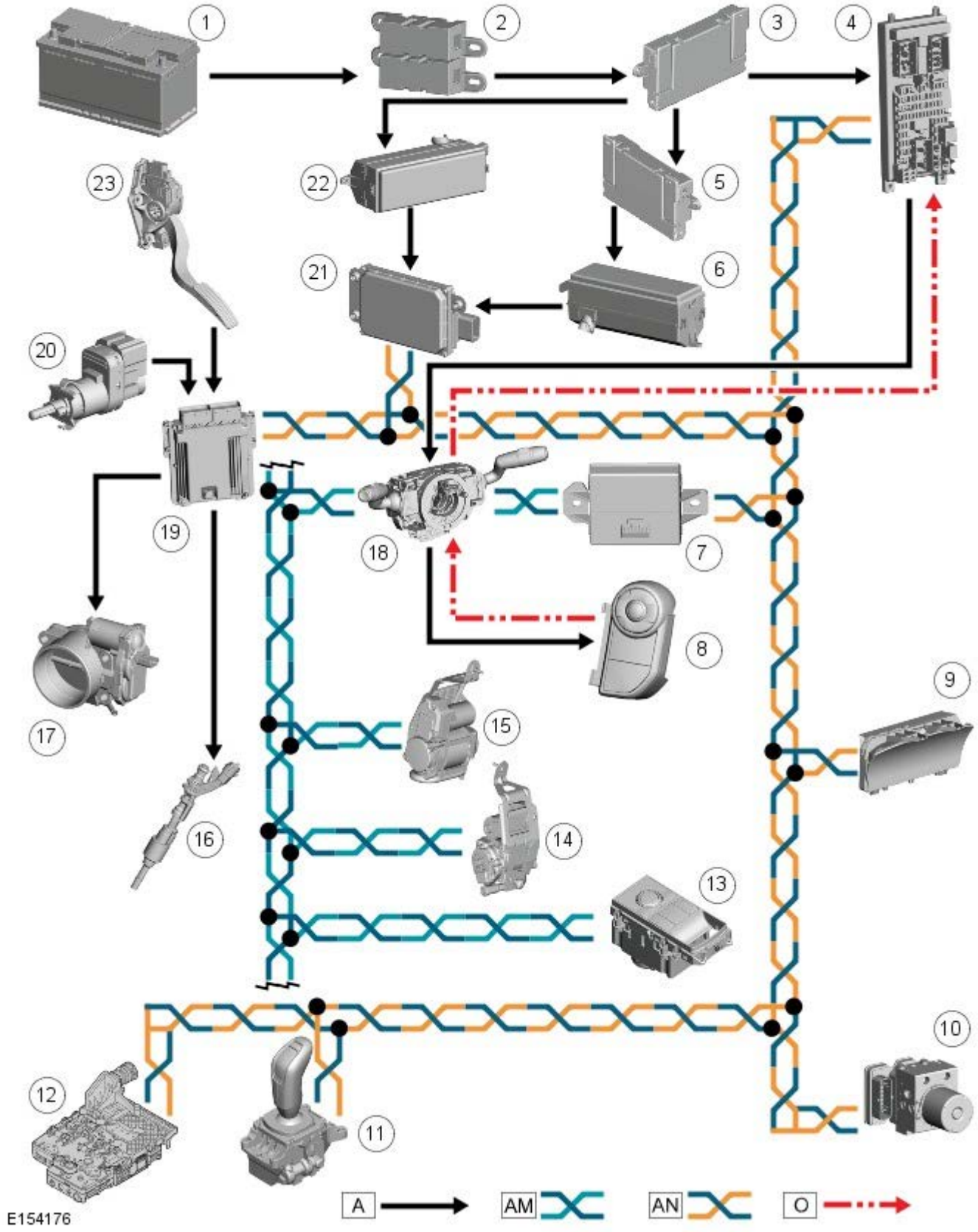


A = Hardwired, O = LIN (Local Interconnect Network) bus, AM = High speed CAN (Controller Area Network) Chassis bus, AN = High speed CAN Powertrain bus.

Item	Part Number	Description

1	-	Battery
2	-	Battery Junction Box 2 (BJB2)
3	-	Battery Junction Box (BJB)
4	-	Central Junction Box (CJB)
5	-	Clockspring
6	-	Right steering wheel switchpack
7	-	Instrument Cluster (IC)
8	-	Anti-lock Brake System (ABS) control module
9	-	Transmission Control Switch (TCS)
10	-	Terrain Response® switchpack
11	-	Gateway Module (GWM)
12	-	Transmission Control Module (TCM)
13	-	Electric throttle
14	-	Fuel injectors
15	-	Engine Control Module (ECM)
16	-	Accelerator Pedal Position (APP) sensor
17	-	Brake pedal switch

Control Diagram - Adaptive Speed Control



A = Hardwired, O = LIN (Local Interconnect Network) bus, AM = High speed CAN (Controller Area NetworkO Chassis bus, AN = High speed CAN Powertrain bus.

Item	Part Number	Description
1	-	Battery
2	-	Battery Junction Box 2 (BJB2)
3	-	Battery Junction Box (BJB)
4	-	Central Junction Box (CJB)
5	-	Auxiliary Junction Box (AJB)
6	-	Engine Junction Box (EJB)
7	-	Gateway Module (GWM)
8	-	Right steering wheel switchpack

9	-	Instrument Cluster (IC)
10	-	Anti-lock Brake System (ABS) control module
11	-	Transmission Control Switch (TCS)
12	-	Transmission Control Module (TCM)
13	-	Terrain Response® switchpack
14	-	Left active seatbelt retractor
15	-	Right active seatbelt retractor
16	-	Fuel injectors
17	-	Electric throttle
18	-	Clockspring and steering angle sensor
19	-	Engine Control Module (ECM)
20	-	Brake pedal switch
21	-	Adaptive Speed Control Module (ASCM)
22	-	Rear Junction Box (RJB)
23	-	Accelerator Pedal Position (APP) sensor

Published: 31-Jul-2012

Speed Control - TDV8 4.4L Diesel - Speed Control

Diagnosis and Testing

Principles of Operation

For a detailed description of the speed control system, refer to the relevant description and operation sections in the workshop manual.
REFER to: Speed Control (310-03B, 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 damage and system integrity

Visual Inspection

Mechanical	Electrical
• Ensure the speed control sensor is free from obstructions • Adaptive speed control module • Brake switch • Visibly damaged or worn components	• Fuse(s) • Damage to wiring loom, incorrect location of wiring, wiring stretched or taught • Loose or corroded electrical connector(s) • Steering wheel switches • Brake switch • Adaptive speed 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 DTCs and refer to the DTCs 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 speed control sensor for correct vertical alignment, and carry out speed control sensor alignment procedure using manufacturer approved diagnostic system

Symptom Chart

Symptom	Possible Cause	Action
Speed control inhibited or disabled	• Power or ground supply to adaptive speed control module • Steering wheel speed control switch/circuits • Throttle sensors • Brake switch • ABS fault • Speed control sensor obstructed	• Check for DTCs that could be caused by power or ground failure to the module and refer to DTC index • Check for sticking, jammed and broken speed control switches. Refer to the electrical circuit diagrams and check speed control switch circuits for short circuit, open circuit, high resistance • Check for engine throttle position sensor DTCs and refer to the relevant DTC index. For throttle position sensor tests REFER to: Electronic Engine Controls - 4.4L V8 - TdV8 (303-14B, Diagnosis and Testing). • Check for correct installation and adjustment of brake switch. Refer to the electrical circuit diagrams and check brake switch circuits for short circuit, open circuit, high resistance • Check ABS system for related DTCs and refer to the relevant DTC index • Make sure there is no snow, ice or other obstruction on the fascia in front of the speed control radar. Adaptive cruise control will not engage until the radar has detected valid target(s)
Unable to regulate/adjust vehicle speed	• Steering wheel switch malfunction	• Check for sticking, jammed and broken speed control switches. Refer to the electrical circuit diagrams and check speed control switch circuits for short circuit, open circuit, high resistance
Unable to cancel speed control from steering wheel	• Steering wheel switch malfunction	• Check for sticking, jammed and broken speed control switches. Refer to the electrical circuit diagrams and check speed control switch circuits for short circuit, open circuit, high resistance
Unable to cancel speed control from brake pedal	• Brake switch malfunction	• Check for correct installation and adjustment of brake switch. Refer to the electrical circuit diagrams and check brake switch circuits for short, open circuit, high resistance

For a list of DTCs that could be logged on this vehicle, please refer to Section 100-00. REFER to: (100-00)

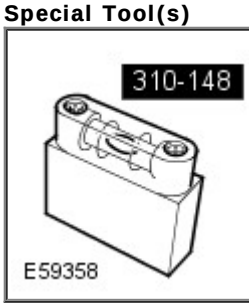
Diagnostic Trouble Code (DTC) Index - DTC: Adaptive Speed Control Module (Description and Operation), Diagnostic Trouble Code (DTC) Index - TDV8 4.4L Diesel, DTC: Module Name: Engine Control Module (Description and Operation).

Published: 02-Aug-2012

Speed Control - TDV8 4.4L Diesel - Speed Control Sensor Adjustment

General Procedures

Special Tool(s)

	310-148 Setting Tool, Speed Control

NOTES:

Special tool 310-148 is graduated in 0.5 degree increments.

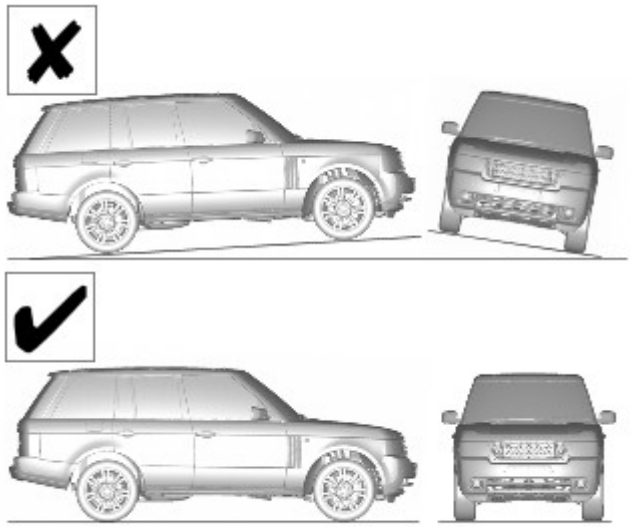
Removal steps in this procedure may contain installation details.

This procedure details how to adjust the speed control sensor vertically. There is no horizontal adjustment required.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Refer to: Front Bumper Cover (501-19, Removal and Installation).



E122311

3. NOTE: Make sure that the vehicle is standing on a level surface.

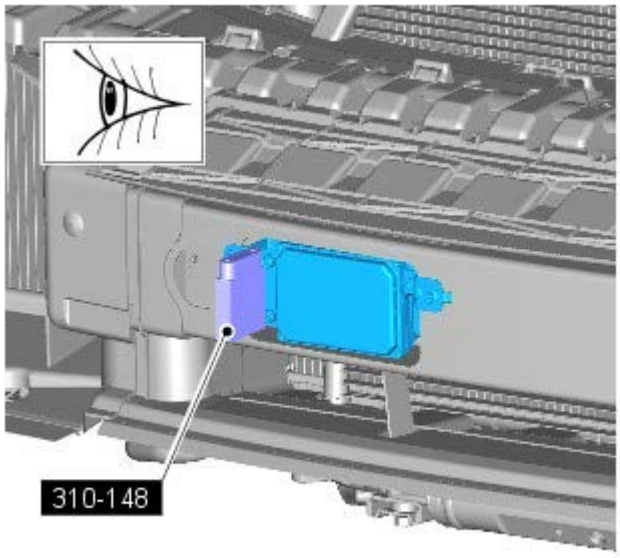
   Set the air suspension ride height to the STANDARD setting.

4. NOTES:

   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.

   If necessary, adjust the level of radar with the torx screw until the level gauge indicates that the radar is level.

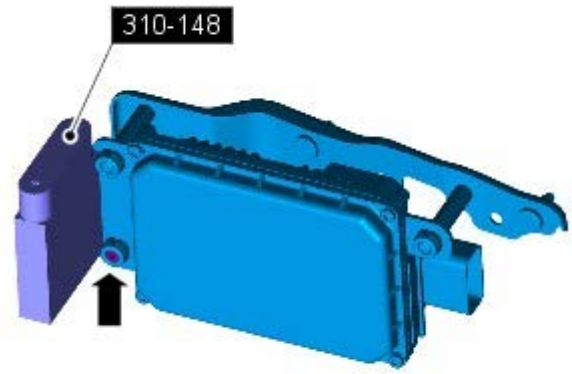
   Special Tool(s): 310-148



E146024

5. NOTE: The speed sensor has no mechanical horizontal adjustment.

   Special Tool(s): 310-148



E132168

6.

- From the diagnostic tool menu, select: Service Alignment Mode.
- The follow indicator will now be flashing, this indicates that the vehicle is in "service alignment" and now requires driving.
- The vehicle speed must be above 30 mph (48 kph).
- Choose a road with plenty of stationary objects, like street lights, road signs, or barriers. Use an inside or outside lane.
- Following vehicles too closely will obscure the stationary targets from the radar, a time gap of 2 seconds is recommended.
- A straight road will produce a quicker and better result, although the process will still operate on a curved road.
- When the flashing follow indicator light extinguishes, the ACC system is now functional, and a required vehicle speed can now be set by the driver and the ACC system will operate as normal.

Published: 12-Sep-2012

Speed Control - TDV8 4.4L 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 Exterior Lighting, Removal and Installation).

Installation

1. To install, reverse the removal procedure.

Published: 08-Aug-2012

Speed Control - TDV8 4.4L Diesel - Speed Control Sensor

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

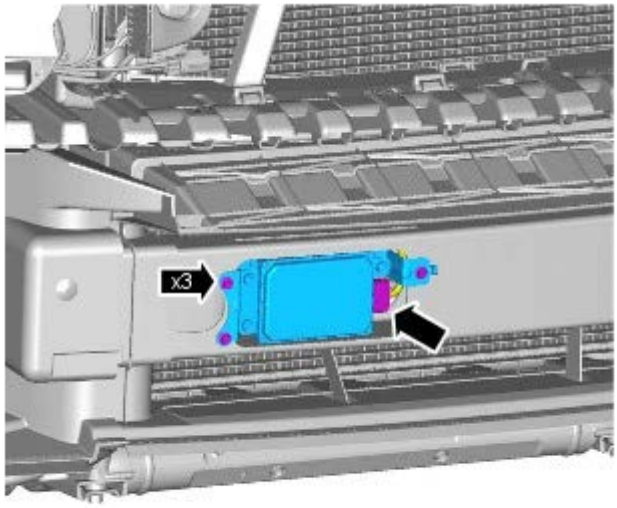
   Refer to: Specifications (414-00, Specifications).

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



E145878

Installation

1. To install, reverse the removal procedure.

2. Refer to: Speed Control Sensor Adjustment (310-03C Speed Control - V8 S/C 5.0L Petrol, General Procedures).

Published: 12-Sep-2012

Speed Control - TDV8 4.4L Diesel - Speed Control Switch

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

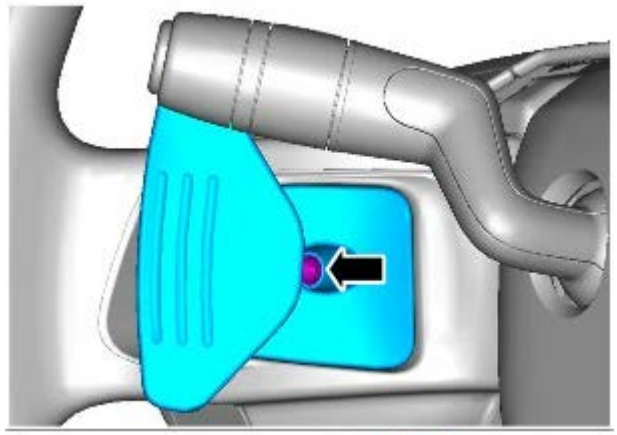
1. Make the air bag supplemental restraint system (SRS) safe.

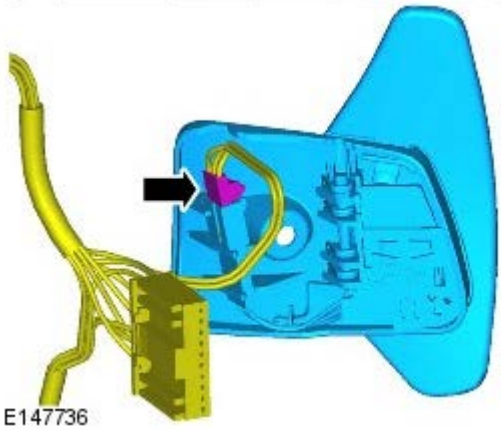
   Refer to: Standard Workshop Practices (100-00 General Information, Description and Operation).

2. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

3. Refer to: Driver Air Bag Module (501-20B Supplemental Restraint System, Removal and Installation).

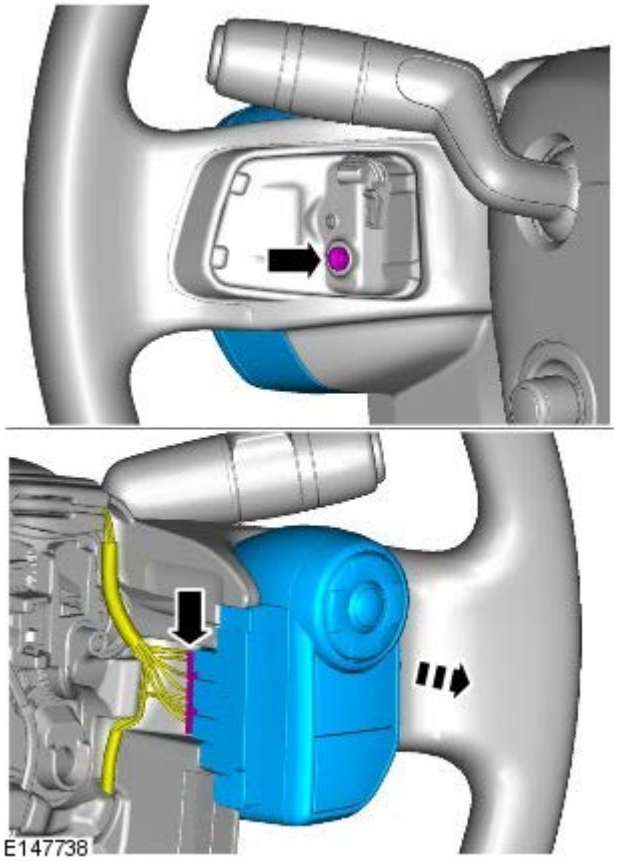




4. NOTE: Make sure that the harness is routed to the position noted on removal.

   Torque: 3 Nm

5. *Torque:* 3 Nm



Installation

1. To install, reverse the removal procedure.