

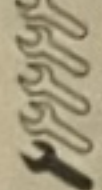
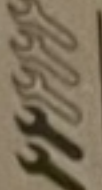
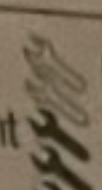
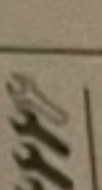
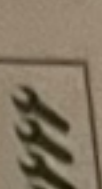
Chapter 4 Part C: Emission control systems

4C•1

Contents

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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
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Specifications

EVAP canister purge valve

Resistance at 20°C 45 ± 5 ohms

EVAP pressure sensor

Pressure:	Voltage (approx)
-0.038 bar	0.1
0 bar	2.5
0.012 bar	2.0

EVAP shut-off control valve

Resistance at 20°C 24.5 ± 1.5 ohms

Heated oxygen sensors

Type	Bosch LSF 4.7 (with preheating)
Resistance at 20°C (pins 1 and 2)	9.0 ohms (approx)

Torque wrench settings

	Nm	lbf ft
Petrol engines		
Oxygen sensor	40	30
Diesel engines		
Exhaust gas recirculation (EGR) pipe bolts	25	18
Exhaust gas recirculation (EGR) valve bolts/nuts	25	18
Exhaust gas temperature sensors	45	33

1 General information

1 All petrol engine models use unleaded petrol and also have various other features built into the fuel system to help minimise harmful emissions. These include a crankcase emission control system, a catalytic converter, and an evaporative emission control system to keep fuel vapour/exhaust gas emissions down to a minimum.

2 All diesel engine models are also designed to meet strict emission requirements. All models are fitted with a crankcase emission control system, one or two catalytic converters, and a particulate filter (model and market dependent) to keep exhaust emissions down to a minimum. All models are also fitted with

an exhaust gas recirculation (EGR) system to further decrease exhaust emissions.
3 In certain non-UK territories, having strict emissions laws, a secondary air injection system is fitted.

Petrol engines

Evaporative emissions control

4 To minimise the escape into the atmosphere of unburned hydrocarbons, an evaporative emissions control system is fitted. The system is sometimes referred to as the 'evaporative-loss control device' (ELCD). The fuel tank filler cap is sealed, and a charcoal canister collects the petrol vapours generated in the tank when the car is parked. The vapours are stored until they can be cleared from the canister (under the control of the fuel system ECM via the purge valve) into the

intake tract, to be burned by the engine during normal combustion.

5 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 control valve is not opened by the ECM until the engine has warmed-up, and the engine is under load; the valve solenoid is then modulated on and off, to allow the stored vapour to pass into the intake tract.

Crankcase emissions control

6 To reduce emissions of unburned hydrocarbons from the crankcase into the atmosphere, the engine is sealed. The blow-by gases and oil vapour are drawn from inside the crankcase, through an external oil trap, which is connected to the crankcase via the camshaft cover and breather hose. The gases are then

evacuated to the throttle housing and also via the turbocharger to the intake manifold.

7 Under conditions of high manifold depression (idling, deceleration) the gases will be sucked positively out of the crankcase to the throttle housing. Under conditions of low manifold depression (acceleration, full-throttle running) the gases 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.

Exhaust emissions control

8 To minimise the amount of pollutants, which escape into the atmosphere, all models are fitted with a catalytic converter in the exhaust system. The catalytic converter system is of the 'closed-loop' type, in which an oxygen sensor (two on some models) in the exhaust system provides the fuel-injection/ignition system ECM with constant feedback on the oxygen content of the exhaust gases. This enables the ECM to adjust the mixture to provide the best possible conditions for the converter to operate.

9 The oxygen sensors have a built-in heating element, controlled by the ECM through the sensor relay, to quickly bring the sensor's tip to an efficient operating temperature. The sensor's tip is sensitive to oxygen, and sends the ECM a varying voltage depending on the amount of oxygen in the exhaust gases; if the intake air/fuel mixture is too rich, the sensor sends a high-voltage signal. The voltage falls as the mixture weakens. Peak conversion efficiency of all major pollutants occurs if the intake air/fuel mixture is maintained at the chemically correct ratio for the 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 ECM using the signal change as a reference point, and correcting the intake air/fuel mixture accordingly by altering the fuel injector pulse width (injector opening time).

Diesel engines

Crankcase emission control

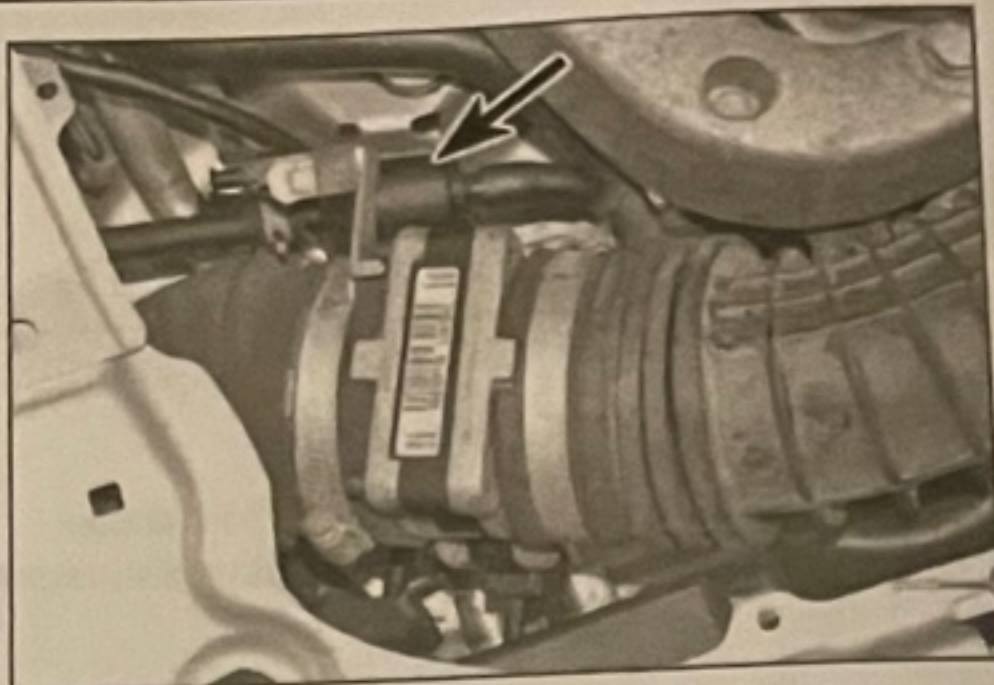
10 Refer to paragraphs 6 and 7.

Exhaust emission control

11 To minimise the level of exhaust pollutants released into the atmosphere, a catalytic converter is fitted in the exhaust system. On some models, a second catalytic converter is fitted instead of the particulate filter.

12 The catalytic converter consists of a canister containing a fine mesh impregnated with a catalyst material, over which the hot exhaust gases pass. The catalyst speeds up the oxidation of harmful carbon monoxide, unburned hydrocarbons and soot, effectively reducing the quantity of harmful products released into the atmosphere via the exhaust gases.

13 The particulate filter is designed to trap



2.16 Purge valve (arrowed) mounted on the airflow sensor retaining clip

soot particles. A pressure sensor measures the pressure drop across the filter, to inform the engine management ECM when the filter is full. The ECM then initiates filter regeneration. This process involves injecting extra fuel into the cylinders during the exhaust stroke. This fuel greatly raises the temperature of the exhaust gases, and burns off the soot trapped into the filter. This process is completely automatic, and takes approximately 15 minutes.

Exhaust gas recirculation system

14 This system is designed to recirculate small quantities of exhaust gas into the intake tract, and therefore into the combustion process. This process reduces the level of unburnt hydrocarbons present in the exhaust gas before it reaches the catalytic converter. The system is controlled by the injection system ECM, using the information from its various sensors, via the electrically-operated EGR valve.

2 Petrol engine emissions control systems – component renewal

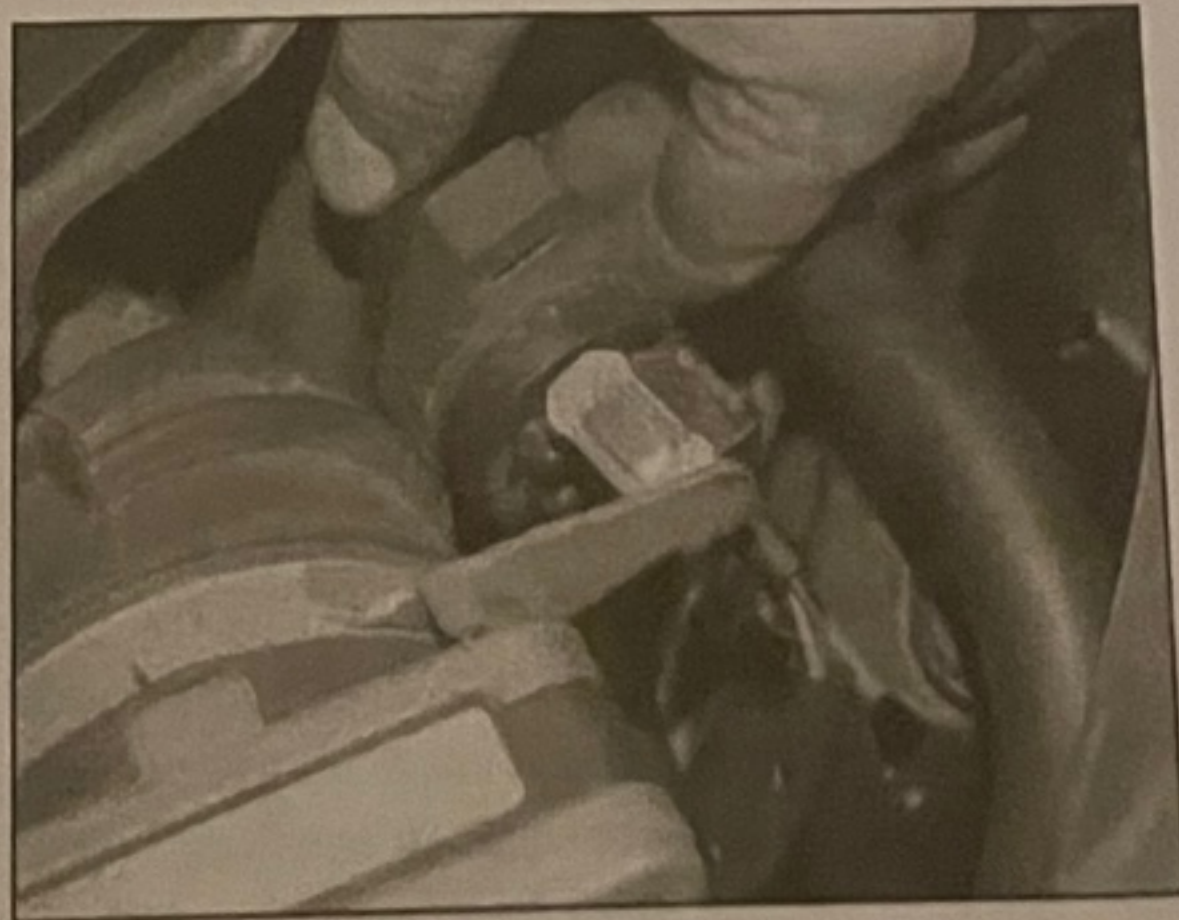


Warning: Refer to the precautions given in Chapter 4A, Section 8, and the information detailed in the 'Safety First!' Section of this manual, before disturbing any component in the fuel supply system.

Evaporative emission control

Pressure sensor

1 The pressure sensor is located on top of the



2.18 Pull the valve rubber mounting from the mounting bracket

fuel tank, remove the fuel tank as described in Chapter 4A, Section 12.

2 Clean around the pressure sensor, making sure no dirt enters the pressure sensor when the sensor is removed.

3 Undo the retaining screw and withdraw the sensor and O-ring seal from the fuel tank.

4 Refitting is a reversal of removal procedure.

Note: Renew the sensor O-ring seal. Lubricate with acid-free petroleum jelly.

Charcoal canister (early models)

5 The charcoal canister (early models) is located on the front right-hand side of the car.

6 Apply the handbrake, then jack up the right-hand wing with the purge valve.

7 Remove the right-hand front wheel (see Jacking and vehicle support).

8 Note the positions of the hoses connected to the purge valve (A is connected to the tank).

9 Unhook the canister from its mounting bracket and remove it from under the car.

10 Refitting is a reversal of the removal procedure. **Note:** Make sure the retaining clips for the hoses are not damaged and the hoses are securely fitted in the position noted.

Charcoal canister (later models)

11 The charcoal canister is located on the front right-hand side of the fuel tank.

12 Clean around the charcoal canister, making sure no dirt enters the fuel tank when the canister is removed.

13 Release the retaining clips on the hoses connected to the canister and disconnect them, noting their fitted position.

14 Undo the retaining screw and withdraw the canister, unhooking it from its holder on the top of the fuel tank.

15 Refitting is a reversal of removal procedure. **Note:** Make sure the retaining clips for the hoses are not damaged and the hoses are securely fitted in the position noted.

Purge valve

16 The purge valve is mounted on the front right-hand side inner wing panel (see illustration). Check that the hoses connected to the purge control valve are clear by removing them and blowing through them. If the purge control valve is thought to be faulty, it must be renewed.

17 Release the retaining clip(s) on the hoses connected to the valve and disconnect them, noting their fitted position.

18 Remove purge valve from the mounting bracket, noting its fitted position (see illustration).

19 Twist the valve and unplug the connector

then withdraw the purge valve.

20 Refitting is a reversal of removal procedure, but make sure it is fitted in the correct position.

Shut-off control valve

21 The shut-off valve (see illustration) is located on the side of the fuel tank.

22 Cut the cable-wiring connector to the control valve, to unclip the valve.

23 Using a screwdriver, disconnect the valve from the pipe.

24 Clean off any dirt from the valve, then unclip the valve. Disconnect the top of the valve.

25 Unclip the control valve, then release the valve. If required, disconnect the valve.

26 Refitting is a reversal of removal procedure, but make sure the top of the valve is correctly fitted in the recess in the wing panel.

Crankcase

27 The crankcase has no attention intervals that oil trap on top of the undamaged.

Oxygen

Note: On sensors converted there is a risk of the car is DELICATE knocked any clear.

Front

28 On upper illustration.

29 The valve together at the (see illustration).

30 The exhaust pipe reconnected.

31

then withdraw the purge valve from the vehicle.
 Refitting is a reversal of the removal procedure, but make sure that the purge valve is fitted in the correct position as noted on removal.

Shut-off control valve

21 The shut-off valve (where fitted) is clipped to the side of the fuel filler pipe at the rear of the vehicle (see illustration). Park the vehicle on a firm level surface, and then select first gear (manual transmission) or Park (automatic transmission) and chock the front wheels securely. Raise the rear of the car and support it securely on axle stands (see *Jacking and vehicle support*).

22 Cut the cable-tie and disconnect the wiring connector to the shut-off valve.

23 Using a screwdriver carefully prise the control valve, to unclip it from the fuel filler pipe.

24 Clean off any dirt from around the control valve, then unclip the cover from the top of the valve. Disconnect the wiring connector from the top of the valve and withdraw the washer.

25 Unclip the cover from the bottom of the valve, then release the securing clip and disconnect the hose from the bottom of the valve. If required, the filter can now be renewed.

26 Refitting is a reversal of the removal procedure, but make sure that the wiring at the top of the valve locates correctly in the recess in the washer.

Crankcase emissions control

27 The components of this system require no attention other than to check at regular intervals that the hose(s) and the external oil trap on the cylinder block are clear and undamaged (see illustrations).

Oxygen sensors

Warning: When renewing the sensors, check the type fitted and refit with the same type.

Note: On some models there are two oxygen sensors fitted, one before the catalytic converter and one after. On other models there is one oxygen sensor fitted to the front of the catalytic converter. The oxygen sensor is DELICATE. It will not work if it is dropped or knocked, if its power supply is disrupted, or if any cleaning materials are used on it.

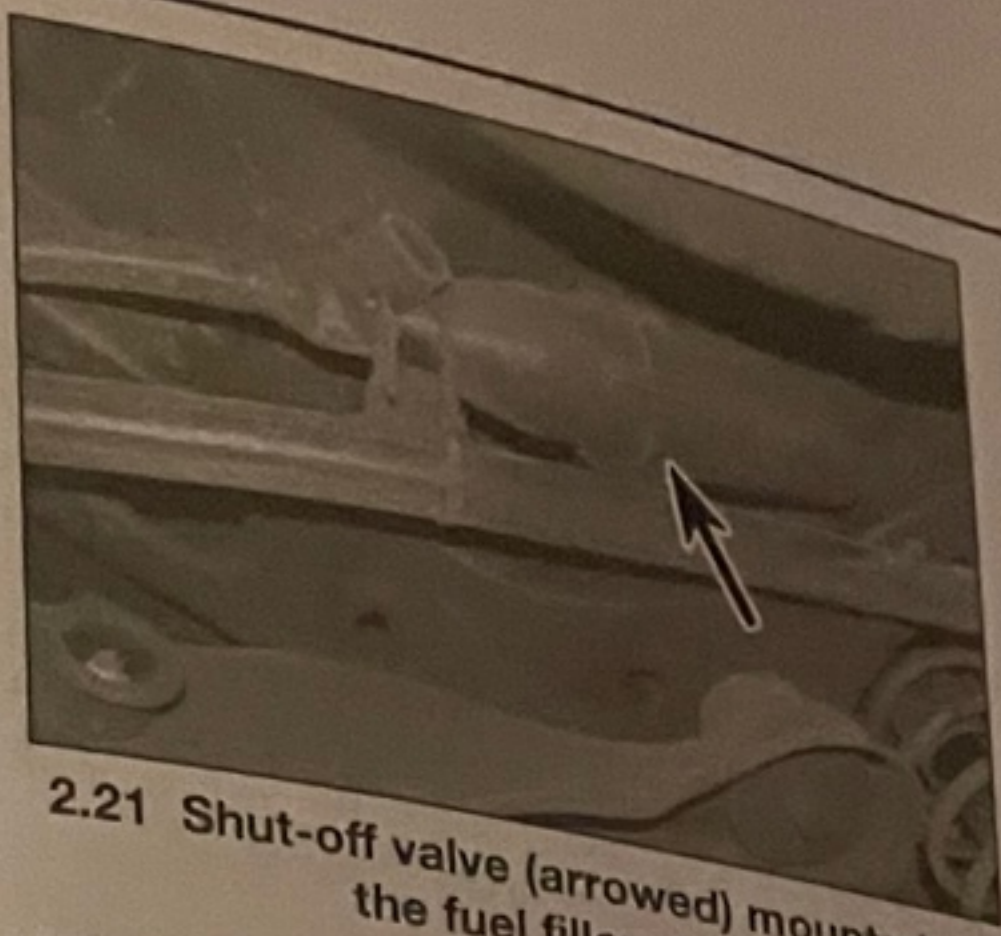
Front oxygen sensor

28 Open the bonnet and remove the upper cover from the intake manifold (see illustration).

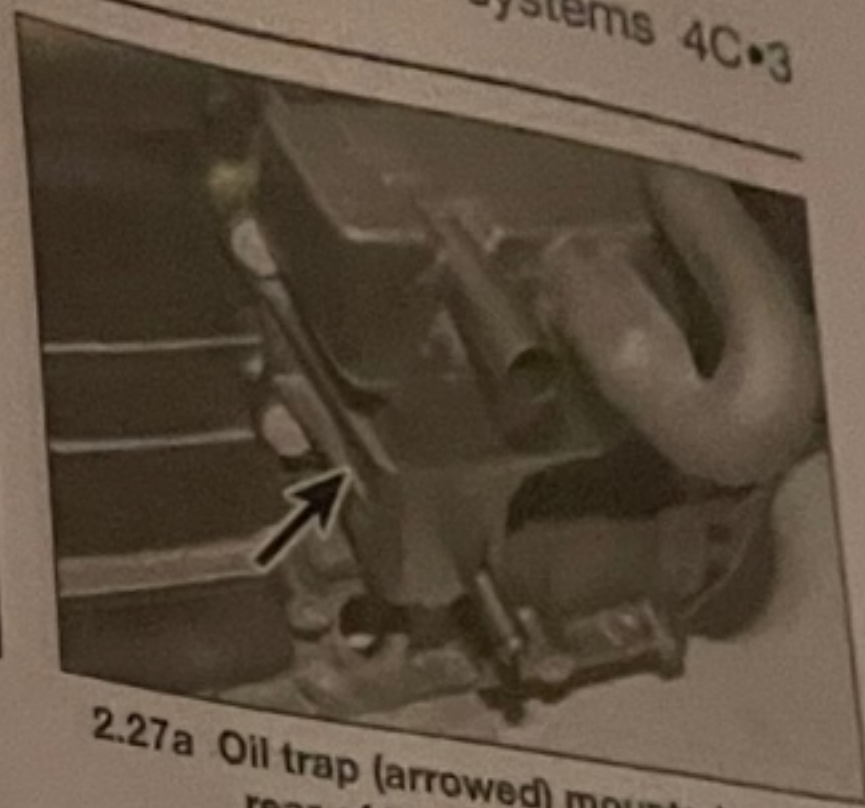
29 Release the securing clip and disconnect the wiring plug connectors, then press lugs together to release from the mounting bracket at the left-hand side rear of the cylinder head (see illustration).

30 Remove the heat shield from above the exhaust manifold; disconnect the bypass pipe from across the top of the heat shield if required.

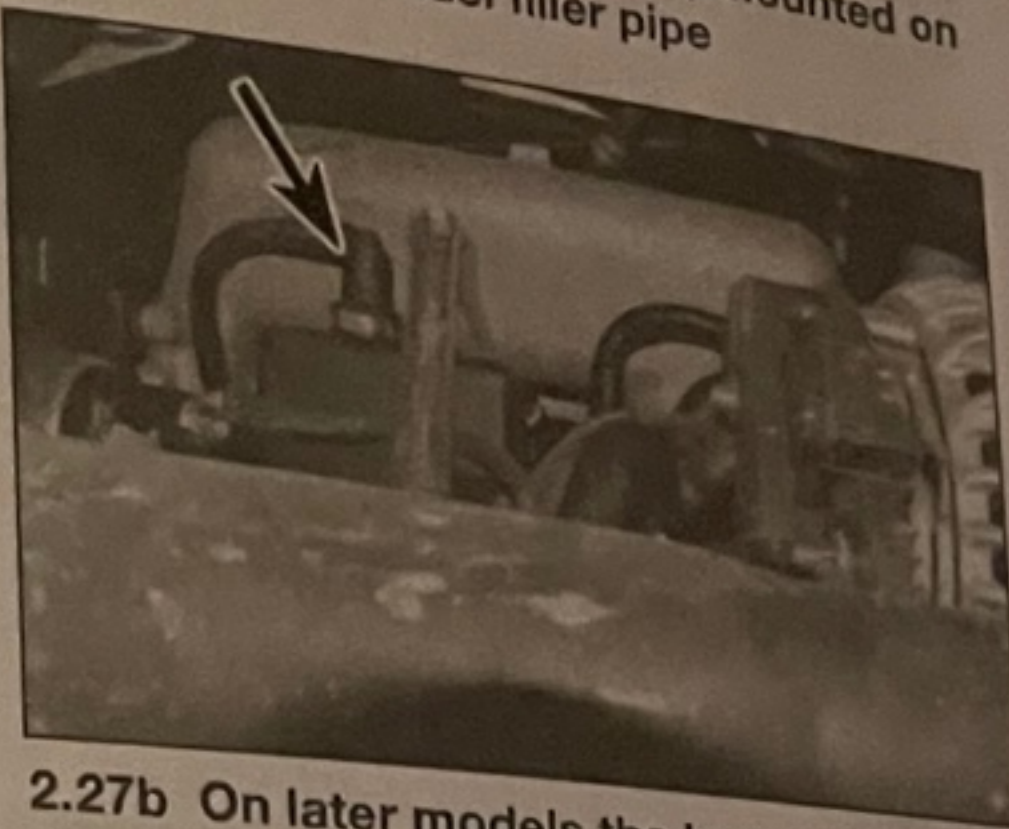
31 Release the cable-tie from the wiring to



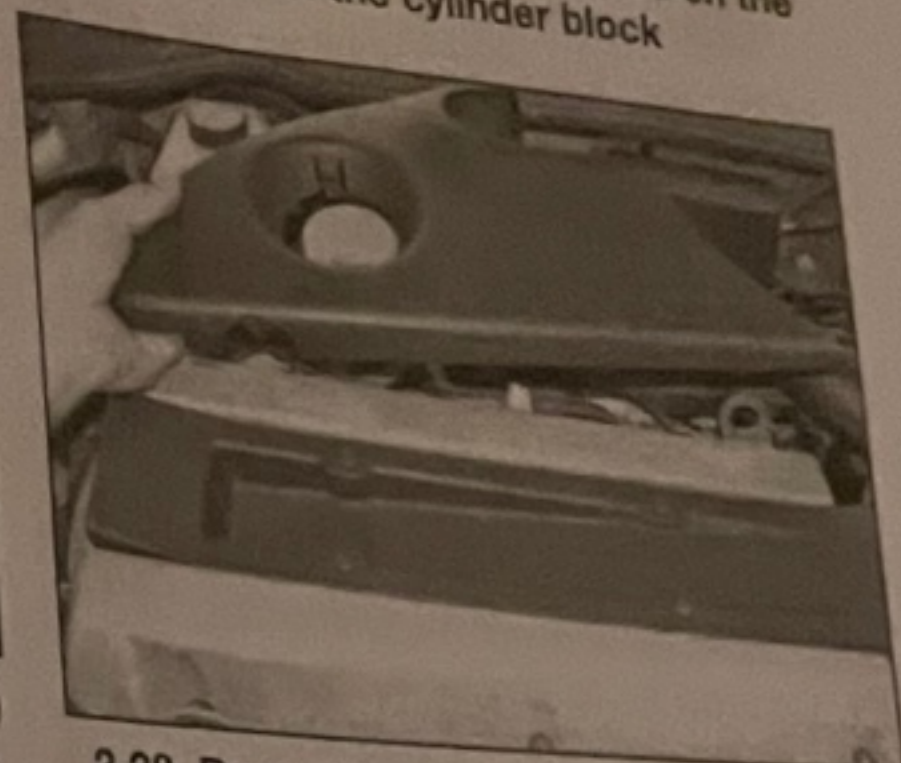
2.21 Shut-off valve (arrowed) mounted on the fuel filler pipe



2.27a Oil trap (arrowed) mounted on the rear of the cylinder block



2.27b On later models the hoses (arrowed) have quick-release connections on the oil trap



2.28 Removing the upper cover from the intake manifold

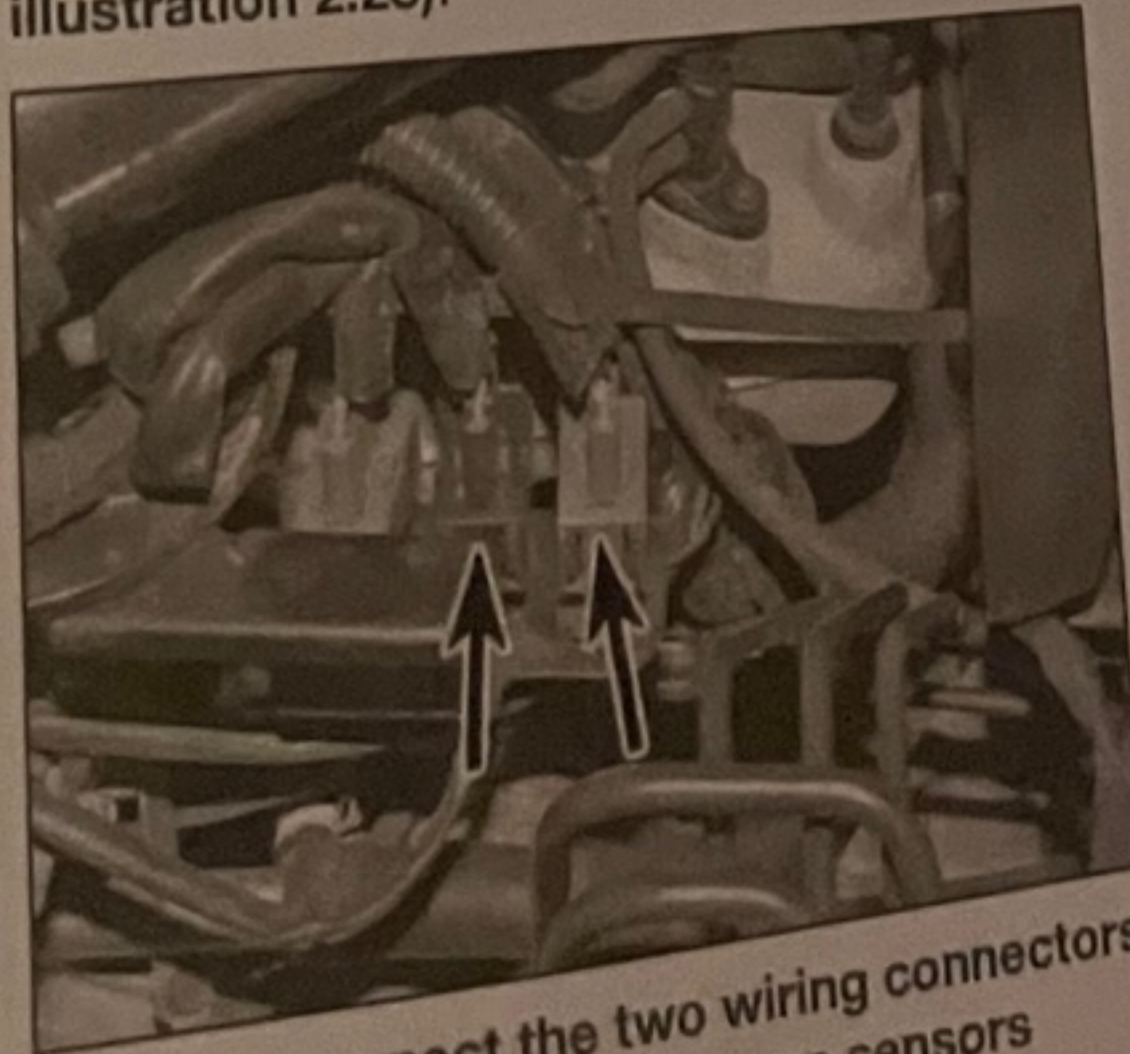
the oxygen sensor, and withdraw the wiring harness.

32 Unscrew the sensor from the exhaust system downpipe (see illustration), and remove it. The sensor may be tight, in which case it will help if it is turned back-and-forth on its threads as it is being removed. Note that it is possible to obtain a special slotted socket, which locates on the sensor without causing any damage to the wiring.

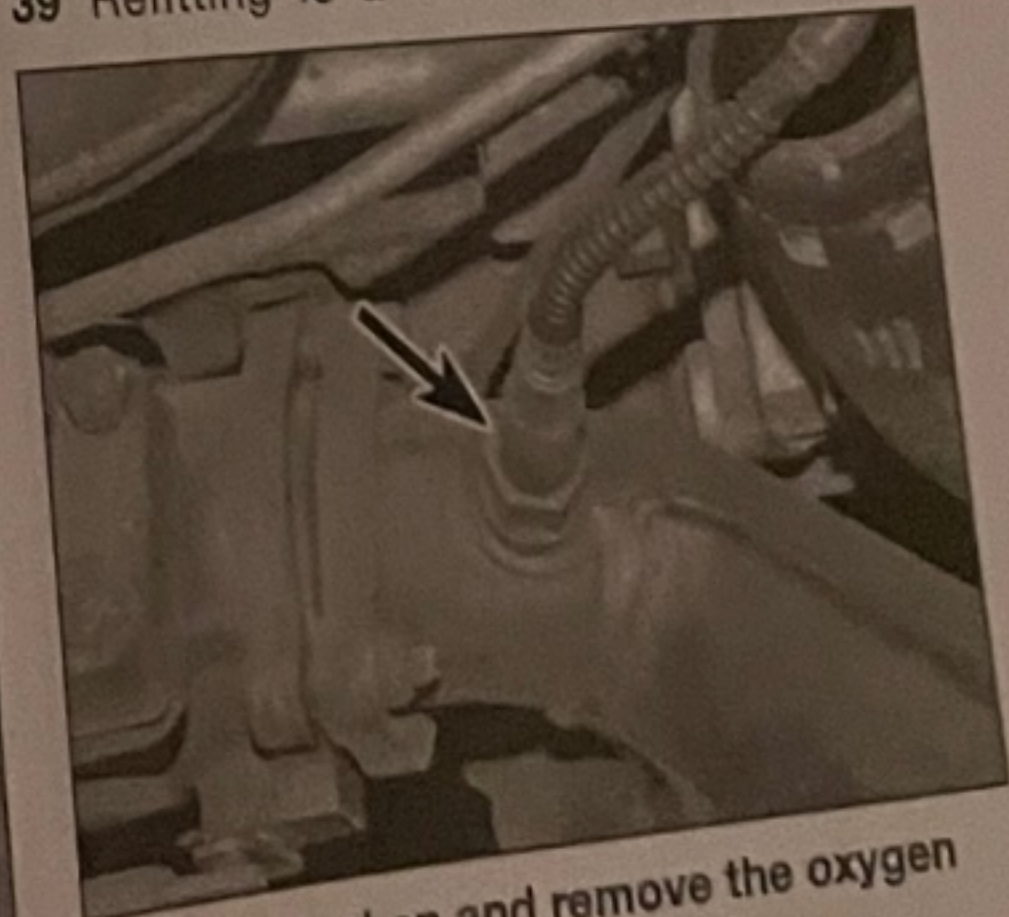
33 Refitting is a reverse of the removal procedure. Prior to installing the sensor, apply a smear of high-temperature grease to the sensor threads. Tighten the sensor to the specified torque. The wiring must be correctly routed, and in no danger of contacting the exhaust system.

Rear oxygen sensor

34 Open the bonnet and remove the upper cover from the intake manifold (see illustration 2.28).



2.29 Disconnect the two wiring connectors (arrowed) for the oxygen sensors



2.32 Slacken and remove the oxygen sensor (arrowed)

35 Release the securing clip and disconnect the wiring plug connectors then press the lugs together and release the wiring plug from the mounting bracket at the rear left-hand side of the cylinder head (see illustration 2.29).

36 Release the cable-tie from the wiring to the oxygen sensor, and withdraw the wiring harness.

37 Apply the handbrake, then jack up the front of the car and support on axle stands (see *Jacking and vehicle support*).

38 Pull the wiring harness down, then unscrew the sensor from the exhaust system front pipe (see illustration), and remove it. The sensor may be tight, in which case it will help if it is turned back-and-forth on its threads as it is being removed. Note that it is possible to obtain a special slotted socket which locates on the sensor without causing any damage to the wiring.

39 Refitting is a reverse of the removal



2.38 Slacken and remove the oxygen sensor (arrowed)

procedure. Prior to installing the sensor, apply a smear of high-temperature grease to the sensor threads. Tighten the sensor to the specified torque. The wiring must be correctly routed, and in no danger of contacting the exhaust system.

Testing

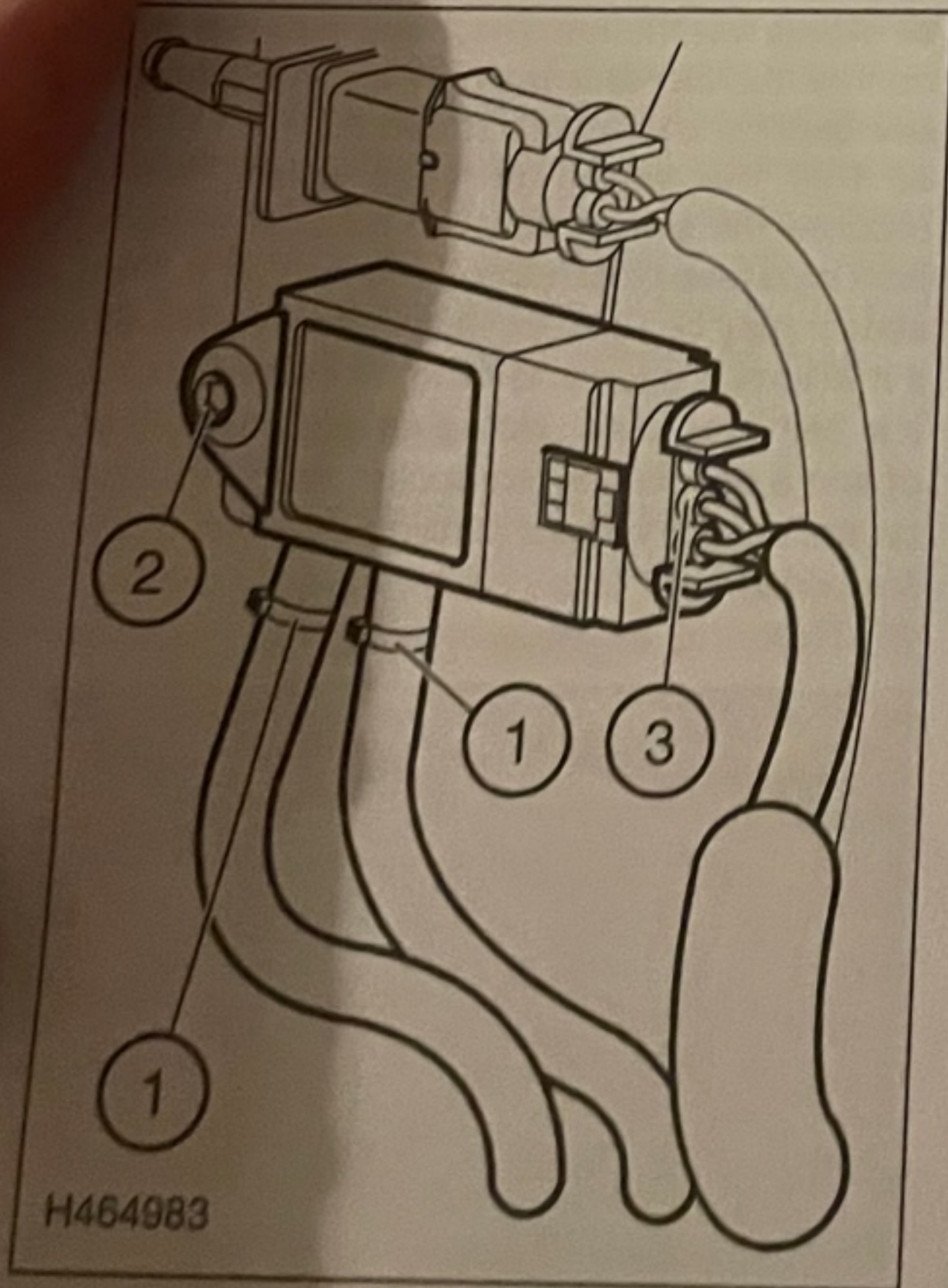
40 The oxygen sensors may be tested with a multimeter by disconnecting the wiring at the connector, trace the wiring back from the sensor and disconnect the wiring plug.

41 Connect an ohmmeter between terminals 1 and 2 on the sensor wiring plug. **Do not** connect the ohmmeter to the ECM wiring. The resistance should be approximately 9 ohms, when the temperature of the sensor is 20°C.

42 Reconnect the wiring after making the test.

Catalytic converter

43 Removal and refitting of the catalytic converter is described in Chapter 4A, Section 20, as part of the exhaust system procedures.



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3.8 Particulate filter pressure sensor
 1 Delivery hoses 3 Wiring plug
 2 Retaining bolt

Testing

44 The performance of the catalytic converter can only be checked by measuring the exhaust gases using a good quality, carefully calibrated exhaust gas analyser.

45 If the CO level at the tailpipe is too high, the vehicle should be taken to a Saab dealer so that the fuel injection and ignition systems, including the oxygen sensor, can be thoroughly checked using special diagnostic equipment. Once these have been checked and are known to be free from faults, the fault must be in the catalytic converter, which must be renewed as described in Chapter 4A.

3 Diesel engine emission control systems - testing and component renewal

Crankcase emission control

1 The components of this system require no attention other than to check that the hose(s) are clear and undamaged at regular intervals.

Exhaust emission control

Testing

2 The performance of the catalytic converter(s) can only be checked by measuring the exhaust gases using a good quality, carefully calibrated exhaust gas analyser.

3 If the catalytic converter(s) is thought to be faulty, before assuming a fault, it is worth checking the problem is not due to a faulty injector(s). Refer to your Saab dealer or specialist for further information.

Catalytic converter renewal

4 Catalytic converter renewal is described in Chapter 4B, Section 18.

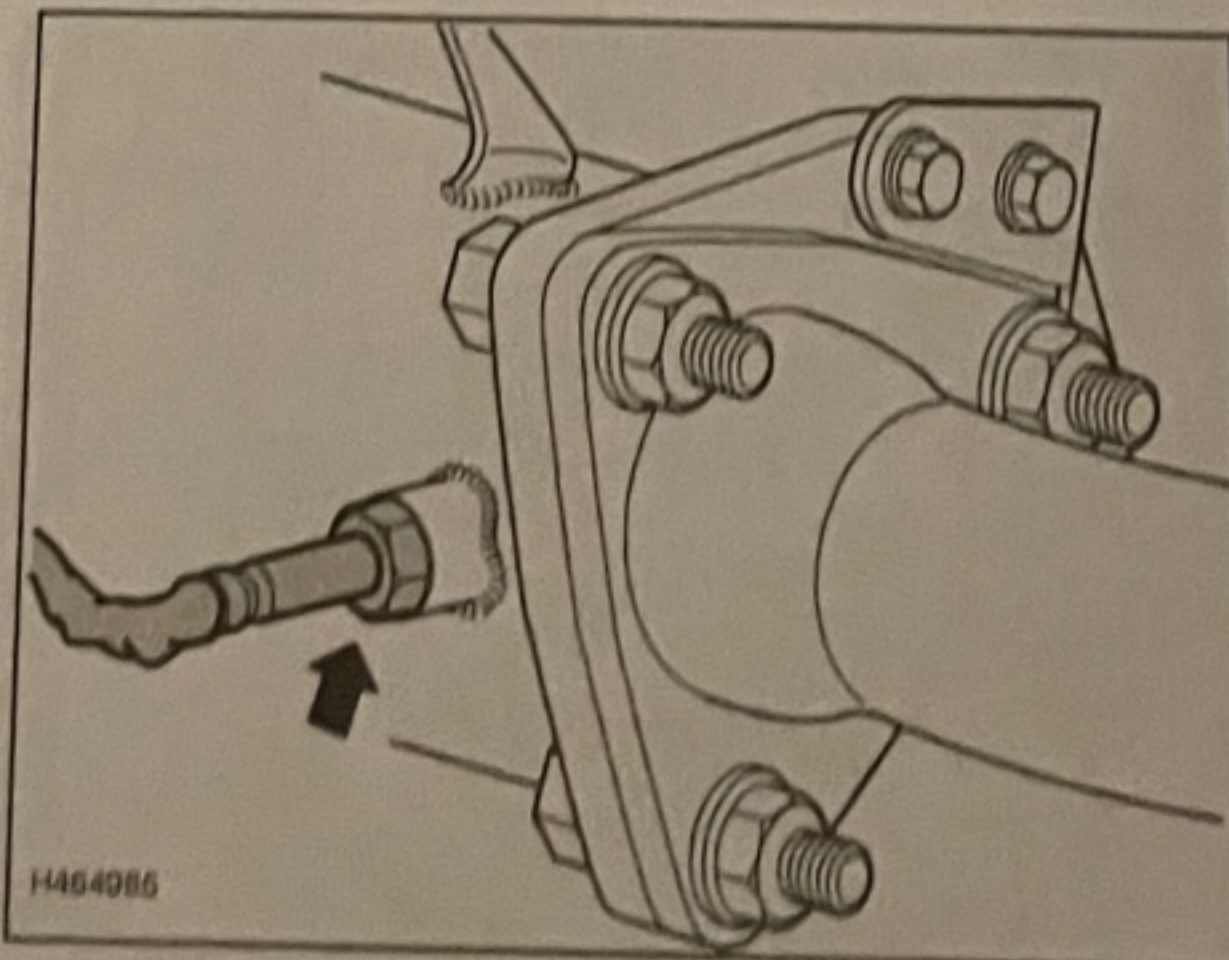
Particulate filter renewal

5 Particulate filter renewal is described in Chapter 4B, Section 18.

Particulate filter pressure sensor renewal

6 Remove the plastic cover from the top of the engine.

7 The sensor is located on the bulkhead at the left-hand side of the engine compartment. Disconnect the sensor wiring plug.



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3.14a Front exhaust gas temperature sensor

8 Note their fitted positions, then remove the clips and disconnect the hoses from the sensor (see illustration).

9 Undo the screw and remove the sensor if a new sensor has been fitted. The engine management ECM adaptation valve must be reset using Saab diagnostic equipment. Entrust this task to a Saab dealer or specialist.

Exhaust gas temperature sensor

11 Two temperature sensors are fitted in the exhaust system. The front sensor is fitted in the intake to the front catalytic converter. The rear sensor is fitted into the front edge of the rear catalytic converter. To remove the sensor, raise the vehicle and support it securely on axle stands (see *Jacking and vehicle support*).

12 Remove the front right-hand rear wheel and wheel arch liner.

13 Disconnect the sensor wiring plug.

14 Working underneath the vehicle, disconnect the sensor from the catalytic converter (see illustrations).

15 Upon refitting the sensor, apply a smear of high-temperature anti-seize grease to the sensor threads, and tighten it to the specified torque.

Exhaust gas recirculation system

Testing

16 Comprehensive testing of the system can only be carried out using specialist electronic equipment which is connected to the engine system diagnostic wiring connector.

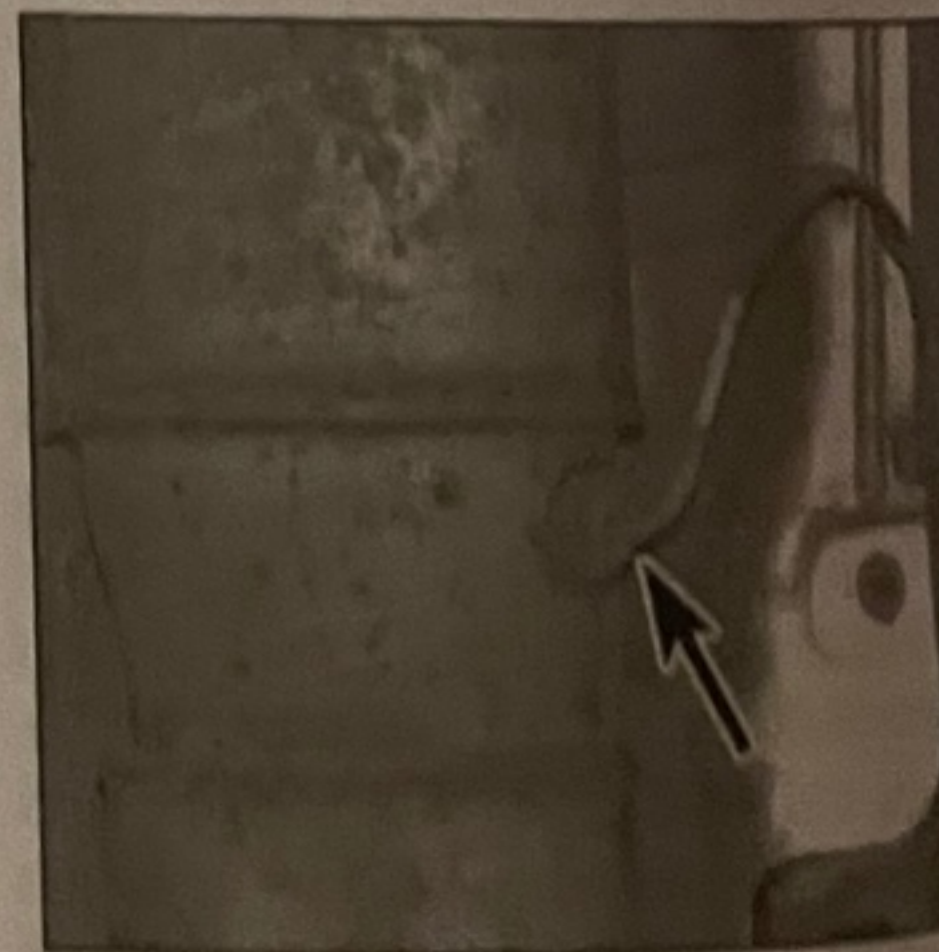
EGR valve renewal

17 Remove the plastic cover over the top of the engine.

18 Disconnect the EGR valve wiring plug from the connector.

19 Unscrew the two bolts on the top of the valve and detach the metal EGR pipe from the base of the valve. Recover the gasket (see illustration).

20 Unscrew the two nuts and two bolts securing the EGR valve to the intake manifold and lift off the engine cover bracket (see illustration).



3.14b Rear exhaust gas temperature sensor

21 Refitting is the reverse of removal. Fit new gaskets and bolts to the sensor.

4 Catalytic converter general information and precautions

1 The catalytic converter is a simple device, but it is not, in itself, but the owner should be aware of its function properly.

Petrol engine

- a) DO NOT use a catalytic converter with a catalytic converter.
- b) Always keep the catalytic converter well maintained.
- c) If the engine is over-revved, drive the engine at a moderate speed.
- d) DO NOT use this will cause the engine to burn.
- e) DO NOT use this when the engine is running.

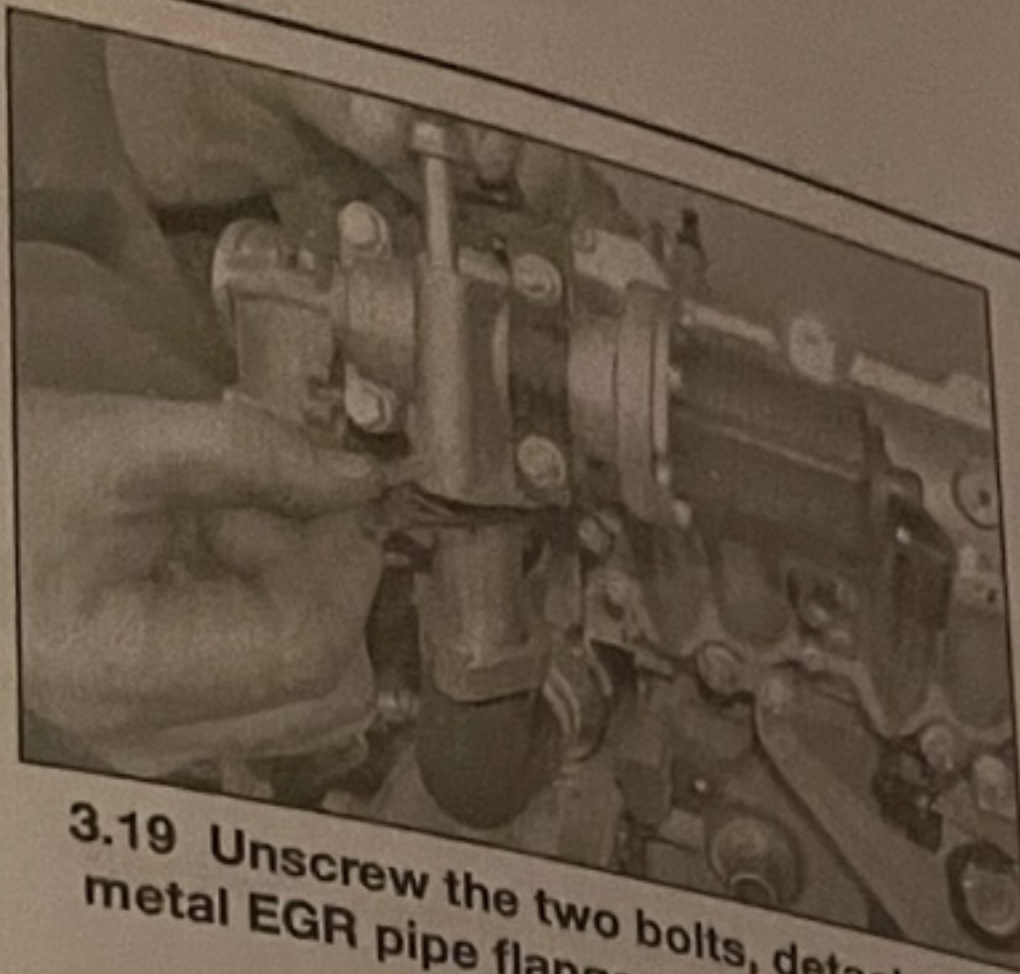
21 Refitting is the reverse of removal using new gaskets and tightening the retaining nuts and bolts to the specified torque.

4 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.

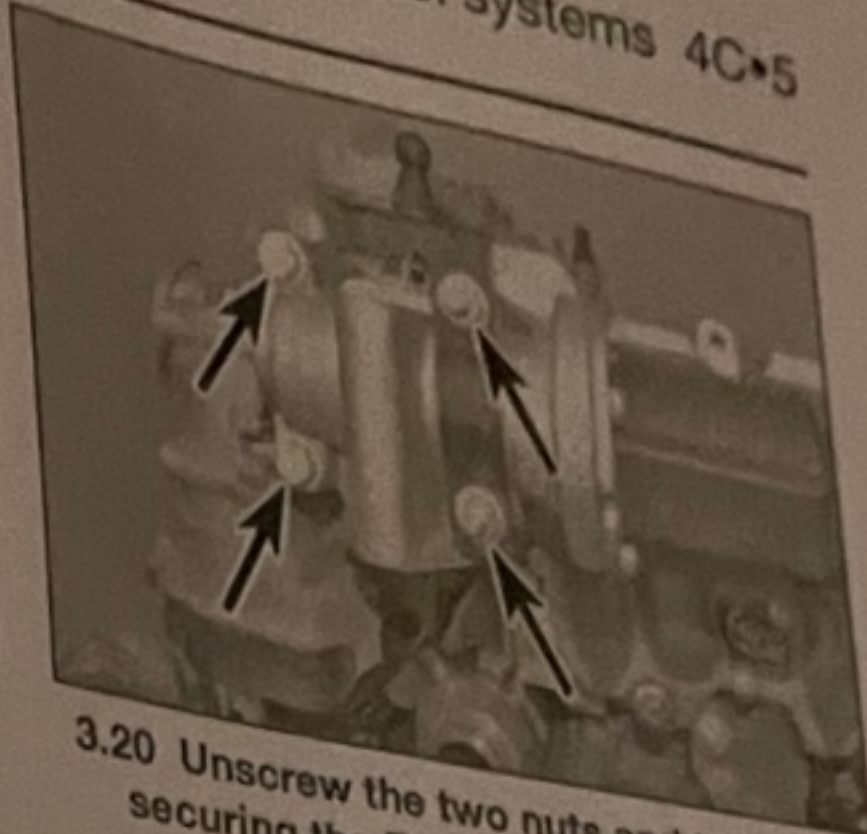
Petrol engines

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



3.19 Unscrew the two bolts, detach the metal EGR pipe flange and recover the gasket

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3.20 Unscrew the two nuts and two bolts securing the EGR valve to the intake manifold

- throttle before switching off. Allow it to return to idle first.
- DO NOT use fuel or engine oil additives – these may contain substances harmful to the catalytic converter.
 - DO NOT continue to use the car if the engine burns oil to the extent of leaving a visible trail of blue smoke.
 - Remember that the catalytic converter operates at very high temperatures. DO NOT, therefore, park the car in dry undergrowth, over long grass, or over piles of dead leaves, after a long run.
 - Remember that the catalytic converter is FRAGILE – do not strike it with tools during servicing work.

- 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 cars and once the car has covered a few thousand miles the problem should disappear.
- The catalytic converter, used on a well-maintained and well-driven car, should last for between 50 000 and 100 000 miles – if the converter is no longer effective it must be renewed.

Diesel engines

- 2 Refer to the information given in parts, f, g, h, i and k of the petrol engines information given above.