Chapter 4 Part D: Fuel system - sequential electronic fuel injection engines

Contents

Degrees of difficulty

Easy, suitable for novice with little experience 

Fairly easy, suitable for beginner with some experience 

Fairly difficult, suitable for competent DIY mechanic 

Difficult, suitable for experienced DIY mechanic 

Very difficult, suitable for expert DIY or professional 

Specifications

General

System type	Sequential Electronic Fuel injection (SEFi)
Application	1.4 litre PTE engines and 1.6 and 1.8 litre Zetec engines

Fuel grade

Fuel octane requirement	95 RON unleaded

Fuel pressure

Regulated fuel pressure:*	
Pressure regulator vacuum hose disconnected	2.7 ± 0.2 bars
With engine running and pressure regulator vacuum hose connected	2.1 ± 0.2 bars
Hold pressure - engine stopped after five minutes*	1.8 bars minimum

**The figures quoted are specific to Zetec engines. No values are quoted by the manufacturer for PTE engines, however they are likely to be similar.*

Torque wrench settings

	Nm	lbf ft
PTE engines		
Inlet air duct to cylinder head cover	9	7
Inlet manifold to cylinder head	18	13
Inlet manifold upper to lower sections	18	13
Inlet air temperature sensor	15	11
Fuel rail-to-lower inlet manifold	23	17
Camshaft position sensor	6	4
Oxygen sensor	60	44
Zetec engines		
Throttle housing-to-inlet manifold screws	9	7
Inlet manifold to cylinder head	18	13
Idle speed control valve bolts	6	4
Inlet air temperature sensor	15	11
Fuel pressure regulator bolts	6	4
Fuel injector bolts	6	4
Fuel rail-to-inlet manifold bolts	9	7
Camshaft position sensor	8	6
Oxygen sensor	60	44

1 General information and precautions

General information

The fuel system consists of a fuel tank (mounted under the body, beneath the rear seats), fuel hoses, an electric fuel pump mounted in the fuel tank, and a sequential electronic fuel injection system.

The electric fuel pump supplies fuel under pressure to the fuel rail, which distributes fuel evenly to all injectors. A pressure regulator controls the system pressure in relation to inlet tract depression. From the fuel rail, fuel is injected into the inlet ports, just above the inlet valves, by four fuel injectors. The system also includes features such as the flushing of fresh (ie, cold) fuel around each injector on start-up, thus improving hot starts.

The amount of fuel supplied by the injectors is precisely controlled by the EEC IV engine management module. The module uses the signals derived from the crankshaft position sensor and the camshaft position sensor, to trigger each injector separately in cylinder firing order (sequential injection), with benefits in terms of better fuel economy and lower exhaust emissions.

The EEC IV module is the heart of the entire engine management system, controlling the fuel injection, ignition and emissions control systems. The module receives information from various sensors which is then computed and compared with pre-set values stored in it's memory, to determine the required period of injection.

Information on crankshaft position and engine speed is generated by a crankshaft position sensor. The inductive head of the sensor runs just above the engine flywheel and scans a series of 36 protrusions on the flywheel periphery. As the crankshaft rotates, the sensor transmits a pulse to the system's ignition module every time a protrusion passes it. There is one missing protrusion in the flywheel periphery at a point corresponding to 90° BTDC. The ignition module recognises the absence of a pulse from the crankshaft position sensor at this point to establish a reference mark for crankshaft position. Similarly, the time interval between absent pulses is used to determine engine speed. This information is then fed to the EEC IV module for further processing.

The camshaft position sensor is located in the cylinder head so that it registers with a lobe on the camshaft. The camshaft position sensor functions in the same way as the crankshaft position sensor, producing a series of pulses; this gives the EEC IV module a reference point, to enable it to determine the firing order, and operate the injectors in the appropriate sequence.

The mass air flow sensor is based on a "hot-wire" system, sending the EEC IV module a constantly-varying (analogue) voltage signal corresponding to the mass of air passing into the engine. Since air mass varies with temperature (cold air being denser than warm), measuring air mass provides the module with a very accurate means of determining the correct amount of fuel required to achieve the ideal air/fuel mixture ratio.

Engine temperature information is supplied by the coolant temperature sensor. This component is an NTC (Negative Temperature Coefficient) thermistor - that is, a semi-conductor whose electrical resistance decreases as its temperature increases. It provides the EEC IV module with a constantly-varying (analogue) voltage signal, corresponding to the temperature of the engine coolant. This is used to refine the calculations made by the module, when determining the correct amount of fuel required to achieve the ideal air/fuel mixture ratio.

Inlet air temperature information is supplied by the inlet air temperature sensor. This component is also an NTC thermistor - see the previous paragraph - providing the module with a signal corresponding to the temperature of air passing into the engine. This is used to refine the calculations made by the module, when determining the correct amount of fuel required to achieve the ideal air/fuel mixture ratio.

A throttle position sensor is mounted on the end of the throttle valve spindle, to provide the EEC IV module with a constantly-varying (analogue) voltage signal corresponding to the throttle opening. This allows the module to register the driver's input when determining the amount of fuel required by the engine.

Road speed is monitored by the vehicle speed sensor. This component is a Hall-effect generator, mounted on the transmission's speedometer drive. It supplies the module with a series of pulses corresponding to the vehicle's road speed, enabling the module to control features such as the fuel shut-off on overrun.

Where power steering is fitted, a pressure-operated switch is screwed into the power steering system's high-pressure pipe. The switch sends a signal to the EEC IV module to reduce engine speed should the power steering fluid pressure become excessively high.

The oxygen sensor in the exhaust system provides the module with constant feedback - "closed-loop" control - which enables it to adjust the mixture to provide the best possible conditions for the catalytic converter to operate.

The air inlet side of the system consists of an air cleaner housing, the mass air flow sensor, an inlet hose and duct, and a throttle housing.

The throttle valve inside the throttle housing is controlled by the driver, through the accelerator pedal. As the valve opens, the amount of air that can pass through the system increases. As the throttle valve opens further, the mass air flow sensor signal alters, and the EEC IV module opens each injector for a longer duration, to increase the amount of fuel delivered to the inlet ports.

Both the idle speed and mixture are under the control of the EEC IV module, and cannot be adjusted. Not only can they not be adjusted, they cannot even be checked, except with the use of special Ford diagnostic equipment.

Precautions

Warning: Petrol is extremely flammable - great care must be taken when working on any part of the fuel system. Do not smoke or allow any naked flames or uncovered light bulbs near the work area. Note that gas powered domestic appliances with pilot flames, such as heaters, boilers and tumble dryers, also present a fire hazard - bear this in mind if you are working in an area where such appliances are present. Always keep a suitable fire extinguisher close to the work area and familiarise yourself with its operation before starting work. Wear eye protection when working on fuel systems and wash off any fuel spilt on bare skin immediately with soap and water. Note that fuel vapour is just as dangerous as liquid fuel; a vessel that has just been emptied of liquid fuel will still contain vapour and can be potentially explosive. Petrol is a highly dangerous and volatile liquid, and the precautions necessary when handling it cannot be overstressed.

Many of the operations described in this Chapter involve the disconnection of fuel lines, which may cause an amount of fuel spillage. Before commencing work, refer to the above Warning and the information in "Safety first" at the beginning of this manual.

When working with fuel system components, pay particular attention to cleanliness - dirt entering the fuel system may cause blockages which will lead to poor running.

Note: *Residual pressure will remain in the fuel lines long after the vehicle was last used, when disconnecting any fuel line, it will be necessary to depressurise the fuel system as described in Section 2.*

2 Fuel system - depressurisation

Refer to Part B, Section 2.

3 Fuel lines and fittings - general information

Refer to Part B, Section 3.

4.2a Disconnect the mass air flow sensor wiring multi-plug . . .

4.2b . . . release the retaining clips . . .

4.2c . . . and withdraw the sensor

4 Air cleaner assembly and air inlet components - removal and refitting

Air cleaner assembly

1 Disconnect the battery negative (earth) lead (refer to Chapter 5A, Section 1).
2 Disconnect the mass air flow sensor wiring multi-plug, then release the clips and withdraw the sensor, complete with inlet hose, from the air cleaner cover **(see illustrations)**. Carefully position the mass air flow sensor and hose assembly to one side.
3 Detach the fresh air inlet duct from the air cleaner housing.
4 Unscrew the air cleaner housing retaining nut, then pull the housing upwards to release the locating pegs from their rubber grommets. As the housing is withdrawn, detach the crankcase breather hose **(see illustration)**. Remove the assembly from the car.
5 Refitting is the reverse of the removal procedure. Ensure that the housing pegs seat fully in their grommets, and that the mass air flow sensor is correctly located.

Air inlet components

6 On PTE engines, disconnect the HT leads from the spark plugs, labelling them if necessary to avoid confusion on refitting.
7 Slacken the hose clip, and detach the flexible air inlet hose from the mass air flow sensor.
8 On PTE engines, disconnect the ventilation hose from the inlet duct over the top of the engine.
9 On PTE engines undo the two inlet duct retaining bolts; On Zetec engines , undo the two bolts and lift off the air inlet duct retaining strap **(see illustration)**. Withdraw the inlet duct from the throttle housing and remove the duct and flexible hose from the engine.
10 Refitting is the reverse of the removal procedure.

5 Accelerator cable - removal, refitting and adjustment

Removal

1 Disconnect the battery negative (earth) lead (refer to Chapter 5A, Section 1).
2 Fold back the carpet and insulation in the driver's footwell to gain access to the accelerator pedal.
3 Detach the accelerator cable from the pedal.
4 From within the engine compartment, detach the outer cable from the adjuster/support bracket by removing the metal retaining clip **(see illustration)**.
5 Pivot the throttle quadrant by hand, detach the inner cable nipple from the throttle lever and remove the cable.

Refitting

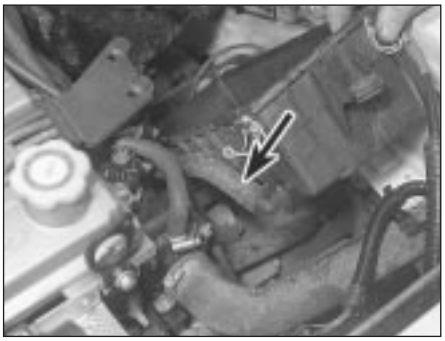
6 Refit in the reverse order of removal. When the cable is reconnected at each end, adjust the cable as follows.

Adjustment

7 Remove the outer cable metal retaining clip at the adjuster/support bracket and lubricate the cable adjuster grommet with soapy water.
8 Remove any slack by pulling the cable outer as far as possible out of the adjuster. Have an assistant depress the accelerator pedal fully - the cable outer will move back into the adjuster - and hold it there while the clip is refitted.
9 Check that the throttle quadrant moves smoothly and easily from the fully-closed to the fully-open position and back again as the assistant depresses and releases the accelerator pedal. Re-adjust the cable if required.

6 Accelerator pedal - removal and refitting

Refer to Part A, Section 5.



4.4 Unscrew front retaining nut and lift the air cleaner housing, disconnecting the breather hose (arrowed)

4.9 Unscrew the nuts (arrowed) to release the air intake duct on Zetec engines

5.4 Detach the accelerator outer cable retaining clip (arrowed)

7 Fuel pump/fuel pressure - checking

Note: *Refer to the warning note in Section 1 before proceeding.*

Fuel pump operation check

1 Switch on the ignition, and listen for the fuel pump (the sound of an electric motor running, audible from beneath the rear seats). Assuming there is sufficient fuel in the tank, the pump should start and run for approximately one or two seconds, then stop, each time the ignition is switched on. **Note:** *If the pump runs continuously all the time the ignition is switched on, the electronic control system is running in the backup (or "limp-home") mode referred to by Ford as "Limited Operation Strategy" (LOS). This almost certainly indicates a fault in the EEC IV module itself, and the vehicle should therefore be taken to a Ford dealer for a full test of the complete system, using the correct diagnostic equipment; do not waste time or risk damaging the components by trying to test the system without such facilities.*

2 Listen for fuel return noises from the fuel pressure regulator. It should be possible to feel the fuel pulsing in the regulator and in the feed hose from the fuel filter.

3 If the pump does not run at all, check the fuse, relay and wiring (see Chapter 12). Check also that the fuel cut-off switch has not been activated and if so, reset it.

Fuel pressure check

4 A fuel pressure gauge will be required for this check and should be connected in the fuel line between the fuel filter and the fuel rail, in accordance with the gauge maker's instructions. On Zetec engines, a pressure gauge equipped with an adapter to suit the Schrader-type valve on the fuel rail pressure test/release fitting (identifiable by its blue plastic cap, and located on the union of the fuel feed line and the fuel rail) will be required. If the Ford special tool 29-033 is available, the tool can be attached to the valve, and a conventional-type pressure gauge attached to the tool.

5 If using the service tool, ensure that its tap is turned fully anti-clockwise, then attach it to the valve. Connect the pressure gauge to the service tool. If using a fuel pressure gauge with its own adapter, connect it in accordance with its maker's instructions.

6 Start the engine and allow it to idle. Note the gauge reading as soon as the pressure stabilises, and compare it with the regulated fuel pressure figures listed in the *Specifications*.

a) If the pressure is high, check for a restricted fuel return line. If the line is clear, renew the fuel pressure regulator.

b) If the pressure is low, pinch the fuel return line. If the pressure now goes up, renew the fuel pressure regulator. If the pressure does not increase, check the fuel feed line, the fuel pump and the fuel filter.

7 Detach the vacuum hose from the fuel pressure regulator; the pressure shown on the gauge should increase. Note the increase in pressure, and compare it with that listed in the *Specifications*. If the pressure increase is not as specified, check the vacuum hose and pressure regulator.

8 Reconnect the regulator vacuum hose, and switch off the engine. Verify that the hold pressure stays at the specified level for five minutes after the engine is turned off.

9 Carefully disconnect the fuel pressure gauge, depressurising the system first as described in Section 2. Be sure to cover the fitting with a rag before slackening it. Mop up any spilt petrol.

10 Run the engine, and check that there are no fuel leaks.

8 Fuel tank - removal, inspection and refitting

Proceed as described in Part A, Section 8, but before disconnecting the battery, relieve the residual pressure in the fuel system (see Section 2), and equalise tank pressure by removing the fuel filler cap.

9 Fuel pump/fuel gauge sender unit - removal and refitting

Refer to Part B, Section 9.

10 Fuel tank ventilation tube - removal and refitting

Refer to Part A, Section 10, but note that the ventilation tube connects to the combined roll-over/anti-trickle-fill valve assembly but, instead of venting to atmosphere, a further tube runs the length of the vehicle to the evaporative emission control system carbon canister in the front right-hand corner of the engine compartment.

Further information on the evaporative emission control system is contained in Part E of this Chapter.

11 Fuel tank filler pipe - removal and refitting

Refer to Part A, Section 11.

12 Fuel cut-off switch - removal and refitting

Refer to Part B, Section 12.

13 Fuel injection system - checking

Refer to Part B, Section 13

14 Fuel injection system components - removal and refitting

Note: *Refer to the warning note in Section 1 before proceeding.*

Throttle housing

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

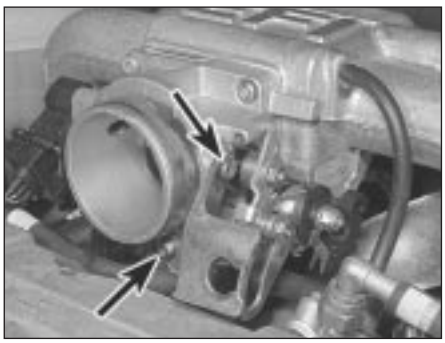
2 Remove the air inlet components as described in Section 4.

3 Disconnect the accelerator cable from the throttle linkage (see Section 5).

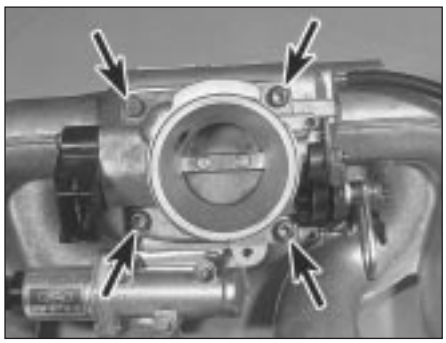
4 Disconnect the throttle position sensor multi-plug.

5 Unscrew the retaining bolts, and detach the accelerator cable support bracket at the throttle housing **(see illustration)**.

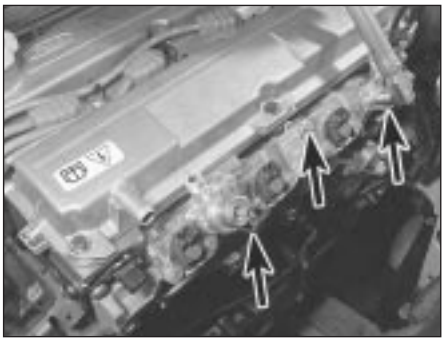
6 Unscrew the throttle housing-to-manifold retaining bolts **(see illustration)**, and unbolt the throttle housing support bracket bolts (where fitted). Remove the throttle housing



14.5 Unscrew the retaining bolts (arrowed), and detach the accelerator cable support bracket



14.6 Throttle housing retaining bolts (arrowed)



14.17a Unscrewing fuel rail mounting bolts (arrowed)

14.17b Note nose seals (arrowed) between rail and intermediate flange

14.18 Removing an injector from the fuel rail. Note the O-ring seals (arrowed)

and gasket. Discard the gasket - this must be renewed whenever it is disturbed.

7 Refit in the reverse order of removal. Check that the mating faces are clean, and fit a new gasket. Adjust the accelerator cable as described in Section 5 on completion.

Fuel rail and injectors

Note: *The following procedure is applicable mainly to Zetec engines; specific information for the PTE engine was not available at the time of writing. However, apart from minor differences in component attachments, both engine types are very similar in this area.*

8 Relieve the residual pressure in the fuel system (see Section 2), and equalise tank pressure by removing the fuel filler cap.

Warning: This procedure will merely relieve the increased pressure necessary for the engine to run - remember that fuel will still be present in the system components, and take precautions accordingly before disconnecting any of them.

9 Disconnect the battery negative (earth) lead - see Chapter 5A, Section 1.

10 Remove the air inlet components as described in Section 4.

11 Disconnect the accelerator cable from the throttle linkage (see Section 5).

12 Disconnect the throttle position sensor multi-plug.

13 Remove the throttle housing mounting screws, then detach the throttle housing and gasket from the inlet manifold. Discard the gasket - this must be renewed whenever it is disturbed.

14 Detach the crankcase breather hose from the cylinder head cover, and the fuel pressure regulator vacuum hose from the inlet manifold.

15 Releasing the wire clips, unplug the four fuel injector multi-plugs and the inlet air temperature sensor multi-plug.

16 Refer to Section 3 and disconnect the fuel feed and return lines at the quick-release couplings, then unclip the fuel hoses from the inlet manifold; use rag to soak up any spilt fuel. **Note:** *Do not disturb the threaded couplings at the fuel rail unions unless absolutely necessary; these are sealed at the factory. The quick-release couplings will suffice for all normal service operations.*

17 Unscrew the three bolts securing the fuel rail **(see illustration)**. Withdraw the rail, carefully prising it out of the inlet manifold, and draining any remaining fuel into a suitable clean container. Note the seals between the rail noses and the manifold; these must be renewed whenever the rail is removed **(see illustration)**.

18 Clamping the rail carefully in a vice fitted with soft jaws, unscrew the two bolts securing each injector, and withdraw the injectors **(see illustration)**. Place each in a clean, clearly-labelled storage container.

19 If the injector(s) are being renewed, discard the old injector, the nose seal and the O-rings. If only the injector O-rings are being renewed, and it is intended that the same injectors will be re-used, remove the old nose seal and O-rings, and discard them.

20 Refitting is the reverse of the removal procedure, noting the following points:

a) Lubricate each nose seal and O-ring with clean engine oil on installation.

b) Locate each injector carefully in the fuel rail recess, ensuring that the locating tab on the injector head fits into the slot provided in the rail. Tighten the bolts securely.

*c) Fit a new seal to each fuel rail nose, and ensure that the seals are not displaced as the rail is refitted **(see illustration)**. Ensure that the fuel rail is settled fully in the manifold before tightening the bolts.*

d) Ensure that the hoses and wiring are routed correctly, and secured on reconnection by any clips or ties provided.

e) Adjust the accelerator cable as described in Section 5.

f) On completion, switch the ignition on and off five times, to activate the fuel pump and pressurise the system, without cranking the engine. Check for signs of fuel leaks around all disturbed unions and joints before attempting to start the engine.

Fuel pressure regulator

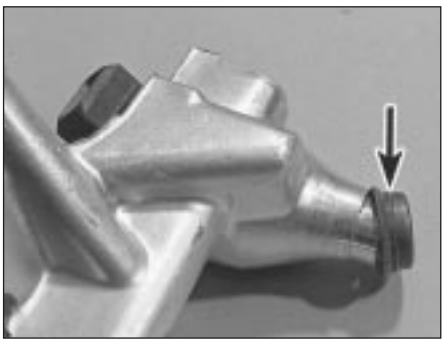
21 Relieve the residual pressure in the fuel system (see Section 2), and equalise tank pressure by removing the fuel filler cap.

Warning: This procedure will merely relieve the increased pressure necessary for the engine to run - remember that fuel will still be present in the system components, and take precautions accordingly before disconnecting any of them.

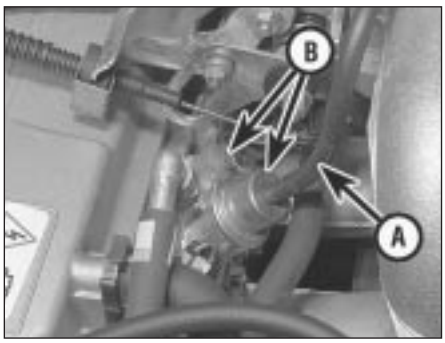
22 Disconnect the battery negative (earth) lead - see Chapter 5A, Section 1.

23 Disconnect the vacuum hose from the regulator.

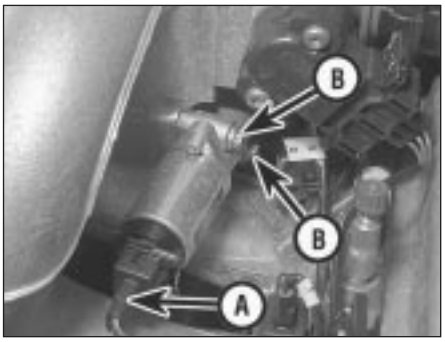
24 Unscrew the two regulator retaining bolts **(see illustration)** then use a wad of clean rag to soak up any spilt fuel, and withdraw the regulator.



14.20 Fit new nose seals (arrowed) before refitting the fuel rail



14.24 Fuel pressure regulator vacuum hose (A) and retaining bolts (B)



14.27 Idle speed control valve wiring multi-plug (A) and visible mounting bolts (B)

25 Refitting is the reverse of the removal procedure, noting the following points:

a) Renew the regulator sealing O-ring whenever the regulator is disturbed. Lubricate the new O-ring with clean engine oil on installation.

b) Locate the regulator carefully in the fuel rail recess, and tighten the bolts securely.

c) On completion, switch the ignition on and off five times, to activate the fuel pump and pressurise the system, without cranking the engine. Check for signs of fuel leaks around all disturbed unions and joints before attempting to start the engine.

Idle speed control valve

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

27 Disconnect the valve's wiring multi-plug **(see illustration)**.

28 Unscrew the three retaining bolts, and withdraw the valve from the inlet manifold.

29 Refitting is the reverse of the removal procedure, noting the following points:

a) Clean the mating surfaces carefully, and always fit a new gasket whenever the valve is disturbed.

b) Once the wiring and battery are reconnected, start the engine and allow it to idle. When it has reached normal operating temperature, check that the idle speed is stable, and that no induction (air) leaks are evident. Switch on all electrical loads (headlights, heated rear window, etc), and check that the idle speed is still satisfactory.

Mass air flow sensor

30 Releasing its wire clip, unplug the electrical connector from the sensor **(see illustration 4.2a)**.

31 Release the two clips and detach the sensor from the air cleaner cover **(see illustrations 4.2b and 4.2c)**.

32 Slacken the clamp securing the sensor to the air inlet hose, and withdraw the sensor.

33 Refitting is the reverse of the removal procedure. Ensure that the sensor and air cleaner cover are seated correctly and securely fastened, so that there are no air leaks.

EEC IV engine management module

Note: *The module is fragile. Take care not to drop it, or subject it to any other kind of impact. Do not subject it to extremes of temperature, or allow it to get wet. Refer to Part B, Section 14 for illustrations of the following procedure.*

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

35 Remove the cooling system expansion tank as described in Chapter 3, for access to the module multi-plug.

36 Unscrew and remove the two nuts securing the module cover in the engine compartment, then carefully draw the cover away from its location. Unscrew the module multi-plug retaining bolt and disconnect the multi-plug from the module.

37 The aid of an assistant will be required at this stage, to support and withdraw the module from inside the passenger compartment as its mounting bracket retaining tags are compressed and released from the engine compartment. Do not allow the module to drop into the passenger compartment as irreparable damage is likely to result. The module may be separated from its mounting bracket by undoing the securing bolts.

38 Refitting is a reversal of the removal procedure, ensuring that the module mounting bracket retaining tags are felt to snap into position. Refit the expansion tank as described in Chapter 3 on completion.

Crankshaft position sensor

39 Refer to Chapter 5B.

Camshaft position sensor

40 Where applicable, release the fuel feed and return hoses from their clip. On PTE engines, detach the adjacent engine breather hose.

41 Releasing its wire clip, unplug the sensor's wiring multi-plug. Remove the retaining screw, and withdraw the sensor from the cylinder head; be prepared for slight oil loss **(see illustration)**.

42 Refitting is the reverse of the removal procedure, noting the following points:

a) Apply petroleum jelly or clean engine oil to the sensor's sealing O-ring.

b) Locate the sensor fully in the cylinder head, and wipe off any surplus lubricant before securing it.

c) Tighten the screw to the specified torque wrench setting.

Coolant temperature sensor

43 Refer to Chapter 3.

Inlet air temperature sensor

44 Releasing its clip, unplug the sensor's electrical connector, then unscrew the sensor from the inlet manifold **(see illustration)**.

45 Refitting is the reverse of the removal procedure.

Throttle position sensor

46 Releasing its wire clip, unplug the sensor's wiring multi-plug. Remove the retaining screws, and withdraw the unit from the throttle housing **(see illustration)**. *Do not* force the sensor's centre to rotate past its normal operating sweep; the unit will be seriously damaged.

47 Refitting is the reverse of the removal procedure, noting the following points:

a) Ensure that the sensor is correctly orientated, by locating its centre on the D-shaped throttle shaft (throttle closed), and aligning the sensor body so that the bolts pass easily into the throttle housing.

14.41 Disconnecting the camshaft position sensor wiring multi-plug (Zetec engine shown)

14.44 Removing the intake air temperature sensor from the rear of the inlet manifold (Zetec engine shown)

14.46 Throttle position sensor mounting screws (arrowed)

b) Tighten the screws evenly and securely (but do not overtighten them, or the potentiometer body will be cracked).

Vehicle speed sensor

48 The sensor is mounted at the base of the speedometer drive cable, and is removed with the speedometer drive pinion. Refer to the relevant Section of Chapter 7A or B, as applicable.

Power steering pressure switch

49 Releasing its clip, unplug the switch's electrical connector, then unscrew the switch from the power steering high pressure pipe. Place a wad of rag underneath, to catch any spilt fluid. If a sealing washer is fitted, renew it if it is worn or damaged.

50 Refitting is the reverse of the removal procedure; tighten the switch securely, then top-up the fluid reservoir (see *"Weekly Checks")* to replace any fluid lost from the system, and bleed out any trapped air (see Chapter 10).

Oxygen sensor

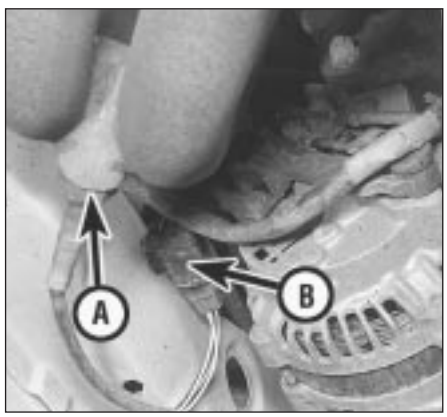
Note: *The sensor is delicate, and will not work if it is dropped or knocked, if its power supply is disrupted, or if any cleaning materials are used on it.*

51 Raise and support the front of the vehicle if required to remove the sensor from underneath ("see *Jacking and vehicle support"*).

52 Release the sensor's wiring multi-plug from its support bracket, and unplug it to disconnect the sensor **(see illustration)**.

53 Unscrew the sensor from the exhaust system front downpipe; collect the sealing washer (where fitted).

54 On refitting, clean the sealing washer (where fitted) and renew it if it is damaged or worn. Apply a smear of anti-seize compound to the sensor's threads, to prevent them from welding themselves to the downpipe in service. Refit the sensor, tightening it to its specified torque wrench setting; a slotted socket will be required to do this. Reconnect the wiring, and refit the connector plug.



14.52 Oxygen sensor (A) and wiring multi-plug (B) (Zetec engine shown)

15 Inlet manifold - removal and refitting

Note: *Refer to the warning note in Section 1 before proceeding.*

Removal

PTE engines

1 The inlet manifold is a two-piece assembly comprising an upper and lower section bolted together.

2 Drain the cooling system with reference to Chapter 1.

3 Relieve the residual pressure in the fuel system (see Section 2), and equalise tank pressure by removing the fuel filler cap.

Warning: This procedure will merely relieve the increased pressure necessary for the engine to run - remember that fuel will still be present in the system components, and take precautions accordingly before disconnecting any of them.

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

5 Remove the air inlet components (Section 4) and disconnect the accelerator cable from the throttle linkage (Section 5).

6 Remove the fuel injectors and fuel rail as described in Section 14.

7 Noting their locations, disconnect the coolant, vacuum and breather hoses from the manifold.

8 Disconnect the wiring multi-plugs from the engine sensors at the inlet manifold.

9 Undo the retaining bolts, and withdraw the manifold from the cylinder head. Note the location of the engine lifting bracket and earth lead, where fitted. Remove the gasket.

10 With the manifold removed, clean all traces of the old gasket from the mating surfaces of the manifold and the cylinder head.

Zetec engines

11 Relieve the residual pressure in the fuel system (see Section 2), and equalise tank pressure by removing the fuel filler cap.

Warning: This procedure will merely relieve the increased pressure necessary for the engine to run - remember that fuel will still be present in the system components, and take precautions accordingly before disconnecting any of them.

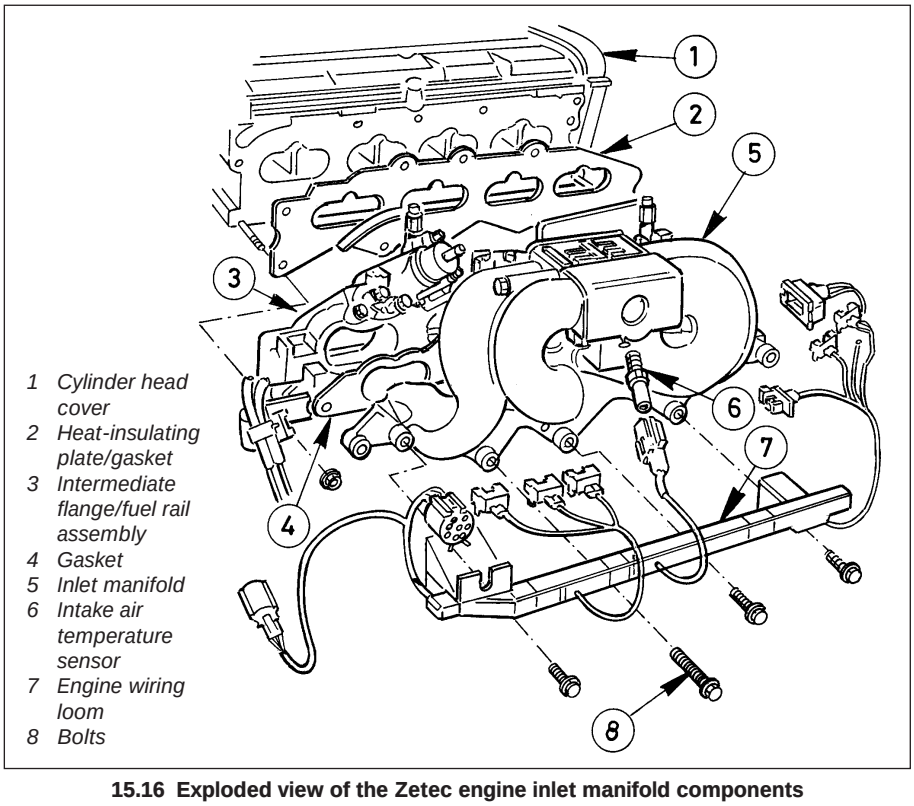
12 Disconnect the battery negative (earth) lead (refer to Chapter 5A, Section 1).

13 Remove the air inlet components (Section 4) and disconnect the accelerator cable from the throttle linkage (Section 5).

14 Disconnect the crankcase breather hose from the cylinder head cover union.

15 Unbolt the upper part of the exhaust manifold heat shield.

16 Remove the two screws securing the wiring "rail" to the top of the manifold - this is simply so that it can be moved as required to reach the manifold bolts **(see illustration)**.



1 *Cylinder head cover*
2 *Heat-insulating plate/gasket*
3 *Intermediate flange/fuel rail assembly*
4 *Gasket*
5 *Inlet manifold*
6 *Intake air temperature sensor*
7 *Engine wiring loom*
8 *Bolts*

15.16 Exploded view of the Zetec engine inlet manifold components

Unplug the electrical connectors at the camshaft position sensor and the coolant temperature sensor, then unclip the wiring from the ignition coil bracket, and secure it to the manifold.

17 Remove the three screws securing the wiring "rail" to the rear of the manifold. Releasing its wire clip, unplug the large electrical connector (next to the fuel pressure regulator) to disconnect the wiring of the manifold components from the engine wiring loom.

18 Marking or labelling them as they are unplugged, disconnect the vacuum hoses at the manifold and throttle housing.

19 Undo the fuel feed and return lines connecting the engine to the chassis. Plug or cap all open fittings.

20 Unbolt the earth lead from the cylinder head rear support plate/engine lifting eye, then unscrew the bolt securing the support plate/lifting eye.

21 Unscrew the nuts and bolts securing the manifold to the cylinder head, and withdraw it. Take care not to damage vulnerable components as the manifold assembly is manoeuvred out of the engine compartment.

22 With the manifold removed, clean all traces of the old gasket from the mating surfaces of the manifold and the cylinder head.

Refitting

All engines

23 Refitting is the reverse of the removal procedure, noting the following points:

a) Fit a new gasket, then locate the manifold on the head and install the nuts and bolts.

b) Tighten the nuts/bolts in three or four equal steps to the specified torque, working from the centre outwards, to avoid warping the manifold.

c) Refit the remaining parts in the reverse order of removal - tighten all fasteners to the torque wrench settings specified (where given).

d) Where drained, refill the cooling system as described in Chapter 1.

e) Before starting the engine, check the accelerator cable for correct adjustment and the throttle linkage for smooth operation (Section 5).

f) When the engine is fully warmed-up, check for signs of fuel, inlet and/or vacuum leaks.