

Fuel (10.00)

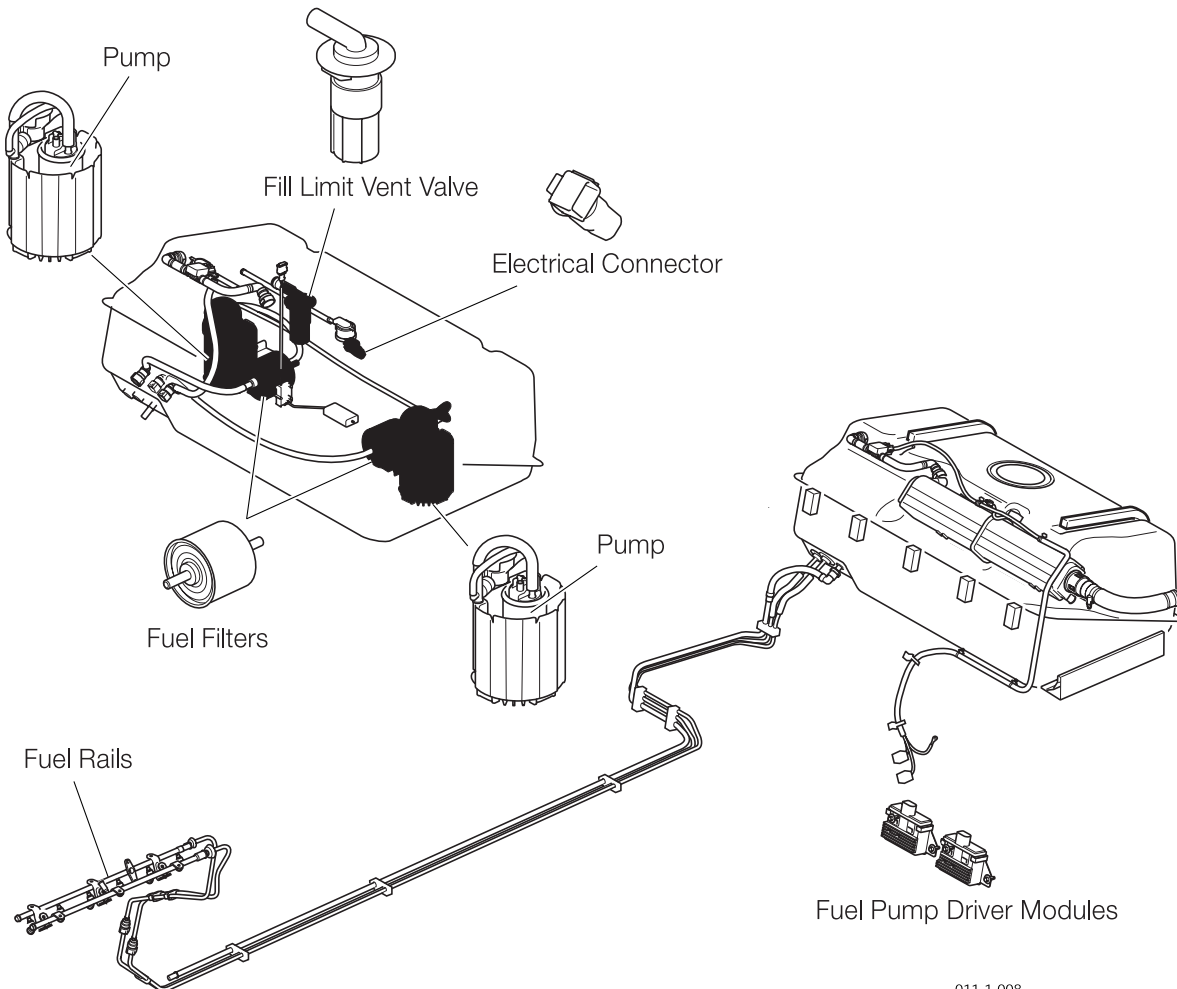
Contents

Fuel Tank and Lines (10.01)	10-1-2
Description	1-2
Fuel Tank.....	1-3
Fuel Pumps.....	1-4
Jet Pumps	1-4
Filler Neck and Check Valve	1-5
Valves and Sensors.....	1-5
<i>Fuel Limit Vent Valve (FLVV)</i>	1-5
<i>Roll Over Valves</i>	1-5
Fuel System Schematic	1-6
Evaporative Loss System.....	1-6
System Operation	1-6
Fuel Tank Vents and Control Valves	1-6
<i>On-Board Refuelling Vapour Recovery</i>	1-7
Safety Precautions	1-8
Specifications.....	1-8
Maintenance	1-8
Fuel System	1-8
<i>Depressurising</i>	1-8
<i>Priming</i>	1-9
<i>Pressure Test</i>	1-9
Fuel Tank.....	1-9
<i>Draining</i>	1-9
<i>Removal</i>	1-9
<i>Installation</i>	1-11
Fuel Filters	1-11
<i>Removal</i>	1-11
<i>Installation</i>	1-12
Fuel Pumps.....	1-12
<i>Removal</i>	1-12
<i>Installation</i>	1-13

Fuel (10.00)

Fuel Tank and Lines (10.01)

Description



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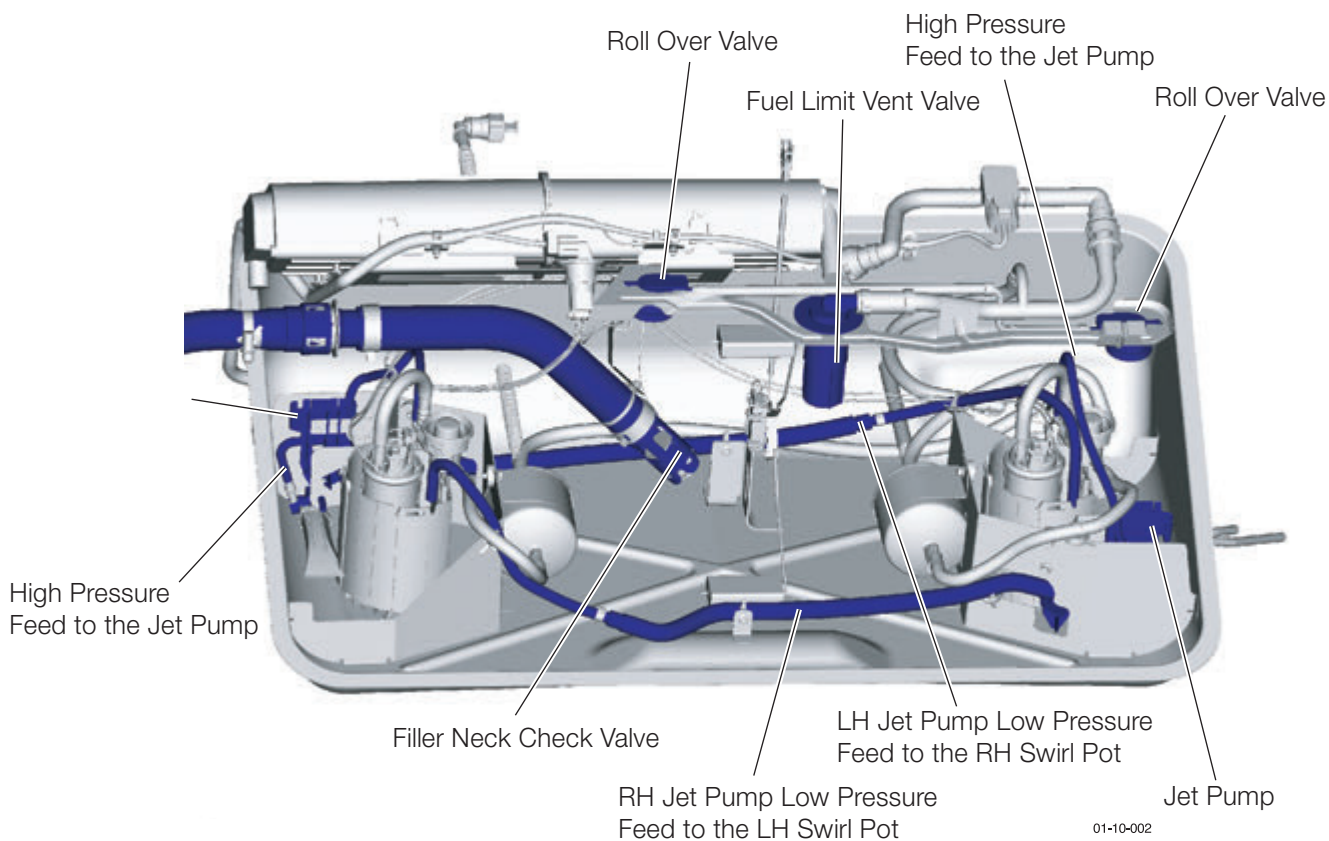
This vehicle uses a return less fuel system in which two fuel pumps, controlled by the fuel pump driver modules, are run to supply fuel through two in-tank filters to the two fuel rails (Refer to 'Fuel Charging System (03.04)', page 3-5-1). Each fuel rail is installed with six fuel injectors. A pressure sensor and a temperature sensor are fitted on the primary fuel rail. The secondary fuel rail is installed only with a pressure sensor. The fuel pump speeds are varied as required to regulate the fuel pressure in the fuel rails.

The RH fuel pump feeds the engine LH bank fuel rail.

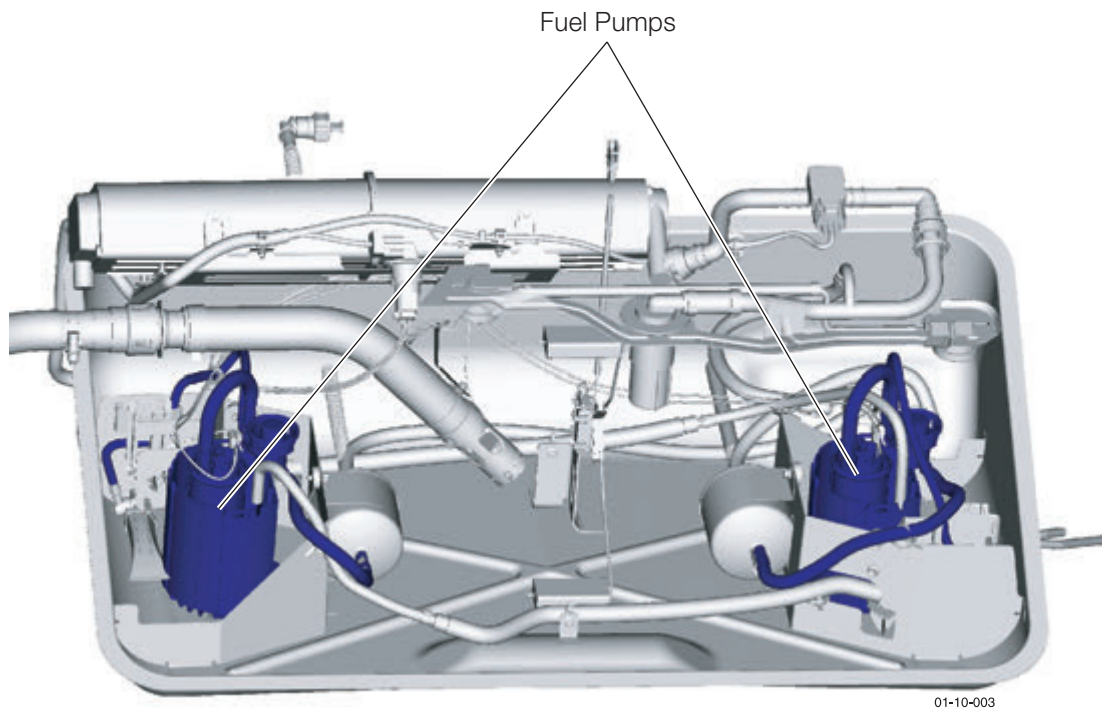
The LH fuel pump feeds the engine RH bank fuel rail.

Fuel Tank

The fuel tank incorporates a single filler neck and check valve, internal fuel pumps, internal fuel filters, a sender unit and an 'on board refuelling vapour recovery' system.



Fuel Pumps



The two modular fuel pumps are immersed in the base of the fuel tank. The pumps can deliver up to 150 litres / hour. The in-tank fuel lines connect to the external lines using two quick-fit connectors in the base of the fuel tank.

During normal running, pressurised fuel from each fuel pump passes from the tank, through an 3 micron in-tank fuel filter to one of the two fuel rails on the engine.

Fuel temperature is measured on the primary fuel rail. If fuel temperature becomes excessive, the fuel pressure is increased to prevent fuel vaporisation (boiling).

Fuel pressure is measured by sensors on each fuel rail. The fuel pressure to each rail is regulated as required by continuously changing the run speed of the associated fuel pump. Maximum pressure in the system is limited to 5.3 bar by in-tank pressure regulators.

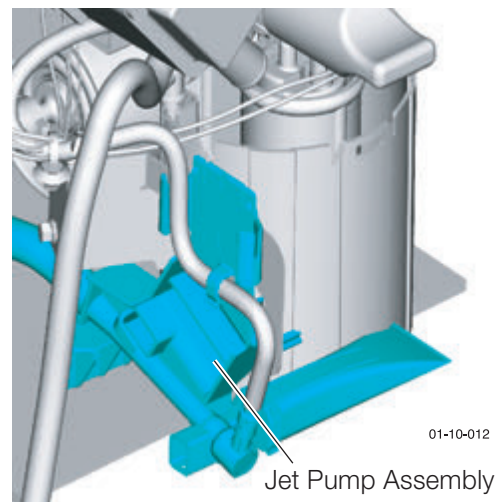
A constant head of fuel is maintained in the fuel pump modules to ensure that the pumps cannot run dry in a 'low fuel' situation.

Jet Pumps

Fuel feed from the fuel pumps is split three ways:

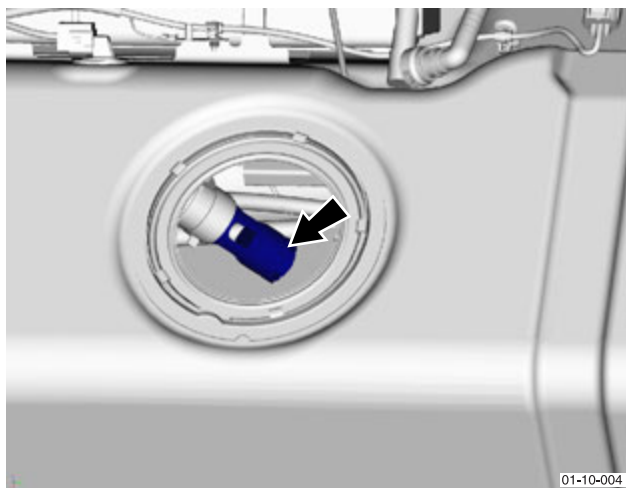
1. Feed to the fuel rails.
2. Feed to the swirl pot jet pumps (integral to the FDM).
3. Feed to the externally mounted jet pumps.

These pumps ensure that the appropriate pump swirl pot is maintained with fuel under severe dynamic conditions.



Filler Neck and Check Valve

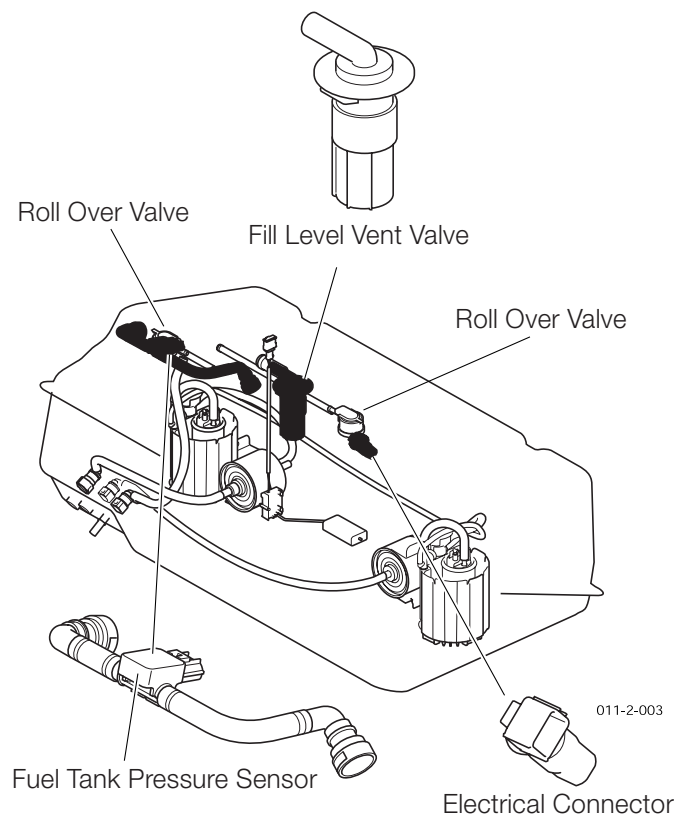
Incoming fuel passes through a check valve at the base of the filler neck. This valve is normally held closed by light spring pressure. The valve opens under the pressure of incoming fuel and closes again when fuel flow ceases. The check valve prevents surging of fuel in the filler neck.



The filler neck also forms part of the on-board refuelling vapour recovery system. Incoming fuel forms a liquid seal in the filler neck. Thus any air displaced during fuel tank filling cannot escape via the filler neck.



Valves and Sensors



Fuel Limit Vent Valve (FLVV)

This valve contains a float which rises to cut off the path for displaced air when the fuel level rises towards maximum during fuel filling. This causes a rapid pressure build up in the tank which triggers the cut-off valve in the fuel delivery nozzle. This discourages overfilling of the fuel tank.

The FLVV also includes an over pressure relief valve set at about 2 psi to vent the tank if all other vents fail.

Roll Over Valves

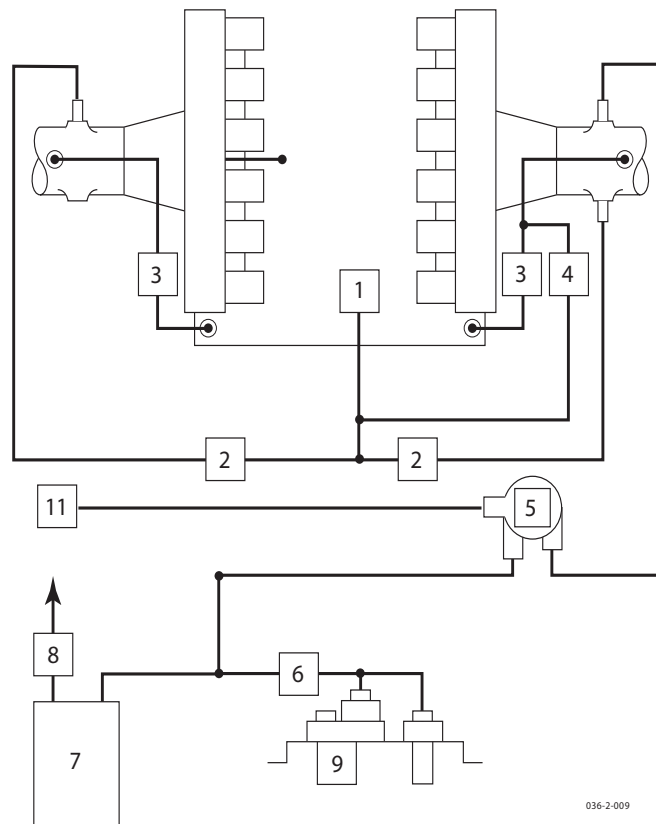
The roll over valves purpose is to vent the highest point of the tank. If the tank is grossly overfilled (e.g. many clicks over the normal filler nozzle cut-off), the FLVV will suffer a hydraulic lock. The roll over vent valve allows venting of the tank at the highest possible level in this situation.

All three valves allow the tank to breath until it is inverted when they will close to prevent fuel spill. The fuel level vent valve controls the fuel height of the tank by creating a pressure spike inside the tank which shuts of the fill nozzle. If the vehicle is inverted in an accident, this valve will close to prevent leakage of liquid fuel.

Fuel System Schematic

It includes the positive crankcase ventilation and vapour recovery systems.

1. Oil separator
2. PCV valve
3. Check valve
4. Relief valve
5. Vapour management valve
6. Fuel tank pressure transducer
7. Carbon canister
8. Canister vent valve
9. Fuel limit vent valve
10. Test port



Evaporative Loss System

Fuel vapour is displaced from the fuel tank during filling. Vapour is also displaced due to fuel evaporation in higher temperatures. Displaced fuel vapour is absorbed in the carbon canister filter located on top of the fuel tank.

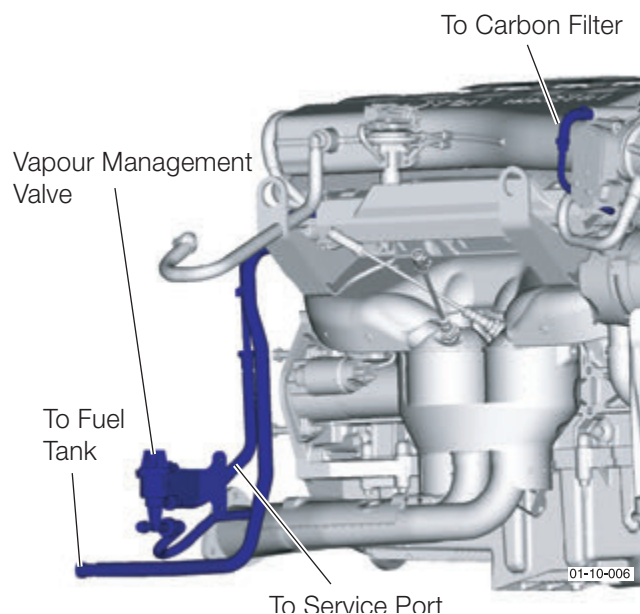
During normal engine running, absorbed fuel vapour is purged from the carbon canisters and mixed with the normal fuel/air charge in the inlet manifold.

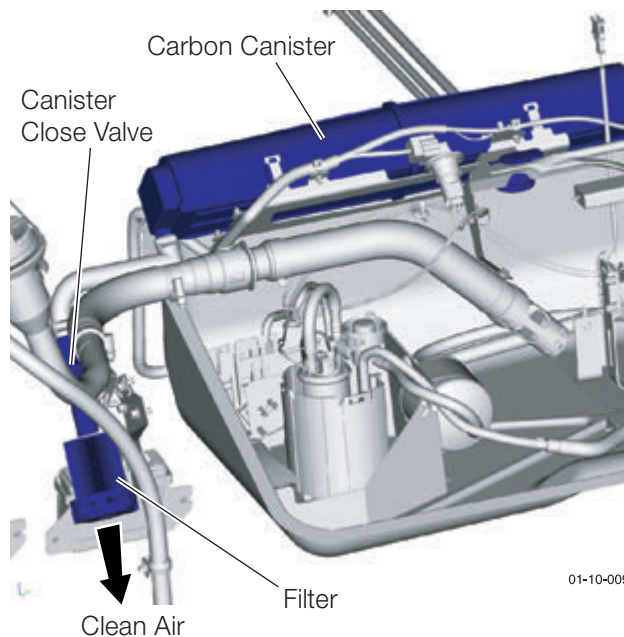
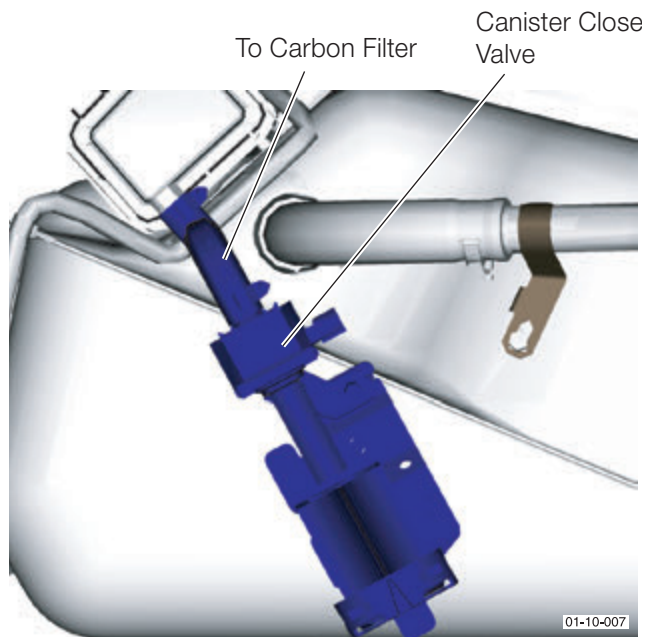
System Operation

Displaced fuel vapour leaves the fuel tank via the normally open fuel level vent valve and the roll over valves. It passes through the carbon canister where fuel hydrocarbons are absorbed. Clean air leaves the system via the normally open canister vent valve. This valve is only closed during diagnostic pressure testing of the fuel system.

During normal engine running, the single vapour management valve in the engine bay is periodically opened, when negative pressure exists in the intake manifold, allowing fresh air flow into the open canister vent valve, through the carbon canister, through the vapour management valve and into the primary inlet manifold. This fresh air flow progressively purges any absorbed fuel vapour from the carbon canister.

Fuel Tank Vents and Control Valves



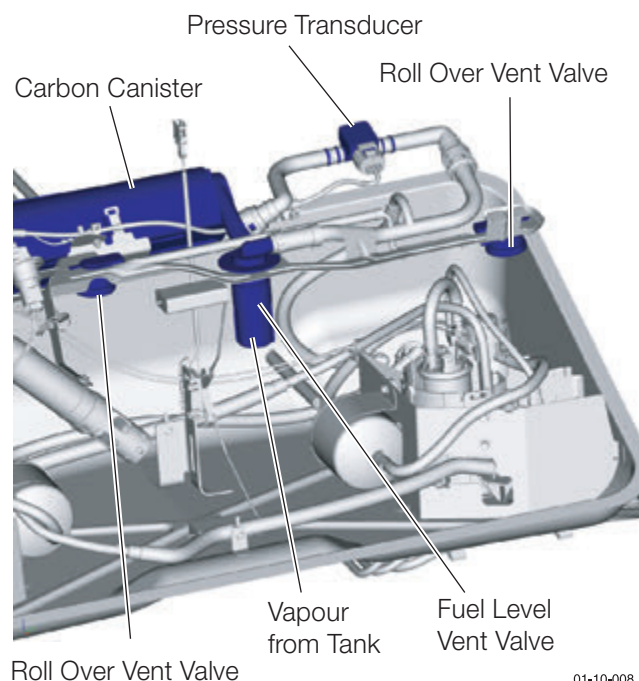


On-Board Refuelling Vapour Recovery

All of the vapour displaced from the tank by refuelling passes through a series of valves and through a carbon canister. This filters out and stores all the fuel vapour and clean air exits the carbon canister port.

Normal Fuel Fill - Air displaced from the fuel tank during filling can only exit via the fuel level vent valve and be forced through the carbon canister. Any fuel vapour in the displaced air is absorbed in the carbon filter material. No fuel vapour can escape to the atmosphere. Clean air then exits the carbon canister, via an additional filter, to atmosphere.

Excessive Fuel Fill - In the event of overfilling of the fuel tank, the fuel level vent valve will close at normal maximum fuel level. Finally the roll over vent valve will close, completely sealing the tank. Any excess pressure in the fuel tank will 'blow off' via the Over-pressure vent valve (part of the roll over vent valves) in the Fuel Level vent valve assembly.



Safety Precautions

Operations on fuel system result in fuel liquid and vapour being present in the working environment. This presents a very serious risk and the following precautions must be strictly observed:

Warning

Operations on refuelling and the fuel system must only be performed by personnel who have completed training on fuel handling.

Warning

Smoking must not be allowed near the working area. "NO SMOKING" signs must be posted around the working area.

Warning

Any operation which could involve sparks or naked lights (e.g. battery testing, welding, metal grinding, etc.) must not be allowed near the working area.

Warning

A CO2 fire extinguisher must be available close at hand.

Warning

Dry sand must be available close at hand to soak up any accidental fuel spillage.

Warning

If necessary, empty the fuel into an explosion proof container using suitable fireproof fuel handling equipment.

Warning

The working area must be well ventilated.

Warning

Disconnect the battery before commencing work on the fuel system.

Warning

Depressurise the fuel system before disconnecting any fuel lines.

Specifications

Pump Pressure		
Nominal pump pressure 40 psi (2.7 bar) above inlet manifold pressure.		
Torque Figures		
Description	Nm	lb. / ft.
Tank retaining plate bolts	20-25	15-18.5

Maintenance

Fuel System

Warning

Never break into the fuel system of a hot engine. Catalysts and exhaust systems run at high temperatures and present a serious fire risk if fuel is spilled onto them when hot.

Warning

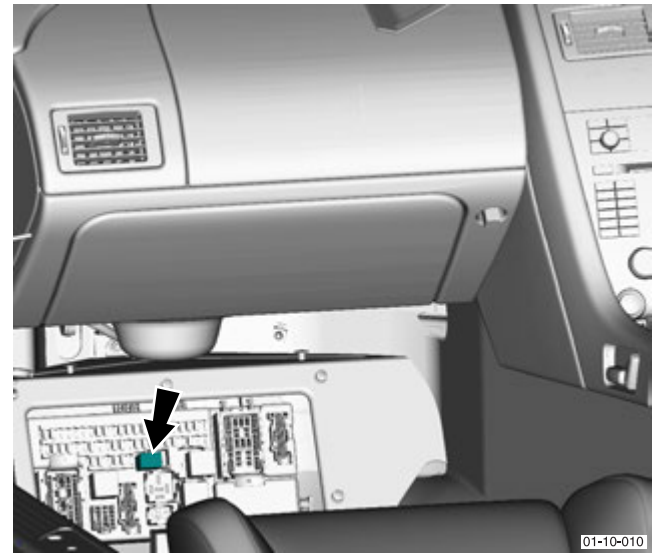
The fuel system is pressurised when the engine is running. Residual pressure will remain in the fuel system as the ignition is switched off. Opening a pressurised fuel line will cause a fuel leak and a fire risk.

The fuel system must only be serviced by staff trained in fuel handling.

Depressurising

Repair Operation Time (ROT)	
Item	Code
Fuel System Depressurising	10.01.EK

- Read and observe fuel system safety precautions (Refer to 'Safety Precautions', page 10-1-8).
- Remove the fuel pump relay from the CEM.



- Attempt to start the engine. The engine will run for approx. 11 seconds then stall. With the fuel pumps disabled the fuel lines will depressurise.

Two fault codes will show on each bank.

- P0087 'fuel pressure too low'
- P1233 'fuel pump driver module disabled or off line'

Both of these codes can be erased from each bank after the repairs to the fuel system

Warning

Fire Risk. Before starting work on the fuel system disconnect the earth lead from the vehicle battery.

- Switch off the ignition and install the fuel pump relay.

Priming

⚠ Warning ⚠

Fire Risk. Do not switch on the ignition until all work on the fuel system is completed and area is cleared of fuel and fuel vapour contamination.

The fuel system is self priming.

There must be a minimum of 5 litres of fuel in the tank.

Pressure Test

⚠ Warning ⚠

Fire Risk. Depressurise the fuel system before disconnecting pipe work. Use a pan or absorbent cloth to catch fuel spills which may occur due to residual pressure. Clean up spillages immediately and dispose of fuel contaminated materials safely.

- Set the WDS system to monitor the pressure in each fuel rail.
- Start the engine and monitor the fuel pressure readings.
 - Both fuel rails must show a pressure of more than 40 psi for the engine to function satisfactorily.
 - If either fuel rail is lower than 40 psi, check for blocked or restricted fuel filter or fuel lines on the side showing low pressure.
- If the filter and fuel lines are serviceable, suspect a defective fuel pump.

Fuel Tank

Repair Operation Time (ROT)	
Item	Code
Fuel Tank Renew	10.01.FB

Draining

⚠ Warning ⚠

Fire Risk. Before starting work on the fuel system disconnect the earth lead from the vehicle battery.

⚠ Warning ⚠

Read and follow all fuel handling instructions given at the start of this chapter and in the bowser manufacturers fuel handling documentation before commencing work on fuel system.
This procedure must only be performed by staff who are fully trained in fuel handling.

- Remove the following:

For trim, seat belt and seat removal refer to the following:
 (Refer to 'Interior Trim (01.05)', page 1-4-1)
 (Refer to 'Seating (01.10)', page 1-7-1)
 (Refer to 'Restraining Devices (01.20)', page 1-14-1)

- Passenger front seat
 - Both rear seats
- Disconnect the seat belts lower mounts.

- Remove the following:

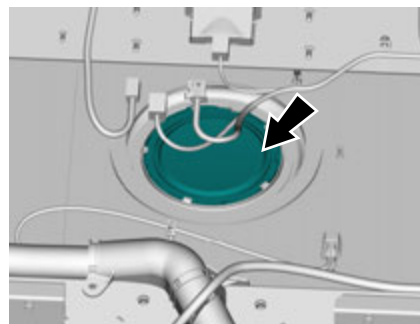
- Passenger rear ¼ panel
- Rear top panel
- Both seat belts
- Satellite Navigation (if installed)

- Remove the access cover over the fuel tank flange.

⚠ Warning ⚠

Ensure there is adequate ventilation inside the vehicle (i.e. place the vehicle in a well ventilated area, with the windows open).

- Remove the tank service cover plate (Refer to '310-136 (Fuel Tank Drainage Adaptor)', page 20-1-7).



- Install the fuel drain cover plate (Refer to '310-136 (Fuel Tank Drainage Adaptor)', page 20-1-7).
- Connect the external pipe to a fuel recovery unit. Recover the fuel according to the recovery unit instructions.

Several litres of fuel will remain in the tank sump after draining.

- After fuel recovery, remove the service tool from the fuel tank. Carry out the intended repair or service procedure.

When installing the service cover plate always use a new seal.

Removal

⚠ Warning ⚠

Fire Risk. Before starting braking in to the fuel system disconnect the earth (- ve) lead from the vehicle battery.

⚠ Warning ⚠

Fuel vapour is explosive. During the following procedure, fuel tank and fuel lines will be open. Ensure good ventilation and take all necessary precautions to eliminate fire risks.

⚠ Warning ⚠

Read and follow the fuel handling instructions given in Safety Precautions at the start of this section.

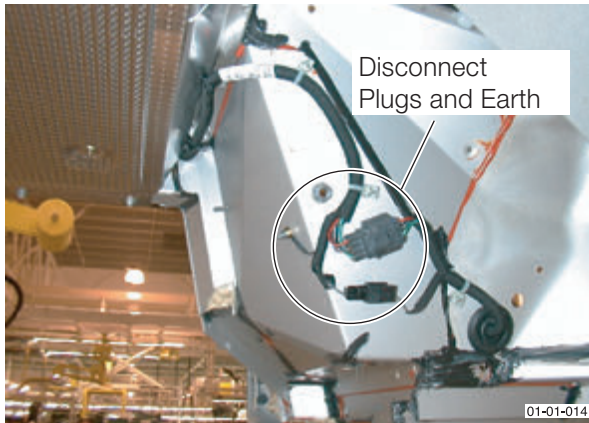
Take all necessary precautions to prevent sparks from electrical / electrostatic discharge or from friction.

- Depressurise the fuel system (Refer to 'Depressurising', page 10-1-8).
- Disconnect the earth lead from the vehicle battery.

3. Drain the tank.

Several litres of fuel will remain in the tank sump after draining.

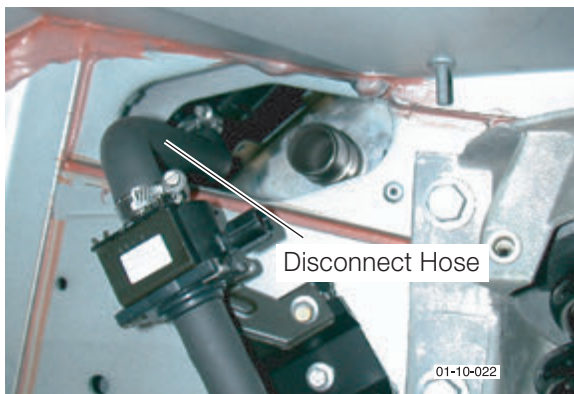
4. Remove the rear subframe (Refer to 'Rear Subframe', page 2-1-4).
5. Disconnect the tank wiring harness plugs and earth cable.
6. Disconnect the wiring harness earths and plugs



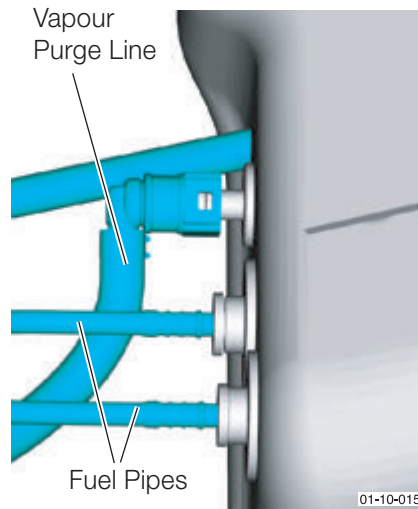
7. Remove the filler neck from the tank (Refer to '310-134 (Filler Neck Disconnect Tool)', page 20-1-6)
Cap the filler neck on the tank.



8. Disconnect the On-Board Refuelling Vapour Recovery hose to the filter.



9. Disconnect the vapour purge and fuel pipes from the tank (Refer to '310-040 (Fuel Pipe Disconnect Tool)', page 20-1-6). Cap the open ends on the tank and on the pipes.



10. Place a suitable adjustable support, i.e. a transmission jack, under the fuel tank retaining plate.

Warning

This is a two person operation. The fuel tank is heavy. Withdraw fuel tank with care.

11. Remove bolts (x18) that secure the fuel tank retaining plate. Allow the fuel tank retaining plate and fuel tank to lower on the adjustable support.

The tank may remain in position after retaining plate is removed. Manoeuvre the tank out from the vehicle body.



Installation

⚠ Warning ⚠

Fire Risk. Before starting braking in to the fuel system disconnect the earth lead from the vehicle battery.

⚠ Warning ⚠

Read and follow the fuel handling instructions given in Safety Precautions at the start of this section.

1. Place the fuel tank on to it's retaining plate. Using a suitable adjustable support, raise the fuel tank and retaining plate into position. Secure the tank with the tank retaining plate. Torque bolts (x18) to **20-25 Nm**.
2. Connect the fuel lines.

When reconnecting the fuel lines at the tank, check for complete engagement of locking clips. Test the fuel system integrity before refitting the shear plate and rear undertray.

3. Remove the cap from the filler neck on the tank. Install the filler neck to the tank.
4. Connect the On-Board Refuelling Vapour Recovery hose to the filter.
5. Connect the tank wiring harness plugs and earth cable.
6. Install the rear subframe (Refer to 'Rear Subframe', page 2-1-4).
7. Fill the tank.
8. Check and ensure integrity of the fuel system.

⚠ Warning ⚠

Fire Risk. Do not connect the battery and switch on the ignition until all work on the fuel system is completed and the area is cleared of fuel contamination.

Remove contaminated material, open fuel containers, waste fuel. Fully ventilate vehicle and work area to remove all fuel fumes.

9. Connect the earth lead to the vehicle battery.

⚠ Warning ⚠

Fire Risk. Do not start the engine until the fuel system integrity is confirmed.

10. Switch on the ignition. Confirm there are no fuel leaks.
11. Start the engine and check for correct fuel system operation (i.e. correct engine running).

Fuel Filters

Repair Operation Time (ROT)

Item	Code
Fuel Filter Renew	(x1) 10.01.AB
	(x2) 10.01.BB

Caution

The following procedure is completed inside the vehicle cabin area. Extra care must be taken to ensure no fuel or fuel vapours come into contact with the vehicle interior.

Removal

1. Depressurise the fuel system (Refer to 'Depressurising', page 10-1-8).
2. Drain the fuel tank (Refer to 'Draining', page 10-1-9).

⚠ Warning ⚠

Several litres of fuel remain in the tank sump after draining.

3. Disconnect the earth lead from vehicle battery.
4. Remove the passenger front seat.
5. Remove both rear seat backs and bases.
6. Remove the rear trim.
 - Rear ¼ panels
 - Rear top panel
 - Both seat belts

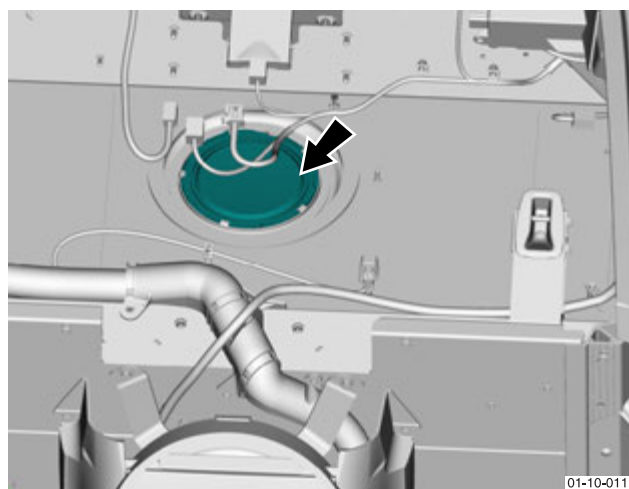
For trim, seat belt and seat removal refer to the following: (Refer to 'Interior Trim (01.05)', page 1-4-1)

7. Remove the access cover over the fuel tank flange.

⚠ Warning ⚠

Ensure there is adequate ventilation inside the vehicle (i.e. place the vehicle in a well ventilated area, with the windows open).

8. Remove the tank service cover plate (Refer to '310-136 (Fuel Tank Drainage Adaptor)', page 20-1-7).

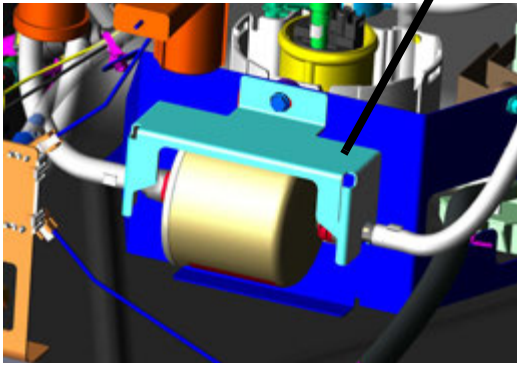


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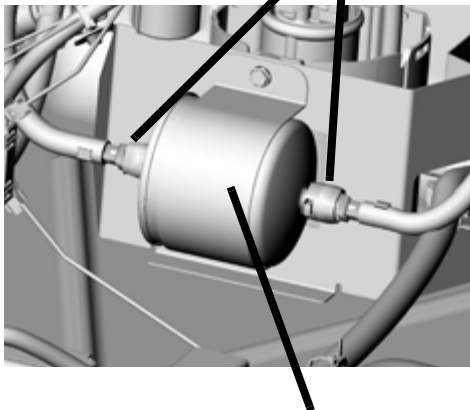
The following operation is completed using one hand and without sight of the fuel filter.

9. Remove the fuel filter.

9.1 Release the fuel filter pipe clamp.



9.2 Release the two fuel filter pipes (quick release unions).



9.3 Remove the fuel filter clamp.

9.4 Withdraw the fuel filter.

10. Repeat for the second fuel filter.

Installation

The following operation is completed using one hand and without sight of the fuel filter.

1. Insert a fuel filter through the fuel tank opening. Secure in position using the fuel filter clamp.
2. Connect the fuel pipes (x2).
Repeat for the second fuel filter.
3. Install the tank service cover plate (Refer to '310-136 (Fuel Tank Drainage Adaptor)', page 20-1-7).

When installing the service cover plate always use a new seal.

4. Connect the earth lead to the vehicle battery.

⚠ Warning ⚠

Fire Risk. Do not start engine until fuel system integrity is confirmed.

5. Switch on the ignition. Confirm there are no fuel leaks.

6. Start the engine and check for correct fuel system operation (i.e. correct engine running).
7. Install the vehicle seat belts and trim.

For trim, seat belt and seat installation refer to the following:

(Refer to 'Interior Trim (01.05)', page 1-4-1)

(Refer to 'Seating (01.10)', page 1-7-1)

(Refer to 'Restraining Devices (01.20)', page 1-14-1)

Fuel Pumps

Repair Operation Time (ROT)

Item	Code
Fuel Pump Renew	(x1) 10.01.CB
	(x2) 10.01.DB

Caution

The following procedure is completed inside the vehicle cabin area. Extra care must be taken to ensure no fuel or fuel vapours come into contact with the vehicle interior.

Removal

1. Depressurise the fuel system (Refer to 'Depressurising', page 10-1-8).
2. Drain the fuel tank (Refer to 'Draining', page 10-1-9).

⚠ Warning ⚠

Several litres of fuel remain in the tank sump after draining.

3. Disconnect the earth lead from the vehicle battery.
4. Remove the following:

For trim, seat belt and seat removal refer to the following:

(Refer to 'Interior Trim (01.05)', page 1-4-1)

(Refer to 'Seating (01.10)', page 1-7-1)

(Refer to 'Restraining Devices (01.20)', page 1-14-1)

- Passenger front seat
- Both rear seats

5. Disconnect the seat belts lower mounts.
6. Remove the following:

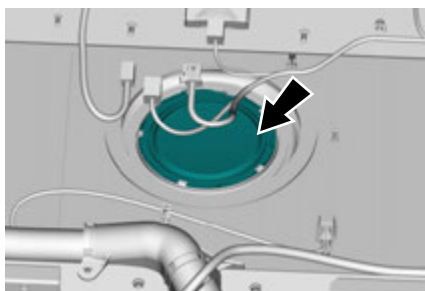
- Passenger rear ¼ panel
- Rear top panel
- Both seat belts

7. Remove the access cover over the tank flange.

⚠ Warning ⚠

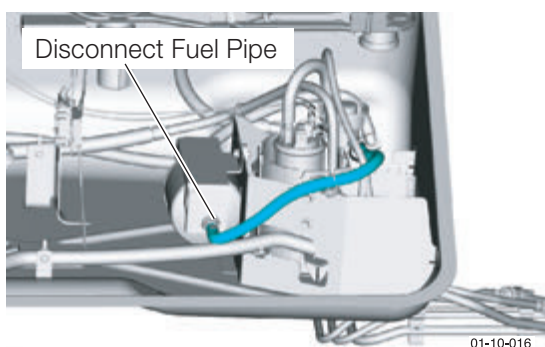
Ensure there is adequate ventilation inside vehicle (i.e. vehicle in a well ventilated area, windows open).

8. Remove the tank service cover plate (Refer to '310-136 (Fuel Tank Drainage Adaptor)', page 20-1-7).

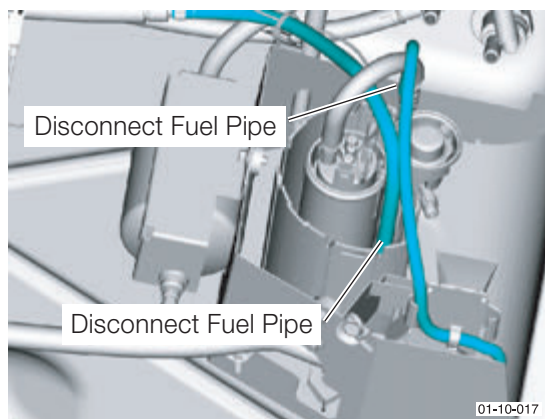


The following operation is completed using one hand and without sight of the fuel pump.

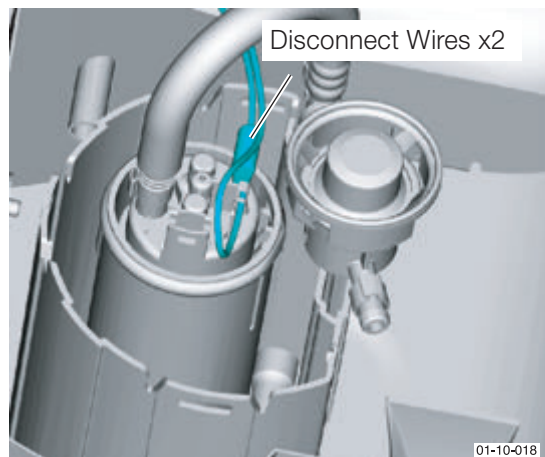
9. Disconnect the main fuel pipe from the fuel filter (2).



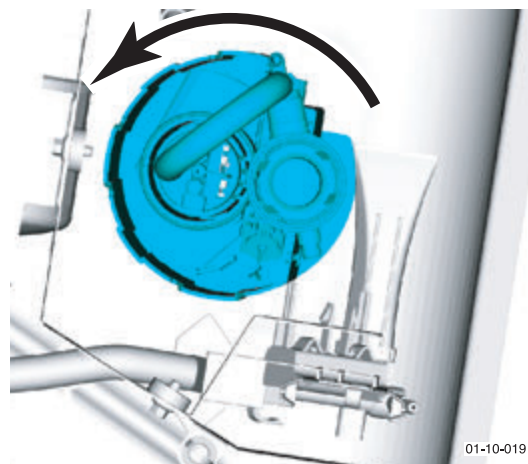
10. Disconnect the cross feed fuel pipes.



11. Disconnect the wiring harness plug.



12. Using the service tool (Refer to '310-140 (Fuel Pump Install / Remove)', page 20-1-7), twist the fuel pump anti-clockwise to release it from the mounting bracket. Withdraw the fuel pump.



Installation

1. Place the fuel pump to its mounting. Using the service tool twist clockwise to secure (Refer to '310-140 (Fuel Pump Install / Remove)', page 20-1-7).

The fuel pump should 'click' into place.

2. Install the main fuel pipe, the cross feed pipes and the wiring harness plug.
3. Install the tank service cover plate (Refer to '310-136 (Fuel Tank Drainage Adaptor)', page 20-1-7).

When installing the service cover plate always use a new seal.

4. Connect the earth lead to the vehicle battery.

Warning

Fire Risk. Do not start engine until fuel system integrity is confirmed.

5. Switch on the ignition. Confirm there are no fuel leaks.
6. Start the engine and check for correct fuel system operation (i.e. correct engine running).
7. Install both seat belts.
8. Install the rear top panel.
9. Install the passenger rear ¼ panel.
10. Connect the seat belts lower mounts.
11. Install the rear seats.

Install the seat backs then the seat bases.

12. Install the passenger front seat.



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