


Chapter 4 Part C:

Fuel system - electronic fuel injection 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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4C

Specifications

General

System type	Electronic Fuel injection (EFI) with turbocharger on RS Turbo models
Application	1.6 litre CVH engines

Fuel grade

Fuel octane requirement:	
Engines without catalytic converter*	95 RON unleaded or 97 RON leaded
Engines with catalytic converter	95 RON unleaded (leaded fuel must not be used)
*Refer to dealer for latest recommendations	

Fuel system data

Idle speed and mixture settings	See Chapter 1
Fuel pump pressure - engine not running	3.0 bars minimum
Regulated fuel pressure - engine running at idle speed	2.3 to 2.5 bars
Hold pressure - engine stopped after two minutes	Not less than 0.8 bars below regulated pressure

Turbocharger

Type	Garrett AiResearch T02
Boost pressure	0.47 to 0.51 bars

Torque wrench settings

	Nm	lbf ft
Idle speed control valve bolts	4 to 5	3 to 4
Fuel pressure regulator bolts	8 to 12	6 to 9
Fuel rail bolts	20 to 26	15 to 19
Inlet air temperature sensor	20 to 25	15 to 18
Inlet manifold	16 to 20	12 to 15
Oxygen sensor	50 to 70	37 to 52
Intercooler-to-radiator bolts	4 to 6	3 to 5
Boost control valve screws	2.2 to 2.7	1.5 to 2
Exhaust manifold heatshield bolts	21 to 26	16 to 19
Exhaust manifold-to-engine nuts (non-Turbo models)	14 to 17	11 to 13
Exhaust manifold-to-engine nuts (Turbo models)	28 to 31	21 to 23
Exhaust manifold-to-turbocharger bolts	20 to 28	15 to 21
Turbocharger-to-exhaust downpipe nuts	35 to 47	26 to 35
Turbocharger cooling pipe banjo union bolts	22 to 29	17 to 22
Turbocharger oil feed and return line couplings	15 to 20	11 to 15

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 an electronic fuel injection system.

Fuel is supplied under pressure from the fuel pump to the fuel distributor rail mounted on top of the inlet manifold (see illustration). The fuel rail acts as a pressurised fuel reservoir for the fuel injectors. The electro-mechanical injectors have only "on" or "off" positions, the volume of fuel being injected to

meet the engine operating conditions being determined by the length of time that the injectors are opened. The volume of fuel required for one power stroke is determined by the EEC IV engine management module, and is divided by two equal amounts. The first half of the required volume is injected into the static air ahead of the inlet valve one complete engine revolution before the inlet valve is due to open. After one further revolution, the inlet valve opens and the required fuel volume is injected into the air flow being drawn into the cylinder. The fuel will therefore be consistently injected to two inlet valves simultaneously at a particular crankshaft position.

The volume of air drawn into the engine is governed by the air filter unit and other variable operating factors. These variables are assessed by the EEC IV module and the

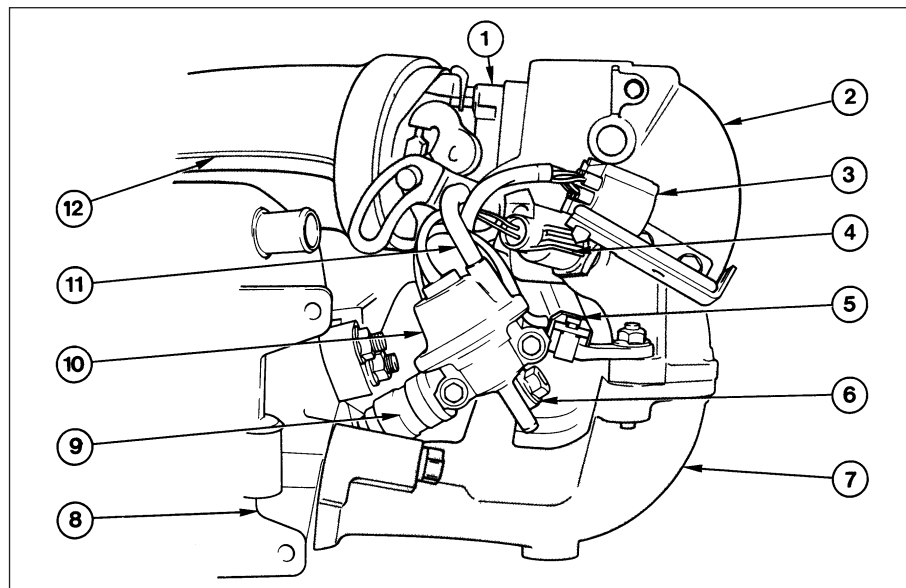
corresponding signals are produced to actuate the injectors accordingly.

The engine base idle speed can be adjusted (if required), by turning the adjuster screw (covered by a tamperproof cap) in the throttle housing. Provision for adjusting the fuel mixture is made by the mixture screw in the potentiometer unit mounted on the bulkhead.

An idle speed control valve, itself controlled by the EEC-IV engine management module, stabilises the engine idle speed under all conditions by the opening of an auxiliary air passage which bypasses the throttle. Apart from a base-idle speed adjustment, no adjustments to the operational idle speed can be made.

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 to determine engine temperature, speed and load, and the quantity of air entering the engine. The sensors also inform the module of throttle position, inlet air temperature and, on models with catalytic converters, exhaust gas oxygen content. All the information supplied to the module is computed and compared with pre-set values stored in its 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.



1.2 General view of the 1.6 litre EFI fuel injection system arrangement

- | | | |
|---------------------------------|-----------------------------------|----------------------------|
| 1 Throttle housing | 5 Wiring harness ducting | 9 Fuel injector |
| 2 Upper inlet manifold section | 6 Fuel rail | 10 Fuel pressure regulator |
| 3 Wiring loom connector | 7 Lower section of inlet manifold | 11 Vacuum hose |
| 4 Intake air temperature sensor | 8 Cylinder head | 12 Air inlet duct |

Engine temperature information is supplied by the coolant temperature sensor. This component is an NTC (Negative Temperature Coefficient) thermistor - that is, a semiconductor 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.

A manifold absolute pressure sensor measures inlet manifold vacuum, and supplies this information to the EEC IV module for calculation of engine load at any given throttle position.

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.

On models with a catalytic converter, the oxygen sensor in the exhaust system provides the EEC IV 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.

On turbocharged engines, control of the turbocharger boost pressure is also governed by the EEC IV module, acting through the boost control valve. This allows inlet manifold depression to be applied to the turbocharger wastegate control.

The turbocharger consists of a turbine that is driven by the exhaust gases, to suck air through the air filter and to compress it into the engine. An air-cooled intercooler, mounted next to the radiator, cools the inlet air (heated by its passage through the turbocharger); this increases the density of the compressed fuel/air mixture entering the engine, thus improving the engine's power output.

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 spill 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.

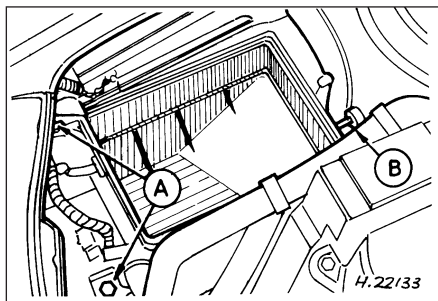
When working with fuel system components, pay particular attention to cleanliness - dirt entering the fuel system may cause blockages which will lead to poor running.

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.

Note: Refer to Section 16 for specific precautions relating to turbocharged engines.

2 Fuel system - depressurisation

Refer to Part B, Section 2.



4.6 Air cleaner housing attachments

A Bolts B Grommet

3 Fuel lines and fittings - general information

Refer to Part B, Section 3.

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



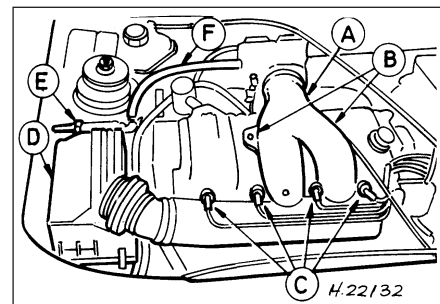
Note: Air cleaner element renewal and air cleaner temperature control system checks (where applicable) are described in Chapter 1.

Air cleaner assembly

- 1 Disconnect the battery negative (earth) lead (refer to Chapter 5A, Section 1).
- 2 If the idle speed control valve is mounted on the air cleaner, disconnect the multi-plug and the air bypass hose from the valve.
- 3 Disconnect the flexible hose between the air cleaner lid and the air inlet duct or turbocharger air inlet.
- 4 Disconnect the crankcase breather hose from the front of the air cleaner housing.
- 5 Unclip and remove the air cleaner lid, then withdraw the element.
- 6 Remove the two bolts securing the forward end of the air cleaner housing, free the rearward end of the housing from its location and carefully withdraw from the vehicle (see illustration).
- 7 Refitting is a reversal of the removal procedure.

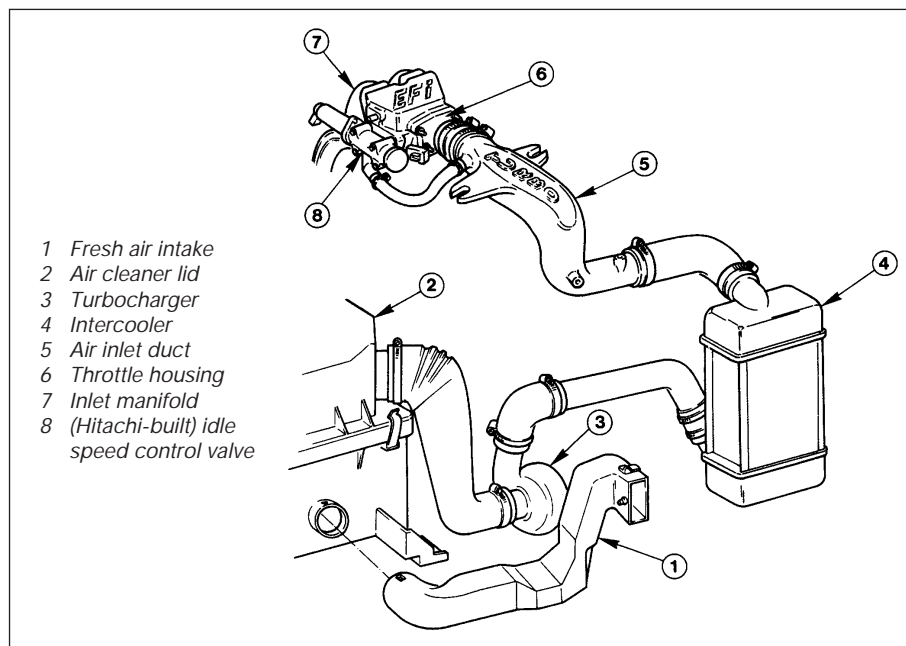
Air inlet components

- 8 Disconnect the battery negative (earth) lead (refer to Chapter 5A, Section 1).
- 9 If the idle speed control valve is mounted on the air cleaner, disconnect the multi-plug and the air bypass hose from the valve (see illustration).
- 10 Disconnect the HT leads from the spark plugs, labelling them if necessary to avoid confusion on refitting.



4.9 General view of the air inlet components on non-Turbo models

- A Air inlet duct
- B Air inlet duct securing bolts
- C Spark plug HT lead connectors
- D Air cleaner lid
- E Idle speed control valve multi-plug
- F Air bypass hose



4.12 Air intake, turbocharger and intercooler details on Turbo models

11 On non-Turbo models, disconnect the flexible hose between the air cleaner lid and the air inlet duct.

12 On Turbo models, disconnect the idle speed control valve air bypass hose from the air inlet duct and the flexible hose between the air inlet duct and intercooler (see illustration).

13 Undo the two retaining bolts, and remove the air inlet duct from the rocker cover.

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

3 Fold back the carpet and insulation in the driver's footwell to gain access to the accelerator pedal.

4 Detach the accelerator cable from the pedal.

5 Working at the throttle housing end of the cable, pivot the throttle quadrant by hand to release the tension from the cable, then detach the inner cable nipple from the throttle lever (see illustration).

6 Detach the outer cable from the adjuster/support bracket, then remove the cable.

Refitting and adjustment

7 Refit in the reverse order of removal. When the cable is reconnected at each end, have an

assistant depress the accelerator, and check that the throttle fully opens and shuts without binding. Ensure that there is a small amount of slack in the inner cable when the throttle is fully released. If adjustment is required, release the outer cable retaining clip from the cable at the adjustment/support bracket, slide the cable through the adjuster grommet to the point required, then refit the retaining clip to secure it in the set position.

6 Accelerator pedal - removal and refitting



Refer to Part A, Section 5.

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



5.45 Accelerator cable retention arrangement at the throttle linkage

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.

5 Disconnect the wiring from the E-DIS ignition coil and the fuel injectors.

6 Switch the ignition on and off twice, and check that the pump pressure is as listed in the Specifications.

7 If the pressure is not as specified, check the fuel system for leaks or damage. If the system appears okay, renew the fuel pump.

8 Reconnect the wiring to the ignition coil and fuel injectors.

9 If the pump pressure was satisfactory, start the engine and allow it to idle. Disconnect the vacuum hose at the fuel pressure regulator, and plug the hose. Note the gauge reading as soon as the pressure stabilises, and compare it with the figures given for regulated fuel pressure in the Specifications.

10 If the regulated fuel pressure is not as specified, remove the plug from the top of the fuel pressure regulator, and using a suitable Allen key, adjust the pressure regulator as necessary.

11 Switch off the engine, and check that the fuel pressure stays at the specified hold pressure for two minutes after the engine is turned off.

12 Carefully disconnect the fuel pressure gauge, depressurising the system first as described in Section 2. Reconnect the ignition coil and fuel injector wiring.

13 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 on models with evaporative emission control, 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 a 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.



14.7 Throttle housing retaining bolt locations (arrowed)



14.9b ... unbolt the wiring harness ...

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

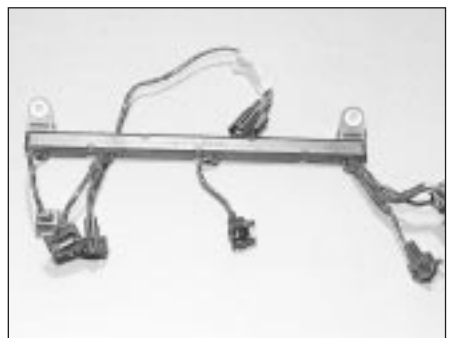
Note: Refer to the warning note in Section 1 before proceeding.

Fuel rail and injectors

Note: For simplicity, and to ensure that the necessary absolute cleanliness on reassembly, the following procedure describes the removal of the fuel rail assembly, complete with the injectors and pressure regulator, so that the injectors can be serviced individually on a



14.9a Disconnect the wiring multi-plug from each injector ...



14.9c ... and remove the complete harness

clean work surface. It is also possible to remove and refit an individual injector, once the fuel system has been depressurised and the battery has been disconnected. If this approach is followed, read through the complete procedure, and work as described in the relevant paragraphs, depending on the amount of preliminary dismantling required. Be careful not to allow any dirt to enter the system.

1 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.

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

3 Disconnect the HT lead connectors from the spark plugs, and release the leads from their locating grooves in the air inlet duct. Position them out of the way. On Turbo models, undo the two screws and remove the HT lead bracket.

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

5 Unscrew the retaining nuts and the bolt, and detach the accelerator cable support bracket at the throttle housing.

6 Disconnect the wiring connector from the throttle position sensor.

7 Unscrew the four retaining bolts, and remove the throttle housing and its mating face gasket (see illustration).

8 Disconnect the wiring multi-plug from the engine coolant temperature sensor and the inlet air temperature sensor.

9 Disconnect the wiring multi-plugs from the fuel injectors, then undo the two retaining bolts and detach the wiring harness from the fuel rail (see illustrations).

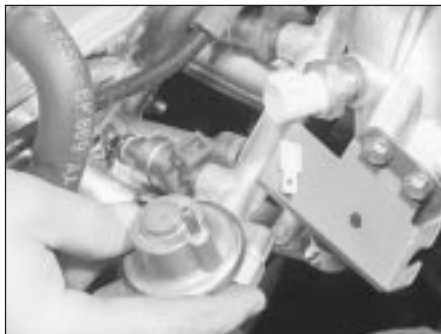
10 Unscrew the fuel supply pipe at the fuel rail. Plug the rail and pipe, to prevent further fuel spillage and the possible ingress of dirt.

11 Disconnect the fuel return and vacuum pipes from the pressure regulator, and catch any fuel spillage in a clean cloth.

12 Unscrew the fuel rail securing bolts, and carefully withdraw the rail (complete with injectors) from the engine (see illustrations).



14.12a Remove the fuel rail retaining bolts ...



14.12b . . . and withdraw the fuel rail and injectors

13 Detach the fuel injectors from the fuel rail, then remove the upper and lower seal from each injector (see illustration). All seals must be renewed (even if only one injector is to be renewed).

14 Prior to refitting the injectors, ensure that all mating surfaces are perfectly clean. Lubricate the new injector seals with clean engine oil to ease their assembly to the injectors.

15 Refitting is a reversal of the removal procedure. Refer to the *Specifications* at the start of this Chapter for the tightening torques. When refitting the fuel rail, ensure that the injectors are correctly located. Ensure that the mating surfaces of the throttle housing are perfectly clean before assembling.

16 On completion, restart the engine and check the various fuel connections for any signs of leaks.

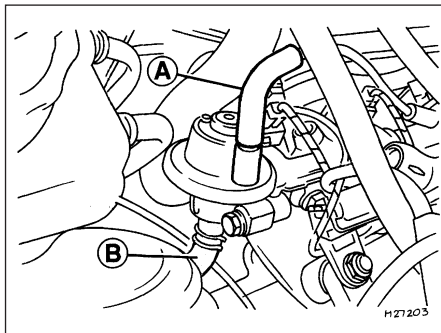
Fuel pressure regulator

17 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.

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



14.20 Fuel pressure regulator showing vacuum pipe (A) and fuel return pipe connection (B)



14.13 Remove the seals from the injectors

19 Release the fuel return pipe securing clip, and detach the pipe from the regulator.

20 Pull free the vacuum pipe from the regulator connector (see illustration).

21 Unscrew the two retaining bolts and remove the regulator. Remove the old sealing ring for renewal.

22 Refit in the reverse order of removal. Lubricate the new seal ring with clean engine oil to ease assembly. When the regulator is refitted and the fuel and vacuum lines are reconnected, turn the ignition on and off five times (without cranking the engine) and check for any sign of fuel leaks before restarting the engine.

Idle speed control valve

Note: The idle speed control valve may be mounted on the air cleaner, on the engine compartment bulkhead, or on the side of the inlet manifold according to valve make and year of manufacture. Valves manufactured by Weber are mounted on the air cleaner and require periodic maintenance (see Chapter 1). Bulkhead and inlet manifold mounted valves are manufactured by Hitachi and are maintenance free.

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

24 Disconnect the valve's wiring multiplug (see illustration).

25 Where applicable disconnect the air hose(s) from the valve.

26 Undo the two or four bolts (according to type), and remove the valve from the air cleaner, bulkhead or inlet manifold.



14.24 Disconnect the multi-plug from the idle speed control valve. Upper valve retaining bolt (arrowed)

27 Refitting is a reversal of the removal procedure. Ensure that the mating faces are clean before reassembling.

28 When the valve is refitted, restart the engine and check that there are no induction leaks. Run the engine until its normal operating temperature is reached, and check that the idle speed is stable. Stop the engine, connect up a tachometer in accordance with its maker's instructions, then restart the engine and check that the idle speed is as specified with all electrical items (lights, heater blower motor, etc) switched off, then on. The idle speed should remain the same. Switch off the electrical items, turn the engine off and detach the tachometer to complete the test.

Throttle housing

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

30 Disconnect the ignition HT lead connectors from the spark plugs, and release the leads from their locating grooves in the air inlet duct. Position them out of the way.

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

32 Unscrew the retaining nuts and the bolt, and detach the accelerator cable support bracket at the throttle housing.

33 Disconnect the wiring connector from the throttle position sensor.

34 Unscrew the four retaining bolts, and remove the throttle housing and its mating face gasket (see illustration 14.7).

35 Refit in the reverse order of removal. Check that the mating faces are clean, and fit a new gasket.

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.

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

37 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.

38 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.

39 Refitting is a reversal of the removal procedure, ensuring that the module mounting bracket retaining tags are felt to snap into position



14.43 Disconnecting the intake air temperature sensor multi-plug

Crankshaft position sensor

40 Refer to Chapter 5B.

Coolant temperature sensor

41 Refer to Chapter 3.

Inlet air temperature sensor

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

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

44 Refitting is the reverse of the removal procedure.

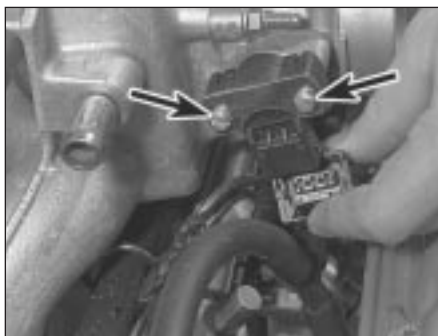
Throttle position sensor

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

46 Releasing its wire clip, unplug the sensor's electrical connector. 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 (see illustration):

- a) Ensure that the potentiometer is correctly orientated, by locating its centre on the D-shaped throttle shaft (throttle closed), and



14.46 Disconnect the multi-plug from the throttle position sensor. Sensor retaining screws (arrowed)

aligning the potentiometer body so that the bolts pass easily into the throttle housing.

- 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.

Manifold absolute pressure sensor

49 The sensor is located near the centre of the engine compartment bulkhead.

50 Disconnect the wiring multi-plug, and detach the vacuum hose from the base of the sensor.

51 Undo the two retaining screws, and withdraw the sensor from its location.

52 Refitting is the reverse of the removal procedure.

Power steering pressure switch

53 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.

54 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.

55 Release the sensor's wiring multi-plug from its bracket below the starter motor, and unplug it to disconnect the sensor.

56 Raise and support the front of the vehicle if required to remove the sensor from underneath ("see Jacking and vehicle support"). Remove the sensor heat shields then unscrew the sensor from the exhaust system front downpipe; collect the sealing washer (where fitted).

57 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.

Fuel mixture/CO% adjustment potentiometer

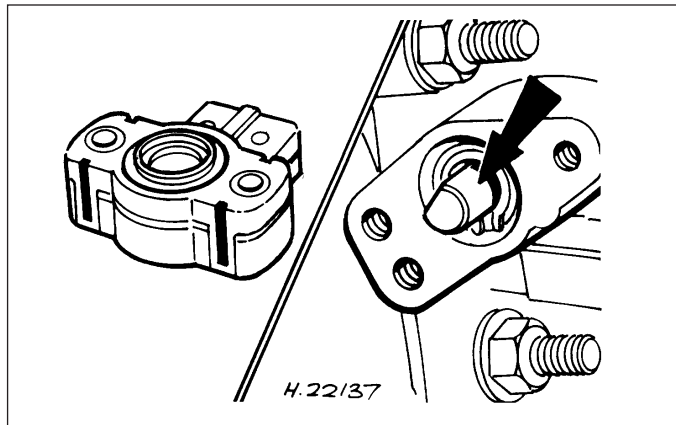
58 The fuel mixture/CO% adjustment potentiometer is located on the engine compartment bulkhead below the ignition module.

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

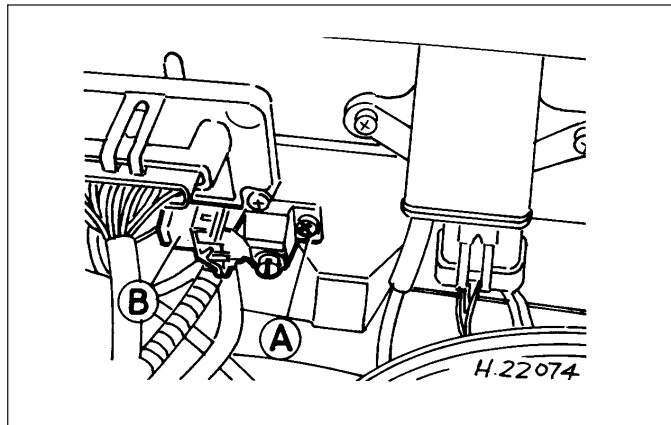
60 Disconnect the potentiometer's wiring multiplug (see illustration).

61 Unscrew the retaining screw and remove the potentiometer from the bulkhead.

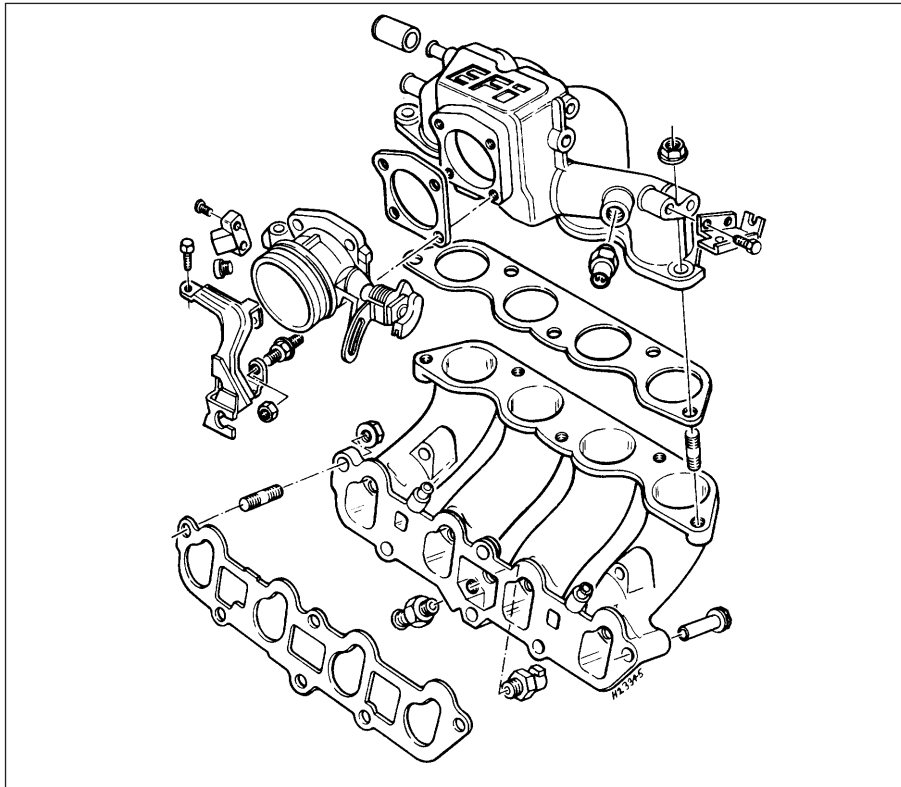
62 Refitting is the reverse of the removal procedure.



14.47 General view of the throttle position sensor and its "D" shaped throttle spindle location (arrowed)



14.60 Fuel mixture/CO% adjustment potentiometer
A Securing screw B Multi-plug



15.1 Exploded view of the inlet manifold arrangement

15 Inlet manifold - removal and refitting



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

Removal

- 1 The inlet manifold is a two-piece assembly comprising an upper and lower section bolted together (see illustration).
- 2 Drain the cooling system with reference to Chapter 1.
- 3 Depressurise the fuel system as described in Section 2.
- 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.

Refitting

- 11 Refitting is the reversal of removal. Use a new gasket, and tighten the retaining bolts to the specified torque (see illustration). Refit the remainder of the components with reference to the appropriate Chapters of this manual. Refill the cooling system as described in Chapter 1 on completion.

16 Turbocharger - general information and precautions

General information

- 1 A water-cooled turbocharger is used on all Turbo models covered by this manual. The turbocharger increases the efficiency of the engine by raising the pressure in the inlet manifold above atmospheric pressure. Instead of the air/fuel mixture being simply sucked into the cylinders it is actively forced in.
- 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 other end of which is another vaned wheel known as the

compressor wheel. The compressor wheel spins in its own housing and compresses the inducted air on the way to the inlet manifold.

3 After leaving the turbocharger, the compressed air passes through an intercooler, which is an air-to-air heat exchanger mounted with the radiator. Here the air gives up heat which it acquired when being compressed. This temperature reduction improves engine efficiency and reduces the risk of detonation.

4 Boost pressure (the pressure in the inlet manifold) is limited by the turbocharger wastegate control, which diverts the exhaust gas away from the turbine wheel in response to the boost control valve. The valve is controlled by the EEC IV engine management module.

5 The turbo shaft is pressure-lubricated by means of a feed pipe from the engine's main oil gallery. The shaft "floats" on a cushion of oil. A drain pipe returns the oil to the sump.

6 Water cooling reduces the operating temperature of the turbocharger, and in particular, the shaft bearings. Water continues to circulate by convection after the engine has stopped, so cooling the unit if it is hot after a long run.

Precautions

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

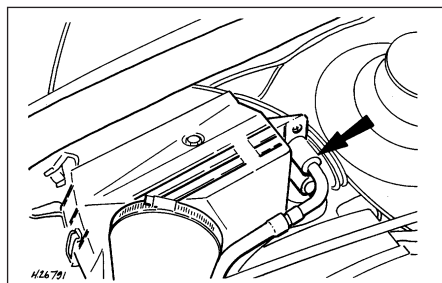
- a) Do not operate the turbo with any parts exposed. Foreign objects falling onto the rotating vanes could cause extensive damage and (if ejected) personal injury.
- b) Do not race the engine immediately after start-up, especially if it is cold. Give the oil a few seconds to circulate.
- c) Always allow 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.
- d) Allow the engine to idle for several minutes before switching off after a high-speed run.
- e) Observe the recommended intervals for oil and filter changing, and use a reputable oil of the specified quality. Neglect of oil changing, or use of inferior oil, can cause carbon formation on the turbo shaft and subsequent failure.

17 Intercooler - removal and refitting



Removal

- 1 Disconnect the battery negative (earth) lead (refer to Chapter 5A, Section 1).
- 2 Remove the flexible hose connecting the intercooler to the air inlet duct, then the pipe



18.2 Location of turbo boost control valve (arrowed)

and flexible hose connecting the turbocharger to the intercooler (see illustration 4.12). Use adhesive tape to seal the turbocharger ports against the entry of dirt.

3 Unbolt the horn nearest the intercooler.

4 Unbolt the radiator/intercooler assembly from the bonnet closure panel and the body crossmember.

5 Move the assembly as far as possible towards the engine, and unbolt the intercooler from the radiator; withdraw the intercooler.

Refitting

6 Refitting is the reverse of the removal procedure, tightening all nuts and bolts to the specified torque settings, and not forgetting to unseal the turbocharger openings before reconnecting the intercooler pipe and hose.

18 Turbocharger boost control valve - removal and refitting



Removal

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

2 Disconnect the control valve wiring at its multi-plug (see illustration).

3 Marking or labelling the valve hoses so that each can be reconnected to its original union, disconnect the hoses from the valve.

4 Remove the securing screws and withdraw the valve.

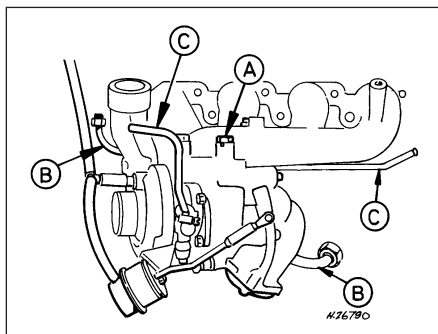
Refitting

5 Refitting is the reverse of the removal procedure; tighten the screws to the specified torque setting.

19 Turbocharger boost pressure - checking and adjustment



Accurate checking and adjustment of the turbocharger boost pressure requires



20.4 Turbocharger/exhaust manifold assembly details

A Exhaust manifold-to-turbocharger bolts

B Oil pipes

C Coolant pipes (metal)

considerable skill and experience and the use of Ford special tools and diagnostic test equipment. This work should therefore be entrusted to a Ford dealer or performance engine specialist.

20 Turbocharger - removal, examination and refitting



Removal

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

2 Drain the cooling system as described in Chapter 1.

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

4 Disconnect the turbocharger coolant feed and return hoses by slackening the clamps and pulling the hoses off the turbocharger's metal pipes (see illustration).

5 Remove the pipe and flexible hoses connecting the turbocharger to the air cleaner and intercooler. Use adhesive tape to seal the turbocharger ports against the entry of dirt.

6 Disconnect the turbocharger oil feed and return pipes by unscrewing the couplings.

7 Remove its three retaining screws and withdraw the exhaust manifold heat shield.

8 Disconnect the exhaust system downpipe from the turbocharger, then disconnect the hose from the boost control valve to the turbocharger wastegate control actuator.

9 Unscrew the exhaust manifold nuts, and withdraw the manifold and turbocharger as an assembly, protecting the radiator with cardboard or similar.

10 To separate the turbocharger from the manifold, flatten back the raised lockwasher

tabs and unscrew the three retaining bolts. Disconnect the turbocharger oil and coolant pipes if required. This is as far as the unit can be dismantled; **do not** disturb the wastegate or its actuator and linkage.

Examination

11 With the turbocharger in the vehicle, check that there are no air leaks around any part of the air inlet components, and that the boost control valve hoses are intact and securely fastened.

12 With the turbocharger removed, check the turbine wheels and blades (as far as possible) for signs of wear or damage. Spin the turbine and check that it rotates smoothly and easily, with no sign of roughness, free play or abnormal noise. If possible, check for axial play (endfloat) of the shaft. Check that the wastegate, its actuator and linkage show no visible signs of wear, damage or stiffness due to dirt and corrosion.

13 If any sign of wear or damage is found, the turbocharger must be renewed.

Refitting

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

- a) Refit the oil and coolant pipes, tightening the unions to the specified torque settings.
- b) Always use new lockwashers when refitting the turbocharger to the manifold; again, tighten the bolts to their specified torque setting.
- c) Protect the radiator when refitting the assembly, and always fit a new exhaust manifold gasket.
- d) Ensure that the oil feed and return pipes are absolutely clean before reconnecting them and tightening them to the specified torque setting.
- e) Owners are well advised to change the engine oil and filter whenever the turbocharger is disturbed (see Chapter 1).
- f) When reassembly is complete and the cooling system refilled (see Chapter 1), disable the ignition system by disconnecting the E-DIS ignition coil wiring multi-plug, then turn the engine over on the starter motor until the oil pressure light goes out. This is essential to ensure that the turbocharger oil supply is established BEFORE the engine is started; do not forget to reconnect the coil before attempting to start the engine

Notes