

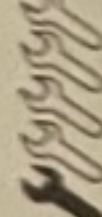
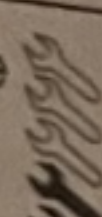

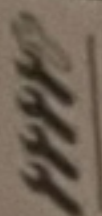

Chapter 4 Part A: Fuel and exhaust systems – petrol engines

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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

System type

All models

Manifold absolute pressure (MAP) sensor

Pressure:

-0.75 bar	0.9
-0.50 bar	1.3
0 bar	2.1
0.25 bar	2.5
0.50 bar	2.9
0.75 bar	3.3
Manifold absolute pressure (MAP) sensor – supply voltage	5 volts

Saab Trionic SFI engine management system

Voltage (approx.)

Intake air temperature (IAC) sensor

Temperature (°C):

-30	4.5
-10	3.9
20	2.4
40	1.5
60	0.9
80	0.54
90	0.41
Intake air temperature (IAC) sensor – supply voltage	5 volts

Throttle body

Throttle motor – pins 10 and 5 at 20°C

1.13 ± 0.5 ohms

Throttle position sensor 1:

0.065 to 1.090 volts
3.930 to 4.775 volts

Closed – pins 6 and 9

Fully open – pins 6 and 9

3.910 to 4.935 volts
0.025 to 1.070 volts

Throttle position sensor 2:

Closed – pins 8 and 9

Fully open – pins 8 and 9

3.990 to 4.645 volts
0.400 to 1.055 volts

Pedal switch

Pedal position sensor 1:

Released – pins 1 and 9

Fully depressed – pins 1 and 9

Pedal position sensor 2:

Released – pins 3 and 9

Fully depressed – pins 3 and 9

0.355 to 1.010 volts
3.945 to 4.600 volts

4A•2 Fuel and exhaust systems – petrol engines

Crankshaft position sensor

Resistance (pins 1 and 2) at 20°C

860 ± 90 ohms

Fuel pressure regulator

Pressure

3.0 ± 0.1 bars

Injectors

Type

Bosch EV6 E

Version

4 hole nozzle

Nozzle colour code

brown

Resistance at 20°C

15.95 ± 0.8 ohms

Flow rating (at 3 bar fuel pressure)

176 ± 7 ml/30 seconds

Maximum flow difference between injectors

20 ml

Idle air control valve

Resistance at 20°C

8.0 ± 1 ohms

Fuel filter capacity

0.6 litres

Fuel pump

Type

Electric immersed in fuel tank

Capacity at 3.0 bars

700 ml/30 seconds (minimum)

Resistance (ohms):

Fuel level sensor in full position

425 ± 6.5

Fuel level sensor in empty position

50 ± 1.5

Turbocharger

Type:

2.0t engine

Garrett GT17

Pressure

0.40 ± 0.03 bars

2.3t engine

Garrett GT17

Pressure

0.40 ± 0.03 bars

2.3HOT Aero engine

Mitsubishi TD04HL-15T-5

Pressure

0.45 ± 0.03 bars

Wastegate preload (all types)

2.0 mm

Turbo shaft play (axial)

0.036 to 0.091 mm

Fuel system

System pressure

3.0 bars

Residual pressure (after 20 mins)

2.3 bars (min)

Recommended fuel

2.0t and 2.3t engines

95 RON unleaded

2.3HOT Aero engine

98 RON unleaded

Idle speed

All models

Controlled by ECM (not adjustable)

Exhaust gas CO content

All models

Controlled by ECM (not adjustable)

Torque wrench settings

Nm

lbf ft

Coolant temperature sensor

13

10

Exhaust heat shield

20

15

Exhaust manifold to cylinder head

25

18

Exhaust manifold-to-turbocharger nuts

24

18

Exhaust pipe to turbocharger

24

18

Exhaust system joint nuts and bolts

22

16

Fuel filter banjo fittings

21

15

Fuel pump screw ring

75

55

Intake manifold

24

18

Oxygen sensor

55

41

Throttle body to intake manifold

8

6

Turbocharger to exhaust manifold

24

18

2.5 Slacken the retaining clips (arrowed) and disconnect the intake pipes

General information and precautions

The fuel supply system consists of a fuel tank mounted under the rear of the car (with an electric fuel pump immersed in it), a fuel filter and the fuel feed and return lines. The fuel pump supplies fuel to the fuel rail, which acts as a reservoir for the four fuel injectors, which inject fuel into the intake tracts. A fuel filter is incorporated in the feed line from the pump to the fuel rail to ensure that the fuel supplied to the injectors is clean. The filter is mounted adjacent to the fuel tank.

The engine management system is of Saab Tronic type; refer to the relevant Sections for further information on the operation of the system.

A cruise control system is fitted as standard equipment on most of the later Saab models, and is available as an option on earlier models.

The turbocharger fitted is of a water-cooled type. Boost pressure is controlled by the Saab Tronic engine management.

Precautions

- Many of the procedures in this Chapter require the disconnection of fuel lines, which may result in some fuel spillage. Before carrying out any operation on the fuel system, refer to Section 8.
- See the precautions given in 'Safety first' at the front of this manual and follow them implicitly. Petrol is a highly dangerous and

2.6 Remove the lower air cleaner housing (arrowed) and withdraw the air cleaner

2 Air cleaner assembly - removal and refitting

Removal

- Remove the front grille as described in Chapter 11.
- Remove the right-hand headlight unit as described in Chapter 12.
- Slacken the retaining clip, and disconnect the intake pipe from the top of the air cleaner assembly (see illustration 2.5).
- Apply the handbrake, then jack up the front of the car and support on axle stands (see Jacking and vehicle support). Remove the right-hand front wheel, undo the retaining screws and remove the wheel arch liner.
- From under the vehicle, slacken the retaining clip, and disconnect the intake pipe from the bottom of the air cleaner assembly (see illustration).
- Unscrew the lower mounting nuts (see illustration), and lower the air cleaner assembly from under the inner wing. Note: It may be necessary to remove a couple of retaining screws from the right-hand side of the front bumper to allow removal of the air cleaner assembly.
- If required, undo the retaining bolts and remove the bracket for the air intake pipe (see illustration), then withdraw the air intake pipe from across the front of the radiator.

2.7 Undo the retaining clip around the air intake pipe

Refitting

- Refitting is a reversal of the removal procedure. Make the necessary adjustment of the air cleaner assembly, secure it in place in the inner wing panel.

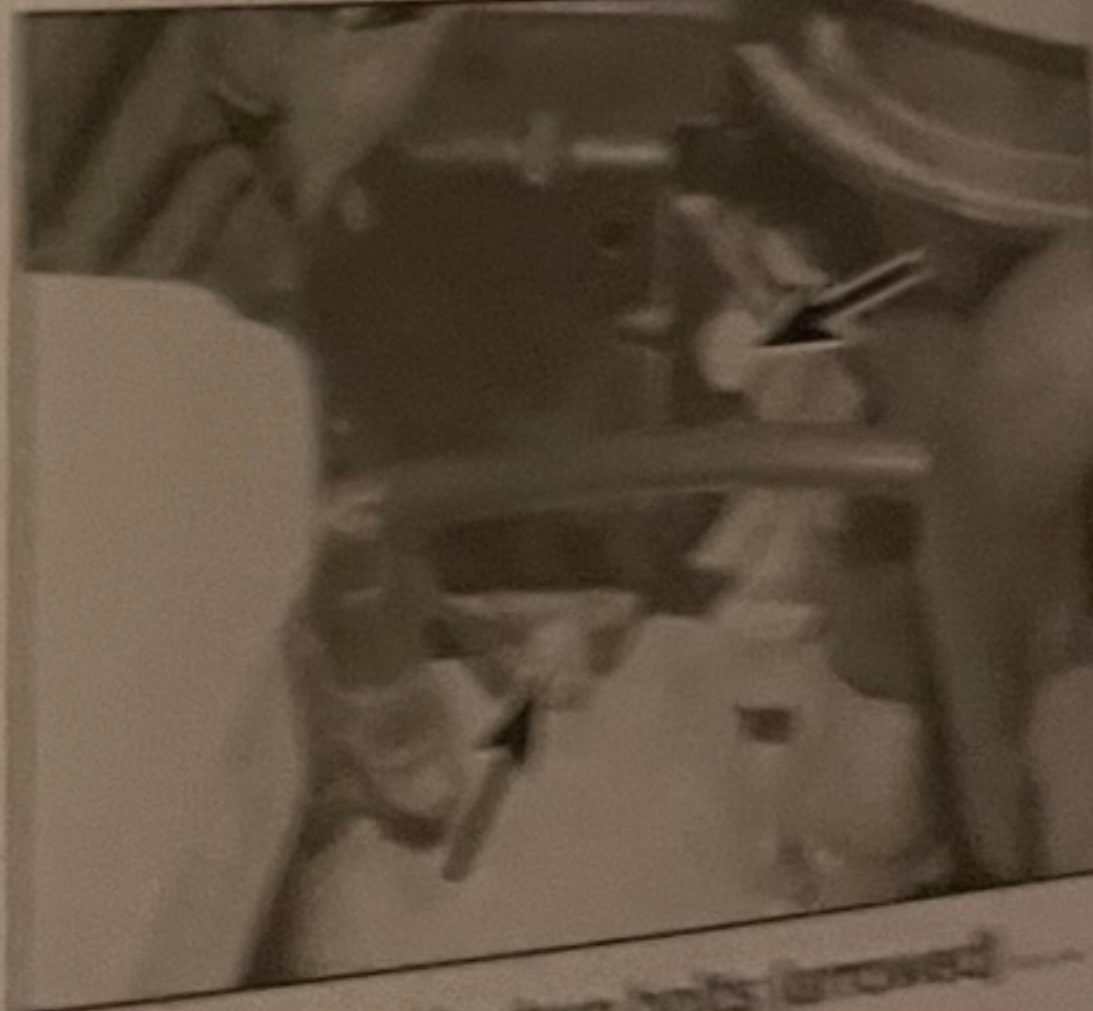
3 Accelerator cable - removal and refitting

Removal

- From inside the vehicle, undo the retaining screws and withdraw the cable cover plate from the driver's footwell as described in Chapter 11.
- While holding the accelerator pedal, slacken the cable locknuts and disconnect the cable from the top of the pedal (see illustration).
- Working under the bonnet, remove the engine oil filler cap/dipstick then undo and remove the cover from the top of the engine. Undo the retaining bolts and remove the cover from the throttle linkage (see illustration).
- Attach a piece of string or wire to the end of the accelerator cable inside the vehicle, and then pull the cable (with string or wire connected) into the engine compartment. Disconnect the string or wire and leave it through the bulkhead for refitting.



2.1 Disconnect the inner cable (arrowed) from the top of the accelerator pedal



2.2a Undo the two bolts (arrowed)



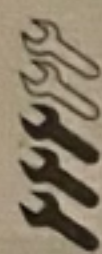
2.2b ...and remove the throttle linkage cover

- 5 Rotate the throttle housing sector and disconnect the inner cable.
- 6 Pull out the locking clip (noting its position in the grooves on the sleeve), and disconnect the accelerator outer cable from the bracket on the throttle housing (see illustration).

Refitting

- 7 Apply a little petroleum jelly to the rubber bush (grommet) in the bulkhead, connect the string or wire to the accelerator cable, and draw it back through the bulkhead.
- 8 Untie the string, and reconnect the cable and bushing to the accelerator pedal inside the car.
- 9 Refit the accelerator outer cable to the bracket on the throttle housing, and secure with the locking clip in the position noted on removal.
- 10 Reconnect the inner cable to the throttle housing sector. If there is too much slack in the inner cable, move the locking clip further along the grooves in the outer cable sleeve.
- 11 Refit the inner facia lower trim panel, this is a reversal of the removal procedure; see Chapter 11.
- 12 Refit the engine upper cover and throttle valve cover; this is a reversal of the removal procedure.

4 Accelerator pedal – removal and refitting



Removal

- 1 From inside the vehicle, undo the retaining screws and withdraw the facia lower panel from the driver's footwell as described in Chapter 11.
- 2 While holding the accelerator pedal, slide the bush backwards and disconnect the cable from the top of the accelerator pedal. On models without an accelerator cable, disconnect the wiring connector from the pedal position sensor assembly.
- 3 Unscrew the bolts on the pedal bracket, and remove the pedal (see illustrations).

Refitting

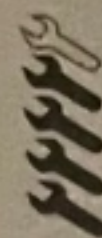
- 4 Refitting is a reversal of removal, but make sure that the mounting bolts are tightened



3.6 Remove the outer cable clip (arrowed) securing the accelerator cable to the bracket

securely. If necessary, adjust the accelerator cable as described in Section 3, paragraph 10.

5 Cruise control system – description and component renewal



Description

- 1 The cruise control system allows the driver to pre-select the speed of the car and then release the accelerator pedal. The cruise control system then adjusts the throttle automatically to maintain a constant road speed. The system is deactivated when either the clutch or brake pedals are depressed, when neutral gear is selected (models with automatic transmission) or when the main cruise control switch is switched off. The system has a memory function, which allows a pre-selected cruising speed to be resumed if the operation of the cruise control has been interrupted by depressing the brake or clutch pedals.
- 2 When the cruise control system is active, the pre-selected road speed may be increased or decreased in small increments, by means of the multifunction cruise control system switch.
- 3 In the event of a fault in the cruise control system, first check all relevant wiring for security. Further testing is best left to a Saab dealer, who will have the necessary diagnostic equipment to find the fault quickly.
- 4 The main components of the system are as follows:

- a) **Electronic Control Module (ECM):** the module is supplied with the speed of the car by signals sent from the speed sensor in the instrument panel. The system is not operative at speeds below 20 mph. When the cruise control system is active, the engine management system is informed of this fact by a signal to the ECM. The ECM determines the vehicle's speed from a signal supplied by the road speed sensor. The Braking System (ABS) ECM.
- b) **Switches:** the main multifunction switch for the cruise control system is integral with the steering column stalk switch. Switches mounted on the facia and operated by the brake and clutch pedals deactivate the system when either pedal is depressed. As a fail-safe, the brake pedal cruise control switch is earthed through the brake stop-light bulbs, via the main stop-light switch. If this circuit develops a fault, the cruise control system will not operate.
- c) **Indicator light:** the CRUISE indicator light on the instrument panel is illuminated whenever the cruise control system is operating.

Component renewal

Electronic Control Module

- 5 The cruise control uses the same electronic control module as the engine management system. Refer to the information given in Section 14 of this Chapter for the removal and refitting procedure.

Multifunction control switch

- 6 Refer to the information given in Chapter 11, Section 4, for the removal of the steering column switch.

Stop-light switch

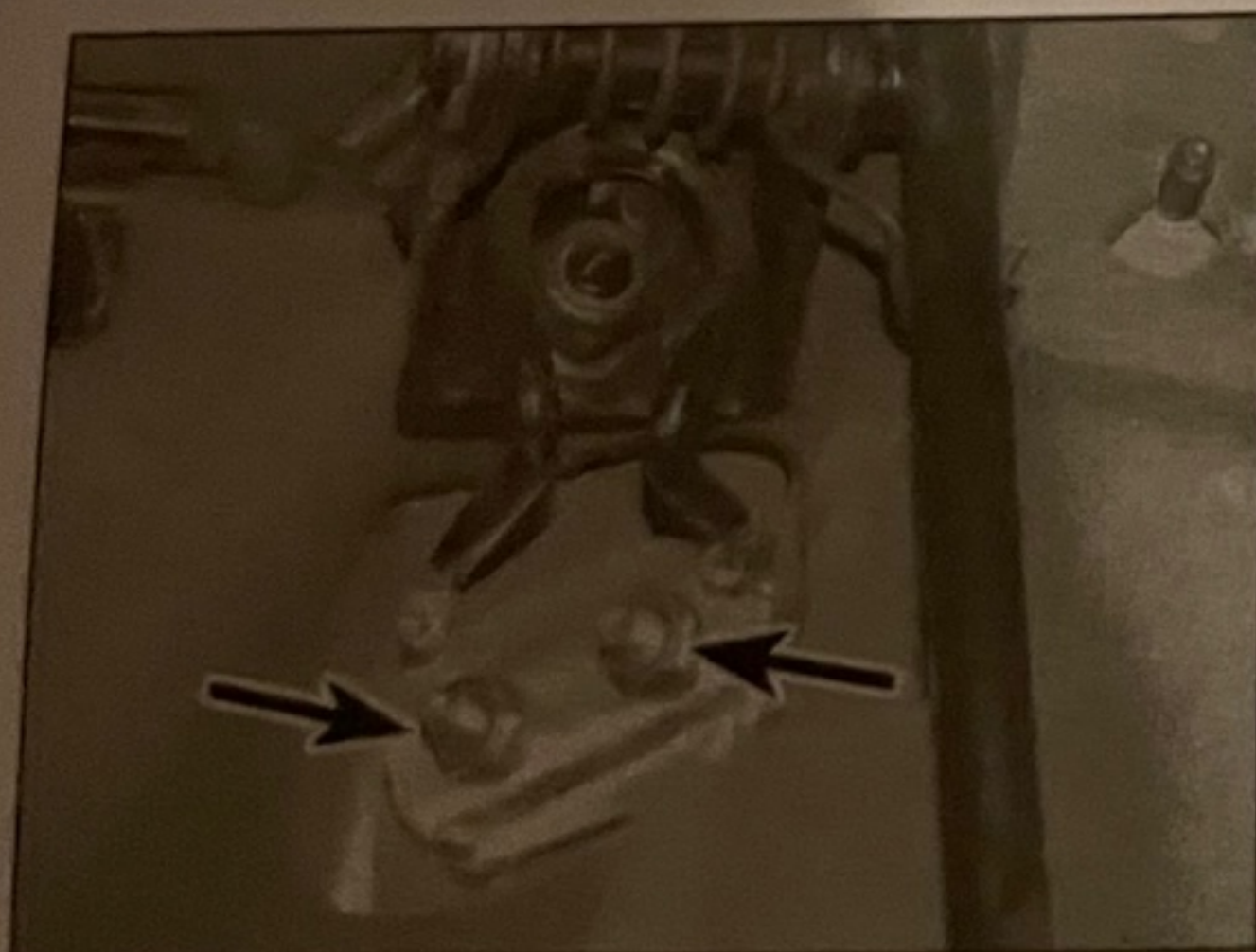
- 7 Refer to the information given in Chapter 11, Section 4, for the removal of the stop-light switch.

Pedal switches

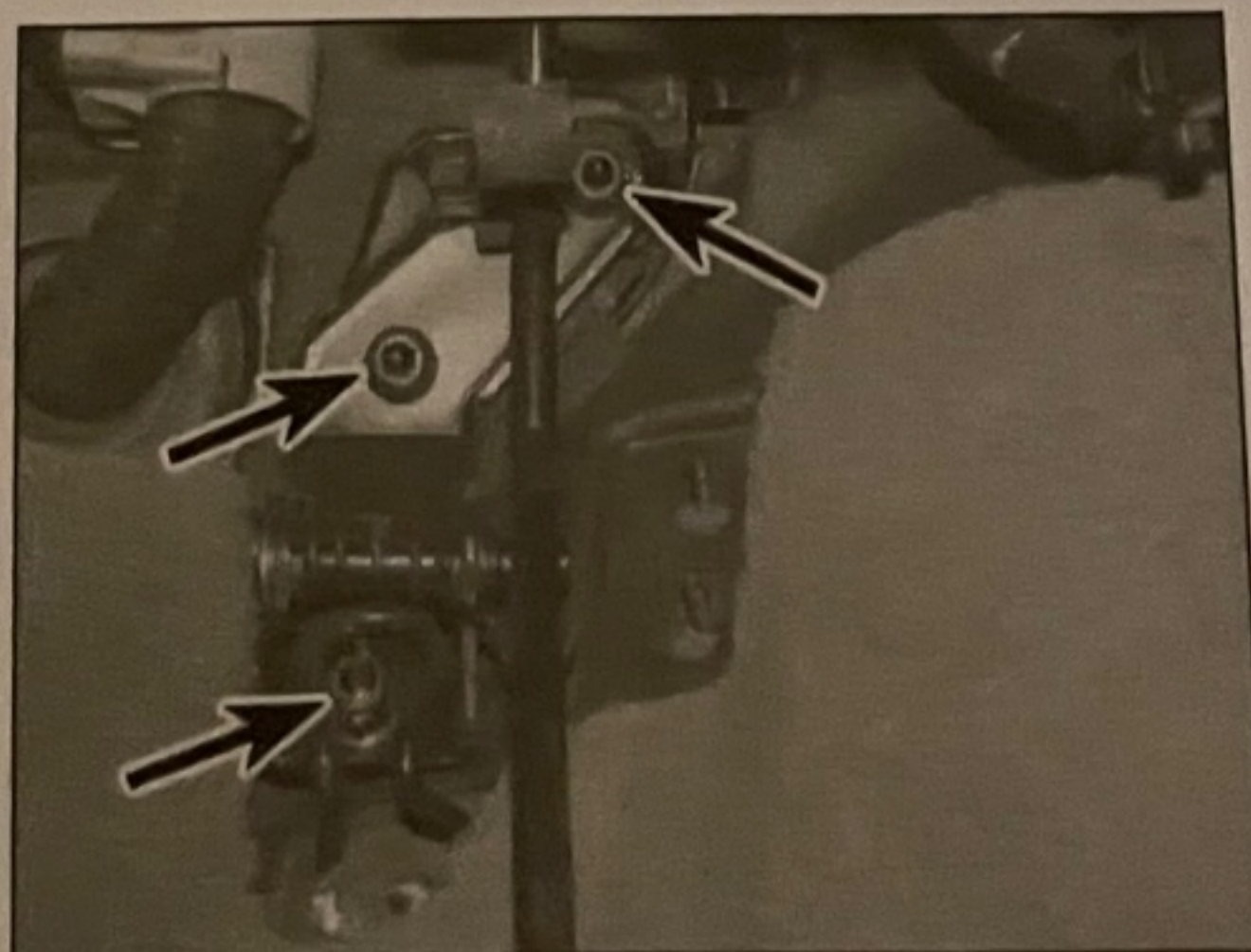
- 8 From inside the vehicle, undo the retaining screws and withdraw the facia lower panel from the driver's foot well as described in Chapter 11.
- 9 Reach behind the facia and unplug the wiring from the relevant switch.
- 10 Carefully prise the switch from its mounting bracket.
- 11 To refit the switch, carefully pull the switch plunger out, and then depress the brake or clutch pedal (as applicable). Insert the switch into its mounting bracket, and slowly release the pedal until it contacts the switch plunger. Reconnect the wiring securely.

6 Unleaded petrol – general information and usage

Note: The information given in this Chapter is correct at the time of writing, and is only to fuels currently available in the UK.



4.3a Undo the two retaining bolts (arrowed) ...



4.3b ... then remove the three pedal securing nuts (arrowed)

updated information is thought to be required, check with a Saab dealer. If travelling abroad, consult one of the motoring organisations (or a similar authority) for advice on the petrol available, and their suitability for your vehicle.

1 The fuel recommended by Saab is given in the Specifications at the start of this Chapter.

2 The RON and MON are different testing standards; RON stands for Research Octane Number (also written as RM), while MON stands for Motor Octane Number (also written as MM).

3 All Saab 9-5 models covered in this manual are designed to run on unleaded fuel with a minimum octane rating of 91 RON; 95 RON and 98 RON unleaded fuel is recommended. All models are equipped with a catalytic converter, and must be run on unleaded fuel only. Under no circumstances should leaded fuel/LRP be used, as this will damage the catalytic converter.

7 Engine management system – general information

The Saab Trionic engine management system controls three functions of the engine from a single electronic control module (ECM). The three functions comprise the fuel injection system, ignition system, and the turbocharger boost control system. Details of the components related to the ignition function are given in Chapter 5B.

The system is microprocessor-controlled, and the fuel system provides the correct amount of fuel necessary for complete combustion under all engine conditions. Data from various sensors is processed in the ECM, in order to determine the opening period of the fuel injectors for the exact amount of fuel to be injected into the intake manifold.

The system is of sequential type, where fuel is injected in sequence with the engine's firing order. Conventional sequential fuel injection systems require a camshaft sensor, which works in conjunction with the crankshaft position sensor to indicate which cylinder at TDC is on its compression stroke and which is on its exhaust stroke. The Trionic system has no camshaft sensor; it determines each cylinder's stroke by applying a small direct current voltage across each spark plug. When a cylinder on its combustion stroke approaches TDC, this voltage causes an ionisation current to flow across the terminals of the spark plug, thus indicating which cylinder requires fuel injection and ignition next. Sequential control of the ignition timing to control combustion knock is achieved in the same manner (see Chapter 5B).

When the ignition is initially switched on and after the fuel pump is operating, all the injectors operate simultaneously for a short period; this helps to minimise cold start cranking times.

The main components of the system are as follows:

- a) **ECM:** the electronic control module controls the entire operation of the fuel injection system, ignition system, cruise control and turbocharger boost control system.
- b) **Crankshaft position sensor:** the crankshaft position sensor provides a datum for the ECM to calculate the position of the crankshaft in relation to TDC. The sensor is triggered by a reluctor disc that rotates inside the crankcase.
- c) **Manifold absolute pressure (MAP) sensor:** the MAP sensor provides a voltage to the ECM, proportional to the pressure in the intake manifold.
- d) **Charge air (boost) pressure/temperature sensor:** the air pressure/temperature sensor is integrated into one component and informs the ECM of the pressure and temperature of the air in the hose between the intercooler and the throttle body.
- e) **Engine coolant temperature sensor:** the engine coolant temperature sensor informs the ECM of the engine temperature.
- f) **Mass airflow sensor:** is located behind the right-hand headlamp. The engine load is measured by means of a hot-film type air mass flow meter, rather than by measuring intake manifold depression. The meter houses a heated metal filament, which is mounted in the flow of the air intake. The temperature reduction in the wire caused by the flow of air over it causes a change in electrical resistance, which is converted to a variable voltage output signal. Measuring air mass flow, rather than volume flow compensates for the changes in air density encountered when driving on roads at different altitudes. Note that this method of measurement also precludes the need for a measurement of intake air temperature.
- g) **Throttle position sensor:** the throttle position sensor informs the ECM of the throttle valve position.
- h) **Charge air (boost) control valve:** the boost pressure control valve (also referred to as the solenoid valve) is located on a bracket at the front of the cylinder head. It controls the operation of the turbocharger. Under certain conditions (ie, in 1st gear), boost pressure is reduced.
- i) **Charge air (boost) bypass valve:** the bypass valve is located on the engine wiring harness connector bracket at the rear of the engine compartment on the bulkhead. It is a safety device to prevent any damage to the turbocharger. Under certain conditions, when there is a build-up of pressure the valve is opened by the vacuum from the intake manifold.
- j) **Fuel pressure regulator:** is connected to the end of the fuel rail on the intake manifold and regulates the fuel pressure to approximately 3.0 bars.
- k) **Fuel pump:** the fuel pump is housed in the fuel tank. The pump housing incorporates a separate feed pump, which supplies the main fuel pump with pressurised fuel, free of air bubbles.
- l) **Injectors:** each fuel injector consists of a solenoid-operated needle valve, which opens under the commands from the ECM. Fuel from the fuel rail is then delivered through the injector nozzle into the intake manifold.
- m) **Oxygen sensor:** the oxygen sensor provides the ECM with constant feedback on the oxygen content of the exhaust gases (see Chapter 4C).
- n) **EVAP canister-purge valve:** the EVAP canister-purge valve is operated when the engine is started, to purge fuel accumulated in the canister. In order to allow the oxygen sensor to compensate for the additional fuel, the system is operated in short phases (see Chapter 4C).
- o) **Ignition discharge module and spark plugs:** the ignition discharge module (or cartridge) contains four HT coils connected directly to the spark plugs (see Chapter 5B).
- p) **Limp-home solenoid:** the limp-home solenoid is located on the rear of the throttle body. If a safety related fault occurs in the throttle control, it will go into the limp-home mode. The Check Engine lamp will go on immediately and the diagnostic trouble code will have to be cleared with the diagnostic tool.

Check Engine indicator lamp

If the Check Engine warning light comes on, the car should be taken to a Saab dealer at the earliest opportunity. A complete test of the engine management system can then be carried out, using dedicated Saab electronic diagnostic test equipment.

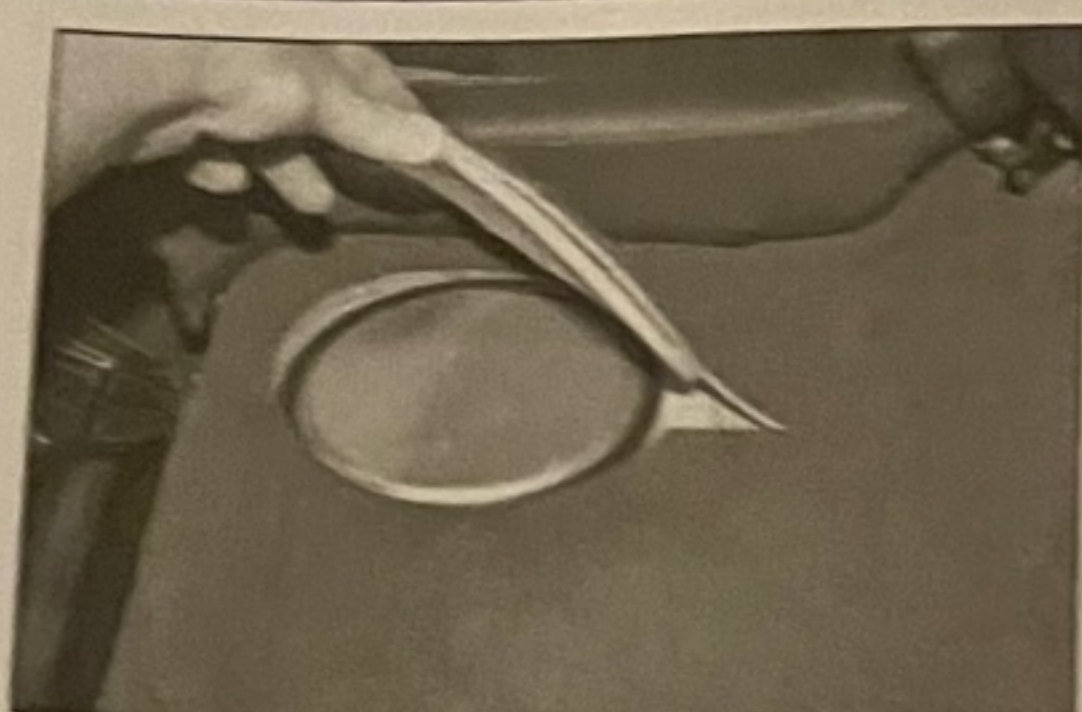
8 Fuel supply system – precautions and depressurisation

Note: Refer to the Precautions at the end of Section 1 before proceeding.

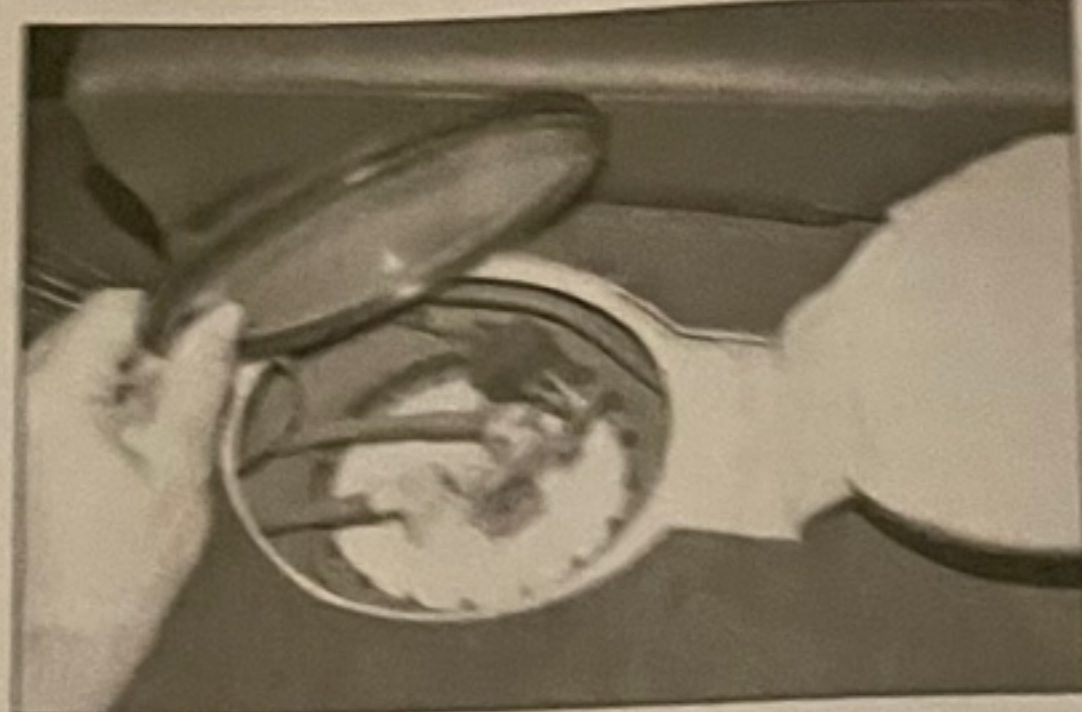
Warning: Residual fuel pressure may remain for some time after the ignition has been switched off, and must be relieved before any of these components are disturbed for servicing work.

1 The fuel system referred to in this Section is defined as the tank-mounted fuel pump, the fuel filter, the fuel injectors, the fuel rail and the pressure regulator, and the metal pipes and flexible hoses connected between these components. All these contain fuel, which will be under pressure while the engine is running and/or while the ignition is switched on.

Warning: The following procedure will merely relieve the pressure in the fuel system – remember that fuel will still be present in the system components, and to take precautions



9.2a Lift up the carpet under the rear seat...



9.2b ... and prise out the fuel pump cover



9.3 Disconnect the wiring plug



9.4 Undo the retaining screw to release the fuel pipes from the pump

accordingly before disconnecting any of them.

2 Open the fusebox cover, on the right-hand side of the fascia panel (see *Weekly checks*) and remove the fuel pump fuse (should be fuse number 15 – check in Chapter 12 for exact location for your model).

3 Turn the ignition key and crank the engine. If it starts and runs, allow it to idle until it stops through fuel starvation; this should not take more than a few seconds. Try to start it two more times, to ensure that all pressure has been relieved.

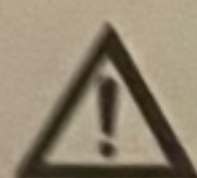
4 Disconnect the battery negative terminal, then refit the fuel pump fuse.

5 Place a suitable container beneath the

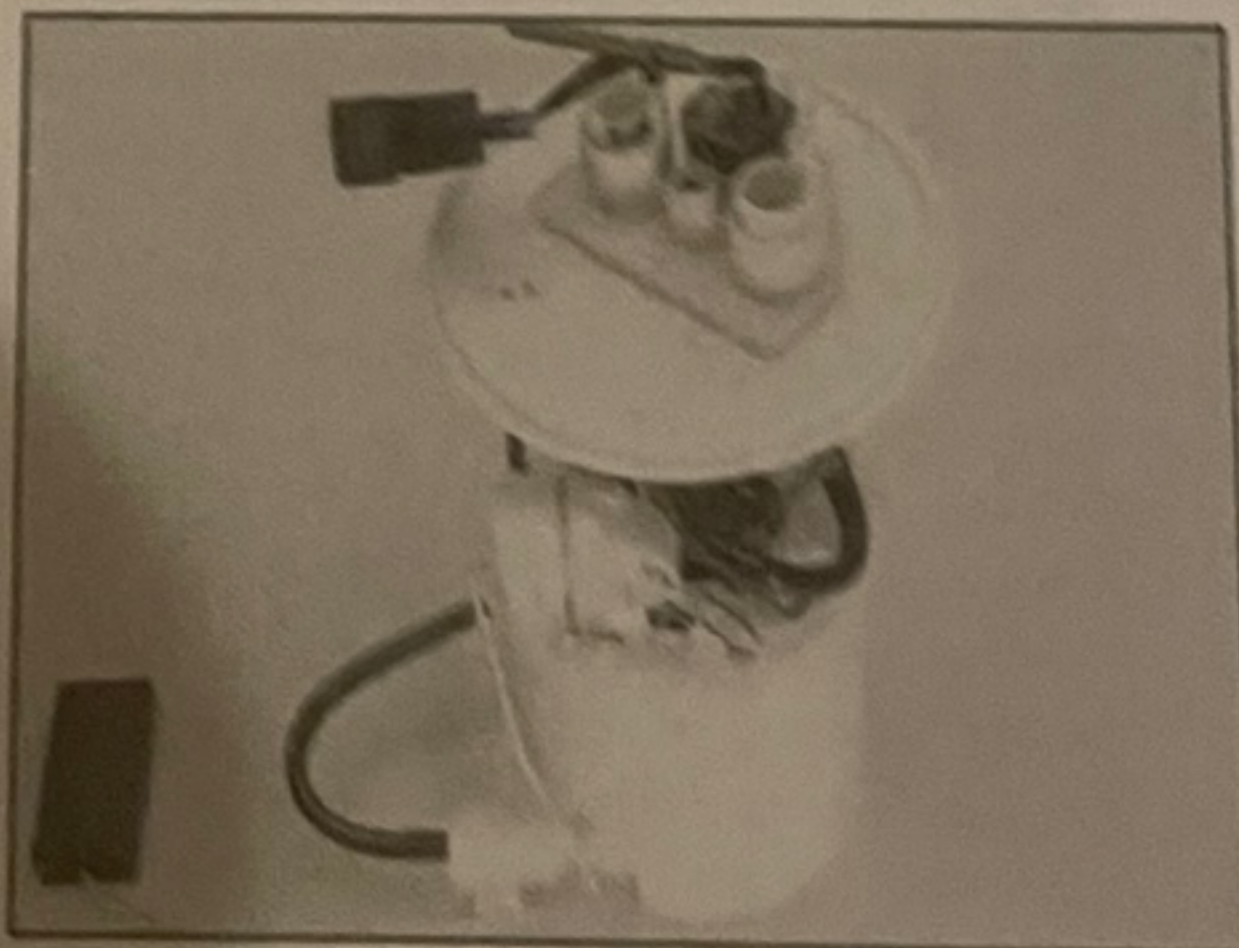
relevant connection/union to be disconnected, and have a large rag ready to soak up any escaping fuel not being caught by the container.

6 Slowly loosen the connection or union nut (as applicable) to avoid a sudden release of pressure, and position the rag around the connection to catch any fuel spray which may be expelled. Once the pressure is released, disconnect the fuel line.

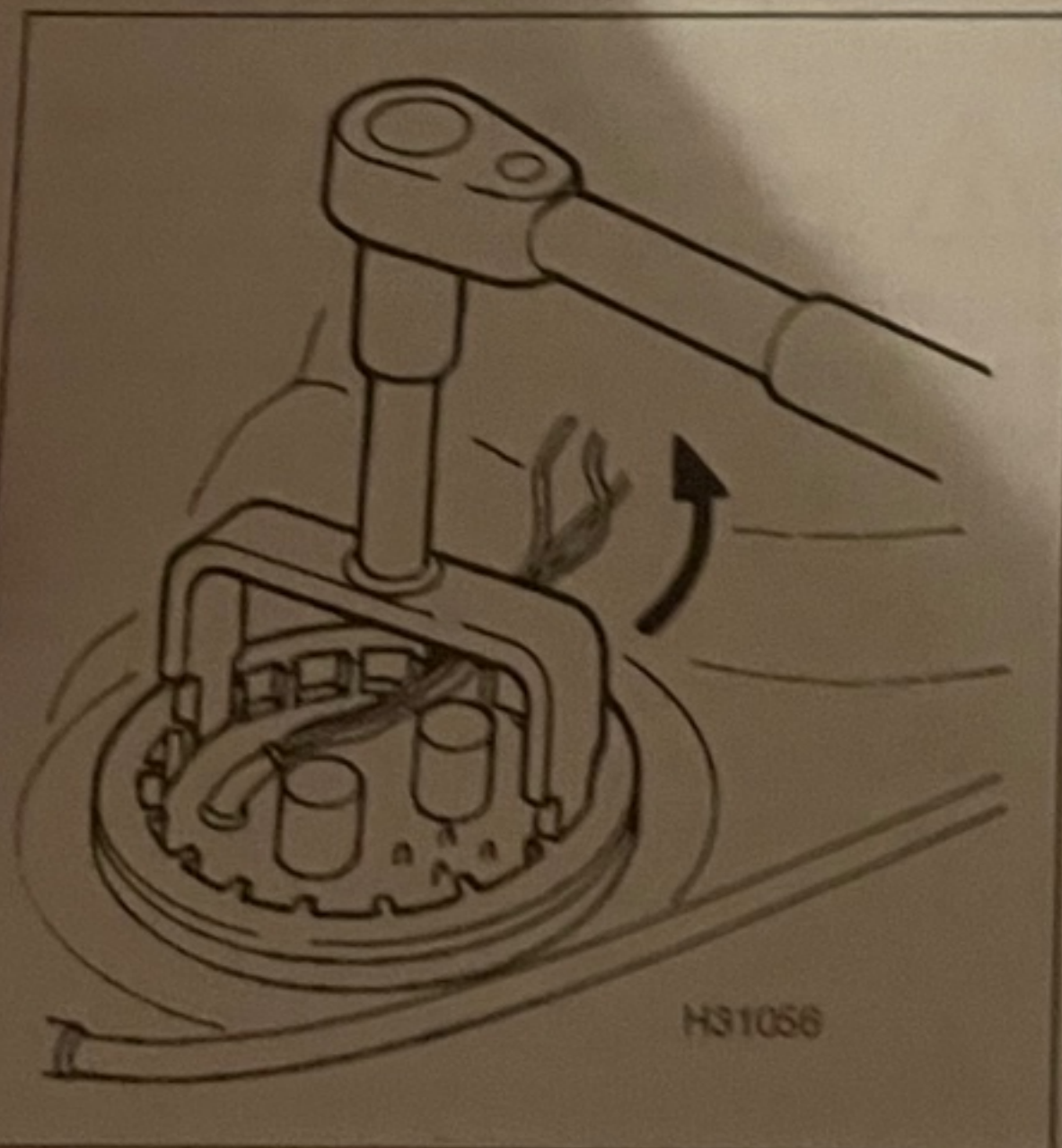
9 Fuel pump – removal and refitting



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



9.6 Fuel pump removed from the fuel tank



9.5 Unscrew and remove the locking ring from the top of the fuel pump

Note: On all models, the fuel pump incorporates the fuel gauge sender unit.

Removal

1 Release the pressure in the fuel system as described in Section 8, then disconnect the battery negative cable and position a rag around the connection.

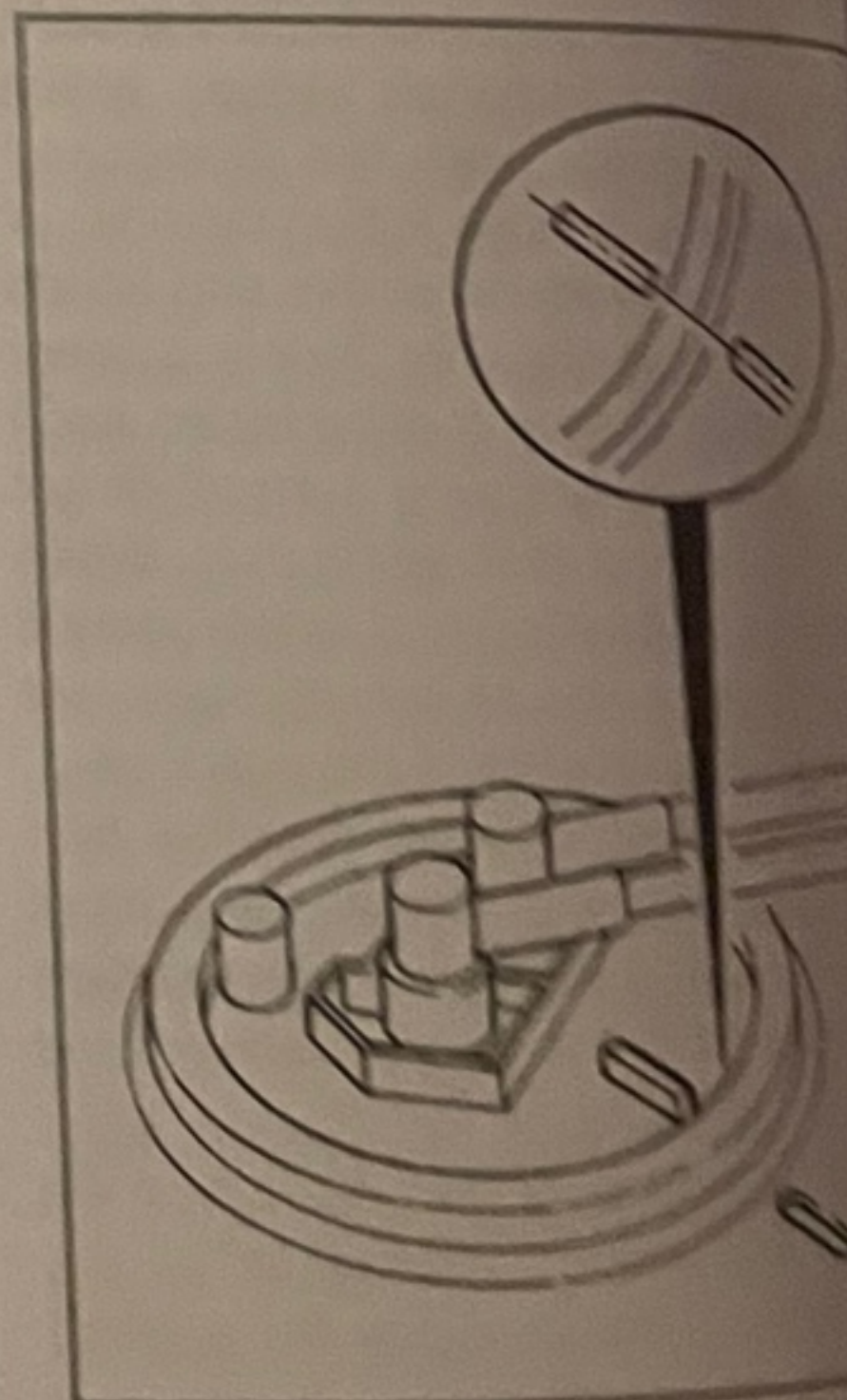
2 Lift up the rear seat cushion and fold the carpet mat in Chapter 11. Fold the carpet mat and unclip the fuel pump cover from the panel (see illustrations).

3 Disconnect the upper wiring plug on the top of the fuel pump sender unit (see illustration).

4 Remove the two fuel lines from the fuel pump/sender unit with a screwdriver to undo the retaining bracket (see illustration). Position a rag around the connection to catch any fuel spray, which may be expelled from the fitted position of the fuel lines. One is the pressure feed line and the other is the return (which may also be connected to the top of the fuel pump/sender unit).

5 The unit is secured by a screwed ring, but a large pair of grips (water pump pliers) inserted between the sender unit and the inside edge of the ring will achieve the result. Unscrew and remove the ring (see illustration). Note the location of the ring on the top of the pump and tank.

6 Carefully lift the pump flange away from the surface of the fuel tank. Allow the tank to drain back into the tank, then rotate the pump clockwise through about one half of a turn and withdraw it from the tank (see illustration). Have a large rag ready to soak up any escaping fuel not drained from the unit. Recover the O-ring seal from the aperture.



9.8 When refitting the fuel pump ensure that the markings on the fuel pump and tank are aligned

Refitting

- 7 Fit a new O-ring seal to the fuel tank aperture, pressing it firmly into its recess.
- 8 Lower the fuel pump into the fuel tank, rotating it to ensure that the alignment markings on the fuel pump and tank line up (see illustration).
- 9 Screw the large plastic locking ring into position and tighten it using the method described for its removal. Apply acid-free petroleum jelly to the screw threads.
- 10 Refit the fuel lines and wiring connectors to the fuel pump/sender unit, noting the correct fitted position (see paragraph 4). The refitting is a reversal of removal procedure.
- 11 Refit the rear seat cushion, then reconnect the battery negative cable.

10 Fuel pump relay – removal and refitting

Removal

- 1 The fuel pump relay is located on the main relay board, behind the facia (see Chapter 12 for further information).
- 2 Remove the battery cover, then disconnect the battery negative cable and position it away from the terminal.
- 3 Release the fasteners and detach the lower cover panel from the driver's side of the facia.
- 4 Remove the securing screw and lower the fuseboard away from the facia.
- 5 The fuel pump relay is the one that is labelled G; 1st column from the left, 3rd row from the top (see illustration).
- 6 Grasp the relay and pull it squarely from the relay board.

Refitting

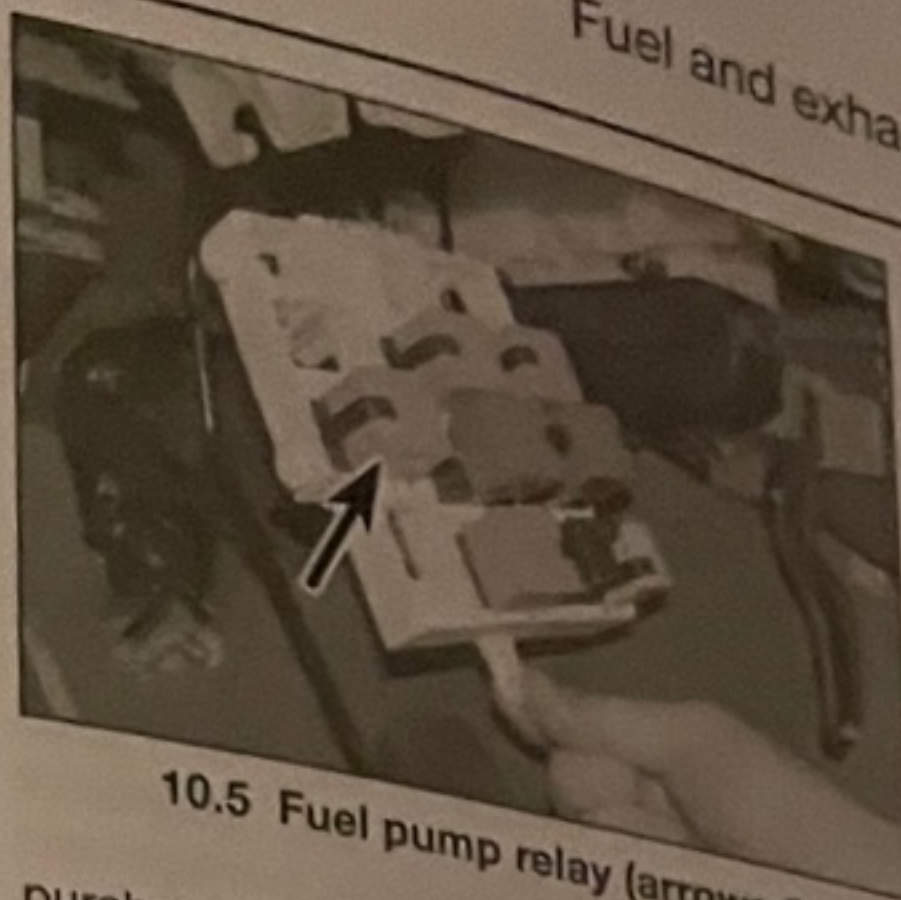
- 7 Refitting is a reversal of removal. Ensure that the relay is pushed firmly into its base.

11 Fuel gauge sender unit – removal and refitting

On all models, the fuel gauge sender unit is integral with the fuel pump and can only be



12.7 Undo the fuel filler pipe retaining bolt (arrowed)



10.5 Fuel pump relay (arrowed)

purchased as a complete assembly; refer to Section 9 for fuel pump removal and refitting.

12 Fuel tank – removal, repair and refitting

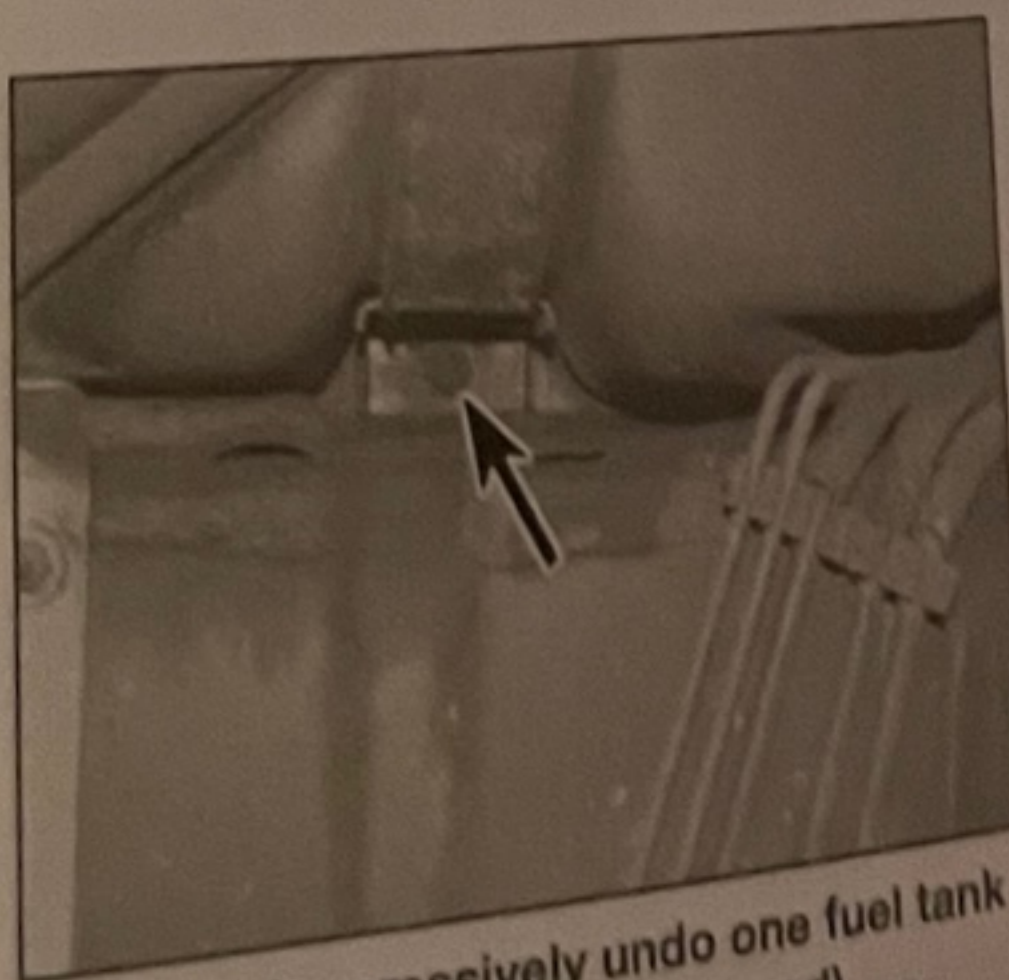


Warning: Refer to the precautions given in Section 8, and the information detailed in the 'Safety First!' Section of this manual, before disturbing any component in the fuel supply system.

- 1 Before removing the fuel tank, it is preferable that all the fuel is first removed from the tank. Since a fuel tank drain plug is not provided, carry out the removal operation when the tank is almost empty.

Removal

- 2 Release the pressure in the fuel system as described in Section 8, then disconnect the battery negative cable and position it away from the terminal.
- 3 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*).
- 4 With reference to Section 9 (fuel pump removal), carry out the procedures from paragraphs 2 to 4, disconnecting the fuel pipes and wiring connectors from the fuel pump.
- 5 Remove the rear section of the exhaust system as described in Section 20.



12.10a Progressively undo one fuel tank support strap bolt (arrowed) ...

- 6 Release the locking clip and disconnect the purge pipe.
- 7 Undo the retaining bolt and detach the filler neck hose from the tank (see illustration).
- 8 With reference to Chapter 9, disconnect the both handbrake cables from the rear brakes.
- 9 Position a trolley jack centrally underneath the fuel tank, with a plank of wood placed on the jack head. Raise the jack until it just starts to take the weight of the fuel tank.
- 10 Progressively undo the bolts securing the fuel tank support straps to their respective mounting brackets (see illustrations). Unhook the ends of each support strap from their brackets, as they become slack.
- 11 Disconnect any remaining breather hoses or cables that may prevent the removal of the tank.
- 12 With the help of an assistant, lower the fuel tank to the ground and remove it from under the car.

Repair

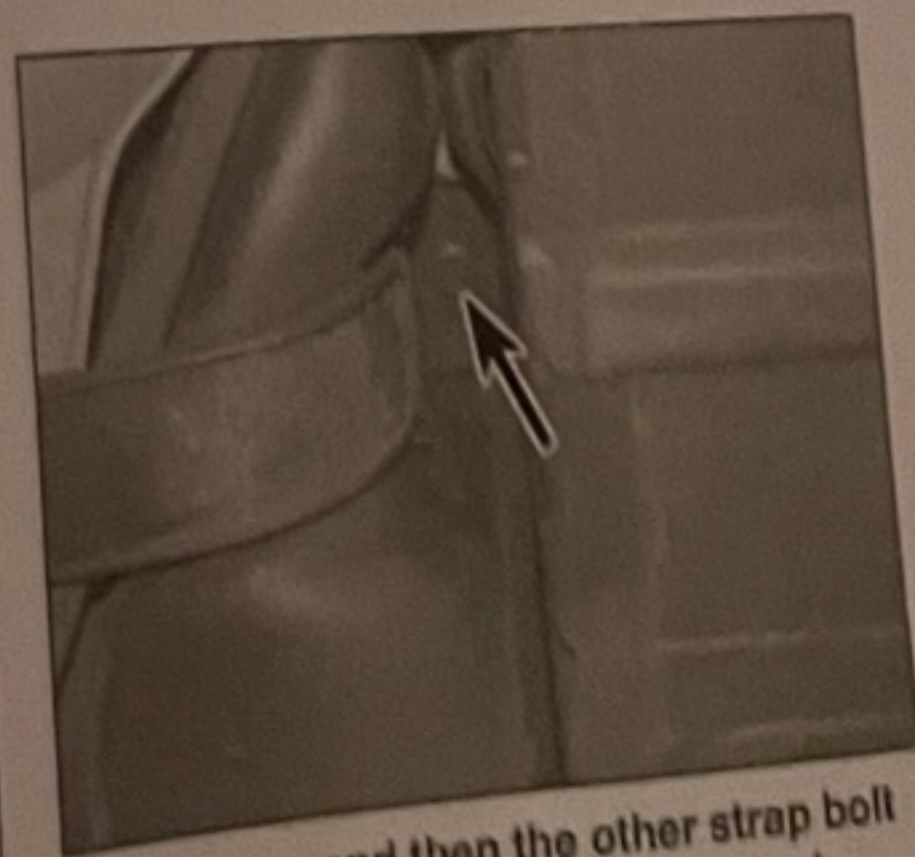
- 13 If the tank is contaminated with sediment or water, remove the fuel pump and wash the tank out with clean fuel. In certain cases, it may be possible to have small leaks or minor damage repaired. Seek the advice of a suitable specialist before attempting to repair the fuel tank.

Refitting

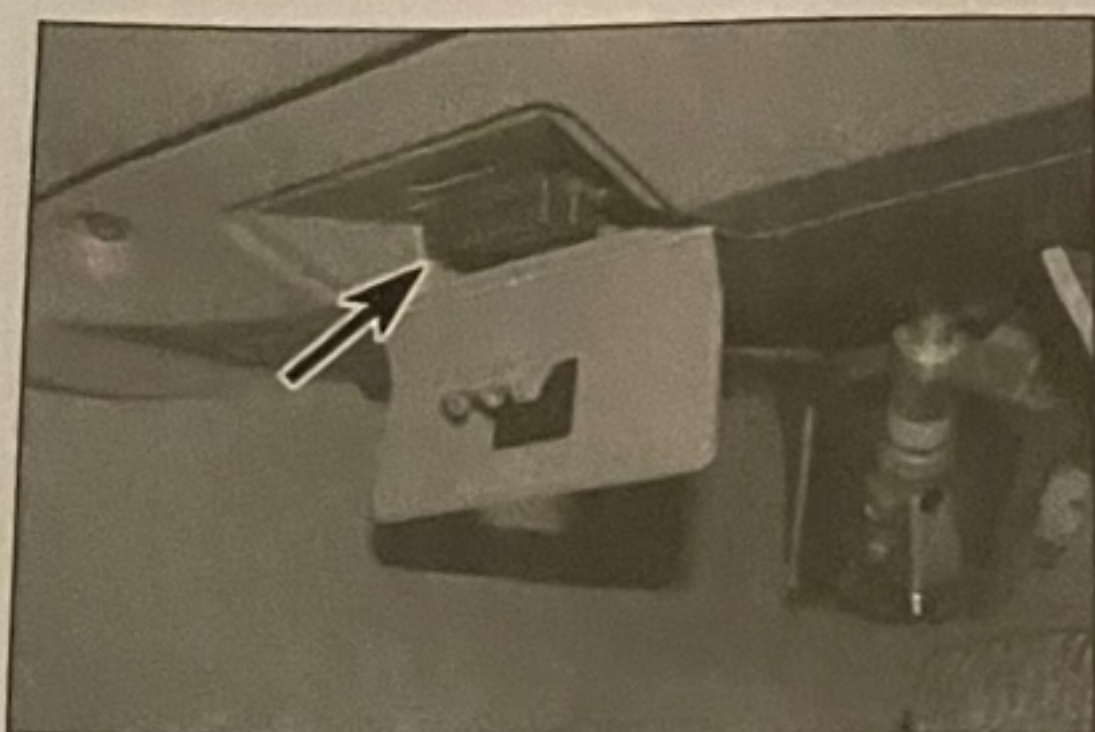
- 14 Refitting is a reversal of removal, noting the following points:
 - a) Inspect the O-rings at the fuel supply and return quick-release unions, on the top of the fuel pump.
 - b) Ensure that all fuel lines and breather hoses are correctly routed and are not kinked or twisted.
 - c) Tighten the fuel tank support straps securely.

13 Engine management system – general information

- 1 The engine idle speed and air-to-fuel mixture (and hence the exhaust gas CO content) are automatically controlled by the ECM. The checking of idle speed and



12.10b ... and then the other strap bolt (arrowed) to release the fuel tank



13.3 Diagnostic connector (arrowed) under driver's side facia panel

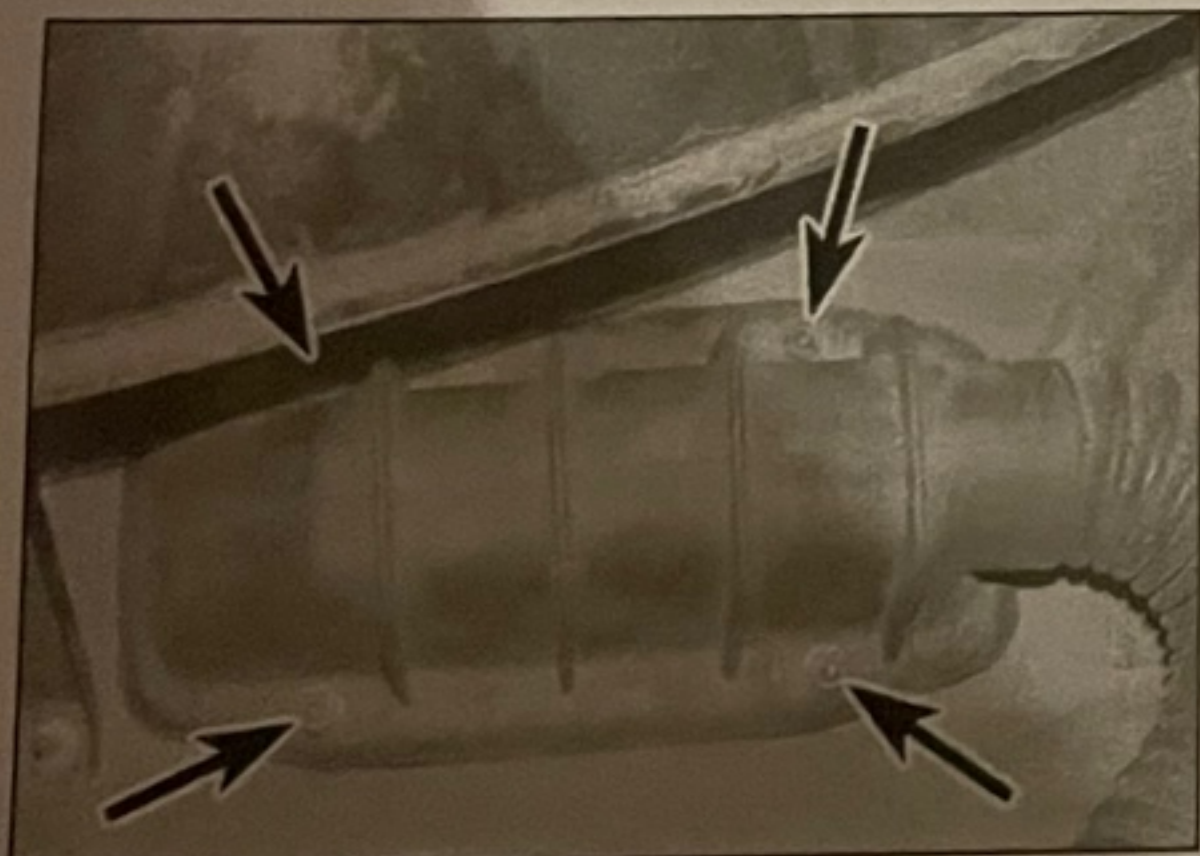
mixture is possible on all models by using a tachometer and exhaust gas analyser, note some difficulty may be experienced connecting a conventional tachometer to the engine because of the Direct Ignition system. In addition, as all models are fitted with catalytic converters, the levels of CO, HC and NOx produced may be difficult to measure accurately with anything other than professional test equipment if the system is operating normally. However, it may be possible to at least confirm the existence of a fuelling or ignition fault, by detecting high levels of one or more of these exhaust gas pollutants, using a commercially-available exhaust gas analyser.

2 If a fault appears to be present in the engine management system, first ensure that all the system wiring connectors are securely

connected and free of corrosion. Then ensure that the fault is not due to poor maintenance – ie, check that the air cleaner filter element is clean, that the fuel filter has been renewed at the specified interval, and that the spark plugs and associated HT components are in good condition. Also check that the engine breather hoses are clear and undamaged. Finally, check that the cylinder compression pressures are correct, referring to Chapters 1A, 2A and 5B for further information.

3 If these checks fail to reveal the cause of the problem, the car should be taken to a Saab dealer for testing. A diagnostic connector is incorporated in the engine management system wiring harness, into which a special Saab electronic diagnostic tester can be plugged. The tester will identify any faults detected by the engine management system ECM by interpreting fault codes stored in the ECM's memory. It also allows system sensors and actuators to be tested remotely without disconnecting them or removing them from the vehicle. This alleviates the need to test all the system components individually, using conventional test equipment. The diagnostic connector is located on the underside of the facia, on the driver's side of the vehicle (see illustration).

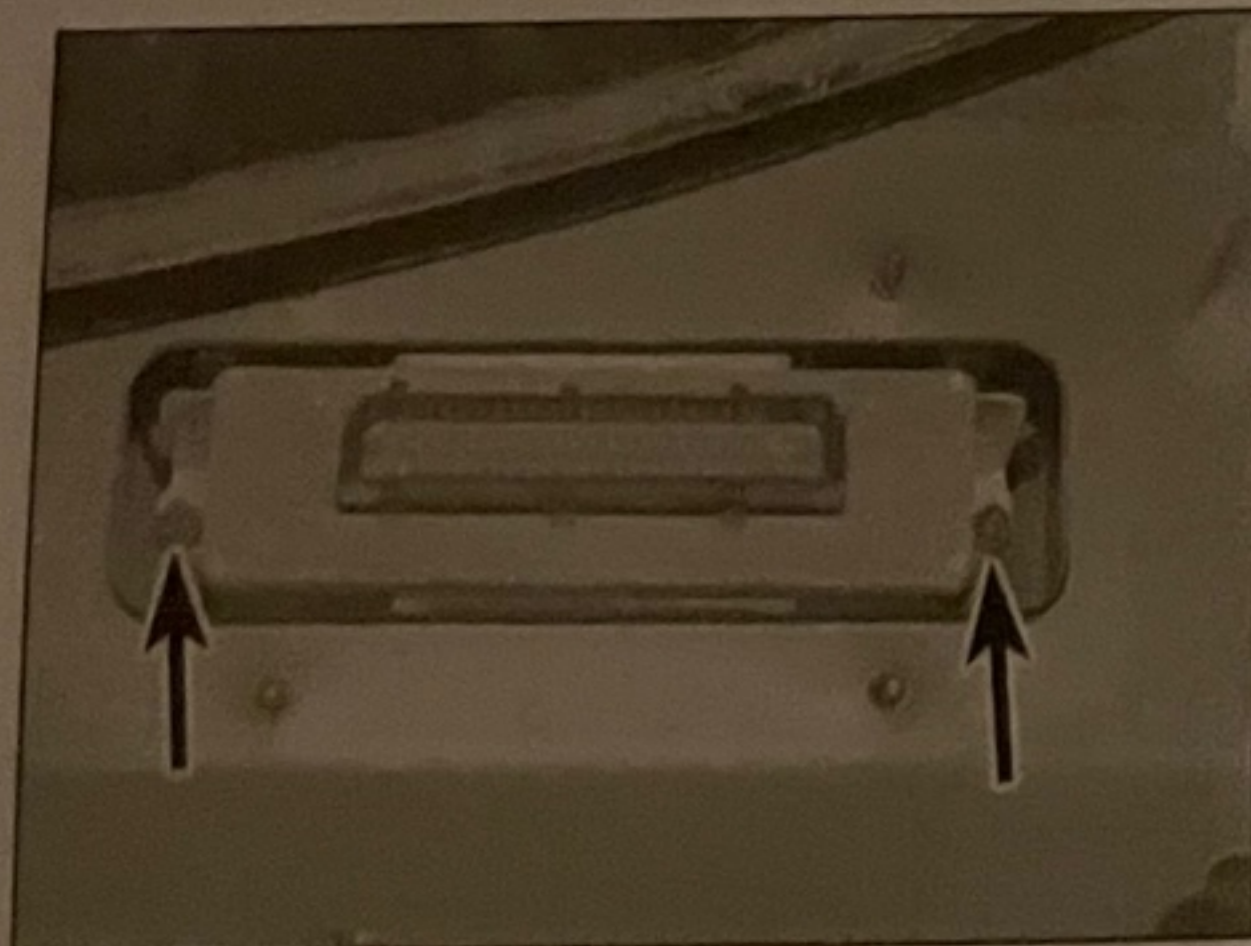
4 If the Check Engine warning light comes on, the car should be taken to a Saab dealer at the earliest opportunity. A complete test of the engine management system can then be carried out, using dedicated Saab electronic diagnostic test equipment.



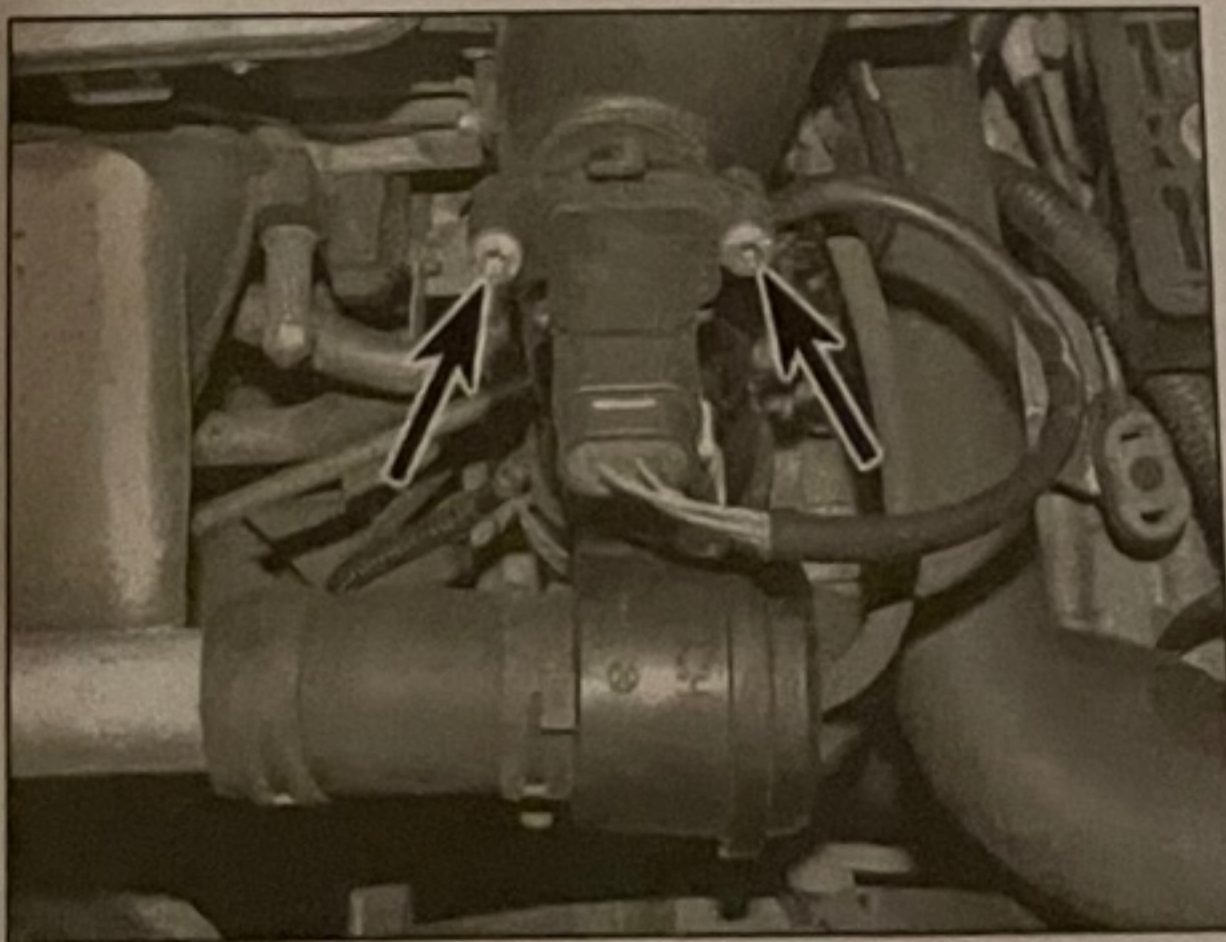
14.3 Undo the four retaining nuts (arrowed)



14.4 Unclip the multiplug wiring connector from the control module

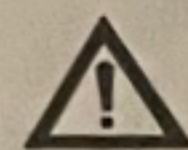


14.5 Undo the two retaining nuts (arrowed) to withdraw the ECM



14.8 Disconnect the wiring plug, then undo the two retaining screws (arrowed)

14 Engine management system components – removal and refitting



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

Electronic Control Module (ECM) Removal

1 Ensure that the ignition is switched off. Disconnect the battery negative cable and position it away from the terminal.

2 Remove the windscreen wipers and the windscreen lower scuttle panel as described in Chapter 12.

3 Undo the retaining nuts from the ECM module cover inside the scuttle panel (see illustration).

4 Carefully lift the cover, release the locking lever and disconnect the multiplug connector from the control module (see illustration).

5 Undo the two retaining nuts (a magnetic socket will be useful for this) and withdraw the ECM straight up from the vehicle (see illustration).

Refitting

6 Refitting is a reversal of removal. Ensure that the wiring harness multiway connector is secured with the locking lever. Note that if a new ECM has been fitted, it will gradually 'learn' the engine's characteristics as the vehicle is driven. Driveability, performance and fuel economy may be slightly reduced during this period.

Charge air (boost) pressure/temperature sensor

Removal

7 The pressure/temperature sensor is located in the main air intake duct to the throttle housing.

8 Disconnect the wiring connector from the sensor, unscrew the sensor from the air intake duct, and recover the sealing washer (see illustration).

Refitting

9 Refitting is a reversal of removal, but ensure and if necessary renew any sealing washer.

Manifold absolute pressure sensor

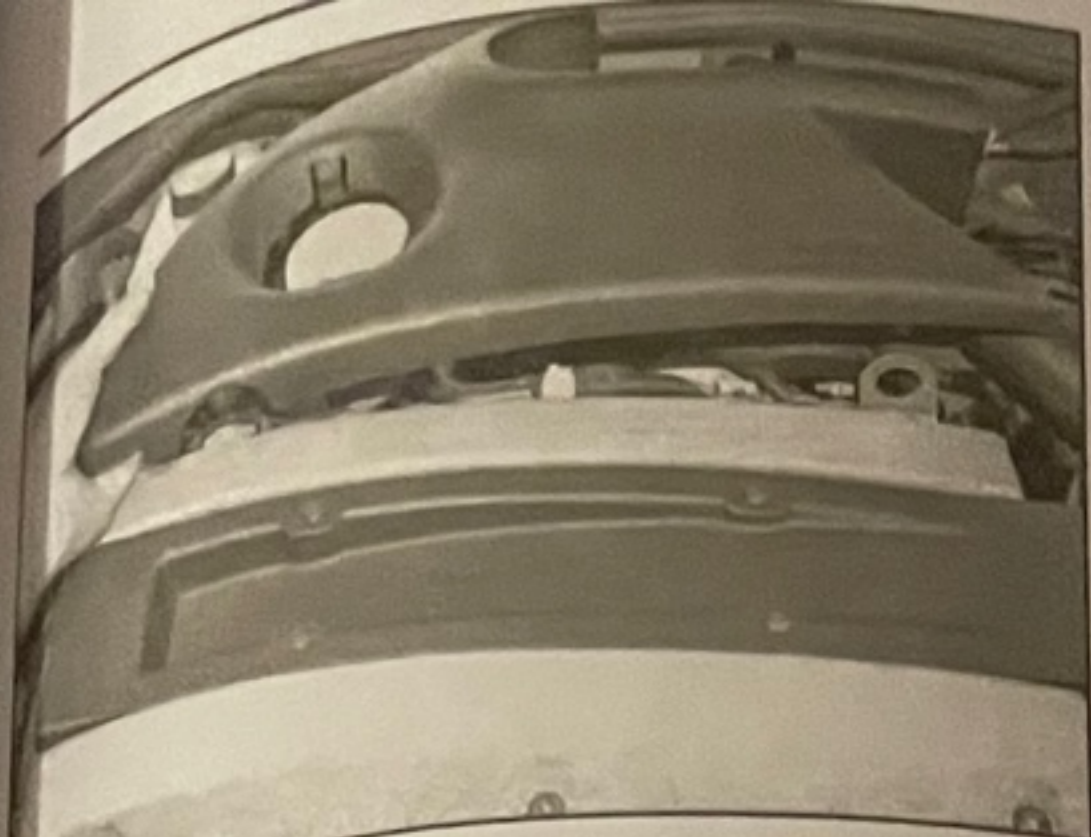
Removal

10 Unclip the engine upper cover panel above the intake manifold (see illustration).

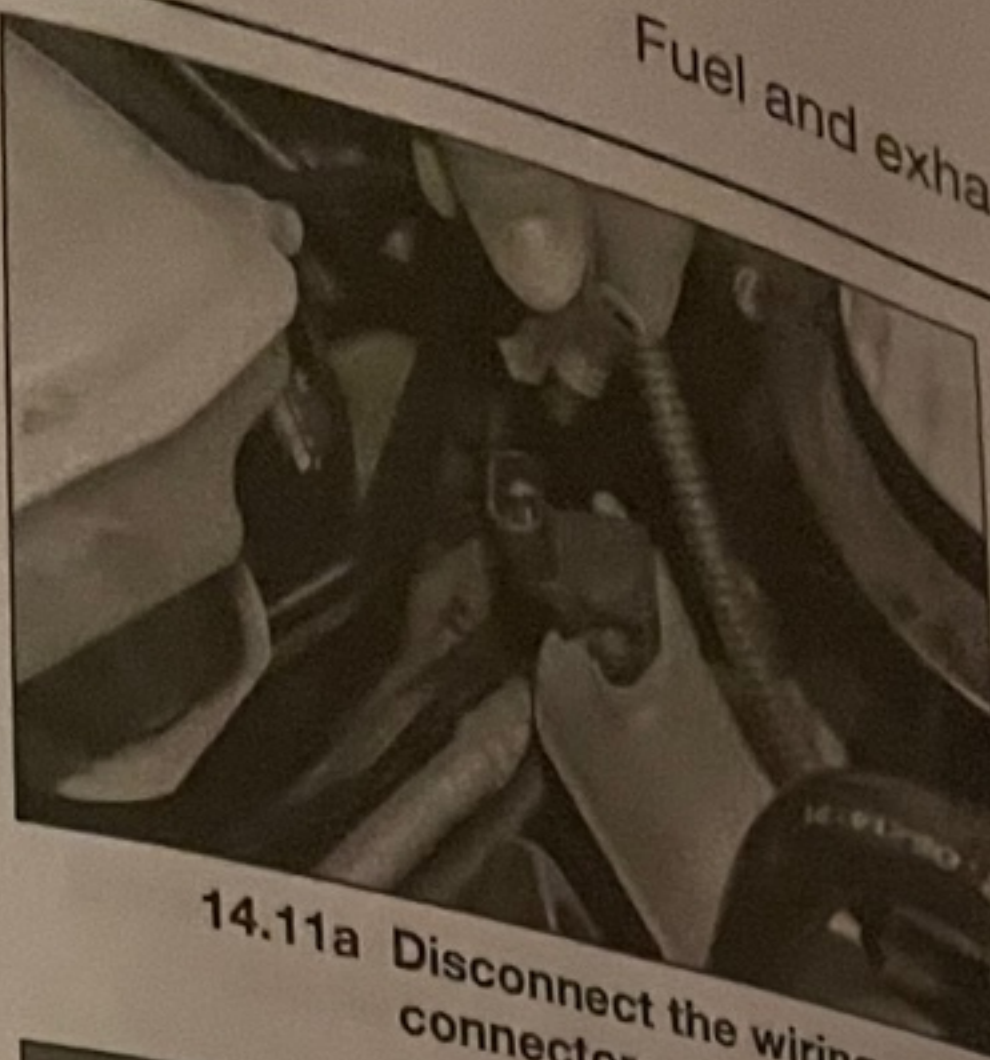
11 Disconnect the wiring plug, then remove the securing screws and withdraw the sensor from the intake manifold (see illustrations).

Refitting

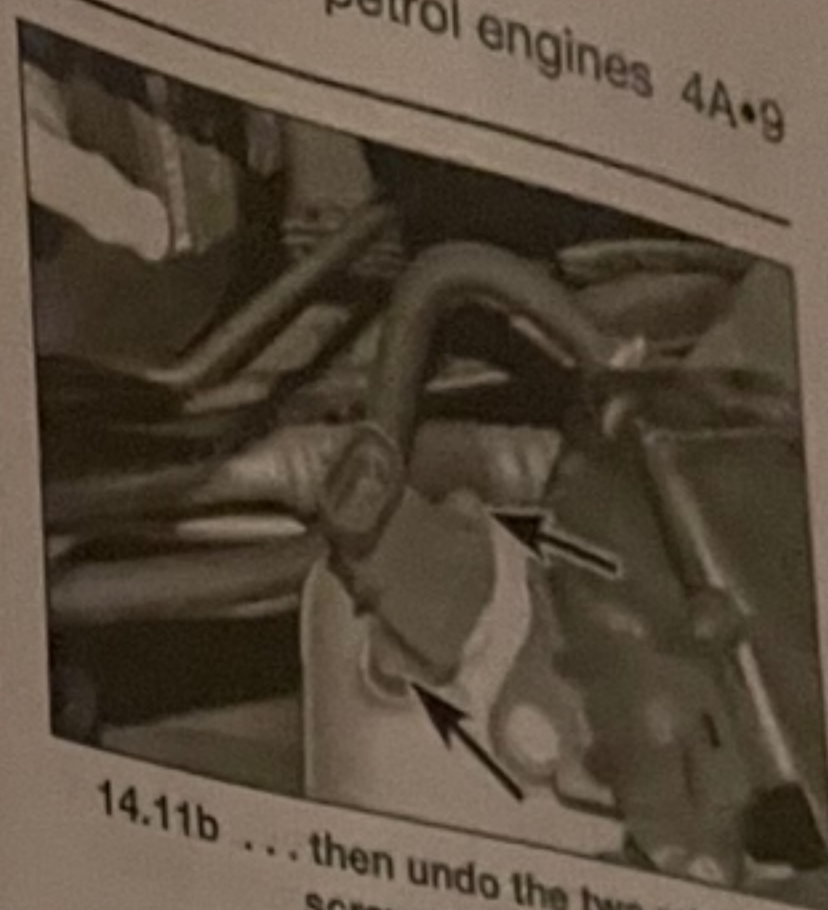
12 Refitting is a reversal of removal, but ensure and if necessary renew any sealing washer.



14.10 Removing the engine upper plastic cover



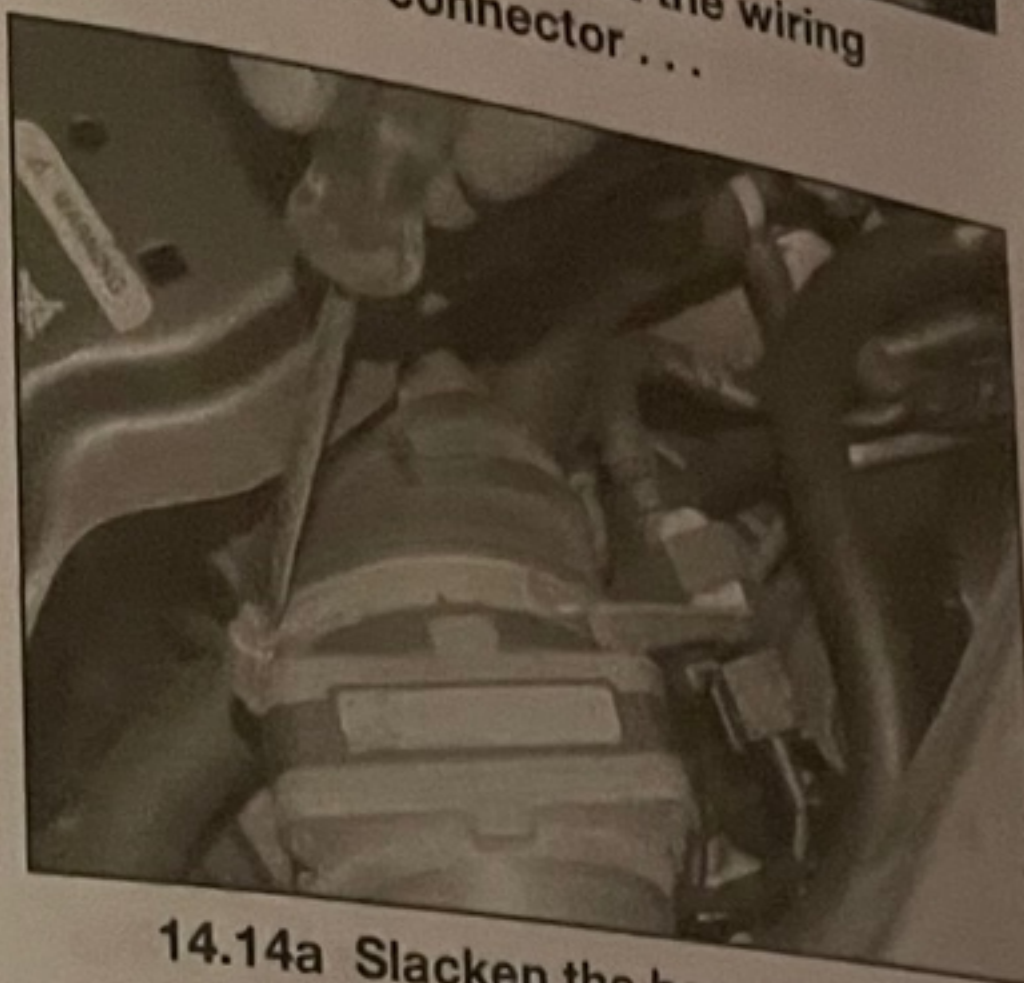
14.11a Disconnect the wiring connector ...



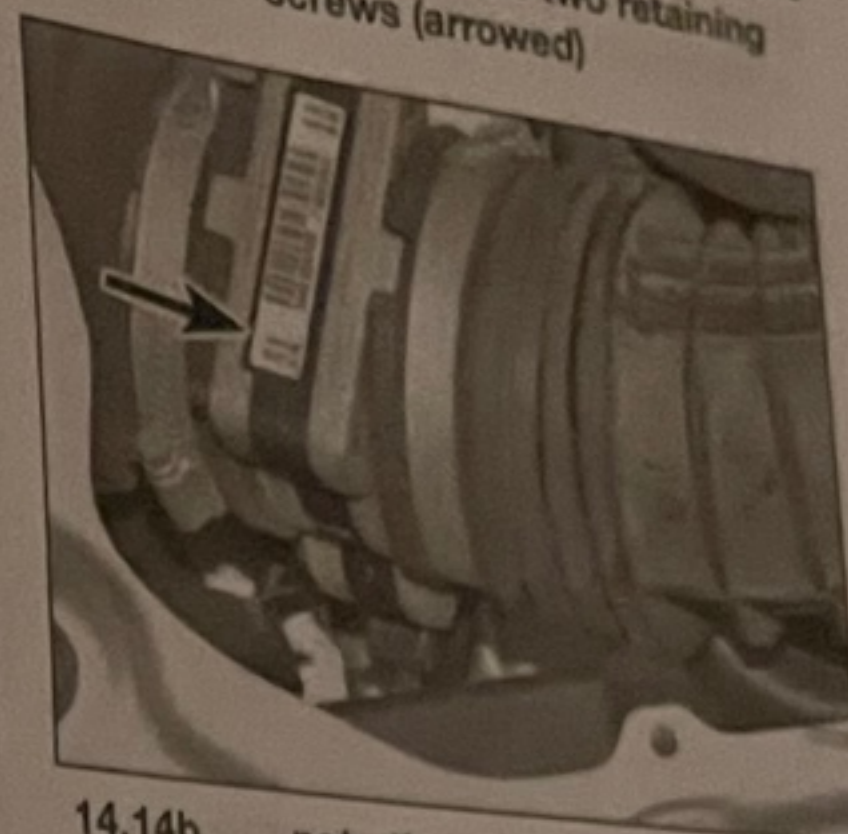
14.11b ... then undo the two retaining screws (arrowed)



14.13 Slacken the two retaining clips (arrowed)



14.14a Slacken the hose clip, and withdraw the airflow sensor ...



14.14b ... note the direction of the arrow

Mass airflow sensor

Removal

13 The mass airflow sensor is located in the right-hand front corner of the engine bay behind the right-hand headlamp unit. Slacken the two retaining clips and withdraw the rubber intake hose from the vehicle (see illustration).

14 Slacken the hose clip on the intake hose and withdraw the airflow sensor. Note the direction of the arrow on the sensor; this is for the correct direction of the airflow (see illustrations).

15 Disconnect the wiring connector from the bottom of the sensor as it is removed (see illustration).

Refitting

16 Refitting is a reversal of removal, but check

that the arrows on the sensor are pointing in the direction of flow and the wiring connector is secure.

Coolant temperature sensor

Removal

17 The sensor is threaded into the left-hand side of the cylinder head. Ensure that the engine is completely cold, and then release the pressure in the cooling system by removing and then refitting the expansion tank filler cap (see *Weekly checks*).

18 To make access easier, it may be necessary to slacken the hose clips and remove the air intake assembly from the top of the throttle body.

19 Unplug the wiring connector from the sensor (see illustration).

20 Unscrew the sensor from the coolant

housing on the left-hand end of the cylinder head. Be prepared for some coolant loss (see illustration).

Refitting

21 Clean the threads, then insert the sensor into the intake manifold, and tighten securely. Fit new sealing washer if necessary.

22 Ensure that the wiring connector is securely refitted.

23 Top-up the cooling system with reference to *Weekly checks*.

Crankshaft position sensor

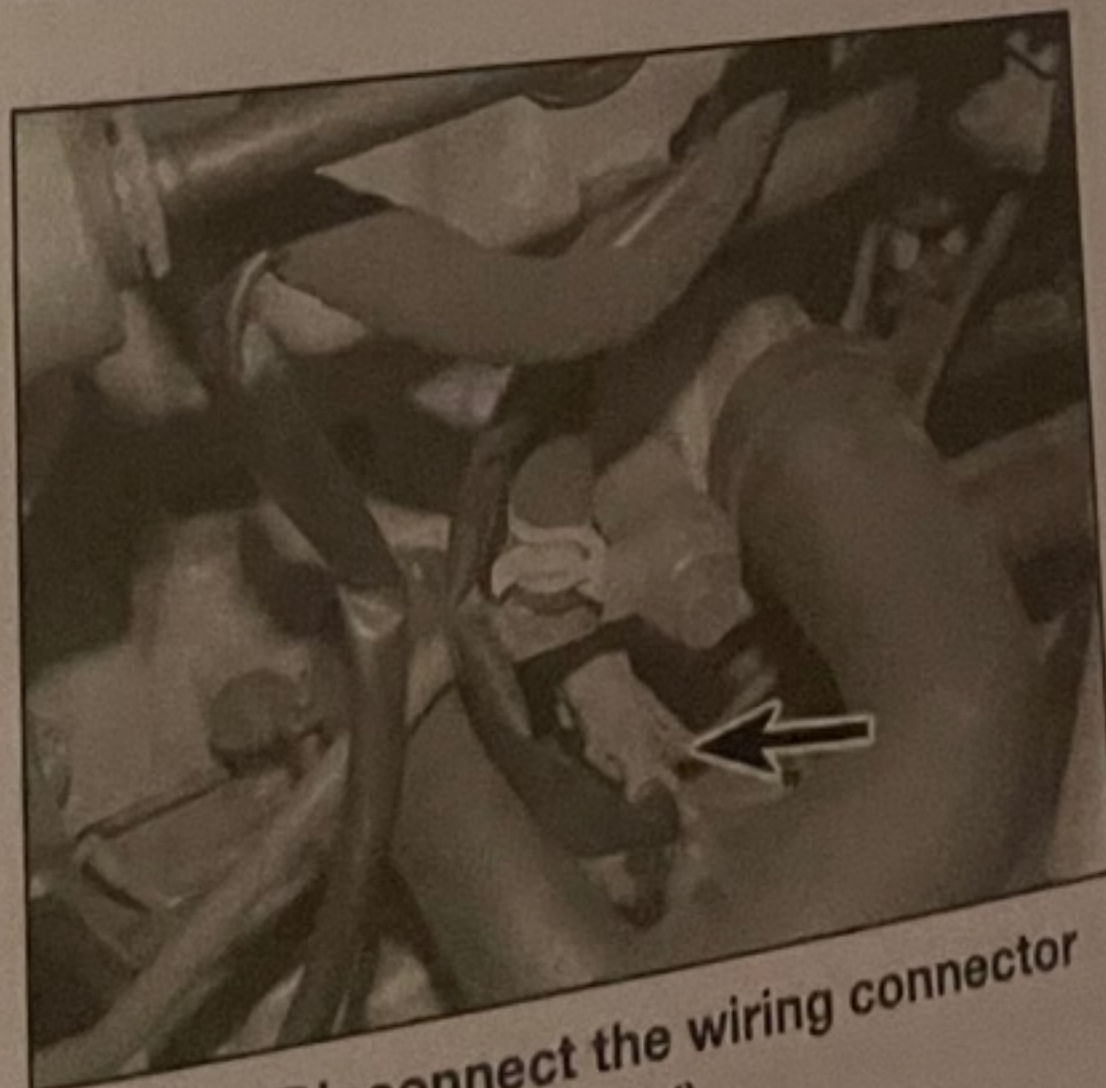
Removal

24 The crankshaft position sensor is located on the front surface of the cylinder block, at the transmission end (see illustration).

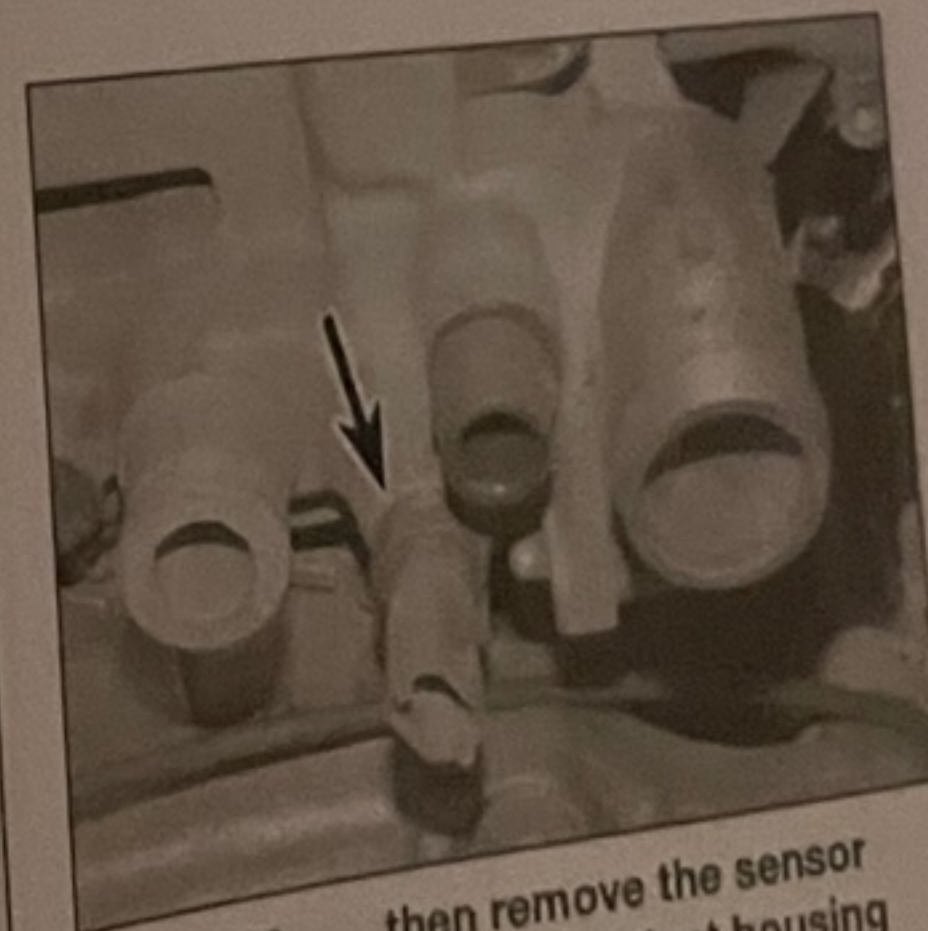
25 Undo the retaining nut and unclip the heat



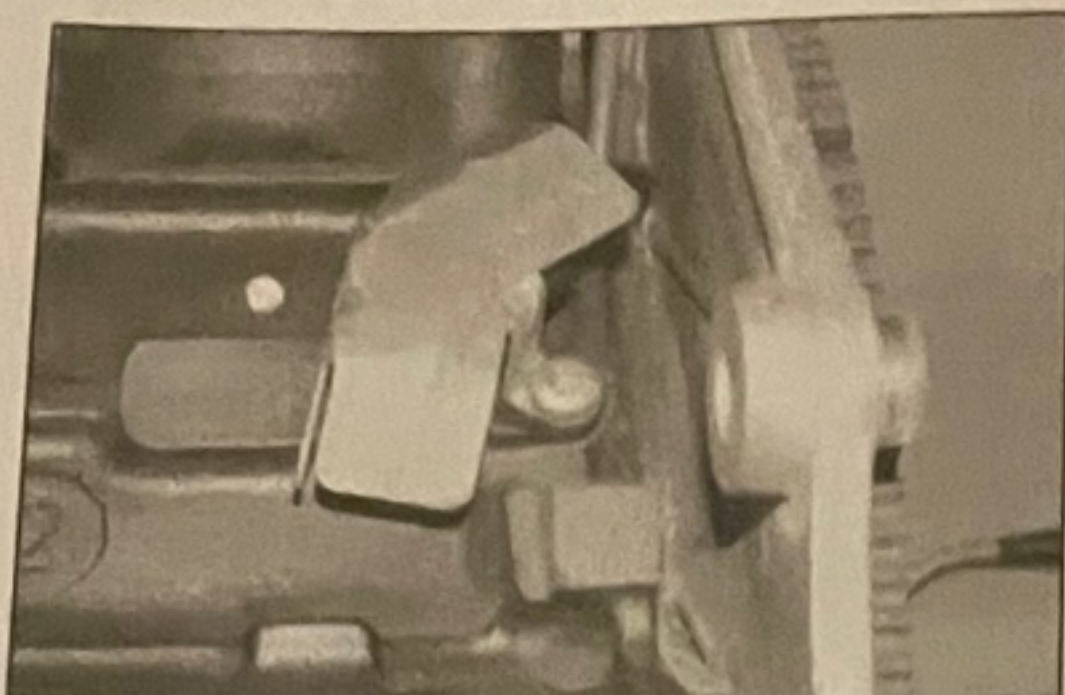
14.15 Disconnecting the wiring connector as the sensor is withdrawn



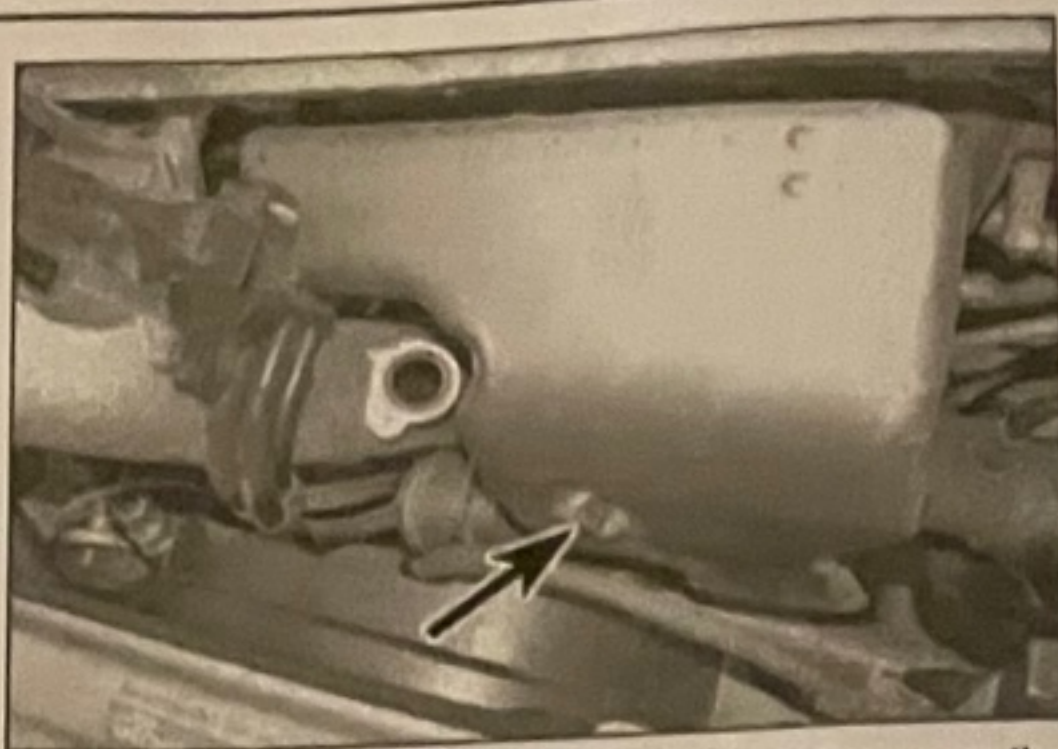
14.19 Disconnect the wiring connector (arrowed) ...



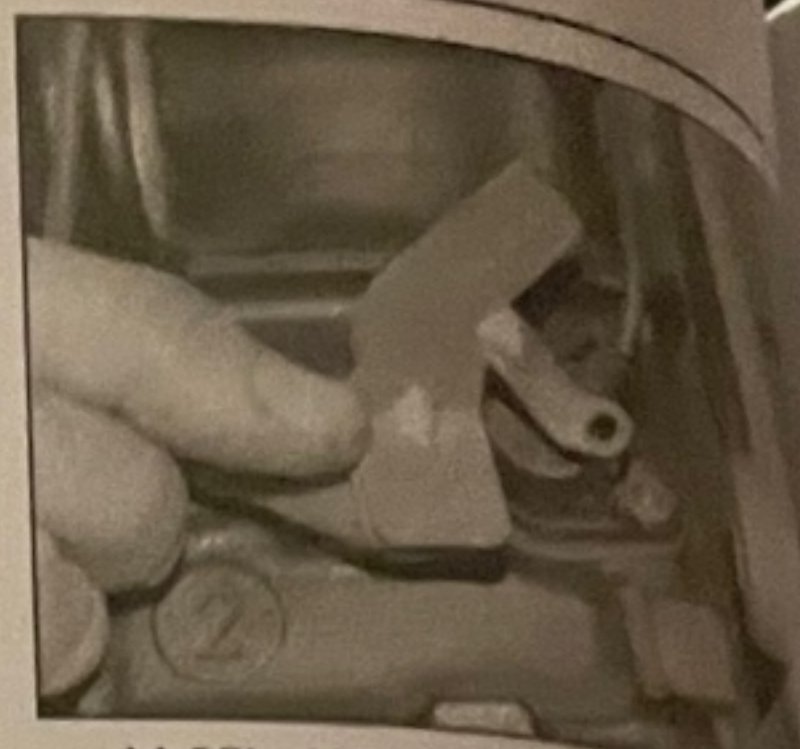
14.20 ... then remove the sensor (arrowed) from the coolant housing



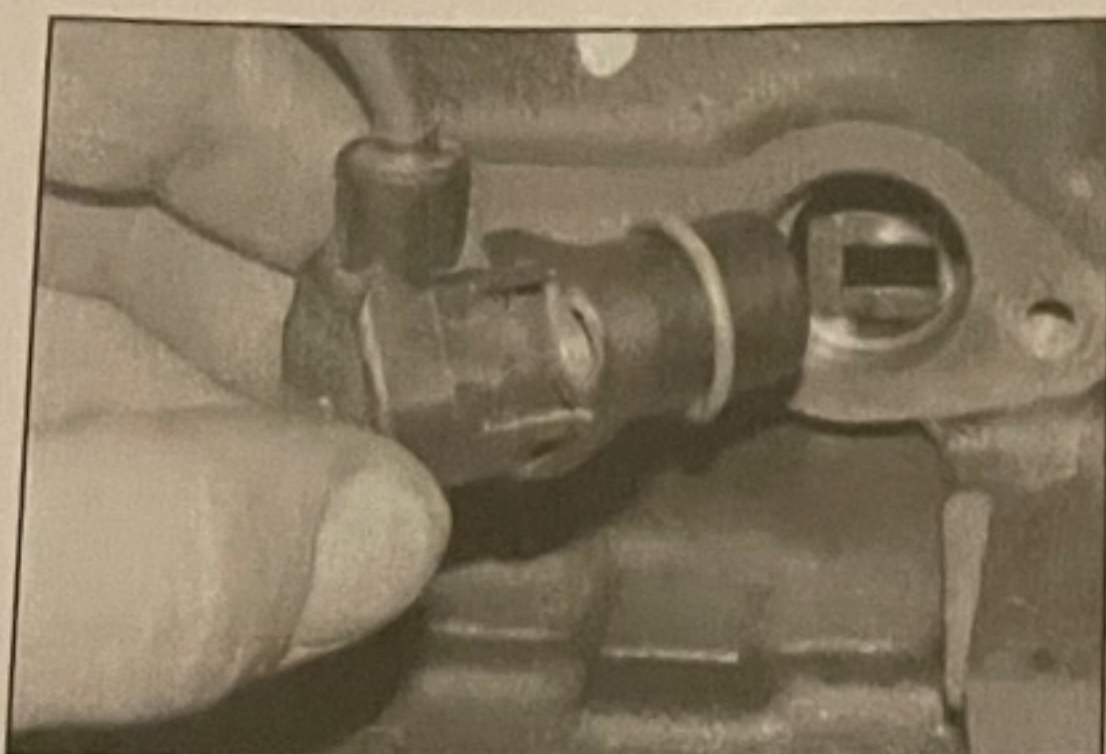
14.24 Crankshaft sensor is located behind a shield on the front of the cylinder block



14.25a Undo the retaining nut (arrowed) and remove the heat shield



14.25b Undo the retaining screw and remove the sensor shield

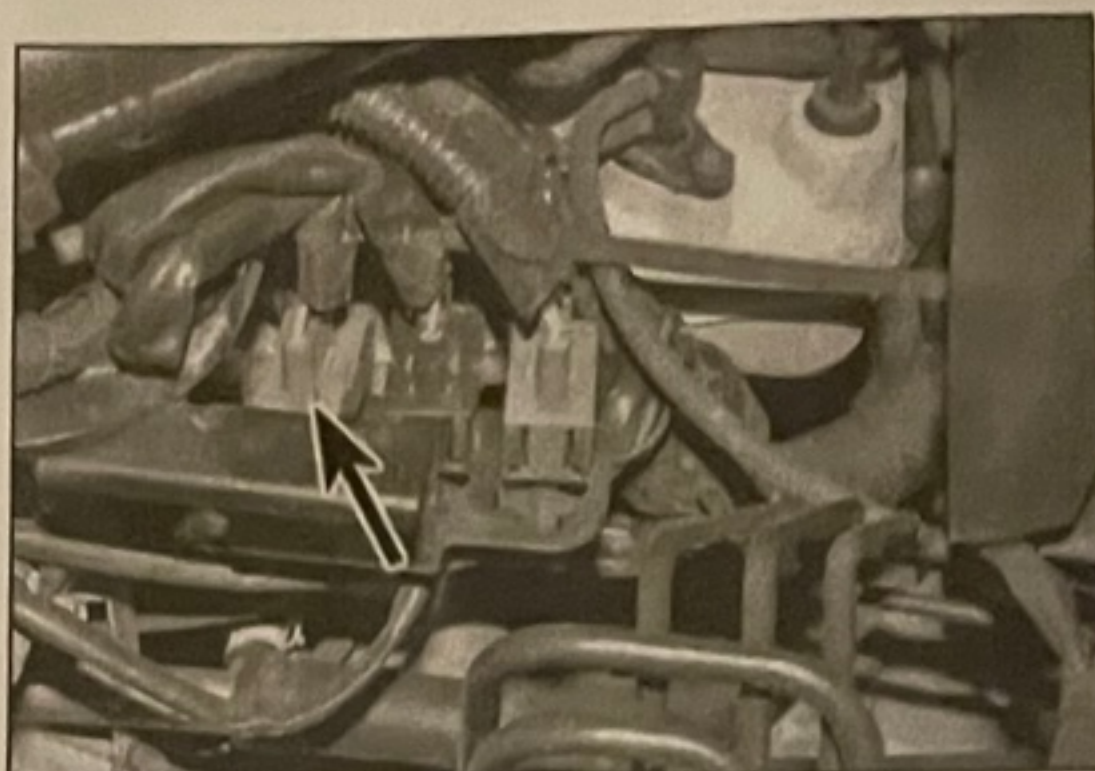


14.26 Withdraw the sensor and recover the O-ring

shield from the exhaust manifold, then undo the securing bolt and remove the shield/cover from the sensor (see illustrations).



Warning: The exhaust system and turbocharger may be hot.



14.27a Wiring plug connector location (arrowed)

26 Withdraw the sensor from its location on the front left-hand side of the cylinder block (see illustration). Recover the O-ring, noting how it is fitted. Clean the seating in the cylinder block.



14.27b Pull out locking clip (arrowed) disconnect the wiring plug connector

27 Note the routing of the wiring around the left-hand end of the cylinder head, and disconnect the wiring at the connector (see illustrations). Release the wiring from retaining clips along its length.

Refitting

28 Refitting is a reversal of removal, ensure that the O-ring is properly seated. Tighten the sensor retaining screw securely. Ensure the wiring is retained with the clips/cable following its original routing, and that the multiway connector is securely reconnected.

Throttle body

Removal

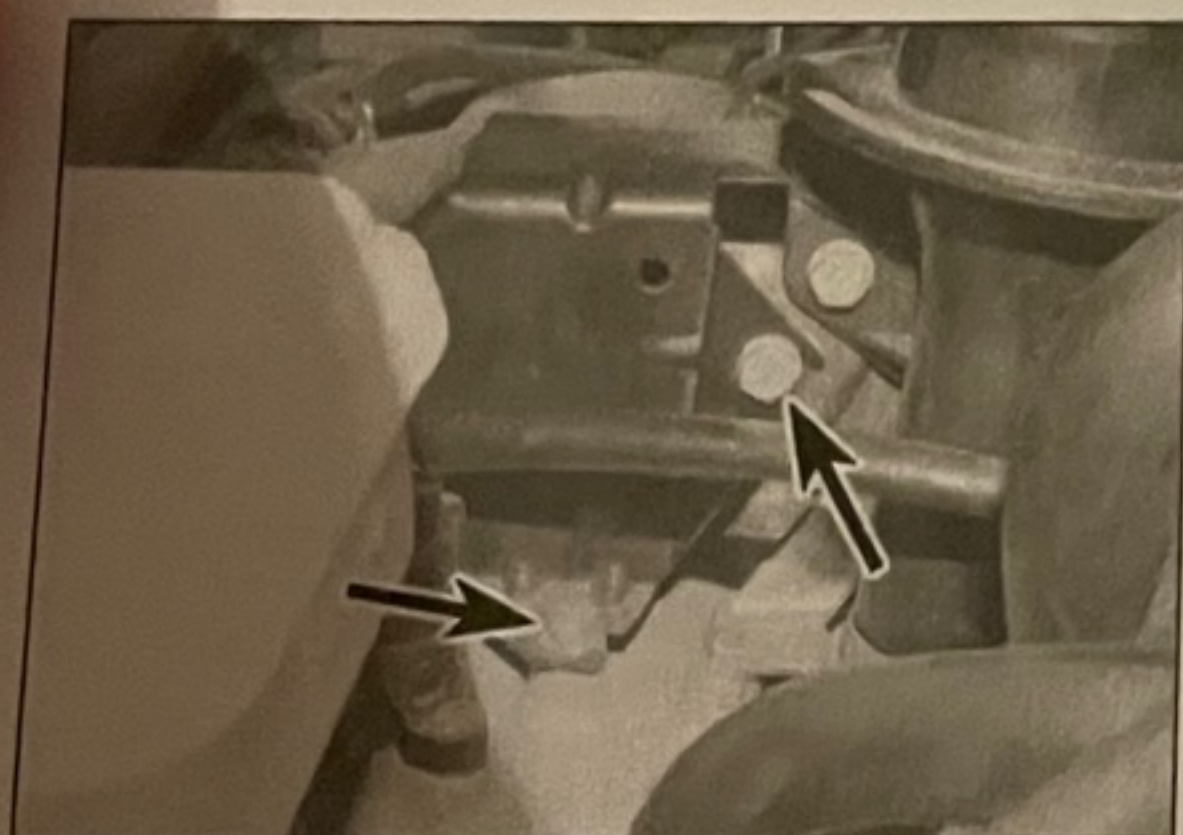
29 Ensure that the ignition switch is turned to the OFF position. Making sure the engine is completely cold; release the pressure in the cooling system by removing and then refitting the expansion tank filler cap (see Warning checks).

30 Unclip the engine upper cover panel from the top of the throttle body, then undo the retaining bolts and remove the cover from the throttle linkage (see illustration).

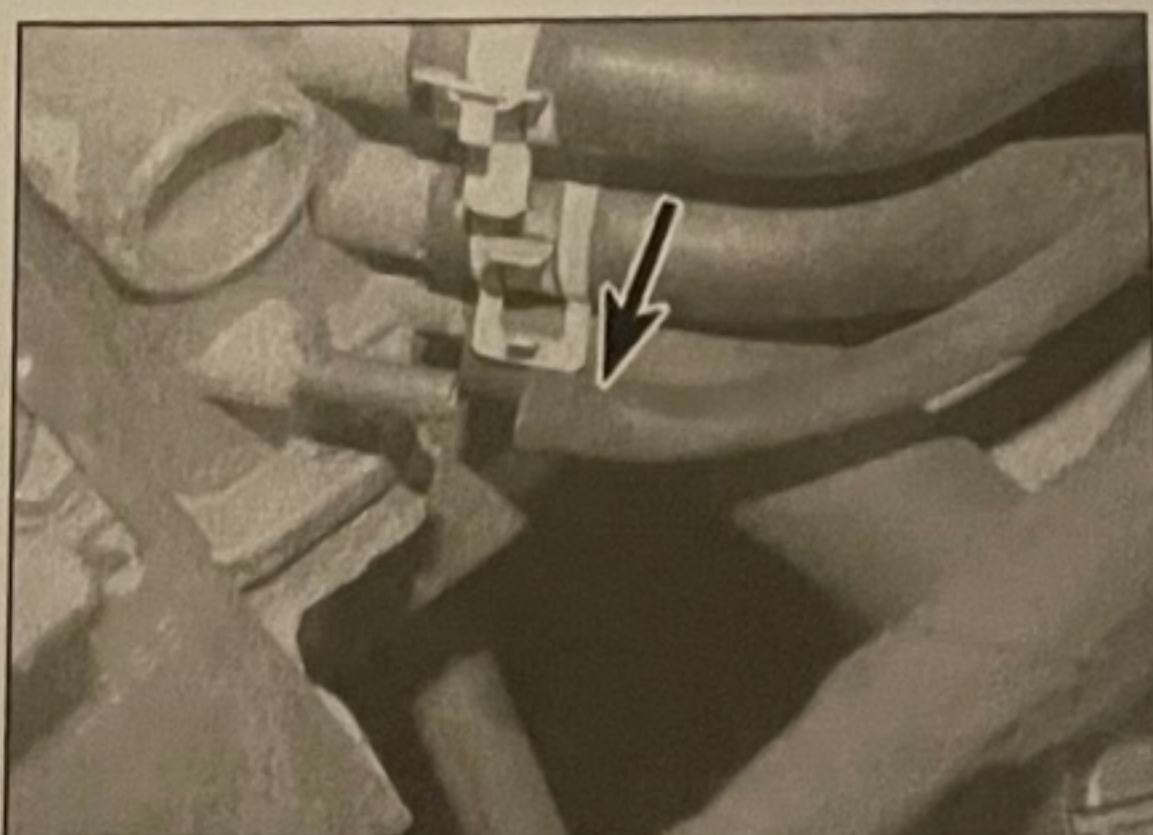
31 Remove the lower vacuum hose from the throttle body (see illustration).

32 Clamp the two coolant hoses that are connected to the throttle body, and then release the retaining clips and disconnect the hoses (see illustrations).

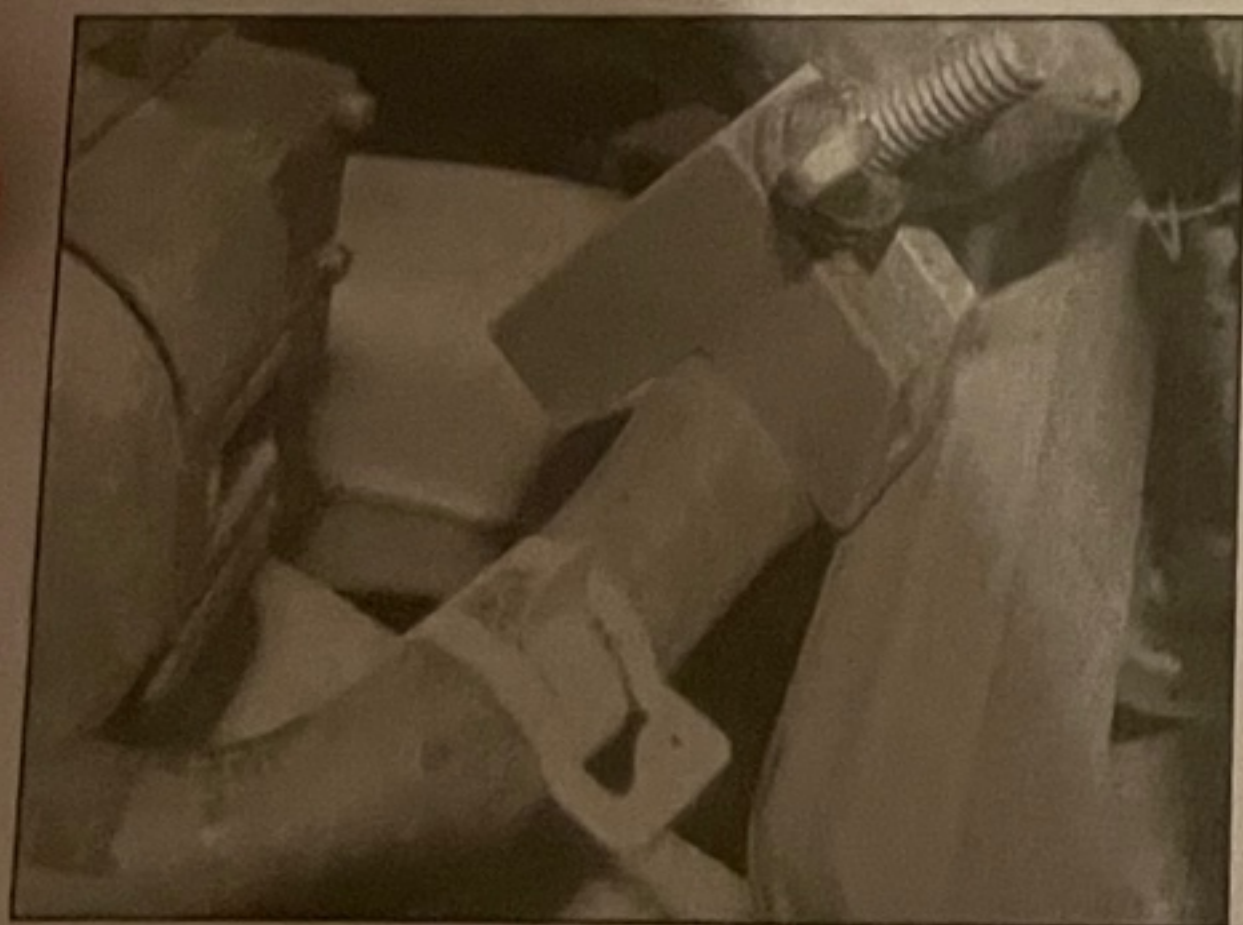
33 Remove the air bypass hose from the lower part of the throttle body. Slacken the securing clip and disconnect the hose at the rear of the throttle body, below the limp home solenoid (see illustration).



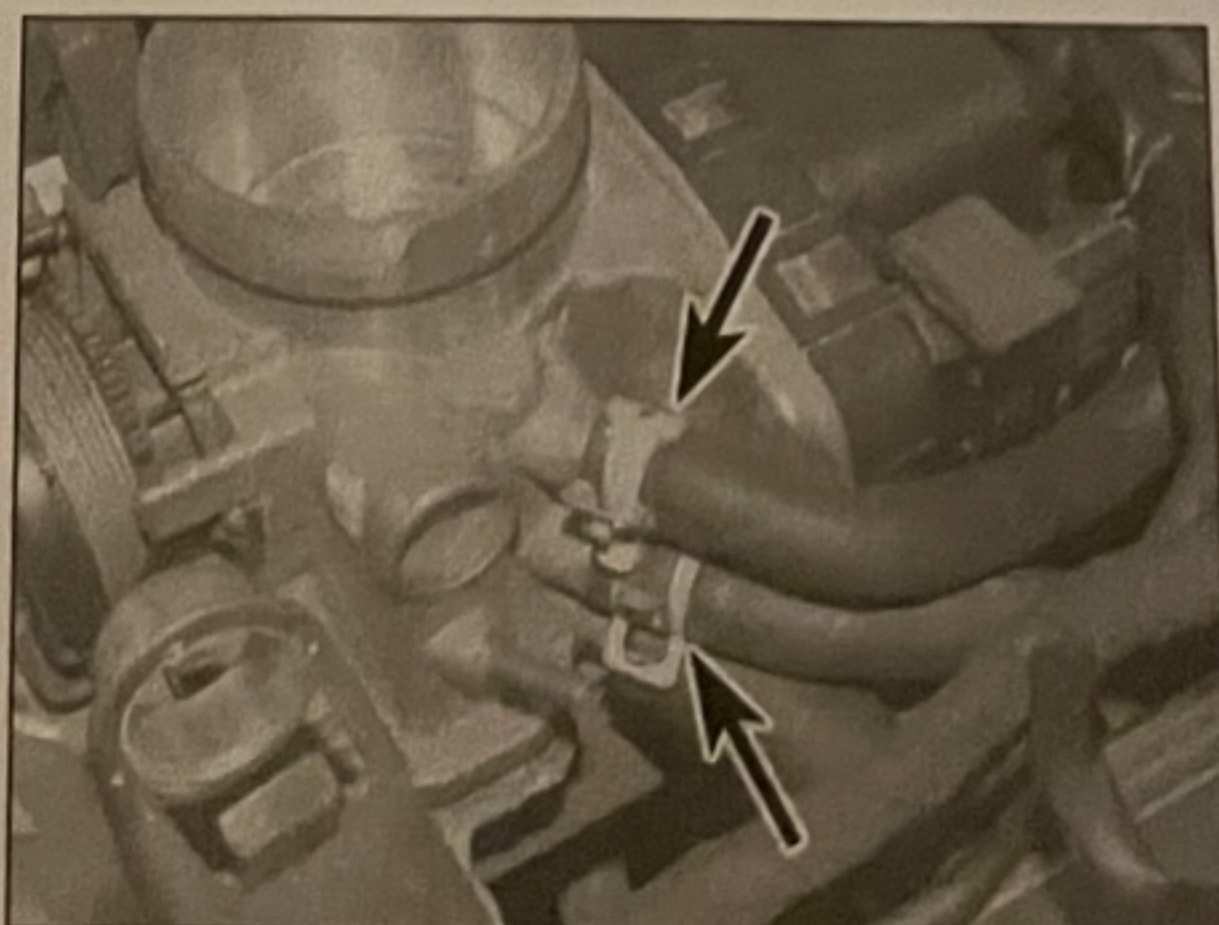
14.30 Undo the retaining bolts (arrowed) and remove the cover



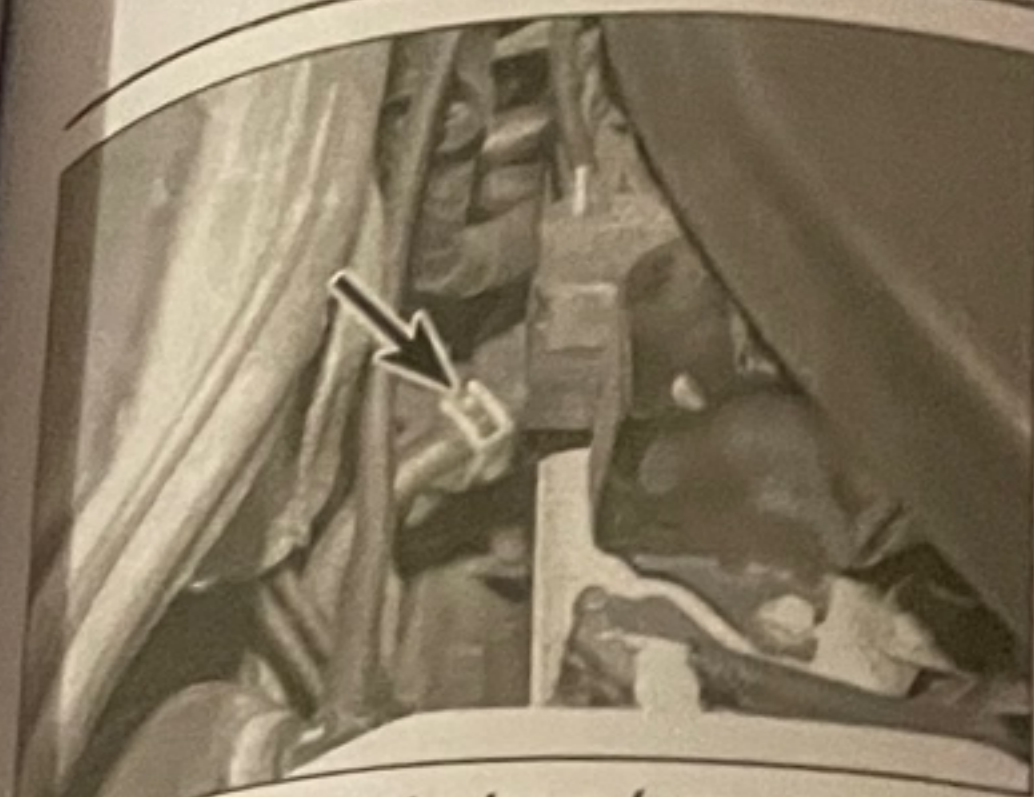
14.31 Disconnect the vacuum hose (arrowed)



14.32a Clamp the coolant hoses ...



14.32b ... then release the securing clips (arrowed) and disconnect the coolant hoses



14.33 Disconnect the hose (arrowed) from the rear of the throttle body



14.35 Disconnecting the wiring plug from the limp-home solenoid

34 Undo the retaining bolt on the front of the cylinder head for the turbocharger delivery pipe. Slacken the retaining clip and carefully lift the delivery pipe from the top of the throttle body (see illustrations).

35 Unclip the accelerator inner cable from the throttle linkage, then remove the rubber cover and disconnect the wiring connector from the limp-home solenoid on the back of the throttle body (see illustration).

36 Disconnect the 10-pin multiplug connector from the side of the throttle body (see illustration).

37 Undo the three retaining bolts and remove the throttle body from the intake manifold (see illustration).

Refitting

38 Refitting is a reversal of removal. Renew the seal if necessary and ensure that all connections are secure.

Fuel supply rail, injectors and pressure regulator

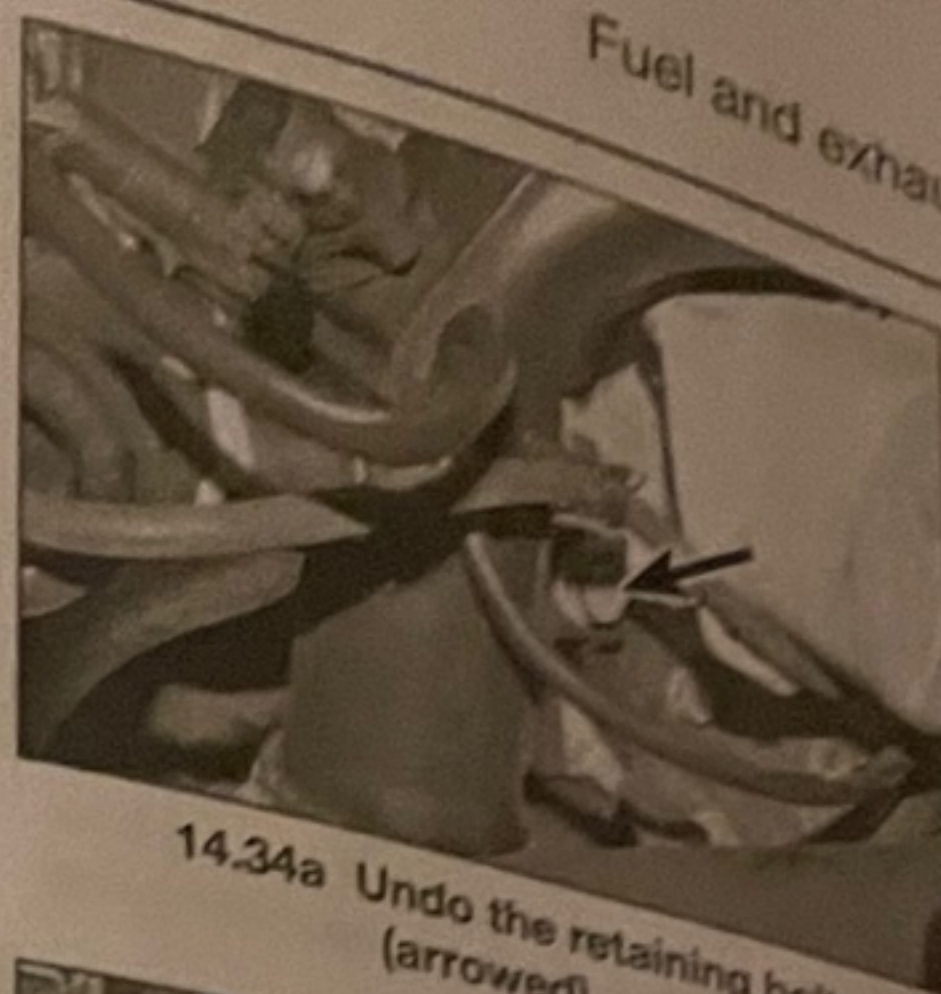
Removal

39 Depressurise the fuel system as described in Section 8. Ensure that the ignition switch is then turned to the OFF position.

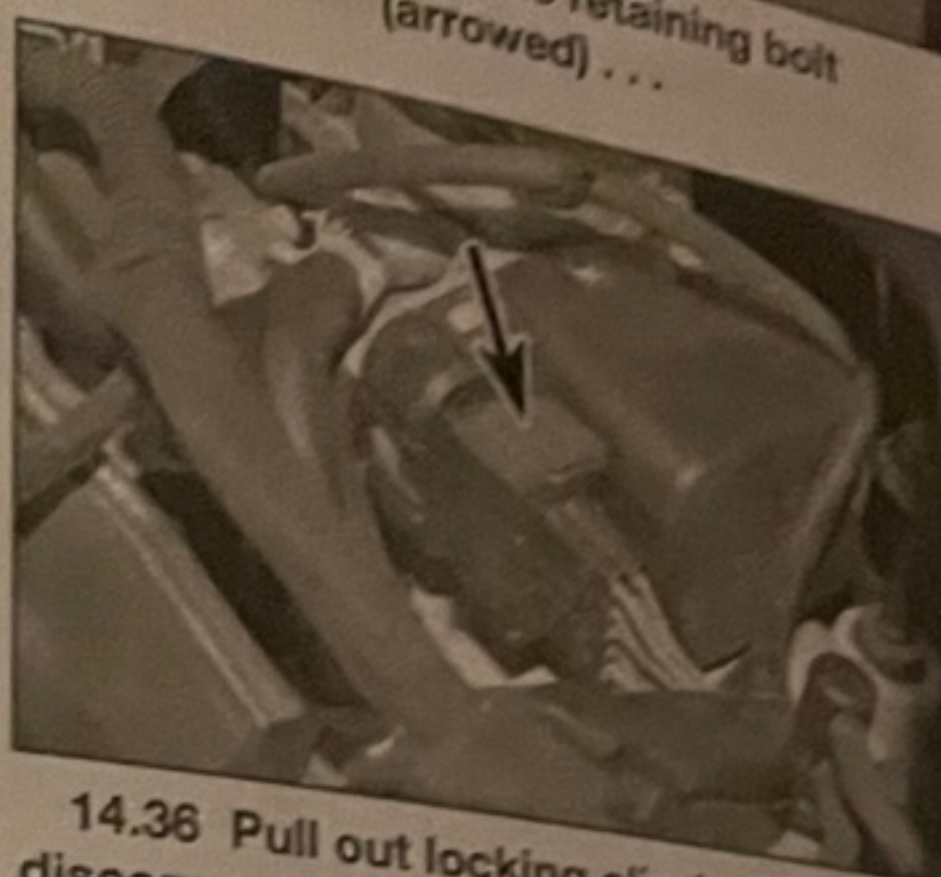
40 Unclip the engine upper cover panel from the top of the throttle body.

41 Release the securing clip and disconnect the crankcase breather hose from the cylinder head cover (see illustration).

42 Unbolt the dipstick/filler tube from the rear of the cylinder head and remove (see illustrations). Plug the pipe to prevent dirt entering the engine.

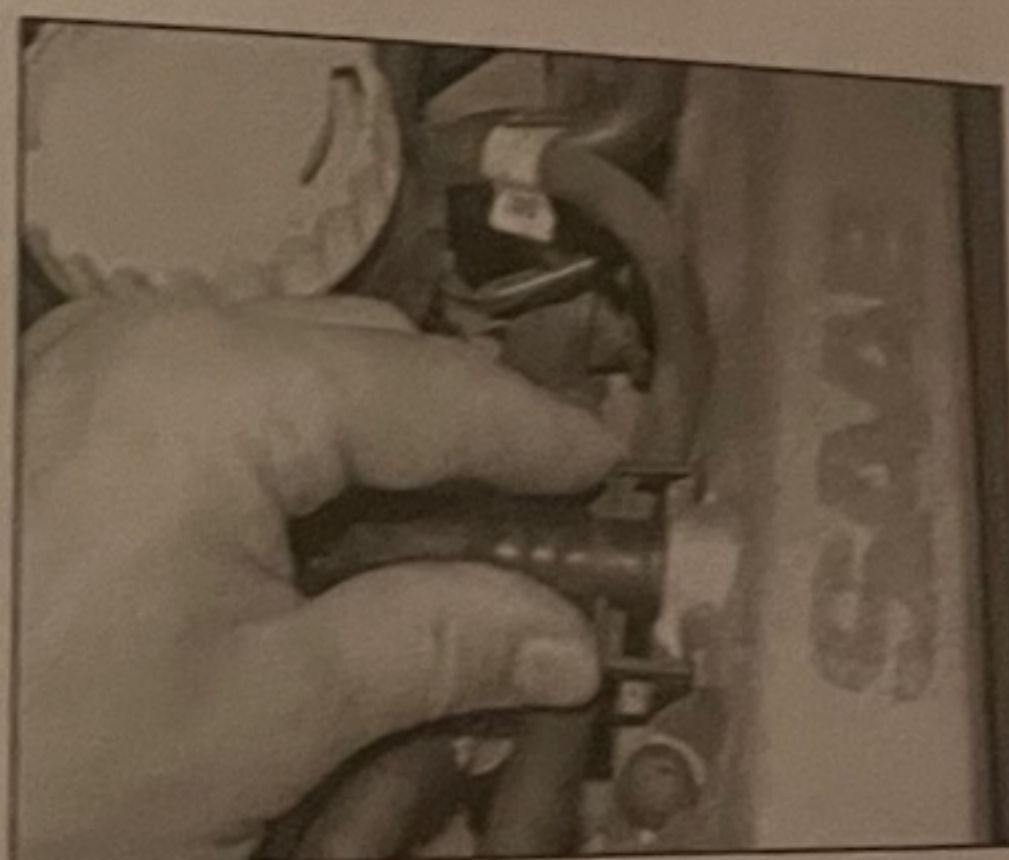


14.34a Undo the retaining bolt (arrowed) ...

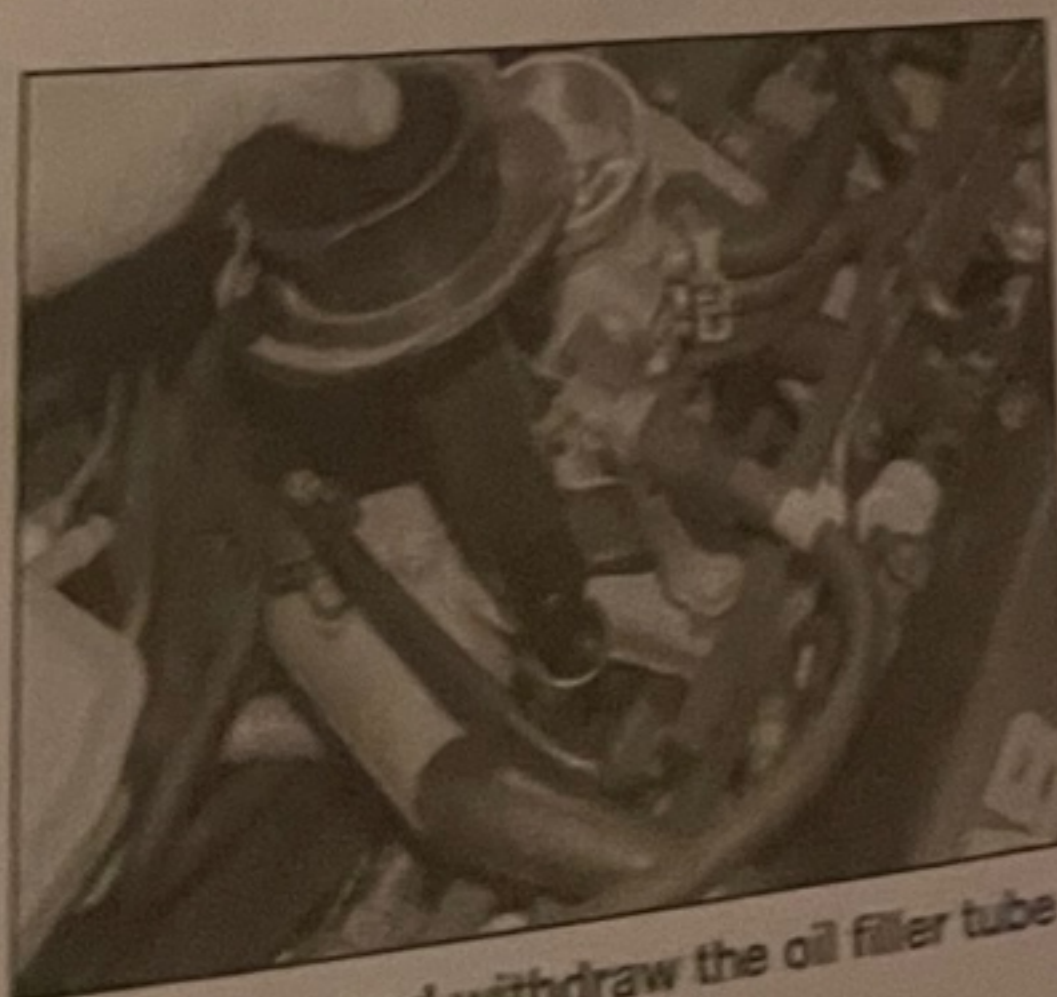


14.36 Pull out locking clip (arrowed) to disconnect the wiring plug connector from the throttle body

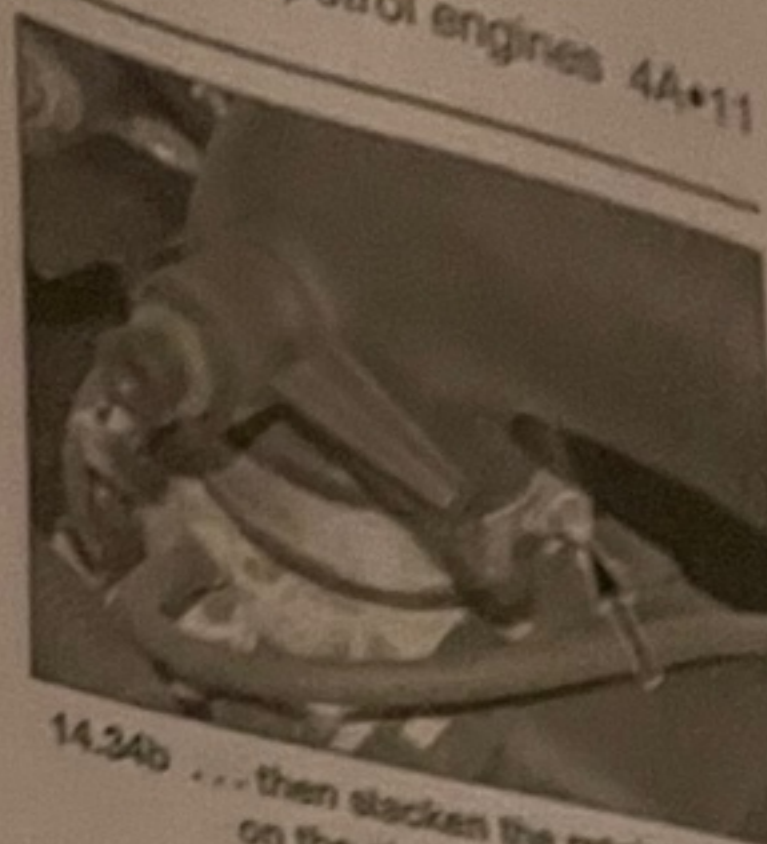
43 Refer to Section 3 and disconnect the accelerator cable from the throttle body. Disconnect the quick-release fuel lines from the fuel rail, fit caps to the open fuel lines to prevent ingress of dirt (see illustration).



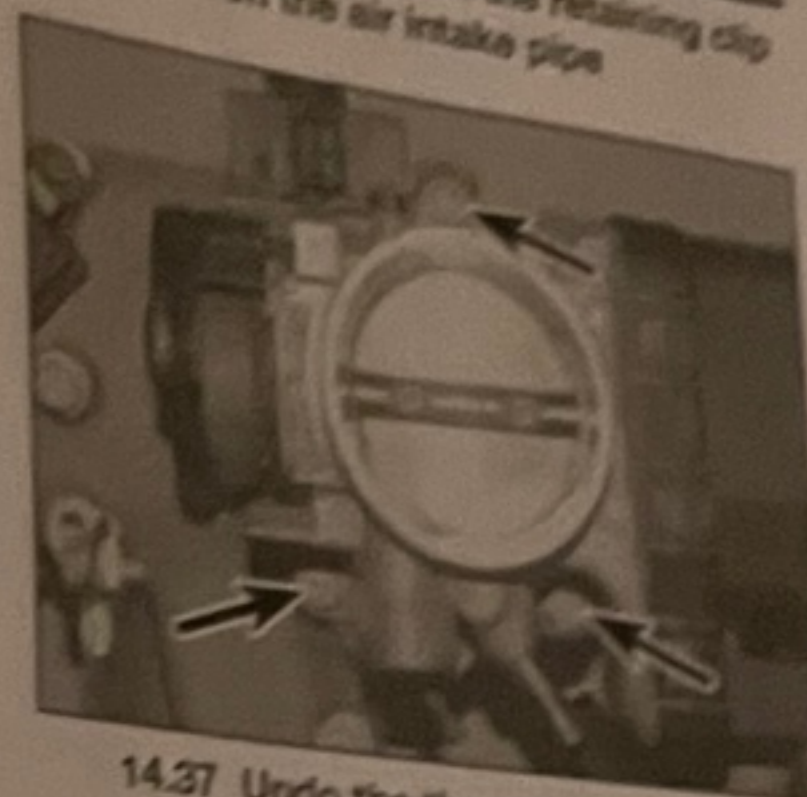
14.41 Disconnect the breather hose from the cylinder head cover



14.42b ... and withdraw the oil filler tube



14.34b ... then slacken the retaining clip on the air intake pipe

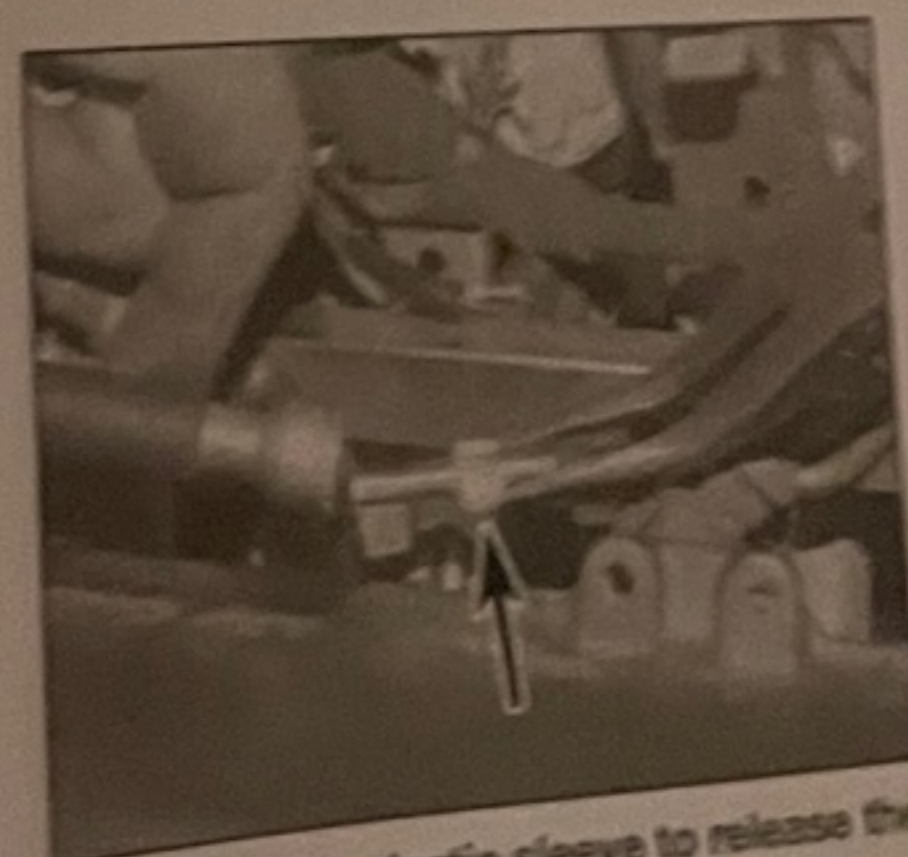


14.37 Undo the three throttle body retaining bolts (arrowed)

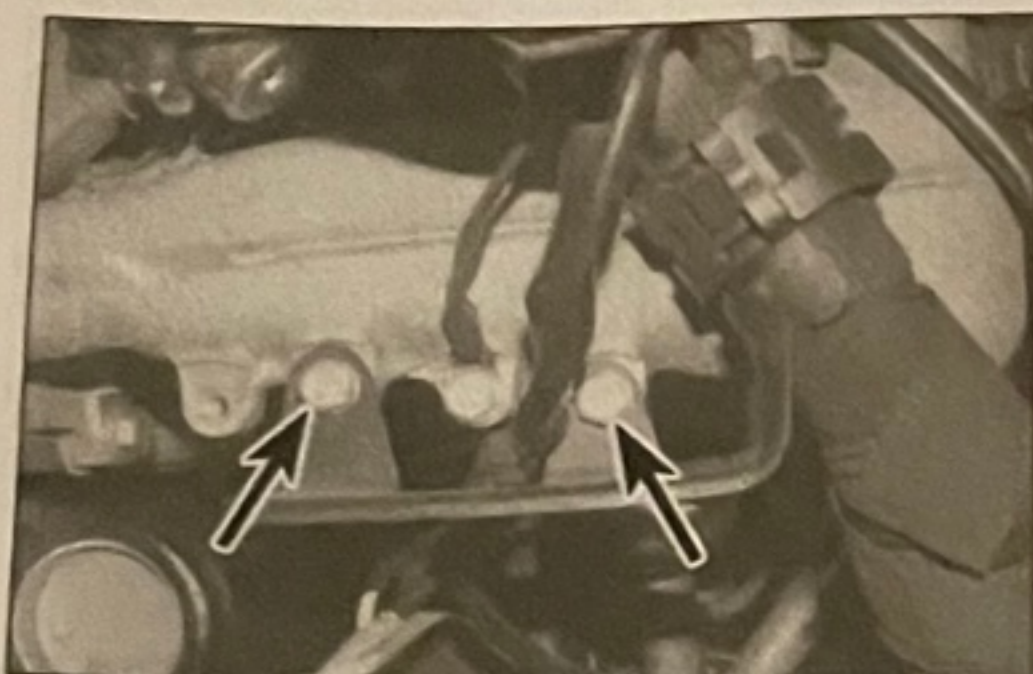
44 Undo the retaining bolt on the front of the cylinder head for the turbocharger delivery pipe. Slacken the retaining clip and carefully lift the delivery pipe from the top of the throttle body (see illustrations 14.34a and 14.34b).



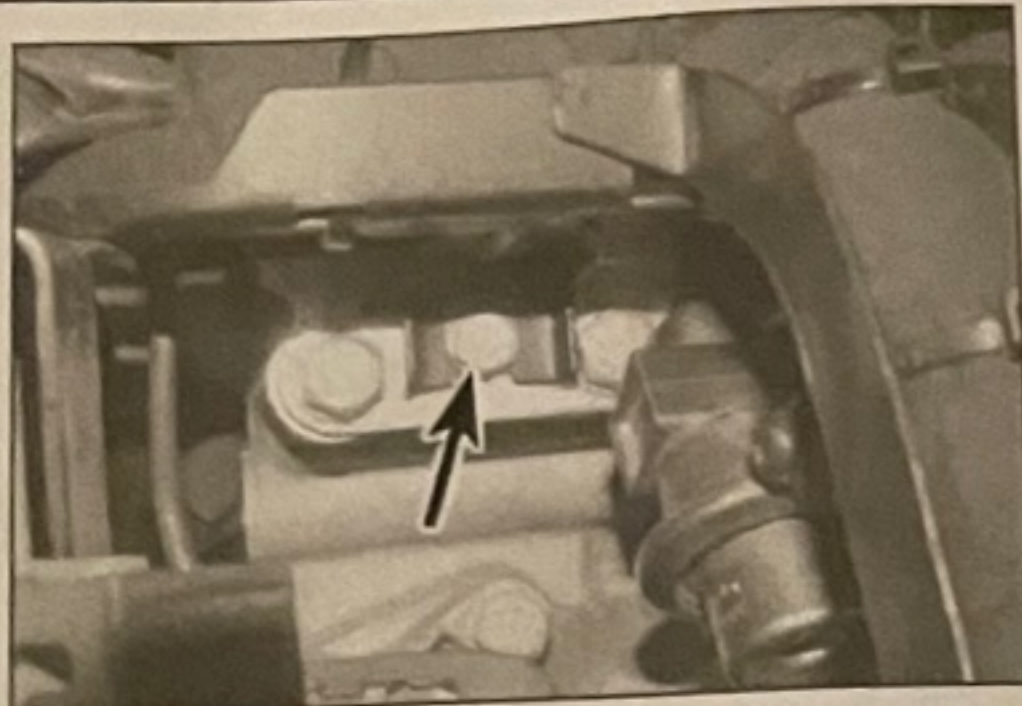
14.42a Undo the retaining bolt (arrowed) ...



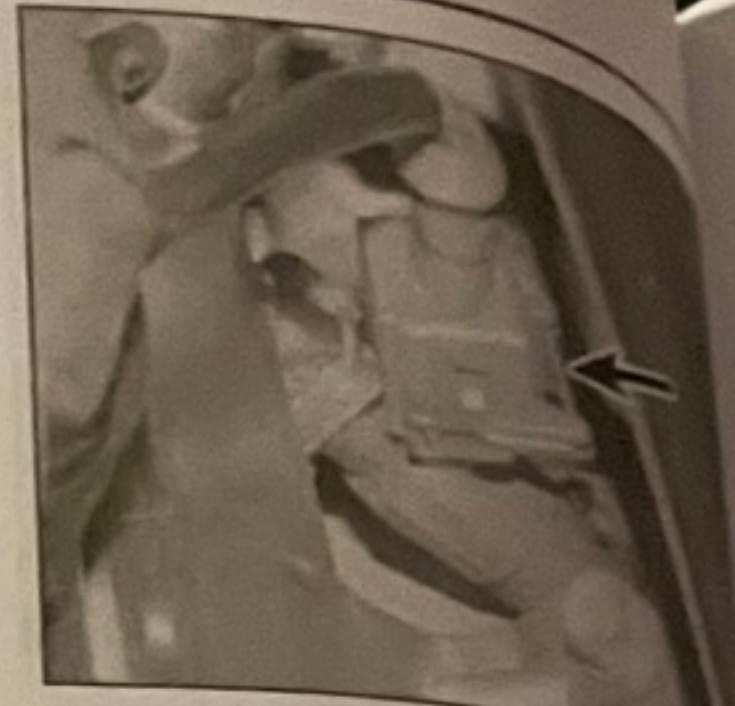
14.43 Using a plastic sleeve to release the securing clips on the fuel lines



14.45a Undo the two lower retaining bolts (arrowed) ...



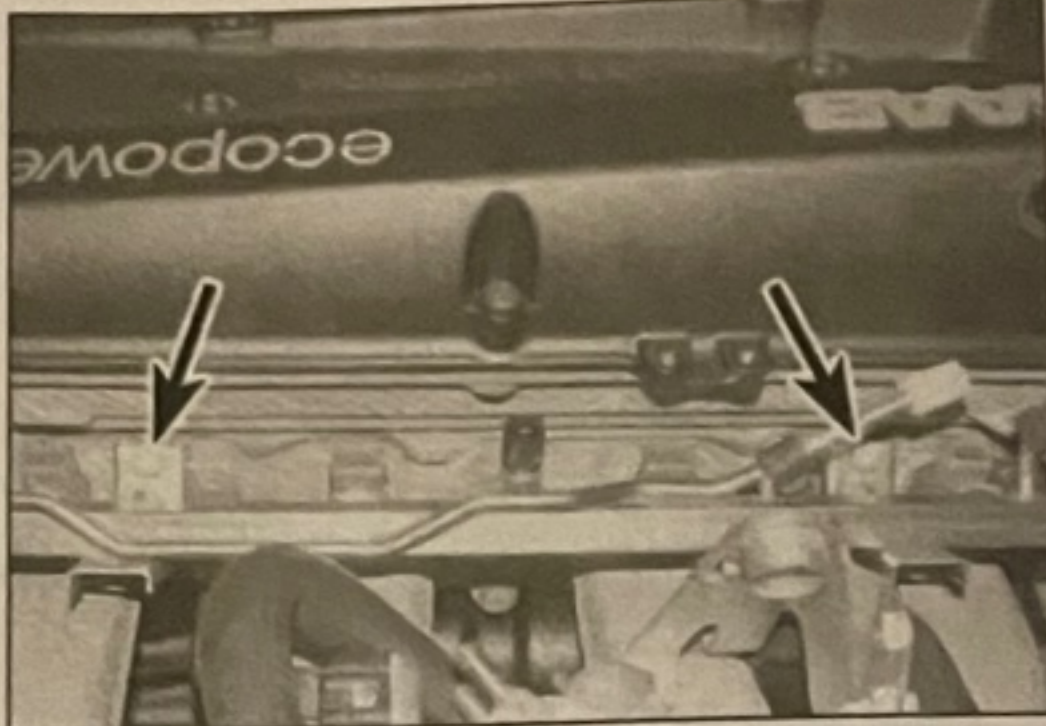
14.45b ... and the upper retaining bolt (arrowed) from the wiring harness guide



14.46a Press in the securing clip (arrowed) ...



14.46b ... and disconnect the wiring connector from the injector



14.47 Fuel rail securing bolts (arrowed)

45 Slacken and withdraw the bolts securing the cable guide bracket to the left-hand end of the cylinder head/intake manifold (see illustrations). For better access, release the

cable-ties and detach the wiring harness from the cable guide, then move the cable guide to one side.

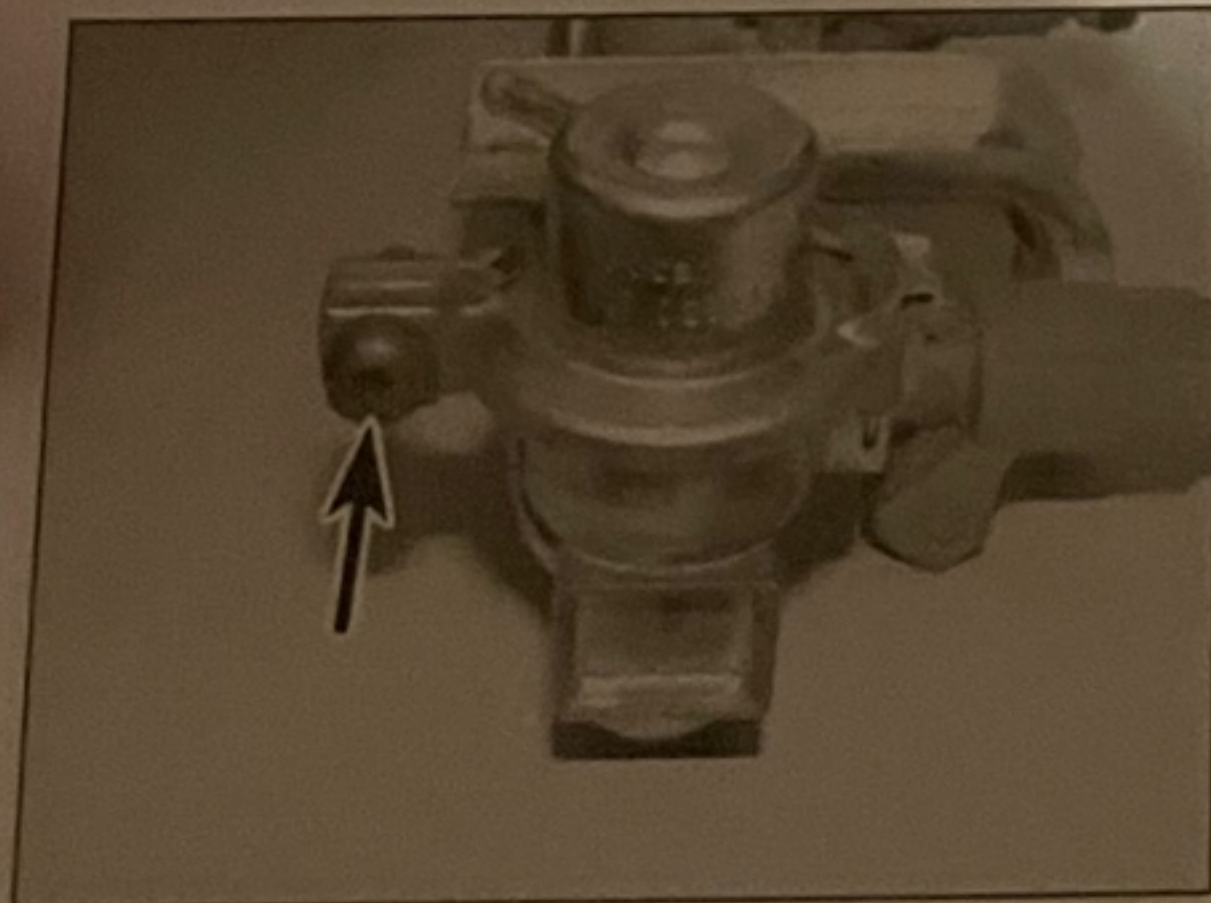
46 Release the locking clips and then



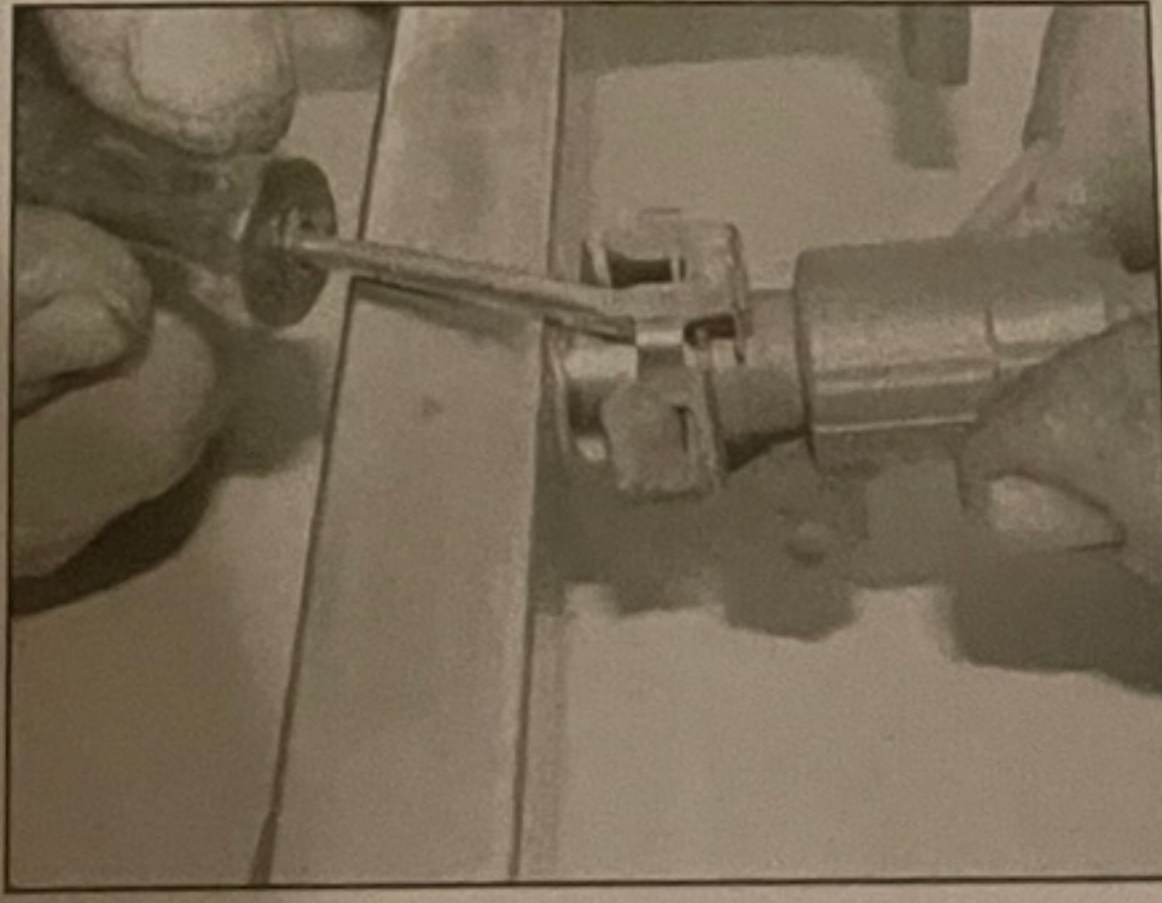
14.48a Disconnect the vacuum hose from the regulator ...



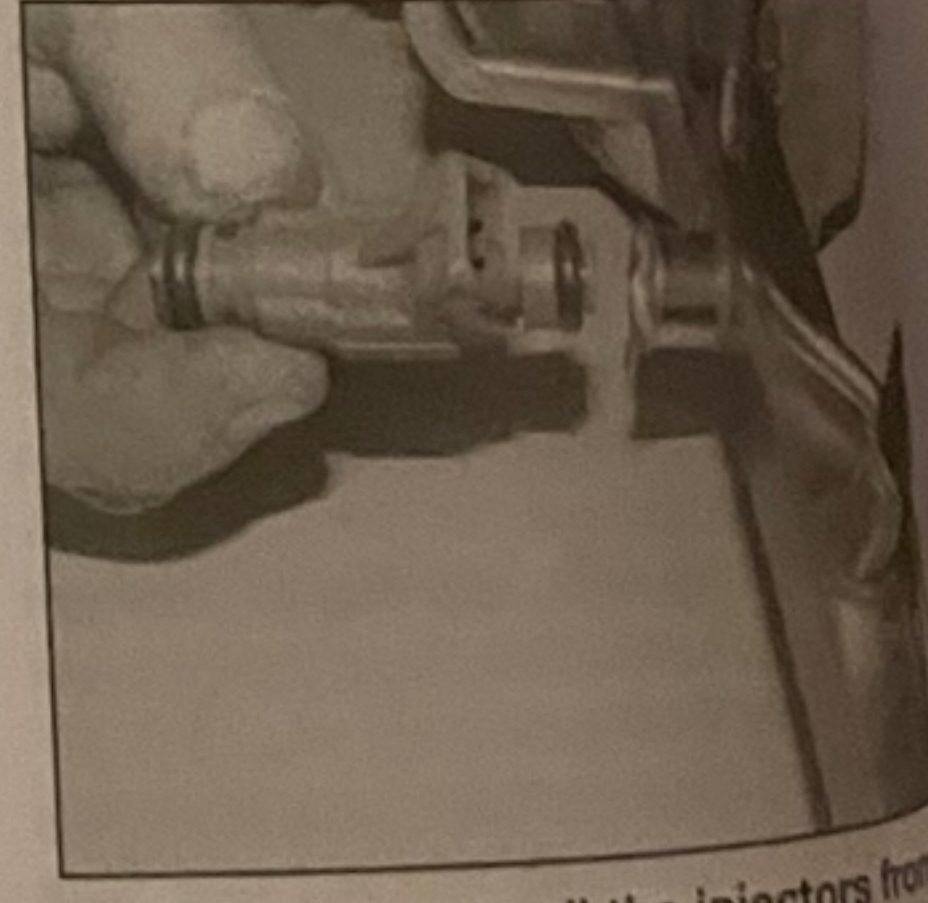
14.48b ... then withdraw the fuel rail from the intake manifold



14.49 Undo the retaining screw (arrowed) to release the regulator from the fuel rail



14.50a Prise out the retaining clips ...



14.50b ... and pull the injectors from the fuel rail

unplug the wiring from all four injectors (see illustrations), release any cable-ties and move wiring loom to one side.

47 Remove the two bolts securing the fuel rail to the cylinder head (see illustrations). Place a cloth beneath the fuel rail, to soak up any fuel which will escape as the fuel rail is removed.

48 Disconnect the vacuum hose from the fuel pressure regulator, then lift the fuel rail from the intake manifold complete with the fuel injectors (see illustrations). Recover the O-ring seals and discard; new ones should be used on refitting. Plug up the holes in the cylinder head to prevent dirt entering the engine.

49 If required, release the metal clamp securing the fuel pressure regulator from the end of the fuel rail (see illustration).

50 To remove the injectors from the fuel rail, release the retaining clips and pull the injectors from the fuel rail. Recover the rubber O-ring seals and discard; new ones should be used on refitting (see illustrations).

Refitting

51 Refitting is a reversal of the removal procedure. Fit the injectors to the fuel rail (using new O-rings), then press the fuel rail and injectors into the intake manifold assembly. Before locating the new fuel rail O-rings in the intake manifold, apply a little petroleum jelly to them, to facilitate entry of the injectors. Make sure that all the injector plugs are connected securely. When refitting the turbocharger air intake to the turbocharger body, ensure that the O-ring seals are properly seated.

14.52 Charge air (I)

Charge air (I) Removal

52 The valve is in the corner of the engine on the air intake manifold.

53 Ensure that the valve is closed and then unplug the valve (see illustrations).

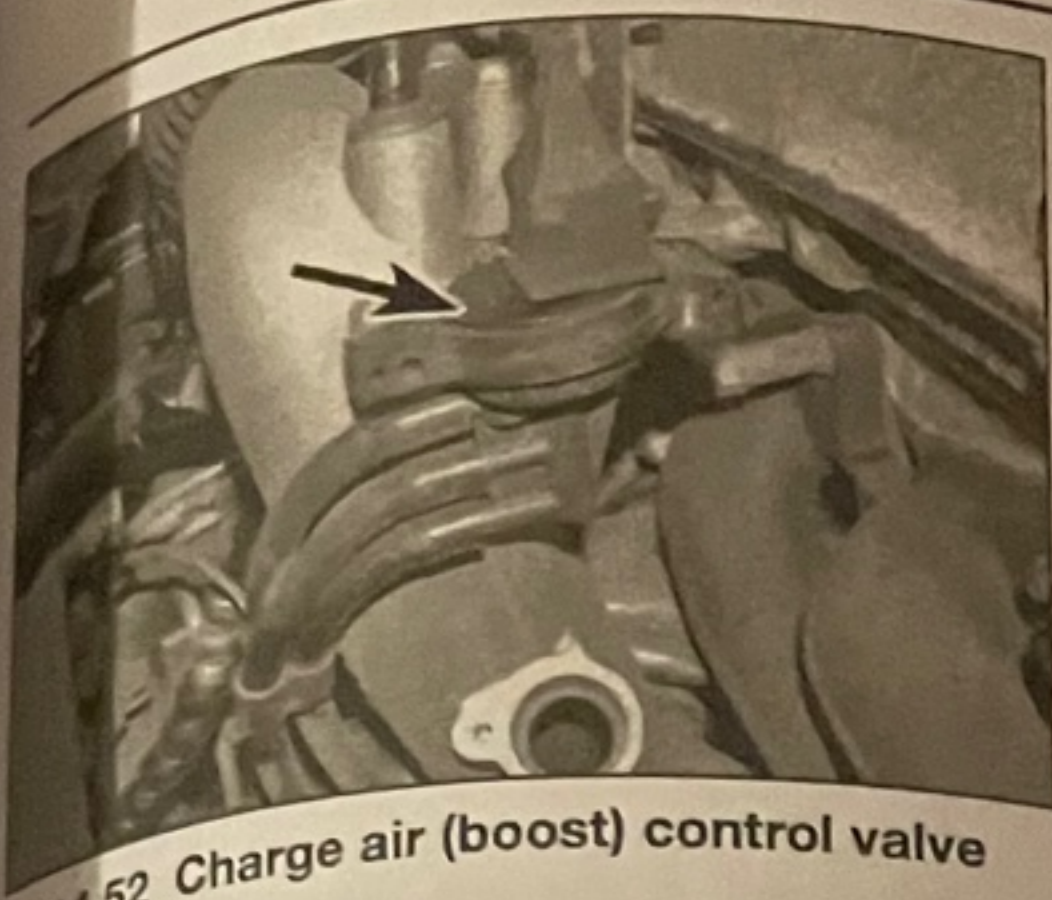
54 Mark each valve to identify it when refitting. Release the valve port from the valve port.

55 Slide the locating peg into the compartment.

Refitting

56 Refitting is a reversal of the removal procedure. Ensure that the correct

14.57



14.52 Charge air (boost) control valve

Charge air (boost) control valve

Removal

52 The valve is located at the front right-hand corner of the engine, mounted on a bracket on the air intake pipe (see illustration).

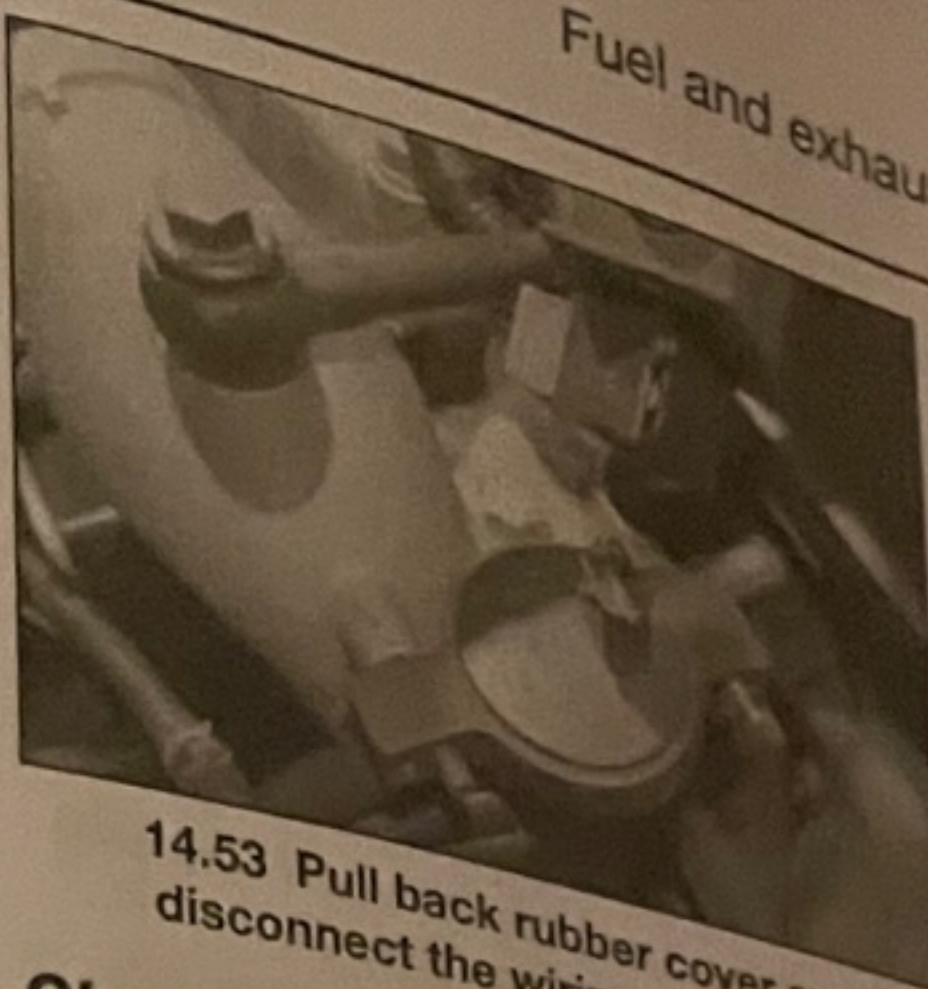
53 Ensure that the ignition is switched off, and then unplug the wiring connector from the valve (see illustration).

54 Mark each of the hoses leading to the valve to identify their fitted positions, then release the clips and detach the hoses from the valve ports (see illustration).

55 Slide the control valve off the two locating pegs and remove from the engine compartment.

Refitting

56 Refitting is a reversal of removal. It is vitally important that the hoses are refitted to the correct ports on the boost control valve.



14.53 Pull back rubber cover and disconnect the wiring connector

Charge air (boost) bypass valve

Removal

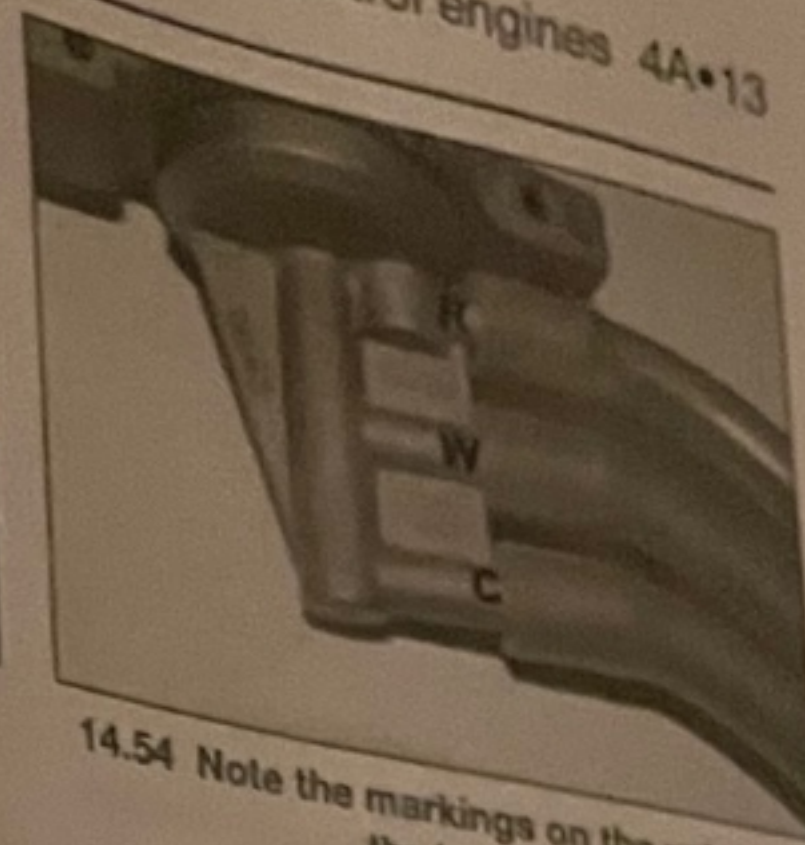
57 Unclip the engine upper cover panel from the top of the throttle body, then unclip the cover from the engine harness bracket on the bulkhead (see illustration).

58 Undo the two retaining nuts from the mounting bracket (see illustration), then lift the control valve mounting plate and unhook it from the bulkhead.

59 As the unit is withdrawn, disconnect the lower multiplug connector from the bypass valve (see illustration).

60 Mark each of the vacuum hoses leading to the valve to identify their fitted positions, and then detach the hoses from the valve body.

61 Drill out the two rivets and remove the control valve (see illustration).



14.54 Note the markings on the valve for the hoses

Refitting

62 Refitting is a reversal of removal. Using new pop rivets, fasten the control valve to the mounting plate.

Limp-home solenoid

Removal

63 Unclip the engine upper cover panel from above the intake manifold (see illustration 14.10).

64 Pull back the rubber cover then disconnect the wiring plug from the limp-home solenoid. Remove the securing screws and withdraw the sensor from the throttle body (see illustrations).

Refitting

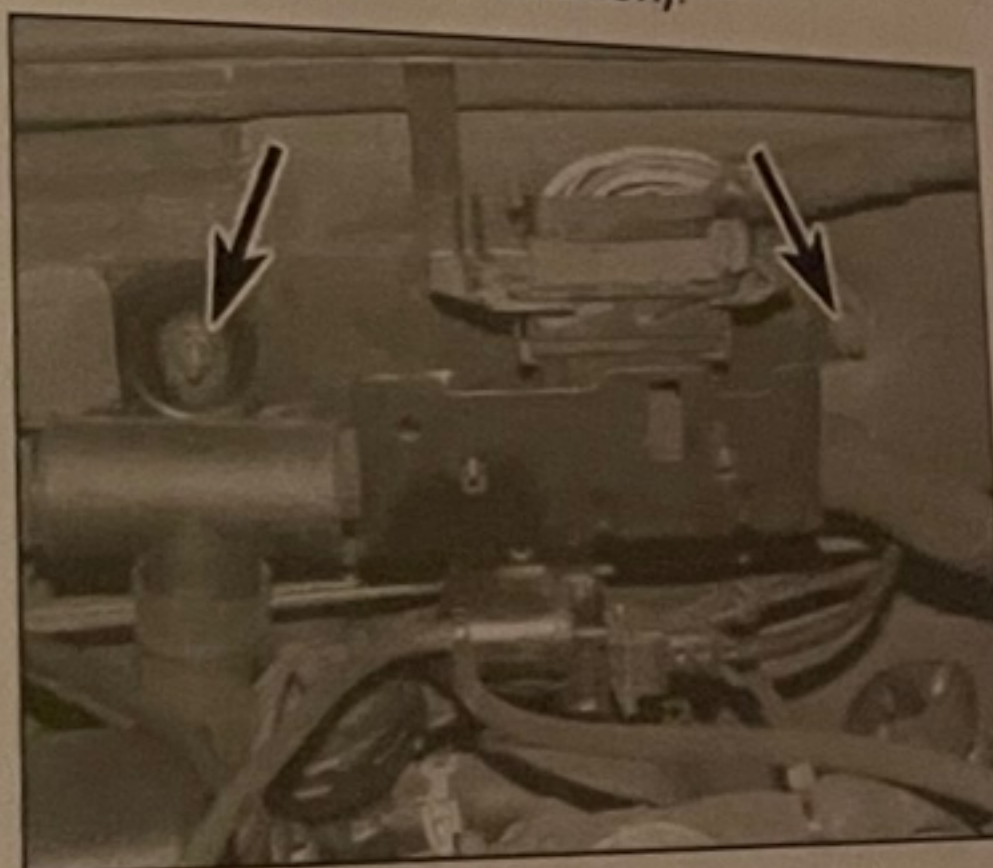
65 Refitting is a reversal of removal, but check and if necessary renew any sealing washers.

Oxygen sensor

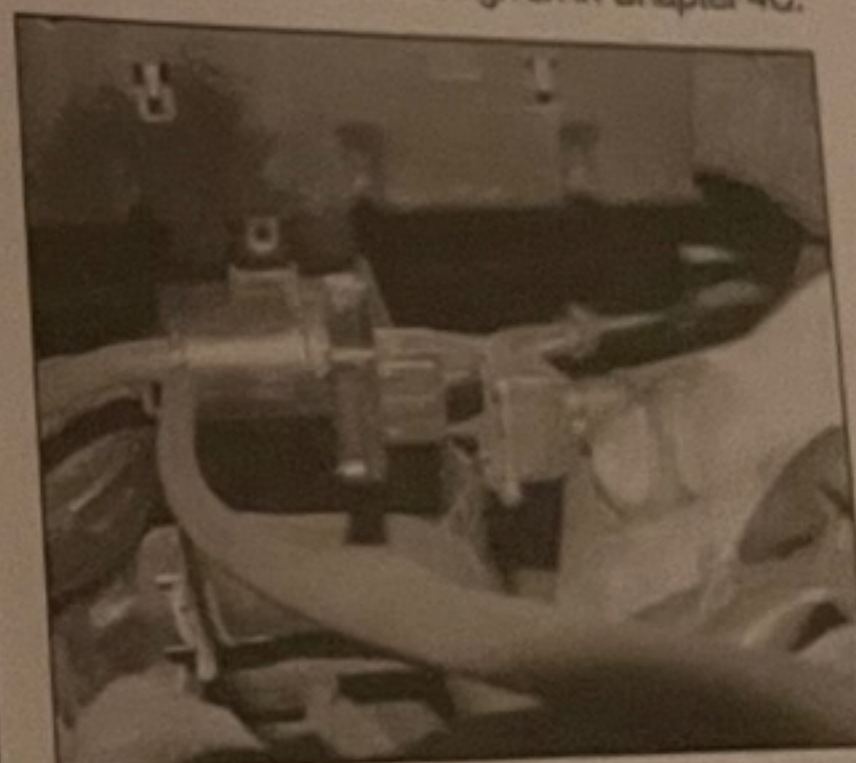
66 Refer to the information given in Chapter 4C.



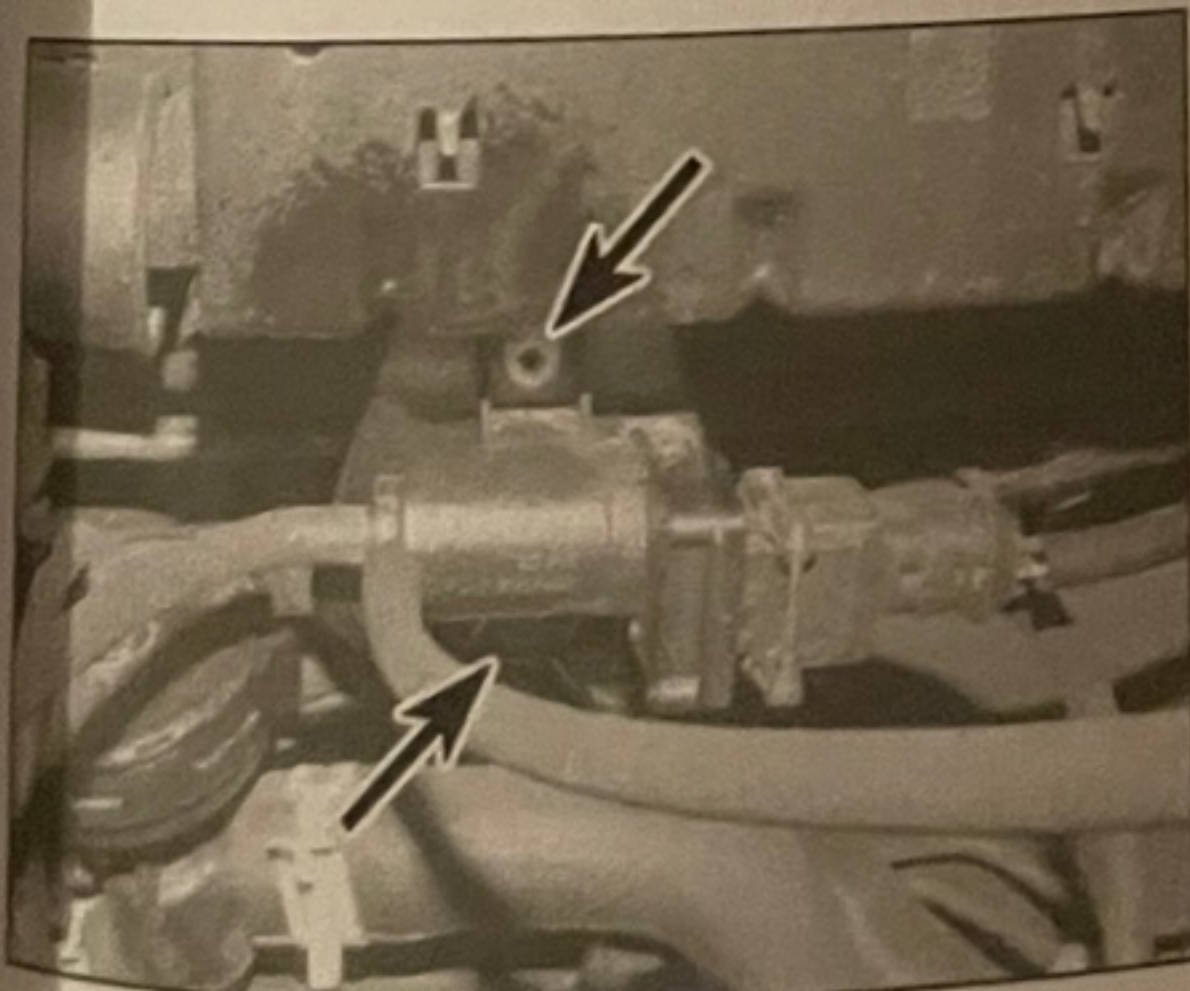
14.57 Unclip the cover from the engine harness on the bulkhead



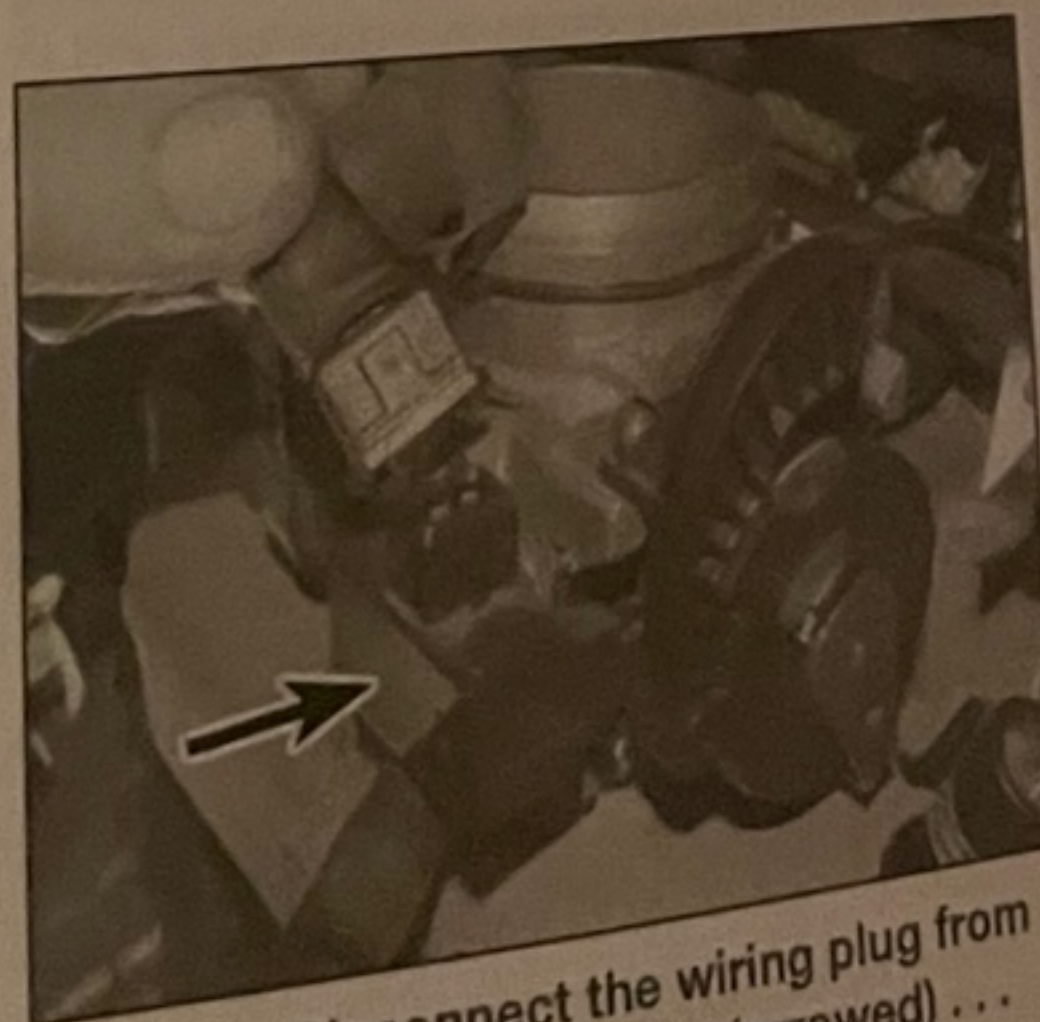
14.58 Undo the two retaining nuts (arrowed)



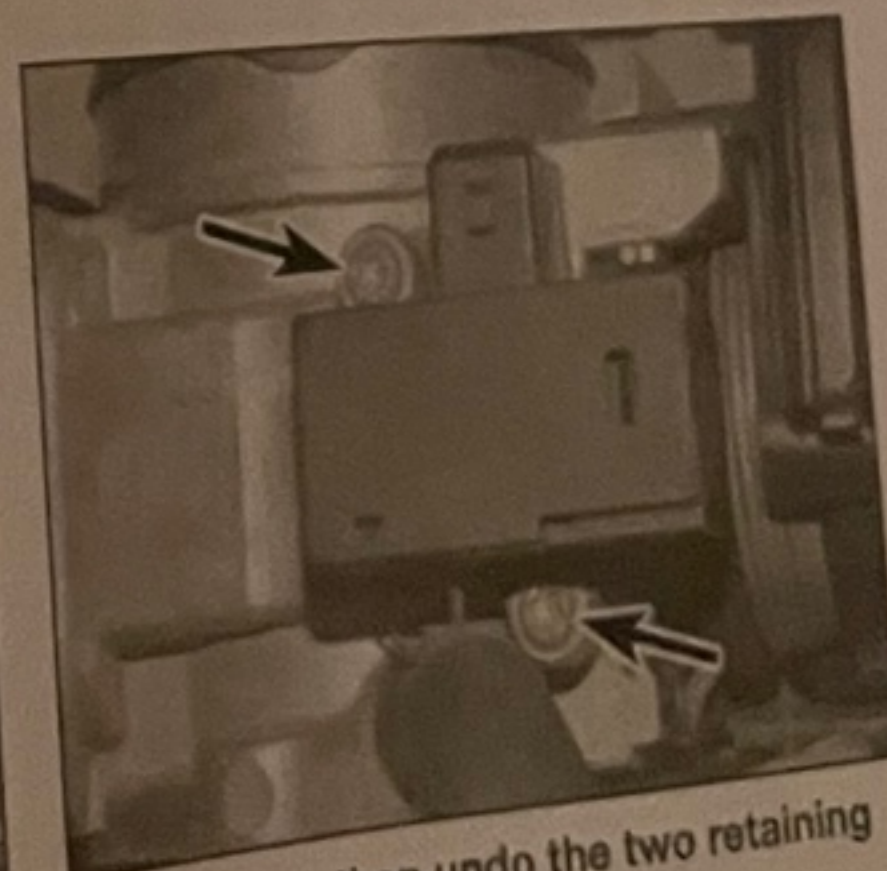
14.59 Disconnect the wiring connector from the valve



14.61 Drill out the two rivets (arrowed)



14.64a Disconnect the wiring plug from the limp-home solenoid (arrowed) ...



14.64b ... then undo the two retaining screws (arrowed)



16.3 Undo the two retaining bolts (arrowed) from the exhaust stay bracket

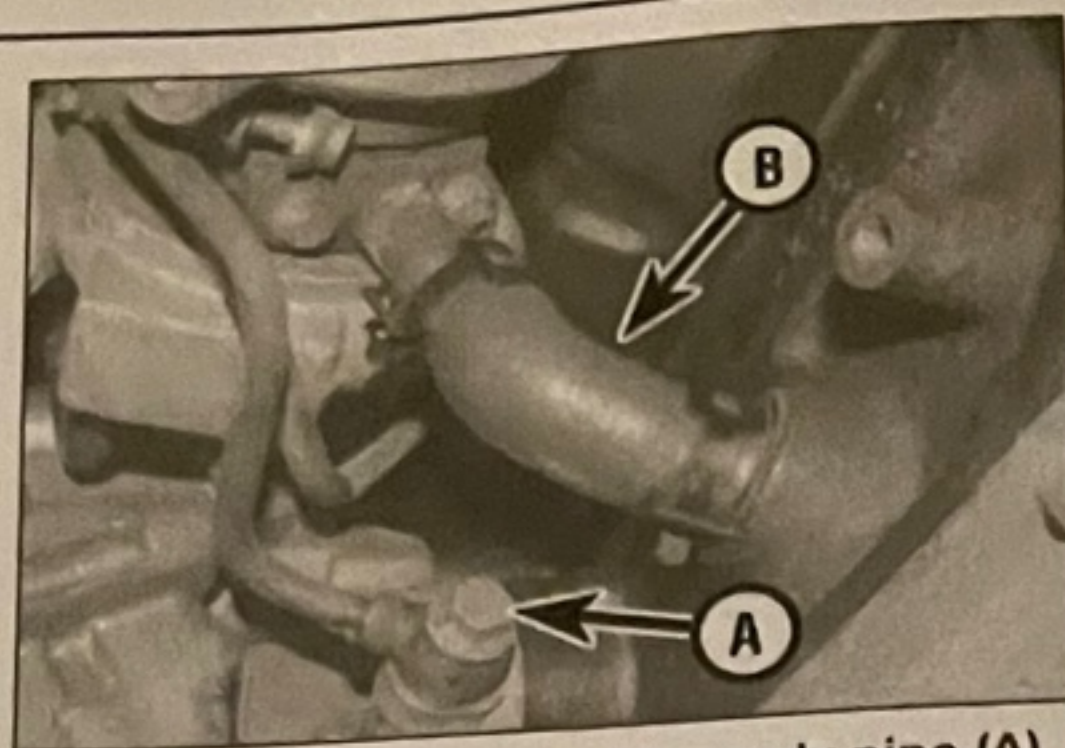
15 Turbocharger – description and precautions

1 The turbocharger increases engine efficiency and performance by raising the pressure in the intake manifold above atmospheric pressure. Instead of the intake air being sucked into the combustion chambers, it is forced in under pressure. This leads to a greater charge pressure increase during combustion and improved fuel burning, which raises the thermal efficiency of the engine. Under these conditions, additional fuel is supplied by the fuel injection system, in proportion to the increased airflow.

2 Energy for the operation of the turbocharger comes from the exhaust gas. The gas flows through a specially shaped housing (the turbine housing) and in so doing spins the turbine wheel. The turbine wheel is attached to a shaft, at the end of which is another vaned wheel known as the compressor wheel. The compressor wheel spins in its own housing, and compresses the intake air on the way to the intake manifold.

3 Between the turbocharger and the intake manifold, the compressed air passes through an intercooler. This is an air-to-air heat exchanger, mounted in front of the radiator and supplied with cooling air from the front grille and electric cooling fans. The temperature of the intake air rises due to the compression action of the turbocharger – the purpose of the intercooler is to cool the intake air again, before it enters the engine. Because cool air is denser than hot air, this allows a greater mass of air (occupying the same volume) to be forced into the combustion chambers, resulting in a further increase in the engine's thermal efficiency.

4 Boost pressure (the pressure in the intake manifold) is limited by a wastegate, which diverts the exhaust gas away from the turbine wheel in response to a pressure-sensitive actuator. The wastegate valve is controlled by the engine management system ECM, via an electronic boost control valve. The ECM opens and closes (modulates) the boost valve several times a second, which results in manifold vacuum being applied to the wastegate valve



16.4a Disconnect the oil supply pipe (A) and oil return pipe (B)

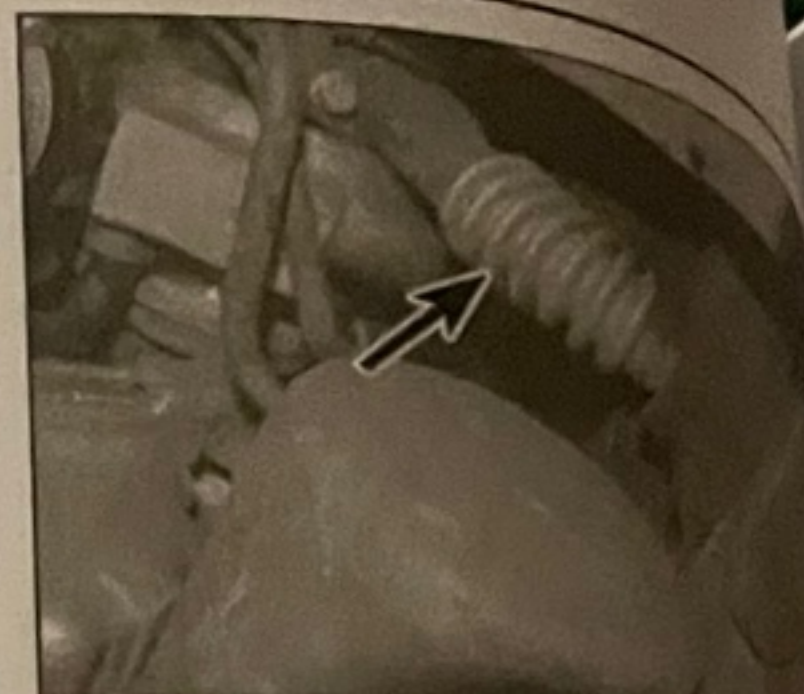
in a series of rapid pulses – the duty ratio of the pulses depends primarily on engine speed and load. The ECM monitors boost pressure via the manifold pressure sensor, and uses the boost control valve to maintain pressure at an optimum level throughout the engine speed range. If the ECM detects that combustion pre-ignition ('pinking' or 'knocking') is taking place, the boost pressure is reduced accordingly to prevent engine damage; see Chapter 5B for greater detail.

5 A boost bypass valve fitted in the airflow between the low-pressure supply and high-pressure delivery sides of the turbocharger compressor allows excess boost to be dumped into the intake air ducting when the throttle is closed at high engine speed (ie, during overrun or deceleration). This improves driveability by preventing compressor stall (and therefore reducing turbo 'lag'), and also by eliminating the surging that would otherwise occur when the throttle is reopened.

6 The turbo shaft is pressure-lubricated by an oil feed pipe from the main oil gallery. The shaft 'floats' on a cushion of oil and has no moving bearings. A drain pipe returns the oil to the sump. The turbine housing is water-cooled and has a dedicated system of coolant supply and return pipes.

7 The turbocharger operates at extremely high speeds and temperatures. Certain precautions must be observed during servicing activities, to avoid injury to the operator, or premature failure of the turbo.

- Do not operate the turbo with any of its parts exposed, or with any of its hoses removed. Foreign objects falling onto the rotating vanes could cause excessive damage, and (if ejected) personal injury.
- Do not race the engine immediately after start-up, especially if it is cold. Give the oil a few seconds to circulate.
- Always allow the engine to return to idle speed before switching it off – do not blip the throttle and switch off, as this will leave the turbo spinning without lubrication.
- Allow the engine to idle for a few minutes before switching off after a high-speed run. This will allow the turbine housing to cool before the coolant stops circulating under pressure.
- Observe the recommended intervals for oil and filter changing, and use a reputable oil of



16.4b On some models the return pipe (arrowed) is a metal corrugated pipe. Use of inferior oil, can cause carbon formation on the turbo shaft, leading to subsequent failure.

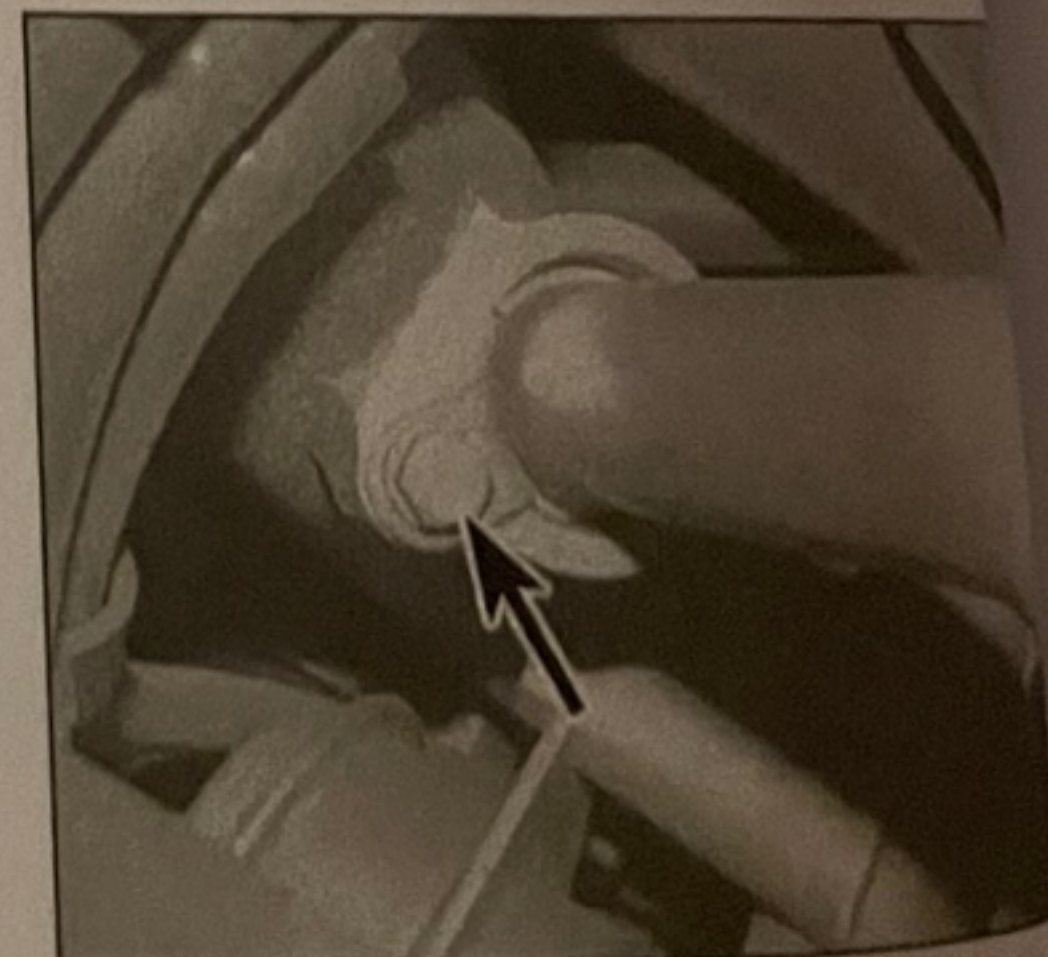
16 Turbocharger – removal and refitting

Note 1: The exhaust system and turbocharger may still be hot, make sure the vehicle is cooled down before working on the engine.

Note 2: Saab recommends that the oil filter should be changed (as described in Chapter 1A), when removing the turbocharger.

Removal

- 1 Apply the handbrake, then jack up the car and support on axle stands (see Chapter 1A for Jacking and vehicle support).
- 2 Remove the shield from beneath the radiator, then drain the cooling system as described in Chapter 1A.
- 3 Undo the retaining bolts and remove the turbocharger stay bracket (see illustration).
- 4 Slacken the unions and disconnect the supply and return pipes from the turbocharger (see illustrations). Plug the open ports to prevent contamination.
- 5 Working at the top of the engine, undo the retaining nut and unclip the heat shield from the exhaust manifold.
- 6 Undo the retaining bolt/clips and remove the air bypass hose (see illustrations). Note that there is an O-ring seal at the connection to the intake pipe.



16.6a Undo the retaining bolt (arrowed)

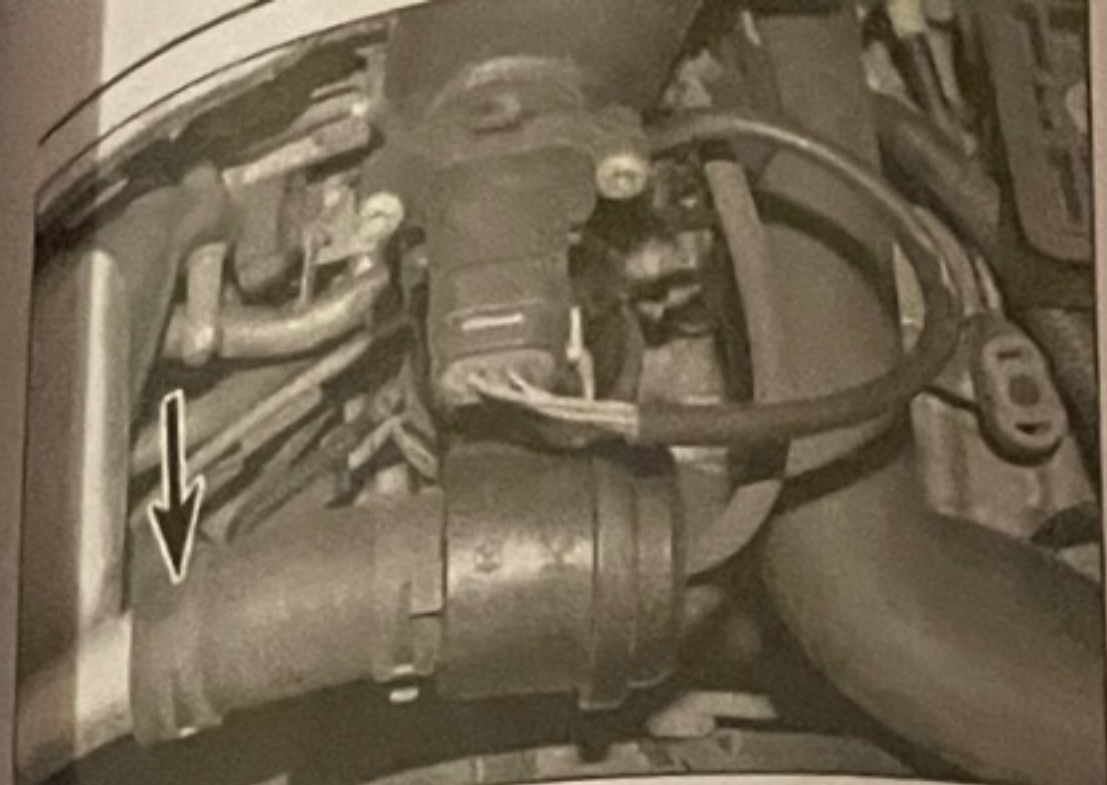


16.6b ... a

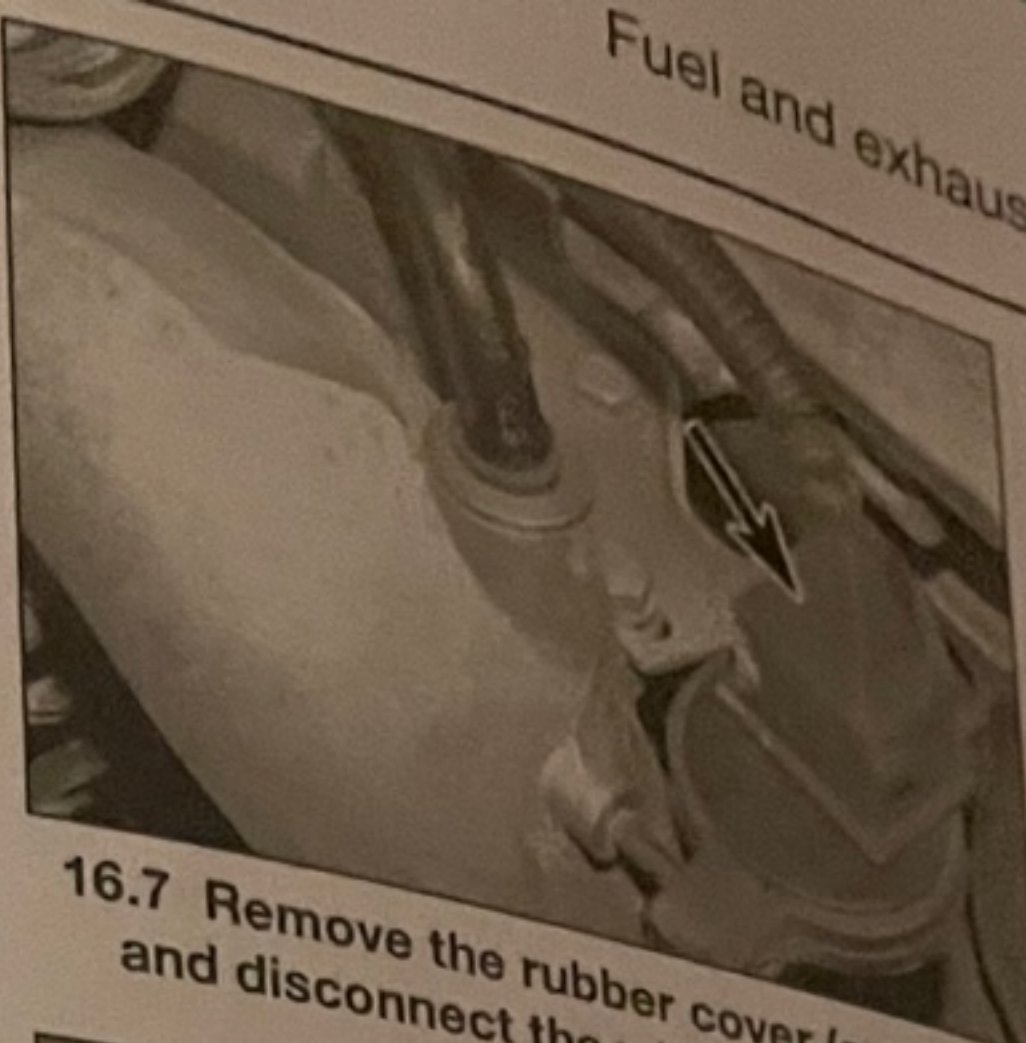


16.8b

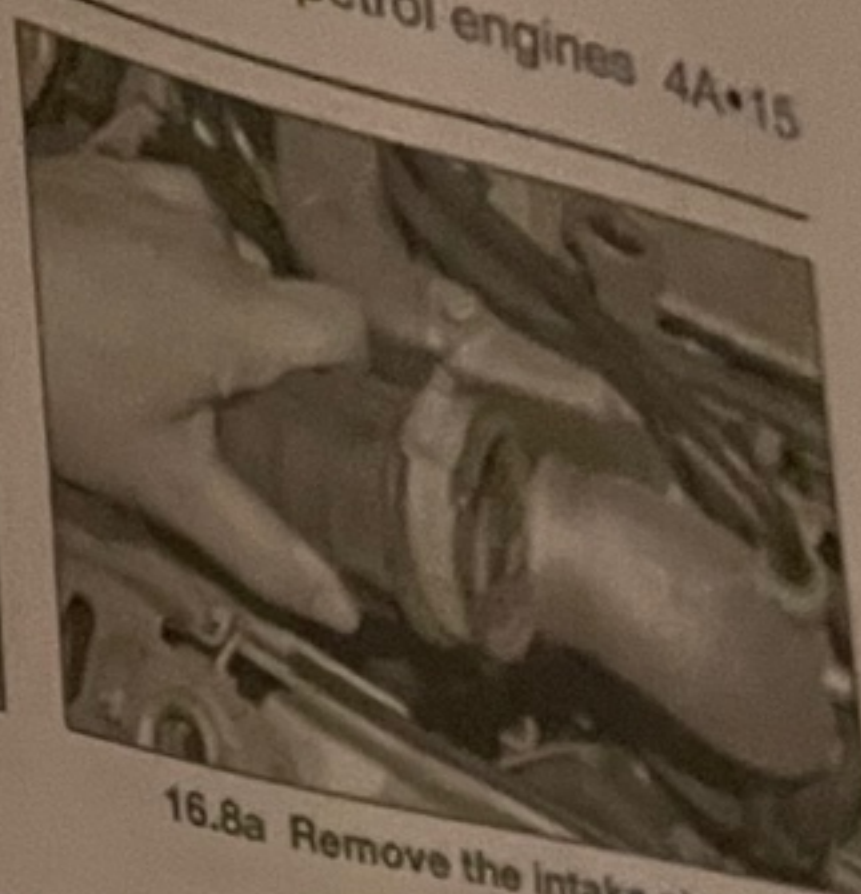
- 7 Disconnect the charge air hose.
- 8 Slacken the intake manifold union, then move the intake manifold to the right-hand side of the engine (see illustration).
- 9 Undo the retaining bolts and remove the turbocharger stay bracket (see illustration).
- 10 Undo the retaining nut and unclip the heat shield from the exhaust manifold.
- 11 Disconnect the air bypass hose (see illustration).
- 12 Undo the retaining bolt/clips and remove the air bypass hose (see illustration). Note that there is an O-ring seal at the connection to the intake pipe.
- 13 Disconnect the charge air hose.
- 14 Disconnect the intake manifold union, then move the intake manifold to the right-hand side of the engine (see illustration).
- 15 Disconnect the charge air hose.
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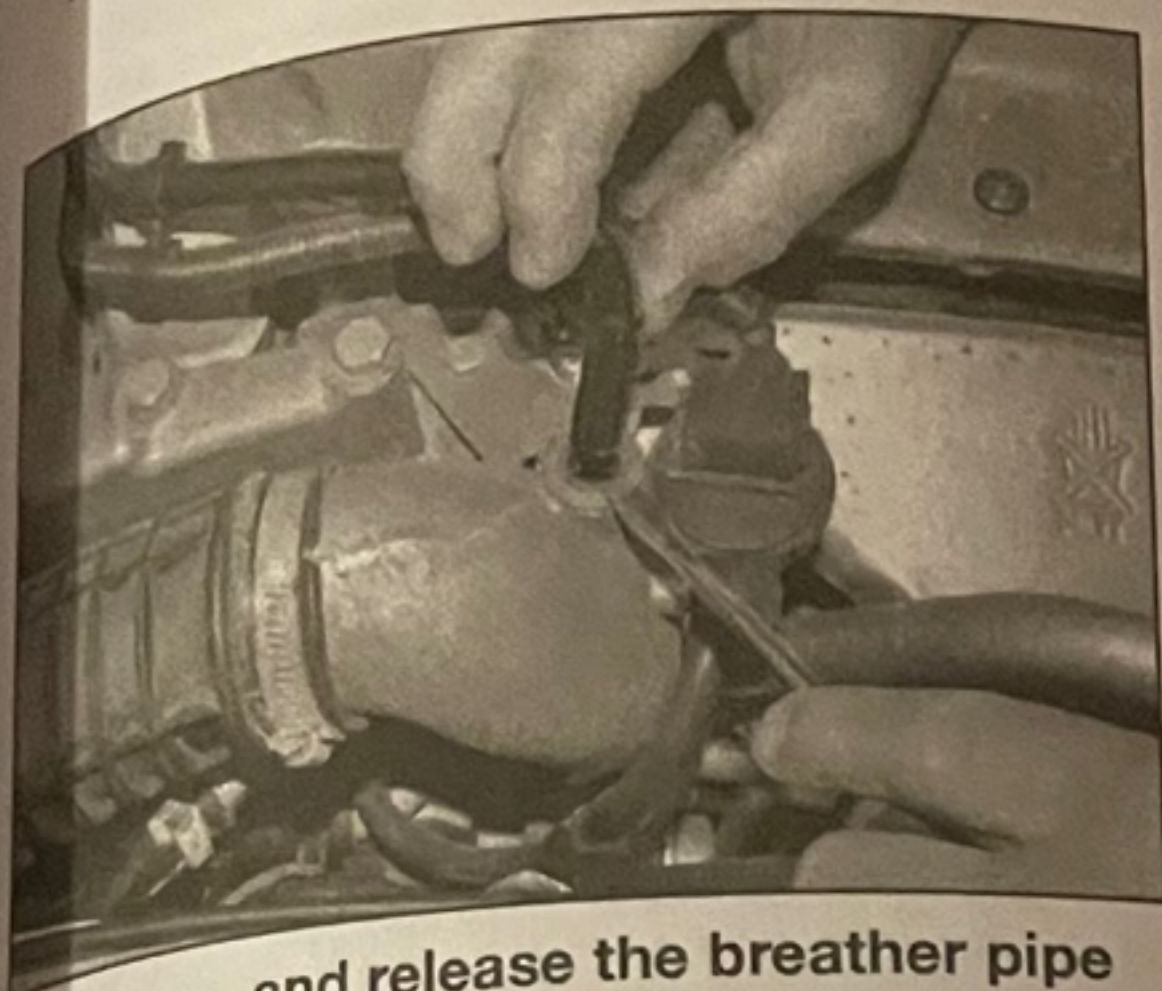
16.6b ... and release the securing clip (arrowed)



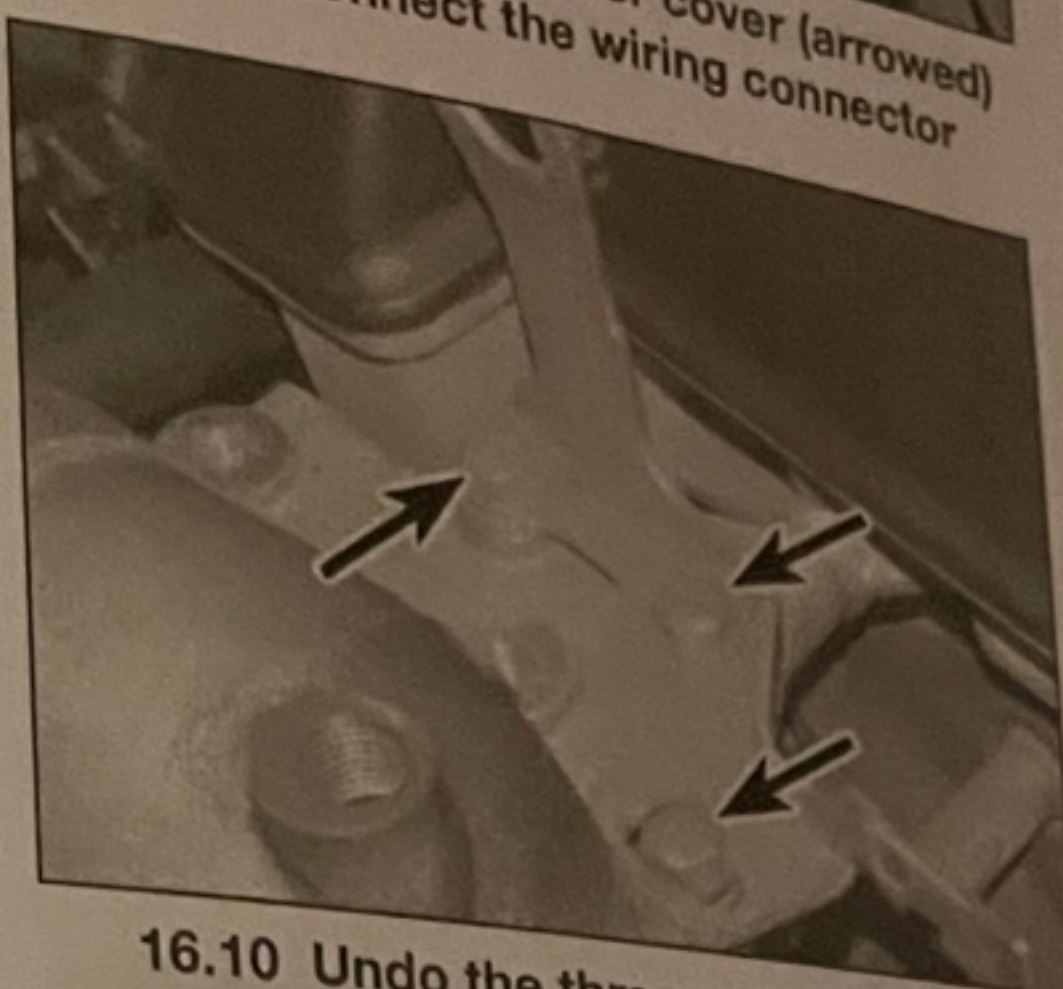
16.7 Remove the rubber cover (arrowed) and disconnect the wiring connector



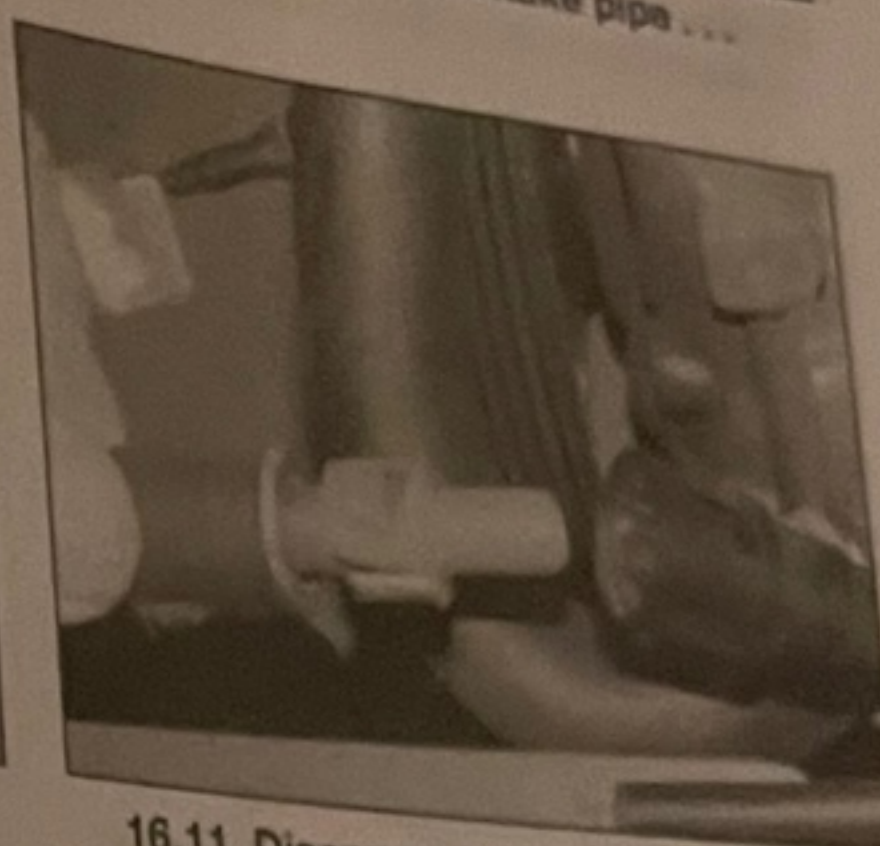
16.8a Remove the intake pipe ...



16.8b ... and release the breather pipe



16.10 Undo the three retaining bolts (arrowed)



16.11 Disconnect the coupling on the EVAP hose

7 Disconnect the wiring connectors from the charge air control valve (see illustration).

8 Slacken the retaining clip on the hose to the intake pipe/turbo unit and disconnect the breather pipe (banjo bolt or quick-release coupling) from the intake pipe (see illustrations).

9 Undo the retaining bolt (or unclip) the breather pipe and wiring loom from the right-hand end of the camshaft cover and move them to one side.

10 Undo the retaining bolt(s) and remove the lifting eye from the front of the cylinder head (see illustration).

11 Disconnect the quick-release coupling on the EVAP hose (see illustration).

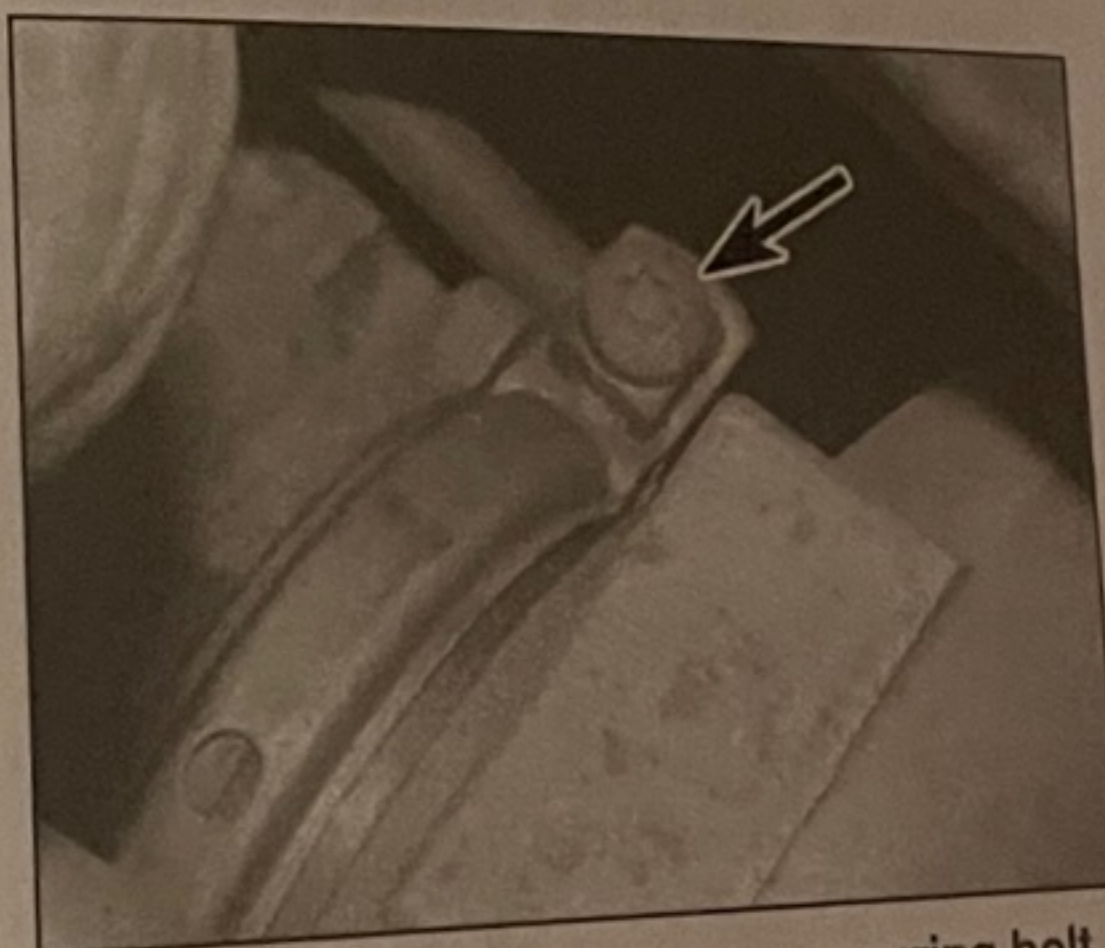
12 Undo the retaining bolt and withdraw the intake pipe V-clamp from the turbo, then withdraw the intake pipe (see illustrations). Disconnect the vacuum hose as the intake pipe is removed.

13 From under the vehicle, slacken the securing clip on the hose from the charge air cooler to the turbo and disconnect (see illustration). Plug the open ports to prevent contamination or damage to the turbo.

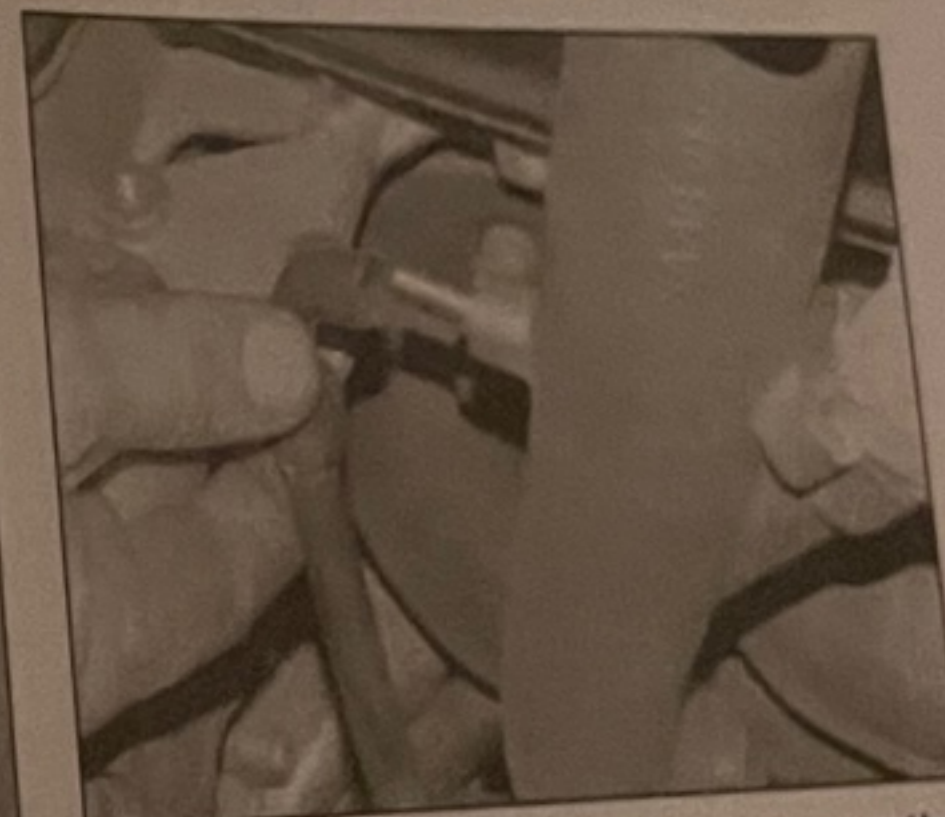
14 Unbolt and remove the exhaust system front pipe from the turbo, carefully lower the front pipe onto an axle stand (or similar) taking care not to damage it (see Section 20 of this Chapter).

15 Undo the unions and detach the coolant supply pipe from the coolant pump and the turbo housing (see illustrations), retrieve the copper sealing washers. Plug the open ports to prevent contamination.

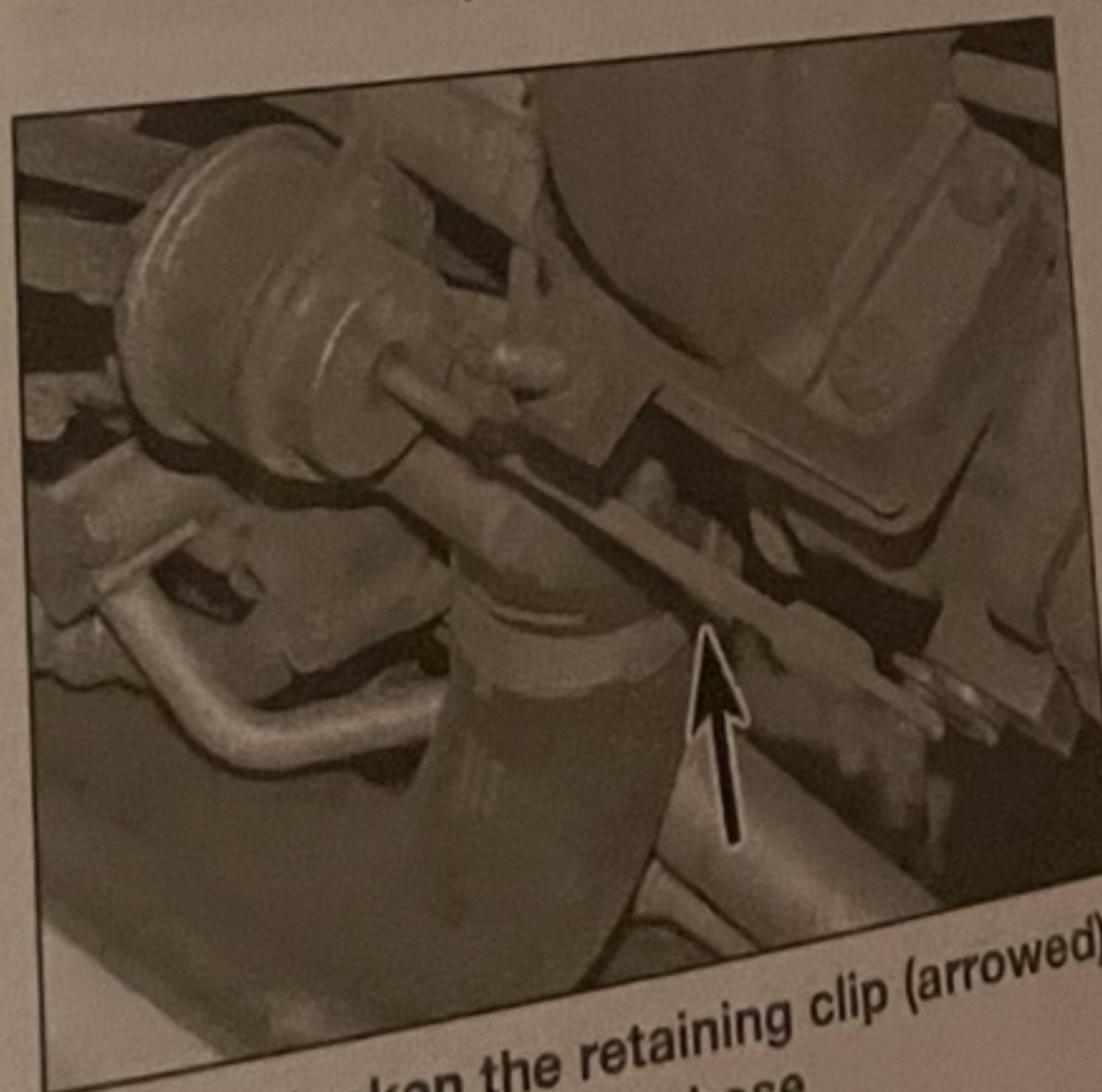
16 Undo the unions and detach the coolant return pipe from the turbo housing (see illustration). Retrieve the copper sealing washers, and then plug the open ports to prevent contamination.



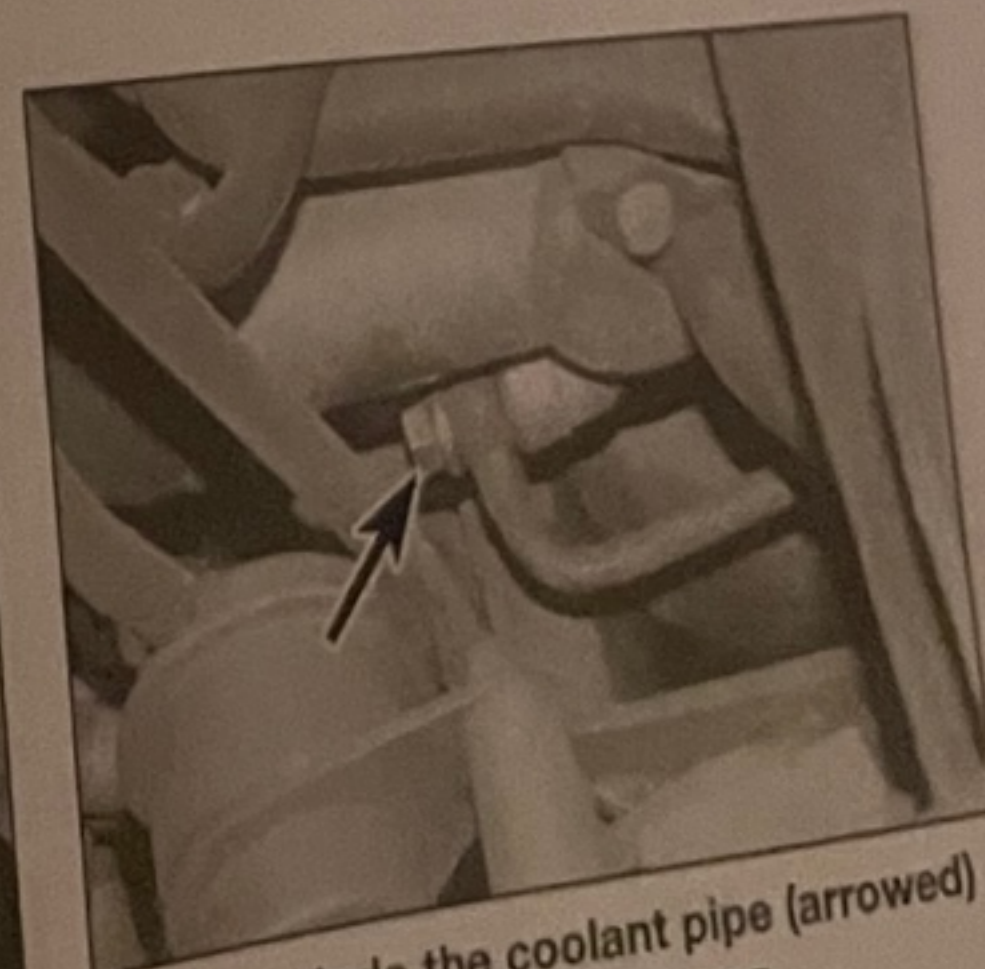
16.12a Slacken the clamp securing bolt (arrowed)



16.12b Disconnect the vacuum pipe as the intake pipe is removed

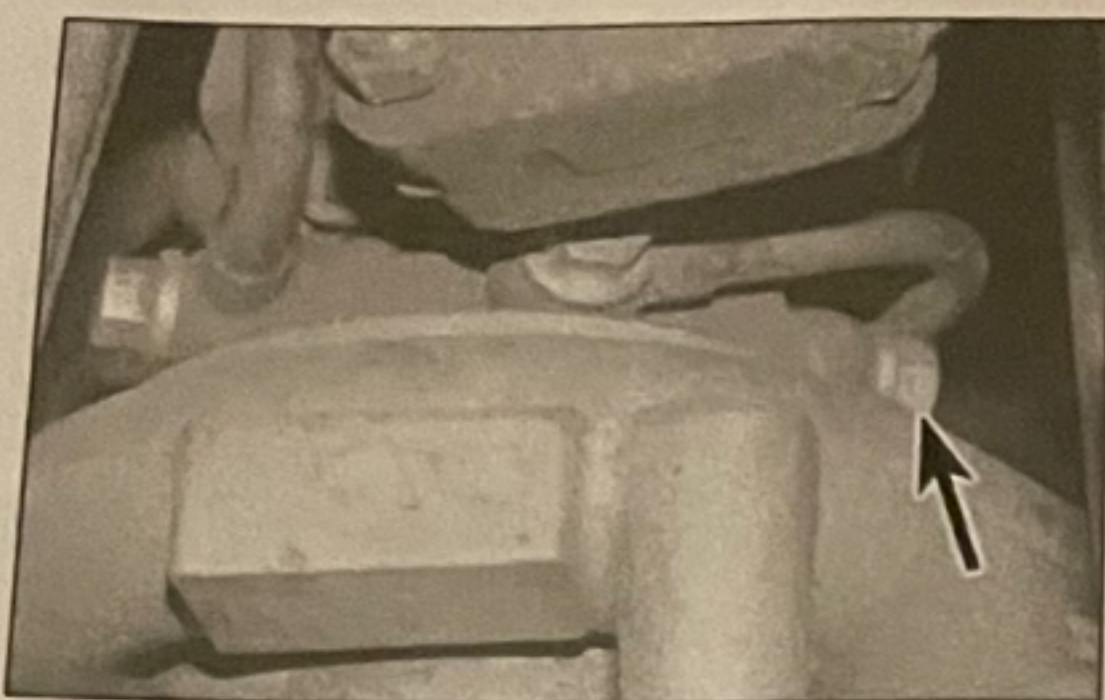


16.13 Slacken the retaining clip (arrowed) from the hose



16.15a Undo the coolant pipe (arrowed) from the coolant pump ...

Warning: The flexible section of the exhaust should not be bent out of alignment by any more than 5° as this can cause damage to the exhaust causing leakage and noise.



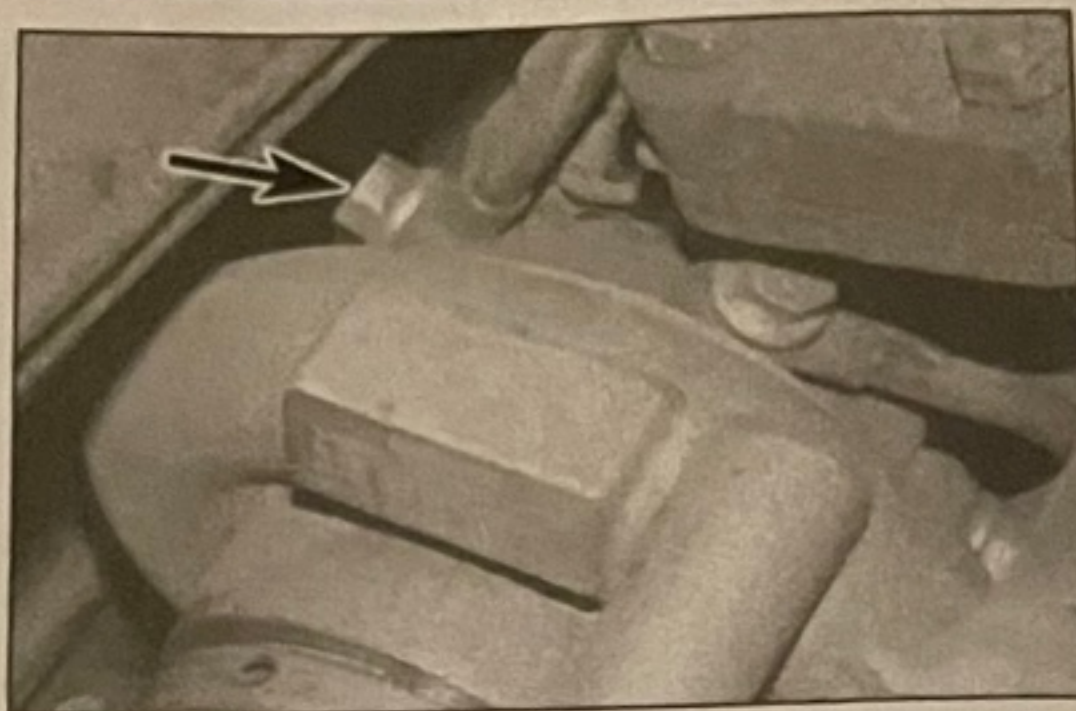
16.15b ... and the coolant pipe (arrowed) from the front of the turbocharger

17 Apply some easing oil to the exhaust manifold studs, then slacken the turbocharger securing nuts and remove the turbocharger from the vehicle (**see illustration**). Check around the turbocharger for any pipes that may still be connected.

Refitting

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

- a) Fill the turbocharger interchamber with clean engine oil, through the oil supply union on the turbocharger. This is important, as the turbocharger must have oil in it when the engine is started.
 - b) Thoroughly clean the exhaust manifold mating surface, before refitting the turbocharger.
 - c) Renew all copper union sealing washers, O-ring seals and gaskets, where applicable.
 - d) Tighten all nuts, bolts and oil and coolant unions to the correct torque settings, where specified.
 - e) Apply a suitable high-temperature, anti-seize compound to the threads of the exhaust system-to-turbocharger and exhaust manifold-to-turbocharger studs and nuts.
 - f) Ensure that the charge air (boost) control valve hoses are refitted correctly to the turbocharger, wastegate actuator and air hose (see illustration 14.54).
- 19** On completion, check that the radiator drain plug is tight, and then refit the shield panel.



16.16 Undo the coolant pipe (arrowed) from the rear of the turbocharger

20 Lower the car to the ground, then check and if necessary top-up the engine oil level (see *Weekly checks*). If not already done, it is strongly recommended that the engine oil be changed before starting the engine if a new turbocharger has been fitted, as this will protect the turbo bearings during the 'running-in' period.

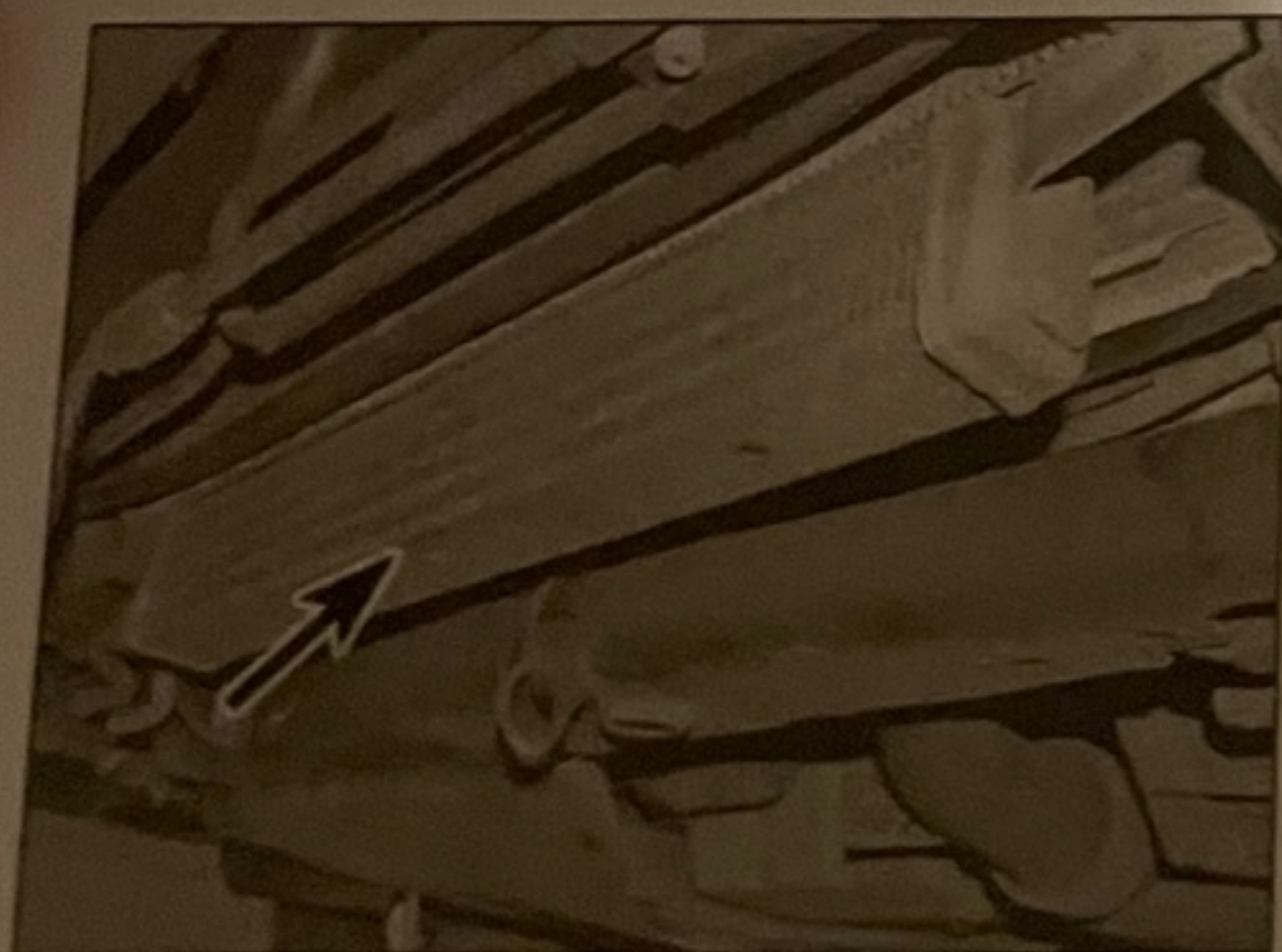
21 Refill the cooling system as described in Chapter 1A.

22 It is recommended that the boost pressure is checked by a Saab dealer at the earliest opportunity.

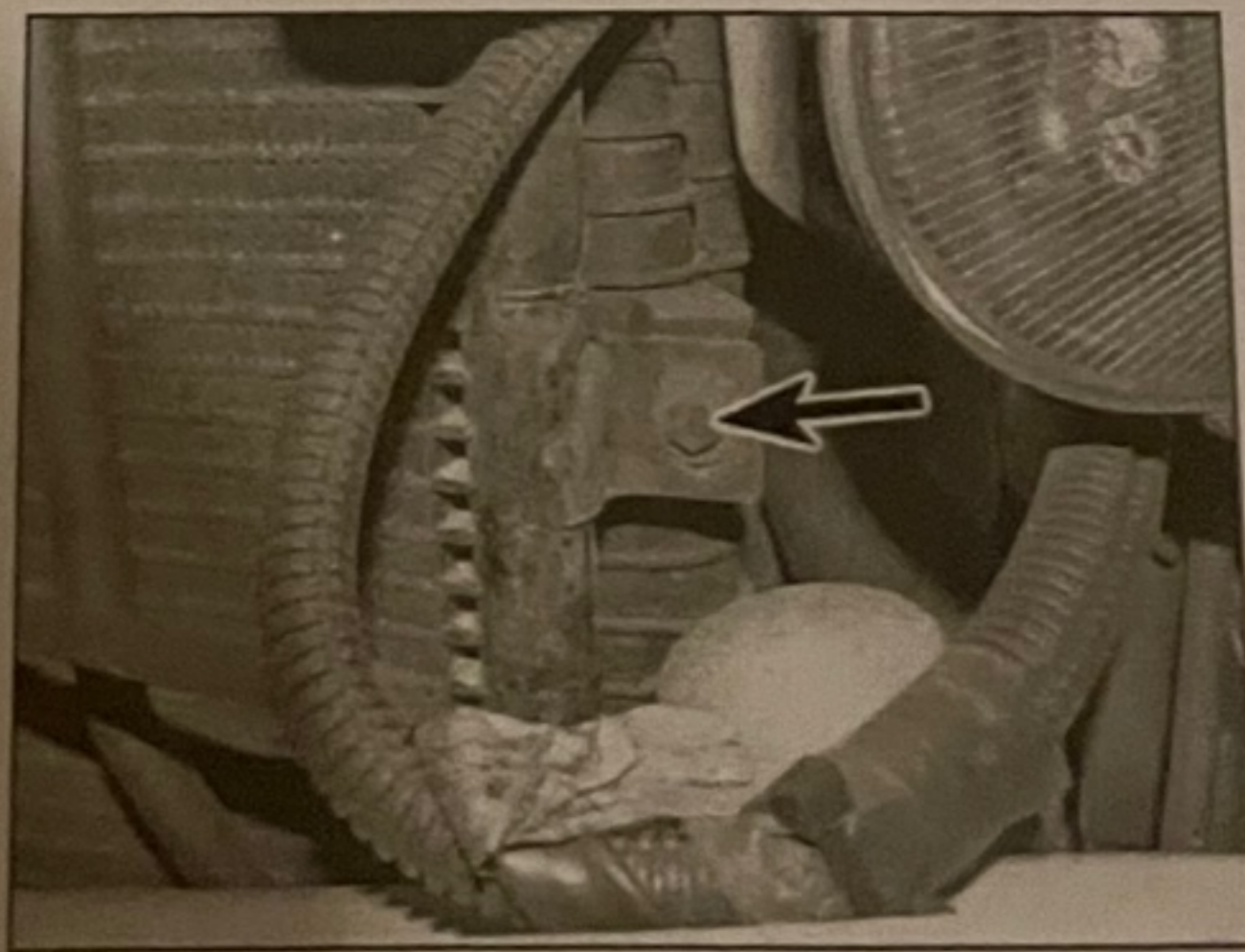
17 Intercooler – removal and refitting

Removal

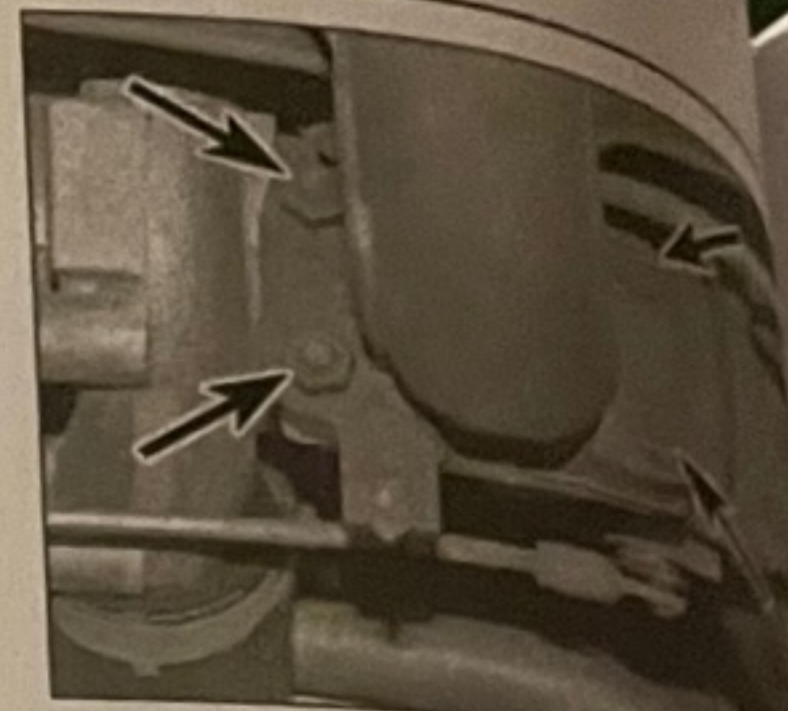
- 1 Raise the front of the vehicle and support it securely on axle stands (see *Jacking and vehicle support*).
- 2 Remove the front bumper as described in Chapter 11.
- 3 The intercooler is sandwiched between the radiator and the air conditioning condenser. Remove the radiator as described in Chapter 3.
- 4 Undo the retaining bolts and remove the oil cooler from below the front of the vehicle (see *illustration*). Suspend the oil cooler from the subframe by using cable-ties or similar, taking care not to damage the cooler pipes.
- 5 Using cable-ties secure the condenser to



17.4 Engine oil cooler



17.5a Condenser mounting bolt – left-hand side . . .



16.17 Slacken the four turbocharger securing bolts (arrow).

the front crossmember and then undo the bolts (one each side) securing the crossmember to the intercooler (see illustrations).

6 Release the hose clips and disconnect the air hoses from the left-hand and right-hand end of the intercooler.


7 Move the intercooler out from the engine compartment, lift it from its mountings, and disconnect it from the engine compartment.

Refitting

8 Refitting is a reversal of removal the relevant Chapters for reference. that the air hose clips are secured.

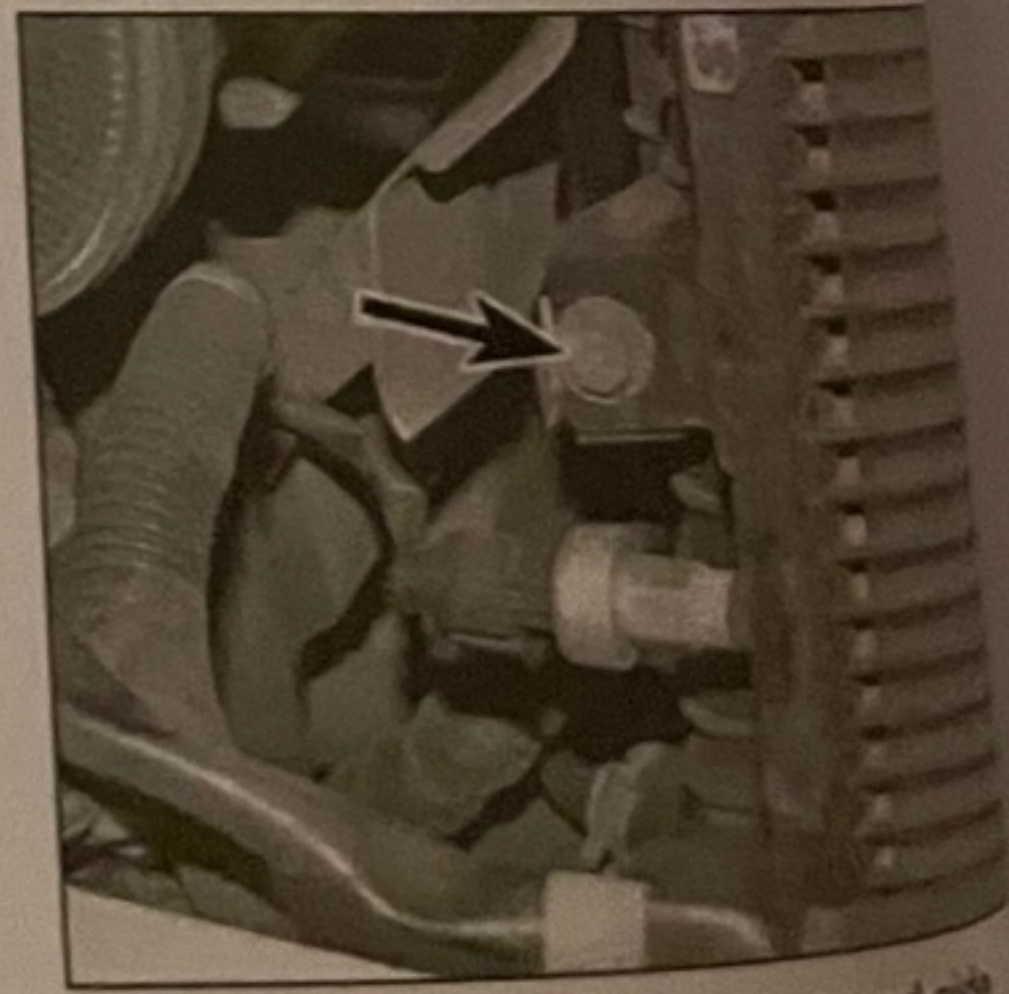
18 Intake manifold – removal and refitting



 **Warning:** Refer to the precautions given in Section 1, and the information detailed in the 'First!' Section of this manual, before disturbing any component in the supply system.

Removal

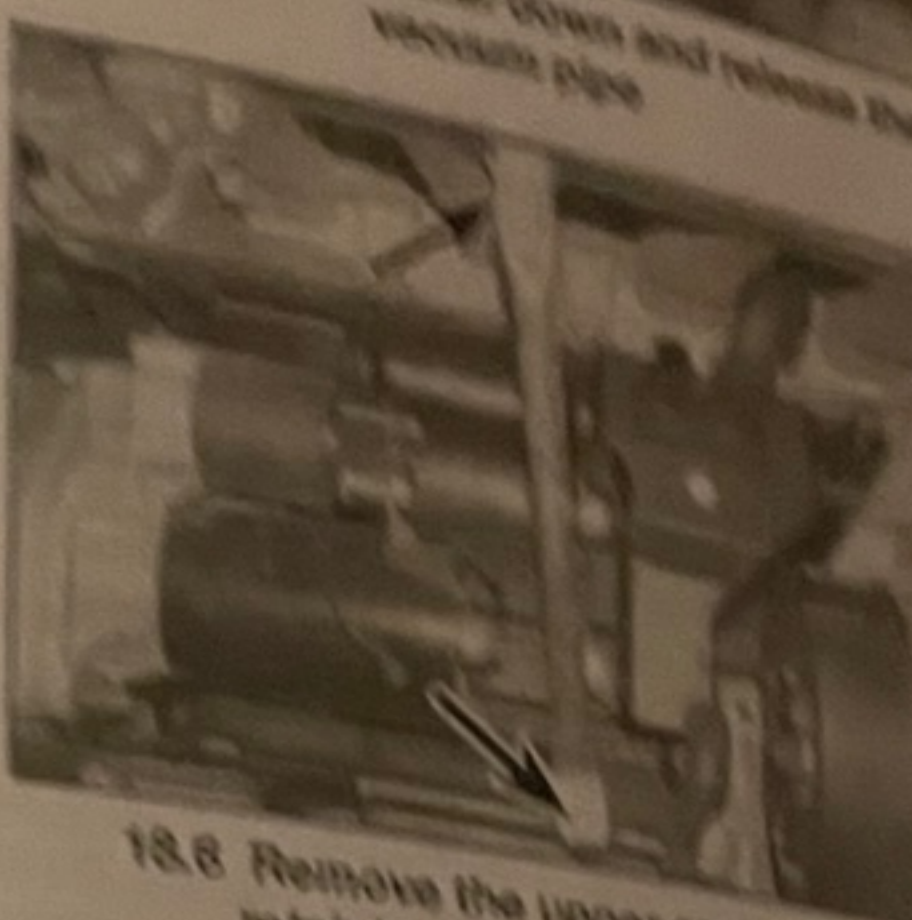
- 1 Disconnect the battery negative lead.
- 2 Refer to Section 14, and remove the fuel rail from the intake manifold.
- 3 Remove the fuel rail and fuel injectors from the intake manifold as described in Section 14.
- 4 Disconnect the brake servo vacuum hose from the intake manifold (see illustration).



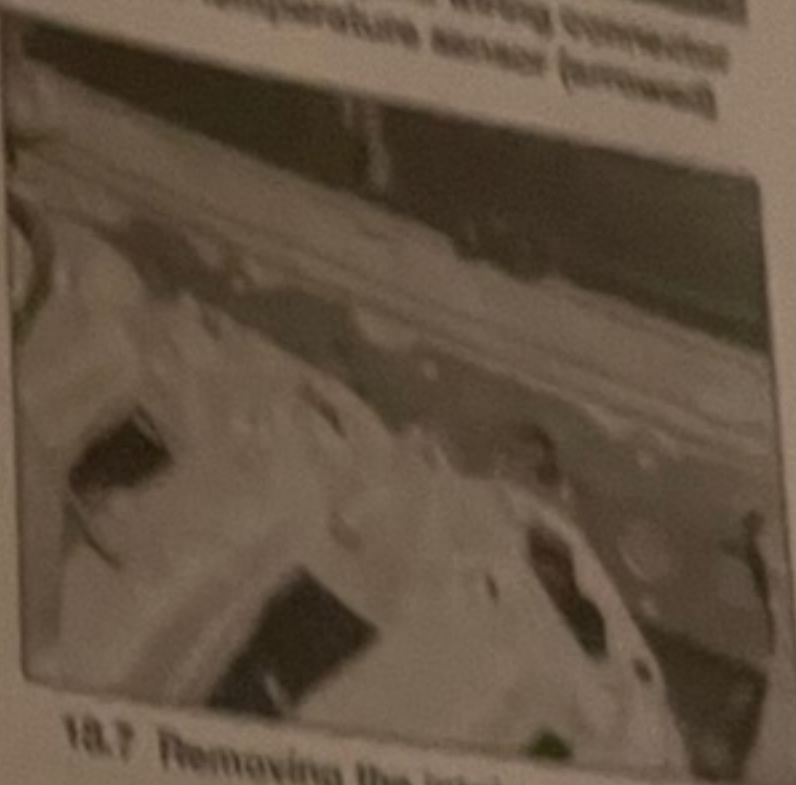
17.5b ... and right-hand side

68.5 Deconstructing the wiring connector from the temperature sensor (arrow)

12.5 Disconnecting the wiring connector from the temperature sensor (arrow)



18.8 Remove the upper and lower retaining bolts (arrowed)



12.7 Removing the intake manifold and gasket

General information

† The exhaust system consists of two sections:

† The exhaust system consists of two sections:

- 1) The front section (incorporating one catalytic converter on 2.0 litre models, and two catalytic converters on 2.3 litre models).
 - 2) The rear section (incorporating two silencers, which are a combination of resonance and absorption types).
- 2 If one of the silencers in the rear section of exhaust is leaking or damaged, it can be renewed by cutting the exhaust pipe approximately 95 mm ahead of the rear

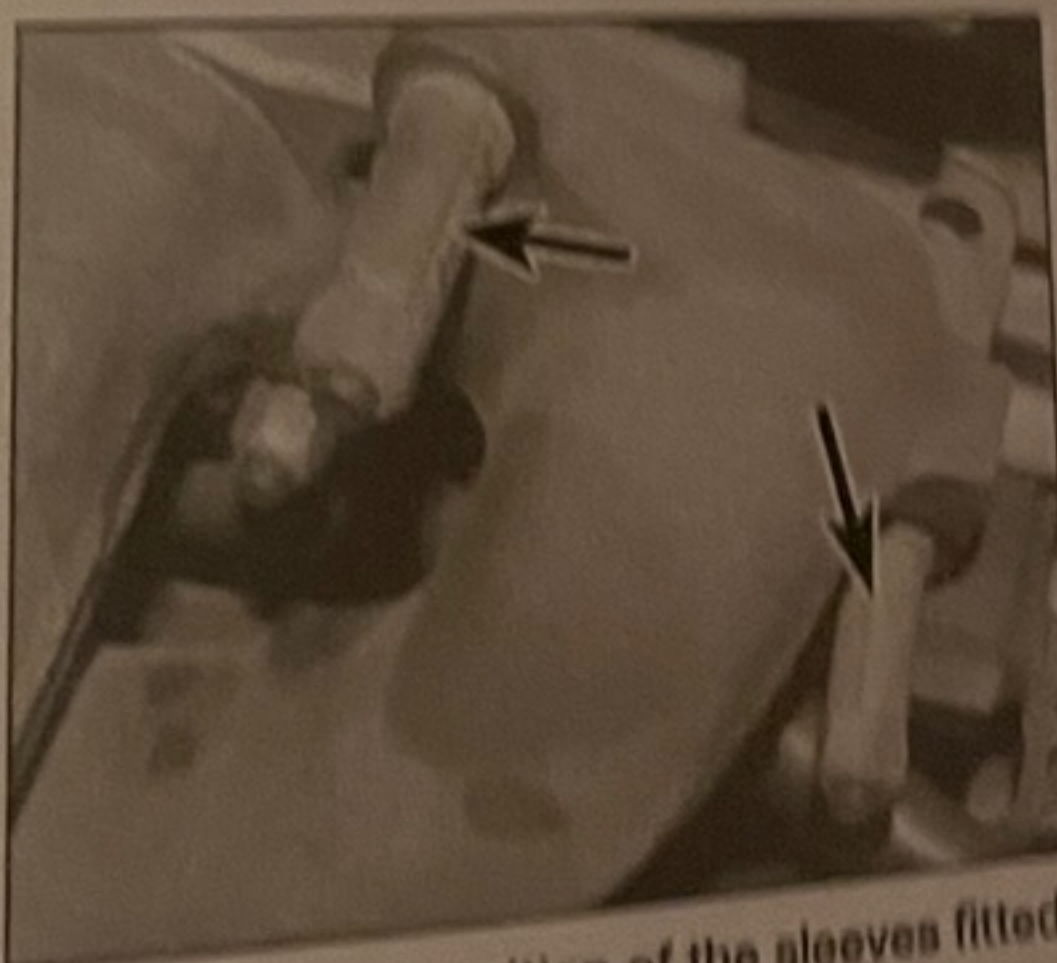
silencer. A new silencer can then be fitted (making the system into three sections). Check with your local exhaust dealer for availability of parts.

3 The exhaust system sections are joined by flanges with no gaskets, this is for the ease of removing the exhaust and ensuring a good fit. The outer exhaust casing is aluminium to protect against corrosion and the silencers are made of stainless 12% chrome steel.

4 On 2.0 litre models, there is one oxygen sensor located in the front pipe. On 2.3 litre models, there are two oxygen sensors located in the front pipe.

8 The front pipe incorporates a support bracket, which is also connected to the turbocharger.

6 On all models, the system is suspended throughout its entire length by rubber mountings.



19.5 Note the position of the sleeves fitted beneath some of the stud nuts (two shown)



10.6 Renew the manifold gasket

0077-0476

...
...
...

to verify the oxygen sensor wiring with
Chapter 4C, Section 2.

2. Remove the exhaust system front pipe
at catalytic converter with reference to
drawing 27.

Remove the auxiliary drivebelt as described in Chapter 14. To gain access to the right-hand engine manifold nuts, the power steering and pump must be unbolted and moved aside; see Chapter 10 for details. Note that there is no need to disconnect the hydraulic lines.

5 Unscrew and remove the exhaust manifold mounting nuts, and then lift the manifold from the cylinder head. Note the position of the sleeves fitted beneath some of the stud nuts (see illustration).

6 Remove the gasket from the studs on the cylinder head (see illustration).

7 Clean the contact surfaces of the cylinder head and exhaust manifold.

8 Refit the exhaust manifold to the studs on the cylinder head together with a new gasket, then tighten the mounting nuts to the specified torque. Make sure that the sleeves are correctly located, as previously noted.

9 Refit the power steering pump with reference to Chapter 10.

10 Refit the auxiliary drivebelt as described in Chapter 1A.

11 Refit the exhaust front pipe with reference to Section 20.

12 Reconnect the oxygen sensor wiring with reference to Chapter 4C, Section 2.

13 Lower the car to the ground.



20.12 Undo the exhaust bracket bolt (arrowed)

Removal

7 Each exhaust section can be removed individually as described in the following paragraphs. Alternatively, it is possible to remove the complete exhaust system in one piece, but without disconnecting the flange between the front and rear sections.

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

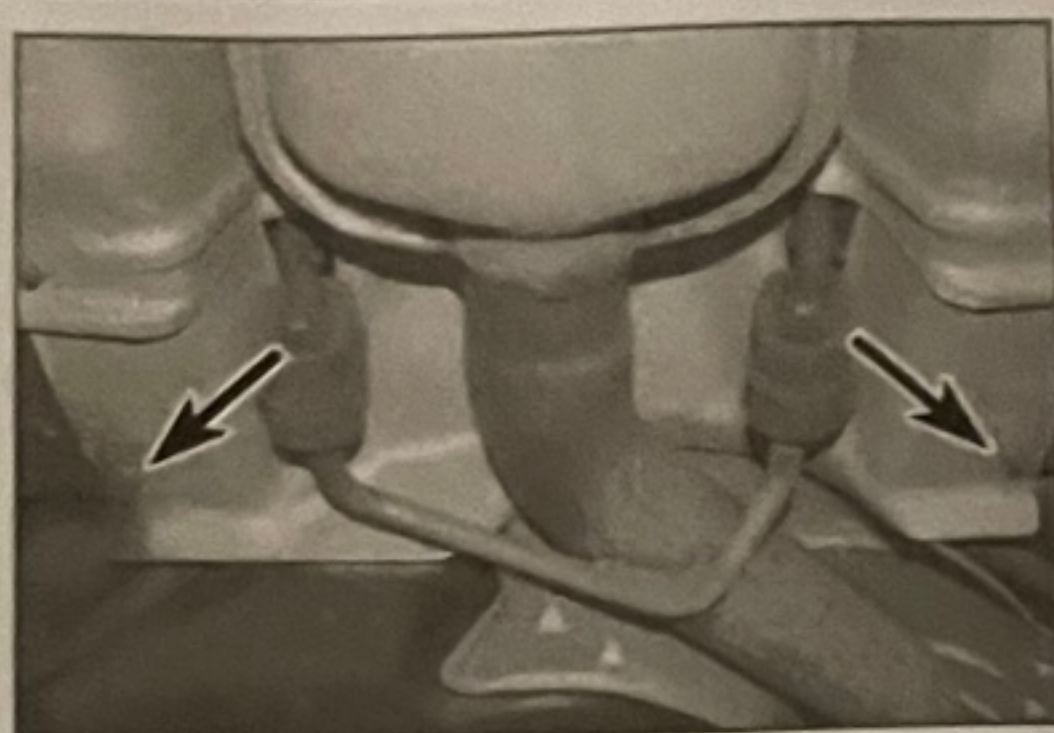
Front section

Note: Do not drop the catalytic converter, as it contains a fragile ceramic element.

9 Remove the front oxygen sensor as described in Chapter 4C, Section 2.

10 Undo the retaining nut and unclip the heat shield from the exhaust manifold. Slacken the three nuts securing the front pipe to the turbocharger; do not fully remove at this point.

11 Where applicable, remove the lower engine cover from under the vehicle.



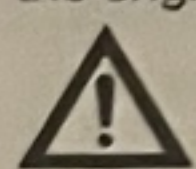
20.19 Heat shield retaining nuts (arrowed) – two shown

12 Remove the bolts securing the front pipe to its support bracket under the front of the engine (see illustration).

13 Unscrew the nuts and separate the flange joint between the front pipe and the rear exhaust section.

14 Support the exhaust front section and remove the three retaining nuts which were slackened in paragraph 10.

15 Remove the clips from the rubber mountings, then unhook the mounting rubbers from the underbody and lower the pipe between the engine and the subframe crossmember.



Warning: The flexible section of the exhaust should not be bent out of alignment by any more than 5° as this can cause damage to the exhaust causing leakage and noise.

Rear section

16 Unscrew the nuts and separate the flange joint between the front pipe and the rear exhaust section.

17 Remove the clips from the rubber mountings, then support the exhaust and

unhook the mounting rubbers from the underbody of the vehicle. Lower the rear section to the ground.

18 If either one of the silencers in the section of exhaust is leaking or damaged, then it can be renewed individually or the exhaust pipe as described above.

Heat shields

19 The heat shields are secured to the underbody by securing nuts (see illustration). Each shield can be removed once the exhaust section has been removed.

Refitting

20 Each section is refitted by a reversal of the removal sequence, noting the following points:

- Ensure that all traces of corrosion have been removed from the flared tube ends in the flanges, and where applicable renew the front pipe-to-exhaust manifold turbocharger gasket(s).
- When tightening the nuts on the front section of exhaust to the turbo, tighten them alternately to avoid distortion of the flange.
- Inspect the rubber mountings for signs of damage or deterioration, and renew if necessary.
- Refit the oxygen sensor with reference to Chapter 4C, Section 2.
- Make sure that all rubber mountings are correctly located with their retaining clips and that there is adequate clearance between the exhaust system and underbody.
- Make sure the rear of the exhaust is aligned centrally with the cut-out in the rear bumper and matches the bumper profile.

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