Chapter 4 Part E: Fuel and exhaust systems – Emissions control systems

Contents

Degrees of difficulty

Easy, suitable for novice with little experience 

Fairly easy, suitable for beginner with some experience 

Fairly difficult, suitable for competent DIY mechanic 

Difficult, suitable for experienced DIY mechanic 

Very difficult, suitable for expert DIY or professional 

Specifications

Torque wrench settings	Nm	lbf ft
Oxygen sensor:		
4-cylinder engines with sensor in front pipe	20	15
4-cylinder engines with sensor in manifold	55	41
V6 engines	45	33
Air suction valve pipe nuts	22	16
Air suction valve pipe bolts	12	9
EGR valve nuts and bolts	22	16

1 General information

1 To minimise pollution of the atmosphere from incompletely-burned and evaporating gases, and to maintain good driveability and fuel economy, a number of emissions control systems are used on later vehicles covered by this manual. They include the following:

(a) The engine management system (comprising both fuel and ignition sub-systems) itself.
(b) Crankcase emissions control.
(c) Evaporative emissions control system.
(d) Exhaust emissions control (air injection system, exhaust gas recirculation system, catalytic converter).

2 Before assuming an emission control system is malfunctioning, check the fuel and ignition systems carefully (see the earlier Parts of this Chapter, and Chapter 5). The diagnosis of most emission control devices requires specialised tools, equipment and training. If checking and servicing become too difficult, or if a procedure is beyond the scope of your skills, consult your Rover dealer or other specialist. **Note:** *The most frequent cause of emissions problems is simply a loose or broken electrical connector or vacuum hose, so always check the electrical connectors and vacuum hoses first.*

3 Pay close attention to any special precautions outlined in this Chapter. It should be noted that the illustrations of the various systems may not exactly match the system installed on your vehicle, due to changes made by the manufacturer during production or from year-to-year.

Crankcase emissions control

4 To reduce the emissions of unburned hydrocarbons from the crankcase into the atmosphere, a Positive Crankcase Ventilation (PCV) system is used whereby the engine is sealed and the blow-by gasses and oil vapour are drawn from inside the crankcase, through an oil separator, into the inlet tract to be burned by the engine during normal combustion.

5 Under conditions of high manifold depression (idling, deceleration) the gasses will be sucked positively out of the crankcase. Under conditions of low manifold depression (acceleration, full-throttle running) the gasses are forced out of the crankcase by the (relatively) higher crankcase pressure; if the engine is worn, the raised crankcase pressure (due to increased blow-by) will cause some of the flow to return under all manifold conditions.

Evaporative emissions control

6 To minimise the escape into the atmosphere of unburned hydrocarbons, an evaporative emissions control system is fitted to models equipped with a catalytic converter. The fuel tank filler cap and vents are sealed and a charcoal canister is mounted in the engine compartment to collect the petrol vapours generated in the tank when the car is parked. It stores them until they can be cleared from the canister via the purge valve into the inlet tract, to be burned by the engine during normal combustion.

7 To ensure that the engine runs correctly when it is cold and/or idling, and to protect the catalytic converter from the effects of an over-rich mixture, the purge valve is not allowed to open until the engine has warmed-up, and is under load; the valve is then opened to allow the stored vapour to pass into the inlet tract.

8 On 4-cylinder engines the vacuum supply to operate the purge valve is regulated by a purge control valve solenoid which itself is under the control of the ECU. The solenoid is mounted either separately within the engine compartment or, on later models, directly on top of the charcoal canister.

9 On V6 engines the vacuum supply to the purge valve is regulated by the constant vacuum control valve (under ECU control) and by a thermostatic valve which is opened or closed depending on coolant temperature.

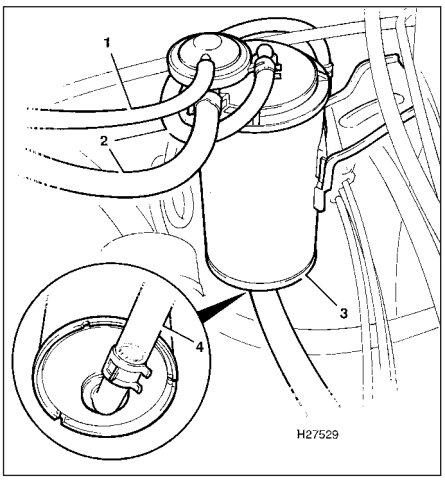
Exhaust emissions control

10 To minimise the amount of pollutants which escape into the atmosphere, some models are fitted with a catalytic converter in

the exhaust system. On all models where a catalytic converter is fitted, the system is of the closed-loop type, in which an oxygen sensor in the exhaust system provides the fuel injection/ignition system ECU with constant feedback on the oxygen content of the exhaust gasses. This enables the ECU to adjust the mixture by altering injector opening time, to provide the best possible conditions for the converter to operate.

11 The oxygen sensor has a built-in heating element, controlled by the ECU to quickly bring the sensor's tip to an efficient operating temperature. The sensor's tip is sensitive to oxygen, and sends the ECU a varying voltage depending on the amount of oxygen in the exhaust gasses; if the intake air/fuel mixture is too rich, the exhaust gasses are low in oxygen, so the sensor sends a voltage signal proportional to the oxygen detected, the voltage altering as the mixture weakens and the amount of oxygen in the exhaust gasses rises. Peak conversion efficiency of all major pollutants occurs if the intake air/fuel mixture is maintained at the chemically-correct ratio for complete combustion of petrol - 14.7 parts (by weight) of air to 1 part of fuel (the "stoichiometric" ratio). The sensor output voltage alters in a large step at this point, the ECU using the signal change as a reference point, and correcting the intake air/fuel mixture accordingly, by altering the fuel injector opening time.

12 To further improve emissions performance, later V6 engines are fitted with an air injection system and an exhaust gas recirculation (EGR) system. The air injection system operates by introducing fresh air from the air cleaner into the exhaust manifold under the control of the fuel/ignition ECU, and an air suction valve. The EGR system recirculates a proportion of the exhaust gasses through the EGR valve and back into the combustion chambers via the inlet manifold. Operation of the system is controlled by the fuel/ignition ECU which opens and closes the EGR valve according to operating conditions.



2.4 Charcoal canister attachments on V6 engines

1 Vacuum hose
2 Vapour hoses
3 Canister
4 Air inlet hose

2 Emissions control systems - testing and component renewal

Crankcase emissions control

1 The checking and testing procedures for the PCV system are contained in Chapter 1.

Evaporative emissions control

Testing

2 If the system is thought to be faulty, disconnect the hoses from the charcoal canister and purge valve, and check that they are clear by blowing through them. If the purge control valve, purge control valve solenoid or charcoal canister are thought to be faulty, they must be renewed. Testing of the control side of the system should be entrusted to a dealer with the dedicated test equipment necessary to interrogate the system quickly and accurately.

Charcoal canister - renewal

3 If the purge control valve solenoid is located on top of the canister, disconnect it's wiring multiplug.

4 Release the clips and disconnect the hoses from the top of the canister. Note their locations for correct refitting, and pull the hoses straight off the pipe stubs, otherwise the stubs may break off inside the hose **(see illustration)**.

5 Where fitted, release the securing strap and lift the canister from its location. On early models, disconnect the additional hose at the base of the canister.

6 Refitting is a reversal of removal, ensuring that the hoses are correctly fitted.

Purge control valve solenoid (early 4-cylinder engines) - renewal

7 Disconnect the wiring multiplug from the solenoid **(see illustration)**.

8 Release the clip and disconnect the vacuum hose from the solenoid. Pull the hose straight off the pipe stub otherwise the stub may break off inside the hose.

9 Extract the circlip from the purge hose at the base of the solenoid and pull off the hose. Recover the O-ring from the pipe stub, ensuring that it doesn't remain in the hose.

10 Slide the solenoid from its bracket and remove it from the car.

11 Refitting is a reversal of removal, but use a new O-ring on the purge hose stub.

Purge control valve solenoid (later 4-cylinder engines) - renewal

12 Disconnect the wiring multiplug from the solenoid.

13 Release the clip and disconnect the vacuum hose from the solenoid. Pull the hose straight off the pipe stub otherwise the stub may break off inside the hose.

14 Compress the retaining tags and withdraw the solenoid from the charcoal canister. Recover the O-ring from the base of the solenoid.

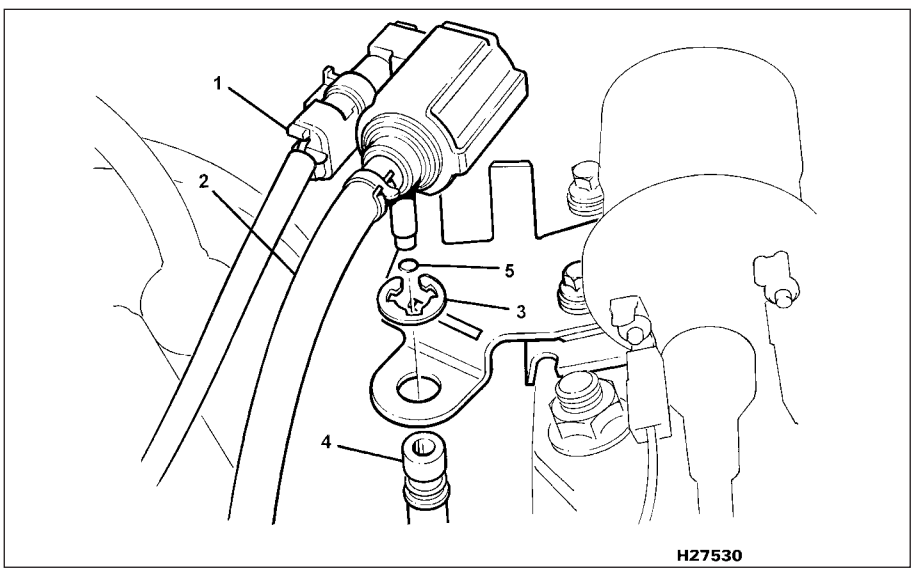
15 Refitting is a reversal of removal, but use a new sealing O-ring.

Thermostatic valve (V6 engines) - renewal

16 Drain the cooling system as described in Chapter 1.

17 Refer to Part D, Section 12, and remove the fast idle valve.

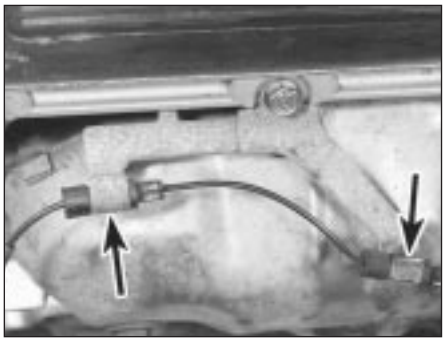
18 Disconnect the two vacuum hoses at the



2.7 Purge control valve solenoid attachments on early 4-cylinder engines

1 Wiring multiplug
2 Vacuum hose
3 Purge hose circlip
4 Purge hose
5 O-ring

2.18 Disconnect the two vacuum hoses at the thermostatic valve (arrowed)



2.37 Release the oxygen sensor lead from the support bracket clips (arrowed)

2.42 Rear oxygen sensor location in the exhaust manifold

thermostatic valve and release the upper hose from its support clip **(see illustration)**.

19 Unscrew the thermostatic valve from the coolant passage and remove it from the engine.

20 Refitting is a reversal of removal, but apply a thread sealant to the valve threads prior to refitting.

Constant vacuum control valve (V6 engines) - renewal

21 The constant vacuum control valve is located in the control box mounted on the engine compartment bulkhead. Further information on the control box and its components can be found in Part D, Section 12.

Exhaust emissions control

Testing

22 Many of the exhaust emissions control components are an integral part of the engine management system, and testing can only be accurately carried out using Rover test equipment. On V6 engines, any system faults will be stored in the ECU self-diagnosis memory and displayed as a series of flashing fault codes on the LED display. These can be quickly interpreted by a dealer to isolate the location of the fault and save time-consuming individual component testing.

23 If a component is known to be faulty, or if fault diagnosis has been carried out by a dealer, it can then be renewed as follows.

Oxygen sensor (4-cylinder engines) - renewal

Note: *The oxygen sensor is delicate, and will not work if it is dropped or knocked, if its power supply is disrupted, or if any cleaning materials are used on it.*

24 On models with Lucas multi-point fuel injection, the sensor is located on top of the exhaust downpipe, under the car.

25 Disconnect the sensor wiring harness multiplug at the connector in the engine compartment. Release the harness from the engine compartment cable ties and note the harness routing.

26 Jack up the front of the car and securely support it on axle stands.

27 Release the wiring harness from the underbody cable ties.

28 Unscrew the sensor from the exhaust pipe and collect the sealing washer.

29 Refitting is a reversal of removal using a new sealing washer. Prior to installing the sensor, apply a smear of high temperature grease to the sensor threads. Ensure that the sensor is securely tightened and make sure that the wiring is routed correctly with no danger of it contacting either the exhaust system or engine.

30 On models with MEMS multi-point fuel injection, the sensor is located in the exhaust manifold.

31 Release the wiring harness from its support bracket on the thermostat housing and disconnect the harness multiplug.

32 Unscrew the sensor from the exhaust manifold and collect the sealing washer.

33 Refitting is a reversal of removal using a new sealing washer. Prior to installing the sensor, apply a smear of high temperature grease to the sensor threads and ensure that the sensor is securely tightened.

Front oxygen sensor (V6 engines) - renewal

34 Refer to the note at the beginning of paragraph 24 before proceeding.

35 Refer to Chapter 3, and remove the radiator.

36 Undo the three bolts securing the heat shield to the exhaust manifold.

37 Disconnect the sensor lead at the wiring connector and release the lead from the support bracket clips **(see illustration)**.

38 Remove the heat shield and unscrew the sensor from the manifold.

39 Refitting is a reversal of removal using a new sealing washer. Prior to installing the sensor, apply a smear of high temperature grease to the sensor threads and ensure that the sensor is securely tightened. Refit the radiator as described in Chapter 3.

Rear oxygen sensor (V6 engines) - renewal

40 Refer to the note at the beginning of paragraph 24 before proceeding.

41 Jack up the front of the car and securely support it on axle stands.

42 From under the car, disconnect the sensor lead at the wiring connector and unscrew the sensor from the manifold **(see illustration)**.

43 Refitting is a reversal of removal using a new sealing washer. Prior to installing the sensor, apply a smear of high temperature grease to the sensor threads and ensure that the sensor is securely tightened.

Air suction valve (V6 engines) - renewal

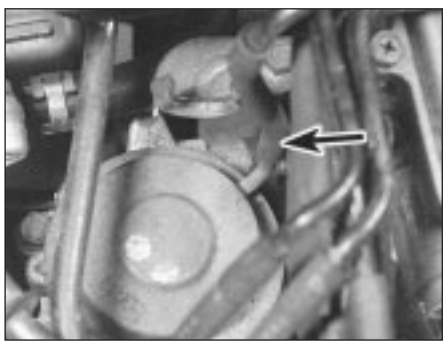
44 Disconnect the battery negative (earth) lead (refer to Chapter 5, Section 1).

45 Release the clip and disconnect the brake servo vacuum hose from the inlet manifold **(see illustration)**.

46 Undo the bolt securing the pipe bracket at the rear of the air suction valve.

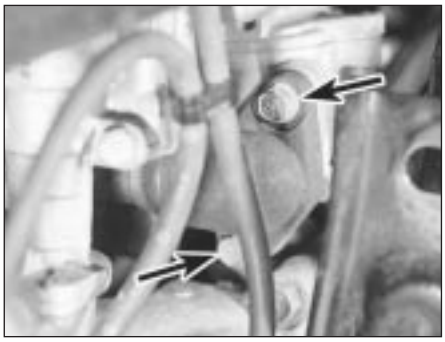
47 Disconnect the air suction valve vacuum hose **(see illustration)**.

2.45 Disconnect the brake servo vacuum hose (arrowed) from the inlet manifold



2.47 Disconnect the air suction valve vacuum hose (arrowed)

2.56 Undo the two nuts from the suction valve pipe front flange and release the heat shield



2.57 Undo the two bolts (arrowed) at the suction valve pipe rear flange

48 Undo the two air suction pipe retaining bolts
49 Undo the two bolts securing the fuel pipe retaining clips adjacent to the air suction valve.
50 Relieve the fuel system pressure as described in Part D, Section 5.
51 Undo the two banjo union bolts securing the fuel pipes to the front fuel rail. Release the pipes and collect the copper washers. Cover the open unions after disconnection then move the pipes away.
52 Undo the vacuum pipe cluster support bracket bolt and move the pipes slightly for access to the air suction valve.
53 Undo the three bolts and withdraw the air suction valve from the manifold. Recover the gasket.
54 Refitting is a reversal of removal. Clean the mating faces prior to refitting and use a new gasket.

Air suction valve pipe (V6 engines) - renewal

55 Remove the throttle body and the electronic idle control valve as described in Part D, Section 12.
56 Undo the two nuts from the suction valve pipe front flange and release the heat shield **(see illustration)**.
57 Undo the two bolts at the suction valve pipe rear flange **(see illustration)**.
58 Disconnect the lead from the thermal transmitter and release the lead from its clip.
59 Release the air suction pipe flanges and remove the pipe from the engine. Recover the two flange gaskets.
60 Refitting is a reversal of removal. Clean the valve flange and manifold mating faces prior to refitting and use a new gasket.

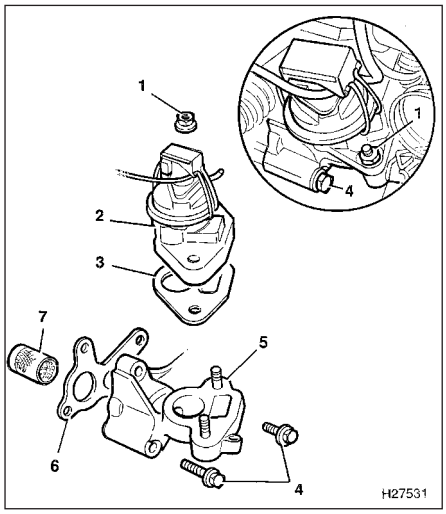
EGR valve and filter (V6 engines) - renewal

61 Remove the air intake trunking and air cleaner assembly as described in Part D, Section 2.
62 Disconnect the EGR valve multiplug and release the multiplug from its bracket.
63 Disconnect the vacuum hose at the valve.
64 Undo the two nuts and remove the EGR valve from the filter housing **(see illustration)**. Recover the flange gasket.
65 Undo the two filter housing retaining bolts and remove the housing from the cylinder head. Recover the flange gasket and remove the filter from the housing.
66 Clean the valve core and body using compressed air and a small screwdriver. Take care not to actuate the valve while holding it.
67 Refitting is a reversal of removal. Fit a new filter during reassembly and use new gaskets at the mating faces.

3 Catalytic converter - general information and precautions

1 The catalytic converter is a reliable and simple device, which needs no maintenance in itself, but there are some facts of which an owner should be aware if the converter is to function properly for its full service life.

(a) DO NOT use leaded petrol in a vehicle equipped with a catalytic converter - the lead will coat the precious metals, reducing their converting efficiency, and will eventually destroy the converter.
(b) Always keep the ignition and fuel systems well-maintained in accordance with the manufacturer's schedule (see Chapter 1).
(c) If the engine develops a misfire, do not drive the vehicle at all (or at least as little as possible) until the fault is cured.
(d) DO NOT push- or tow-start the vehicle - this will soak the catalytic converter in unburned fuel, causing it to overheat when the engine does start.
(e) DO NOT switch off the ignition at high engine speeds, ie do not "blip" the throttle immediately before switching off.



2.64 EGR valve and filter components

1 Valve retaining nuts
2 EGR valve
3 Gasket
4 Filter housing bolts
5 Filter housing
6 Gasket
7 Filter

(f) DO NOT use fuel or engine oil additives - these may contain substances harmful to the catalytic converter.
(g) DO NOT continue to use the vehicle if the engine burns oil to the extent of leaving a visible trail of blue smoke.
(h) Remember that the catalytic converter operates at very high temperatures. DO NOT, therefore, park the vehicle in dry undergrowth, over long grass or piles of dead leaves, after a long run.
(i) Remember that the catalytic converter is FRAGILE. Do not strike it with tools during servicing work.
(j) In some cases, a sulphurous smell (like that of rotten eggs) may be noticed from the exhaust. This is common to many catalytic converter-equipped vehicles. Once the vehicle has covered a few thousand miles, the problem should disappear - in the meantime, try changing the brand of petrol used.
(k) The catalytic converter used on a well-maintained and well-driven vehicle should last for between 50 000 and 100 000 miles. If the converter is no longer effective, it must be renewed.

2 The catalytic converter is located between the exhaust system front and intermediate sections and is removed and refitted in the same way as the other sections. Always renew the converter flange seals when the unit is disturbed in any way, and ensure that all retaining nuts are securely tightened. Refer to the relevant earlier Parts of this Chapter, for details of exhaust system removal and refitting.