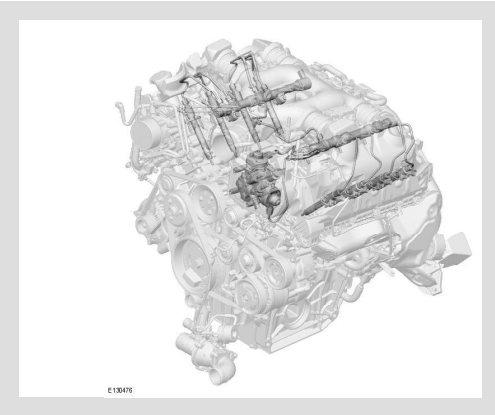


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FUEL CHARGING AND CONTROLS – TDV8 4.4L DIESEL [G1311591]

DESCRIPTION AND OPERATION

COMPONENT LOCATION



OVERVIEW

The 4.4L V8 diesel engine is equipped with a high-pressure common rail fuel injection system. With this fuel injection process, a high-pressure fuel pump delivers a uniform level of pressure to the shared fuel lines (the common rails), which serve all 8 fuel injectors. Pressure is controllable, to the optimum level for smooth operation, up to 2000 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 2000 bar for greater atomisation of fuel (increasing performance and lowering emissions)
- Variable injection to optimize combustion in all engine operating conditions
- Low tolerances and high precision throughout the life of the system.

The fuel system is divided into 2 sub systems:

- Low-pressure system
- High-pressure system.

The low-pressure system features the following components:

- In-tank fuel pump delivery module
- Secondary fuel pump located in the engine compartment
- Fuel pressure regulator (integral to the fuel pump delivery module)
- Fuel filter
- Return pipes and fuel cooler
- Injector return pipes
- Fuel cooler.

The low-pressure system pressure is regulated to 0.5 bar (7.3 lbf/in²) from the fuel pump delivery module in the fuel tank. The secondary fuel pump raises the fuel delivery pressure to the high pressure fuel pump to 4.5 bar (65.3 lbf/in²).

The high-pressure system features the following components:

- High-pressure fuel pump
- Common fuel rails
- High-pressure fuel pipes
- Injectors.

LOW-PRESSURE SYSTEM

IN-TANK FUEL PUMP

The electric fuel pump delivery module is located inside the fuel tank. Fuel is pumped from the tank via the in-tank fuel pump at a pressure of 0.5 bar (7.3 lbf/in²) to the secondary fuel pump. For additional information, refer to: [Fuel Tank and Lines](#) (310-01B Fuel Tank and Lines - TDV8 4.4L Diesel, Description and Operation).

SECONDARY FUEL PUMP

A secondary fuel pump is located in the left-hand (LH) side of the engine compartment. The pump receives fuel from the low pressure pump delivery module in the fuel tank. The secondary pump then increases the fuel pressure to the high pressure fuel pump 4.5 bar (65.3 lbf/in²). For additional information, refer to: [Fuel Tank and Lines](#) (310-01B Fuel Tank and Lines - TDV8 4.4L Diesel, Description and Operation).

FUEL FILTER

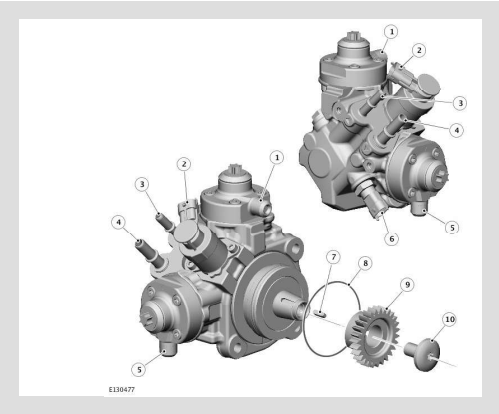
The fuel filter is located in the engine compartment on the LH side, packaged to be protected against damage. Attached to the fuel inlet on the filter is an electrical fuel heater, which will operate at fuel temperatures of 2°C (35.6°F) or below and will switch off at 7°C (44.6°F) or higher. This allows warm pre-heated diesel fuel to circulate inside the fuel filter to prevent waxing in cold operating conditions.

FUEL COOLER

A water cooled fuel cooler is fitted on the LH side of the engine compartment. The cooler is located in the fuel return line and is also connected to coolant system. For additional information, refer to: [Fuel Tank and Lines](#) (310-01B Fuel Tank and Lines - TDV8 4.4L Diesel, Description and Operation).

HIGH-PRESSURE SYSTEM

HIGH-PRESSURE FUEL PUMP



| ITEM | DESCRIPTION |
|------|---|
| 1 | Fuel outlet - high-pressure fuel pump to LH common rail |
| 2 | Metering Valve |
| 3 | Fuel return to fuel filter |
| 4 | Fuel supply from secondary fuel pump |
| 5 | Fuel outlet - high-pressure fuel pump to LH fuel rail |
| 6 | Fuel temperature sensor |
| 7 | Woodruff key |
| 8 | O-ring seal |
| 9 | Fuel injection pump drive gear |
| 10 | Drive flange bolt |

The high-pressure fuel pump is a 2-piston (90 degree apart) radial plunger pump with a high-pressure displacement of 1.0 cc and the ability to produce a maximum pressure of 2000 bar.

The pump is driven from the LH inlet camshaft via a drive gear and must be timed to the engine. (Refer to the repair procedures for timing process For additional information, refer to: [Fuel Pump](#) (303-04A Fuel Charging and Controls - TDV8 4.4L Diesel, Removal and Installation).)

The required supply pressure to the pump is 4.5 bar (65.3 lbf/in²) to 7.0 bar (101.5 lbf/in²). The return pressure is -0.3 bar to +0.8 bar gage.

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

The high-pressure fuel pump consists of the following components:

- Metering valve
- High-pressure pumping elements (2 off)
- Fuel temperature sensor.

The metering valve is a variable position solenoid valve electronically controlled by the ECM. The metering valve is located between the fuel inlet and the high-pressure pumping elements. The metering valve regulates the amount of fuel that is delivered to the common rails via the pumping elements. When there is no signal to the metering valve the valve is closed, therefore there is no fuel delivery.

The 2 high-pressure pumping elements each have a high-pressure outlet that connects to the LH common rail via high-pressure pipes.

The high-pressure fuel pump can supply up to 2000 bar fuel pressure continuously with a pump speed which is the same as engine speed. It is calibrated to deliver fuel pressure dependant upon engine speed and load and is always under full control.

When the high-pressure fuel pump is rotated, fuel pressure is created when the metering is open and the Pressure Control Valve (PCV) in the right-hand (RH) common rail is closed. The metering valve and PCV are variable position to allow variable fuel delivery and pressure control.

When the ECM actuates the piezo injectors, the rail pressure drop is offset by additional fuel being delivered to the high-pressure rails by the high-pressure fuel pump.

METERING VALVE

The metering valve is fixed directly to the high-pressure fuel pump.

The metering valve regulates the fuel supply (and hence the quantity of fuel) from the internal transfer pump to the high-pressure fuel pump elements, depending on the fuel pressure required in the common rail.

This makes it possible to match the delivery of the high-pressure fuel pump 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 high-pressure fuel pump, improving the efficiency of the engine.



NOTES:

- The fuel metering valve default is closed without electrical supply. An open circuit connector will prevent the engine from running.
- The metering valve forms part of the high-pressure fuel pump and cannot be replaced as a separate component in service.

PRESSURE CONTROL VALVE (PCV)

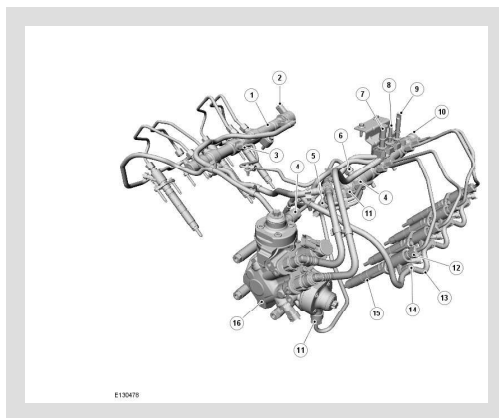
The PCV is located on the RH common rail. It governs the fuel pressure at the high-pressure outlets of the high-pressure fuel pump and thus, the fuel pressure within the rail. In addition, the PCV dampens any fluctuations in pressure, which occur during the delivery of fuel through the high-pressure fuel pump 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 attracts the armature to the coil. This forces the ball valve onto its seat via the control pin. The entire armature is coated with fuel for lubrication and cooling.

HIGH-PRESSURE COMMON FUEL RAILS



| ITEM | DESCRIPTION |
|------|--|
| 1 | RH common rail manifold |
| 2 | Fuel pressure control valve |
| 3 | Common rail manifold balance pipe - RH manifold connection |
| 4 | Fuel outlet - high-pressure fuel pump to LH fuel rail |
| 5 | Fuel pressure sensor |
| 6 | Common rail manifold balance pipe - LH manifold connection |
| 7 | Pressure feed connection from fuel filter to high pressure fuel pump |

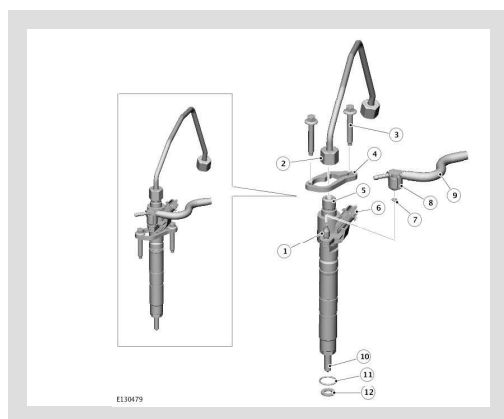
| ITEM | DESCRIPTION |
|------|---|
| 8 | Fuel return connection form injector leak-back |
| 9 | Fuel return connection from high pressure pump to fuel cooler |
| 10 | LH common rail manifold |
| 11 | Fuel outlet - high-pressure fuel pump to LH fuel rail |
| 12 | Fuel injector pressure supply (8 off) |
| 13 | Fuel leak-back tube (8 off) |
| 14 | Injector leak-back coupling (8 off) |
| 15 | Fuel injector (8 off) |
| 16 | High pressure fuel injection pump |

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

All high-pressure pipes have an internal diameter of 3.0 mm. Total rail volume is 33 cc.

The LH rail is fitted with a fuel pressure sensor and the RH rail is fitted with a Pressure control Valve (PCV). Both the pressure sensor and the PCV are connected to and controlled by the ECM.

FUEL INJECTORS



| ITEM | DESCRIPTION |
|------|--|
| 1 | Leak-back connection |
| 2 | High pressure supply pipe from common rail |
| 3 | Bolt (2 off per injector) |
| 4 | Injector clamp |
| 5 | High-pressure connection |

| ITEM | DESCRIPTION |
|------|----------------------------------|
| 6 | Electrical harness connection |
| 7 | O-ring seal - leak back coupling |
| 8 | Injector leak-back coupling |
| 9 | Fuel leak-back tube |
| 10 | Nozzle spray holes |
| 11 | O-ring seal |
| 12 | Injector nozzle washer |

The fuel injectors are operated directly by the ECM for fuel metering (start of injection and quantity of fuel injected).

The operating components of the piezo fuel injectors are:

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

Each injector has a code which must be programmed into the ECM to identify which cylinder it is associated with. Therefore it is important that the injectors must be replaced into the correct cylinders.



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.



CAUTION:

After engine shut down the common rails are maintained at a high pressure ready for the next engine start. Pressure will only fall to zero as you start to release the first pipe union, so care must be taken to prevent fuel leakage and contain any fuel losses until the fuel pressure has dissipated

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 energizing the piezo actuators, therefore, no fuel is injected and the engine speed drops to zero.