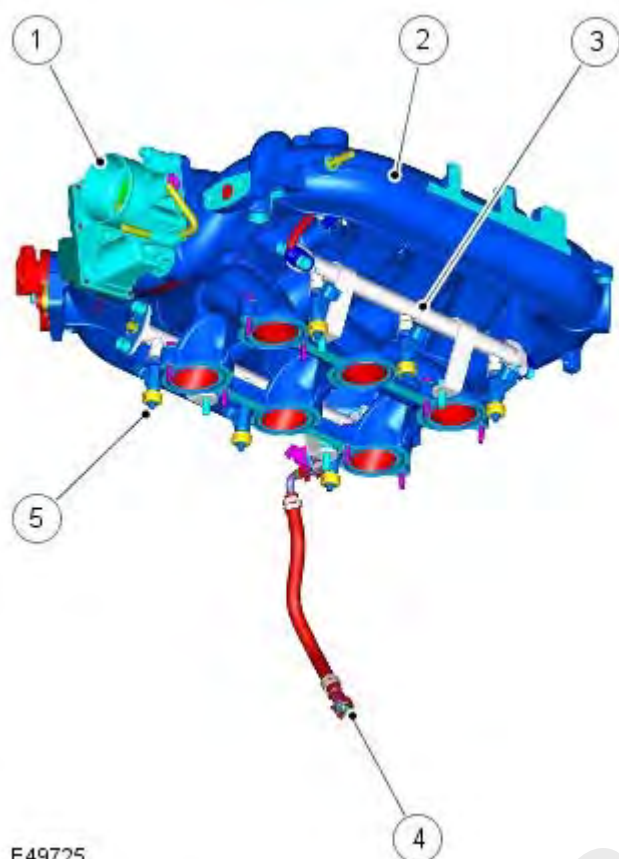


Fuel Charging and Controls - V6 4.0L Petrol - Fuel Charging and Controls

Description and Operation

Component Locations



E49725

Item	Part Number	Description
1	-	Throttle body
2	-	Intake manifold
3	-	Fuel rail
4	-	Fuel jump hose
5	-	Fuel injectors (6 of)

GENERAL

The major components of the fuel charging and control system comprise an intake manifold, a fuel pump, a fuel rail and six injectors. The fuel pump supplies fuel from the tank at a constant pressure, via a pipe routed along the underside of the vehicle, to the fuel rail. The fuel rail distributes the fuel equally to each of the six injectors.

INTAKE MANIFOLD

The intake manifold is located on top of the engine. The manifold is manufactured from a composite material with metal insert fixings. The manifold comprises a central chamber with six tracts leading to the inlet ports on the engine. For additional information, refer to: [Intake Air Distribution and Filtering](#) (303-12C Intake Air Distribution and Filtering - V6 4.0L Petrol, Description and Operation).

FUEL PUMP

The submersible electric pump fuel pump and the fuel pressure regulator are located in the fuel tank. A pump module flange on top of the fuel tank allows access to the fuel pump for removal and installation.

The fuel pump, when running, outputs fuel at a constant pressure to the fuel rail. The pressure regulator controls the pressure. Excess fuel from the pressure regulator is directed to the front jet pump. The controlled pressure provides more fuel to the fuel rail than the maximum requirement of the engine; therefore a constant pressure is maintained in the rail under all operating conditions.

For additional information, refer to: [Fuel Tank and Lines](#) (310-01C Fuel Tank and Lines - V6 4.0L Petrol, Description and Operation).

The fuel pump is controlled by the ECM via a fuel pump relay, which is located in the Battery Junction Box (BJB).

When the ignition is switched to position II, the ECM provides an earth path for the coil of the fuel pump relay on pin 95 of ECM connector C0634. The relay is energised for a short period to pressurise the fuel system. When the ECM senses that the engine is being cranked by receipt of a valid signal from the Crankshaft Position (CKP) sensor, the ECM energises the fuel pump relay for as long as the engine is running.

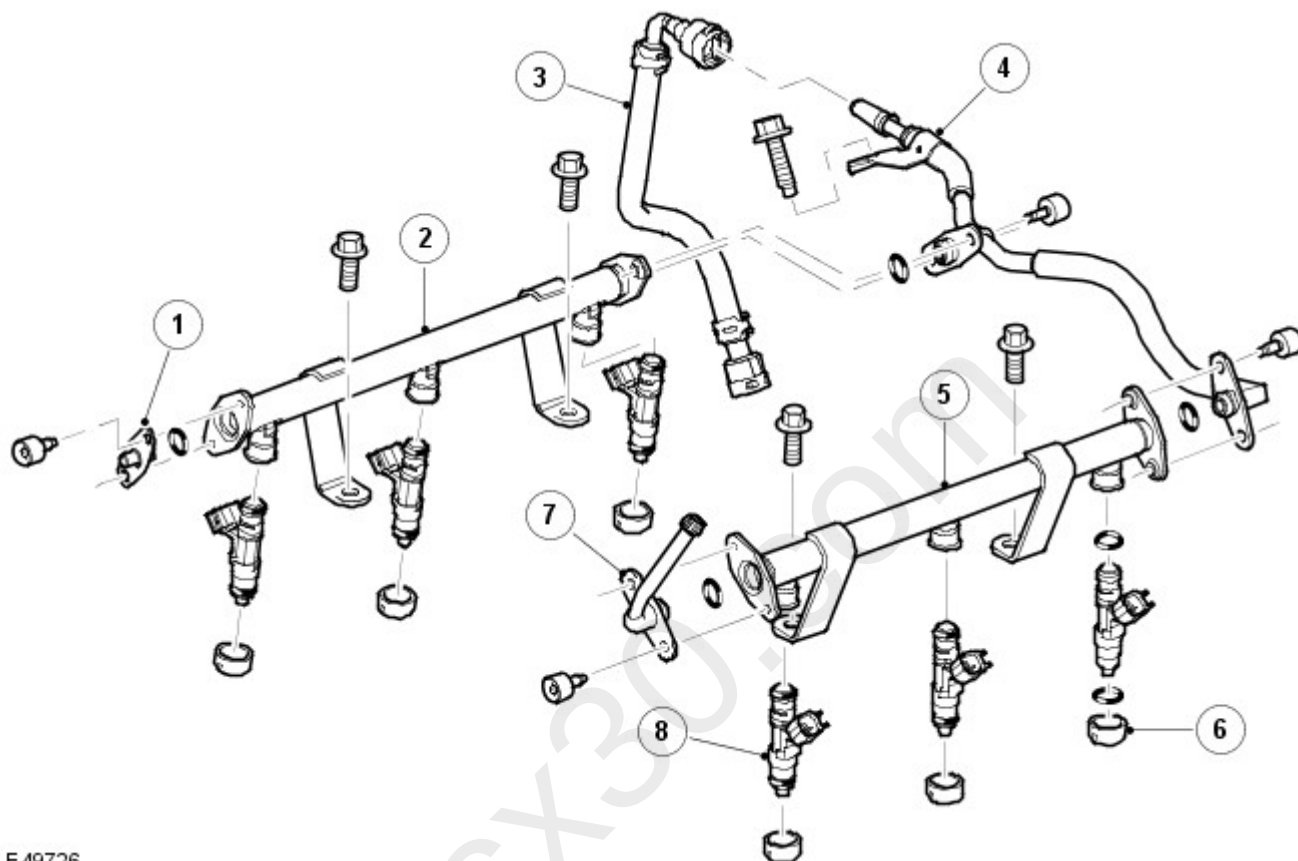
For additional information, refer to: [Electronic Engine Controls](#) (303-14C Electronic Engine Controls - V6 4.0L Petrol,

Description and Operation).

THROTTLE BODY

The throttle body is located centrally at the front of the intake manifold. The engine torque is controlled by the electronic throttle body. An electronic pedal assembly determines throttle opening. The signal from the pedal assembly is sent to the EMS and the throttle is opened to the correct angle by means of an electric motor integrated into the throttle body. Sensors in the throttle body are used to determine the position of the throttle plate and the rate of change in its angle. For additional information, refer to: [Electronic Engine Controls](#) (303-14C Electronic Engine Controls - V6 4.0L Petrol, Description and Operation).

FUEL RAIL



E 49726

Item	Part Number	Description
1	-	End cover
2	-	RH fuel rail
3	-	Fuel jump hose
4	-	Fuel supply pipe
5	-	LH fuel rail
6	-	Injector seat inserts
7	-	Schraeder valve
8	-	Injectors (6 of)

Each fuel rail maintains a constant fuel pressure of 4.5bar (65 psi) and is attached to each cylinder head with two bolts. Three fuel injectors are installed in each cylinder head and connected to the fuel rail. 'O' ring seals are used to seal the injectors in both the fuel rails and cylinder heads. A quick release coupling connects the feed pipe from the fuel tank to the fuel rail via the fuel jump hose.

A flange with two threaded holes on the rear of the LH and RH fuel rails provide attachment for the fuel supply pipe. The fuel supply pipe has two metal-flanged ends, which locate on the fuel rail. A seal prevents leakage and each flange is secured with two bolts.

A Schraeder valve is installed in the front end of the LH fuel rail to provide a pressure test connection for maintenance.

INJECTORS

Six injectors are held between the fuel rails and each cylinder head. The injectors are sealed to the fuel rail and cylinder head by 'O' ring seals, which should be renewed whenever an injector is refitted to an engine. A small amount of engine oil can be applied to the 'O' rings to aid installation. No other form of lubrication should be used. Each injector sits on an insert that also needs to be renewed each time an injector is replaced.

Each injector contains a solenoid-operated needle valve, which is closed while the solenoid winding is de-energised. The solenoid winding is connected to a power feed from the main relay and to an earth through the ECM. The ECM switches the earth to control the opening and closing of the needle valve. While the needle valve is open, fuel is sprayed into the cylinder inlet tract onto the back of the inlet valves. The ECM meters the amount of fuel injected by adjusting the time that the needle valve is open.

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

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Fuel Charging and Controls - V6 4.0L Petrol - Fuel Charging and Controls

Diagnosis and Testing

Principles of Operation

For a detailed description of the fuel charging and controls system and operation, refer to the relevant Description and Operation section of the workshop manual.

REFER to: [Fuel Charging and Controls](#) (303-04E Fuel Charging and Controls - V6 4.0L Petrol, Description and Operation).

Inspection and Verification



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

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

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

Visual Inspection

Mechanical	Electrical
● Fuel leaks ● Damaged fuel lines ● Damaged push connect fittings ● Fuel level ● Fuel contamination/grade/quality ● Throttle body ● Damaged fuel tank filler pipe cap ● Damaged fuel tank filler pipe	● Fuses ● Inertia switch ● Loose or corroded electrical connectors ● Harnesses ● Sensor(s) ● Engine Control Module (ECM)

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

Symptom Chart

Symptom	Possible Causes	Action
Engine cranks, but does not fire	● Low/Contaminated fuel ● Ignition system ● Fuel system ● Crankshaft Position (CKP) sensor ● Harness ● Engine Control Module fault	Check the fuel level and condition. For ignition system tests, refer to the relevant section of the workshop manual. Check for injector DTCs. For CKP and harness tests, refer to the relevant section of the workshop manual. Refer to the warranty policy and procedures manual if a module is suspect.
Engine cranks and fires, but will not start	● Evaporative emissions purge valve ● Fuel system ● Spark plugs ● Ignition coil failure(s)	For purge valve tests, refer to the relevant section of the workshop manual. Check for injector DTCs. For ignition system tests, refer to the relevant section of the workshop manual.
Difficult to start cold	● Check coolant anti-freeze content ● Battery ● Crankshaft position (CKP) sensor ● Fuel system ● Evaporative emissions purge valve	For battery information, refer to the relevant section of the workshop manual. For CKP sensor tests, refer to the relevant section of the workshop manual. Check for injector DTCs. For purge valve tests, refer to the relevant section of the workshop manual.
Difficult to start hot	● Injector leak ● Fuel system ● Fuel temperature sensor ● Intake air temperature (IAT) sensor ● Mass air flow (MAF) sensor ● Evaporative emissions purge valve ● Ignition system	Check for injector DTCs. For fuel temperature sensor, intake air temperature sensor and Mass Air Flow sensor tests, refer to the relevant section of the workshop manual. For purge valve and ignition system tests, refer to the relevant section of the workshop manual.

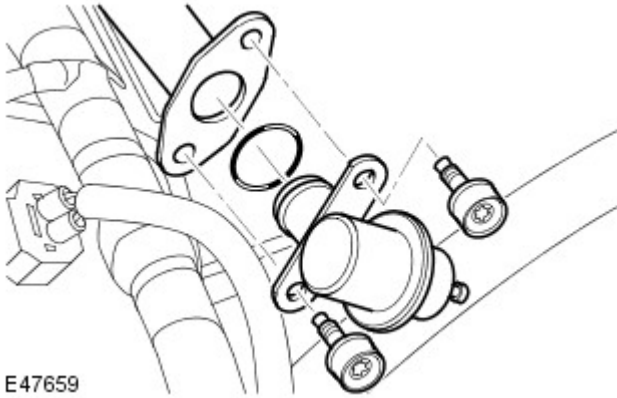
Symptom	Possible Causes	Action
Difficult to start after hot soak (vehicle standing after engine has reached operating temperature)	● Injector leak ● Fuel system ● Fuel temperature sensor ● Intake air temperature sensor ● Mass Air Flow sensor ● Evaporative emissions purge valve ● Ignition system	Check for injector DTCs. For fuel temperature sensor, intake air temperature sensor and Mass Air Flow sensor tests, refer to the relevant section of the workshop manual. For purge valve and ignition system tests, refer to the relevant section of the workshop manual.
Engine stalls soon after start	● Breather system disconnected/restricted ● Engine control module relay ● Mass Air Flow sensor ● Fuel rail pressure (FRP) sensor ● Ignition system ● Air filter restricted ● Air leakage ● Fuel lines	Check the engine breather system. Check the engine control module relay operation. For Mass Air Flow sensor and fuel rail pressure sensor and ignition system tests, refer to the relevant section of the workshop manual. For air intake and fuel line information, refer to the relevant section of the workshop manual.
Engine hesitates/poor acceleration	● Fuel pump ● Fuel lines ● Injector leak ● Fuel pressure ● Air leakage ● Throttle position (TP) sensors ● Accelerator pedal position (APP) sensor ● Throttle motor ● Ignition system ● HO2 sensors ● Transmission malfunction ● Restricted pedal travel (carpet, etc)	For fuel pump and fuel line information, refer to the relevant section of the workshop manual. Check for injector DTCs. For intake system checks, throttle position sensor and accelerator pedal position sensor tests, refer to the relevant section of the workshop manual. For throttle motor tests refer to the guided diagnostic routine on the approved diagnostic system. For ignition system tests, refer to the relevant section of the workshop manual. Check for DTCs relating to HO2 sensors, refer to the DTC index. For transmission information, refer to the relevant section of the workshop manual. Check the accelerator pedal travel.
Engine backfires	● Fuel pump ● Fuel lines ● Air leakage ● Mass Air Flow sensor ● Accelerator pedal position sensor ● HO2 sensors ● Ignition system	For fuel pump and fuel line and intake system information, refer to the relevant section of the workshop manual. For Mass Air Flow sensor and accelerator pedal position sensor tests, refer to the relevant section of the workshop manual. Check for DTCs relating to HO2 sensors, refer to the DTC index. For ignition system tests, refer to the relevant section of the workshop manual.
Engine surges	● Fuel pump ● Fuel lines ● Mass Air Flow sensor ● Harness ● Throttle position sensors ● Throttle motor ● Ignition system	For fuel pump and fuel line information, refer to the relevant section of the workshop manual. For Mass Air Flow sensor and throttle position sensor tests, refer to the relevant section of the workshop manual. For throttle motor tests refer to the guided diagnostic routine on the approved diagnostic system. For ignition system tests, refer to the relevant section of the workshop manual.
Engine detonates/knocks	● Fuel pump ● Fuel lines ● Fuel quality ● Knock sensor (KS)/circuit malfunction ● Fuel rail pressure sensor ● Mass Air Flow sensor ● HO2 sensors ● Air leakage ● BARO sensor malfunction (internal engine control module fault)	For fuel pump and fuel line information, refer to the relevant section of the workshop manual. For fuel rail pressure sensor, Mass Air Flow sensor and knock sensor tests, refer to the relevant section of the workshop manual. Check for DTCs relating to HO2 sensors, refer to the DTC index. For intake system, refer to the relevant section of the workshop manual. Refer to the warranty policy and procedures manual if a module is suspect.
No throttle response	● Accelerator pedal position sensor malfunction ● Throttle position sensors ● Throttle motor	For accelerator pedal position sensor and throttle position sensor tests, refer to the relevant section of the workshop manual. For throttle motor tests refer to the guided diagnostic routine on the approved diagnostic system.
Poor throttle response	● Accelerator pedal position sensor malfunction ● Throttle position sensors ● Throttle motor	For accelerator pedal position sensor, throttle position sensor, engine coolant temperature sensor and Mass Air Flow sensor tests, refer to the relevant section of the workshop manual. For throttle motor tests refer to the guided diagnostic routine on the approved diagnostic system.
DTC Index For a list of Diagnostic Trouble Codes (DTCs) that could be triggered on this format, please refer to the relevant section of the workshop manual. For intake system checks refer to the relevant section of the workshop manual. For breather system checks, refer to the relevant section of the workshop manual.	● Mass Air Flow sensor ● Transmission malfunction ● Traction control event ● Air leakage ● Breather system disconnected/restricted	For intake system checks refer to the relevant section of the workshop manual. For breather system checks, refer to the relevant section of the workshop manual.

Fuel Charging and Controls - V6 4.0L Petrol - Fuel Pressure Regulator

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the intake manifold.
For additional information, refer to: Intake Manifold Assembly (303-04, Removal and Installation).
3. Remove the fuel pressure regulator.
 - Remove the 2 Torx bolts.
 - Remove and discard the O-ring seal.



Installation

1. Install the fuel pressure regulator.
 - Clean the component mating faces.
 - Install a new O-ring seal.
 - Tighten the bolts to 6 Nm (4 lb.ft).
2. Install the intake manifold.
For additional information, refer to: Intake Manifold Assembly (303-04, Removal and Installation).
3. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Fuel Charging and Controls - V6 4.0L Petrol - Fuel Rail

Removal and Installation

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

Removal

• WARNINGS:



Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.



Do not carry or operate cellular phones when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

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

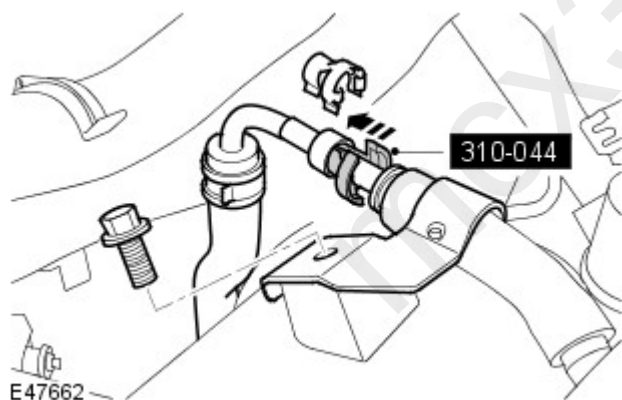
- Remove the bolt.



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

Using the special tool, disconnect the fuel line.

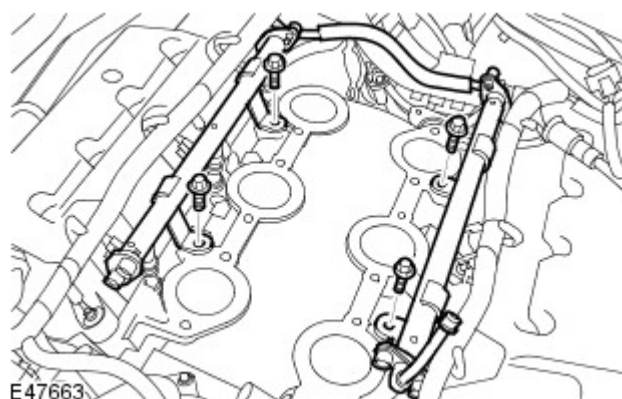
- Position an absorbent cloth to collect fluid spillage.
- Depress the quick release connector.

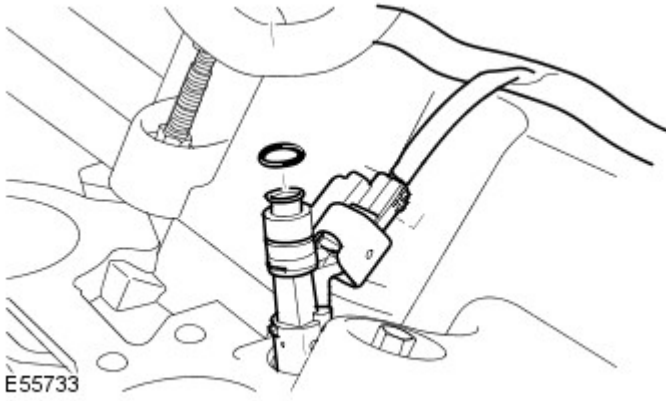


5. WARNING: The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.

Remove the fuel rail.

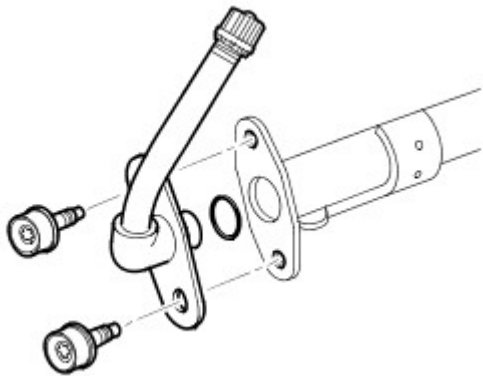
- Remove the 4 bolts.
- Position an absorbent cloth to collect fluid spillage.





6. Release and remove the fuel injectors.

- Remove and discard the fuel injector O-ring seals.



7. Remove the schraeder valve.

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

Installation

1. Install the schraeder valve.

- Clean the component mating faces.
- Install a new O-ring seal.
- Tighten the bolts to 6 Nm (4 lb.ft).

2. Clean the components.

3. Install the fuel rail.

- Install fuel injector O-ring seals.
- Lubricate the O-ring seals.
- Tighten the bolts to 25 Nm (18 lb.ft).

4. Connect the fuel line to the fuel rail.

- Clean the component mating faces.
- Install the clip.
- Tighten the bolt to 6 Nm (4 lb.ft).

5. Install the intake manifold.

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

6. Connect the battery ground cable.

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

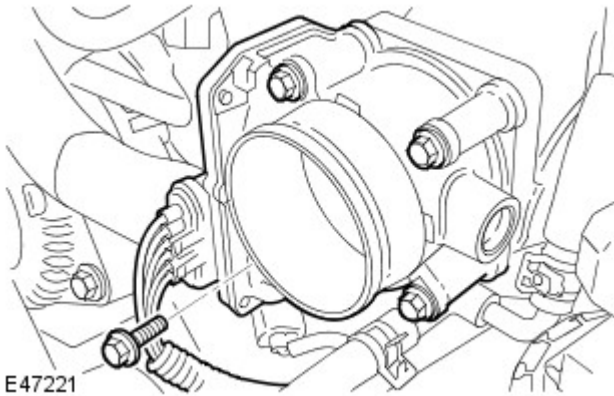
Fuel Charging and Controls - V6 4.0L Petrol - Throttle Body Gasket

Removal and Installation

Removal

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

- Remove the 4 bolts.
- Remove and discard the throttle body gasket.



Installation

1. Install the throttle body.
 - Clean the components.
 - Install a new gasket.
 - Tighten the 4 bolts to 10 Nm (7 lb.ft).
2. Install the air intake resonator.
For additional information, refer to: [Intake Air Resonator](#) (303-12C Intake Air Distribution and Filtering - V6 4.0L Petrol, Removal and Installation).
3. Install the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
4. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Fuel Charging and Controls - V6 4.0L Petrol - Fuel Injector

Removal and Installation

Removal

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

2. WARNINGS:

 Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

 Do not carry or operate cellular phones when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

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

Remove the fuel rail.

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

3. Remove the fuel injector.

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



Installation

1. Clean the component mating faces.
2. To install, reverse the removal procedure.
 - Lubricate the new O-ring seal with clean engine oil.