

Chapter 4 Part C:

Exhaust and emission control systems

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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



Specifications

Torque wrench settings

Exhaust manifold nuts:

	Nm	lbf ft
1.2 litre	27	20
1.4 and 1.8 litre	25	18
1.6 litre	30	22
Exhaust manifold-to-downpipe nuts	30	22
Exhaust system clamp nuts/bolts	25	18
Oxygen sensor:		
1.2 litre	36	27
1.4 litre	55	41
1.6 and 1.8 litre	40	30

1 General information

1 All models use unleaded petrol, and have various features built into the fuel system to help minimise harmful emissions. All models are equipped with a crankcase emission-control system, a catalytic converter, and an evaporative emission control system to minimise fuel vapour emissions.

Crankcase emission control

2 To reduce the emission of unburned hydrocarbons from the crankcase into the atmosphere, the engine is sealed and the blow-by gases 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.

3 Under conditions of high manifold depression (idling, deceleration) the gases will be sucked positively out of the crankcase. 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 emission control

4 To minimise the amount of pollutants which escape into the atmosphere, all models are fitted with a catalytic converter in the exhaust system. 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, enabling the ECU to adjust the mixture to provide the best possible conditions for the converter to operate.

5 The oxygen sensor's tip is sensitive to oxygen, and sends the ECU a varying voltage depending on the amount of oxygen in the exhaust gases; if the intake air/fuel mixture is too rich, the exhaust gases are low in oxygen so the sensor sends a low-voltage signal, the voltage rising as the mixture weakens and the amount of oxygen rises in the exhaust gases.

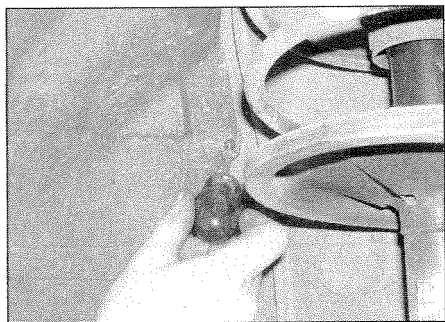
6 Peak conversion efficiency of all major pollutants occurs if the intake air/fuel mixture is maintained at the chemically-correct ratio for the complete combustion of petrol of 14.7 parts (by weight) of air to 1 part of fuel (the 'Stoichiometric ratio'). The sensor output

voltage alters in a large step at this point (known as the Lambda point), the ECU using the signal change as a reference point and correcting the intake air/fuel mixture accordingly by altering the fuel injector pulse width.

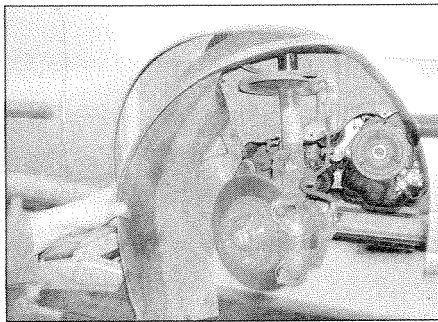
Evaporative emission control

7 To minimise the escape into the atmosphere of unburned hydrocarbons, an evaporative emissions control system is also fitted to all models. The fuel tank filler cap is sealed and a charcoal canister is mounted behind the right-hand front wing. The canister collects the petrol vapours released from the fuel in the tank when the car is parked and stores them until they can be cleared from the canister (under the control of the engine management system ECU) via the purge valve into the inlet tract to be burned by the engine during normal combustion.

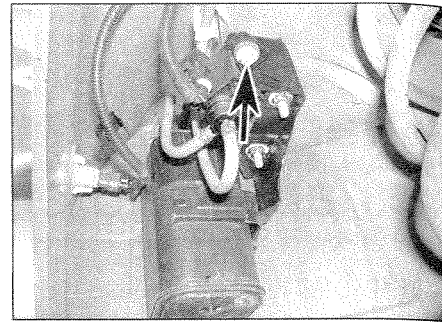
8 To ensure that the engine runs correctly when it is cold and/or idling and to protect the catalytic converter from the effects of an over-rich mixture, the purge control valve is not opened by the ECU until the engine has warmed up, and the engine is under load; the valve solenoid is then modulated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



2.4a Remove the retaining screws and other fasteners ...



2.4b ... and unclip the wheelarch liner



2.6 Charcoal canister seen from front wheelarch - retaining bolt arrowed

2 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. Note that the hoses contain 'flame trap' inserts, to prevent the flame front from vapour, ignited in the inlet manifold, from travelling back to the crankcase.

Evaporative emission control system

Testing

2 If the system is thought to be faulty, disconnect the hoses from the charcoal canister and purge control valve and check that they are clear by blowing through them. Full testing of the system can only be carried out using specialist electronic equipment which is connected to the engine management system diagnostic wiring connector (see Chapter 4A or 4B). If the purge control valve or charcoal canister are thought to be faulty, they must be renewed.

Charcoal canister

3 The charcoal canister is located behind the right-hand front wing. To gain access to the canister, loosen the right-hand front wheel bolts, firmly apply the handbrake, then jack up the front of the vehicle and support it on axle stands. Remove the right-hand front wheel.

4 Remove the retaining screws and fasteners and remove the wheelarch liner to gain access to the canister (see illustrations).

5 Mark the vapour hoses for identification purposes, then disconnect them from the canister ports.

6 Unscrew the retaining bolt, recover the washers, then remove the canister from the vehicle (see illustration).

7 Refitting is a reverse of the removal procedure, ensuring the hoses are correctly and securely reconnected.

Purge valve

8 On 1.2 litre models, the valve is mounted on

a bracket, at the rear right-hand corner of the engine compartment. On all other models, it is mounted on a bracket next to the charcoal canister, inside the right-hand front wheelarch cavity. To remove the valve, unplug the wiring connector, then prise the valve from its mounting bracket.

Fuel tank safety valve

9 A safety valve mounted on the upper surface of the fuel tank controls the flow of fuel vapour to the charcoal canister. It contains a one-way valve that prevents liquid fuel from flowing out, if the fuel level in the tank is very high, or if the vehicle overturns in an accident. It also permits ventilation of the fuel tank, preventing the build up of vacuum that can occur as the fuel level in the tank drops.

10 Access to the valve can only be gained by first removing the fuel tank; removal is then self-evident.

Exhaust emission control

Testing

11 The performance of the catalytic converter can be checked only by measuring the exhaust gases using a good-quality, carefully-calibrated exhaust gas analyser, in accordance with the manufacturers instructions.

12 If the CO level at the tailpipe is too high, the vehicle should be taken to a FIAT dealer so that the complete fuel injection and ignition systems, including the oxygen sensor, can be thoroughly checked using the special diagnostic equipment.

Catalytic converter

13 Refer to Section 5.

Oxygen sensor

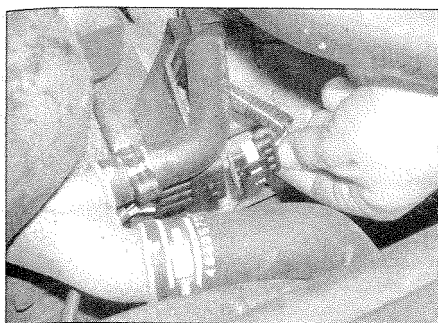
14 Refer to Section 6.

3 Catalytic converter - general information and precautions

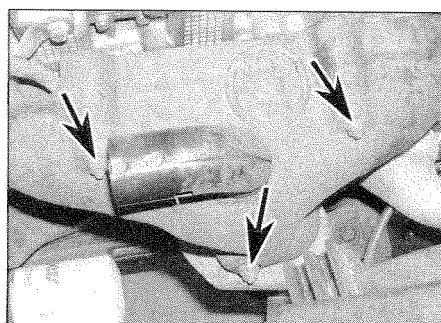
1 The catalytic converter is a reliable and simple device which needs no maintenance in itself, but there are some facts of which an owner should be aware if the converter is to

function properly for its full service life:

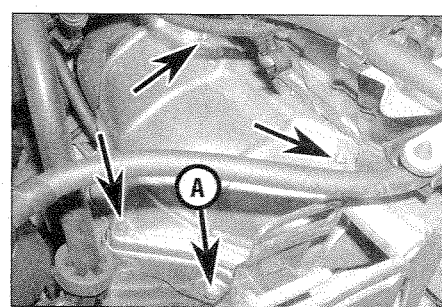
- a) *DO NOT use leaded petrol (or lead-replacement petrol) in a car equipped with a catalytic converter - the lead (or other additives) will coat the precious metals, reducing their converting efficiency and will eventually destroy the converter.*
- b) *Always keep the ignition and fuel systems well-maintained in accordance with the manufacturer's schedule (see Chapter 1).*
- c) *If the engine develops a misfire, do not drive the car at all (or at least as little as possible) until the fault is cured.*
- d) *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.*
- e) *DO NOT switch off the ignition at high engine speeds - ie do not 'blip' the throttle immediately before switching off the engine.*
- 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 car 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 car 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, and take care handling it when removing it from the car for any reason.*
- 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 cars, and has more to do with the sulphur content of the brand of fuel being used than the converter itself.*
- k) *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.*



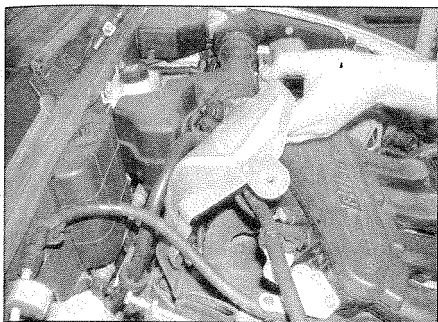
4.3 Disconnect the oxygen sensor wiring plug - 1.4 litre model shown



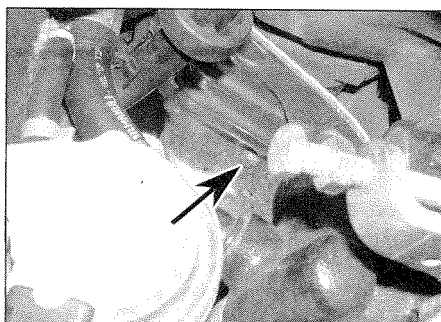
4.5a Exhaust manifold hot-air shroud nuts (arrowed) on a 1.4 litre model ...



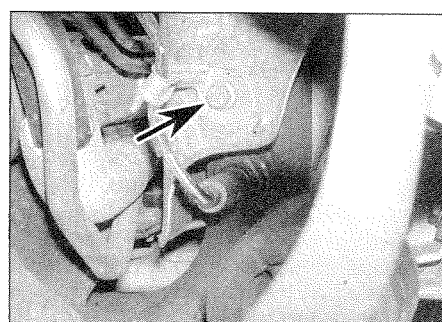
4.5b ... and on a 1.6 litre model - also remove bolt (A) which secures the downpipe shroud



4.5c Removing the exhaust manifold shroud - 1.6 litre model



4.5d Remove the upper bolt ...



4.5e ... and lower bolt ...

4 Exhaust manifold - removal and refitting

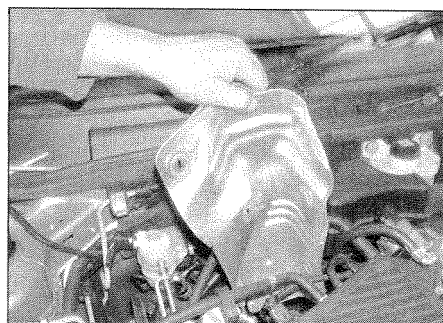
4C

Removal

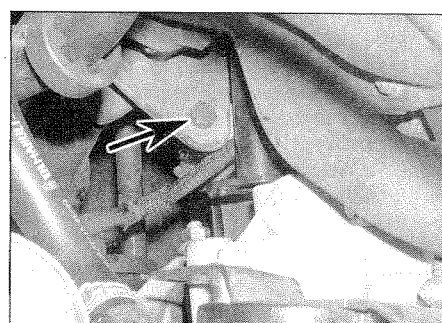
- 1 Jack up the front of the vehicle and support on axle stands. The exhaust manifold is located at the front of the engine on all models except those with the 1.6 litre engine.
- 2 On 1.6 litre models, access to the exhaust manifold is improved by removing the upper section of the inlet manifold as described in Chapter 4B.
- 3 Locate the oxygen sensor, which is at the top of the exhaust downpipe, just below the manifold. Trace the wiring from the sensor back to the connector plug and disconnect it (see illustration). Alternatively, remove the sensor completely (see Section 6).
- 4 Where applicable, disconnect the hot-air duct from the shroud above the exhaust manifold.
- 5 Unscrew the studs and nuts securing the manifold shrouds, and remove the shrouds from the manifold and/or downpipe (see illustrations). If any of the fasteners proves difficult to unscrew, don't use excessive force, or the stud may shear - try a little penetrating oil, and if necessary, try tightening the fastener slightly before loosening it once more.
- 6 Where applicable, unscrew the nuts/bolts and separate the halves of the downpipe support bracket (see illustration).

- 7 Unscrew the nuts and disconnect the exhaust downpipe from the exhaust manifold flange (see illustration). Recover the gasket.
- 8 Progressively slacken and remove the manifold mounting nuts (see illustration). Use plenty of penetrating oil if the studs are

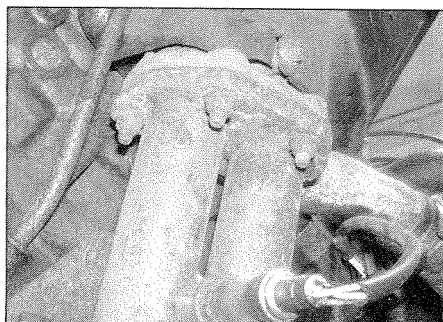
rusty. If a nut appears to be sticking, do not try to force it; turn the nut back half a turn, apply some more penetrating oil to the stud threads, wait several seconds for it to soak in, then gradually unscrew the nut by one turn. Repeat this process until the nut is free.



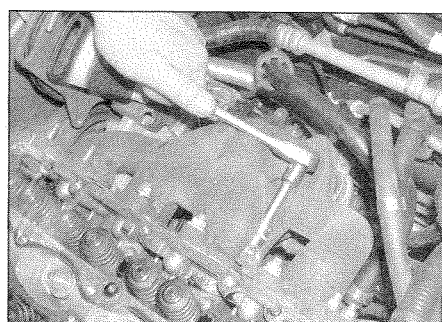
4.5f ... and remove the downpipe shroud - 1.6 litre model



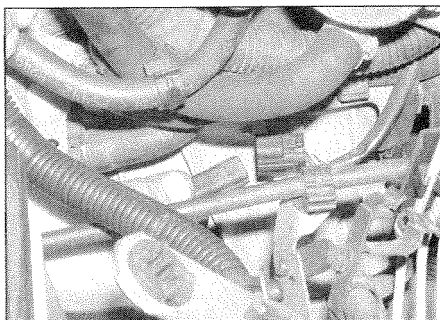
4.6 Exhaust downpipe support bracket bolt (arrowed)



4.7 Exhaust manifold-to-downpipe joint nuts



4.8 Unscrewing the manifold nuts - 1.6 litre engine shown



5.7 Disconnecting the oxygen sensor on a 1.8 litre model - seen with the airflow meter removed

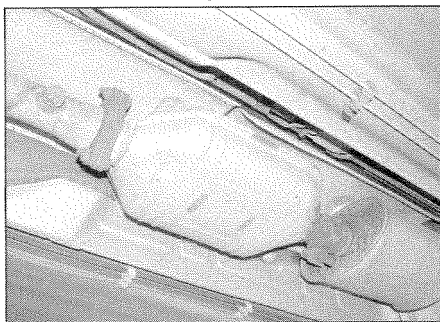
9 Remove the washers, then withdraw the manifold from the cylinder head and recover the gaskets from the studs.

10 In some cases, the manifold studs will come out with the nuts - this poses no great problem, and the studs can be refitted if they are in good condition. For preference, however, a complete set of manifold and downpipe studs and nuts should be obtained as required, as the old ones are likely to be in less-than-perfect condition.

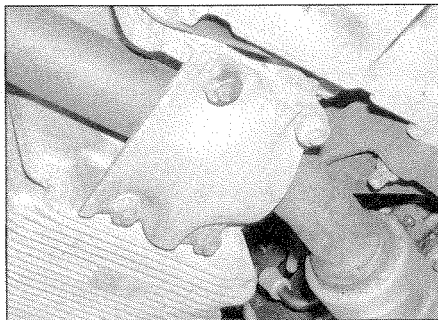
Refitting

11 Refitting is a reversal of the removal procedure, noting the following points:

- Always fit new manifold gaskets.*
- If any studs were broken when removing, drill out the remains of the stud, and fit new studs and nuts.*
- It is recommended that new studs and nuts are used as a matter of course - even if the old ones came off without difficulty, they may not stand being re-tightened. New components will be much easier to remove in future, should this be necessary.*
- If the old studs are re-used, clean the threads thoroughly to remove all traces of rust.*
- Apply a little copper grease to the nut and stud threads - this may make subsequent removal easier.*
- Tighten the manifold securing nuts to the specified torque.*



5.13 Catalytic converter on a 1.8 litre model



5.9 Four nuts secure this plate fitted below the exhaust downpipe

5 Exhaust system - general information and component renewal

General information

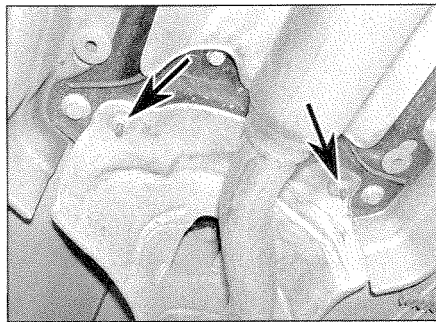
1 A three-section exhaust system is fitted, consisting of a downpipe, a catalytic converter, and a tailpipe section containing one centre silencer (two on 1.8 litre models), and a tailpipe with an integral silencer. The downpipe-to-manifold and downpipe-to-catalytic converter joints are both of flange and gasket type, whereas the remaining joints are sleeve type joints, secured with a clamp ring.

2 The system is suspended along its entire length by rubber mountings.

Removal

3 Each exhaust section can be removed individually or, alternatively, the complete system can be removed as a unit. Where separation of the rear sleeve joint is necessary, it may be more practical to remove the entire system rather than try and separate the joint in position.

4 To remove the system or part of the system, first jack up the front of the vehicle and support on axle stands (see *Jacking and vehicle support*). Alternatively, position the vehicle over an inspection pit or on car ramps.



5.21 Typical exhaust heatshield - securing nuts arrowed

Downpipe

5 Where applicable, remove the nuts/bolts securing the downpipe heat shield, and remove the shield to improve access.

6 Support the catalytic converter using an axle stand or blocks of wood.

7 Locate the oxygen sensor, which is at the top of the exhaust downpipe, just below the manifold. Trace the wiring from the sensor back to the connector plug and disconnect it (see illustration). Alternatively, remove the sensor completely (see Section 6).

8 Where applicable, unscrew the nuts/bolts and separate the halves of the downpipe support bracket.

9 On 1.8 litre models, remove the four nuts securing the plate which fits across the downpipe, where it passes under the sump (see illustration).

10 Unscrew and remove the bolts securing the downpipe to the catalytic converter, then separate the joint and recover the gasket.

11 Bend back the locktabs (where fitted) then unscrew the nuts securing the downpipe to the exhaust manifold, and lower the downpipe. Recover the gasket.

Catalytic converter

12 Support the centre silencers and tailpipe section using axle stands or blocks of wood.

13 Unscrew and remove the bolts securing the downpipe to the catalytic converter, then separate the joint and recover the gasket (see illustration).

14 Unscrew the clamp bolt and separate the converter from the tailpipe section.

15 Release the mounting rubber and remove the converter from under the vehicle.

Centre silencer(s) and tailpipe

16 Support the catalytic converter using an axle stand or blocks of wood.

17 Unscrew the clamp bolts and separate the catalytic converter from the tailpipe section.

18 Release the mounting rubbers and remove the tailpipe section from under the vehicle.

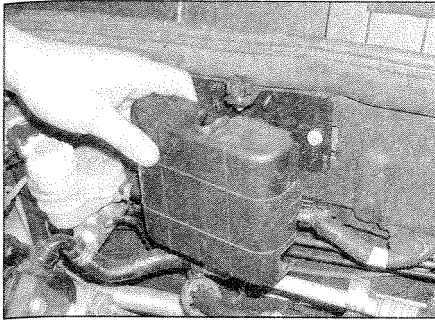
Complete system

19 Disconnect the downpipe from the exhaust manifold as described previously.

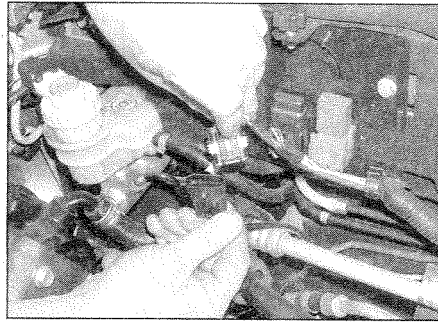
20 With the aid of an assistant, free the system from all its mounting rubbers and manoeuvre it out from underneath the vehicle.

Heatshields

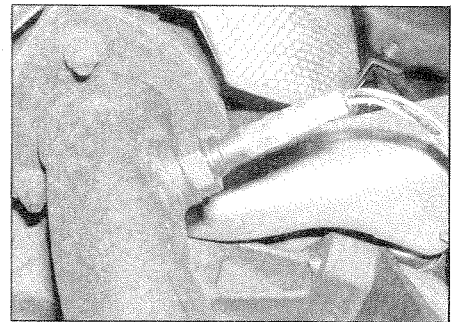
21 The heatshields are secured to the underbody by a combination of screws and nuts (see illustration). They are easily removed once the exhaust system has been lowered away from the underside of the floorpan, although in most cases, they can be removed with the system still in place.



6.2a On 1.6 litre models, unscrew the retainer and remove the relay box cover . . .



6.2b . . . then locate and disconnect the wiring plug for the oxygen sensor



6.3 Oxygen sensor on a 1.8 litre model

Refitting

22 Each section is refitted by a reverse of the removal sequence, noting the following points:

- a) Ensure that all traces of corrosion have been removed from the flanges and renew all necessary gaskets.
- b) Inspect the rubber mountings for signs of damage or deterioration and renew as necessary.
- c) Before refitting the tailpipe joint, smear some exhaust system jointing paste to the joint mating surfaces to ensure an air-tight seal. Tighten the clamp bolt.
- d) Prior to fully tightening the rear joint clamp, ensure that all rubber mountings are correctly located and that there is adequate clearance between the exhaust system and vehicle underbody.

6 Oxygen (lambda) sensor - removal and refitting

Note: The oxygen sensor is delicate component, and may be damaged if it is dropped or knocked, or if any cleaning materials are used on it.

Removal

1 The sensor is threaded into the exhaust downpipe. Access if best gained from underneath the vehicle. Apply the handbrake, then jack up the front of the vehicle and support on axle stands (see *Jacking and vehicle support*).

2 Ensure that the ignition is switched off, then

trace the wiring from the sensor back to the connector in the engine compartment and unplug it (see *illustrations*).

3 Working beneath the vehicle, unscrew the sensor, taking care to avoid damaging the sensor probe as it is removed (see *illustration*).

Note: As a flying lead remains connected to the sensor after it has been disconnected, if the correct spanner is not available, a slotted socket will be required to remove the sensor.

Refitting

4 Apply a little anti-seize grease to the sensor threads - avoid contaminating the probe tip.

5 Refit the sensor to the downpipe, tightening it to the specified torque.

6 Reconnect the wiring and lower the vehicle to the ground.