

Fuel Charging and Controls - TDV6 2.7L Diesel -

General Specification

Item	Description
* Recommended fuel	Diesel or Automotive Gas Oil (AGO) to EN590 Specification

* This engine is NOT compatible with 'Bio-diesel' fuel

Torque Specifications

Description	Nm	lb-ft
High pressure fuel supply lines to injector and supply manifold unions:		
Stage 1 - Union to injector	15	11
Stage 2 - Union to supply manifold	15	11
Stage 3 - Union to injector	30	22
Stage 4 - Union to supply manifold	30	22
High pressure fuel supply lines to supply manifold and diverter rail unions:		
Stage 1 - Union to supply manifold	15	11
Stage 2 - Union to diverter rail	15	11
Stage 3 - Union to supply manifold	35	26
Stage 4 - Union to diverter rail	35	26
Fuel injection diverter rail studs	23	17
Fuel supply line retaining bolts	10	7
Crankcase vent oil separator locating stud	10	7
EGR coolant cross-over pipe bolts	13	10
Intake air shut-off throttle retaining stud	10	7
Intake air shut-off throttle elbow retaining bolt	10	7
Fuel injection pump pulley nut	50	37
Fuel injection pump securing bolts	23	17
Fuel injection pump belt rear cover retaining bolt	7	5
Fuel injection pump belt tensioner retaining bolt	25	18
Fuel injector retaining bolts	10	7

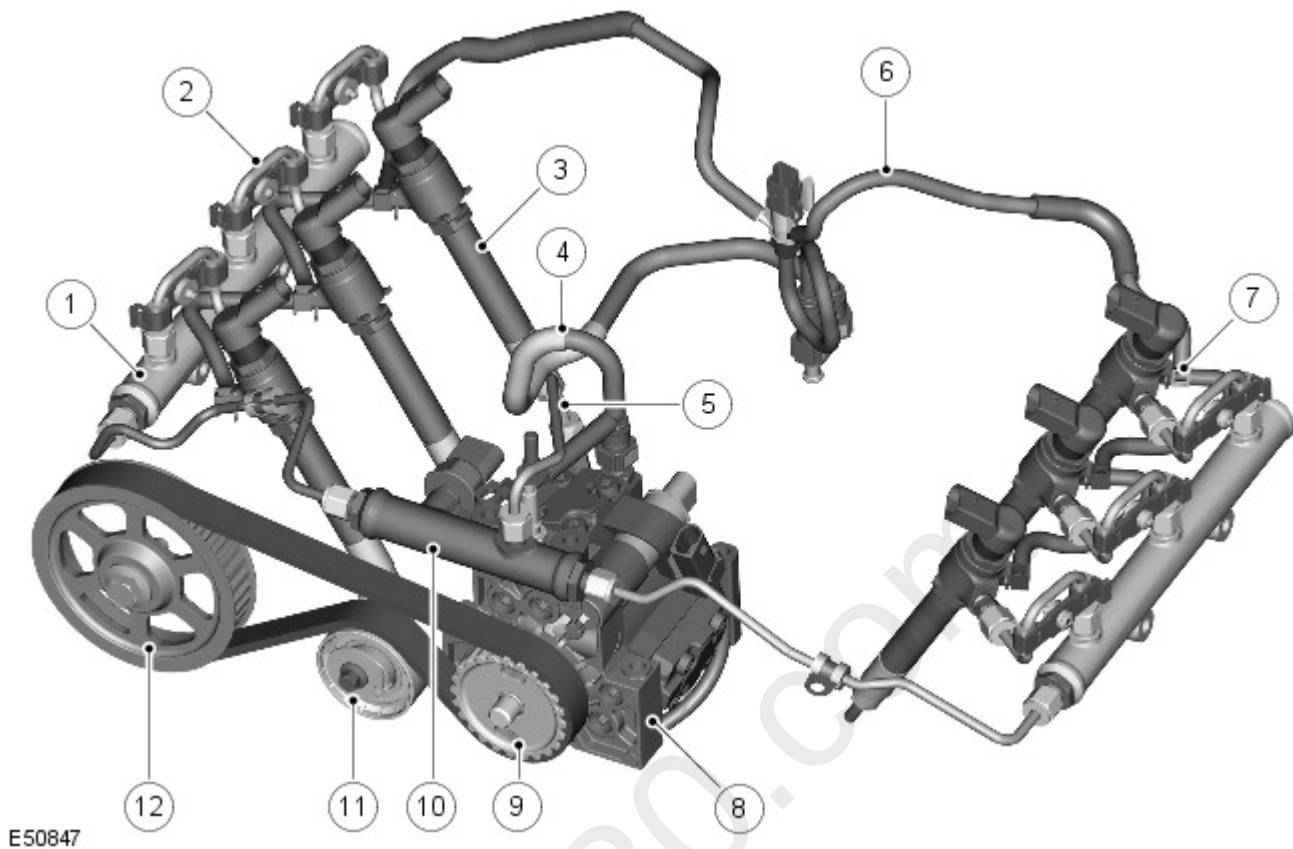
Fuel Pressures

Component	bar	psi
Fuel pump	0.5	7.25
High pressure fuel injection pump	1650 maximum	23931 maximum

Fuel Charging and Controls - TDV6 2.7L Diesel - Fuel Charging and Controls

Description and Operation

Component Locations



E50847

Item	Part Number	Description
1	-	High-pressure (HP) fuel rail (2 of)
2	-	HP pipe - Fuel rail to injector (6 of)
3	-	Injectors (6 of)
4	-	Low Pressure (LP) pipe - Fuel return
5	-	HP pipe - High Pressure Pump (HPP) to fuel diverter rail
6	-	LP pipe - Injector leak-back
7	-	Connector to injector (part of 6)
8	-	HPP
9	-	HPP pulley
10	-	HP diverter rail
11	-	Rear Engine Accessory Drive (READ) belt tensioner
12	-	LH exhaust camshaft pulley

GENERAL

The TdV6 is equipped with a High-Pressure (HP) common rail fuel injection system. With this fuel injection process, a High-Pressure Pump (HPP) delivers a uniform level of pressure to the shared fuel lines (the common rails), which serve all six fuel injectors. Pressure is controllable, to the optimum level for smooth operation, up to 1650 bar.

The common rail system supports a pre-injection (pilot) phase, which reduces combustion noise and mechanical load.

Fuel injection pressure is generated independently of engine speed and fuel injection events.

The fuel injection timing and volume are calculated by the Engine Control Module (ECM), 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 1650 bar for greater atomisation of fuel (increasing performance and lowering emissions)
- Variable injection to optimise combustion in all engine operating conditions
- Low tolerances and high precision throughout the life of the system

The fuel system is divided into 2 sub systems:

- Low-Pressure (LP) system
- HP system.

The LP system features the following components:

- In-tank fuel pump
- Fuel pressure regulator (integral to the fuel delivery module)
- Fuel filter
- Return pipes and fuel cooler
- Injector return pipes
- Fuel coolers (engine and vehicle)

The LP system pressure is regulated to 0.5 bar.

The HP system features the following components:

- HPP
- Common rails and diverter rail
- HP fuel pipes
- Injectors.

LP SYSTEM

In-tank Fuel Pump

The electric fuel pump is located inside the fuel tank. Fuel is pumped from the tank via the in-tank fuel pump, to the HPP via the fuel filter.

For additional information, refer to: [Fuel Tank and Lines](#) (310-01A Fuel Tank and Lines - TDV6 2.7L Diesel, Description and Operation).

Fuel Filter

The fuel filter is located in the engine compartment on the left hand side, packaged to be protected against damage. Incorporated in the fuel filter housing is a bimetallic temperature valve, which will start to close at 30°C (86°F) and will fully close at 50°C (122°F). This allows pre-heated diesel fuel to circulate inside the fuel filter to prevent waxing in cold operating conditions.

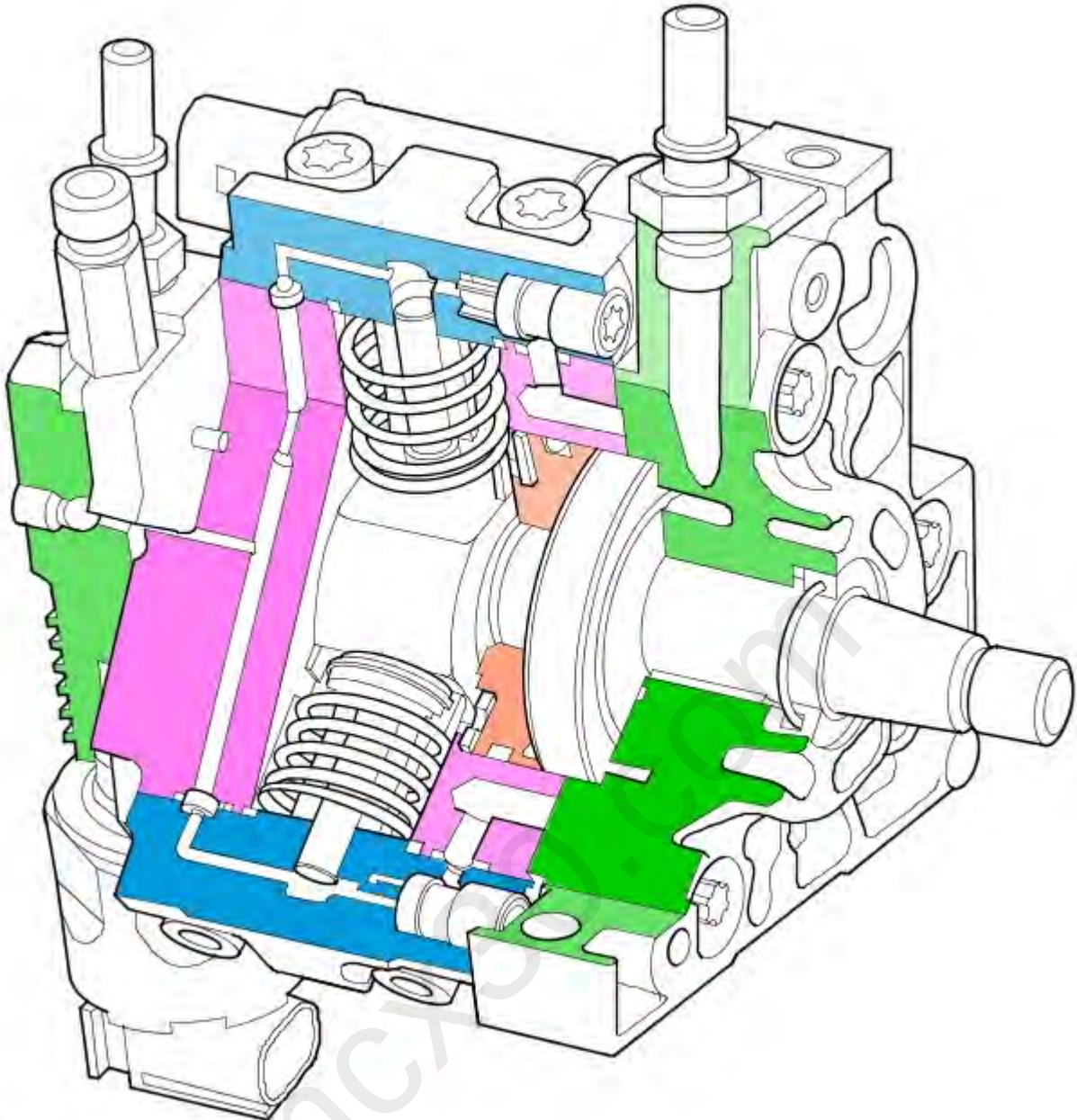
Fuel Cooler

Two fuel coolers are fitted to the vehicle. One is located in the 'vee' of the engine block, and has a coolant system connection to aid heat transfer. The second cooler is located in the fuel return line and is a fuel to air cooler.

For additional information, refer to: [Fuel Tank and Lines](#) (310-01A Fuel Tank and Lines - TDV6 2.7L Diesel, Description and Operation).

HP SYSTEM

HPP



E50833

The HPP is a three-piston (120 degree apart) radial plunger pump with a HP displacement of 0.8 cc. As mentioned, it has the ability to produce a maximum pressure of 1650 bar. The housing is cast from iron, the flange is cast from aluminium.

The pump is driven from the camshaft via a toothed belt. It does not need to be timed to the engine during belt replacement in service.

The required supply pressure to the HPP is -0.3 bar to +0.5 bar gauge. The return pressure is -0.3 bar to +0.8 bar gauge.

The pump is sized to deliver sufficient fuel to the HP rails for all engine-operating conditions.

The HPP consists of the following components:

- Internal Transfer Pump (ITP)
- Volume Control Valve (VCV)
- HP pumping elements (3 of)
- Pressure Control Valve (PCV)

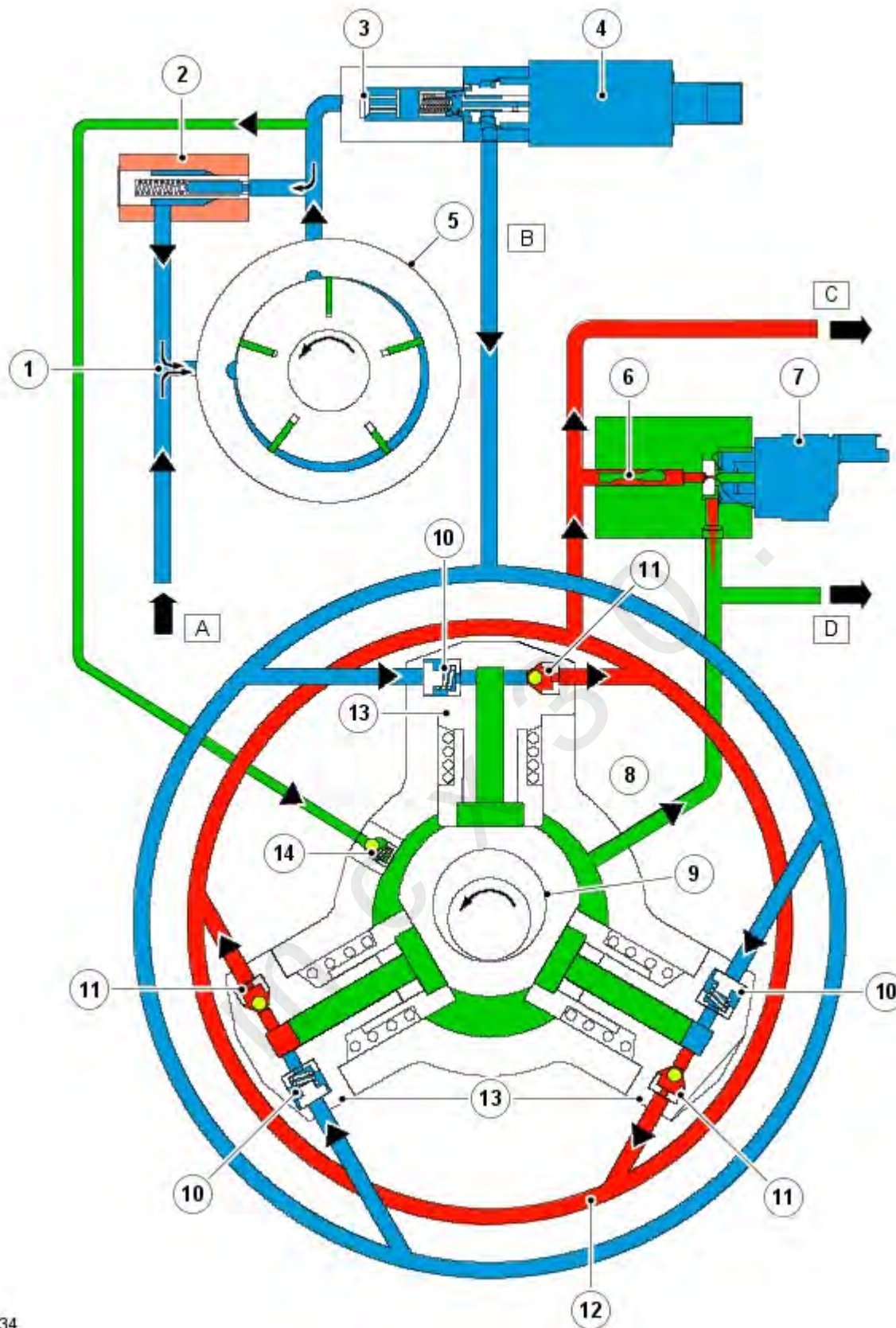
The ITP is a 5 vane pump. This conveys fuel to the VCV.

The VCV is a variable position solenoid valve electronically controlled by the ECM. The VCV is located between the ITP and the HP pumping elements. The VCV determines the amount of fuel that is delivered to the HP pumping elements. When there is no signal to the VCV the valve is closed, therefore no fuel delivery.

The 3 HP pumping elements are connected together in a fuel ring circuit within the pump. There is a single HP outlet connection for the HP pipe to the HP diverter rail.

The PCV is a variable position solenoid valve electronically controlled by the ECM. The PCV is located between the HP pumping elements and the HP outlet connection. The PCV regulates the amount of fuel pressure in the fuel rails and is controlled by the ECM. When there is no signal to the PCV the valve is open, therefore no rail pressure can be generated.

High Pressure Fuel Flow



E50834

Item	Part Number	Description
A	-	LP fuel supply
B	-	Fuel supply to the HP pumping elements
C	-	HP outlet connection to the HP diverter rail
D	-	LP fuel return (spill)
1	-	LP side of ITP
2	-	ITP pressure relief valve
3	-	Screen filter
4	-	VCV
5	-	ITP

6	-	Edge filter (to protect PCV)
7	-	PCV
8	-	N/A
9	-	Eccentric on HPP drive shaft
10	-	Pumping element inlet valve
11	-	Pumping element outlet valve
12	-	HP ring line
13	-	HPP elements (3 of)
14	-	Lubricating valve

The fuel induced by the ITP (5) is conveyed to the VCV (4) and the lubricating valve (14).

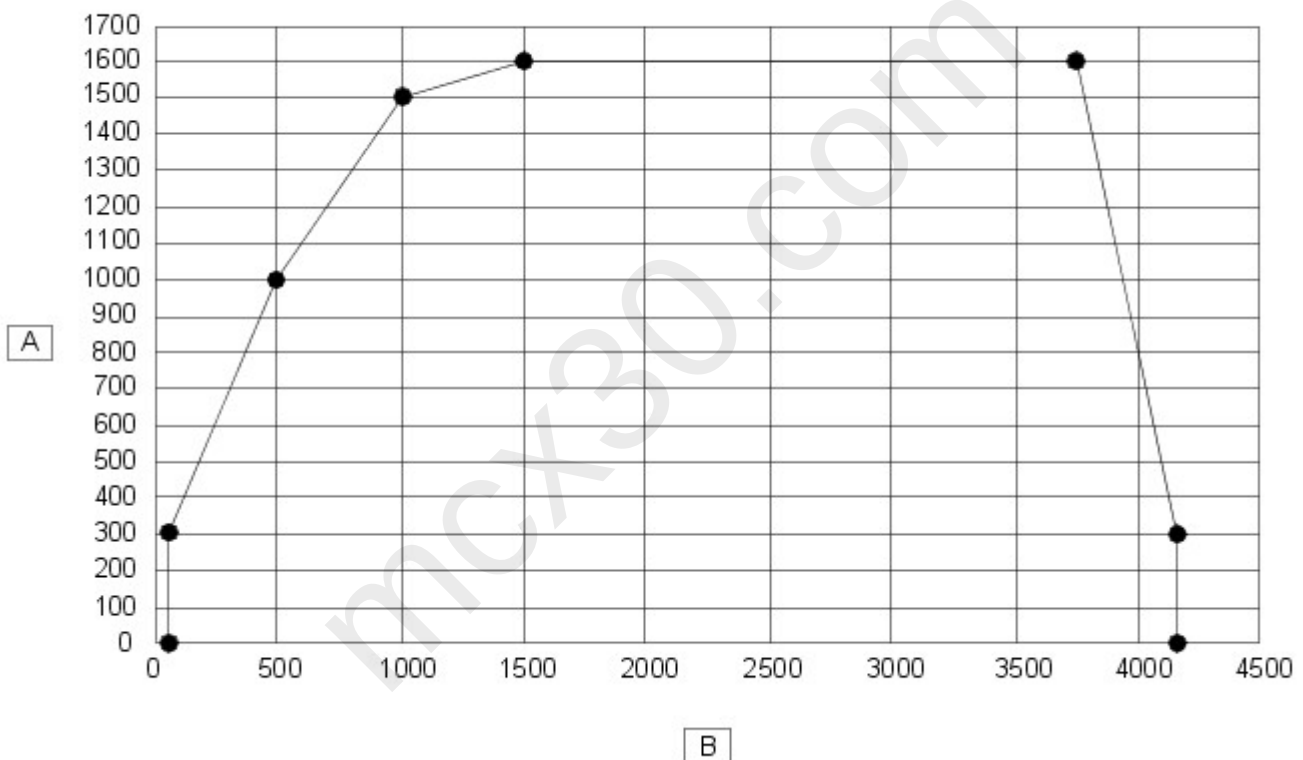
When the VCV is closed, the ITP pressure relief valve (2), lying parallel to the transfer pump, opens and conveys the fuel back to the LP side (1) of the transfer pump.

The fuel passes through the lubricating valve (14) into the interior of the HPP and from there to the fuel return (D). The fuel is used to lubricate the pump.

The VCV (4) determines the quantity of fuel (B) that is supplied to the pumping elements (13).

The fuel from the HP outlets (11) of the three pumping elements comes together in a ring line (12) and is conveyed through the HP outlet of the HPP ©) to the rails.

The PCV (7) regulates the fuel pressure in the fuel rails. Reducing rail pressure via the PCV results in fuel from the rail returning to the LP fuel return (D).



E50835

Item	Part Number	Description
A	-	Pump pressure (bar)
B	-	Pump speed (rpm)

The HPP can supply up to 1600 bar fuel pressure continuously with short excursions to 1650 bar. Pump speed is 5/6 engine speed. However it is calibrated to deliver fuel pressure dependant upon engine speed and load and is always under full control.

When the HPP is rotated, pressure is created when the VCV is open and the PCV is closed. The VCV and PCV are variable position to allow variable fuel delivery and pressure control.

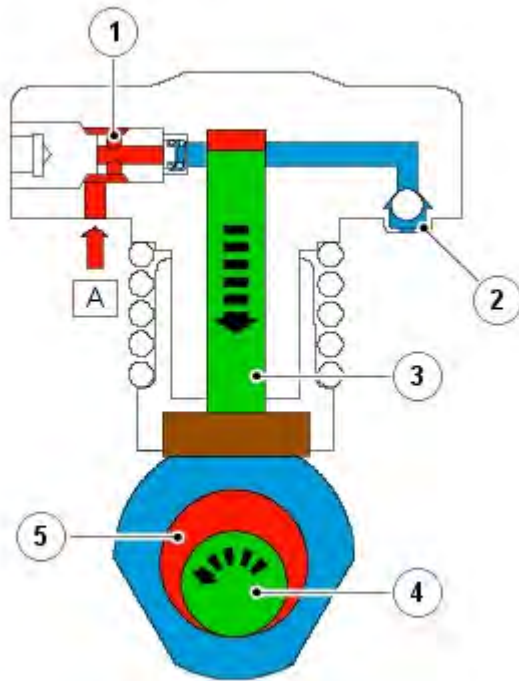
When the ECM actuates the piezo actuators, the rail pressure drop is off-set by additional fuel being delivered to the HP rails by the PCV.

Pressure Reduction After Engine Has Stopped

The fuel pressure in the system is reduced within a few seconds after the engine has stopped as the PCV no longer has the holding current it requires, and therefore opens. No residual pressure remains in the system and the fuel is returned to the fuel return line (D) through the open PCV. The system is pressureless.

Function of High A Pressure Element

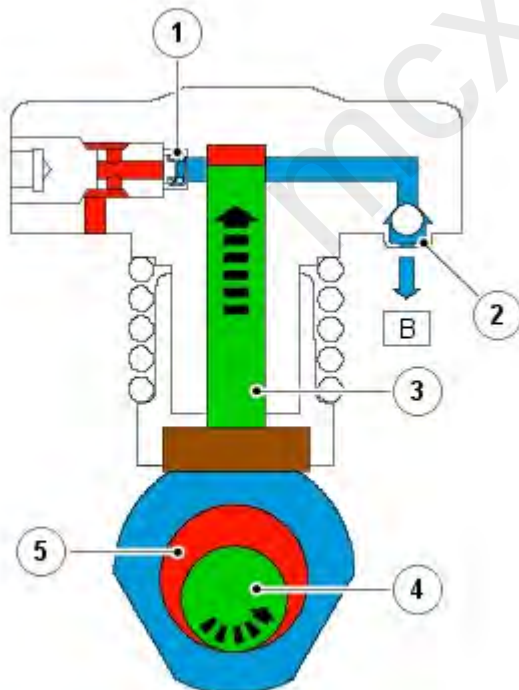
Fuel Induction



E50836

During the downward motion of the piston (3), a vacuum in the pump cylinder is generated, which opens the inlet valve (1) against the force exerted by the valve spring. The fuel (A), which is flowing past the VCV, is sucked in. At the same time the outlet valve (2) is closed due to the pressure difference between the pump cylinder and the HP fuel in the ring line.

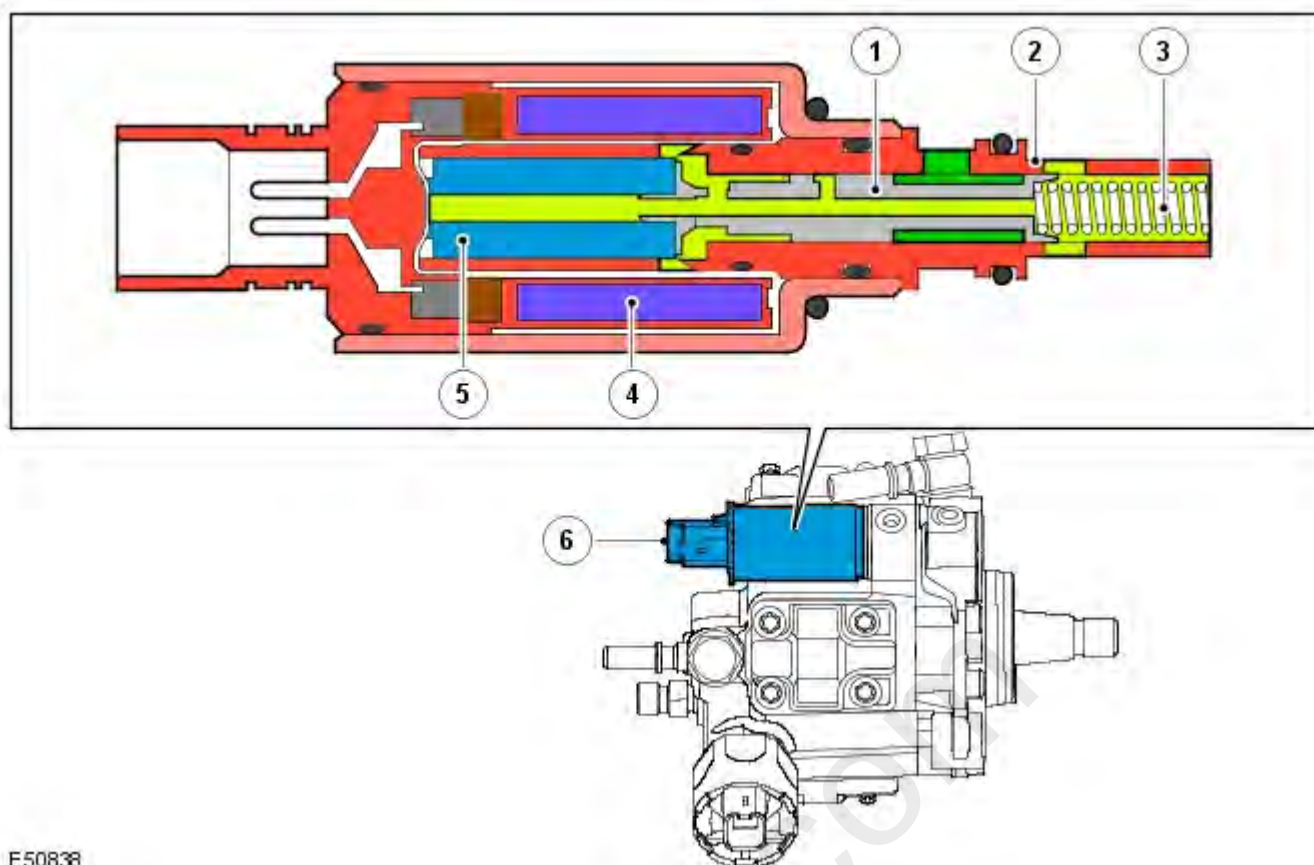
Fuel Delivery



E50837

The eccentric on the HPP driveshaft (5) presses the piston (3) upwards. The inlet valve (1) is then closed through the force exerted by the valve spring and the pressure being built up in the pump cylinder. The outlet valve (2) opens when the pressure in the pump cylinder is greater than the fuel pressure in the ring line (B).

Volume Control Valve (VCV)



E50838

Item	Part Number	Description
1	-	Piston
2	-	Sleeve
3	-	Compression spring
4	-	Coil
5	-	Armature
6	-	VCV

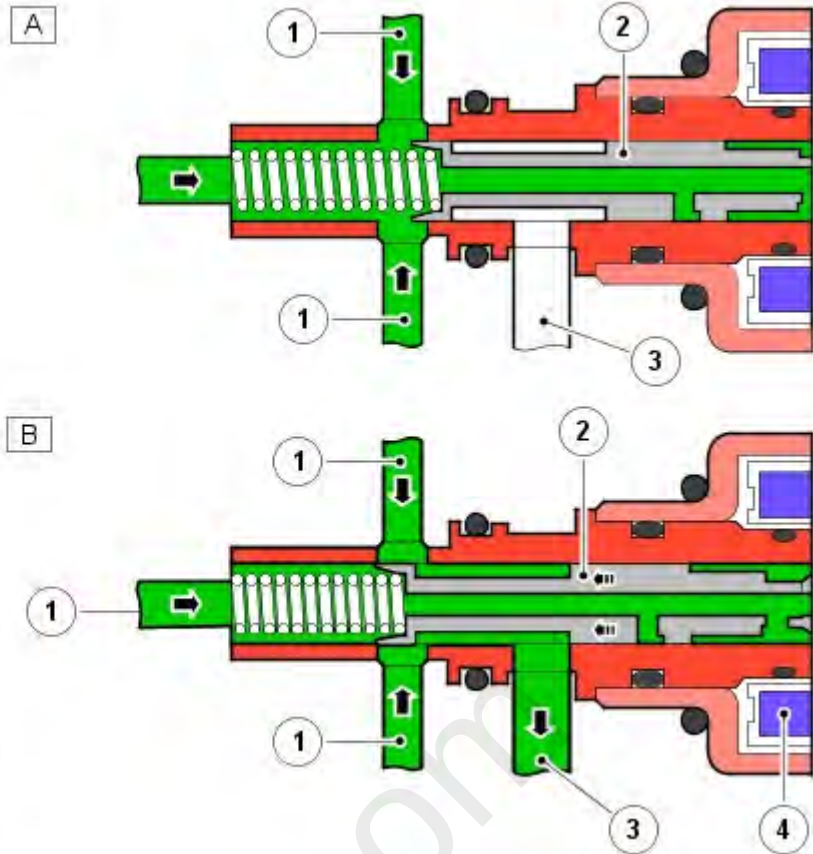
The VCV is fixed directly to the HPP.

The VCV regulates the fuel supply (and hence the quantity of fuel) from the transfer pump to the HPP elements, depending on the fuel pressure in the rail.

This makes it possible to match the delivery of the HPP to the requirements of the engine from the low-pressure 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 HPP, improving the efficiency of the engine.

- NOTE: The fuel volume control valve default is closed without electrical supply. An open circuit connector will prevent the engine from running.
- NOTE: The VCV cannot be replaced as a separate component in service.



E50839

Item	Part Number	Description
A	-	VCV not actuated
B	-	VCV actuated
1	-	Fuel supply from the transfer pump
2	-	Piston
3	-	Fuel supply to the HPP
4	-	Coil energised
5	-	Quantity of fuel
6	-	Control current
7	-	VCV at constant engine speed

VCV Not Actuated (A)

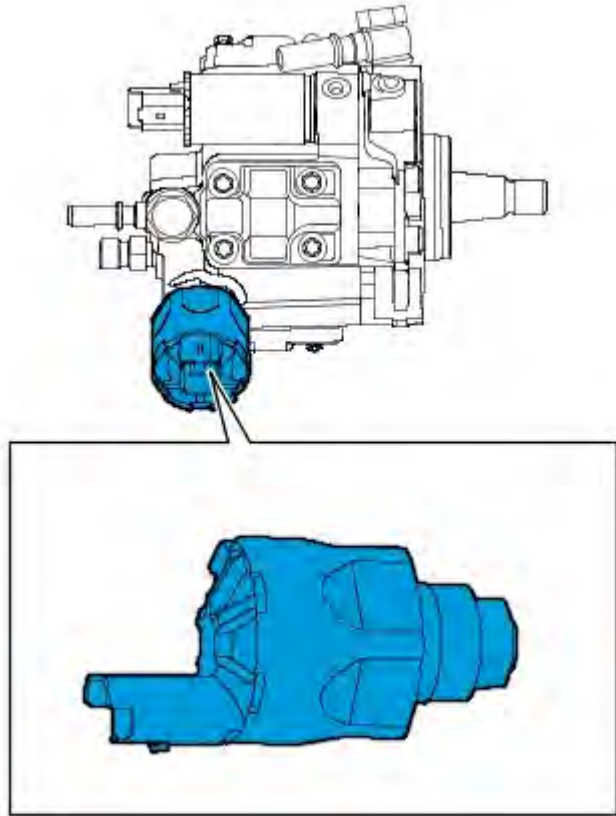
When there is no power supplied, the piston (2) closes the opening between the two connections (1) and (3) through the force of the compression spring. The fuel supply to the HPP is interrupted.

VCV Actuated (B)

The ECM energizes the coil (4) of the valve, according to the engines requirements. The armature force is proportional to the control current and counteracts the compression spring through the moving piston (2).

As a result, the opening between the two connections (1) and (3) and hence the quantity of fuel (5) supplied through the connector (3) to the HPP is also proportional to the control current (6). This means that the greater the opening cross-section, the greater the quantity of fuel supplied.

Pressure Control Valve (PCV)



E50840

The PCV is located on the HPP. It governs the fuel pressure at the HP outlet of the HPP and thus, the fuel pressure within the rail. In addition, the PCV dampens the fluctuations in the pressure, which occur during the delivery of fuel through the HPP and through the injection process.

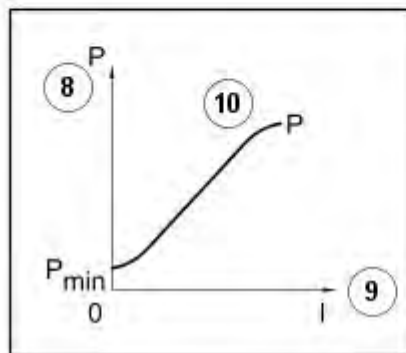
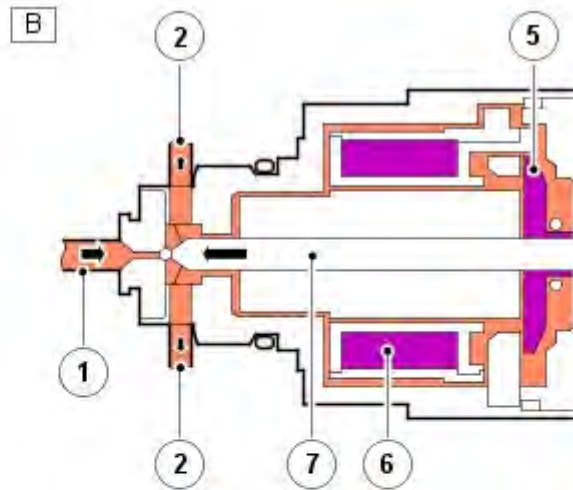
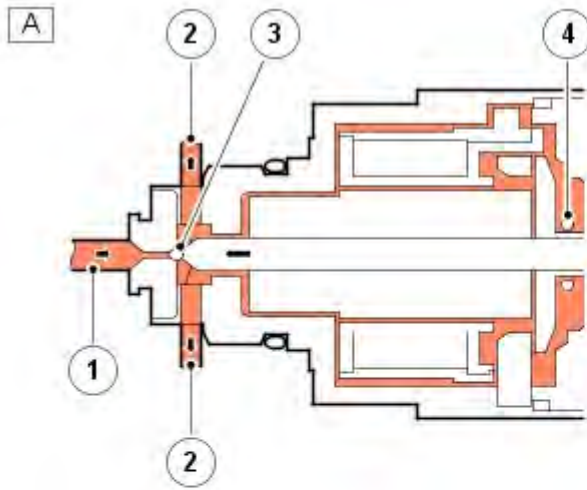
The PCV ensures that optimum pressure exists in the rail for every operating condition of the engine.

The PCV is an electro-magnetically operated valve with spring support.

The electrical current supplied by the ECM through the solenoid pulls back the control pin. This allows the diesel fuel to pass the ball valve and thus the fuel flow into the common rails.

The entire armature is coated with fuel for lubrication and cooling.

- NOTE: The PCV cannot be replaced as a separate component in service.



E50841

Item	Part Number	Description
A	-	PCV non-controlled
B	-	PCV controlled
1	-	Fuel from the HPP
2	-	To fuel return
3	-	Ball valve
4	-	Compression spring
5	-	Armature
6	-	Coil energised
7	-	Control pin
8	-	High pressure fuel
9	-	Control current
10	-	Characteristic of the PCV

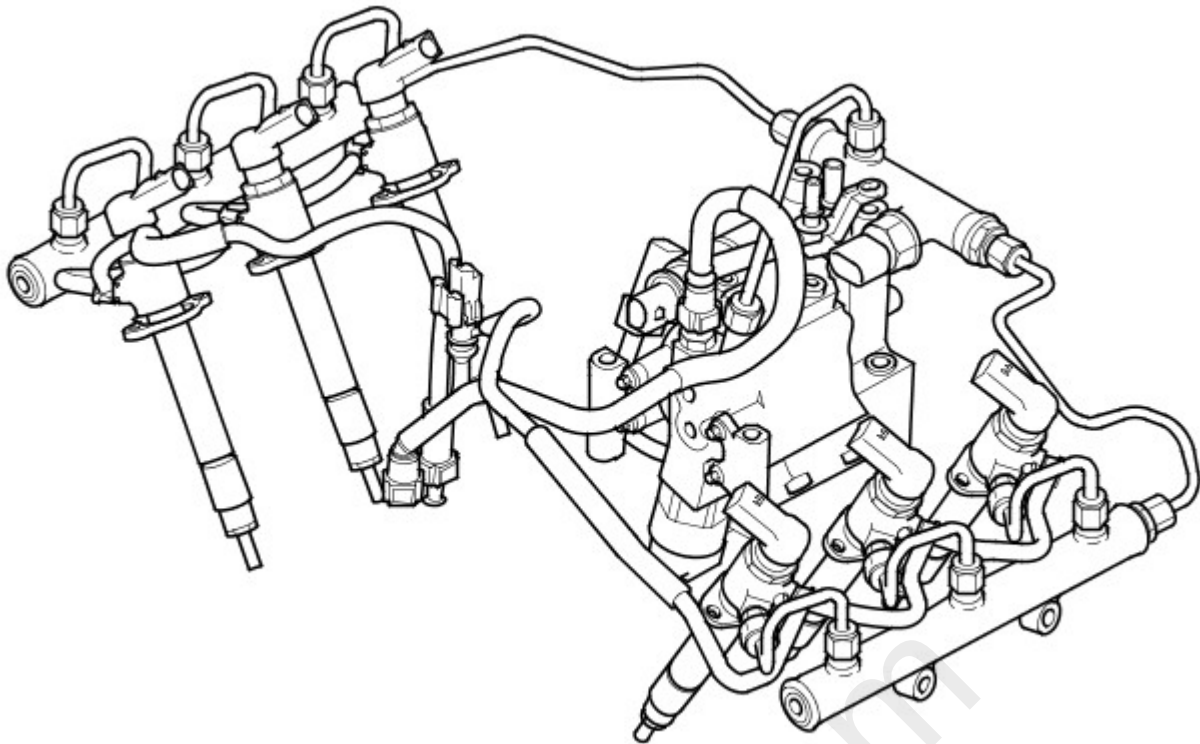
PCV Non-controlled (A)

The ball valve (3) will only be operated through the force exerted upon it by the spring (4). Thereby, the PCV is classed as open.

PCV Controlled (B)

The current flowing through the solenoid (6) draws the pin (7) down. This in turn transfers the magnetic force via the pin to the ball valve (3). The pull of the pin, and the pressure on the ball valve, is proportional to the valve flow (9).

HP Common Fuel Rails

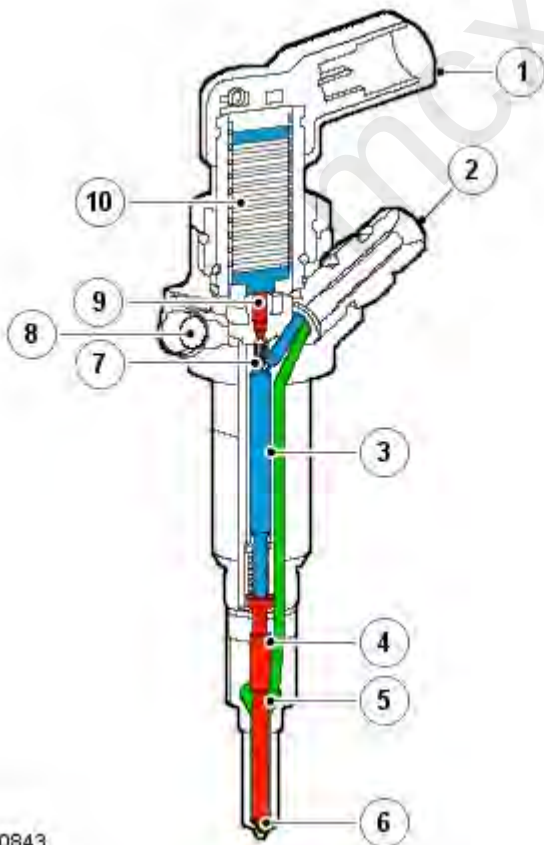


E50842

The fuel rails are manufactured from forged steel. They store the fuel at high pressure and prevent pressure fluctuations in the HP system.

All HP pipes have an internal diameter of 2.5mm except the pipes to the injectors, which are 3.0mm. Total rail volume is 33cc.

FUEL INJECTORS



E50843

Item	Part Number	Description
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1	-	Harness connection
2	-	HP connection
3	-	Control piston
4	-	Nozzle needle
5	-	Nozzle HP chamber
6	-	Nozzle spray holes
7	-	Valve mushroom
8	-	Fuel return
9	-	Valve piston
10	-	Piezo actuator

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:

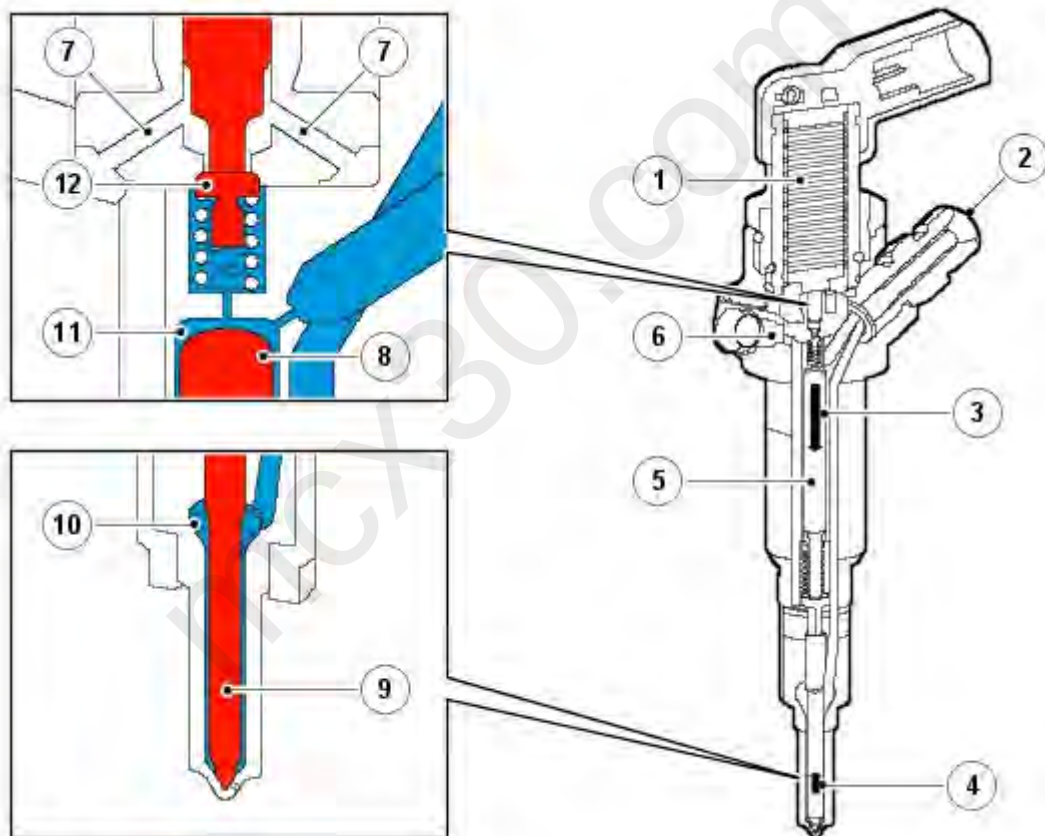
- The piezo actuator
- The injector body containing the hydraulic servo system
- The fuel injector nozzle

• NOTE: New injectors can be installed in any cylinder and DO NOT have to be configured.

• NOTE: 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.

• NOTE: For safety reasons, the engine must be at standstill for 30 seconds before starting work on the HP fuel systems.

Fuel Injector Not Actuated (Not Injecting Fuel)



E50844

Item	Part Number	Description
1	-	Piezo actuator
2	-	HP connection
3	-	Hydraulic force applied on control piston
4	-	Hydraulic force acting on tip of nozzle
5	-	Control piston
6	-	Fuel return
7	-	Fuel return
8	-	Control piston
9	-	Nozzle needle
10	-	High pressure chamber of nozzle
11	-	Control chamber
12	-	Valve mushroom

The HP fuel from the fuel-rail passes through the HP connection (2) into the control chamber (11) and into the HP chamber (10) of the fuel injector nozzle.

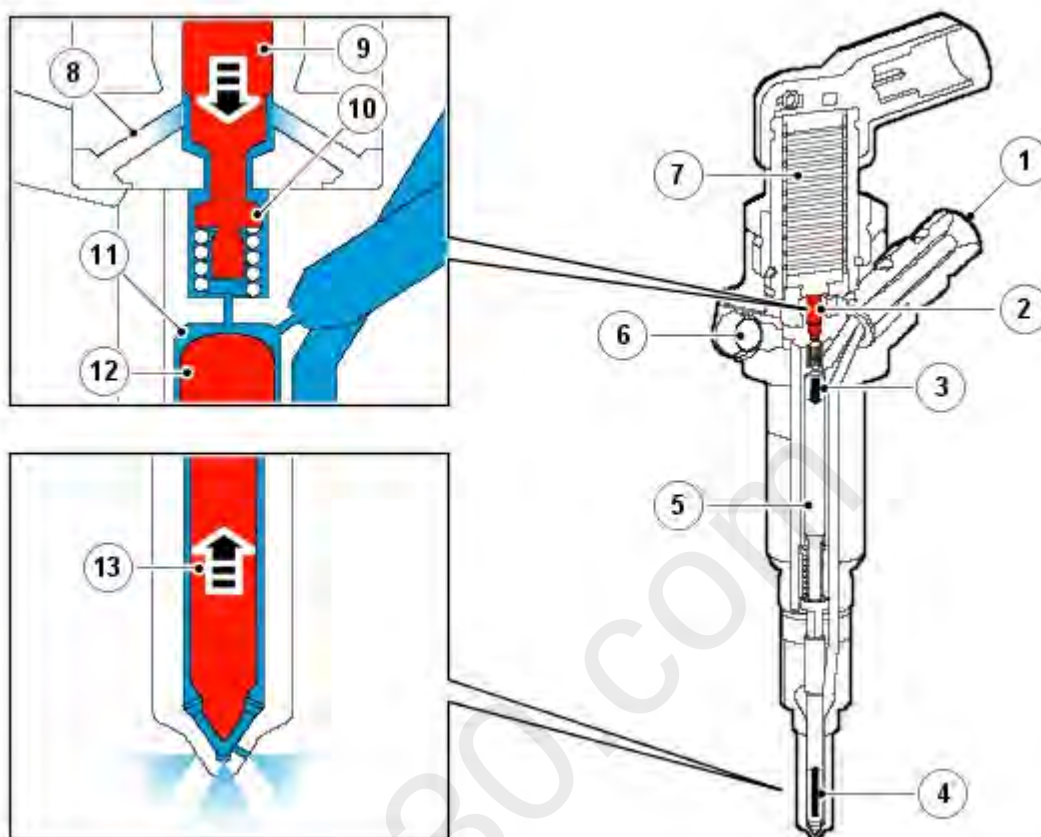
The piezo actuator (1) is currentless and the valve mushroom (12) closes the bore to the fuel return (7) by means of spring

pressure.

There is how ever a continuous fuel return (6) to vent internal leakage within the injector.

The hydraulic force (3), which is now applied on the control piston by the fuel under high pressure in the control chamber (11) through the control piston (8), is greater than the hydraulic force (4) acting on the tip of the nozzle (since the area of the control piston in the control chamber is greater than the area of the tip of the nozzle).

Fuel Injector Actuated (Injecting Fuel)



E50845

Item	Part Number	Description
1	-	High pressure supply
2	-	Valve piston
3	-	Hydraulic force applied on control piston
4	-	Hydraulic force acting on tip of nozzle
5	-	Control piston
6	-	Fuel return
7	-	Piezo actuator
8	-	Fuel return
9	-	Valve piston
10	-	Valve mushroom
11	-	Control chamber
12	-	Control piston
13	-	Nozzle needle

The piezo actuator (7) energized by the ECM extends (charging phase) and presses on the valve piston (9). The valve mushroom (10) opens the bore, which connects the control chamber (11) to the fuel return (8 then 6).

As a result, the pressure in the control chamber drops, and the hydraulic force (4) acting on the tip of the nozzle needle is now greater than the force (3) acting on the control piston in the control chamber.

The nozzle needle (13) moves upwards and the fuel passes through the six spray holes into the combustion chamber.

Engine Starting

During starting, the fuel rail pressure must be at least 150 bar. Should the pressure be below this figure, the injectors will not operate, resulting in the vehicle not starting.

Engine Stopped

To stop the engine the ECM stops energising the piezo actuators, therefore, no fuel is injected and the engine speed drops to zero.

Fuel Charging and Controls - TDV6 2.7L 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 of the workshop manual.

REFER to: [Fuel Charging and Controls](#) (303-04A Fuel Charging and Controls - TDV6 2.7L 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 its 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. **1.** Verify the customer concern.
2. **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 (EGR) system	● Glow plug indicator ● Inertia switch ● Fuel pump module ● Sensor(s) ● Engine Control Module (ECM) ● Fuel volume control valve (FVCV) ● Fuel pressure control valve (FPCV) ● Fuel rail pressure (FRP) sensor ● Fuel temperature sensor ● Fuel injector(s) ● Exhaust Gas Recirculation (EGR) system

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 start	● Inertia fuel shutoff switch ● Low/Contaminated fuel ● Air leakage ● Low-pressure fuel system fault ● Fuel pump module (lift pump) fault ● Blocked fuel filter ● Fuel volume regulator blocked/contaminated ● Fuel pressure control valve blocked/contaminated ● Fuel pump fault ● Crankshaft position (CKP) sensor	Check that the inertia switch has not tripped. 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 (EGR) 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 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)	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.

Symptom	Possible Causes	Action
	valve(s) fault	
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 blocked/contaminated ● Fuel pressure control valve blocked/contaminated ● Fuel temperature sensor leak ● High pressure fuel leak ● Injector(s) fault ● Exhaust gas recirculation (EGR) valve(s) fault	Check the low-pressure fuel system for leaks/damage. 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.

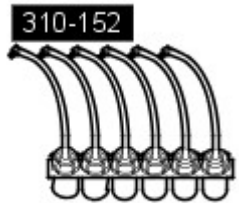
DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.

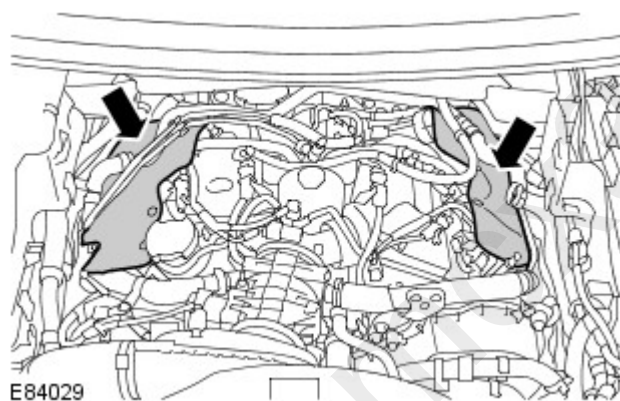
REFER to: [Diagnostic Trouble Code \(DTC\) Index - TDV6 2.7L Diesel, DTC: Engine Control Module \(PCM\)](#) (100-00 General Information, Description and Operation).

Fuel Charging and Controls - TDV6 2.7L Diesel - Fuel Injector Balance and Spill Check

General Procedures

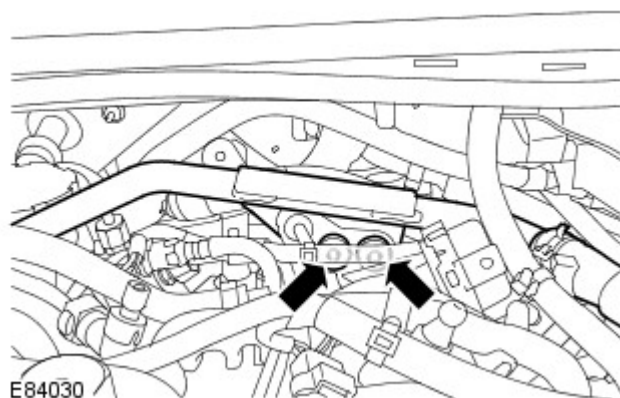
Special Tool(s)	
 310-152 E84154	Fuel Injector Spill Test Kit 310-152
 310-152-02 E84153	Fuel Return Blanking Caps 310-152-02

1. Disconnect the battery ground cable.
For additional information, refer to: Specifications (414-00 Charging System - General Information, Specifications).
2. Remove the engine cover.
For additional information, refer to: Engine Cover - 2.7L Diesel (501-05 Interior Trim and Oramentation, Removal and Installation).
3. Remove the injector sound proofing.

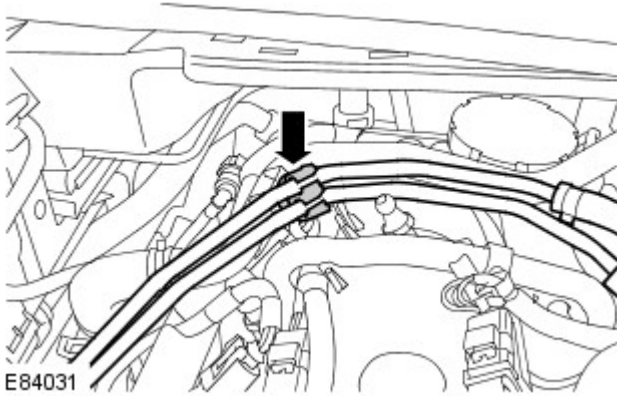


4. Release the EGR coolant cross-over pipe.

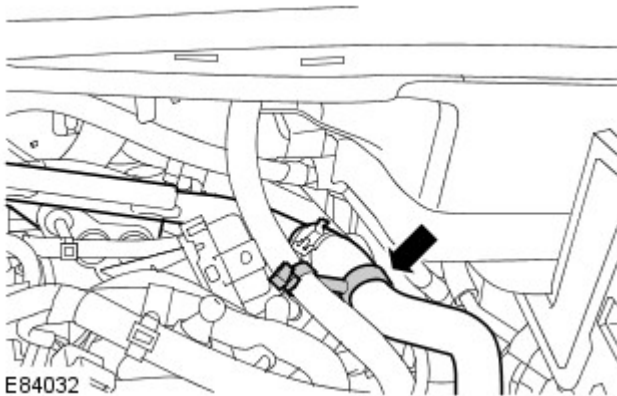
- Remove the 2 bolts.



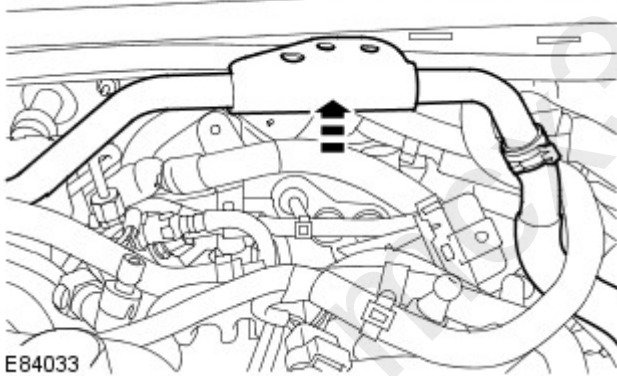
5. Release the fuel supply and fuel return clips from the heater hose.



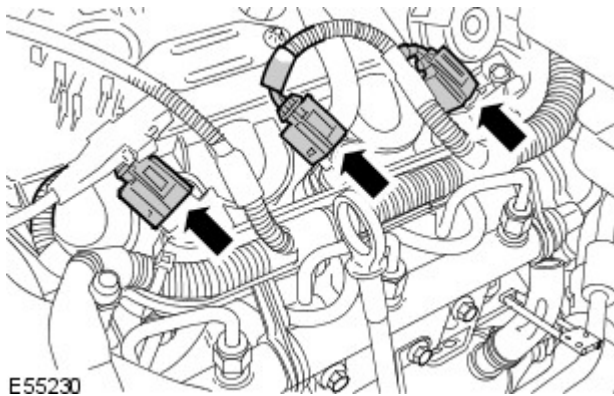
6. Release the engine harness and heater hose from clip.



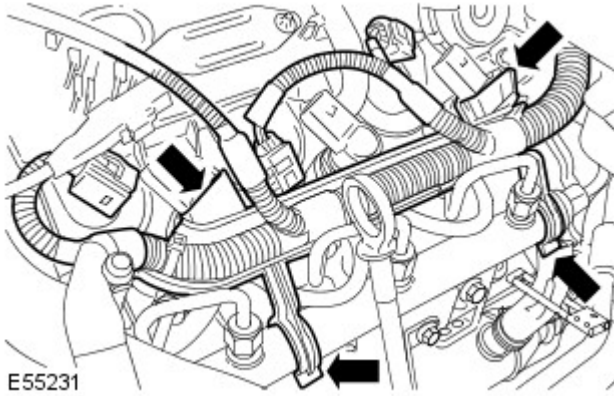
7. Release the coolant pipe on bulkhead and position aside. Do not disconnect the coolant pipe.



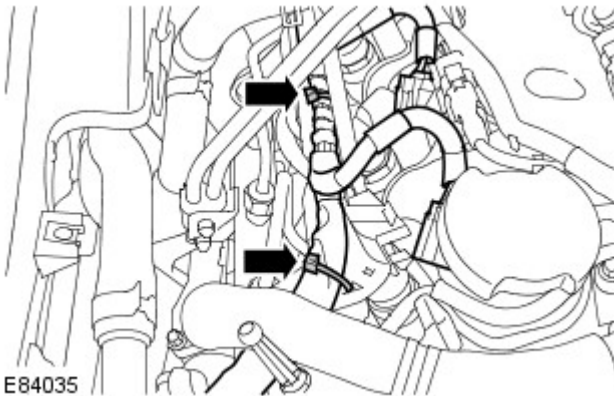
8. Disconnect the fuel injector electrical connectors.



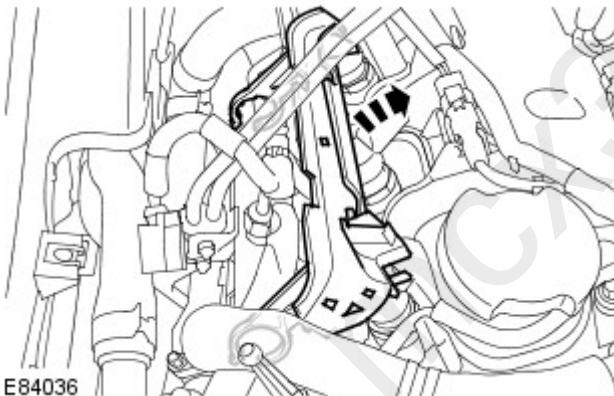
9. Detach the fuel injection wiring harness.



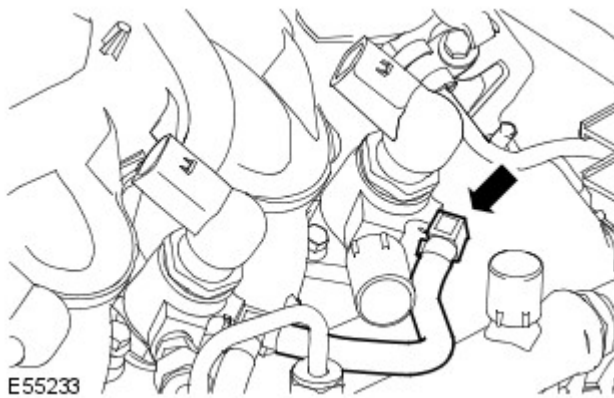
10. Cut and remove cable ties securing harness to support tray.



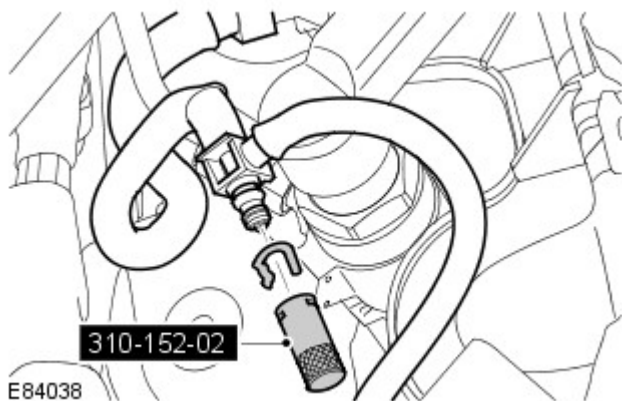
11. Release the harness bracket clips and remove the support trays.



12. Disconnect the fuel return line from the fuel injectors.

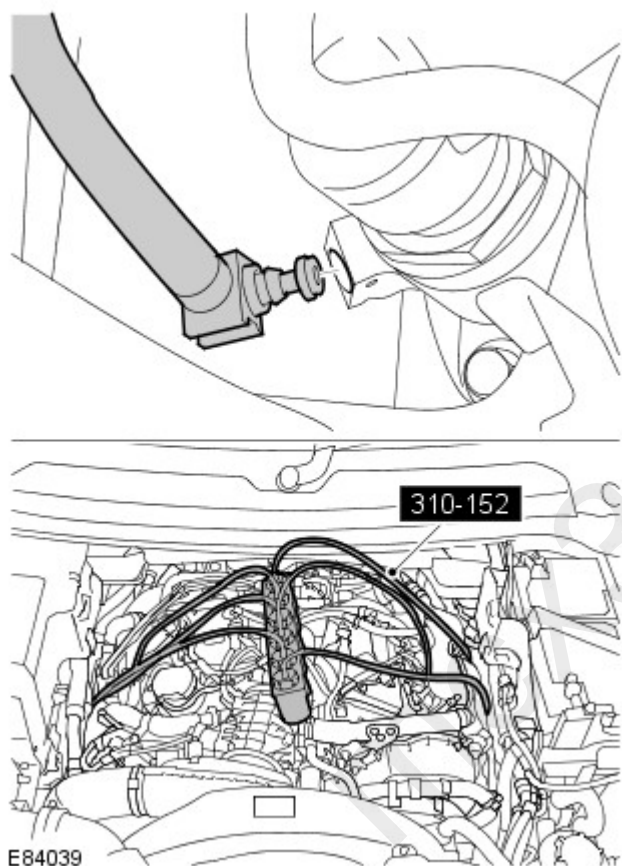


13. Blank-off each spill return with plugs from kit.



14. Connect the fuel injector electrical connectors.

15. Connect spill bottle to each of the injectors.



16. Connect the battery ground cable.

17. Connect Land Rover approved diagnostic equipment to vehicle.

18. Run cylinder balance test from 'live data'.

- Injector balance limits are between 700 and 1.3 k.
- Note any injector that is outside of these figures (a figure below the limit will usually mean a reduction in fuelling, and a figure above will result in an increase to fuelling).

19.  **WARNING:** Before starting engine, ensure all connectors are properly secure.

 **CAUTION:** Do not reject any of the injectors if the spill rates are even but outside of the correct rates shown. The spill rate can be affected by varying fuel rail pressure and fuel temperature. Only suspect a faulty injector(s) if the amount of fuel collected is significantly higher than the others. A faulty injector could fill a bottle within 2 minutes.

- **NOTE:** The figures shown are to be used as a guide only.

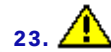
Start the engine and immediately check the spill rate into the bottles. If possible, allow engine to run for 2 minutes. If any bottle is filling at a very fast rate and is likely to fill before 2 minutes is reached, stop engine and note which injector the fuel is coming from.

Time	Flow Rate
1 minute idle	Min rate 10 ml - Max rate 25 ml
4 minute idle	Min rate 15 ml - Max rate 26 ml

20. Disconnect the battery ground cable.

21. Disconnect all spill pipes and bottles. Replace an injector(s) that has either excessive spill or failed the balance check.

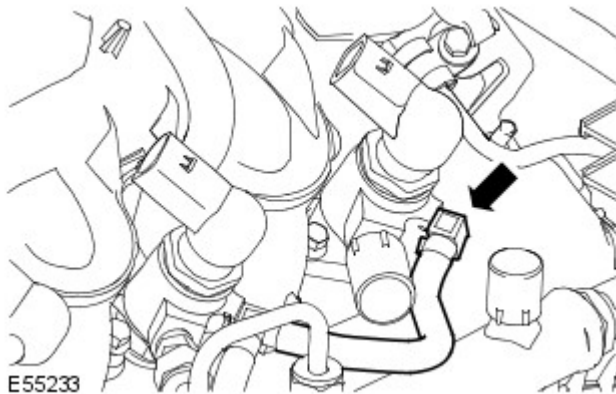
22. Remove blank-off plugs from spill return pipes.



23. CAUTION: Make sure the fuel return line retaining clip is correctly installed to the fuel injector before installing the return line.

Connect the fuel return line to the fuel injector.

- Visually inspect the fuel return line O-ring seals for damage.
- Apply a light coating of petroleum jelly to the fuel return line O-ring seals.



24. Disconnect the injector electrical connectors and release the wiring harness.

25. Install the injector harness support trays and secure with cable ties.

26. Connect and secure the fuel injector wiring harness electrical connectors.

27. Secure the engine harness to heater hose clip.

28. Secure the fuel supply and fuel return to heater hose clips.

29. Refit coolant pipe to mounting at rear of engine.

30. Install the EGR coolant cross-over pipe.

- Tighten the bolts to 13 Nm (10 lb.ft).

31. Install the injector sound proofing.

32. Install the engine cover.

For additional information, refer to: Engine Cover - 2.7L Diesel (501-05 Interior Trim and Ornamentation, Removal and Installation).

33. Connect the battery ground cable.

For additional information, refer to: Specifications (414-00 Charging System - General Information, Specifications).

Fuel Charging and Controls - TDV6 2.7L 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.

Fuel Charging and Controls - TDV6 2.7L Diesel - Fuel PumpVIN Range:**SALLA000304->END OF 06MY**

Removal and Installation

Special Tool(s)	
 310-139 E54548	Holder - Fuel Pump Pulley 310-139
 310-138 E54547	Reaction Arm - Fuel Pump Pulley 310-138

Removal

• WARNINGS:

-  Do not carry or operate cellular phones when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.
-  Do not carry out any repairs to the fuel system with the engine running. The fuel pressure within the system can be as high as 1650 bar (23,931 lb-sq-in). Failure to follow this instruction may result in personal injury.
-  Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.
-  This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow these instructions may result in personal injury.

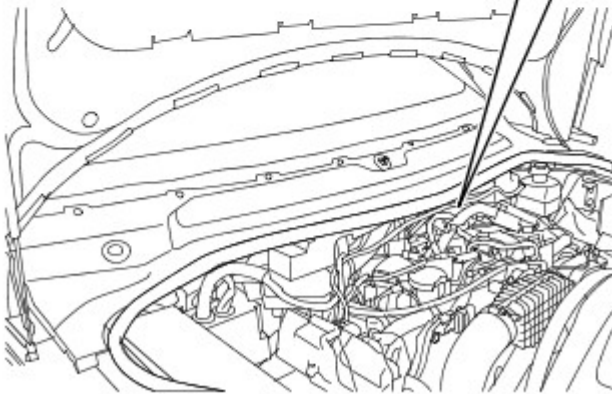
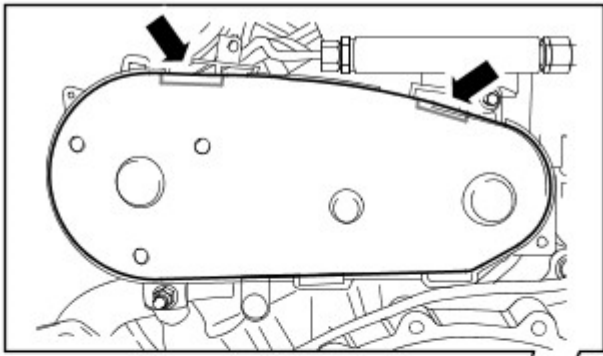
• CAUTIONS:

-  Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.
-  Always carry out the cleaning process before carrying out any repairs to the fuel injection system components. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.
-  Diesel fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.
-  Do not disassemble or clean inside the fuel pump, even with an ultrasonic cleaner. Always install a new fuel pump when required.

1. Disconnect the battery ground cable.
For additional information, refer to: Specifications (414-00, Specifications).
2. Remove the crankcase vent oil separator.
For additional information, refer to: [Crankcase Vent Oil Separator](#) (303-08A Engine Emission Control - TDV6 2.7L Diesel, Removal and Installation).

3. Remove the fuel injection pump belt cover.

- Reposition the engine wiring harness to allow access to the fuel injection pump belt cover.

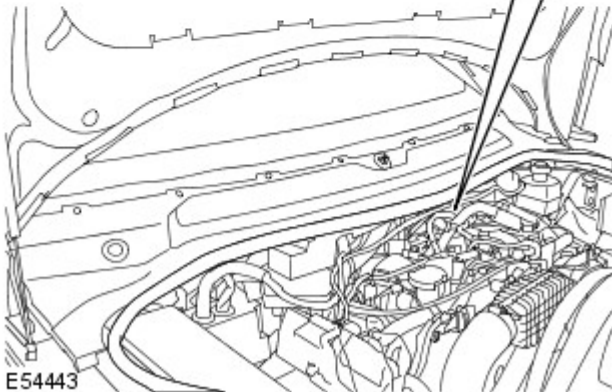
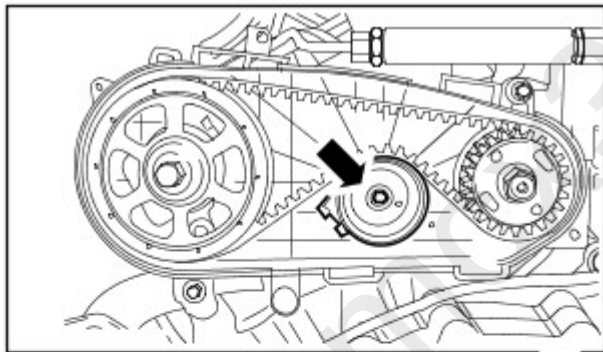


E54442

4. NOTE: The fuel injection pump belt is not timed to the engine.

Remove and discard the fuel injection pump belt tensioner.

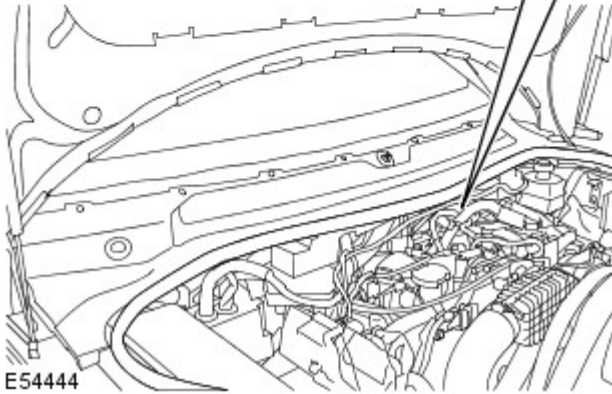
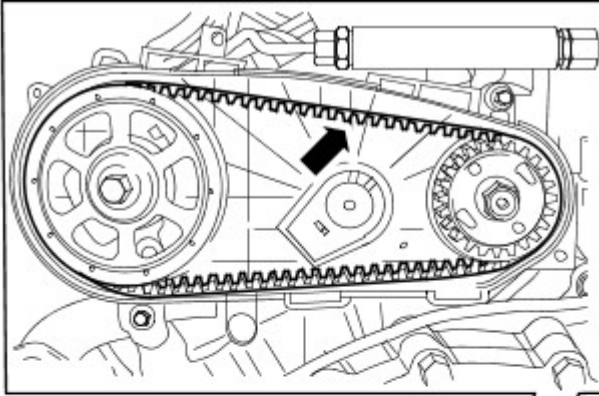
- Remove the LH retaining bolt.



E54443

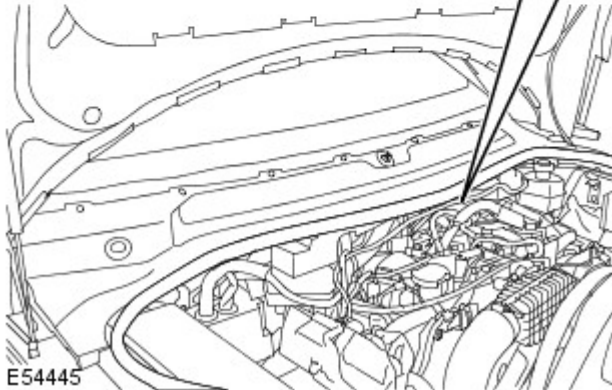
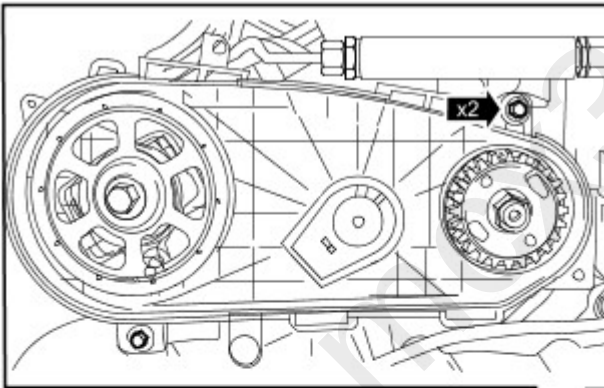
- 5. NOTE:** The fuel injection pump rotates in a counter-clockwise direction when viewed from the rear of the engine.

Remove and discard the fuel injection pump belt.



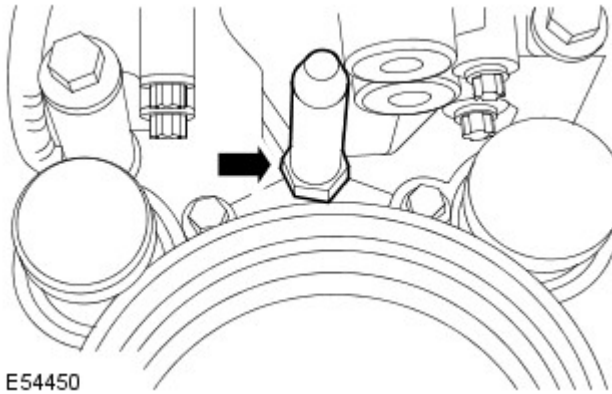
E54444

- 6.** Remove the fuel injection pump belt rear cover retaining bolts.



E54445

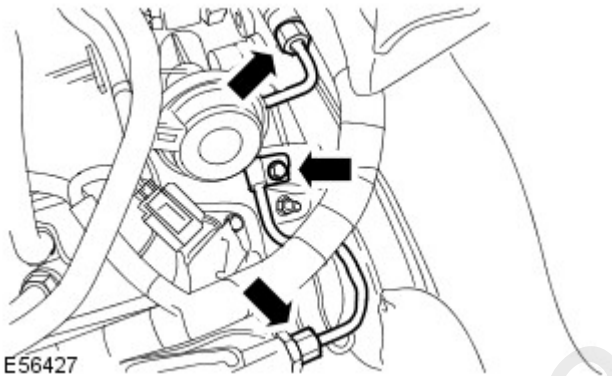
7. Remove the crankcase vent oil separator locating stud.



8. **NOTE:** Left-hand shown, right-hand similar.

Release the high-pressure fuel supply lines.

- Remove the LH retaining bolt.



9.  **CAUTION:** Make sure that the high-pressure fuel supply line remains in contact with the fuel injection supply manifold and the fuel injection diverter rail until both unions have been detached and cleaned. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

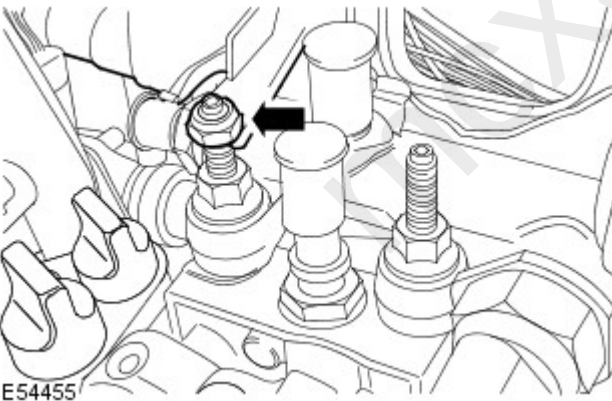
• **NOTE:** Left-hand shown, right-hand similar.

Remove and discard the high-pressure fuel supply lines.

- Install blanking caps to the exposed ports.

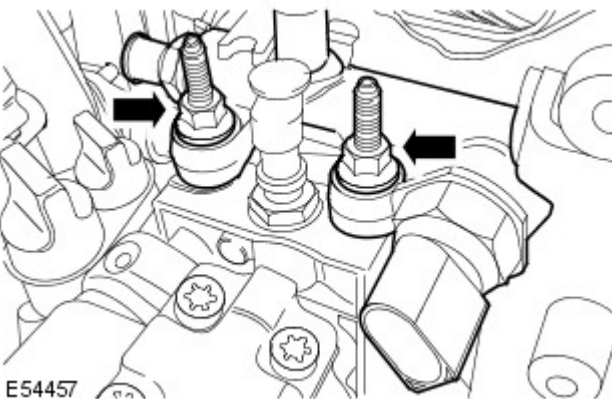
10. Release the fuel charging wiring harness.

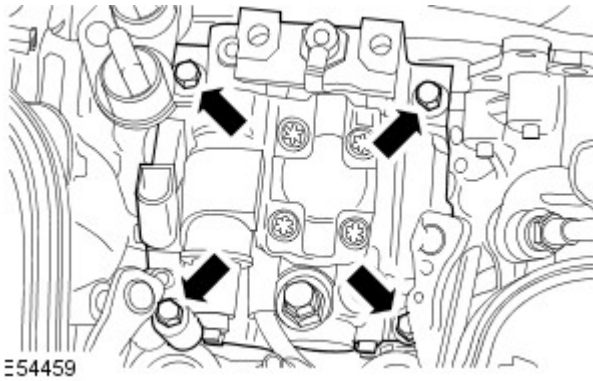
- Remove the retaining nut.



11. Remove the fuel injection diverter rail.

- Remove the 2 studs.



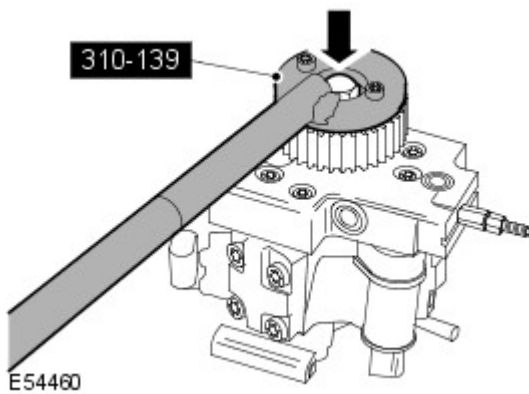


12. Remove the fuel injection pump.

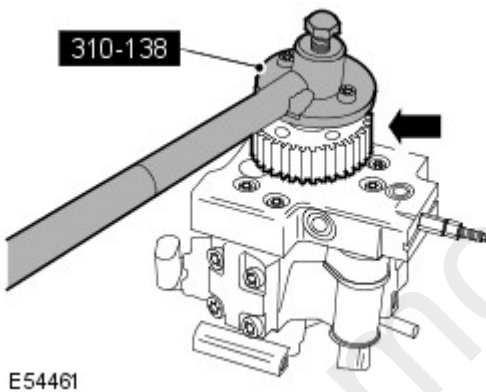
- Remove the four retaining bolts.

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

Using the special tool, remove the fuel injection pump pulley retaining nut.



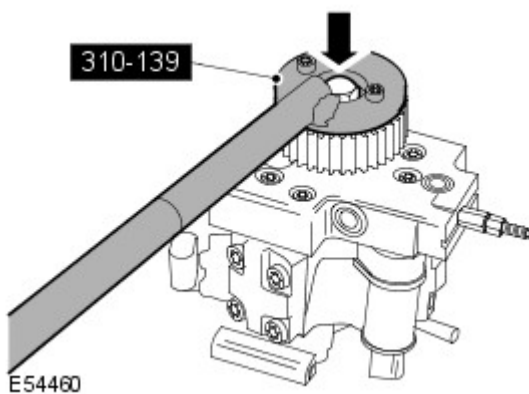
14. Using the special tool, remove the fuel injection pump pulley.



Installation

1. Using the special tool, install the fuel injection pump pulley.

- Tighten to 50 Nm (37 lb.ft).



2. Install the fuel injection pump.

- Tighten the bolts to 23 Nm (17 lb.ft).

3. Install the fuel injection diverter rail.

- Install the two retaining studs, but do not fully tighten at this stage.

4. Attach the fuel charging wiring harness.

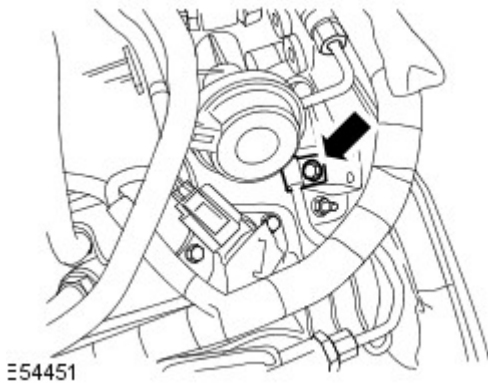
- Install the retaining nut.

5. Install the new high-pressure fuel supply lines.

- Remove the blanking caps from the ports.
- Loosely install the new high-pressure fuel supply lines.
- Tighten the fuel injection diverter rail retaining studs to 23 Nm (17 lb.ft).
- Stage 1: Tighten the high-pressure fuel supply line union at the fuel injection supply manifold to 15 Nm (11 lb.ft).
- Stage 2: Tighten the high-pressure fuel supply line union at the fuel injection diverter rail to 15 Nm (11 lb.ft).
- Stage 3: Tighten the high-pressure fuel supply line union at the fuel injection supply manifold to 35 Nm (26 lb.ft).
- Stage 4: Tighten the high-pressure fuel supply line union at the fuel injection pump to 35 Nm (26 lb.ft).

6. Attach the high-pressure fuel supply lines.

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



7. Install the crankcase vent oil separator locating stud.

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

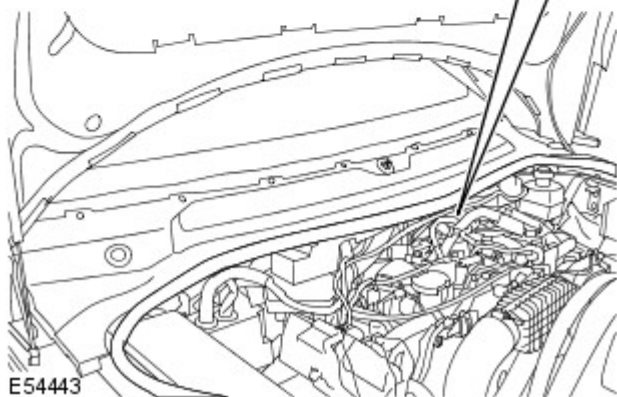
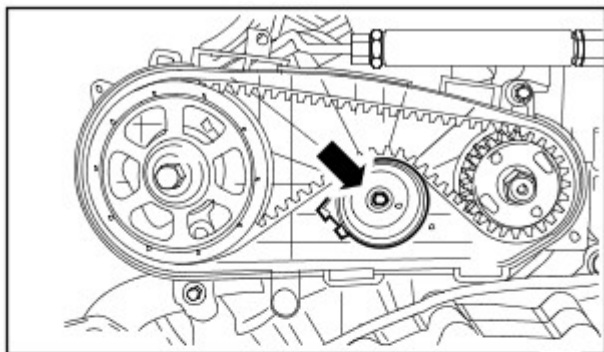
8. Install the fuel injection pump belt rear cover retaining bolts.

- Tighten to 7 Nm (5 lb.ft).

9.  **CAUTION:** Do not install the new fuel injection pump belt to the pulleys with the fuel pump belt tensioner installed. Failure to follow this instruction may result in damage to the fuel pump belt.

• **NOTE:** The fuel injection pump rotates in a counter-clockwise direction when viewed from the rear of the engine.

Install the new fuel injection pump belt.



10. ⚠ CAUTION: Make sure that the fuel injection pump belt tensioner tang is correctly located to the fuel injection pump belt rear cover. Failure to follow this instruction may result in damage to the engine.

Install a new fuel injection pump belt tensioner.

- Locate the tang on the new fuel injection pump belt tensioner into the fuel injection pump rear cover.
- Tighten to 25 Nm (18 lb.ft).
- Remove and discard the fuel injection pump belt tensioner locking pin.

11. Install the fuel injection pump belt cover.

- Reposition the engine wiring harness to allow access to the fuel injection pump belt cover.

12. Install the crankcase vent oil separator.

For additional information, refer to: [Crankcase Vent Oil Separator](#) (303-08A Engine Emission Control - TDV6 2.7L Diesel, Removal and Installation).

13. Connect the battery ground cable.

For additional information, refer to: Specifications (414-00, Specifications).

14. Bleed the fuel system.

For additional information, refer to: [Low-Pressure Fuel System Bleeding](#) (310-00 Fuel System - General Information, General Procedures).

Fuel Charging and Controls - TDV6 2.7L Diesel - Fuel PumpVIN Range: 07**MODEL YEAR->CURRENT**

Removal and Installation

Special Tool(s)	
 310-161 E83080	Holding tool 310-161
 310-160 E83081	Remover 310-160

Removal

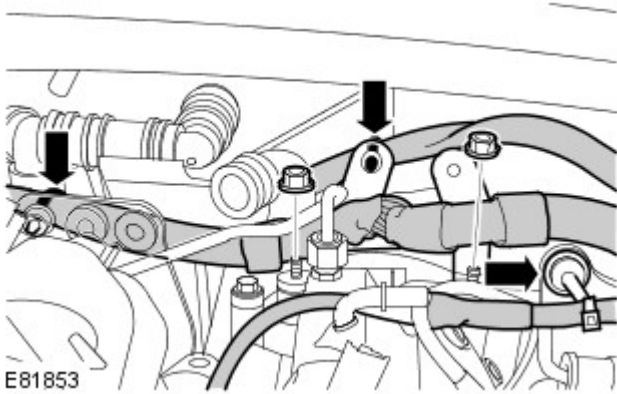
• WARNINGS:

-  Do not carry or operate cellular phones when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.
-  Do not carry out any repairs to the fuel system with the engine running. The fuel pressure within the system can be as high as 1650 bar (23,931 lb-sq-in). Failure to follow this instruction may result in personal injury.
-  Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.
-  This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow these instructions may result in personal injury.

• CAUTIONS:

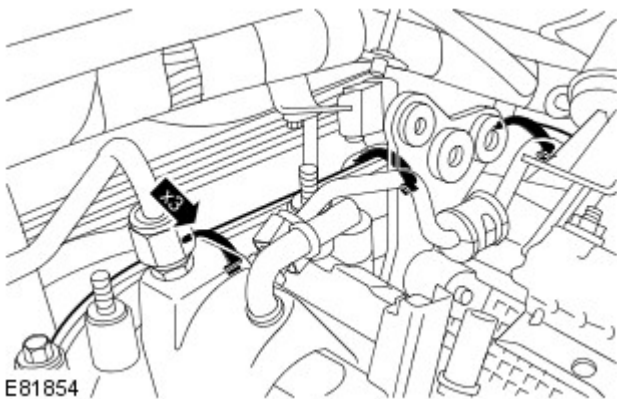
-  Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.
-  Always carry out the cleaning process before carrying out any repairs to the fuel injection system components. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.
-  Diesel fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.
-  Do not disassemble or clean inside the fuel pump, even with an ultrasonic cleaner. Always install a new fuel pump when required.

1. Disconnect the battery ground cable.
For additional information, refer to: Specifications (414-00, Specifications).
2. Remove the crankcase vent oil separator.
For additional information, refer to: [Crankcase Vent Oil Separator](#) (303-08A Engine Emission Control - TDV6 2.7L Diesel, Removal and Installation).



3. Release the fuel charging wiring harness.

- Release the 3 clips.
- Remove the 2 nuts.



4. Remove the fuel injection pump belt cover.

- Reposition the engine wiring harness to allow access to the fuel injection pump belt cover.
- Release the 3 clips.

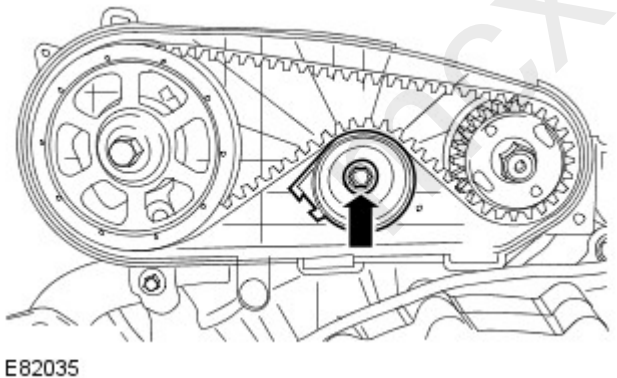
5. NOTE: The fuel injection pump belt is not timed to the engine.

Remove and discard the fuel injection pump belt tensioner.

- Remove and discard the bolt.

6. NOTE: The fuel injection pump rotates in a counter-clockwise direction when viewed from the rear of the engine.

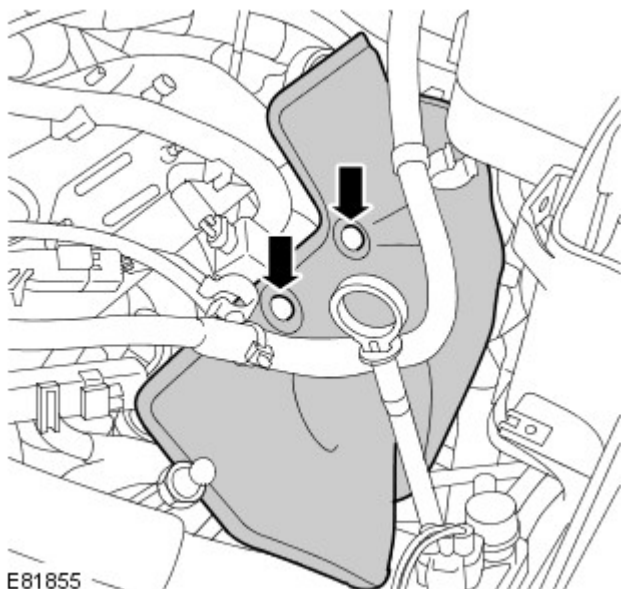
Remove and discard the fuel injection pump belt.



7. NOTE: Left-hand shown, right-hand similar.

Remove the injector sound proofing.

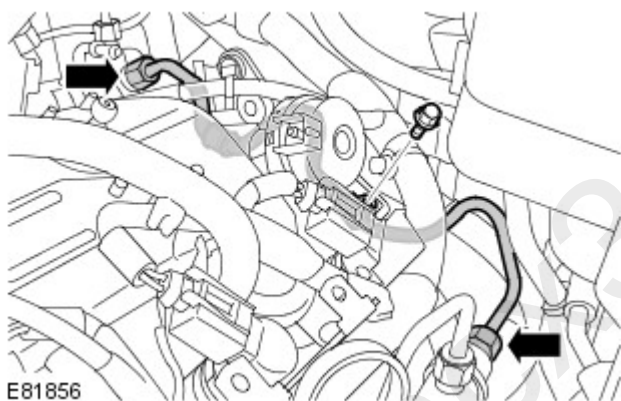
- Remove the 4 clips.



8. NOTE: Left-hand shown, right-hand similar.

Release the high-pressure fuel supply lines.

- Remove the bolt.



9.  CAUTION: Make sure that the high-pressure fuel supply line remains in contact with the fuel injection supply manifold and the fuel injection pump until both unions have been detached and cleaned. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

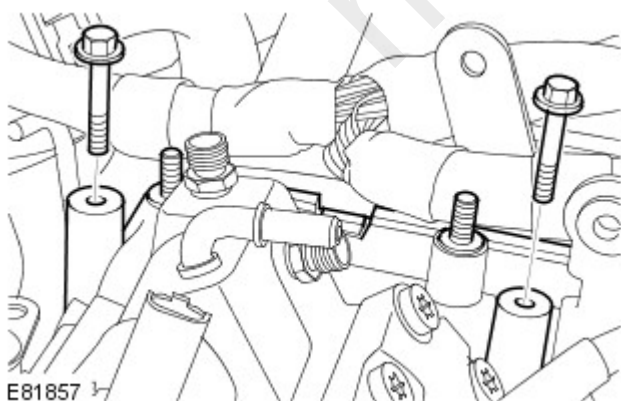
● NOTE: Left-hand shown, right-hand similar.

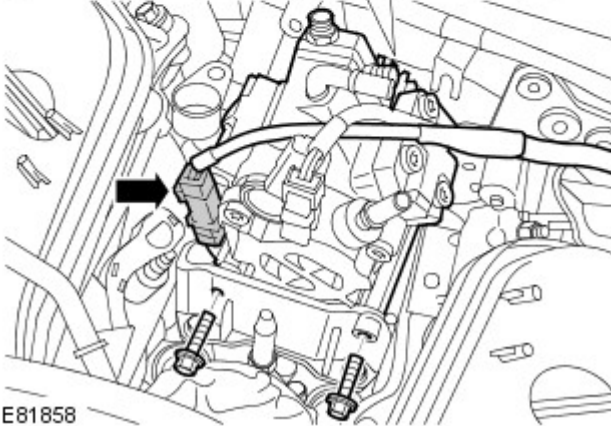
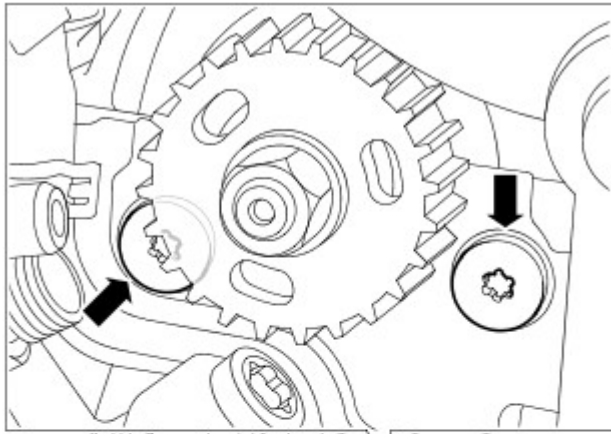
Remove and discard the high-pressure fuel supply lines.

- Install blanking caps to the exposed ports.

10. Remove the timing belt rear cover access panel.

- Remove the 2 bolts.





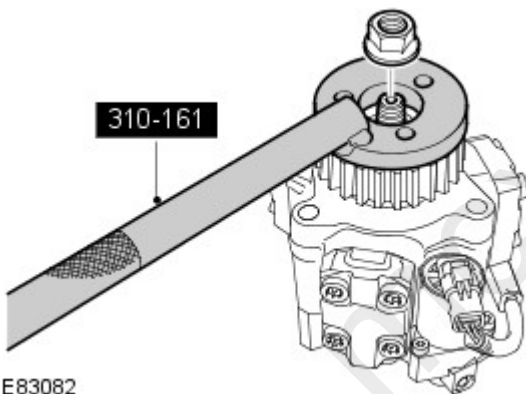
E81858

11. Remove the fuel injection pump.

- Remove and discard the 2 Torx bolts.
- Remove and discard the 2 bolts.
- Release the electrical connector.

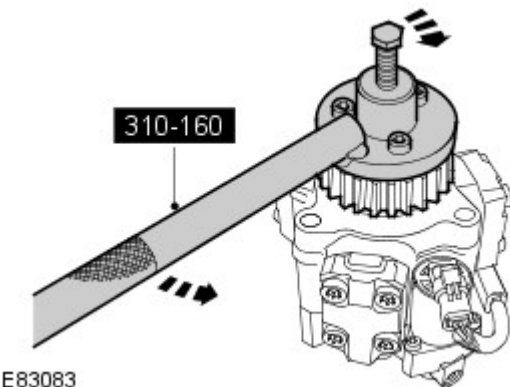
12. NOTE: Do not disassemble further if the component is removed for access only.

Using the special tool, remove the fuel injection pump pulley retaining nut.



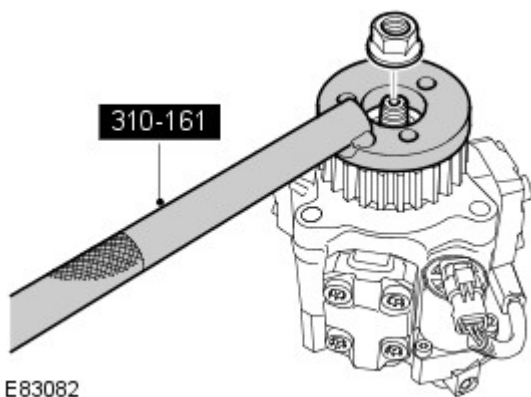
E83082

13. Using the special tool, remove the fuel injection pump pulley.



E83083

Installation



1. Using the special tool, install the fuel injection pump pulley.

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

2. Install the fuel injection pump.

- Clean the component mating faces.
- Loosely install the new bolts.
- Stage 1: Tighten the Torx bolts to 23 Nm (17 lb.ft).
- Stage 2: Tighten the M8 bolts to 23 Nm (17 lb.ft).
- Connect the electrical connector.

3. Install the timing belt rear cover access panel.

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

4. Install the new high-pressure fuel supply lines.

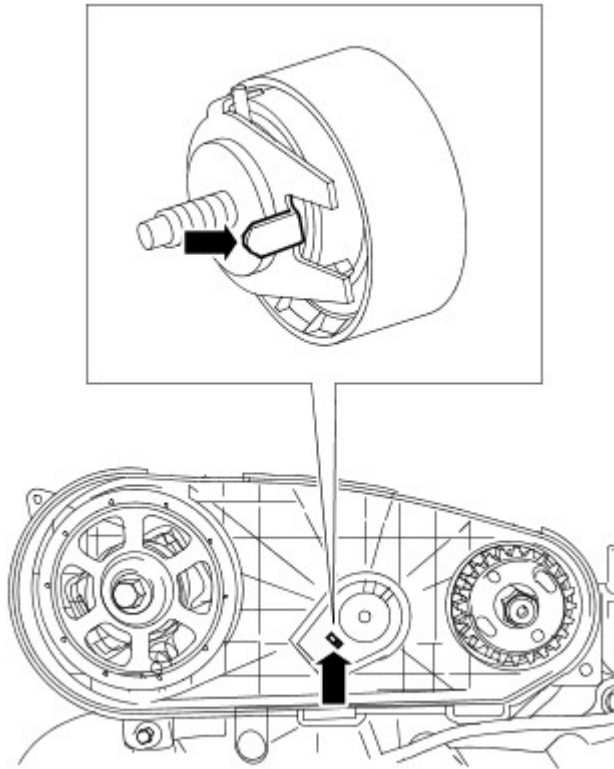
- Remove the blanking caps from the ports.
- Clean the components mating faces.
- Loosely install the new high-pressure fuel supply lines.
- Stage 1: Tighten the high-pressure fuel supply line union at the fuel injection supply manifold to 15 Nm (11 lb.ft).
- Stage 2: Tighten the high-pressure fuel supply line union at the fuel injection pump to 15 Nm (11 lb.ft).
- Stage 3: Tighten the high-pressure fuel supply line union at the fuel injection supply manifold to 35 Nm (26 lb.ft).
- Stage 4: Tighten the high-pressure fuel supply line union at the fuel injection pump to 35 Nm (26 lb.ft).

5. Attach the high-pressure fuel supply lines.

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

6. Install the injector sound proofing.

- Secure the 4 clips.



E81861

7.  **CAUTION:** Make sure that the fuel injection pump belt tensioner tang is correctly located to the fuel injection pump belt rear cover. Failure to follow this instruction may result in damage to the engine.

• **NOTE:** Do not remove the fuel injection pump belt tensioner locking pin at this stage.

Install a new fuel injection pump belt tensioner.

- Clean the components mating faces.
- Locate the tang on the new fuel injection pump belt tensioner into the fuel injection pump rear cover.
- Tighten the bolt to 25 Nm (18 lb.ft).

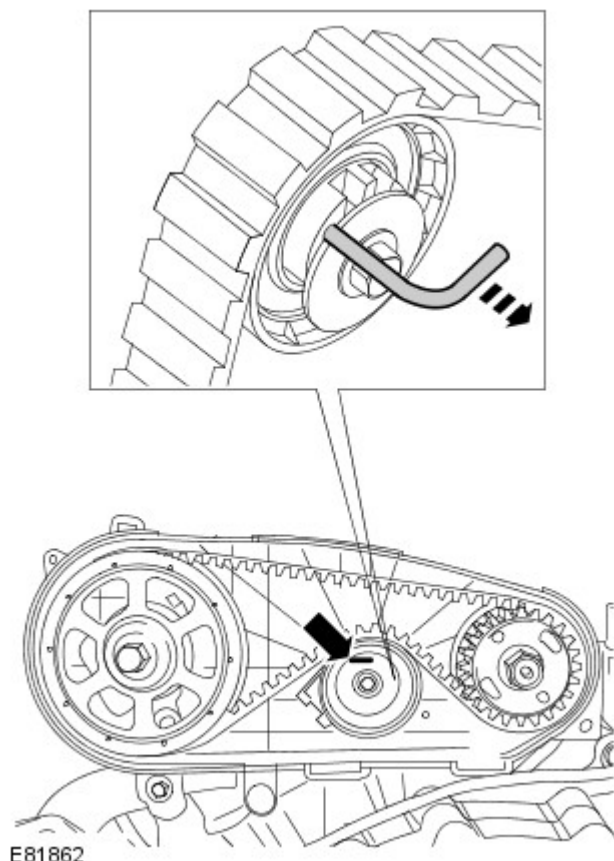
8.  **CAUTION:** Do not install the new fuel injection pump belt to the pulleys with the fuel pump belt tensioner locking pin removed. Failure to follow this instruction may result in damage to the fuel pump belt.

• **NOTE:** The fuel injection pump rotates in a counter-clockwise direction when viewed from the rear of the engine.

Install the new fuel injection pump belt.

- Make sure the components are clean and dry.

9. Remove and discard the fuel injection pump belt tensioner locking pin.



10. Install the fuel injection pump belt cover.

- Secure with the 3 clips.
- Reposition the engine wiring harness to allow access to the fuel injection pump belt cover.

11. Attach the fuel charging wiring harness.

- Secure with the 3 clips.
- Tighten the nuts to 10 Nm (7 lb.ft).

12. Install the crankcase vent oil separator.

For additional information, refer to: [Crankcase Vent Oil Separator](#) (303-08A Engine Emission Control - TDV6 2.7L Diesel, Removal and Installation).

13. Connect the battery ground cable.

For additional information, refer to: Specifications (414-00, Specifications).

14. Bleed the fuel system.

For additional information, refer to: [Low-Pressure Fuel System Bleeding](#) (310-00 Fuel System - General Information, General Procedures).

Fuel Charging and Controls - TDV6 2.7L Diesel - Fuel Injector

Removal and Installation

Special Tool(s)	
	Fuel Injector remover
	303-1127

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.

 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.

 This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow these instructions may result in personal injury.

 Do not carry 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.

• 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.

 Do not disconnect the fuel injector electrical connectors with the engine running. Failure to follow this instruction may result in serious damage to the engine.

 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.

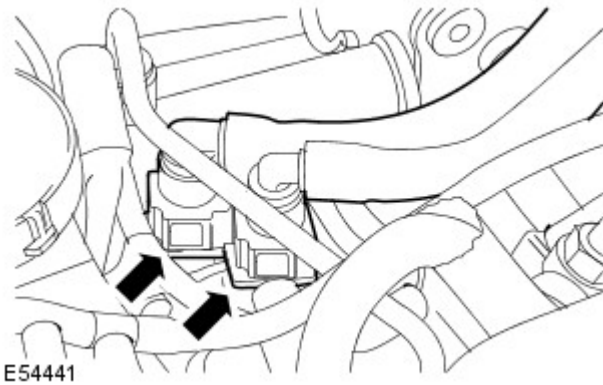
 Diesel fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

 Do not disassemble the fuel injectors or clean the nozzles, even with an ultrasonic cleaner. Always install new fuel injectors when required.

1. Disconnect the battery ground cable.
For additional information, refer to: Specifications (414-00, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - 2.7L V6 - TdV6](#) (501-05 Interior Trim and Oramentation, Removal and Installation).

3. Disconnect the low-pressure fuel lines.

- Install blanking caps to the exposed ports.



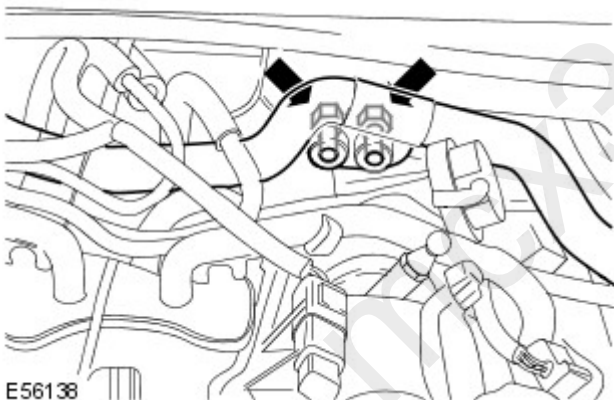
4. Disconnect both exhaust gas recirculation (EGR) coolant cross-over pipe hoses.

- Clamp the EGR coolant hoses to minimize coolant loss.



5. Remove the EGR coolant cross-over pipe.

- Remove the two retaining bolts.

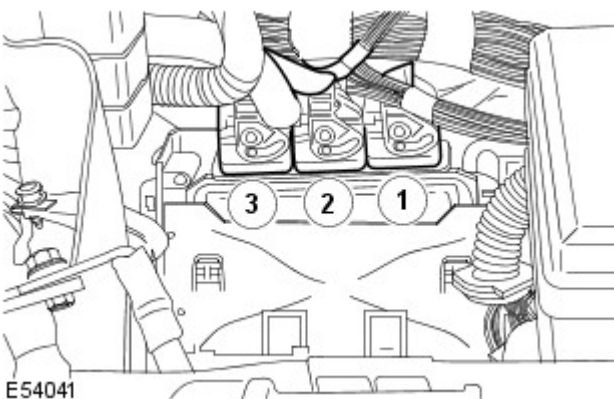


6. Remove the battery.

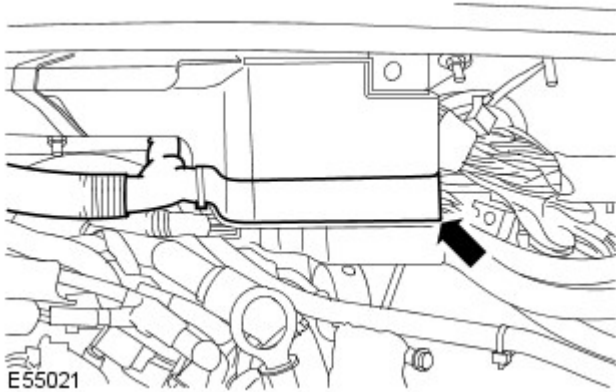
For additional information, refer to: [Battery](#) (414-01 Battery, Mounting and Cables, Removal and Installation).

7. NOTE: Right hand drive shown, for Left hand drive reverse the sequence.

Disconnect the three engine harness electrical connectors in the order shown.

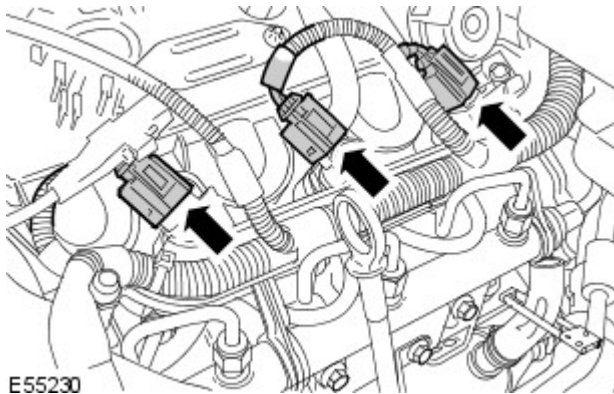


8. Release the engine wiring harness from the bulkhead.



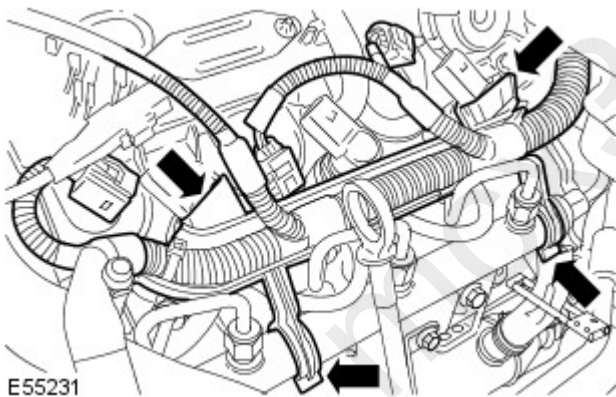
9. Remove the injector sound proofing.

10. Disconnect the fuel injector electrical connectors.



11. Release the engine wiring harness.

- Release the 4 clips.



12. CAUTIONS:

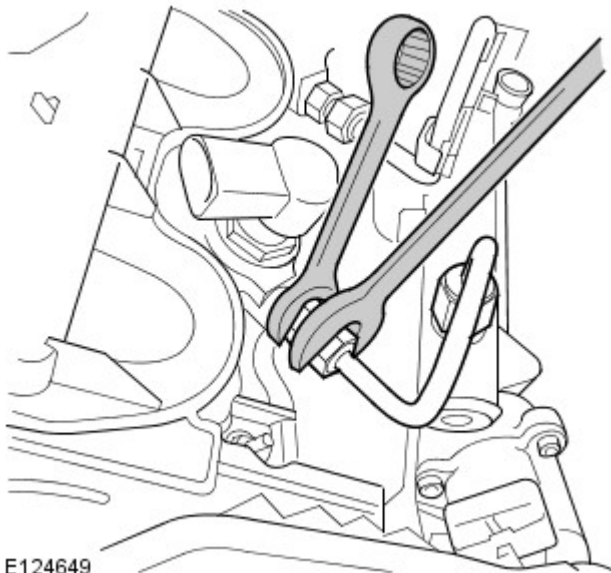


Make sure that the high-pressure fuel supply line remains in contact with the fuel pump and fuel injection diverter rail until both unions have been detached and cleaned. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.



Do not use any aggressive cleaning fluid or a wire brush to clean the fuel injector nozzle.

Using the pneumatic vacuum gun, vacuum foreign material from the high-pressure fuel supply line, the fuel injector and the fuel injection supply manifold.
For additional information, refer to: [Fuel Injection Component Cleaning](#) (303-04A Fuel Charging and Controls - TDV6 2.7L Diesel, General Procedures).



E124649

13. CAUTIONS:

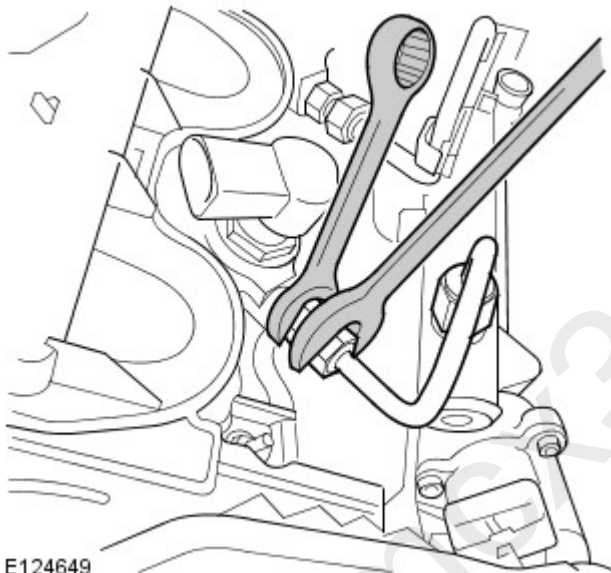


Make sure that the high-pressure fuel supply line remains in contact with the fuel injection supply manifold and the fuel injection diverter rail until both unions have been detached and cleaned. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.



Make sure that the fuel injector adaptor union does not move when loosening the high-pressure fuel supply lines. Failure to follow this instruction may result in damage to the fuel injector or the fuel injector adaptor union.

Loosen the high-pressure fuel supply line from the fuel injector and fuel rail.

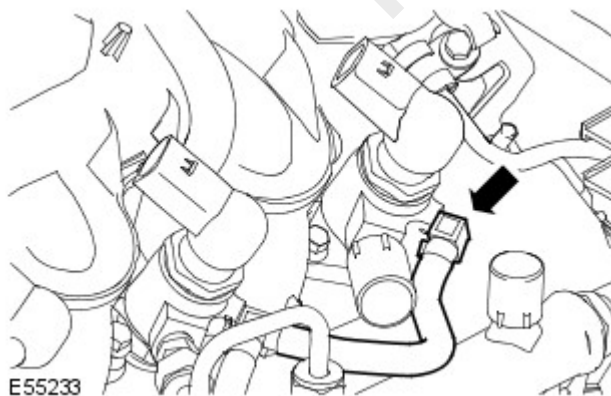


E124649

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

• **NOTE:** Right-hand shown, left-hand similar.

Remove and discard the high-pressure fuel supply line.



E55233

15. Disconnect the fuel return line from the fuel injector.

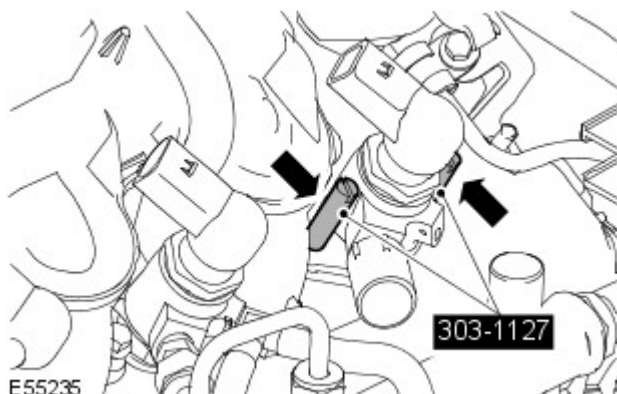
- Remove and discard the fuel return line retaining clip.

16. Remove the two fuel injector retaining bolts.

- Remove the fuel injector retaining clamp spacer.

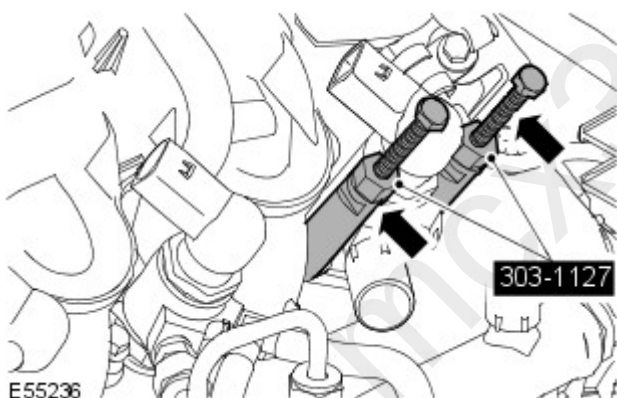


17. Install the special tool studs.



18.  **CAUTION:** Make sure the fuel injector remover legs are correctly engaged to the fuel injector. Failure to follow this instruction may result in damage to the component.

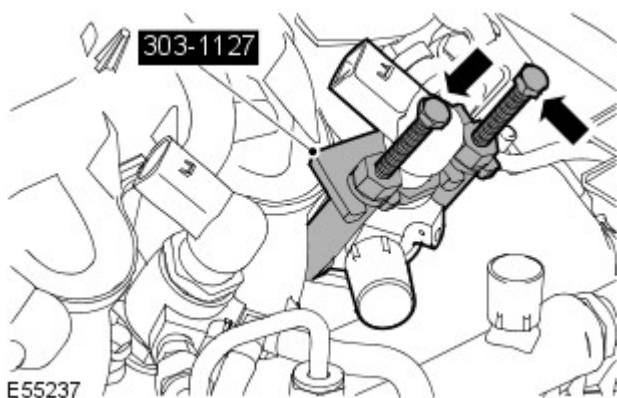
Install the special tool remover legs to the studs.



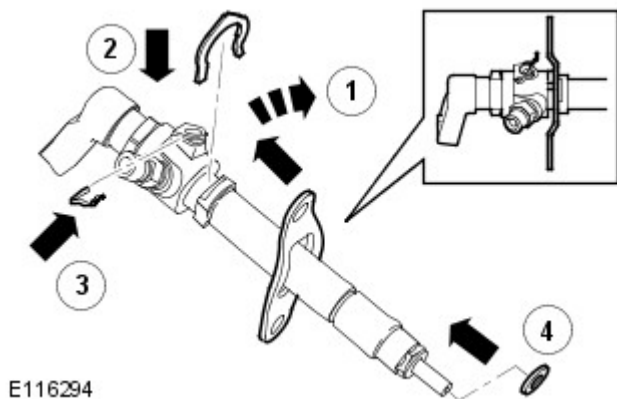
19.  **CAUTION:** Make sure the fuel injector remover legs are correctly engaged to the fuel injector. Failure to follow this instruction may result in damage to the component.

Remove the fuel injector.

- Rotate the special tool bolts evenly, in a clockwise direction.
- Remove the special tool.
- Remove and discard the fuel injector retaining clamp.
- Remove and discard the sealing washer.



Installation



E116294

1. CAUTIONS:



Do not disassemble the fuel injectors or clean the nozzles, even with an ultrasonic cleaner. Always install new fuel injectors when required.



Do not use tools to install the new fuel return line clip. Failure to follow this instruction will result in damage to the retaining clip.

Install a new fuel injector retaining clamp.

1. Install a new fuel injector retaining clamp.
2. Install the fuel injector retaining clamp spacer.
3. Install a new fuel return line retaining clip.
4. Install a new sealing washer.

2. Install the fuel injector.

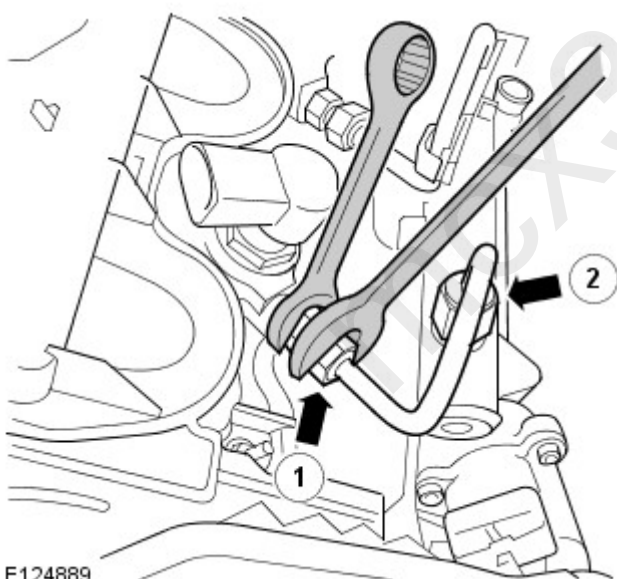
- Install the two bolts and tighten to 10 Nm (7 lb.ft).



CAUTION: Make sure the fuel return line retaining clip is correctly installed to the fuel injector before installing the return line.

Connect the fuel return line to the fuel injector.

- Visually inspect the fuel return line O-ring seals for damage.
- Apply a light coating of petroleum jelly to the fuel return line O-ring seals.



E124889

4. CAUTIONS:



Do not allow the unions to hit the olive ends of the high-pressure fuel supply line as this may damage the ends of the line and allow foreign matter to enter the fuel injection system.



Maintain pressure on the high-pressure fuel supply lines to keep the olives in contact with the fuel rail and the fuel injector cones while installing unions.

- **NOTE:** Remove and discard the blanking caps.

Install the new high-pressure fuel supply lines.

- Install the new high-pressure fuel supply line, tighten the fuel supply line unions finger tight.
- Tighten the high-pressure fuel supply line in the shown sequence.
- Tighten the high-pressure fuel supply line union 1 to fuel injector to 15 Nm.
- Tighten the high-pressure fuel supply line union 2 to fuel rail to 15 Nm.
- Tighten the high-pressure fuel supply line union 1 to fuel injector to 35 Nm.
- Tighten the high-pressure fuel supply line union 2 to fuel rail to 35 Nm.

5. Attach the engine wiring harness.

6. Connect the fuel injector electrical connectors.

7. Install the injector sound proofing.

8. Attach the engine wiring harness to the bulkhead.

9. Connect the three engine harness electrical connectors.

10. Install the battery.

For additional information, refer to: [Battery](#) (414-01 Battery,

Mounting and Cables, Removal and Installation).

11. Install the EGR coolant cross-over pipe.

- Install the two retaining bolts.
- Tighten the bolts to 13 Nm (10 lb.ft).

12. Connect both EGR coolant cross-over pipe hoses.

- Remove the EGR coolant hose clamps.

13. Connect the low-pressure fuel lines.

- Remove the blanking caps from the ports.

14. Connect the battery ground cable.

For additional information, refer to: Specifications (414-00, Specifications).

15. Check and top-up the coolant.

16. Bleed the fuel system.

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Fuel Charging and Controls - TDV6 2.7L Diesel - Fuel Injectors

Removal and Installation

Special Tool(s)	
	Fuel Injector remover
	303-1127

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.

 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.

 This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow these instructions may result in personal injury.

 Do not carry 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.

• 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.

 Do not disconnect the fuel injector electrical connectors with the engine running. Failure to follow this instruction may result in serious damage to the engine.

 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.

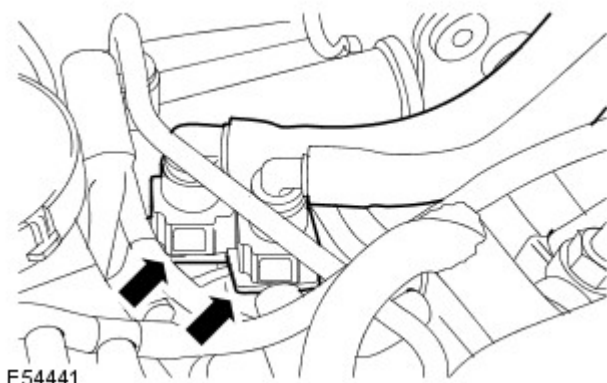
 Diesel fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

 Do not disassemble the fuel injectors or clean the nozzles, even with an ultrasonic cleaner. Always install new fuel injectors when required.

1. Disconnect the battery ground cable.
For additional information, refer to: Specifications (414-00, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - 2.7L V6 - TdV6](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

3. Disconnect the low-pressure fuel lines.

- Install blanking caps to the exposed ports.



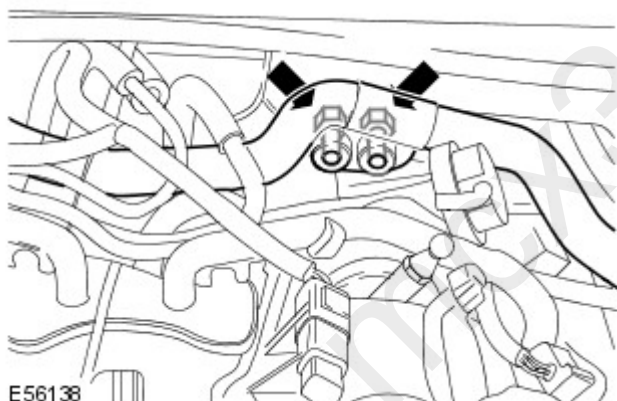
4. Disconnect both exhaust gas recirculation (EGR) coolant cross-over pipe hoses.

- Clamp the EGR coolant hoses to minimize coolant loss.



5. Remove the EGR coolant cross-over pipe.

- Remove the two retaining bolts.

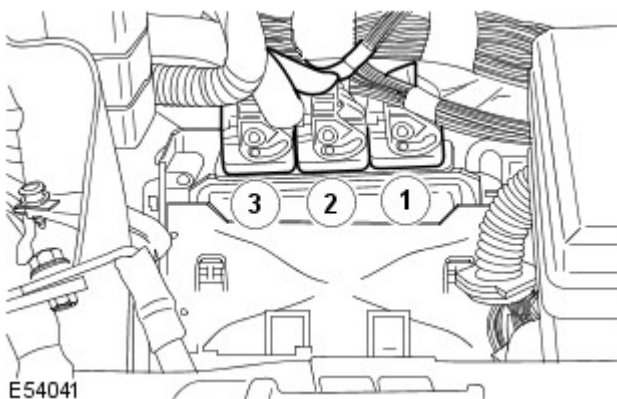


6. Remove the battery.

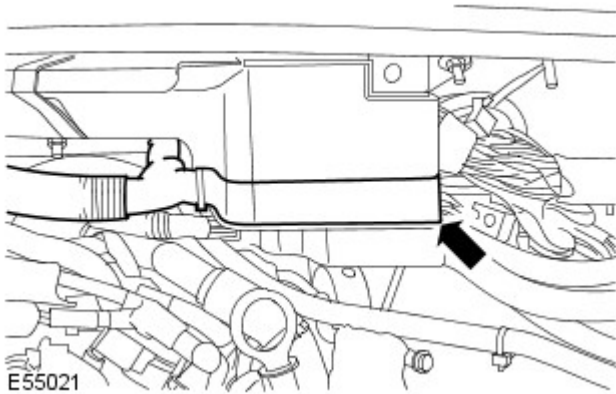
For additional information, refer to: [Battery](#) (414-01 Battery, Mounting and Cables, Removal and Installation).

7. NOTE: Right hand drive shown, for Left hand drive reverse the sequence.

Disconnect the three engine harness electrical connectors in the order shown.

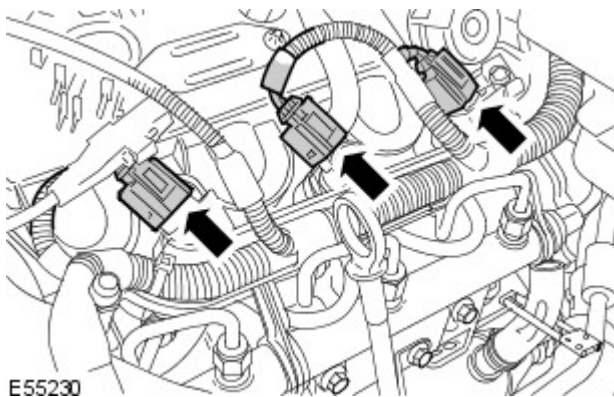


8. Release the engine wiring harness from the bulkhead.



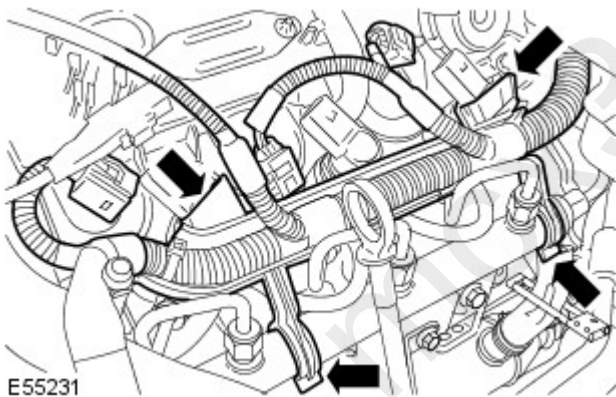
9. Remove the NVH pads from each cylinder bank.

10. Disconnect the fuel injector electrical connectors.



11. Release the engine wiring harness.

- Release the 4 clips.



12. CAUTIONS:

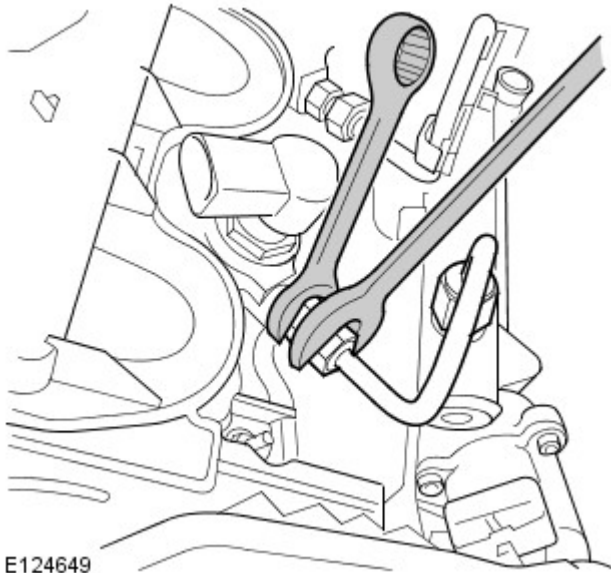


Make sure that the high-pressure fuel supply line remains in contact with the fuel pump and fuel injection diverter rail until both unions have been detached and cleaned. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.



Do not use any aggressive cleaning fluid or a wire brush to clean the fuel injector nozzle.

Using the pneumatic vacuum gun, vacuum foreign material from the high-pressure fuel supply line, the fuel injector and the fuel injection supply manifold.

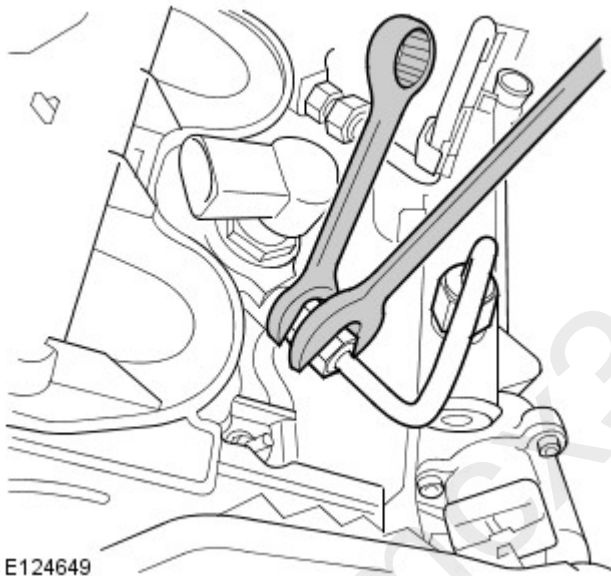


13. CAUTIONS:

⚠ Make sure that the high-pressure fuel supply line remains in contact with the fuel injection supply manifold and the fuel injection diverter rail until both unions have been detached and cleaned. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

⚠ Make sure that the fuel injector adaptor union does not move when loosening the high-pressure fuel supply lines. Failure to follow this instruction may result in damage to the fuel injector or the fuel injector adaptor union.

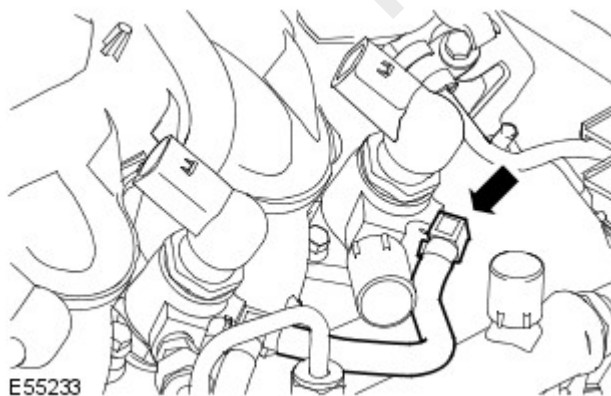
Loosen the high-pressure fuel supply line from the fuel injector and fuel rail.



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

• **NOTE:** Right-hand shown, left-hand similar.

Remove and discard the high-pressure fuel supply line.



15. Disconnect the fuel return line from the fuel injector.

- Remove and discard the fuel return line retaining clip.

16. Remove the two fuel injector retaining bolts.

- Remove the fuel injector retaining clamp spacer.

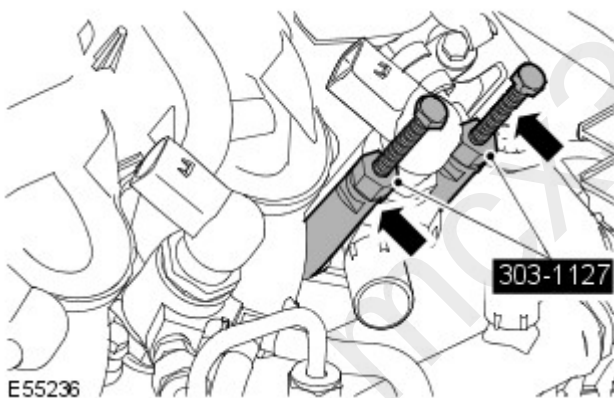


17. Install the special tool studs.



18.  **CAUTION:** Make sure the fuel injector remover legs are correctly engaged to the fuel injector. Failure to follow this instruction may result in damage to the component.

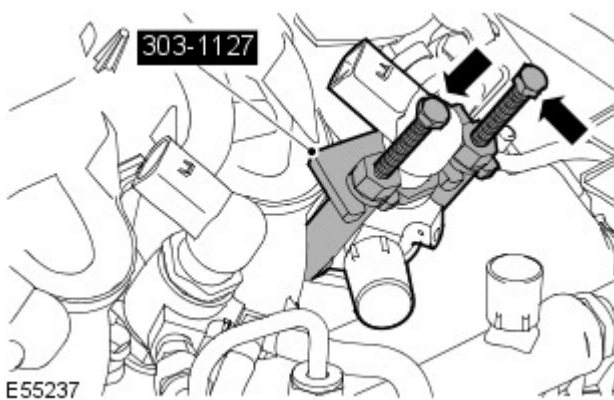
Install the special tool remover legs to the studs.



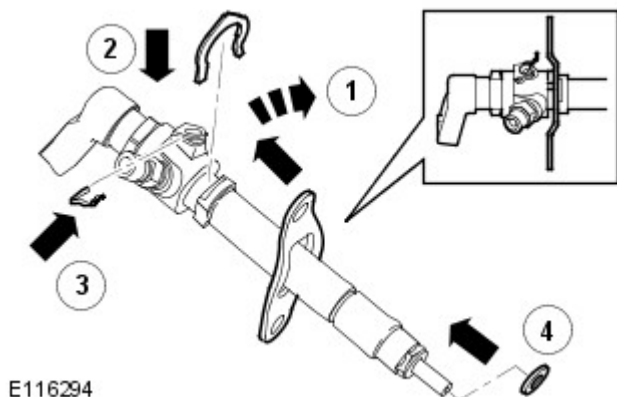
19.  **CAUTION:** Make sure the fuel injector remover legs are correctly engaged to the fuel injector. Failure to follow this instruction may result in damage to the component.

Remove the fuel injector.

- Rotate the special tool bolts evenly, in a clockwise direction.
- Remove the special tool.
- Remove and discard the fuel injector retaining clamp.
- Remove and discard the sealing washer.



Installation



E116294

1. CAUTIONS:



Do not disassemble the fuel injectors or clean the nozzles, even with an ultrasonic cleaner. Always install new fuel injectors when required.



Do not use tools to install the new fuel return line clip. Failure to follow this instruction will result in damage to the retaining clip.

Install a new fuel injector retaining clamp.

1. Install a new fuel injector retaining clamp.
2. Install the fuel injector retaining clamp spacer.
3. Install a new fuel return line retaining clip.
4. Install a new sealing washer.

2. Install the fuel injector.

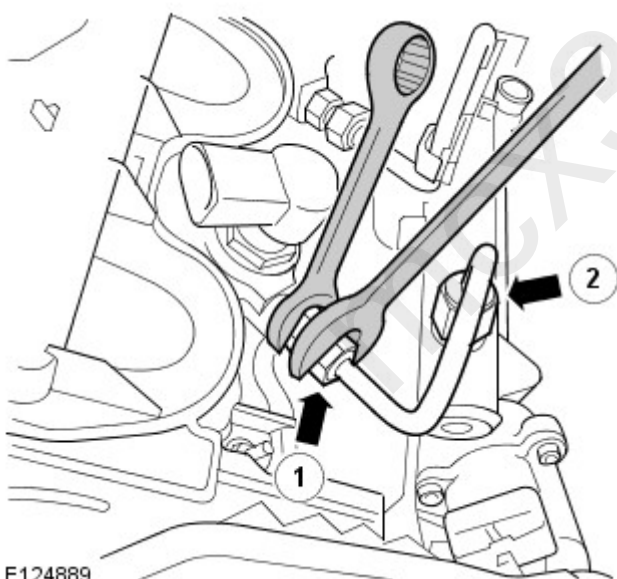
- Install the two bolts and tighten to 10 Nm (7 lb.ft).



CAUTION: Make sure the fuel return line retaining clip is correctly installed to the fuel injector before installing the return line.

Connect the fuel return line to the fuel injector.

- Visually inspect the fuel return line O-ring seals for damage.
- Apply a light coating of petroleum jelly to the fuel return line O-ring seals.



E124889

4. CAUTIONS:



Do not allow the unions to hit the olive ends of the high-pressure fuel supply line as this may damage the ends of the line and allow foreign matter to enter the fuel injection system.



Maintain pressure on the high-pressure fuel supply lines to keep the olives in contact with the fuel rail and the fuel injector cones while installing unions.

- **NOTE:** Remove and discard the blanking caps.

Install the new high-pressure fuel supply lines.

- Install the new high-pressure fuel supply line, tighten the fuel supply line unions finger tight.
- Tighten the high-pressure fuel supply line in the shown sequence.
- Tighten the high-pressure fuel supply line union 1 to fuel injector to 15 Nm.
- Tighten the high-pressure fuel supply line union 2 to fuel rail to 15 Nm.
- Tighten the high-pressure fuel supply line union 1 to fuel injector to 35 Nm.
- Tighten the high-pressure fuel supply line union 2 to fuel rail to 35 Nm.

5. Attach the engine wiring harness.

6. Connect the fuel injector electrical connectors.

7. Install the NVH pads on the cylinder banks.

8. Attach the engine wiring harness to the bulkhead.

9. Connect the three engine harness electrical connectors.

10. Install the battery.

For additional information, refer to: [Battery](#) (414-01 Battery,

Mounting and Cables, Removal and Installation).

11. Install the EGR coolant cross-over pipe.

- Install the two retaining bolts.
- Tighten the bolts to 13 Nm (10 lb.ft).

12. Connect both EGR coolant cross-over pipe hoses.

- Remove the EGR coolant hose clamps.

13. Connect the low-pressure fuel lines.

- Remove the blanking caps from the ports.

14. Connect the battery ground cable.

For additional information, refer to: Specifications (414-00, Specifications).

15. Check and top-up the coolant.

16. Bleed the fuel system.

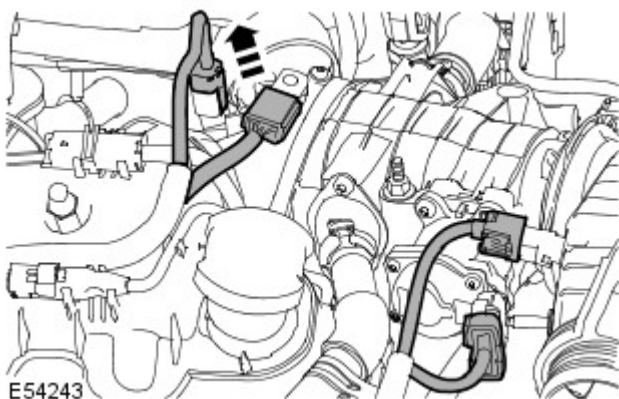
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Fuel Charging and Controls - TDV6 2.7L Diesel - Intake Air Shutoff Throttle

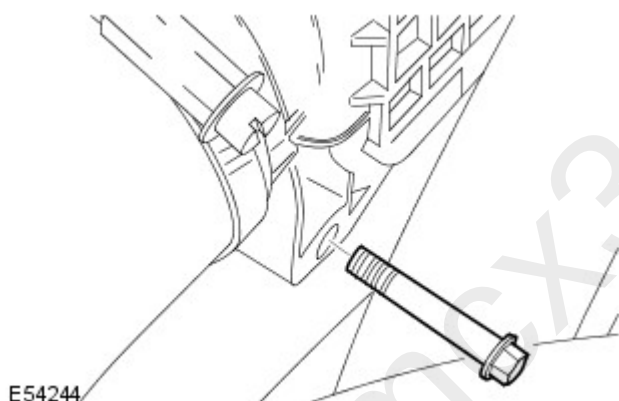
Removal and Installation

Removal

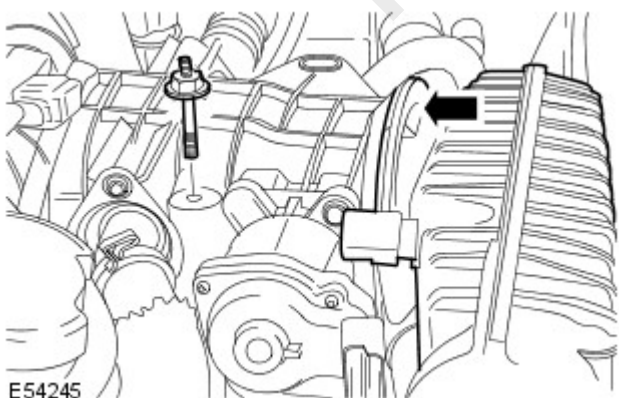
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Disconnect the three electrical connectors.
 - Release the fuel return line valve.



4. Remove the intake air shutoff throttle elbow retaining bolt.

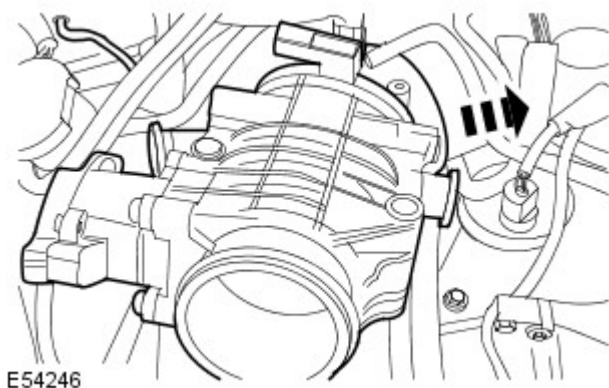


5. Release the intake air shutoff throttle elbow.
 - Remove the intake air shutoff throttle retaining stud.

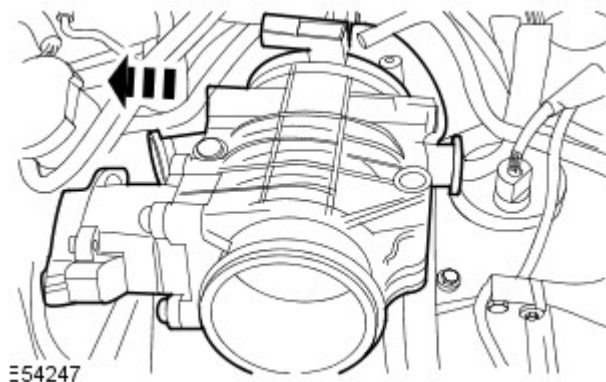


6. Release the LH EGR valve outlet tube retaining clip.
7. Release the RH EGR valve outlet tube retaining clip.

8. Reposition the intake air shutoff throttle.

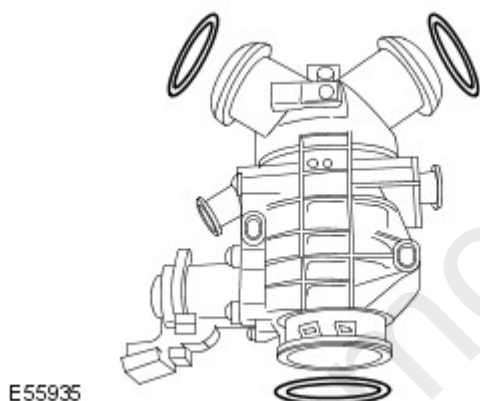


9. Remove the intake air shutoff throttle.



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

Remove and discard the O-ring seals.



Installation

1.  CAUTION: The O-ring seals are to be reused unless damaged.

Install the intake air shutoff throttle.

2. Align the intake air shutoff throttle.

3. Secure the RH EGR valve outlet tube.

4. Secure the LH EGR valve outlet tube.

5. Secure the intake air shutoff throttle elbow.

- Tighten the intake air shutoff throttle retaining stud to 10 Nm (7 lb.ft).

6. Tighten the intake air shutoff throttle elbow retaining bolt to 10 Nm (7 lb.ft).

7. Connect the three electrical connectors.

- Secure the fuel line return valve.

8. Install the engine cover.

For additional information, refer to: [Engine Cover - TDV6 3.0L](#)

[Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

9. Connect the battery ground cable.

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

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Fuel Charging and Controls - TDV6 2.7L Diesel - Fuel Diverter Rail

Removal and Installation

General Equipment

Pneumatic vacuum gun

Removal

• 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.



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



This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow these instructions may result in personal injury.



Do not carry 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.

• 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.



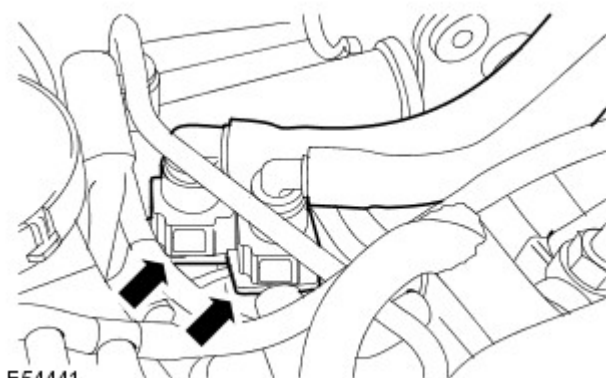
Diesel fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.



Do not remove the fuel rail pressure sensor from the fuel injection diverter rail.

• NOTE: If a new fuel rail pressure sensor is to be installed, a new fuel injection diverter rail and fuel rail pressure sensor must be installed as an assembly.

1. Disconnect the battery ground cable.
For additional information, refer to: Specifications (414-00, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - 2.7L V6 - TdV6](#) (501-05 Interior Trim and Oramentation, Removal and Installation).
3. Disconnect the low-pressure fuel lines.
 - Install blanking caps to the exposed ports.

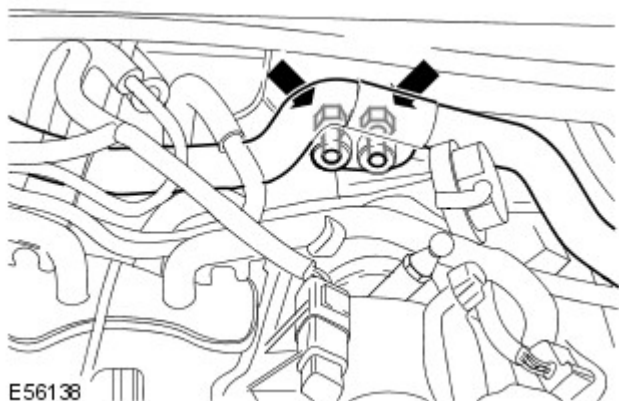


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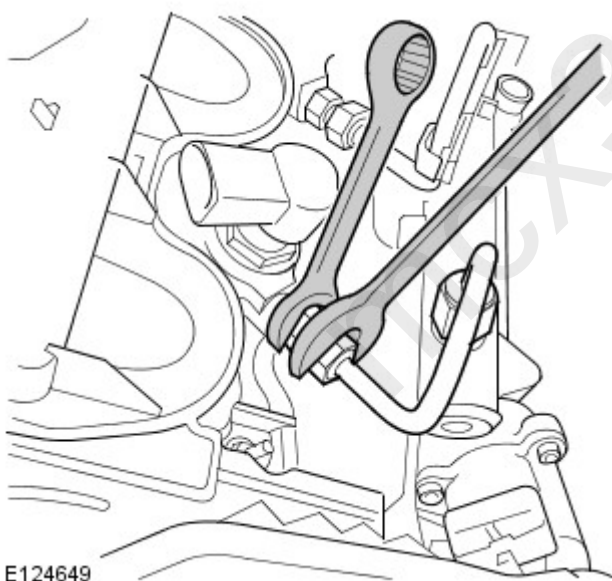
4. Disconnect both exhaust gas recirculation (EGR) coolant cross-over pipe hoses.

- Clamp the EGR coolant hoses to minimize coolant loss.



5. Remove the EGR coolant cross-over pipe.

- Remove the two retaining bolts.



6. CAUTIONS:

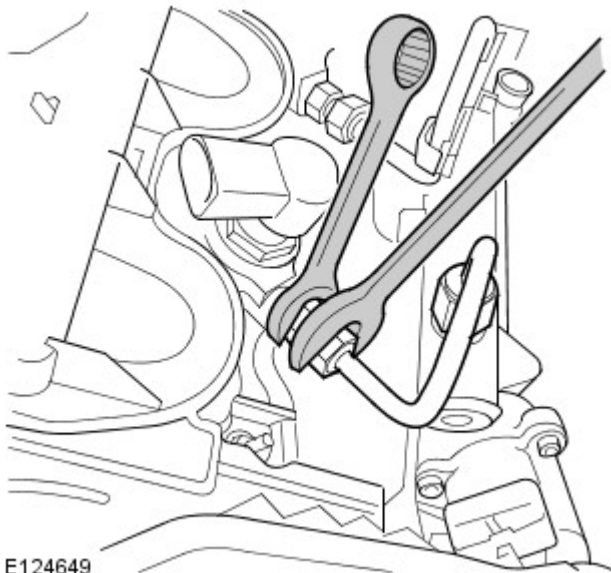


Make sure that the high-pressure fuel supply line remains in contact with the fuel injection supply manifold and the fuel injection diverter rail until both unions have been detached and cleaned. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.



Make sure that the fuel injector adaptor union does not move when loosening the high-pressure fuel supply lines. Failure to follow this instruction may result in damage to the fuel injector or the fuel injector adaptor union.

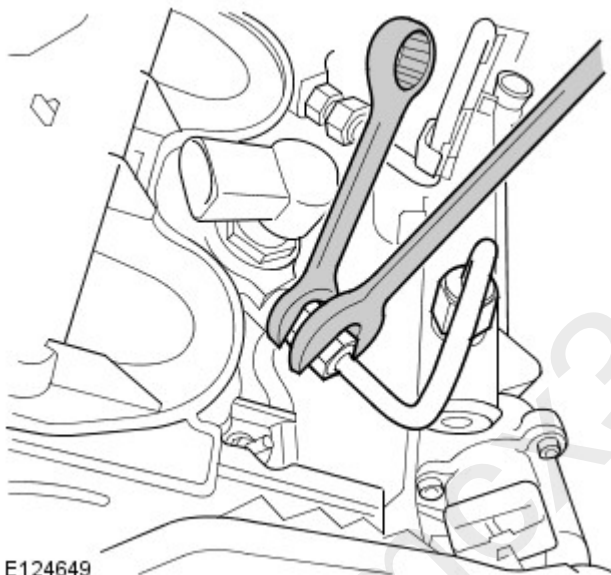
Loosen the high-pressure fuel supply line from the fuel injector and fuel rail.



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

- **NOTE:** Right-hand shown, left-hand similar.

Remove and discard the high-pressure fuel supply line.



8.  **CAUTION:** Make sure that the high-pressure fuel supply line remains in contact with the fuel pump and fuel injection diverter rail until both unions have been detached and cleaned. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

- **NOTE:** Crankcase vent oil separator shown removed for clarity.

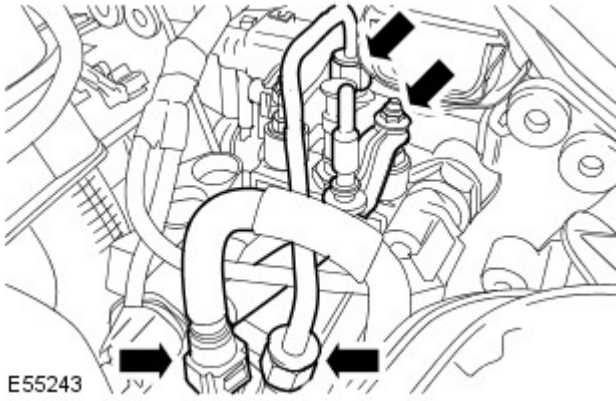
Remove and discard the high-pressure fuel supply line.

- Install blanking caps to the exposed ports.

9.  **CAUTION:** Make sure that the high-pressure fuel supply line remains in contact with the fuel injection supply manifold and the fuel injection diverter rail until both unions have been detached and cleaned. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

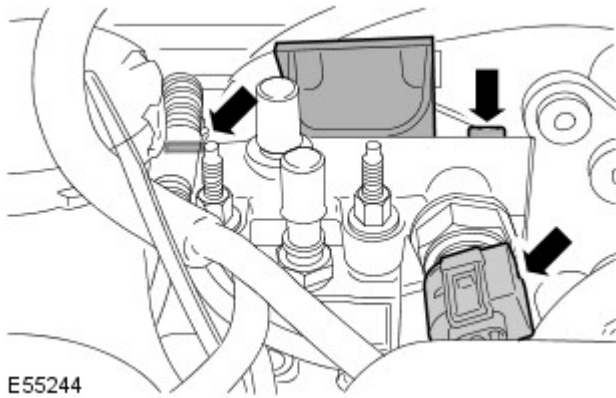
Using the pneumatic vacuum gun, vacuum foreign material from the high-pressure fuel supply line, the fuel injectors and the fuel rail.

For additional information, refer to: [Fuel Injection Component Cleaning](#) (303-04A Fuel Charging and Controls - TDV6 2.7L Diesel, General Procedures).



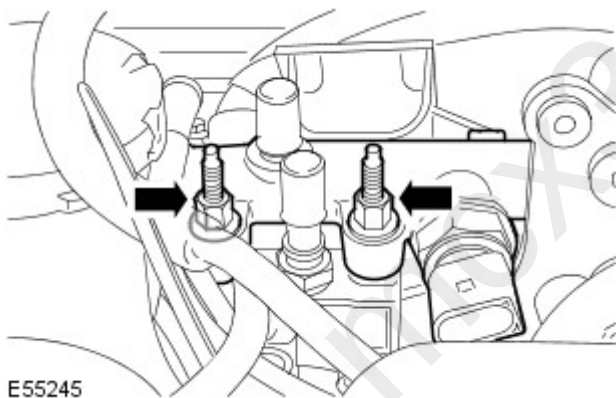
10. Release the low-pressure fuel line.

- Disconnect the low-pressure fuel line.
- Install blanking caps to the exposed ports.



11. Disconnect the fuel rail pressure (FRP) sensor electrical connector.

- Release the fuel charging wiring harness.



12. Remove the FRP and fuel injection diverter rail assembly.

- Remove the 2 studs.

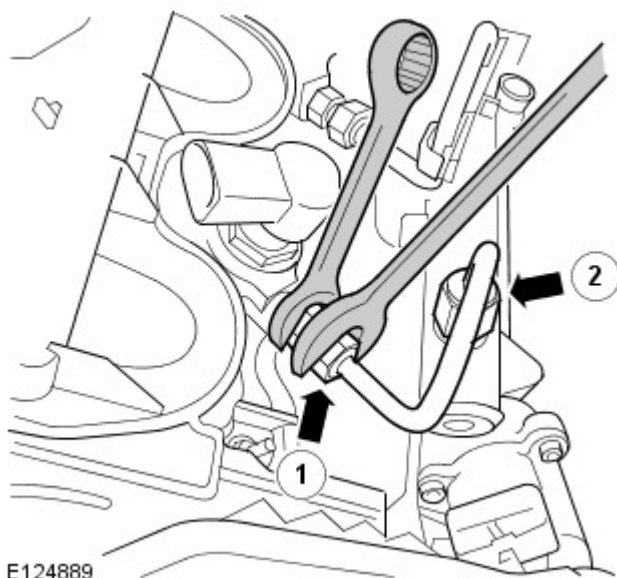
Installation

1. Install the FRP and fuel injection diverter rail assembly.

- Install the two retaining studs, but do not fully tighten at this stage.

2. Connect the FRP sensor electrical connector.

- Attach the fuel charging wiring harness.



3. CAUTIONS:

⚠ Do not disassemble the fuel injectors or clean the nozzles, even with an ultrasonic cleaner. Always install new fuel injectors when required.

⚠ Do not use any aggressive cleaning fluid or a wire brush to clean the fuel injector nozzle.

Install the new high-pressure fuel supply line.

- Install the new high-pressure fuel supply line, tighten the fuel supply line unions finger tight.
- Tighten the high-pressure fuel supply line in the shown sequence.
- Tighten the high-pressure fuel supply line union 1 to fuel injector to 15 Nm.
- Tighten the high-pressure fuel supply line union 2 to fuel rail to 15 Nm.
- Tighten the high-pressure fuel supply line union 1 to fuel injector to 35 Nm.
- Tighten the high-pressure fuel supply line union 2 to fuel rail to 35 Nm.

4. Attach the low-pressure fuel line.

- Remove the blanking caps from the ports.
- Connect the low-pressure fuel line.

5. Install the new high-pressure fuel supply lines.

- Remove the blanking caps from the ports.
- Loosely install the new high-pressure fuel supply lines.
- Stage 1: Tighten the high-pressure fuel supply line union at the fuel injection supply manifold to 15 Nm (11 lb.ft).
- Stage 2: Tighten the high-pressure fuel supply line union at the fuel injection diverter rail to 15 Nm (11 lb.ft).
- Stage 3: Tighten the high-pressure fuel supply line union at the fuel injection supply manifold to 35 Nm (26 lb.ft).
- Stage 4: Tighten the high-pressure fuel supply line union at the fuel injection diverter rail to 35 Nm (26 lb.ft).

6. Secure the high-pressure fuel supply lines.

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

7. Install the EGR coolant cross-over pipe.

- Install the two EGR coolant cross-over pipe retaining bolts.
- Tighten to 13 Nm (10 lb.ft).

8. Connect both EGR coolant cross-over pipe hoses.

- Remove the EGR coolant hose clamps.

9. Connect the low-pressure fuel lines.

- Remove the blanking caps from the ports.

10. Install the engine cover.

For additional information, refer to: [Engine Cover - 2.7L V6 - TdV6](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

11. Connect the battery ground cable.

For additional information, refer to: Specifications (414-00, Specifications).

12. Bleed the fuel system.

For additional information, refer to: [Low-Pressure Fuel System](#)

[Bleeding](#) (310-00 Fuel System - General Information, General Procedures).

13. Check and top-up the coolant.

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